Contra Costa Community College District
Project # D-628
Design-Build Services
Engineering Technology Renovation Project
Diablo Valley College
321 Golf Club Road, Pleasant Hill, CA 94523

Scheduled Deliverable Date:	
Actual Submittal Date:	

PROJECT DESIGN MILESTONE ACCEPTANCE

Campus: _____

Project Name: _____

Project Number: _____

Milestone Acceptance Phase: _____

Estimator: _____

Established Project Construction Budget [a]: _____

Approved Estimate Last Phase: _____

Submitted Estimate This Phase: _____

Current District Approved Construction Budget [b]:

List All Alternates including Costs

$ _____

$ _____

$ _____

Conditions of Approval (list below)

1.
2.
3.

Attached Exhibit A for list of Design Drawings & Specifications
Attached Exhibit B for list of District Comments on Design Documents
Attached Exhibit C for list of District Attendees at Design Review Meeting

Notes:

a. Established Project Construction Budget is as referenced in the Design-Build Agreement
b. Current District Approved Budget includes any adjustments made since the Design-Build Agreement was executed

Contra Costa Community College District

Project # D-628
Design-Build Services
Engineering Technology Renovation Project
Diablo Valley College
321 Golf Club Road, Pleasant Hill, CA 94523

Print and Sign Your NAME	Print Your TITLE/Department	Telephone / E-Mail
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)
Print Name		(Phone)
(Sign)	(Date)	(E-Mail)

Add/Remove signature rows as required

FIRST AMENDMENT TO THE
PROJECT STABILIZATION AGREEMENT
for the
CONTRA COSTA COMMUNITY COLLEGE DISTRICT

Preamble

This is the First Amendment (this "Amendment") to the Project Stabilization Agreement ("Agreement") for the Contra Costa Community College District entered into as of the 22nd day of October, 2012, by and between the Contra Costa Community College District ("District") together with contractors and/or subcontractors who became or will become signatory to the Agreement by signing the Agreement Exhibit A, the "Agreement to be Bound", and the Contra Costa Building & Construction Trades Council ("Council") and its affiliated local unions that have executed the Agreement (all of whom are referred to collectively as "Unions").

Recitals

WHEREAS the District, the Council, and the Unions desire to amend the Agreement to reflect certain agreed upon changes as set forth below, with the understanding that all other terms, conditions and Recitals in the Agreement remain valid and in effect; and

WHEREAS Article 2, Section 2.4.10 of the Agreement provides that the District and the Contra Costa Building and Construction Trades Council may mutually agree in writing to amend and extend this Agreement at any time.

NOW THEREFORE, in consideration of the mutual promises and covenants herein contained, the District and the Contra Costa Building and Construction Trades Council, and its affiliated local unions that become signatory to this Amendment, together with the contractors and/or subcontractors who became or will become signatory to the Agreement, do mutually agree to amend the Agreement as noted below with all other terms and conditions to remain unchanged and in effect.

Amendment

Article 1 Section 1.6 is hereby amended and revised to state as follows:

"Project" means any District construction project that has a total minimum estimated construction cost of one million dollars ($1,000,000) or more. The District may, at its discretion, designate other project(s) or contract(s) with a total estimated construction cost of less than one million dollars ($1,000,000) to be covered by this Agreement if the District believes it is in the best interest of the District to do so. Routine maintenance of District properties are not covered by the scope of this Agreement.

Article 2 is hereby amended to include Section 2.4.11 which states as follows:

2.4.11 Pursuant to Section 2.4.10, this Agreement has been reviewed and considered for extension or renewal, and the District and the Contra Costa Building and Construction Trades Council have agreed that the Agreement shall be extended for a term of five (5) years from the original expiration date of the Agreement which is the 22nd day of October 2017. At the close of the extension term, the Agreement shall be reviewed and considered for further extension or renewal, with modifications, if appropriate. Except as amended herein, the Agreement shall continue in full force and effect in accordance with its terms.

Contra Costa Community College District

BY: _____ DATE: 11/9/17

Fred E. Wood
Chancellor

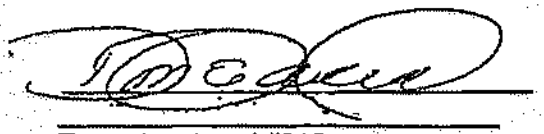
Contra Costa Building and Construction
Trades Council, AFL-CIO

BY: _____ DATE: 10/16/2017

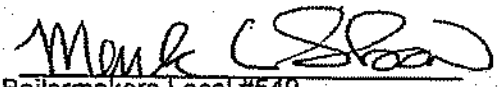
Bill Whitney, Chief Executive Officer

SIGNATURE PAGE
UNIONS

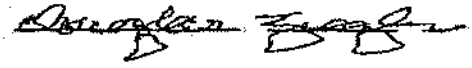
Asbestos Workers Local #16



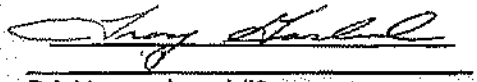
Teamsters Local #315



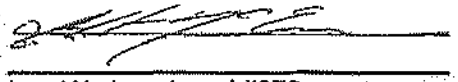
Boilermakers Local #549



Roofers Local #81

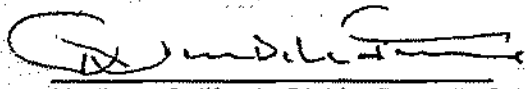


Bricklayers Local #3

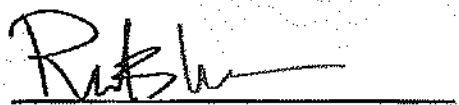


Iron Workers Local #378

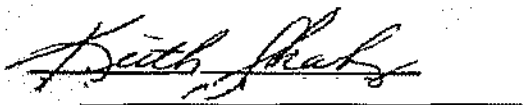
Northern California Regional Council of Carpenters for itself and on behalf of its affiliated local unions



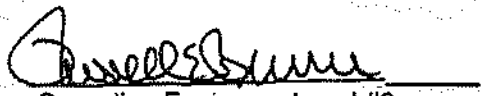
Northern California District Council of Laborers for itself and on behalf of its affiliated local unions



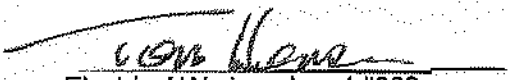
Sheet Metal Workers Local #104



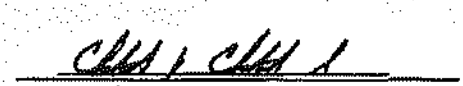
Cement Masons Local #300



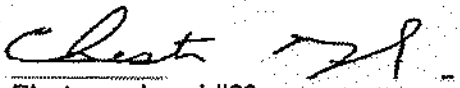
Operating Engineers Local #3



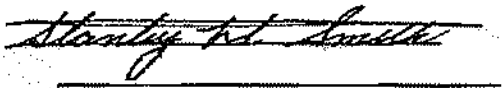
Electrical Workers Local #302



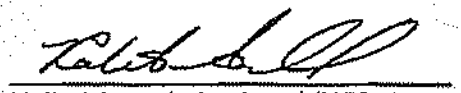
District Council #16, Painters and Allied Trades for itself and on behalf of its affiliated local unions



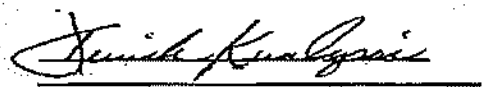
Plasterers Local #66



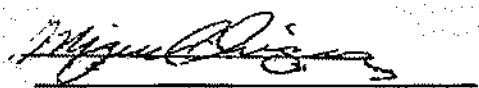
Sprinkler Fitters Local #483



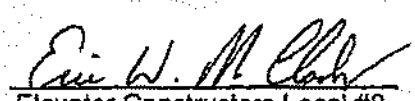
United Association Local #159



United Association Local #342



United Association Local #355



Elevator Constructors Local #8

PROJECT STABILIZATION AGREEMENT

for the

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

PREAMBLE

This Project Stabilization Agreement is entered into this 29 day of OCTOBER, 2012 by and between the Contra Costa Community College District (hereinafter, the "District"), together with contractors and/or subcontractors, who shall become signatory to this Agreement by signing the "Agreement To Be Bound" (Exhibit A) (all of whom are referred to herein as "Contractors/Employers"), and the Contra Costa County Building & Construction Trades Council ("Council") and its affiliated local unions that have executed this Agreement (all of whom are referred to collectively as "Unions").

Recitals

WHEREAS, the purpose of this Agreement is to promote efficiency of construction operations during the construction of District Projects and provide for peaceful settlement of labor disputes and grievances without strikes or lockouts, thereby promoting the District's interest and the public's interest in assuring the timely and economical completion of the District's construction Projects; and

WHEREAS, the successful and efficient completion of the District's construction Projects is of the utmost importance to the District and its educational programs and mission; and

WHEREAS, large numbers of workers of various skills will be required in the performance of the construction work, including those to be represented by the Unions affiliated with the Council; and

WHEREAS, it is recognized that District construction Projects require multiple contractors and bargaining units on the job site at the same time over an extended period of time, and that the potential for work disruption is substantial in the absence of a binding commitment to maintain continuity of work; and

WHEREAS, the interests of the general public, the District, the Unions and Contractors/Employers would be best served if the construction work proceeded in an orderly manner without disruption because of strikes, sympathy strikes, work stoppages, picketing, lockouts, slowdowns or other interferences with work; and

WHEREAS, the Contractors/Employers and the Unions desire to mutually establish and stabilize wages, hours and working conditions for the workers employed on District Projects by

the Contractors/Employers and the Unions to the end that a satisfactory, continuous and harmonious relationship will exist among the parties to this Agreement; and

WHEREAS, this Agreement is not intended to replace, interfere, abrogate, diminish or modify existing local or national collective bargaining agreements in effect during the duration of the Program, insofar as a legally binding agreement exists between the Contractor(s)/Employer(s) and the affected Union(s) except to the extent that the provisions of this Agreement are inconsistent with said collective bargaining agreements, in which event, the provisions of this Agreement shall prevail; and

WHEREAS, the contracts for the construction of District Projects will be awarded in accordance with the applicable provisions of the California Public Contract Code; and

WHEREAS, the parties signatory to this Agreement pledge their full good faith and trust to work towards mutually satisfactory completion of all District construction Projects subject to the Agreement.

NOW, THEREFORE, the parties, in consideration of the mutual promises and covenants herein contained, do mutually agree as follows:

ARTICLE 1

DEFINITIONS

1.1 "Agreement" means this Project Stabilization Agreement, plus Exhibit A and Exhibit B.

1.2. "District" means the Contra Costa Community College District and the administrative staff under its Chancellor.

1.3. "Contractor(s)/Employer(s)" means any individual, firm, partnership, corporation or other entity, or any combination thereof, including joint ventures, which is an independent business enterprise and has entered into a contract with the District or any of its contractors or subcontractors of any tier, with respect to construction work on any District Project covered by this Agreement.

1.4. "Master Agreement" means the Master Collective Bargaining Agreement of each craft union signatory hereto, copies of which have been made available by the Council to the District and are on file with the Council and which are incorporated herein by reference and designated the "Schedule A(s)," and are listed in Exhibit B.

1.5. "Project Manager" or "Construction Manager" means any employee or business entity(ies) designated by the District to oversee District Projects subject to this Agreement.

1.6. "Project" means any District construction project that has a total minimum estimated construction cost of two million dollars ($2,000,000) or more. The District may, at its discretion,

designate other project(s) or contract(s) with a total estimated construction cost of less than two million dollars ($2,000,000) to be covered by this Agreement if the District believes it is in the best interest of the District to do so. Routine maintenance of District properties are not covered by the scope of this Agreement.

1.7. "Union" or "Unions" means the Contra Costa Building and Construction Trades Council, AFL-CIO and its affiliated local unions that have executed this Agreement.

ARTICLE 2

SCOPE OF AGREEMENT AND TERM

2.1. This Agreement shall apply to all on-site demolition, construction, alteration, painting or repair of buildings, structures and other works and related activities on any Project covered by this Agreement that is within the craft jurisdiction of one of the Unions and that is directly or indirectly part of the Project, including, without limitation, pipelines (including those in linear corridors built to serve the Project), pumps, pump stations, start-up, site preparation, on-site survey work, soils and material inspection and testing, including x-ray technicians, and all on-site fabrication work provided such work is within the fabrication provision of a local Master Agreement or national agreement of one of the Unions. On-site fabrication work includes work done for the Project in temporary yards or areas near the Project, and at the site of any batch plant constructed solely to supply materials to the Project. This Agreement also covers all off site work, including fabrication, that is traditionally performed by any of the Unions that are directly or indirectly part of the Project, provided such work is covered by a provision of a local Master Agreement or a local addendum to a national agreement of the applicable Union(s) including delivery and off-haul work to the full extent of the law.

2.2. This Agreement shall govern the award of all construction contracts on all District Projects covered by this Agreement. The District has the absolute right to combine, consolidate, add, or cancel covered Project(s) or portions of covered Project(s). Once a construction Project is completed, it is no longer covered by this Agreement. For the purposes of this Agreement, a construction Project shall be considered completed upon filing of a Notice of Completion.

2.3. All labor disputes involving the application or interpretation of the collective bargaining agreement to which a signatory Contractor/Employer and a signatory Union are parties shall be resolved pursuant to the resolution procedures of the collective bargaining agreement. All disputes relating to the interpretation or application of this Agreement shall be subject to resolution pursuant to the grievance arbitration procedure set forth herein.

2.4. Exclusions:

2.4.1. This Agreement shall be limited to construction work on covered Projects and is not intended to, and shall not, govern any construction work performed at the District at any time prior to the effective date, or after the expiration or termination, of this Agreement.

2.4.2. This Agreement is not intended to, and shall not affect or govern the award of public works contracts by the District which are outside the approved scope of the Projects.

2.4.3. This Agreement is not intended to, and shall not affect the operation or maintenance of the District.

2.4.4. This Agreement shall not apply to a Contractor's/Employer's executives, managerial employees, engineering employees, supervisors (except those covered by existing building and construction trades collective bargaining agreements), and office and clerical employees.

2.4.5. This Agreement shall not apply to employees of the District.

2.4.6. This Agreement shall not apply to contracts awarded pursuant to any emergency public works project(s).

2.4.7 The District shall retain the right at all times to perform and/or subcontract small, incidental portions of related work on the Project site not contracted by the construction contract documents to the signatory Contractor(s) bound to this Agreement.

2.4.8. No provisions negotiated in any Master Agreement solely to apply to work covered by this Project Stabilization Agreement shall apply if such provisions are less favorable to the Contractor for work covered by this Project Stabilization Agreement than those provisions uniformly required of contractors for construction work normally covered by those Master Labor Agreements.

2.4.9 It is the legal obligation of the District to obtain the most competitive bids while maintaining the conditions of the Agreement. To ensure that a competitive bid is received from a range of general contractors, the Contra Costa Building and Construction Trades Council shall assist the District in soliciting interested parties in bidding on the Project(s). Additionally, the District recognizes that multiple subcontractor quotations of bids ensure the most competitive overall bid. The Contra Costa Building and Construction Trades Council shall assist the District in encouraging and soliciting local and other subcontractors in bidding to interested general contractors. In the event the Project bids over the estimated construction cost of the Project, the District reserves the right to request a list of all subcontractors which bid to the two lowest general contractors to verify that adequate competitive bidding was conducted. Additionally, if the project bids are over the estimated construction cost and fewer than three (3) general contractors bid on the Project(s), the District reserves the right, without reservation, to reject all bids and re-bid the Project.

2.4.10 This Agreement shall become effective on the day it is signed by the District, the Contra Costa Building and Construction Trades Council, AFL-CIO, and its affiliated local Unions and shall continue in full force and effect for a period of five (5) years, at which time this Agreement will be reviewed and considered for extension or renewal, with modifications, if appropriate. The terms of this Agreement shall continue to apply to

those Projects subject to this Agreement until construction is completed. The District and the Contra Costa Building and Construction Trades Council may mutually agree in writing to amend, extend or terminate this Agreement at any time. Should either the District or the Contra Costa Building and Construction Trades Council, AFL-CIO, wish to unilaterally terminate this Agreement prior to its expiration, that party must provide written notice to the other party and, if a mutually acceptable resolution cannot be reached, shall submit the request to a neutral arbitrator selected from the following list of arbitrators, through a striking procedure, with a coin toss determining the order of striking, for a final and binding determination whether just cause exists for early termination of the Agreement because it is no longer serving the Purposes, as set forth in the Recitals, herein:

Thomas Angelo
William Riker
Barry Winograd
Jerilou Cossack
William Engler

ARTICLE 3

EFFECT OF AGREEMENT

3.1. By executing this Agreement, the Unions and the District agree to be bound by each and all of the provisions of the Agreement.

3.2. By accepting the award of a construction contract for a Project, whether as contractor or subcontractor, the Contractor/Employer agrees to be bound by each and every provision of the Agreement and agrees that it will evidence its acceptance prior to the commencement of work by executing the Agreement to be Bound in the form attached hereto as Exhibit A.

3.3. At the time that any Contractor/Employer enters into a subcontract with any subcontractor providing for the performance of a Construction Contract, the Contractor/Employer shall provide a copy of this Agreement to said subcontractor and shall require the subcontractor as a part of accepting an award of a construction subcontract to agree in writing to be bound by each and every provision of this Agreement prior to the commencement of work. If a Contractor/Employer requires a subcontractor to agree in writing to comply with the terms of this Agreement as a condition of awarding work to the subcontractor, the Contractor/Employer shall not be liable in any way for the subcontractor's failure to pay the wages and benefits required by this Agreement except as required by the provisions of the California Labor Code.

3.4. Except as enumerated in this Agreement, all other terms and conditions of employment described in the Master Agreement of the Union having traditional and customary jurisdiction over the work shall apply. The provisions of this Agreement shall take precedence over conflicting provisions of any applicable Master Agreement, or any other national, area or local collective bargaining agreement, except that all work performed under the NTL Articles of

Agreement, the National Stack/Chimney Agreement and the National Cooling Tower Agreement; all instrument calibration work and loop checking Covered Work shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and work within the craft jurisdiction of the Elevator Constructors will be performed under the terms of the National Agreements of the International Union of Elevator Constructors; provided that Articles 4 and 13 of this Agreement shall apply to all Covered Work. In the absence of a conflict, the provisions of the applicable Master Agreements shall govern.

3.5. This Agreement shall only be binding on the signatory parties hereto and shall not apply to the parents, affiliates, subsidiaries or other ventures of any such party.

3.6. This Agreement shall not be effective unless and until the District, the Contra Costa Building and Construction Trades Council AFL-CIO and all the Unions listed on the signature page have signed and dated this Agreement.

ARTICLE 4

WORK STOPPAGES. STRIKES, SYMPATHY STRIKES AND LOCKOUTS

4.1. The Unions, District and Contractor(s)/Employer(s) agree that for the duration of the Program:

4.1.1. There shall be no strikes, sympathy strikes, work stoppages, picketing, handbilling or otherwise advising the public that a labor dispute exists, or slowdowns of any kind, for any reason, by the Unions or employees employed on a covered Project, at the job site of the Project or at any other facility of the District because of a dispute on a covered Project or with a Contactor/Employer on the Project. It shall not be considered a violation of this provision for a Union to withhold labor (but not picket) from any Contractor/Employer who fails to make its timely payment of Trust Fund contributions or fails to meet its weekly payroll. The affected Union shall give 72-hour written notice to the District prior to withholding labor due to a Contractor's failure to make timely payment of Trust Fund contributions or payroll. Although disputes arising between the Unions and Contractor(s)/Employer(s) on other projects are not governed by this Agreement, a Union may not take any action against Contractor(s)/Employer(s) on District property and/or on a District Project because of a dispute between the Unions and Contractor(s)/Employer(s) on other projects.

4.1.1.1 If the arbitrator determines, in accordance with this Article, a work stoppage has occurred, the respondent Union(s) shall, within eight (8) hours of receipt of the decision, direct all of the employees they represent on the Project to immediately return to work. If the craft(s) involved do not return to work by the beginning of the next regularly scheduled shift following such eight (8) hour period after receipt of the arbitrator's decision, and the respondent Union(s) have not complied with their obligations to immediately instruct, order and use their best efforts to cause a cessation of the violation and return the employees they

represent to work, then the non-complying respondent Union(s) shall each pay a sum as liquidated damages to the District, and each will pay an additional sum per shift, as set forth in 4.1.1.3 below, for each shift thereafter on which the craft(s) have not returned to work.

4.1.1.2 If the arbitrator determines in accordance with this Article that a lock-out has occurred, the respondent Contractor(s) shall, within eight (8) hours after receipt of the decision, return all the affected employees to work on the Project, or otherwise correct the violation found by the arbitrator. If the respondent Contractor(s) do not take such action by the beginning of the next regularly scheduled shift following the eight (8) hour period, each non- complying respondent Contractor shall pay or give as liquidated damages, to the affected Union(s) (to be apportioned among the affected employees and the benefit funds to which contributions are made on their behalf, as designated by the arbitrator) and each shall pay an additional sum per shift, as set forth in 4.1.1.3 below, for each shift thereafter in which compliance by the respondent Contractor(s) have not been completed.

4.1.1.3 The arbitrator shall retain jurisdiction to determine compliance with this Section and to establish the appropriate sum of liquidated damages, which shall be not less than One Thousand Dollars ($1,000.00), nor more than Five Thousand Dollars ($5,000.00) per shift for each non-complying entity.

4.1.2. As to employees employed on a covered Project, there shall be no lockout of any kind by a Contactor/Employer subject to the Agreement.

4.1.3. If a Master Agreement between a Contractor/Employer and the Union expires before the Contractor/Employer completes the performance of a Construction Contract and the Union or Contractor/Employer gives notice of demands for a new or modified Master Agreement, the Union agrees that it will not strike the Contractor/Employer on said contract for work covered under this Agreement, and the Union and the Contractor/Employer agree that the expired Master Agreement shall continue in full force and effect for work covered under this Agreement until a new or modified Master Agreement is reached between the Union and Contractor/Employer.

4.2. When a remedy is sought for an alleged breach of this Article, any party to this Agreement shall institute the following procedure, prior to any other action at law or equity.

4.2.1. A party invoking this procedure shall notify Thomas Angelo, as the permanent arbitrator, or Robert Hirsch, as the alternate, under this procedure. In the event that the permanent arbitrator is unavailable at any time, the alternate will be contacted. If neither is available, then a selection shall be made from the list of arbitrators in Article 12, Section 12.2. Notice to the arbitrator shall be by the most expeditious means available, with notices by facsimile or telephone to the party alleged to be in violation and to the Contra Costa Building and Construction Trades Council and involved Union if a Union is alleged to be in violation.

4.2.2. Upon receipt of said notice, the District will contact the designated arbitrator named above or his alternate who will attempt to convene a hearing within twenty-four (24) hours if it is contended that the violation still exists.

4.2.3. The arbitrator shall notify the parties by facsimile or telephone of the place and time for the hearing. Said hearing shall be completed in one session, which, with appropriate recesses at the arbitrator's discretion, shall not exceed twenty-four (24) hours unless otherwise agreed upon by all parties. A failure of any party to attend said hearings shall not delay the hearing of evidence or the issuance of any award by the arbitrator.

Thomas Angelo's postal address, phone number, fax number and e-mail address are:

Thomas Angelo
PO Box 1937
Mill Valley CA 94943
Phone: (415) 381-1701
Fax: (415) 380-9792
tangelomv@gmail.com

Robert Hirsch postal address, phone number, and e-mail address are:

Robert Hirsch
PO Box 170428
San Francisco, CA 94117
Phone: 415-362-9999
Rmhirsch@gmail.com

4.2.4. The sole issue at the hearing shall be whether or not a violation of Article 4, Section 4.1 of the Agreement has occurred. The arbitrator shall have no authority to consider any matter of justification, explanation or mitigation of such violation or to award damages, which issue is reserved for court proceedings, if any. The award shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without a written opinion. If any party desires a written opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the award. The arbitrator may order cessation of the violation of this Article and other appropriate relief and such award shall be served on all parties by hand or registered mail upon issuance.

4.2.5. Such award may be enforced by any Court of competent jurisdiction upon the filing of this Agreement and all other relevant documents referred to above in the following manner. Written notice of the filing of such enforcement proceedings shall be given to the other party. In the proceeding to obtain a temporary order enforcing the arbitrator's award as issued under Section 4.2.4 of this Article, all parties waive the right

to a hearing and agree that such proceedings may be ex parte. Such agreement does not waive any party's right to participate in a hearing for a final order or enforcement. The Court's order or orders enforcing the arbitrator's award shall be served on all parties by hand or delivered by certified mail.

4.2.6. Any rights created by statute or law governing arbitration proceedings inconsistent with the above procedure or which interfere with compliance are waived by the parties.

4.2.7. The fees and expenses of the arbitrator shall be divided equally between the parties to the arbitration.

4.2.8. The parties to this Agreement agree that the labor organizations have not waived their legal rights to undertake otherwise lawful activity with regard to any dispute or disputes which they may have regarding non-Project construction work and operations; provided, however, that any such activities by the signatory Unions shall not disrupt or interfere in any way with any work done at any District site. Recognizing the above and, in order to carry out the principles of this Agreement, the parties agree that should a signatory Union have a dispute with regard to non-covered work on or adjacent to any District site, the signatory Union will notify the Contra Costa Building and Construction Trades Council and shall not undertake on or adjacent to the property, any public activity regarding the dispute. Representatives of the involved Union and the Council shall meet with the representatives of the District to discuss and review the valid, legal manner and means by which the signatory Union may undertake its activities with regard to this dispute (giving due consideration in such discussions and review to the traditional concerns for the ongoing operations of the Project and to the importance of the continuity of the work covered by the Master Agreement), and develop a program which allows the signatory Union to exercise its legal rights but at the same time eliminates any possible disruptive effect on the ongoing Project construction work.

4.2.9. Should any Union or the District (or its Project Manager/Project Contractors/Employers) become aware of a possible or actual labor dispute involving non-Project construction work or operations and involving non-signatory unions which may result in public activity on or about any District site by such non-signatory unions, the representative of each will jointly meet to discuss such activity and to work together, using their best efforts, to avoid having such activity adversely impact or otherwise delay or interfere with ongoing Project construction work.

4.2.10. To the extent any provision in this Article 4 conflicts with the dispute resolution provisions of Public Contract Code section 20104, et seq, this Article 4 shall be null and void.

ARTICLE 5

PRECONSTRUCTION CONFERENCE

5.1. A preconstruction conference shall be held prior to the commencement of each construction Project. Such conference shall be attended by a representative each from the participating Contractor(s)/Employer(s) and Union(s) and the Project Manager.

ARTICLE 6

NO DISCRIMINATION

6.1. The Contractor(s)/Employer(s) and Unions agree not to engage in any form of discrimination on the ground or because of; race, color, creed, national origin, ancestry, age, sex, sexual orientation, disability or Acquired Immune Deficiency Syndrome or AIDS Related Condition (AIDS/ARC), or union status against any employee, or applicant for employment, on the Program.

ARTICLE 7

UNION SECURITY

7.1. The Contractor(s)/Employer(s) recognize the Union(s) as the sole bargaining representative of all craft employees working within the scope of this Agreement.

7.2. No employee covered by this Agreement is required to join any Union as a condition of being first employed on the Project.

7.3. All employees working on the Project shall be governed by the applicable Union security clause of the applicable craft's "Schedule A" Agreement. Employees hired by the Contractor(s)/Employer(s) shall, as a condition of employment, be responsible for the payment of the applicable monthly working dues and any associated fees uniformly required for union membership in the local Union which is signatory to this Agreement. Further, there is nothing in this Agreement that would prevent non-union employees from joining the local Union.

7.4. Authorized representatives of the Unions shall have access to the Projects whenever work covered by this Agreement is being, has been, or will be performed on the Projects, provided it is not disruptive to the work on the Projects or the operation of the District.

ARTICLE 8

REFERRAL

8.1. Contractor(s)/Employer(s) performing construction work on covered Projects shall, in filling craft job requirements be bound by and utilize the registration facilities and referral systems established or authorized by the signatory Unions when such procedures are not in violation of Federal law. The Contractor(s)/Employer(s) shall have the right to reject any applicant referred by the Union(s), in accordance with the applicable Master Agreement.

8.2. The Contractor(s)/Employer(s) shall have the unqualified right to select and hire directly all supervisors above the level of General Foreman it considers necessary and desirable, without such persons being referred by the Union(s). The selection of craft foremen and general foremen shall be entirely the responsibility of the Contractor(s). Foremen and general foremen shall take orders from the designated Contractor(s) representatives.

8.3. In the event that referral facilities maintained by the Unions are unable to fill the requisition of a Contractor/Employer for employees within a forty-eight (48) hour period (Saturday, Sundays and holidays excluded) after such requisition is made by the Contractor/Employer, the Contractor/Employer shall be free to obtain work persons from any source.

8.4. Unions will exert their utmost efforts to recruit sufficient numbers of skilled craft persons to fulfill the requirements of the Contractor(s)/Employer(s). The parties to this Agreement support the development of increased numbers of skilled construction workers from graduates of District schools and residents of Contra Costa County and the surrounding East Bay Area to meet the needs of District Projects and the requirements of the industry generally. Toward that end, the Unions agree to encourage the referral and utilization, to the extent permitted by law and the hiring hall procedures, of qualified graduates of District schools, Contra Costa residents and residents of the East Bay Area as journeymen and apprentices to covered Projects and entrance into such apprenticeship and training programs as may be operated by the Unions.

8.5. Recognizing the special needs of District Projects, the Unions shall consider a Contractor(s)/Employer(s) request to transfer key employees to work on a covered Project in a manner consistent with the Union's referral procedures.

ARTICLE 9

BENEFITS

9.1. All Contractor/Employers agree to pay contributions to the vacation, pension and other form of deferred compensation plan, apprenticeship, and health benefit funds established in the applicable Schedule A for each hour worked on the Project in amounts no less than those designated in the Department of Industrial Relations Wage Determination of the applicable craft.

9.2. The Contractor(s)/Employer(s) shall not be required to pay contributions to any other trust funds that are not contained in the published prevailing wage determination to satisfy their obligation under this Article except those Contractor(s)/Employer(s) who are signatory to the Master Agreements with the respective trades shall continue to pay all trust fund contributions as outlined in such Master Agreements.

9.3. By signing this Agreement, the Contractor(s)/Employer(s) adopt and agree to be bound by the written terms of the legally established Trust Agreements as described in Section 9.1 above specifying the detailed basis on which payments are to be made into, and benefits paid out of, such Trust Funds.

9.4. Wages, Hours, Terms and Conditions of Employment: The wages, hours and other terms and conditions of employment on a Project shall be governed by the Master Agreement of the respective crafts, copies of which shall be on file with the District, to the extent such Master Agreement is not inconsistent with the applicable Department of Industrial Relations Prevailing Wage Determinations which shall establish minimum wages. Where a subject is covered by the Master Agreement and not covered by a Wage Determination or this Agreement, the Master Agreement will prevail. When a subject is covered by both the Master Agreement and this Agreement, to the extent there is any inconsistency, this Agreement will prevail.

ARTICLE 10

LOCAL HIRE

10.1. It is an objective of the parties that not less than 25 percent (25%) of all hours worked by journeyman and apprentices on the Project, on a craft by craft basis, be worked by residents of the area served by the Contra Costa Community College District. The Unions will exert their utmost efforts to recruit sufficient numbers of skilled craft persons to fulfill the requirements of the Contractor(s)/Employer(s). The parties to this Agreement support the development of increased numbers of skilled construction workers from the area served by the District. To the extent allowed by law, and consistent with the local Union's hiring hall provisions, and as long as they possess the requisite skills and qualifications, residents of the area served by the District, including journeyman and apprentices, shall be referred for Project work covered by this Agreement.

ARTICLE 11

COMPLIANCE

11.1. It shall be the responsibility of the Contractor(s)/Employer(s) and Unions to investigate and monitor compliance with the provisions of the Agreement contained in Article 9. Nothing in this agreement shall be construed to interfere with or supersede the usual and customary legal remedies available to the Unions and/or employee benefit Trust Funds to collect delinquent Trust Fund contributions from Employers on the Project. The District shall monitor and enforce compliance with the prevailing wage requirements of the State and Contractor'(s)/Employer'(s) compliance with this Agreement if the District operates a labor compliance program ("LCP") on the Covered Project and if that LCP requires the District to monitor and enforce this compliance.

ARTICLE 12

GRIEVANCE ARBITRATION PROCEDURE

12.1. The parties understand and agree that questions between or among parties signatory to a Master Agreement arising out of or involving the interpretation of a Master Agreement shall be resolved under the grievance procedure provided in that Master Agreement. The parties further understand and agree that in the event any dispute arises out of the meaning, interpretation or application of the provisions of this Agreement, such dispute shall be settled by means of the procedures set out herein. No grievance filed under this Grievance Arbitration Procedure shall be recognized unless the grieving party (Union on its own behalf, or on behalf of an employee whom it represents, or a Contractor/Employer on its own behalf) provides notice in writing to the signatory party with whom it has a dispute within five (5) days after becoming aware of the dispute but in no event more than thirty (30) days after it reasonably should have become aware of the event giving rise to the dispute. The time limits in this Section 12.1 may be extended by mutual written agreement of the parties.

12.2. Grievances shall be settled according to the following procedures:

Step 1: Within five (5) business days after the receipt of the written notice of the grievance, the Business Representative of the involved local Union or his/her designee, or the representative of the employee, and the representative of the involved Contractor/Employer shall confer and attempt to resolve the grievance.

Step 2: In the event that the representatives are unable to resolve the dispute within the five (5) business days after its referral to Step 1, the International Union Representative and the Contractor involved shall meet within seven (7) working days of the referral of the dispute to this second step to arrive at a satisfactory settlement thereof. Meeting minutes shall be kept by the Contractor. In the event that these representatives are unable to resolve the dispute after its referral to Step 2, either involved party may submit it within three (3) business days to the Grievance Committee, which shall meet within five (5) business days after such referral (or such longer time as is mutually agreed upon by all representatives on the Grievance Committee), to confer in an attempt to resolve the grievance. The Grievance Committee shall be comprised of

- two (2) representatives of the District; and
- two (2) representatives of the Contra Costa Building & Construction Trades Council.

If the dispute is not resolved within such time (five (5) business days after its referral or such longer time as mutually agreed upon) it may be referred within five (5) business days by either party to Step 3.

Step 3: Within five (5) business days after referral of a dispute to Step 3, the representatives shall choose a mutually agreed upon arbitrator for final and binding

arbitration. The parties agree that if the permanent arbitrator or his alternate is not available, an arbitrator shall be selected by the alternate striking method from the list of five (5) below:

1. Barry Winograd

2. Thomas Angelo

3. Robert Hirsch

4. William Riker

5. Joseph Grodin

The decision of the Arbitrator shall be binding on all parties. The Arbitrator shall have no authority to change, amend, add to, or detract from, any of the provisions of the Agreement. The expense of the Arbitrator shall be divided equally between the parties to the arbitration.

The Arbitrator shall arrange for a hearing on the earliest available date from the date of his/her selection. A decision shall be given to the parties within five (5) calendar days after completion of the hearing unless such time is extended by mutual agreement. A written opinion may be requested by a party from the presiding Arbitrator.

The time limits specified in any step of the Grievance Procedure set forth in Section 12.2 may be extended by mutual agreement of the parties initiated by the written request of one party to the other, at the appropriate step of the Grievance Procedure. However, failure to process a grievance, or failure to respond in writing within the time limits provided above, without an agreed upon extension of time, shall be deemed a waiver of such grievance without prejudice, or without precedent to the processing of and/or resolution of like or similar grievances or disputes.

In order to encourage the resolution of disputes and grievances at Steps 1 and 2 of this Grievance Procedure, the parties agree that such settlements shall not be precedent setting.

ARTICLE 13

JURISDICTIONAL DISPUTES

13.1. The assignment of Covered Work will be solely the responsibility of the Employer performing the work involved; and such work assignments will be in accordance with the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (the "Plan") or any successor Plan.

13.2. All jurisdictional disputes on this Project between or among the Building and Construction Trades Unions and their employers, parties to this Agreement, shall be settled and

adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted in the future by the Building and Construction Trades Department. Decisions rendered shall be final, binding and conclusive on the Employers and Unions parties to this Agreement.

13.2.1. For the convenience of the parties, and in recognition of the expense of travel between Northern California and Washington, DC, at the request of any party to a jurisdictional dispute under this Agreement an Arbitrator shall be chosen by the procedures specified in Article V, Section 5, of the Plan from a list composed of John Kagel, Thomas Angelo, Robert Hirsch, and Thomas Pagan, and the Arbitrator's hearing on the dispute shall be held at the offices of the applicable Building and Construction Trades Council. All other procedures shall be as specified in the Plan.

13.3. All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage, or slow-down of any nature, and the Employer's assignment shall be adhered to until the dispute is resolved. Individuals violating this Section shall be subject to immediate discharge.

13.4. Each Employer will conduct a pre-job conference with the Local Council prior to commencing work. Primary Employer will be advised in advance of all such conferences and may participate if they wish. Pre-job conferences for different Employers may be held together.

ARTICLE 14

APPRENTICES

14.1. Recognizing the need to maintain continuing support of programs designed to develop adequate numbers of competent workers in the construction industry, the Contractor(s)/Employer(s) shall employ apprentices of a State-approved Apprenticeship Program in the respective crafts to perform such work as is within their capabilities and which is customarily performed by the craft in which they are indentured.

14.2. The apprentice ratios will be in compliance with the applicable provisions of the California Labor Code and Prevailing Wage Rate Determination.

14.3. There shall be no restrictions on the utilization of apprentices in performing the work of their craft provided they are properly supervised.

ARTICLE 15

HELMETS TO HARDHATS

15.1. The Contractors/Employers and Unions recognize a desire to facilitate the entry into the building and construction trades of veterans and members of the National Guard and Reserves who are interested in careers in the building and construction industry. The

Contractors/Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center"), a joint Labor-Management Cooperation Trust Fund, established under the authority of Section 6(b) of the Labor-Management Cooperation Act of 1978, 29 U.S.C. Section 175(a), and Section 302(c)(9) of the Labor-Management Relations Act, 29 U.S.C. Section 186(c)(9), and a charitable tax exempt organization under Section 501(c)(3) of the Internal Revenue Code, and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

15.2. The Unions and Contactors/Employers agree to coordinate with the Center to create and maintain an integrated database of veterans and members of the National Guard and Reserves interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Contractors/Employers and Unions will give credit to such veterans and members of the National Guard and Reserves for bona fide, provable past experience.

15.3. In recognition of the work of the Center and the value it offers to the Project, Contractors/Employers performing work on the Project, on a voluntary basis, may elect to contribute to the Center the amount of one cent ($0.01) per hour for each hour worked by each individual employee covered by this Agreement. Any such payments shall be forwarded monthly to the Center in a form and manner to be determined by the Center's Trustees.

15.4. The Center shall function in accordance with, and as provided in the Agreement and Declaration of Trust creating the fund, and any amendments thereto, and any other of its governing documents. Each Contractor(s)/Employer(s) electing to contribute to the Center approves and consents to the appointment of the Trustees designated pursuant to the Trust Agreement establishing the Center and hereby adopts and agrees to be bound by the terms and provisions of the Trust Agreement.

ARTICLE 16

MANAGEMENT RIGHTS

16.1. The Contractor(s)/Employer(s) shall retain full and exclusive authority for the management of their operations, including the right to direct their work force in their sole discretion. No rules, customs or practices shall be permitted or observed which limit or restrict production, or limit or restrict the working efforts of employees except that lawful manning provisions in the Master Agreement shall be recognized.

16.2. Except as provided in Section 2.1, there shall be no limitation or restriction upon the choice of materials or upon the full use and installation of equipment, machinery, package units, factory pre-cast prefabricated or preassembled materials, tools or other labor saving devices. The on-site installation or application of all items shall be performed by the craft having jurisdiction over such work; provided, however, it is recognized that installation of specialty items which may be furnished by the owner of the Project or a Contractor shall be performed by

construction persons employed under this Agreement who may be directed by other personnel in a supervisory role, provided, however, in limited circumstances requiring special knowledge of the particular item(s), may be performed by construction persons of the vendor or other companies where necessary to protect a manufacturer's warranty. In such instances all provisions of this Agreement shall apply. The issue of whether it is necessary to use construction persons of the vendor or other companies to protect the manufacturer's warranty shall be subject to the grievance and arbitration clause of this Agreement.

ARTICLE 17

SAVINGS CLAUSE

17.1 The parties agree that in the event any article, provision, clause, sentence or word of the Agreement is determined to be illegal or void as being in contravention of any applicable law, by a court of competent jurisdiction such as the Department of Industrial Relations, the Division of Apprenticeship Standards, and other applicable labor related governmental agencies the remainder of the Agreement shall remain in full force and effect. The parties further agree that if any article, provision, clause, sentence or word of the Agreement is determined to be illegal or void, by a court of competent jurisdiction or other labor related governmental authorities, the parties shall substitute, by mutual agreement, in its place and stead, an article, provision, clause, sentence or word which will meet the objections to its validity and which will be in accordance with the intent and purpose of the article, provision, clause, sentence or word in question.

ARTICLE 18

MISCELLANEOUS PROVISIONS

18.1 Counterparts: This Agreement may be executed in counterparts, such that original signatures may appear on separate pages, and when bound together all necessary signatures shall constitute an original. Facsimile signature pages transmitted to other parties to this Agreement shall be deemed equivalent to original signature.

18.2 Warranty of Authority: Each of the persons signing this Agreement represents and warrants that such person has been duly authorized to sign this Agreement on behalf of the party indicated, and each of the parties by signing this Agreement warrants and represents that such party is legally authorized and entitled to enter into this Agreement.

18.3 Ratification by Governing Board: This Agreement shall not be binding on the District until it is approved by the Contra Costa Community College District Governing Board.

18.4 The Agreement shall be included as a condition of the award of all Construction Contracts that are a part of the PSA Program.

18.5 The parties shall establish and implement reasonable substance abuse testing procedures and regulations, which may include prehire, reasonable cause, random and post-

accident testing, to the extent permitted and/or required by Federal and State Law. Should the District administrator for the PSA approve an established program to which signatory Unions are currently a party, such program may become the Project-wide substance abuse testing program, after consultation with the Unions. Until there is such a Project-site substance abuse testing procedure negotiated by the District administrator and the Unions for the PSA, such substance abuse testing procedures as are contained in the Schedule A's shall be applicable to work on the Project, pursuant to their terms.

Contra Costa Community College District

BY: _____ DATE: 10-22-12

Helen Benjamin
Chancellor

Contra Costa Building & Construction Trades
Council AFL-CIO (Council)

BY: _____ DATE: Oct. 22, 2012.

Greg Feere
Secretary-Treasurer
Business Manager

Exhibit A

Agreement to Be Bound

Project Stabilization Agreement

The undersigned, as a Contractor on the Contra Costa Community College Project Stabilization Agreement "Project", subject to the Project Stabilization Agreement "Agreement", for and in consideration of the award to it of a contract to perform work on said Project, and in further consideration of the promises made in the Agreement and all attachments, a copy of which was received and is acknowledged, hereby:

1. Accepts and agrees to be bound by the terms and conditions of the Agreement together with any and all amendments and supplements now existing or which are later made thereto only for the duration and scope of the Contractor's work on the Project.

2. The Contractor agrees to be bound by the legally established trust agreements designated in local master collective bargaining agreements. The Contractor authorizes the parties to such local trust agreements to appoint trustees and successor trustee to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor.

3. Certifies that it has no commitments or agreements which would preclude its full and complete compliance with the terms and conditions of said Agreement.

4. Agrees to secure from any Contractor(s) (as defined in said Agreement) which are or become a subcontractor (of any tier) to it a duly executed Agreement to be Bound in a form identical to this document.

_____	_____
Signature of (Sub)Contractor	Date
_____	_____
(Authorized Officer & Title)	Contractor's State License #

Exhibit B

List of "Schedule A" Agreements:

Collective Bargaining Agreements of each craft signatory to this Project Stabilization Agreement

1. Asbestos Workers Local 16
2. Boilermakers Local 549
3. Bricklayers Local 3
4. Northern California Regional Council of Carpenters for and on Behalf of Their Affiliated Crafts
5. Sheet Metal Workers Local 104
6. Operating Engineers Local 3
7. Painters District Council 16
8. Sprinkler Fitters Local 483
9. United Association Local 342
10. Teamsters Local 315
11. Hod Carriers Local 166
12. Roofers Local 81
13. Iron Workers Local 378
14. Laborers Local Union 324
15. Laborers Local Union 67
16. Cement Masons Local 300
17. Electrical Workers Local 302
18. Plasterers Local 66
19. United Association Local 159
20. United Association Local 355
21. Elevator Constructors Local 8

SIGNATURE PAGE
UNIONS

Asbestos Workers Local 16

Hod Carriers Local 166

Boilermakers Local 549

Roofers Local 81

Bricklayers Local 3

Iron Workers Local 378

Northern California Regional Council of Carpenters for and on Behalf of Their Affiliated Crafts

Laborers Local Union 324

Laborers Local Union 67

Sheet Metal Workers Local 104

Cement Masons Local 300

Operating Engineers Local 3

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Painters District Council 16

Plasterers Local 66

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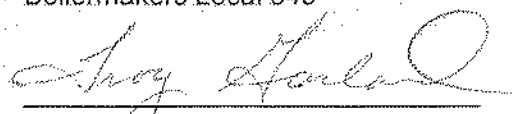
Boilermakers Local 549



Bricklayers Local 3

Northern California Regional Council of Carpenters for and on Behalf of Their Affiliated Crafts

Sheet Metal Workers Local 104

Operating Engineers Local 3

Painters District Council 16

Sprinkler Fitters Local 483

United Association Local 342

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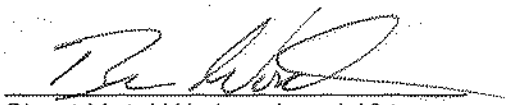

Sheet Metal Workers Local 104

Operating Engineers Local 3

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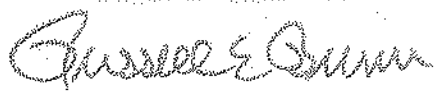

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Laborers Local Union 67

Cement Masons Local 300 Contra Costa Comm. College - Mandatory

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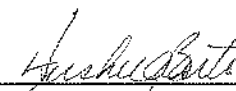

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Sheet Metal Workers Local 104

Operating Engineers Local 3

Painters District Council 16

Sprinkler Fitters Local 483

United Association Local 342

Teamsters Local 315

Hod Carriers Local 166

Roofers Local 81

Iron Workers Local 378

Laborers Local Union 324

Laborers Local Union 67

Cement Masons Local 300

Electrical Workers Local 302

Plasterers Local 66

United Association Local 159

United Association Local 355

Elevator Constructors Local 8

SIGNATURE PAGE
UNIONS

Asbestos Workers Local 16

Boilermakers Local 549

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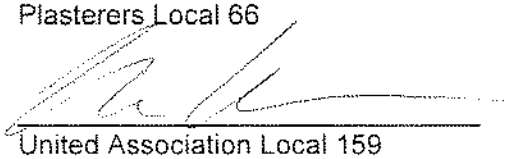

United Association Local 159

United Association Local 355

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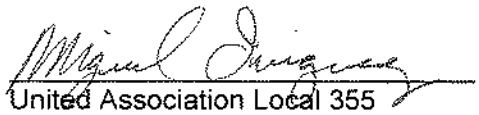

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SECOND AMENDMENT TO THE
PROJECT STABILIZATION AGREEMENT
for the
CONTRA COSTA COMMUNITY COLLEGE DISTRICT

Preamble

This is the Second Amendment to the Project Stabilization Agreement for the Contra Costa Community College District ("Agreement") entered into as of the 22nd day of October, 2012, by and between the Contra Costa Community College District ("District") together with contractors and/or subcontractors who became or will become signatory to the Agreement by signing an "Agreement to be Bound" (referred to collectively as "Contractors/Employers") and the Contra Costa Building and Construction Trades Council ("Council") and its affiliated local unions that have executed the Agreement (referred to collectively as "Unions").

Recitals

WHEREAS, Section 2.4.10 of the Agreement provides that the District and the Council may mutually agree in writing to amend and/or extend the Agreement at any time; and

WHEREAS, the original five-year term of the agreement ended on October 22, 2017; and

WHEREAS, the parties amended the Agreement on October 11, 2017, to add new section 2.4.11, which extended the term of the Agreement for an additional five years and provided for a further extension if mutually agreed; and

WHEREAS, the Agreement will terminate on October 22, 2022, unless extended; and

WHEREAS, the parties desire to extend the term of the Agreement for an additional five years and provide for a further roll-over unless either party opts to terminate the Agreement; and

WHEREAS, the parties desire to modify certain provisions of the Agreement related to the employment of apprentices and Veterans on District projects;

NOW THEREFORE, in consideration of the mutual promises and covenants herein contained, the Contra Costa Community College District and the Contra Costa Building and Construction Trades Council do mutually agree to amend the Agreement as indicated below, with all other terms and conditions to remain unchanged and in effect.

Amendment

Article 2 is hereby amended to include new Section 2.4.12, as follows:

> 2.4.12 Pursuant to Section 2.4.10 and Section 2.4.11, this Agreement has been reviewed and considered for extension or renewal, and the District and the Council agree that the Agreement shall be extended for an additional term of five (5) years from the expiration date of the First Amendment to the Agreement. Thereafter, approximately ninety (90) days prior to each five (5) year anniversary of this Agreement, the District and the Contra Costa Building and Construction Trades Council shall meet to discuss whether to extend this Agreement and any necessary modifications to it. The District or the Council may terminate this Agreement by providing written notice to the other party prior to the expiration of the term. Absent such written notice to terminate this Agreement by either the District or the Council, this Agreement, with any agreed-upon modifications, will roll over for an additional five (5) years.

Article 10, Section 10.1 is hereby amended and revised to state as follows:

> 10.1 It is an objective of the parties that not less than 25 percent (25%) of all hours worked by journeyman and apprentices on the Project, on a craft by craft basis, be worked by residents of the area served by the Contra Costa Community College District to the extent allowed by law. The Unions will exert their outmost efforts to recruit sufficient numbers of skilled craft persons to fulfill the requirements of the Contractor(s) /Employer(s). The parties to this Agreement support the development of increased numbers of skilled construction workers that are representative of the diverse communities served by the District in Contra Costa County. To the extent allowed by law, and consistent with the local Union's hiring hall provisions, and as long as they possess the requisite skills and qualifications, residents of the diverse areas served by the District, including journeyman and apprentices, shall be referred for Project work covered by this Agreement.

Article 14, Section 14.1 is hereby amended and revised to state as follows:

> 14.1 Recognizing the need to maintain continuing support of programs designed to develop adequate numbers of competent workers in the construction industry, the Contractor(s)/Employer(s) shall employ apprentices enrolled in a State-approved joint labor-management apprenticeship program in the respective crafts to perform such work as is within their capabilities and which is customarily performed by the craft in which they are indentured.

Article 14 is hereby amended to include new Section 14.4 as follows:

> 14.4 Recognizing the need for local apprentice programs as stated in Section 14.1, the Unions agree to collaborate with the District to develop and implement viable new pathways to apprenticeship programs.

Article 15 is hereby amended to include new Section 15.5, as follows:

> 15.5 In addition, the Unions and Contractors/Employers agree to utilize the District's Veteran's Centers as one of their resources as part of their development and implementation of apprenticeships.

This amendment to the Agreement shall become effective on the day it is executed by the District and the Council, and approved by the Contra Costa Community College District Governing Board. Except as stated herein, the Agreement and the prior amendments to the Agreement shall continue in full force and effect in accordance with their terms.

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Contra Costa Community College District

BY: _____ DATE: 8/19/21

Bryan Reece, Ph.D.
Chancellor

Contra Costa Building and Construction
Trades Council, AFL-CIO

BY: _____ DATE: 8/19/2021

Bill Whitney, Chief Executive Officer

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2022 4CD Districtwide Energy & Sustainability Goals

On November 9th, 2022, the Contra Costa Community College Governing Board adopted Board Resolution 20B in support of Sustainability and Climate Action. This resolution adopted nine sustainability goals, which are in support of the 2019 California Community Colleges Board of Governors (BOG) Climate Change and Sustainability Policy and in support of the 2021 California Community Colleges Board of Governors (BOG) Climate Action and Sustainability Framework. The Framework refined the 2019 policy to reach further as well as extended the end target year by five years, putting it out to 2035. This framework aligns with current state policies and includes comprehensive goals for establishing benchmarks and meeting targets for reductions in greenhouse gas emissions, energy efficiency, water usage reduction, waste, transportation, food systems, and sustainable purchasing.

The 4CD resolution forms a basis for future planning of needed infrastructure upgrades as well as future building retrofits in our long-range master plans, and serves as a guidepost for fine tuning campus operations. Presently, and for the first time, the State Chancellor's Office Scheduled Maintenance 2022/23 funding year includes an energy efficiency projects category, signaling a movement in the State's desire to include funding for these goals.

All new major construction projects shall be designed and constructed to be Zero Net Energy, meeting the above goals and meeting building codes. 4CD has already designed several buildings to be ZNE Ready and are certifying some to be ZNE, using existing onsite PV. Combining this precedence with the shift in building codes to ZNE, we ask that all major construction projects go to electric heating/cooling and all electric heating hot water systems, combined with ZNE.

4CD has continued to improve all facilities through such sustainable projects as LED lighting upgrades, building automation/climate control systems, water conservation projects throughout all campuses and reducing utility costs and reliance on fossil fuels by investing in renewable energy sources across 4CD. Project teams should be innovative at combining projects and technology that may result in lower total cost of ownership, or balanced total costs (e.g. updating to LED lighting when replacing an HVAC system can result in smaller size/right sizing HVAC equipment)

Following is a graphical summary of the 4CD Districtwide Sustainability Goals:

The table below shows 4CD goals in more detail, with key intermediate goals and some of the steps required to achieve the 2035 goals, as set forth in the BOG 2021 Framework.

Categories	Intermediate Goals by 2025	Intermediate Goals by 2030	Goals by 2035
#1: Greenhouse Gas (GHG)	Establish baseline/benchmark greenhouse gas emissions. Conduct emissions inventory and create a Climate Action Plan.	Reduce GHG by 75% below the baseline.	Reduce GHG by 100% below the baseline.
#2: Renewable Energy	Establish Campus wide EUI score Conduct Effective Useful Life (EUL) analysis of all gas using appliances and systems Plan for electrification of systems with EUL of less than 10 years	Decrease EUI by 25% Produce or procure 75% of electrical consumption using renewable energy	Decrease EUI by 40% ZNE Campus

Categories	Intermediate Goals by 2025	Intermediate Goals by 2030	Goals by 2035
#3: Green Building and ZNE	Benchmark EUI for each building Develop ZNE and campus electrification strategy Optionally conduct LEED or WELL assessments of existing buildings.	All new buildings LEED or WELL Gold Reduce natural gas usage by 30%.	All new buildings ZNE and Zero Carbon All existing buildings LEED O&M Gold or WELL Gold equivalent Reduce natural gas usage by 75%.
#4: Transportation	Conduct accounting and conditions assessment of fleet vehicles; assess remainder rolling stock for electrification Develop EV charging infrastructure to encourage faculty, staff and students to use EVs Promote accessible shared transport methods Make pedestrian and bicycle assess improvements by 2025.	50% of new fleet vehicles must be ZE vehicles 50% of rolling stock must be ZE Implement green parking permits by 2030	100% of new fleet vehicles must be ZE vehicles 100% of rolling stock must be ZE Achieve 50% reduction in Single Occupant Vehicle (SOV) transportation
#5: Zero Waste	Conduct waste categorization assessment Benchmark and comply with T14, Division 2, Chapter 5 Benchmark and comply with Title 14, CCR Division 7 Develop a total material consumption benchmark Conduct an AB341 compliance assessment Centralize reporting for waste and resource recovery	Achieve zero waste to landfill Conduct a circularity analysis Reduce material consumption by 10%	Maintain zero waste to landfill. Increase material circularity by 25% Decrease consumption of materials by 25% by 2035

Categories	Intermediate Goals by 2025	Intermediate Goals by 2030	Goals by 2035
#6: Procurement	Benchmark sustainability of existing products and services Adopt sustainable procurement policy and administrative procedure Purchase environmentally preferable electronics products.	Increase procurement of sustainable products and services by 25%	Increase procurement of sustainable products and services by 50%
#7: Water	Develop local benchmarks for potable water usage Identify non-potable water resources Create landscape zoning map and irrigation metering strategy Adopt CCC Model Stormwater Management Program practices	Reduce potable water usage by 25% Install meters on all landscape irrigation systems of 2500 SF or more (unless using local or municipal reclaimed water) Landscape plantings are 90% native Irrigated turf cannot exceed 50% of landscaped areas on campus Follow Municipal Separate Storm Sewer Systems (MS4) requirements	Reduce potable water usage by 50% Limit stormwater runoff and discharge to predevelopment levels for temperature, rate, volume and duration of flow through the use of green infrastructure and low impact development for the campus AND for new buildings and major modifications
#8: Curriculum	Seek to further integrate sustainability into the academic curriculum. Will solicit and evaluate feedback from faculty, staff, students and community organizations to monitor the effects of sustainability and energy conservation efforts on instructional programs and the environment.		
#9: Food Systems	Campus food service organizations track their sustainable food purchases. See Real Food Challenge (www.realfoodchallenge.org/resources/real-food-resources/) guidelines, or equivalent, with consideration to campus-requested improvements	Increase sustainable food purchases to 20% of total food budget	80% of food served on campus meets the goals of the Real Food Challenge or equivalent

Below are references to supporting documents used to develop the 4CD Energy and Sustainability Goals:

1122-20B-FP Resolution in Support of Sustainability & Climate Action – This is the 4CD board resolution adopted in November of 2022.

2019 Board of Governors Item Resolution on Climate Change Goals & Policy – This is the California Community Colleges Board of Governor's 2019 Resolution adopting the Climate Change Goals and Policy.

2021 BOG Climate Action and Sustainability Framework – This is the California Community Colleges Board of Governor's 2021 Climate Action and Sustainability Framework which provides an update to the 2019 goals and policy as well as a framework to achieve the 2021 updated goals.

DIABLO VALLEY COLLEGE

Contra Costa Community College District

CLASSROOM DESIGN STANDARDS

JANUARY 19, 2018
FINAL REPORT

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CONSULTANTS

ARCHITECTURAL
WRNS Studio

MEP
Interface Engineering

AV/IT
The Shalleck Collaborative

ACOUSTICS
RGD Acoustics

LIGHTING
Watt Lighting

COST
Cumming

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EXECUTIVE SUMMARY

This Classroom Design Standards was commissioned at Diablo Valley College (DVC) to develop a comprehensive set of design standards for future learning environments on the campus. It provides an aggregate foundation for the holistic development of such spaces, for both new constructions and/ or renovations. Three typical classroom sizes were designed - Small: for 30 students, Medium: for 45 students and Large: for 90 students.

Classrooms have evolved over the years from traditional or hierarchical lectures to more collaborative and experiential learning environments. The existing classrooms at DVC are out-dated at 15 sf/student and do not meet the needs of 21st Century Learning Environments. A key to the development of an effective 21st century learning environment is creating a setting where students and faculty are engaged and energized, resulting in 'active' education. Embodying the college's mission statement, these environments are designed for diversity and inclusion that foster personal growth and life-long learning. The campus aims to create collaborative multi-modal learning environments focused on skill-based and community-based learning.

The architectural design for such 21st Century Learning Environments focuses on creating connections with the physical and social context, both inside and outside the classroom, that fosters the innovative and interdisciplinary partnerships. This can be achieved through a spatial organization that emphasizes - 1) incorporating an inventory of flexible furniture and equipment to facilitate the diverse needs of the users; 2) maximizing daylight and thermal/ acoustic comfort to cultivate an environment for user well-being; 3) integrating technology, both digital and analog, to enable seamless collaboration; 4) promoting ideation and tinkering using 'hands-on' learning to encourage students to be masters of theory and practice; and 5) providing an inclusive experience for persons of varying demographics and learning styles.

The design standards included here encompass a synthesis of the foundational work authored by the visionary leadership of all the Stakeholders. Based on the input from all stakeholders, the Executive Steering Committee decided on the following planning parameters for this classroom design standards:

- Small classrooms – 27 ASF/Student
- Medium classrooms – 25 ASF/Student (*while a couple of classrooms on a project by project basis will be at 27 ASF to allow for additional capacity for certain programs only)*
- Large classrooms – 25 ASF/Student

The detailed strategies for a variety of physical layouts, inventory of furnishings and selection of technology and equipment ascertain that the teaching and learning environments on campus are full of choices in a technology-enabled, peer-to-peer community. These standards provide general, best-practice performance criteria rather than prescriptive specifications that can be adopted by the campus for the detailed design and construction of any future learning environment.

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01
INTRODUCTION

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This Classroom Design Standards was developed as a collaboration among student, faculty and staff representatives from various departments at the College.

1.1 PROJECT TEAM

In order to foster an inclusive leadership team, the project had 4 committees, each with its defined responsibility, as follows:

DECISION GROUP
(Make Decisions)
Executive Steering Committee

CORE COMMITTEE
(Provide Input)
Rachel Westlake, VP, Instruction
Obed Vazquez, Dean, Engineering/ Social Science
Despina Prapavessi, Dean, Math/CS/ Business
Mike Holtzclaw, Senior Dean, San Ramon Campus
Kim Schenk, Senior Dean Curriculum
Rick Robison, Dean, Library, Educational Technology and Learning Support
Toni Fannin, Interim Dean, AFA
Beth McBrien, Academic Senate President/ Instructor
John Freytag, Academic Senate Vice President/ Faculty
Anne Kingsley, Faculty (English Department & Distance Education)
Cheryl Wilcox, Faculty (Math)
Mario Tejada, Faculty (CIS Instructor), DE Chair
Lee Rode, Faculty (Psychology)
John Hanecak, Faculty (Communication Studies)
Joan Symonds, Faculty (ECE & AEBG Faculty Co-coordinator)
Daniel Kiely, Librarian, Chair
Newin Orante, VP, Student Services
Percy Roper, IT Manager
James Buchanan, Director, Facilities Management & Operations
Frank Ichigaya, Custodial Manager
David Hagerty, Manager, Disability Support Services
Edward Carney, Chief of Police
Tracy Marcial, District Energy Manager

STAKEHOLDER COMMITTEE
(Provide Direction)
Core Committee Members
Christine Worsley, Dean/ AD
John Nahlen, VP, Business & Administrative Services

PLANNING COMMITTEE
(Day-to-day Management & Coordination)
Ines Zildzic, Associate CFP
Rachel Westlake, Vice President of Instruction
Mitch Fine, Partner, WRNS Studio
Lilian Asperin, Associate/ Project Director, WRNS Studio
Prairna Gupta Garg, Architect, WRNS Studio

In addition, the other participants of the project team include the following consultants:

Ian Hunter, Principal, The Shalleck Collaborative
Scott Krenzke, Senior Consultant, The Shalleck Collaborative
Jason Neches, Principal, WATT Lighting
Timothy Der, Principal, RGD Acoustics Inc.
Hormoz Janssens, Managing Principal, Interface Engineering
Eunice Yoon, Associate/ Senior Mechanical Engineer, Interface Engineering
Robin Roderick, Senior Electrical Engineer, Interface Engineering
Nick Mata, Director, Cumming Corporation

1.2 PROCESS

The design process for this project was designed to gather both quantitative and qualitative data to inform the comprehensive set of design standards for three typical classroom sizes on the campus (Small: 30 students, Medium: 45 students and Large: 90 students).

The quantitative phase of the process was defined by data collection via campus-wide surveys issued to students, faculty and staff. These surveys were designed to solicit information about the current state of the teaching and learning environments as well as desires for the future of these critical spaces within the campus. To capitalize on the extraordinary response rate obtained, the design team organized and led interactive discussions and workshops with the different stakeholder groups (Students, Faculty, Faculty Affairs, Student Affairs, Diversity and Inclusion, AV/IT Services, Accessibility, and Custodial) to identify those unique qualitative attributes that taken together embody the aspirations for "21st century Learning Environments at DVC" in times of changing pedagogies.

The process also emphasized on 'Inclusivity' by launching a project-specific micro-website to share information and solicit any feedback from the larger campus community. (*www.dvcclassroomstandards.com*)

1.3 SUSTAINABILITY

Governing Board Policy 6004 Environmental Stewardship and Sustainability, adopted in 2010, provides the groundwork for institutionalizing sustainability principles into every facet of Contra Costa Community College District. The DVC Sustainability Committee's work will pave the way for integration of these goals and policies into College's Strategic Plan in support of College's commitment to ensure student success as well as meeting the goal of 50% of existing California State buildings being required to be to be Zero Net Energy (ZNE) by 2025.

A thorough sustainability approach was considered throughout the design process to promote healthy and energy efficient learning environments. We prioritized organizing primary building components to benefit from daylight while mitigating heat gain; selecting high-efficiency equipment to conserve energy; specifying

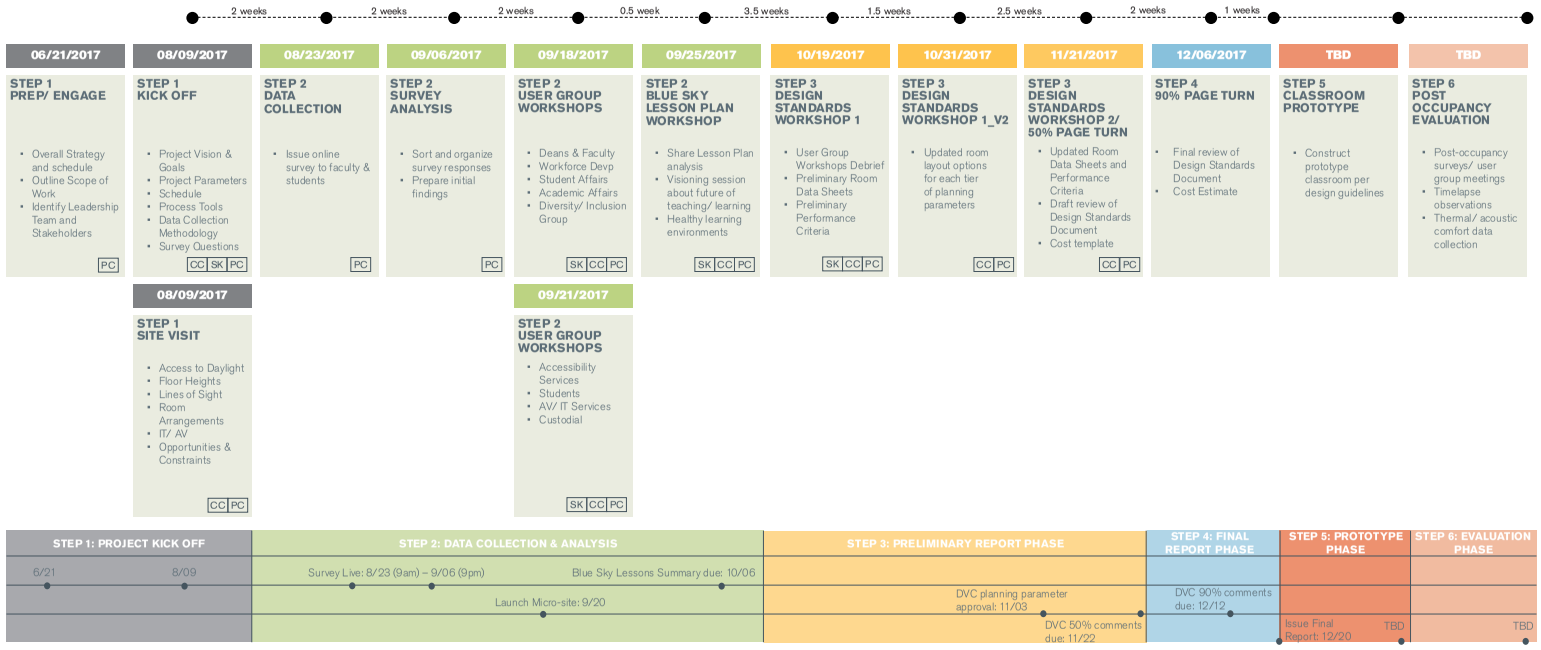
furniture systems that meet green standards; and selecting materials that have recycled content and are durable over time. These strategies will be augmented by the use of non-toxic markers, low-VOC paints and other certified material applications that are congruent with the campus's commitment to green buildings and environmental stewardship.

1.4 SCHEDULE

A project-specific road map outlining the different steps within the process was developed as a working tool to ensure timely completion of the project.

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

CLASSROOM DESIGN STANDARDS ROADMAP



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PC PLANNING COMMITTEE

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Rachel Westlake, Vice President of Instruction
Mitch Fine, WRNS
Lilian Asperin, WRNS
Praima Gupta Garg, WRNS

Governance/ Council Meetings TBC

WRNSSTUDIO

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02
SURVEY ANALYSIS

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OVERVIEW

As a key method for data collection, the surveys were designed to solicit information about the current state of the teaching and learning environments and desires for the future of these critical spaces on campus. Three groups of respondents (students, faculty and staff) were invited to participate via campus-wide email outreach.

The survey period lasted two weeks from August 23rd to September 6th, 2017. Responses were collected online through SurveyMonkey*. Gathered responses were used to inform the spatial, functional and operational layouts of each size (Small, Medium and Large) of general-use classrooms.

In total, the survey garnered 1,044 responses. Below are statistics for each group:

Students: 779 respondents
Faculty: 223 respondents
Staff: 42 respondents

SURVEY QUESTIONS

To ensure consistency, a similar set of questions was developed for all respondent groups. The survey included the following areas of inquiry:

1. Identify your primary campus.
   - Pleasant Hill
   - San Ramon

2. For Students: How long have you attended DVC?
   - I am new to DVC (first semester)
   - 2-4 semesters
   - 4-6 semesters
   - 6+ semesters

   For Faculty: Identify your academic area.
   - Full-time
   - Adjunct

   For Staff: What type of unit do you belong to?
   - Instructional
   - Student Services
   - Maintenance & Operations
   - IT
   - Other

2A. For Faculty (only): Identify your academic area.
   - Addiction Studies
   - Administration of Justice
   - Anthropology
   - Architecture
   - Art History
   - Art/Photography
   - Biological Science
   - Business Administration
   - Communication Studies
   - Computer Information Systems
   - Computer Network Technology
   - Computer Science
   - Construction
   - Counseling
   - Culinary Arts
   - Dental Programs
   - Digital Media Studies
   - Drama
   - DSS – Special Education
   - Early Childhood Education
   - Economics/Political Science
   - Electrical/Electronics/Energy Systems
   - Engineering
   - Engineering Technology/Industrial Design
   - English/ESL
   - Foreign Language
   - Geography
   - Geology/Physical Science/Astronomy/Physics
   - Health Science/Nutrition
   - History
   - Horticulture
   - Humanities/Philosophy
   - Journalism
   - Kinesiology/Athletics/Dance
   - Library Tech
   - Mathematics
   - Music/Music Industry Studies
   - Psychology
   - Sociology/Social Sciences

3. Please score each of the following classroom attributes on a scale of 1 (not important to your classroom experience) to 5 (extremely important to your classroom experience).
   - Comfortable/ ergonomic furniture
   - Ability to rearrange and move furniture quickly and without much effort
   - Comfortable room temperature and/or ability to adjust temperature
   - Good acoustics and minimal sound from adjoining spaces
   - Ease of physical movement within the room
   - Ability to subdivide a space/create break-out spaces
   - Ability to control light levels and create different zones within the room
   - Availability of whiteboards or other writable surfaces on the walls
   - Availability of projection screens
   - Availability of multiple electrical outlets
   - Availability of technology that enables interaction between students and/or teacher
   - Having a clear line of sight throughout the room
   - Having access to natural light and views
   - Ability to contact IT, Media Services, evening services, or emergency services from within the room

** SurveyMonkey is an online survey development, cloud-based company that provides customizable surveys.*

4. Please score each of the following technology attributes within the classroom on a scale of 1 (not important) to 5 (extremely important) as it relates to your teaching/ learning experience.
    - Ability to record a lecture by video
    - Ability to use a document camera
    - Ability to digitally record content from writeable surfaces
    - Ability to present digital content and mark/edit it real-time
    - Ability for students to share their work wirelessly on any digital display within the room
    - Having dedicated monitors/ screens for group work, either fixed or movable
    - Having good microphones and speakers in the room
    - Having simple and standardized technology interfaces in all rooms
    - Having reliable and consistent Wi-Fi access

5. Please list three attributes of the classrooms you are currently using that ENHANCE your teaching/ learning experience.

6. Please list three attributes of the classrooms you are currently using that DISRUPT your teaching/ learning experience.

7. What additional considerations would you like the planning committee to keep in mind when thinking about the design and operation of future learning environments?

ANALYSIS METHODOLOGY

Because a primary intent of the survey was to elicit quantitative as well as qualitative information, analyzing the survey required a focused organization. While the first five questions provided responses that could be easily measured and sorted, the last three questions were open-ended and designed to encourage deeper and more elaborate responses. The responses for these questions were sorted into six categories in an effort to standardize the answers and gain key insights.

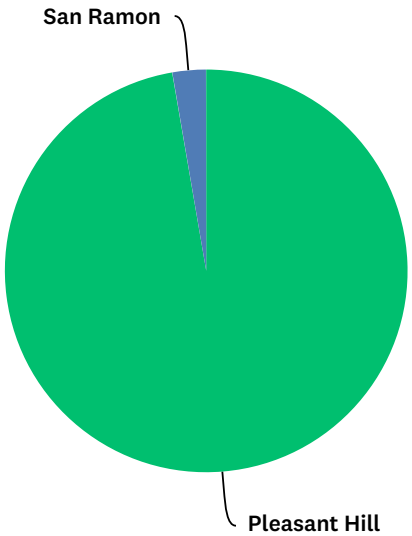
Some of the most elaborate and informative responses were given to question 7 (additional considerations) and often resulted in classification into more than one category. These occurrences were repeatedly counted in multiple categories in an effort to maintain the richness of the comprehensive responses.

The six categories were:

- **Environmental:** Attributes that relate to human comfort like color, natural and artificial lighting, air quality, room temperature, acoustics and lighting/temperature control systems.
- **Equipment:** Attributes that relate to non-technology-enabled equipment such as writable wall surfaces, ergonomic, moveable & accessible furniture and wall clocks.
- **Instructional/Learning:** Non-tangible attributes that relate to teaching methodology and learning outcomes such as faculty/student interaction, smaller class sizes that enhance student engagement.
- **Maintenance:** Attributes that relate to satisfactory facility upkeep such as cleanliness and theft prevention.
- **Room Arrangement:** Attributes that relate to spatial organization such as flexibility of furniture, line of sight, accessibility/ movement within the room and room safety measures.
- **Technology:** Attributes that relate to technology-enabled equipment such as projectors and smart boards, smart podium/ instructor stations, microphones and sound systems, electrical outlets, document camera, wireless internet, computer software and faculty training.

STUDENT RESPONSES

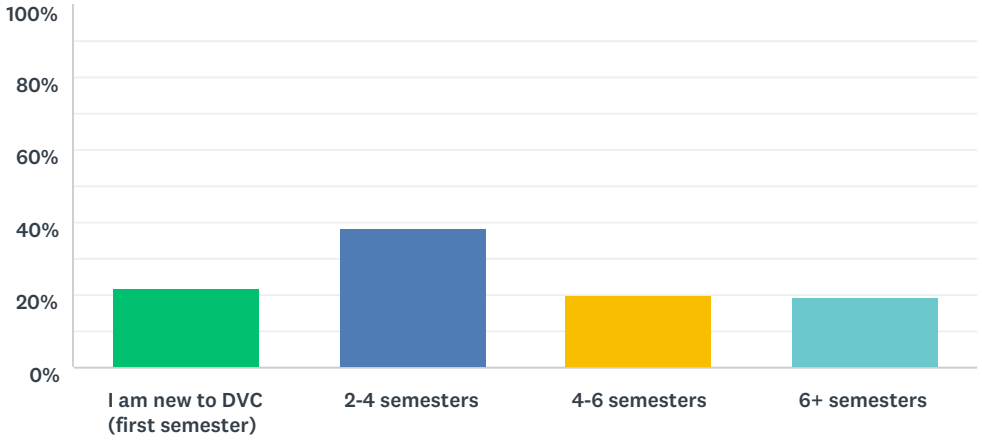
1. IDENTIFY YOUR **PRIMARY CAMPUS**



**The Pleasant Hill campus is significantly larger in population than the San Ramon campus, therefore, the number of responses are proportionately balanced between the two campuses.*

ANSWER CHOICES	RESPONSES	
Pleasant Hill	97.31%	759
San Ramon	2.69%	21
TOTAL		780

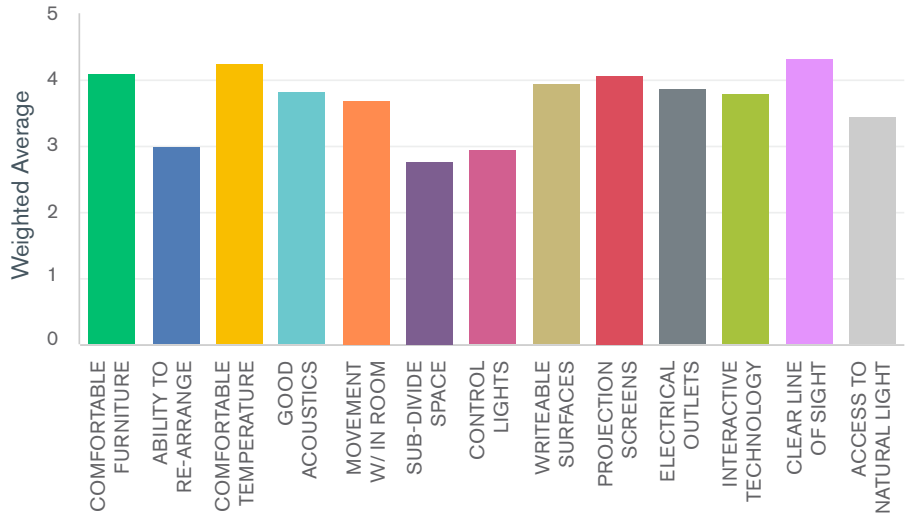
2. HOW LONG HAVE YOU **ATTENDED DVC**?



ANSWER CHOICES	RESPONSES	
I am new to DVC (first semester)	22.18%	173
2-4 semesters	38.46%	300
4-6 semesters	20.00%	156
6+ semesters	19.36%	151
TOTAL		780

STUDENT RESPONSES

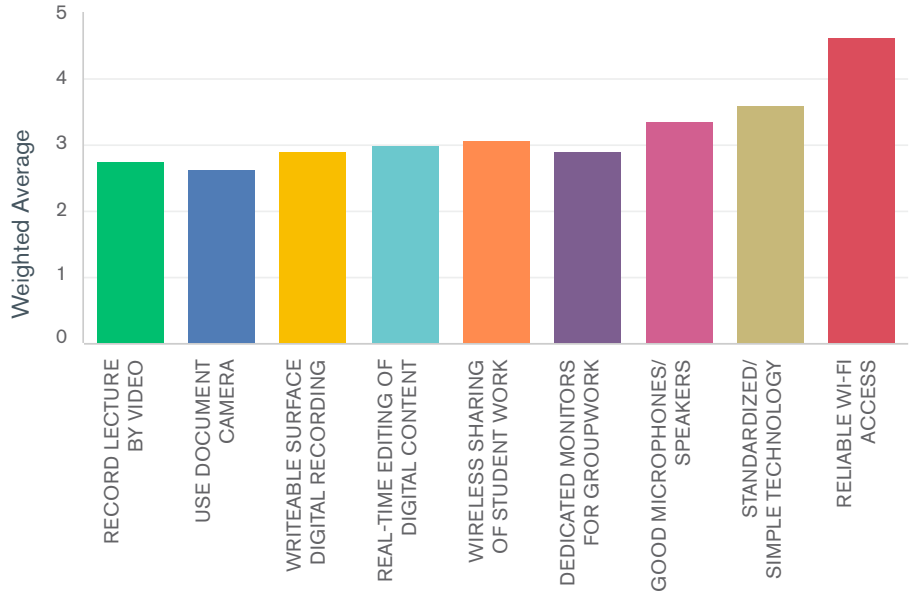
3. SCORE **CLASSROOM ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO YOUR LEARNING EXPERIENCE.



	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Comfortable/ ergonomic furniture	0.90% 7	6.15% 48	19.23% 150	30.26% 236	43.46% 339	780	4.09
Ability to rearrange and move furniture quickly and without much effort	12.69% 99	25.00% 195	29.49% 230	16.54% 129	16.28% 127	780	2.99
Comfortable room temperature and/or ability to adjust temperature	0.77% 6	4.23% 33	13.72% 107	31.41% 245	49.87% 389	780	4.25
Good acoustics and minimal sound from adjoining spaces	2.05% 16	9.62% 75	24.49% 191	30.51% 238	33.33% 260	780	3.83
Ease of physical movement within the room	1.92% 15	11.92% 93	28.59% 223	30.51% 238	27.05% 211	780	3.69
Ability to subdivide a space/create break-out spaces	18.08% 141	27.18% 212	26.03% 203	15.64% 122	13.08% 102	780	2.78
Ability to control light levels and create different zones within the room	15.13% 118	25.38% 198	23.97% 187	19.74% 154	15.77% 123	780	2.96
Availability of whiteboards or other writable surfaces on the walls	1.92% 15	9.36% 73	20.26% 158	27.82% 217	40.64% 317	780	3.96
Availability of projection screens	1.03% 8	6.54% 51	17.95% 140	32.44% 253	42.05% 328	780	4.08
Availability of multiple electrical outlets	3.59% 28	11.41% 89	18.21% 142	26.79% 209	40.00% 312	780	3.88
Availability of technology that enables interaction between students and/or teacher	4.36% 34	11.67% 91	21.54% 168	25.00% 195	37.44% 292	780	3.79
Having a clear line of sight throughout the room	0.90% 7	4.74% 37	13.21% 103	23.46% 183	57.69% 450	780	4.32
Having access to daylight and views	8.08% 63	18.72% 146	23.46% 183	19.36% 151	30.38% 237	780	3.45

STUDENT RESPONSES

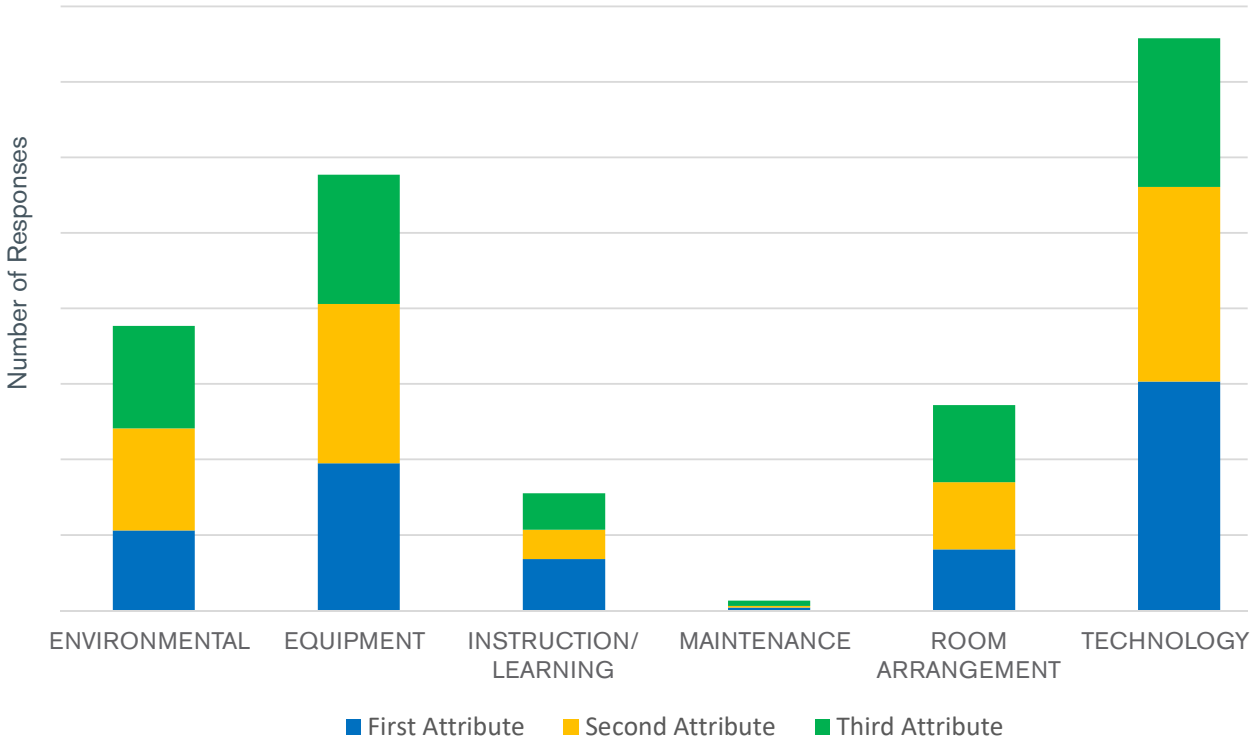
4. SCORE **TECHNOLOGY ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO YOUR LEARNING EXPERIENCE.



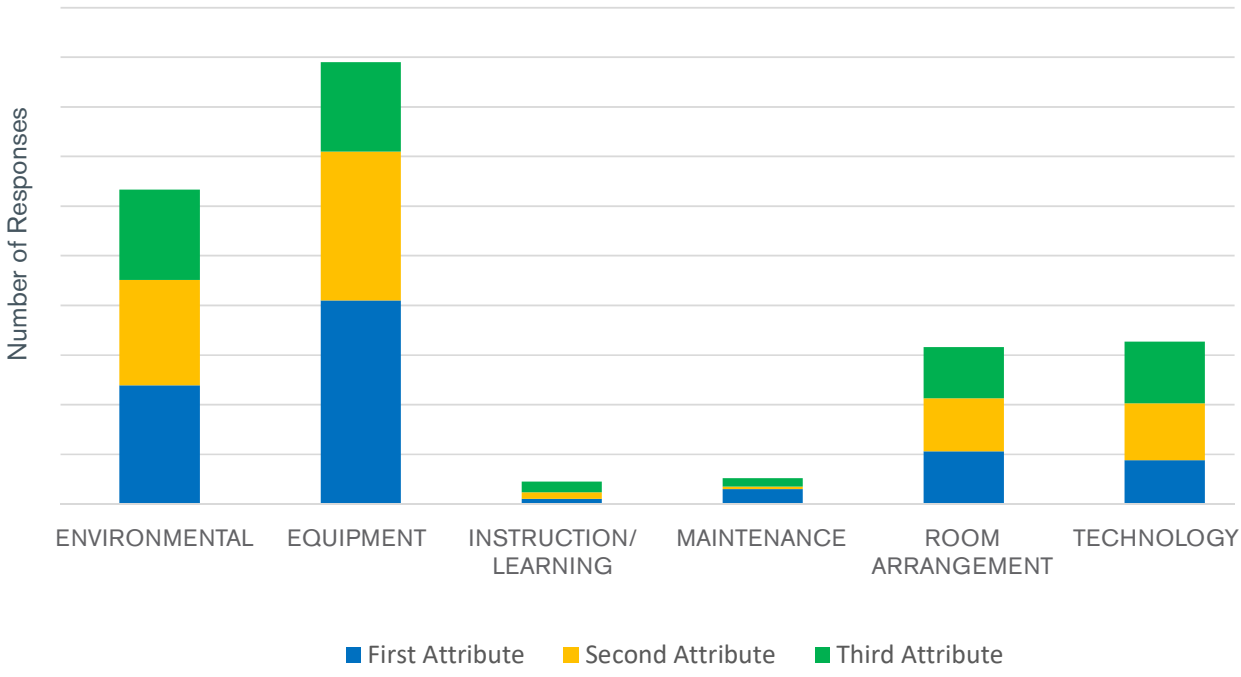
	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Ability to record a lecture by video	22.05% 172	24.23% 189	24.62% 192	13.85% 108	15.26% 119	780	2.76
Ability to use a document camera	24.10% 188	26.28% 205	25.13% 196	12.95% 101	11.54% 90	780	2.62
Ability to digitally record content from writeable surfaces	18.85% 147	21.28% 166	27.31% 213	16.92% 132	15.64% 122	780	2.89
Ability to present digital content and mark/edit it real-time	13.59% 106	23.97% 187	27.95% 218	16.79% 131	17.69% 138	780	3.01
Ability for students to share their work wirelessly on any digital display within the room	13.59% 106	21.28% 166	27.95% 218	17.69% 138	19.49% 152	780	3.08
Having dedicated monitors/ screens for group work, either fixed or movable	15.26% 119	25.26% 197	28.33% 221	15.64% 122	15.51% 121	780	2.91
Having good microphones and speakers in the room	10.13% 79	15.64% 122	27.18% 212	24.10% 188	22.95% 179	780	3.34
Having simple and standardized technology interfaces in all rooms	5.38% 42	12.18% 95	29.49% 230	23.46% 183	29.49% 230	780	3.59
Having reliable and consistent Wi-Fi access	1.15% 9	2.69% 21	5.51% 43	13.59% 106	77.05% 601	780	4.63

STUDENT RESPONSES

5. LIST THREE ATTRIBUTES THAT **ENHANCE** YOUR LEARNING EXPERIENCE.

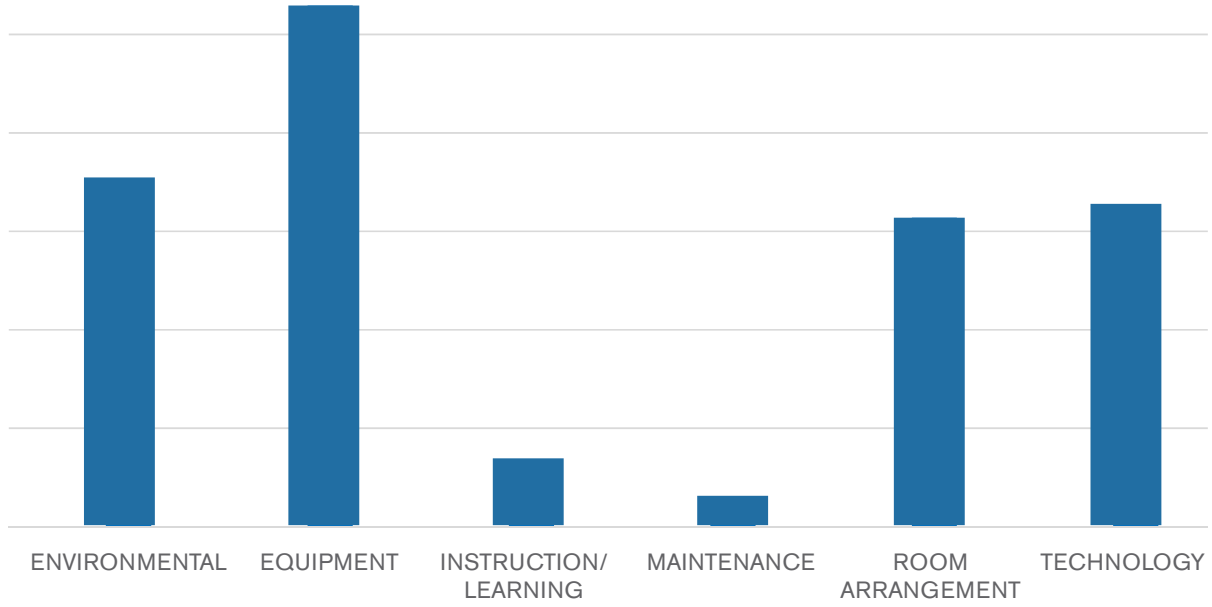


6. LIST THREE ATTRIBUTES THAT **DISRUPT** YOUR LEARNING EXPERIENCE.



STUDENT RESPONSES

7. **ADDITIONAL CONSIDERATIONS** ABOUT THE DESIGN AND OPERATION OF FUTURE LEARNING ENVIRONMENTS?



STUDENT RESPONSES

Analysis

Between the two campuses, the majority of the student responses were from the Pleasant Hill campus and most of the respondents had attended DVC for 2-4 semesters.

For question 3, most of the student respondents found all the classroom attributes as being important, very important or extremely important. The attributes that yielded the highest positive responses included:

- Having a clear line of sight throughout the room
- Comfortable room temperature
- Comfortable furniture
- Projection screens

Following these attributes, the next tier of positive responses included:

- Having good acoustics
- Movement within the room
- Interactive technology
- Writeable surfaces
- Access to electrical outlets

For question 4, there was clearly one technology attribute with the highest responses - reliable wi-fi access. Simple/ standardized technology and good microphones/ speakers were in the second tier of importance within this category.

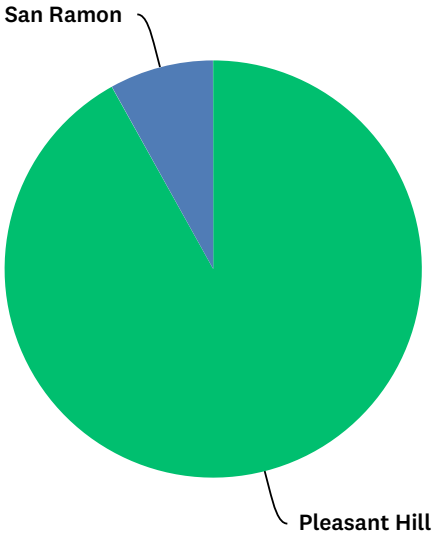
For question 5 (attributes that enhance), the majority of student responses profiled as two categories: Technology and Equipment. Within these, Technology stands out as the outlier, highlighting its positive effect on student learning. The ability to access wi-fi (when available) and work on their own devices as well as the ability to share digital content through projectors (by faculty and students) benefits their learning experience in the classroom. Following this, the students ranked the Equipment category next highest, thereby underlining that furniture and writeable surfaces are also key to their learning environment. The Environmental category was next in priority highlighting that comfortable temperature, good lighting and acoustics in some existing classrooms enhanced their learning. This was followed by the Room Arrangement category displaying that improved flexibility in the current classroom arrangements could augment their learning. The last category with few responses was Instruction/ Learning which emphasized on smaller class sizes as being more effective learning environments.

For question 6 (attributes that disrupt), the majority of student responses highlighted on the two categories: Equipment and Environmental. Unlike question 5, the Equipment category was the most important for students and was attributed to the outdated and poorly functioning instructional toolkits found in the current classrooms. Comfortable/ ergonomic, accessible and movable furniture that provides ample desk space for their materials (laptop, books, notepads etc.) as well as flexibility of movement within the room and large writeable surfaces like whiteboards/ writeable walls are key to their learning experience. The Environmental category ranked second highest by the students signifying that comfort (thermal, light, acoustic, views etc.) is imperative for them to stay focused in the learning environment. Room Arrangement and Technology followed third as disrupting causes with the lack of clear sight lines and insufficient wi-fi connectivity as the key factors compromising their learning.

For question 7, the student responses focused on tangible elements that they value as important in the future learning environments. Their responses were dispersed among four key categories: Environmental, Equipment, Room Arrangement and Technology. Of these, Environmental and Equipment stood out to be the fundamental elements that every future classroom should have according to the students. The need for welcoming and comfortable, non-distracting surroundings that would help them concentrate was noted. Students declared that their attention during instructional activities was enhanced by daylight, fresh air and comfortable room temperatures. Similar to the response to question 6, in terms of Equipment, students expressed a preference for flexible ergonomic furniture that fits ‘all sizes’. Not having enough workspace and circulation space between the desks disrupts their learning. Following this, Technology ranked similar to Room Arrangement confirming that updates to the classroom technology (audio-visual systems, wi-fi, interactive digital media etc) are as important as flexible classroom layouts contributing to better learning environments characterized by collaboration.

FACULTY RESPONSES

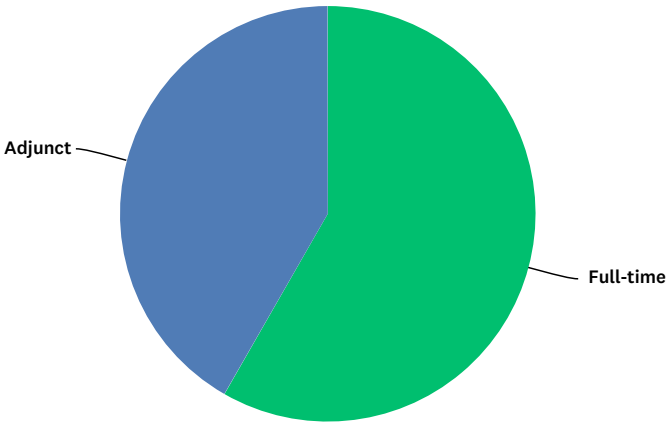
1. IDENTIFY YOUR **PRIMARY CAMPUS**



**The Pleasant Hill campus is significantly larger in population than the San Ramon campus, therefore, the number of responses are proportionately balanced between the two campuses.*

ANSWER CHOICES	RESPONSES	
Pleasant Hill	91.93%	205
San Ramon	8.07%	18
TOTAL		223

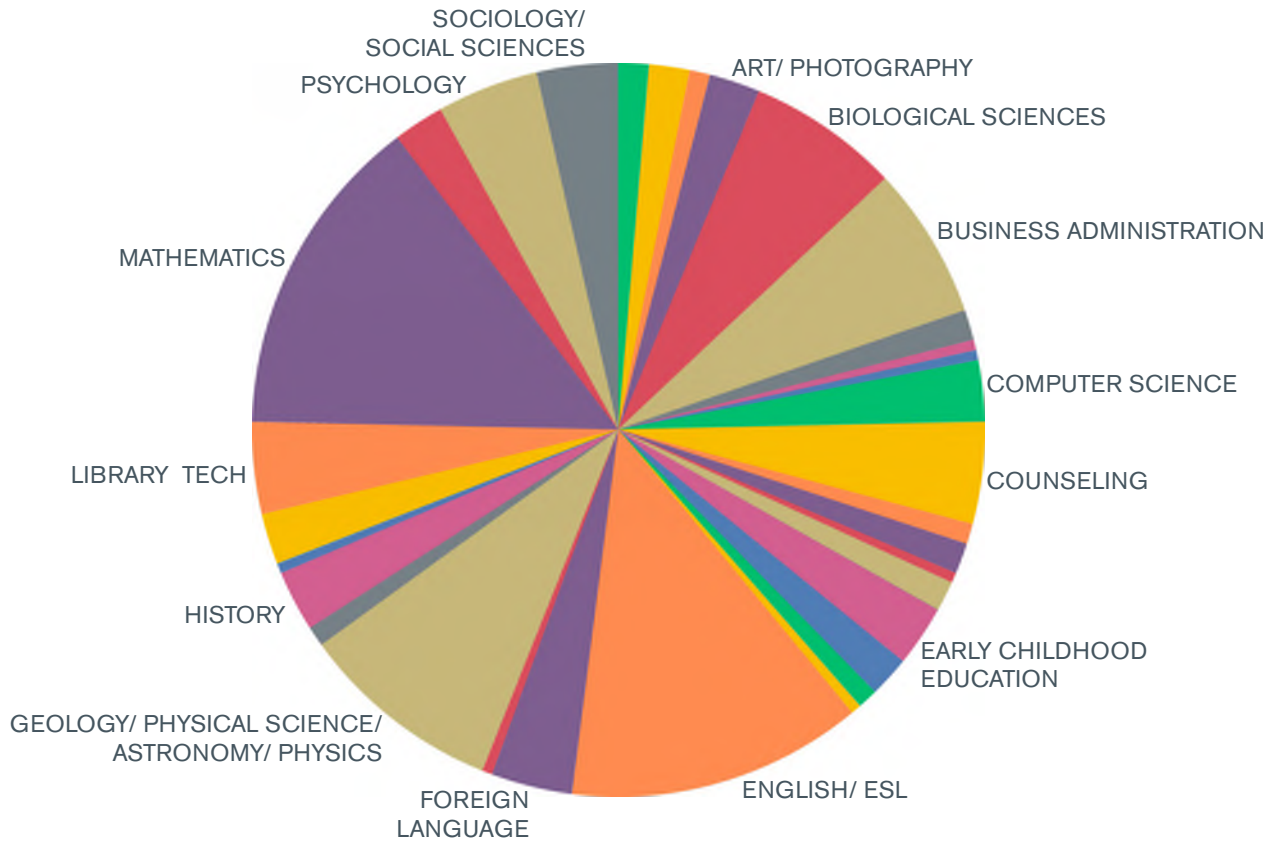
2. IDENTIFY YOUR **FACULTY POSITION.**



ANSWER CHOICES	RESPONSES	
Full-time	58.30%	130
Adjunct	41.70%	93
TOTAL		223

FACULTY RESPONSES

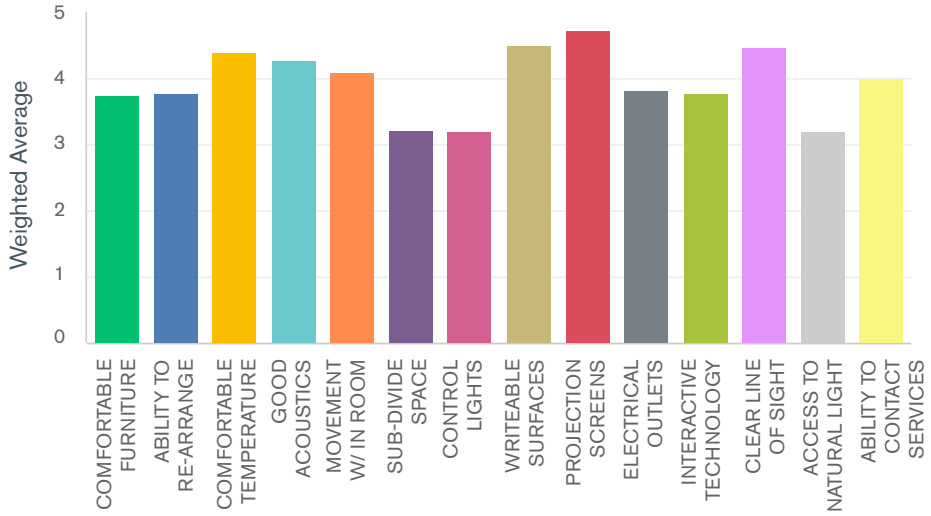
2A. IDENTIFY YOUR **ACADEMIC AREA.**



ANSWER CHOICES	RESPONSES	
Addiction Studies	0.00%	0
Administration of Justice	1.35%	3
Anthropology	0.00%	0
Architecture	1.79%	4
Art History	0.90%	2
Art/Photography	2.24%	5
Biological Science	6.73%	15
Business Administration	6.73%	15
Communication Studies	1.35%	3
Computer Information Systems	0.45%	1
Computer Network Technology	0.45%	1
Computer Science	2.69%	6
Construction	0.00%	0
Counseling	4.48%	10
Culinary Arts	0.90%	2
Dental Programs	1.35%	3
Digital Media Studies	0.45%	1
Drama	1.35%	3
DSS – Special Education	0.00%	0
Early Childhood Education	2.69%	6
Economics/Political Science	1.79%	4
Electrical/Electronics/Energy Systems	0.90%	2
Engineering	0.00%	0
Engineering Technology/Industrial Design	0.45%	1
English/ESL	13.00%	29
Foreign Language	3.59%	8
Geography	0.45%	1
Geology/Physical Science/Astronomy/Physics	8.97%	20
Health Science/Nutrition	0.90%	2
History	2.69%	6
Horticulture	0.45%	1
Humanities/Philosophy	0.00%	0
Journalism	0.00%	0
Kinesiology/Athletics/Dance	2.24%	5
Library Tech	4.04%	9
Mathematics	14.35%	32
Music/Music Industry Studies	2.24%	5
Psychology	4.48%	10
Sociology/Social Sciences	3.59%	8
TOTAL		223

FACULTY RESPONSES

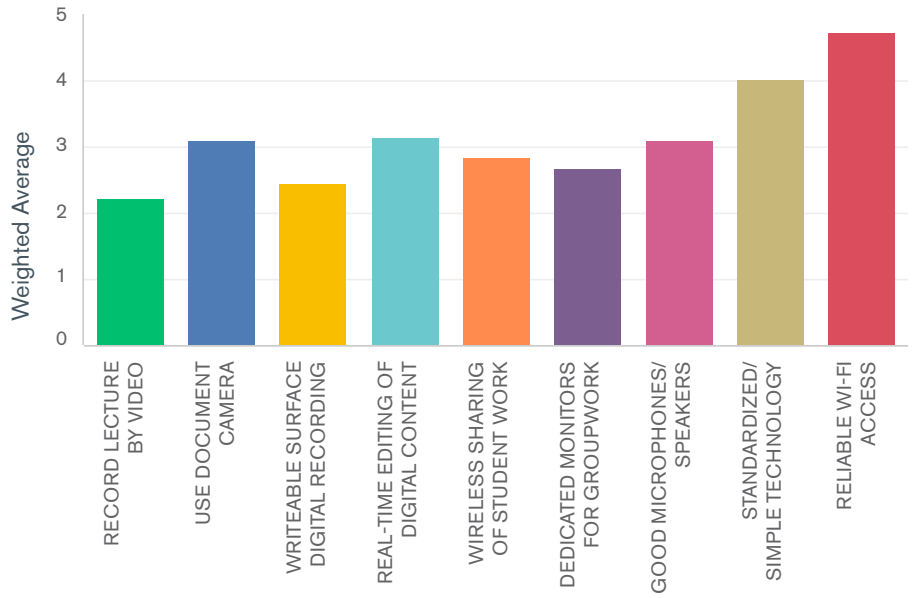
3. SCORE **CLASSROOM ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO YOUR TEACHING EXPERIENCE.



	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Comfortable/ ergonomic furniture	1.79% 4	12.11% 27	24.66% 55	31.39% 70	30.04% 67	223	3.76
Ability to rearrange and move furniture quickly and without much effort	6.73% 15	11.66% 26	16.59% 37	26.46% 59	38.57% 86	223	3.78
Comfortable room temperature and/or ability to adjust temperature	0.45% 1	1.79% 4	9.42% 21	35.43% 79	52.91% 118	223	4.39
Good acoustics and minimal sound from adjoining spaces	0.90% 2	4.04% 9	14.80% 33	27.80% 62	52.47% 117	223	4.27
Ease of physical movement within the room	0.45% 1	4.48% 10	19.73% 44	34.53% 77	40.81% 91	223	4.11
Ability to subdivide a space/create break-out spaces	13.90% 31	21.97% 49	16.59% 37	23.32% 52	24.22% 54	223	3.22
Ability to control light levels and create different zones within the room	11.21% 25	23.32% 52	21.08% 47	21.97% 49	22.42% 50	223	3.21
Availability of whiteboards or other writable surfaces on the walls	0.45% 1	2.69% 6	9.42% 21	20.63% 46	66.82% 149	223	4.51
Availability of projection screens	1.35% 3	1.35% 3	3.59% 8	11.21% 25	82.51% 184	223	4.72
Availability of multiple electrical outlets	6.28% 14	11.66% 26	16.59% 37	24.66% 55	40.81% 91	223	3.82
Availability of technology that enables interaction between students and/or teacher	8.07% 18	12.11% 27	13.90% 31	25.56% 57	40.36% 90	223	3.78
Having a clear line of sight throughout the room	0.00% 0	2.24% 5	7.62% 17	30.04% 67	60.09% 134	223	4.48
Having access to daylight and views	11.21% 25	19.73% 44	26.46% 59	24.22% 54	18.39% 41	223	3.19
Ability to contact IT, Media Services, evening services, or emergency services from within the room	4.93% 11	8.97% 20	16.59% 37	21.08% 47	48.43% 108	223	3.99

FACULTY RESPONSES

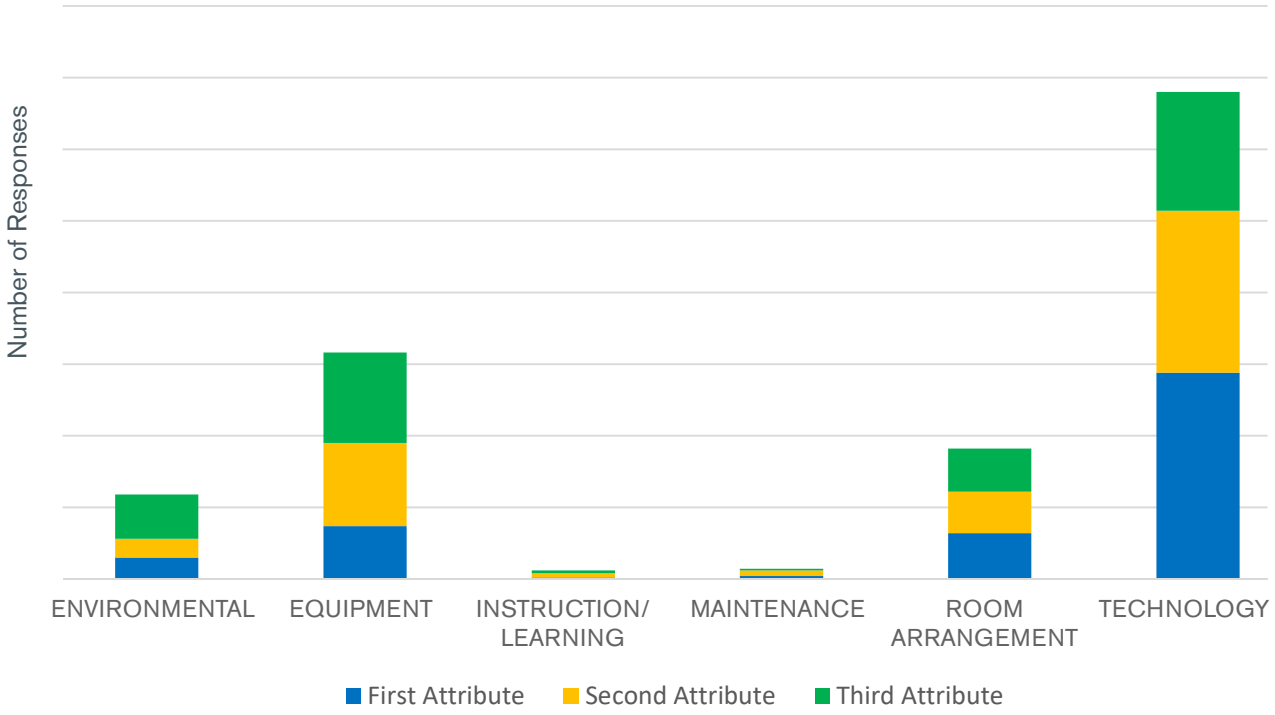
4. SCORE **TECHNOLOGY ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO YOUR TEACHING EXPERIENCE.



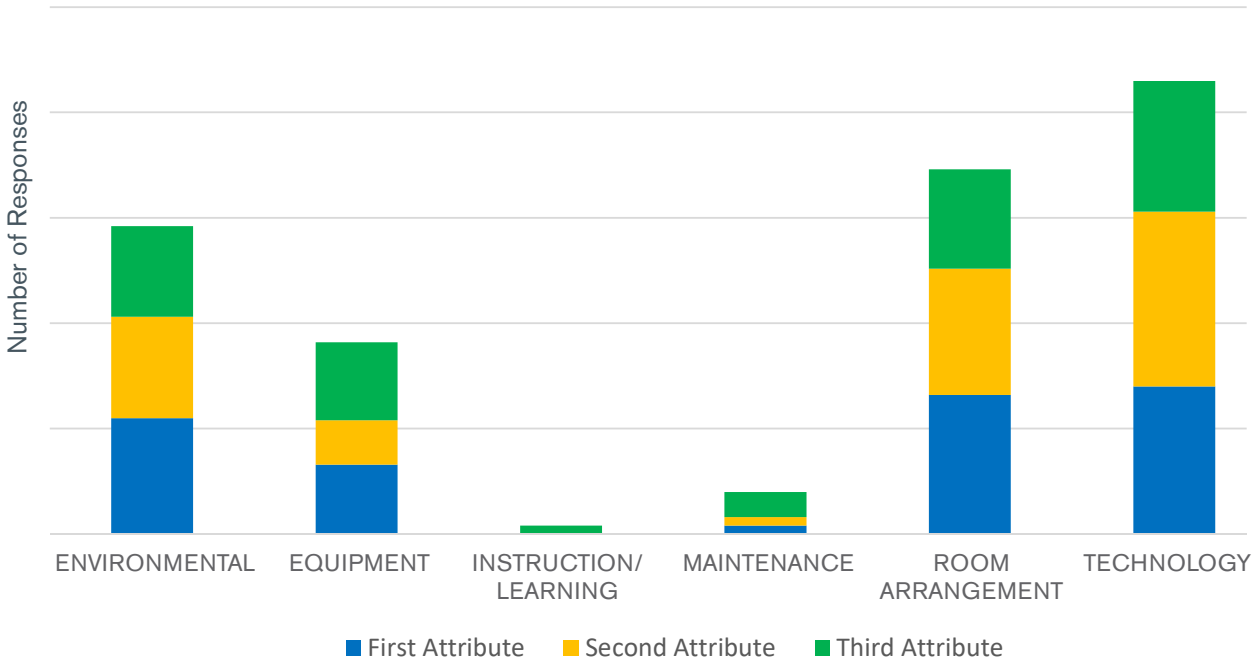
	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Ability to record a lecture by video	35.43% 79	29.60% 66	19.73% 44	7.17% 16	8.07% 18	223	2.23
Ability to use a document camera	20.63% 46	17.94% 40	21.97% 49	11.21% 25	28.25% 63	223	3.09
Ability to digitally record content from writeable surfaces	26.91% 60	30.94% 69	22.87% 51	8.07% 18	11.21% 25	223	2.46
Ability to present digital content and mark/edit it real-time	17.04% 38	17.94% 40	22.42% 50	19.28% 43	23.32% 52	223	3.14
Ability for students to share their work wirelessly on any digital display within the room	20.18% 45	23.77% 53	21.97% 49	20.18% 45	13.90% 31	223	2.84
Having dedicated monitors/ screens for group work, either fixed or movable	27.35% 61	22.42% 50	20.63% 46	15.25% 34	14.35% 32	223	2.67
Having good microphones and speakers in the room	19.28% 43	12.56% 28	26.01% 58	22.42% 50	19.73% 44	223	3.11
Having simple and standardized technology interfaces in all rooms	5.38% 12	7.62% 17	14.35% 32	25.11% 56	47.53% 106	223	4.02
Having reliable and consistent Wi-Fi access	1.79% 4	0.90% 2	4.48% 10	8.97% 20	83.86% 187	223	4.72

FACULTY RESPONSES

5. LIST THREE ATTRIBUTES THAT **ENHANCE** YOUR TEACHING EXPERIENCE.

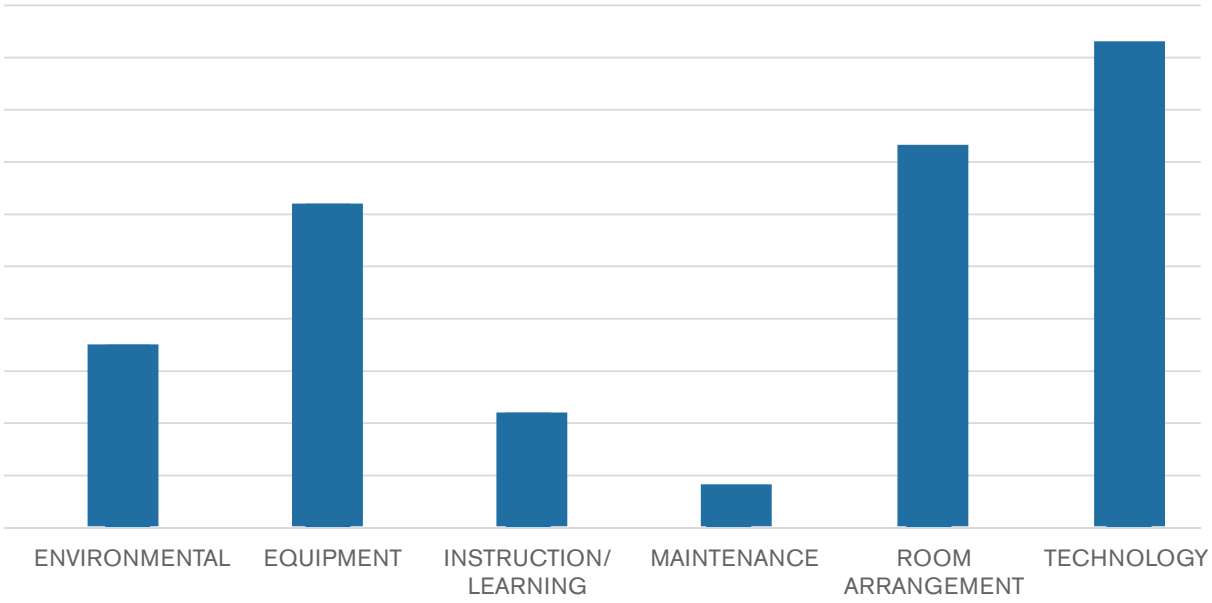


6. LIST THREE ATTRIBUTES THAT **DISRUPT** YOUR TEACHING EXPERIENCE.



FACULTY RESPONSES

7. **ADDITIONAL CONSIDERATIONS** ABOUT THE DESIGN AND OPERATION OF FUTURE LEARNING ENVIRONMENTS?



FACULTY RESPONSES

Analysis

Between the two campuses, the majority of the faculty responses were also from the Pleasant Hill campus with approximately 58% full-time and 42% adjunct faculty members.

For question 2A, the academic departments with the highest faculty responses included Mathematics and English, followed by Geology/ Physical Science/ Astronomy/ Physics, Biological Science and Business Administration.

For question 3, similar to the students, most of the faculty respondents found all the classroom attributes as being important, very important or extremely important. The attributes that yielded the highest positive responses included:

- Having a clear line of sight throughout the room
- Comfortable room temperature
- Writeable surfaces
- Projection screens

Following these attributes, the next tier of positive responses included:

- Having good acoustics
- Movement within the room
- Ability to contact IT services

For question 4, reliable wi-fi access was clearly the technology attribute with the highest faculty responses followed by simple/ standardized technology. It emphasizes the need for upgrading the campus data infrastructure to accommodate the growing use of wireless interfaces in current and future teaching methodologies.

For question 5 (attributes that enhance), Technology stands out as the outlier with the highest number of responses and its positive effect for instruction is evident. Use of the smart podiums and projectors aids the dispersion of knowledge and helps students follow coursework in class. The category of Equipment was ranked second by the faculty which shows that although technology is important in classrooms, writable surfaces and other demonstration equipment are important tools for teaching. Room Arrangement and Environmental concerns averaged similar after Technology and Equipment, thus highlighting the significance of comfort and collaboration in the teaching environment. There were negligible responses for the Instruction/Learning and Maintenance category.

For question 6 (attributes that disrupt), the majority of faculty responses focused on the four categories: Environmental, Equipment, Room Arrangement, and Technology. The outliers in this question were Technology and Room Arrangement, emphasizing that the need for reliable/ standardized technology and collaborative teaching environments. Environmental concerns were ranked next highlighting that natural daylight, improved acoustics and provision of mechanical/ lighting control systems can considerably improve the current classrooms. With, Equipment ranked the lowest of the four attributes, the faculty noted that lack of adequate writeable surfaces and flexible/ movable furniture limited their ability to teach effectively.

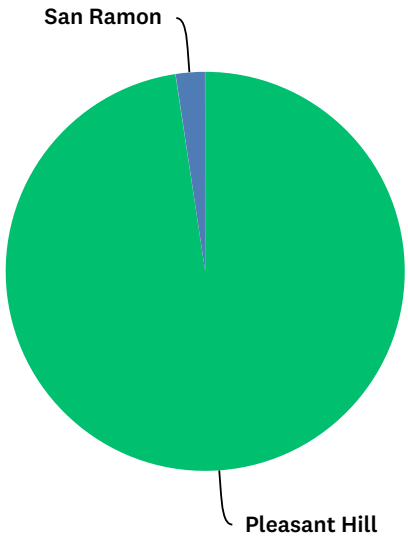
For question 7, the faculty responses were enriching even though they seem similar to question 6 as the faculty were able to share their candid feelings/ un-filtered experience. Technology was mentioned the most frequently as the current systems are outdated and unreliable. In the rooms with the smart podiums, it was mentioned that the bulky design sets an authoritative tone in the classroom which biases towards the instructor and inhibits student sight lines. The limited work area also provides no space for the instructor's course materials/ handouts. These limitations, combined with the inability to freely connect to wi-fi during class which restricts faculty-student interaction/ group share capabilities through interactive media, need to be resolved in future learning environments on campus.

Many faculty members also addressed the need for learning environments that allow faculty to employ a variety of teaching methods, including teacher-directed lectures, formal and informal group discussions, peer-to-peer learning, teacher-student engagement and hands-on skill building. They also stressed the need to have projectors and writeable surfaces located in the room so they are accessible at the same time, unlike the current classroom layouts where the projector screen blocks a large part of the white boards when in use. Thus, Room Arrangement follows as the second focus category for this question.

Equipment was ranked next as the need for writeable surfaces and moveable furniture would help faculty teach better. The Environmental concerns were next in importance followed by Instruction/ Learning. Faculty emphasized the need for upgraded technology to facilitate hybrid/on-line classes as well as provide flexibility to innovate new teaching methodologies that are not dictated by 'the projector' implying more of a 'lecture' mode. All of these unique answers are crucial to the Classroom Design Standards as they identify the ways in which faculty are responding to changes in the educational paradigm.

STAFF RESPONSES

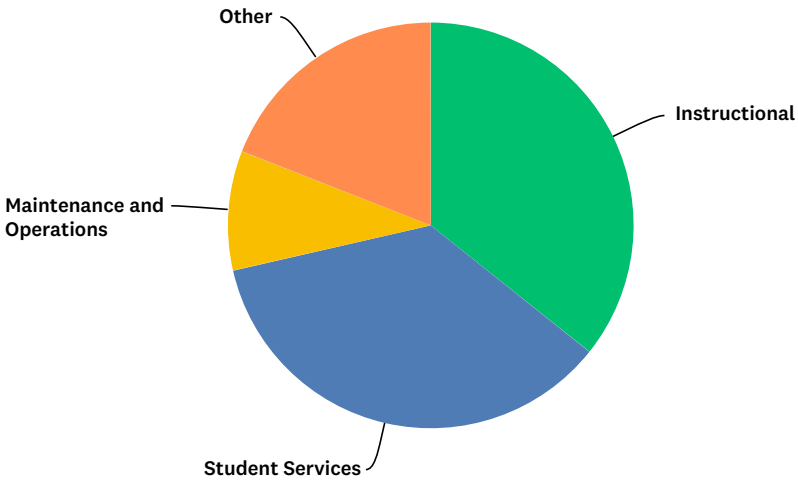
1. IDENTIFY YOUR **PRIMARY CAMPUS**



**The Pleasant Hill campus is significantly larger in population than the San Ramon campus, therefore, the number of responses are proportionately balanced between the two campuses.*

ANSWER CHOICES	RESPONSES	
Pleasant Hill	97.62%	41
San Ramon	2.38%	1
TOTAL		42

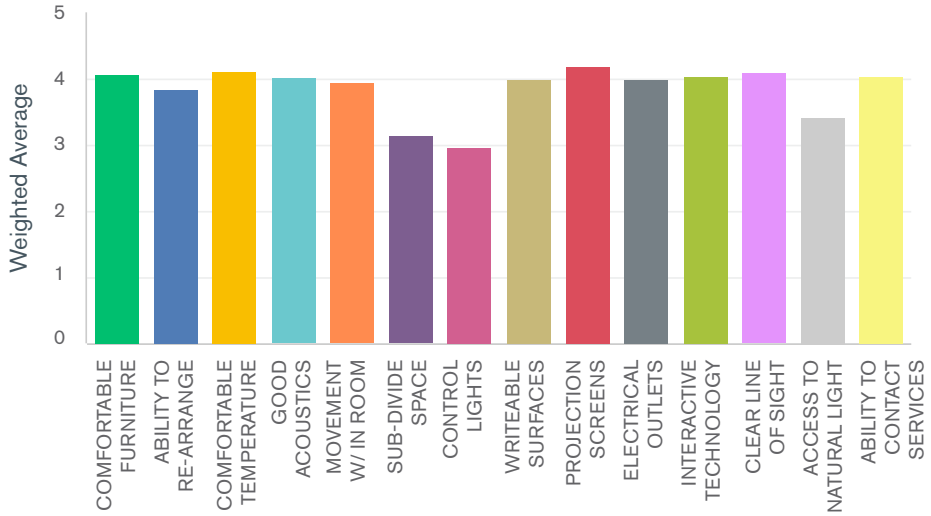
2. WHAT TYPE OF **UNIT** DO YOU BELONG TO?



ANSWER CHOICES	RESPONSES	
Instructional	35.71%	15
Student Services	35.71%	15
Maintenance and Operations	9.52%	4
IT	0.00%	0
Other	19.05%	8

STAFF RESPONSES

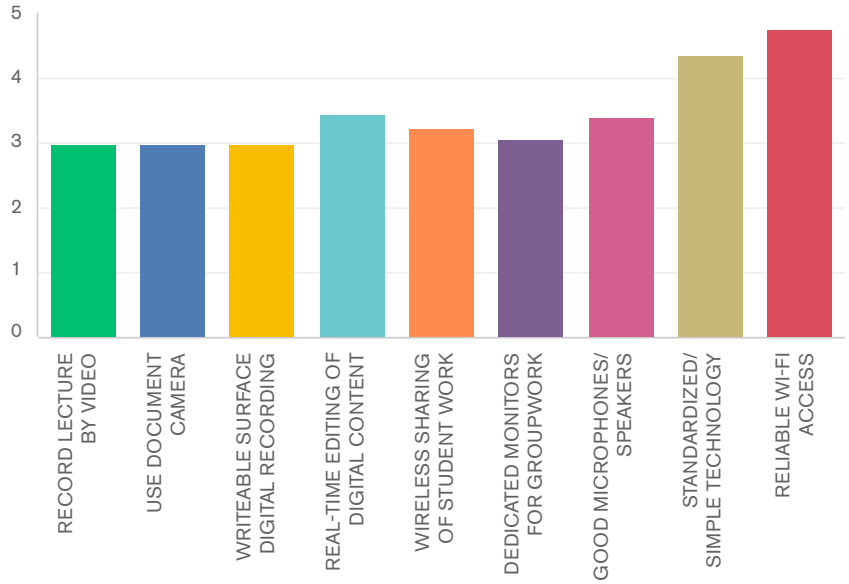
3. SCORE **CLASSROOM ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO THE TEACHING/ LEARNING EXPERIENCE.



	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Comfortable/ ergonomic furniture	0.00% 0	11.90% 5	16.67% 7	23.81% 10	47.62% 20	42	4.07
Ability to rearrange and move furniture quickly and without much effort	0.00% 0	11.90% 5	28.57% 12	21.43% 9	38.10% 16	42	3.86
Comfortable room temperature and/or ability to adjust temperature	2.38% 1	2.38% 1	21.43% 9	28.57% 12	45.24% 19	42	4.12
Good acoustics and minimal sound from adjoining spaces	0.00% 0	4.76% 2	23.81% 10	35.71% 15	35.71% 15	42	4.02
Ease of physical movement within the room	0.00% 0	7.14% 3	26.19% 11	30.95% 13	35.71% 15	42	3.95
Ability to subdivide a space/create break-out spaces	9.52% 4	19.05% 8	33.33% 14	23.81% 10	14.29% 6	42	3.14
Ability to control light levels and create different zones within the room	9.52% 4	26.19% 11	30.95% 13	23.81% 10	9.52% 4	42	2.98
Availability of whiteboards or other writable surfaces on the walls	0.00% 0	9.52% 4	14.29% 6	42.86% 18	33.33% 14	42	4.00
Availability of projection screens	0.00% 0	2.38% 1	16.67% 7	40.48% 17	40.48% 17	42	4.19
Availability of multiple electrical outlets	0.00% 0	12.20% 5	12.20% 5	39.02% 16	36.59% 15	41	4.00
Availability of technology that enables interaction between students and/or teacher	0.00% 0	4.76% 2	23.81% 10	33.33% 14	38.10% 16	42	4.05
Having a clear line of sight throughout the room	0.00% 0	7.14% 3	16.67% 7	35.71% 15	40.48% 17	42	4.10
Having access to daylight and views	11.90% 5	9.52% 4	30.95% 13	19.05% 8	28.57% 12	42	3.43
Ability to contact IT, Media Services, evening services, or emergency services from within the classroom	4.76% 2	11.90% 5	14.29% 6	11.90% 5	57.14% 24	42	4.05

STAFF RESPONSES

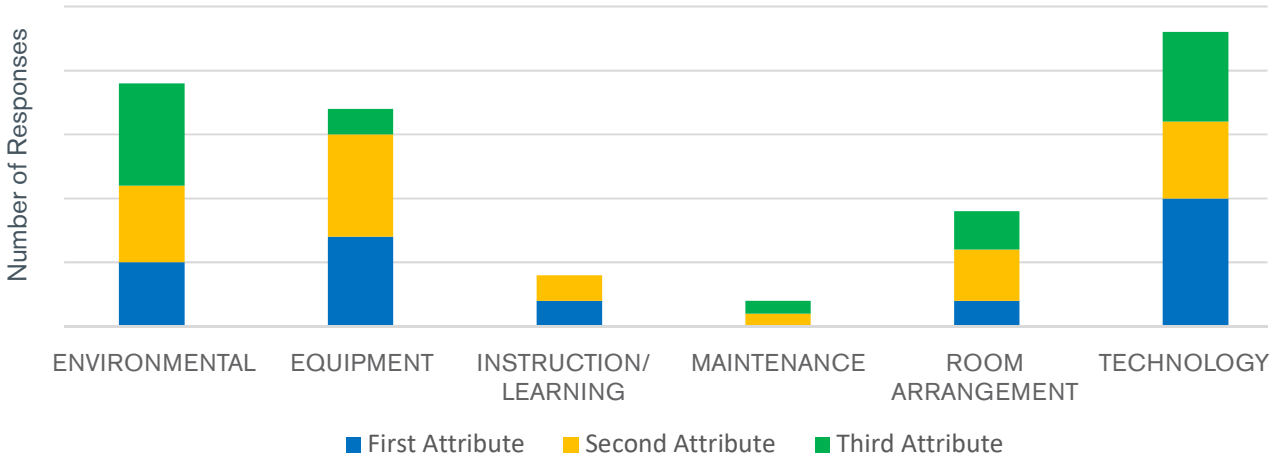
4. SCORE **TECHNOLOGY ATTRIBUTES** ON A SCALE OF 1 (NOT IMPORTANT) TO 5 (EXTREMELY IMPORTANT) AS IT RELATES TO THE TEACHING/ LEARNING EXPERIENCE.



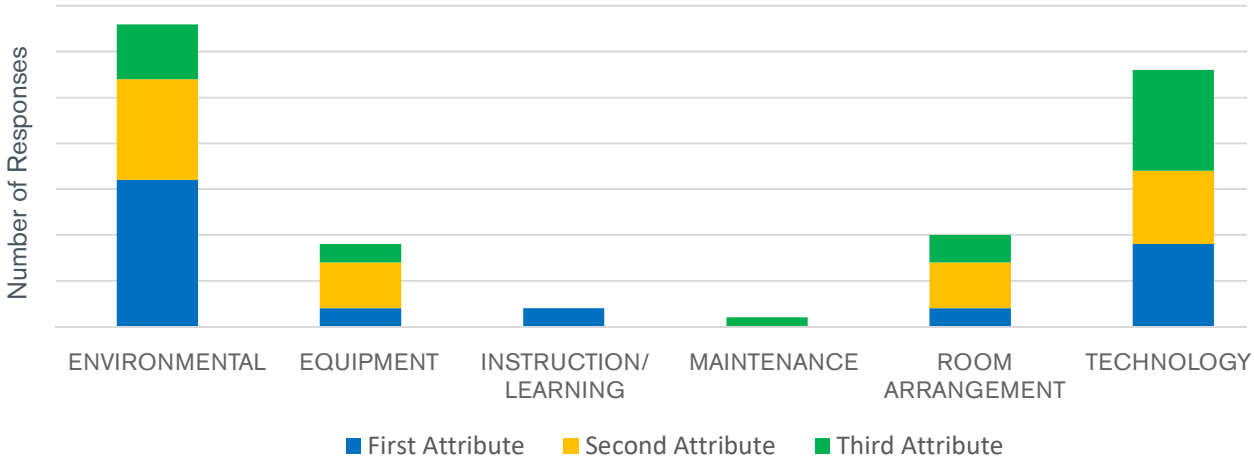
	1. NOT IMPORTANT	2. SOMEWHAT IMPORTANT	3. IMPORTANT	4. VERY IMPORTANT	5. EXTREMELY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Ability to record a lecture by video	5.00% 2	35.00% 14	30.00% 12	17.50% 7	12.50% 5	40	2.98
Ability to use a document camera	2.50% 1	30.00% 12	40.00% 16	22.50% 9	5.00% 2	40	2.98
Ability to digitally record content from writeable surfaces	7.32% 3	31.71% 13	29.27% 12	19.51% 8	12.20% 5	41	2.98
Ability to present digital content and mark/edit it real-time	0.00% 0	21.95% 9	26.83% 11	34.15% 14	17.07% 7	41	3.46
Ability for students to share their work wirelessly on any digital display within the room	2.44% 1	24.39% 10	31.71% 13	31.71% 13	9.76% 4	41	3.22
Having dedicated monitors/ screens for group work, either fixed or movable	0.00% 0	39.02% 16	26.83% 11	24.39% 10	9.76% 4	41	3.05
Having good microphones and speakers in the room	0.00% 0	21.95% 9	31.71% 13	29.27% 12	17.07% 7	41	3.41
Having simple and standardized technology interfaces in all rooms	0.00% 0	7.32% 3	7.32% 3	29.27% 12	56.10% 23	41	4.34
Having reliable and consistent Wi-Fi access	0.00% 0	0.00% 0	4.76% 2	14.29% 6	80.95% 34	42	4.76

STAFF RESPONSES

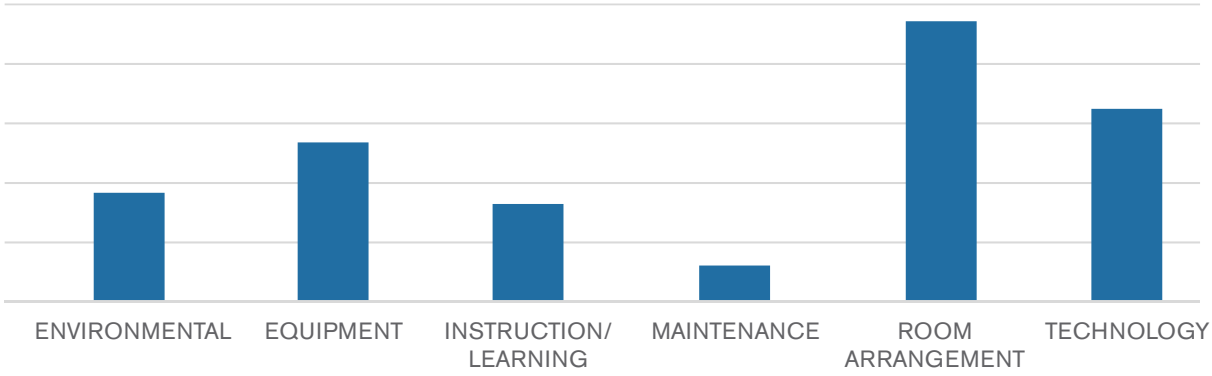
5. LIST THREE ATTRIBUTES THAT **ENHANCE** THE LEARNING/ TEACHING EXPERIENCE.



6. LIST THREE ATTRIBUTES THAT **DISRUPT** THE LEARNING/ TEACHING EXPERIENCE.



7. **ADDITIONAL CONSIDERATIONS** ABOUT THE DESIGN AND OPERATION OF FUTURE LEARNING ENVIRONMENTS?



STAFF RESPONSES

Analysis

Between the two campuses, the majority of the staff responses were also from the Pleasant Hill campus with most input from the Instructional and Student Services units.

For question 3, similar to the students and faculty, most of the staff respondents found all the classroom attributes as being important, very important or extremely important. The attributes that yielded the highest positive responses included:

- Having a clear line of sight throughout the room
- Comfortable room temperature
- Projection screens

For question 4, similar to the students and faculty, reliable wi-fi access was the technology attribute with the highest staff responses followed by simple/ standardized technology.

For question 5 (attributes that enhance), the categories with the highest responses were: Technology, Environmental and Equipment. While Technology was slightly higher than the other two categories, it highlights that all three are critical to the learning environments. Projection screens, good wi-fi, writable surfaces, good acoustics/ daylight, and comfortable furniture are all essential.

For question 6 (attributes that disrupt), the majority of staff responses focused on the two categories: Environmental and Technology. The Environmental category was clearly the outlier emphasizing the need to upgrade the classroom infrastructure for adequate thermal comfort, proper acoustics, access to daylight, and an overall welcoming environment.

For question 7, Room Arrangement was the category with the highest staff responses as they felt that collaboration and group work were limited in the current classrooms due to the existing furniture and equipment. Having adequate space to move around in the room and facilitate interactions was necessary. It was also noted that flexible room arrangements helps the maintenance staff in their cleanliness operations as it is easy to move furniture around. Technology and Equipment were the next highly ranked categories.

CUMULATIVE SURVEY ANALYSIS

Patterns

The similar set of questions issued to all users generated congruent response patterns in some questions and some unique response patterns in others.

In question 3 (general classroom attributes), all respondents identified similar attributes of importance for teaching and learning: clear line of sight, comfortable temperature, comfortable furniture and projection screens.

In question 4 (classroom technology attributes), all respondents identified similar attributes of importance for teaching and learning: reliable wi-fi access and simple/ standardized technology.

In question 5 (enhancing attributes), all respondents identified Technology as the single most important attribute for teaching and learning, followed by Equipment. While the students and staff highlighted Environmental concerns next in line followed by Room Arrangement, the faculty had the opposite response.

In question 6 (disrupting attributes), all respondents had different priorities. For the students Equipment was the most important attribute, for the faculty it was Technology and for the staff it was Environmental. Apart from these, the faculty did note that Room Arrangement was also hindering their teaching.

Similar to question 6, in question 7 (additional considerations for designing future learning environments), all respondents had different rankings and no overlapping patterns were traced. While the students focused on Equipment and Environmental attributes, the faculty and staff focused on Technology and Room Arrangement.

Opportunities

The large pool of survey responses and their analysis above set a rich foundation upon which to build the Classroom Design Standards for Diablo Valley College. The extensive feedback from the students, faculty and staff was helpful in identifying constraints and opportunities on the campus. The qualitative insights from the surveys are grouped into three categories listed below.

Experiential Collaboration

Experiential Collaboration will focus on developing an ideal space plan for different sized classrooms, primarily addressing the needs for visibility and flexibility. The following attributes will be considered:

- Providing clear lines of sight throughout the room by adequately locating writeable surfaces and digital media as well as minimizing glare.
- Specifying furniture that is flexible to arrange and can be modified to suit the needs of different instructional methods within the same space.
- Creating a diverse environment for multi-modal learning including hands-on project work, social interaction and technical knowledge sharing.
- Locating physical elements (such as doors) to enhance and promote circulation in the classrooms.
- Specifying furniture with adequate writable surface as well as capability to accommodate books and digital devices.
- Placing furniture (tables and chairs) to meet accessibility requirements and providing adequate space for movement by users while classes are in session.
- Providing secured storage to allow for demonstration materials and innovative project tools.

Healthy/ Whole

Healthy/ Whole will focus on elements of universal design by developing a comfortable learning environment for all users, primarily addressing the needs for a healthy environment and comfortable furniture that fosters the holistic student development and accommodate individual learning styles. The following attributes will be considered:

- Creating a welcoming environment that is aesthetically pleasing by using clean/simple finishes and color in the classroom.
- Achieving adequate acoustic levels using insulated building materials and voice amplification systems to improve speech intelligibility and mitigate noise reverberation.
- Providing adequate daylight in the classroom by positioning the windows to minimize glare on digital media/writeable surfaces while providing views to the outside.
- Accommodating lighting control systems to provide zones of lighting and the flexibility of switching between lecture/ presentation, group work, report out and/ or meditation modes.
- Upgrading the temperature control mechanisms in the classrooms to render more comfortable spaces.
- Providing ergonomic and flexible furniture to aid comfort and accommodate the diversity within the student population (eg. students with disabilities)

Tech-Enabled

Tech-Enabled will focus on developing a minimum standard for technology and other equipment in the classroom primarily addressing the needs for audio-visual and other technical methods. The following attributes will be considered:

- Furnishing a variety of simple/ standardized instructional equipment in appropriate quantities to support all sizes of classrooms including interactive digital displays and sound systems.

- Establishing a backbone for campus-wide on-demand learning (wi-fi access anytime, anywhere, by any means).
- Providing energy efficient equipment with automated controls to help improve performance and conserve energy.
- Providing for adequate quantity of charging outlets for all users independent of furniture location.
- Specifying flexible un-tethered instructor stations to foster a non-authoritative classroom layout.

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03
TRANSFORMING DVC

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USER GROUP WORKSHOPS

OVERVIEW

The User Group Workshops were held on September 18, 2017 and September 21, 2017 and were well attended by 35 stakeholders from both campuses. These workshops delved deeper into the opportunities and challenges recognized in the survey and were geared towards understanding the needs/ concerns of the different stakeholders on campus. During each hour long session, WRNS Studio engaged all the user groups in similar discussions and activities to gain parallel feedback that captured the essence of the thinking about the future – how teaching and learning can be transformed at DVC.

Participants (per user group) included:

User Group 1: Deans & Faculty
Mike Holtzclaw, Senior Dean, San Ramon Campus
Obed Vazquez, Dean, Engineering/ Social Science
Rick Robison, Dean, Library, Educational Technology and Learning Support
Mario Tejada, Faculty (CIS Instructor), DE Chair
Lee Rode, Faculty (Psychology)
John Freytag, ASUP/ Faculty
Anne Kingsley, Faculty (English Department & Distance Education)

User Group 2: Faculty Affairs
Kim Schenk, Senior Dean, Curriculum and Instruction
Teresa Molnar, Academic Scheduling Specialist
Joy Brucelas, Senior Administrative Assistant, Office of Instruction

User Group 3: Deans & Faculty
Christine Worsky, Dean/ AD
Toni Fannin, Interim Dean, AFA
Joseph Gorga, Interim Dean of Physical, Biological & Health Sciences
Daniel Kiely, Librarian, Chair
Cheryl Wilcox, Faculty (Math)
Joan Symonds, Faculty (ECE & AEBG Faculty Co-coordinator)

User Group 4: Student Affairs
Newin Orante, VP Student Services
Emily Stone, Dean, Student Support Services
Kenyetta Tribble, Dean, Student Services, San Ramon Campus
Beth Hauscarriague, Dean, Counseling and Enrollment Services

User Group 5: Diversity & Inclusion
Rosa Armendariz, Interim Dean, Student Engagement and Equity

User Group 6: AV/IT Services
Percy Roper, Manager, Technology Systems
John Vohs, Staff, IT
Jeff Jewell, Staff, Media Services

User Group 7: Students
Nastaran Qassemi, Student Ambassador (Psychology)
Isabelle Young, Student Ambassador (Psychology)
Jorge Salinas, Student Ambassador (Psychology)
Leonard Baxa, Veteran Alliance (Business)
Terrence Custer (Computer Science)
Louis Barrios (Civil Engineering)

User Group 8: Accessibility
David Hagerty, Manager, DSS
Carrie Million, Assistive Tech Specialist, DSS
Ron Tenty, Testing Accommodations Coordinator, DSS
Rose Desmond, Alternative Media Coordinator, DSS

User Group 9: Custodial
James Buchanan, Director, Facilities Management & Operations

The products of these sessions are included in the Appendix of this document, inclusive of notes and interactive participation in some cases represented by colored dots reflecting voting by participants. Following is the summary and key insights from the discussions.

Stakeholder engagement photographs

DISCUSSION: CHANGING PEDAGOGY AT DVC

WRNS Studio led the discussions by asking each user group three critical questions to gather input on the changing pedagogy at DVC - What are the key obstacles to innovation in the current classrooms; How can DVC capitalize on the campus's diversity within the classroom; and If you could do more in the classroom, what would you do? The stakeholders input varied with some sharing similar ideas and others bringing new perspective to enrich the discussion. Below is a consolidated summary:

"Obstacle to Innovation"

- Flexibility/ Adaptability
  The integration of group work to enable learning through collaboration was unanimously noted as a key desire for innovative pedagogy at DVC. The current classroom environment does not allow for flexibility with its bulky furniture and lack of space to move around. In order to effectively achieve this vision of collaborative learning, classrooms need to provide furniture and equipment that is easy to move and accommodates various group sizes (2-6 persons) and scenarios (lecture, all class discussion/ dialogue, groupwork/ activity). This would also require a cultural change on campus where students are active participants in the room willing to reconfigure their learning environment and faculty don't feel that they loosing class time to re-arrange furniture.

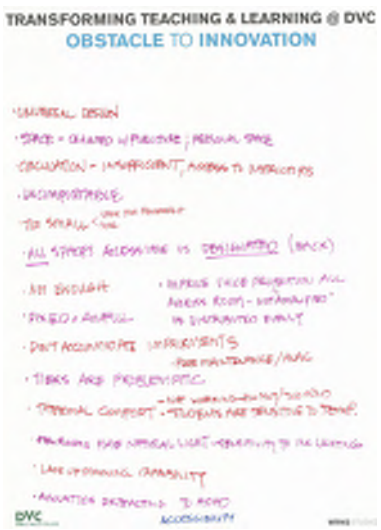
- Reliable Wi-fi: Anytime/ Anywhere
  Reliable wi-fi has become a necessity for 21st century learning environments with faculty wanting to engage students with technology as a part of their instruction. The campus has come a long way in integrating IT/AV into classrooms and upgrading its wireless network to foster a digital learning environment on campus. However, more needs to be done with the growing needs of the students and faculty.

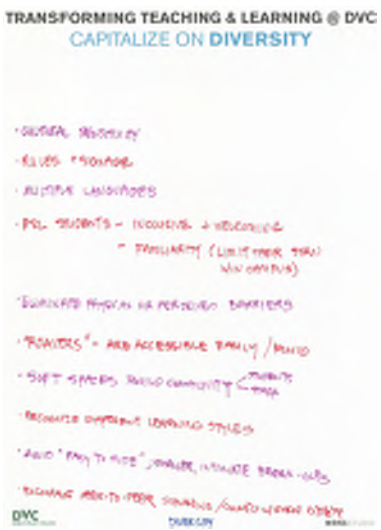
- Simple/ Standardized Technology
  The stakeholders expressed the desire for simple and standardized technology in all the classrooms such that it is easy to use by anyone and campus IT services do not have to be contacted for small issues. The existing control panels are located at the instructor lecterns but are not very intuitive or user-friendly. Faculty waste precious class time trying to get a projector to work and sometime have to even change the nature of their class due to the incompatible technology interface. Along with standardizing the classroom software, the hardware components like projectors, speakers, lighting controls etc should also be standardized to avoid a learning curve for the users. Faculty training can help achieve this goal of seamless technology integration faster.

- Writeable surfaces: Fixed/ mobile
  The walls within a classroom are as seen as important real estate and should be equipped with the maximum possible amount of writeable surfaces for use by faculty and students, formally and informally, during and after class. Currently, there are limited whiteboards in the classroom, many of which are occupied by the faculty/ projector screen as a part of instruction.

- Universal Design
  Since DVC serves a diverse population, it is critical for the learning environments on campus to be accessible to all users. Aspects of Universal Design that provide adequate space for movement to a disabled user within the entire room, provide comfortable/ergonomic furniture to users of all body shapes/sizes, provide a comfortable learning environment that is visually and acoustically appropriate etc. should be incorporated into the design standards.

- Operate at Class Capacity
  Faculty expressed the need to operate the courses at class capacity or increase the size of the classrooms to





Sample Discussion Poster Images. See more in the Appendix.


Stakeholder engagement photographs

accommodate the surge space required. Classes at DVC are packed with approximately 10% extra students beyond the class capacity at the start of the semester to accommodate for peak demand. As the semester progresses, some students drop out and the class reaches its optimum size. However, during the surge period, the room does not function adequately - less space to move around and collaborate, improper sight lines for students etc.

"Capitalize on Diversity"

- Welcoming/ Attractive
  Stakeholders expressed the importance of enhancing the look and feel of classrooms to create a welcoming and attractive learning environment where students feel inspired and motivated. Access to daylight and views, use of color, educational displays like posters/ quotes on walls etc. were described as ways to achieve this goal.

- Inclusive/ Multi-directional
  Beyond creating a vibrant space, faculty values mobility within a classroom as that provides better interaction with students, facilitates eye contact, and fosters engagement. By creating a room that is multi-directional, i.e. digital media and writeable surface on all walls, it breaks away from the traditional classroom layouts that defined a 'front of the room' and makes the learning environment more inclusive where the instructor can move freely and is perceived as less authoritative. This also helps keeping all students engaged in the classroom as there is no 'back of the room' for them to hide. With such layouts and better acoustics/ technology, students from different cultures who are soft-spoken and/or shy of public speaking can feel more comfortable sharing their thoughts.

- Responsive Engagement
  In order to capitalize on the diversity on the campus, the learning environments at DVC need to foster responsive engagement where the instructors are sensitive to the cultural backgrounds and meet the students 'where they are'. This implies faculty understanding the learning styles and pace of all their students and tailoring their course to such that all students are active learners. Flexibility/ mobility through the room can aid this as the instructors can move around helping students even if the students are hesitant to approach.

- Multiple Languages
  Many students at DVC speak different languages and are not fluent in English as their primary language. Hence, they have a longer learning curve in the classroom and often rely on their peers for support. Suggestions like providing lecture recordings to students for later review at their own pace, lecture captioning in popular languages, providing after-class learning support services etc. would greatly help students overcome the language barrier and grow as independent thinkers.

- "Rethink" Rules & Signage
  Signs are an important visual language that should be carefully scripted and designed on a diverse campus such that they do not discriminate against any user. The stakeholders mentioned how the word "No" in front of many rules/ signs on campus creates negativity amongst students and often results in opposite behavior. Also, food/drink are becoming inherent components in 21st century learning enhancing the student learning experience thus restricting refreshments during class is limited their full learning potential. Similarly, an example of the 'person in a wheelchair' sign on the ADA desks was shared as discriminating against other disabled users like pregnant women/ students with back problems who might use the desk.

- Recognize the "Learning Curve"
  More than anything else, today's learners want choice and control. Some students reported feeling left out with regards to the pace of lectures and their challenges with comprehension due to language barriers, environmental conditions within rooms, and poor visibility of class content. They also stressed on how they have different learning styles - visual, auditory, kinesthetic etc. - and need the faculty to be sensitive to and address their styles.

- Peer to Peer Learning
  For students at DVC, learning in the context of the social network is of utmost importance. Since many students are from diverse backgrounds or first generation students, they connect better with their peers than the faculty for in-class and out-of class learning. To facilitate this collaborative learning, room layouts and faculty need to accommodate peer-to-peer interaction.

"If I Could Do More"

- Produce rather than Absorb
  Education has evolved over generations from passive knowledge intake to more active learning. Students are not listening to unidirectional lectures and absorbing content, but are engaging in dialogue and hands-on projects to learn the same content. This pedagogical shift is what the stakeholders would like to see more of in their learning environments.

- "Creative" Space/ Professional Development
  By designing the classrooms with flexible/ modular components, the stakeholders would like to use the learning environments as multi-purpose spaces for retreat activities, professional development and other creative learning sessions. Having access to low-tech movable supplies/ storage carts could help facilitate a magnitude of interactive sessions like seminars/ hackathons.

- Hybrid Learning and Global Reach
  With technology becoming an essential part of 21st century education, the faculty envision conducting hybrid classes that are part on-line and part in-person to maximize on-campus collaborative learning. They also foresee increased use of technology within the classroom to connect with experts/ educators globally via video-conferencing.

  Per David Hagerty, any video content shown for classes must contain captions but the campus is not able to meet requirements of ADA and Section 508 of the Rehabilitation Act.

- Interdisciplinary
  The needs of 21st century student are evolving towards a culture of interdisciplinary partnerships. New academic breakthroughs that are born through the interaction amongst the different departments and need a pedagogical shift in the way academic courses are structured. Groupwork amongst students in multi-discipline classes leads to innovation, ideation and creation, where students learn from each other rather than just the instructor. The stakeholders also stressed on a desire to collaborate with community partners to cultivate holistic student growth.

- Stand-up Class
  A unique model for the classroom which provided for a stand-up configuration was desired by some stakeholders to accommodate different users in the room. Research shows that some students are more attentive when standing, however, provisions for sit/stand modes need to be provided in the room to cater to students with disabilities.

- Mindfulness
  Stakeholders would like to foster mindfulness in the learning environment by creating physical spaces that have ample natural light and ventilation as well as a course structure that provides students with reflection time during their learning.

ACTIVITY: THE CLASSROOM OF THE FUTURE

WRNS Studio led the activities by asking each user group to imagine the 'Classroom of the Future' at DVC through three different lenses for each unique size of the classroom - Equipment Toolkit, Learning Mode, and Room Configuration. The stakeholders used colored dots to vote their preferences on the interactive posters. Below is a consolidated summary of their inputs:

"My Ideal" Equipment Toolkit

- Writeable Surfaces
  The writeable surfaces that gained the maximum responses for all the class sizes were ones that allow for interactive displays and capturable annotations which can be duplicated on multiple projection screens and/or saved for distribution. For medium and large classroom, moveable whiteboards were also preferred. Walls with writeable paint were preferred by some stakeholders, though their maintenance was highlighted as a concern.

- Chairs
  To maximize student comfort and flexibility, nesting chairs with cushion seat and mesh back that have part wheels and are part gliding were highlighted as preferred. In addition, sit/stand stools to provide for sight lines in large classrooms were noted as 'nice to have'.

- Tables
  Tables on wheels that are easy to move/ reconfigure, adjustable in height, nest/ fold, and allow access to integrated power were unanimously preferred by all stakeholders. For the larger classrooms, sit/stand tables were also highlighted as 'nice to have'.

- Instructor Station
  The faculty expressed a preference for non-bulky and untethered instructor stations that allow them to freely move in class. Also, a combination of a height adjustable work

Sample Activity Poster Images. See more in the Appendix.

desk and podium that facilitates faculty with disabilities and allows adequate desk area for papers/ handouts etc. was requested. It was also mentioned that the work surface at the podium level should be large enough to accommodate the instructor laptop and reading notes along with other control devices. In terms of technology, the instruction station should be able to house a switcher, document camera, DVD player, and room controls for lighting/ sound.

"My Ideal" Learning Mode

- Group Activity
  For all classroom sizes, group activity was the most preferred teaching/ learning mode amongst all stakeholders. Whether it is an all-class discussion, small group discussions, peer-peer learning activities, or hands-on projects, group interaction results in enhanced learning outcomes. More and more faculty are incorporating group activity as a part of their course within each class period or at multiple times during the semester. It was mentioned that groups of 2-6 students is ideal for DVC to foster student engagement.

- Teacher-Student Interaction
  In addition to peer group interactions, students also mentioned that interactions with the instructor was very important to their in-class learning experience. Being able to check-in on their work as a group as well as individually ask questions helped them understand better and feel engaged. Room configurations that allow instructors to freely move through the room and access all student groups should be designed.

"My Ideal" Room Configuration

- Multi-modal/ Multi-directional
  To accommodate the preferred group activity learning mode in all class sizes, the rooms need to be configured with multi-directional digital and analog media and flexible furniture to maximize collaboration. Tech-enabled rooms with 360 degree viewing and hearing allow students and faculty to participate from any location within the room. This multi-modal learning environment represents the pedagogical vision of the stakeholders.

BLUE SKY LESSON PLANS WORKSHOP

OVERVIEW

The Blue Sky Lesson Plans Workshop was held on September 25, 2017 and was attended by stakeholders from both campuses. This all-day workshop was set up to engage with the faculty to catalyze "transformational" thinking about the future of teaching and learning environments.

WRNS Studio shared a brief summary of a few lesson plans that were shared by the campus before leading a series of interactive exercises that focused on understanding the evolving pedagogies through the lenses of Skills, Learning Styles, Experimental, Inclusivity, Mindfulness and Beyond.

Faculty and Deans were then encouraged to create new drafts of an "ideal" lesson plan of the future, taking into consideration two arcs: the semester and the class period. Thereafter, the visioning session and lesson plan insights were overlaid on the three sizes of environments being planned to identify the required toolkit to augment their effectiveness, which include Spatial, Equipment and Function.

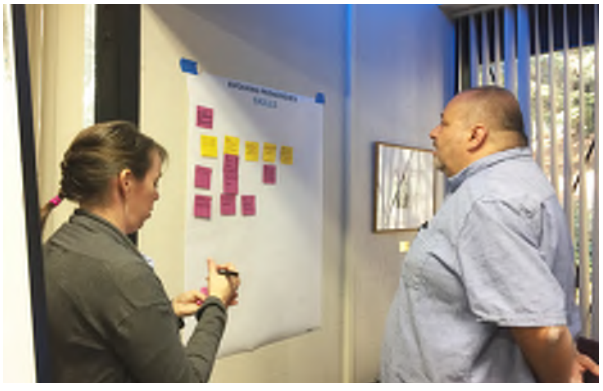
Participants included:
Rachel Westlake, Vice President of Instruction
Toni Fannin, Interim Dean, AFA
Joseph Gorga, Interim Dean of Physical, Biological & Health Sciences
Despina Prapavessi, Dean, Math/ CS/ Business
Daniel Kiely, Librarian, Chair
Katy Agnost, English Department Chair
John Freytag, Faculty (Oceanography), Biology Department Chair
Mario Tejada, Faculty (CIS Instructor), DE Chair
Anne Kingsley, Faculty (English Department & Distance Education)
Lee Rode, Faculty (Psychology)
Cheryl Wilcox, Faculty (Math)
Lisa Smiley-Ratchford, Faculty (Sociology)
Kris Koblik, Faculty (Art History)

The products of this session (inclusive of notes and interactive participation by the stakeholders), along with some articles on 'Higher Education Trends' discussed during the workshop, are included in the Appendix. Following is the summary and key insights from the discussions.

EXISTING LESSON PLAN DEBRIEF

Prior to the workshop, WRNS Studio received four lesson plan outlines from different departments at DVC: English, Mathematics, Psychology and Library. Although, the lessons were very different in content, they all portrayed similar pedagogical methods and ideas. Below are the key attributes:

- Less Lecture, More Interaction
  - Eliminate the 'front' of the classroom
- Web and Video Interface
  - Reliable wi-fi for quick data polling and discussion
- Flex Orientations
  - Keep student more engaged in their learning
  - Interdisciplinary activities
- Scales of Discussions/ Activity
  - All class
  - Group work
  - Team Teaching
  - Individual/ Pair
  - Test taking layouts
- Teaching/ Learning Methodologies
  - Demonstrate
  - Observe
  - Examine
  - Simulate
  - Debate
  - Produce
- Learning Through Display
  - Gallery/ Exhibition
  - Class as an event
  - Host a larger audience
  - Showcase student work
  - Provide storage space for display materials



Stakeholder engagement photographs

Stakeholder engagement photographs

- 'Open' Classroom/ Extending Beyond
  - Fostering community-based learning
  - Making the coursework help positively impact the world
  - "Expanding boundaries" of the learning environment by pulling expertise from outside sources into the classroom through video conferencing, engaging in hybrid (partly online) learning, learning through field trips/ real life examples etc.

EXERCISE 1: EVOLVING PEDAGOGIES

The DVC Educational Master Plan is 'student-centered' and highlights the core values of excellence, equity and student learning while broadening the interdependence between the students, the college and the community. The 'Evolving Pedagogies' exercise was designed to align with the campus mission and take it a step further by engaging the faculty in 'out of the box' thinking about pedagogical methods that will foster student success at DVC. Participants were asked to team in pairs and brainstorm over six themes relating to evolving pedagogies and had 10 minutes to provide input on one theme before moving to the other. Below are the salient points from the exercise:

Skills

Skill development is critical to learning as it defines the learning outcomes and is a measure for evaluation. It is not only important to identify what skills need to be developed in college that will help the student excel in their chosen career path and educate them to be a holistic individual ready for the world, but also understand the resources required to facilitate that skill development. Analytical and critical thinking, problem-solving, decision making, project management, big-data simulation and evaluation, research, real-life application, learning in different rhetorical modes, digital literacy, self-challenging, public-speaking and content curation, examining public data/ news, critique and curiosity were discussed to be some of the key skills that students should graduate with. By following this 'skill-based' learning, attendance to class will be more of a rewarding experience than an obligation. Students will want to know the "Why?" and transform data to knowledge, not just "Pass".

Learning Styles

A diverse student body defines the campus and informs their desire to have a 360-degree, didactic atmosphere that is visual, auditory, engaging and kinesthetic. Many students represent various cultural backgrounds and generations, speak different languages, and require a variety of accommodations. This implies that successful learning environments need to provide for all learning styles. The concept of 'layering' was discussed where multiple modes of teaching/ learning are applied, including but not limited to - graphics and words, digital presentation and writing on the board, real life projects and hypothetical scenario-based learning, virtual exploration and critical analysis of course content and many more. Instructors need to be able to explore the possibilities of pedagogical change or use of social media in learning, beyond prohibiting its use in the classroom, in order to create a more involved and engaging learning environment.

Experiential

Experiential learning is the process of learning through experience eg. hands-on and/or real-life projects, where students are actively engaged in problem-solving and learning. Techniques such as hackathons*/ un-conferences** help grow a start-up/ entrepreneur mind set for the students and teach them how to focus on critical issues in a short time-frame. Combining this with community-based learning and/or interdisciplinary project-based learning aids a comprehensive development of their mind. For faculty, the challenge is how to create the right atmosphere for such learning inside and outside the classroom. Inviting guest speakers, doing field-trips, using social media etc. help establish a dynamic learning experience.

** Hackathon is a design sprint-like event with a goal to generate ideas/ create solutions for a specific topic/ focus area.*

*** Un-conference is a loosely structured conference emphasizing the informal exchange of information and ideas between participants, rather than following a conventionally structured program of events.*

Inclusivity/ Learning Communities

For students and faculty at DVC, learning in the context of the social network is of utmost importance, however, many a times students feel intimidated or inhibited by their peers/ instructors who all come from diverse backgrounds. To overcome this, the faculty discussed creating 'brave' spaces/ learning environments where the students not only felt safe to share their opinions but also brave enough to break the socio-cultural barriers and learn with an unbiased filter. Spaces that encourage collegial and dynamic learning among students and with the community at large are preferred. Here, you "build on your experiences" which contribute to the important transition to becoming a mature adult with a firm understanding of your personal point of view. In order to completely transform the classroom and make it inclusive, a mind shift needs to take place for both students and faculty that they recognize the 'student as the expert' instead of defaulting the 'expert' title to the instructor only. By doing so, students will feel more engaged in their learning environments. By encouraging student participation and recognizing failure as an opportunity, the learning environments can feel more welcoming and inclusive. Interdisciplinary courses that connect multiple disciplines help create dynamic learning communities on campus and push towards unknown boundaries.

Mindfulness

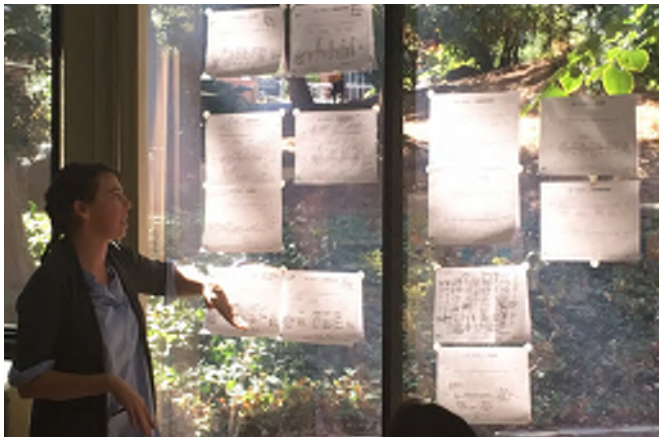
With an increase in 'healthy learning' trends in higher education, campuses are incorporating contemplative and mindful teaching methodologies to help students become more aware, attentive and focused in their learning. This includes the time to debrief a specific topic/ learning concept, asking students to collate the key learning insights from a class, helping students self-pace themselves, eliminating distractions by creating a welcoming and attractive learning environment and structuring the lessons to include mindfulness in the coursework. It also suggests a 'student-first' ideology where the 'classroom belongs to the students' so instructors do not impose their personalities on the learning environment - the room should be reflective of what the students want and who they are. Physical attributes of the room like access to natural light, proper acoustics, ability to control lights and sound etc. all help create a mindful learning environment.

Beyond

With the world becoming more and more connected through technology, the boundaries of the physical classroom are expanding. Instructors are innovating new lesson plans that are hybrid/ partially on-line in order to maximize the in-class time for active engagement/ 'learning by doing' activities. It also implies how instructors are leveraging the technology within the classroom to connect globally using digital media and participating in open/ crowd sourced platforms to gain a breadth of knowledge/ data. Under this concept, the faculty also discussed ways to cultivate 'self-motivated learning' amongst students and keeping them engaged outside the classroom. This could be facilitated through soft spaces outside the classroom such that in-class conversations can continue beyond class time, thereby emphasizing that the future of learning environments is to consider the entire physical campus and all the virtual platforms as a classroom and not just a single room.

EXERCISE 2: MY IDEAL LESSON PLAN

To take the 'transformational' pedagogical thinking a step further, faculty and deans were asked to create new drafts of an "ideal" lesson plan of the future incorporating the aspects of the 'Evolving Pedagogies' exercise that they had just completed. Participants were encouraged to think of their lesson plan in a 'Pre-During-Post' scenario - what outcomes are desired before, during and after - a semester and a class period. Options for different class durations and sizes were provided to the faculty to understand a diverse set of lesson plan types. After individually working on their plans, each participant reported out their vision to the larger group. Although the faculty disciplines and courses were different, their lessons plans had many similarities. This goes to show that students thrive in certain environments that embark the right methodologies to create a comfortable learning atmosphere. Below are the salient points from the exercise:



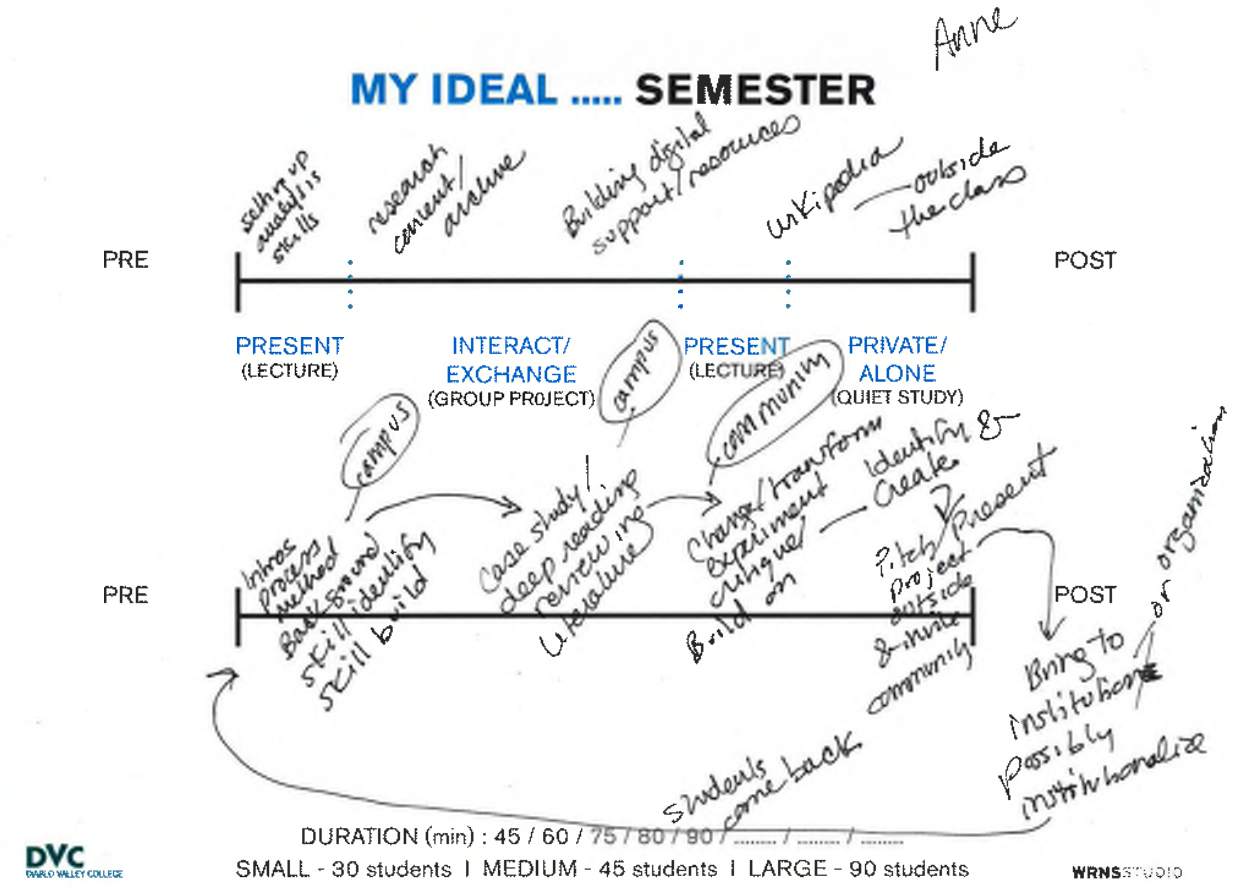
Stakeholder engagement photographs

My Ideal Semester

The 'Ideal Semester' is envisioned as a skill-based structure where the course content is overlaid with critical skills the students need to have upon completion. Understanding the subject material and developing the skills required to excel are both equally important. Students are taught in different ways and given projects/ deliverables that require them to learn new skills. This makes them get out of their comfort zone and exposes them to newer ways of learning. Many faculty also incorporated other course skills or proposed to connect with different disciplines, thus making the student learning experience interdisciplinary. Skills assessment is imagined to be happening throughout the course and is not something kept for the end. This provides students an opportunity to improve during the semester. For pre and post semester, the faculty currently share course learning objectives, reading materials, schedule etc through the campus learning management system (Canvas) or email, but would like to engage students in research/ projects that are not bound by the duration of the semester - something students start in a semester but continue afterwards due to their passion in the subject.

My Ideal Class

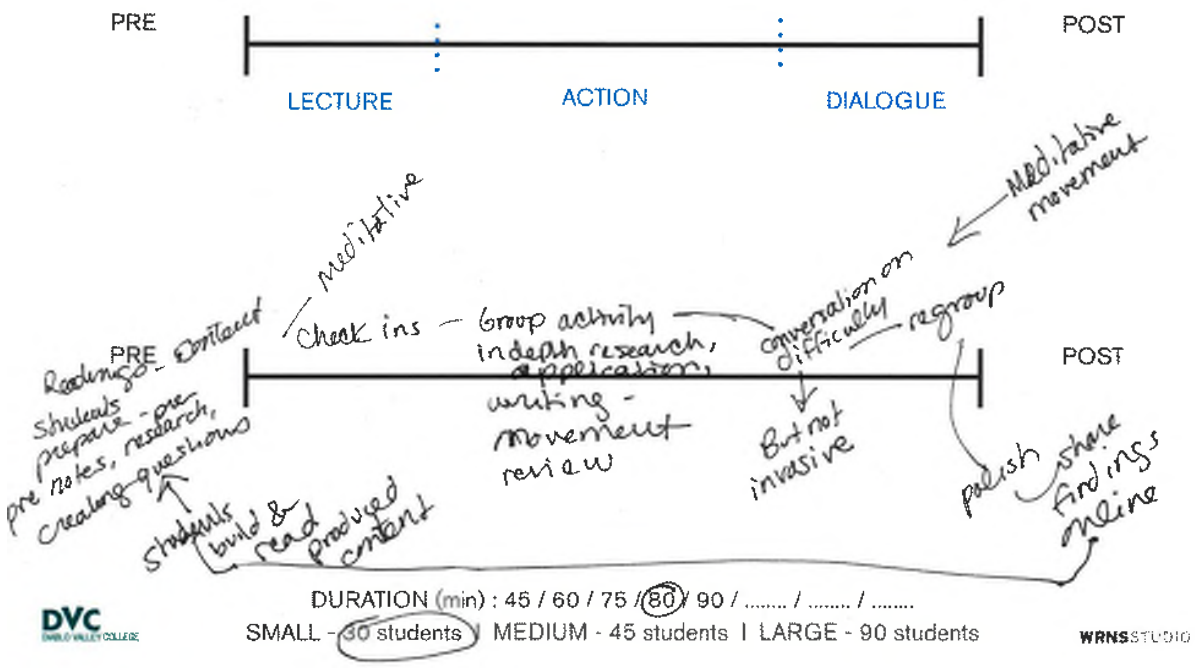
The 'Ideal Class' is envisioned as a multi-modal learning environment with a combination of Lecture, Action and Dialogue that takes place more than once during the course of the class period depending on the content to be covered. A lecture mode is typically when the instructor checks-in with the students, explains key concepts, leads a demonstration, and engages with the entire class in a more one-directional way. During the action mode, students are engaged in some sort of activity - whether it is doing hands-on projects, group-work, watching a video clip, working on in-class hand-outs, etc. These activities range in time allocation depending on the class structure but are always followed by some form of dialogue or discussion. These can be as individual team check-ins by the instructor, an all class discussion, and/or group discussions/ report outs. They are usually set up as a multi-directional exchange of learning outcomes. Though currently the faculty keep the students motivated pre and post class with specified reading material and/or homework, ideally they would like to inculcate 'self-motivation' amongst the students such that students come to/ leave class with a curiosity and conduct their own research beyond what is required for the class. A few instructors for this reason included some time for 'reflection' at the end of their class period where students could take a few moments to absorb what they've learned and ask questions if concepts are unclear.



Sample faculty responses from the exercise. See Appendix for all faculty responses.

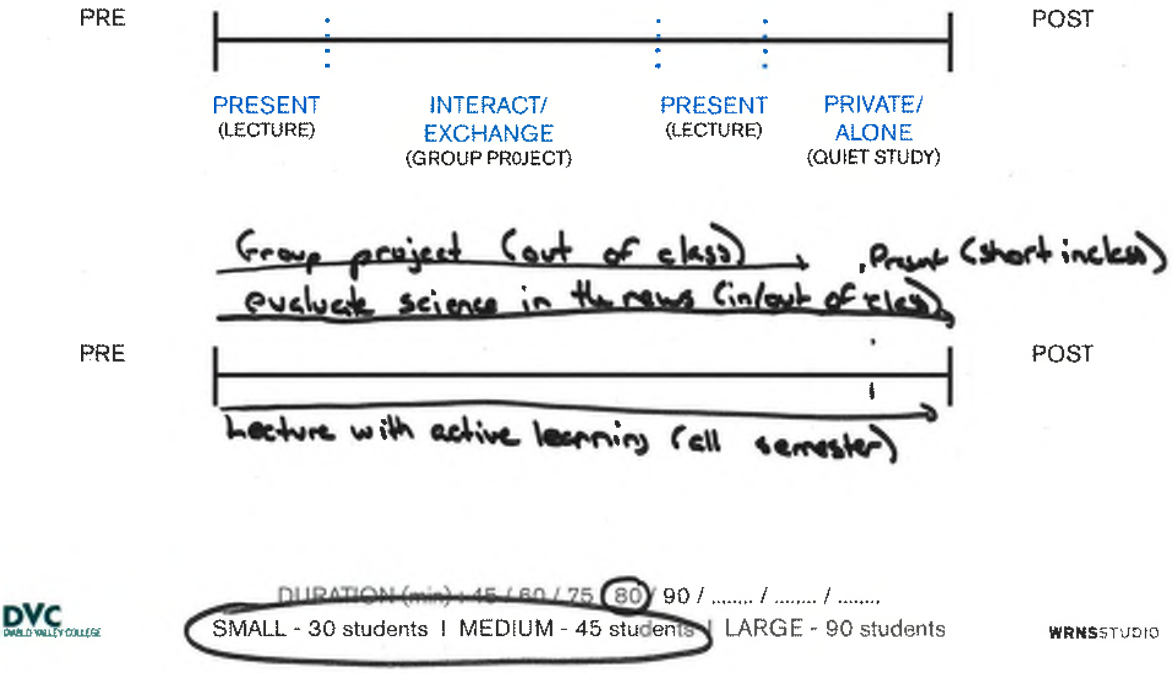
Anne

MY IDEAL ..... CLASS

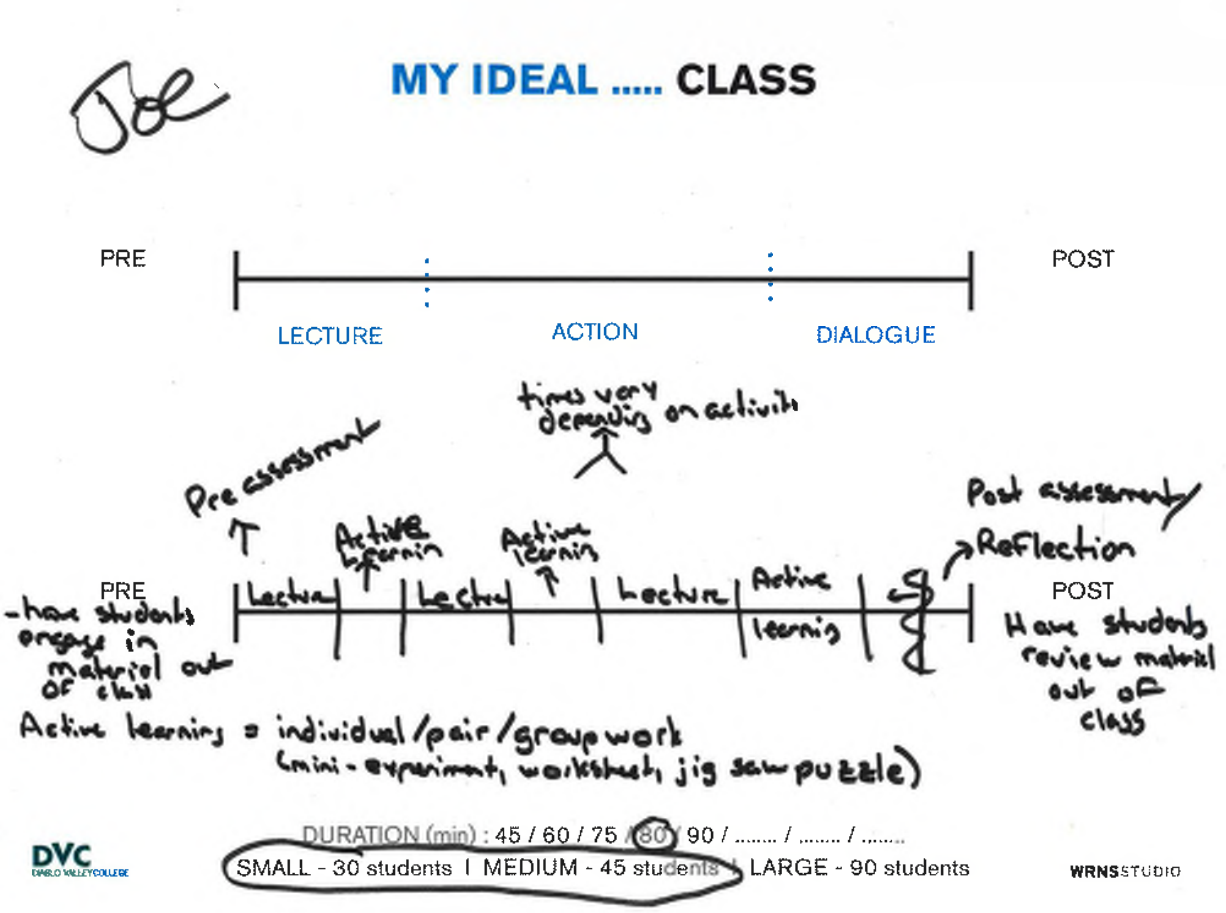


Joe

MY IDEAL ..... SEMESTER



Sample faculty responses from the exercise. See Appendix for all faculty responses.



Sample faculty responses from the exercise. See Appendix for all faculty responses.

PLANNING STRATEGY

PLANNING PARAMETER

As learnt through all the data collected in the surveys and user workshops, academic programs have tremendously evolved with the main educational emphasis on '*learning by doing'.* This popular pedagogy prioritizes creation of collaborative learning environments that move beyond the traditional model of lecture learning. See reference images below.

In-class activities and groupwork requires space for students to engage with each other and equipments such as whiteboards, digital screens and a multitude of their own devices as well as with the instructor. This results in wider desk workspace and adequate space for movement within the room. Also, in order to design a learning environment that is 'Universal' i.e. equally accessible by all users irrespective of their physical, mental or other disabilities, adequate space for movement anywhere within the room needs to be planned for. Hence, a planning parameter of 30 ASF/student is currently recommended as the best practice for Higher Education learning environments.

The existing classrooms at DVC were planned at 15 ASF/student and the current new projects on campus are planned at 20 ASF/student. Though, this is a huge leap from the existing classrooms, it still does not provide adequate space for the needs of the users. The recommended standard of 30 ASF/student is very high (and almost unachieveable for funding) compared to what exists at DVC. To arrive at the appropriate planning parameter for DVC, a series of meetings were conducted with the Core Committee, Academic Senate and Executive Steering Committee. See Appendix for comparative planning parameter analysis presented to the campus. Based on the input from all stakeholders, the Executive Steering Committee decided on the following planning parameters for this classroom design standards:

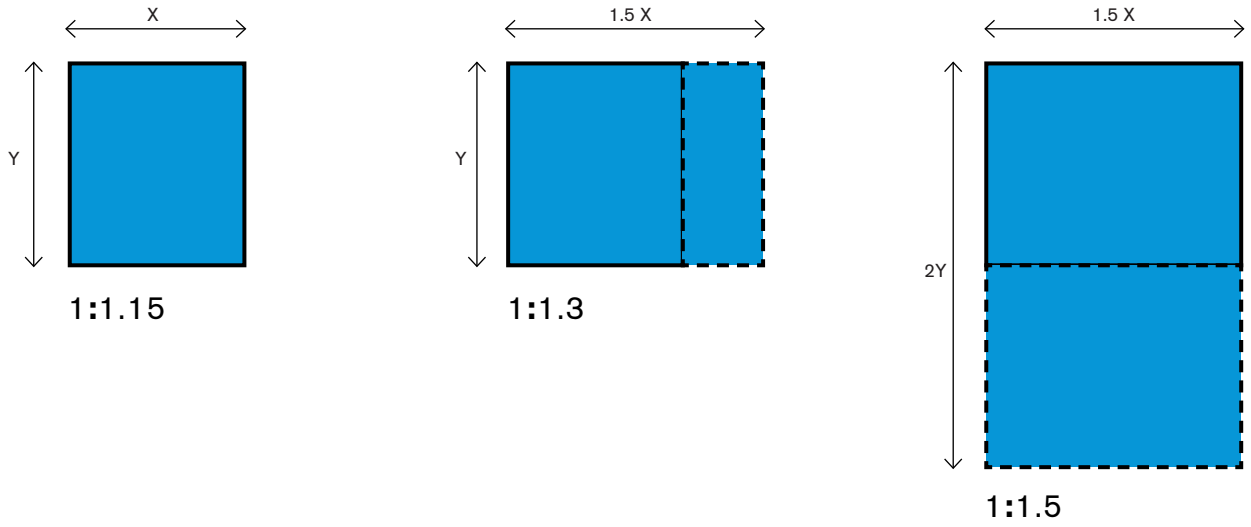
- Small classrooms – 27 ASF/Student
- Medium classrooms – 25 ASF/Student (*while a couple of classrooms on a project by project basis will be at 27 ASF to allow for additional capacity for certain programs only)*
- Large classrooms – 25 ASF/Student

A key parameter for this decision was the choice of 18" deep desks as opposed to 24" deep. The amount of worksurface for students is lesser in the thinner desks, however, more space is made available for movement and circulation within the room, thereby allowing easy access for all users (disabled or not) to move around and fostering the goal of Universal Design.

ROOM PROPORTIONS & MODULAR SIZING

Equity and inclusion are key values in 21st century learning. Hence, the spatial design needs to accommodate and enhance these, such that all users feel fully engaged. Room proportions

Traditional classroom setting vs Collaborative classroom setting



Small - 810 ASF
30 students @ 27 ASF/student

Medium - 1125 ASF
45 students @ 25 ASF/student

Large - 2250 ASF
90 students @ 25 ASF/student

Figure 1: Modular Planning Strategy

that foster sight lines, acoustics, flexibility and movement play an important part in designing such spaces to make sure faculty and students are active participants in their teaching/learning.

While the traditional classrooms were more rectangular in proportion, thereby defining a 'front' of the room, 21st century learning environments break away from this disposition and are trending towards more square proportions given all walls are equally equipped with digital and analog media. A best practice standard of a room not higher than 1:1.5 (width : length) in proportion is recommended to achieve the above results. Exceptions to this may be possible with additional strategies to mitigate aspects of non-inclusivity.

In addition to the above, strategic planning with modular sizing can help create flexibility and future proof campus assets. The design standards established in this report highlight this very strategy for the DVC campus. As the class sizes increase in student capacity from 30 to 45 to 90 students in modular multiples, so should the space they occupy. Keeping one room dimension the same, a 45 student Medium classroom is 1.5 times a 30 student Small classroom and a 90 student Large classroom is twice the size of a Medium classroom. This allows for a regular planning grid and also flexibility for change. For example, a large classroom could be subdivided into two medium classrooms, temporarily with moveable partitions or permanently with a fixed wall. All building systems should be designed to supplement this flexibility. Figure 1 above highlights this modular planning strategy.

Electric lighting for the Diablo Valley College Classroom Standards shall follow the following principles. The goal of these lighting principles is to support a positive, enriching and healthy classroom environment, where lighting can influence classroom behavior, student-teacher and student-student

LIGHTING & HEALTHY LEARNING

engagement and communication, task performance, retention of information, and the visual comfort of all occupants.

LIGHTING QUALITY

- General/ambient lighting system provides soft, shadow-free, uniform illumination throughout classroom. Diffuse light to the occupants and tasks will increase user comfort and satisfaction, reducing distracting shadows from hands, desk objects, and partitions while reducing glare and improving facial modeling.
- Visual comfort and glare control is extremely important, with careful consideration of fixture brightness above 45-degress from Nadir [luminance (cd/m2) and intensity (cd)] to avoid undue discomfort to occupants.
- Good color fidelity (CRI = 90 or greater) from the general lighting system.
- Horizontal AND vertical illumination are both important:
    - Proper visibility of writeable surfaces shall be provided via vertical illuminance from the general lighting system. Researchers @ the University of Illinois Urbana (2003) identified certain "attractors" that aid the learning process and "detractors" that have an opposite event. This research determined that illumination of teaching services such as white boards is an attractor and therefore has a positive correlative relationship with retention of information.
    - Instructors AND students look their best with sufficient vertical illumination, improving student-teacher engagement.
    - Classrooms will feel more spacious with proper vertical illumination (this is especially important if a classroom lacks windows)
- Target light levels, per the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13):
    - Horizontal illuminance @ desk height, 2.5' above finished floor = 500 lux (50fc) average throughout classroom to accommodate a wide range of tasks/uses (15fc for computer use, 40fc for paper tasks/reading, 50fc for art or science projects).
    - Vertical illuminance @ white board (i.e. vertical writable surfaces) = 300 lux (30fc) average.
    - Vertical illuminance @ pin-up walls (aka "tack board") = 150 lux (15fc) average.
    - Vertical illuminance @ background walls (not writable surfaces) = 150 lux (15fc) average.
    - In many situations the classroom/task light levels may be lower (such as A/V presentations or computer use), but the lighting system must be able to achieve average light levels noted above upon demand.
    - Refer to Target Light Level Chart in the appendix for illuminance recommendations based on a wide variety of classroom tasks. It is assumed the lower light levels are achieved via the classroom dimming system.
- Target uniformity of lighting, per the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13):
    - Ratio of average to minimum values across the task surface (not including corners or far edges) should be < 1.4 : 1.
    - Lighting that is uniform tends to reinforce impressions of space, alertness and visual clarity.
    - Uniform lighting allows for flexible classroom use, as it does not favor any instructional orientation or furniture placement. This is especially important in mixed-use, multi-nodal classrooms with no specific "front" where a teacher may lecture from any location in the room.
    - Classroom material finishes:
        - Matte finishes are ideal to diffuse light and minimize reflected glare. Satin finish is an acceptable compromise, but avoid gloss or semi-gloss finishes throughout.
        - Horizontal work surfaces (desks, lab benches,etc) = 25% - 40% reflectance to provide comfortable contrast as surround to white paper or computer tasks. Horizontal work surfaces shall be non-glossy to avoid distracting reflections from windows and overhead lights.
        - Ceiling = minimum 70% reflectance (higher % is better)
        - Walls
          80% reflectance @ window walls (to reduce contrast between windows and adjacent surfaces)
          60%-70% reflectance @ non-window walls
          Small accent walls with color/darker reflectance is acceptable if limited to 10% of any student's visual field.
        - Floors = as light colored as practical

FLEXIBILITY OF USE

- Instructors shall have the ability to control lights locally to set the classroom into various, preset "lighting scenes" to accommodate a variety of learning configurations and/or modes. The lighting scenes could adjust the brightness of lights, the distribution of light within the space (i.e. perimeter -vs- center of room -vs- wall illumination), and the color temperature of light. Suggested preset scenes include the following:
    1. Typical lecture / test taking (same scene could

also be used for "welcome" and "departure" modes)
2. Small group work
3. Classroom group discussion (i.e. sit in a circle)
4. Meditation
5. A/V (i.e. projection)
6. Off

- In addition to preset lighting scenes, the instructor can manually adjust light levels and color temperature via a local controller (i.e. keypad) or smartphone/tablet interface. A smartphone/tablet interface also provides individual fixture control.
- Instead of relying on traditional, hardwire circuiting for control zones, all fixtures are wired to general power and receive illumination/dimming instructions via an individual digital address to each fixture location. Refer to the diagrams of lighting control zones in the appendix. This digital address feature allows lighting to adapt to different teaching modes and room configurations independent of fixture circuiting.
    - Digital addressing allows for daylight-responsive dimming adjacent the windows as required by California Title24 building code), but also the ability to immediately reassign these SAME daylight-responsive light fixtures to different control zones at night or during A/V (i.e. projection) mode when daylight is no longer a variable in the lighting controls.
    - Digital addressing allows for selective tuning (i.e. dimming) of light fixtures located in the center of the room to improve uniformity of task lighting throughout the space. Without this capability, desks in the center of the room will receive higher light levels than those at the perimeter.
- Independent control of wall illumination in medium and large classrooms:
    - In medium classrooms, localized wall illumination is provided at the primary "front" wall to allow use of the writeable surfaces in parallel with the short-throw projectors, while general room lighting is dimmed.
    - In the large classrooms, wall illumination is provided on 3 sides (all walls except the window wall) to increase the sense of spaciousness and provide additional flexibility of use akin to an auditorium. Additionally, localized wall illumination is provided at the primary "front" wall to allow use of the writeable surfaces in parallel with the short-throw projector, while general room lighting is dimmed.
- One exciting, new development in classroom lighting involves the adjustment of lighting spectrum (the color temperature of white light, aka "tunable white") based on learning objectives and/or time of day.
    - A quick definition of color temperature (aka CCT) relates to the "warmth" or "coolness" of white light and is available in architectural lighting equipment between 2200K – 6500K color temperature. Common examples experienced everyday include:
        - "Warm" color temperature: Candlelight (1800K), Incandescent light bulb (2700K)
        - "Neutral" color temperature: Typical office/school lighting (3500K)
        - "Cool" color temperature: Office / school / retail lighting (4000K), Sunny day (5000K), Overcast / cloudy day (6500K).
    - Technology to change electric lighting color temperature is available today, though this involves a small cost premium over a comparable lighting system fixture with a single color temperature. Refer to the case studies on "tunable white" lighting in the appendix. As stated in the September 2017 Department of Energy elementary school case study of tunable white lighting … "Like other classroom upgrades (better furnishings, better instructional technology, better air quality, etc.), the justification for color-tunable systems needs to include non-energy benefits related to a better learning and working environment, possibly linked to student learning outcomes, teacher satisfaction and retention, and human health impacts."
    - Users can assign preset scenes for specific color temperature settings, as well as have real-time override of color temperature settings (i.e. incremental changes to "warmer" or "cooler" settings). In addition, users will have independent control of light fixture dimming (aka intensity) from the color temperature.
    - Examples of preset color temperature scenes include the following. See "Sample Product Cutsheets (Lighting), BLT Series Tunable White" in the appendix for photos of these example lighting scenes:
        - General / Welcome: 4200K color temperature provides a moderate cool white light for an active environment of students arriving or departing class.
        - Testing: 3500K provides a neutral white light (neither warm nor cool) that is good for test taking where students may be seated for extended duration and highly focused.
        - Reading / Calming: 3000K provides a warm, residential color of white light suitable for quiet reading or conversation. Ideally suited for students engaged in quiet group conversation or other activities where the instructor wishes to impart a calming / soothing environment.
        - Energy: 5000K color temperature is a noticeably cool color temperature (akin to daylight) that is useful to counteract

fatigue in the classroom such as during a post-lunch dip / late afternoon. This color temperature is a bit extreme for normal classroom operation and is best reserved for times when the students appear sluggish.

- The influence of lighting spectra on human behavior and health is a highly active area of research. Much of the health-related research involves office workers, hospital workers/ patients, or assisted living residents that spend a majority of daylight hours within a closed environment, with the goal of syncing color temperature and intensity of indoor electric lighting with the daylight cycle and human circadian (bodyclock) rhythms.
- The focus of such research involves improving sleep quality, with the theory that better quality sleep = better mood / focus / alertness / overall health = better performance and productivity metrics as well as decreased injuries in assisted living facilities.
- Given the relatively short time that students and teachers will spend in any classroom, we've focused on research related to behavioral impacts of tunable white lighting systems for the Diablo Valley College Classroom Standards. Within educational facilities tunable white lighting has been primarily tested in K-12 schools though research observations can be applied to the college level.
- Within a classroom environment, suggested uses of tunable white lighting include the following. In effect, the adjustment of lighting color temperature (in addition to dimming settings) can quickly adjust the personality of a classroom to best suit upcoming activities.
    - Encourage student behavior/mood such as calming, focused, engagement, alertness. In effect, changing the color temperature of light incorporates aspects of "nudge theory" of behavioral science, giving behavioral cues to the desired teaching goals. Teachers can be proactive in terms of setting the classroom lighting environment (color AND intensity) appropriate to the learning task.
    - The aspect of variety in a classroom environment is undervalued in this author's view. Lighting cues (such as change in color temperature or intensity such as found in a theater) can facilitate transitions between class activities or class periods, helping to maximize time for learning by focusing the students when class or the next task starts.
    - Morning/daytime classes could be set with cooler color temperatures (4000K or above) to support human circadian needs and work in sympathy with available daylight, while evening/night classes could be set with warmer color temperatures (3000K or lower) to set a proper mood akin to the late hour of class. Conversely, one could employ cool color temperature (5000K) during an evening class to energize the students.

DURABILITY/ LONGEVITY

- Fixtures shall be easily maintainable
    - Compatible with 2x2 ceiling grid for easy access
    - Require minimum cleaning through the use of sealed light diffusers and optical compartments that restrict ability for dust and bugs to settle.
    - Minimum rated life of 60,000 hours per IESNA TM-21 criteria @ L70.
    - Field-replaceable LED engines and drivers/ power supplies, with access to LED engines and drivers from below the fixture or within the plenum (without the need to demount the fixture from the ceiling grid).
- Future-proofing of the lighting
    - Digital addressing of fixtures (explained above) allows for easy reconfiguration / revision of control zones without need for rewiring.
    - Tunable white lighting follows advancements in research in behavioral science and health impacts of lighting on humans (i.e. the impact of light spectra on occupant mood, alertness / wakefulness, and teacher/student engagement).
        - Tunable white lighting is another tool (in addition to overall brightness and distribution of light) that quickly changes a classroom focus and mood at the push of a button.
        - For classrooms lacking natural light / daylight, tunable white lighting is a useful tool to help sync occupant's expectations for time-of-day and provide variation throughout the class period to keep students engaged.

DAYLIGHT

- Daylight in a classroom environment brings physiological and psychological benefits to students and teachers alike.
    - Daylighting can impact people and spaces by providing sensory stimulation (dynamic variation in intensity, color, direction and quality of daylight), connection to nature, time/weather information, full-spectrum light, and an indirect component of light on walls and ceilings that leads to improved modeling of people and spaces and informs a pleasant and comfortable visual environment.
    - Variability in daylight is an important factor

in countering low-level sensory deprivation (i.e. sleepiness, loss of focus/attention, etc.) that could result from being in a windowless, unchanging environment for extended periods. Seasonal and time-of-day variations also enliven and animate interior environments.
    - Daylight apertures allow occupants to occasionally view distant objects outside the classroom that relaxes eye muscles and eases discomfort. Prolonged close viewing stresses the eye muscles while distant viewing causes the eye muscles to relax. The direction of any view to the outside should be widely separated from sightlines to visual tasks (to prevent distraction and/or excessive contrast in one's field of view).
- Research in educational environments suggest a positive impact that daylight may have on student learning rates and test scores. Refer to studies on daylighting in schools in the appendix.
- Daylight design in classrooms requires a balance between the benefits of incorporating daylight (bright, variable, full spectrum light, views to the outside, connection to time of day/weather, energy savings from turning off/dimming electric lights) -vs- user comfort (glare control and unwanted solar heat gain). Emphasis on user comfort is extremely vital to daylighting success.
    - Fenestration (windows, clerestories) are best placed parallel to student/teacher sightlines when classroom desks are set in Lecture Mode. Refer to daylighting diagrams in the appendix.
    - Given the Diablo Valley College Classroom Standard intentionally does not have a pre-assigned "front" of class, recommendations on fenestration types/locations are provided based on a classroom's solar orientation (North, South, East, West) and student/furniture orientation within a typical classroom.
    - Direct sun exposure onto task surfaces (horizontal or vertical) is to be avoided / mitigated as this may lead to visual distractions and/or discomfort.
    - Classroom furniture layout should be arranged so that students do not directly face windows as this may cause visual comfort (excessive contrast) or distraction.
    - Avoid placing whiteboards/writeable surfaces on walls directly opposite windows (clerestories are an exception) as this may cause a veiling reflection on the whiteboard that severely limits visibility by students. If writeable surfaces opposite windows cannot be avoided, window shades will help mitigate veiling reflections on the whiteboard.
- Shading system
    - During A/V mode window shades shall be deployed to darken the room (in addition to dimming of general lighting).
    - Full, black out conditions not recommended due to excessive visual contrast between the projected image and the ambient environment. A common practice is for light fixtures over the screen area to be turned off, and all others operated at a low level sufficient for note taking.

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04
SMALL CLASSROOMS

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Small Classrooms at DVC are those with 30 student stations. This classroom size is used to mainly instruct English and Communication courses. The types of activities range from all-class discussions to smaller group discussions. Some group discussions require students to collaboratively work on a project/ deliverable together while others are simple dialogue exchanges. The intimate size of the small classroom also lends itself to skill building where faculty are able to assess student comprehension of key concepts.

The room is equipped to support a variety of activities and settings, which require a range of lighting levels, analog/ digital displays and interactive lecture display/ annotation capture capability. The use of energy efficient equipment with automated controls helps improve performance and conserve energy. Due to unknown conditions of the exterior wall/ fenestration pattern of the specific project these standards will be applied to, clerestory windows for natural daylight are proposed as a baseline in the classroom layout.

The room is also equipped with surface-mounted, floor raceways along the perimeter and the central area which terminate in access points that can be located throughout the learning space to support a variety of activities and settings.

Hard-wired media access points for plugging in the instructor/ student devices are distributed at three locations (2 wall and 1 floor) in the room.

The proposed classroom inventory aims to be durable, flexible, adaptable, and playful (using the range of colors available for the various products). It consists of nesting chairs on casters and glides to enable free movement; flip-top stackable tables on casters with integrated power outlets to provide maximum flexibility within the space; multi-modal instructor station with lockable storage on casters to provide mobility and a range of teaching postures; and writeboards with seamless short throw digital projection system to integrate active teaching. Accessible furniture, similar to the rest of the classroom inventory, is integrated within the space to eliminate segregation and foster collaboration amongst students. Generous circulation space is provided within the classroom to allow for a wheelchair to freely move in the space.

As the maximum classroom occupancy is less than 50 per design standards and code (Refer CBC Table 1004.1.2 - Maximum floor area allowance per occupant for 'Classrooms'), one exit is required (Refer CBC Table 1006.2.1).

CLASSROOM INVENTORY**

CHAIR (1)
Movable on 4 legs (2 casters & 2 slide)
Foldable/ Nesting
Mesh back and Fabric/ Vinyl Seat
Arm/ Armless

TABLE
Foldable/ Nesting
Movable on Lockable Casters
Integrated power outlet
ADA compliant

INSTRUCTOR STATION
Integrated workdesk/ podium with option for larger podium work area
Un-tethered/ On Casters
Integrated power outlet
Adjustable Height of desk and podium worksurface
ADA compliant

WRITEABLE SURFACE (1)
Projection & Dry-erase

***Refer to the Appendix for sample product cutsheets.*

ROOM DATA SHEET (SMALL CLASSROOM)

AREA	810 ASF.
STUDENT STATIONS	30.
PLANNING PARAMETER	27 ASF/ Student.
ROOM PROPORTION	Length : Width ~ 1.1x : 1x
MINIMUM CEILING	10'-6".
FUNCTION	Interactive Lecture / Skill Learning and Collaborative Group work/ Skill Application.

SPECIAL REQUIREMENTS

CEILINGS**	Suspended acoustical ceiling system with smooth texture, light reflective, impact/scratch resistant, 2'x2' or 2'x4', white tiles and tegular lay-in grid, minimum NRC rating of 1.0 (Optima by Armstrong or similar).
WALLS**	Full height metal framing with drywall on both sides. Insulate interior of all wall cavities with non-cellulose sound blankets. At partitions facing corridors, use staggered double studs. *(Upgrade: Full-height glass walls at corridors with translucent writeable film.)* Writeable Surface: High-performance dry-erase whiteboard on all walls as per window layout. 3'-0" minimum bottom of board with 1" x 4" wood marker tray (see sketch detail in layouts). Use high-performance dry-erase and projectable whiteboard for walls with Interactive Short Throw Display Projectors. Paint (Field): Semi-gloss interior paint, No VOC. Use accent color if desired. Base: Resilient, pre-molded corners and straight at carpet flooring.
FLOORS**	4" Raised access floor system with 2'x2' base tiles finished with 2'x2' carpet tile. (Tate ConCore Understructure/ PosiTile Carpet or similar). Carpet tile equal or greater than 10 stitches per inch, yarn weight of 20 to 30 ounces, stain/moisture/wear resistant, impervious type backing material, anti-static, UL Class A.
WINDOWS	Energy-efficient, transparent glazing to provide access to daylight and minimize heat loss or gain. Provide automated solar shading (Mechoshade or similar) to control light and glare while projection equipment is in use. Integrate controls with other AV controls. The exterior wall and fenestration pattern may vary on a project by project basis, hence, clerestory windows are shown as a base in the classroom standard layouts. The clerestory is suggested as a baseline for pricing, so that there is a budget allocation to begin with, which affords a certain allowance for glazing to be integrated. Each room will be particular with regards to existing condition, location on campus, and other considerations so the clerestory is certainly not seen as a final decision. The benefit of the clerestory is that it allows writable surfaces to be maximized.
DOORS	36" wide minimum, solid core, wood doors with narrow vertical tempered glass vision panel and hollow metal frames. No transfer grills or kick plates.
HARDWARE	Mechanical lever locks with means of interior locking (push button) for security. (Upgrade) Electronic locks with mechanical (push button) override from the inside with capability to tie into campus-wide security system. All electronic locks to be placed on the door and not the wall. Door hardware groups across various campuses shall be specified to provide a secured environment during a lock-down scenario, in particular by providing an interior override function as well as remote and local lock down. For existing general-use classrooms, replace mortise style

***Refer to the Appendix for example product cutsheets.*

with hotel style deadbolt locks similar to Corbin Russwin ML2013. For new construction of general-use classrooms, use Corbin Russwin CL 3351 or 3129 series. Where required, electrified locks, including those with HID card access, shall include a push button to override the card access on the exterior, similar to Sargetnt IN120 and IN220 HID, or Schlage AD-400 series. For large classrooms (over 90 students), crash bars must provide a means to override the dogged down feature and electronic lock open feature with a mechanical thumb turn device, similar to Von Duprin crash bar with 2SI feature.

HVAC

Recommended Temparature Range: Summer 74F +-2F / Winter 70F +-2F or per campus standards.
No additional humidity control may be required if RH is within acceptable condition per AHSRAE 55 thermal comfort and not required by Campus.
Low velocity air flow diffusers, especially when corner screen is provided to avoid agitating the screen. Lockable thermostat zone control.
Provide wall mounted zone temperature sensor with LCD display including room temperature, room CO2 level, temperature setpoint control, and after-hour override timer control with user adjustable duration.
Zone occupancy to be monitored by connection to the lighting occupancy sensors.
Where HVAC return paths to classrooms are not ducted, acoustical boots should be used to maintain the composite sound isolation performance of enclosing assemblies.
Ensure that mechanical systems adhere to the guidelines provided in the latest version of the Noise and Vibration Control chapter in the ASHRAE HVAC Applications Handbook.
CO2 Sensors for Demand Control Ventilation required per California Energy Code.
AV rack and laptop storage carts are located in closets outside the classroom. If they are located in the room, provide supply and return passthrough to remove additional heatload in the room.

PLUMBING

Automatic fire sprinklering system as required by California Building Code. Do not route plumbing through or near classroom areas.

LIGHTING

GENERAL REQUIREMENTS

- Target light levels, per the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13):
    - Horizontal illuminance @ desk height, 2.5' above finished floor = 500 lux (50fc) average throughout classroom to accommodate a wide range of tasks/uses (15fc for computer use, 40fc for paper tasks/reading, 50fc for art or science projects).
    - Vertical illuminance @ white board (i.e. vertical writable surfaces) = 300 lux (30fc) average.
    - Vertical illuminance @ pin-up walls (aka "tack board") = 150 lux (15fc) average.
    - Vertical illuminance @ background walls (not writable surfaces) = 150 lux (15fc) average.
    - In many situations the classroom/task light levels may be lower (such as A/V presentations or computer use), but the lighting system must be able to achieve average light levels noted above upon demand.
- Emergency egress lighting shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured at floor level throughout the room (since path of egress varies for different room layouts).
- Light fixtures and controls shall provide simple and affordable solution for classroom lighting.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Daylight photosensors and occupancy/vacancy sensors may be provided by 3rd party manufacturer, but shall be fully compatible with classroom light fixtures and warrantied by the installing electrical contractor.
- All LEDs used in the LED light fixture shall be of proven quality from established and reputable LED diode manufacturers with minimum 5 years experience in the manufacture of LED diodes. LED light fixture supplier shall have minimum 5 years experience designing, selling and supporting installations of LED systems.
- All light fixtures and control gear shall be UL-listed (or equivalent by ETL / CSA) for indoor locations.
- Manufacturer of LED systems shall utilize an advanced production LED binning process to maintain

***Refer to the Appendix for example product cutsheets.*

color consistency within a 4-step MacAdam ellipse per ANSI Standard C78.377 within all luminaires unless otherwise specified.

- Manufacturer shall provide photometric data for all light fixtures based on test results from an independent testing lab including candlepower distribution data in polar graph form, total lumen output per light fixture, and total wattage per light fixture.
- Contractor to consult with the owner and provide if required, back-stock of all led power supplies/ drivers in a quantity to the owners' preference.
- All lighting equipment (including but not limited to light fixtures, LED drivers/power supplies, control interfaces, user interfaces, daylight photosensors, occupancy/vacancy sensors) shall be furnished with 5-year warranty for full replacement (materials and labor) effective from the date of substantial construction completion.
- All electrical lighting shall follow the latest applicable codes and standards (see Appendix for lighting code summary):
    - 2016 California Building Standards Code ("Title 24")
        Part 3 Electrical Code – Installation requirements and egress lighting levels.
        Part 6 Energy Code, Subchapter 4 – Lighting control and dimming requirements.
        Part 6 Energy Code, Subchapter 5 – Energy use (Lighting Power Density)
        Part 9 California Fire Code, Section 1008 Means of Egress Illumination
    - CalGreen Building Standards Code (Part 11 of Title 24)

LIGHTING FIXTURES**

2' x 2' General Light Fixture

- Shall be 2' x 2' square and work within a standard 2' x 2' suspended ceiling grid system. Acuity 2BLT2-40L-ADP-120-EZ1-LP935-N100-LATC or similar for fixed 3500K color temperature. *(Upgrade) Acuity 2BLT2-TUWH-PROR-40L-ADP-120-NLT-LATC or similar for tunable white option.*
- Emergency Lighting fixture shall be same Acuity 2BLT2-40L fixture as others in classroom, but shall incorporate EL14L (1400 lumen) battery pack.
- Light fixture appearance shall have design-neutral aesthetics with clean, refined details to blend into the ceiling. Expressive design statements are discouraged from the general lighting fixtures.
- Powder coat, white finish.
- Minimum rated life of 60,000 hours per IESNA TM-21 criteria @ L70. LED fixture manufacturer shall power the LED diodes at a drive current recommended by LED diode manufacturer to reach minimum 60,000 hour rated life @ L70. LED diodes shall not be "overdriven" at a higher drive current to increase light output to detriment of rated lamp life.
- Field-replaceable LED engines and drivers/power supplies, with access to LED engines and drivers from below the fixture or within the plenum (without the need to demount the fixture from the ceiling grid).
- Sealed light diffusers and optical compartments that restrict ability for dust and bugs to settle within the fixture.
- Fixture provided with a range of fixed lumen outputs ranging from 3000 – 5000 lumens per fixture (@ 3500K) to accommodate classroom ceiling heights ranging from 9'-0" to 12-6". Upon implementation, project design team is responsible for specifying the fixture's lumen output to achieve the required light levels as noted within the Design Standards document.
- For tunable white option, fixture shall provide consistent lumen when varying the color temperature (i.e. constant lumen curve).
- Nominal 4,000 delivered lumens @ delivered lumens per watt (LPW) > 100 LPW.
- CRI = 80+ (basic version) or 90+ (enhanced version) for light fixtures
- Color temperature = 3500K (basic version) or Tunable White with range from 3000K – 5000K (enhanced version).
- Spacing to mounting height ratio (S / MH) > 1.18 in any direction. Typical on-center spacing of 2x2 light fixtures is 8', though 10' spacing is permissible for ceiling heights 10'-6" or taller.
- To control glare to occupants, 2x2 light fixtures shall have the following performance requirements:
    Luminance < 4500 cd/m2 @ 45° above Nadir, <4000 cd/m2 @ 55°, < 3500 cd/m2 @ 65°, < 3000 cd/m2 @ 75°, 2500 cd/m2 @ 85°.
    Intensity < 1000cd at angles 50° or higher above Nadir.

- Dimmable to 5% light output without flicker or jumps in light output.

LIGHTING CONTROLS

General Description

- Acuity nLight system or similar for fixed 3500K color temperature. *(Upgrade) Acuity nTune system or similar for tunable white option.*
- Occupancy/ Vacancy sensor, required per Title24 building code, shall automatically turn off classroom lighting when room is unoccupied.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Light fixtures work together as a single network (within one classroom only) and does not require a centralized (whole-building) control system.
- The system is scalable to multiple classrooms by simply repeating the single-network model.
- Control system shall be easy to install, commission, and maintain. Fixtures and controls work together as a system with "out of the box / plug and play" connectivity.
- Digital addressing of fixtures (explained above) allows for easy reconfiguration / revision of control zones without need for rewiring.
- Classroom lighting control system shall be linkable with campus Building Management System (BMS).
- Classroom lighting control system shall be compatible with California's Title24 Demand Response requirements.
- *(Upgrade) Allows for individual fixture calibration for lumen output or color temperature (if tunable white) should a light engine require replacement or color shift (if tunable white) is observed over time.*
- Allows for integration of 3rd party light fixtures into the classroom lighting control system using industry-standard control protocols.

Emergency Lighting

- Designated 2' x 2' classroom emergency light fixtures (EM fixtures) shall be of same family, type, appearance, digital addressing capability, and lumen output under normal power operation as adjacent 2' x 2' classroom fixtures.
- EM fixtures shall be UL924 listed for emergency operation.
- EM fixtures shall operate as normal light fixtures when normal power is available (i.e. they can dim or turn off according to preset scenes or user override). The EM fixtures shall automatically override to emergency-mode light output (1400lm) upon loss of normal power via automatic transfer to the specified battery backup power source.
- Upon loss of normal power, EM fixtures shall operate with 1400 delivered lumens for a period not less than 90 minutes.

User Controls

- All user controls shall be mounted within the acceptable range for ADA compliance, namely 36" on center, above finished floor.
- Instructor access to lighting controls via localized keypad mounted at instructor station and/or classroom wall.
- *(Upgrade) For tunable white feature, provide side-by-side (double gang) keypad with one keypad hosting preset scenes, and second keypad hosting independent control of color temperature and light level/intensity/dimming for the selected scene.* See "Sample Product Cutsheets (Lighting), Tunable White" in the appendix.
- Preset scenes are customizable by school administration.
- Lighting controls shall permit additional interface/coordination with the classroom A/V control system to automatically control lighting in connection with A/V actions (such as turning on projectors, projection screen and window shade deployment, etc.)

Digital Addressing

- All classroom light fixtures shall allow for individual fixture addressing (aka digital addressing) that is independent of power/control wire configuration.

- Digital addressing features shall allow for individual fixture control of intensity and *(upgrade) color temperature (if tunable white)*, as well as grouping of light fixtures (via software) into control zones that are independent of power/control wire configuration.
    - This feature shall permit individual fixtures to be within MULTIPLE control zones, and such control zone grouping to CHANGE depending on the selected lighting scene.
    - This feature shall permit onsite calibration of individual fixture's lumen output (via software) to balance uniformity of light levels throughout a classroom.

Lighting Control Sensors

- (1x) Acuity daylight photosensor or similar and (1x) Acuity dual technology (PIR and Ultrasonic) occupancy/vacancy sensor or similar. Each single sensor can control multiple fixtures in the classroom.
- Specified light fixture shall offer (as an option) a daylight photosensor as well as an occupancy/ vacancy sensor integral to the light fixture. Each integral sensor can control multiple fixtures in the classroom.
- Compatibility with 3rd party sensors if needed (such as daylight photosensors or vacancy sensors) via hard-wired OR wireless communication.
- Occupancy/ Vacancy sensors for light fixtures shall also trigger HVAC operation (or vice-versa)

ACOUSTICS

SOUND ISOLATION

General Description

- The noise generation potential at all classroom adjacencies should be carefully evaluated when determining the acoustical requirements of both vertical and horizontal classroom partitions. For classrooms that must be located adjacent to spaces expected to generate high sound levels such as music practice/performance rooms, stairwells, elevators, mechanical equipment rooms, active corridors and nearby lobbies, additional acoustical consideration should be paid the STC rating of the partitions, windows and any communicating doors.

Walls

- In general, the sound isolation across the partition will depend on several factors. The primary factor will be the STC performance of the partition assembly itself. Other factors include whether there are doors or windows between the rooms and penetrations such as ductwork and piping. Consideration of these various factors as well as choice of construction systems and methods and cost will ultimately dictate the recommended wall assemblies, type of door gasketing, glazing size and selections, and ceiling systems.
- For the base condition, the walls surrounding the classrooms should be full-height (i.e. slab-to-slab) and achieve a minimum acoustical performance rating of Sound Transmission Class (STC) 50 or Noise Isolation Class (NIC) 45.
- For classrooms adjacent to loud spaces such as lobbies, band rooms and mechanical rooms, a special assessment should be performed to determine the required minimum STC rating of the partition. Depending upon the specific adjacency, the expected range of performance is STC 55 to 60.

Doors

- For the base condition, all classroom entry doors should be fully acoustically gasketed at the jambs and at the bottom. Typical adjacencies such as to a private office or a vestibule, should also include a fully acoustically gasketed door.
- For classrooms that open onto a primary circulation corridor or lobby, the doors should have a minimum acoustic rating of STC 35. For communicating doors between classrooms, specify STC 45 to 50 or greater depending upon the specific adjacency.

Floor/Ceiling Assemblies

- Where classrooms are located below active and potentially noisy spaces, the floor/ceiling assembly should be designed to achieve minimum:
    - Air-borne Sound: STC 50
    - Impact Noise: IIC 45

- For air-borne sound attenuation, an 8" minimum thickness concrete slab with suspended lay-in ceiling will achieve a minimum STC of 50. For wood framed construction, use of light-weight concrete and resilient isolation clips such as resilient channel at the ceiling gypsum board will likely be necessary.
- For impact noise attenuation, carpet without any additional acoustical treatment is conditionally acceptable. Areas with significant amount hard finish will require an additional sound-attenuation underlayment such as rubber or cork.

Exterior Façade/Windows

- Classrooms potentially exposed to excessive outdoor noise sources such as roadway traffic and air-craft flyovers will require an environmental noise survey in order to determine the minimum STC performance requirements of the windows and wall.
- The standard noise level criteria for all classroom due to exterior/outdoor noise sources should be a 15-minute average noise level of 35 dBA (Leq) or less and a maximum noise level of 50 dBA (Lmax-Slow).
- Where the outdoor noise level is found to be 60 dBA or greater, the mechanical air-ventilation system in the classroom must be designed so that the fresh-air requirement can be achieve with operable windows in the closed position.

ROOM ACOUSTICS

The overall acoustical finish scheme in the classrooms should control excessive sound reverberation and support excellent speech-intelligibility.

Base Classroom Design

- Reverberation Time (RT60 at 500 Hz): less than 0.6 sec
- The ceiling is the most cost-effective surface to consider for locating the primary acoustical finish. Typically, a lay-in tile ceiling having a minimum NRC 1.0 such as Optima by Armstrong or similar should be considered.
- Sound absorbing wall panels should be considered as follows:
    1. Wall panels should have a minimum acoustic performance of NRC 0.75 and be at least 2" thick.
    2. Where possible, apply acoustical wall panels on at least one surface of each pair of parallel walls and in the wall area between seated and standing ear height. See layouts for recommended locations of wall panels.

Upgrade or Non-Standard Classroom Considerations

- *In the case where upgraded sound-isolation might require a "hard-lid" ceiling and where a dropped lay-in tile ceiling cannot be installed, then the exposed hard-lid ceiling should be treated with minimum NRC 0.80 and 2" thick acoustic panels.*
- *Sound absorbing wall panels should be considered as follows:*
    1. *When less than 100% of the ceiling area is not acoustically treated, then a remaining equivalent area of acoustical panels having should be applied to the walls.*
    2. *If "front-firing" loudspeakers are being considered, the wall opposite the loudspeakers should be fully covered with acoustical wall panels as feasible.*
    3. *If wood finishes are desired, consider perforated or kerfed acoustic panels having minimum NRC 0.80 such as by RGP Corporation, or slats or grills such as 9Wood Company.*
- *Acoustic treatments may also be required to minimize flutter echoes and control extraneous echoes.*

MECHANICAL NOISE/ VIBRATION CONTROL

- The noise level in the classrooms as generated by mechanical equipment (HVAC, Electrical, Plumbing, Elevator Equipment and AV equipment) should be limited to a maximum noise level of Noise Criteria (NC) 30 in the classrooms.
- All potentially noisy MEP and Elevator equipment located adjacent to, above or below the classroom, including fans, pumps and electrical transformers should be carefully evaluated for both air-borne and structure-borne noise and as required, acoustically treated and/or the intervening

***Refer to the Appendix for example product cutsheets.*

partition or floor/ceiling be acoustically upgraded.

- The air-velocity in ductwork located within the classroom should not exceed 800 fpm. The air velocity in the final branch-duct should not exceed the diffuser neck velocity by more than 150 fpm, unless otherwise noted. The air-velocity at the neck of each supply and return diffuser should not exceed 400 fpm.
- VAV boxes should be sized to limit the total pressure drop to 0.5-inches TSP or less and have both a radiated and discharge sound level of less than NC 30.
- FCU and VAV boxes with radiated noise levels greater than NC 30 must not be located in the ceiling over the classrooms.
- Flexible ductwork shall not be used on medium pressure duct systems upstream of VAV box connections.
- Sheet metal ductwork should be internally lined with 1-inch minimum thickness of acoustical duct-liner.
- Air-transfer boots should be constructed completely of acoustically lined sheet metal, include at least one 90-degree elbow and sized depending upon the degree of sound-isolation required and for maximum 500 fpm.
- Supply and return diffusers should be selected to perform no greater than NC 25.
- Ducts, pipes and conduit attached to vibration isolated equipment should include flexible or resilient type connections and may be required to be vibration isolated from the building depending upon proximity of the duct or pipe to acoustically sensitive spaces and the power of the attached equipment.
- The noise emission from AV Equipment should also be considered. Where noisy AV equipment is unavoidable and is needed to be located in the classroom, then sound-rated ventilated equipment racks should be considered.

AUDIO/VISUAL EQUIPMENT**

AUDIO SYSTEM

(Upgrade) Audio DSP (Digital Signal Processor): *QSC Core 110f or equal (Only required for capture/ conferencing)*

Loudspeakers: QSC AC-C6T or equal

Amplifier: QSC CMX300Va or equal

Wireless Microphone: N/A

Voice Lift: N/A

Assistive Listening: N/A

VIDEO SYSTEM

Minimum viewer distance to digital display (especially in lecture mode) should be equal to the width of the display screen/ projected image.

Projection:

Standard Projection: Panasonic PT-RZ770 or equal – 7000 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 1-chip DLP, Laser Source

Interactive-Short Throw: Epson Brightlink Pro 1460Ui or equal – 4400 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 3 LCD, with output capabilities for mirroring annotation and content onto a larger projection screen. Provide equivalent laser source model if available.

Projection Surface:

Motorized Screen: Draper Access V ceiling-recessed, tab-tensioned, motorized screen or similar for video projection sized 72.5”x116” for viewing from the back of the classroom. The bottom of the viewable image shall be at 4’-0”AFF. Screen material shall be Matte white or equal. *(Upgrade): Screen material shall be TecVision XH900X ALR (ambient light rejecting) or equal for use in moderate to higher ambient light and wider viewing angles.*

***Refer to the Appendix for example product cutsheets.*

Markerboard: Low gloss or matte surface white-dry erase board for interactive short-throw projection. PolyVision projection surface or equal.

Transport and Switching:
Video Matrix Switcher (location: main equipment rack):
Crestron DM-MD8X8 Digital Media Switcher
-Input Cards: (2) DMC-4K-HDCP2, (1) DMC-DVI, (1) DMC-4K-C-DSP-HDCP2
-Output Cards: (1) DMC-4K-HDO

Instructor Station:
Instructor Station Video Switcher: Crestron DM-MD8X1-4K-C with DM output for instructor station
Instructor Station Cable Cubby: Extron Cable Cubby 500
DVD Player: Denon DN-500 or equal at instructor station
Document Camera: Elmo P10HD or equal at instructor station
Wireless Presentation: Mersive Solstice or equal at main equipment rack

Capture/Conferencing (upgrade): Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.
PTZ Camera: Panasonic AW-HE40SWPJ with HDMI output (or equal) located on the back wall of the room.
Capture/Stream Unit: Extron SMP351 or equal (location: main equipment rack)
Conferencing Unit: Extron MediaPort 200 or equal (location: main equipment rack)
In-Room Computer: Dell or equal (location: main equipment rack)
Single Element Ceiling Microphone: (2x) Audix M55 or equal
(Upgrade) Ceiling Array Microphone: (2x) Shure MXA910 or equal

CONTROL SYSTEM
Control Processor: Crestron CP3N control processor or equal. The AV system shall be able to send preset recall signals to the master control units for window shades and lighting so these components can be controlled via one cohesive system (location: main equipment rack).

Touch Screen: Crestron TSW-760 7" Touch Screen on the wall and *placed at instructor's station (upgrade)*. Wireless control shall be configured for controlling the room via an app or laptop. Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.

UTILITY / OTHER
See layouts for recommended locations of data/power and hardwired AV connections.

A campus-standard instructor's station shall be provided. The instructor's station would include the DVD player, document camera, laptop connections, USB thumb drive connections for lecture capture, and other items as needed.

AV equipment shall be installed into a Middle Atlantic MRK-AXS or equal pull-out equipment rack stored in an AV closet located outside the room.

VOICE/DATA**

Six dual ports at wired AV station unless noted otherwise. Wireless internet access required throughout. (1) Wi-Fi Acces Ports: Aruba 220 series Acess Points or per current campus standards.

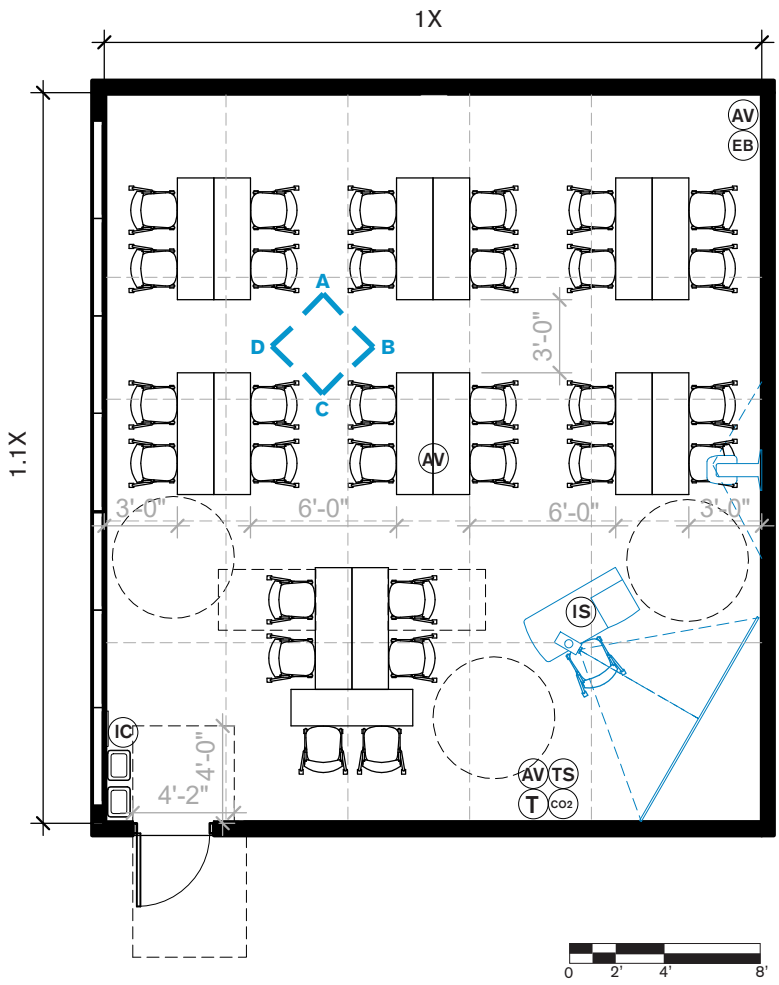
Provide CAT 6 or better connection for the wall mounted IP speaker/clock/ microphone as per campus/ district standard. No separate power conenction required for this product. System to tie into the Building Alarm System. Installation height 8'-0" AFF or as required by manufacturer's manual. Emergency call button (linked to the IP speaker alarm panel) at accessible height of 48" AFF located away from the exit door. See layouts for locations.

POWER

Provide wall power/data fourplex receptacles at +18" AFF, spaced 5'-0" on center. *(Upgrade) Provide continuous, perimeter wall mounted raceway for power/ data/ AV (below the marker tray at +35" AFF),*

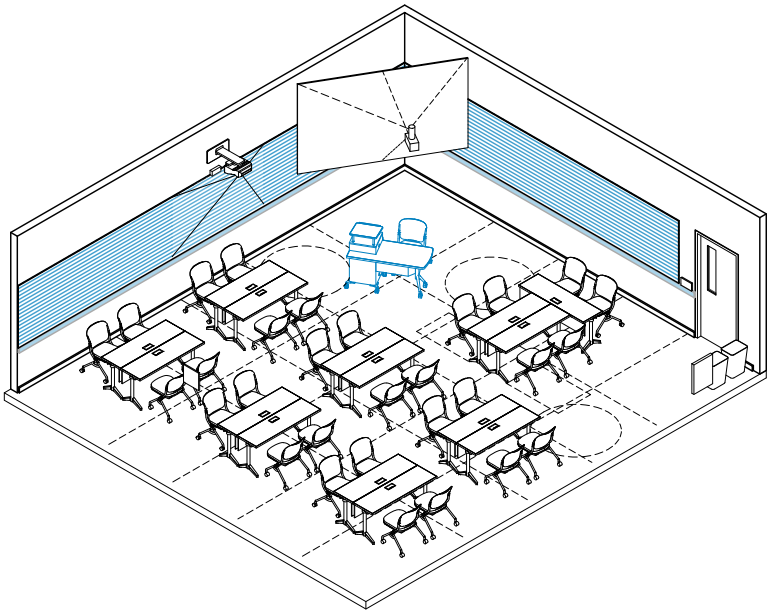
	cover color to match wall color. Receptacles in raceway to be duplex, 5'-0" on center. See layouts for conceptual detail sketch at raceway & writeable surface junction. Provide pop-up, flush-mounted, fourplex floor boxes at 5'-0" on center within the 4" high, raised floor system. Floor boxes fed either down the walls from above ceiling in existing classrooms or from below grade in new construction. Provide adequate power for video projector and other AV equipment. Provide additional outlets at Instructor's station for multiple devices. Provide a provisional recessed receptacle for a wall clock at 8'-0" AFF on one wall in the room, ideally the wall with the short-throw displays. Power for egress lighting will be provided by batteries integral to the fixtures as required to give the egress lighting levels stated. An option would be to provide power from a central battery/ inverter system. Using that option would depend on the building and/or classroom or assembly space type.
SECURITY**	Provide IP speaker with integrated wall clock for campus-wide emergency/ alerts per campus/ district standards. Provide adequate signage for safety instructions.
FURNITURE**	Provide products with active and flexible comfort capabilities while addressing concerns of Universal Design and minimum warranty requirements per campus/ district furniture performance standards.
OTHER CONSIDERATIONS	Do not locate classrooms near or below spaces with loud activities, high impacts and/or high sound pressure level sources, such as fitness areas or mechanical rooms. Do not locate classrooms near electrical transformers, stairwells, elevator shafts, or elevator equipment rooms. Minimize contrast ratio between classroom field and projection screen. Provide 16-gauge pre-notched backing stud with flange fastened with pan head sheet metal screws at partitions with wall-mounted equipment. Provide clear "permanent" use-instructions for furniture and technology in the classroom.
OWNER-PROVIDED SUPPLIES	Multi-pack, eco-friendly non-toxic dry-erase markers and erasers; cleaner spray.

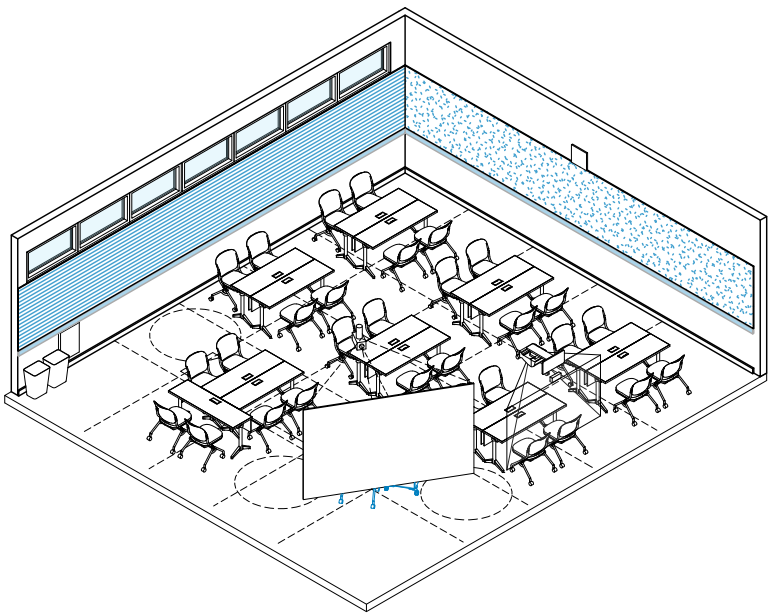
CONCEPTUAL DESIGN (GROUPWORK MODE 1)



LEGEND

- IS — INSTRUCTOR STATION
- IP — IP SPEAKER
- EB — EMERGENCY BUTTON
- WR — WALL RACEWAY (UPGRADE)
- TS — TOUCH SCREEN CONTROL @48”
- T — THERMOSTAT
- CO2 — CO2 MONITOR
- AV — WIRED AV CONNECTION OUTLET
- IC — WALL HUNG CHAIR FOR INTERPRETER
- SC — STORAGE CONSOLE
- WRITABLE SURFACES
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2’ x 2’ LIGHT FIXTURES
- EM — 2’ x 2’ EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS





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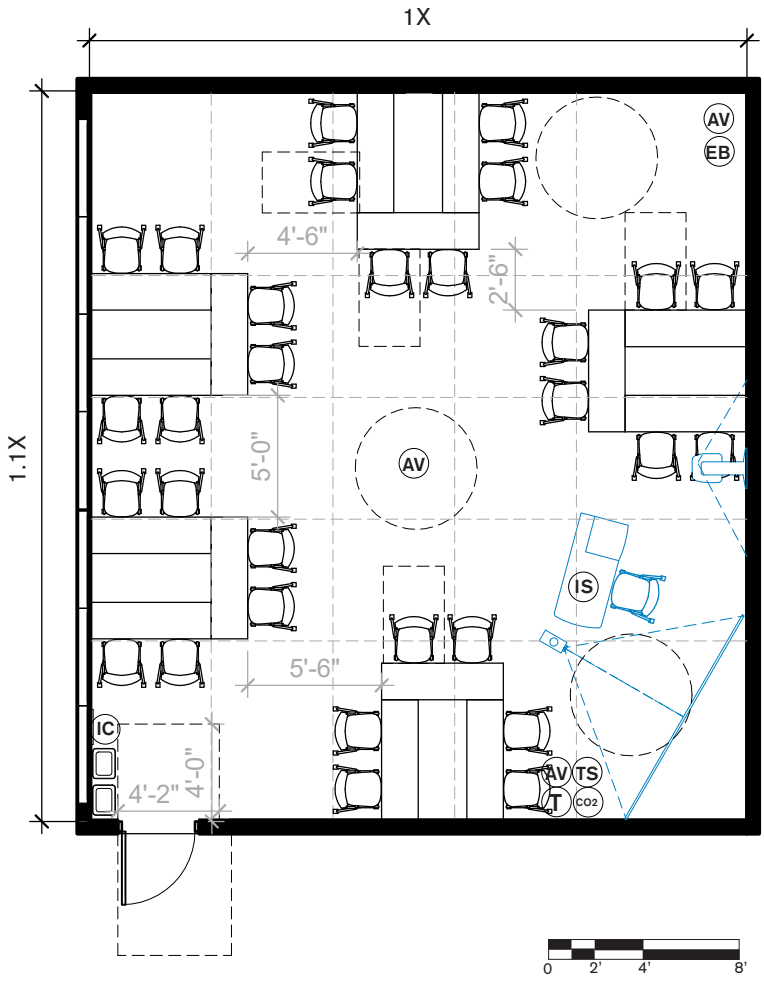
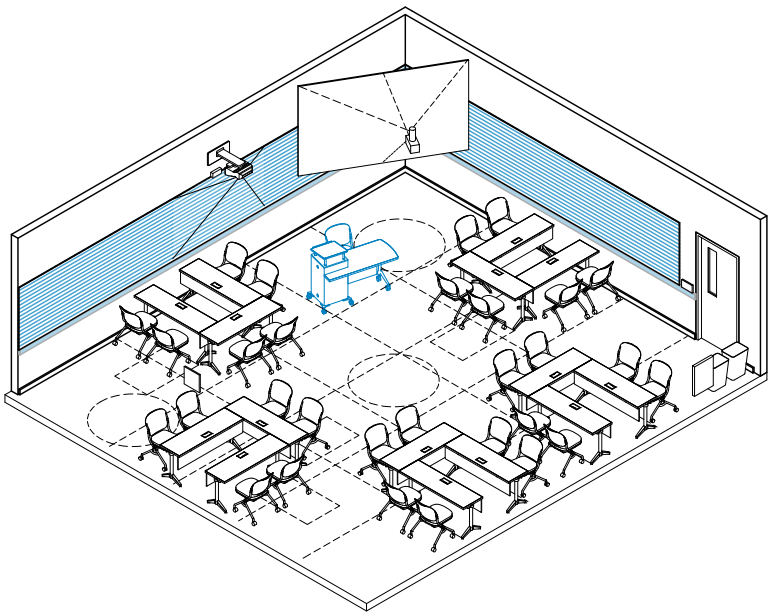
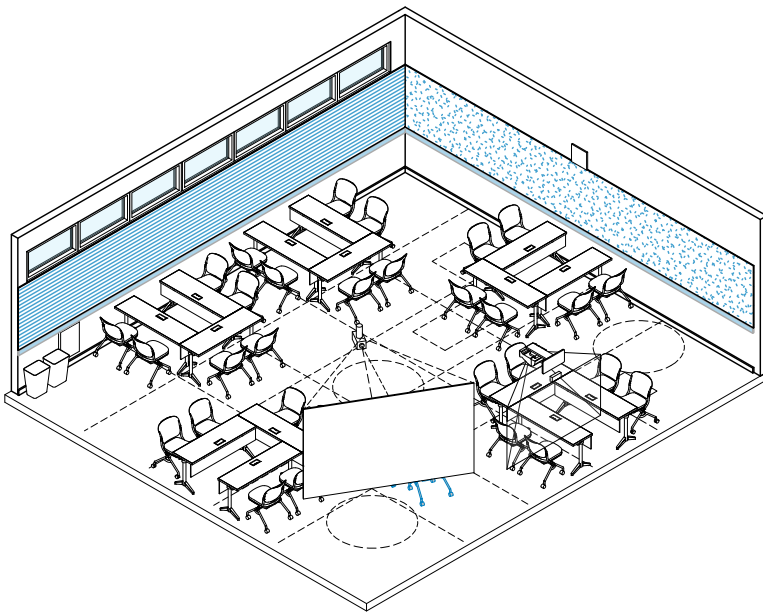
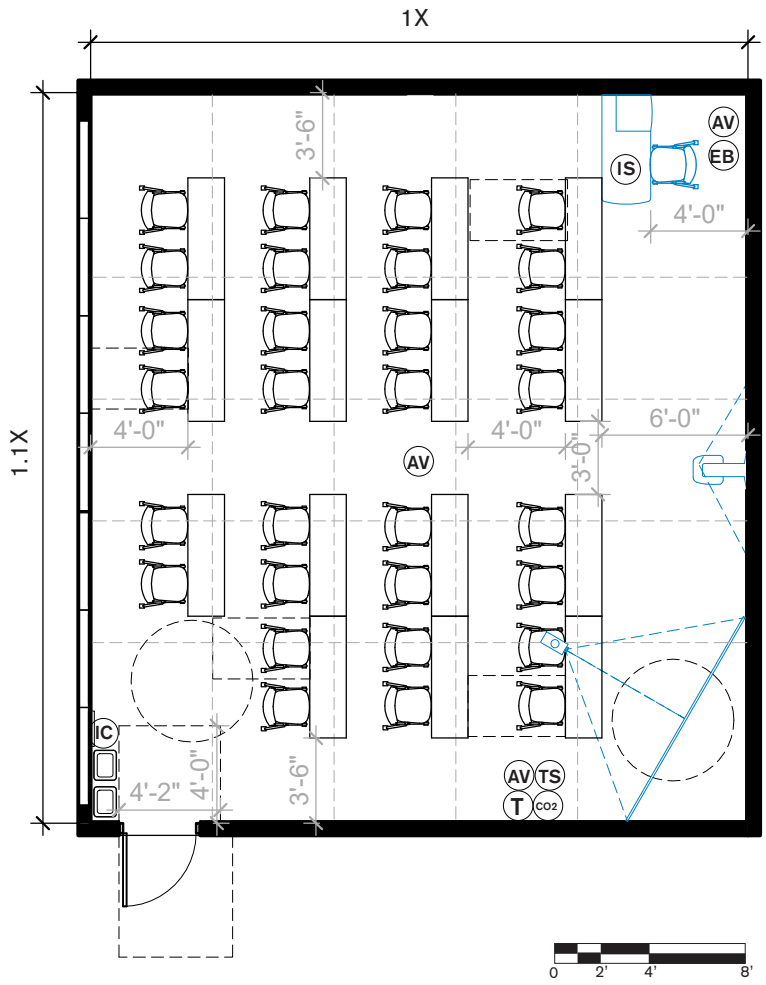




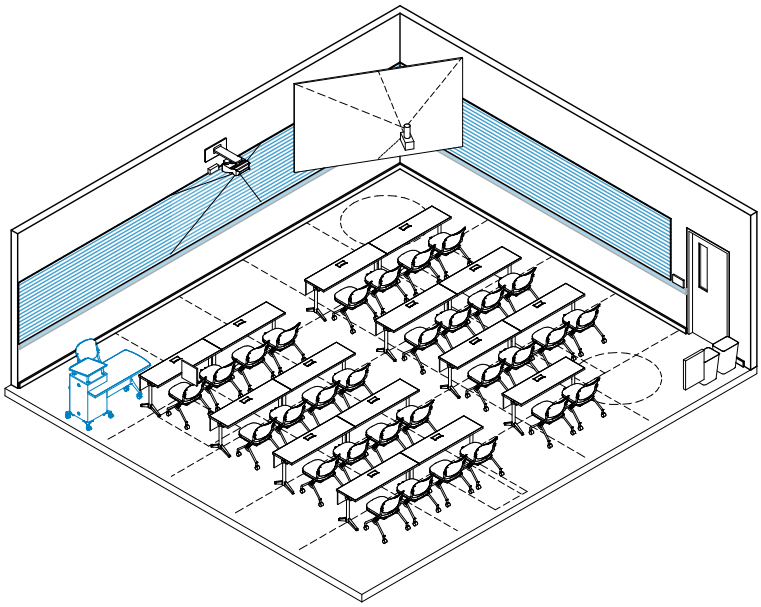


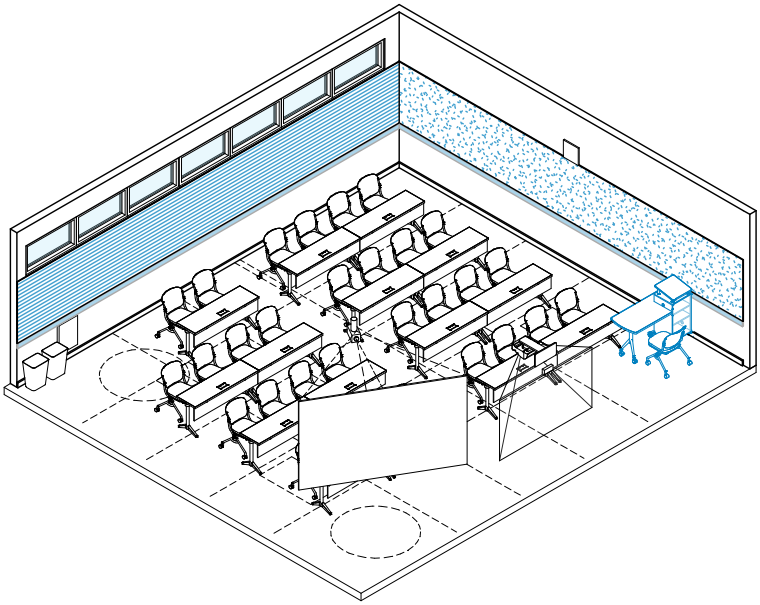
CONCEPTUAL DESIGN (LECTURE MODE)



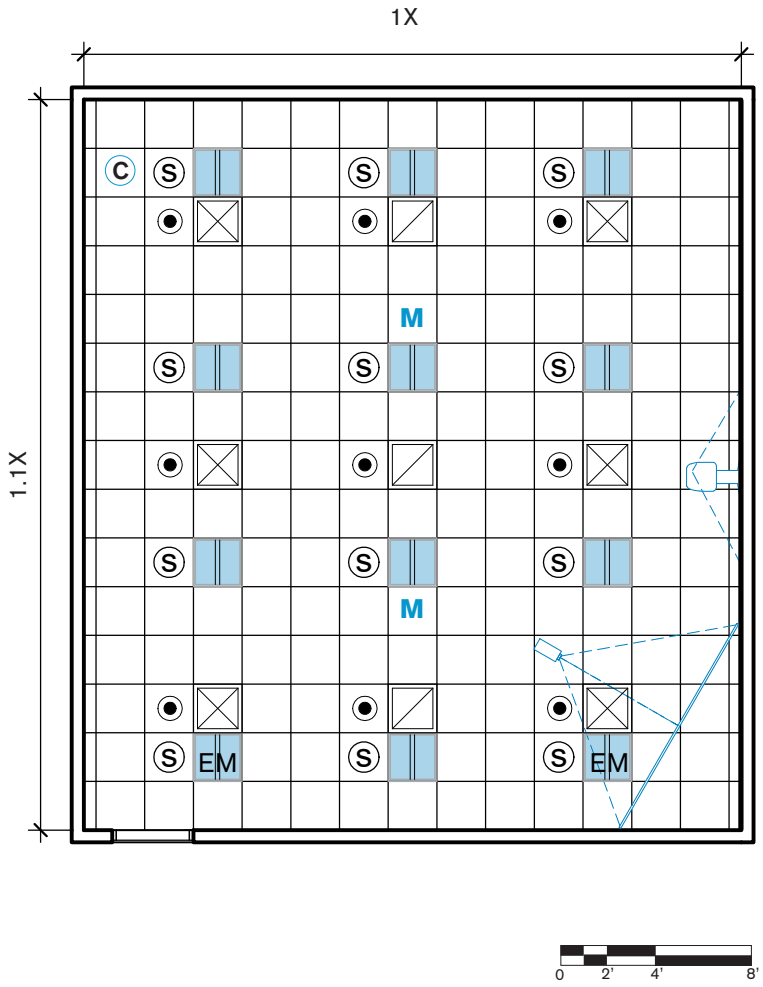
LEGEND

- IS — INSTRUCTOR STATION
- IP — IP SPEAKER
- EB — EMERGENCY BUTTON
- WR — WALL RACEWAY (UPGRADE)
- TS — TOUCH SCREEN CONTROL @48”
- T — THERMOSTAT
- CO2 — CO2 MONITOR
- AV — WIRED AV CONNECTION OUTLET
- IC — WALL HUNG CHAIR FOR INTERPRETER
- SC — STORAGE CONSOLE
- WRITABLE SURFACES
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2’ x 2’ LIGHT FIXTURES
- EM — 2’ x 2’ EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS





CONCEPTUAL DESIGN (REFLECTED CEILING PLAN)



LEGEND

- IS — INSTRUCTOR STATION
- IP — IP SPEAKER
- EB — EMERGENCY BUTTON
- WR — WALL RACEWAY (UPGRADE)
- TS — TOUCH SCREEN CONTROL @48"
- T — THERMOSTAT
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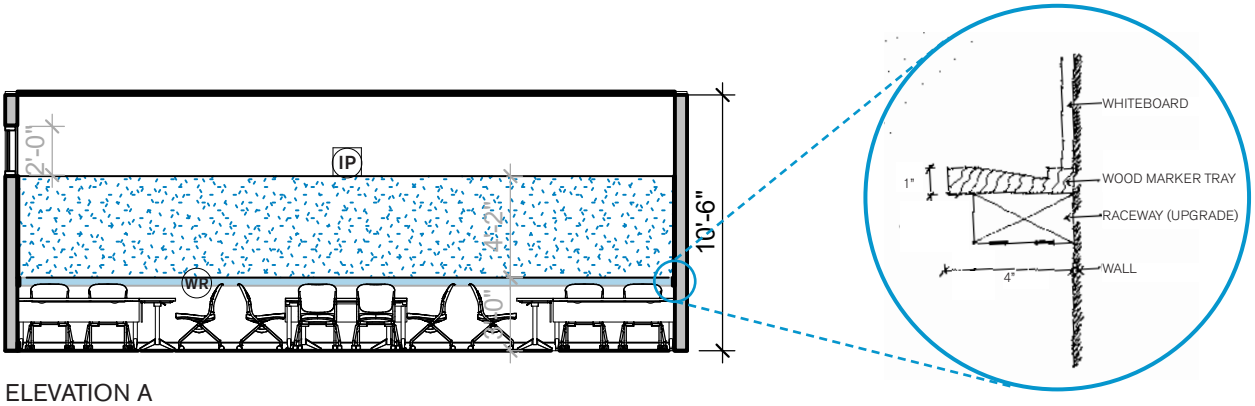
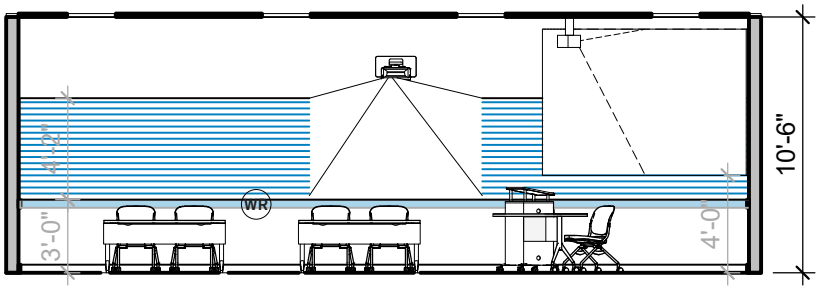
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2' x 2' LIGHT FIXTURES
- EM — 2' x 2' EMERGENCY LIGHT FIXTURES

CONCEPTUAL DESIGN (ELEVATIONS)



ELEVATION A



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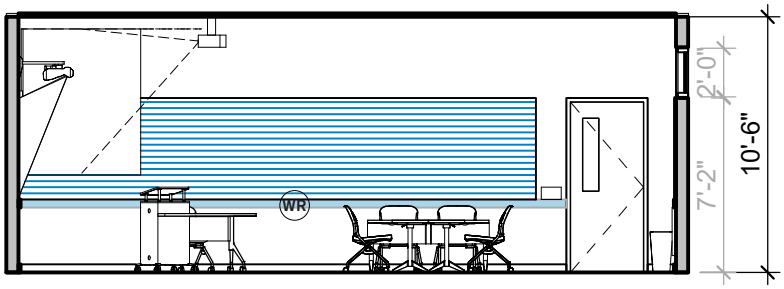

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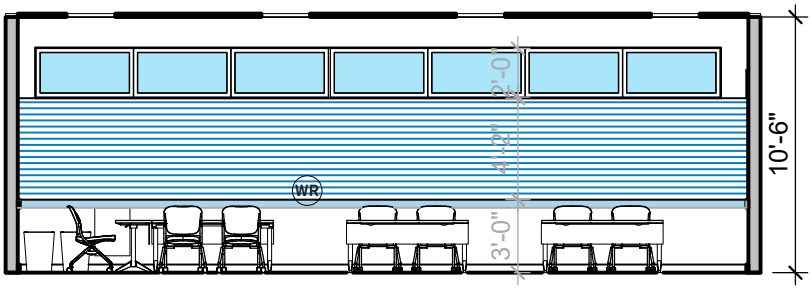

ELEVATION D

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05
MEDIUM CLASSROOMS

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Medium Classrooms at DVC are those with 45 student stations. This classroom size is used to mainly instruct Science and Social Science courses. Since learning styles are as varied as the number of student stations, the room has the capability for multiple furniture settings, all of which can be arranged with the help of students. This would require a behavioral shift at DVC where students and faculty are more engaged in their learning environment.

There is no "front" of the classroom and the space is generally omni-directional, mixed with a range of adjustable furniture options and movable group work easels, and multi-modal with respect to technology to support the 21st century classroom. The room is equipped to support a variety of activities and settings, which require a range of lighting levels, analog/ digital displays and interactive lecture display/ annotation capture capability. The use of energy efficient equipment with automated controls helps improve performance and conserve energy. Due to unknown conditions of the exterior wall/ fenestration pattern of the specific project these standards will be applied to, clerestory windows for natural daylight are proposed as a baseline in the classroom layout.

The room is also equipped with surface-mounted, floor raceways along the perimeter and the central area which terminate in access points that can be located throughout the learning space to support a variety of activities and settings. Hard-wired media access points for plugging in the instructor/ student devices are distributed at three locations (2 wall and 1 floor) in the room.

The proposed classroom inventory aims to be durable, flexible, adaptable, and playful (using the range of colors available for the various products). It consists of nesting chairs on casters and glides to enable free movement; flip-top stackable tables on casters with integrated power outlets to provide maximum flexibility within the space; multi-modal instructor station with lockable storage on casters to provide mobility and a range of teaching postures; and writeboards with seamless short throw digital projection system to integrate active teaching. Accessible furniture, similar to the rest of the classroom inventory, is integrated within the space to eliminate segregation and foster collaboration amongst students. Generous circulation space is provided within the classroom to allow for a wheelchair to freely move in the space.

Although the maximum classroom occupancy is less than 50 per the design standards, it may be calculated as over 50 per code (Refer CBC Table 1004.1.2 - Maximum floor area allowance per occupant for 'Classrooms'). Hence, two exits are provided (Refer CBC Table 1006.2.1).

CLASSROOM INVENTORY**

CHAIR (1)
Movable on 4 legs (2 casters & 2 slide)
Foldable/ Nesting
Mesh back and Fabric/ Vinyl Seat
Arm/ Armless

TABLE
Foldable/ Nesting
Movable on Lockable Casters
Integrated power outlet
ADA compliant

INSTRUCTOR STATION
Integrated workdesk/ podium with option for larger podium work area
Un-tethered/ On Casters
Integrated power outlet
Adjustable Height of desk and podium worksurface
ADA compliant

WRITEABLE SURFACE (1)
Projection & Dry-erase

***Refer to the Appendix for sample product cutsheets.*

ROOM DATA SHEET (MEDIUM CLASSROOM)

AREA	1125 ASF.
STUDENT STATIONS	45.
PLANNING PARAMETER	25 ASF/ Student. *(Some classrooms on a project by project basis will be at 27 ASF/ student to allow for additional capacity for certain programs only.)*
ROOM PROPORTION	Length : Width ~ 1.25x : 1x
MINIMUM CEILING	11'-6".
FUNCTION	Interactive Lecture / Skill Learning and Collaborative Group work/ Skill Application.

SPECIAL REQUIREMENTS

CEILINGS**	Suspended acoustical ceiling system with smooth texture, light reflective, impact/scratch resistant, 2'x2' or 2'x4', white tiles and tegular lay-in grid, minimum NRC rating of 1.0 (Optima by Armstrong or similar).
WALLS**	Full height metal framing with drywall on both sides. Insulate interior of all wall cavities with non-cellulose sound blankets. At partitions facing corridors, use staggered double studs. *(Upgrade: Full-height glass walls at corridors with translucent writeable film.)* Writeable Surface: High-performance dry-erase whiteboard on all walls as per window layout. 3'-0" minimum bottom of board with 1" x 4" wood marker tray (see sketch detail in layouts). Use high-performance dry-erase and projectable whiteboard for walls with Interactive Short Throw Display Projectors. Paint (Field): Semi-gloss interior paint, No VOC. Use accent color if desired. Base: Resilient, pre-molded corners and straight at carpet flooring.
FLOORS**	4" Raised access floor system with 2'x2' base tiles finished with 2'x2' carpet tile. (Tate ConCore Understructure/ PosiTile Carpet or similar). Carpet tile equal or greater than 10 stitches per inch, yarn weight of 20 to 30 ounces, stain/moisture/wear resistant, impervious type backing material, anti-static, UL Class A.
WINDOWS	Energy-efficient, transparent glazing to provide access to daylight and minimize heat loss or gain. Provide automated solar shading (Mechoshade or similar) to control light and glare while projection equipment is in use. Integrate controls with other AV controls. The exterior wall and fenestration pattern may vary on a project by project basis, hence, clerestory windows are shown as a base in the classroom standard layouts. The clerestory is suggested as a baseline for pricing, so that there is a budget allocation to begin with, which affords a certain allowance for glazing to be integrated. Each room will be particular with regards to existing condition, location on campus, and other considerations so the clerestory is certainly not seen as a final decision. The benefit of the clerestory is that it allows writable surfaces to be maximized.
DOORS	(2) 36" wide minimum, solid core, wood doors with narrow vertical tempered glass vision panel and hollow metal frames. No transfer grills or kick plates.
HARDWARE	Mechanical lever locks with means of interior locking (push button) for security. *(Upgrade) Electronic locks with mechanical (push button) override from the inside with capability to tie into campus-wide security system. All electronic locks to be placed on the door and not the wall.* Door hardware groups across various campuses shall be specified to provide a secured environment during a lock-down scenario, in particular by providing an interior override function

***Refer to the Appendix for example product cutsheets.*

as well as remote and local lock down. For existing general-use classrooms, replace mortise style with hotel style deadbolt locks similar to Corbin Russwin ML2013. For new construction of general-use classrooms, use Corbin Russwin CL 3351 or 3129 series. Where required, electrified locks, including those with HID card access, shall include a push button to override the card access on the exterior, similar to Sargetnt IN120 and IN220 HID, or Schlage AD-400 series. For large classrooms (over 90 students), crash bars must provide a means to override the dogged down feature and electronic lock open feature with a mechanical thumb turn device, similar to Von Duprin crash bar with 2SI feature.

HVAC

Recommended Temparature Range: Summer 74F +-2F / Winter 70F +-2F or per campus standards.
No additional humidity control may be required if RH is within acceptable condition per AHSRAE 55 thermal comfort and not required by Campus.
Low velocity air flow diffusers, especially when corner screen is provided to avoid agitating the screen. Lockable thermostat zone control.
Provide wall mounted zone temperature sensor with LCD display including room temperature, room CO2 level, temperature setpoint control, and after-hour override timer control with user adjustable duration.
Zone occupancy to be monitored by connection to the lighting occupancy sensors.
Where HVAC return paths to classrooms are not ducted, acoustical boots should be used to maintain the composite sound isolation performance of enclosing assemblies.
Ensure that mechanical systems adhere to the guidelines provided in the latest version of the Noise and Vibration Control chapter in the ASHRAE HVAC Applications Handbook.
CO2 Sensors for Demand Control Ventilation required per California Energy Code.
AV rack and laptop storage carts are located in closets outside the classroom. If they are located in the room, provide supply and return passthrough to remove additional heatload in the room.

PLUMBING

Automatic fire sprinklering system. Do not route plumbing through or near classroom areas.

LIGHTING

GENERAL REQUIREMENTS

- Target light levels, per the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13):
    - Horizontal illuminance @ desk height, 2.5' above finished floor = 500 lux (50fc) average throughout classroom to accommodate a wide range of tasks/uses (15fc for computer use, 40fc for paper tasks/reading, 50fc for art or science projects).
    - Vertical illuminance @ white board (i.e. vertical writable surfaces) = 300 lux (30fc) average.
    - Vertical illuminance @ pin-up walls (aka "tack board") = 150 lux (15fc) average.
    - Vertical illuminance @ background walls (not writable surfaces) = 150 lux (15fc) average.
    - In many situations the classroom/task light levels may be lower (such as A/V presentations or computer use), but the lighting system must be able to achieve average light levels noted above upon demand.
- Emergency egress lighting shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured at floor level throughout the room (since path of egress varies for different room layouts).
- Light fixtures and controls shall provide simple and affordable solution for classroom lighting.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Daylight photosensors and occupancy/vacancy sensors may be provided by 3rd party manufacturer, but shall be fully compatible with classroom light fixtures and warrantied by the installing electrical contractor.
- All LEDs used in the LED light fixture shall be of proven quality from established and reputable LED diode manufacturers with minimum 5 years experience in the manufacture of LED diodes. LED light fixture supplier shall have minimum 5 years experience designing, selling and supporting installations of LED systems.
- All light fixtures and control gear shall be UL-listed (or equivalent by ETL / CSA) for indoor locations.
- Manufacturer of LED systems shall utilize an advanced production LED binning process to maintain

***Refer to the Appendix for example product cutsheets.*

color consistency within a 4-step MacAdam ellipse per ANSI Standard C78.377 within all luminaires unless otherwise specified.

- Manufacturer shall provide photometric data for all light fixtures based on test results from an independent testing lab including candlepower distribution data in polar graph form, total lumen output per light fixture, and total wattage per light fixture.
- Contractor to consult with the owner and provide if required, back-stock of all led power supplies/ drivers in a quantity to the owners' preference.
- All lighting equipment (including but not limited to light fixtures, LED drivers/power supplies, control interfaces, user interfaces, daylight photosensors, occupancy/vacancy sensors) shall be furnished with 5-year warranty for full replacement (materials and labor) effective from the date of substantial construction completion.
- All electrical lighting shall follow the latest applicable codes and standards (see Appendix for lighting code summary):
    - 2016 California Building Standards Code ("Title 24")
        Part 3 Electrical Code – Installation requirements and egress lighting levels.
        Part 6 Energy Code, Subchapter 4 – Lighting control and dimming requirements.
        Part 6 Energy Code, Subchapter 5 – Energy use (Lighting Power Density)
        Part 9 California Fire Code, Section 1008 Means of Egress Illumination
    - CalGreen Building Standards Code (Part 11 of Title 24)

LIGHTING FIXTURES**

2' x 2' General Light Fixture

- Shall be 2' x 2' square and work within a standard 2' x 2' suspended ceiling grid system. Acuity 2BLT2-40L-ADP-120-EZ1-LP935-N100-LATC or similar for fixed 3500K color temperature. *(Upgrade) Acuity 2BLT2-TUWH-PROR-40L-ADP-120-NLT-LATC or similar for tunable white option.*
- Emergency Lighting fixture shall be same Acuity 2BLT2-40L fixture as others in classroom, but shall incorporate EL14L (1400 lumen) battery pack.
- Light fixture appearance shall have design-neutral aesthetics with clean, refined details to blend into the ceiling. Expressive design statements are discouraged from the general lighting fixtures.
- Powder coat, white finish.
- Minimum rated life of 60,000 hours per IESNA TM-21 criteria @ L70. LED fixture manufacturer shall power the LED diodes at a drive current recommended by LED diode manufacturer to reach minimum 60,000 hour rated life @ L70. LED diodes shall not be "overdriven" at a higher drive current to increase light output to detriment of rated lamp life.
- Field-replaceable LED engines and drivers/power supplies, with access to LED engines and drivers from below the fixture or within the plenum (without the need to demount the fixture from the ceiling grid).
- Sealed light diffusers and optical compartments that restrict ability for dust and bugs to settle within the fixture.
- Fixture provided with a range of fixed lumen outputs ranging from 3000 – 5000 lumens per fixture (@ 3500K) to accommodate classroom ceiling heights ranging from 9'-0" to 12-6". Upon implementation, project design team is responsible for specifying the fixture's lumen output to achieve the required light levels as noted within the Design Standards document.
- For tunable white option, fixture shall provide consistent lumen when varying the color temperature (i.e. constant lumen curve).
- Nominal 4,000 delivered lumens @ delivered lumens per watt (LPW) > 100 LPW.
- CRI = 80+ (basic version) or 90+ (enhanced version) for light fixtures
- Color temperature = 3500K (basic version) or Tunable White with range from 3000K – 5000K (enhanced version).
- Spacing to mounting height ratio (S / MH) > 1.18 in any direction. Typical on-center spacing of 2x2 light fixtures is 8', though 10' spacing is permissible for ceiling heights 10'-6" or taller.
- To control glare to occupants, 2' x 2' light fixtures shall have the following performance requirements:
    Luminance < 4500 cd/m2 @ 45° above Nadir, <4000 cd/m2 @ 55°, < 3500 cd/m2 @ 65°, < 3000 cd/m2 @ 75°, 2500 cd/m2 @ 85°.
    Intensity < 1000cd at angles 50° or higher above Nadir.

***Refer to the Appendix for example product cutsheets.*

- Dimmable to 5% light output without flicker or jumps in light output.

Linear Wallwash / Accent Fixture (Upgrade)

- *Wallwash fixture shall be nominal 4" or 6" wide and available in 2' and 4' lengths.*
- *Accent fixtures shall be nominal 4" or 6" square shape and provide lockable vertical tilt and horizontal rotation to orient the light output towards the target wall surface.*
- *Fixture shall be capable of end-to-end through wire connection for continuous runs (interrupted by ceiling grid where needed).*
- *Color temp matching the 2' x 2' general lighting fixture. If 2' x 2' fixture uses tunable white light engine, standardize the linear wallwasher @ 3500K color temperature (tunable white not needed for the wall washers).*
- *Powder coat, white finish to match the 2' x 2' general lighting fixture.*
- *Max intensity (i.e. CBCP) of wallwash fixture or accent fixture shall exit the fixture at an angle to hit the target vertical wall surface @ 5'-0" AFF given a classroom's ceiling height and light fixture setback distance. Upon implementation, project design team is responsible for specifying the fixture's setback distance to target 5' AFF on the vertical wall surface with the fixture's CBCP.*
- *Accent light fixture shall be aimed at nominal 30° angle from Nadir to the 5' AFF target on the wall/whiteboard surface. Accent fixture shall have CBCP (specified by project design team to match project ceiling height) to achieve the required light levels on the wall/whiteboard surface as noted within the Design Standards document.*
- *Wallwash lens / fixture aperture shall be shielded or angled away from student line of sight (i.e. angled towards the vertical wall surface) to mitigate glare to occupants. Flush lens (to the ceiling plane) is NOT acceptable for the wallwash fixture.*
- *Wallwash fixture provided with a range of fixed lumen outputs ranging from 350 – 675 lumens per foot (@ 3500K) to accommodate variety of layouts (single fixture, dashed line, continuous row). Upon implementation, project design team is responsible for specifying the fixture's lumen output to achieve the required light levels and uniformity on the wall/whiteboard surface as noted within the Design Standards document.*
- *CRI = 80+ (basic version) or 90+ (enhanced version).*
- *Dimmable to 5% light output without flicker or jumps in light output.*
- *Fully compatible with the specified control system, including digital addressing of wallwash / accent fixtures.*

LIGHTING CONTROLS

General Description

- Acuity nLight system or similar for fixed 3500K color temperature. *(Upgrade) Acuity nTune system or similar for tunable white option.*
- Occupancy/ Vacancy sensor, required per Title24 building code, shall automatically turn off classroom lighting when room is unoccupied.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Light fixtures work together as a single network (within one classroom only) and does not require a centralized (whole-building) control system.
- The system is scalable to multiple classrooms by simply repeating the single-network model.
- Control system shall be easy to install, commission, and maintain. Fixtures and controls work together as a system with "out of the box / plug and play" connectivity.
- Digital addressing of fixtures (explained above) allows for easy reconfiguration / revision of control zones without need for rewiring.
- Classroom lighting control system shall be linkable with campus Building Management System (BMS).
- Classroom lighting control system shall be compatible with California's Title24 Demand Response requirements.
- *(Upgrade) Allows for individual fixture calibration for lumen output or color temperature (if tunable white) should a light engine require replacement or color shift (if tunable white) is observed over time.*
- Allows for integration of 3rd party light fixtures into the classroom lighting control system using

***Refer to the Appendix for example product cutsheets.*

industry-standard control protocols.

Emergency Lighting

- Designated 2' x 2' classroom emergency light fixtures (EM fixtures) shall be of same family, type, appearance, digital addressing capability, and lumen output under normal power operation as adjacent 2' x 2' classroom fixtures.
- EM fixtures shall be UL924 listed for emergency operation.
- EM fixtures shall operate as normal light fixtures when normal power is available (i.e. they can dim or turn off according to preset scenes or user override). The EM fixtures shall automatically override to emergency-mode light output (1400lm) upon loss of normal power via automatic transfer to the specified battery backup power source.
- Upon loss of normal power, EM fixtures shall operate with 1400 delivered lumens for a period not less than 90 minutes.

User Controls

- All user controls shall be mounted within the acceptable range for ADA compliance, namely 36" on center, above finished floor.
- Instructor access to lighting controls via localized keypad mounted at instructor station and/or classroom wall.
- *(Upgrade) For tunable white feature, provide side-by-side (double gang) keypad with one keypad hosting preset scenes, and second keypad hosting independent control of color temperature and light level/intensity/dimming for the selected scene.* See "Sample Product Cutsheets (Lighting), Tunable White" in the appendix.
- Preset scenes are customizable by school administration.
- Lighting controls shall permit additional interface/coordination with the classroom A/V control system to automatically control lighting in connection with A/V actions (such as turning on projectors, projection screen and window shade deployment, etc.)

Digital Addressing

- All classroom light fixtures shall allow for individual fixture addressing (aka digital addressing) that is independent of power/control wire configuration.
- Digital addressing features shall allow for individual fixture control of intensity and *(upgrade) color temperature (if tunable white)*, as well as grouping of light fixtures (via software) into control zones that are independent of power/control wire configuration.
    - This feature shall permit individual fixtures to be within MULTIPLE control zones, and such control zone grouping to CHANGE depending on the selected lighting scene.
    - This feature shall permit onsite calibration of individual fixture's lumen output (via software) to balance uniformity of light levels throughout a classroom.

Lighting Control Sensors

- (1x) Acuity daylight photosensor or similar and (1x) Acuity dual technology (PIR and Ultrasonic) occupancy/vacancy sensor or similar. Each single sensor can control multiple fixtures in the classroom.
- Specified light fixture shall offer (as an option) a daylight photosensor as well as an occupancy/vacancy sensor integral to the light fixture. Each integral sensor can control multiple fixtures in the classroom.
- Compatibility with 3rd party sensors if needed (such as daylight photosensors or vacancy sensors) via hard-wired OR wireless communication.
- Occupancy/ Vacancy sensors for light fixtures shall also trigger HVAC operation (or vice-versa)

ACOUSTICS

SOUND ISOLATION

General Description

- The noise generation potential at all classroom adjacencies should be carefully evaluated when determining the acoustical requirements of both vertical and horizontal classroom partitions. For classrooms that must be located adjacent to spaces expected to generate high sound levels such as music practice/performance rooms, stairwells, elevators, mechanical equipment rooms, active

***Refer to the Appendix for example product cutsheets.*

corridors and nearby lobbies, additional acoustical consideration should be paid the STC rating of the partitions, windows and any communicating doors.

Walls

- In general, the sound isolation across the partition will depend on several factors. The primary factor will be the STC performance of the partition assembly itself. Other factors include whether there are doors or windows between the rooms and penetrations such as ductwork and piping. Consideration of these various factors as well as choice of construction systems and methods and cost will ultimately dictate the recommended wall assemblies, type of door gasketing, glazing size and selections, and ceiling systems.
- For the base condition, the walls surrounding the classrooms should be full-height (i.e. slab-to-slab) and achieve a minimum acoustical performance rating of Sound Transmission Class (STC) 50 or Noise Isolation Class (NIC) 45.
- For classrooms adjacent to loud spaces such as lobbies, band rooms and mechanical rooms, a special assessment should be performed to determine the required minimum STC rating of the partition. Depending upon the specific adjacency, the expected range of performance is STC 55 to 60.

Doors

- For the base condition, all classroom entry doors should be fully acoustically gasketed at the jambs and at the bottom. Typical adjacencies such as to a private office or a vestibule, should also include a fully acoustically gasketed door.
- For classrooms that open onto a primary circulation corridor or lobby, the doors should have a minimum acoustic rating of STC 35. For communicating doors between classrooms, specify STC 45 to 50 or greater depending upon the specific adjacency.

Floor/Ceiling Assemblies

- Where classrooms are located below active and potentially noisy spaces, the floor/ceiling assembly should be designed to achieve minimum:
    - Air-borne Sound: STC 50
    - Impact Noise: IIC 45
- For air-borne sound attenuation, an 8" minimum thickness concrete slab with suspended lay-in ceiling will achieve a minimum STC of 50. For wood framed construction, use of light-weight concrete and resilient isolation clips such as resilient channel at the ceiling gypsum board will likely be necessary.
- For impact noise attenuation, carpet without any additional acoustical treatment is conditionally acceptable. Areas with significant amount hard finish will require an additional sound-attenuation underlayment such as rubber or cork.

Exterior Façade/Windows

- Classrooms potentially exposed to excessive outdoor noise sources such as roadway traffic and air-craft flyovers will require an environmental noise survey in order to determine the minimum STC performance requirements of the windows and wall.
- The standard noise level criteria for all classroom due to exterior/outdoor noise sources should be a 15-minute average noise level of 35 dBA (Leq) or less and a maximum noise level of 50 dBA (Lmax-Slow).
- Where the outdoor noise level is found to be 60 dBA or greater, the mechanical air-ventilation system in the classroom must be designed so that the fresh-air requirement can be achieve with operable windows in the closed position.

ROOM ACOUSTICS

The overall acoustical finish scheme in the classrooms should control excessive sound reverberation and support excellent speech-intelligibility.

Base Classroom Design

- Reverberation Time (RT60 at 500 Hz): less than 0.8 sec

***Refer to the Appendix for example product cutsheets.*

- The ceiling is the most cost-effective surface to consider for locating the primary acoustical finish. Typically, a lay-in tile ceiling having a minimum NRC 1.0 such as Optima by Armstrong or similar should be considered.
- Sound absorbing wall panels should be considered as follows:
    1. Wall panels should have a minimum acoustic performance of NRC 0.75 and be at least 2" thick.
    2. Where possible, apply acoustical wall panels on at least one surface of each pair of parallel walls and in the wall area between seated and standing ear height. See layouts for recommended locations of wall panels.

Upgrade or Non-Standard Classroom Considerations

- *In the case where upgraded sound-isolation might require a "hard-lid" ceiling and where a dropped lay-in tile ceiling cannot be installed, then the exposed hard-lid ceiling should be treated with minimum NRC 0.80 and 2" thick acoustic panels.*
- *Sound absorbing wall panels should be considered as follows:*
    1. *When less than 100% of the ceiling area is not acoustically treated, then a remaining equivalent area of acoustical panels having should be applied to the walls.*
    2. *If "front-firing" loudspeakers are being considered, the wall opposite the loudspeakers should be fully covered with acoustical wall panels as feasible.*
    3. *If wood finishes are desired, consider perforated or kerfed acoustic panels having minimum NRC 0.80 such as by RGP Corporation, or slats or grills such as 9Wood Company.*
- *Acoustic treatments may also be required to minimize flutter echoes and control extraneous echoes.*

MECHANICAL NOISE/ VIBRATION CONTROL

- The noise level in the classrooms as generated by mechanical equipment (HVAC, Electrical, Plumbing, Elevator Equipment and AV equipment) should be limited to a maximum noise level of Noise Criteria (NC) 30 in the classrooms.
- All potentially noisy MEP and Elevator equipment located adjacent to, above or below the classroom, including fans, pumps and electrical transformers should be carefully evaluated for both air-borne and structure-borne noise and as required, acoustically treated and/or the intervening partition or floor/ceiling be acoustically upgraded.
- The air-velocity in ductwork located within the classroom should not exceed 800 fpm. The air velocity in the final branch-duct should not exceed the diffuser neck velocity by more than 150 fpm, unless otherwise noted. The air-velocity at the neck of each supply and return diffuser should not exceed 400 fpm.
- VAV boxes should be sized to limit the total pressure drop to 0.5-inches TSP or less and have both a radiated and discharge sound level of less than NC 30.
- FCU and VAV boxes with radiated noise levels greater than NC 30 must not be located in the ceiling over the classrooms.
- Flexible ductwork shall not be used on medium pressure duct systems upstream of VAV box connections.
- Sheet metal ductwork should be internally lined with 1-inch minimum thickness of acoustical duct-liner.
- Air-transfer boots should be constructed completely of acoustically lined sheet metal, include at least one 90-degree elbow and sized depending upon the degree of sound-isolation required and for maximum 500 fpm.
- Supply and return diffusers should be selected to perform no greater than NC 25.
- Ducts, pipes and conduit attached to vibration isolated equipment should include flexible or resilient type connections and may be required to be vibration isolated from the building depending upon proximity of the duct or pipe to acoustically sensitive spaces and the power of the attached equipment.
- The noise emission from AV Equipment should also be considered. Where noisy AV equipment is unavoidable and is needed to be located in the classroom, then sound-rated ventilated equipment racks should be considered.

***Refer to the Appendix for example product cutsheets.*

AUDIO/VISUAL EQUIPMENT**

AUDIO SYSTEM

Audio DSP (Digital Signal Processor): QSC Core 110f or equal
Loudspeakers: QSC AC-C6T or equal
Amplifier: QSC CMX300Va or equal

(Upgrade) Wireless Microphone *(Only required for capture/ conferencing): Shure QLXD24/ SM58 handheld transmitter and receiver, Shure QLXD14 bodypack transmitter and receiver and (2x) countryman B-3 bodypack microphones or equal.* Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.

Voice Lift: N/A

Assistive Listening: Listen Technologies LT-800-072 transmitter and LR-4200-072 receivers (provide 4% of seating capacity) or equal.

VIDEO SYSTEM

Minimum viewer distance to digital display (especially in lecture mode) should be equal to the width of the display screen/ projected image.

Projection:
Standard Projection: (2x) Panasonic PT-RZ770 or equal – 7000 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 1-chip DLP, Laser Source

Interactive-Short Throw: (2x) Epson Brightlink Pro 1460Ui or equal – 4400 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 3 LCD, with output capabilities for mirroring annotation and content onto a larger projection screen. Provide equivalent laser source model if available.

Projection Surface:
Motorized Screen: (2x) Draper Access V ceiling-recessed, tab-tensioned, motorized screen or similar for video projection sized 87.5"x140" for viewing from the back of the classroom in all directions. The bottom of the viewable image shall be at 4'-0"AFF. Screen material shall be Matte white or equal. *(Upgrade): Screen material shall be TecVision XH900X ALR (ambient light rejecting) or equal for use in moderate to higher ambient light and wider viewing angles.*

Markerboard: Low gloss or matte surface white-dry erase board for interactive short-throw projection. PolyVision projection surface or equal.

Transport and Switching:
Video Matrix Switcher (location: main equipment rack):
Crestron DM-MD8X8 Digital Media Switcher
-Input Cards: (3) DMC-4K-HDCP2, (2) DMC-DVI, (1) DMC-4K-C-DSP-HDCP2
-Output Cards: (2) DMC-4K-HDO

Instructor Station:
Instructor Station Video Switcher: Crestron DM-MD8X1-4K-C with DM output for instructor station
Instructor Station Cable Cubby: Extron Cable Cubby 500
DVD Player: Denon DN-500 or equal at instructor station
Document Camera: Elmo P10HD or equal at instructor station
Wireless Presentation: Mersive Solstice or equal at main equipment rack

Capture/Conferencing (upgrade): Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.
PTZ Camera: Panasonic AW-HE40SWPJ with HDMI output (or equal) located on the back wall of the room.
Capture/Stream Unit: Extron SMP351 or equal (location: main equipment rack)
Conferencing Unit: Extron MediaPort 200 or equal (location: main equipment rack)

***Refer to the Appendix for example product cutsheets.*

In-Room Computer: Dell or equal (location: main equipment rack)
Triple Element Ceiling Microphone: (2x) Audix M3 or equal
(Upgrade) Ceiling Array Microphone: (2x) Shure MXA910 or equal

CONTROL SYSTEM

Control Processor: Crestron CP3N control processor or equal. The AV system shall be able to send preset recall signals to the master control units for window shades and lighting so these components can be controlled via one cohesive system (location: main equipment rack).

Touch Screen: Crestron TSW-760 7" Touch Screen on the wall and *placed at instructor's station (upgrade)*. Wireless control shall be configured for controlling the room via an app or laptop. Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.

UTILITY / OTHER

See layouts for recommended locations of data/power and hardwired AV connections.

A campus-standard instructor's station shall be provided. The instructor's station would include the DVD player, document camera, laptop connections, USB thumb drive connections for lecture capture, and other items as needed.

AV equipment shall be installed into a Middle Atlantic MRK-AXS or equal pull-out equipment rack stored in an AV closet located outside the room.

VOICE/DATA**

Six dual ports at wired AV station unless noted otherwise. Wireless internet access required throughout. (1) Wi-Fi Acces Ports: Aruba 220 series Acess Points or per current campus standards.

Provide CAT 6 or better connection for the wall mounted IP speaker/clock/ microphone as per campus/ district standard. No separate power conenction required for this product. System to tie into the Building Alarm System. Installation height 8'-0" AFF or as required by manufacturer's manual. Emergency call button (linked to the IP speaker alarm panel) at accessible height of 48" AFF located away from the exit door. See layouts for locations.

POWER

Provide wall power/data fourplex receptacles at +18" AFF, spaced 5'-0" on center. *(Upgrade) Provide continuous, perimeter wall mounted raceway for power/ data/ AV (below the marker tray at +35" AFF), cover color to match wall color. Receptacles in raceway to be duplex, 5'-0" on center.* See layouts for conceptual detail sketch at raceway & writeable surface junction.

Provide pop-up, flush-mounted, fourplex floor boxes at 5'-0" on center within the 4" high, raised floor system. Floor boxes fed either down the walls from above ceiling in existing classrooms or from below grade in new construction.

Provide adequate power for video projector and other AV equipment. Provide additional outlets at Instructor's station for multiple devices.

Provide a provisional recessed receptacle for a wall clock at 8'-0" AFF on one wall in the room, ideally the wall with the short-throw displays.

Power for egress lighting will be provided by batteries integral to the fixtures as required to give the egress lighting levels stated. An option would be to provide power from a central battery/ inverter system. Using that option would depend on the building and/or classroom or assembly space type.

SECURITY**

Provide IP speaker with integrated wall clock for campus-wide emergency/ alerts per campus/ district standards. Provide adequate signage for safety instructions.

FURNITURE**

Provide products with active and flexible comfort capabilities while addressing concerns of Universal Design and minimum warranty requirements per campus/ district furniture performance standards.

OTHER CONSIDERATIONS	Do not locate classrooms near or below spaces with loud activities, high impacts and/or high sound pressure level sources, such as fitness areas or mechanical rooms. Do not locate classrooms near electrical transformers, stairwells, elevator shafts, or elevator equipment rooms. Minimize contrast ratio between classroom field and projection screen. Provide 16-gauge pre-notched backing stud with flange fastened with pan head sheet metal screws at partitions with wall-mounted equipment. Provide clear “permanent” use-instructions for furniture and technology in the classroom.
OWNER-PROVIDED SUPPLIES**	Multi-pack, eco-friendly non-toxic dry-erase markers and erasers; cleaner spray.

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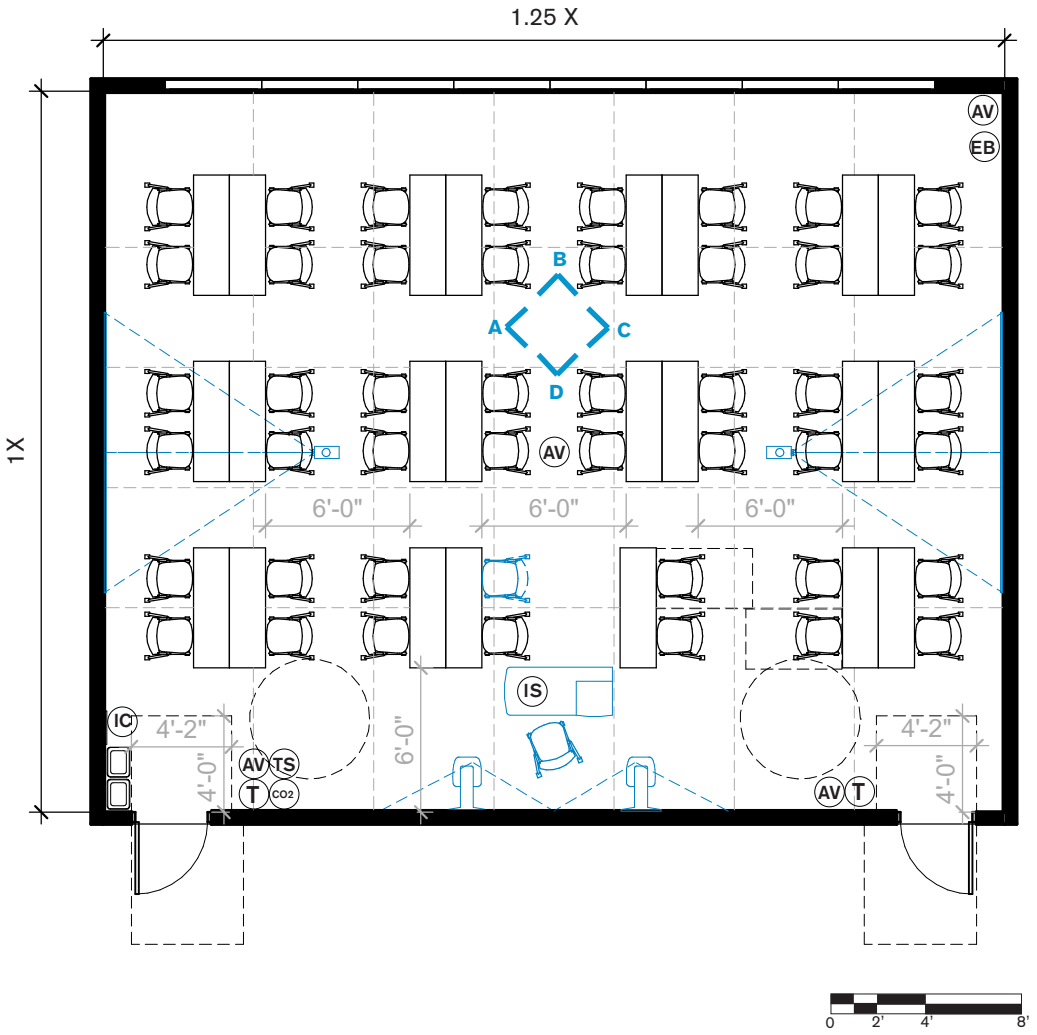
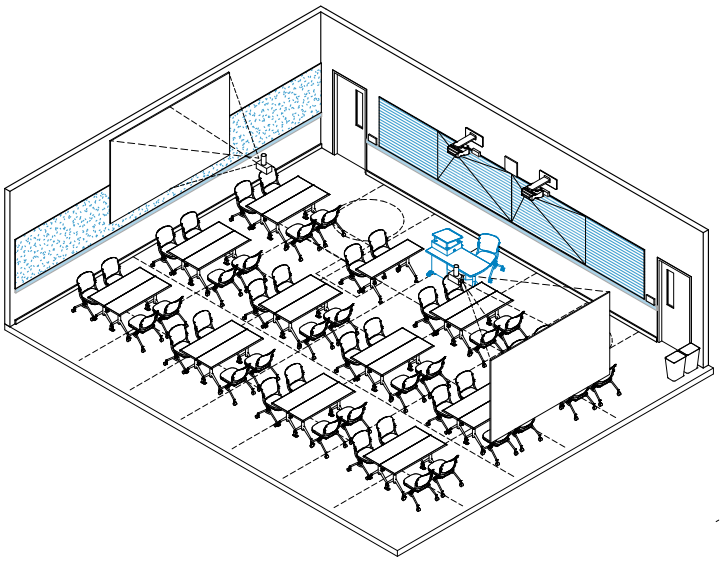
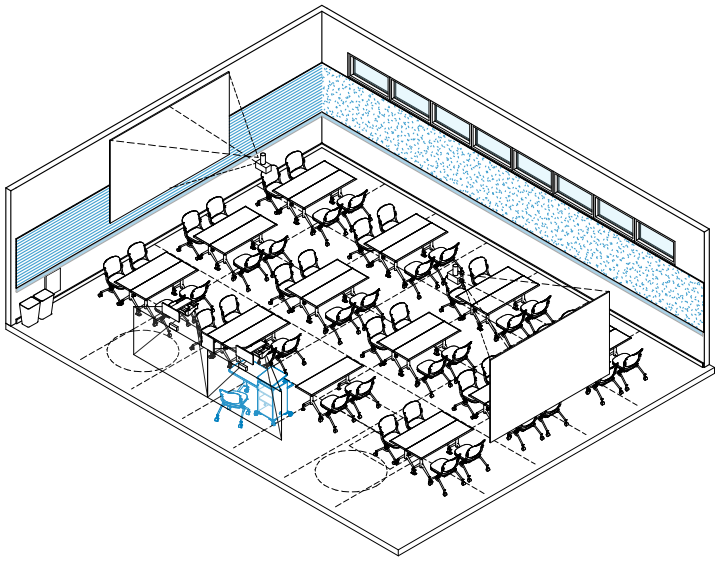
CONCEPTUAL DESIGN (GROUPWORK MODE 1)



LEGEND

- IS — INSTRUCTOR STATION
- IP — IP SPEAKER
- EB — EMERGENCY BUTTON
- WR — WALL RACEWAY (UPGRADE)
- TS — TOUCH SCREEN CONTROL @48"
- T — THERMOSTAT
- CO2 — CO2 MONITOR
- AV — WIRED AV CONNECTION OUTLET
- IC — WALL HUNG CHAIR FOR INTERPRETER
- SC — STORAGE CONSOLE
- WRITABLE SURFACES
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2' x 2' LIGHT FIXTURES
- EM — 2' x 2' EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS





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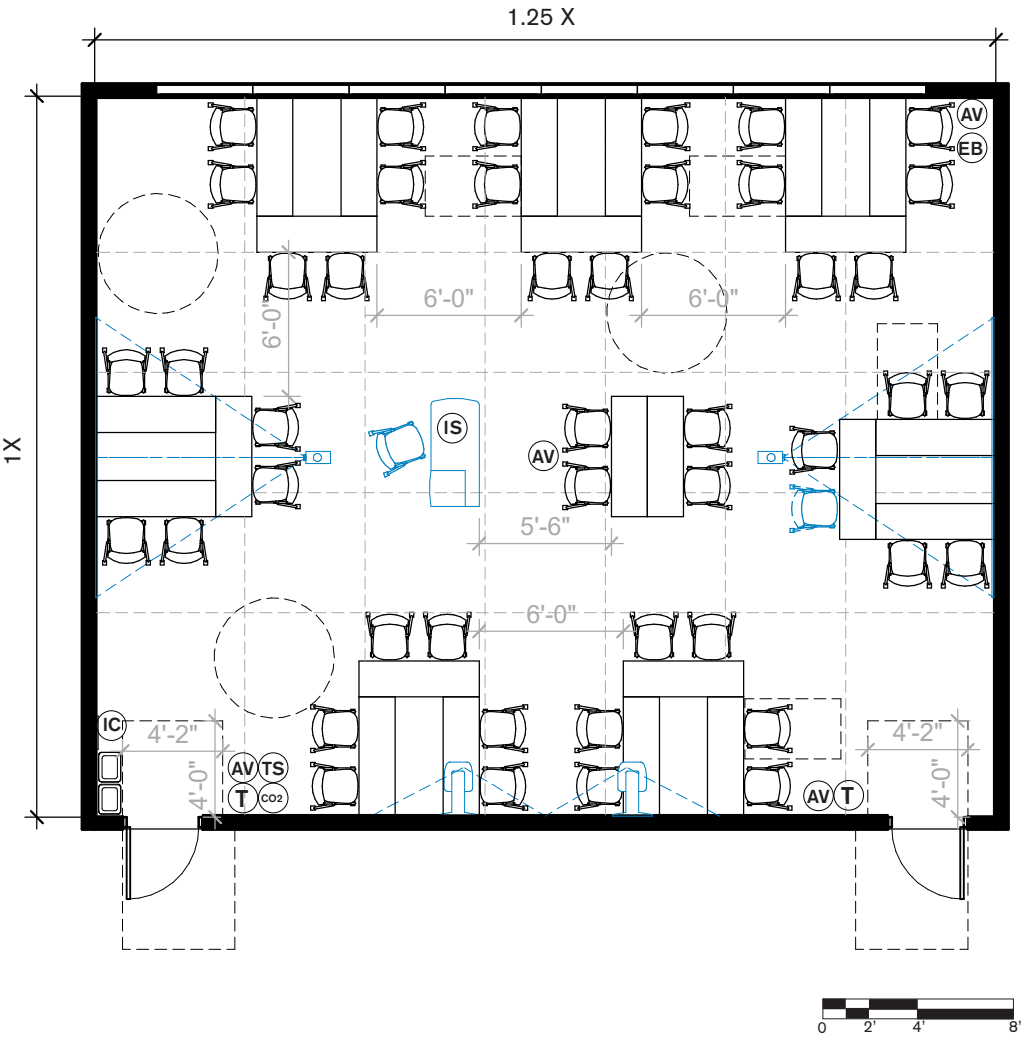
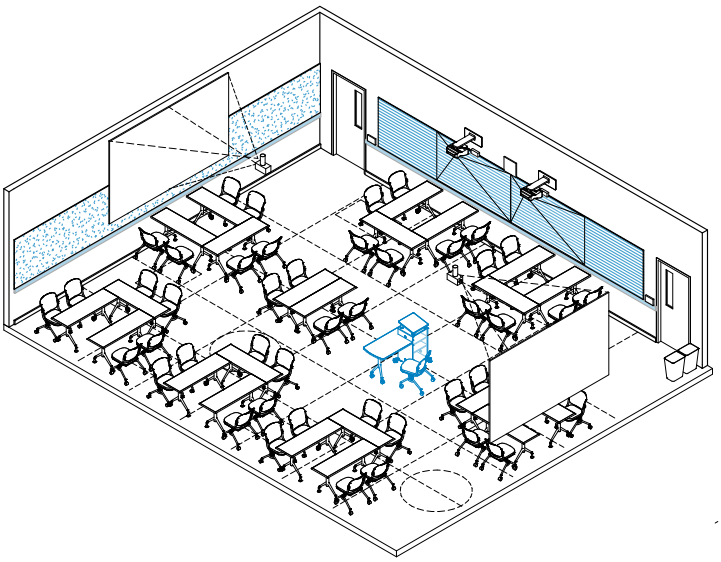
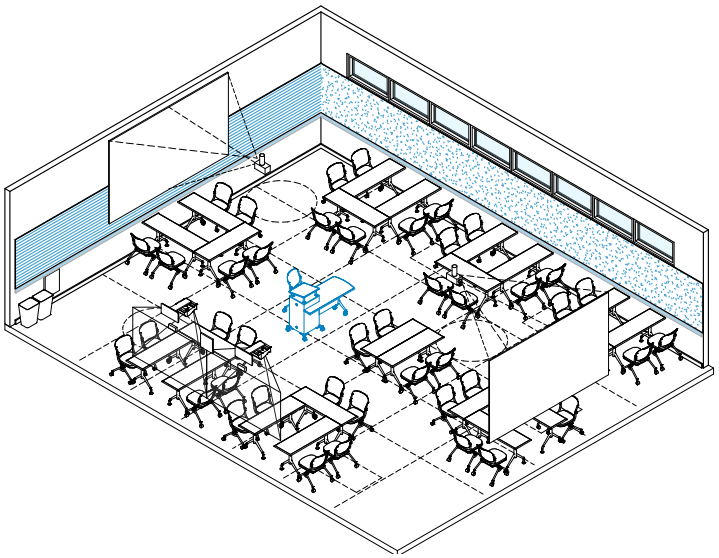
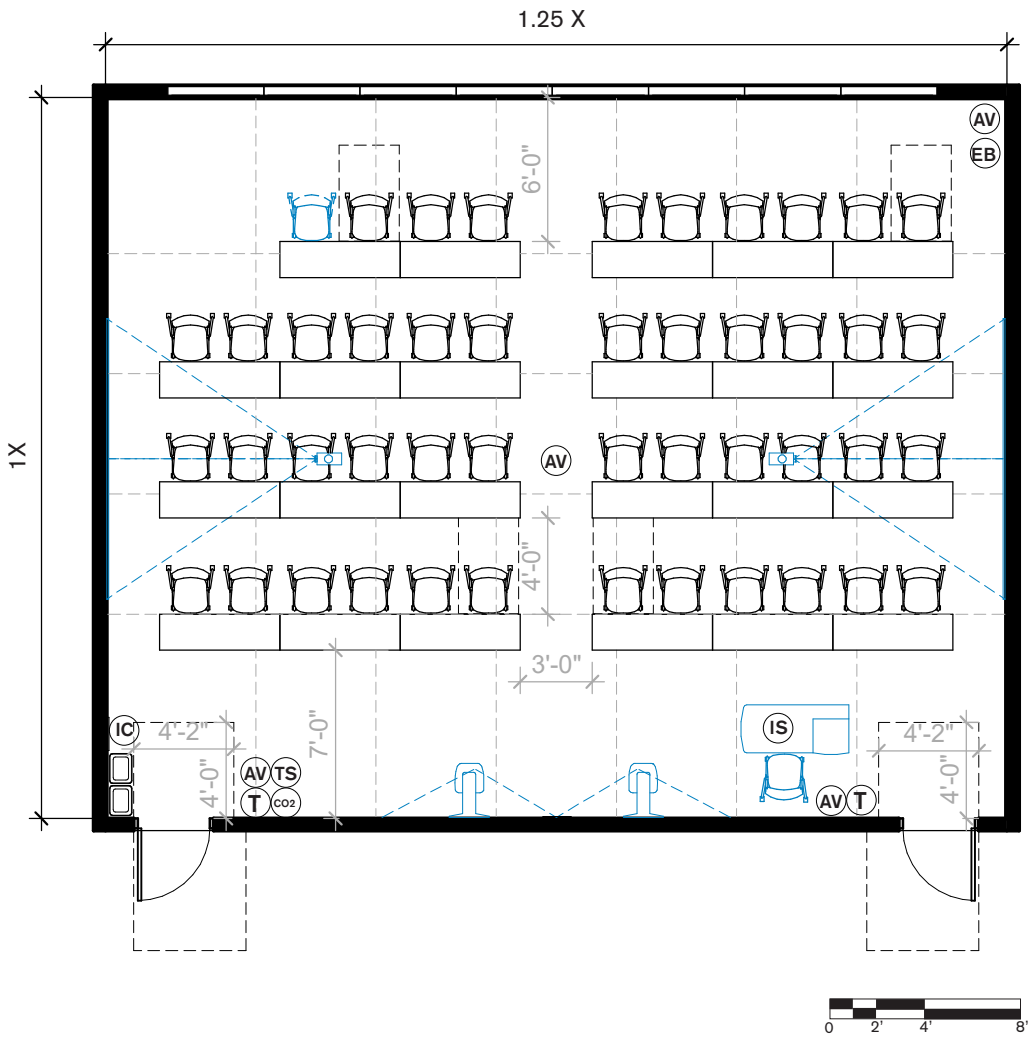






CONCEPTUAL DESIGN (LECTURE MODE)



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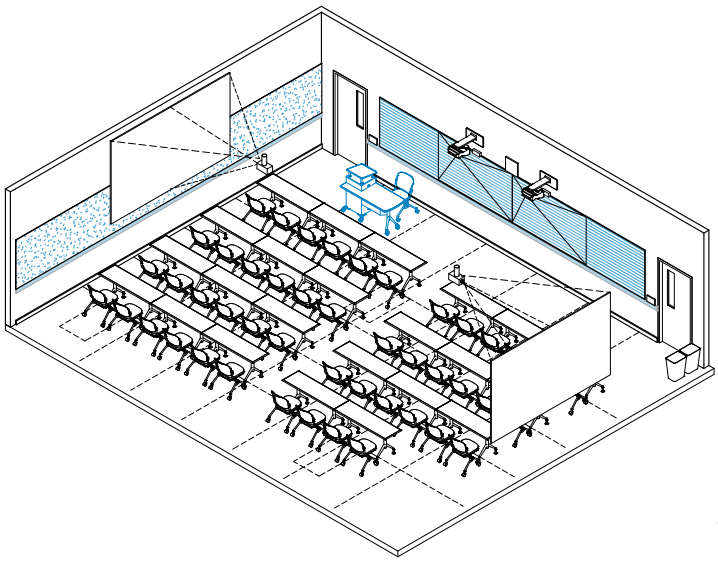
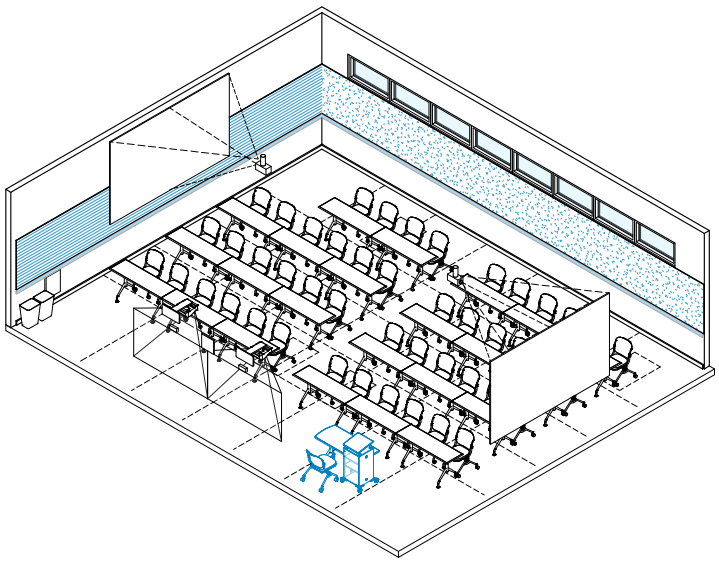
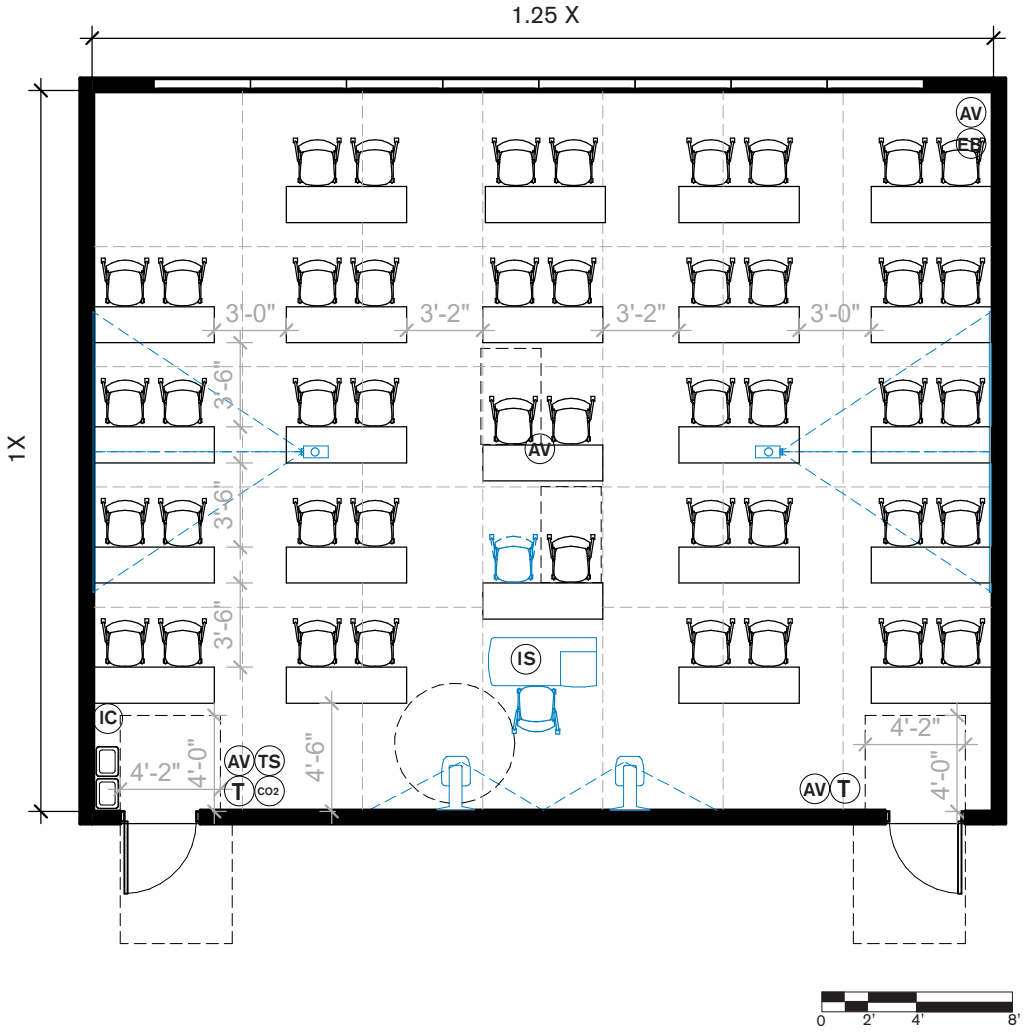
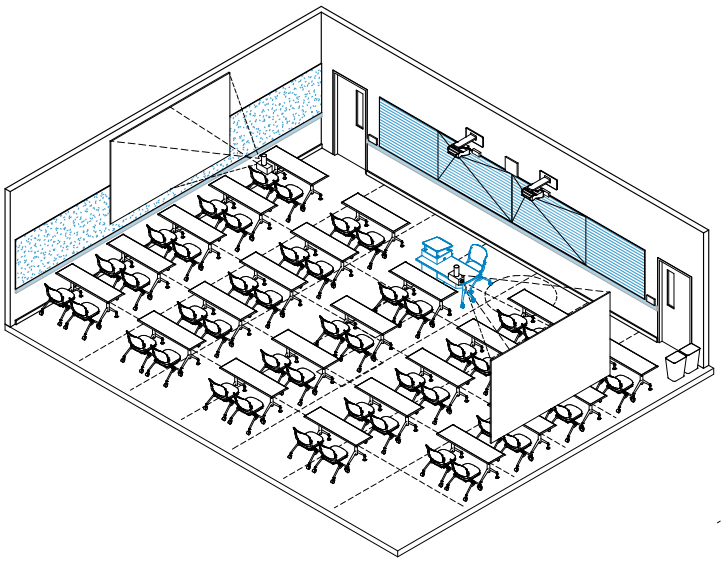
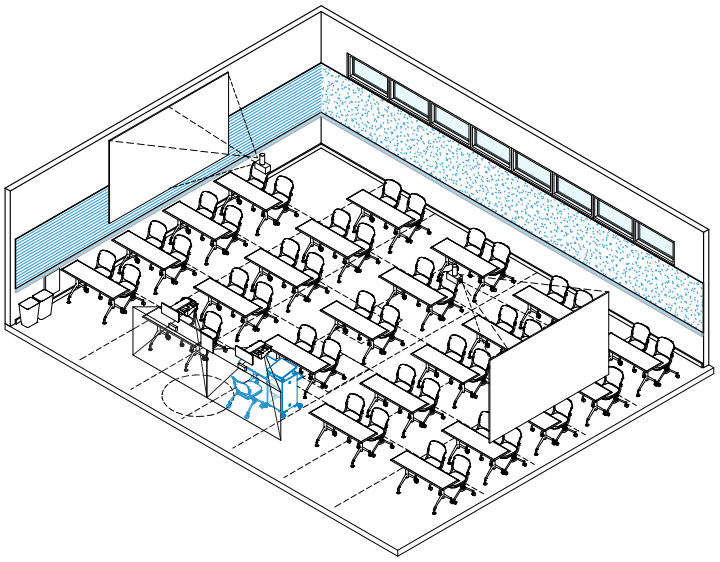




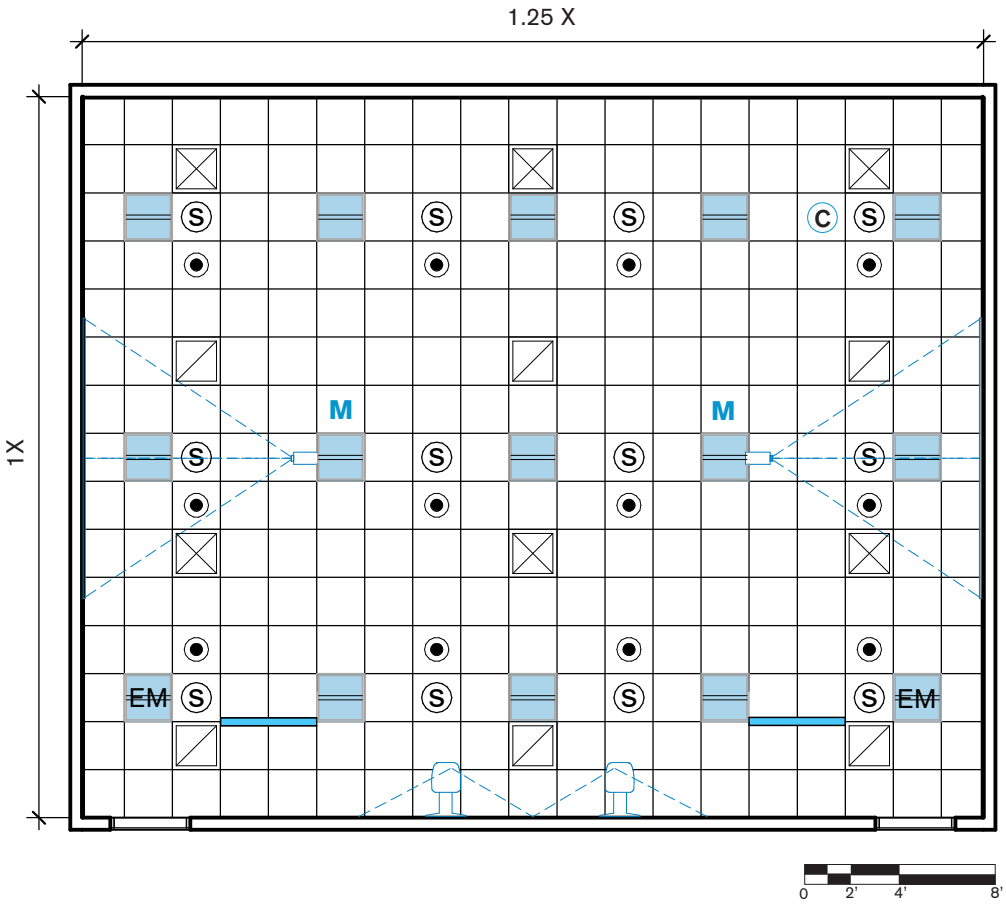
CONCEPTUAL DESIGN (TESTING MODE)







CONCEPTUAL DESIGN (REFLECTED CEILING PLAN)



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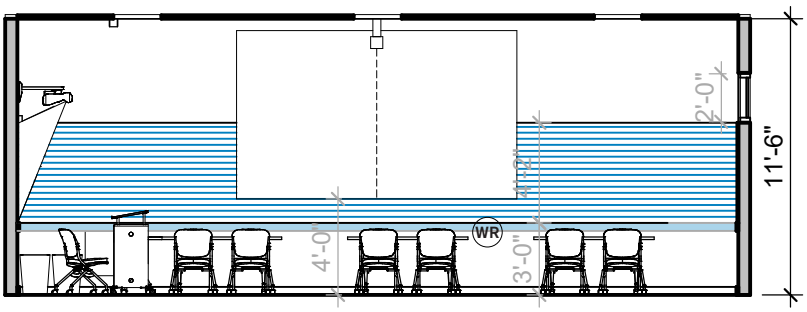
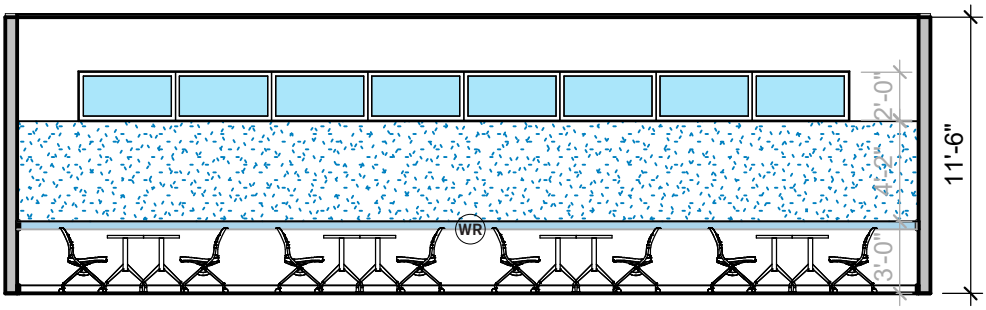
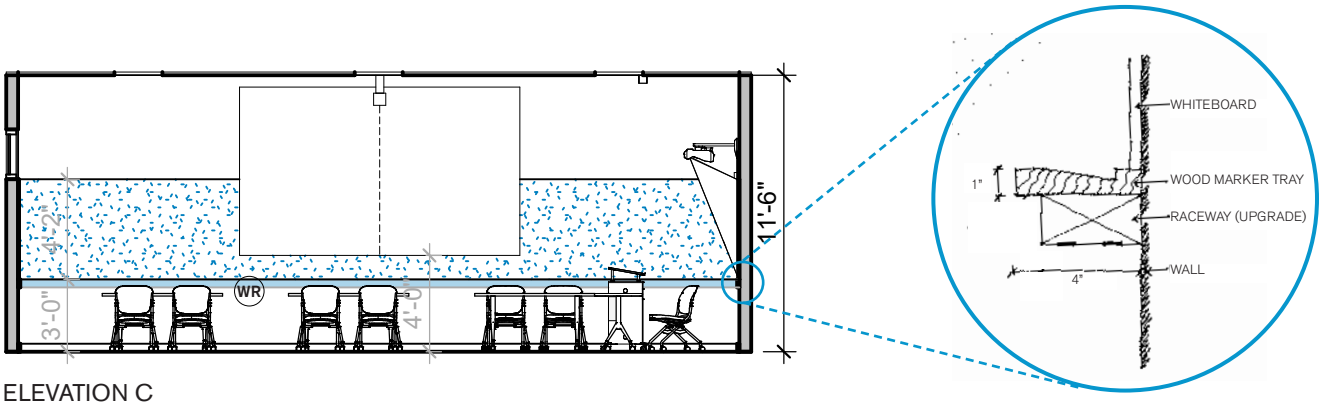
CONCEPTUAL DESIGN (ELEVATIONS)



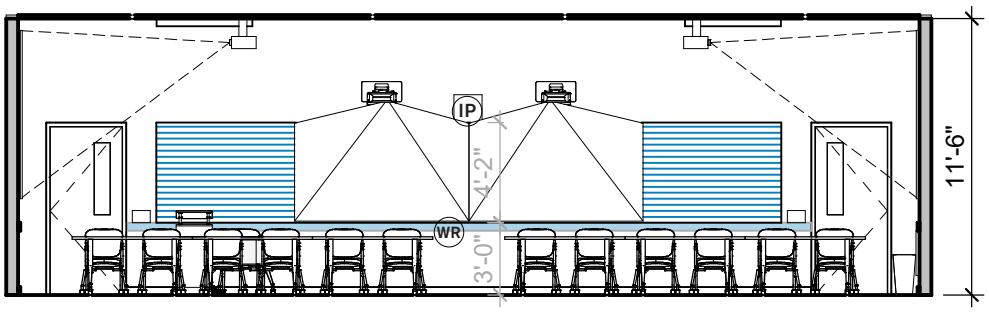
ELEVATION A



ELEVATION B



ELEVATION C



ELEVATION D

06
LARGE CLASSROOMS

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Large Classrooms at DVC are those with 90 student stations. This classroom size is used to mainly instruct double sections of the medium class courses or triple sections of the small class courses. Since learning styles are as varied as the number of student stations, the room has the capability for multiple furniture settings, all of which can be arranged with the help of students. This would require a behavioral shift at DVC where students and faculty are more engaged in their learning environment.

There is no "front" of the classroom and the space is generally omni-directional, mixed with a range of adjustable furniture options and movable group work easels, and multi-modal with respect to technology to support the 21st century classroom. The room is equipped to support a variety of activities and settings, which require a range of lighting levels, analog/ digital displays and interactive lecture display/ annotation capture capability. The use of energy efficient equipment with automated controls helps improve performance and conserve energy. Due to unknown conditions of the exterior wall/ fenestration pattern of the specific project these standards will be applied to, clerestory windows for natural daylight are proposed as a baseline in the classroom layout.

The room is also equipped with surface-mounted, floor raceways along the perimeter and the central area which terminate in access points that can be located throughout the learning space to support a variety of activities and settings.

Hard-wired media access points for plugging in the instructor/ student devices are distributed at four locations (2 wall and 2 floor) in the room.

The proposed classroom inventory aims to be durable, flexible, adaptable, and playful (using the range of colors available for the various products). To enable faculty-student engagement and uninterrupted sightlines in a flat floor classroom, furnishings are adjustable in height. It consists of nesting chairs on casters and glides to enable free movement; flip-top stackable tables on casters with integrated power outlets to provide maximum flexibility within the space; multi-modal instructor station with lockable storage on casters to provide mobility and a range of teaching postures; and writeboards with seamless short throw digital projection system to integrate active teaching. Accessible furniture, similar to the rest of the classroom inventory, is integrated within the space to eliminate segregation and foster collaboration amongst students. Generous circulation space is provided within the classroom to allow for a wheelchair to freely move in the space. Additional flexibility can be added to the classrooms by incorporating acoustically-rated room partitions that would divide the room into two-medium sized classrooms.

The maximum classroom occupancy is over 50 per code (Refer CBC Table 1004.1.2 - Maximum floor area allowance per occupant for 'Classrooms'), hence, two exits are required (Refer CBC Table 1006.2.1).

CLASSROOM INVENTORY**

CHAIR (1)
Movable on 4 legs (2 casters & 2 slide)
Foldable/ Nesting
Mesh back and Fabric/ Vinyl Seat
Arm/ Armless

CHAIR (2)
Adjustable Height for bar height seating with footrest
Movable
Mesh back and Fabric/ Vinyl Seat
Arm/ Armless

TABLE
Foldable/ Nesting
Movable on Lockable Casters
Integrated power outlet
Adjustable Height (for sit/ stand combinations)
ADA compliant

INSTRUCTOR STATION
Integrated workdesk/ podium with option for larger podium work area
Un-tethered/ On Casters
Integrated power outlet
Adjustable Height of desk and podium worksurface
ADA compliant

WRITEABLE SURFACE (1)
Projection & Dry-erase

WRITEABLE SURFACE (2)
Moveable
Double-sided writeable surface

***Refer to the Appendix for sample product cutsheets.*

ROOM DATA SHEET (LARGE CLASSROOM)

AREA	2250 ASF.
STUDENT STATIONS	90.
PLANNING PARAMETER	25 ASF/ Student.
ROOM PROPORTION	Length : Width ~ 1.5x : 1x
MINIMUM CEILING	12'-6".
FUNCTION	Interactive Lecture / Skill Learning and Collaborative Group work/ Skill Application.

SPECIAL REQUIREMENTS

CEILINGS**	Suspended acoustical ceiling system with smooth texture, light reflective, impact/scratch resistant, 2'x2' or 2'x4', white tiles and tegular lay-in grid, minimum NRC rating of 1.0 (Optima by Armstrong or similar).
WALLS**	Full height metal framing with drywall on both sides. Insulate interior of all wall cavities with non-cellulose sound blankets. At partitions facing corridors, use staggered double studs. *(Upgrade: Full-height glass walls at corridors with translucent writeable film.)* Writeable Surface: High-performance dry-erase whiteboard on all walls as per window layout. 3'-0" minimum bottom of board with 1" x 4" wood marker tray (see sketch detail in layouts). Use high-performance dry-erase and projectable whiteboard for walls with Interactive Short Throw Display Projectors. Paint (Field): Semi-gloss interior paint, No VOC. Use accent color if desired. Base: Resilient, pre-molded corners and straight at carpet flooring.
FLOORS**	4" Raised access floor system with 2'x2' base tiles finished with 2'x2' carpet tile. (Tate ConCore Understructure/ PosiTile Carpet or similar). Carpet tile equal or greater than 10 stitches per inch, yarn weight of 20 to 30 ounces, stain/moisture/wear resistant, impervious type backing material, anti-static, UL Class A.
WINDOWS	Energy-efficient, transparent glazing to provide access to daylight and minimize heat loss or gain. Provide automated solar shading (Mechoshade or similar) to control light and glare while projection equipment is in use. Integrate controls with other AV controls. The exterior wall and fenestration pattern may vary on a project by project basis, hence, clerestory windows are shown as a base in the classroom standard layouts. The clerestory is suggested as a baseline for pricing, so that there is a budget allocation to begin with, which affords a certain allowance for glazing to be integrated. Each room will be particular with regards to existing condition, location on campus, and other considerations so the clerestory is certainly not seen as a final decision. The benefit of the clerestory is that it allows writable surfaces to be maximized.
DOORS	(2) 36" wide minimum, solid core, wood doors with narrow vertical tempered glass vision panel and hollow metal frames. No transfer grills or kick plates.
HARDWARE	Mechanical lever locks with means of interior locking (push button) for security. *(Upgrade) Electronic locks with mechanical (push button) override from the inside with capability to tie into campus-wide security system. All electronic locks to be placed on the door and not the wall.* Door hardware groups across various campuses shall be specified to provide a secured environment during a lock-down scenario, in particular by providing an interior override function as well as remote and local lock down. For existing general-use classrooms, replace mortise style

***Refer to the Appendix for example product cutsheets.*

with hotel style deadbolt locks similar to Corbin Russwin ML2013. For new construction of general-use classrooms, use Corbin Russwin CL 3351 or 3129 series. Where required, electrified locks, including those with HID card access, shall include a push button to override the card access on the exterior, similar to Sargetnt IN120 and IN220 HID, or Schlage AD-400 series. For large classrooms (over 90 students), crash bars must provide a means to override the dogged down feature and electronic lock open feature with a mechanical thumb turn device, similar to Von Duprin crash bar with 2SI feature.

HVAC

Recommended Temparature Range: Summer 74F +-2F / Winter 70F +-2F or per campus standards.
No additional humidity control may be required if RH is within acceptable condition per AHSRAE 55 thermal comfort and not required by Campus.
Low velocity air flow diffusers, especially when corner screen is provided to avoid agitating the screen. Lockable thermostat zone control.
Provide wall mounted zone temperature sensor with LCD display including room temperature, room CO2 level, temperature setpoint control, and after-hour override timer control with user adjustable duration.
Zone occupancy to be monitored by connection to the lighting occupancy sensors.
Where HVAC return paths to classrooms are not ducted, acoustical boots should be used to maintain the composite sound isolation performance of enclosing assemblies.
Ensure that mechanical systems adhere to the guidelines provided in the latest version of the Noise and Vibration Control chapter in the ASHRAE HVAC Applications Handbook.
CO2 Sensors for Demand Control Ventilation required per California Energy Code.
AV rack and laptop storage carts are located in closets outside the classroom. If they are located in the room, provide supply and return passthrough to remove additional heatload in the room.

PLUMBING

Automatic fire sprinklering system. Do not route plumbing through or near classroom areas.

LIGHTING

<u>GENERAL REQUIREMENTS</u>

- Target light levels, per the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13):
    - Horizontal illuminance @ desk height, 2.5' above finished floor = 500 lux (50fc) average throughout classroom to accommodate a wide range of tasks/uses (15fc for computer use, 40fc for paper tasks/reading, 50fc for art or science projects).
    - Vertical illuminance @ white board (i.e. vertical writable surfaces) = 300 lux (30fc) average.
    - Vertical illuminance @ pin-up walls (aka "tack board") = 150 lux (15fc) average.
    - Vertical illuminance @ background walls (not writable surfaces) = 150 lux (15fc) average.
    - In many situations the classroom/task light levels may be lower (such as A/V presentations or computer use), but the lighting system must be able to achieve average light levels noted above upon demand.
- Emergency egress lighting shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured at floor level throughout the room (since path of egress varies for different room layouts).
- Light fixtures and controls shall provide simple and affordable solution for classroom lighting.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Daylight photosensors and occupancy/vacancy sensors may be provided by 3rd party manufacturer, but shall be fully compatible with classroom light fixtures and warrantied by the installing electrical contractor.
- All LEDs used in the LED light fixture shall be of proven quality from established and reputable LED diode manufacturers with minimum 5 years experience in the manufacture of LED diodes. LED light fixture supplier shall have minimum 5 years experience designing, selling and supporting installations of LED systems.
- All light fixtures and control gear shall be UL-listed (or equivalent by ETL / CSA) for indoor locations.
- Manufacturer of LED systems shall utilize an advanced production LED binning process to maintain color consistency within a 4-step MacAdam ellipse per ANSI Standard C78.377 within all luminaires

***Refer to the Appendix for example product cutsheets.*

unless otherwise specified.

- Manufacturer shall provide photometric data for all light fixtures based on test results from an independent testing lab including candlepower distribution data in polar graph form, total lumen output per light fixture, and total wattage per light fixture.
- Contractor to consult with the owner and provide if required, back-stock of all led power supplies/drivers in a quantity to the owners' preference.
- All lighting equipment (including but not limited to light fixtures, LED drivers/power supplies, control interfaces, user interfaces, daylight photosensors, occupancy/vacancy sensors) shall be furnished with 5-year warranty for full replacement (materials and labor) effective from the date of substantial construction completion.
- All electrical lighting shall follow the latest applicable codes and standards (see Appendix for lighting code summary):
    - 2016 California Building Standards Code ("Title 24")
        Part 3 Electrical Code – Installation requirements and egress lighting levels.
        Part 6 Energy Code, Subchapter 4 – Lighting control and dimming requirements.
        Part 6 Energy Code, Subchapter 5 – Energy use (Lighting Power Density)
        Part 9 California Fire Code, Section 1008 Means of Egress Illumination
    - CalGreen Building Standards Code (Part 11 of Title 24)

LIGHTING FIXTURES**

2' x 2' General Light Fixture

- Shall be 2' x 2' square and work within a standard 2' x 2' suspended ceiling grid system. Acuity 2BLT2-40L-ADP-120-EZ1-LP935-N100-LATC or similar for fixed 3500K color temperature. *(Upgrade) Acuity 2BLT2-TUWH-PROR-40L-ADP-120-NLT-LATC or similar for tunable white option.*
- Emergency Lighting fixture shall be same Acuity 2BLT2-40L fixture as others in classroom, but shall incorporate EL14L (1400 lumen) battery pack.
- Light fixture appearance shall have design-neutral aesthetics with clean, refined details to blend into the ceiling. Expressive design statements are discouraged from the general lighting fixtures.
- Powder coat, white finish.
- Minimum rated life of 60,000 hours per IESNA TM-21 criteria @ L70. LED fixture manufacturer shall power the LED diodes at a drive current recommended by LED diode manufacturer to reach minimum 60,000 hour rated life @ L70. LED diodes shall not be "overdriven" at a higher drive current to increase light output to detriment of rated lamp life.
- Field-replaceable LED engines and drivers/power supplies, with access to LED engines and drivers from below the fixture or within the plenum (without the need to demount the fixture from the ceiling grid).
- Sealed light diffusers and optical compartments that restrict ability for dust and bugs to settle within the fixture.
- Fixture provided with a range of fixed lumen outputs ranging from 3000 – 5000 lumens per fixture (@ 3500K) to accommodate classroom ceiling heights ranging from 9'-0" to 12-6". Upon implementation, project design team is responsible for specifying the fixture's lumen output to achieve the required light levels as noted within the Design Standards document.
- For tunable white option, fixture shall provide consistent lumen when varying the color temperature (i.e. constant lumen curve).
- Nominal 4,000 delivered lumens @ delivered lumens per watt (LPW) > 100 LPW.
- CRI = 80+ (basic version) or 90+ (enhanced version) for light fixtures
- Color temperature = 3500K (basic version) or Tunable White with range from 3000K – 5000K (enhanced version).
- Spacing to mounting height ratio (S / MH) > 1.18 in any direction. Typical on-center spacing of 2x2 light fixtures is 8', though 10' spacing is permissible for ceiling heights 10'-6" or taller.
- To control glare to occupants, 2x2 light fixtures shall have the following performance requirements:
    Luminance < 4500 cd/m2 @ 45° above Nadir, <4000 cd/m2 @ 55°, < 3500 cd/m2 @ 65°, < 3000 cd/m2 @ 75°, 2500 cd/m2 @ 85°.
    Intensity < 1000cd at angles 50° or higher above Nadir.
- Dimmable to 5% light output without flicker or jumps in light output.

***Refer to the Appendix for example product cutsheets.*

Linear Wallwash / Accent Fixture (Upgrade)

- *Wallwash fixture shall be nominal 4" or 6" wide and available in 2' and 4' lengths.*
- *Accent fixtures shall be nominal 4" or 6" square shape and provide lockable vertical tilt and horizontal rotation to orient the light output towards the target wall surface.*
- *Fixture shall be capable of end-to-end through wire connection for continuous runs (interrupted by ceiling grid where needed).*
- *Color temp matching the 2' x 2' general lighting fixture. If 2' x 2' fixture uses tunable white light engine, standardize the linear wallwasher @ 3500K color temperature (tunable white not needed for the wall washers).*
- *Powder coat, white finish to match the 2' x 2' general lighting fixture.*
- *Max intensity (i.e. CBCP) of wallwash fixture or accent fixture shall exit the fixture at an angle to hit the target vertical wall surface @ 5'-0" AFF given a classroom's ceiling height and light fixture setback distance. Upon implementation, project design team is responsible for specifying the fixture's setback distance to target 5' AFF on the vertical wall surface with the fixture's CBCP.*
- *Accent light fixture shall be aimed at nominal 30° angle from Nadir to the 5' AFF target on the wall/whiteboard surface. Accent fixture shall have CBCP (specified by project design team to match project ceiling height) to achieve the required light levels on the wall/whiteboard surface as noted within the Design Standards document.*
- *Wallwash lens / fixture aperture shall be shielded or angled away from student line of sight (i.e. angled towards the vertical wall surface) to mitigate glare to occupants. Flush lens (to the ceiling plane) is NOT acceptable for the wallwash fixture.*
- *Wallwash fixture provided with a range of fixed lumen outputs ranging from 350 – 675 lumens per foot (@ 3500K) to accommodate variety of layouts (single fixture, dashed line, continuous row). Upon implementation, project design team is responsible for specifying the fixture's lumen output to achieve the required light levels and uniformity on the wall/whiteboard surface as noted within the Design Standards document.*
- *CRI = 80+ (basic version) or 90+ (enhanced version).*
- *Dimmable to 5% light output without flicker or jumps in light output.*
- *Fully compatible with the specified control system, including digital addressing of wallwash / accent fixtures.*

LIGHTING CONTROLS

General Description

- Acuity nLight system or similar for fixed 3500K color temperature. *(Upgrade) Acuity nTune system or similar for tunable white option.*
- Occupancy/ Vacancy sensor, required per Title24 building code, shall automatically turn off classroom lighting when room is unoccupied.
- Light fixtures and controls shall be provided by a single manufacturer as a complete system to ensure full compatibility between components and full warranty for the entire lighting & controls system.
- Light fixtures work together as a single network (within one classroom only) and does not require a centralized (whole-building) control system.
- The system is scalable to multiple classrooms by simply repeating the single-network model.
- Control system shall be easy to install, commission, and maintain. Fixtures and controls work together as a system with "out of the box / plug and play" connectivity.
- Digital addressing of fixtures (explained above) allows for easy reconfiguration / revision of control zones without need for rewiring.
- Classroom lighting control system shall be linkable with campus Building Management System (BMS).
- Classroom lighting control system shall be compatible with California's Title24 Demand Response requirements.
- *(Upgrade) Allows for individual fixture calibration for lumen output or color temperature (if tunable white) should a light engine require replacement or color shift (if tunable white) is observed over time.*
- Allows for integration of 3rd party light fixtures into the classroom lighting control system using industry-standard control protocols.

***Refer to the Appendix for example product cutsheets.*

Emergency Lighting

- Designated 2' x'2' classroom emergency light fixtures (EM fixtures) shall be of same family, type, appearance, digital addressing capability, and lumen output under normal power operation as adjacent 2' x 2' classroom fixtures.
- EM fixtures shall be UL924 listed for emergency operation.
- EM fixtures shall operate as normal light fixtures when normal power is available (i.e. they can dim or turn off according to preset scenes or user override). The EM fixtures shall automatically override to emergency-mode light output (1400lm) upon loss of normal power via automatic transfer to the specified battery backup power source.
- Upon loss of normal power, EM fixtures shall operate with 1400 delivered lumens for a period not less than 90 minutes.

User Controls

- All user controls shall be mounted within the acceptable range for ADA compliance, namely 36" on center, above finished floor.
- Instructor access to lighting controls via localized keypad mounted at instructor station and/or classroom wall.
- *(Upgrade) For tunable white feature, provide side-by-side (double gang) keypad with one keypad hosting preset scenes, and second keypad hosting independent control of color temperature and light level/intensity/dimming for the selected scene.* See "Sample Product Cutsheets (Lighting), Tunable White" in the appendix.
- Preset scenes are customizable by school administration.
- Lighting controls shall permit additional interface/coordination with the classroom A/V control system to automatically control lighting in connection with A/V actions (such as turning on projectors, projection screen and window shade deployment, etc.)

Digital Addressing

- All classroom light fixtures shall allow for individual fixture addressing (aka digital addressing) that is independent of power/control wire configuration.
- Digital addressing features shall allow for individual fixture control of intensity and *(upgrade) color temperature (if tunable white)*, as well as grouping of light fixtures (via software) into control zones that are independent of power/control wire configuration.
    - This feature shall permit individual fixtures to be within MULTIPLE control zones, and such control zone grouping to CHANGE depending on the selected lighting scene.
    - This feature shall permit onsite calibration of individual fixture's lumen output (via software) to balance uniformity of light levels throughout a classroom.

Lighting Control Sensors

- (1x) Acuity daylight photosensor or similar and (1x) Acuity dual technology (PIR and Ultrasonic) occupancy/vacancy sensor or similar. Each single sensor can control multiple fixtures in the classroom.
- Specified light fixture shall offer (as an option) a daylight photosensor as well as an occupancy/ vacancy sensor integral to the light fixture. Each integral sensor can control multiple fixtures in the classroom.
- Compatibility with 3rd party sensors if needed (such as daylight photosensors or vacancy sensors) via hard-wired OR wireless communication.
- Occupancy/ Vacancy sensors for light fixtures shall also trigger HVAC operation (or vice-versa)

ACOUSTICS

SOUND ISOLATION

General Description

- The noise generation potential at all classroom adjacencies should be carefully evaluated when determining the acoustical requirements of both vertical and horizontal classroom partitions. For classrooms that must be located adjacent to spaces expected to generate high sound levels such as music practice/performance rooms, stairwells, elevators, mechanical equipment rooms, active corridors and nearby lobbies, additional acoustical consideration should be paid the STC rating of the partitions, windows and any communicating doors.

***Refer to the Appendix for example product cutsheets.*

Walls

- In general, the sound isolation across the partition will depend on several factors. The primary factor will be the STC performance of the partition assembly itself. Other factors include whether there are doors or windows between the rooms and penetrations such as ductwork and piping. Consideration of these various factors as well as choice of construction systems and methods and cost will ultimately dictate the recommended wall assemblies, type of door gasketing, glazing size and selections, and ceiling systems.
- For the base condition, the walls surrounding the classrooms should be full-height (i.e. slab-to-slab) and achieve a minimum acoustical performance rating of Sound Transmission Class (STC) 50 or Noise Isolation Class (NIC) 45.
- For classrooms adjacent to loud spaces such as lobbies, band rooms and mechanical rooms, a special assessment should be performed to determine the required minimum STC rating of the partition. Depending upon the specific adjacency, the expected range of performance is STC 55 to 60.

Doors

- For the base condition, all classroom entry doors should be fully acoustically gasketed at the jambs and at the bottom. Typical adjacencies such as to a private office or a vestibule, should also include a fully acoustically gasketed door.
- For classrooms that open onto a primary circulation corridor or lobby, the doors should have a minimum acoustic rating of STC 35. For communicating doors between classrooms, specify STC 45 to 50 or greater depending upon the specific adjacency.

Floor/Ceiling Assemblies

- Where classrooms are located below active and potentially noisy spaces, the floor/ceiling assembly should be designed to achieve minimum:
    - Air-borne Sound: STC 50
    - Impact Noise: IIC 45
- For air-borne sound attenuation, an 8" minimum thickness concrete slab with suspended lay-in ceiling will achieve a minimum STC of 50. For wood framed construction, use of light-weight concrete and resilient isolation clips such as resilient channel at the ceiling gypsum board will likely be necessary.
- For impact noise attenuation, carpet without any additional acoustical treatment is conditionally acceptable. Areas with significant amount hard finish will require an additional sound-attenuation underlayment such as rubber or cork.

Exterior Façade/Windows

- Classrooms potentially exposed to excessive outdoor noise sources such as roadway traffic and air-craft flyovers will require an environmental noise survey in order to determine the minimum STC performance requirements of the windows and wall.
- The standard noise level criteria for all classroom due to exterior/outdoor noise sources should be a 15-minute average noise level of 35 dBA (Leq) or less and a maximum noise level of 50 dBA (Lmax-Slow).
- Where the outdoor noise level is found to be 60 dBA or greater, the mechanical air-ventilation system in the classroom must be designed so that the fresh-air requirement can be achieve with operable windows in the closed position.

ROOM ACOUSTICS

The overall acoustical finish scheme in the classrooms should control excessive sound reverberation and support excellent speech-intelligibility.

Base Classroom Design

- Reverberation Time (RT60 at 500 Hz): less than 1.0 sec
- The ceiling is the most cost-effective surface to consider for locating the primary acoustical finish. Typically, a lay-in tile ceiling having a minimum NRC 1.0 such as Optima by Armstrong or similar should be considered.

***Refer to the Appendix for example product cutsheets.*

- Sound absorbing wall panels should be considered as follows:
    1. Wall panels should have a minimum acoustic performance of NRC 0.75 and be at least 2" thick.
    2. Where possible, apply acoustical wall panels on at least one surface of each pair of parallel walls and in the wall area between seated and standing ear height. See layouts for recommended locations of wall panels.

Upgrade or Non-Standard Classroom Considerations

- *In the case where upgraded sound-isolation might require a "hard-lid" ceiling and where a dropped lay-in tile ceiling cannot be installed, then the exposed hard-lid ceiling should be treated with minimum NRC 0.80 and 2" thick acoustic panels.*
- *Sound absorbing wall panels should be considered as follows:*
    1. *When less than 100% of the ceiling area is not acoustically treated, then a remaining equivalent area of acoustical panels having should be applied to the walls.*
    2. *If "front-firing" loudspeakers are being considered, the wall opposite the loudspeakers should be fully covered with acoustical wall panels as feasible.*
    3. *If wood finishes are desired, consider perforated or kerfed acoustic panels having minimum NRC 0.80 such as by RGP Corporation, or slats or grills such as 9Wood Company.*
- *Acoustic treatments may also be required to minimize flutter echoes and control extraneous echoes.*

MECHANICAL NOISE/ VIBRATION CONTROL

- The noise level in the classrooms as generated by mechanical equipment (HVAC, Electrical, Plumbing, Elevator Equipment and AV equipment) should be limited to a maximum noise level of Noise Criteria (NC) 30 in the classrooms.
- All potentially noisy MEP and Elevator equipment located adjacent to, above or below the classroom, including fans, pumps and electrical transformers should be carefully evaluated for both air-borne and structure-borne noise and as required, acoustically treated and/or the intervening partition or floor/ceiling be acoustically upgraded.
- The air-velocity in ductwork located within the classroom should not exceed 800 fpm. The air velocity in the final branch-duct should not exceed the diffuser neck velocity by more than 150 fpm, unless otherwise noted. The air-velocity at the neck of each supply and return diffuser should not exceed 400 fpm.
- VAV boxes should be sized to limit the total pressure drop to 0.5-inches TSP or less and have both a radiated and discharge sound level of less than NC 30.
- FCU and VAV boxes with radiated noise levels greater than NC 30 must not be located in the ceiling over the classrooms.
- Flexible ductwork shall not be used on medium pressure duct systems upstream of VAV box connections.
- Sheet metal ductwork should be internally lined with 1-inch minimum thickness of acoustical duct-liner.
- Air-transfer boots should be constructed completely of acoustically lined sheet metal, include at least one 90-degree elbow and sized depending upon the degree of sound-isolation required and for maximum 500 fpm.
- Supply and return diffusers should be selected to perform no greater than NC 25.
- Ducts, pipes and conduit attached to vibration isolated equipment should include flexible or resilient type connections and may be required to be vibration isolated from the building depending upon proximity of the duct or pipe to acoustically sensitive spaces and the power of the attached equipment.
- The noise emission from AV Equipment should also be considered. Where noisy AV equipment is unavoidable and is needed to be located in the classroom, then sound-rated ventilated equipment racks should be considered.

AUDIO/VISUAL EQUIPMENT**

AUDIO SYSTEM

Audio DSP (Digital Signal Processor): QSC Core 110f or equal
Loudspeakers: QSC AC-C6T or equal
Amplifier: QSC CMX300Va or equal

***Refer to the Appendix for example product cutsheets.*

Wireless Microphone: Shure QLXD24/SM58 handheld transmitter and receiver, Shure QLXD14 bodypack transmitter and receiver and (2x) countryman B-3 bodypack microphones or equal.

Voice Lift: *Meyer Sound Constellation (Upgrade). If selected, Audio DSP, loudspeakers, amplifier and wireless microphones above would be removed. All classroom audio would utilize constellation speakers, amplifiers and processor.* Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.

Assistive Listening: Listen Technologies LT-800-072 transmitter and LR-4200-072 receivers (provide 4% of seating capacity) or equal.

VIDEO SYSTEM
Minimum viewer distance to digital display (especially in lecture mode) should be equal to the width of the display screen/ projected image.

Projection:
Standard Projection: (3x) Panasonic PT-RZ770 or equal – 7000 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 1-chip DLP, Laser Source

Interactive-Short Throw: (2x) Epson Brightlink Pro 1460Ui or equal – 4400 ANSI lumens, 1920x1200 (WUXGA), 16:10 Aspect ratio, 3 LCD, with output capabilities for mirroring annotation and content onto a larger projection screen. Provide equivalent laser source model if available.

Projection Surface:
Motorized Screen: (3x) Draper Access V ceiling-recessed, tab-tensioned, motorized screen or similar for video projection sized 87.5"x140" for viewing from half of the classroom depth in the long direction and full classroom depth in the short direction. The bottom of the viewable image shall be at 4'-0"AFF. Screen material shall be Matte white or equal. *(Upgrade): Screen material shall be TecVision XH900X ALR (ambient light rejecting) or equal for use in moderate to higher ambient light and wider viewing angles.*

Markerboard: Low gloss or matte surface white-dry erase board for interactive short-throw projection. PolyVision projection surface or equal.

Transport and Switching:
Video Matrix Switcher (location: main equipment rack):
Crestron DM-MD16X16 Digital Media Switcher
-Input Cards: (4) DMC-4K-HDCP2, (2) DMC-DVI, (1) DMC-4K-C-DSP-HDCP2
-Output Cards: (3) DMC-4K-HDO

Instructor Station:
Instructor Station Video Switcher: Crestron DM-MD8X1-4K-C with DM output for instructor station
Instructor Station Cable Cubby: Extron Cable Cubby 500
DVD Player: Denon DN-500 or equal at instructor station
Document Camera: Elmo P10HD or equal at instructor station
Wireless Presentation: Mersive Solstice or equal at main equipment rack

Capture/Conferencing (upgrade)*:* Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.
PTZ Camera: Panasonic AW-HE40SWPJ with HDMI output (or equal) located on the back wall of the room.
Capture/Stream Unit: Extron SMP351 or equal (location: main equipment rack)
Conferencing Unit: Extron MediaPort 200 or equal (location: main equipment rack)
In-Room Computer: Dell or equal (location: main equipment rack)
Triple Element Ceiling Microphone: (4x) Audix M3 or equal

***Refer to the Appendix for example product cutsheets.*

(Upgrade) Ceiling Array Microphone: (4x) Shure MXA910 or equal

CONTROL SYSTEM

Control Processor: Crestron CP3N control processor or equal. The AV system shall be able to send preset recall signals to the master control units for window shades and lighting so these components can be controlled via one cohesive system (location: main equipment rack).

Touch Screen: Crestron TSW-760 7" Touch Screen on the wall and *placed at instructor's station (upgrade)*. Wireless control shall be configured for controlling the room via an app or laptop. Backend infrastructure for 'upgrade' system to be installed in the base classroom to avoid re-wiring.

UTILITY / OTHER

See layouts for recommended locations of data/power and hardwired AV connections.

A campus-standard instructor's station shall be provided. The instructor's station would include the DVD player, document camera, laptop connections, USB thumb drive connections for lecture capture, and other items as needed.

AV equipment shall be installed into a Middle Atlantic MRK-AXS or equal pull-out equipment rack stored in an AV closet located outside the room.

VOICE/DATA**

Six dual ports at wired AV station unless noted otherwise. Wireless internet access required throughout. (2) Wi-Fi Acces Ports: Aruba 220 series Acess Points or per current campus standards.

Provide CAT 6 or better connection for the wall mounted IP speaker/clock/ microphone as per campus/ district standard. No separate power conenction required for this product. System to tie into the Building Alarm System. Installation height 8'-0" AFF or as required by manufacturer's manual. Emergency call button (linked to the IP speaker alarm panel) at accessible height of 48" AFF located away from the exit door. See layouts for locations.

POWER

Provide wall power/data fourplex receptacles at +18" AFF, spaced 5'-0" on center. *(Upgrade) Provide continuous, perimeter wall mounted raceway for power/ data/ AV (below the marker tray at +35" AFF), cover color to match wall color. Receptacles in raceway to be duplex, 5'-0" on center.* See layouts for conceptual detail sketch at raceway & writeable surface junction.

Provide pop-up, flush-mounted, fourplex floor boxes at 5'-0" on center within the 4" high, raised floor system. Floor boxes fed either down the walls from above ceiling in existing classrooms or from below grade in new construction.

Provide adequate power for video projector and other AV equipment. Provide additional outlets at Instructor's station for multiple devices.

Provide a provisional recessed receptacle for a wall clock at 8'-0" AFF on one wall in the room, ideally the wall with the short-throw displays.

Power for egress lighting will be provided by batteries integral to the fixtures as required to give the egress lighting levels stated. An option would be to provide power from a central battery/ inverter system. Using that option would depend on the building and/or classroom or assembly space type.

SECURITY**

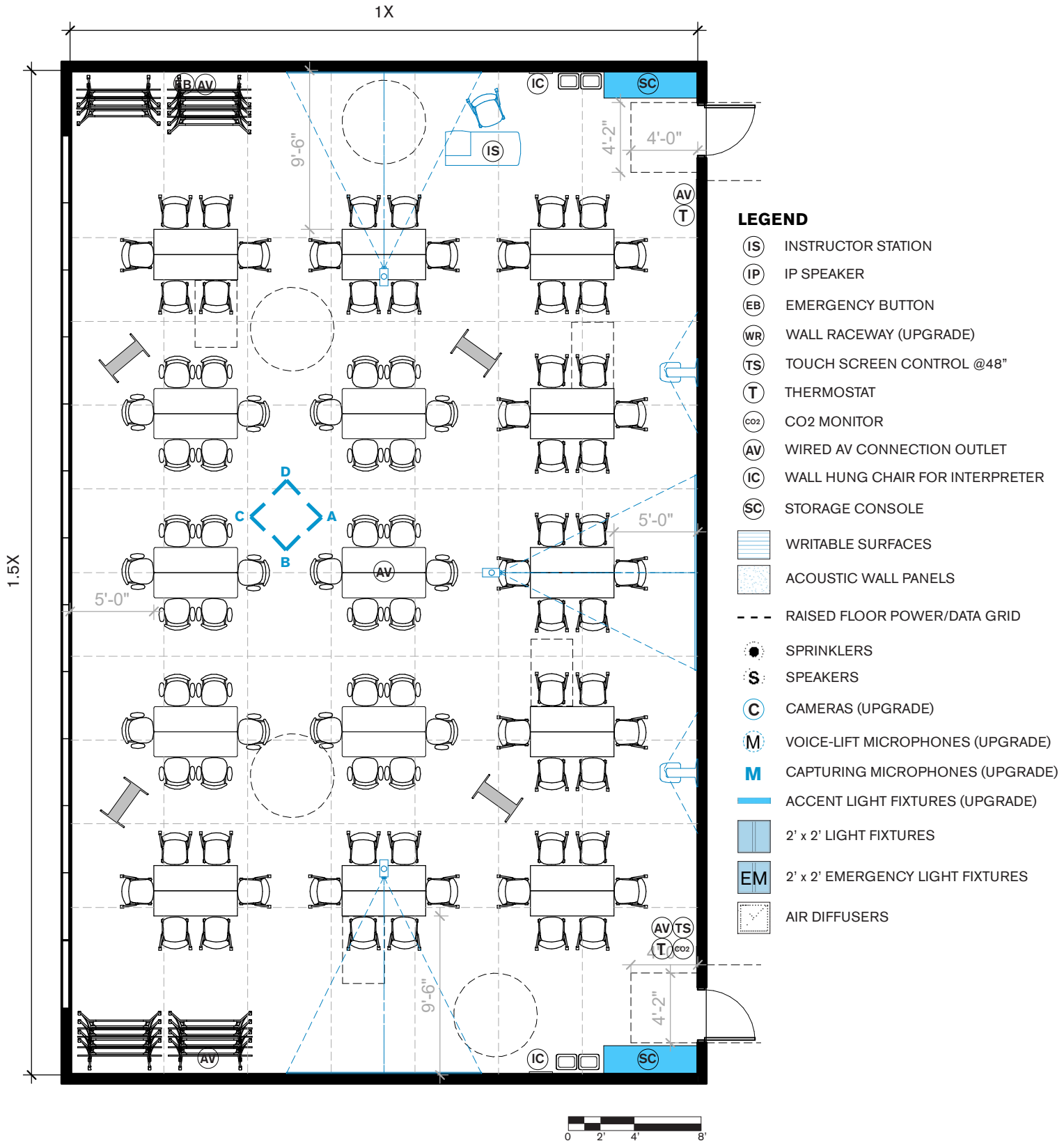
Provide IP speaker with integrated wall clock for campus-wide emergency/ alerts per campus/ district standards. Provide adequate signage for safety instructions.

FURNITURE**

Provide products with active and flexible comfort capabilities while addressing concerns of Universal Design and minimum warranty requirements per campus/ district furniture performance standards.

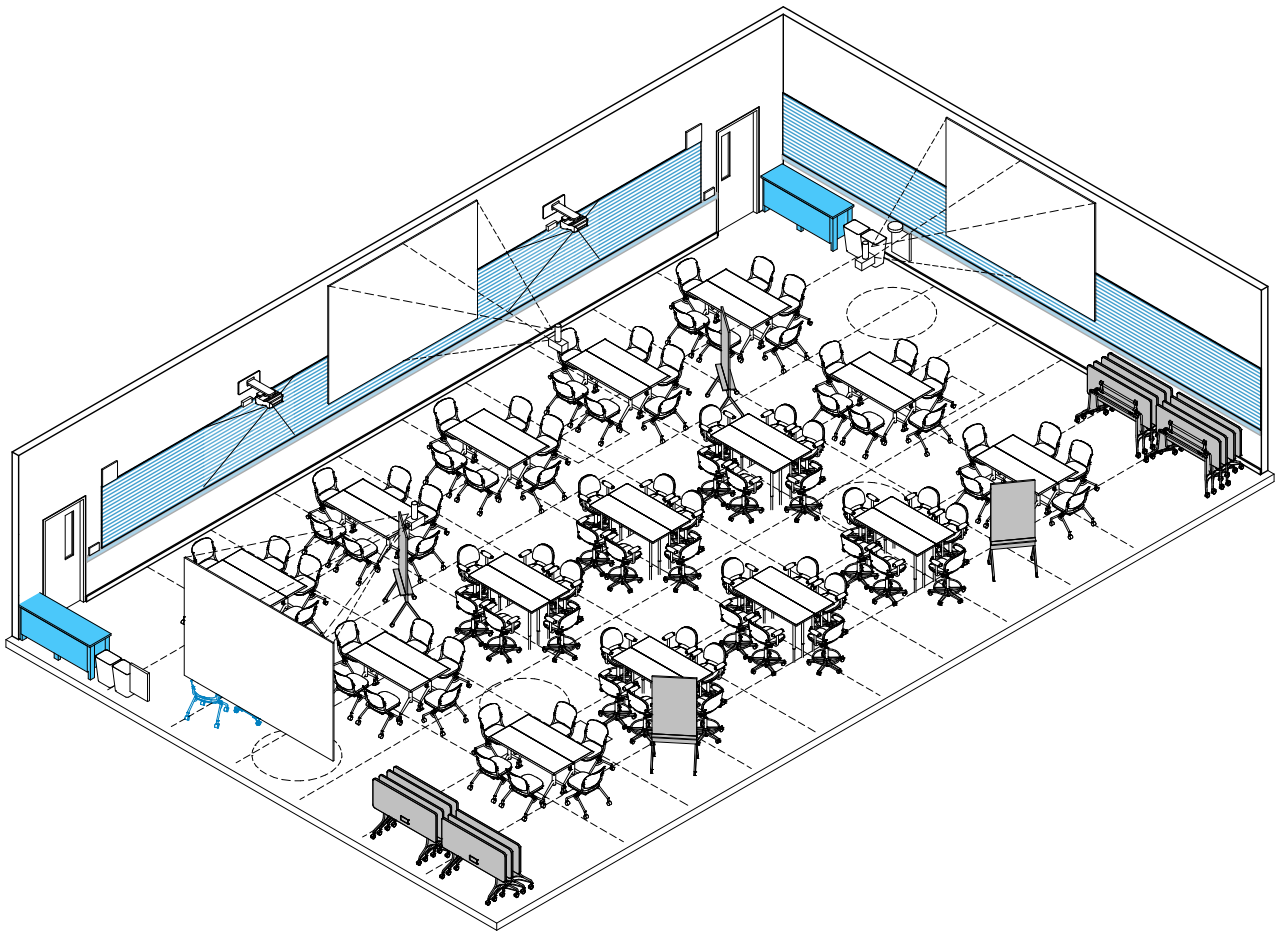
OTHER CONSIDERATIONS	Do not locate classrooms near or below spaces with loud activities, high impacts and/or high sound pressure level sources, such as fitness areas or mechanical rooms. Do not locate classrooms near electrical transformers, stairwells, elevator shafts, or elevator equipment rooms. Minimize contrast ratio between classroom field and projection screen. Provide 16-gauge pre-notched backing stud with flange fastened with pan head sheet metal screws at partitions with wall-mounted equipment. Provide clear “permanent” use-instructions for furniture and technology in the classroom.
OWNER-PROVIDED SUPPLIES**	Multi-pack, eco-friendly non-toxic dry-erase markers and erasers; cleaner spray.

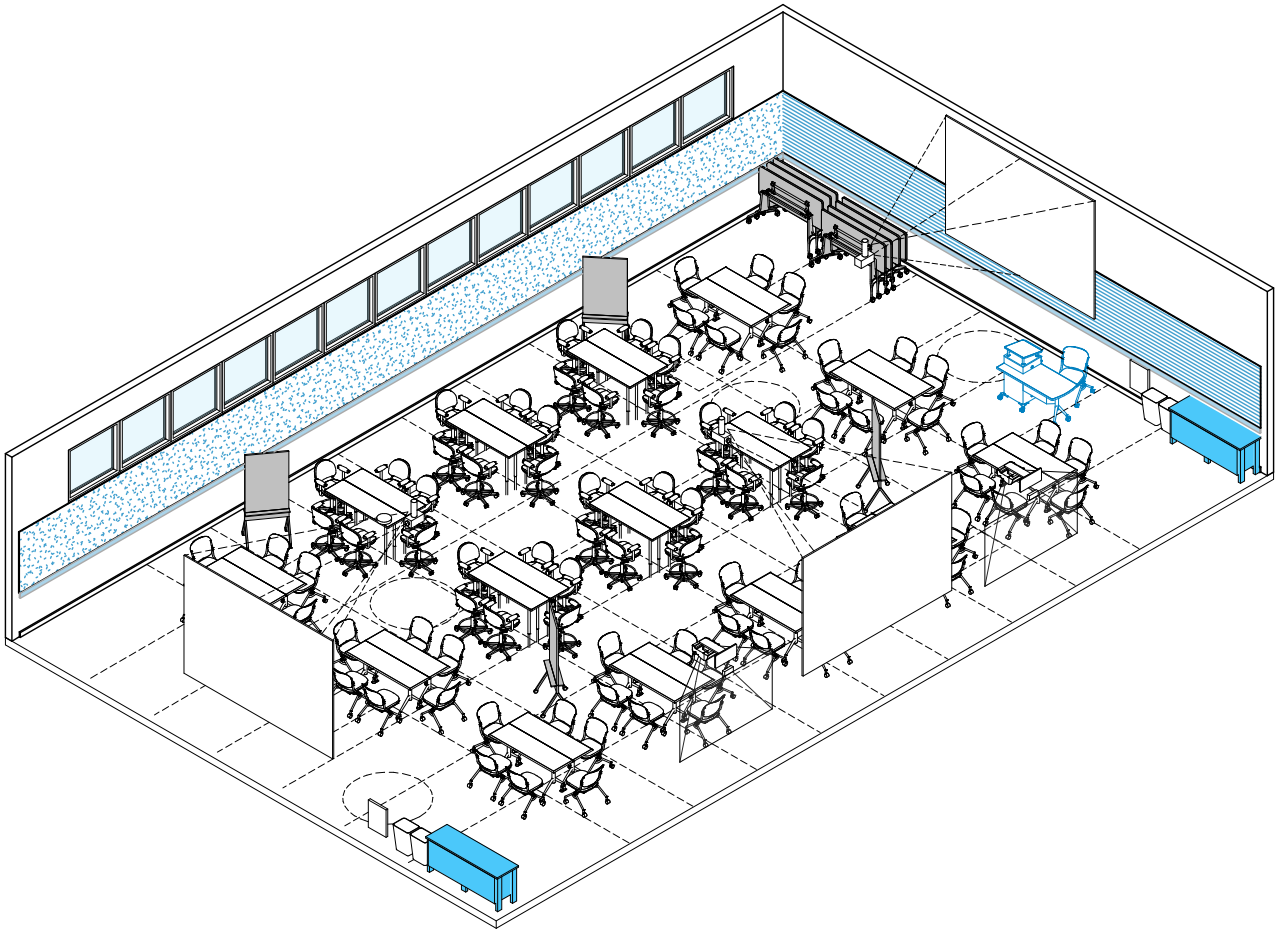
CONCEPTUAL DESIGN (GROUPWORK MODE 1)



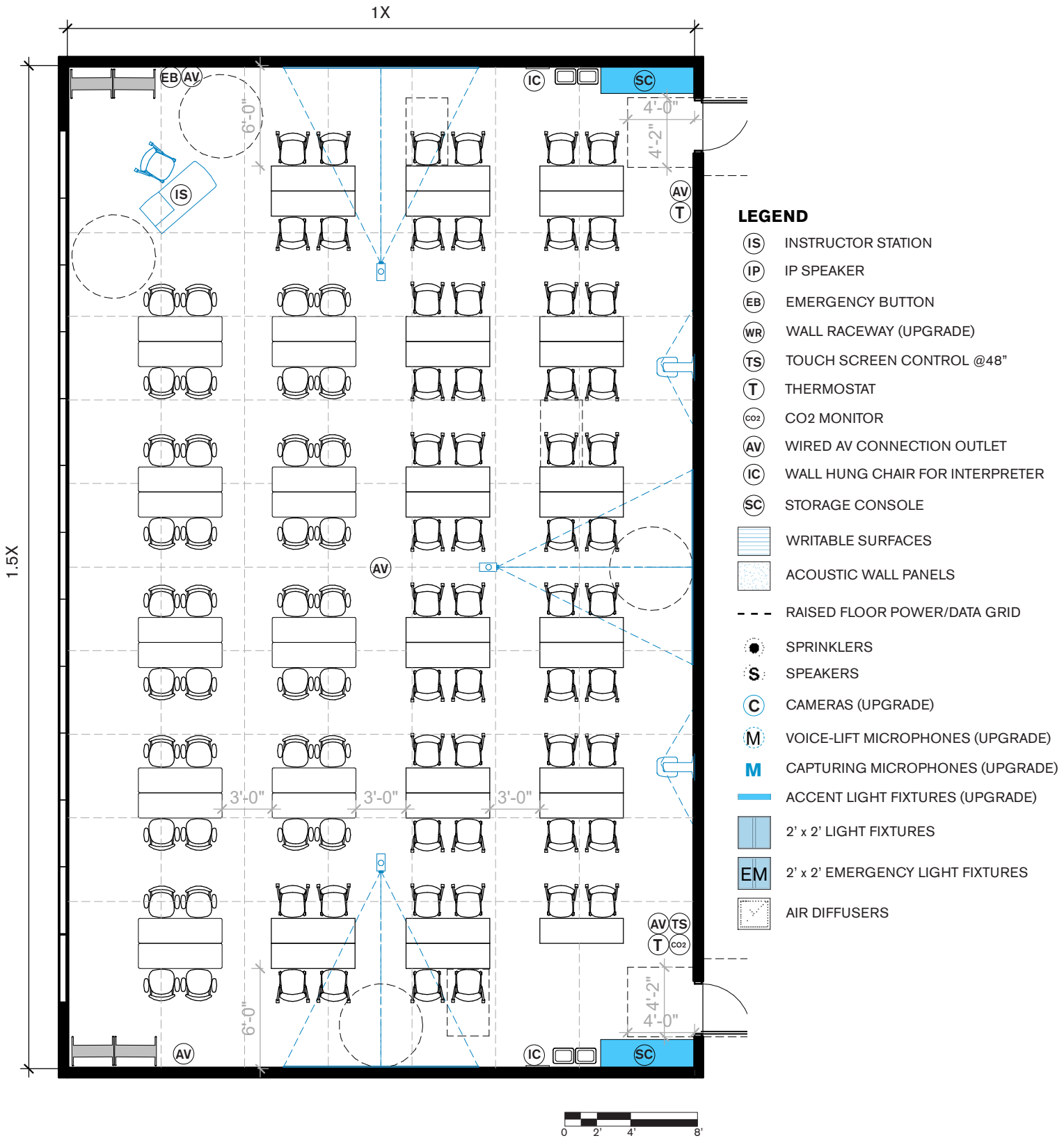
LEGEND

- IS — INSTRUCTOR STATION
- IP — IP SPEAKER
- EB — EMERGENCY BUTTON
- WR — WALL RACEWAY (UPGRADE)
- TS — TOUCH SCREEN CONTROL @48"
- T — THERMOSTAT
- CO2 — CO2 MONITOR
- AV — WIRED AV CONNECTION OUTLET
- IC — WALL HUNG CHAIR FOR INTERPRETER
- SC — STORAGE CONSOLE
- WRITABLE SURFACES
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2' x 2' LIGHT FIXTURES
- EM — 2' x 2' EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS





CONCEPTUAL DESIGN (GROUPWORK MODE 2)



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- WRITABLE SURFACES
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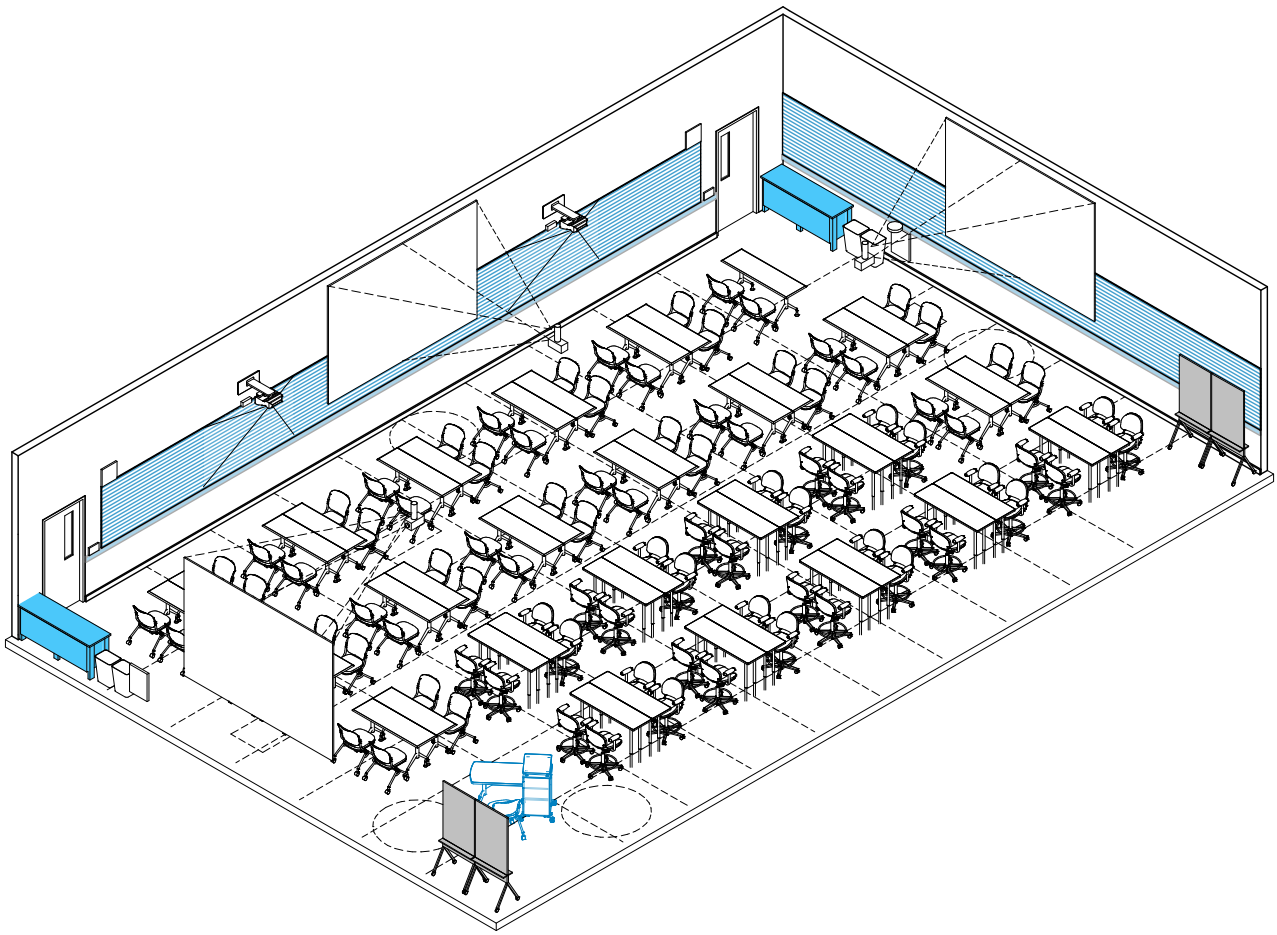
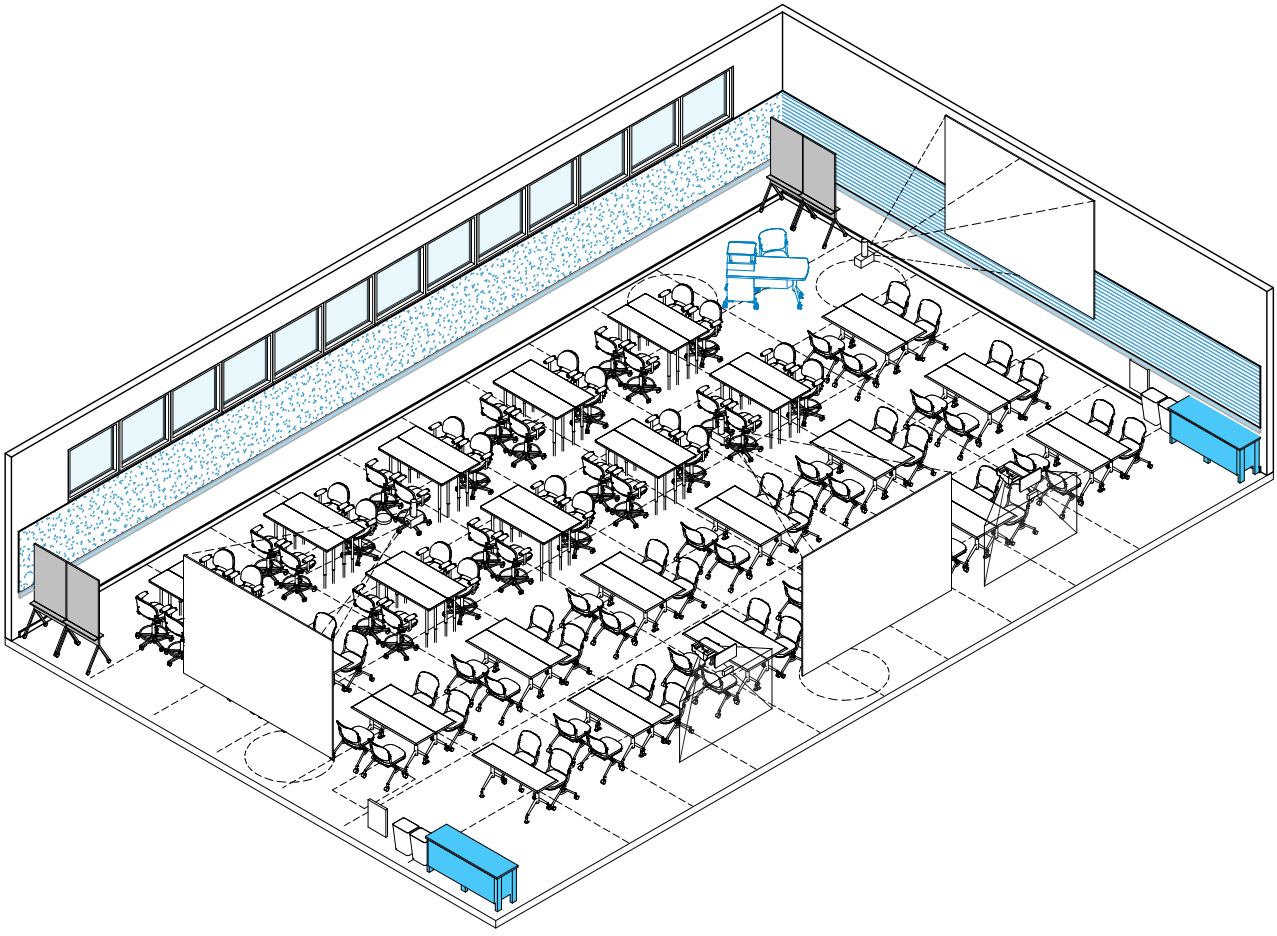
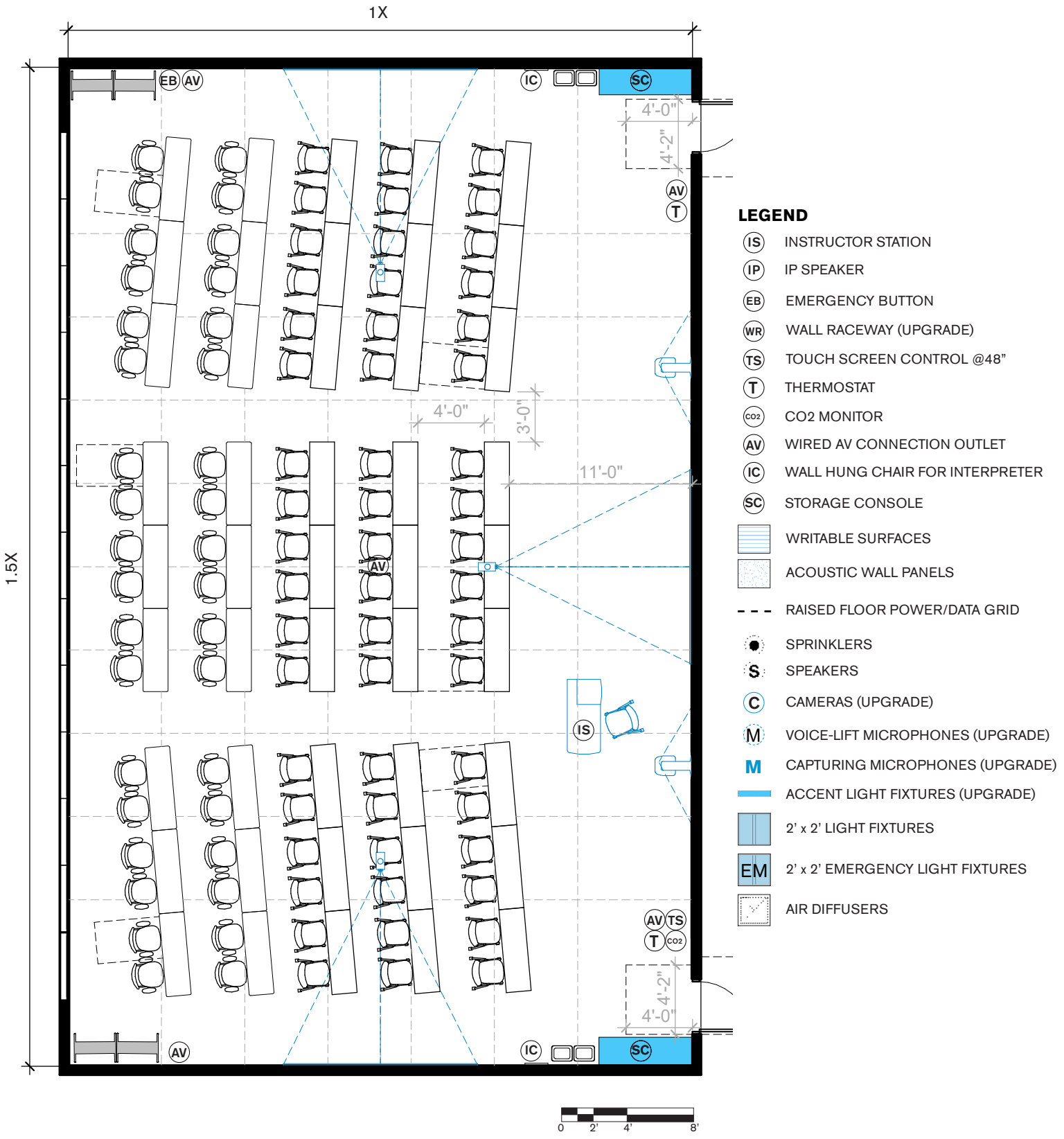
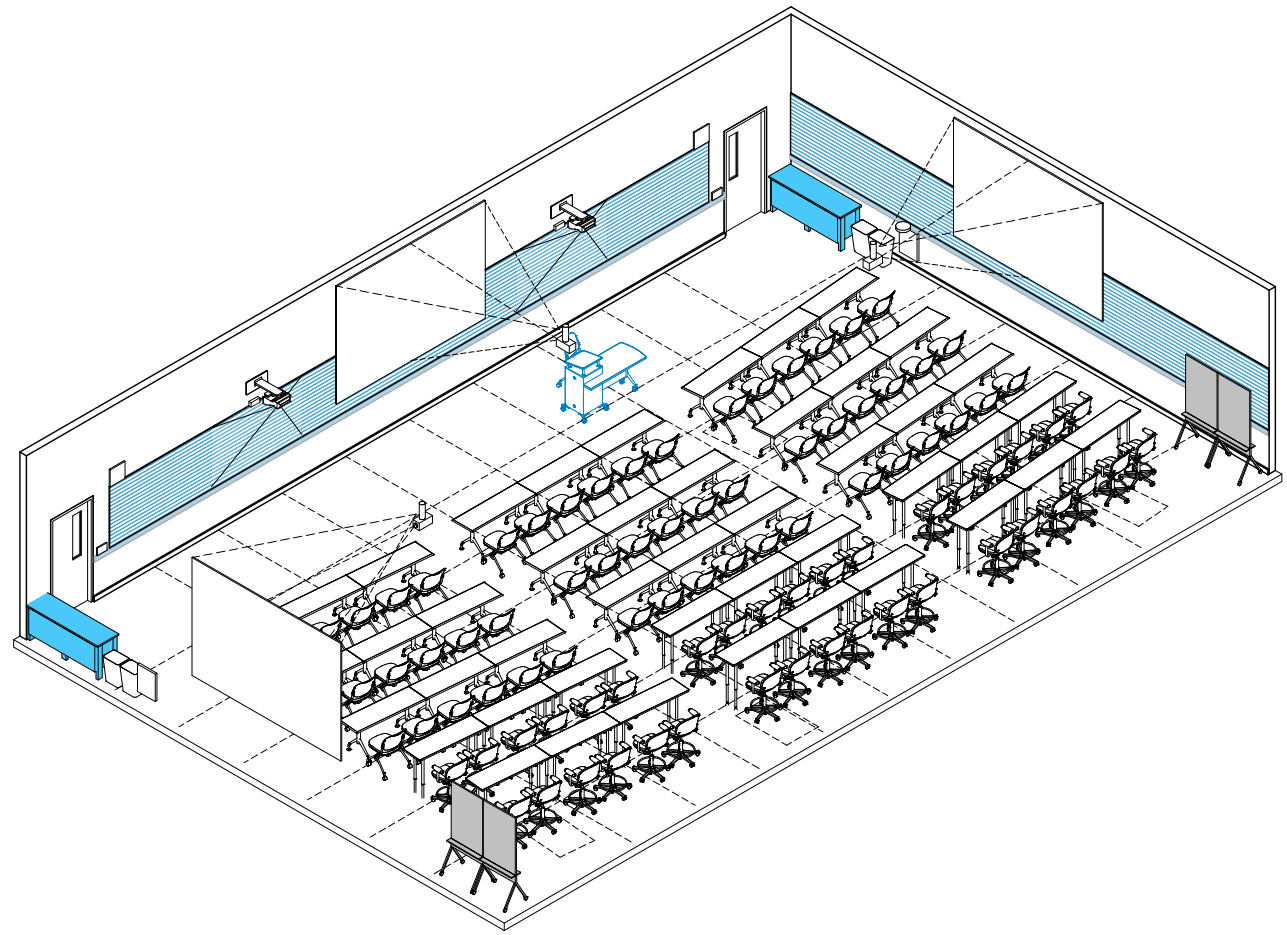
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2' x 2' LIGHT FIXTURES
- EM — 2' x 2' EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS

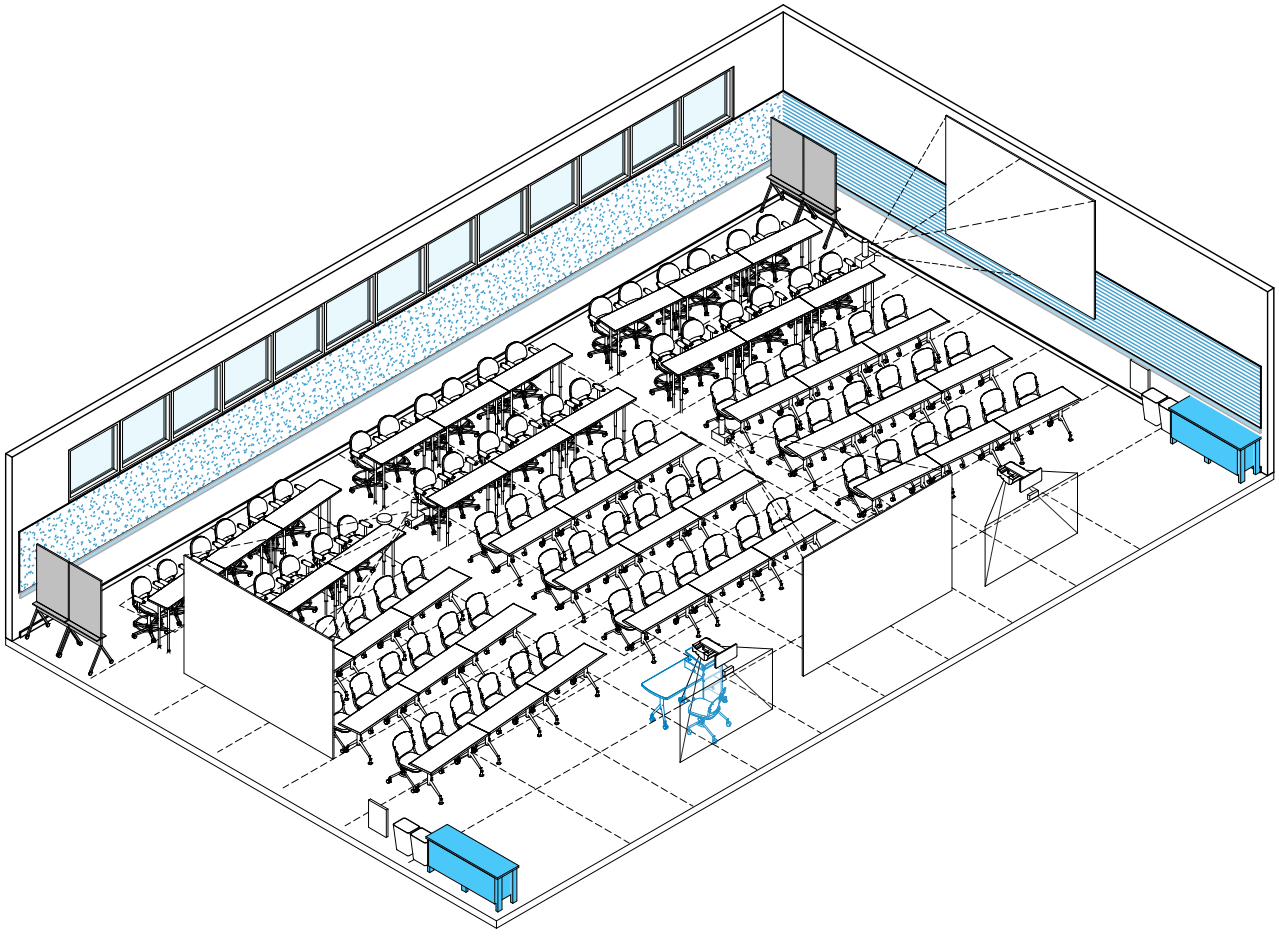




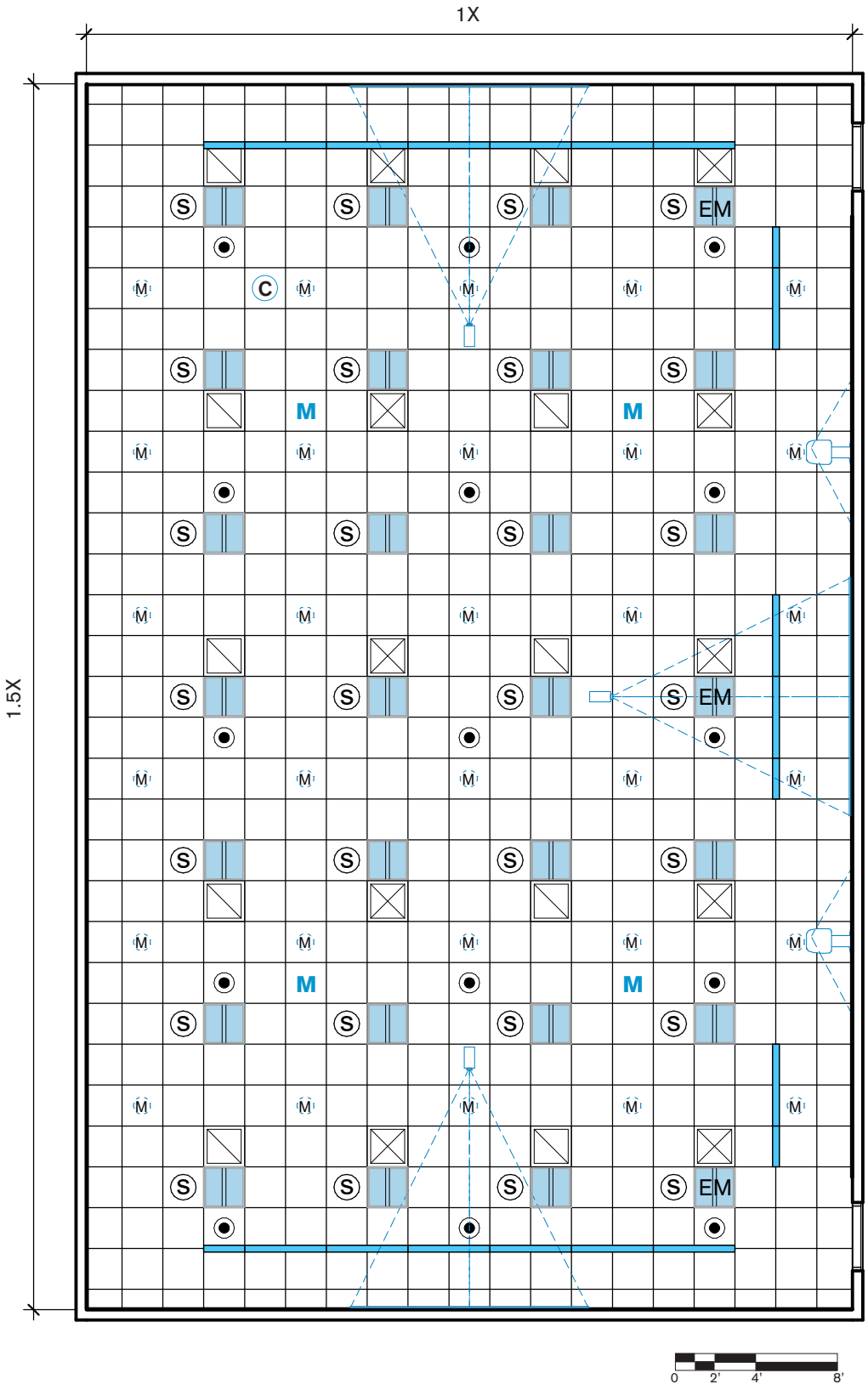
CONCEPTUAL DESIGN (LECTURE MODE)







CONCEPTUAL DESIGN (REFLECTED CEILING PLAN)



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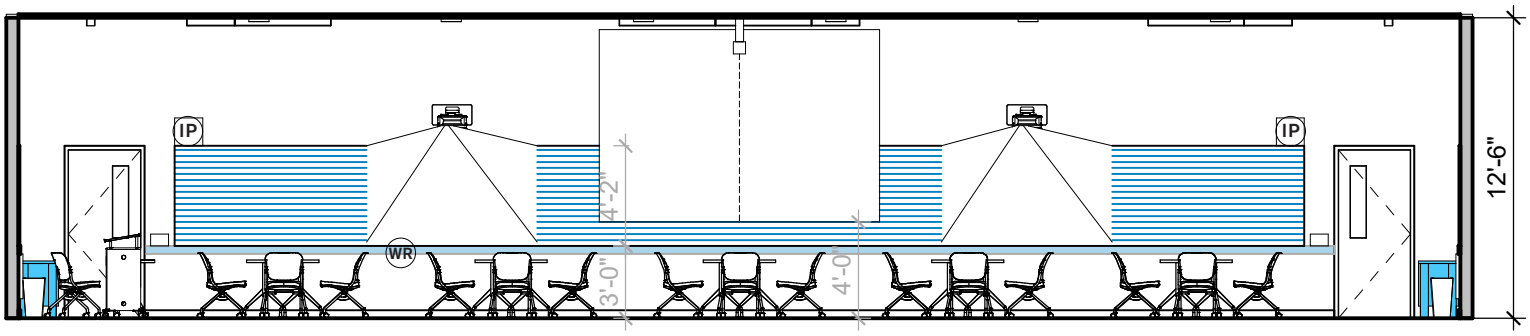
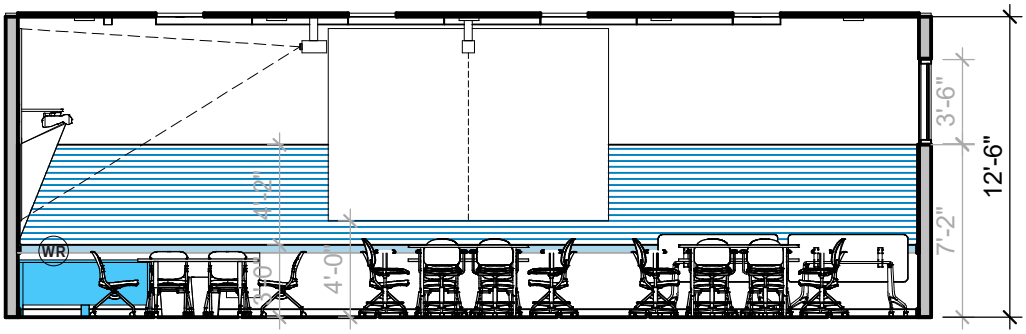
- CO2 — CO2 MONITOR
- AV — WIRED AV CONNECTION OUTLET
- IC — WALL HUNG CHAIR FOR INTERPRETER
- SC — STORAGE CONSOLE
- WRITABLE SURFACES
- ACOUSTIC WALL PANELS
- RAISED FLOOR POWER/DATA GRID
- SPRINKLERS
- S — SPEAKERS
- C — CAMERAS (UPGRADE)
- M — VOICE-LIFT MICROPHONES (UPGRADE)
- M — CAPTURING MICROPHONES (UPGRADE)
- ACCENT LIGHT FIXTURES (UPGRADE)
- 2' x 2' LIGHT FIXTURES
- EM — 2' x 2' EMERGENCY LIGHT FIXTURES
- AIR DIFFUSERS

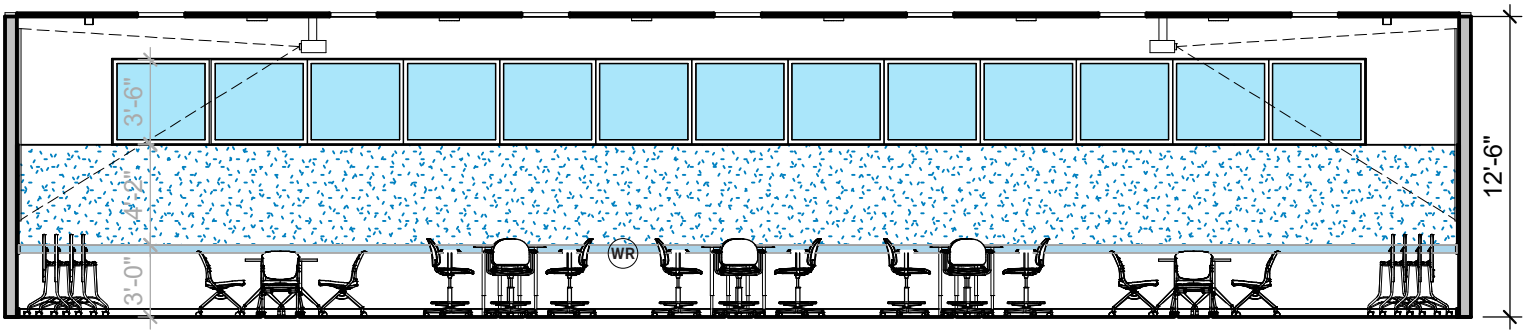
CONCEPTUAL DESIGN (ELEVATIONS)



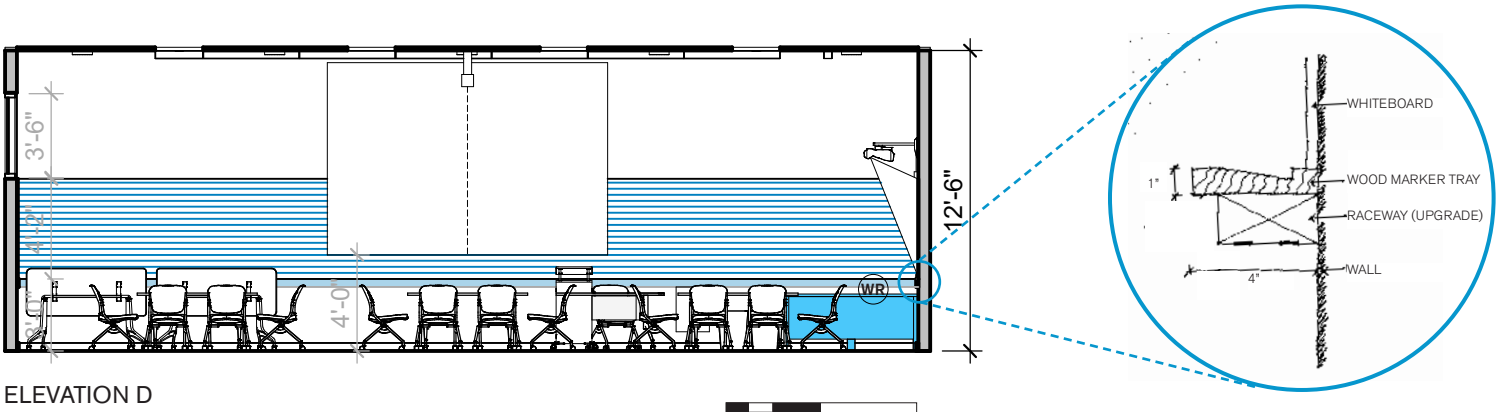
ELEVATION A



ELEVATION B



ELEVATION C



ELEVATION D

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07
APPENDIX

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HIGHER EDUCATION TRENDS

Learning environments need to adapt to the changing pedagogy that focuses on 'learning by doing'. Many campuses are moving in this direction to maximize student engagement. This section highlights some research articles and case studies, shared by the stakeholders and WRNS Studio, that reflect a few current and future trends in Higher Education. To access the full articles, visit the project mircowebsite: www.dvcclassroomdesignstandards.com

Rethinking the Classroom, Herman Miller Solution Essay, 2008

This research article explains the relationship between active teaching/ learning methods and student retention rates. It emphasizes on a holistic learning environment that physically and physiologically promotes experiential learning, problem-solving/ communication skills and builds a sense of identity/ belonging.

Reimagining the Modern Classroom, The Atlantic, 2016

This research article underlines the pedagogical shift from the traditional hierarchical classroom layout to the current, more democratic group layouts. It lays stress on the 'student-centered' environments that help build 'skills for life' with art, plants, color, light, air etc. as important elements enriching the learning space.

Odegaard's Active Learning Classrooms, SCUP 2017 Pacific Conference

This session explored how Odegaard's 24-hour active learning classrooms have become sites for pedagogical transformation and unexpected collaborations. It showcases that resource-rich environments with robust support can multiply opportunities for students, faculty, and staff to learn and collaborate. A two year post-occupancy study was conducted to analyze the pros and cons of the project.

"Transformations: Putting the Student First", SCUP 2017 Pacific Microsymposium, Stanford University

The microsymposium investigated how learning environments can best support innovative, supportive, and experiential learning. A panel of thought leaders discussed the importance of considering physical space, curriculum development and the unique experiences of first-year and/or first-generation students. Further, a series of tours exemplified a range of spaces, including how technology can be leveraged in a multi-purpose room to enhance collaborative learning, how flexibility can be created within a space with minimal intervention and how these innovative learning environments impact student learning.

LIGHTING PRINCIPLES & TRENDS

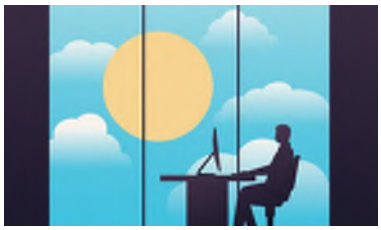
Lighting has proven to have positive impacts on the learning environments by improving student behavior, attention and health. Many campuses are moving to maximize the benefits from lighting, both through natural and artificial light. This section highlights some research articles and case studies, shared by WATT Lighting, that reflect a few current and future trends in Higher Education. To access the full articles, visit the project mircowebsite: www.dvcclassroomdesignstandards.com

Tuning the Light in Classrooms, Department of Energy, 2017
This research article for an elementary school highlights the faculty response and impact of color change on student behavior/ learning.

Tunable White Case Studies, Technology Development Workshop, Department of Energy, 2016
This presentation of case studies showcases renderings highlighting different light fixture color temperature and impact on the room environment.

Lighting Up Learning, 2015
This research article underlines the concept of human-centric lighting improving learning environment and student health.

The Benefits of Natural Light, 2014
This article reinforces the benefits of daylight on human efficiency and productivity thereby suggesting higher learning and retention rates for students.



Windows and Classrooms, 2003
This study investigates whether daylight and other aspects of the indoor environment in elementary school student classrooms have an effect on student learning, as measured by their improvement on standardized math and reading tests over an academic year.

Lighting Code Summary

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PROJECT:	Diablo Valley College (DVC 17004)
DATE:	11/10/17
MEMO OBJECT:	Lighting Code Summary – 50% Page Turn

Memo Distribution:

NAME	ORGANIZATION
Jason Neches	WATT
Prairna Gupta-Garg	WRNS
Lilian Asperin	WRNS

Electric lighting for the Diablo Valley College Classroom Standards shall follow the following codes / standards:

Applicable Lighting Codes & Standards:

1. **2016 California Building Standards Code (aka "Title 24") – Effective 1/1/17**
    a. **Part 3 Electrical** Code – Installation requirements and egress lighting levels. The California Electrical Code (CEC) contains electrical design and construction standards. Provisions contained in the CEC provide minimum standards to safeguard life or limb, health, property, and public welfare, and to protect against hazards that may arise from the use of electricity by regulating and controlling the design, construction, installation, quality of materials, location and operation of electrical equipment, wiring, and systems. This volume is pre-assembled with the National Electrical Code of the National Fire Protection Association (NFPA) with necessary California amendments.
    b. **Part 6 Energy Code, Subchapter 4** – Lighting control and dimming requirements. The California Energy Code contains energy conservation standards applicable to all residential and non-residential buildings throughout California, including schools and community colleges
        i. Occupancy/Vacancy Sensors (turns of electric lights after a period of vacancy)
        ii. Daylight Dimming (dimming of electric lights if sufficient daylight is available in prescribed daylighting zones)
        iii. Demand Response (dimming of lighting upon request of local power utility)
            1. For new construction …. "Buildings greater than 10,000 ft² shall be capable of automatically reducing lighting power in response to a Demand Signal. Total lighting power must have the ability to automatically be lowered by a minimum of 15% of the installed wattage upon receipt of a demand response signal sent by demand response program implementers."
            2. For renovation with 10% or more of existing luminaires in enclosed space are "altered" (replaced, relocated) or new fixtures are added, then lighting must comply with Demand Response requirement.
            3. Exception to Demand Response requirement in existing building renovation is when new lighting < 85% of lighting power allowance per the "Area Category Method" in Section 140.6(c)2.
    c. **Part 6 Energy Code, Subchapter 5** – Energy use (Lighting Power Density, aka LPD)
        i. Using "Complete Building Method"
            1. 0.95W/sf for "School Buildings" per Table 104.6-B

Lighting Code Summary

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2. Power adjustment factors (PAF) may be available for typical classrooms (if needed) for additional wattage allowance under certain control scenarios per Table 104.6-A.
    a. Note that only one PAF may be used for each qualifying light fixture (aka luminaire) unless otherwise noted.
    b. Lighting controls that are required for compliance with Part 6, Subchapter 4, shall not be eligible for a PAF.
    c. Daylight Dimming plus OFF Control:
        i. 10% additional wattage for the luminaires in the primary sidelit daylight zone.
    d. Institutional Tuning (presetting of light fixtures to max 85% of full light output or full power draw). This PAF allowance CAN be added to other PAFs:
        i. 10% additional for luminaires in non-daylight areas
        ii. 10% for luminaires in daylight areas.
    e. Demand Responsive Control for building types less than 10,000sf. This PAF allowance CAN be added to other PAFs:
        i. 5% additional wattage for affected luminaires.

ii. Using the "Area Method"
1. 1.20W/sf for "Classroom, lecture, training, vocational areas" per Table 140.6-C
2. Additional lighting power allowance "per linear foot of white board or chalk board" = 5.5W/LF per Table 140.6-C.
3. This additional power allowance for the white board is not permissible if Complete Building Method or Tailored Method is used for any area in the building.

iii. Using the "Tailored Method"
1. The Tailored Method is not permitted for "Classroom, lecture, training, vocational" area types.

d. **Part 9 California Fire Code, Section 1008 Means of Egress Illumination**.
    i. Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured along the path of egress at floor level.
    ii. Illumination levels shall be permitted to decline to 0.6 footcandle (6 lux) average and a minimum at any point of 0.06 footcandle (0.6 lux) at the end of the emergency lighting time duration.
    iii. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.
    iv. The large classroom is classified as a "place of assembly" per the California Fire Code and egress lighting for the large classroom shall comply with any additional "place of assembly" requirements (if any).

2. **CalGreen Building Standards Code (Part 11 of Title 24) – Effective 1/1/17**. The California Green Building Standards Code contains standards applicable to residential and non-residential buildings throughout California, including schools and community colleges.
    a. For energy efficiency mandatory measures, CalGreen refers back to Title24 Part 6.
    b. Appendix A5 of CalGreen describes "Voluntary Measures" (aka Tiers) for Non-Residential Buildings that allow a project to go beyond basic CalGreen requirements if mandated by owner / local jurisdiction.
    c. Tier 1 mandates 90% of Title 24 allowance for total indoor energy budget
    d. Tier 2 mandates 85% of Title 24 allowance for total indoor energy budget
    e. Both Tier 1 and Tier 2 mandates 90% of Title24 outdoor lighting power

Lighting Code Summary

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f. Appendix A6 of CalGreen includes large chapter on Lighting (A5.209) within “Voluntary Standards for Health Facilities” that is referenced as part of the voluntary Tier 1 / Tier 2 aspect of CalGreen.
g. Owner to clarify if these additional “Voluntary Tiers” are required for the project as part of CalGreen compliance.

3. The project lighting shall comply with LEED requirements if instructed.
4. The project lighting shall comply with Diablo Valley College Classroom Standards.
5. The project lighting shall comply with the Illuminating Engineering Society of North America (IESNA) Recommended Practice on Lighting for Educational Facilities (RP-3-13). For quick reference, target light levels and uniformity ratios are provided with the Diablo Valley College Classroom Standards document.

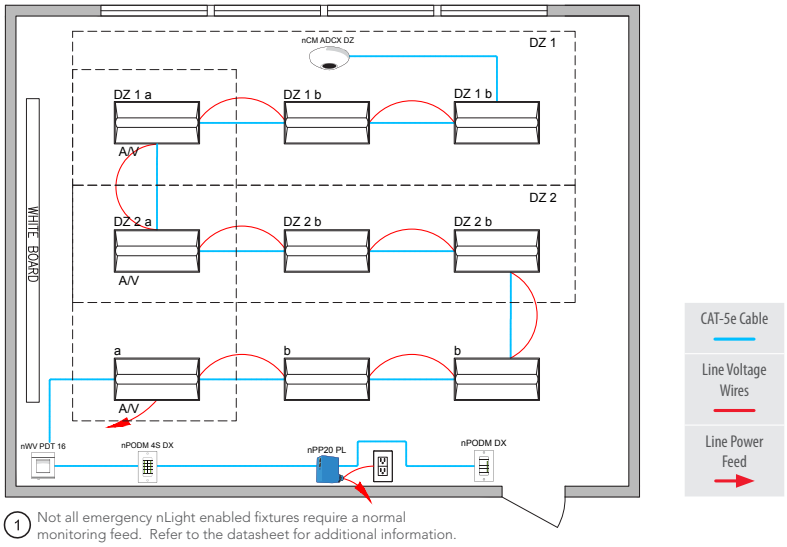
Lighting Control Diagrams

Typical Classroom wiring diagram and control schematic for digital addressable fixtures

14 CLASSROOM* with nLight Enabled Fixtures

Supports the Following Requirements:

- Local Switch (Section 130.1a)
- Multi-Level Lighting (Dimming) Control (Section 130.1b)
- Automatic Full-Off and Partial On via Occupancy Sensors (Section 130.1c)
- Areas with less than 120W in the primary Daylight zone do not require automatic daylight harvesting (Section 130.1d)
- Automatic Demand Response (ADR) ready (Section 130.1e)



(1) Not all emergency nLight enabled fixtures require a normal monitoring feed. Refer to the datasheet for additional information.

Bill of Materials

Symbol	Qty	Product #	Description
	9	See Appendix A	nLight Enabled Fixture
	1	nPP20 PL	Plug Load Relay Pack
	1	nPODM DX	On/Off & Raise/Lower WallPod
	1	nCM ADCX DZ	Automatic Dimming Control Photocell
	1	nWV PDT 16	Dual Technology Wide View Occupancy Sensor

Options

	1	nPODM 4S DX	Teacher Station - 4 Scene Control & Master On/Off/Raise/Lower

OPERATION DETAILS:

Lights:
- All lights are dimmable
- Each fixture independently controllable
- Maximum level can be limited (i.e., task tuned) to 80%
- Optional Automatic lumen compensation

Occupancy Control:
- Partial-On Occupancy Sensors automatically activate between 50-70 percent of controlled lighting power or fixtures must be turned on manually
- Lights automatically turn off when room becomes vacant

Daylight Control:
- Smooth continuous dimming
- Custom grouping of fixtures into separate daylight zones (max. number of zones = number of fixtures)

Manual Control:
- Master on/off & raise/ lower control of entire room
- Optional 4 scene control

ADDITIONAL OPTIONS:

- Surface or recessed mount sensors also available
- Add Graphic WallPod (model **nPOD GFX**) to add up to 16 manual controls and 16 scenes
- Room can be connected to nLight backbone to enable network control or ADR (see pg. 26)
- Occupancy sensors can be used to control HVAC systems via an optional relay contact "AR" or through a system wide BACNET control interface option on the Eclypse controller.

**Apply this design to classrooms, lecture halls or training rooms.*

www.acuitycontrols.com • 800-535-2465

Lighting Control Diagrams

Lighting Control Diagram using "digital addressing" feature

MEDIUM CLASSROOM
GROUPWORK MODE 1

Scene 1
Classroom welcome/exit (with daylighting)

Lighting control groups running parallel to the window wall in the conventional zoning strategy. This strategy also works well when the primary A/V projection wall is directly opposite the windows.

These two rows of lights closest to the clerestory windows are dimmed automatically if available daylight per Title24 requirements (aka *daylight dimming*)

MEDIUM CLASSROOM
GROUPWORK MODE 1

Scene 2
Large format projection

During A/V mode, the window wall shades are lowered, overriding the daylight dimming requirements. With digital addressing of light fixtures, control zoning is no longer limited to daylight zones.

Primary projection wall is now this wall. Light fixture zoning immediately reconfigures due to the digital addressing of individual light fixtures.

These wallwashers can be independently controlled to provide some direct light on writable surfaces during A/V mode

Lighting Control Diagrams

Lighting Control Diagram using "digital addressing" feature

MEDIUM CLASSROOM
GROUPWORK MODE 1

Scene 3
Center bright (i.e. gather in center of room)

Any grouping of light fixtures becomes possible with digital addressing. Decisions about control zoning are unrelated to fixture wiring, and can be changed at any time via software interface (rather than electrical wiring).

Target Light Level Chart

Applications and Tasks[a]	Notes	Recommended Maintained Illuminance Targets (lux)[b,c,d] Horizontal (E_h) Targets: Visual Ages of Observers (years) where at least half are <25	25-65	>65	Vertical (E_v) Targets: Visual Ages of Observers (years) where at least half are <25	25-65	>65	Uniformity Targets[e] Over Area of Coverage: 1st ratio $E_h/2^{nd}$ ratio E_h if different uniformities apply Max:Avg	Avg:Min	Max:Min	Typical Area of Coverage[b] Task Area	Room or Area
		Category / Gauge			Category / Gauge							
AUDITORIA	(Multipurpose continued)											
No AV	E_h @2' 6" AFF; E_v @4' AFF	R 250	500	1000 Avg	O 100	200	400 Avg		3:1			
• Dancing (Social)	E_h @dance floor; E_v @5' AFF	K 25	50	100 Avg	I 15	30	60 Avg		3:1			
• Exhibition	E_h @2' 6" AFF; E_v @5' AFF	P 150	300	600 Avg	O 100	200	400 Avg		3:1			
• Study	Typical paper and/or laptop	P 150	300	600 Avg	M 50	100	200 Avg		3:1			
• Testing	E_h @2' 6" AFF; E_v @4' AFF											
· Combination	Typical paper and/or laptop	P 150	300	600 Avg	M 50	100	200 Avg		2:1			
· Laptop only	CSA/ISO Type I and II negative polarity screens.[i]	N 75	150	300 Avg	K 25	50	100 Avg		2:1			
· Paper only	Variety of paper tasks[j]	Q 200	400	800 Avg	N 75	150	300 Avg		2:1			
• Performance	Dedicated to artistic performances (likely fixed seating); For dedicated theaters see **IES HB, 10th Edition, Chapter 28 | LIGHTING FOR HOSPITALITY AND ENTERTAINMENT**											
• House	As the architect coordinates contrast markings with steps, curbs, and ramps, localized lighting may be deemed appropriate.											
· During event	E_h @floor; E_v @4' AFF	2	2	2 Min	F 5	10	20 Avg		5:1/3:1			
· Pre/Post event	E_h @floor; E_v @5' AFF	L 37.5	75	150 Avg	K 25	50	100 Avg		3:1			
• Stage												
· Access ramps/stairs	See AUDITORIA/Circulation											
· Amateur productions												
Dance (performance)	E_h and E_v @5' AFF	P 150	300	600 Avg	R 250	500	1000 Avg		1.5:1			
Demonstration	E_h @3' AFF; E_v @4' 6" AFF	T 500	1000	2000 Avg	R 250	500	1000 Avg		3:1			
Music	E_h and E_v @4' AFF	P 150	300	600 Avg	R 250	500	1000 Avg		2:1			
Theater	Simple, no stage lighting cues. E_h and E_v @5' AFF	P 150	300	600 Avg	P 150	300	600 Avg		2:1			
· Professional productions	Stage lighting as determined by production crew; See IES DG-20 | Stage Lighting **A Guide to the Planning of Theatres and Auditoriums** for guidance on architectural and electrical infrastructure											
• Prefunction	Anteroom or transition space adjoining auditorium											
• During event	E_h @floor; E_v @4' AFF	K 25	50	100 Avg	I 15	30	60 Avg		3:1			
• Pre/Post event, intermission	E_h @floor; E_v @5' AFF	N 75	150	300 Avg	L 37.5	75	150 Avg		3:1			
• Sound and light lock	Transition from lobby or foyer space adjoining auditorium											
• During event	E_h @floor; E_v @5' AFF	2	2	2 Min	I 15	30	60 Avg		5:1/3:1			
• Pre/Post event, intermission	E_h @floor; E_v @5' AFF	M 50	100	200 Avg	K 25	50	100 Avg		3:1			
BUILDING ENTRIES	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS**											
CLASSROOMS												
• Arts												
• Art Studies	E_h @2' 6"; E_v @4' AFF	R 250	500	1000 Avg	P 150	300	600 Avg		3:1			
• Graphic Arts												
· Displays												
Fine art	See **IES HB 10th Edition, Chapter 21 | LIGHTING FOR ART**											
Permanent/Temporary	Awards, student art, plaques											
Dimensional	E_h and E_v @artworks											

Table 3b: Illuminance values for educational facilities.

Applications and Tasks[a]	Notes	Recommended Maintained Illuminance Targets (lux)[b,c,d] Horizontal (E_h) Targets: Visual Ages of Observers (years) where at least half are <25	25-65	>65	Vertical (E_v) Targets: Visual Ages of Observers (years) where at least half are <25	25-65	>65	Uniformity Targets[e] Over Area of Coverage: 1st ratio $E_h/2^{nd}$ ratio E_h if different uniformities apply Max:Avg	Avg:Min	Max:Min	Typical Area of Coverage[b] Task Area	Room or Area
		Category / Gauge			Category / Gauge							
CLASSROOMS	(continued)											
Dark finish	<50% reflectance	Avg = 5 times E_h of surrounding space			Avg = 5 times E_h of surrounding space				4:1			
Light finish	≥50% reflectance	Avg = 3 times E_h of surrounding space			Avg = 3 times E_h of surrounding space				4:1			
Flat												
Horizontal	E_h and E_v @artworks											
Dark finish	<50% reflectance	Avg = 5 times E_h of surrounding space							4:1			
Light finish	≥50% reflectance	Avg = 3 times E_h of surrounding space							4:1			
Vertical	E_h and E_v @artworks											
Dark finish	<50% reflectance				Avg = 5 times E_h of surrounding space				4:1			
Light finish	≥50% reflectance				Avg = 3 times E_h of surrounding space				4:1			
· Drafting and Design	On drafting board or table											
· Blueline blueprint	Also see READING AND WRITING/Xerograph	R 250	500	1000 Avg	M 50	100	200 Avg	see **IES HB Table 12.6**				
· CAD (exclusively)	See READING AND WRITING/VDT Screen and Keyboard											
· CAD/paper mixed	See READING AND WRITING, establish tasks and normalize to illuminance of most important task or most common task; use controls to provide illuminance variability if tasks so demand.											
· Light table	On light table	M 50	100	200 Avg	I 15	30	60 Avg		2:1			
· Photographic (inspection)												
Color and B+W prints	E_h @2' 6"; E_v @4' AFF	R 250	500	1000 Avg	M 50	100	200 Avg	see **IES HB Table 12.6**				
· Negative lightbox	Architectural lighting illuminances on front of backlit light box	K 25	50	100 Max	K 25	50	100 Max	2:1	see **IES HB Table 12.6**			
• Kiln Room	E_h @2' 6"; E_v @4' AFF	R 250	500	1000 Avg	P 150	300	600 Avg		3:1			
• Music Room	E_h and E_v @4' AFF	P 150	300	600 Avg	O 100	200	400 Avg		2:1			
• General Classrooms												
• Learning/teaching	Interactive experience											
· AV (dedicated AV viewing)	E_h @2' 6"; E_v @4' AFF	K 25	50	100 Avg	I 15	30	60 Avg		2:1			
· Chalkboard					Q 200	400	800 Avg		3:1			
· Dedicated VDT screens	CSA/ISO Type I and II negative polarity screens.[i] E_h @2' 6"; E_v @4' AFF	N 75	150	300 Avg	K 25	50	100 Avg		2:1			
· Hardcopy and writing	Variety of paper tasks.[j] E_h @2' 6"; E_v @4' AFF	Q 200	400	800 Avg	N 75	150	300 Avg		2:1			
· Tack board					N 75	150	300 Avg		3:1			
· White board					P 150	300	600 Avg		3:1			
• Home Economics	At all food prep and detailed work areas	500	500	500 Min	O 100	200	400 Avg	see **IES HB Table 12.6**				
• Lecture Halls	See AUDITORIA/Lecture Hall											
• Science Lab												
• Bench	E_h @3'; E_v @4' 6" AFF	R 250	500	1000 Avg	P 150	300	600 Avg	see **IES HB Table 12.6**				
• Demonstration Area	E_h @3' AFF; E_v @4' 6" AFF	T 500	1000	2000 Avg	R 250	500	1000 Avg		3:1			
• Seminar Rooms	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS/CONFERENCING/Meeting**											

Table 3c: Illuminance values for educational facilities.

Target Light Level Chart

Table 3d: Illuminance values for educational facilities.

ANSI/IES RP-28-16

Applications and Tasks[a]	Notes	Recommended Maintained Illuminance Targets (lux)[b,c,d] Horizontal (E_h) Targets — Visual Ages of Observers (years) where at least half are					Vertical (E_v) Targets — Visual Ages of Observers (years) where at least half are				Uniformity Targets[e] Over Area of Coverage — 1st ratio E_h/2nd ratio E_v if different uniformities apply			Typical Area of Coverage[b]	
		<25	25-65	>65			<25	25-65	>65		Max:Avg	Avg:Min	Max:Min	Task Area	Room or Area
		Category			Gauge	Category				Gauge					
CLASSROOMS	(continued)														
• Shops	E_h @3' AFF; E_v @4' AFF. Also see 30 | LIGHTING FOR MANUFACTURING.														
• Assembly	Difficult process	T	500	1000	2000	Avg	R	250	500	1000	Avg	see **IES HB Table 12.6**			
• Inspection	Difficult process	T	500	1000	2000	Avg	R	250	500	1000	Avg	see **IES HB Table 12.6**			
• Machining	Medium benchwork	T	500	1000	2000	Avg	R	250	500	1000	Avg	see **IES HB Table 12.6**			
• Woodworking	Fine process	T	500	1000	2000	Avg	R	250	500	1000	Avg	see **IES HB Table 12.6**			
• Study Halls		P	150	300	600	Avg	O	100	200	400	Avg	2:1			
CONFERENCING	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS**														
DORMITORIES															
• Circulation	See TRANSITION SPACES/Circulation-Corridors														
• Dorm Room															
• Casual Reading	E_h @2' AFF; E_v @4' AFF	O	100	200	400	Avg	M	50	100	200	Avg	see **IES HB Table 12.6**			
• Desk	E_h @2'-6" AFF; E_v @4' AFF	Q	200	400	800	Avg	N	75	150	300	Avg	see **IES HB Table 12.6**			
• General	E_h @floor; E_v @5' AFF	J	20	40	80	Avg	G	7.5	15	30	Avg	4:1			
• Elevators	See TRANSITION SPACES/Elevators														
• Entries	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS/BUILDING ENTRIES**														
• Escalators/Moving Walkways	See TRANSITION SPACES/Escalators/Moving Walkways														
• Gallery (student work)	E_h and E_v @artworks	P	150	300	600	Avg	P	150	300	600	Avg	3:1			
• Game Room															
• Electronic	E_h @2'-6" AFF; E_v @4' AFF	K	25	50	100	Avg	I	15	30	60	Avg	3:1			
• Traditional	E_h @tables; E_v @4' AFF	P	150	300	600	Avg	K	25	50	100	Avg	see **IES HB Table 12.6**			
• Kitchen															
• In-suite	E_h and E_v @3' AFF	R	250	500	1000	Avg	L	37.5	75	150	Avg	see **IES HB Table 12.6**			
• Institutional	See 22 | LIGHTING FOR COMMON APPLICATIONS/Food Service														
• Student-use	E_h and E_v @3' AFF	R	250	500	1000	Avg	L	37.5	75	150	Avg	see **IES HB Table 12.6**			
• Laundry	E_h and E_v @3' AFF	P	150	300	600	Avg	K	25	50	100	Avg	3:1			
• Living Room	E_h @floor; E_v @4' AFF	P	150	300	600	Avg	K	25	50	100	Avg				
• Lobbies	See TRANSITION SPACES/Lobbies														
• Mailboxes	E_h @floor; E_v @mailbox faces	K	25	50	100	Avg	M	50	100	200	Avg	3:1			
• Media Lounge	E_h @2'-6" AFF; E_v @4' AFF	M	50	100	200	Avg	K	25	50	100	Avg	3:1			
• Multipurpose	E_h @2'-6" AFF; E_v @display walls	P	150	300	600	Avg	M	50	100	200	Avg	3:1			
• Toilets	See TOILETS/LOCKER ROOMS														
FOOD SERVICE	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS**														
IT	See **Table E1 | LIGHTING FOR COMMON APPLICATIONS**														
LIBRARIES	See **IES HB, 10th Edition, Chapter 29 | LIGHTING FOR LIBRARIES**														
PARKING	See **IES HB, 10th Edition, Chapter 26 | LIGHTING FOR EXTERIORS**														
PEDESTRIAN WAYS	See **IES HB, 10th Edition, Chapter 26 | LIGHTING FOR EXTERIORS**														

Target Light Level Chart

ANSI/IES RP-3-13

Table 3 notes

Notes

The table column headings are discussed in detail in the Illuminance Criteria Section. Refere to the discussion on procedures for establishing illuminance targets for a project.

a. Applications, tasks, or viewing specifics encountered on any given project may be different from these and may warrant different criteria. Refer to IES Lighting Handbook, Section 29.3.1 Applications and Tasks. The designer is responsible for making final determinations of applications, tasks, and illuminance criteria. Outdoor tasks are so noted.
b. Values cited are to be maintained over time on the area of coverage.
c. Values cited are consensus and deemed appropriate for respective functional activity. IN a few situations, code requirements are within 10% of IES recommendations. This is apparently an artifact of metrification. Footcandle conversions of any values cited in this table should be made at 1 fcc to 10 lx. Regardless, codes, ordinances, or mandates may supersede any of the IES criteria for any of the applications and tasks and the designer must design accordingly.
d. Targets are intended to apply to the respective plane or planes of the task.
e. Illuminance uniformity targets offer best results when planned in conjunction with luminance ratios and surface reflectances. Any parenthetical uniformity values reference respective parenthetical applications or tasks, such as a curfew situation associated with nighttime outdoor lighting.
f. Applications and tasks cited with a sunburst icon are candidates for strategies employing any combination of daylighting and electric lighting to achieve target values during daylight hours. Daylighting may require unconventional approaches.
g. Tasks with specular components, like computers with CSA/ISO Type III screens or printed tasks with glossy ink or glossy paper, are prone to veiling reflections. The likelihood of an application's or task's predisposition to veiling reflections is indicated by the reflected-light icon: black and white signals high likelihood; gray and white signals moderate likelihood; pale gray and white signals some likelihood; and all-white signals little-to-no likelihood.
h. The designer must establish areas of coverage to which targets apply. Green highlight identifies task proper or task area as the typical area of coverage for respective cited targets. Amber highlight identifies room or designated areas as the typical area of coverage for respective cited targets.
i. Nighttime illuminance targets are intended for application during dark hours of operations where lighting is deemed necessary or desirable. At curfew (client-or-jurisdiction-defined), if lighting is still deemed necessary or desirable, then reduce lighting as indicated.
j. Alternatively, design to specific tasks, if known, from READING AND WRITING.
k. For applications where task position is indefinite, such as some types of flexible meeting rooms, the typical area of coverage is "Room or Designated Area." For applications where task position is known, such as an office desk or a reading chair, a more efficient approach is likely achieved when target illuminance is applied to the "Task Proper or Task Area."
l. E_h and E_v elevations are based on conventional worksurface and seated eye height. Where other elevations are programmed, designer must adjust illuminance-criteria planes of interest accordingly.

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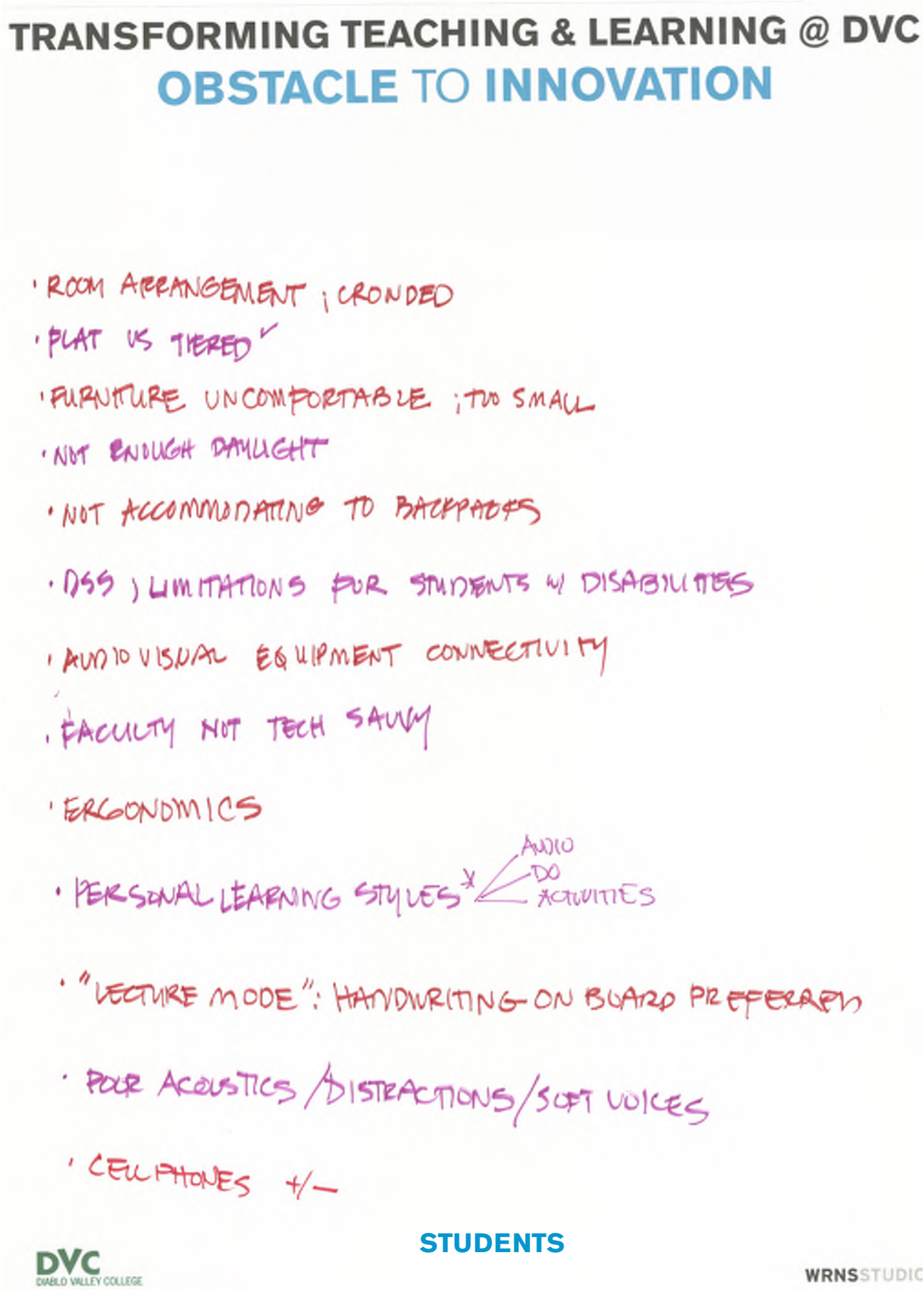
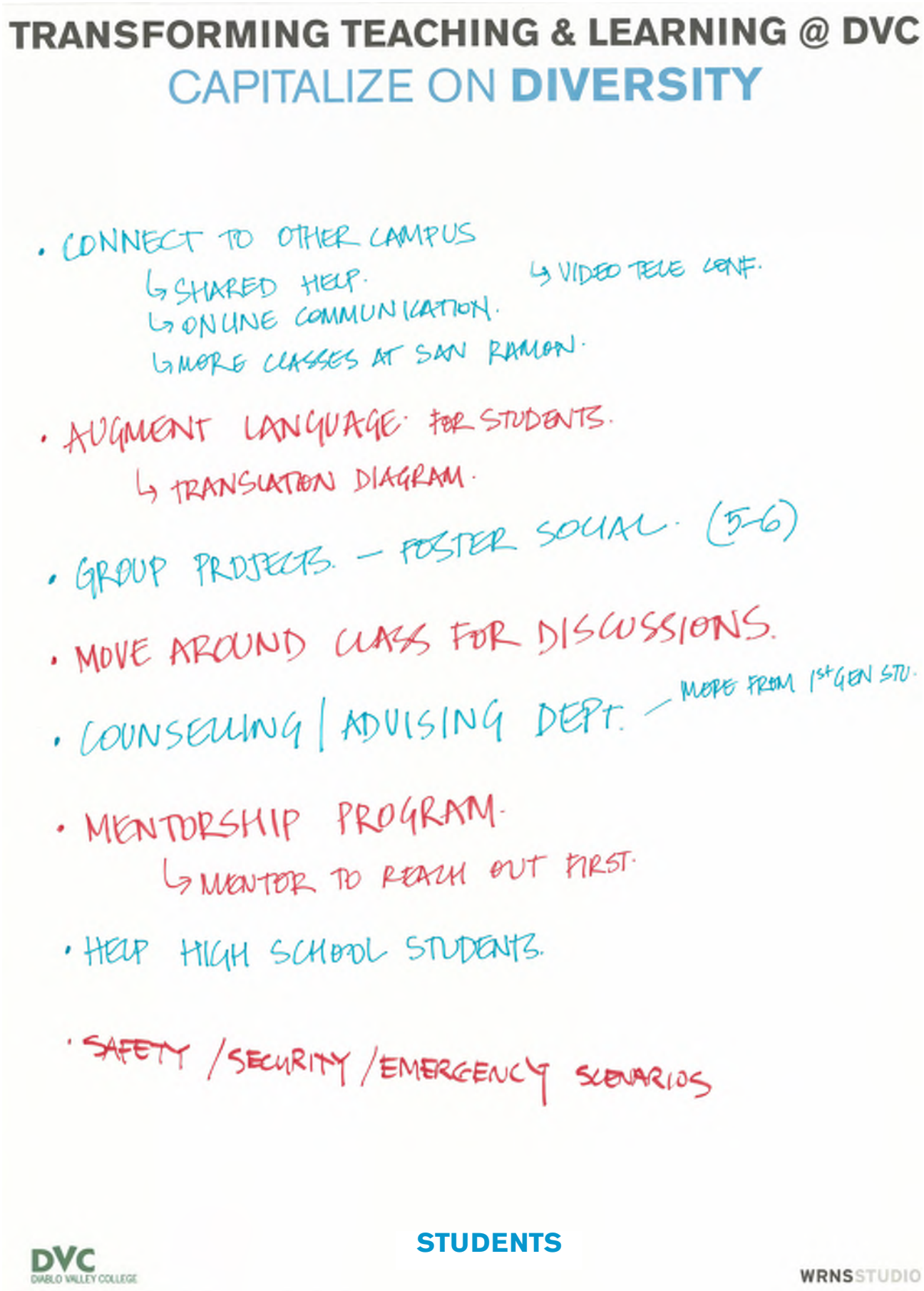
Debrief Posters from User Group Workshop (Sept 18, 2017)

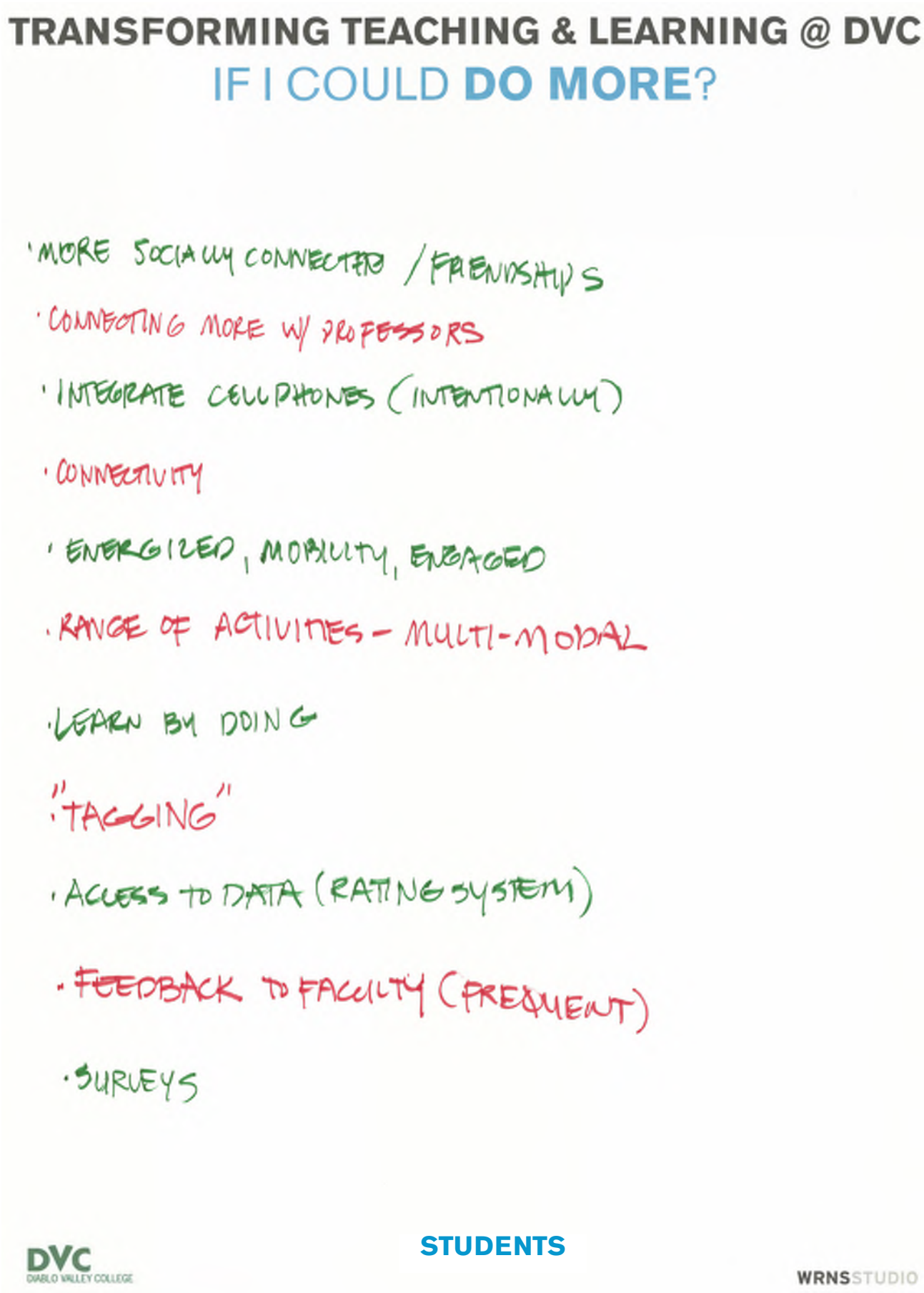


Debrief Posters from User Group Workshop (Sept 18, 2017)



STUDENTS

Debrief Posters from User Group Workshop (Sept 18, 2017)



Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ... EQUIPMENT TOOLKIT

WRITEABLE SURFACES

FIXED NON-ELECTRONIC WHITE BOARD

FIXED INTERACTIVE WHITE BOARD

MOVEABLE WHITE BOARD

WRITEABLE WALLS

CHAIRS

WHEELS/ STACKABLE

WHEELS/ STORAGE/ WORKSPACE

WHEELS/ CUSHION SEAT/ ADJUSTABLE HEIGHT

WHEELS/ FOOT REST/ ADJUSTABLE HEIGHT

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WHEELS/ OUTLETS

WHEELS/ OUTLETS/ ADJUSTABLE HEIGHT/ FOLDABLE

WHEELS/ FOLDABLE/ ROUND

FIXED/ OUTLETS/ ADJUSTABLE HEIGHT/ DISPLAY MEDIA

INSTRUCTOR STATION

MOVABLE
FIXED/ WORKSPACE/ BUILT-IN TECHNOLOGY/ STORAGE

MOVEABLE/ WORK-SPACE/ CONNECTED TECHNOLOGY

MOVEABLE/ DESK-PODIUM COMBINA-TION/ WIRELESS TECHNOLOGY/ STORAGE

MOVEABLE/ DESK-PODIUM COMBINA-TION (MORE WORK-SPACE)/ WIRELESS TECHNOLOGY

DVC DIABLO VALLEY COLLEGE

STUDENTS

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Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ... LEARNING DEVICE

SMART PHONE

NOTEBOOK

LAPTOP

AUDIO RECORDING

LECTURE CAPTURE

WRITEABLE SURFACES

STUDENTS

DVC DIABLO VALLEY COLLEGE

WRNSSTUDIO

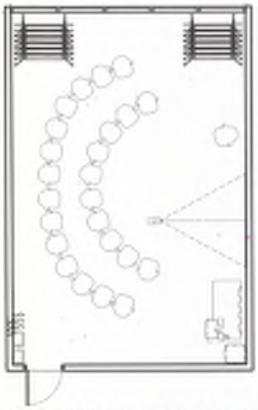
Debrief Posters from User Group Workshop (Sept 18, 2017)

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

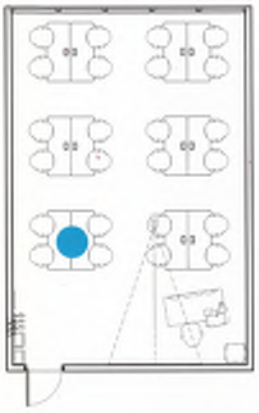
MY IDEAL...ROOM CONFIGURATION

(SMALL CLASSROOM ~ 25-30 students)



LECTURE/ SEMINAR SETTING

MOVEABLE FURNITURE FOR ALL-CLASS DISCUSSIONS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK W/ DESKS

GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK AND ACCESS TO DAYLIGHT

COLOR.
POSTERS.
QUOTES.
(in class+ hallway).
MURALS

STUDENTS

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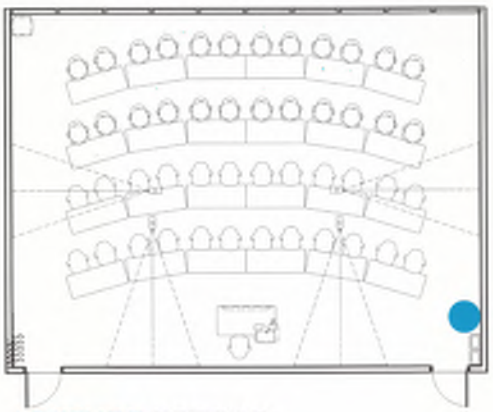
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

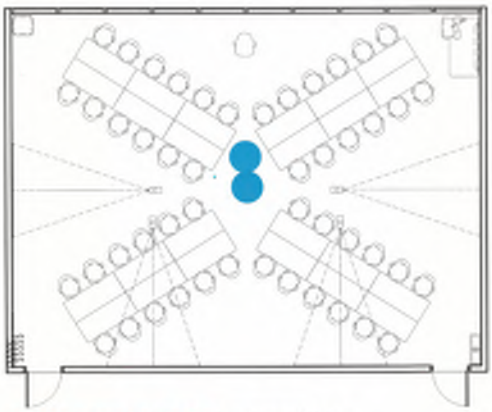
MY IDEAL...ROOM CONFIGURATION

(MEDIUM CLASSROOM ~ 40-50 students)



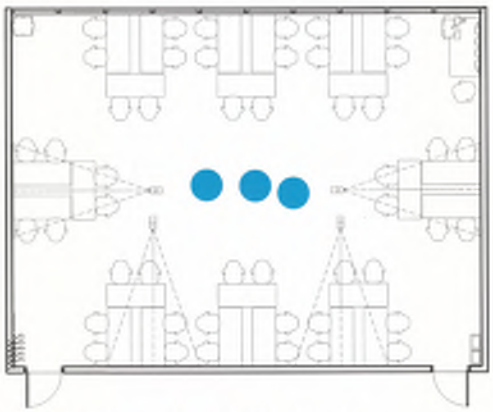
LECTURE SETTING

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

STUDENTS

DVC DIABLO VALLEY COLLEGE

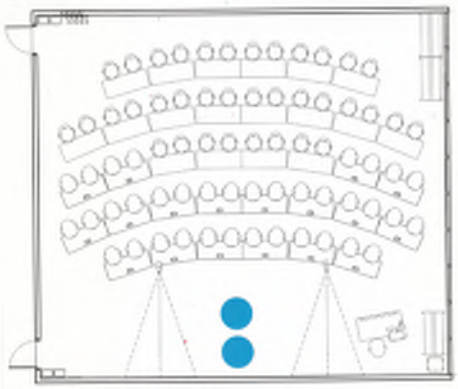
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

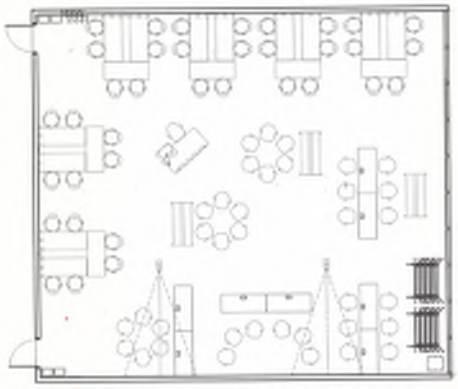
MY IDEAL...ROOM CONFIGURATION

(LARGE CLASSROOM ~ over 50 students)



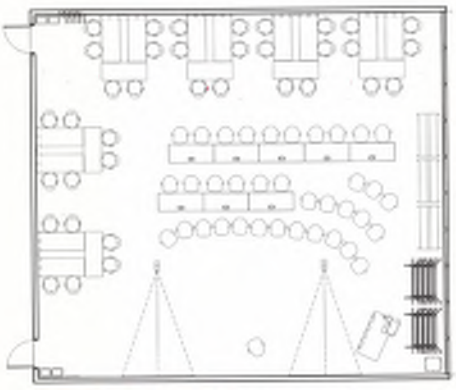
LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES

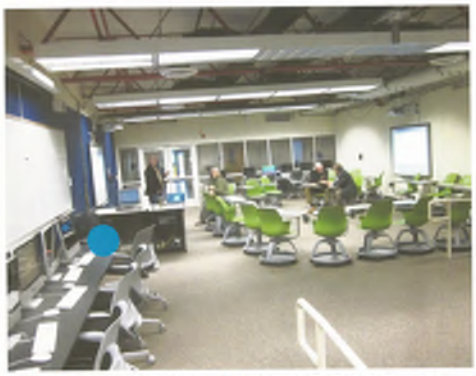


GROUP WORK SETTING

VARIETY OF FLEXIBLE WRITEABLE SURFACES, FURNITURE & DIGITAL MEDIA FOR COLLABORATION



GROUP WORK SETTING



MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

STUDENTS

DVC DIABLO VALLEY COLLEGE

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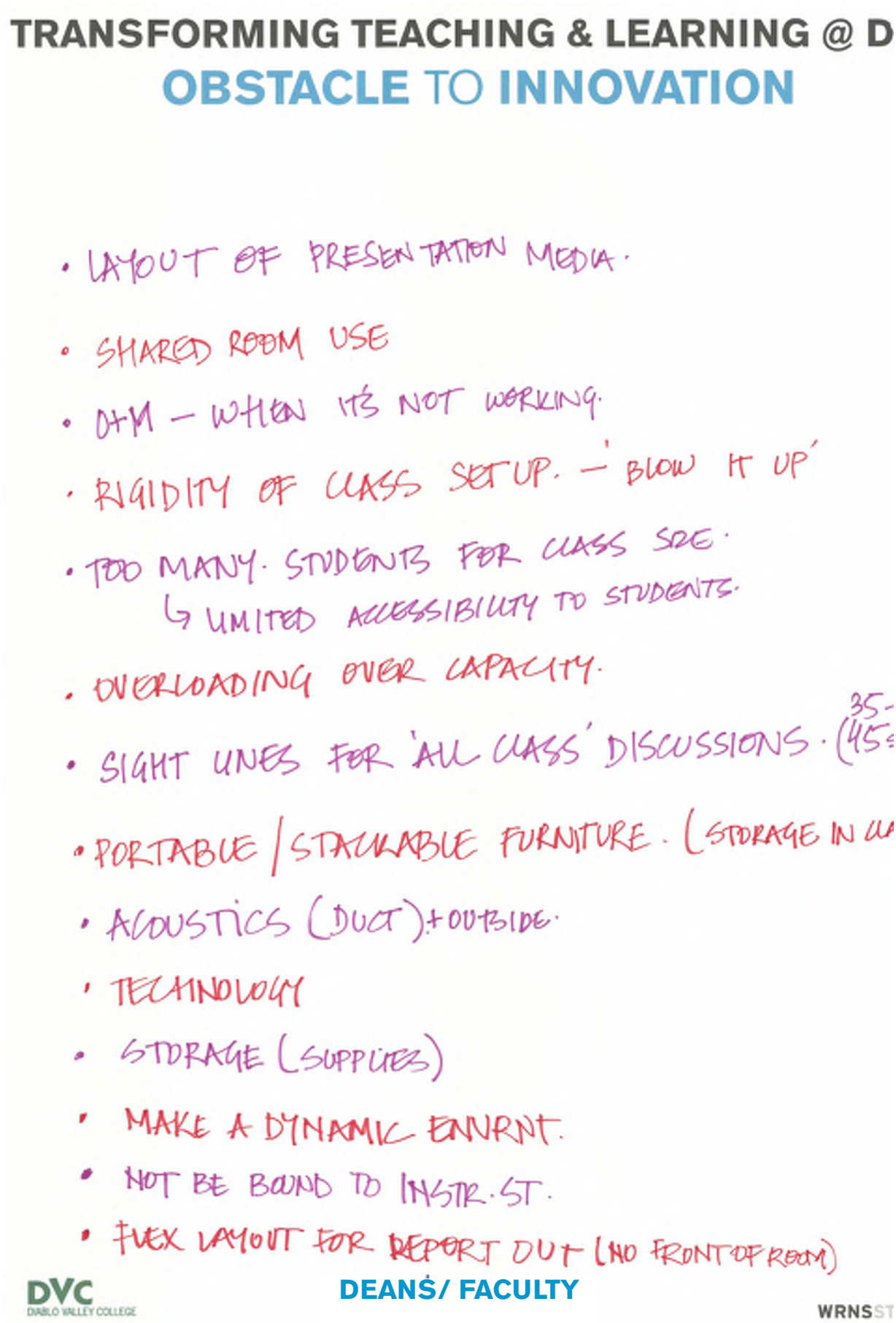

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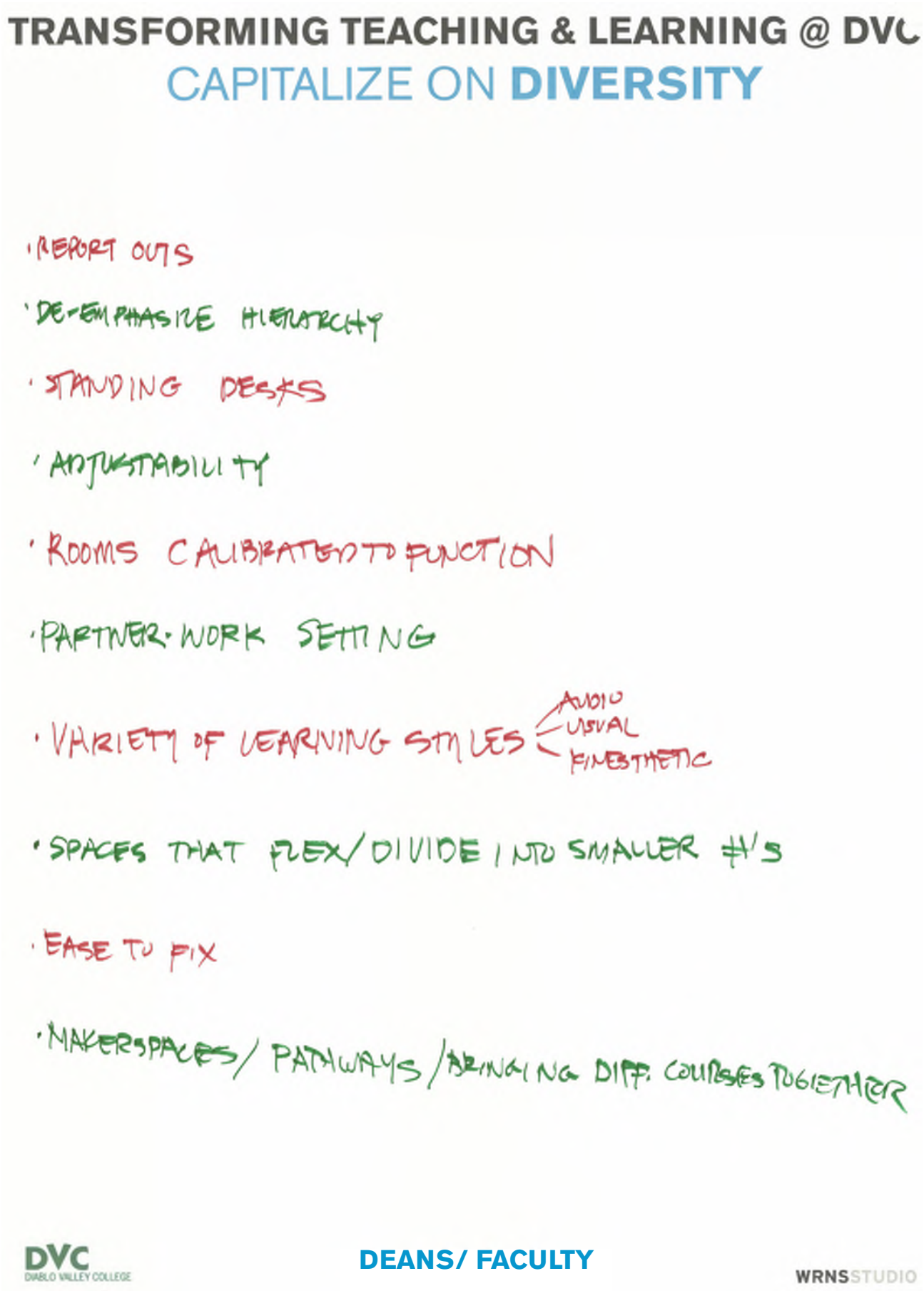
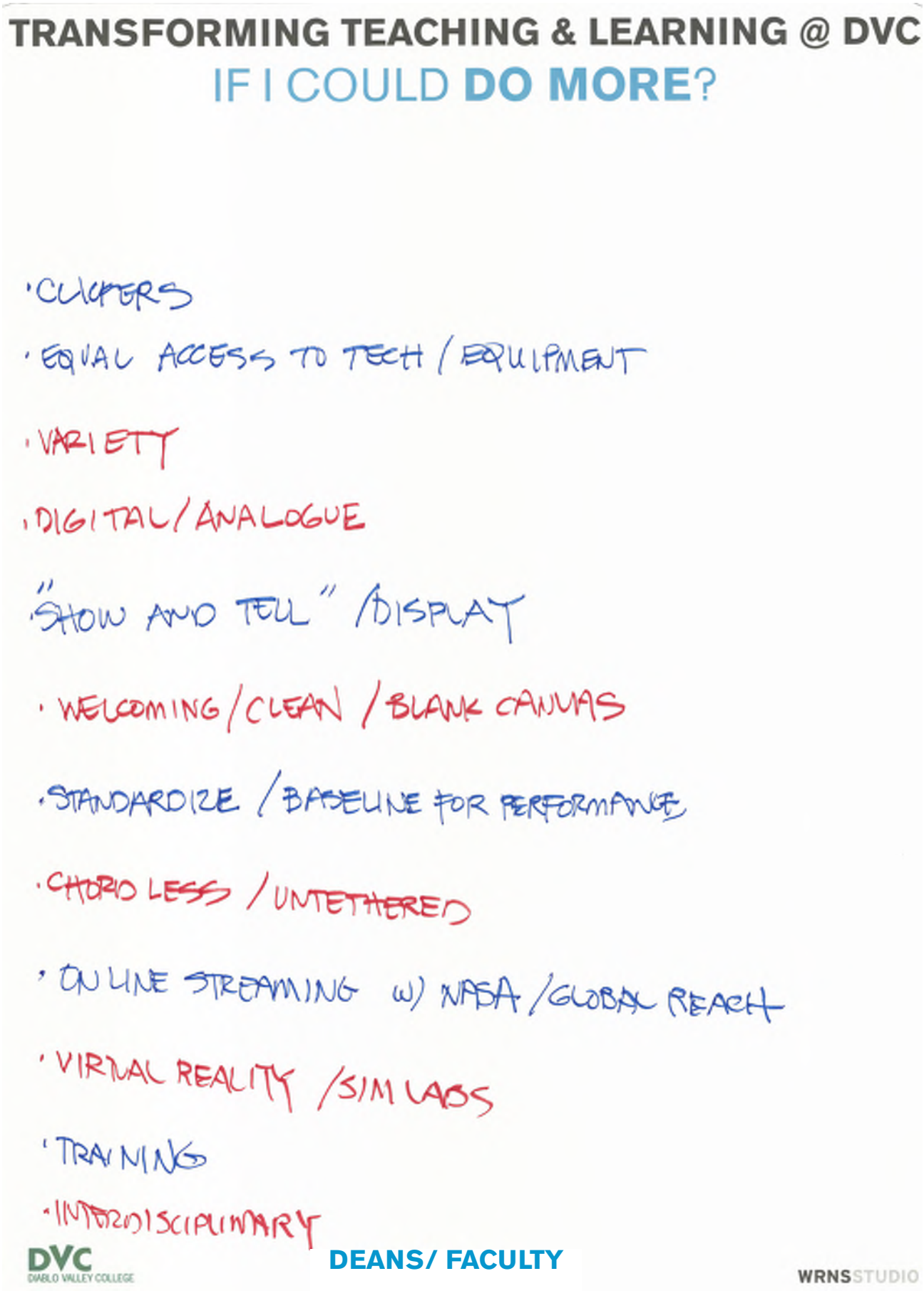


DEANS/ FACULTY

Debrief Posters from User Group Workshop (Sept 18, 2017)



Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ... EQUIPMENT TOOLKIT

S M L XL

WRITEABLE SURFACES

FIXED NON-ELECTRONIC WHITE BOARD

FIXED INTERACTIVE WHITE BOARD

MOVEABLE WHITE BOARD

WRITEABLE WALLS

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MOVEABLE/ DESK-PODIUM COMBINA-TION (MORE WORK-SPACE)/ WIRELESS TECHNOLOGY

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ...

TEACHING/ LEARNING MODE

LECTURE

TEACHER-STUDENT ENGAGEMENT

SMALL GROUP DISCUSSIONS

IN-CLASS GROUP WORK

PRESENT/ REPORT OUT (DIGITAL)

PRESENT/ REPORT OUT (ANALOG)

'PEER-PEER' LEARNING

HANDS-ON PROJECTS

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

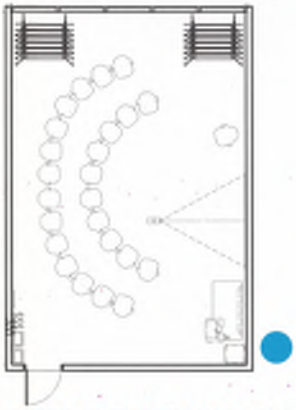
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

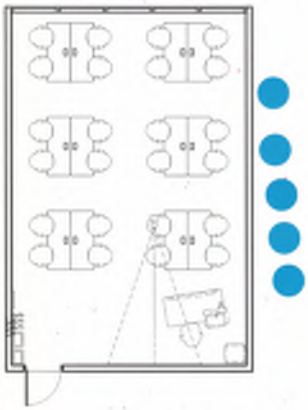
MY IDEAL...ROOM CONFIGURATION

(SMALL CLASSROOM ~ 25-30 students)



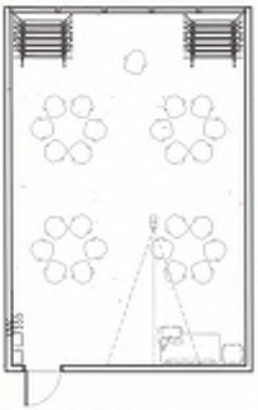
LECTURE/ SEMINAR SETTING

MOVEABLE FURNITURE FOR ALL-CLASS DISCUSSIONS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK W/ DESKS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK AND ACCESS TO DAYLIGHT

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

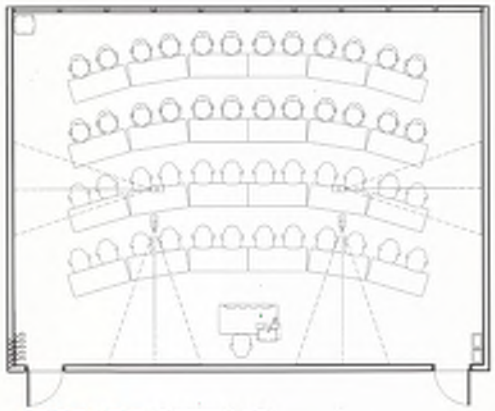
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

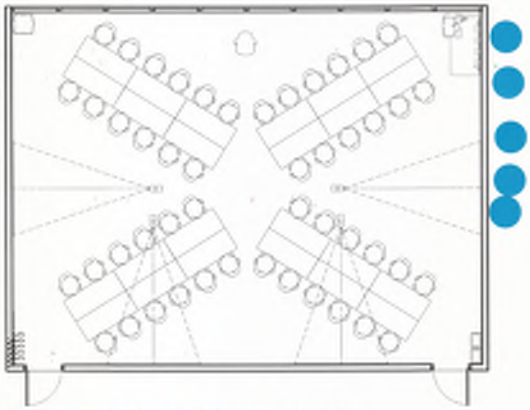
MY IDEAL...ROOM CONFIGURATION

(MEDIUM CLASSROOM ~ 40-50 students)



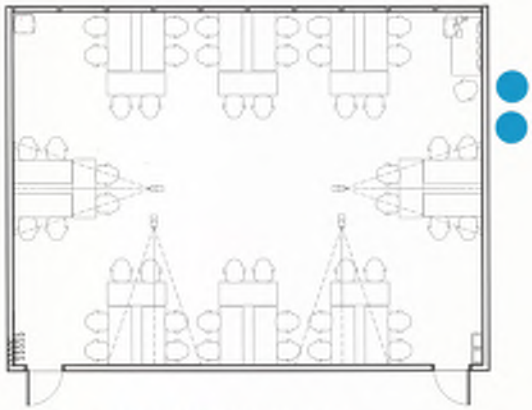
LECTURE SETTING

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

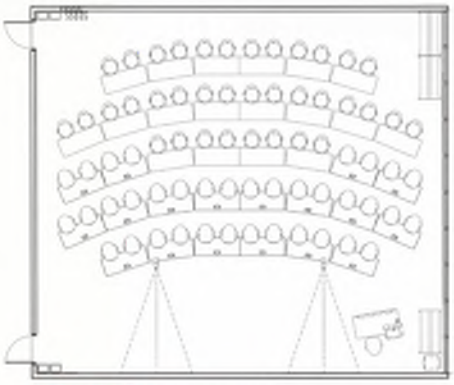
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

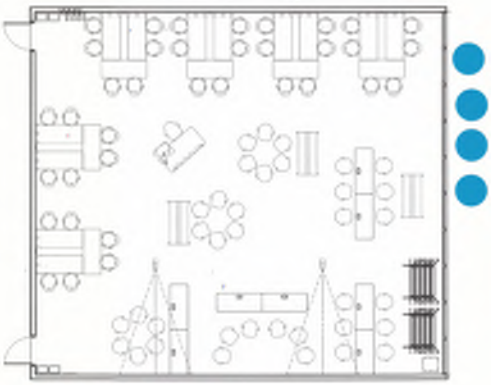
MY IDEAL...ROOM CONFIGURATION

(LARGE CLASSROOM ~ over 50 students)



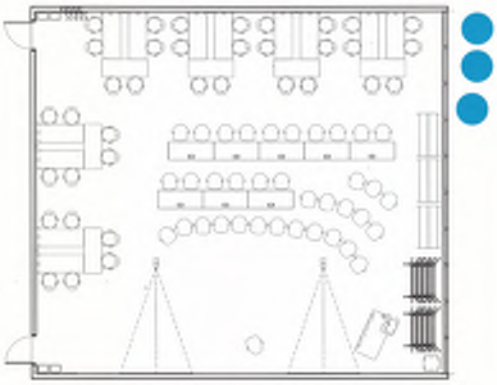
LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES

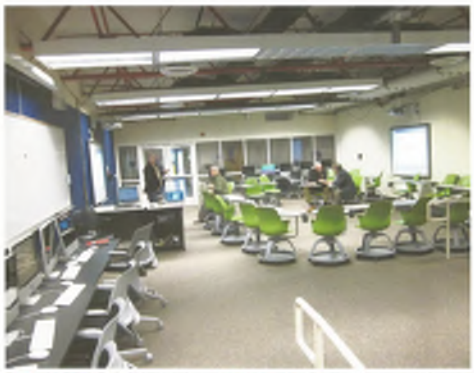


GROUP WORK SETTING

VARIETY OF FLEXIBLE WRITEABLE SURFACES, FURNITURE & DIGITAL MEDIA FOR COLLABORATION



GROUP WORK SETTING



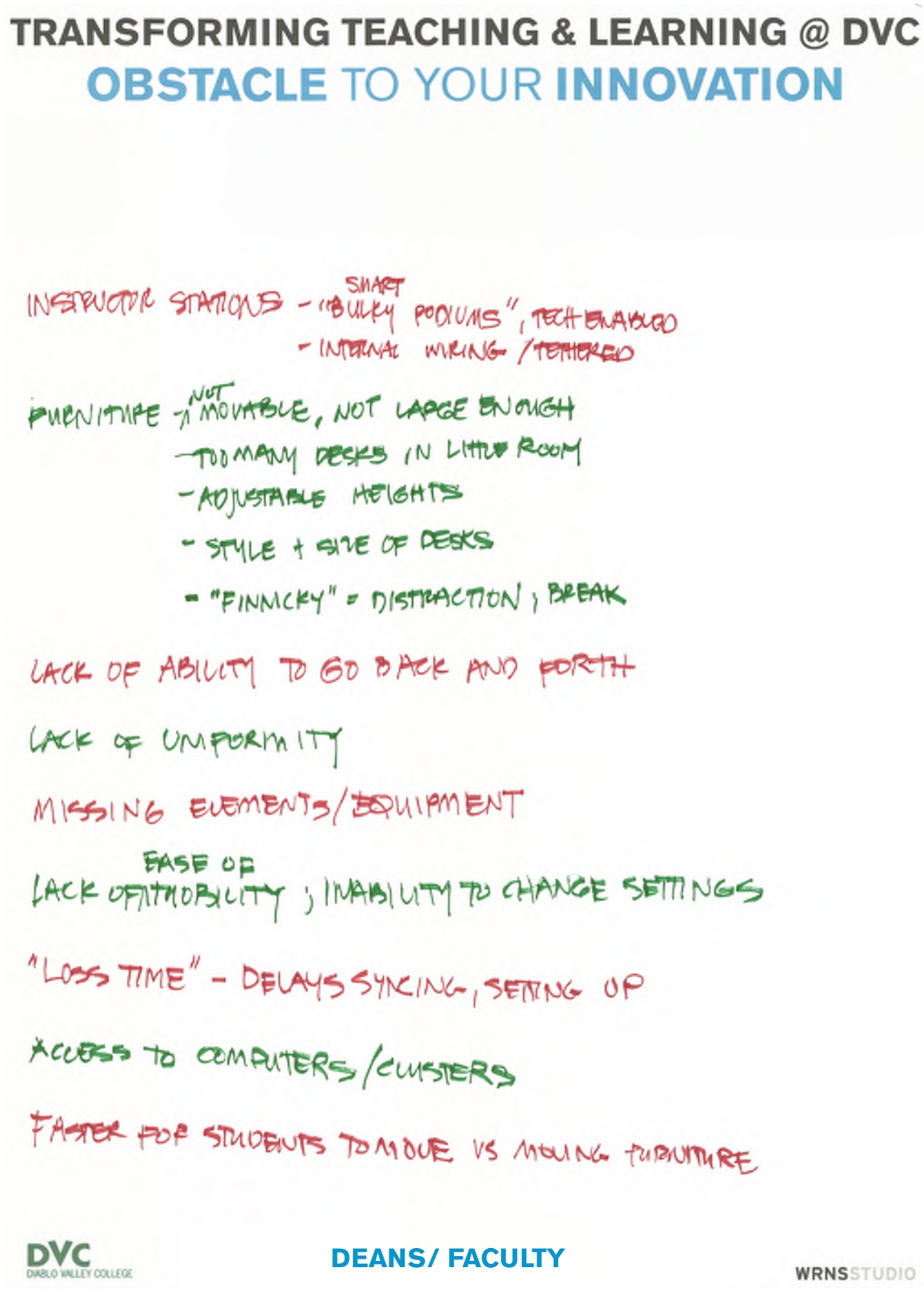
MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)



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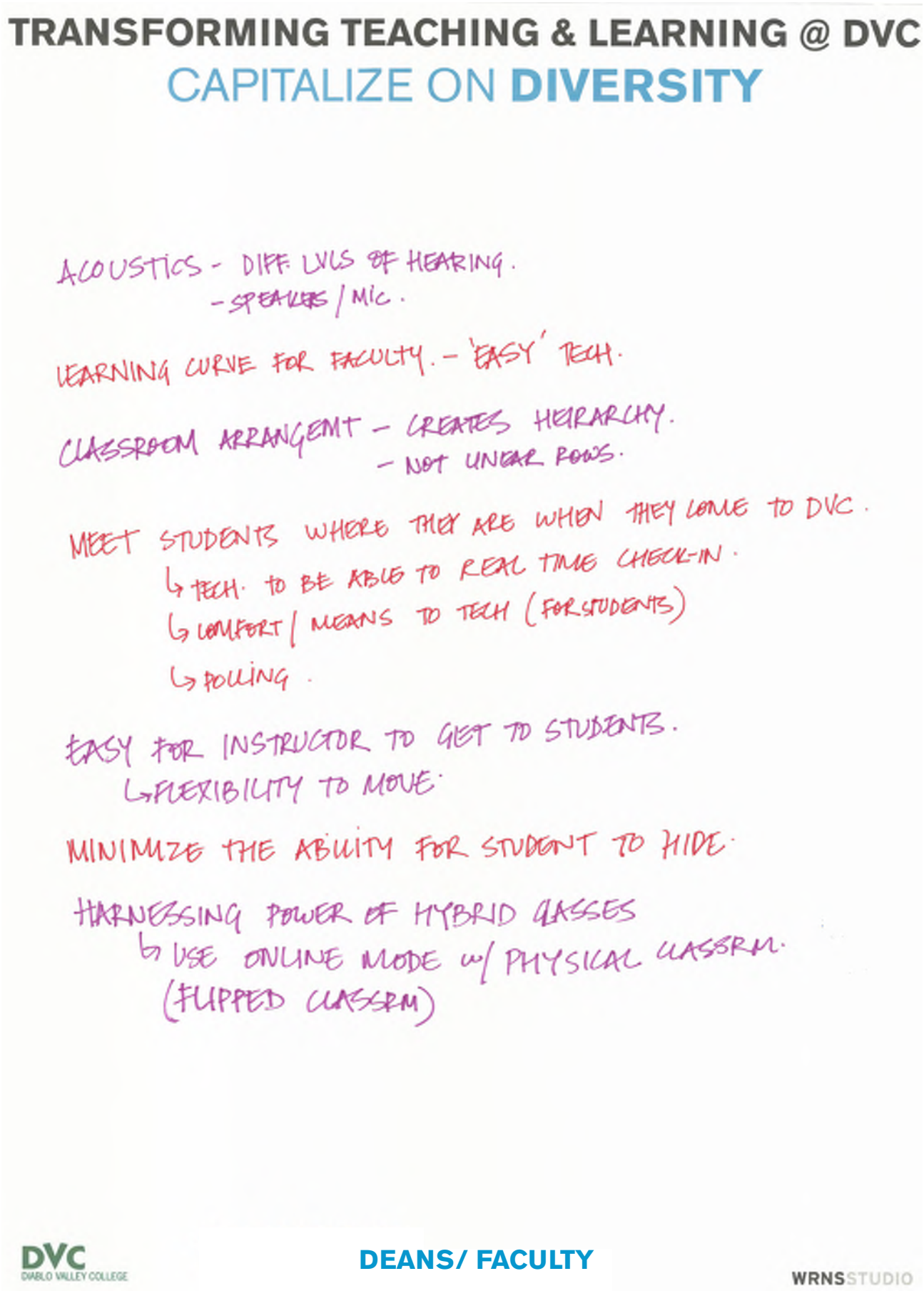

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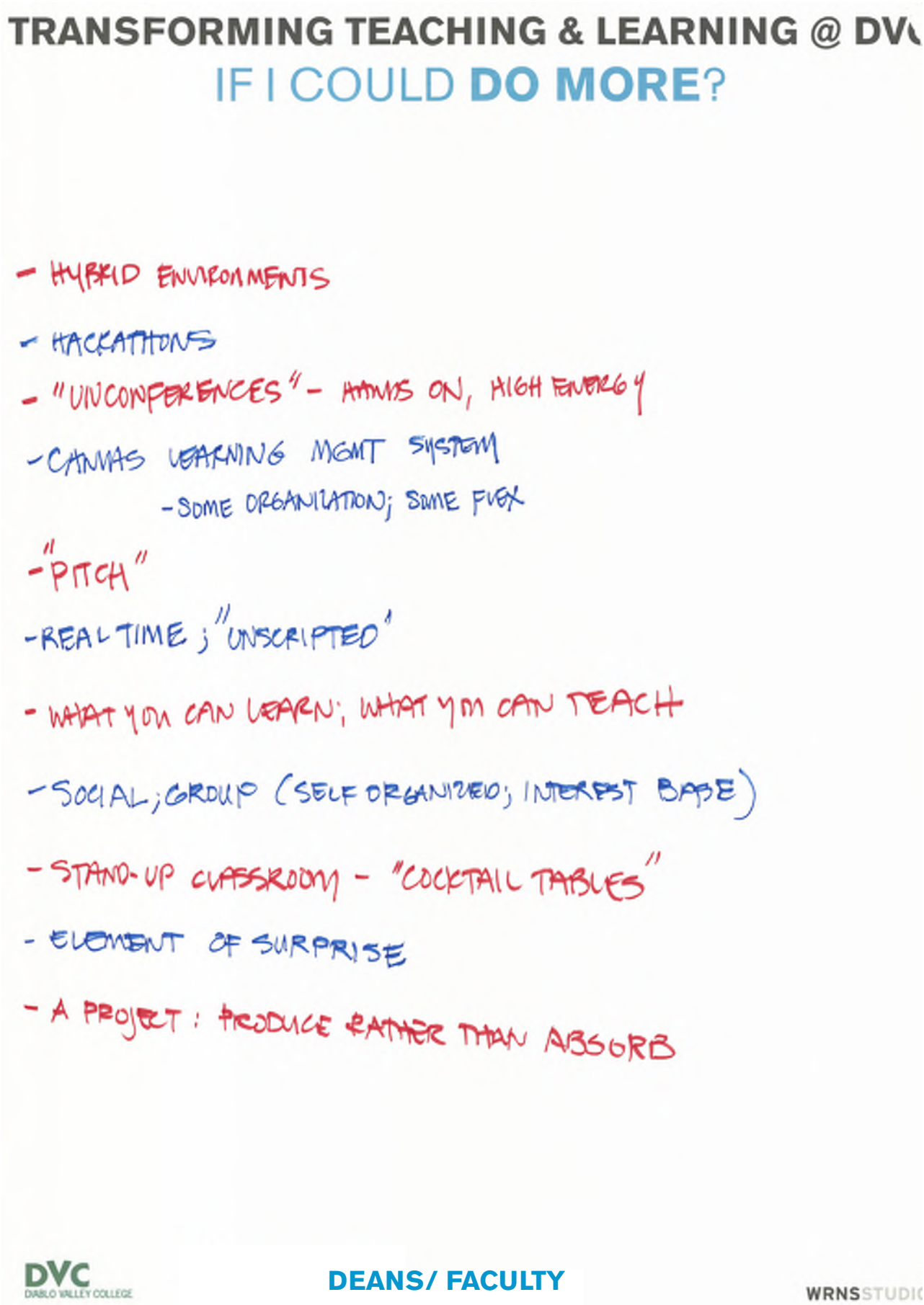

Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ... EQUIPMENT TOOLKIT

WRITEABLE SURFACES

FIXED NON-ELECTRONIC WHITE BOARD

FIXED INTERACTIVE WHITE BOARD

MOVEABLE WHITE BOARD

WRITEABLE WALLS

CHAIRS

WHEELS/ STACKABLE

WHEELS/ STORAGE/ WORKSPACE

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INSTRUCTOR STATION

FIXED/ WORKSPACE/ BUILT-IN TECHNOLOGY/ STORAGE

MOVEABLE/ WORK-SPACE/ CONNECTED TECHNOLOGY

MOVEABLE/ DESK-PODIUM COMBINA-TION/ WIRELESS TECHNOLOGY/ STORAGE

MOVEABLE/ DESK-PODIUM COMBINA-TION (MORE WORK-SPACE)/ WIRELESS TECHNOLOGY

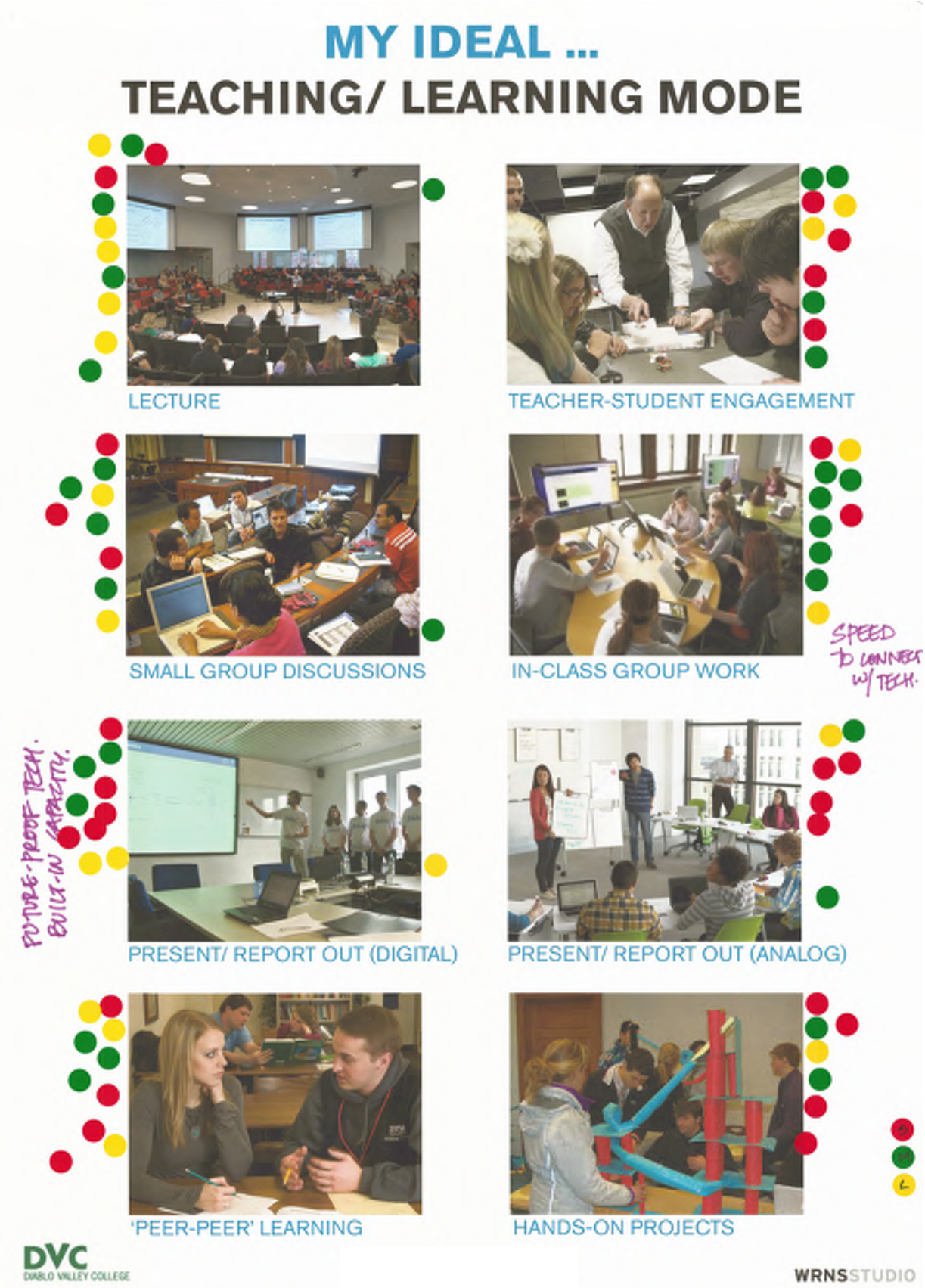
DEANS/ FACULTY

#ADJUSTABLE HT OF WORKSURFACES

DVC DIABLO VALLEY COLLEGE

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)



DEANS/ FACULTY

Debrief Posters from User Group Workshop (Sept 18, 2017)

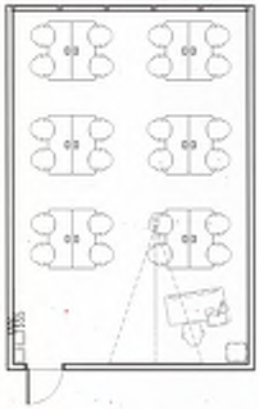
TRANSFORMING TEACHING & LEARNING @ DVC

MY IDEAL...ROOM CONFIGURATION

(SMALL CLASSROOM ~ 25-30 students)

LECTURE/ SEMINAR SETTING

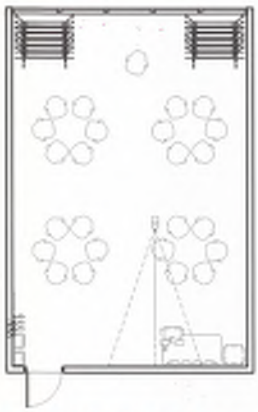
MOVEABLE FURNITURE FOR ALL-CLASS DISCUSSIONS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK W/ DESKS

- UNIVERSAL DESIGN
- SAFETY / SHELTER IN PLACE
- ACCESS TO SECURITY / CAMPUS POLICE
- LOCK DOORS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK AND ACCESS TO DAYLIGHT

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

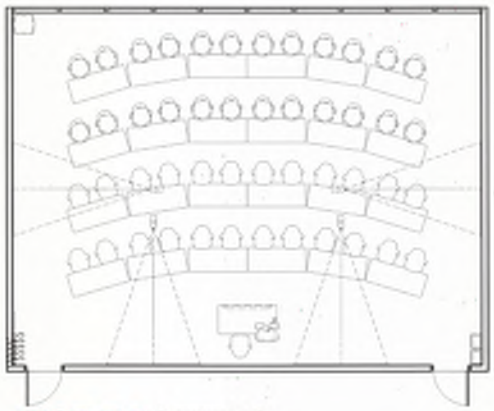
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

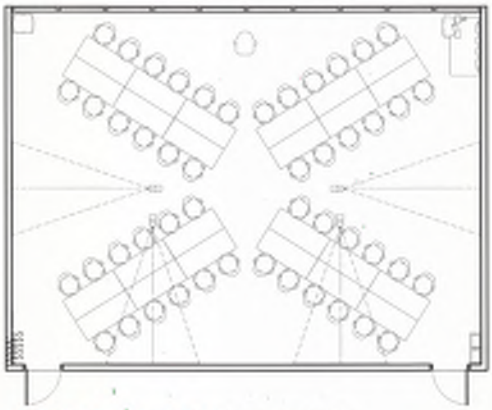
MY IDEAL...ROOM CONFIGURATION

(MEDIUM CLASSROOM ~ 40-50 students)



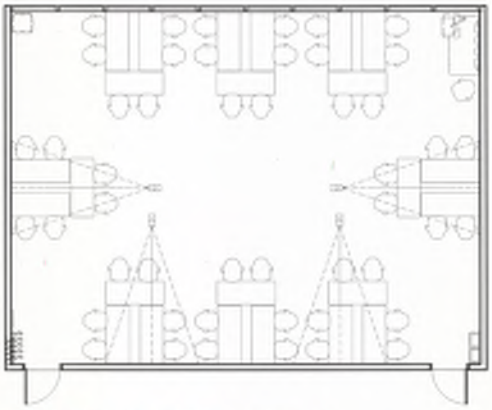
LECTURE SETTING

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

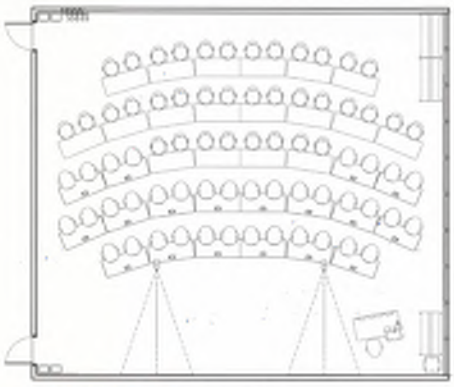
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

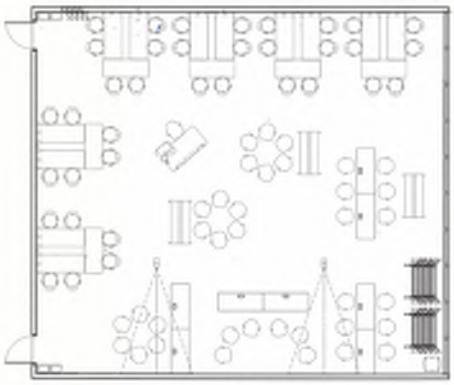
MY IDEAL...ROOM CONFIGURATION

(LARGE CLASSROOM ~ over 50 students)



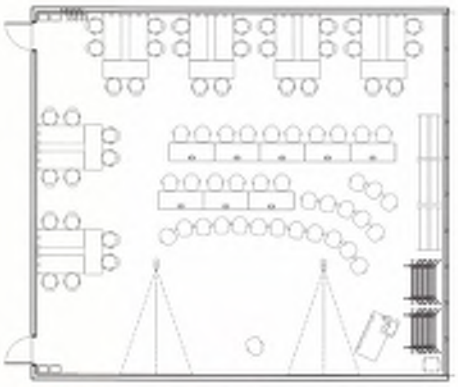
LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES

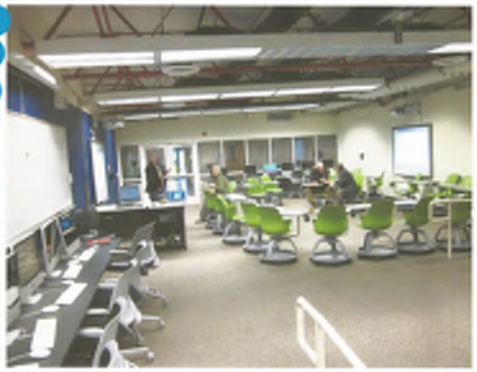


GROUP WORK SETTING

VARIETY OF FLEXIBLE WRITEABLE SURFACES, FURNITURE & DIGITAL MEDIA FOR COLLABORATION



GROUP WORK SETTING



MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

DVC DIABLO VALLEY COLLEGE

DEANS/ FACULTY

WRNSSTUDIO

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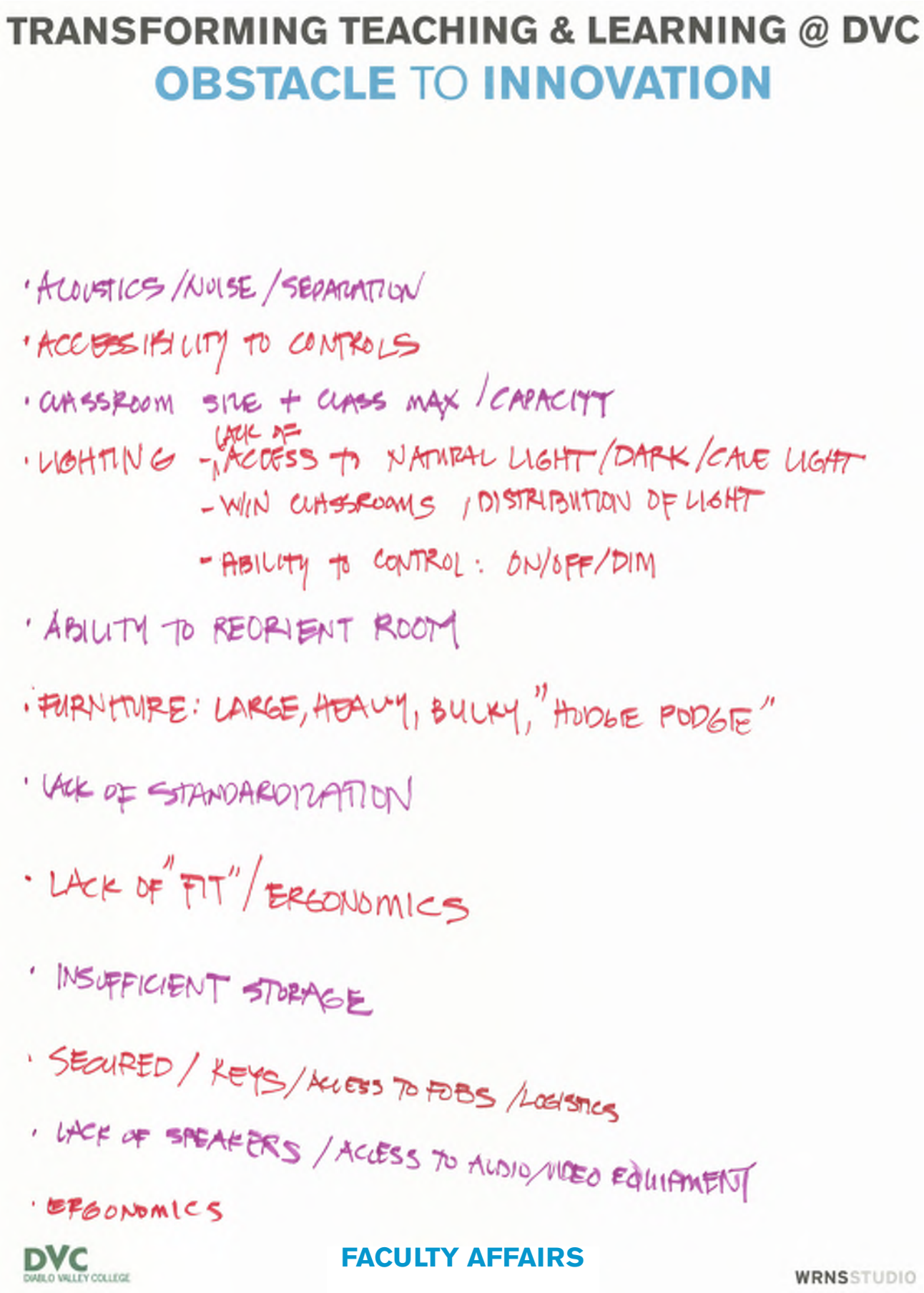


Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

CAPITALIZE ON **DIVERSITY**

- RETURN TO "TYPICAL" SET UP
- FOOL PROOF STRATEGIES
- SYSTEMATIZE : FIRST VS LONG TERM COST
- GENERATION GAP.
  - ↳ LEARNING CURVE. (MAKE TECH EASY).
- KEEP IT SIMPLE
- FUTURE PROOF (FEW SETTINGS).

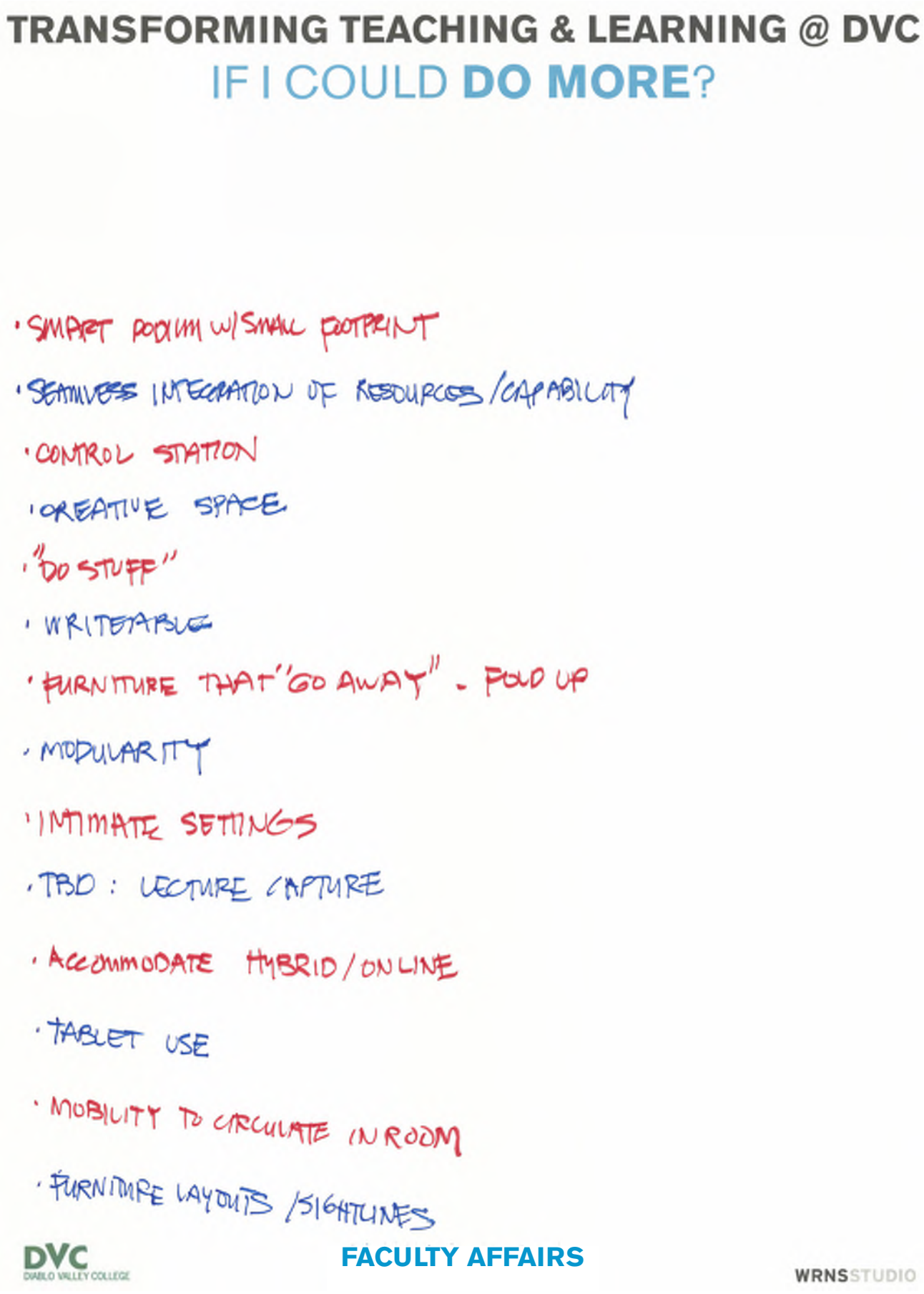
- NO ROOM TO INCREASE CAPACITY.
  - ↳ STUDENTS MORE THAN CAP.
- FURNITURE NEEDS TO FIT ALL.
- WELCOMING | ATTRACTIVE SPACE.

DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)



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MY IDEAL ... EQUIPMENT TOOLKIT

S M L XL

WRITEABLE SURFACES

FIXED NON-ELECTRONIC WHITE BOARD

FIXED INTERACTIVE WHITE BOARD

MOVEABLE WHITE BOARD

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WHEELS/ STACKABLE

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DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ...
TEACHING/ LEARNING MODE

LECTURE

TEACHER-STUDENT ENGAGEMENT

SMALL GROUP DISCUSSIONS

IN-CLASS GROUP WORK

PRESENT/ REPORT OUT (DIGITAL)

PRESENT/ REPORT OUT (ANALOG)

'PEER-PEER' LEARNING

HANDS-ON PROJECTS

DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

WRNSSTUDIO

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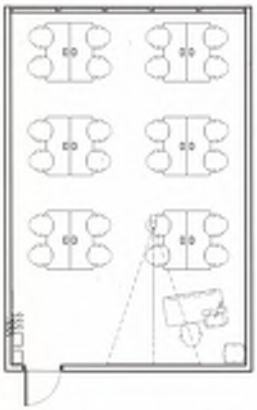
TRANSFORMING TEACHING & LEARNING @ DVC

MY IDEAL...ROOM CONFIGURATION

(SMALL CLASSROOM ~ 25-30 students)

LECTURE/ SEMINAR SETTING

MOVEABLE FURNITURE FOR ALL-CLASS DISCUSSIONS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK W/ DESKS

GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK AND ACCESS TO DAYLIGHT

DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

WRNSSTUDIO

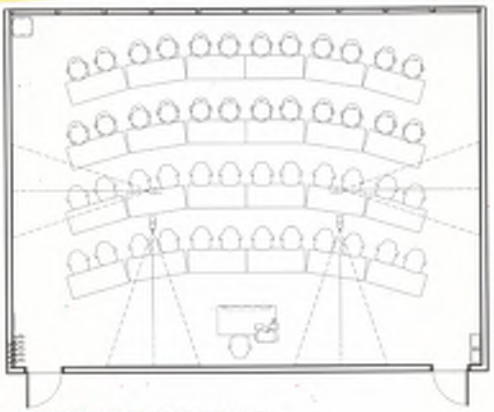
Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

MY IDEAL...ROOM CONFIGURATION

ET 114

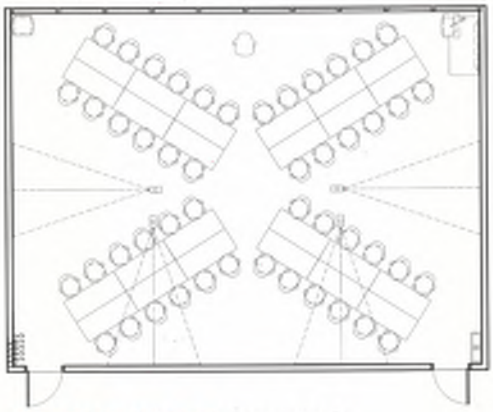
(MEDIUM CLASSROOM ~ 40-50 students)



LECTURE SETTING

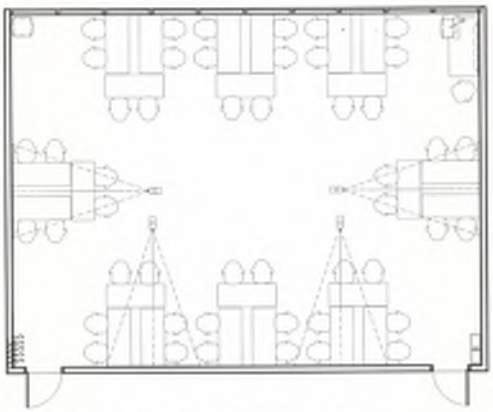
MORE CIRCULATION & SPACE TO PUT STUFF.

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



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TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

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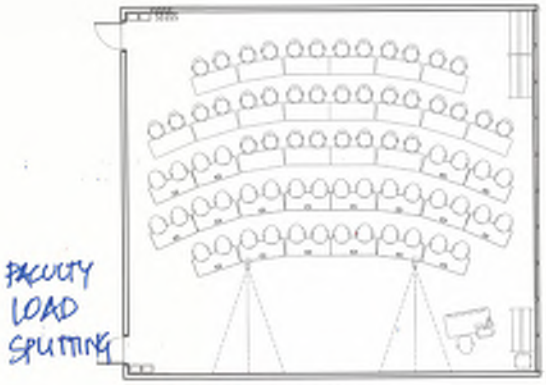
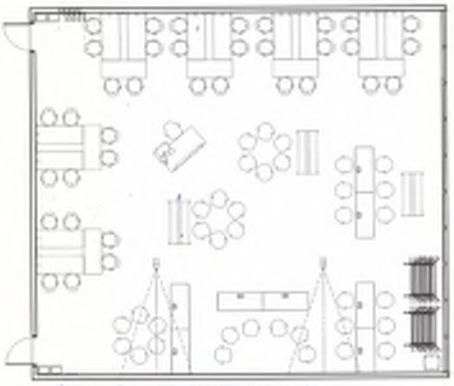
MY IDEAL...ROOM CONFIGURATION

(LARGE CLASSROOM ~ over 50 students)



LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES



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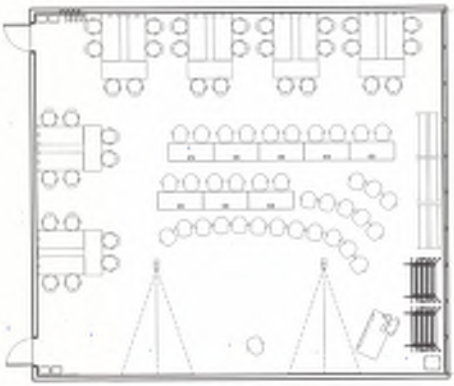
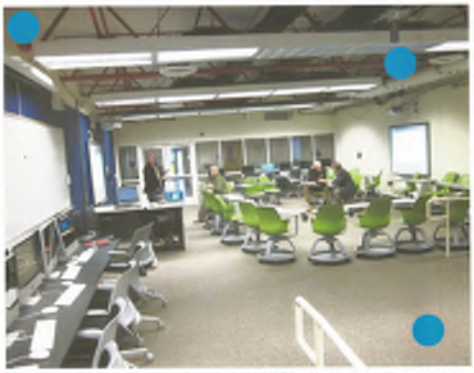
VARIETY OF FLEXIBLE WRITEABLE SURFACES, FURNITURE & DIGITAL MEDIA FOR COLLABORATION



GROUP WORK SETTING



MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

DVC DIABLO VALLEY COLLEGE

FACULTY AFFAIRS

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

CAPITALIZE ON **DIVERSITY**

- CULTURALLY RESPONSIVE CLASSRM (WELCOMING).
  - ↳ MULTI-DIRECTIONAL.
- INSTRUCTOR ENGAGING IN ALL SPACES.
  - ↳ NO PODIUM
- MAXIMIZE FLEX.
- LIGHTING | TEMP.
- LAPTOPS AVAILABLE ~~OK~~ IN CLASS.
- COMPREHENSION OF STUDENT MOTIVATION.
  - ↳ PSYCHOLOGY THINKING eg STUDENT LEGS HANGING.
- MULTIPLE SEATING & RESPONSIVE ENGAGEMENT.

- DIFFERENT WAY OF SAYING "NO" – SIGNAGE, WORD CHOICE
  - CREATE ACCOUNTABILITY

DVC DIABLO VALLEY COLLEGE

STUDENT AFFAIRS

WRNSSTUDIO

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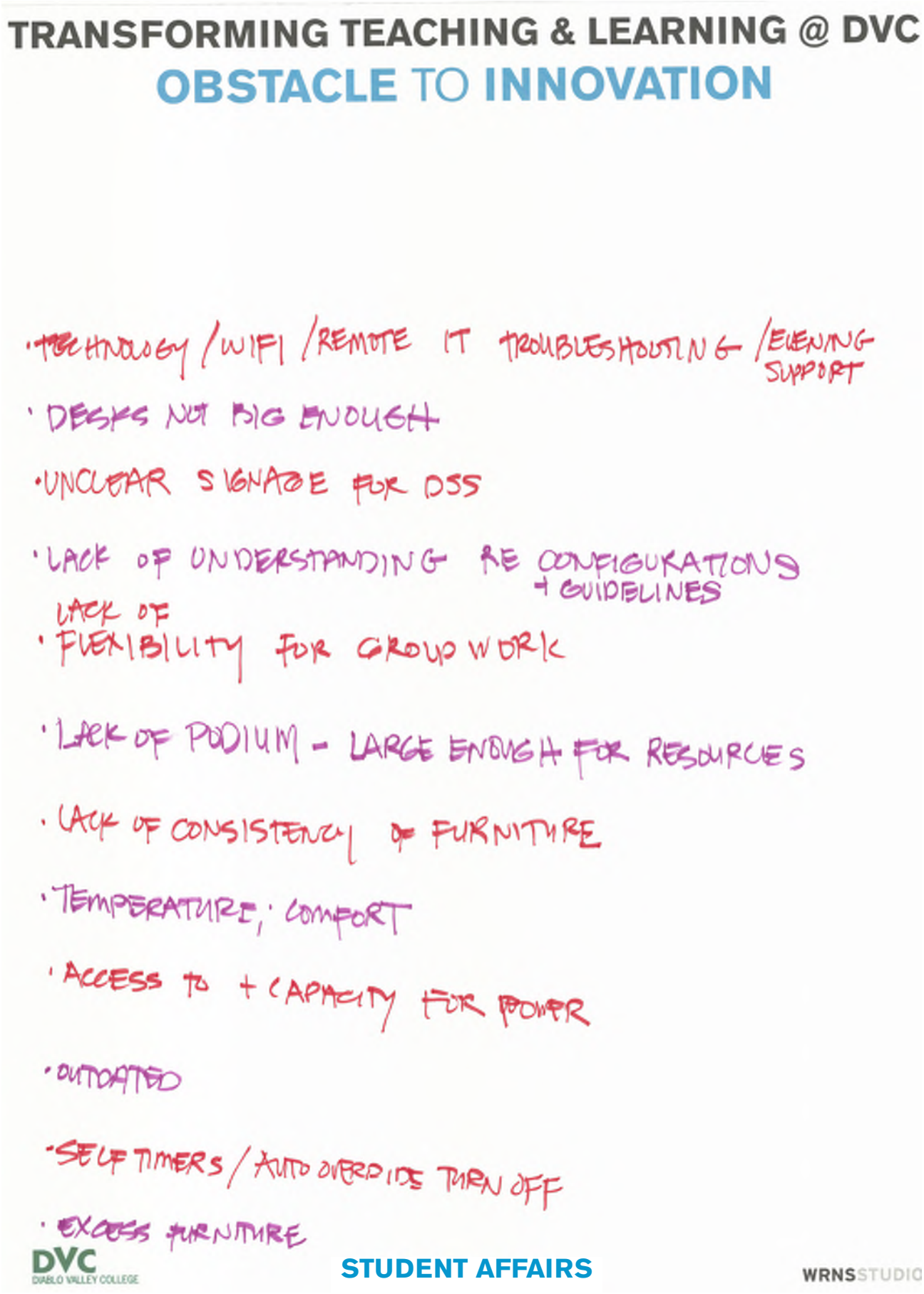

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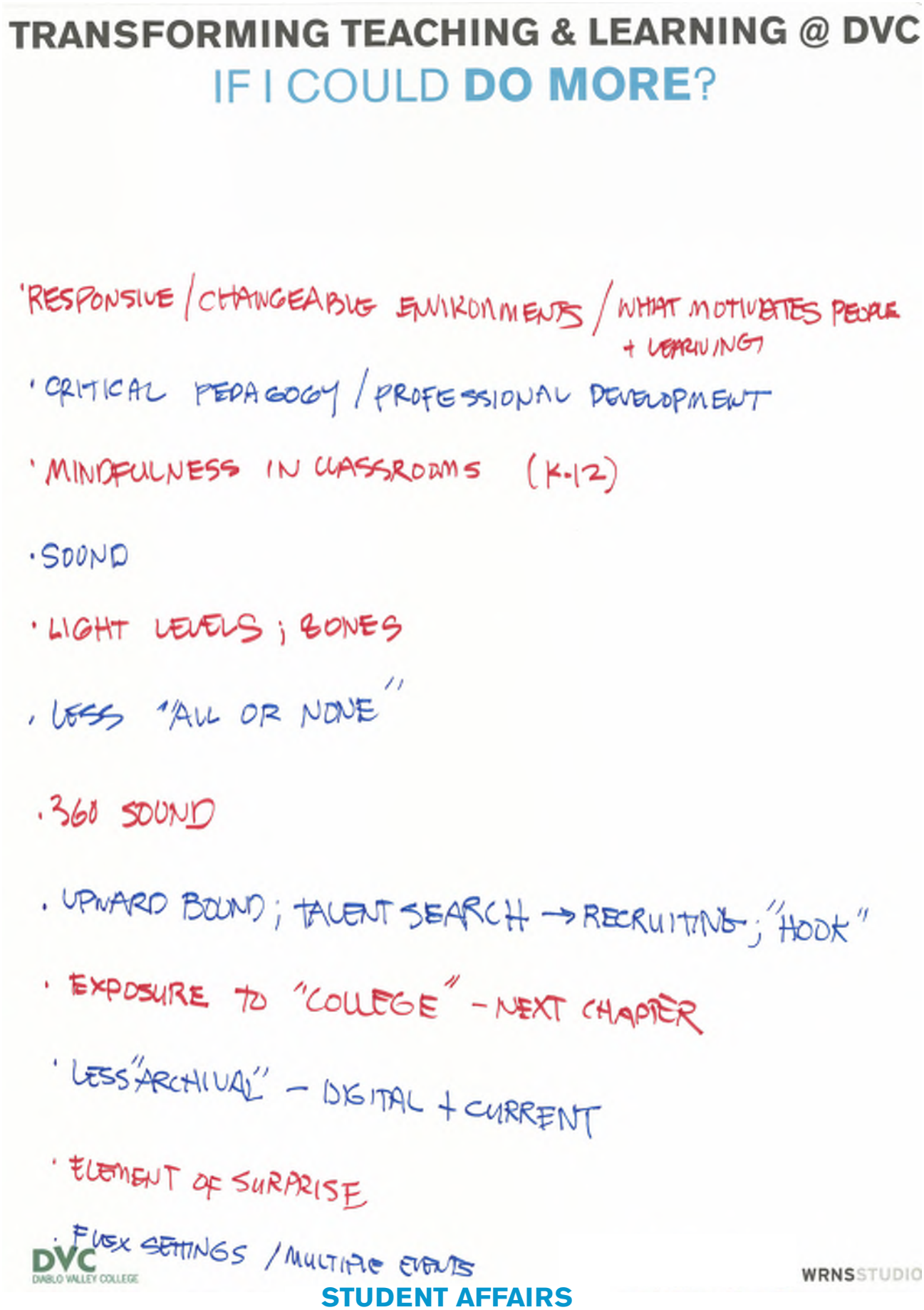

STUDENT AFFAIRS

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TEACHING/ LEARNING MODE

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SMALL GROUP DISCUSSIONS

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HANDS-ON PROJECTS

DVC DIABLO VALLEY COLLEGE

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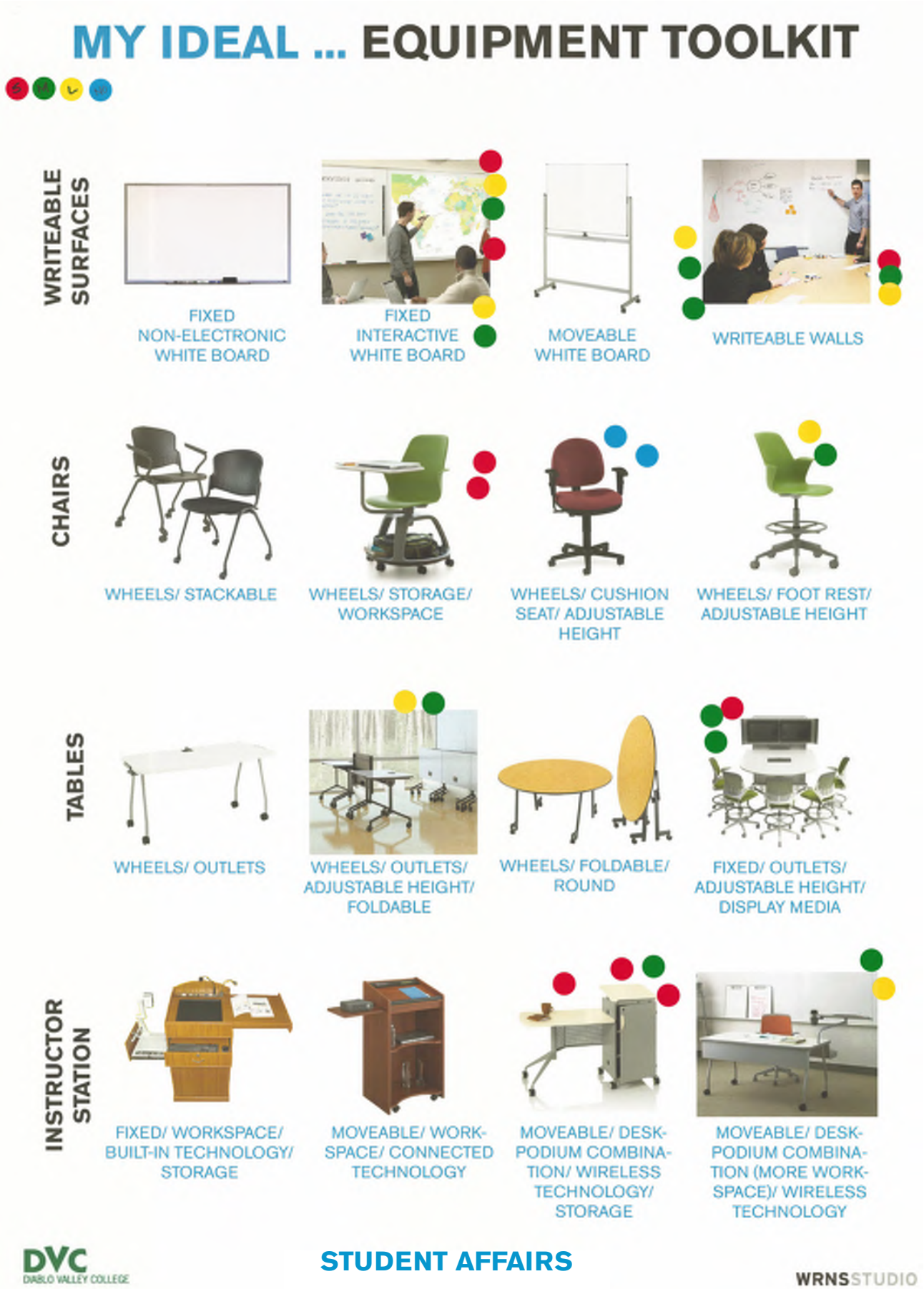


Debrief Posters from User Group Workshop (Sept 18, 2017)

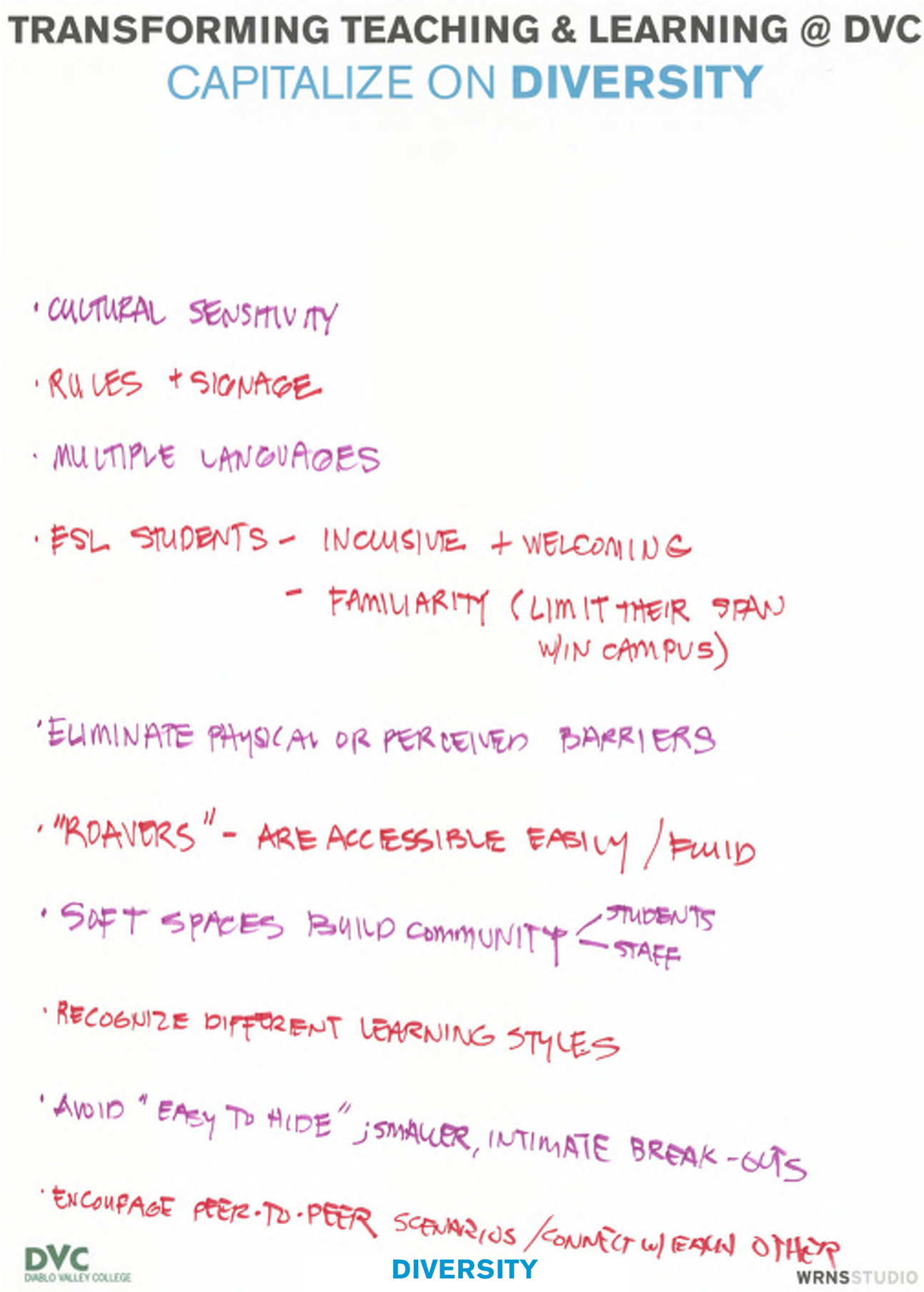
- LACK OF WI-FI
- RELIABLE TECH.
- NO BLACKBOARDS → MODERNIZE.
- THERMAL COMFORT.
- 'INCLUSIVE EXCELLENCE' → FOSTER IT IN THE ENVRNT.
- ENVIRONMENTAL CONCERNS
- IT SUPPORT
- STUDY ROOMS. — HOW THEY HELP LEARNING.
  - ↳ DIFF. STUDENT NEEDS.
- MOVABLE FURNITURE.

DVC DIABLO VALLEY COLLEGE

DIVERSITY

WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)



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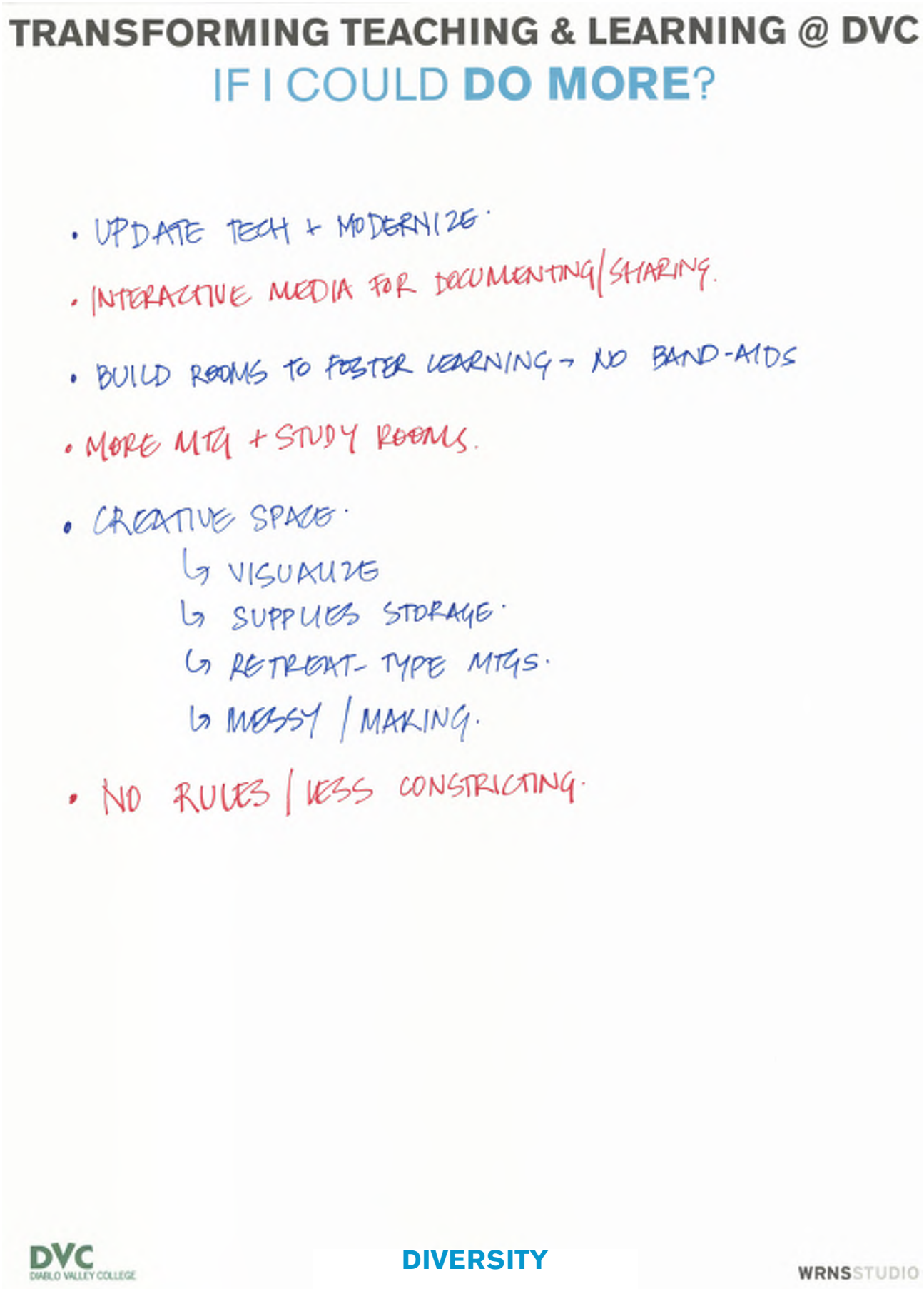

Debrief Posters from User Group Workshop (Sept 18, 2017)

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DVC DIABLO VALLEY COLLEGE

DIVERSITY

WRNSSTUDIO

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DVC DIABLO VALLEY COLLEGE

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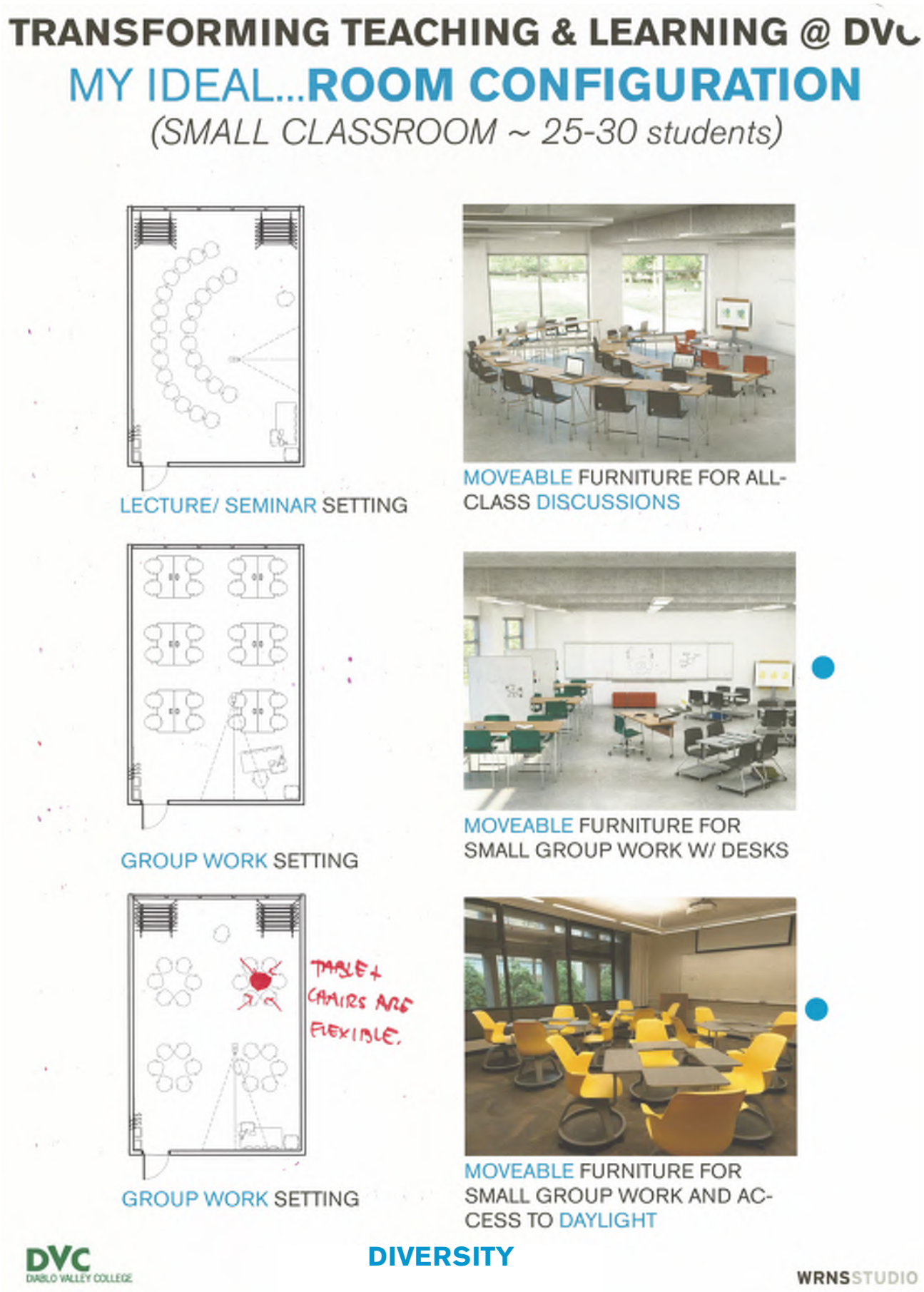

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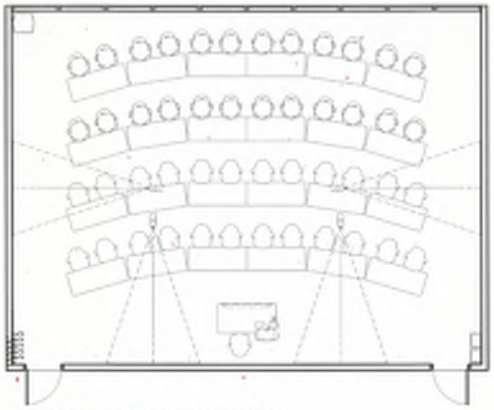
TRANSFORMING TEACHING & LEARNING @ DVC

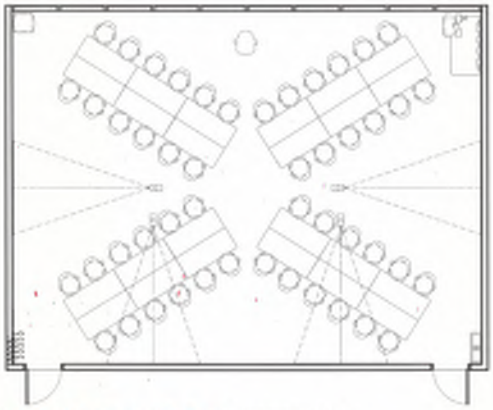
MY IDEAL...ROOM CONFIGURATION

(MEDIUM CLASSROOM ~ 40-50 students)



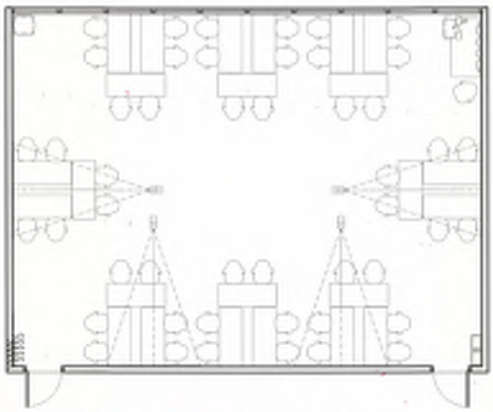
LECTURE SETTING

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

DVC DIABLO VALLEY COLLEGE

DIVERSITY

WRNSSTUDIO

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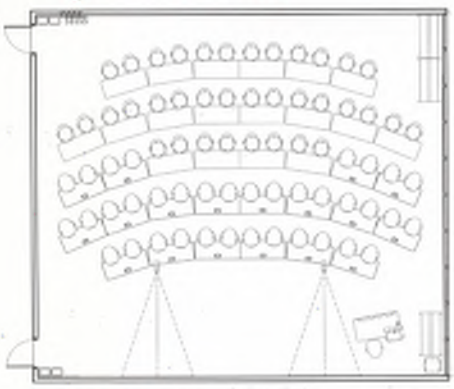
TRANSFORMING TEACHING & LEARNING @ DVC

MY IDEAL...ROOM CONFIGURATION

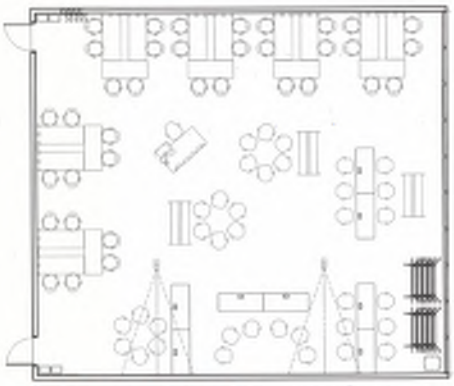
(LARGE CLASSROOM ~ over 50 students)

(CASE STUDIES)



LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES



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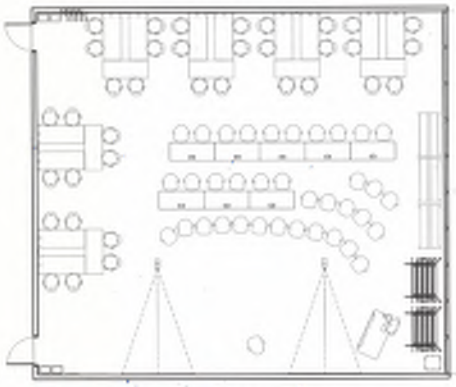

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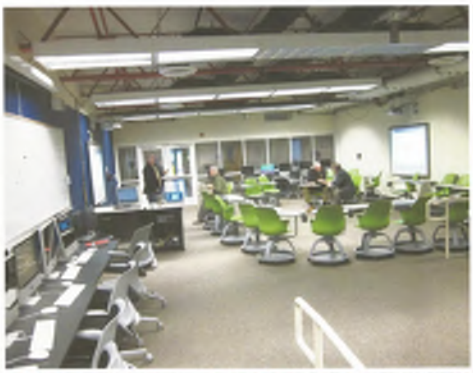

MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

DIVERSITY

DVC DIABLO VALLEY COLLEGE

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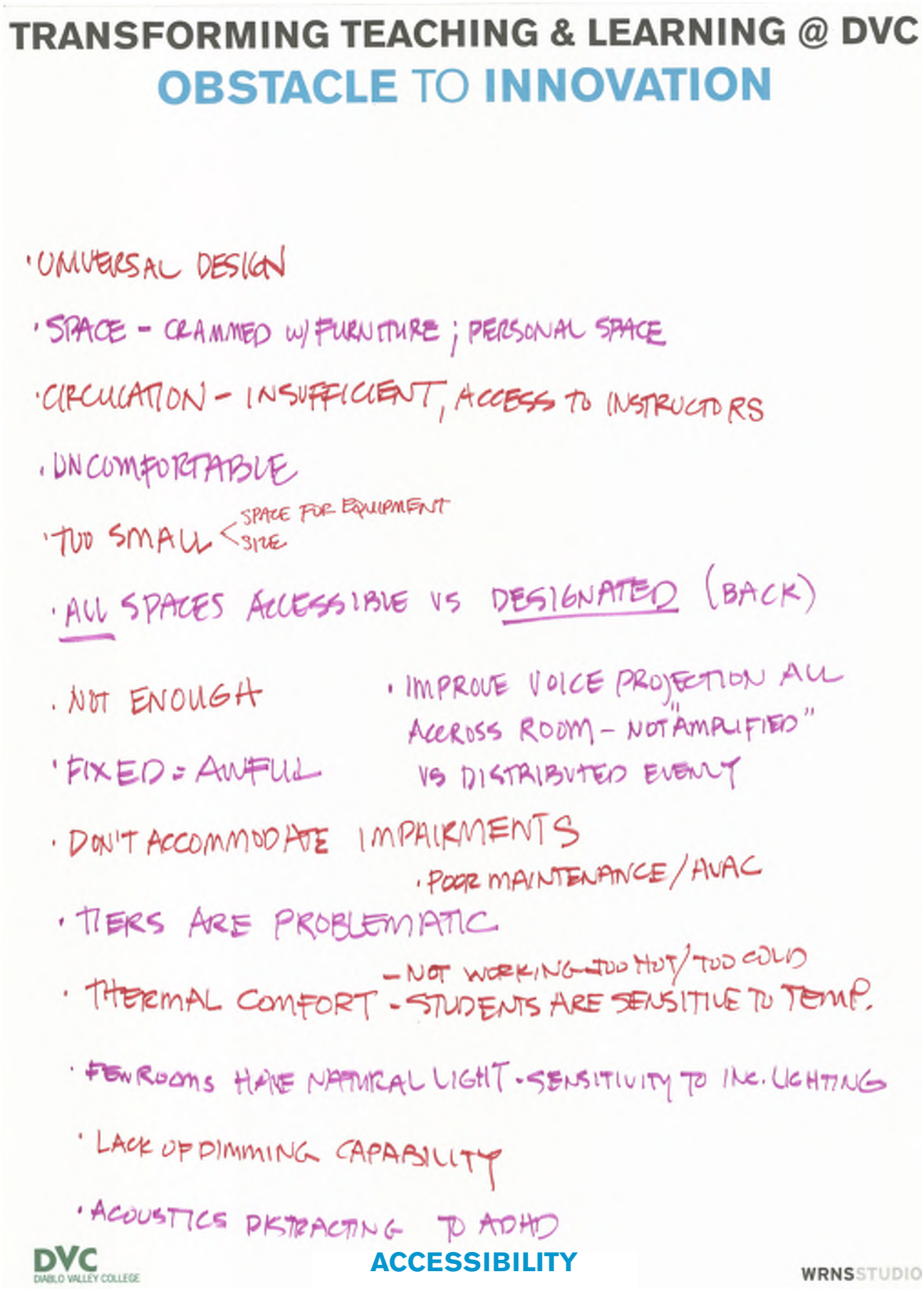

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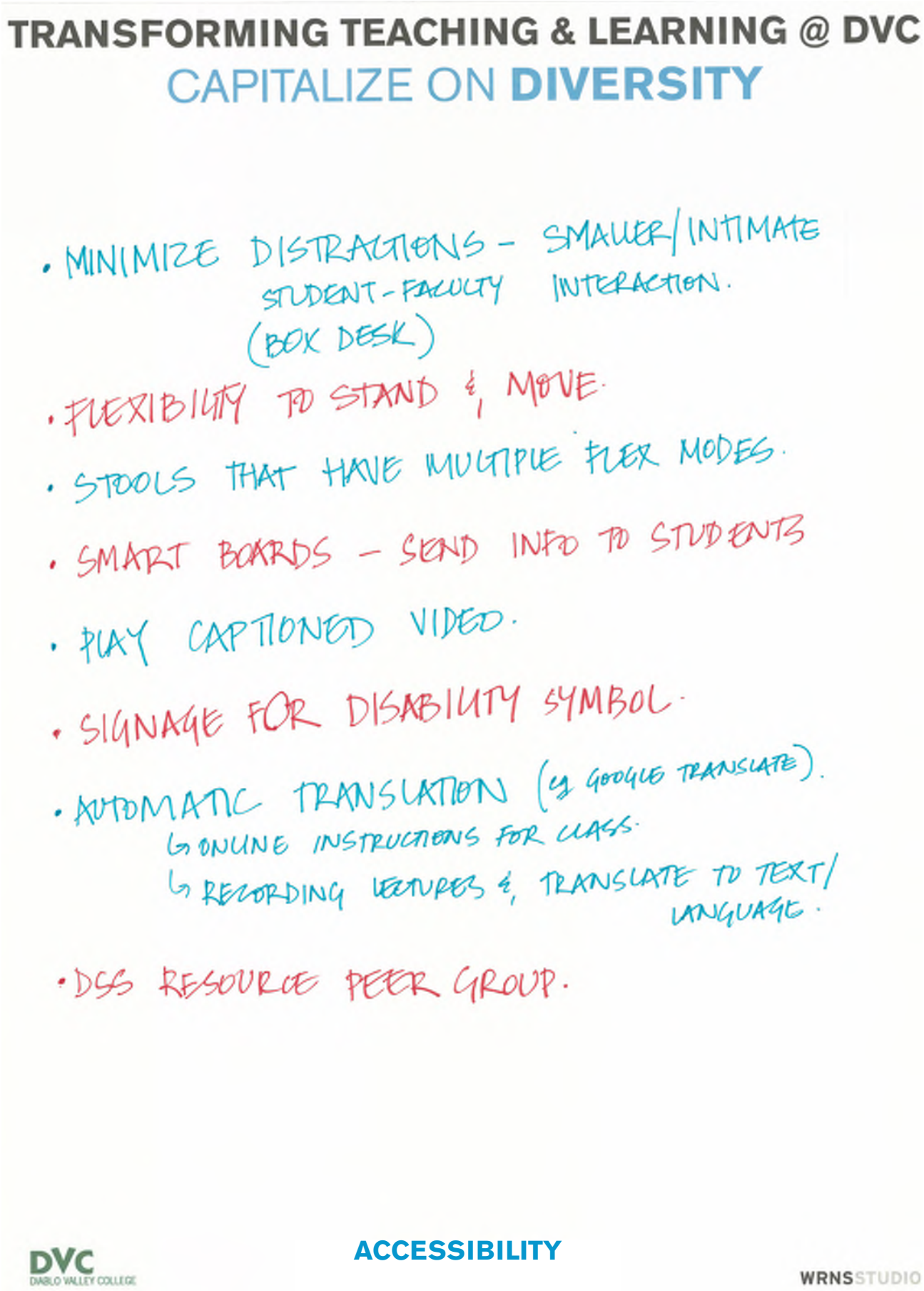

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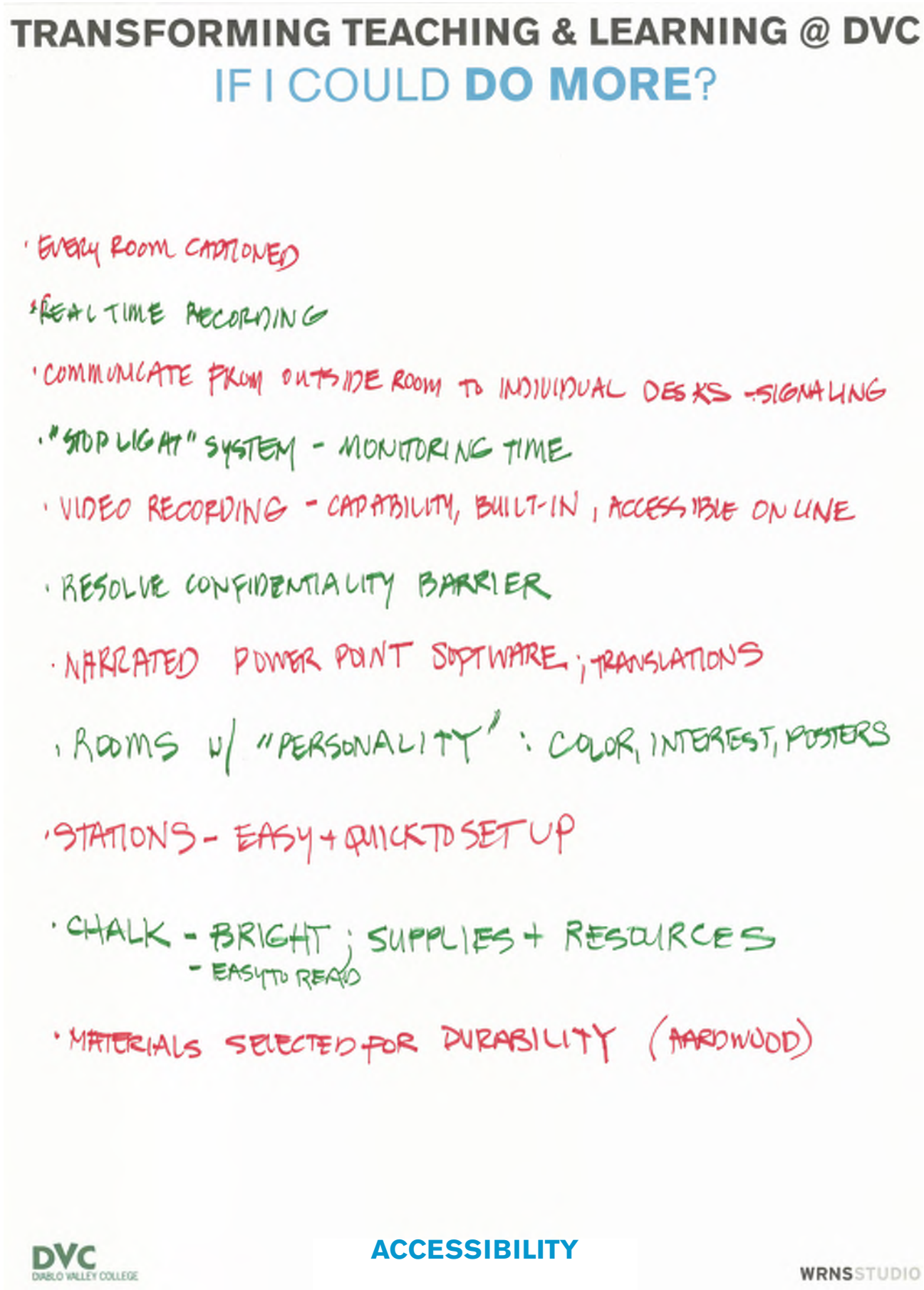

ACCESSIBILITY

Debrief Posters from User Group Workshop (Sept 18, 2017)

MY IDEAL ... EQUIPMENT TOOLKIT

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FIXED NON-ELECTRONIC WHITE BOARD

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DVC DIABLO VALLEY COLLEGE

ACCESSIBILITY

WRNSSTUDIO

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DIABLO VALLEY COLLEGE

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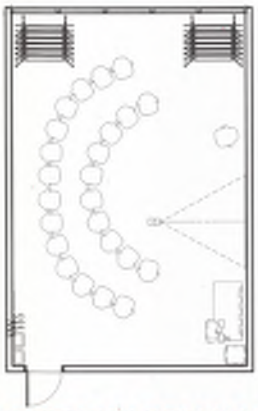
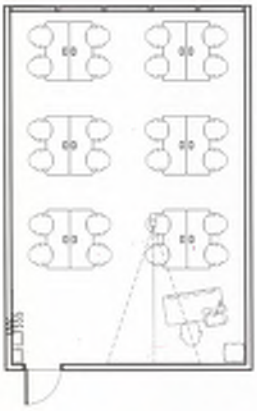
(SMALL CLASSROOM ~ 25-30 students)



LECTURE/ SEMINAR SETTING

MOVEABLE FURNITURE FOR ALL-CLASS DISCUSSIONS



GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK W/ DESKS

GROUP WORK SETTING

MOVEABLE FURNITURE FOR SMALL GROUP WORK AND ACCESS TO DAYLIGHT

DVC DIABLO VALLEY COLLEGE

ACCESSIBILITY

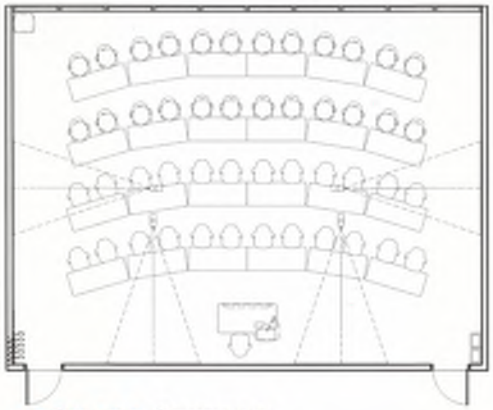
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

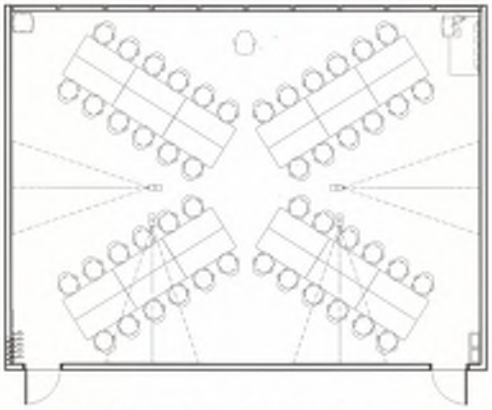
MY IDEAL...ROOM CONFIGURATION

(MEDIUM CLASSROOM ~ 40-50 students)



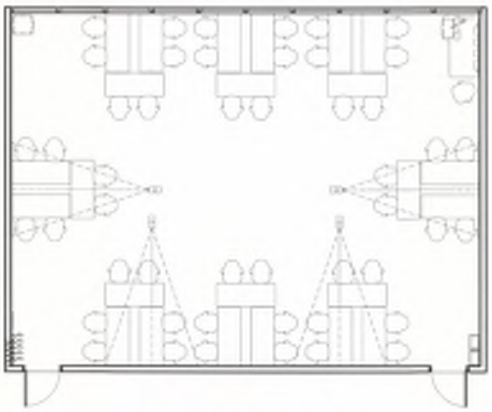
LECTURE SETTING

ADJUSTABLE SEATING AIDS CLEAR SIGHT LINES



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS



GROUP WORK SETTING

TECHNOLOGY ENABLED ROOM WITH MULTIPLE SCREENS FOR 360 DEG VIEWING

DVC DIABLO VALLEY COLLEGE

ACCESSIBILITY

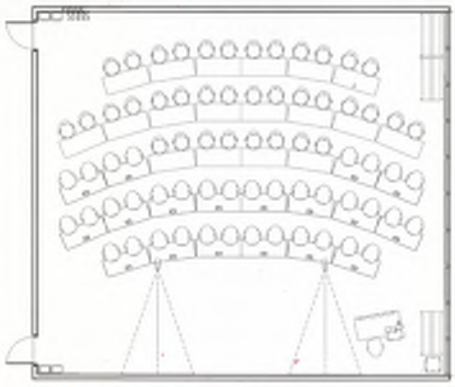
WRNSSTUDIO

Debrief Posters from User Group Workshop (Sept 18, 2017)

TRANSFORMING TEACHING & LEARNING @ DVC

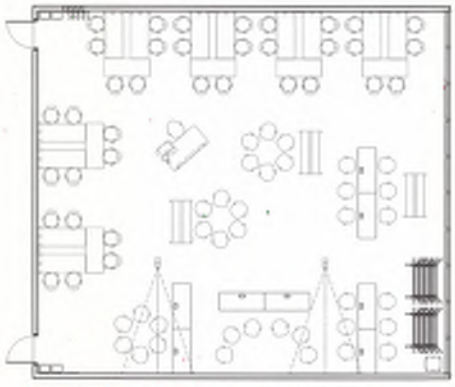
MY IDEAL...ROOM CONFIGURATION

(LARGE CLASSROOM ~ over 50 students)



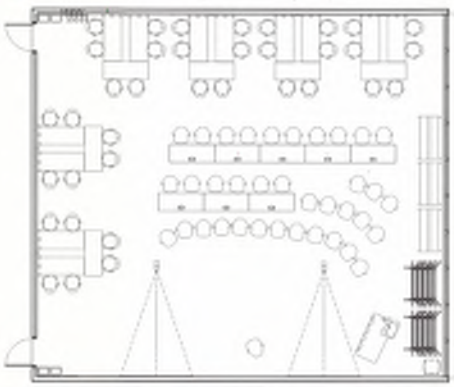
LECTURE SETTING

ADJUSTABLE FURNITURE IN FLAT ROOMS FOR CLEAR SIGHT LINES

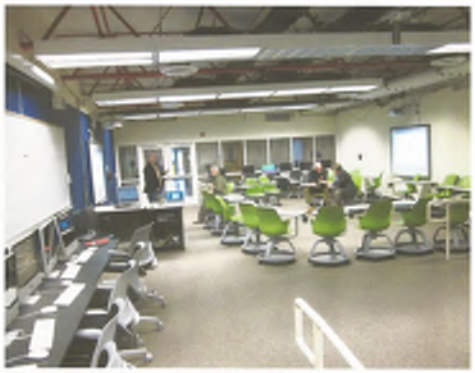


GROUP WORK SETTING

VARIETY OF FLEXIBLE WRITEABLE SURFACES, FURNITURE & DIGITAL MEDIA FOR COLLABORATION



GROUP WORK SETTING



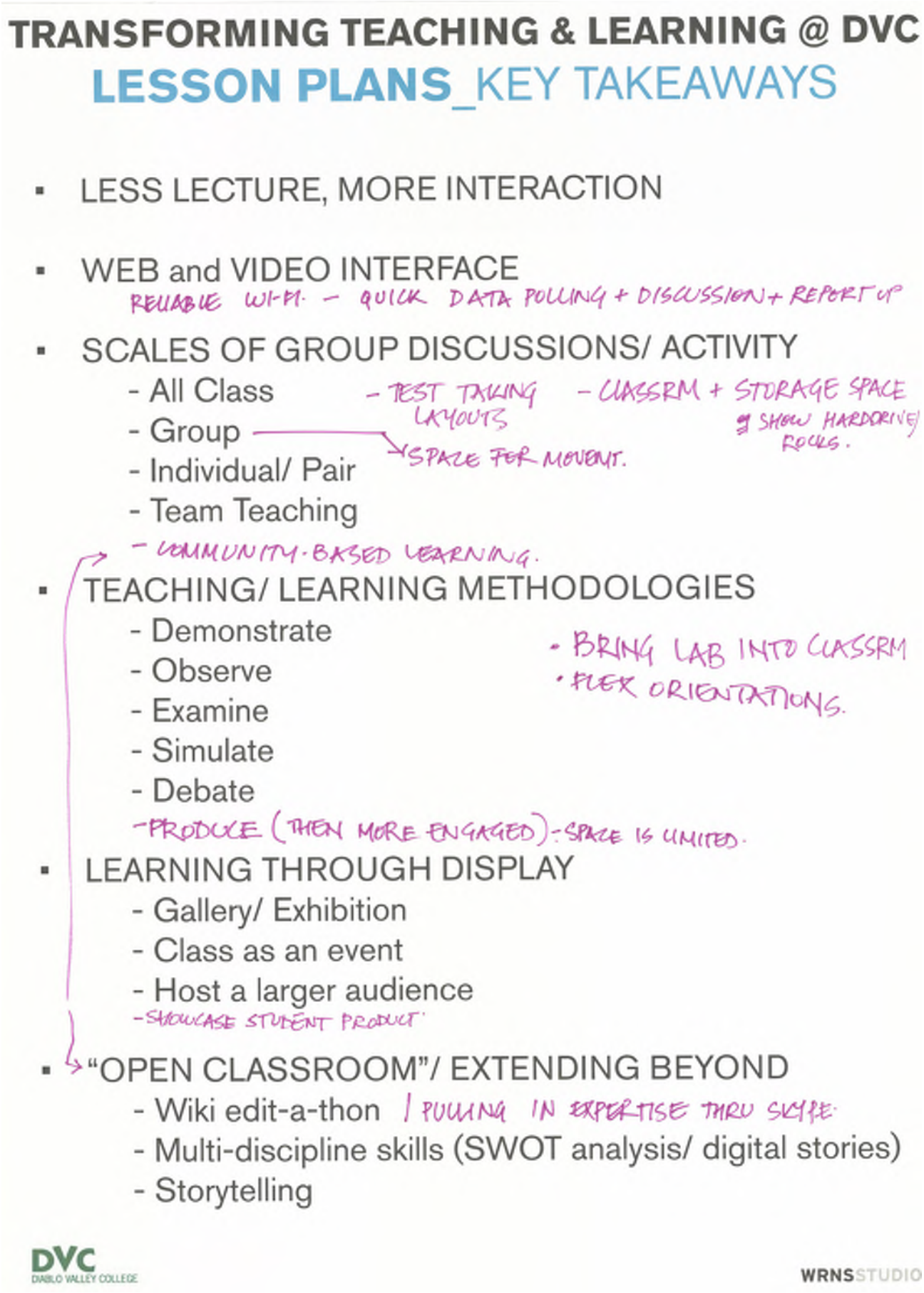
MULTI-MODAL; MULTI-SCALE WITHIN SAME ROOM

DVC DIABLO VALLEY COLLEGE

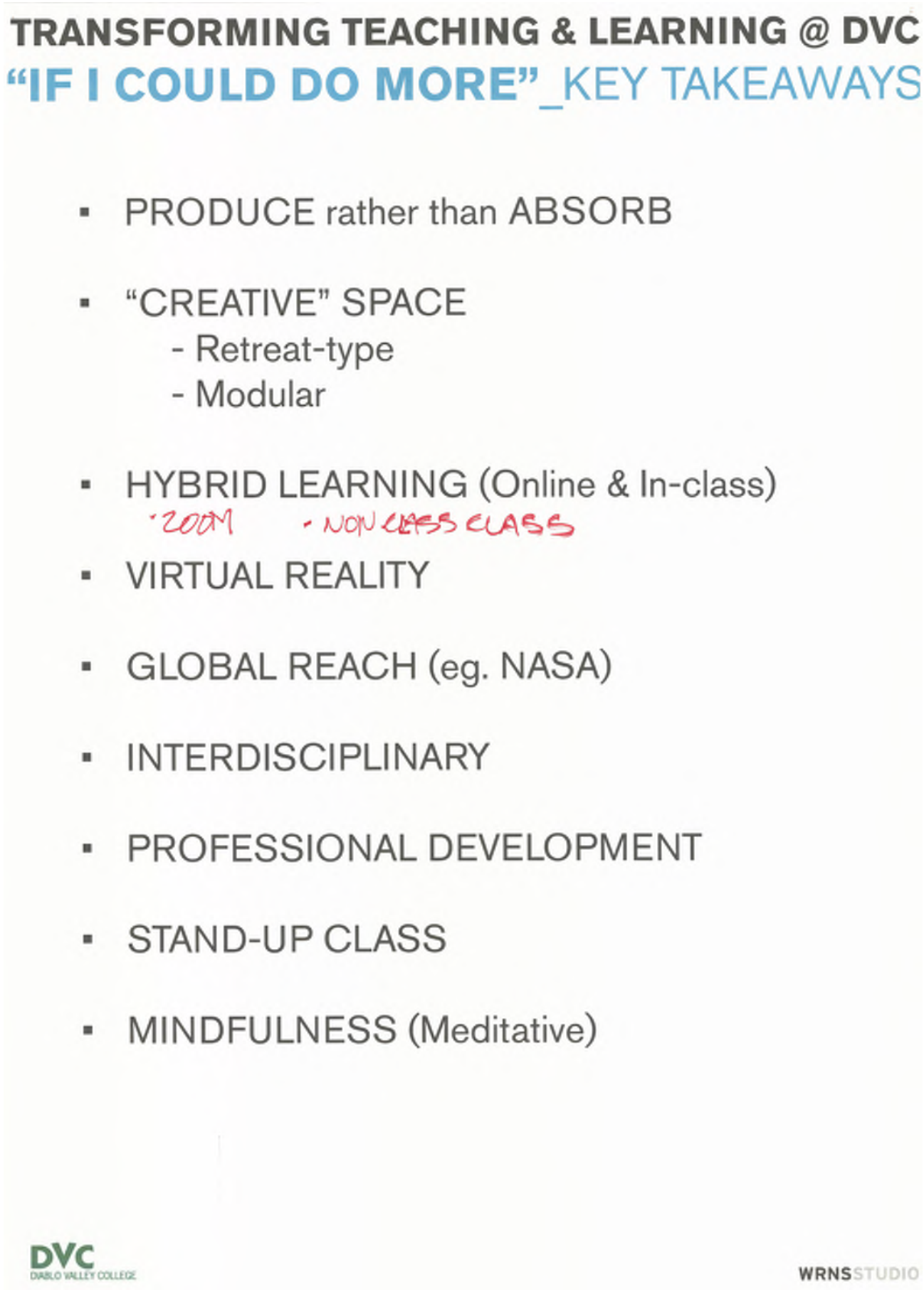
ACCESSIBILITY

WRNSSTUDIO

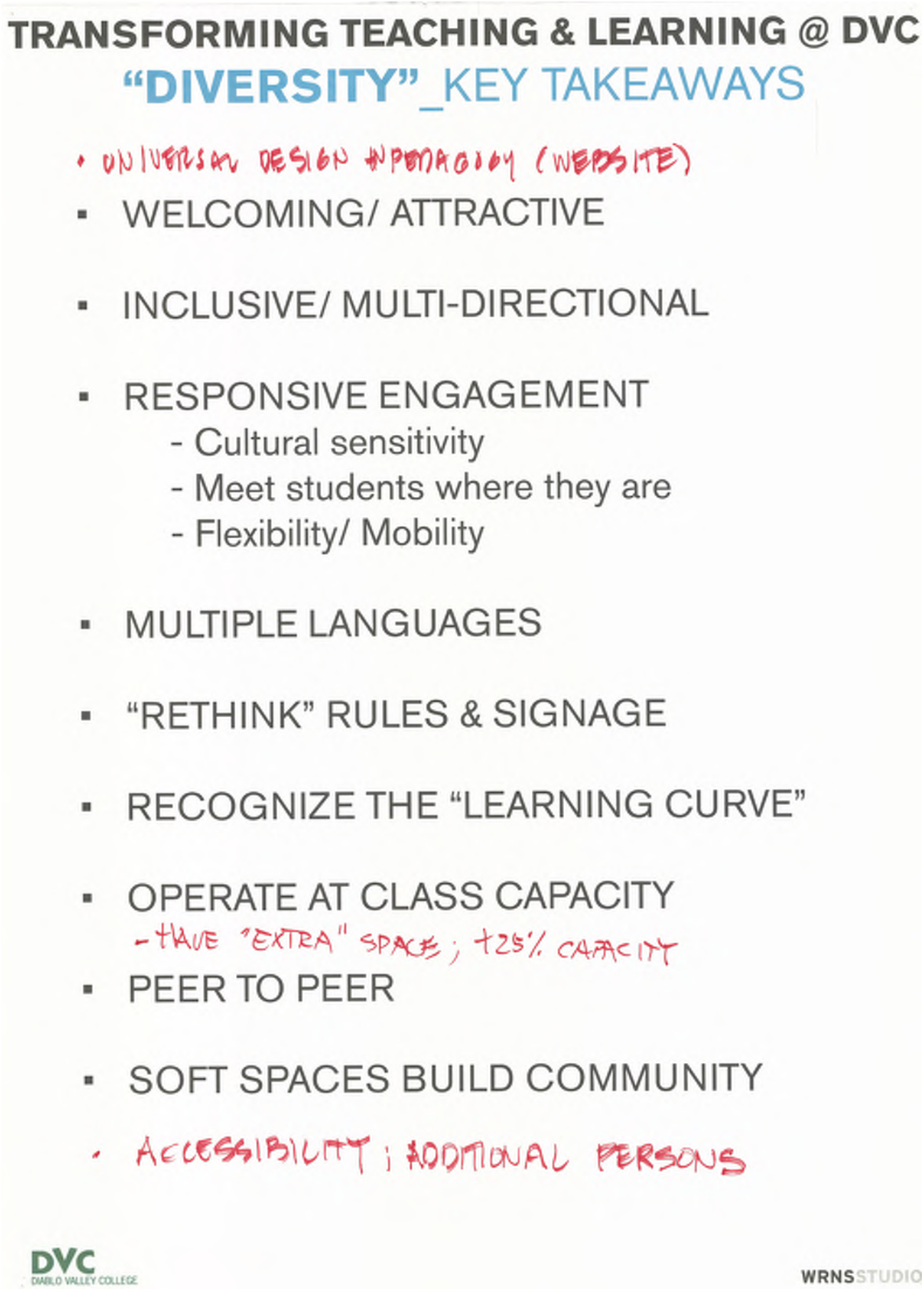
Debrief Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



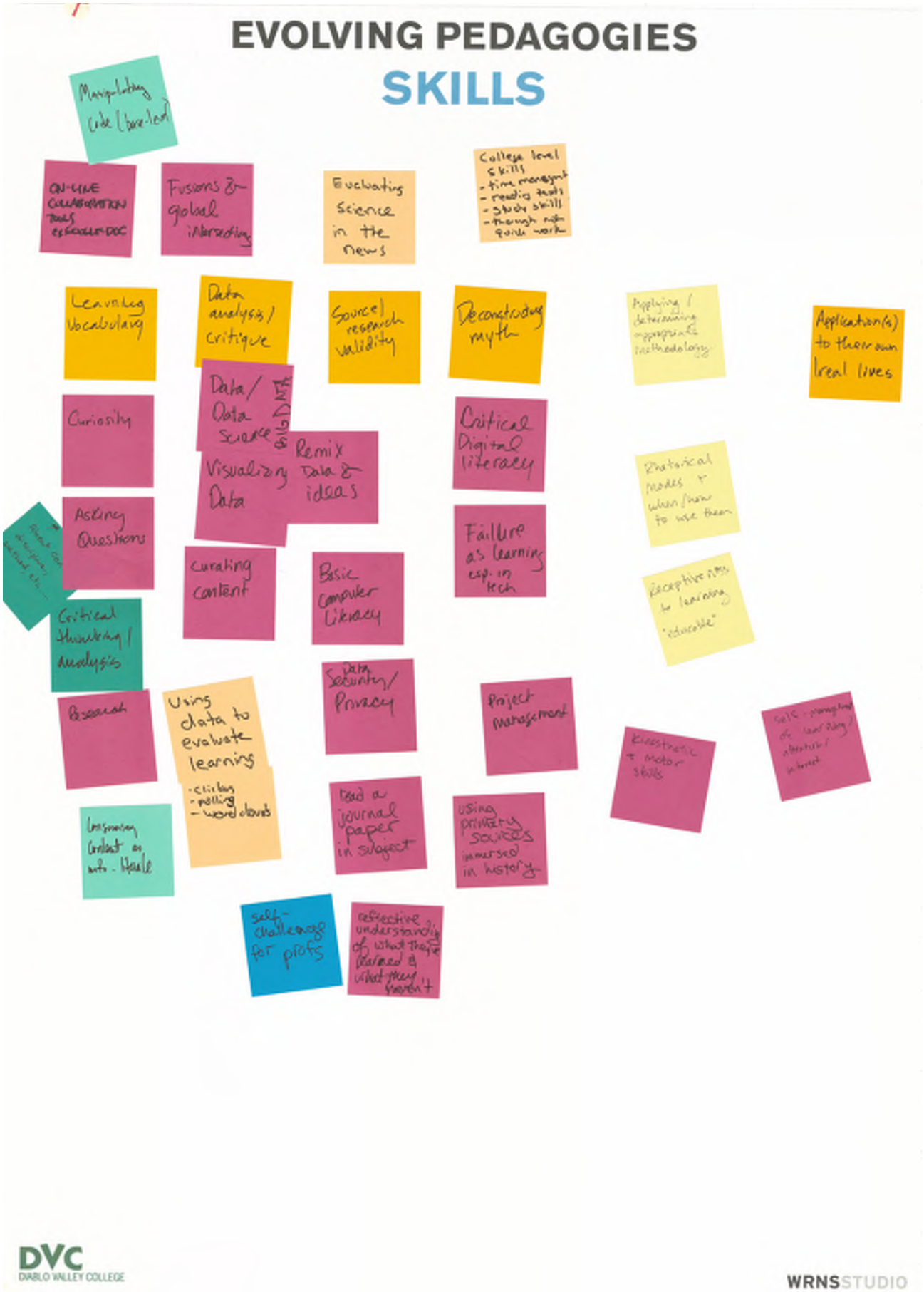
Debrief Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



Debrief Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



Exercise 1 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



Exercise 1 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

DVC DIABLO VALLEY COLLEGE

WRNSSTUDIO

Exercise 1 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

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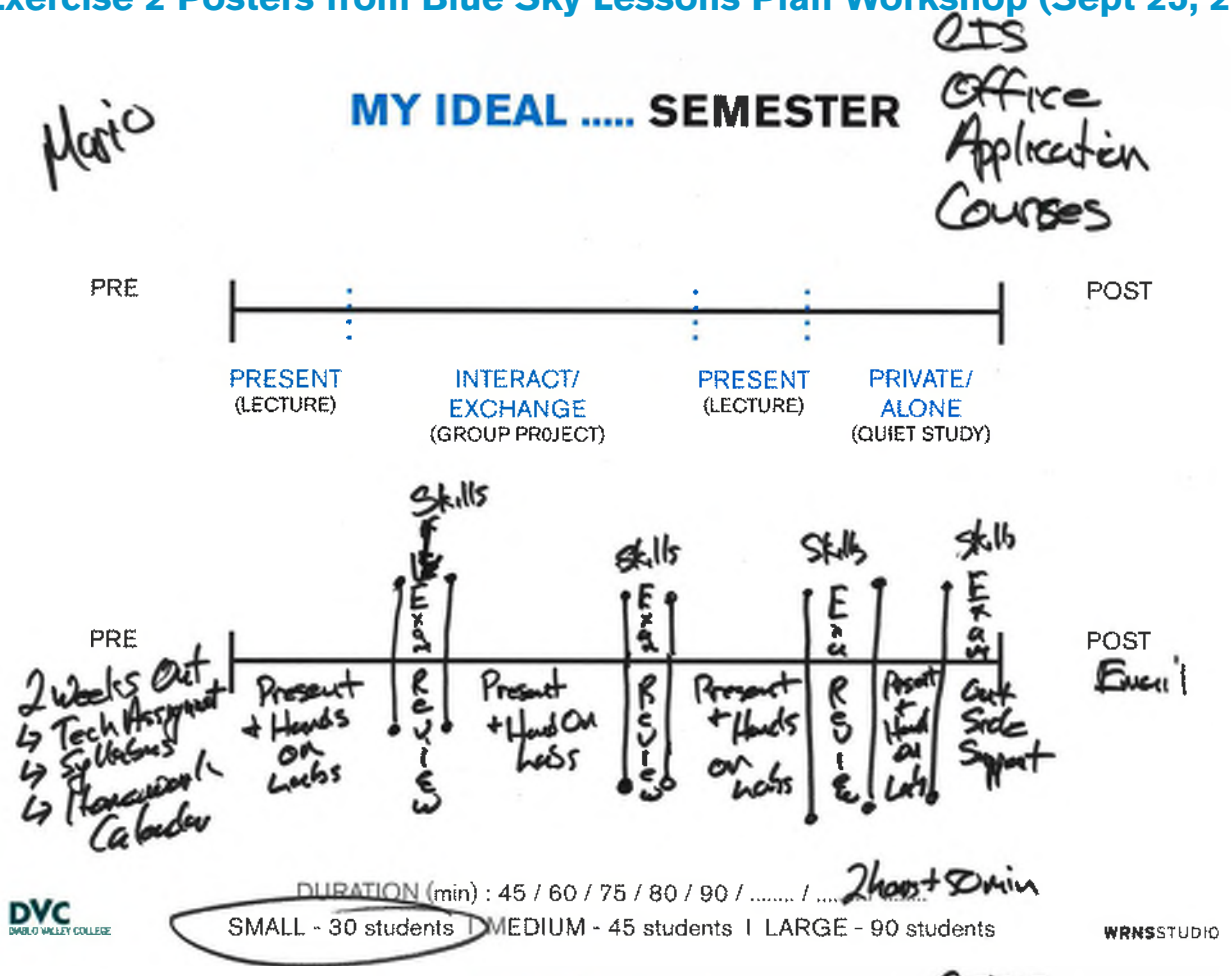
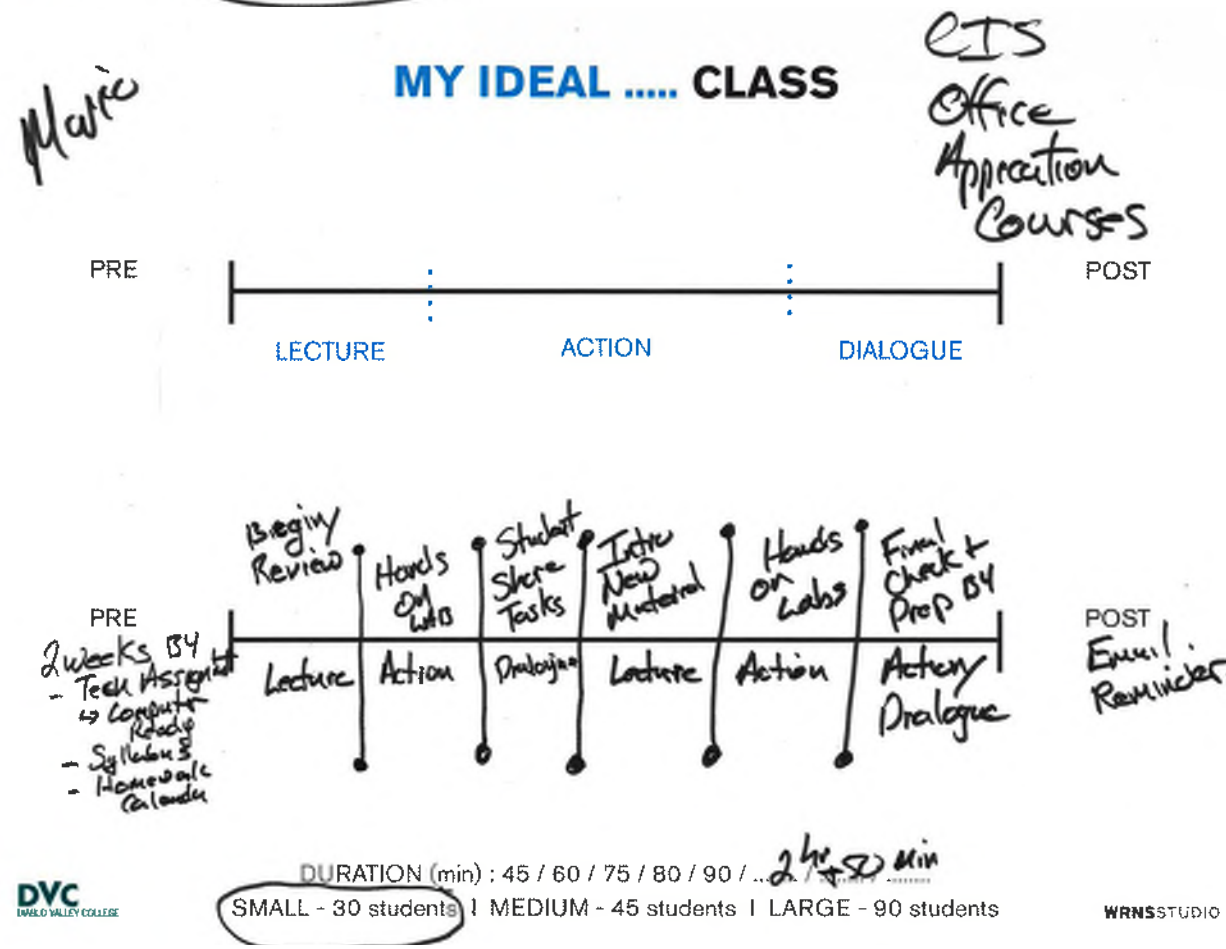
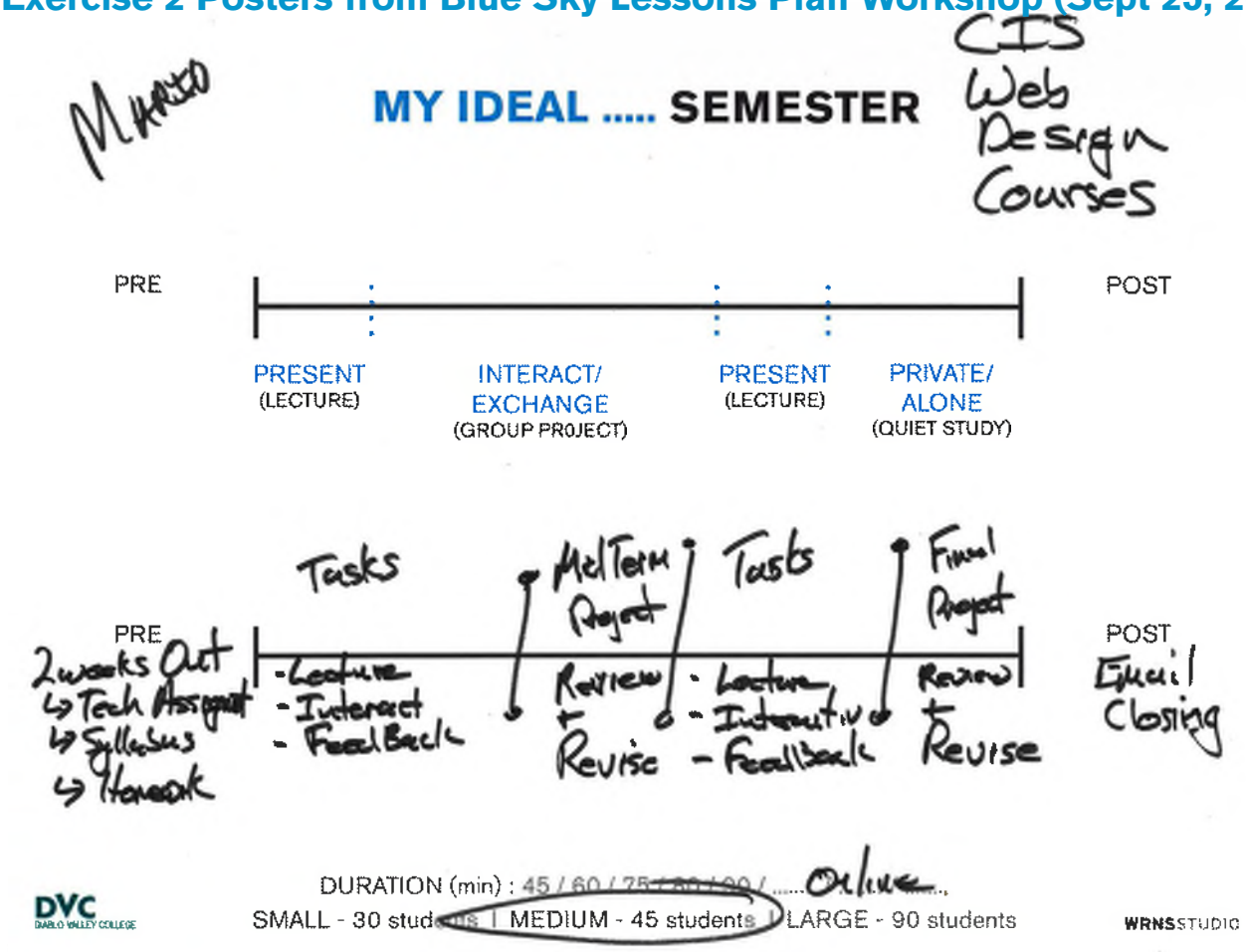
Exercise 1 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

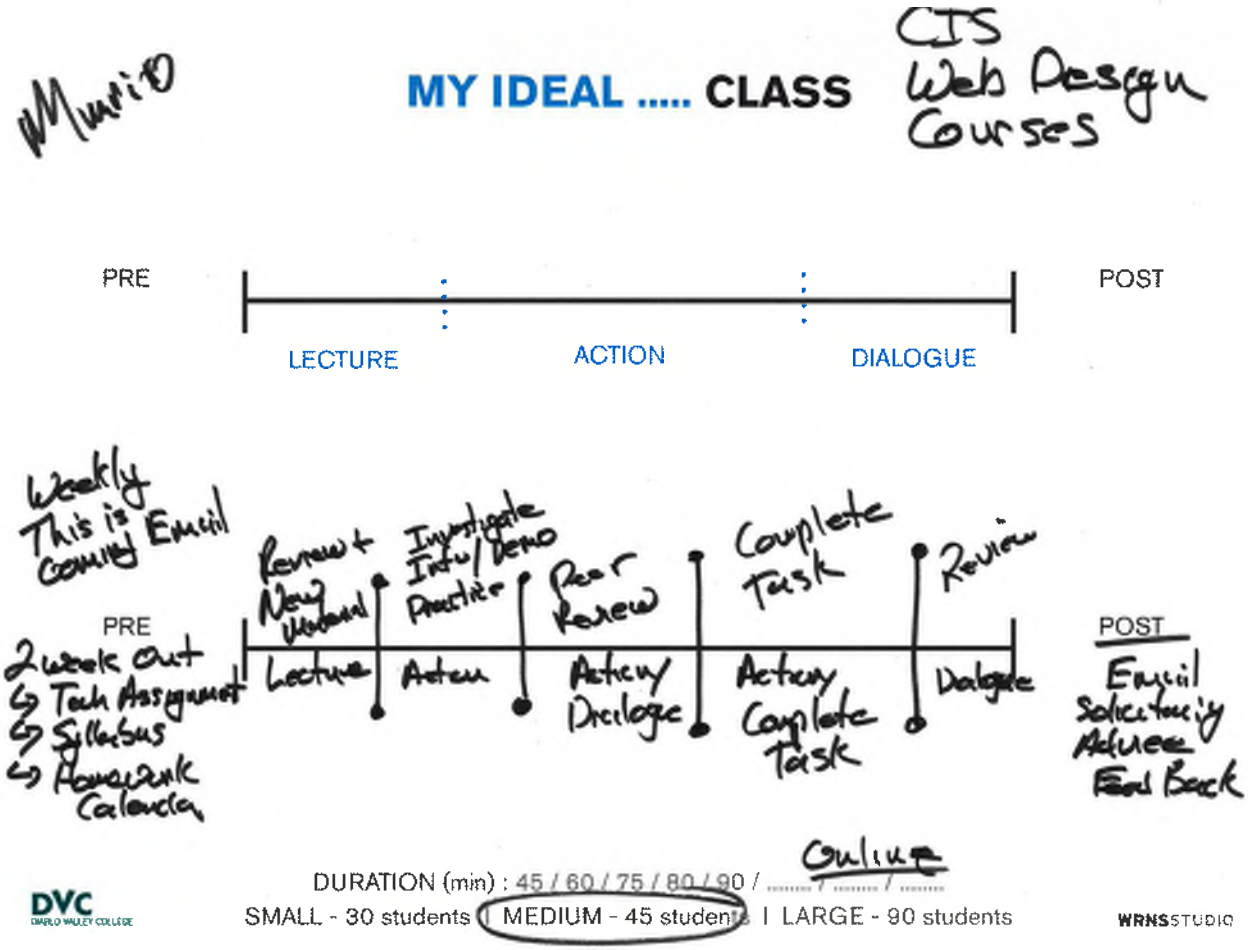
Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)





Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

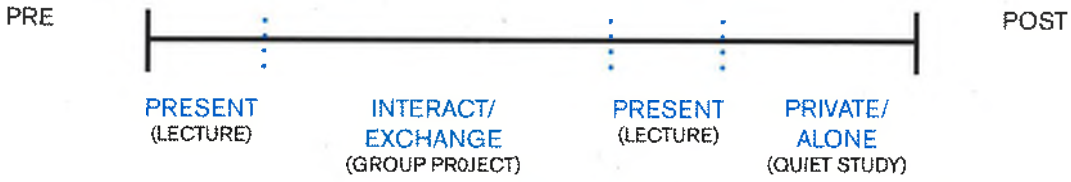


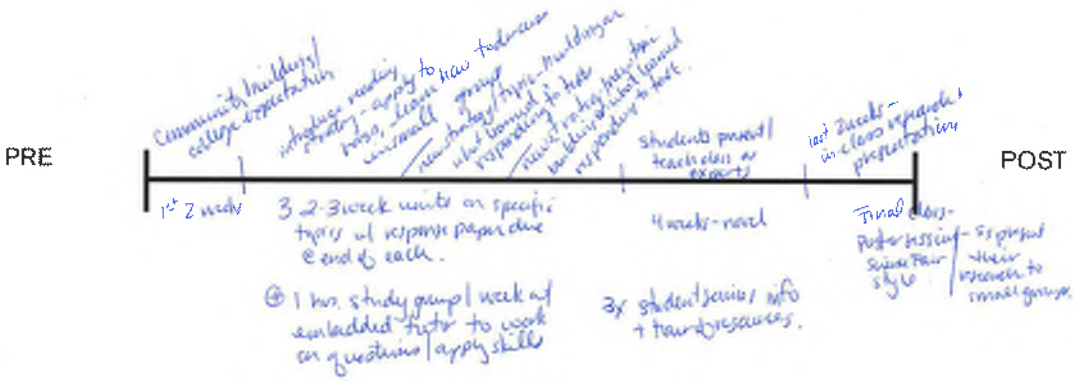


Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

Katy Agnost
Pre-transfer Eng. 96
(2 levels below transfer)
reading strategy

MY IDEAL ..... SEMESTER





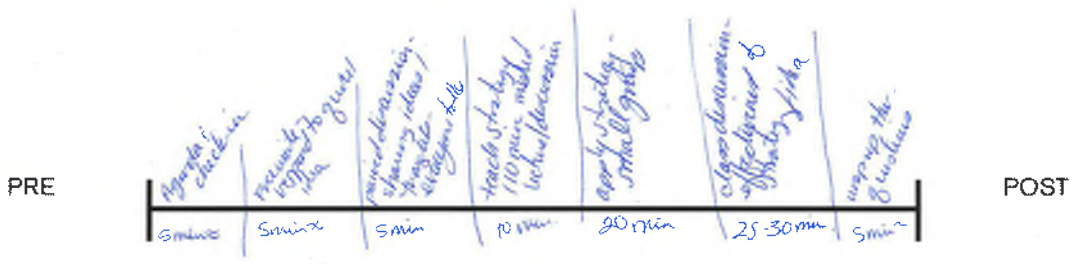
DURATION (min) : 45 / 60 / (75) / 80 / 90 / ..... / ..... / .....
SMALL - (30 students) I MEDIUM - 45 students I LARGE - 90 students

DVC DIABLO VALLEY COLLEGE

WRNSSTUDIO

Katy Agnost
Pre-transfer Eng. 96
2 levels below

MY IDEAL ..... CLASS



DURATION (min) : 45 / 60 / (75) / 80 / 90 / ..... / ..... / .....
SMALL - (30 students) I MEDIUM - 45 students I LARGE - 90 students

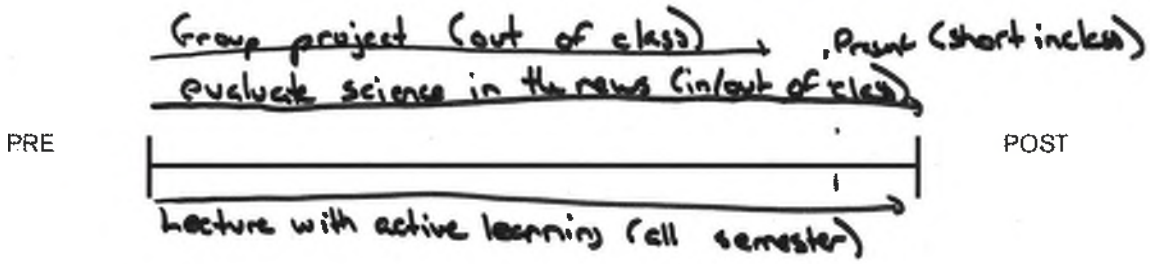
DVC DIABLO VALLEY COLLEGE

WRNSSTUDIO

Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

Joe

MY IDEAL ..... SEMESTER



DVC DIABLO VALLEY COLLEGE

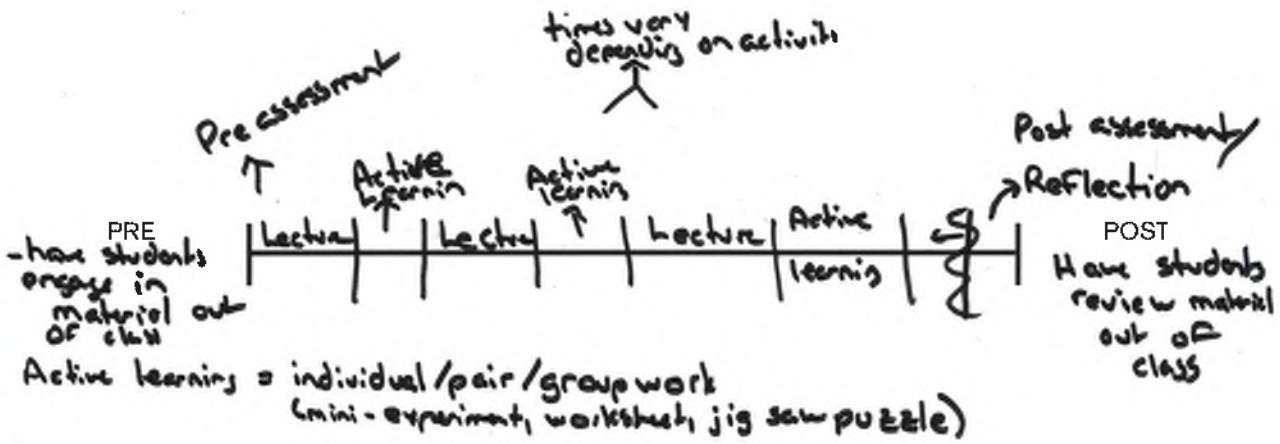
DURATION (min) : 45 / 60 / 75 / 80 / 90 / ..... / ..... / .....

SMALL - 30 students | MEDIUM - 45 students | LARGE - 90 students

WRNSSTUDIO

Joe

MY IDEAL ..... CLASS



DVC DIABLO VALLEY COLLEGE

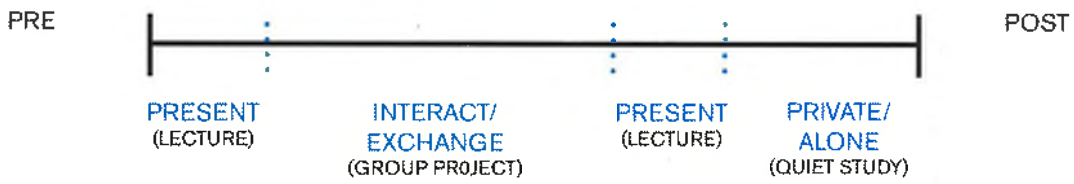
DURATION (min) : 45 / 60 / 75 / 80 / 90 / ..... / ..... / .....

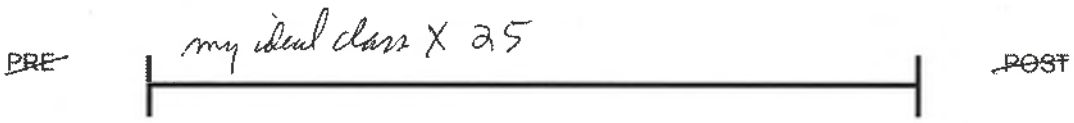
SMALL - 30 students | MEDIUM - 45 students | LARGE - 90 students

WRNSSTUDIO

Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

MY IDEAL ..... SEMESTER

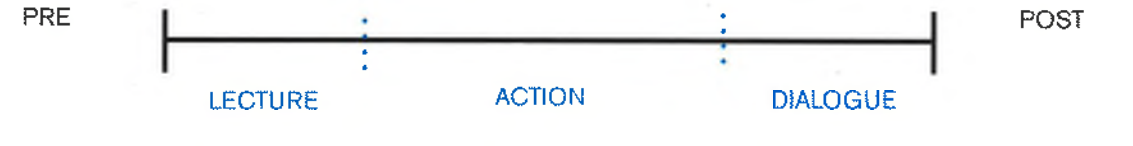


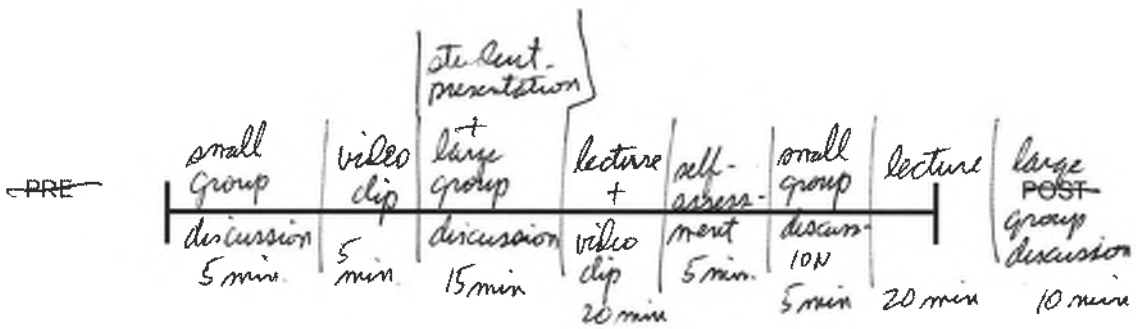


DURATION (min) : 45 / 60 / 75 / 80 / 90 / ..... / ..... / .....
SMALL - 30 students I MEDIUM - 45 students I LARGE - 90 students

WRNSSTUDIO

MY IDEAL ..... CLASS

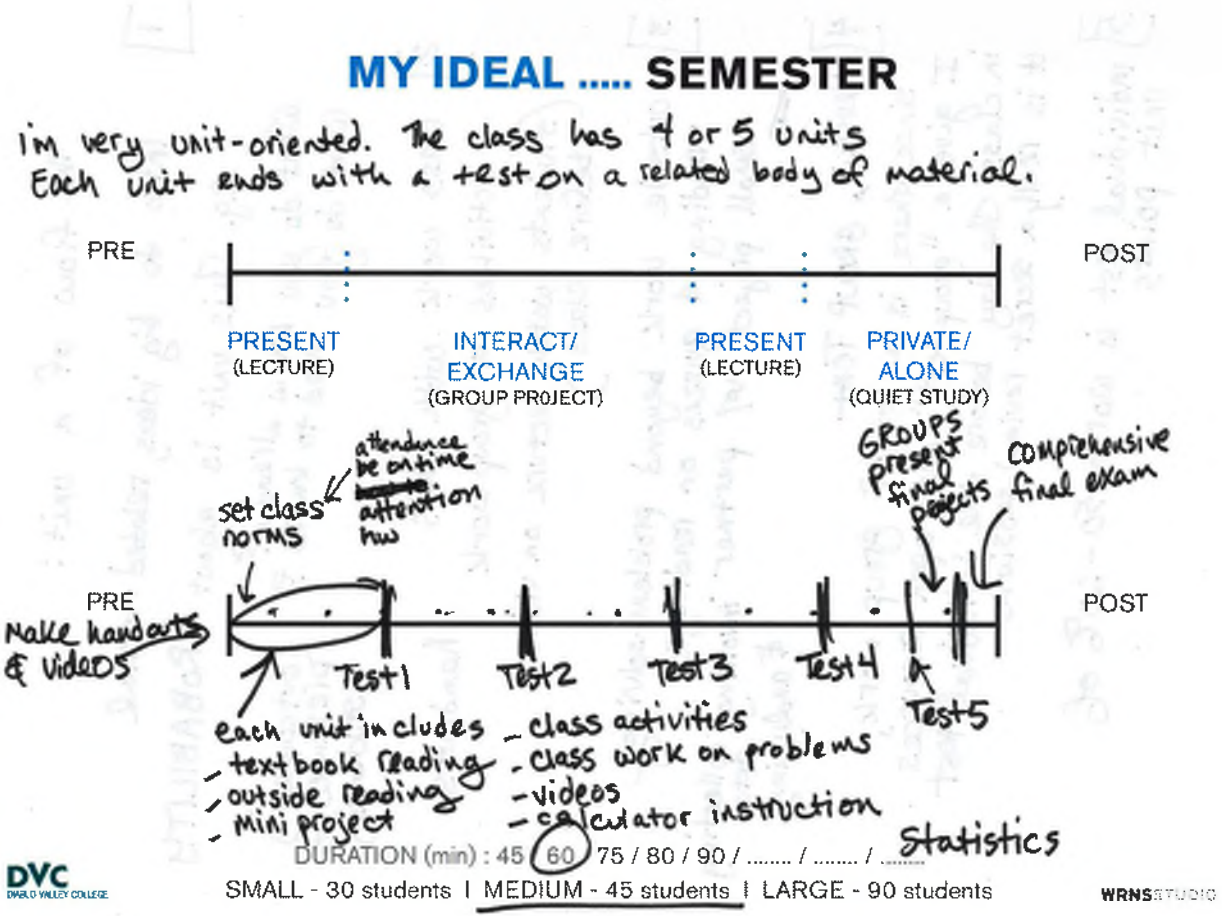


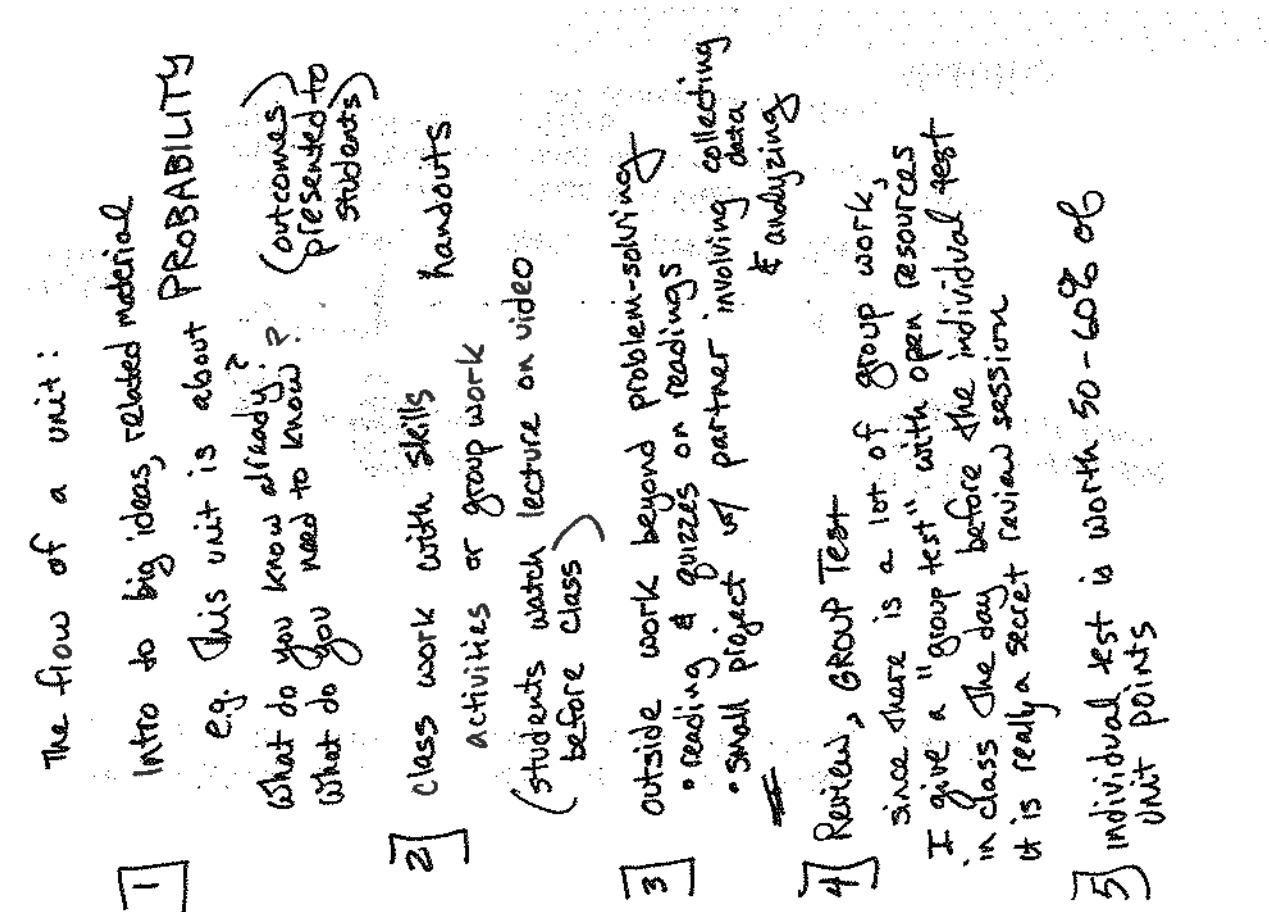


DURATION (min) : 45 / 60 / 75 (80) 90 / ..... / ..... / .....
SMALL - 30 students (MEDIUM - 45 students) LARGE - 90 students

WRNSSTUDIO

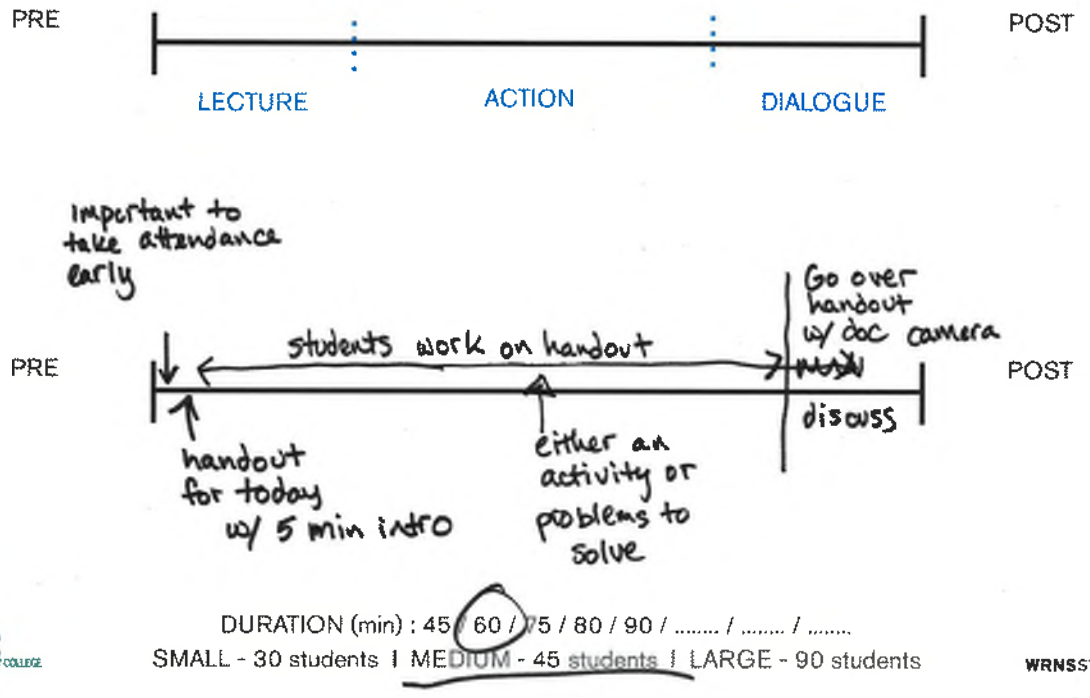
Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



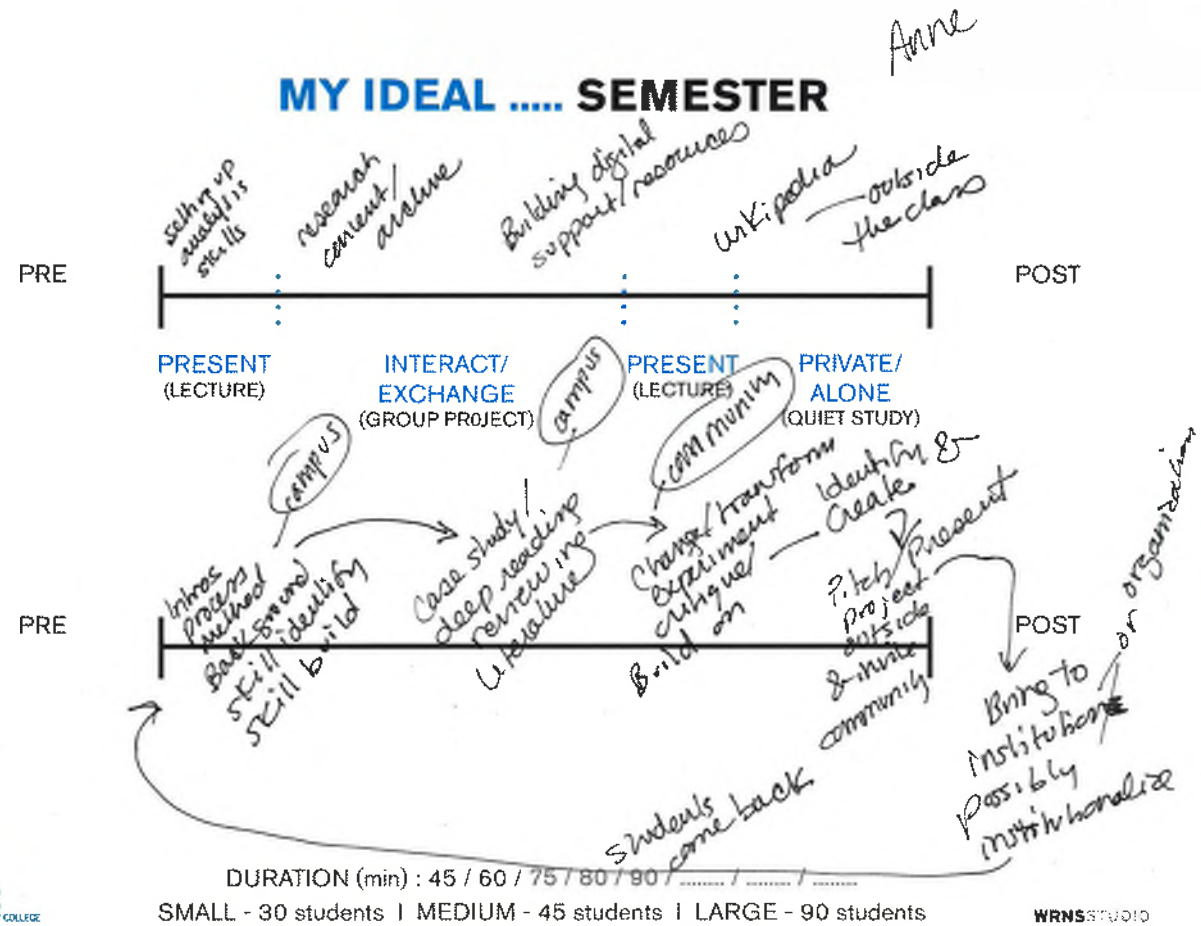


Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

MY IDEAL ..... CLASS



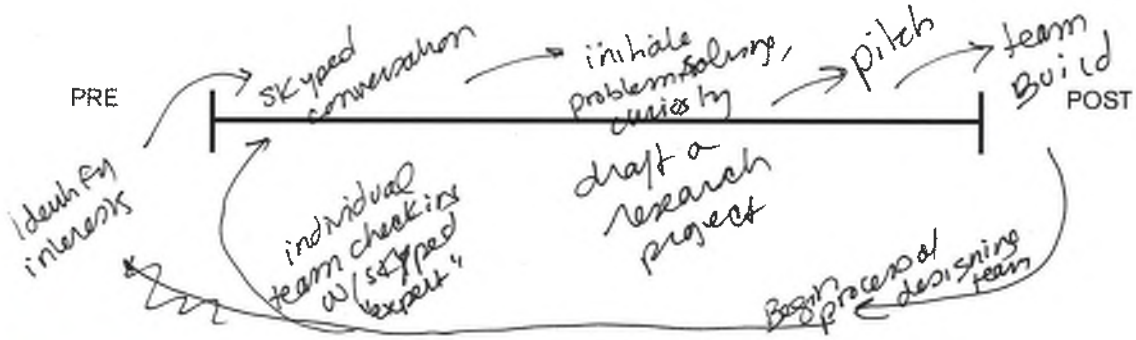
MY IDEAL ..... SEMESTER



Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

MY IDEAL ..... CLASS

Anne



DVC DIABLO VALLEY COLLEGE

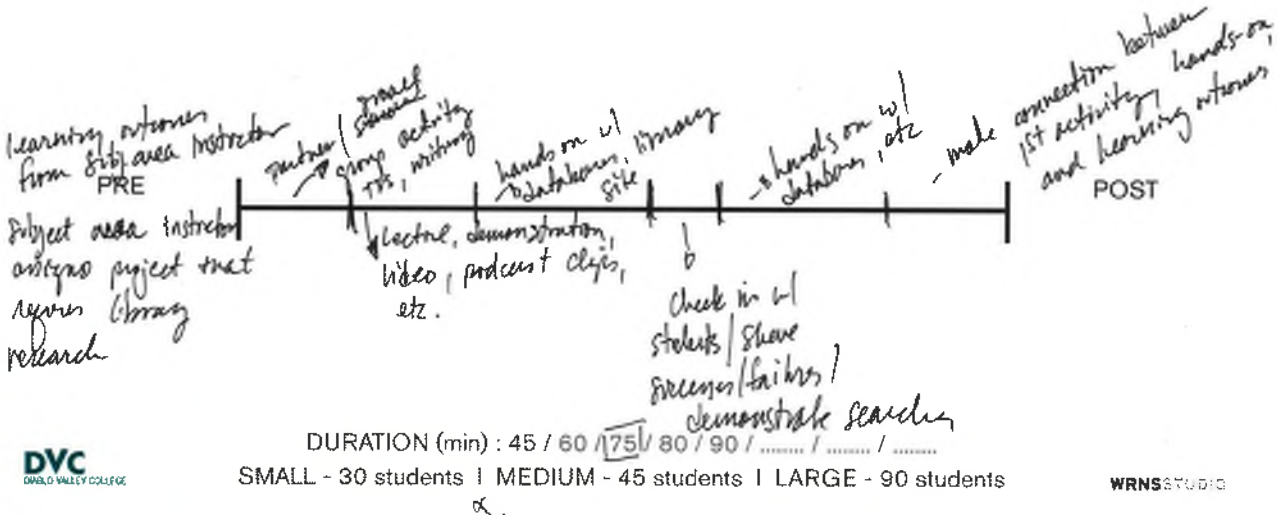
DURATION (min) : 45 / 60 / 75 / 80 / 90 / ..... / ..... / .....

SMALL - 30 students | MEDIUM - 45 students | LARGE - 90 students

WRNSSTUDIO

Library workshop Daniel

MY IDEAL ..... CLASS



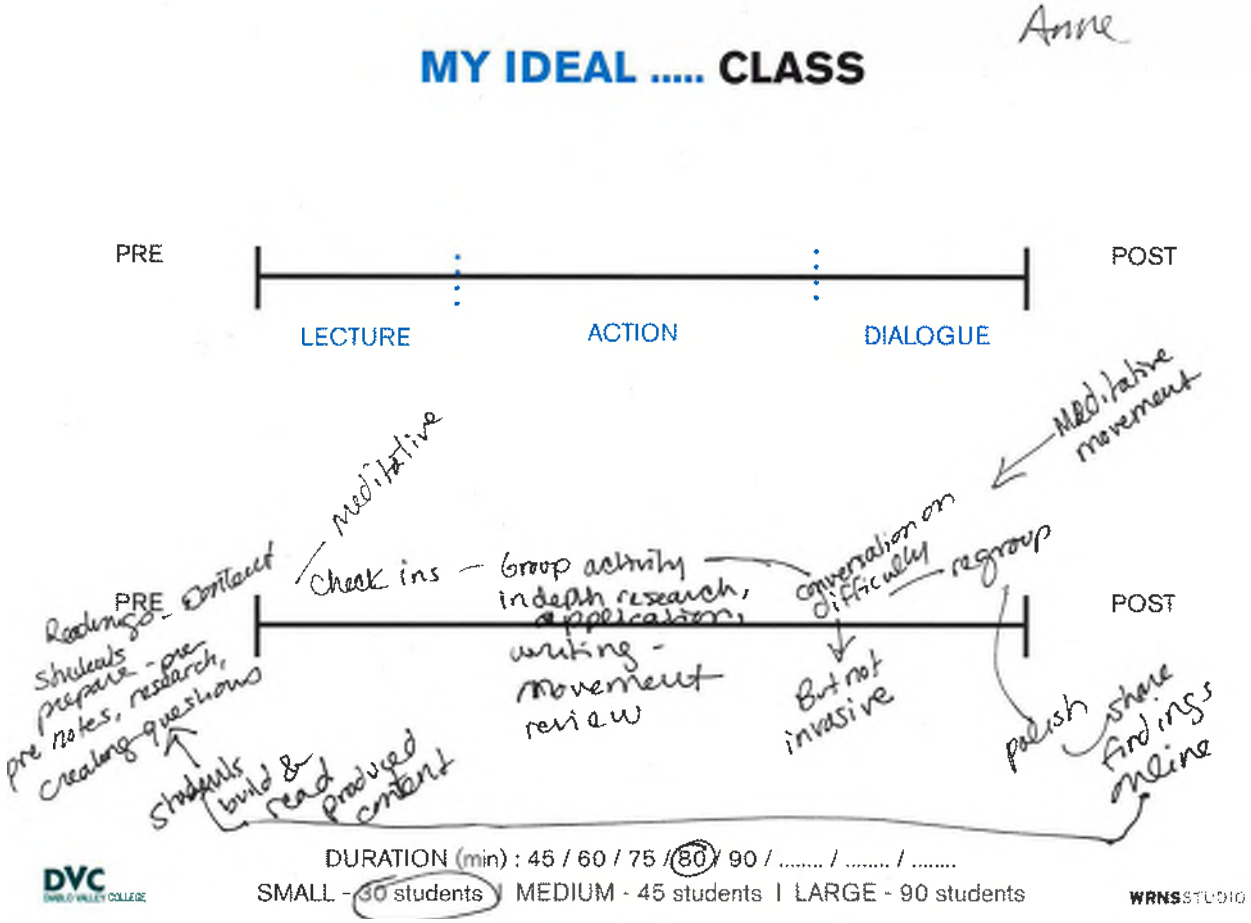
DVC DIABLO VALLEY COLLEGE

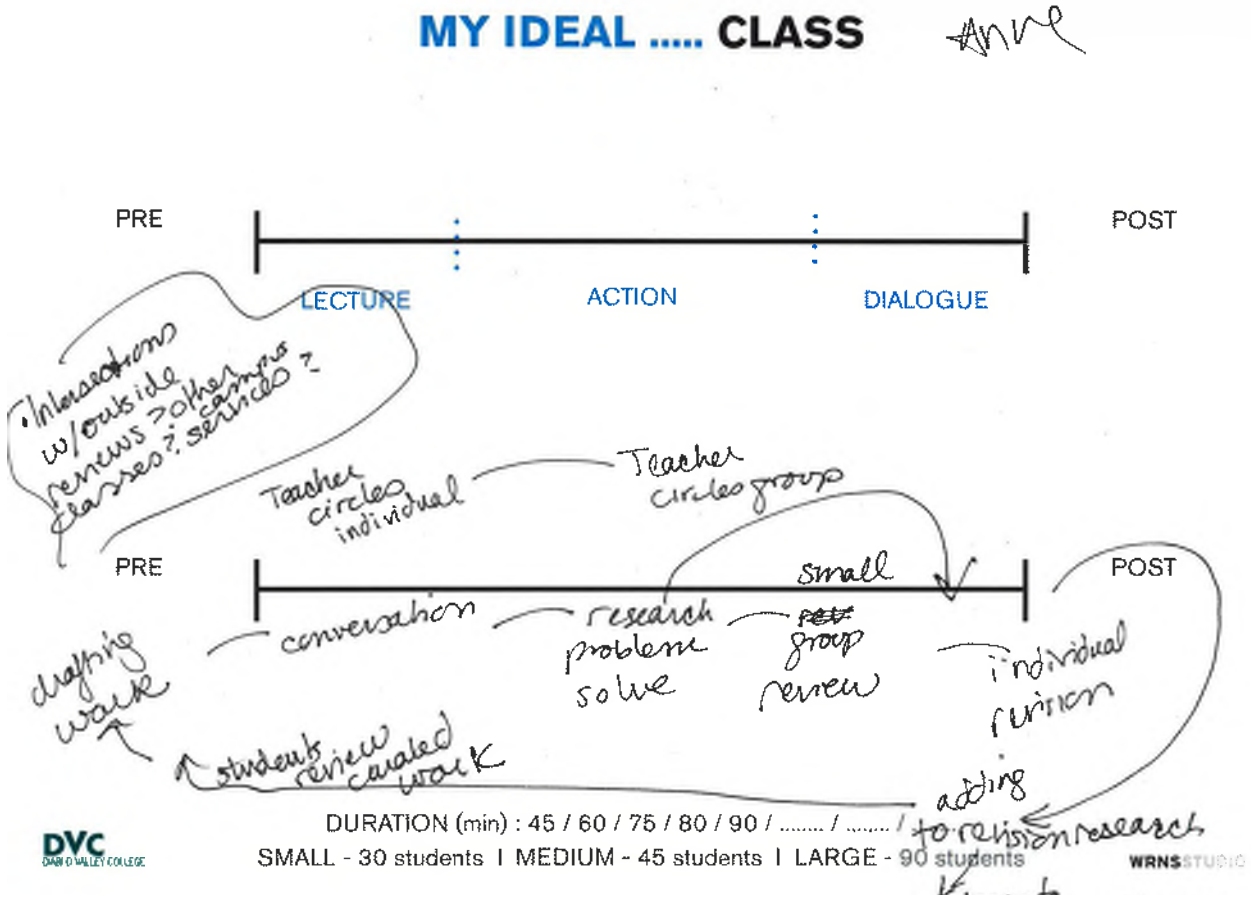
DURATION (min) : 45 / 60 / 75 / 80 / 90 / ..... / ..... / .....

SMALL - 30 students | MEDIUM - 45 students | LARGE - 90 students

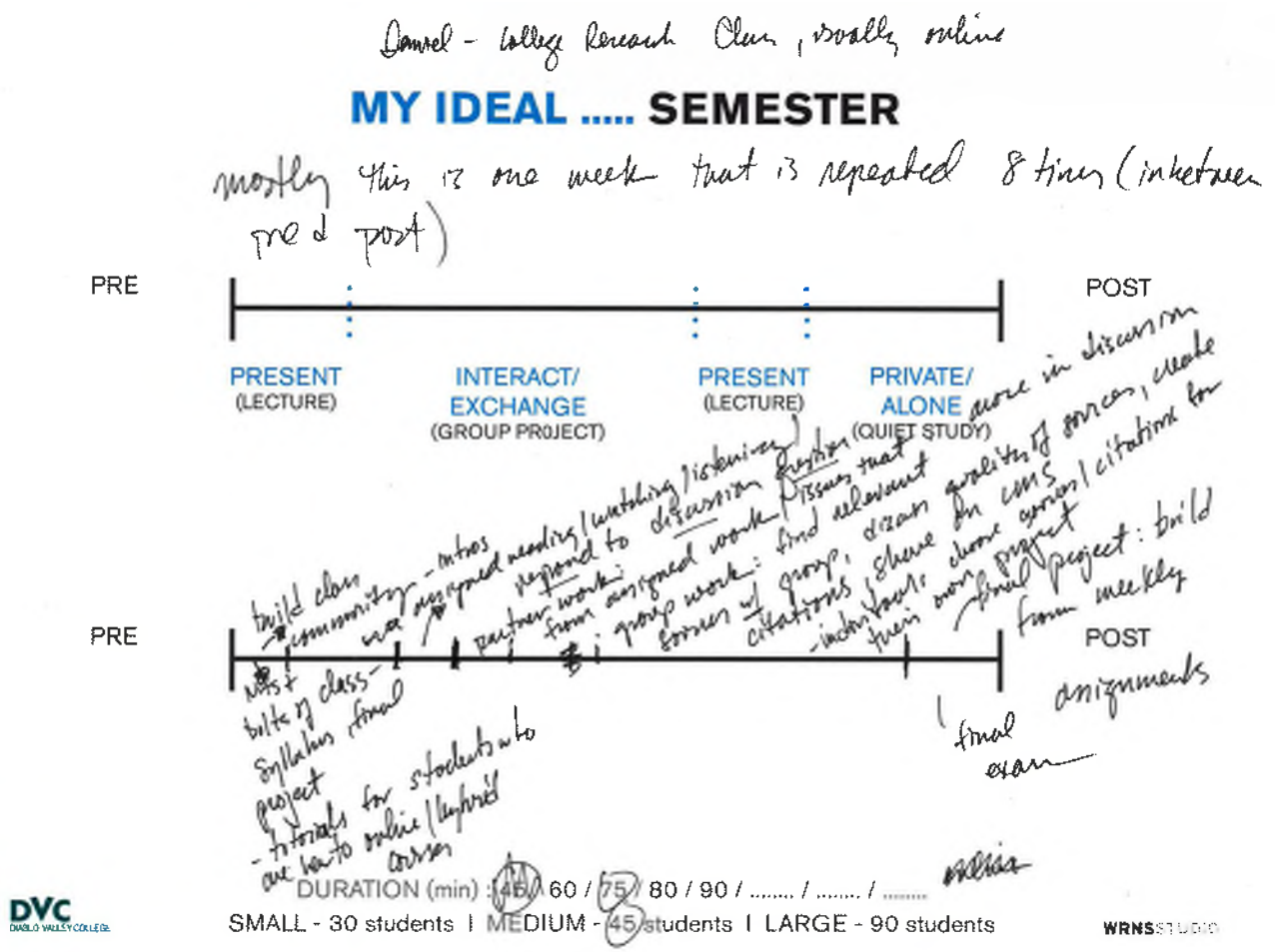
WRNSSTUDIO

Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)





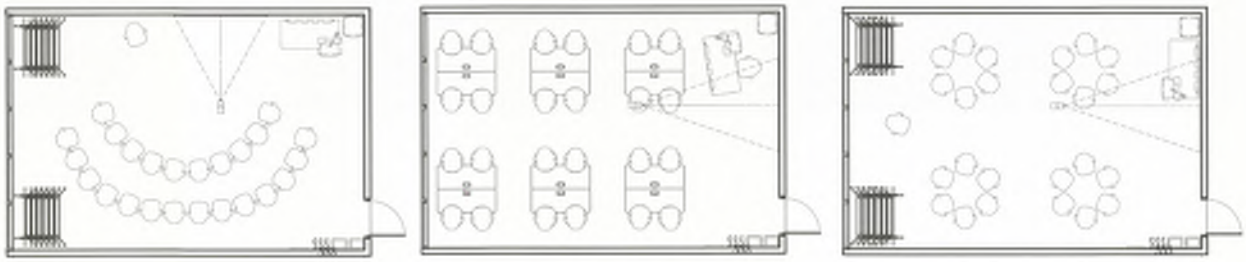
Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)



Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

+20% MY IDEAL...LESSON PLAN TOOLKIT

(SMALL CLASSROOM ~ 30 students)



SPATIAL

WALL ACCESS
EXTRA CIRCULATION SPACE
FLEXIBILITY / EASILY TRANSFORMED
THE SMALLER THE BETTER FOR FLEXIBILITY
WINDOWS GOOD

EQUIPMENT

PAPER BOX/RETURN/DROP OFF
MULTI-DIRECTIONAL A/V
SMART BOARD
LARGER TABLES
COUNTER FOR HANDCUFFS/HANDCUFFS...

FUNCTIONALITY

QUIET
HIGH TECH → LOW QUICKLY
CAMP FIRE VS THEATRICS
FURNITURE AND HOW IT'S LEFT FOR THE NEXT CLASS
DEMONSTRATIONS, LAB EQUIP OR HOOK UPS ~~for~~ INFRASTRUCTURE
LIGHT CONTROL - MULTI FUNCTION
FRESH AIR OR ~~&~~ EXTERIOR ACCESS
CLEAN ENVIRONMENTS (AESTHETIC) (OR) CREATE A CAMPUS IDENTITY

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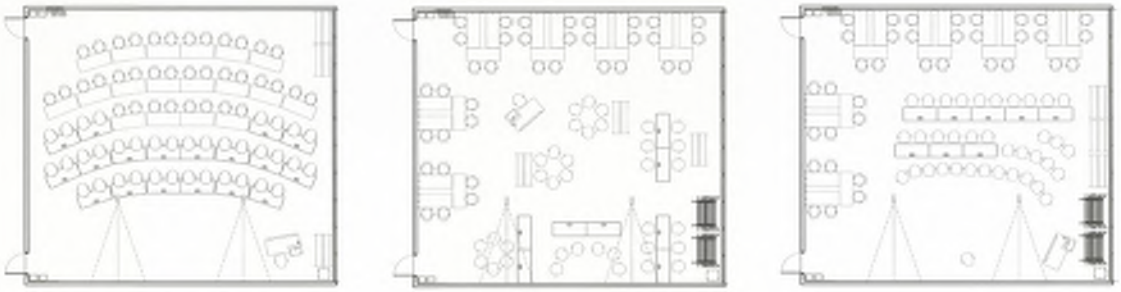
WRNSSTUDIO

Exercise 2 Posters from Blue Sky Lessons Plan Workshop (Sept 25, 2017)

MY IDEAL...LESSON PLAN TOOLKIT

(LARGE CLASSROOM ~ 90 students)



SPATIAL

SIGHTLINES ARE IMPORTANT
CIRCULATION PATHS NEED TO BE MORE FLUID
FLEXIBILITY

EQUIPMENT

SPEAKERS / MICS IMPORTANT - RECORDING - ALL CLASS TYPES
PROJECTION (PROJECT FACES ETC)
MOVEABLE WHITE BOARDS
MULTIPLE SURFACE TYPES

FUNCTIONALITY

SIGHTLINES TO ALL TYPES OF WALL PRESENTATION
↳ FLEXIBLE FOR ALL ORIENTATIONS
FLEXIBILITY IN TEACHING LOCATION
USE AS EVENT - STORAGE
ELEVATED TEACHING PLATFORM
RELIABLE TECH
* DURABILITY / CONSISTENCY *
* ADAPTATION FOR FUTURE TECH *

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Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Design Workshop #1_Key Comments

- Planning parameter of 30sf/ student is high. Show options for 20/25 sf/student.
- Performance criteria and cost shall be organized in two categories - "Must-haves" and "Nice-to-haves".
- Build in the back-end infrastructure for Hi-Tech enabled rooms. This facilitates phasing based on funding availability for the campus.
- Eliminate "Exhibition Mode" from layout options. Ceiling-hung, unistrut idea more apt for conference rooms than classrooms.
- Clerestory and Sill window options preferred equally by different stakeholders.
- Provide dedicated furniture/ equipment in the classroom. Avoid moving items between rooms.
- Avoid bulky moveable equipment within classroom.
- Consider all aspects of Universal Design - ease of access, liability with moveable furniture, privacy etc.
- Use stackable, 4-legged chairs vs bulky, 5-wheeled chairs. The latter economize space but have limited ergonomic comfort. Explore options to lock back casters.
- Prefer projectable whiteboard vs painted writeable wall - ease of maintainenance.
- Consider projector screen locations to enable simultaneous use of writeable surfaces.

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Design Workshop #1_v2_Summary

1. Planning parameter of 20sf/ student does not enable engaged, active learning environments.

   Limits collaboration

   Inadequate viewing distance to the screen

   Compromises Universal Design

   A 30sf/ student planning parameter would be ideal, however, 25sf/ student with possible expansion to 27 sf/student seems more appropriate and achievable. (Present option to ESC.)
2. The depth of workspace could vary from 18" to 24". This would provide adequate workspace for students in lecture/ groupwork modes as well as space for movement within the Small classrooms. Deeper, 24" wide work surfaces would be 'nice-to-have' if space allows.
3. Ideal group size is 4 students. Might organize as 6 students at times but rarely do groups of 8.
4. Rooms may be designed for actual capacity + 10% extra to accommodate peak student loads at the start of the semester. (Present option to ESC.)
5. Baseline for AV equipment is (1) short-throw and (2) ceiling-hung projectors with ability to show different content in each display. This will scale up with the size of the classroom.
6. Stakeholders would like to engage with prototypes of furniture and AV equipment.

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Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

User Input




DVC

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Furniture Kit of Parts

CHAIRS

Torsion Air Nesting
Mesh back
Fabric/ Vinyl Seat
Arm/ Armless/ Tablet arm

Torsion Air Stool (Non-nesting)
Mesh back
Fabric/ Vinyl Seat
Arm/ Armless/ Tablet arm

TABLES

Collaborative Rectangle
Nesting Leg
D – 24", 30"
W – 60", 66", 72", 84", 96"

Pirouette Nesting Table
On Casters
Available with integrated power
Not Adjustable Ht


Trek Nesting Table
On Casters
Available with integrated power
Pin Height Adjustable (Customized for Standing Ht)
Can be used for ADA

WorkUp Table
Best for ADA
Counter Balance Height Adjustable (Easy)

INSTRUCTOR STATION

All Terrain Mobile
Intergrated workdesk/ podium
Un-tethered

WRITEABLE SURFACE

Scribe Mobile
Moveable
Double-sided writeable surface

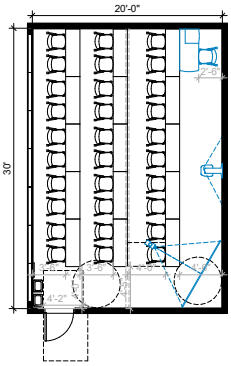
Ultimate Whiteboard
Projection & Dry-erase

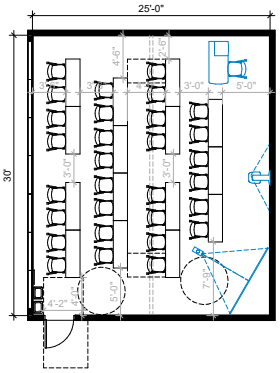
DVC

WRNSSTUDIO

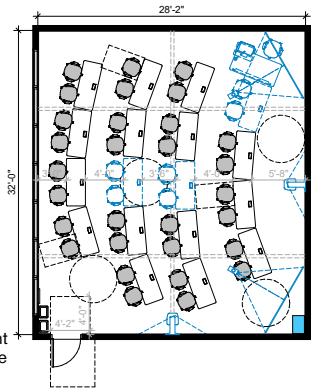
Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Small Classroom (30 students)_Lecture Mode





* 27 sf/student @ SCC space standard



20 sf/student ~ 600sf

+ Area allocation per student closer to current campus projects
- Smaller workspace at desks (18" deep)
- Desks placed close together
- Narrow dead-end aisles
- Limits students in wheelchairs to certain desk locations
- Not easy for students to move in/out of aisle seating
- Limits view for students infront of intsructor station
- Not adequate viewing distance from screen for all students

25 sf/student ~ 750sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks
+ Central aisle breaks help movement
+ More accessible to wheelchairs with some maneuvering
- Smaller workspace at desks (18" deep)
- Some desks placed close together
- Less space for students/ faculty/ disabled users to move around than 30sf/ student
- Higher per student area allocation than current campus projects

30 sf/student ~ 900sf

+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates movement through row seating
+ Universal Design: Entire room easily accessible to wheelchairs with 30 students
+ Wider workspace at desks (24" deep)
+ Allows for moveable storage/ supplies cabinet
+ Accommodates upto 20% extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

DVC

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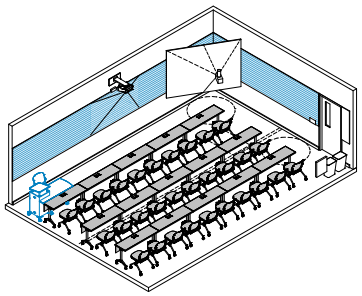
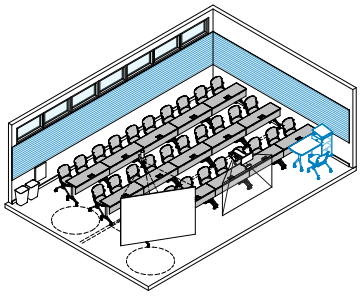
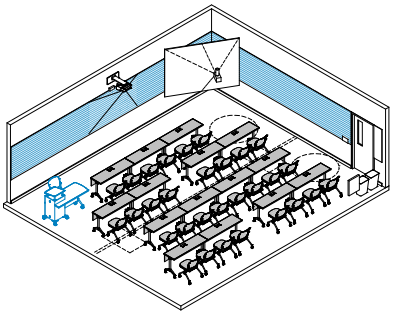
Small Classroom (30 students)_Lecture Mode

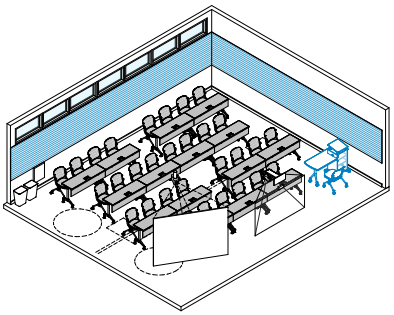
20 sf/student ~ 600sf



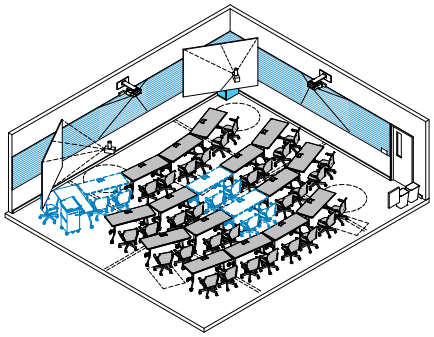


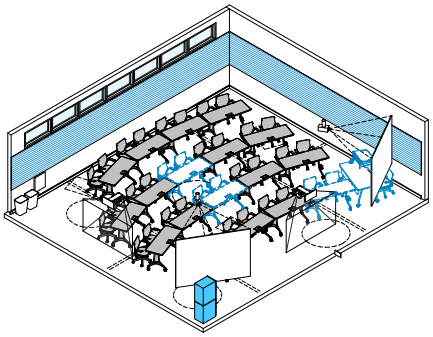
25 sf/student ~ 750sf





30 sf/student ~ 900sf





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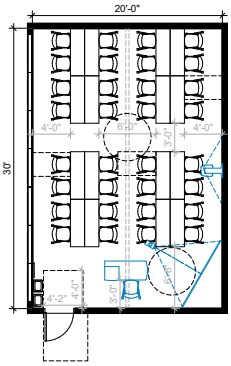
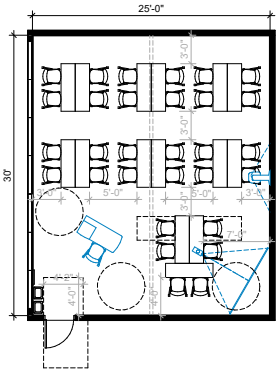
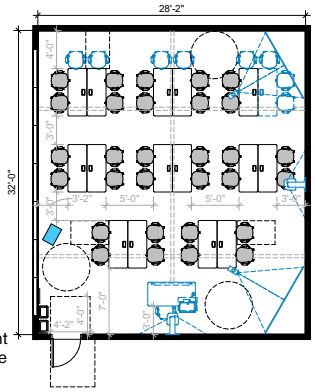
Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Small Classroom (30 students)_Groupwork Mode 1





* 27 sf/student @ SCC space standard



20 sf/student ~ 600sf

+ Area allocation per student closer to current campus projects
- Smaller workspace at desks (18" deep)
- Not adequate space to create groups of 4 with space between desks
- Less space for students/ faculty/ disabled users to move around/ collaborate
- Limits students in wheelchairs to certain desk locations
- Not adequate viewing distance from screen for some students

25 sf/student ~ 750sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks and to move around/ collaborate
+ Front of the room more accessible to wheelchairs with some maneuvering
- Smaller workspace at desks (18" deep)
- Some desks placed close to the wall
- Less space for students/ faculty/ disabled users to move around/ collaborate than 30sf/ student
- Not adequate viewing distance from screen for some students
- Higher per student area allocation than current campus projects

30 sf/student ~ 900sf

+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates easy movement/ collaboration
+ Universal Design: Entire room easily accessible to wheelchairs
+ Easily accommodates groups of 6 students
+ Wider workspace at desks (24" deep)
+ Allows for moveable storage/ supplies cabinet
+ Adequate viewing distance from screen for all students
+ Accommodates upto 20% extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

DVC

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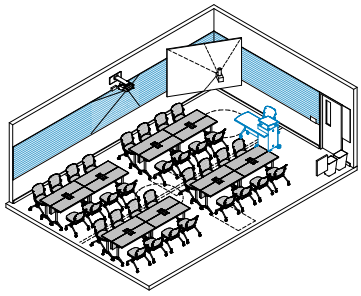
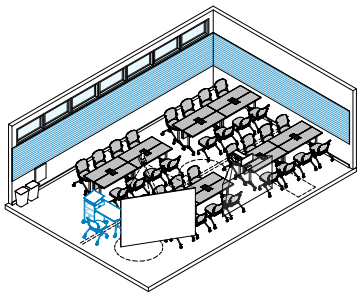
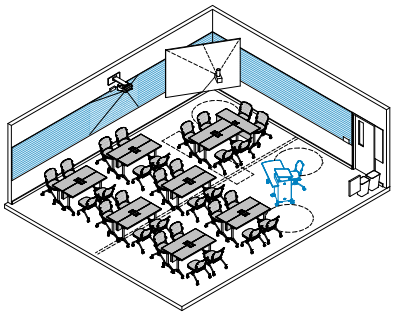
Small Classroom (30 students)_Groupwork Mode 1

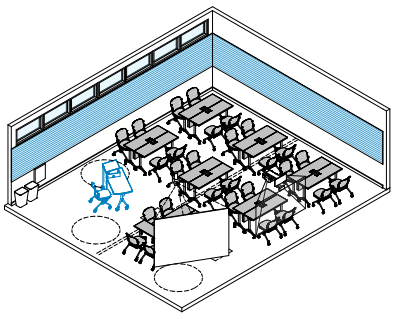
20 sf/student ~ 600sf



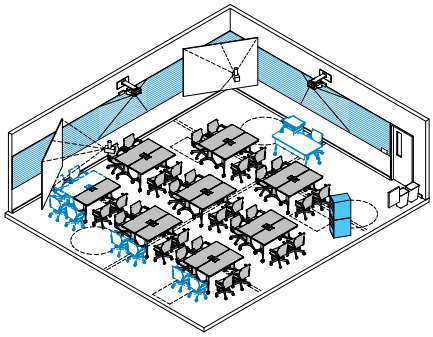


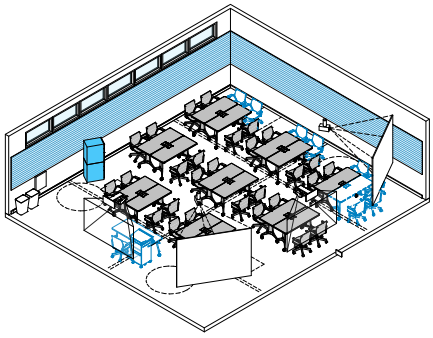
25 sf/student ~ 750sf





30 sf/student ~ 900sf



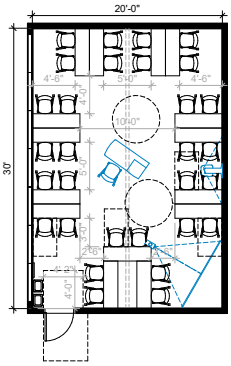


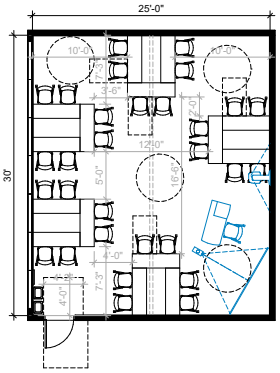
DVC

WRNSSTUDIO

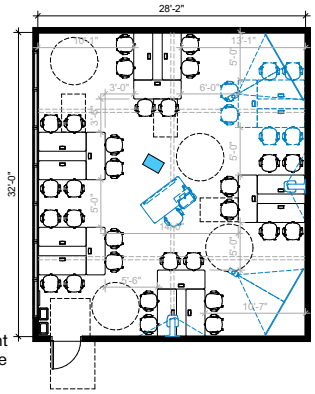
Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Small Classroom (30 students)_Groupwork Mode 2





* 27 sf/student @ SCC space standard



20 sf/student ~ 600sf

+ Area allocation per student closer to current campus projects
- Smaller workspace at desks (18" deep)
- Desks placed close together
- Less space for students/ faculty/ disabled users to move around/ collaborate
- Limits students in wheelchairs to certain desk locations
- Accommodates groups of 4, not ideal to have groups of 6 students
- Not adequate viewing distance from screen for all students

25 sf/student ~ 750sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks and to move around/ collaborate
+ Corners of the room accessible to wheelchairs with some maneuvering
+ Accommodates groups of 6 students
- Smaller workspace at desks (18" deep)
- Some desks placed close together
- Less space for students/ faculty/ disabled users to move around/ collaborate than 30sf/ student
- Not adequate viewing distance from screen for all students
- Higher per student area allocation than current campus projects

30 sf/student ~ 900sf

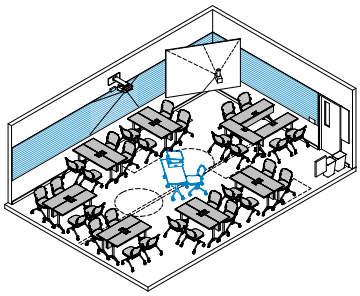
+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates movement/ collaboration
+ Universal Design: Entire room easily accessible to wheelchairs
+ Easily accommodates groups of 6 students
+ Wider workspace at desks (24" deep)
+ Allows for moveable storage/ supplies cabinet
+ Adequate viewing distance from screen for all students
+ Accommodates upto 20% extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

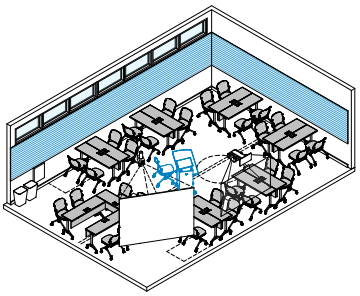
DVC

WRNSSTUDIO

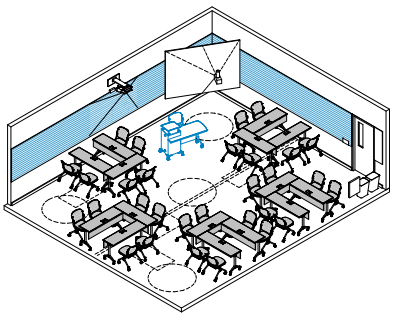
Small Classroom (30 students)_Groupwork Mode 2

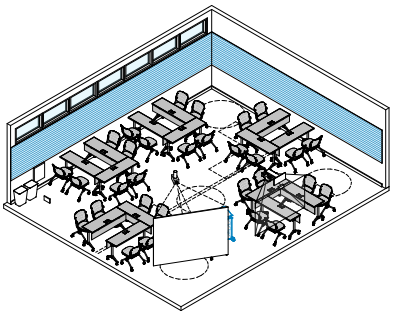
20 sf/student ~ 600sf



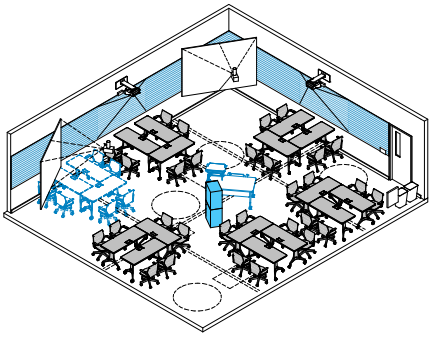


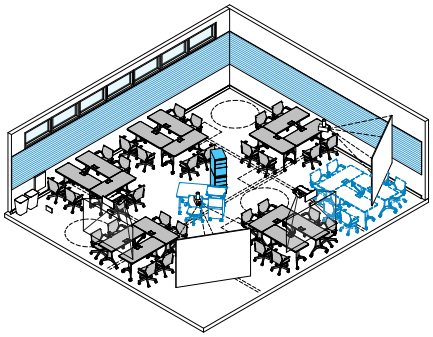
25 sf/student ~ 750sf





30 sf/student ~ 900sf



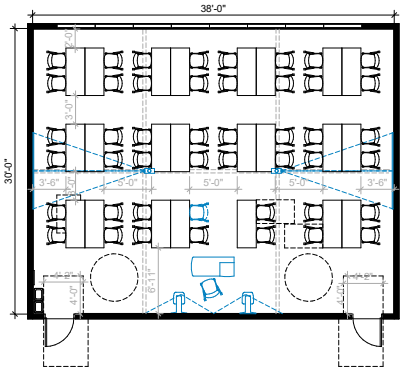


DVC

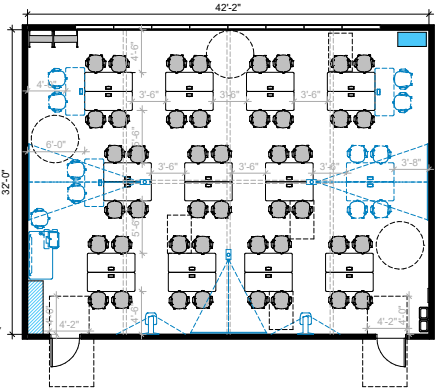
WRNSSTUDIO

Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Medium Classroom (45 students)_Groupwork Mode 1



* 27 sf/ student @ SCC space standard



20 sf/student ~ 900sf

+ Area allocation per student closer to current campus projects
+ Wider workspace at desks (24" deep)
- Desks placed close together
- Not adequate space to create groups of 4 with space between desks
- Less space for students/ faculty/ disabled users to move around/ collaborate
- Limits students in wheelchairs to certain desk locations
- Not adequate viewing distance from screen for some students

25 sf/student ~ 1125sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks and to move around/ collaborate
+ Wider workspace at desks (24" deep)
+ Better viewing distance from screen
- Some desks placed close toto the walls
- Less space for students/ faculty/ disabled users to move around/ collaborate than 30sf/student
- Limits students in wheelchairs to certain desk locations
- Higher per student area allocation than current campus projects

30 sf/student ~ 1350sf

+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates movement/ collaboration
+ Universal Design: Entire room easily accessible to wheelchairs
+ Wider workspace at desks (24" deep)
+ Allows for moveable storage/ supplies cabinet
+ Adequate viewing distance from screen for all students
+ Accommodates upto 20% extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

DVC

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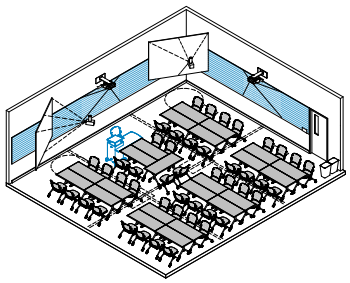
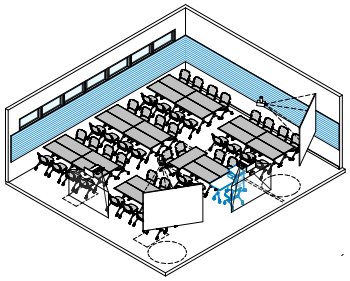
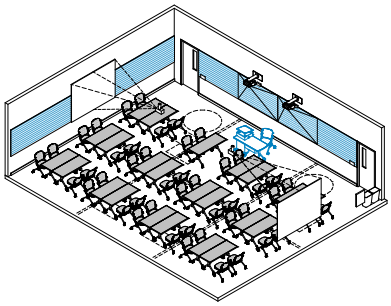
Medium Classroom (45 students)_Groupwork Mode 1

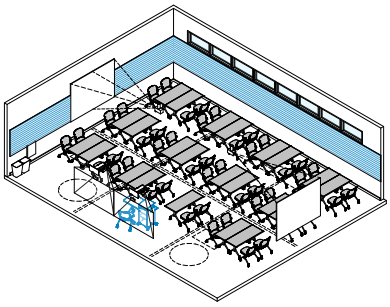
20 sf/student ~ 900sf



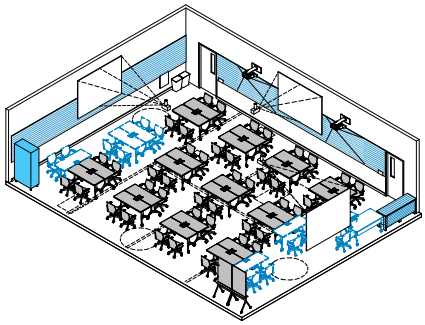


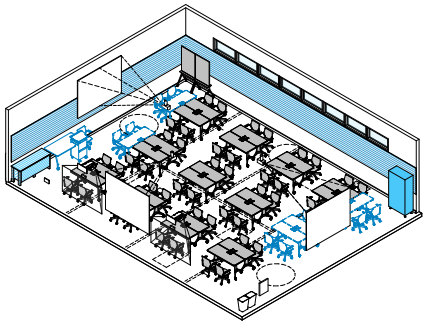
25 sf/student ~ 1125sf





30 sf/student ~ 1350sf



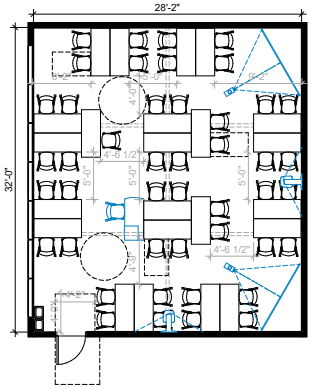


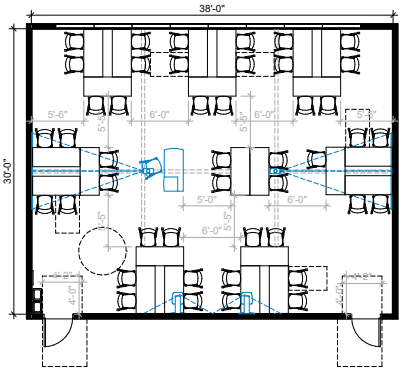
DVC

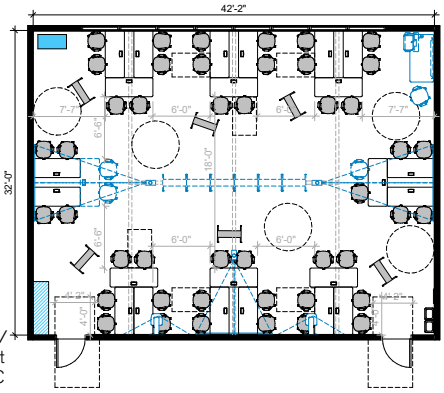
WRNSSTUDIO

Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Medium Classroom (45 students)_Groupwork Mode 2







* 27 sf/ student @ SCC space standard

20 sf/student ~ 900sf

+ Area allocation per student closer to current campus projects
+ Wider workspace at desks (24" deep)
- Desks placed close together
- Less space for students/ faculty/ disabled users to move around/ collaborate
- Accommodates groups of 4, not ideal to have groups of 6 students
- Not adequate viewing distance from screen for some students

25 sf/student ~ 1125sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks and to move around/ collaborate
+ More accessible to wheelchairs
+ Accommodates groups of 6 students
+ Wider workspace at desks (24" deep)
- Some desks placed close together
- Less space for students/ faculty/ disabled users to move around/ collaborate than 30sf/student
- Higher per student area allocation than current campus projects

30 sf/student ~ 1350sf

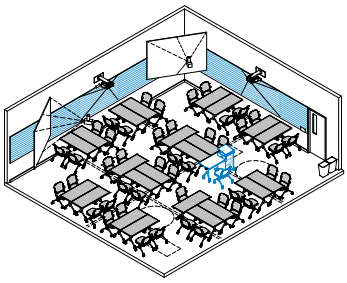
+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates movement/ collaboration
+ Universal Design: Entire room easily accessible to wheelchairs
+ Easily accommodates groups of 6 students
+ Wider workspace at desks (24" deep)
+ Allows for moveable storage/ supplies cabinet
+ Adequate viewing distance from screen for all students
+ Accommodates upto 20% extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

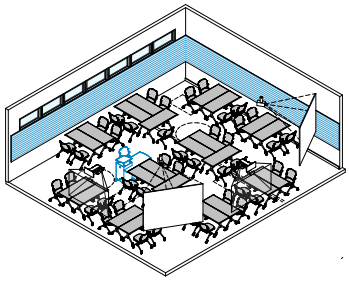
DVC

WRNSSTUDIO

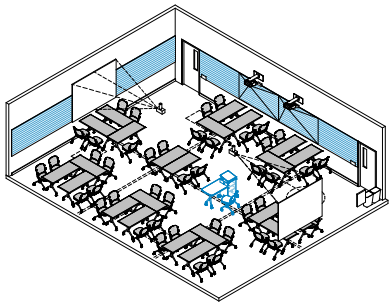
Medium Classroom (45 students)_Groupwork Mode 2

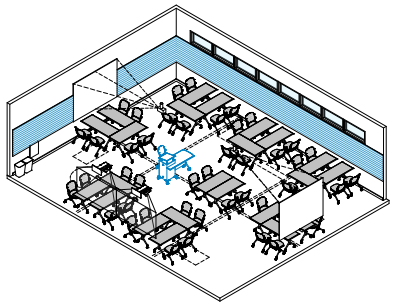
20 sf/student ~ 900sf



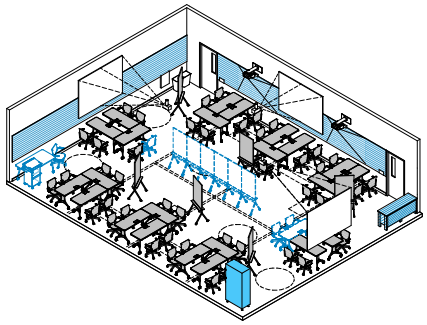


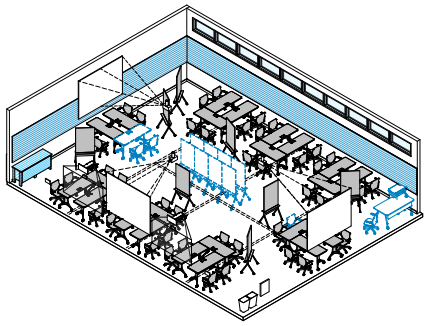
25 sf/student ~ 1125sf





30 sf/student ~ 1350sf



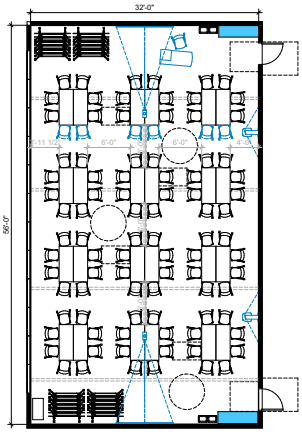


DVC

WRNSSTUDIO

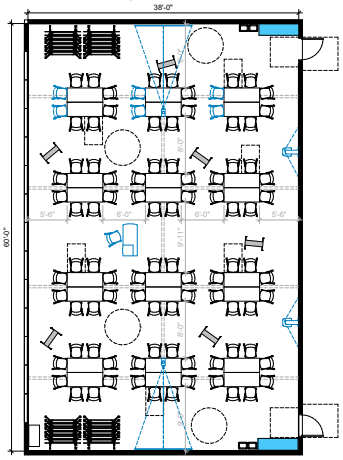
Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

Large Classroom (90 students)_Groupwork Mode



20 sf/student ~ 1800sf

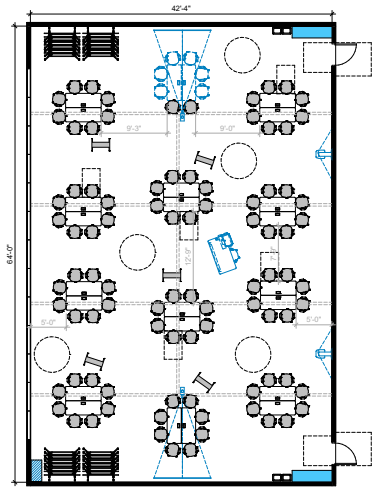
+ Area allocation per student closer to current campus projects
+ Wider workspace at desks (24" deep)
- Desks placed close together
- Less space for students/ faculty/ disabled users to move around/ collaborate
- Limits students in wheelchairs to certain desk locations
- Not adequate space for moveable white boards



25 sf/student ~ 2250sf

+ Area allocation per student closer to but below peer community college standards
+ More space between desks and to move around/ collaborate
+ Universal Design: Entire room easily accessible to wheelchairs
+ Wider workspace at desks (24" deep)
+ Accommodates extra seating
- Less space for students/ faculty/ disabled users to move around/ collaborate than 30sf/student
- Higher per student area allocation than current campus projects

* 27 sf/ student @ SCC space standard



30 sf/student ~ 2700sf

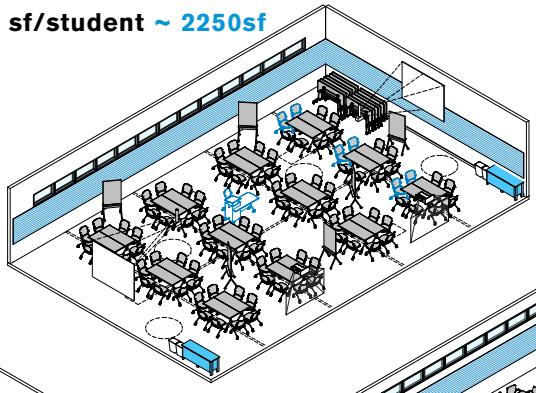
+ Area allocation per student as per Higher Ed trending standards (21st century classroom design standard)
+ More open layout of the room, facilitates movement/ collaboration
+ Universal Design: Entire room easily accessible to wheelchairs
+ Easily accommodates large groups
+ Wider workspace at desks (24" deep)
+ Accommodates upto 20% or more extra student capacity (anticipates peaks in class size)
- Higher per student area allocation than current campus projects

DVC

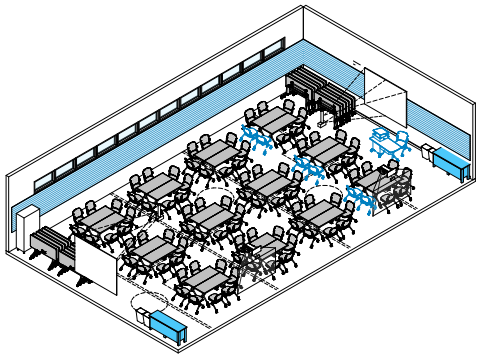
WRNSSTUDIO

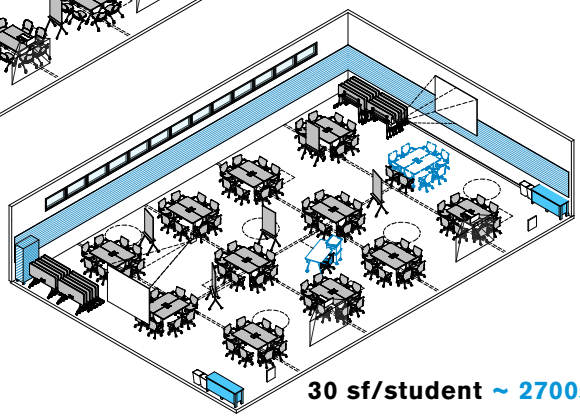
Large Classroom (90 students)_Groupwork Mode

25 sf/student ~ 2250sf



20 sf/student ~ 1800sf





30 sf/student ~ 2700sf

DVC

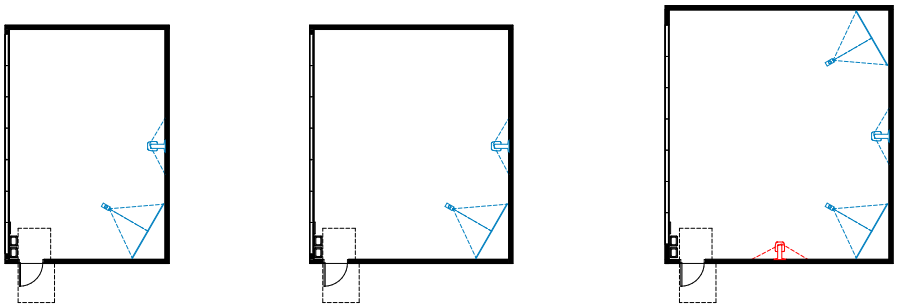
WRNSSTUDIO

Design Workshop 1_ version 2 (October 31, 2017) Planning Parameters

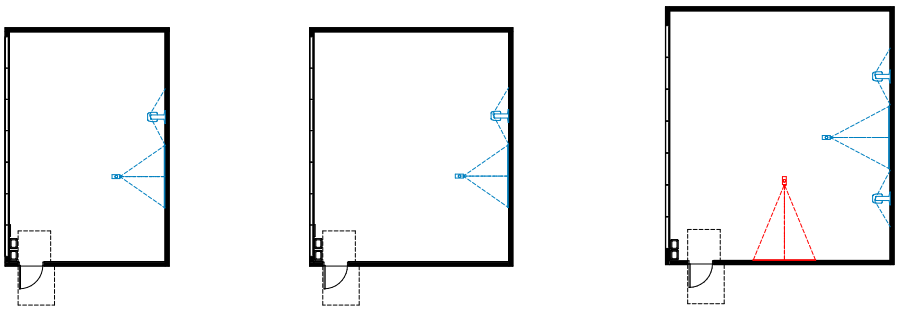
Small Classroom (30 students) AV Layout Options

20 sf/student **25 sf/student** **30 sf/student**

OPTION 1: Angled Screens



OPTION 2: Wall Screens



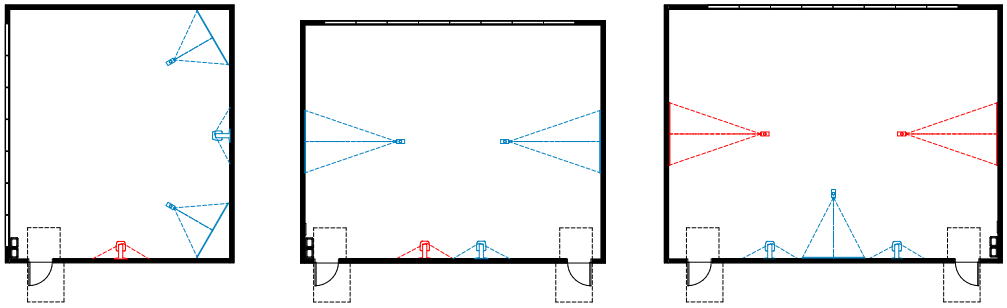
DVC

WRNSSTUDIO

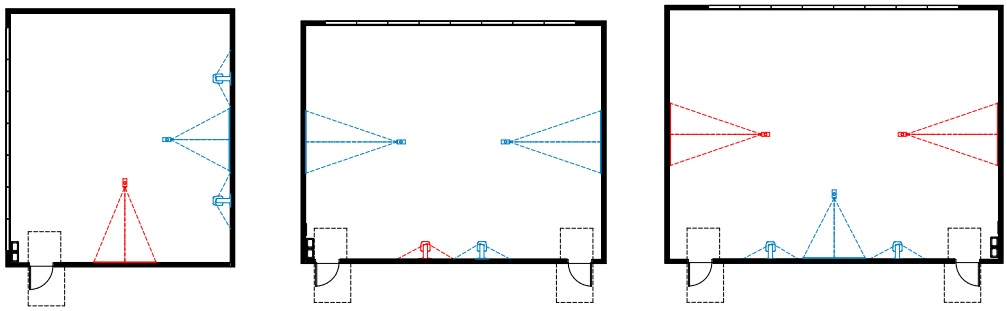
Medium Classroom (45 students) AV Layout Options

20 sf/student **25 sf/student** **30 sf/student**

OPTION 1: Angled Screens



OPTION 2: Wall Screens



DVC

WRNSSTUDIO

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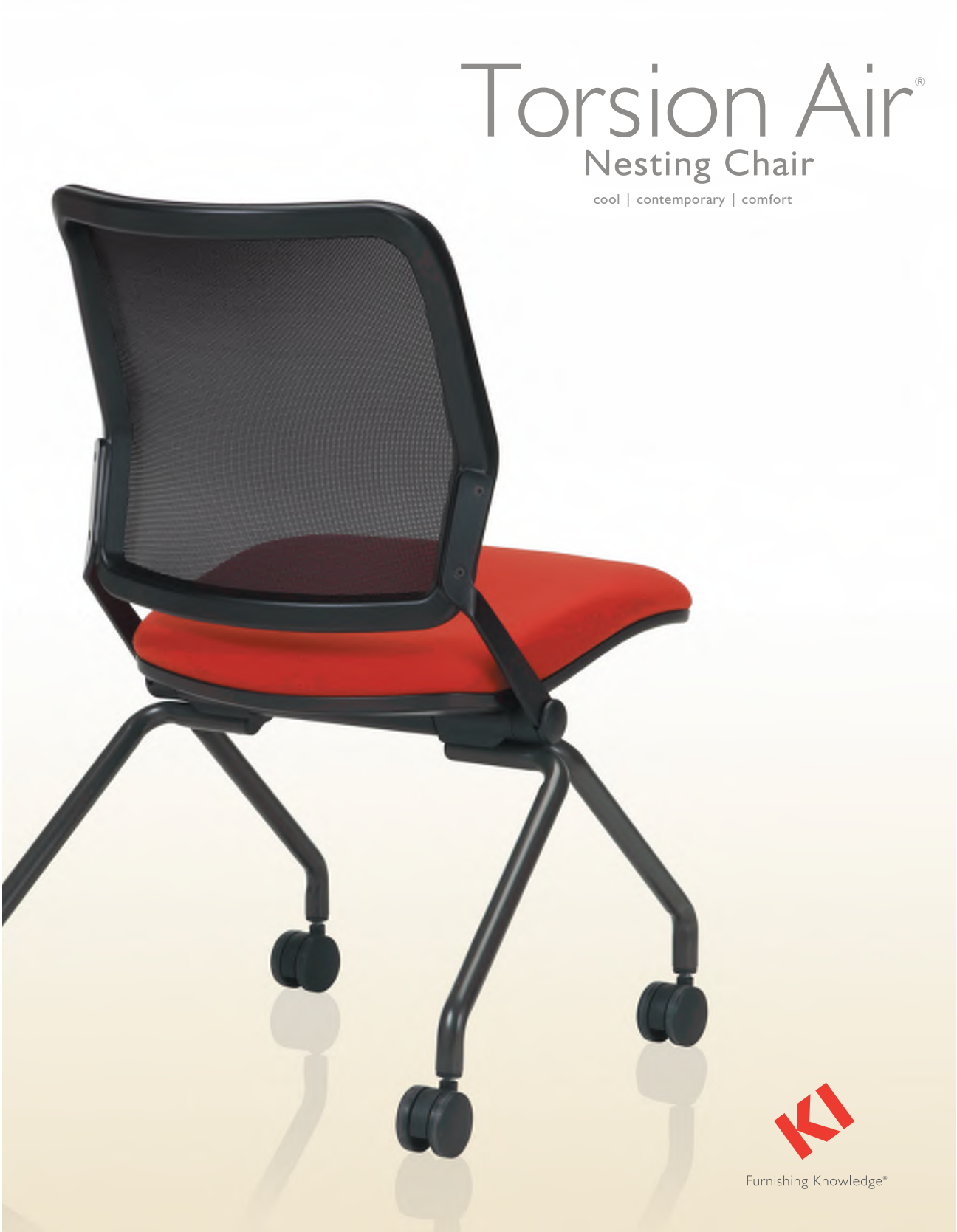
Sample Product Cutsheets (Furniture)



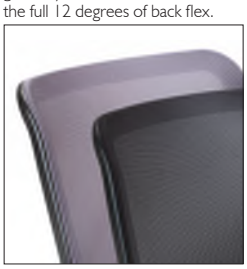
Sample Product Cutsheets (Furniture)

Designed by Giancarlo Piretti, Torsion Air nesting chairs are available with arms, armless, flip-up tablet, or Piretti tablet and provide nesting chair solutions for any application. The Torsion Air seating collection also includes stack chairs, task chairs, and task stools.

Nests for easy storage and mobility.

Patented torsion flex mechanism gradually increases resistance over the full 12 degrees of back flex.

Optional bell glides.



Mesh back available in black or grey mesh.

Learn more about Torsion Air Nesting Chair

Printed on FSC® certified paper using only vegetable-based inks, including metallics. Please recycle.

FSC www.fsc.org MIX Paper from responsible sources FSC® C016863

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Torsion Air® Nesting Chair

Discover the essence of clean, modern, conforming comfort. This fresh interpretation of KI's classic flex-back Torsion combines a lighter visual impression, breathability, and exceptional comfort.

Breathable mesh back allows for air ventilation and natural coolness for reviving comfort. The supple, flexible mesh conforms to the unique curvature of your back and provides integral lumbar support.

Torsion Air is ultra strong and durable. This chair is tested and warranted for use by persons 300 pounds or less.

Specifications:

Seat: W17 D18.5 H18
Back: W17 H16

Armless: W23-7/8 D24.25 H33.5

With Arms: W23-7/8 D24.25 H33.5

With Standard Flip-Up Tablet:
W27 D31 H33.5
Tablet: W20.75 D12.5

With Piretti Tablet:
W25 D30.25 H33.5
Tablet: W22 D12

Furnishing Knowledge®

Sample Product Cutsheets (Furniture)

Sample Product Cutsheets (Furniture)

Designed by Giancarlo Piretti, Torsion Air task chairs and task stools are available with arms or armless and provide task chair solutions for any application. The Torsion Air seating collection also includes stack chairs and nesting chairs. Bases available in polished aluminum, warm grey and black.

Cooling mesh back available in black or grey mesh. Durability assured by KI's 15-year warranty.

Patented torsion flex mechanism gradually increases resistance over the full 12 degrees of back flex.

Learn more about
Torsion Air Task Seating

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MIX Paper from responsible sources FSC® C016863

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Torsion Air® Task Seating

Cool
Discover the essence of clean, modern, conforming comfort. This fresh interpretation of KI's classic flex-back Torsion combines a lighter visual impression, breathability, and exceptional comfort.

Contemporary
Breathable mesh back allows for air ventilation and natural coolness for reviving comfort. The supple, flexible mesh conforms to the unique curvature of your back and provides integral lumbar support.

Comfort
Torsion Air is ultra strong and durable. This chair is tested and warranted for use by persons 300 pounds or less.

Specifications:

Seat: W17 D18.5
Back: W17 H16

W26.5 D26.5 H33.5-38.5
Seat Height: 18-23

Task Stool
W27.5 D26.5 H36.5-44
Seat Height: 23-33.5

Furnishing Knowledge®

Sample Product Cutsheets (Furniture)

Sample Product Cutsheets (Furniture)

NESTING
REDEFINED

The innovative articulating leg of Pirouette Nesting Tables, designed by Giancarlo Piretti, creates a leg-within-leg nesting solution. As the table top is raised, the legs articulate inward for straight-line nesting. This decreases the amount of floor space needed for storage, while maximizing leg room for those seated on both sides of the table. Pirouette's clean design profile stands apart from standard nesting tables.

ACHIEVING
NEW HEIGHTS

Pirouette offers both fixed and nesting tables in three heights. This allows for tiered classrooms, while maintaining the ability to be easily reconfigured. Varying heights offer clear sight lines, ensuring no one feels they are "seated in the back of the room".

LEARNING
RECONFIGURED

Pirouette top shapes provide needed functional benefits. Single Chevron and Double Chevron tops support either focus work or collaboration. Subtle angularity encourages peer to peer interaction, yet creates a division of personal space for focused work.

Shown above: two Single Chevron tables combined.

Sample Product Cutsheets (Furniture)

Guitar Pick

Single Chevron

Double Chevron

Round

Square

Rectangle

120° Scale Up

Half Round

Trapezoid

Learn more about Pirouette

Chevron Fixed
H – 29", 36", 42"
D – 18", 24", 30" (Ends)
D – 21", 27", 33" (Midpoint)
W – 60", 72"

Chevron Nesting
H – 29" D – 18", 24", 30" (Ends)
D – 21", 27", 33" (Midpoint)
W – 60", 72"
H – 36"
D – 24", 30" (Ends)
D – 27", 33" (Midpoint)
W – 60", 72"
H – 42"
D – 24", 30" (Ends)
D – 27", 33" (Midpoint)
W – 60", 72"

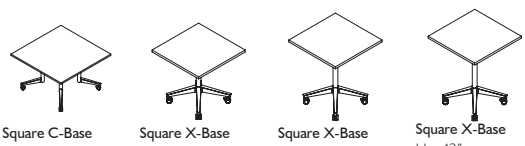
Training Rectangle Fixed
H- 29", 36", 42"
D – 18", 24", 30"
W – 36", 42", 48", 54", 60", 66", 72"

Training Rectangle Nesting
H – 29"
D – 18", 24", 30"
W – 36", 42", 48", 54", 60", 66", 72"
H – 36"
D – 24", 30"
W – 36", 42", 48", 54", 60", 66", 72"
H – 42"
D – 24", 30"
W – 36", 42", 48", 54", 60", 66", 72"

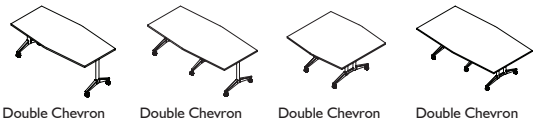
Half Round Fixed
H – 29",
W/D – 48"x24", 60"x30", 72"x36"
120° Scale Up Fixed
H – 29", D – 30"
W – 72"
Trapezoid Fixed
H – 29", D – 30"
W – 60"

Half Round Nesting
H – 29",
W/D – 48"x24", 60"x30", 72"x36"
120° Scale Up Nesting
H – 29", D – 30"
W – 72"
Trapezoid Nesting
H – 29", D – 30"
W – 60"

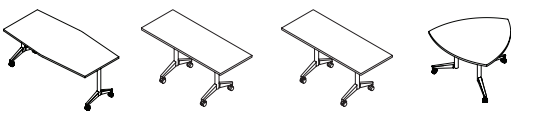
Round C-Base
H – 29"
D – 48", 60"
Round X-Base
H – 29"
D - 30", 36", 42"
Round X-Base
H – 36"
D - 30", 36", 42"
Round X-Base
H – 42"
D - 30", 36", 42"



Square C-Base
H – 29"
D – 42", 48", 60"
W – 42", 48", 60"
Square X-Base
H – 29"
D - 30", 36"
W – 30", 36"
Square X-Base
H – 36"
D - 30", 36"
W – 30", 36"
Square X-Base
H – 42"
D - 30", 36"
W – 30", 36"



Double Chevron Fixed T-Base (2)
H – 29"
D – 30", 36" (Ends)
D – 36", 42 (Midpoint)
W – 60", 72"
Double Chevron Fixed T-Base (3)
H – 29"
D – 36" (Ends)
D – 42" (Midpoint)
W – 84", 96"
Double Chevron Fixed TT-Base (2)
H – 29"
D – 42", 48" (Ends)
D – 48", 54" (Midpoint)
W – 60", 72", 84"
Double Chevron Fixed TT-Base (3)
H – 29"
D – 42", 48" (Ends)
D – 48", 54" (Midpoint)
W – 96", 120"



Double Chevron Nesting
H – 29"
D – 30", 36" (Ends)
D – 36", 42" (Midpoint)
W – 60", 72"
Collaborative Rectangle Nesting
H- 29",
D – 24", 30"
W – 60", 66", 72", 84", 96"
Collaborative Rectangle Fixed
H- 29",
D – 24", 30"
W – 60", 66", 72", 84", 96"
Guitar Pick
H – 29"
D – 48", 54", 60"
W – 48", 54", 60"

Rectangular Fixed Conf. Tables T-Base
H – 29", D – 36"
W – 84", 96"
Rectangular Fixed Conf. Tables TT-Base
H – 29", D – 42", 48"
W – 60", 72", 84"
Rectangular Fixed Conf. Tables TT-Base
H – 29", D – 42", 48"
W – 96", 120"

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Furnishing Knowledge®

Sample Product Cutsheets (Furniture)

Sample Product Cutsheets (Furniture)

Sample Product Cutsheets (Furniture)

Instructor Desking

700 Series® Instructor's Desk
The desk's durable construction and universal design allows one desk to be used with left or right facing surface for greater flexibility. An integrated bookcase provides storage, keeping users organized while maximizing space.

All Terrain® Instructor's Desk
Peninsula top features integrated storage with a rollout shelf for convenient access. Desk offers a flat lecture surface as well as ample work space. Grommets discreetly hide wires while the modesty panel gives users privacy.

All Terrain® Mobile Instructor's Desk
Its minimal scale and smooth-rolling casters offer exceptional mobility. The binder tower with angled surface provides an area to prop materials for lecturing. Grommets discreetly hide wires while the modesty panel gives users privacy.

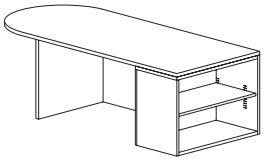
All Terrain® Mobile Lectern
Smooth-rolling casters allow the lectern to be moved easily from space to space. A convenient storage unit holds teaching materials. Its compact scale makes it ideal for any learning environment. Lecterns are available with an angled surface for lecturing ease.

All Terrain® Instruct with RACK Instructor's Desk
A wider cabinet allows utilization of an AV rack.
The lockable vented access doors on the rear of the unit provide permanent storage and ventilation for learning equipment like laptops and projectors. Wires are easily passed through the cabinet for wire management.

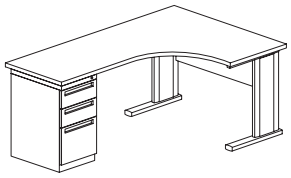
WorkZone® Instructor's Desk
The desk design provides durability and flexibility.
Its pedestal-supported worksurface provides easily accessible storage. The square shoe shape gives ample writing space and a place for office accessories.

Sample Product Cutsheets (Furniture)

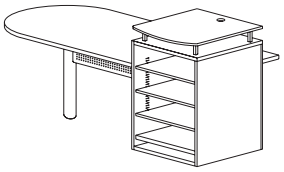
Statement of Line



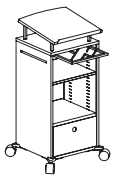
700 Series® Instructor's Desk



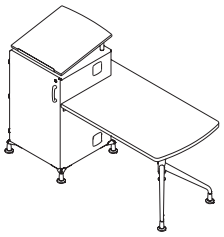
WorkZone® Instructor's Desk



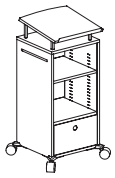
All Terrain® Instructor's Desk



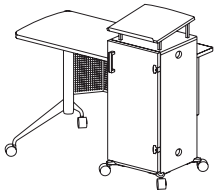
All Terrain® Mobile Lectern – Bowed Front



All Terrain® Instruct with RACK Instructor's Desk



All Terrain® Mobile Lectern – Shaped



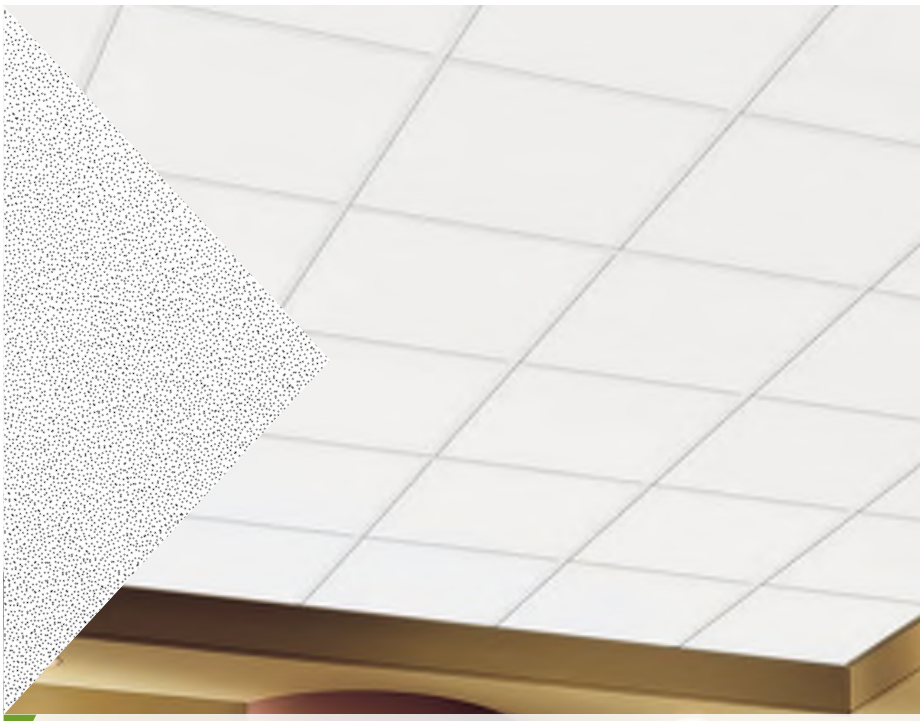
All Terrain® Mobile Instructor's Desk

Sample Product Cutsheets (Acoustical)

OPTIMA®

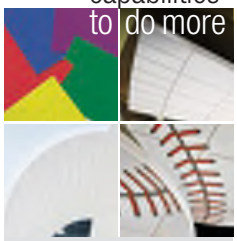
Square Lay-in
fine texture

10-YEAR REPLACEMENT PANEL AVAILABILITY
3152, 3153



Optima® Square Lay-in panels with Prelude® 15/16" suspension system (Pgs. 391-392)

plus... capabilities to do more



armstrongceilings.com/capabilities
See more photos at:
armstrongceilings.com/photogallery

Smooth-textured Optima® panels provide excellent acoustical absorption and more standard-size options than any other texture in the line.

KEY SELECTION ATTRIBUTES

- Outstanding acoustical performance for open plan areas, both Articulation Class (180-200) and NRC (0.90-1.00)
- Items with PB suffix are manufactured with a plant-based binder
- Optima® PB panels are part of the Sustain™ portfolio and meet the most stringent sustainability compliance standards today
- Smooth, clean, durable finish – Washable, Impact-resistant, Scratch-resistant, Soil-resistant
- Energy-saving high light-reflective finish
- Non-directional visual reduces scrap and installation time
- Sag-resistant large-size panels
- Compatible with TechZone® Ceiling Systems (Pgs. 337-344)
- Item 3352 available with Create!™ printed images and patterns, see pages 245-247
- 30-Year Limited System Warranty against visible sag, mold, and mildew

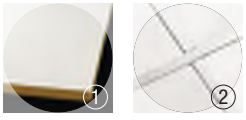
TYPICAL APPLICATIONS

- Open plan offices
- Computer rooms
- Corridors (walls-to-deck)
- Auditoriums
- Waiting rooms/nurses' stations
- Areas with indirect lighting systems

COLOR

White
(WH)

DETAILS



1. Optima® Square Lay-in
2. Optima Square Lay-in with Prelude® 15/16" suspension system

Sample Product Cutsheets (Acoustical)

OPTIMA®

Square Lay-in
fine texture

PLANT BASED BINDER As Noted

Declare℠ Living Building Challenge Compliant PB Suffix Only

SUSTAIN™ High Performance Sustainable Ceiling Systems PB Suffix Only

LEED® UP TO 71% RECYCLED CONTENT — Calculate LEED contribution at armstrongceilings.com/greengenie

energy management ✓ | construction waste mgmt ✓ | regional materials ✓ | design for flexibility ✓ | EPD ✓ | recyclable/ extended producer resp. ✓ | biobased materials ✓ | recycled content ✓ | sourcing of raw materials ✓ | material ingredient reporting ✓ | low emitting/ materials ✓ | lighting quality ✓ | acoustics ✓

▲ LOCATION DEPENDENT ▲ PB ONLY ▲ PB ONLY ▲ PB ONLY

VISUAL SELECTION

PERFORMANCE SELECTION

Dots represent high level of performance. $$$$

Edge Profile	Susp. Dwg. Pgs. 407-411 armstrongceilings.com/catdwgs	Item No.	Dimensions (Inches)	UL Classified Acoustics NRC + CAC =	Total Acoustics[1]	Articulation Class AC	Fire Performance	Light Reflect	Anti-Mold & Mildew Bio-Block	Sag Resist Humi-Guard+	Certified Low VOC Emissions	Durability: Wash	Impact	Scratch	Soil	Recycled Content	Recycle Program	30-Yr Warranty
OPTIMA®																		
15/16" Square Lay-in	1	**1462**	4 x 48 x 1"	N/A	N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**1463**	4 x 60 x 1"	N/A	N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**1400**	6 x 48 x 1"	N/A	N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**1404**	6 x 60 x 1"	N/A	N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3156**	20 x 60 x 1"	0.95 •	N/A	–	190 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3150** **3150PB**	24 x 24 x 3/4"	0.90 •	N/A	–	180 •	Class A	0.90 •	•	•	– •	•	•	•	•	•	•	•
	1	**3152** **3152PB**	24 x 24 x 1"	0.95 •	N/A	–	190 •	Class A	0.90 •	•	•	– •	•	•	•	•	•	•	•
	1	**3352**	24 x 24 x 1"	0.90 •	26	–	200 •	Class A	0.90 •	•	•	–	•	•	•	•	•	–	•
	1	**3159**	24 x 24 x 1-1/2"	1.00 •	N/A	–	200 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•

[1] Total Acoustics® ceiling panels have an ideal combination of noise reduction and sound-blocking performance in one product.
Optima items with the PB suffix are included in the Sustain™ portfolio and carry Declare℠ certification.

SUSPENSION SYSTEMS

15/16"

Prelude®

Blizzard White – Suspension System Finish
A color and texture coordinated suspension system to complement Optima® ceiling panels for a monolithic look and feel.

PHYSICAL DATA

Material
3150, 3156, 3159, 1462, 1463, 1400, 1404, 3152 – Fiberglass with DuraBrite® acoustically transparent membrane 3352 – Fiberglass with DuraBrite acoustically transparent membrane; CAC backing

Surface Finish
DuraBrite with factory-applied latex paint

Fire Performance
ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled).

ASTM E1264 Classification
Type XII, Form 2, Pattern E
Fire Class A

Humidity/Sag Resistance
HumiGuard® Plus ceiling panels are recommended for areas subject to high humidity, up to, but not including, standing water and outdoor applications.

Mold/Mildew Protection
Ceiling panels with BioBlock® resist the growth of mold and mildew.

VOC Emissions
(PB suffix items only)
Third-party certified compliant with California Department of Public Health CDPH/EHLB/Standard Method Version 1.1, 2010. This standard is the guideline for low emissions in LEED, CalGreen Title 24, ANSI/ASHRAE/USGBC/IES Standard 189; ANSI/GBI Green Building Assessment Protocol.

Primary (Embodied) Energy
See all LCA information on our EPDs.

High Recycled Content
Contains greater than 50% total recycled content. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines.

Acoustical Details
Some items have CAC backing. CAC backing may be available as a special order. A CAC value of 37 can be achieved by backloading fiberglass products with item 769 or 770.

Insulation Value
1400, 1404, 1462, 1463,
3152, 3156, 3352, –
R Factor – 4.0 (BTU units)
R Factor – 0.70 (Watts units)
3150 – R Factor – 3.0 (BTU units)
R Factor – 0.53 (Watts units)
3159 – R Factor – 6.0 (BTU units)
R Factor – 1.05 (Watts units)

Application Consideration
Do not mix Optima panels and Optima® Health Zone™ panels in the same room.

30-Year Performance Guarantee & Warranty
When installed with Armstrong® Suspension System. Details at armstrongceilings.com

Weight; Square Feet/Carton
1400 – 0.13 lbs/SF; 24 SF/ctn
1404 – 0.16 lbs/SF; 30 SF/ctn
1462 – 0.44 lbs/SF; 16 SF/ctn
1463 – 0.44 lbs/SF; 20 SF/ctn
3150, 3150PB – 0.44 lbs/SF; 128 SF/ctn
3152, 3152PB – 0.45 lbs/SF; 96 SF/ctn
3159 – 0.61 lbs/SF; 64 SF/ctn
3156 – 0.47 lbs/SF; 100 SF/ctn
3352 – 0.46 lbs/SF; 96 SF/ctn

Minimum Order Quantity
1 carton, excludes other size panels

Metric Items Available
3150M, 3152M, 3156M, 3159M –
Metric items are subject to extended lead times and minimum quantities. Contact your representative for more details.

Sample Product Cutsheets (Acoustical)

FIBERGLASS

OPTIMA®

Square Lay-in
fine texture

PLANT BASED BINDER
As Noted

Declare℠
Living Building Challenge Compliant
PB Suffix Only

SUSTAIN™
High Performance Sustainable Ceiling Systems
PB Suffix Only

UP TO 71% RECYCLED CONTENT

Calculate LEED contribution at armstrongceilings.com/greengenie

LEED®: energy management; construction waste mgmt; regional materials; design for flexibility; EPD; recyclable/ extended producer resp.; biobased materials; recycled content; sourcing of raw materials; material ingredient reporting; low emitting/ materials; lighting quality; acoustics

▲ LOCATION DEPENDENT ▲ PB ONLY ▲ PB ONLY ▲ PB ONLY

VISUAL SELECTION

PERFORMANCE SELECTION

Dots represent high level of performance.

Edge Profile	Susp. Dwg. Pgs. 407-411 armstrongceilings.com/catdwgs	Item No.	Dimensions (Inches)	UL Classified Acoustics NRC	+	CAC	=	Total Acoustics[1]	Articulation Class AC	Fire Performance	Light Reflect	Anti-Mold & Mildew Bio-Block	Sag Resist Humi-Guard+	Certified Low VOC Emissions	Wash (Durability)	Impact (Durability)	Scratch (Durability)	Soil (Durability)	Recycled Content	Recycle Program	30-Yr Warranty
OPTIMA®																					
15/16" Square Lay-in	1	**3151** **3151PB**	24 x 48 x 3/4"	0.90 •		N/A		–	180 •	Class A	0.90 •	•	•	– •	•	•	•	•	•	•	•
	1	**3153** **3153PB**	24 x 48 x 1"	0.95 •		N/A		–	190 •	Class A	0.90 •	•	•	– •	•	•	•	•	•	•	•
	1	**3353**	24 x 48 x 1"	0.90 •		26		–	200 •	Class A	0.90 •	•	•	–	•	•	•	•	•	–	•
	1	**3155**	24 x 48 x 1-1/2"	1.00 •		N/A		–	200 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3356**	24 x 48 x 1-1/2"	0.95 •		26		–	200 •	Class A	0.90 •	•	•	–	•	•	•	•	•	–	•
	1	**3164**	24 x 60 x 3/4"	0.90 •		N/A		–	180 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3161**	24 x 72 x 3/4"	0.90 •		N/A		–	180 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3162**	24 x 96 x 3/4"	0.90 •		N/A		–	180 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3158**	30 x 30 x 1"	0.95 •		N/A		–	190 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3157**	30 x 60 x 1"	0.95 •		N/A		–	190 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**3160** **3160PB**	48 x 48 x 1"	0.95 •		N/A		–	190 •	Class A	0.90 •	•	•	– •	•	•	•	•	•	•	•
	1	**3154**	48 x 96 x 1"	0.95 •		N/A		–	190 •	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•

[1] Total Acoustics® ceiling panels have an ideal combination of noise reduction and sound-blocking performance in one product.
Optima items with the PB suffix are included in the Sustain™ portfolio and carry Declare℠ certification.

Sample Product Cutsheets (Acoustical)

OPTIMA®

Square Lay-in
fine texture

PLANT BASED BINDER
As Noted

Declare℠
Living Building Challenge Compliant
PB Suffix Only

SUSTAIN™
High Performance Sustainable Ceiling Systems
PB Suffix Only

UP TO 71% RECYCLED CONTENT

Calculate LEED contribution at armstrongceilings.com/greengenie

LEED®: energy management ✓ | construction waste mgmt ✓ | regional materials ✓ | design for flexibility ✓ | EPD ✓ | recyclable/ extended producer resp. ✓ | biobased materials ✓ | recycled content ✓ | sourcing of raw materials ✓ | material ingredient reporting ✓ | low emitting/ materials ✓ | lighting quality ✓ | acoustics ✓

▲ LOCATION DEPENDENT ▲ PB ONLY ▲ PB ONLY ▲ PB ONLY

VISUAL SELECTION

PERFORMANCE SELECTION

Dots represent high level of performance. $$$$

Edge Profile	Susp. Dwg. Pgs. 407-411 armstrongceilings.com/catdwgs	Item No.	Dimensions (Inches)	UL Classified Acoustics NRC + CAC =	Total Acoustics[1]	Articulation Class AC	Fire Performance	Light Reflect	Anti-Mold & Mildew: Bio-Block	Sag Resist: Humi-Guard+	Certified Low VOC Emissions	Durability: Wash	Durability: Impact	Durability: Scratch	Durability: Soil	Recycled Content	Recycle Program	30-Yr Warranty
OPTIMA®																		
15/16" Square Lay-in 	1	FS **FastSize™ Panels**	W: 4" – 48" / L: 4" – 120" 1" Thick	N/A N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**Other Size Panels**	W: 4" – 24" / L: 4" – 96" 3/4" Thick	N/A N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•
	1	**Other Size Panels**	W: 4" – 42" / L: 4" – 120" W: 4" – 48" / L: 4" – 114" 1-1/2" Thick	N/A N/A	–	N/A	Class A	0.90 •	•	•	–	•	•	•	•	•	•	•

[1] Total Acoustics® ceiling panels have an ideal combination of noise reduction and sound-blocking performance in one product. Optima items with the PB suffix are included in the Sustain™ portfolio and carry Declare℠ certification.

FS **FastSize**: Factory-finished, made-to-order sizes, shipped fast (1 carton min.)

SUSPENSION SYSTEMS

15/16"

Prelude®

Blizzard White – Suspension System Finish
A color and texture coordinated suspension system to complement Optima® ceiling panels for a monolithic look and feel.

PHYSICAL DATA

Material
3153, 3155, 3158 – Fiberglass with DuraBrite® acoustically transparent membrane 3353, 3356 – Fiberglass with DuraBrite acoustically transparent membrane; CAC backing

Surface Finish
DuraBrite scrim with factory-applied latex paint

Fire Performance
ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled).

ASTM E1264 Classification
Type XII, Form 2, Pattern E
Fire Class A

Humidity/Sag Resistance
HumiGuard® Plus ceiling panels are recommended for areas subject to high humidity, up to, but not including, standing water and outdoor applications.

Mold/Mildew Protection
Ceiling panels with BioBlock® resist the growth of mold and mildew.

VOC Emissions (PB suffix items only)
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Primary (Embodied) Energy
See all LCA information on our EPDs.

High Recycled Content
Contains greater than 50% total recycled content. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines.

Acoustical Details
Some items have CAC backing. CAC backing may be available as a special order. A CAC value of 37 can be achieved by backloading fiberglass products with item 769 or 770.

Insulation Value
3153, 3158, 3353, 3154, 3160, 3157 –
R Factor – 4.0 (BTU units)
R Factor – 0.70 (Watts units)
3151, 3161, 3162, 3164 –
R Factor – 3.0 (BTU units)
R Factor – 0.53 (Watts units)
3155, 3356 –
R Factor – 6.0 (BTU units)
R Factor – 1.05 (Watts units)

Application Consideration
Do not mix Optima panels and Optima® Health Zone™ panels in the same room.

30-Year Performance Guarantee & Warranty
When installed with Armstrong® Suspension System. Details at armstrongceilings.com

Weight; Square Feet/Carton
3151, 3151PB – 0.44 lbs/SF; 128 SF/ctn
3153, 3153PB, 3160, 3160PB – 0.45 lbs/SF; 96 SF/ctn
3155, 3356 – 0.61 lbs/SF; 64 SF/ctn
3158 – 0.47 lbs/SF; 75 SF/ctn
3353 – 0.46 lbs/SF; 96 SF/ctn
3154 – 0.45 lbs/SF; 128 SF/ctn
3157 – 0.56 lbs/SF; 100 SF/ctn
3161 – 0.43 lbs/SF; 96 SF/ctn
3164 – 0.43 lbs/SF; 100 SF/ctn
3162 – 0.42 lbs/SF; 128 SF/ctn

Minimum Order Quantity
1 carton, excludes other size panels

Metric Items Available
3151M, 3153M, 3154M, 3155M, 3158M, 3160M, 3353M, 3356M – Metric items are subject to extended lead times and minimum quantities. Contact your representative for more details.

TechLine / 1 877 276-7876
armstrongceilings.com/commercial
(search: optima)
BPCS-3048-517

Armstrong® CEILING & WALL SOLUTIONS

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FIBERGLASS

Sample Product Cutsheets (Architectural)

Understructure Systems

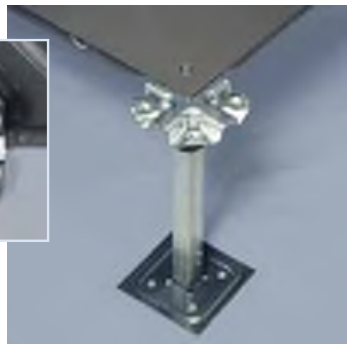
for ConCore and All Steel Systems

PosiLock®

Understructure Features

- PosiLock® design provides self-engagement and positioning of floor panels.
- Self-capturing fastener remains within the panel - will not get lost.
- Steel pedestal head provides maximum strength.
- Pedestal nut provides anti-vibration and locking features.
- Seismic force-resistant pedestals are available that limit or eliminate the need for special bracing.
- Typical floor heights from 6"-16" (15cm-40cm).

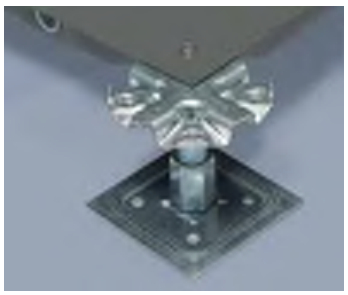
Panel engagement feature viewed from underside



Low Finished Floor Height PosiLock®

Understructure Features

- Available in floor heights from $2^{7}/_{8}$" to 4" (7cm-10cm).
- PosiLock® design provides self-engagement and positioning of floor panels.
- $2^{7}/_{8}$" (7cm) finished floor height is ideal for renovation applications while providing enough space under the floor to allow for easy cable management.
- Excellent for classroom renovations and the creation of training areas.
- Easily levels uneven floors.

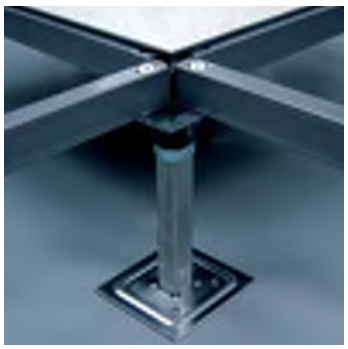


PosiLock® pedestal for low floor height systems

Bolted Stringer

Understructure Features

- Designed for computer rooms, data centers, industrial applications, and heavy rolling load areas.
- Allows floors to be built over 24" (60cm) high.
- Panels can be gravity-held in understructure for fast removal and replacement.
- Stringers provide lateral resistance to heavy rolling loads and seismic loading.
- Seismic force-resistant pedestals are available that limit or eliminate the need for special bracing.
- Typical floor heights from 12"-36" (30cm-90cm).



Hot Dipped Galvanized Pedestals

Seismic Pedestals

Understructure Features

- Available with standard and fillet welded base assembly.
- Steel pedestal head provides optimum strength.
- Seismic force-resistant pedestals are available that limit or eliminate the need for special bracing.
- Vertical supports ranging from 17 gauge 7/8" (2.2cm) galvanized tubing to Schedule 40 pipe.
- Pedestals can accommodate finished floor heights over 36" (90cm).
- Easily levels uneven floors.

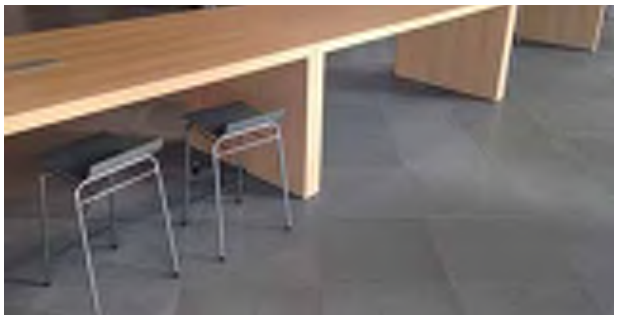
Sample Product Cutsheets (Architectural)

Complete Design Freedom

for unique and coordinated interior aesthetics

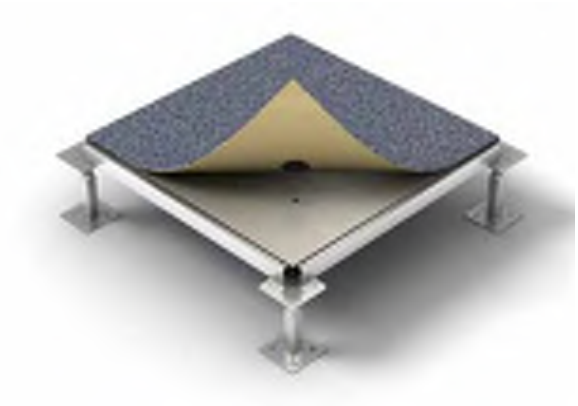
Concrete

- Offers unique natural finish appeal
- PVC edge banding provides a consistent seam appearance
- Maintains full benefits of a raised access floor
- Smooth concrete surface with exposed aggregate
- High recycled content



PosiTile® Carpet

- 24” and 60cm PosiTile® carpet tiles with four permanently affixed positioning buttons are quickly positioned on access floor panels for one-to-one fit
- No sticky adhesive on floor panels when carpet tiles are removed
- Carpet waste is avoided when floor panels and carpet tiles with matching cutout holes are relocated. No attic stock of carpet required due to planned churn
- A totally sustainable, cradle to cradle carpet tile product



Custom Finishes

Tate has developed an on-line resource of tested and approved finishes for access floor applications. If you do not see a finish style or color you like, Tate can work with you to develop a custom finish.

On the website you will find vendor contact information, application renderings, and product photos to help you select a finish for your facility.

Please visit **www.tateinc.com** If you are interested in using a material or vendor that does not appear on the list . For more information call Tate at **800-231-7788** or e-mail **tateinfo@tateinc.com.**

Sample Product Cutsheets (Lighting)

LITHONIA LIGHTING®

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — BLT enclosure components are die-formed for dimensional consistency and painted after fabrication with a polyester powder paint for improved performance and protection.

The reflector is finished with a high reflective matte white powder paint for improved aesthetics and increased light diffusion.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with linear prisms or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 70% LED lumen maintenance at 60,000 hours (L70/60,000).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission, while nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

Driver disconnect provided where required to comply with US and Canadian codes.

SENSOR— Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The rES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is both a digital PIR occupancy sensor/automatic dimming photocell. It pairs to other luminaires and wall switches through our mobile app, CL*AIR*ITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated.

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Catalog Number
Notes
Type

BLT Series LED

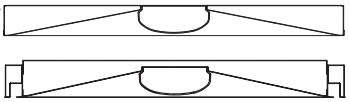
2BLT

2' x 2'
LED

eldoLED nLIGHT

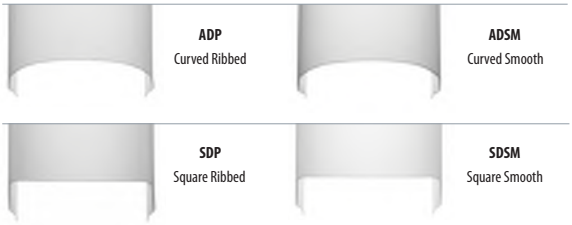
Specifications

Length: 23-3/4 (60.3)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)



All dimensions are inches (centimeters) unless otherwise specified.

Multiple Diffuser Options



A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

Sample Product Cutsheets (Lighting)

2BLT Volumetric Recessed Lighting 2'x2'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

2BLT2

Series	Air function	Lumens[2]	Diffuser	Voltage	Driver	Color temperature
2BLT2 2X2 BLT	(blank) Static A Air supply/ return[1]	**Standard efficiency (>100 LPW)** 20L 2000 33L 3300 40L 4000 **High efficiency[3,4] (>130 LPW)** 33LHE 3300 40LHE 4000 48LHE 4800	ADP Curved, linear prisms ADSM Curved, smooth SDP Square, linear prisms SDSM Square, smooth **Includes trim rings to match sensored version** ADPT Curved, linear prisms ADSMT Curved, smooth SDPT Square, linear prisms SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V[5]	EZ1 eldoLED dims to 1% (0-10 volt dimming) SLD Step-level dimming[6] LE1 Lutron Ecosystem driver dims to 1%[6,7]	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

Controls	Occupancy control[10]	Options
(blank) No nLight® N80 nLight® with 80% lumen management N80EMG nLight® with 80% lumen management For use with generator supply EM power[8] N100 nLight® without lumen management N100EMG nLight® without lumen management For use with generator supply EM power[8] NLTAIR nLight AIR enabled[9]	(blank) No sensor control **nLight Wired Networking** NES7 nLight™ nES 7 PIR integral occupancy sensor[11] NESPDT7 nLight™ nES PDT 7 dual technology integral occupancy control[11] NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[11] NESPDT7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell[11] **nLight Wireless Networking** RES7N nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities **Individual Control** MSD7ADCX PIR integral occupancy sensor with automatic dimming control photocell[6,12] MSDPDT7ADCX PDT integral occupancy sensor with automatic dimming control photocell[6,12] **nLight Wireless Zone** RES7Z nLight AIR PIR integral occupancy sensor with automatic dimming photocell for zone control	EL7L 700 lumen battery pack[13] EL14L 1400 lumen battery pack[13] EL14LSD 1400 lumen battery pack with self-diagnostic testing feature[13,14] CP Chicago plenum[15] BGTD Bodine Generator Transfer Device[16] PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge, purple and gray[17] PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage purple and grey wires[17] GLR Fast-blowing fuse[18] GMF Slow-blowing fuse[18] NPLT Narrow pallet RRL_ RELOC®-ready luminaire[19] LATC Earthquake clip DWAM Anti-Microbial paint JP32 Job packaging IP5X Gasketed diffuser compartment to meet IP5X rating[20]

Accessories next page

Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	00190887529708	3241	30	108	3500K/82 CRI	120-277	52
	2BLT2 33L ADP LP840	00190887529739	3313	30	111	4000K/82CRI	120-277	52
	2BLT2 33L ADP EL14L LP835	00190887529890	3241	30	108	3500K/82CRI	120-277	52
	2BLT2 33L ADP EL14L LP840	00190887529937	3313	30	111	4000K/82CRI	120-277	52
MTO	2BLT2 33L ADP 347 LP835		3241	30	108	3500K/82 CRI	347	52
	2BLT2 33L ADP 347 LP840		3313	30	111	4000K/82CRI	347	52

*Generic 0-10V Dimming to 10%.

Notes

1 Consult factory for airflow data.
2 Approximate lumen output.
3 All versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com.
4 Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
5 Not available with SLD EL7L, or EL14L options.
6 Not available with N80, N80EMG, N100, N100EMG, NLTAIR, or occupancy control.
7 Not available with controls, occupancy controls, or PWS options. Consult factory for Hi-Lume dimming.
8 nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
9 Must order with RES7N or RES7Z sensor. Only available with EZ1 driver.
10 Must specify diffuser with trim rings. See sensor options on page 4.
11 Requires N80, N80EMG, N100, or N100EMG.
12 Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
13 When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
14 For more information, please see the PSSD2 specification sheet.
15 Not available with N80, N80EMG, N100, or N100EMG.
16 Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options.
17 Not available with nLight wired/wireless network or individual controls.
18 Must specify voltage, 120 or 277, with GLR and GFM fusing.
19 For ordering logic consult RRL_2013.
20 Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.

LITHONIA LIGHTING®
An AcuityBrands Company

2BLT-2X2

Sample Product Cutsheets (Lighting)

2BLT Volumetric Recessed Lighting 2'x2'

Accessories: *Order as separate catalog number.*

DGA22	Drywall grid adapter for 2x2 recessed fixture

nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODM [color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODM DX [color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD GFX [color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODB [color]
On/Off two pole	rPODB 2P [color]
On/Off & raise/lower single pole	rPODB DX [color]
On/Off & raise/lower two pole	rPODB 2P DX [color]
On/Off & raise/lower single pole	rPODBZ DX WH[1]

Notes
1 Can only be ordered with the RES7Z zone control sensor version.

Replacement Parts: *Order as separate catalog number.*

*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M57	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237M5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

Sample Product Cutsheets (Lighting)

2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options						
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking	nLight AIR Zone
		PIR	PDT			
MSD7ADCX	X	X				
MSDPDT7ADCX	X		X			
NES7		X		X		
NES7ADCX	X	X		X		
NESPDT7			X	X		
NESPDT7ADCX	X		X	X		
RES7N	X	X			X	
RES7Z	X	X				X

Basic nLight Zone

Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

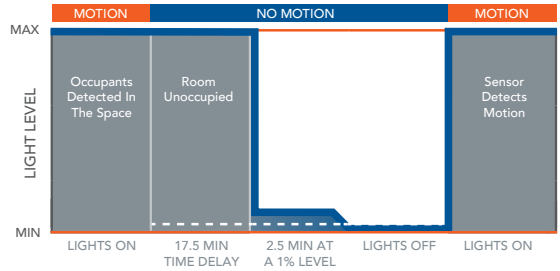
The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the NES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

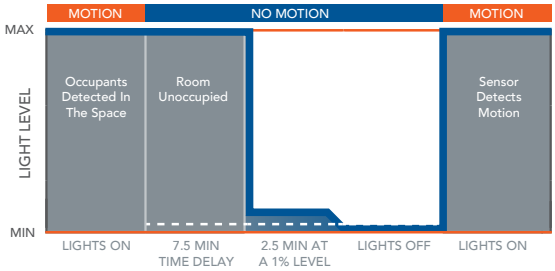
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the NESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation



*The presetting on the automatic dimming photocell is 5fc.

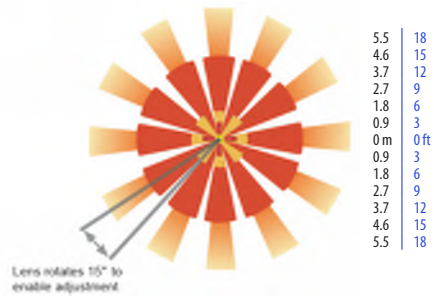
Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and costly. The integrated rES 7 smart sensor is part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

9 FT Mounting



Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

LITHONIA LIGHTING®
An AcuityBrands Company

2BLT-2X2

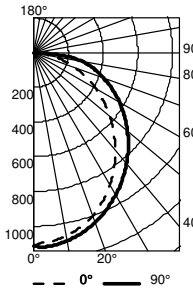
LED: One Lithonia Way Conyers, GA 30012 Phone: 800-858-7763 www.lithonia.com Rev. 03/13/17

Sample Product Cutsheets (Lighting)

2BLT Volumetric Recessed Lighting 2'x2'

PHOTOMETRICS

2BLT2 33L ADP LP835, 3241 delivered lumens, test no. LTL28918P4, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1114	1114
5°	1092	1118
15°	1042	1075
25°	943	996
35°	808	891
45°	653	770
55°	492	638
65°	334	501
75°	177	359
85°	44	147
90	5	2

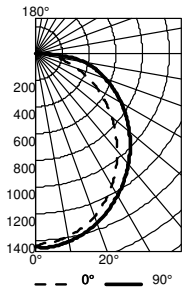
Coefficients of Utilization

RCR	pf 80% pc 70% pw 50%	80% 70% 30%	80% 70% 10%	20% 70% 50%	20% 70% 30%	20% 70% 10%	20% 50% 50%	20% 50% 30%	20% 50% 10%
0		119	119	119	116	116	116	111	111	111
1		108	103	98	100	96	92	96	92	89
2		98	89	82	87	80	75	83	78	73
3		89	78	69	76	68	62	73	66	61
4		81	69	60	67	59	52	65	57	52
5		75	61	52	60	52	45	58	50	44
6		69	55	46	54	46	39	52	45	39
7		64	50	41	49	41	35	48	40	34
8		59	46	37	45	37	31	44	36	31
9		56	42	34	41	33	28	40	33	28
10		52	39	31	38	30	25	37	30	25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	852	26.3	26.3
0° - 40°	1385	42.7	42.7
0° - 60°	2440	75.3	75.3
0° - 90°	3242	100.0	100.0
90° - 180°	0	0.0	0.0
0° - 180°	3242	100.0	100.0

2BLT2 40L ADP LP835, 4210 delivered lumens, test no. LTL28918P5, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1447	1447
5°	1419	1452
15°	1354	1396
25°	1224	1294
35°	1050	1158
45°	849	1001
55°	640	829
65°	434	650
75°	230	466
85°	57	191
90	7	3

Coefficients of Utilization

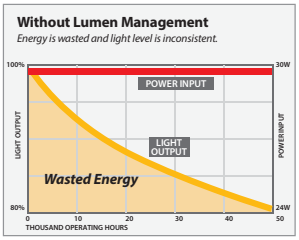
RCR	pf 80% pc 70% pw 50%	80% 70% 30%	80% 70% 10%	20% 70% 50%	20% 70% 30%	20% 70% 10%	20% 50% 50%	20% 50% 30%	20% 50% 10%
0		119	119	119	116	116	116	111	111	111
1		108	103	98	100	96	92	96	92	89
2		98	89	82	87	80	75	83	78	73
3		89	78	69	76	68	62	73	66	61
4		81	69	60	67	59	52	65	57	52
5		75	61	52	60	52	45	58	50	44
6		69	55	46	54	46	39	52	45	39
7		64	50	41	49	41	35	48	40	34
8		59	46	37	45	37	31	44	36	31
9		56	42	34	41	33	28	40	33	28
10		52	39	31	38	30	25	37	30	25

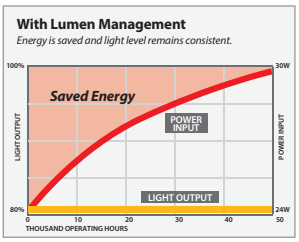
Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1107	26.3	26.3
0° - 40°	1799	42.7	42.7
0° - 60°	3169	75.3	75.3
0° - 90°	4211	100.0	100.0
90° - 180°	0	0.0	0.0
0° - 180°	4211	100.0	100.0

Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.





Performance Data

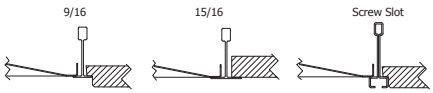
Lumen Package	Lumens	Input Watts	LPW
20L ADP LP830	2157	20	110
20L ADP LP835	2213	20	113
20L ADP LP840	2261	20	116
20L ADP LP850	2373	20	121
33L ADP LP830	3160	30	106
33L ADP LP835	3241	30	108
33L ADP LP840	3313	30	111
33L ADP LP850	3476	30	116
40L ADP LP830	4103	39	106
40L ADP LP835	4209	39	108
40L ADP LP840	4302	39	111
40L ADP LP850	4514	39	116
AIR 20L ADP LP830	2019	20	103
AIR 20L ADP LP835	2060	20	105
AIR 20L ADP LP840	2116	20	108
AIR 20L ADP LP850	2134	20	109
AIR 33L ADP LP830	2957	28	104
AIR 33L ADP LP835	3017	28	107
AIR 33L ADP LP840	3099	28	109
AIR 33L ADP LP850	3126	28	110
AIR 40L ADP LP830	3841	39	99
AIR 40L ADP LP835	3919	39	101
AIR 40L ADP LP840	4025	39	104
AIR 40L ADP LP850	4060	39	104

HE Performance Data

Lumen Package	Lumens	Input Watts	LPW
33LHE ADP LP830	3537	28	126
33LHE ADP LP835	3628	28	130
33LHE ADP LP840	3708	28	132
33LHE ADP LP850	3891	28	139
40LHE ADP LP830	4118	32	127
40LHE ADP LP835	4224	32	131
40LHE ADP LP840	4317	32	134
40LHE ADP LP850	4530	32	140
48LHE ADP LP830	4699	37	128
48LHE ADP LP835	4820	37	131
48LHE ADP LP840	4927	37	134
48LHE ADP LP850	5169	37	140

MOUNTING DATA

Ceiling Type	Appropriate Trim Type
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

LITHONIA LIGHTING®
An AcuityBrands Company

2BLT-2X2

LED: One Lithonia Way Conyers, GA 30012 Phone: 800-858-7763 www.lithonia.com Rev. 03/13/17

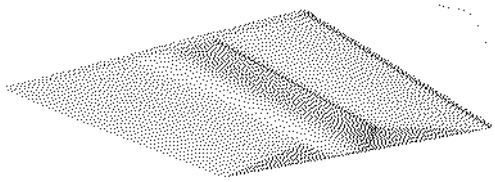
Sample Product Cutsheets (Lighting)

LITHONIA LIGHTING®

Catalog Number
Notes
Type

BLT Series LED

2BLT Tunable White

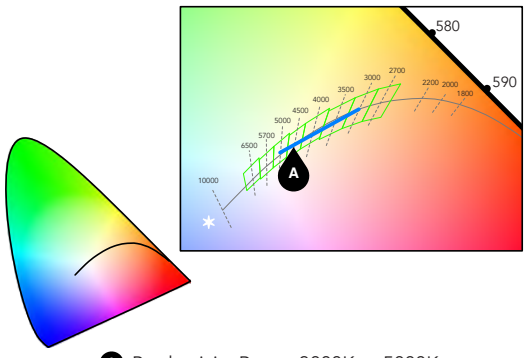


2' x 2'
LED

eldoLED nLIGHT

Tunable White GPHD

- **Gamut**: One dimensional Warm-Cool
- **Path**: Direct 3000K to 5000K (Productivity Range)
- **Handle**: Two Natural Language Handles: Intensity and CCT
- **Data**: nLight with nTune technology for both handles of control



A Productivity Range 3000K to 5000K

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-9/16") also makes it an excellent choice for renovation projects.

BLT Tunable White is perfect in classrooms and educational settings as it allows the light color temperature to be adjusted to the optimal light level for student tasks such as reading or test taking.

CONSTRUCTION — BLT enclosure components are die-formed for dimensional consistency and painted after fabrication with a polyester powder paint for improved performance and protection.

The reflector is finished with a high reflective matte white powder paint for improved aesthetics and increased light diffusion.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability. Injection molded diffuser light traps add a finished look to the diffuser ends and help seal the diffuser to the housing end plates. Optional diffuser trim rings provide an attractive mounting for integral sensors as well as adding a decorative element to the luminaire aesthetics.

LED boards are accessible from below; driver is accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with linear prisms or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 70% LED lumen maintenance at 60,000 hours (L70/60,000).

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Integrated nLight®controls make each luminaire addressable — allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices and the BLT luminaires using standard Cat-5 cabling. Unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission.

Driver disconnect provided where required to comply with US and Canadian codes.

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView™.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 2 for the nLight sensor options.

INSTALLATION — The BLT's low profile design of only 2-9/16" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Sample Product Cutsheets (Lighting)

2BLT Tunable White Volumetric Recessed Lighting 2'x2'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 TUWH PROR 40L ADP NLT

2BLT2

Series	Dynamic feature	Dynamic range	Lumens[1]	Diffuser	Voltage	Control interface type
2BLT2 2X2 BLT	TUWH Tunable white	PROR Productivity range (3000-5000K)	20L 2000 33L 3300 40L 4000	ADP Curved, linear prisms ADSM Curved, smooth SDP Square, linear prisms SDSM Square, smooth **Diffusers w/ trim rings** ADPT Curved, linear prisms ADSMT Curved, smooth SDPT Square, linear prisms SDSMT Square, smooth	(blank) MVOLT 120 120 277 277 347 347[2]	NLT nLight nTune interface[3]

Occupancy control[4]

(blank)	No sensor control
nLight Wired Networking	
NES7	nLight™ nES 7 PIR integral occupancy sensor
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell

Options

EL7L	700 lumen battery pack[5]
EL14L	1400 lumen battery pack[5]
BGTD	Bodine Generator Transfer Device[6]
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
GLR	Fast-blowing fuse[7]
GMF	Slow-blowing fuse[7]
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire[8]
LATC	Earthquake clip
DWAM	Anti-Microbial paint
90CRI	90 CRI
IP5X	Gasketed diffuser compartment to meet IP5X rating[9]

Accessories: *Order as separate catalog number.*

DGA22	Drywall grid adapter for 2x2 recessed fixture

nLight® Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODM	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODM DX	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
		Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1
Power Supply			
nLight Power Supply	nPS 80		

Replacement parts: *Order as separate catalog number.*

*237LJR	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens (light traps included)
*237LKH	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens (light traps included)
*237LKY	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens (light traps included)
*237LL7	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens (light traps included)
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237M4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237M57	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens (trims included)
*237M5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens (trims included)

Notes
1. Approximate lumen output.
2. Not available with EL7L or EL14L battery packs.
3. Requires power from nLight network bridge or nPS 80.
4. Must specify diffuser with trim rings. See sensor options in ordering information.
5. When using pre-wire option, use PWS1846.
6. Must specify voltage. Requires BSE labeling. Consult factory for options.
7. Must specify voltage, 120 or 277 with GLR & GMF fusing.
8. For ordering logic consult: RRL 2013.
9. Not available with Occupancy Control sensors.

LITHONIA LIGHTING® An AcuityBrands Company

MAINSTREAM DYNAMIC BY ACUITY BRANDS

2BLT-2X2-NTUNE

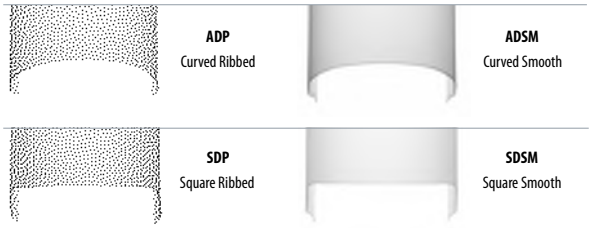
Sample Product Cutsheets (Lighting)

2BLT Tunable White Volumetric Recessed Lighting 2'x2'

Specifications

Length: 23-3/4 (60.3)
Width: 23-3/4 (60.3)
Depth: 2-9/16 (6.5)
All dimensions are inches (centimeters) unless otherwise specified.

Mulitple Diffuser Options



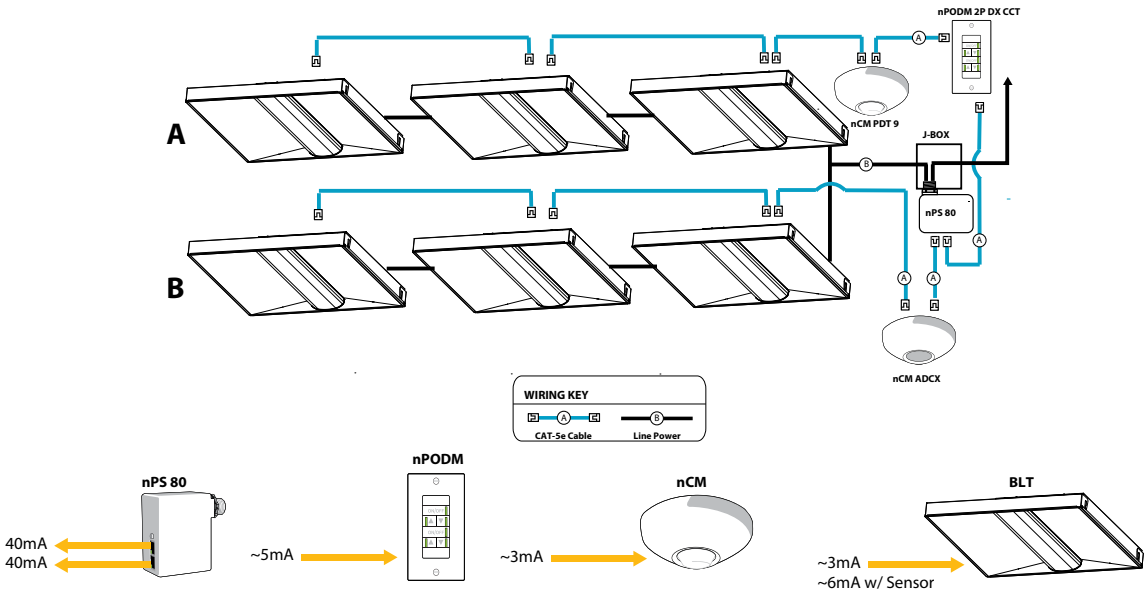
Tunable White Wall Pods

nPODM 2P DX CCT

nPODM 4S DX EDUTW

nPODM 4S EDUTW

Typical nLight network layout with power supply, sensor and wallpod.



Sample Product Cutsheets (Lighting)

2BLT Tunable White Volumetric Recessed Lighting 2'x2'

Sensor Options*				
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking
		PIR	PDT	
NES7		X		X
NES7ADCX	X	X		X
NESPDT7			X	X
NESPDT7ADCX	X		X	X

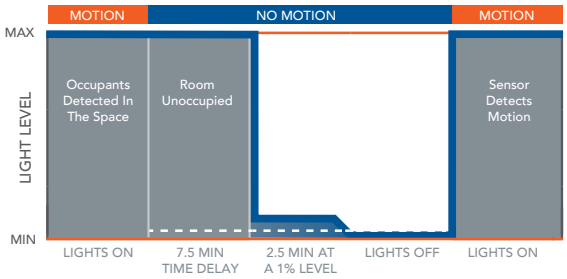
* Requires network to be present for sensors to operate

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the NES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the NESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation

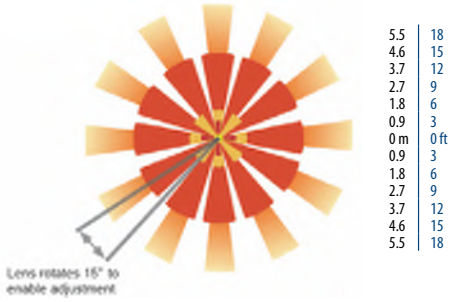


*The presetting on the automatic dimming photocell is 5fc.

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



LITHONIA LIGHTING®
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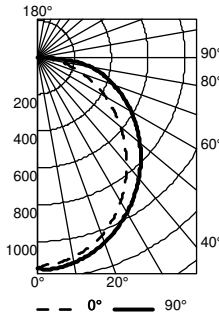
MAINSTREAM DYNAMIC BY ACUITY BRANDS
2BLT-2X2-NTUNE

Sample Product Cutsheets (Lighting)

2BLT Tunable White Volumetric Recessed Lighting 2'x2'

PHOTOMETRICS

2BLT2 TUWH PROR 33L ADP @3000K, 82CRI, 3330 delivered lumens, test no. LTL28918P243, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1145	1145
5°	1122	1149
15°	1071	1105
25°	969	1023
35°	831	916
45°	671	792
55°	506	656
65°	344	514
75°	182	369
85°	45	151
90	5	2

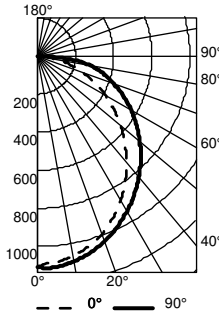
Coefficients of Utilization

RCR	pf pc pw	80% 70%	50%	30%	20% 50%	30%	10%	70% 50%	30%	10%	50% 30%	10%
0		119	119	119	116	116	116	111	111	111		
1		108	103	98	100	96	92	96	92	89		
2		98	89	82	87	80	75	83	78	73		
3		89	78	69	76	68	62	73	66	61		
4		81	69	60	67	59	52	65	57	52		
5		75	61	52	60	52	45	58	50	44		
6		69	55	46	54	46	39	52	45	39		
7		64	50	41	49	41	35	48	40	34		
8		59	46	37	45	37	31	44	36	31		
9		56	42	34	41	33	28	40	33	28		
10		52	39	31	38	30	25	37	30	25		

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	875	26.3	26.3
0° - 40°	1423	42.7	42.7
0° - 60°	2507	75.3	75.3
0° - 90°	3331	100.0	100.0
90° - 180°	0	0.0	0.0
0° - 180°	3331	100.0	100.0

2BLT2 TUWH PROR 33L ADP @4000K, 82CRI, 3223 delivered lumens, test no. LTL28918P246, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1108	1108
5°	1086	1112
15°	1036	1069
25°	937	990
35°	804	886
45°	650	766
55°	490	634
65°	333	498
75°	176	357
85°	44	146
90	5	2

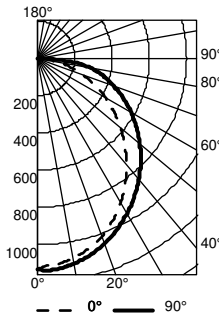
Coefficients of Utilization

RCR	pf pc pw	80% 70%	50%	30%	20% 50%	30%	10%	70% 50%	30%	10%	50% 30%	10%
0		119	119	119	116	116	116	111	111	111		
1		108	103	98	100	96	92	96	92	89		
2		98	89	82	87	80	75	83	78	73		
3		89	78	69	76	68	62	73	66	61		
4		81	69	60	67	59	52	65	57	52		
5		75	61	52	60	52	45	58	50	44		
6		69	55	46	54	46	39	52	45	39		
7		64	50	41	49	41	35	48	40	34		
8		59	46	37	45	37	31	44	36	31		
9		56	42	34	41	33	28	40	33	28		
10		52	39	31	38	30	25	37	30	25		

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	847	26.3	26.3
0° - 40°	1377	42.7	42.7
0° - 60°	2426	75.3	75.3
0° - 90°	3224	100.0	100.0
90° - 180°	0	0.0	0.0
0° - 180°	3224	100.0	100.0

2BLT2 TUWH PROR 33L ADP @5000K, 82CRI, 3292 delivered lumens, test no. LTL28918P249, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1131	1131
5°	1109	1136
15°	1058	1092
25°	957	1012
35°	821	905
45°	664	782
55°	500	648
65°	340	508
75°	180	365
85°	45	149
90	5	2

Coefficients of Utilization

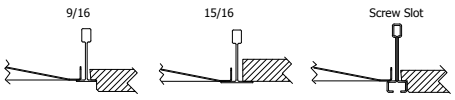
RCR	pf pc pw	80% 70%	50%	30%	20% 50%	30%	10%	70% 50%	30%	10%	50% 30%	10%
0		119	119	119	116	116	116	111	111	111		
1		108	103	98	100	96	92	96	92	89		
2		98	89	82	87	80	75	83	78	73		
3		89	78	69	76	68	62	73	66	61		
4		81	69	60	67	59	52	65	57	52		
5		75	61	52	60	52	45	58	50	44		
6		69	55	46	54	46	39	52	45	39		
7		64	50	41	49	41	35	48	40	34		
8		59	46	37	45	37	31	44	36	31		
9		56	42	34	41	33	28	40	33	28		
10		52	39	31	38	30	25	37	30	25		

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	865	26.3	26.3
0° - 40°	1407	42.7	42.7
0° - 60°	2478	75.3	75.3
0° - 90°	3293	100.0	100.0
90° - 180°	0	0.0	0.0
0° - 180°	3293	100.0	100.0

Performance Data			
Lumen Package	**Lumens**	**Input Watts**	**LPW**
20L ADP @3000K, 82CRI	2067	20	103
20L ADP @4000K, 82CRI	2107	15	140
20L ADP @5000K, 82CRI	2152	18	120
33L ADP @3000K, 82CRI	3330	34	98
33L ADP @4000K, 82CRI	3223	27	119
33L ADP @5000K, 82CRI	3293	31	106
40L ADP @3000K, 82CRI	4142	39	106
40L ADP @4000K, 82CRI	4008	30	134
40L ADP @5000K, 82CRI	4094	35	117

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

LITHONIA LIGHTING®
An AcuityBrands Company

MAINSTREAM DYNAMIC BY ACUITY BRANDS

2BLT-2X2-NTUNE

Sample Product Cutsheets (Lighting)

LITHONIA LIGHTING

BLT Series Tunable White

The first tunable platform integrated into a mainstream digital control network

Tunable White Lighting Solutions for the Classroom

Research[1] supports that lighting can have a positive effect on learning and attention. Lithonia Lighting® and Acuity Controls bring lighting adaptability in an easy-to-use plug & play platform. With simple elegance, nLight® delivers dimming and color tuning effects at the touch of a button.

Tunable White is perfect in classrooms and educational settings as it allows the light color temperature to be adjusted to the optimal light level for student tasks such as reading or test taking.

Mainstream Dynamic Tunable White

Mainstream Dynamic brings exciting features once reserved for niche applications into everyday lighting systems. The Tunable white features allows for the inclusion of white light into various scenes—matching the optimal light for different activities.

When Tunable White is deployed on our nLight controls network, we call it **nTune**. This allows nLight to control lighting color temperature on the same network that manages motion detection, daylight harvesting and dimming. Customers can build a system of controls and luminaires that work seamlessly together.

BLT Series Luminaire

nLight Tunable White Wallstation

MAINSTREAM DYNAMIC
BY ACUITY BRANDS

1 Supporting research www.acuitybrands.com/blttwresearch

Commercial Indoor

AcuityBrands.

Sample Product Cutsheets (Lighting)

BLT Series Tunable White

MAINSTREAM DYNAMIC
BY ACUITY BRANDS

The ***General*** setting provides cool, crisp light ideal for **collaboration**.

The ***Reading*** setting offers relaxing, warmer light for **personal focus tasks**.

The ***Testing*** setting is a neutral, **non-distracting** color temperature.

The ***Energy*** setting is cooler, **refreshing** light to help combat afternoon fatigue.

Features

- Simple plug & play installation by utilizing the nLight network
- Select pre-set color temperatures or adjust to any CCT in the Productivity Range 3000K-5000K
- Optional pre-set and engraved wallpods available with 4 default settings (General, Reading, Testing and Energy)
- Customize your application with SensorView™

A+ Certified solutions from Acuity Brands help you quickly and confidently select and implement lighting systems that are both compatible and consistent.

BLT Series offers more sizes for greater flexibility

2x2 1x4 2x4

Pre-programmed custom engraved wallpods*

nPODM
2P DX CCT

nPODM
4S DX EDUTW

nPODM
4S EDUTW

*Also available without pre-programming and engraving to configure to your customer's optimized settings.

For more information visit www.lithonia.com

One Lithonia Way | Conyers, Georgia 30012 | Phone: 800.279.8041 | www.acuitybrands.com

AcuityBrands.

Sample Product Cutsheets (Lighting)

AcuityControls
nLight®

nLight® takes Tunable White Mainstream

nLight® now natively controls lighting color temperature on the same network that manages motion detection, daylight harvesting and dimming.

Tunable White is perfect in classrooms and educational settings as it allows both the light level and color temperature to be adjusted to the optimal setting for student tasks; such as reading or test taking. nTune™ technology is digital control of color temperature and intensity for nLight enabled luminaires, now an option on the BLT LED luminaires from Lithonia.

Features

- Full luminaire color temperature control through the productivity range 3000K – 5000K
- nLight Wallpods available with default of 4 recommended settings (Reading, Testing, Collaboration and Energy Up)
- Luminaires with nTune technology are compatible with all existing nLight devices
- Tunable White is fully programmable with SensorView™
- Available as an option on the BLT Series Tunable White luminaire

BLT Luminaire

Mainstream Dynamic Tunable White

With Tunable White, you can create white light that shifts seamlessly between color temperatures. Designers and facility operators are granted the freedom to tie scenes to specific activities, or to complement colors or materials within a visual environment.

www.acuitycontrols.com

Sample Product Cutsheets (Lighting)

AcuityControls nLight

2qty user keypads @ Instructor Station (side-by-side) for tunable white option:
nPODM 2P DX CCT
nPODM 4S EDUTW

SensorView Features and Status Panel

- Tunable white switch bindings and scenes can be programmed and modified through SensorView
- Real-time tunable white level available
- Digital LED driver connection enabling tunable white control provides additional driver information (e.g. output power reading and internal driver temperature)

Wallpods for Tunable White Applications

Manually adjust light levels (brighter or dimmer), independent of the color temperature of light

Manually adjust color temperature (CCT) in warmer or cooler increments

nPODM 2P DX CCT

nPODM 4S DX EDUTW

Preset scenes with user-defined "recipe" for color temperature and light level

nPODM 4S EDUTW

A+ Certified solutions from Acuity Brands help you quickly and confidently select and implement lighting systems that are both compatible and consistent.

For lighting applications, A+ means verified consistent performance, visual appearance and system interoperability of all luminaires and controls within the certified solutions. For lighting professionals it means confidence that all parts of the lighting system will work together and meet common Acuity Brands specifications.

One Lithonia Way | Conyers, Georgia 30012 | Phone: 800.535.2465 | www.acuitycontrols.com

AcuityBrands.

Sample Product Cutsheets (Lighting)

ALTERNATE

FINELITE

BUY AMERICAN ACT OF 2009 COMPLIANT

Tuneable White FineTune™ System Wall Controller

Industry Best 10 Year LED Warranty

FineTune™ Tunable White System

Next Generation Luminaires 2015 "Outstanding User Interface"

Intertek 3196318

Date

Project

Type

Comments

DESCRIPTION

FineTune™ controls are easy to use and are covered by a single source 10-year warranty. The FineTune Wall Controller can tune the color temperature and dim the light levels of the FineTune enables luminaires through presets or incremental controls.

Master On/Off
Turns all FineTune system luminaires On or Off

Color Readout
Displays current color temperature selected

Color Presets
Easily select desired color temperature from 6500K to 2700K

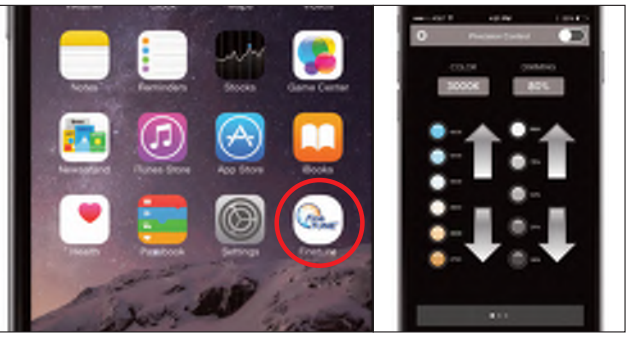
Dimming Presets
Select desired light levels from 100% (MAX) to 0.1%(MIN)

Continuous Dimming
Luminaires dim in 1% increments

Color Tuning
Luminaires change color in 25 CCT increments

SMART PHONE APPLICATION

Scan this QR code to download app



Free smartphone application provides same level of control as our wall controller. The Smartphone app is available on Apple App store and Google Play just search for Finelite.

PLUG AND PLAY

Connect Cat5 cable to the back of the wall controller.

Finelite, Inc. • 30500 Whipple Road • Union City, CA 94587-1530 • 510 / 441-1100 • Fax: 510 / 441-1510 • www.finelite.com

Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for most current data.

Sample Product Cutsheets (Lighting)

ALTERNATE

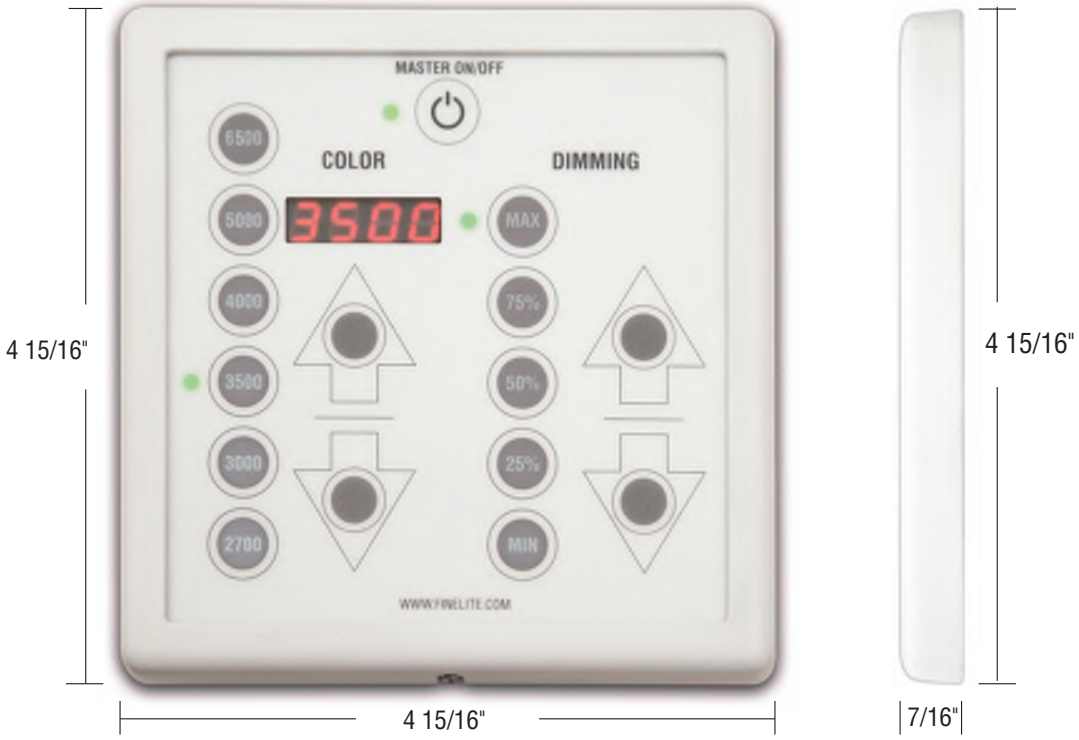
FINELITE

BUY AMERICAN ACT OF 2009 COMPLIANT

Tuneable White FineTune™ System Wall Controller

FINETUNE Wall CONTROLLER

The FineTune™ control interface installs on a 2-gang switch box.



SPECIFICATIONS

CONSTRUCTION: FineTune wall controller is constructed of durable nylon. Connects to system with factory supplied Cat5 cable.

PLACEMENT: Place the wall controller near entrance as per local codes if it is use as the only source of Master On/Off.

PLUG & PLAY CABLES: The user interface is connected to the FineTune Power Control Center (PCC) via plug and play Cat5 cable. Specify length necessary to reach between control and PCC.

FINISH: The control is finished in textured white, minimizing finger prints and dirt.

ELECTRICAL: Plug and play FineTune control is low voltage (24V). Plug and play Cat5 cables connect the control with the Power Control Center (PCC) are plenum rated.

LABELS: Fixture and electrical components are ETL-listed conforming to UL1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.73 (G), this luminaire contains and internal driver disconnect. Damp location.

WARRANTY: 10-year performance-based warranty on all standard components.

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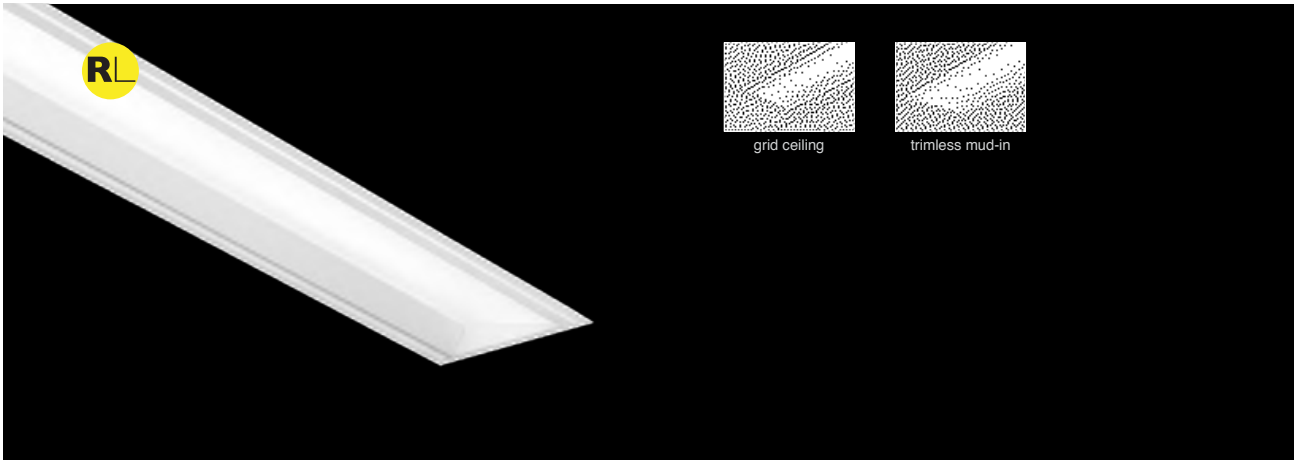
Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for most current data.

Sample Product Cutsheets (Lighting)

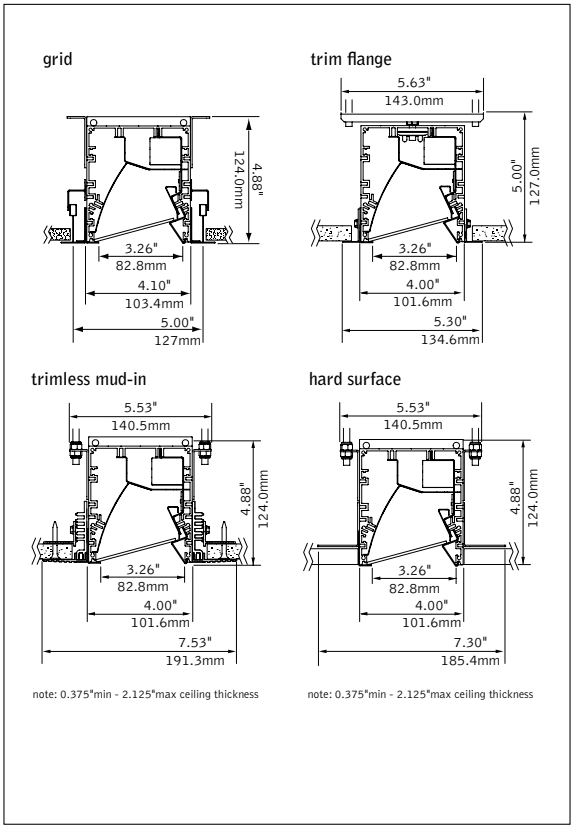
Seem® 4

LED ASYMMETRIC HIGH PERFORMANCE ANGLED LENS

FOCAL POINT®



DIMENSIONAL DATA



FEATURES

Narrow extruded aluminum 4" aperture recessed asymmetric LED luminaire.

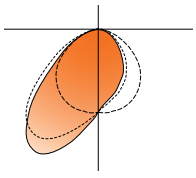
Integrates with ceiling in a variety of mounting styles for a clean, unobtrusive aesthetic.

Individual units and continuous runs in 1' increments.

Angled frosted acrylic lens provides uninterrupted illumination, without pixels or shadows.

Concealed LEDs provide the perfect blend of high performance and visual comfort.

PERFORMANCE



4' Angeld Frosted Lens
875 Lumens per foot

Delivered Lumens: 3500lm

Total System Watts: 49W

PRODUCT OVERVIEW

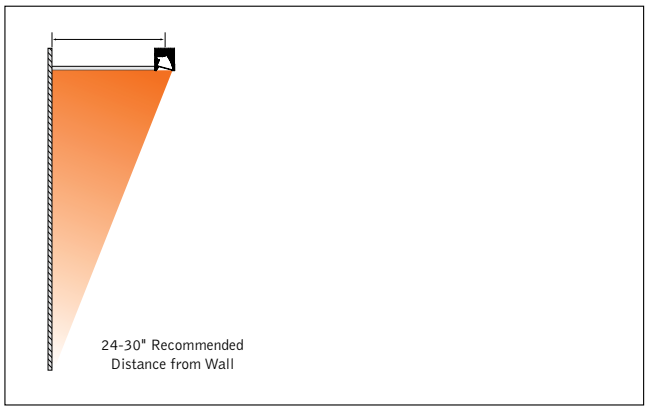
Lumen Output:	1100-3500lm
Wattage:	14-49W
LPW:	71-76
SDCM:	3

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data. Visit designlights.org/QPL for model specifics.

Sample Product Cutsheets (Lighting)

fixture: project:

DETAILS



SPECIFICATIONS

LED System

Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K or 4000K with CRI>80, 3SDCM. LED modules and drivers are replaceable from below.

Construction

Extruded aluminum housing. 20 Ga. steel end caps. Housing for new construction applications. XFW acceptable for use with wood, Type Non- IC only. 2' unit weight: 18 lbs., 3' unit weight: 24 lbs., 4' unit weight: 30 lbs., 5' unit weight: 36 lbs.

Optic

Reflector fabricated of low iridescent, semi-specular premium grade aluminum. Acrylic lens .098" thick with satin finish, up to 8' continuous.

Electrical

Luminaires are pre–wired with factory installed branch circuit wiring and over-molded quick connects. Standard 120-277V constant current driver includes 0-10V analog dimming. Dimming range 100% to 10%. Power factor > .9.

Emergency Battery

IOTA CP12. Emergency output—12W for 90 minutes. Maximum mounting height: 16ft Emergency Circuit maximum mounting height: 16ft

Labels

UL and cUL listed. Suitable for Dry or Damp Locations, indoor use only.

Finish

Polyester powder coat applied over a multi-stage pre–treatment.

Lumen Maintenance

Calculated: L90 at 104,000 hours
Derived from EPA TM-21 calculator

Reported: L90 at >61,000 hours

Reliability

At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

Warranty

LED system rated for operation in ambient environments up to 25°C. 5-year limited warranty.

4' PERFORMANCE CHART

Shielding	Lumens per foot	Delivered Lumens	Tested System Watts	LPW
Angled Frosted Lens	275LF	1100	14	76
	375LF	1500	20	76
	625LF	2500	33	75
	875LF	3500	49	71

Based on 3500k, 4' lengths. Lumen output may vary +/- 5%. Actual wattage may vary +/- 5%

Focal Point LLC reserves the right to change specifications for product improvement without notification.

ORDERING

Luminaire Series		**FSM4AL**
Seem 4 Asymmetric LED	FSM4AL	
Shielding		**FL**
Angled Frosted Lens	FL	
Lumen Output		_____
275 Lumens per foot (Not available with Lutron driver)	275LF	
375 Lumens per foot (4' minimum with LU5 & LH1 Drivers)	375LF	
625 Lumens per foot (4' minimum with LU5 & LH1 Drivers)	625LF	
875 Lumens per foot	875LF	
Color Temperature		_____
3000K	30K	
3500K	35K	
4000K	40K	
Circuit		**1C**
Single Circuit	1C	
Voltage		**UNV**
120/277 UNV Volt	UNV	
Control System & Dimming Level		_____
0-10V - 10% Dimming	LD1	
0-10V - 1% Dimming	L11	
Lutron Hi-Lume EcoSystem (LDE1) - 1% Dimming	LH1	
Lutron 5-Series EcoSystem (LDE5) - 5% Dimming	LU5	
DALI 1% Dimming	D11	
Ceiling Configuration		_____
Std. 15/16" Lay-in	G1	
Std. 15/16" Tegular	T1	
Std. 9/16" Lay-in	G2	
Std. 9/16" Tegular	T2	
9/16" Slot-tee Tegular	G3	
Tall 15/16" Lay-in	G4	
Tall 15/16" Tegular	T4	
Tall 9/16" Lay-in	G5	
Tall 9/16" Tegular	T5	
Node 9/16" Tegular	T6	
Trim Flange Drywall	TF	
Mud-in Trimless, pre-set for 1/2" Drywall	XF1	
Mud-in Trimless, pre-set for 5/8" Drywall	XF2	
Mud-in Trimless, set thickness in field (Mounting equipment assembled in field)	XFF	
Non-Drywall Hard Surface	XFN	
Hard Surface, Wood	XFW	
Factory Options		
Chicago Plenum	CP	_____
Emergency Circuit (625LF & 875LF only)	EC	_____
Emergency Battery Pack (4' lengths or longer)	EM	_____
6' New York City Flex Whip (120V)	FNY1	_____
6' New York City Flex Whip (277V)	FNY2	_____
6' Flex Whip	FW	_____
Finish		**WH**
Matte White Housing	WH	
Luminaire Length (Lengths are nominal. 2' minimum length.)		_____
Specify luminaire/row length in 1' increments (Smaller increments available. Consult factory for details.)	X'	

For more information visit focalpointlights.com/reference or consult factory.

Sample Product Cutsheets (Lighting)

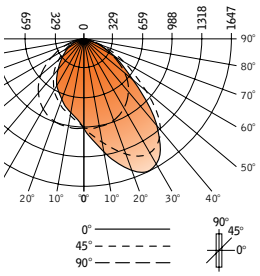
Seem® 4

ASYMMETRIC LED

FSM4AL-FL-625LF-35K-1C-120-LD1-G1-WH-4'

Filename:	FSM4ALFL635LF35K.IES	Lumens:	2493lm
Test #:	18855.0	Watts:	33W
		LPW	75

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	45°	90°	135°	180°	Zonal Lumens
0°	825	825	825	825	825	
5°	974	937	830	753	721	80
15°	1352	1187	827	655	617	261
25°	1647	1439	793	575	59	453
35°	1341	1413	729	471	412	552
45°	814	1048	588	343	290	492
55°	444	620	434	229	170	355
65°	202	314	261	117	85	209
75°	85	112	109	32	27	84
85°	16	11	11	0	8	8
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	0

LUMEN SUMMARY

	Zone	Lumens	% Fixture
	0-30°	793	31.8
	0-40°	1345	54.0
	0-60°	2192	88.0
Total Luminaire	0-90°	2493	100.0
	0-180°	**2493**	**100**

CO-EFFICIENTS OF UTILIZATION

Floor		80				70			20				00
Ceiling									50		30	10	
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00
RCR 0	119	119	119	119	116	116	116	111	111	106	106	102	102	100
1	111	107	104	101	108	105	99	101	96	97	93	94	90	88
2	103	96	90	86	100	94	85	91	83	88	81	85	79	77
3	95	86	79	74	93	85	73	82	72	79	71	77	70	68
4	88	77	70	64	86	76	63	74	63	71	62	69	61	59
5	81	69	61	55	79	68	55	66	54	64	53	62	53	51
6	74	62	54	48	73	61	48	59	47	58	47	56	47	45
7	69	56	48	42	67	55	42	54	42	52	41	51	41	39
8	63	50	42	36	63	49	36	48	36	47	36	46	36	34
9	58	45	37	31	57	44	31	43	31	42	31	41	31	29
10	54	41	33	28	52	40	28	39	28	38	27	37	27	26

Numbers indicate percentage values of reflectivity.

Go to www.focalpointlights.com for additional photometric data.

note: Photometric testing performed in an independent lab with standard lamps and ballasts. Lamp and ballast type and configuration will affect photometric performance.

Sample Product Cutsheets (Audio-Visual)

Q-SYS Core 110f

Unified Core

Q-SYS Core 110f

Specification Sheet

Features

- 128x128 Network Audio Channels
- 16x16 USB Audio Channels
- 24 Channels of Total Analog Audio
- 8 Configurable Flex Channels
- 16x16 GPIO Logic Ports
- 16 Channels of Routable AEC
- Multiple Instance VoIP Lines
- Single POTS Telephone line
- 3 Year Warranty

The Q-SYS™ Core 110f provides a solution for small, single room allowing the Q-SYS platform to accommodate every-day, simple projects up to the largest Enterprise scale deployments. QSC's software based DSP Platform Q-SYS, gives the systems integrator and end-user a unified software design tool and feature set suitable for projects of any scale. The continuity of the Q-SYS software based DSP platform is unique within the competitor space and allows the Q-SYS Core 110f to leverage all the features that are available across the entire Q-SYS Platform to be used in the following applications: Acoustic Echo Canceling (AEC) and sound reinforcement in small to large meeting or multipurpose rooms, sound reinforcement in performance venues such as house of worship and theater, background music systems, wide area paging in airports, convention centers and hospitals.

The Q-SYS Core 110f is a multipurpose software based digital audio signal processor with a total of 8 balanced analog line level audio inputs and 8 balanced analog line level audio outputs. In addition to the fixed 8x8 analog audio I/O, the Core 110f features a software definable bank of 8 balanced analog audio Input/Output Flex Channels, a unique QSC innovation, where each channel can be independently configured during design or run time as either a microphone/line level input or a line level output. As such, the Core 110f offers class leading 24 analog I/O density plus additional specialized I/O such as VoIP, POTS, Internal Media Playback/Recording HDD and USB.

The Q-SYS Core 110f supports a class leading USB audio device port connection that enables the processor to appear in a Microsoft Windows or Mac OS host operating system simultaneously as both a USB Audio and Communications device. The USB Device port (B type) implementation supports up to 16x16 digital audio channels in a flexible, design time configuration environment that can advertise as multiple virtual USB device instances to the host operating system concurrently over a single physical USB connection. In addition to the USB Device port, the Core 110f provides 6 USB Host ports (A type) which enable the Core to host external USB devices and future Q-SYS peripheral products.

Sample Product Cutsheets (Audio-Visual)

Q-SYS Core 110f

Specification Sheet

Benefits

- **Class leading I/O:** Q-SYS Core 110f has 24 analog I/O + USB, POTS and VoIP simultaneously in a single rack space and one SKU, offering the best cost to I/O ratio in a single chassis product available on the market from any manufacturer.
- **Flex Channels:** Nearly all the flexibility of a card based DSP solution without the cost and inconvenience of multiple SKU's and custom parts ordering.
- **Unified software platform:** Single training investment in one software design tool rather than needing to learn several platforms to scale from small to large systems or support different applications.
- **Industry leading hardware design:** Future proof investment in standards based software and computer technology running on Intel processors.
- **Industry first, software based DSP:** Q-SYS suite of conferencing technology applications built and owned by QSC from the ground up allowing for continued refinement.
    - o Software based routable AEC; no additional hardware needed
    - o SIP Softphones offering multiple instances per Q-SYS Core; no additional hardware needed
    - o Gain sharing and gating automixers
- **True IT Software Integration:** The Core 110f provides more than just networked audio integration and is not just another hardware DSP. Q-SYS is primarily a software platform that offers greater software integration functionality such as native support for LDAP contact server integration, SNMP monitoring, SIP Softphones, and software based routable AEC implementation; it truly is a next generation AV/IT product that is free of the fixed hardware limitations seen in competing products.

Key Features

- 128x128 networked audio channels (Q-LAN / AES67), reduced to 64x64 when using Video Bridging capability on built-in USB-B port.
- Up to 24 configurable analog audio I/O
- 8 mic/line level analog audio inputs
- 8 line level analog audio outputs
- 8 Flex Channel mic/line level analog audio inputs or outputs
- Up to 16 assignable and routeable AEC processor instances
- Dual Gigabit Ethernet ports with assignable application resources offering any combination of VoIP, Q-LAN Control, Q-LAN audio or network redundancy
- Up to 16x16 channels of digital audio in and out via software definable USB instances advertised to the host operating system
- 16 General Purpose Inputs (GPI) x 16 General Purpose Outputs (GPO)
- Internal Universal Power Supply plus 12 Volt DC External Power Supply input for redundancy or non-mains power supply sources
- Single software platform for system configuration, control and monitoring via Q-SYS Designer software over Ethernet with support for static or Auto/DHCP TCP/IP addressing
- POTS telephone interface via a standard RJ-11 connector
- Supports up to 4 VoIP Softphone instances in addition to the onboard POTS telephone interface
- Fully compatible with all existing and future Q-SYS accessories such as IO Frames, Paging Stations, and Touch Screen Control Surfaces running Q-SYS user control interfaces
- CE marked, UL listed, and RoHS compliant
- Covered by QSC Systems 3-year warranty

Sample Product Cutsheets (Audio-Visual)

Q-SYS Core 110f

Inputs	Q-SYS Core 110f
Input Frequency Response	
20Hz to 20kHz @ +21dBu	+0.05% / -0.5%
Input THD+N @ 1KHz	
@ +21 dBu Sensitivity & +21 dBu input	< 0.1%
@ +21 dBu Sensitivity & +10 dBu input	< 0.0015%
@ +10 dBu Sensitivity & +8 dBu input	< 0.0007%
@ -10 dBu Sensitivity & -10.5 dBu input	< 0.0006%
@ -39 dBu Sensitivity & -39.5 dBu input	< 0.007%
EIN (no weighting, 20Hz to 20kHz)	< -121dB
Input to Input Crosstalk @1kHz	> 110dB typical, 90dB Max
Input Dynamic Range	
@ +21 dBu Sensitivity	> 109.5dB
@ +10 dBu Sensitivity	> 106.4dB
@ -10 dBu Sensitivity	> 104.6dB
@ -39 dBu Sensitivity	> 104.6dB
Input Common Mode Noise Rejection	
@ +21 dBu Sensitivity	50.7dB
@ +10 dBu Sensitivity	56.5dB
@ -10 dBu Sensitivity	73.2dB
@ -39 dBu Sensitivity	63.2dB
Input Impedance (balanced)	5K ohms nominal
Input Sensitivity Range (1dB Steps)	-39 dBu min to +21 dBu max
Unbalanced Input Signal Level	+ 8 dBu max
Phantom Power	+48V DC, 10mA per input max
Sampling Rate	48kHz
A/D – D/A Converters	24-bit

Outputs

Output Frequency Response	
20Hz to 20kHz @ all settings	+0.2 / -0.5 dB
Output THD	0.003%, +10 dBu max output level
Output Crosstalk @1kHz	> 100dB typical, 90dB max
Output Dynamic Range	> 108dB
Output Impedance (balanced)	220 ohms
Output Level Range: (1dB Steps)	-39 dBu min to +21 dBu max

USB Inputs & Outputs

USB B		
Bit Depth	16-bit	
Number of Channels	up to 16x16	
Sample Rate	48kHz	
Power Consumption	60 watts, typical. 120 watts max	
BTU/Heat load:	205 BTU/Hour	
Compliance	FCC Part 15B (USA), FCC part 68 / TIA-968-B (USA), JATE (Japan), AS/ACIF S002 (Australia), PTC200 (New Zealand), ES203 021 (Europe), ANATEL Resolution 473 (Brazil), NOM-151-SCTI (Mexico), PSTN01 (Taiwan), Industry Canada CS-03 (Canada), CE marked (Europe), UL and C-UL listed (USA & Canada), RCM (Australia), EAC (Eurasian Customs Union) & RoHS Directive (Europe)	
Overall Dimensions/Weight	Device Height: 1.75 inches (44 mm) Device Width: 19.0 inches (483 mm) Device Depth: 11.12 inches (282.5 mm) Device Weight: 11 lbs. (5.0 kg)	Shipping Height: 6.0 inches (152 mm) Shipping Width: 23 inches (584 mm) Shipping Depth: 14 inches (356 mm) Shipping Weight: 12.4 lbs. (5.6 kg)

Specifications subject to change without notice.

Sample Product Cutsheets (Audio-Visual)

Q-SYS Core 110f

Specification Sheet

A&E SPECIFICATIONS

The system processor shall provide up to 128 x 128 networked audio channels individually configurable as either Q-LAN or AES67 formatted networked audio, channel count will reduce to 64 x 64 when using video bridging capability on the built-in USB-B device port. The system processor shall support 24 total analog I/O capacity and shall be presented in the following groupings; 8 Mic/Line inputs, 8 Line outputs and 8 Flex Channel I/O which shall be software definable analog inputs or outputs in single channel increments in any combination ratio.

The system processor shall have the following front panel controls and indicators: blue monochrome OLED display with page forward capacitive touch button, Unit ID capacitive touch button, Power On blue LED, Two USB A Type ports. The system processor shall provide a monochrome 304x96 blue OLED graphics display displaying the device name, design name and system status, LAN A and B settings, and the firmware version. Device Status shall be displayed on the OLED display including I/O status, muting, level present indication, and system status.

On the rear panel, the system processor shall have one 3-pin RS232 Euro Block Connector, HDMI Video Out, 16 GPI general purpose control inputs on 20-pin Euro Block Connector, 16 GPO general purpose control outputs on 20-pin Euro Block Connector. Q-SYS Network: LAN A RJ45 1000 MBps only, LAN B: RJ45 1000 MBps only. The dimensions of the System processor shall be 1.75” x 19” x 11.12” (44 mm x 483 mm x 356 mm).

The system processor shall store a single design which can be comprised of components, wiring, links, text, and graphics on a single or multiple schematic pages. Designs shall include any of the following DSP function blocks, test and measurement components, control components, and layout components: Acoustic Echo Cancellers, SIP Softphone instances, USB Audio host and device blocks, Audio Players, Audio Streaming components, Crossfaders, Crossovers, Delay components, Auto Gain control elements, Compressors, Gates, Duckers, Expanders, Ambient Noise Compensators, Limiters, Gain blocks, Graphic Equalizers, Parametric Equalizers, FIR Filters, All-Pass Filters, Band-Pass Filters, Band-Stop Filters, High-Pass Filters, Low-Pass Filters, FIR High-Pass filters, FIR Low-Pass Filters, Dual-Shelf Equalizers, Notch Filters, Meters, Matrix Mixers, Gain-Sharing Automatic Mixers, Gated Automatic Mixers, Signal Routers, Public Address Routers, Room Combiners, Signal Presence Meters, Tone Generators, Tone and Noise Generators, Dual Trace FFT Measurement Modules, Real Time Analyzers, Signal Injectors, and Signal Probes.

The system processor shall support custom user control interfaces on either proprietary touch screen controllers, or network computers utilizing a control application, or iOS devices on Wi-Fi. Custom control interfaces shall be capable of having multiple user-selectable pages with different controls on each.

The system processor and control engine shall be the QSC Q-SYS Core 110f Flex Channel Processor.

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Sample Product Cutsheets (Audio-Visual)

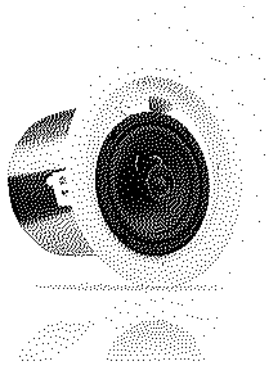
AC-C6T

QSC

AcousticCoverage™ Series

AC-C6T

Two-way, ceiling mount loudspeaker



Features

- High quality transducers provide exceptional clarity through the critical voice range.
- Improved musicality often not seen in typical BGM class products.
- Ported baffle for increased low frequency extension down to 65 Hz.
- Low saturation 70/100V transformers with 8 ohm bypass.
- 4-pole Euroblock connector eases system wiring.
- Advanced voicing via QSC Intrinsic Correction™, applied using the Q-SYS™ Platform or CXD Series amplifiers platforms.
- White (RAL 9010) with UV inhibitors to match complimenting QSC product families.
- Complete EASE, CF2, CAD, & BIM information available online

Wide Area Paging · Background Music · Distance Conferencing Reinforcement· Healthcare Facilities · Concourses · Transportation Terminals · Ancillary Support in Larger Systems

The QSC AcousticCoverage™ Series AC-C6T is a ceiling-mounted 6" two-way loudspeaker with 70/100V transformer, suitable for a wide variety of audio/video conferencing reinforcement, voice paging and background music applications.

AcousticCoverage™ Series is designed to offer integrators a cost-effective solution for applications where voice reinforced coverage is of primary concern, while providing improved musicality often not seen in typical BGM class products.

The high quality 6-inch polypropylene cone transducer with butyl rubber surround and the sensitivity matched coaxially mounted .86-inch silk dome tweeter offers pristine clarity through the critical vocal range for increased speech intelligibilty. With 110 degrees of conical coverage, the AC-C6T reduces the number of loudspeakers required for even coverage in low ceiling applications.

The easy-to-install blind mount assembly features a ported baffle which optimally tunes the galvanized steel backcan for added musicality, creating low frequency extension down to 65 Hz. To maintain this frequency response, the AC-C6T utilizes a 30-watt low-saturation and low-loss 70/100V transformer with varying selectable taps, including an 8Ω bypass. The rotary tap selector switch is accessible under the painted steel grille.

To further enhance performance and speed of install with optimum result, advanced voicing via QSC Intrinsic Correction™ techniques are obtainable using the Q-SYS™ Platform networked audio processing platforms, including CXD Series amplifiers for a complete QSC systems solution.

Installers will appreciate the 4-pole Euroblock connector for loop-thru wiring, located under a quick access swivel plate. Eliminating the termination hassles of star topology wiring designs, the generous Euroblock of the AC-C6T can accept four 18AWG pairs.

A safety tether tab is affixed to the adjustable conduit clasp plate for seismic-sensitive installations. C-ring and tile rails are included with each pair packed assembly, complete with joining screws and cut-out template.

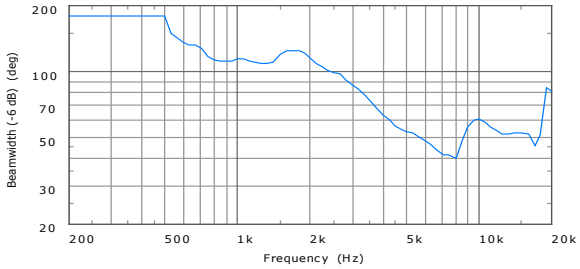
The AC-C6T baffle and grille are QSC standard white (RAL 9010) to match complimenting QSC product families and includes UV inhibitors to prevent discoloration over time. The AC-C6T may also be painted to match any décor.

For your system integration needs, complete EASE, CF2, CAD, and BIM files are available for download at QSC.com.

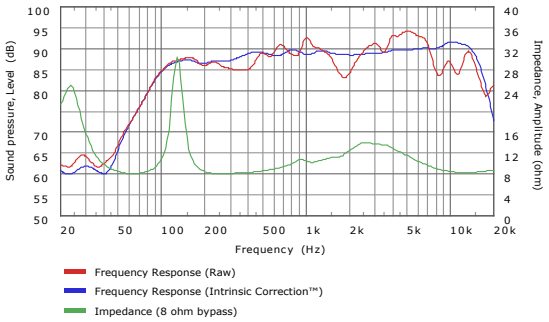
Sample Product Cutsheets (Audio-Visual)

AC-C6T Details

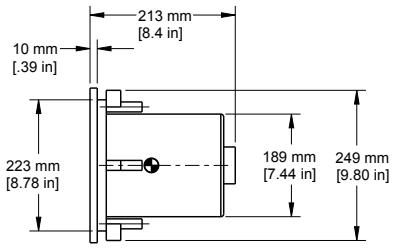
Beamwidth:

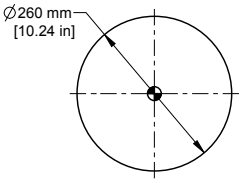


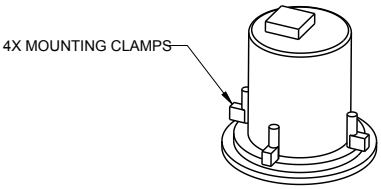
Impedance / Frequence Response:



Dimensions







Specifications:

System Details	AC-C6T
Effective frequency range[1]	65 Hz – 20 kHz
Rated noise power / voltage[2]	30 watts / 15.5 volts (rms)
Broad-band sensitivity[3]	89 dB SPL
Coverage angle (-6 dB)	110° (500 Hz - 5 kHz)
Maximum continuous SPL[4]	104 dB
Maximum peak SPL[4]	110 dB
Rated bypass impedance	8 ohms
Transformer taps	70 V: 30, 15, 7.5, 3.7, 1.9 watts 100 V: 30, 15, 7.5, 3.8 watts 8 ohm bypass
HF transducer	22 mm [.86 in] silk dome tweeter, coaxially mounted
LF transducer	152 mm [6 in] Polypropylene cone with butyl rubber surround
Input connector type	Euroblock connector with parallel output terminals
Baffle material	Painted ABS polymer
Grille material	Painted steel
Back can material	Galvanized steel
Testing	Listed UL1480, UL2043 safe for use in air handling space
Net weight	3.5 kg [7.6 lb]
Product dimensions	Ø260 x 213 mm [Ø10.24 x 8.4 in]
Cut-out Dimensions	Ø229 mm [Ø9 in]
Ceiling Capture Thickness	6.35 - 38.1 mm [0.25 - 1.5 in]
Shipping weight	9.5 kg [21 lb] (pair packed)
Shipping dimensions	622 x 318 x 324 mm [24.5 x 12.5 x 12.8 in]
Included accessories	Rails & C-ring for ceiling tile installation

[1] Half-space, -10 dB from on-axis sensitivity [2] IEC60268-1 noise signal for 2 Hrs
[3] On-Axis, half-space sensitivity, 2.83V, 1 m [4] Calculated from rated noise voltage and sensitivity

As part of QSC's ongoing commitment to product development, specifications are subject to change without notice.

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AC-C6T Spec Sheet 12/02/2016

Sample Product Cutsheets (Audio-Visual)

QSC

CXD-Q Series

CXD4.2Q | CXD4.3Q | CXD4.5Q

Multi-Channel Network Processing Amplifiers

Features

- Seamless Q-SYS integration with audio transport and control via standard Gigabit Ethernet protocols and hardware
- Capable of providing up to 5,000 W continuous and 8,000 W peak with 70V / 100V direct drive on the CXD4.3Q and CXD4.5Q
- Flexible Amplifier Summing Technology™ (FAST) permits total amplifier power to be distributed across one, two, three or all four channels
- PowerLight universal switchmode power supply with PFC for highest effiency, improved audio performance, and low weight.
- Mic/Line input Euroblock connectors and touch-proof Euroblock loudspeaker connections.
- Eight bi-directional GPIO connections that can be used for analog or digital inputs or outputs to/from Q-SYS
- Built-in energy saving modes ensure that the amplifier will draw the minimum amount of AC power while still providing outstanding audio quality
- Q-SYS technical support is available 24/7 - worldwide

The QSC CXD-Q Series represents a revolutionary advancement in amplifier technology and innovation, coupled with outstanding integration capability as part of a Q-SYS system. Designed specifically for the needs of integrators, CXD-Q provides efficient, robust and extraordinarily high fidelity power to drive multiple channels and configurations of loudspeakers – all with optimal energy and rack space efficiency. The CXD-Q Series consists of three powerful, four-channel amplifiers, each a Q-SYS peripheral enabling audio routing, processing, and control. Provided in the amps is the capability to configure and combine channels in various ways to drive a wide range of loudspeaker systems including 70V and 100V without the use of transformers. These amplifiers not only provide the power and processing make your system perform better, they offer outstanding efficiency ensuring that energy costs will be kept to a minimum over the life of the installation.

Flexible Amplifier Summing

CXD-Q amplifiers feature Flexible Amplifier Summing Technology™ (FAST) that actively, two, three or all four outputs. On the CXD4.3Q and CXD4.5Q, this power can also be used to drive 70V or 100V speaker lines directly from any one or all of the four outputs.

This flexibility allows CXD-Q Series amplifiers to drive (for example) two full-range surface mounted speakers along with a subwoofer and one 100V distributed speaker line; or a high-power subwoofer and a bi-amplified full-range loudspeaker; three 70V distributed speaker lines and a low impedance surface mount speaker line; or a single high-power channel driving monster subwoofers.

Q-SYS Connectivity

The CXD-Q amplifiers benefit from the strength of the Q-SYS platform. They are true Q-SYS peripherals meaning that they can connect on a Q-LAN Ethernet network and source and recieve audio signals. In addition to the four Mic/Line input and output channels, the CXD-Q amplifiers affer eight bi-directional Q-SYS GPIO ports for further interfacing with other equipment. It also means that when the CXD-Q amps are in a Q-SYS design the Q-SYS Core manages the system design and amplifiers. If for any reason an amplifier goes off-line or has a fault, the Core can alert the operator and ensure that system retains its integrity.

Power & Space Efficiency

CXD-Q Series amplifiers use QSC's next generation class-D power amp design in combination with a custom power stage utilizing a new output device. These purpose built MOSFET devices provide high voltage operation without needing a full bridge output and offer better audio quality and thermal performance due to co-location of the semiconductors.

CXD-Q amplifiers benefit from the proven PowerLight power supply, made even better with Power Factor Correction (PFC) that aligns the current waveform with the AC mains voltage waveform. PFC enables CXD-Q Series amps to draw current from the wall in a more efficient and controlled manner resulting in incredible power from a single standard AC breaker.

The CXD-Q amplifiers also incorporate several energy conservation and efficiency strategies. One such tool is the unique multi-stage sleep mode that saves energy when possible without sacrificing performance.

With four channels of Mic/Line input and four channels of amplification in just 2RU, the CXD-Q amplifiers replaces equipment taking up as much as three times the rack-space.

Integration Simplicity

Q-SYS is a complete integrated system that encompasses everything from the audio input to the output of the loudspeakers. As part of a Q-SYS system, the CXD-Q amplifiers are just some of the many peripherals that can be intuitively placed in a design and wired into the system. The centralized design maintains operational simplicity because not only does it allow for a "whole system" design philosophy, but the Q-SYS Core configures and manages all peripherals to ensure that all elements of the system are functioning correctly.

With the complete integration facilities provided by Q-SYS, and the power efficiency provided by the custom MOSFET and FAST, the CXD-Q amplifiers are perfect for nearly every installation application.

Sample Product Cutsheets (Audio-Visual)

CXD-Q Series Specifications

		CXD4.2Q	CXD4.3Q	CXD4.5Q
		Peak	Peak	Peak
4 Independent Channels A, B, C, D	70 V	N/A	500 W	1000 W
	100 V	N/A	625 W	1250 W
	8Ω	500 W	900 W	1200 W
	4Ω	700 W	1400 W	2000 W
	2Ω	625 W	1200 W	1600 W
2 Channels BTL Bridged A+B or C+D Doubles Voltage	8Ω	**1200 W**	**2400 W**	**4000 W**
	4Ω	**1500 W**	NR*	NR*
	2Ω	NR*	NR*	NR*
2 Channels Parallel AB or CD Doubles Current	8Ω	500 W	1300 W	1250 W
	4Ω	950 W	**2000 W**	**2400 W**
	2Ω	**1200 W**	**2500 W**	**4000 W**
1 Channel 3CH Parallel ABC Triples Current	8Ω	500 W	1400 W	1400 W
	4Ω	950 W	2400 W	2500 W
	2Ω	1800 W	3500 W	4500 W
1 Channel Bridged/Parallel AB+CD Doubles Current and Voltage	8Ω	**1600 W**	**3500 W**	**4500 W**
	4Ω	**2500 W**	**5000 W**	**7500 W**
	2Ω	NR*	NR*	NR*
1 Channel 4CH Parallel ABCD Quadruples Current	8Ω	500 W	1400 W	1600 W
	4Ω	1000 W	3000 W	3000 W
	2Ω	**1700 W**	**5000 W**	**5300 W**

NR = Not Recommended due to excessive current draw*

BOLD = Optimal configuration for the load and channel count

Sample Product Cutsheets (Audio-Visual)

CXD-Q Series Specifications

	CXD4.2Q	CXD4.3Q	CXD4.5Q
Typical Distortion			
8Ω	0.01 - 0.03%	0.01 - 0.03%	0.01 - 0.03%
4Ω	0.03 - 0.06%	0.03 - 0.06%	0.03 - 0.06%
Maximum Distortion			
4Ω - 8Ω	1.0%	1.0%	1.0%
Frequency response (8Ω)	20 Hz - 15 kHz +/- 0.2 dB 20 Hz - 20 kHz +0.2 dB / -0.7 dB	20 Hz - 15 kHz +/- 0.2 dB 20 Hz - 20 kHz +0.2 dB / -0.7 dB	20 Hz - 15 kHz +/- 0.2 dB 20 Hz - 20 kHz +0.2 dB / -0.7 dB
Noise			
Unweighted Output Unmuted	-101 dB	-101 dB	-101 dB
Weighted Output Muted	-109 dB	-109 dB	-109 dB
Gain (1.2V setting)	34.0 dB	38.4 dB	38.4 dB
Damping factor	>150	>150	>150
Input impedance	>10k, balanced or unbalanced	>10k, balanced or unbalanced	>10k, balanced or unbalanced
Input Sensitivity			
Continuously Variable:	Vrms 1.23mV to 17.35V dBu -56 to 27 dBv -58.2 to 24.8	Vrms 1.23mV to 17.35V dBu -56 to 27 dBv -58.2 to 24.8	Vrms 1.23mV to 17.35V dBu -56 to 27 dBv -58.2 to 24.8
Controls and indicators (front)	Power • Channel MUTE Buttons • Channel SELECT Buttons • Channel Input Signal and CLIP LED Indicators • Channel Output and LIMIT LED Meters • NEXT, PREV, ID Buttons • Control Knob		
Controls and indicators (rear)	AC Power Disconnect		
Input connectors	3-pin Phoenix		
Output connectors	8-pin Phoenix Speaker		
Amplifier and load protection	Short circuit, open circuit, thermal, RF protection. On/Off muting, DC fault shutdown, active inrush limiting		
AC Power Input	Universal Power Supply 100 - 240 VAC, 50 - 60 Hz		
Dimensions (HWD)	3.5" x 19" x 12" (89mm x 482mm x 305mm)	3.5" x 19" x 16" (89mm x 482mm x 406mm)	3.5" x 19" x 16" (89mm x 482mm x 406mm)
Weight, Net / Shipping	18.5 lb (8.4 kg) / 22 lb (10.0 kg)	21.0 lb (9.5 kg) / 25 lb (11.3 kg)	22.0 lb (10.0 kg) / 26 lb (11.8 kg)
Agency approvals	UL, CE, RoHS/WEEE compliant, FCC Class A (conducted and radiated emissions)		
Carton contents	IEC Cable, Quick Start Guide, Phoenix Connectors		

Burst Power- *20 ms 1 kHz sine burst, all channels driven*
Continuous Power- *EIA 1 kHz 1% THD, all channels driven*

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CXD4.5Q Spec Sheet 09/19/2016

Sample Product Cutsheets (Audio-Visual)

QLX-D™ Digital Wireless Specifications (Note: All specifications are subject to change.)

System	**RF Carrier Frequency Range**	470–937.5 MHz, varies by region
	Image Rejection	>70 dB, typical
	Latency	<2.9 ms
	RF Sensitivity	-97 dBm at 10^{-6} BER
	Working Range	100 m (328 ft.) line-of-sight *Note: Actual range depends on RF signal absorption, reflection and interference.*
	Audio Frequency Range	20 Hz to 20 kHz *Note: Dependent on microphone type.*
	Audio Dynamic Range (System Gain @ +10)	>120 dB, A-weighted, typical
	Total Harmonic Distortion	<0.1% (–12 dBFS input, System Gain @ +10)
	Operating Temperature Range	-18°C (0°F) to 50°C (122°F) *Note: Battery characteristics may limit this range.*
QLXD4 Receiver	**Dimensions**	41 mm x 197 mm x 151 mm (1.63 in. x 7.75 in. x 5.94 in.)
	Weight	777 g (1.71 lbs.), without antennas
	Housing	Steel
	Power Requirements	12 V DC @ 0.4 A, supplied by external power supply (tip positive)
	Spurious Rejection	> 80 dB, typical
	Antenna Connector Type	BNC
	Antenna Impedance	50 Ω
	Gain Adjustment Range	-18 to +42 dB (in 1 dB steps)
	Configuration	¼" (6.35 mm): Impedance balanced (Tip = audio, Ring = no audio, Sleeve = ground) XLR: balanced (1= ground, 2 = audio +, 3 = audio –)
	Antenna Impedance	¼" (6.35 mm): 100 Ω (50 Ω Unbalanced) XLR: 100 Ω
	Full Scale Output	¼" (6.35 mm): +12 dBV XLR: LINE setting = +18 dBV, MIC setting = -12 dBV
	Mic/Line Switch	30 dB pad
	Network Interface	Single Port Ethernet 10/100 Mbps
	Network Addressing Capability	DHCP or Manual IP address
QLXD1 Bodypack Transmitter QLXD2 Handheld Transmitter	**Dimensions**	QLXD1: 86 mm x 65 mm x 23 mm (3.38 in. x 2.57 in. x 0.92 in.) without antenna QLXD2: 256 mm x 51 mm (10.1 in. x 2.0 in.) L x Dia.
	Weight	QLXD1: 138 g (4.9 oz.), without batteries QLXD2: 347 g (12.2 oz.), without batteries
	Housing	QLXD1: Cast aluminum QLXD2: Machined aluminum
	Battery Type	Shure SB900 Rechargeable Li-Ion or AA batteries 1.5 V
	Battery Runtime	(@ 10 mW) Shure SB900 rechargeable: up to 10 hours alkaline: up to 9 hours
	RF Output Power	1 mW or 10 mW
	Occupied Bandwidth	< 200 kHz
	Modulation Type	Shure proprietary digital
	Mic Offset Range	0 to 21 dB (in 3 dB steps)

SHURE
LEGENDARY PERFORMANCE™

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QLX-D™ Digital Wireless Systems

POWERFULLY REFINED WIRELESS

QLX-D™ Digital Wireless Systems

An Elevated Standard.

Transparent 24-bit digital audio.
Incredibly efficient wireless.
Powerful networking.
Rugged, secure systems.

Shure QLX-D™ Digital Wireless is the clear choice for exceptionally detailed wireless audio in widely diverse and demanding environments. A highly flexible system featuring streamlined setup and operation, QLX-D boasts impressive RF efficiency to get more channels on air using less spectrum, while the rugged all-metal construction withstands the rigors of constant use. From corporate seminars to music clubs, classroom lectures to houses of worship, Shure QLX-D Digital Wireless has it covered — delivering confident performance, no matter what the venue.

System Components

QLXD1 Bodypack Transmitter
QLXD2 Handheld Transmitter

- Rugged metal construction
- Backlit LCD with easy to navigate menu and controls
- 2 x AA batteries provide up to 9 hours of runtime
- Optional Shure SB900 lithium-ion rechargeable battery provides up to 10 hours of runtime
- External charging contacts for docked charging
- Multiple microphone cartridges available, including the legendary SM58® (QLXD2)

QLXD4 Receiver

- Transparent, 24-bit digital audio
- 20 Hz – 20 kHz frequency range*
- 120 dB dynamic range
- 64/72 MHz overall tuning bandwidth**
- 17 compatible channels per 6 MHz TV channel
- More than 60 pre-set compatible channels per frequency band**
- AES 256-bit encryption
- Ethernet networkable receivers
- Network Scan finds clean frequencies for networked receivers
- AMX/Crestron control system ready
- ShurePlus™ Channels mobile app compatible
- Wireless Workbench® control software compatible

*Microphone dependent **Region dependent

Systems available with:

Handheld
Interchangeable SM, Beta, and KSM microphone cartridges

Lavalier
Miniature and subminiature lavalier condenser microphones

WL93 Miniature Lavalier

MX150 MicroFlex® Subminiature Lavalier

WL183/WL184/WL185 MicroFlex® Lavalier

Headset
Comfortable over-the-ear design

MX153B MicroFlex® Headset Microphone

SM35 Headset Microphone

Instrument
Microphone and cable options for instrument and line input

WA305 Premium Instrument Cable

WB98H/C Clip-On Instrument Microphone

Sample Product Cutsheets (Audio-Visual)

Constellation

Acoustic System

Imagine the Possibilities with Flexible Acoustics

MULTIPLE SONIC ENVIRONMENTS IN ONE ROOM

In acoustics, one size does not fit all. Constellation offers an elegantly simple way for venues to transform architectural acoustics with a finger tap, affording a level of sonic flexibility never before possible.

A BEAUTIFUL MARRIAGE OF SOUND AND ARCHITECTURE

Constellation can seamlessly integrate into an environment, meaning designers can now create an uncompromising, holistic experience for the ear and the eye.

RETOUCHING ACOUSTICS FROM MUSIC HALLS TO CLASSROOMS

With its ability to tailor acoustics, Constellation has been adapted to provide optimal sound across a wide spectrum of environments, elevating listening experiences and reshaping building design.

Sample Product Cutsheets (Audio-Visual)

Enriching Physical Spaces through Engineering

A TECHNOLOGICAL LEAP IN VARIABLE ACOUSTICS

Constellation is a digital approach to controlling reverberation time, early reflections, and other key ingredients vital to the sonic clarity, warmth, and resonance of a space.

ONE POWERFUL PACKAGE

Constellation integrates high-quality loudspeakers, microphones, digital processing, patented algorithms, and proprietary certification techniques in a flexible package available exclusively from Meyer Sound.

USER-CENTERED DESIGN

Through close collaboration with your entire project team, Meyer Sound customizes each system to serve the unique needs of a venue, with easy-to-use presets that allow operators to make instant adjustments.

VISUAL INTEGRATION

System components are available in custom colors to blend seamlessly with your surroundings.

Solutions

Sample Product Cutsheets (Audio-Visual)

LIVE PERFORMANCE SPACES

> "In jazz and almost every form of music, extraordinary concerts can only happen when musicians hear each other clearly, and audiences hear and feel exactly what is happening on stage... If you have a space that is even slightly problematic, do yourself a favor—install Constellation and perfect the experience for both musician and listener."
>
> Wynton Marsalis
> Managing and Artistic Director, Jazz at Lincoln Center

CROSS-GENRE

> "[At SoundBox,] Constellation provides the optimal acoustics for each musical genre and has helped us create a space where audience and musicians can explore a new kind of musical journey together."
>
> Michael Tilson Thomas
> Music Director, San Francisco Symphony

CLASSICAL

> "[With Constellation,] the Meyers have thus had a democratizing influence, allowing ensembles to obtain pleasing results in problematic spaces. They have helped to make classical music a more mobile, adaptable beast, one that is freer to roam the entire cultural landscape. A mirage of the Musikverein can arise almost anywhere, with a few swipes on a screen."
>
> Alex Ross
> Music Critic, *The New Yorker*

Sample Product Cutsheets (Audio-Visual)

LT-800-072-01b
Stationary RF Transmitter (72 MHz)

Configuration:

LT-800-072-01 Stationary RF Transmitter (72 MHz) (North America)

Product Overview:

Offering outstanding audio clarity, digital signal strength, and 57 selectable channels, the LT-800 is a perfect RF transmitter choice for a wide range of applications. Connected to your main audio system, the LT-800 broadcasts strong, reliable audio to both belt pack receivers and stationary receivers, ideal for providing listeners with the best possible assistive listening experience.

Highlights:

- 100% digital signal transmission across up to six (6) channels simultaneously
- Look & Listen (TM) LCD display for quick channel, programming, and channel lock status information
- Balanced and unbalanced audio inputs allow for use with any audio source
- Built-in auto processor optimizes audio (voice or music) prior to transmission
- 57 available, selectable channels
- VU level meter and test tone for simple installation and set up
- 30-day, no-obligation demonstration available for your venue or business
- Backed by Listen Technologies' limited lifetime warranty and hassle-free support

Includes: One (1) LT-800 Stationary RF Transmitter (72 MHz)
One (1) LA-207 Power Supply for LT-800
One (1) Line Cord
One (1) Quick reference card

Product Specification: Stationary RF Transmitter (72 MHz)	
Audio	
Frequency Response	50 Hz - 15 kHz (±3 dB)
Signal-to-Noise Ratio	SQ enabled 80 dB, SQ disabled 60 dB
Audio Input 1	Rear panel, one (1) Female XLR or 1/4 in combo connector, balanced, 0 / -55 dBu (line/mic) nominal input level adjustable, -30 / +21 dBu (line/mic) maximum input level, impedance 20k / 1k ohm (line/mic), phantom power +12 VDC
Audio Input 2	Rear panel, two (2) phono connectors, unbalanced, -10 / +10 dBu nominal input level adjustable, +30 dBu maximum, impedance 100k ohm
Audio Processing	Compression can be turned on/off, slope internally adjustable from 1:1 to 4:1, default 2:1
Contour	Cuts and boosts frequencies above 5 kHz
Distortion	< 2% total harmonic distortion (THD) at 80% deviation
Audio Output	Input 1 and input 2, mixed output (rear panel), two (2) phono connectors, unbalanced, -10 dBu nominal output level, +15 dBu maximum, impedance 10 ohm
Headphone Output	Front panel, one (1) 3.5 mm (0.14 in.) stereo connector, unbalanced, adjustable output level, +3 dBu maximum, impedance 10 ohm
Controls	

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Sample Product Cutsheets (Audio-Visual)

LT-800-072-01b
Stationary RF Transmitter (72 MHz)

Product Specification: Stationary RF Transmitter (72 MHz)	
User Controls	Front Panel: Power, test tone on/off, channel up/down, input levels, mix level, contour, monitor volume controlRear Panel: Input 1 Level, (Line, Mic, Mic-Phantom Power), Input 2 level (-10 / +10 dBu), RF power level (low, mid, high)
Internal Adjustments	Compression ratio for audio processor
Programming	SQ on/off, process on/off, channel lock
Indicators	
LCD	Channel designation, lock status, RF power level, programming (front panel)
Audio Input Status LEDs	Indicates Input 1, Input 2, and Mix audio levels; 10 segment LED's (8 green, 2 red)
Processing	Indicated by a green LED when on (front panel)
Test Tone	Red LED illuminates when test tone is enabled.
RF Power	Indicated on the LCD (low, mid, high)
RF	
Frequency Range	72.025 - 75.950 MHz
Number of Channels	17 wide band, 40 narrow band
Frequency Accuracy	± .005% stability +32º to +122 ºF (0º to +50 ºC)
Antenna Type	Various antennas available
Transmitter Stability	50 PPM
Transmission Range	Up to 305 m (1,000 ft.)
Antenna Connector	BNC
Output Power	80,000 uV at 3 m
Number of Simultaneous Transmitters	6
Power	
Power Supply	In line power supply, Listen part number LA-207 (Line cord is determined by the each Country's AC power standards)
Power Supply Input	100-240 VAC, 50-60 Hz, 0.4 A
Power Supply Output	12 VDC, 1.3 A, 15.6 W
Power Supply Connector	0.02 in (5.0 mm) OD, 0.01 in. (2.5 mm) ID, barrel type
Compliance	UL, CE, GS, TÜV, RoHS
Physical	
Width	21.5 cm (8.50 in.)
Height	4.5 cm (1.75 in.)
Depth	23 cm (9.13 in.)
Color	Dark Grey with white silk screening
Unit Weight with Power Supply	1.6 kg (3.5 lbs.)
Shipping Weight	2.7 kg (6.0 lbs.)
Rack Mounting	One (1) rack space height, 1/2 rack space wide. One (1) or two (2) transmitters can be mounted in one rack space, optional rack mount (LA-326)
Weight	1.2 kg (2.6 lbs.)
Environmental	

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Sample Product Cutsheets (Audio-Visual)

LT-800-072-01b
Stationary RF Transmitter (72 MHz)

Product Specification: Stationary RF Transmitter (72 MHz)	
Temperature - Operation	-10 ºC (14 ºF) to +40 ºC (104 ºF)
Temperature - Storage	-20 ºC (-4 ºF) to +50 ºC (122 ºF)
Relative Humidity	0 to 95% relative humidity, non condensing
Compliance	
Safety	RoHS
RF	FCC Part 15, Part 90, Industry Canada

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Sample Product Cutsheets (Audio-Visual)

LR-4200-072b
Intelligent DSP RF Receiver (72 MHz)

Configuration:

LR-4200-072 Intelligent DSP RF Receiver (72 MHz)

Product Overview:

The LR-4200-072 receiver from Listen Technologies offers outstanding audio clarity and quality with the best range and reception in its class.

Part of our Intelligent Digital Signal Processing (iDSP) line, the LR-4200-072 is the smallest device of its kind, resulting in a compact unit that won't burden the end user. An integrated neck loop/lanyard makes each receiver easy to wear, and the DSP loop driver offers an improved listening experience for anyone with a T-coil-equipped hearing aid. Dual 3.5mm output jacks also allow receivers to be shared between users.

Each receiver is equipped with a micro USB connection which can be used with free iDSP software for charging, set up, programming, inventory management and firmware updates.

Extended speaking sessions, presentations and more can be challenging for other devices, but the LR-4200-072 incorporates advanced Lithium-ion rechargeable batteries that offer long life and reliable power. Charge status, along with channel information and volume level, are easy to read on the integrated OLED display.

From classrooms to boardrooms, conferences and more, the LR-4200-072 is an outstanding receiver choice for any venue looking to offer convenient, reliable assistive listening.

Highlights:

- High performance RF receiver offering best-in-class sensitivity and 20dB less noise than other devices
- Integrated neck loop/lanyard with DSP loop driver for an enhanced T-coil listening experience
- Smallest device of its kind makes it easier to wear and use and for venues to dispense, store and maintain
- OLED display showing channels, battery status, channel status, volume level, and more
- Limited lifetime warranty with hassle-free support
- Lanyard and belt clip options offer convenient and discreet choices for the end user
- Advanced rechargeable battery technology eliminates the costs and hassles associated with frequent battery replacement
- Designed for single-channel applications

Includes: One (1) LR-4200-072 Intelligent DSP RF Receiver (72 MHz)* *The LR-4200-072 comes with a quick start guide and a non-proprietary field replaceable Lithium-ion battery.

Product Specification: Intelligent DSP RF Receiver (72 MHz)	
Audio	
System Distortion	< 2% total harmonic distortion (THD) at 80% deviation
Output/s	Two (2) 3.5 mm (0.14 in.) connectors, unbalanced, 0 dBu nominal output level, 16 mW maximum, impedance 32 ohm
System Frequency Response	50 Hz - 15 kHz (±3 dB)

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Sample Product Cutsheets (Audio-Visual)

LR-4200-072b
Intelligent DSP RF Receiver (72 MHz)

Product Specification: Intelligent DSP RF Receiver (72 MHz)	
System Signal to Noise Ratio	SQ enabled 80 dB, SQ disabled 60 dB
Controls	
User Controls	Power, up/down volume
Programming	Via software and USB port
Set-up Controls	Press and hold up/down volume buttons for 5 seconds to enter channel adjust, use up/down to select channel
Indicators	
LEDs	Flashes when batteries are low or to indicate charging, solid when fully charged
Display	Channel designation, battery level, unit number, charging status
RF	
Frequency Range	72.0250 - 75.9500 MHz
Number of Channels	17 wide band, 40 narrow band
Sensitivity	.6uV typical, 1 uV maximum for 12 dB sinad
Frequency Accuracy	± .005% stability 32 to 122 ºF (0 to 50 ºC)
Squelch	Programmable in 20 steps, automatic on loss of RF signal
Antenna Type	Uses ear phone/neck loop lanyard and short ear phone cable or standard earphone cable
Power	
Power Supply	Micro USB connector, 5 V, 500 mA
Battery Type	Lithium Ion 3.7 Vdc, 1200 mAh
Battery Life	8 Hours of continuous use
Battery Charging Time	Fully charged in 2.5 Hours
Physical	
Color	Black
Unit Weight with Batteries	2.40 oz. (68 g)
Shipping Weight	3.20 oz. (91 g) with 1.0 lbs. (454 g) minimum
Dimensions (H x W x D)	3.75 x 2.00 x 0.64 in. (9.6 x 5 x 1.7 cm)
Unit Weight	1.60 oz. (45 g)
Dimensions with Belt Clip	3.75 x 2.00 x 0.80 in. (9.6 x 5.0 x 2.1 cm)
Environmental	
Temperature - Operation	14 to 104 ºF (-10 to 40 ºC)
Temperature - Storage	(-)4 to 122 °F (-20 to 50 °C)
Relative Humidity	0 to 95% relative humidity, non-condensing
Compliance	
Standards	FCC Part 15, Part 90, Industry Canada, RoHS

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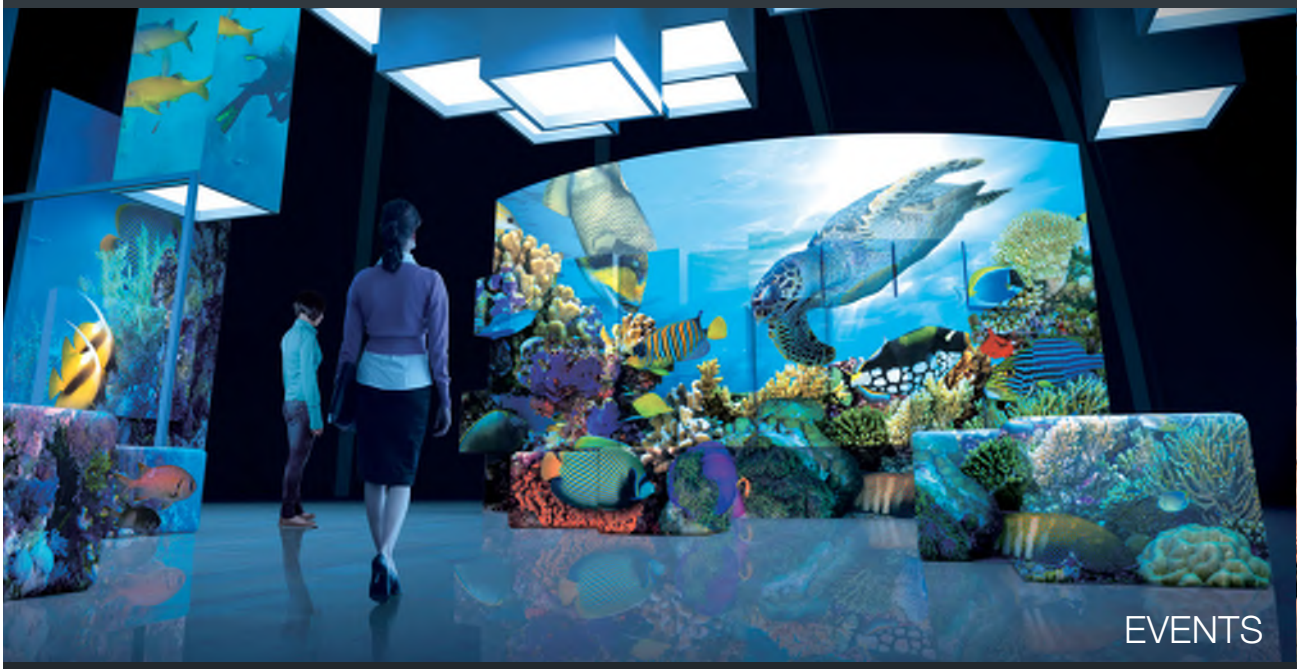
Sample Product Cutsheets (Audio-Visual)

Sample Product Cutsheets (Audio-Visual)



Engineered for Elite Marathon Performance in Permanent or Temporary Installations

With immersive picture quality and practical features, potential application for Panasonic's PT-RZ970 Series projectors extends from permanent installation in museums, theaters, and control rooms through roles in exhibition/rental and staging. Powered by the acclaimed SOLID SHINE Laser drive and latest 1-Chip DLP™ technology, these projectors exceed expectations with low-maintenance stability and vivid color performance maintained for longer than competitive products over years of dependable 24/7 operation. The PT-RZ970 Series: made by professionals, for professionals.

High Picture Quality	Quick Start and Quick Off	Free 360° Install	Dust-Resistant Optics	Economical	20,000 hours*1 Maintenance free

	PT-RZ970/RW930/RX110 Series			PT-RZ770/RW730 Series		PT-RZ660/RW620 Series	
	PT-RZ970/L	PT-RW930/L	PT-RX110/L	PT-RZ770/L	PT-RW730/L	PT-RZ660/L	PT-RW620/L
Resolution	WUXGA	WXGA	XGA	WUXGA	WXGA	WUXGA	WXGA
Brightness	10,000 lm (Center) 9,400 lm*		10,400 lm (Center) 10,000 lm*	7,200 lm (Center) 7,000 lm*		6,200 lm (Center) 6,000 lm*	
Contrast	10,000:1						

* Measured according to strict international ISO 21118 standards. Note: PT-RZ970L / RZ770L / RZ660L / RW930L / RW730L / RW620L / RX110L do not include a lens.

2

Sample Product Cutsheets (Audio-Visual)

See the Advantages of Panasonic's Laser Technology

SOLID SHINE Laser and DLP™ Projection Balances Image Quality with 20,000-hour Maintenance-free*1 Endurance

SOLID SHINE LASER

Harnessing Full-Spectrum Color with Up to 10,400 lm (Center)*2 Brightness

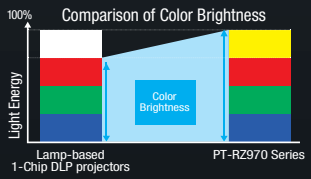
With next-generation DLP™ technology delivering high-resolution detail and dual laser modules outputting up to 10,400 lm (Center)*2 of brightness, Quartet Color Harmonizer to reduce energy loss from the light source, and robust heat-resistant phosphor wheel, the Panasonic SOLID SHINE Laser system produces scintillating images with unfailing reliability.

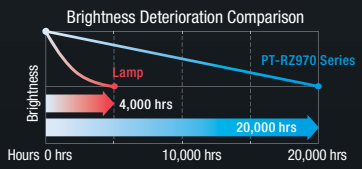
Superior White Balance and Color Reproduction

The Quartet Color Harmonizer wheel mechanism captures a wider color space than comparable projectors, which allows white to be reproduced realistically on screen. Some conventional projectors can't achieve an accurate white balance, so images can appear with a distracting greenish tint. Not the case with Panasonic SOLID SHINE Laser projectors.

SOLID SHINE Laser Maintains Picture Quality for Longer

Thanks to the long-lasting dual solid-state laser modules, there are no lamps to replace, and image color/brightness degrades very gradually in consistent, linear fashion. As well as reducing maintenance hassle, out-of-the-box picture quality is preserved longer.





*1 At this time the brightness will have decreased to approximately half of its original level (Dynamic Contrast Mode: 3, Image Mode: Dynamic). Panasonic recommends cleaning or checkup at point of purchase after about 20,000 hours. Light source lifetime may be reduced depending on environmental conditions. Replacement of parts other than the light source may be required in a shorter period.
*2 PT-RZ970/RW930 features 10,000 lm, PT-RZ770/RW730 7,200 lm, PT-RZ660/RW620 6,200 lm, and PT-RX110 10,400 lm of brightness (measured at center of screen).

3

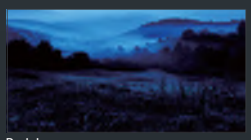
Sample Product Cutsheets (Audio-Visual)

Powerful Brightness, Excellent Picture Quality, Lasting Reliability

Dynamic Contrast Function for High Contrast

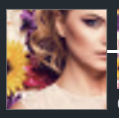
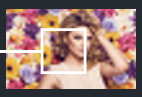
The PT-RZ970 Series directly modulates laser power output to achieve high contrast with low power consumption. Digitally controlled frame-by-frame scene-linking modulation ensures highly precise output adjustment, while accurate 10,000:1*3 contrast is delivered even when bright and dark scenes frequently interchange.

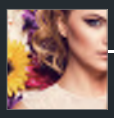
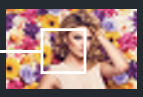

Bright Image


Dark Image

Detail Clarity Processor 3 Sharpens the Finest Details

This unique Panasonic circuit optimizes the sharpness of each image based on the super high, high, medium, and low frequency components of the extracted image information. The resulting images are expressed with natural, convincing realism.



Conventional Projector



Detail Clarity Processor 3

System Daylight View 3 for Sharp and Vivid Images in Bright Environments

Panasonic's premium System Daylight View 3 prevents images from washing out in well-lit environments and enhances brightness perception in multi-projector mapping applications by adjusting sharpness and gamma curves and correcting colors. The result is greater visual impact even in challenging conditions.

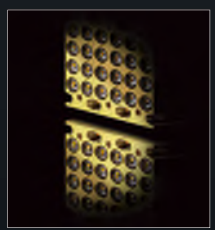

Conventional Projector


System Daylight View 3

Consistent, Stable Performance

Stable 24/7 Operation with Light-source Failover Protection

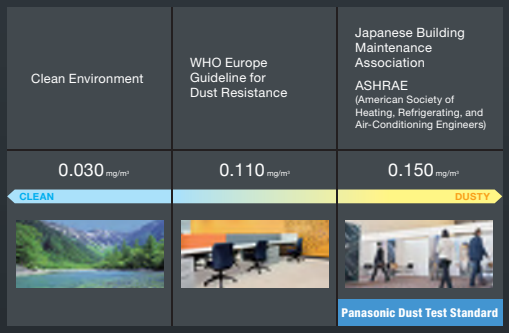
Dual Drive Laser Optical Engine groups laser diodes into two discrete modules. A failsafe redundancy circuit works to minimize brightness- and color-uniformity loss should a laser diode fail, making the PT-RZ970 Series ideal for mission-critical applications. Further, brightness decreases more gradually and consistently than lamp-based projectors over a 20,000-hour*4 maintenance-free projection period.



*3 With Dynamic Contrast Mode set to 3. *4 At this time the brightness will have decreased to approximately half of its original level (Dynamic Contrast Mode: 3, Image Mode: Dynamic). Panasonic recommends cleaning or checkup at point of purchase after about 20,000 hours. Light source lifetime may be reduced depending on environmental conditions. Replacement of parts other than the light source may be required in a shorter period.

Dust-Resistant Airtight Optical Block

The PT-RZ970 Series' optical block is airtight, ensuring consistent, long-lasting image quality for up to 20,000 hours*4 without maintenance. The optical block design passed stringent testing to assure utmost reliability in environments with up to 0.15 mg of particulate matter per cubic meter (based on American Society of Heating, Refrigerating, and Air-Conditioning Engineers [ASHRAE] and Japanese Building Maintenance Association guidelines). The structure prevents brightness degradation from dust intrusion.



Selectable Operational Modes Maintain Image Quality Longer

Approx. 20,000 Hours*4 of Continuous Operation

In Normal Mode, the PT-RZ970 Series can operate continuously for about 20,000 hours*4. In Eco Mode, this is extended to around 24,000 hours*4 of continuous operation. These modes enhance suitability for education and signage applications.

Up to 10 Years*5 Operation with Constant Brightness Modes

In environments where full brightness is not necessary, such as surveillance, control, and simulation rooms, constant operation modes extend light-source replacement to up to 87,600 hours*5 in Long Life 3 Mode—about 10 years of 24/7 projection—with consistent brightness and color.

User Operating Mode

In addition to preset operating modes, the PT-RZ970 Series can be customized to achieve your preferred balance of brightness performance or extended life.

*5 With Operating Mode set to Long Life 3. Long Life Mode is tested in a rear-box projection environment, which is not compliant with ASHRAE. 24 hours/day x 365 days/year x 10 years = 87,600 hours. Replacement of parts other than the light source may be required in a shorter period.

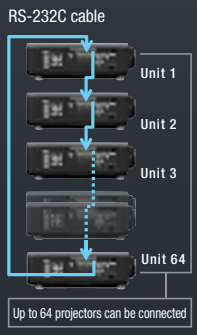
Sample Product Cutsheets (Audio-Visual)

Versatile Installation Flexibility

Unique Contrast Sync and Shutter Sync Function

The PT-RZ970 Series is among the world's first to feature Contrast Sync and Shutter Sync functions (Patent Pending) for multi-screen and mapping applications. Contrast Sync allows the projectors' digitally modulated contrast function to be synchronized over the network for consistent picture quality across screens, while Shutter Sync incorporates a master/slave principle to synchronize shutter on/off timing between all networked projectors. It includes simultaneous fade-in and fade-out functions.

Note: Use of RS-232C straight cable is necessary for all connections. Consult your sales representative for further information.



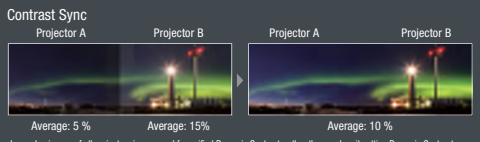
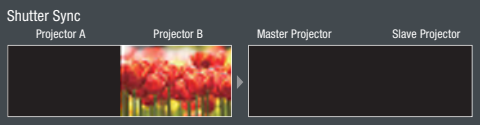


Image luminance of all projectors is averaged for unified Dynamic Contrast, rather than each unit setting Dynamic Contrast separately. Step noise is eliminated in edge-blended areas.



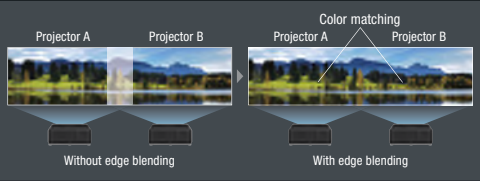
If shutter functions are not linked, shutter ON/OFF timing varies. When shutter functions of slave projectors are linked to a master, shutter ON/OFF timing is uniform*.

* Includes fade-in and fade-out effects. Projector shutter functions can be set to operate individually if desired.

Multi-Screen Support System Seamlessly Connects Multiple Screens

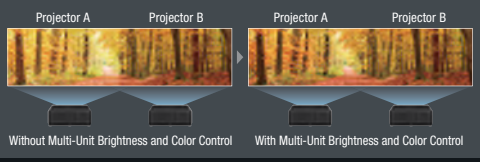
Edge Blending Edges of adjacent screens can be blended and their luminance controlled.

Color Matching Corrects for slight variations in the color reproduction range of individual projectors. PC software assures easy, accurate control.



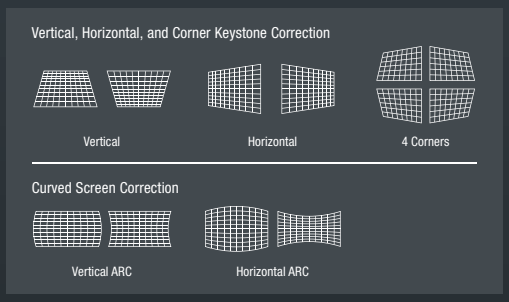
Multi-Unit Brightness and Color Control

This function automatically corrects brightness and color fluctuations that occur over time in individual projectors in a multi-screen system. Control up to eight projectors connected via hub increasing to a maximum of 2,048 projectors with Multi Monitoring & Control Software.



Geometric Adjustment for Custom Screen Surfaces

Geo Adjustment adapts the image for projection onto spherical, cylindrical, and other specially shaped screens. Fine-tuning is performed with the remote control, with no external equipment needed. Paired with Multi-Screen Support System, highly creative mapping presentations are possible in variety of event and staging applications.

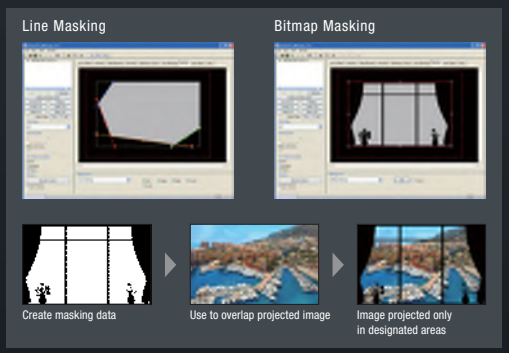


Geometry Manager Pro Software (PT-RZ970/RZ770/RZ660 Only)

Geometry Manager Pro software expands built-in functionality and makes complex adjustments easy. The free software package includes enhanced color matching and edge blending for multi-screen projection and adjustment of multiple screens over the network.

Optional ET-UK20 Upgrade Kit for Geometry Manager Pro (PT-RZ970/RZ770/RZ660 Only)

An optional ET-UK20 Upgrade Kit for Geometry Manager Pro adds creative masking capability using four lines or bitmap data as well as uniformity correction and correction area expansion.



Optional ET-CUK10*6 Series Auto Screen Adjustment Upgrade Kit (PT-RZ970/RZ770/RZ660 Only)

This optional kit activates the Auto Screen Adjustment plug-in software for Geometry Manager Pro, allowing you to set up multiple projectors automatically and simultaneously and save significant amounts of time and money. Performing multi-screen and curved-screen projection calibration in three quick steps using a camera*7 and PC connected to the projector network, this software encompasses geometric adjustment, edge blending, color matching, stacking, brightness, and black level.

*6 Available worldwide except the United States. *7 Supported cameras: Nikon D5200/D5300/D5500.

Reduce Inventory Costs with Shared Lenses

The PT-RZ970 Series shares optional lenses with the Panasonic 1-Chip DLP™ projector range, including the ET-DLE030 Ultra-Short-Throw Lens and ET-DLE085 Zoom Lens for long throw distances, reducing TCO for staging and event companies with large projector inventories. Lenses attach and detach with one-touch ease.

Sample Product Cutsheets (Audio-Visual)

Easy System Flexibility

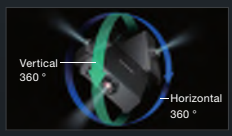
Single-Cable DIGITAL LINK Control and Video Connection

Upward HDBaseT™-compatible DIGITAL LINK supports transmission of uncompressed Full HD video and control commands through a single CAT 5e or higher STP cable for distances of up to 150 m (492 ft)*8. Add an optional DIGITAL LINK Switcher or Digital Interface Box to further simplify installation in large venues while reducing cost and improving reliability at the same time.

*8 150 m (492 ft) transmission available only in Long Reach Mode with optional ET-YFB200G DIGITAL LINK Switcher for signals up to 1080/60p (dot-clock frequency 148.5 MHz). Transmission distance is up to 100 m (328 ft) in other cases.

Free 360-degree Rotation

Projection is possible in any direction vertically and horizontally, and the unit can be rotated 360 degrees for installation at any angle.



Supports Art-Net DMX, Crestron Connected™, and PJLink™

The PT-RZ970 Series is compatible with Art-Net DMX protocol for lighting management. This allows the projector to be connected to a lighting console, opening the door to a range of added functionality and control options. The included LAN/DIGITAL LINK terminal also supports Crestron Connected™ and PJLink™ (Class 1) for easy integration of these projectors into an existing AV network utilizing multiple device brands.

Quick Start and Quick Off

The laser light-source doesn't require any warm-up, so images appear almost instantly (in about 1 second*9) with PT-RZ970 Series projectors. There's also no cool-down period needed when turning the power off at the mains—the projector can be turned on and off any time as necessary.

*9 With Quick Startup Mode set to ON. Quick Startup Mode resets to OFF after duration set in Available Period expires. When Quick Startup Mode is set to ON, the projector continues to warm up, increasing power consumption. Image appears in about 9 seconds on Normal Standby Mode and about 12 seconds on Eco Standby Mode.

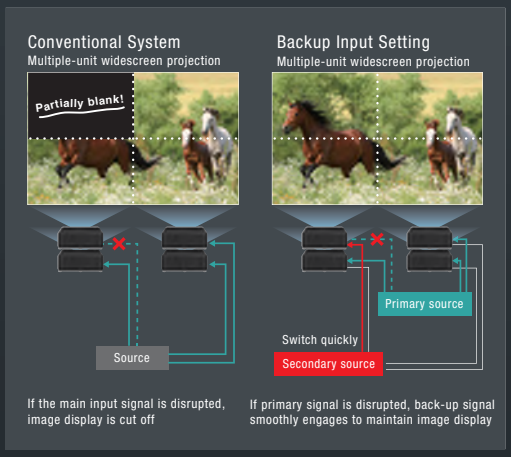
Multi Monitoring & Control Software

This free Panasonic software offers monitoring and control of up to 2,048 devices over a LAN network from a single PC. For monitoring, status for individual devices can be listed in groups, with more detailed information shown separately. Control functions include power ON/OFF, input switching, scheduling, and command inputs.

Backup Input Setting Optimizes Performance

This feature allows smooth switching to a backup input signal should the primary signal be disrupted*10, guaranteeing reliability for mission-critical control rooms, projection mapping, staging, and in other applications where image display must be maintained.

*10 Combination of primary/secondary input terminals is fixed. The Backup Input Setting is enabled only when the input signal to the primary and secondary terminals is the same.



Web Browser Control

These Panasonic SOLID SHINE Laser projectors can be easily operated remotely over a LAN network via a computer's web browser. Projectors can be configured to alert the operator via email if an error has occurred.

Early Warning Software ET-SWA100 Series (Optional)

Early Warning Software monitors the status of projectors and displays connected to an intranet, and informs the operator when an abnormality is detected or predicted, or when there are symptoms of trouble. This minimizes downtime to provide more stable operation.

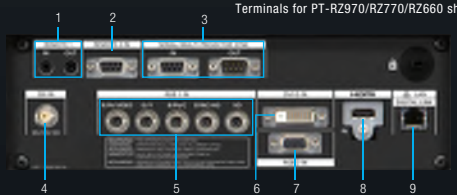
Other Valuable Features

- Quiet Mode to reduce operational noise
- DICOM Simulation Mode offers easy-to-view X-ray photo reproduction*11
- Rec. 709 mode for HDTV projection to provide accurate colors
- Waveform Monitor for simple yet precise calibration
- Lens-centered design and a wide horizontal/vertical lens shift
- Shutter effect with fade in/fade out (configurable in 0.5-second intervals from 0.5 to 4.0 seconds, or to 5-, 7-, or 10-second intervals)
- PJLink™ compatibility
- P-in-P function*12
- Image rotation function
- On-screen menu rotatable in Portrait Mode
- Scheduling function
- 30 m (98 ft) long-range wireless remote control
- Anti-theft features including chain opening and security bar
- Customizable start-up logo
- ID assignment for up to 64 units
- Built-in test pattern
- Selectable 10-language on-screen menu (English, German, French, Spanish, Italian, Portuguese, Russian, Japanese, Chinese, Korean)
- RoHS Directive-compliant

*11 This product is not a medical instrument. Do not use for actual medical diagnosis. *12 The Picture-in-Picture function cannot be used with certain inputs and input signals.

Terminals

Terminals for PT-RZ970/RZ770/RZ660 shown.



1 Remote 1 input/output
2 Remote 2 input
3 Serial/Multi Projector Sync input/output
4 SDI input (PT-RZ970/RZ770/RZ660 only)
5 RGB 1 input
6 DVI-D input
7 RGB 2 input
8 HDMI input
9 LAN/ DIGITAL LINK

Sample Product Cutsheets (Audio-Visual)

Optional Accessories

ET-DLE085
Zoom Lens

ET-DLE105
Zoom Lens

ET-DLE150
Zoom Lens

ET-DLE170*
Zoom Lens
*US/Europe only.
ET-DLE170 is equivalent
of supplied lens.

ET-DLE030
Fixed-Focus
Lens

ET-DLE250
Zoom Lens

ET-DLE350
Zoom Lens

ET-DLE450
Zoom Lens

ET-DLE055
Fixed-Focus
Lens

ET-UK20 (PT-RZ970/RZ770/RZ660 Only)
Geometry Manager Pro Upgrade Kit

ET-CUK10 Series (PT-RZ970/RZ770/RZ660 Only)
Auto Screen Adjustment Upgrade Kit

Note: Available worldwide except in the United States.

ET-SWA100 Series
Early Warning Software

Note: Part number suffix may differ depending on the license type.

ET-PKD120H
High Ceiling
Mount Bracket

ET-PKD120S
Low Ceiling
Mount Bracket

ET-PKD130H
High Ceiling Mount
Bracket with 6-axis
Adjustment Mechanism

ET-PKD130B
Bracket Assembly

ET-YFB200G
DIGITAL LINK Switcher

ET-YFB100G
Digital Interface Box

Note: Use ET-PKD120H, ET-PKD120S, and ET-PKD130H in combination with ET-PKD130B. ET-PKD130H is recommended when used with ET-DLE030.

Projection Distances

Unit: meters (feet)

Screen size (diagonal)		Distance to screen (A)																
		Zoom lenses																Fixed-focus lens*1
		ET-DLE085		ET-DLE105		ET-DLE150		Supplied lens/ET-DLE170		ET-DLE250		ET-DLE350		ET-DLE450		ET-DLE055
		min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	
PT-RZ970/ RZ770/ RZ660 (16:10 aspect ratio)	1.27 (50")	0.82 (2.7)	1.04 (3.4)	1.03 (3.4)	1.41 (4.6)	1.38 (4.5)	2.01 (6.6)	1.82 (6.0)	2.57 (8.4)	2.42 (7.9)	3.87 (12.7)	3.80 (12.5)	5.81 (19.1)	5.66 (18.6)	9.12 (29.9)	0.83 (2.7)
	1.52 (60")	1.00 (3.3)	1.25 (4.1)	1.25 (4.1)	1.70 (5.6)	1.66 (5.5)	2.43 (8.0)	2.20 (7.2)	3.10 (10.2)	2.92 (9.6)	4.65 (15.3)	4.59 (15.1)	7.00 (23.0)	6.85 (22.5)	11.01 (36.1)	1.00 (3.3)
	1.78 (70")	1.17 (3.9)	1.47 (4.8)	1.47 (4.8)	1.99 (6.5)	1.95 (6.4)	2.84 (9.3)	2.58 (8.5)	3.63 (11.9)	3.42 (11.2)	5.44 (17.9)	5.38 (17.6)	8.19 (26.9)	8.04 (26.4)	12.89 (42.3)	1.18 (3.9)
	2.03 (80")	1.35 (4.4)	1.68 (5.5)	1.68 (5.5)	2.28 (7.5)	2.23 (7.3)	3.25 (10.7)	2.95 (9.7)	4.16 (13.6)	3.92 (12.8)	6.23 (20.4)	6.16 (20.2)	9.38 (30.8)	9.23 (30.3)	14.78 (48.5)	1.35 (4.4)
	2.29 (90")	1.52 (5.0)	1.90 (6.2)	1.90 (6.2)	2.57 (8.4)	2.52 (8.3)	3.66 (12.0)	3.33 (10.9)	4.69 (15.4)	4.42 (14.5)	7.02 (23.0)	6.95 (22.8)	10.57 (34.7)	10.43 (34.2)	16.66 (54.7)	1.53 (5.0)
	2.54 (100")	1.70 (5.6)	2.11 (6.9)	2.12 (7.0)	2.86 (9.4)	2.81 (9.2)	4.08 (13.4)	3.71 (12.2)	5.21 (17.1)	4.92 (16.1)	7.81 (25.6)	7.74 (25.4)	11.76 (38.6)	11.62 (38.1)	18.55 (60.8)	1.70 (5.6)
	3.05 (120")	2.05 (6.7)	2.55 (8.4)	2.55 (8.4)	3.44 (11.3)	3.38 (11.1)	4.90 (16.1)	4.47 (14.7)	6.27 (20.6)	5.91 (19.4)	9.39 (30.8)	9.31 (30.6)	14.14 (46.4)	14.00 (45.9)	22.31 (73.2)	2.05 (6.7)
	3.81 (150")	2.57 (8.4)	3.19 (10.5)	3.20 (10.5)	4.32 (14.2)	4.24 (13.9)	6.14 (20.1)	5.60 (18.4)	7.86 (25.8)	7.41 (24.3)	11.75 (38.6)	11.68 (38.3)	17.71 (58.1)	17.58 (57.7)	27.97 (91.8)	2.58 (8.5)
	5.08 (200")	3.44 (11.3)	4.27 (14.0)	4.29 (14.1)	5.77 (18.9)	5.67 (18.6)	8.20 (26.9)	7.50 (24.6)	10.50 (34.5)	9.91 (32.5)	15.70 (51.5)	15.61 (51.2)	23.66 (77.6)	23.54 (77.2)	37.39 (122.7)	3.45 (11.3)
	6.35 (250")	4.31 (14.1)	5.35 (17.6)	5.37 (17.6)	7.23 (23.7)	7.10 (23.3)	10.26 (33.7)	9.39 (30.8)	13.14 (43.1)	12.41 (40.7)	19.64 (64.4)	19.55 (64.1)	29.61 (97.1)	29.50 (96.8)	46.81 (153.6)	–
	7.62 (300")	5.18 (17.0)	6.43 (21.1)	6.46 (21.2)	8.68 (28.5)	8.53 (28.0)	12.33 (40.4)	11.28 (37.0)	15.79 (51.8)	14.91 (48.9)	23.59 (77.4)	23.49 (77.1)	35.56 (116.7)	35.46 (116.3)	56.24 (184.5)	–
	10.16 (400")	6.93 (22.7)	8.59 (28.2)	8.63 (28.3)	11.59 (38.0)	11.39 (37.4)	16.45 (54.0)	15.07 (49.4)	21.07 (69.1)	19.90 (65.3)	31.48 (103.3)	31.36 (102.9)	47.46 (155.7)	47.38 (155.4)	75.08 (246.3)	–
	12.70 (500")	8.67 (28.5)	10.75 (35.3)	10.80 (35.4)	14.50 (47.6)	14.25 (46.7)	20.58 (67.5)	18.86 (61.9)	26.36 (86.5)	24.90 (81.7)	39.37 (129.2)	39.23 (128.7)	59.36 (194.7)	59.30 (194.6)	93.93 (308.2)	–
	15.24 (600")	10.42 (34.2)	12.91 (42.3)	12.97 (42.6)	17.41 (57.1)	17.11 (56.1)	24.70 (81.0)	22.64 (74.3)	31.65 (103.8)	29.89 (98.1)	47.25 (155.0)	47.11 (154.6)	71.25 (233.8)	71.22 (233.7)	112.77 (370.0)	–
PT-RW930/ RW730/ RW620 (16:10 aspect ratio)	1.27 (50")	0.87 (2.8)	1.09 (3.6)	1.09 (3.6)	1.48 (4.9)	1.45 (4.7)	2.12 (6.9)	1.91 (6.3)	2.70 (8.9)	2.54 (8.3)	4.06 (13.3)	4.00 (13.1)	6.11 (20.1)	5.96 (19.5)	9.59 (31.5)	0.87 (2.9)
	1.52 (60")	1.05 (3.4)	1.32 (4.3)	1.32 (4.3)	1.79 (5.9)	1.75 (5.7)	2.55 (8.4)	2.31 (7.6)	3.26 (10.7)	3.07 (10.1)	4.89 (16.0)	4.83 (15.8)	7.36 (24.2)	7.21 (23.6)	11.57 (38.0)	1.06 (3.5)
	1.78 (70")	1.23 (4.1)	1.54 (5.1)	1.54 (5.1)	2.09 (6.9)	2.05 (6.7)	2.98 (9.8)	2.71 (8.9)	3.81 (12.5)	3.59 (11.8)	5.72 (18.8)	5.65 (18.5)	8.61 (28.2)	8.46 (27.8)	13.55 (44.5)	1.24 (4.1)
	2.03 (80")	1.42 (4.7)	1.77 (5.8)	1.77 (5.8)	2.40 (7.9)	2.35 (7.7)	3.42 (11.2)	3.11 (10.2)	4.37 (14.3)	4.12 (13.5)	6.55 (21.5)	6.48 (21.3)	9.86 (32.3)	9.71 (31.9)	15.53 (51.0)	1.42 (4.7)
	2.29 (90")	1.60 (5.3)	2.00 (6.5)	2.00 (6.6)	2.70 (8.9)	2.65 (8.7)	3.85 (12.6)	3.50 (11.5)	4.92 (16.2)	4.64 (15.2)	7.38 (24.2)	7.31 (24.0)	11.11 (36.4)	10.96 (36.0)	17.51 (57.4)	1.61 (5.3)
	2.54 (100")	1.78 (5.9)	2.22 (7.3)	2.23 (7.3)	3.01 (9.9)	2.95 (9.7)	4.28 (14.0)	3.90 (12.8)	5.48 (18.0)	5.18 (16.9)	8.20 (26.9)	8.13 (26.7)	12.36 (40.5)	12.21 (40.1)	19.49 (63.9)	1.79 (5.9)
	3.05 (120")	2.15 (7.1)	2.68 (8.8)	2.68 (8.8)	3.62 (11.9)	3.55 (11.6)	5.15 (16.9)	4.70 (15.4)	6.59 (21.6)	6.21 (20.4)	9.86 (32.4)	9.79 (32.1)	14.86 (48.7)	14.72 (48.3)	23.45 (76.9)	2.16 (7.1)
	3.81 (150")	2.70 (8.9)	3.36 (11.0)	3.37 (11.1)	4.54 (14.9)	4.45 (14.6)	6.45 (21.2)	5.89 (19.3)	8.25 (27.1)	7.79 (25.5)	12.35 (40.5)	12.27 (40.2)	18.61 (61.0)	18.47 (60.6)	29.38 (96.4)	2.71 (8.9)
	5.08 (200")	3.61 (11.9)	4.49 (14.7)	4.51 (14.8)	6.06 (19.9)	5.95 (19.5)	8.61 (28.3)	7.88 (25.8)	11.03 (36.2)	10.41 (34.2)	16.49 (54.1)	16.40 (53.8)	24.85 (81.5)	24.73 (81.1)	39.28 (128.9)	3.63 (11.9)
	6.35 (250")	4.53 (14.9)	5.62 (18.4)	5.65 (18.5)	7.59 (24.9)	7.45 (24.5)	10.78 (35.4)	9.86 (32.4)	13.81 (45.3)	13.03 (42.8)	20.63 (67.7)	20.53 (67.4)	31.10 (102.0)	30.99 (101.7)	49.17 (161.3)	–
	7.62 (300")	5.45 (17.9)	6.76 (22.2)	6.78 (22.3)	9.12 (29.9)	8.95 (29.4)	12.95 (42.5)	11.85 (38.9)	16.58 (54.4)	15.65 (51.4)	24.77 (81.3)	24.67 (80.9)	37.34 (122.5)	37.25 (122.2)	59.06 (193.8)	–
	10.16 (400")	7.28 (23.9)	9.02 (29.6)	9.06 (29.7)	12.17 (39.9)	11.96 (39.2)	17.28 (56.7)	15.83 (51.9)	22.13 (72.6)	20.90 (68.6)	33.05 (108.4)	32.94 (108.1)	49.84 (163.5)	49.76 (163.3)	78.85 (258.7)	–
	12.70 (500")	9.11 (29.9)	11.29 (37.0)	11.34 (37.2)	15.23 (50.0)	14.96 (49.1)	21.61 (70.9)	19.80 (65.0)	27.68 (90.8)	26.14 (85.8)	41.34 (135.6)	41.20 (135.2)	62.33 (204.5)	62.28 (204.3)	98.64 (323.6)	–
	15.24 (600")	10.94 (35.9)	13.55 (44.5)	13.62 (44.7)	18.29 (60.0)	17.96 (58.9)	25.94 (85.1)	23.78 (78.0)	33.23 (109.0)	31.39 (103.0)	49.62 (162.8)	49.47 (162.3)	74.82 (245.5)	74.80 (245.4)	118.42 (388.5)	–
PT-RX110 (4:3 aspect ratio)	1.27 (50")	0.81 (2.6)	1.01 (3.3)	1.01 (3.3)	1.38 (4.5)	1.34 (4.4)	1.97 (6.5)	1.78 (5.8)	2.51 (8.2)	2.36 (7.7)	3.78 (12.4)	3.71 (12.2)	5.68 (18.6)	5.52 (18.1)	8.91 (29.2)	0.81 (2.7)
	1.52 (60")	0.98 (3.2)	1.22 (4.0)	1.22 (4.0)	1.66 (5.4)	1.62 (5.3)	2.37 (7.8)	2.15 (7.0)	3.03 (9.9)	2.85 (9.3)	4.55 (14.9)	4.48 (14.7)	6.84 (22.5)	6.69 (21.9)	10.75 (35.3)	0.98 (3.2)
	1.78 (70")	1.15 (3.8)	1.43 (4.7)	1.43 (4.7)	1.94 (6.4)	1.90 (6.2)	2.77 (9.1)	2.52 (8.3)	3.55 (11.6)	3.34 (11.0)	5.32 (17.5)	5.25 (17.2)	8.01 (26.3)	7.86 (25.8)	12.60 (41.3)	1.15 (3.8)
	2.03 (80")	1.32 (4.3)	1.64 (5.4)	1.65 (5.4)	2.23 (7.3)	2.18 (7.2)	3.18 (10.4)	2.89 (9.5)	4.06 (13.3)	3.83 (12.6)	6.09 (20.0)	6.02 (19.8)	9.17 (30.1)	9.02 (29.6)	14.44 (47.4)	1.32 (4.3)
	2.29 (90")	1.49 (4.9)	1.85 (6.1)	1.86 (6.1)	2.51 (8.2)	2.46 (8.1)	3.58 (11.7)	3.26 (10.7)	4.58 (15.0)	4.31 (14.2)	6.86 (22.5)	6.79 (22.3)	10.33 (33.9)	10.19 (33.4)	16.28 (53.4)	1.49 (4.9)
	2.54 (100")	1.66 (5.4)	2.07 (6.8)	2.07 (6.8)	2.80 (9.2)	2.74 (9.0)	3.98 (13.1)	3.63 (11.9)	5.10 (16.7)	4.80 (15.8)	7.63 (25.0)	7.56 (24.8)	11.50 (37.7)	11.35 (37.2)	18.12 (59.5)	1.66 (5.5)
	3.05 (120")	2.00 (6.6)	2.49 (8.2)	2.49 (8.2)	3.37 (11.0)	3.30 (10.8)	4.79 (15.7)	4.37 (14.3)	6.13 (20.1)	5.78 (19.0)	9.17 (30.1)	9.10 (29.9)	13.82 (45.3)	13.68 (44.9)	21.81 (71.5)	2.01 (6.6)
	3.81 (150")	2.51 (8.2)	3.12 (10.2)	3.13 (10.3)	4.22 (13.8)	4.14 (13.6)	6.00 (19.7)	5.48 (18.0)	7.68 (25.2)	7.24 (23.8)	11.49 (37.7)	11.41 (37.4)	17.31 (56.8)	17.18 (56.4)	27.33 (89.7)	2.52 (8.3)
	5.08 (200")	3.36 (11.0)	4.18 (13.7)	4.19 (13.8)	5.64 (18.5)	5.54 (18.2)	8.02 (26.3)	7.33 (24.0)	10.26 (33.7)	9.69 (31.8)	15.34 (50.3)	15.26 (50.1)	23.13 (75.9)	23.00 (75.5)	36.54 (119.9)	3.38 (11.1)
	6.35 (250")	4.21 (13.8)	5.23 (17.2)	5.25 (17.2)	7.06 (23.2)	6.94 (22.8)	10.03 (32.9)	9.18 (30.1)	12.85 (42.2)	12.13 (39.8)	19.20 (63.0)	19.11 (62.7)	28.94 (95.0)	28.83 (94.6)	45.75 (150.1)	–
	7.62 (300")	5.07 (16.6)	6.29 (20.6)	6.31 (20.7)	8.49 (27.8)	8.33 (27.3)	12.05 (39.5)	11.03 (36.2)	15.43 (50.6)	14.57 (47.8)	23.06 (75.6)	22.96 (75.3)	34.76 (114.0)	34.66 (113.7)	54.97 (180.3)	–
	10.16 (400")	6.77 (22.2)	8.40 (27.5)	8.43 (27.7)	11.33 (37.2)	11.13 (36.5)	16.08 (52.8)	14.73 (48.3)	20.60 (67.6)	19.45 (63.8)	30.77 (100.9)	30.65 (100.6)	46.39 (152.2)	46.31 (151.9)	73.39 (240.8)	–
	12.70 (500")	8.48 (27.8)	10.51 (34.5)	10.56 (34.6)	14.18 (46.5)	13.92 (45.7)	20.12 (66.0)	18.43 (60.5)	25.77 (84.5)	24.33 (79.8)	38.48 (126.2)	38.35 (125.8)	85.02 (190.4)	57.96 (190.2)	91.81 (301.2)	–
	15.24 (600")	10.18 (33.4)	12.62 (41.4)	12.68 (41.6)	17.02 (55.8)	16.72 (54.9)	24.15 (79.2)	22.13 (72.6)	30.94 (101.5)	29.22 (95.9)	46.19 (151.5)	46.05 (151.1)	69.65 (228.5)	69.61 (228.4)	110.23 (361.6)	–

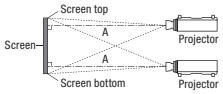
Unit: meters (feet)

Screen size (diagonal)		ET-DLE030 Ultra-Short-Throw Lens*2					
		Projection distance				Close-up system dimensions	
		(A)	(B)	(C)		(D)	(E)
PT-RZ970/ RZ770/ RZ660 (16:10 aspect ratio)	2.54 (100")	0.82 (2.7)	0.65 (2.1)	0.11 (0.4)		0.43 (1.4)	0.63 (2.1)
	3.05 (120")	0.98 (3.2)	0.81 (2.7)	0.28 (0.9)		0.53 (1.7)	0.73 (2.4)
	3.81 (150")	1.23 (4.0)	1.06 (3.5)	0.52 (1.7)		0.68 (2.2)	0.88 (2.9)
	5.08 (200")	1.63 (5.3)	1.46 (4.8)	0.93 (3.1)		0.93 (3.1)	1.13 (3.7)
	6.35 (250")	2.04 (6.7)	1.87 (6.1)	1.34 (4.4)		1.18 (3.9)	1.38 (4.5)
	7.62 (300")	2.45 (8.0)	2.28 (7.5)	1.74 (5.7)		1.43 (4.7)	1.63 (5.4)
	8.89 (350")	2.85 (9.4)	2.68 (8.8)	2.15 (7.1)		1.69 (5.5)	1.89 (6.2)
PT-RW930/ RW730/ RW620 (16:10 aspect ratio)	2.54 (100")	0.86 (2.8)	0.69 (2.3)	0.16 (0.5)		0.59 (1.9)	0.79 (2.6)
	3.05 (120")	1.03 (3.4)	0.86 (2.8)	0.33 (1.1)		0.72 (2.4)	0.92 (3.0)
	3.81 (150")	1.29 (4.2)	1.12 (3.7)	0.58 (1.9)		0.92 (3.0)	1.12 (3.7)
	5.08 (200")	1.71 (5.6)	1.54 (5.1)	1.01 (3.3)		1.25 (4.1)	1.45 (4.8)
	6.35 (250")	2.14 (7.0)	1.97 (6.5)	1.44 (4.7)		1.58 (5.2)	1.78 (5.8)
	7.62 (300")	2.57 (8.4)	2.40 (7.9)	1.86 (6.1)		1.91 (6.3)	2.11 (6.9)
	8.89 (350")	3.00 (9.8)	2.83 (9.3)	2.29 (7.5)		2.24 (7.3)	2.44 (8.0)
PT-RX110 (4:3 aspect ratio)	2.54 (100")	0.80 (2.6)	0.63 (2.1)	0.10 (0.3)		0.41 (1.3)	0.61 (2.0)
	3.05 (120")	0.96 (3.1)	0.79 (2.6)	0.26 (0.9)		0.50 (1.6)	0.70 (2.3)
	3.81 (150")	1.20 (3.9)	1.03 (3.4)	0.49 (1.6)		0.65 (2.1)	0.85 (2.8)
	5.08 (200")	1.60 (5.2)	1.43 (4.7)	0.89 (2.9)		0.88 (2.9)	1.08 (3.5)
	6.35 (250")	1.99 (6.5)	1.83 (6.0)	1.29 (4.2)		1.12 (3.7)	1.32 (4.3)
	7.62 (300")	2.39 (7.8)	2.23 (7.3)	1.69 (5.5)		1.36 (4.5)	1.56 (5.1)
	8.89 (350")	2.79 (9.2)	2.62 (8.6)	2.09 (6.9)		1.60 (5.2)	1.80 (5.9)

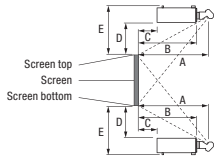
*1 Optical axis shift cannot be operated when using ET-DLE055. *2 Optical axis is fixed to center when using ET-DLE030.

Dimension Definitions

If using lens other than the ET-DLE030

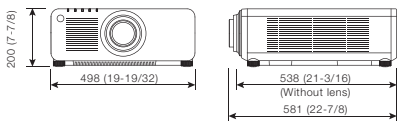


If using the ET-DLE030



Dimensions

unit: mm (inches)



Sample Product Cutsheets (Audio-Visual)

Specifications

Model		PT-RZ970/RZ770/RZ660	PT-RW930/RW730/RW620	PT-RX110
Power supply		AC 100–240 V, 50/60 Hz		
Power consumption		**[PT-RZ970/RW930/RX110]** 1,050 W, Normal*: 742 W, Eco*: 617 W, Long Life 1*: 410–588 W, Long Life 2*: 375–588 W, Long Life 3*: 349–588 W, Shutter*: 82 W; **[PT-RZ770/RW730]** 825 W, Normal*: 593 W, Eco*: 508 W, Long Life 1*: 333–477 W, Long Life 2*: 310–477 W, Long Life 3*: 286–477 W, Shutter*: 72 W; **[PT-RZ660/RW620]** 700 W, Normal*: 499 W, Eco*: 428 W, Long Life 1*: 287–402 W, Long Life 2*: 262–402 W, Long Life 3*: 238–402 W, Shutter*: 69 W; **[Common]** Standby: 85 W with Quick Startup Mode set to ON, 0.3 W with Standby Mode set to Eco, 3 W with Standby Mode set to Normal **In conditions with an operating temperature of 25 °C [77 °F], altitude 700 m [2,297 ft], IEC62087: 2008 Broadcast Content, Picture Mode: Standard, Dynamic Contrast: 2.*		
DLP™ chip	Panel size	17.0 mm (0.67 in) diagonal (16:10 aspect ratio)	16.5 mm (0.65 in) diagonal (16:10 aspect ratio)	17.8 mm (0.7 in) diagonal (4:3 aspect ratio)
	Display method	DLP™ chip × 1, DLP™ projection system		
	Pixels	2,304,000 (1920 x 1200) pixels	1,024,000 (1280 x 800) pixels	786,432 (1024 x 768) pixels
Lens		Powered zoom (throw ratio 1.7–2.4:1), powered focus F 1.7–1.9, f 25.6–35.7 mm	Powered zoom (throw ratio 1.8–2.5:1), powered focus F 1.7–1.9, f 25.6–35.7 mm	
Light source		Laser diodes: Laser Class 1 (Class 3R for US models), light source life*1: 20,000 hours (Normal Mode*) / 24,000 hours (Eco Mode). At this time, brightness will have decreased to approximately half its original level (Operating temperature: 30 °C [86 °F], altitude: 700 m [2,297 ft], dust density 0.15 mg/m^3, Dynamic Contrast Mode: 3) ** Includes Quiet 1/Quiet 2 Mode for PT-RZ970/RW930/RX110.*		
Screen size (diagonal)		1.27–15.24 m (50–600 in), 1.27–5.08 m (50–200 in) with ET-DLE055, 2.54–8.89 m (100–350 in) with ET-DLE030, 16:10 aspect ratio (except PT-RX110), 4:3 aspect ratio (PT-RX110)		
Brightness		PT-RZ970: 10,000 lm (Center)*2 / 9,400 lm*1 / 8,000 lm (Quiet 1)*1 / 6,000 lm (Quiet 2)*1 PT-RZ770: 7,200 lm (Center)*2 / 7,000 lm*1 PT-RZ660: 6,200 lm (Center)*2 / 6,000 lm*1	PT-RW930: 10,000 lm (Center)*2 / 9,400 lm*1 / 8,000 lm (Quiet 1)*1 / 6,000 lm (Quiet 2)*1 PT-RW730: 7,200 lm (Center)*2 / 7,000 lm*1 PT-RW620: 6,200 lm (Center)*2 / 6,000 lm*1	10,400 lm (Center)*2 / 10,000 lm*1 / 8,500 lm (Quiet 1)*1 / 6,400 lm (Quiet 2)*1
Center-to-corner uniformity*1		90 %		
Contrast*1		10,000:1 (Full On/Full Off, Dynamic Contrast Mode: 3)		
Resolution		1920 x 1200 pixels	1280 x 800 pixels	1024 x 768 pixels
Scanning frequency	SD-SDI	SMPTE ST 259 compliant, [YCBCR 4:2:2 10-bit] 480i (525i), 625i (576i)	—	
	HD-SDI	SMPTE ST 292 compliant, [YPBPR 4:2:2 10-bit] 750 (720)/60p, 750 (720)/50p, 1125 (1080)/60i, 1125 (1080)/50i, 1125 (1080)/25p, 1125 (1080)/24p, 1125 (1080)/24sF, 1125 (1080)/30p	—	
	3G-SDI	SMPTE ST 424 compliant, [RGB 4:4:4 12-bit/10-bit] 1125 (1080)/60i, 1125 (1080)/50i, 1125 (1080)/25p, 1125 (1080)/24p, 1125 (1080)/24sF, 1125 (1080)/30p, 2K/24p, 2K/25p, 2K/30p, [YPBPR 4:2:2 10-bit] 1125 (1080)/60p, 1125 (1080)/50p, 2K/48p, 2K/50p, 2K/60p	—	
	HDMI/DVI-D/DIGITAL LINK	525i (480i)*3, 625i (576i)*3, 525p (480p), 625p (576p), 750 (720)/60p, 750 (720)/50p, 1125 (1080)/60i, 1125 (1080)/50i, 1125 (1080)/25p, 1125 (1080)/24p, 1125 (1080)/24sF, 1125 (1080)/30p, 1125 (1080)/60p, 1125 (1080)/50p, 640 x 400–WUXGA*4 (1920 x 1200) (compatible with non-interlaced signals only), dot clock: 25–162 MHz		
	RGB	fH: 15–100 kHz, fV: 24–120 Hz, dot clock: 20–162 MHz		
	YPBPR (YCBCR)	fH: 15.73 kHz, fV: 59.9 Hz [525i (480i)], fH: 15.63 kHz, fV: 50 Hz [625i (576i)], fH: 45.00 kHz, fV: 60 Hz [750 (720)/60p], fH: 33.75 kHz, fV: 60 Hz [1125 (1080)/60i], fH: 28.13 kHz, fV: 50 Hz [1125 (1080)/50i], fH: 27.00 kHz,fV: 24 Hz [1125 (1080)/24p], fH: 33.75 kHz, fV: 30 Hz [1125 (1080)/30p], fH: 56.25 kHz, fV: 50 Hz [1125 (1080)/50p], fH: 31.50 kHz, fV: 59.9 Hz [525p (480p)], fH: 31.25 kHz, fV: 50 Hz [625p (576p)], fH: 37.50 kHz, fV: 50 Hz [750 (720)/50p], fH: 33.75 kHz, fV: 60 Hz [1125 (1080)/60i], fH: 28.13 kHz, fV: 25 Hz [1125 (1080)/25p], fH: 27.00 kHz, fV: 48 Hz [1125 (1080)/24sF], fH: 67.50 kHz, fV: 60 Hz [1125 (1080)/60p]		
	Video/YC	fH: 15.73 kHz, fV: 59.9 Hz (NTSC/NTSC4.43/PAL-M/PAL60), fH: 15.63 kHz, fV: 50 Hz (PAL/PAL-N/SECAM)		
Optical axis shift*5	Vertical (from center of screen)	+50 %, -16 % (powered)	+60 %, -16 % (powered)	+50 %, -13 % (+45 %, -13 % with ET-DLE085/DLE105) (powered)
	Horizontal (from center of screen)	+30 %, -10 % (+28 %, -10 % with ET-DLE085/DLE105) (powered)		
Keystone correction range		Vertical: ±40 ° (±22 ° with ET-DLE085/DLE105/DLE055, +5 ° with ET-DLE030), horizontal: ±15 ° (Cannot be operated with ET-DLE030)		Vertical: ±40 ° (±30 ° with ET-DLE085/DLE105/DLE055, +5 ° with ET-DLE030), Horizontal: ±15 ° (Cannot be operated with ET-DLE030)
Keystone correction range with optional Upgrade Kit ET-UK20		Vertical: ±45 °(±40 ° with ET-DLE150/DLE250/supplied lens [DLE170], ±22 ° with ET-DLE085/DLE105/DLE055, +5 ° with ET-DLE030), horizontal: ±40 ° (±15 ° with ET-DLE085/DLE105/DLE055, Cannot be operated with ET-DLE030), Up to a total of ±55 ° during simultaneous horizontal and vertical correction.	—	
Installation		Ceiling/floor, front/rear, free 360-degree installation		
Terminals	SDI IN	BNC × 1: 3G/HD/SD-SDI input	—	
	HDMI IN	HDMI 19-pin × 1 (Deep Color, compatible with HDCP)		
	DVI-D IN	DVI-D 24-pin × 1 (DVI 1.0 compliant, compatible with HDCP, compatible with single link only)		
	RGB 1 IN	RGB × 1 (BNC × 5): RGB/YPBPR/YCBCR/YC/VIDEO		
	RGB 2 IN	D-sub HD 15-pin (female) × 1: RGB/YPBPR/YCBCR		
	SERIAL/MULTI PROJECTOR SYNC IN	D-sub 9-pin (female) × 1 for contrast sync/shutter sync/external control (RS-232C compliant)		
	SERIAL/MULTI PROJECTOR SYNC OUT	D-sub 9-pin (male) × 1 for contrast sync/shutter sync/RS-232C link control		
	REMOTE 1 IN	M3 × 1 for wired remote control		
	REMOTE 1 OUT	M3 x 1 for link control (for wired remote control)		
	REMOTE 2 IN	D-sub 9-pin (female) × 1 for external control (parallel)		
	LAN/DIGITAL LINK	RJ-45 × 1 for network, DIGITAL LINK connection, 100Base-TX, compatible with Art-Net, PJLink™, Deep Color, HDCP		
Cabinet materials		Molded plastic		
Dimensions (W × H × D)		498 x 200*6 x 581 mm (19 19/32" x 7 7/8"*6 x 22 7/8") (with supplied lens [DLE170]), 498 x 200*6 x 538 mm (19 19/32" x 7 7/8"*6 x 21 3/16") (without lens)		
Weight*7		**PT-RZ970/RW930/RX110/RZ770/RW730**: Approx. 23.2 kg (51.1 lbs.) (with supplied lens [DLE170]), Approx. 22.4 kg (49.4 lbs.) (without lens) **PT-RZ660/RW620**: Approx. 23.1 kg (50.9 lbs.) (with supplied lens [DLE170]), Approx. 22.3 kg (49.2 lbs.) (without lens)		
Operation noise*1		**PT-RZ970/RW930/RX110**: 41 dB (37 dB [Quiet1] / 35 dB [Quiet2]), **PT-RZ770/RW730**: 36 dB, **PT-RZ660/RW620**: 35 dB		
Operating environment		Operating temperature: 0–45 °C (32–113 °F)*8, operating humidity: 10–80 % (no condensation)		
Applicable software		Logo Transfer Software, Multi Monitoring & Control Software, Early Warning Software, Geometry Manager Pro*9 (ET-UK20*9 Upgrade Kit and ET-CUK10*10 Auto Screen Adjustment Kit)		
Supplied accessories		Power cord, wireless/wired remote control unit, batteries (R03/AAA type x 2), software CD-ROM (Logo Transfer Software, Multi Monitoring & Control Software), projection lens cover, lens cover (models with lens only)		

Note: The PT-RZ970L/RZ770L/RZ660L/RW930L/RW730L/RW620L/RX110L delivers the same performance as the PT-RZ970/RZ770/RZ660/RW930/RW730/RW620/RX110, but comes without a lens.

*1 Measurement, measuring conditions, and method of notation all comply with ISO/IEC 21118: 2012 international standards. *2 Measured at center area of projector screen. Measurement method is in compliance with ISO/IEC 21118: 2012. Value is average of all products when shipped. May differ depending on actual unit. *3 Only compatible with dot clock frequency of 27 MHz (pixel repetition signal). *4 WUXGA resolution is supported with CVT-RB signals (WUXGA60RB) and CVT signals (WUXGA50). *5 Optical axis shift is not supported on the ET-DLE055, and the optical axis is fixed with the ET-DLE030. *6 With legs at shortest position. *7 Average value. May differ depending on the actual unit. *8 When used in locations from 0 m to 4,200 m (0 ft to 13,780 ft) above sea level in Normal Mode, and from 0 m to 2,700 m (0 ft to 8,858 ft) above sea level in other modes. If the ambient temperature exceeds 35 °C (95 °F) [30 °C (86 °F) for PT-RZ970/RW930/RX110] when used in locations from 0 m to 2,700 m (0 ft to 8,858 ft) above sea level, or if it exceeds 25 °C (77 °F) when used in locations from 2,700 m to 4,200 m (8,858 ft to 13,780 ft) above sea level, the light output may be reduced to protect the projector. *9 Available only with PT-RZ970/RZ770/RZ660. *10 Available only with PT-RZ970/RZ770/RZ660. Available worldwide except the United States.

The cabinet for each model is available in black or white.

Black models

PT-RZ970B
PT-RW930B
PT-RX110B
PT-RZ770B
PT-RW730B
PT-RZ660B
PT-RW620B

[Models with supplied lens]

PT-RZ970LB
PT-RW930LB
PT-RX110LB
PT-RZ770LB
PT-RW730LB
PT-RZ660LB
PT-RW620LB

[Models without lens]

White models

PT-RZ970W
PT-RW930W
PT-RX110W
PT-RZ770W
PT-RW730W
PT-RZ660W
PT-RW620W

[Models with supplied lens]

PT-RZ970LW
PT-RW930LW
PT-RX110LW
PT-RZ770LW
PT-RW730LW
PT-RZ660LW
PT-RW620LW

[Models without lens]

Panasonic®

For more information about Panasonic projectors, please visit:
Projector Global Website – **panasonic.net/avc/projector**
Facebook – **www.facebook.com/panasonicprojector**
YouTube – **www.youtube.com/user/PanasonicProjector**

All information included here is valid as of February 2017.

Sample Product Cutsheets (Audio-Visual)

EPSON
EXCEED YOUR VISION

SPECIFICATION SHEET

Displays

Interactive

BrightLink® Pro 1460Ui Full HD Interactive Display

The bright Full HD interactive display for more efficient meetings.

Reinvent your whiteboard — turn any wall or existing dry-erase board into a 100" interactive display for more efficient meetings and collaboration, in the room or across the globe

Bright display — 4,400 lumens color/white brightness[1]

Full HD WUXGA display up to 100" — for an optimal viewing experience and clear readability — 3x as big as a 60" flat panel

Easy-to-use, touch-enabled interactivity — just turn on BrightLink Pro and start writing using your finger or the included pens

Wireless screen mirroring — stream Full HD 1080p content; mirror your Android™ device screen with Miracast®

Capture, save and share — no need to transcribe meeting notes or snap a photo; easily save, print or email directly from your BrightLink Pro

Whiteboard sharing — both local and remote participants can simultaneously annotate content from mobile devices, computers and other BrightLink Pros

Wireless device compatibility — wirelessly display documents, files and photos from your iPad®, iPhone®, and Android mobile devices with the Epson iProjection™ App[2]

Convenient DVI-out connectivity — share whiteboard content to a larger display, videoconferencing system or recording device

DuoLink — install two interactive displays side by side to achieve an even larger interactive display area[3]

Sample Product Cutsheets (Audio-Visual)

EPSON
EXCEED YOUR VISION

BrightLink® Pro 1460Ui Full HD Interactive Display

Specifications

Display System Epson® 3LCD, 3-chip technology
Display Method Front/wall mount/table
Driving Method Epson Poly-silicon TFT Active Matrix
Pixel Number 2,304,000 dots (1920 x 1200) x 3
Color Brightness Color Light Output: 4,400 lumens[1]
White Brightness White Light Output: 4,400 lumens[1]
Aspect Ratio 16:10
Native Resolution 1920 x 1200 (WUXGA)
Lamp Type 300 W UHE
Lamp Life[4]
Up to 10,000 hours (ECO Mode)
Up to 5,000 hours (Normal Mode)
Throw Ratio Range 16:10 0.27 (Zoom: Wide), 0.37 (Zoom: Tele)
Size (Projected Distance) Area: 16:10 70" – 100"
Keystone Correction (Manual)
Horizontal: ± 3 degrees
Vertical: ± 3 degrees
USB Plug 'n Play
Mac® 10.7 or later
Windows Vista® or later
Contrast Ratio Up to 16,000:1
Color Reproduction 1.07 billion colors

Wireless Specification

Supported Security Mode
Quick Mode: OPEN, WPA2-PSK
Advanced Mode: OPEN, WPA2-PSK, WPA/WPA2-PSK, WPA2-EAP, WPA/WPA2-EAP
Supported EAP Type: PEAP, PEAP-TLS, EAP-TLS, EAP-Fast, LEAP
Supported Speeds
IEEE 802.11b: 11 Mbps*
IEEE 802.11g: 54 Mbps*
IEEE 802.11n: 130 Mbps*
*Maximum speed and range is achievable when used with the same Enhanced Mode technology. Actual data rates, features and performance may vary depending on your computer system, the environment and other factors.

Projection Lens

Type Manual focus
F-number 1.60
Focal Length 4.2 mm
Zoom Ratio Digital zoom 1.0 – 1.35x

Remote Control

Features Source search, HDMI®, Computer, LAN, Whiteboard, Power, Aspect, Color mode, Volume, E-zoom, A/V Mute, Freeze, Menu, Home, Auto, Enter, Esc, Pointer, User, Pen mode, Split, Home, ID, Link menu, Page-up, Page-down
Operating Angle
Front: Right/left: -30 to +30 degrees
Upper/lower: 0 to +60 degrees
Operating Distance 19.7 ft (6 m)

Other

Speaker 16 W monaural
Operating Temperature 41 ° to 104 °F (5 ° to 40 °C)

Interfaces

Sync In	Audio Out
Sync Out	Video
Remote	Audio
TCH	USB-A x 2
RS-232C	USB-B
Wireless	LAN
Computer	DVI-D Out
Audio	HDMI 2
Monitor Out	HDMI 1/MHL

Other (continued)

Power Supply Voltage 100 – 240 V ± 10%, 50/60 Hz
Power Consumption
520 W (Normal Mode)
430 W (ECO Mode)
<3.0 W Standby (Communication Off)
<0.5 W Standby (Communication Off)
Fan Noise
38 dB (Normal Mode)
30 dB (ECO Mode)
Security Kensington lock provision, security anchor bar, password protection function

Interactive Specifications

Interactive Area (Image Size) 70" – 100" diagonal (16:10, WUXGA)
Input Device Digital pen or finger
Number of Pens Two
Number of Pen Tips Six (4x felt/soft tip, 2x Teflon™ hard tip)
Pen Functions Mouse functions (left and right click), Electronic pen, LED battery status indicator
Pen Specifications
Size: 6.3" (L) x 0.95" (W)
Weight: 1.1 oz (without battery)
Power: AA battery
Compatible battery types: AA x 1. Manganese dry cell, Alkaline dry cell, Panasonic eneloop® BK-3MCCx (The suffix "x" can be blank or A-Z)
Calibration method: Automatic or Manual
Interactive Modes
Whiteboard Mode: 2x pens and 6x fingers
PC-free Annotation Mode: 2x pens and 2x fingers
Computer Interactivity Mode, Easy Interactive Tools: 2x pens and 6x fingers
Requirements for Computer Interactivity
Connection to the computer: Via USB cable or wired/wireless LAN
Software system compatibility: Epson Easy Interactive Driver for Mac only; Windows® driver for Multi Projection and Windows and Linux: No driver required
Mac: Mac OS® X 10.7.x or later

Interactive Software

Epson Easy Interactive Tools for Windows/Mac (available for free unlimited download at Epson.com support page)[5]
System Compatibility
Windows 10, Windows 8/8.1* (all editions except for Starter), Windows 7*, Windows 7 SP1*, Windows Vista SP2** (all editions except for Starter), Windows Vista SP1**, Windows Vista**
Mac OS X® 10.7.x, 10.8.x, 10.10.x, 10.11.x, macOS™ 10.12.x
*32-bit and 64-bit version **32-bit versions only

Dimensions (W x D x H)

Excluding feet 18.7" x 17.6" x 6.3"
Weight
18.7 lb without slide plate
20.1 lb with slide plate

Eco Features

Energy-efficient 3LCD light engine
RoHS compliant
Recyclable product[6]
Epson America, Inc. is a SmartWay® Transport Partner[7]

Support

Epson ConnectionSM
Pre-sales support U.S. and Canada 800-463-7766
Internet website: www.epson.com
www.epson.com/blpro
Service Programs 2-year limited warranty, Epson Road Service program, PrivateLine® dedicated toll-free support and 90-day limited lamp warranty

What's in the Box

BrightLink Pro 1460Ui, 802.11 b/g/n wireless module, Quick User's Guide, Power cable, USB A/B cable (x3), Electronic user manual, Interactive driver for Mac, Multi-projection driver for Windows, Epson Easy Interactive Tools, Network Management software, Projector remote control, Control pad with connecting cable, Pen holder, Two (2) interactive pens, Finger Touch Unit with bracket and cable, Two (2) AA batteries (for interactive pens)

Ordering Information

BrightLink Pro 1460Ui	V11H726520
Genuine Epson lamp (ELPLP92	V13H010L92
Replacement air filter (ELPAF49)	V13H134A45
Replacement wireless module	V12H731P02
Easy interactive pen A (orange)	V12H773010
Easy interactive pen B (blue)	V12H774010
Replacement pen tips (Teflon/hard)	V12H775010
Replacement pen tips (felt/soft)	V12H776010
Ultra short-throw wall mount	V12H777020
100" whiteboard	V12H831000
Motorized interactive table	V12H893020

1 Color brightness (color light output) and white brightness (white light output) will vary depending on usage conditions. Color light output measured in accordance with IDMS 15.4; white light output measured in accordance with ISO 21118. | **2** The projector must be configured on a network. Epson projectors can be networked either through the Ethernet port on the projector (check model specifications for availability) or via a wireless connection. Check your owner's manual to determine if a wireless LAN module must be purchased separately to enable wireless connection on your Epson projector. Not all Epson projectors are able to be networked. Availability varies depending on model. Not all files and formats are supported. See www.epson.com for details. | **3** Certain functionality is only available through EIT software. | **4** Lamp life will vary depending upon mode selected, environmental conditions and usage. Lamp brightness decreases over time. | **5** For a list of supported operating systems, visit epson.com | **6** For convenient and reasonable recycling options, visit www.epson.com/recycle | **7** SmartWay is an innovative partnership of the U.S. Environmental Protection Agency that reduces greenhouse gases and other air pollutants and improves fuel efficiency.

See the latest innovations from Epson Business Solutions at **www.epson.com/forbusiness**

Better Products for a Better Future™
eco.epson.com

SmartWay Transport Partner
Getting There With Cleaner Air

Contact:

Epson America, Inc.
3840 Kilroy Airport Way, Long Beach, CA 90806

Epson Canada Limited
185 Renfrew Drive, Markham, Ontario L3R 6G3

www.epson.com
www.epson.ca

www.epson.com/blpro

Sample Product Cutsheets (Audio-Visual)

ACCESS V

MOTORIZED, CEILING-RECESSED, TAB TENSIONED PROJECTION SCREEN

The ACCESS V is a motorized, ceiling-recessed projection screen with a steel white case that install s above the ceiling. A trim flange finishes the ceiling opening for a clean appearance. Tab-tensioned viewing surface and roller can be installed at the same time, or can be added at a later time.

FEATURES

- INCLUDES: One 110-220V or 220V 3-position switch.
- CASE DIMENSIONS: 8-1/16" W x 7-3/8" H (20.6 cm x 18.7 cm) including flange.
- BLACK DROP: 12" (30 cm) black drop at top of screen is standard.
- HOISTING BRACKETS: Adjustable or removable hoisting brackets included for easy lifting during installation.
- SLIDING BRACKET: Bracket on inside of case accommodates different sizes of screen.
- HINGED DOOR: Bottom panel with new hinge system allows the closure panel to hang in place when opened, or it can be easily removed.
- WARRANTY: One year against defects in materials and workmanship.
- US PATENTS: *http://www.draperinc.com/legal/patents/*

OPTIONS

- CONTROLS: Can be furnished with *standard options*.
- MOTORS: *Built-in Quiet, Low Voltage* and 220V options available.
- VIEWING SURFACES: Available with *viewing surfaces* from the TecVision (premium engineered), OptiFlex (tensioned), CineFlex (rear projection), and ClearSound (acoustically transparent) families.
- EXTRA DROP: Available above image area. Specify color.
- BLACK CASE: Available on request.

SIZES

- 16:10 FORMAT: 137" (348 cm) to 226" (574 cm) dia.
- 16:9 HDTV FORMAT: from 133" (338 cm) to 220" (559 cm) dia.
- 4:3 NTSC/PAL FORMAT: from 150" (381 cm) to 240" (610 cm) dia.
- AV FORMAT: from 96" x 96" (244 cm x 244 cm) to 144" x 192" (366 cm x 488 cm) viewing area
- CUSTOM SIZES AVAILABLE: For smaller screen sizes see the Access FIT V.

SUPPORTING DOCUMENTS

All instructions, technical drawings and other supporting documents are located at:
www.draperinc.com/Documents.aspx

For more information on this product visit:
www.draperinc.com/go/AccessV.htm

DRAPER®

Sample Product Cutsheets (Audio-Visual)

TECHNICAL DATA SHEET AV

OPTIFLEX MATT WHITE XT1000V

TENSIONED SCREEN SURFACE

EXTRA WIDE VIEWING CONE / TYPICAL CONTRAST / ON-AXIS GAIN OF 1.0

The perfect matt white diffusing surface. Recommended for use with all types of projectors provided ambient light can be reasonably controlled. Reflects a uniformly bright image over complete 180° viewing cone with precise resolution and accurate color balance. This surface is GREENGUARD GOLD certified. Available with black backing and without.

SURFACE CHARACTERISTICS

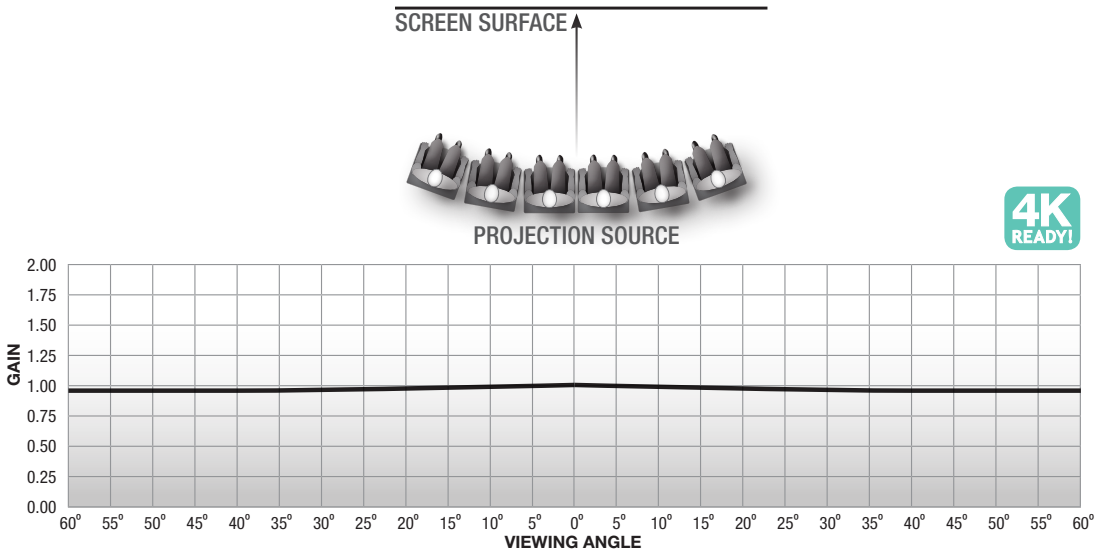
- Maximum Height Without Seams: 187"
- Weight (g/sm): 348
- Thickness (mm): 0.30
- Cleaning: Mild soap and water
- Composition: Flexible PVC

REFLECTIVE PERFORMANCE[1]

- Gain Chart—See below
  0° Gain: 1.0
  Half Gain Angle: Material does not reach half gain.

OptiFlex™ Family of Surfaces
OptiFlex surfaces are suitable for tensioning and are available on permanently tensioned screens and/or tab tensioned roller-operated screens, or both. Choose OptiFlex for the flattest front projection viewing surfaces. All are 4K ready.

[1]Individual test results may vary. Results based on a representative sample in Draper inventory.



GAIN CHART: 0° GAIN: 1.0, VIEWING CONE: 180° OPTIFLEX MATT WHITE XT1000V

Draper, Inc. | 411 S. Pearl St. Spiceland, IN 47385
draperinc.com | 800.238.7999 | 765.987.7999

Sample Product Cutsheets (Audio-Visual)

TECHNICAL DATA SHEET AV

TECVISION XH900X ALR

REJECTS 60% OF AMBIENT LIGHT

HIGH CONTRAST/WIDE VIEWING CONE/ON-AXIS GAIN OF 0.9

This premium optical surface is engineered for high contrast, precise resolution and color accuracy. XH900X ALR performs very well in spaces where there is moderate ambient light and wide viewing angles. Like all TecVision surfaces XH900X ALR offers superior quality, consistency, uniformity and is 8K ready. Also available with acoustically transparent perforated or nano perforated surfaces in limited sizes.

– Lens/Throw distance ratio for best brightness uniformity: 1.2:1 or longer.

SURFACE CHARACTERISTICS

– Maximum Image Height: 276” (701 cm) Always optically seamless
– Weight (g/sm): 445
– Thickness (mm): .36
– Cleaning: Mild soap and soft cloth
– Flame and mildew resistant
– Composition: Flexible PVC

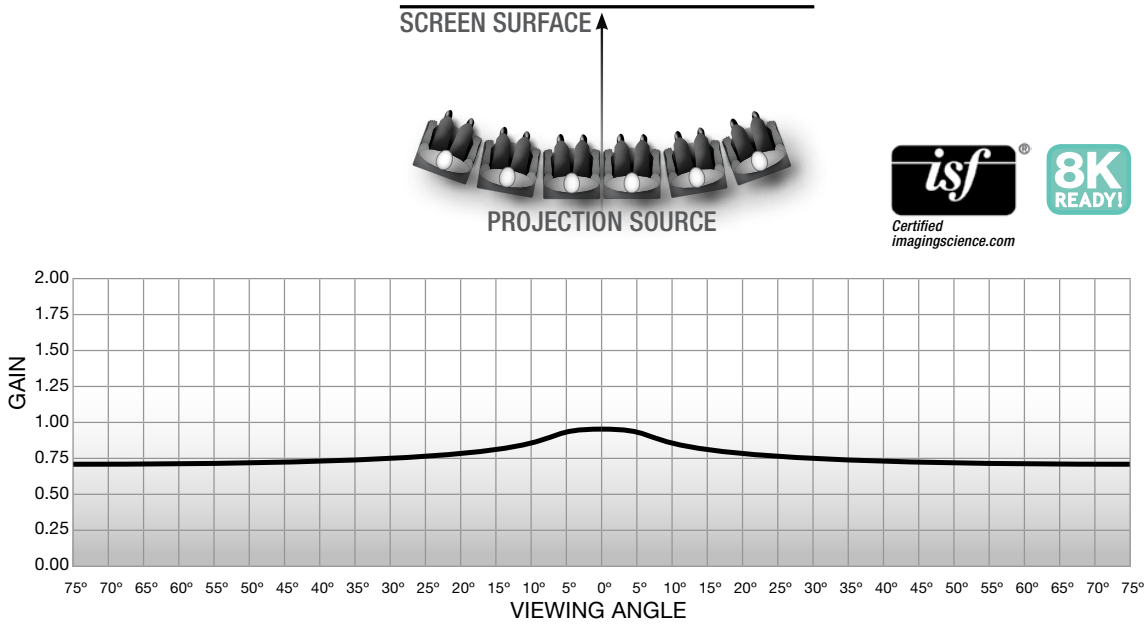
RELECTIVE PERFORMANCE*

– Gain Chart—See below
0° Gain: 0.90
Half Gain Angle: Material does not reach half gain, minimum gain: 0.7
– ALR: 60%

**Individual test results may vary slightly.*

TECVISION

The TecVision Family of Surfaces
TecVision™ Engineered Surface Technology is offered in several exclusive formulations on Draper tab-tensioned and permanently tensioned screens. These formulations are designed to optimize performance and color fidelity in a broad range of settings and at a variety of light levels. White surfaces with gains ranging from 1.0 to 1.8 provide remarkably wide viewing cones. ALR (Ambient Light Rejection) surfaces offer excellent performance under higher room light levels. Other formulations offer performance needed for specific applications like blending and short throw applications in controlled ambient light, or 3-D.



GAIN CHART TECVISION XH900X ALR

Sample Product Cutsheets (Audio-Visual)

CeramicSteel

PolyVision
a steelcase company

POLYVISION e³ CERAMICSTEEL

The world's most popular writing surface

Sample Product Cutsheets (Audio-Visual)

POLYVISION e³ CERAMICSTEEL

FROM CHALKBOARDS TO WHITEBOARDS IN 8 MILLION CLASSROOOMS

PolyVision e3™ CeramicSteel writing surfaces are made for busy offices and boisterous classrooms, providing a super-smooth writing surface that erases like magic and won't scratch, stain or fade for as long as it is in use—guaranteed.

PolyVision e³ is the most popular writing surface for chalkboards and whiteboards, providing superior writability, durability and erasability.

Technical Information

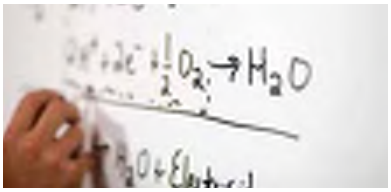
- Can be written on with dry-erase, semi-permanent, water-soluble or permanent marker, chalk, pen or crayon
- Optimum erasability—no ghosting and easy to maintain
- Scratch, bacteria, chemical and fire resistant—will not combust or release toxic fumes in the event of fire
- Greater color contrast
- 99.9% recyclable and Cradle to Cradle Certified™ Silver
- Standard and premium color finishes available
- Colorfast—will not fade
- Safe and clean, releases no harmful chemicals into the environment

Chemical Resistant | Scratch Resistant | Bacteria Resistant

Fire Resistant | Graffiti Resistant | Stain Resistant

Sample Product Cutsheets (Audio-Visual)

A BETTER SURFACE MEANS A BETTER EDUCATIONAL EXPERIENCE



Whiteboard Surfaces: High performance. Low maintenance.

Delivering long-lasting quality with environmental responsibility, PolyVision e³ CeramicSteel is the global choice for whiteboards and markerboards that provide a clean performance and great writing experience for years to come. A smooth surface and resistance to chemicals, scratching and wear ensures unbeatable durability, unmatched erasability and low maintenance throughout a lifetime of use.

Chalkboard Surfaces: Ecological. Durable.

PolyVision e³ CeramicSteel chalkboard surfaces combine an excellent erasability with wear resistance, durability and product lifetime warranty. Our smooth matte finish chalk surfaces will not leave annoying "ghost writing" and yield less chalk dust for a cleaner, healthier environment.

Get creative by adding permanent magnets, or have it delivered with colorful printed patterns, lines, logos or other graphics. Our chalkboard surfaces are a breeze to clean with wet or dry cloths.

Surface Options: The right surface for every need.

The PolyVision e³ CeramicSteel product line offers surface options to meet the precise needs of your environment and product use. For instance, you can specify a super-smooth high-gloss finish for superior dry-erase performance or opt for reduced-glare or low-gloss (matte) surfaces to showcase projected images with exceptional clarity.

Ask your PolyVision representative which e³ surface is right for you. Each one is made for life—and your specific needs.

Our eVision

Today it can be tough to fairly assess what constitutes environmental authenticity. Specifying Cradle to Cradle Certified™ products ensures that PolyVision's materials live up to the world's toughest standards for human and environmental health.

PolyVision e³ CeramicSteel is safe and clean, contains no VOCs and is 99.9% recyclable.

Don't forget, specifying PolyVision e³ CeramicSteel is a healthy business move.

Our surfaces will help you deliver competitive differentiation in the marketplace and meet the growing demand for green building practices. It leads the market in quality and sustainability—so you can, too!

Sample Product Cutsheets (Audio-Visual)

IMADE FOR LIFE

polyvision.com

PolyVision
a steelcase company

PolyVision Americas
10700 Abbotts Bridge Rd.
Suite 100
Duluth, GA 30097 USA
Tel. 1-888-325-6351
info@polyvision.com

PolyVision Europe
Zuiderring 56
3600 Genk, Belgium
Tel. +32(0)89-32 31 30
info@polyvision.be

PolyVision Asia-Pacific
15th Floor, Kinwick Centre
32 Hollywood Road, Central District
Hong Kong
Tel. +32(0)89-32 31 30
info@polyvision.be

Environmental Policy: PolyVision strives for continuous improvement in all areas of environmental stewardship – responsible use of raw materials and natural resources, design processes and operation of all facilities – to protect, replenish, and restore the communities in which we live and serve.

04-30-14 ENG

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8

CRESTRON DIGITALMEDIA

8x8 DigitalMedia™ Switcher

Crestron® DM® Switchers provide the foundation for a complete DigitalMedia™ system, delivering an advanced 4K ultra high-definition AV signal routing solution that's extremely flexible and installer-friendly. The DM-MD8X8 affords ultra fast switching and pure, lossless distribution of HDMI® and other signals to support all the digital media players, HDTV receivers, computers, cameras, and display devices that fill any modern home or commercial facility. DigitalMedia thoughtfully manages all of the disparate AV signals and devices to deliver a transparent user experience, and to ensure an optimum video image and audio signal at every location.

The DM-MD8X8 is field-configurable to handle up to eight AV sources of virtually any type. The outputs are also field-configurable to provide up to eight DM, HDBaseT®, and/or HDMI outputs, or up to four H.264 streaming outputs, in a single chassis.[1] A full selection of DM switcher input and output cards, DM transmitters, and DM receivers provides extensive connectivity throughout a residence or commercial facility, supporting a complete range of analog and digital signal types — all through one switcher!

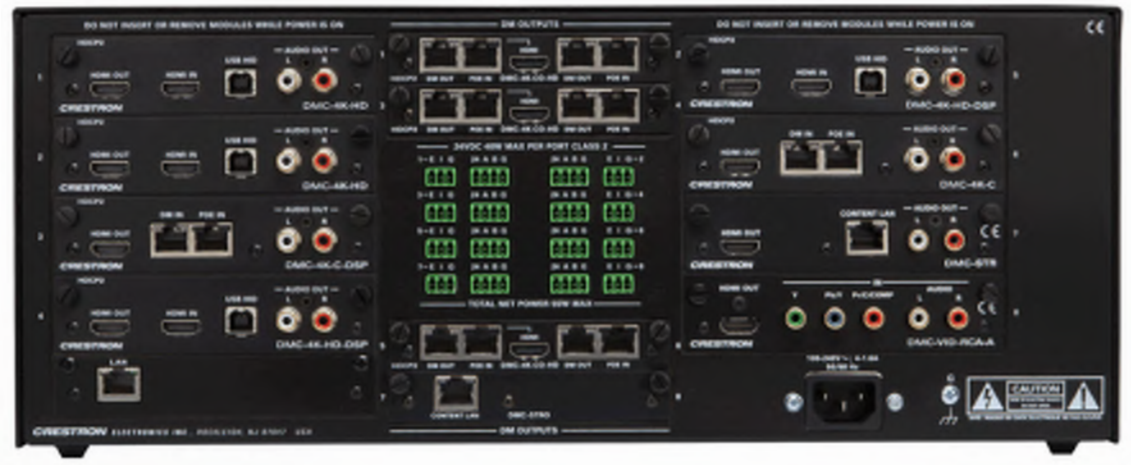
Integrated Ethernet networking and USB distribution provide a complete connectivity solution combined with built-in Crestron control[2] for managing the displays and other room devices without necessitating any additional wiring. User-friendly operation, setup, and troubleshooting tools are provided through the DM-MD8X8 front panel, or via Crestron Toolbox™ software, to make setting up a complete multiroom 4K video distribution system easy.

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the DigitalMedia Switcher Configuration Tool.

- *Delivers a unified HD signal distribution solution incorporating both point-to-point wired and IP streaming technologies*
- *Provides lossless HD AV signal routing over twisted pair copper wire or fiber*
- *Integrates video, audio, networking, and control over one wire or fiber strand*
- *Enables high-performance H.264 streaming from any input source up to 1080p or WUXGA*
- *Affords full matrix switching with ultra high 12.5 Gbps backplane data rate*
- *Handles HDMI® with Deep Color, 3D, 4K, and high-bitrate 7.1 encoded audio[3]*
- *HDBaseT® Certified — Enables direct connection to other HDBaseT certified equipment*
- *HDCP 2.2 compliant via compatible 4K input and output cards[3]*
- *Distributes Full HD 1080p, Ultra HD, and 4K signals over CAT type twisted pair cable at distances up to 330 ft (100 m) via DM 8G+® and HDBaseT[4,9]*
- *Distributes 1080p and WUXGA signals over multimode fiber at distances up to 1000 ft (300 m) via DM 8G® Fiber[5,9]*
- *Distributes 1080p and WUXGA signals over single-mode fiber at distances up to 7.5 miles (12 km) via DM 8G SM Fiber[6,9]*
- *Allows streaming of 1080p signals over an IP network with no distance limitations*
- *Also supports all first-generation DM® CAT and DM Fiber products[7,8,9]*
- *Configurable with up to eight DM, HDBaseT, and/or HDMI outputs*
- *Configurable with up to four streaming outputs[1]*
- *Easy output expansion using multiple DM switchers*
- *Modular inputs support a complete range of digital, analog, and streaming signal types*
- *QuickSwitch HD™ technology manages HDCP keys for fast, reliable switching*
- *Auto-Locking® technology achieves rapid switching between disparate sources*
- *Detects and displays detailed video and audio input information*
- *Performs automatic AV signal format management via EDID*
- *Allows independent scaling for every display through select output cards and DM receivers[12]*
- *Enables device control via CEC*
- *Distributes and routes USB HID mouse and keyboard signals[15]*
- *Expanded USB routing capabilities available using USB over Ethernet Extenders[15]*
- *Allows full audio and USB breakaway switching*
- *Supports analog audio embedding and de-embedding*
- *Integrates with analog audio distribution systems*
- *Enables simultaneous output of stereo and surround sound audio*
- *Includes integrated Ethernet switch with Gigabit LAN port*
- *Private Network Mode — requires just one IP address for the complete DM system*
- *Provides easy setup and diagnostics tools via front panel or software*
- *Half-million hour rated internal universal power supply*
- *4-space 19-inch rack-mountable*

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher



DM-MD8X8 – Rear view with I/O cards installed

4K Ultra HD

Crestron DigitalMedia continues to advance the standard for digital AV signal distribution, delivering the world's first end-to-end 4K system solution. From day one, the DM-MD8X8 was designed to meet the extreme bandwidth requirements for handling 4K and Ultra HD video signals. Support for 4K video also ensures support for the latest generation of computers and monitors with native resolutions beyond 1080p and WUXGA.[3]

DigitalMedia 8G™

As the leader in HDMI and control system technologies, Crestron developed DigitalMedia (DM) to deliver the first complete HD AV distribution system to take HDMI to a higher level. DigitalMedia allows virtually any mix of HDMI and other AV sources to be distributed throughout a room, building, or campus. The latest generation of DM is called DigitalMedia 8G (DM 8G®). Engineered for ultra high-bandwidth and ultimate scalability, DM 8G provides a true one-wire lossless transport for moving high-definition video, audio, Ethernet, and control signals over a choice of twisted pair or fiber optic cable.

DM 8G handles uncompressed Full HD 1080p, Ultra HD, 2K, and 4K video signals with support for 3D, Deep Color, and HDCP 2.2.[3] Audio capabilities include the simultaneous distribution of stereo and multichannel surround sound signals, with support for high-bitrate 7.1 audio formats like Dolby® TrueHD, Dolby Atmos®, and DTS-HD Master Audio™ as well as uncompressed linear PCM. All signals are transported over one CAT type twisted pair cable or one strand of multimode or single-mode fiber. DM 8G enables wire distances up to 330 feet (100 m) via DM 8G+® (DM 8G over twsited pair copper wire)[4,9], 1000 feet (300 m) via DM 8G Fiber (DM 8G over multimode fiber)[5,9], or 7.5 miles (12 km) via DM 8G SM Fiber (DM 8G over single-mode fiber)[6,9].

The DM-MD8X8 provides full support for Crestron DM 8G devices as well as all first-generation DM CAT[7,9] and DM Fiber[8,9] products, letting you take advantage of the latest Crestron DM 8G technology without compromising your existing investment.

HDBaseT® Certified

Crestron DigitalMedia 8G+® technology is designed using HDBaseT Alliance specifications, ensuring interoperability with other HDBaseT certified products. Via DM 8G+, the DM-MD8X8 can be connected directly to an HDBaseT compliant device without requiring a DM transmitter or receiver.

H.264 Streaming

High-performance H.264 streaming capability enables enterprise-wide distribution of HD content over an IP network. Streaming expands the capabilities of DM to remove all distance limitations and allow distribution to virtually any device — anywhere in the world. Streaming is an essential component of any complete DM system, allowing for high-definition signal routing to Crestron touch screens, digital signage displays, remote buildings, and global offices without requiring any new or dedicated wiring. Large-scale streaming to computers and mobile devices can be facilitated through integration with a streaming media system such as Wowza® or Kaltura®.

DigitalMedia with streaming affords the ability to distribute any combination of sources to virtually any device anywhere. Each streaming output supports resolutions up to HD 1080p at bitrates up to 25 Mbps. Built-in scaling enables fast, trouble-free switching between sources of any type or resolution up to 1080p or WUXGA. Audio support includes stereo signals, as well as multichannel audio signals downmixed to stereo via any "DSP" type input card.[10] High-quality video and audio is maintained using high-performance H.264 video and AAC audio compression. The encoded video and audio can be output as independent RTP streams or encapsulated in an MPEG-TS (MPEG-2 Transport Stream) container. HDCP management ensures that protected content cannot be distributed via streaming.

Each streaming output is actually fed internally by two separate switcher outputs, allowing any two input sources to appear picture-in-picture or side-by-side in a single stream. Instant, single-frame switching between two full screen images is also possible. The audio signals from both input sources can also be mixed, allowing both signals to be heard simultaneously.

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher

The DM-MD8X8 can receive streaming signals as well as transmit them. Streaming input capability enables IP cameras and other H.264 encoded sources to be distributed via DigitalMedia alongside HDMI and other non-streaming sources. It also allows DM switchers to be bridged together across a campus or around the world, enabling simplified routing of HD content between buildings and global offices.

DigitalMedia provides many deployment options to address a wide range of streaming applications and accommodate each organization's specific IT requirements. DM with streaming supports both unicast and multicast, with or without RTSP (Real Time Streaming Protocol). Streaming connections can be configured to stream directly to one or more specific IP addresses, or to use RTSP to manage the configuration of numerous connections automatically. Any streaming input or output may be configured to stream via the DM switcher's LAN port or via a dedicated "CONTENT LAN" port, allowing the option to combine control and content on a single network or isolate them onto separate networks.

Modular Architecture

The DM-MD8X8 features a modular architecture with 8 input card slots, and 4 dual output card slots. Each card slot on the DM-MD8X8 is field-installable, allowing for easy and flexible system configuration with the ability to make changes to the system as needs change. A wide selection of input cards is offered to support a complete range of digital and analog AV signal types including HDMI, DVI, Dual-Mode DisplayPort [11], SDI, RGB/VGA and analog video, SPDIF and analog audio, HDBaseT, H.264 streaming, and all types of DigitalMedia. Available outputs include all types of DigitalMedia, as well as HDBaseT, HDMI, analog audio, and H.264 streaming.[1]

Output Expansion

An HDMI "pass-through" output is provided on every input card to allow the inputs of up to 5 DM switchers to be daisy-chained, enabling the configuration of very large distribution systems with many outputs. Using five DM-MD8X8 switchers, it is possible to support up to 40 separate outputs.

QuickSwitch HD™

Handling high-definition digital media means handling HDCP (High-bandwidth Digital Content Protection), the encryption scheme that content providers use to protect their DVDs, Blu-ray™ discs, and broadcast signals against unauthorized copying. Viewing HDCP encrypted content requires a source device to "authenticate" each display and signal processor in the system and issue it a "key" before the content can be viewed. Ordinarily this causes a complete loss of signal for up to 15 seconds each time a new source or display is selected anywhere in the system. To make matters worse, every source device has a limited number of keys available, so connect too many displays and the source will simply stop outputting a signal without warning.

Not to worry — Crestron QuickSwitch HD manages the keys for every HDCP-compliant device in the system, maintaining continuous authentication for each device to ensure fast, reliable routing of any source to any number of display devices.

Auto-Locking® Technology

Crestron Auto-Locking Technology enables super fast signal switching by instantaneously configuring every device in the signal path as soon as the signal hits the first device. Whether switching between sources or TV channels, Auto-Locking significantly reduces the time it takes each device to sense the new signal and configure itself to handle the changes, virtually eliminating any noticeable gap while switching.

EDID Format Management

With all of today's varied AV sources comes a multitude of confusing video and audio formats to keep track of, and chances are not every device in your system supports all of the same formats. Such conflicts can wreak havoc any time you route one source to more than one display or audio component. The media source feeding your 1080p or Ultra HD projector in the theater may restrict itself to a lower resolution, or even shut off completely, if someone decides to view the same signal on a smaller TV in another room. And, instead of enjoying your theater's incredible 7.1 surround sound, you may find yourself limited to 5.1 or even plain old stereo.

DigitalMedia eliminates such conflicts by managing the EDID (Extended Display Identification Data) that modern digital devices use to communicate their capabilities. Via Crestron Toolbox software, the format and resolution capabilities of each device can be assessed, allowing the installer to configure EDID signals appropriately for the most desirable and predictable behavior.

A Scaler for Every Display

High-performance scaling capability can be added to any DM system using select output cards and DM receivers with built in HD and 4K scalers. By placing an independent scaler at every display device, DigitalMedia truly delivers the most flexible and user-friendly solution for routing multiple disparate sources to many different display devices. This "Distributed Scaler Approach" ensures an optimal image on every screen no matter what sources are selected. Distributed scaling allows a high-res computer source to be viewed on any display in the building. It also allows an SD, HD, or Ultra HD video source to be viewed simultaneously on the 4K display in your theater and on lower-resolution displays throughout the house.

Versatile Audio Routing

HDMI is the key to handling 7.1 surround sound formats like Dolby TrueHD, Dolby Atmos, and DTS-HD Master Audio. Great for your high-end home theater, but how do you share that same source with other audio zones in the house?

DigitalMedia provides the answer, allowing for the simultaneous distribution of multichannel surround sound and two-channel stereo signals from the same HDMI source. Using a choice of "DSP" type input cards, the DM-MD8X8 employs onboard digital processing to derive a stereo downmix from the original multichannel signal. Both signals can be routed separately or simultaneously from any of the switcher's DM outputs, allowing either signal to be selected for output at each DM receiver location.

Back at the switcher, the digital stereo signal is also converted to analog to enable sharing with every other room in the house via a Sonnex® Multiroom Audio System or any other audio distribution system. The

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher

DM-MD8X8 also allows surround sound processors and amplifiers to be located centrally instead of at the display location via optional local HDMI outputs.

Built-in Ethernet Switch

In addition to transporting digital video and audio, DigitalMedia can also extend 10/100 Ethernet out to each display and source device via select DM receivers and transmitters, providing high-speed connectivity for any room device that requires a LAN connection. Ethernet is also utilized internally by the Crestron control bus to manage the DM devices in the system and provide display control in each room.

Private Network Mode

To streamline its implementation on a corporate or university LAN, the DM-MD8X8 employs Private Network Mode to provide a single-point connection for the complete system. Using Private Network Mode, the DM-MD8X8 requires just one IP address for the complete DM network including all connected DM receivers and transmitters.

USB Signal Routing

Along with video, audio, and Ethernet, DigitalMedia also provides for the routing of USB HID (Human Interface Device) signals, allowing a USB HID compliant keyboard and/or mouse at one location to control a computer or media server at another location. USB HID connectivity is provided through select DM receivers, transmitters, and input cards.

Crestron also offers USB extenders to enable the routing of virtually any type of USB peripheral to any host device, all managed through the DigitalMedia system. Connect a USB over Ethernet Extender host module (USB-EXT-DM-LOCAL [12]) to each computer, media server, game system, annotator, and any other host that you want to control or communicate with. Then, install a device module (USB-EXT-DM-REMOTE [12]) at every display location to connect keyboards, mice, game controllers, whitboards, flash drives, Web cameras, and mobile devices. Every module communicates with the DM switcher over the local Ethernet network or via a direct connection to the LAN port of a DM transmitter or receiver.

CEC Embedded Device Control

The primary objective of every Crestron system is to enable precisely the control desired for a seamless user experience. DigitalMedia provides an alternative to conventional IR and RS-232 device control by harnessing the CEC (Consumer Electronics Control) signal embedded in HDMI. Through its connection to the control system, the DM-MD8X8 provides a gateway for controlling many devices right through their HDMI or HDBaseT connections, potentially eliminating the need for any dedicated control wires or IR emitters.[13]

Easy Setup

Via the front panel or using Crestron Toolbox software, every step of the DM-MD8X8's setup process is designed to be quick and easy, configuring inputs and outputs automatically while letting the installer make intelligent design decisions along the way. The switcher even tests and measures the length of each DM cable, automatically making the appropriate calibrations for optimal signal transmission to every room. With DigitalMedia, an entire 8x8 system can be commissioned in under an hour.

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the DigitalMedia Switcher Configuration Tool.

Are you upgrading an existing DM switcher that has older "multi-gang" DMCO-series output cards? Use the online Output Card Additions and Upgrades Tool to update your existing output cards and switcher to the new "single-gang" output card format.

Please refer to the DigitalMedia Resources Webpage at http://www.crestron.com/dmresources/ for additional design tools and reference documents.

SPECIFICATIONS

Maximum DM 8G® Cable Lengths

Cable Type: / Resolution:	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	3rd-Party CAT5e (or better) UTP or STP
1080p60 Full HD	330 ft (100 m) via any DM 8G+ cards		
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 2K DCI @24Hz			
2048x1080 2K DCI @60Hz	330 ft (100 m) via "4K" DM 8G+ cards	230 ft (70 m) via "4K" DM 8G+ cards	165 ft (50 m) via "4K" DM 8G+ cards
2560x1440 WQHD			
2560x1600 WQXGA			
3840x2160 Ultra HD			
4096x2160 4K DCI			

Cable Type: / Resolution:	CRESFIBER8G CresFiber® 8G Multimode Fiber	3rd-Party OM3 Multimode Fiber
1080p60 Full HD	1000 ft (300 m) via DM 8G Fiber cards	500 ft (150 m) via DM 8G Fiber cards
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @24Hz		

Cable Type: / Resolution:	CRESFIBER8G-SM CresFiber 8G Single-Mode Fiber	3rd-Party G.652.D (or better) Single-Mode Fiber
1080p60 Full HD	7.5 miles (12 km) via DM 8G SM Fiber cards	
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @24Hz		

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher

Video

Switcher: 8x8 digital matrix, modular input/output cards, Crestron QuickSwitch HD™
Input Signal Types: Configurable via modular plug-in cards supporting HDMI® (DVI & Dual-Mode DisplayPort compatible [11]), DVI, 3G-SDI, RGB/VGA, component, S-Video, composite (NTSC & PAL), DM 8G+® & HDBaseT®, DM 8G Fiber, DM 8G SM Fiber, DM® CAT (legacy), DM Fiber (legacy), & H.264 streaming
Output Signal Types: Configurable via modular plug-in cards supporting HDMI (DVI compatible [14]), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs)
Backplane Data Rate: 12.5 Gbps

Note: For additional specifications, please refer to the spec sheet for each input and output card.

Audio

Switcher: 8x8 digital multichannel audio-follow-video matrix switching, plus independent 8x8 stereo matrix for audio breakaway
Input Signal Types: Configurable via modular plug-in cards supporting HDMI (Dual-Mode DisplayPort compatible [11]), 3G-SDI, analog (stereo 2-channel), SPDIF, DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming
Output Signal Types: Configurable via modular plug-in cards supporting HDMI, analog (stereo 2-channel), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs, and most digital audio input cards also include analog stereo pass-through audio outputs)

Note: For additional specifications, please refer to the spec sheet for each input and output card.

Communications

Ethernet: 10/100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP, Private Network Mode
USB: USB signal routing via select input cards, transmitters, receivers, and extenders [15]; USB computer console port for setup
DigitalMedia: DM 8G+, DM 8G Fiber, DM 8G SM Fiber, DM Fiber, DM CAT, DMNet™, HDCP 2.2 [3], EDID, CEC, PoDM, PoDM+, Ethernet
HDBaseT: HDCP 2.2 [3], EDID, CEC, RS-232, PoH, Ethernet
HDMI: HDCP 2.2 [3], EDID, CEC

NOTE: Supports management of HDCP and EDID; supports management of CEC between connected HDMI and HDBaseT devices and a control system.[13] For additional specifications, please refer to the spec sheet for each input and output card.

Card Slots

1 – 8: (8) DM switcher input card slots;
Each slot accepts (1) DMC-series input card

DM OUTPUTS 1 – 8: (4) DM switcher output card slots;
Each slot accepts (1) DMC-series output card

Connectors

LAN: (1) 8-pin RJ45 female;
10Base-T/100Base-TX/1000Base-T Ethernet port

24ABG / EIG 1 – 8: (8) sets of (1) 4-pin and (1) 3-pin 3.5 mm detachable terminal blocks;
Comprises (8) DMNet ports with "EIG" power selection ports, each set is associated with the corresponding DM CAT output port on any installed DM CAT output card;
Each DMNet port provides power and communications for a DM CAT device connected via DM cable;
Each EIG port connects to an external power supply [16], or to the internal power source via a jumper, to power the DM CAT device connected to the corresponding DMNet port;
Maximum Load: 40 Watts (1.66 Amps @ 24 Volts DC) per port, limited to the available DMNet power from the internal power supply (see "Power Requirements" below) or an external power supply [16]

100-240V~4-1.6A 50/60Hz: (1) IEC 60320 C14 main power inlet;
Mates with removable power cord, included

G: (1) 6-32 screw, chassis ground lug

COMPUTER (front): (1) USB Type B female;
USB computer console port (6 ft cable included)

Controls & Indicators

LCD Display: Green LCD dot matrix, 128 x 64 resolution, adjustable LED backlight, displays inputs/outputs by name, video & audio signal information, Ethernet configuration and setup menus
SOFTKEYS: (4) Pushbuttons for activation of LCD driven functions
HW-R: (1) Recessed pushbutton for hardware reset, reboots the switcher
ROUTE: (1) Pushbutton and red LED, selects ROUTE mode to allow routing changes
VIEW: (1) Pushbutton and red LED, selects VIEW mode for viewing current routes
INFO: (1) Pushbutton and red LED, selects INFO mode for viewing AV and device info
MENU: (1) Pushbutton, steps menu back one level
ENTER: (1) Pushbutton, executes highlighted menu or value
AUDIO: (1) Pushbutton & red LED, selects audio routing view
VIDEO: (1) Pushbutton & red LED, selects video routing view
USB: (1) Pushbutton & red LED, selects USB routing view
Quick-Adjust Knob: (1) Continuous turn rotary encoder, adjusts menu parameters
IN 1 – 8: (8) Pushbuttons and red LEDs, each selects the corresponding input for routing
OUT 1 – 8: (8) Pushbuttons and red LEDs, each selects the corresponding output for routing
LAN (rear): (2) LEDs, green LED indicates Ethernet link status, amber LED indicates Ethernet activity

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher

Power Requirements

Main Power: 4-1.6 Amps @ 100-240 Volts AC, 50/60 Hz
Power Consumption: 220 Watts typical
Available DMNet Power: 55 Watts (2.3 Amps @ 24 Volts DC) from internal power supply
Available PoDM/PoH Power: Refer to the specifications for each DM 8G+ input and output card

Environmental

Temperature: 32° to 104° F (0° to 40° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 750 BTU/hr
Ambient Noise: 31.5 to 37 dBA typical;
30 to 30.5 dBA idle

Enclosure

Chassis: Metal with black finish, vented sides, fan-cooled
Front Panel: Metal, black finish with polycarbonate label overlay
Mounting: Freestanding or 4 RU 19-inch rack-mountable (adhesive feet and rack ears included)

Dimensions

Height: 6.97 in (177 mm) without feet
Width: 17.28 in (439 mm), 19.06 in (485 mm) with rack ears
Depth: 15.71 in (399 mm) without cards

Weight

20.0 lb (9.1 kg) without cards

MODELS & ACCESSORIES

Available Models

DM-MD8X8: 8x8 DigitalMedia™ Switcher

Available Accessories

DMC Series: Input & Output Cards
DM-PSU-8: 8-Port PoDM Power Supply
DM-PSU-16: 16-Port PoDM Power Supply
DM-CBL-ULTRA-NP: DigitalMedia™ Ultra Cable, Non-Plenum Type CMR
DM-CBL-ULTRA-P: DigitalMedia™ Ultra Cable, Plenum Type CMP
DM-CBL-ULTRA-LSZH: DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen
DM-CONN: Connector for DM-CBL & DM-CBL-ULTRA
DM-CBL-8G-NP: DigitalMedia 8G™ Cable, non-plenum
DM-CBL-8G-P: DigitalMedia 8G™ Cable, plenum
DM-8G-CONN: Connector for DM-CBL-8G
DM-8G-CRIMP: Crimping Tool for DM-8G-CONN
DM-8G-CONN-WG: Connector with Wire Guide for DM-CBL-8G
DM-8G-CRIMP-WG: Crimping Tool for DM-8G-CONN-WG
CRESFIBER8G-NP: CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, non-plenum
CRESFIBER8G-P: CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, plenum
CRESFIBER-CONN-SC50UM-12: Connectors for CresFiber® 8G Multimode Fiber Optic Cable, SC 50µm, 12-Pack
CRESFIBER8G-SM-P: CresFiber® 8G Single-Mode Fiber Optic Cable, plenum
CRESFIBER8G-SM-CONN-LC-12: Connectors for CresFiber® 8G Single-Mode Fiber Optic Cable, LC, 12-Pack
CRESFIBER-TK: CresFiber® Termination Kit
USB-EXT-DM: USB over Ethernet Extender with Routing

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher

Notes:

1. All output types are configured in pairs except for streaming (a single streaming output occupies the space of two outputs of any other type). To configure a complete DM switcher with output and input cards, please use the online DigitalMedia Switcher Configuration Tool. Current DM switchers use DMC-series "single-gang" output cards. For older DM switchers with DMCO-series "multi-gang" output cards, please use the online Output Card Additions and Upgrades Tool to update your existing output cards and switcher to the new single-gang output card format.
2. Crestron control via the DM network requires a Crestron control system, sold separately.
3. 4K, Ultra HD, and HDCP 2.2 are currently supported over HDMI, DM 8G+, and HDBaseT using select input and output cards. Refer to the specifications for each input/output card and each connected device for its full capabilities.
4. The maximum cable length for DigitalMedia 8G+ (DM 8G+) or HDBaseT is dependent upon the type of cable, the choice of input/output card, and the resolution of the video signal. Refer to the "Maximum DM 8G Cable Lengths" table for a detailed overview. Crestron legacy cable models DM-CBL DigitalMedia Cable and DM-CBL-D DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment.
5. The maximum cable length for DigitalMedia 8G Fiber (DM 8G Fiber) is 1000 ft (300 m) using CRESFIBER8G multimode fiber optic cable, or 500 ft (150 m) using CRESFIBER (legacy) or third-party OM3 multimode fiber optic cable.
6. The maximum cable length for DigitalMedia 8G Single-Mode Fiber (DM 8G SM Fiber) is 7.5 miles (12 km) using CRESFIBER8G-SM or third-party G.652.D (or better) single-mode fiber optic cable.
7. The maximum cable length for DigitalMedia CAT (DM CAT) is 450 ft (137 m) using DM-CBL DigitalMedia Cable. Actual cable length depends upon multiple factors. Up to two DM Repeaters (Model DM-DR) may be required.
8. The maximum cable length for DigitalMedia Fiber (DM Fiber) is 1000 ft (300 m) using CRESFIBER (legacy), CRESFIBER8G, or third-party OM2/OM3 duplex multimode fiber optic cable.
9. Refer to the Crestron DigitalMedia Design Guide, Doc. #4546 for complete system design guidelines. All wire and cables are sold separately.
10. Streaming output supports 2-channel stereo audio only. Multichannel surround sound audio sources cannot be streamed unless downmixed to stereo. Stereo downmix capability requires a "DSP" type DM switcher input card, sold separately.
11. Any HDMI input can support a DVI or Dual-Mode DisplayPort signal using a suitable adapter or interface cable.
12. Item(s) sold separately.
13. Control of third-party HDBaseT devices using CEC is only supported via "4K" DM 8G+ input and output cards.
14. DVI output is supported via an HDMI output port using a suitable adapter or interface cable. CBL-HD-DVI interface cables are available separately.
15. Manages the routing of USB HID signals between peripheral DM devices and input cards that are equipped with USB HID ports. Also programmable to manage the routing of USB signals between Crestron USB over Ethernet Extender modules (USB-EXT-DM, sold separately). Refer to the USB-EXT-DM spec sheet for more information.
16. For external DMNet power, use a Crestron CNPWS-75, C2N-SPWS300, or other Cresnet power supply as required. Do not interconnect DMNet with Cresnet.

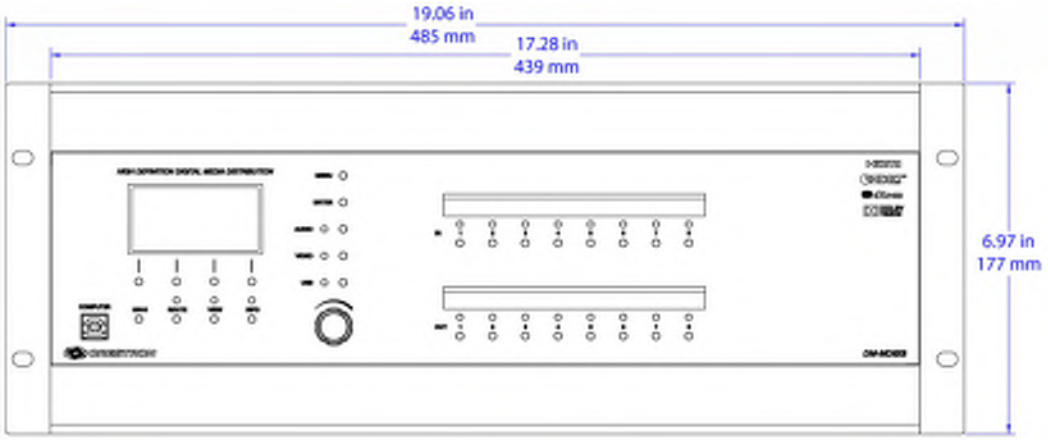
This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at www.crestron.com/salesreps or by calling 800-237-2041.

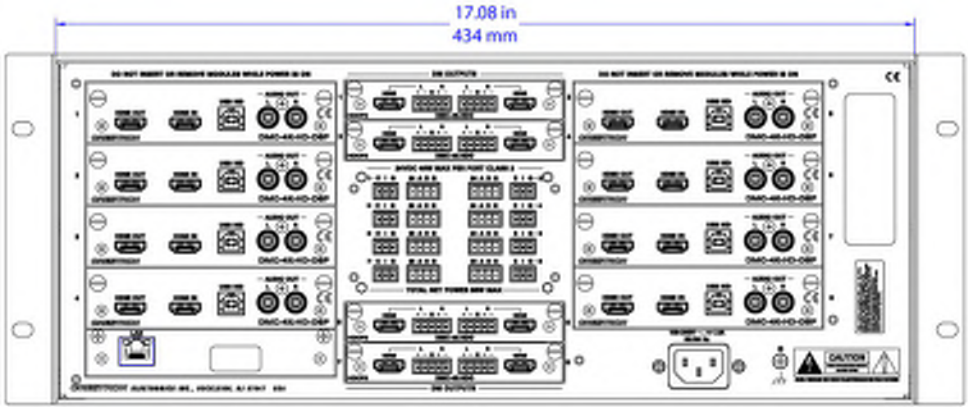
The specific patents that cover Crestron products are listed online at: patents.crestron.com.

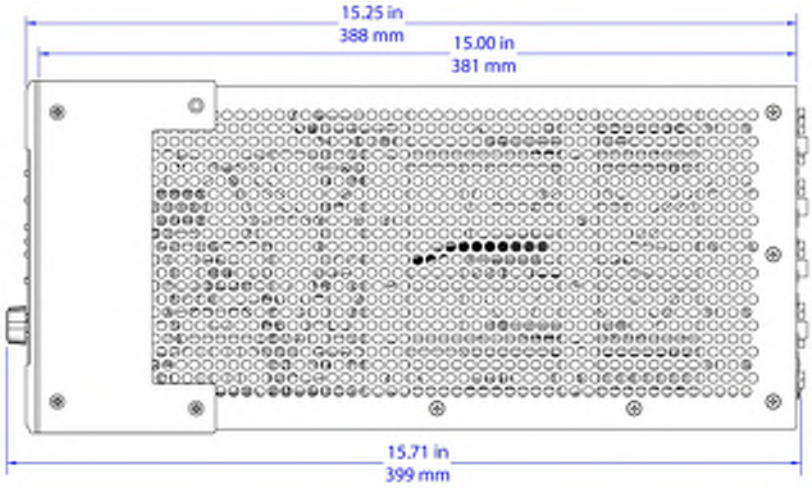
Certain Crestron products contain open source software. For specific information, please visit www.crestron.com/opensource.

Sample Product Cutsheets (Audio-Visual)

DM-MD8X8 8x8 DigitalMedia™ Switcher







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Sample Product Cutsheets (Audio-Visual)

DM-MD16X16

CRESTRON DIGITALMEDIA

16x16 DigitalMedia™ Switcher

Crestron® DM® Switchers provide the foundation for a complete DigitalMedia™ system, delivering an advanced 4K ultra high-definition AV signal routing solution that's extremely flexible and installer-friendly. The DM-MD16X16 affords ultra fast switching and pure, lossless distribution of HDMI® and other signals to support all the digital media players, HDTV receivers, computers, cameras, and display devices that fill any modern home or commercial facility. DigitalMedia thoughtfully manages all of the disparate AV signals and devices to deliver a transparent user experience, and to ensure an optimum video image and audio signal at every location.

The DM-MD16X16 is field-configurable to handle up to 16 AV sources of virtually any type. The outputs are also field-configurable to provide up to 16 DM, HDBaseT®, and/or HDMI outputs, or up to eight H.264 streaming outputs, in a single chassis.[1] A full selection of DM switcher input and output cards, DM transmitters, and DM receivers provides extensive connectivity throughout a residence or commercial facility, supporting a complete range of analog and digital signal types — all through one switcher!

- > *Delivers a unified HD signal distribution solution incorporating both point-to-point wired and IP streaming technologies*
- > *Provides lossless HD AV signal routing over twisted pair copper wire or fiber*
- > *Integrates video, audio, networking, and control over one wire or fiber strand*
- > *Enables high-performance H.264 streaming from any input source up to 1080p or WUXGA*
- > *Affords full matrix switching with ultra high 12.5 Gbps backplane data rate*
- > *Handles HDMI® with Deep Color, 3D, 4K, and high-bitrate 7.1 encoded audio[3]*
- > *HDBaseT® Certified — Enables direct connection to other HDBaseT certified equipment*
- > *HDCP 2.2 compliant via compatible 4K input and output cards[3]*
- > *Distributes Full HD 1080p, Ultra HD, and 4K signals over CAT type twisted pair cable at distances up to 330 ft (100 m) via DM 8G+® and HDBaseT[4,9]*
- > *Distributes 1080p and WUXGA signals over multimode fiber at distances up to 1000 ft (300 m) via DM 8G® Fiber[5,9]*
- > *Distributes 1080p and WUXGA signals over single-mode fiber at distances up to 7.5 miles (12 km) via DM 8G SM Fiber[6,9]*
- > *Allows streaming of 1080p signals over an IP network with no distance limitations*
- > *Also supports all first-generation DM® CAT and DM Fiber products[7,8,9]*
- > *Configurable with up to 16 DM, HDBaseT, and/or HDMI outputs*
- > *Configurable with up to eight streaming outputs[1]*
- > *Easy output expansion using multiple DM switchers*
- > *Modular inputs support a complete range of digital, analog, and streaming signal types*
- > *QuickSwitch HD™ technology manages HDCP keys for fast, reliable switching*
- > *Auto-Locking® technology achieves rapid switching between disparate sources*
- > *Detects and displays detailed video and audio input information*
- > *Performs automatic AV signal format management via EDID*
- > *Allows independent scaling for every display through select output cards and DM receivers[12]*
- > *Enables device control via CEC*
- > *Distributes and routes USB HID mouse and keyboard signals[15]*
- > *Expanded USB routing capabilities available using USB over Ethernet Extenders[15]*
- > *Allows full audio and USB breakaway switching*
- > *Supports analog audio embedding and de-embedding*
- > *Integrates with analog audio distribution systems*
- > *Enables simultaneous output of stereo and surround sound audio*
- > *Includes integrated Ethernet switch with Gigabit LAN port*
- > *Private Network Mode — requires just one IP address for the complete DM system*
- > *Provides easy setup and diagnostics tools via front panel or software*
- > *Half-million hour rated internal universal power supply*
- > *7-space 19-inch rack-mountable*

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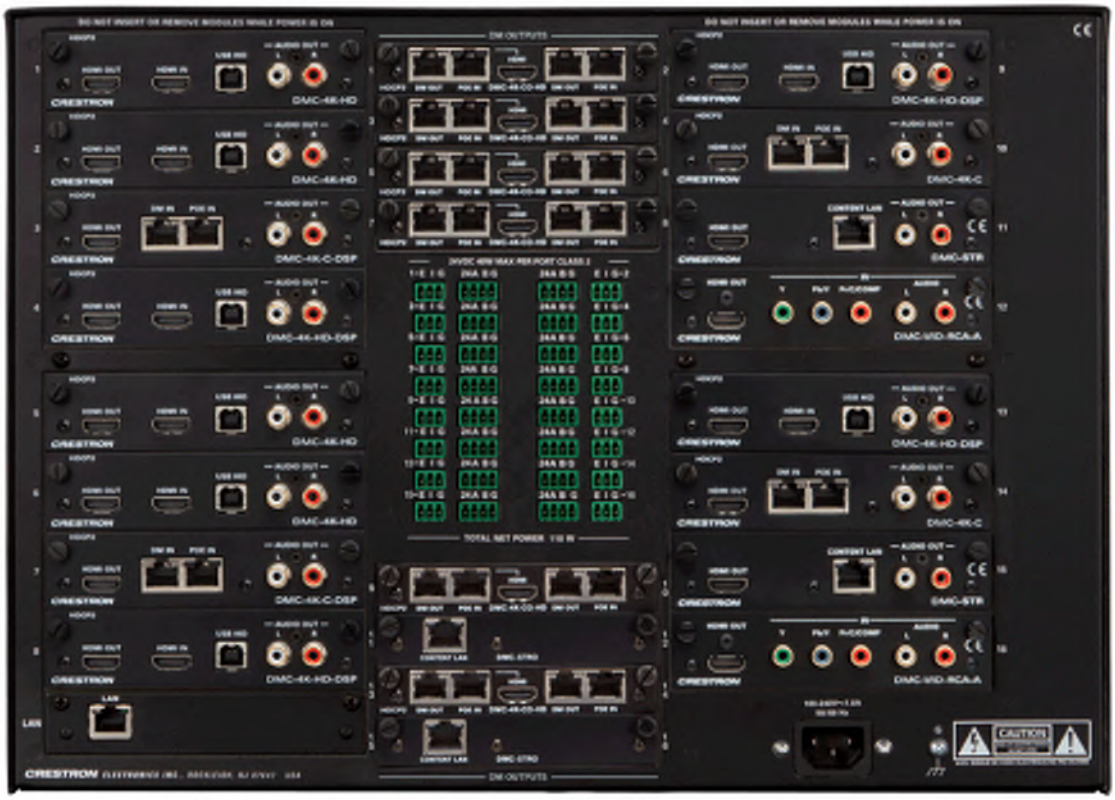
Sample Product Cutsheets (Audio-Visual)

DM-MD16X16 16x16 DigitalMedia™ Switcher



DM-MD16X16 – Rear view with I/O cards installed

Integrated Ethernet networking and USB distribution provide a complete connectivity solution combined with built-in Crestron control [2] for managing the displays and other room devices without necessitating any additional wiring. User-friendly operation, setup, and troubleshooting tools are provided through the DM-MD16X16 front panel, or via Crestron Toolbox™ software, to make setting up a complete multiroom 4K video distribution system easy.

4K Ultra HD

Crestron DigitalMedia continues to advance the standard for digital AV signal distribution, delivering the world's first end-to-end 4K system solution. From day one, the DM-MD16X16 was designed to meet the extreme bandwidth requirements for handling 4K and Ultra HD video signals. Support for 4K video also ensures support for the latest generation of computers and monitors with native resolutions beyond 1080p and WUXGA.[3]

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the DigitalMedia Switcher Configuration Tool.

DigitalMedia 8G™

As the leader in HDMI and control system technologies, Crestron developed DigitalMedia (DM) to deliver the first complete HD AV distribution system to take HDMI to a higher level. DigitalMedia allows virtually any mix of HDMI and other AV sources to be distributed throughout a room, building, or campus. The latest generation of DM is called DigitalMedia 8G (DM 8G®). Engineered for ultra high-bandwidth and ultimate scalability, DM 8G provides a true one-wire lossless transport for moving high-definition video, audio, Ethernet, and control signals over a choice of twisted pair or fiber optic cable.

DM 8G handles uncompressed Full HD 1080p, Ultra HD, 2K, and 4K video signals with support for 3D, Deep Color, and HDCP 2.2.[3] Audio capabilities include the simultaneous distribution of stereo and multichannel surround sound signals, with support for high-bitrate 7.1 audio formats like Dolby® TrueHD, Dolby Atmos®, and DTS-HD Master Audio™ as well as uncompressed linear PCM. All signals are transported over one CAT type twisted pair cable or one strand of multimode or single-mode fiber. DM 8G enables wire distances up to 330 feet (100 m) via DM 8G+® (DM 8G over twisted pair copper wire) [4,9], 1000 feet (300 m) via DM 8G Fiber (DM 8G over multimode fiber) [5,9], or 7.5 miles (12 km) via DM 8G SM Fiber (DM 8G over single-mode fiber) [6,9].

Sample Product Cutsheets (Audio-Visual)

DM-MD16X16 16x16 DigitalMedia™ Switcher

The DM-MD16X16 provides full support for Crestron DM 8G devices as well as all first-generation DM CAT[7,9] and DM Fiber[8,9] products, letting you take advantage of the latest Crestron DM 8G technology without compromising your existing investment.

HDBaseT® Certified

Crestron DigitalMedia 8G+® technology is designed using HDBaseT Alliance specifications, ensuring interoperability with other HDBaseT certified products. Via DM 8G+, the DM-MD16X16 can be connected directly to an HDBaseT compliant device without requiring a DM transmitter or receiver.

H.264 Streaming

High-performance H.264 streaming capability enables enterprise-wide distribution of HD content over an IP network. Streaming expands the capabilities of DM to remove all distance limitations and allow distribution to virtually any device — anywhere in the world. Streaming is an essential component of any complete DM system, allowing for high-definition signal routing to Crestron touch screens, digital signage displays, remote buildings, and global offices without requiring any new or dedicated wiring. Large-scale streaming to computers and mobile devices can be facilitated through integration with a streaming media system such as Wowza® or Kaltura®.

DigitalMedia with streaming affords the ability to distribute any combination of sources to virtually any device anywhere. Each streaming output supports resolutions up to HD 1080p at bitrates up to 25 Mbps. Built-in scaling enables fast, trouble-free switching between sources of any type or resolution up to 1080p or WUXGA. Audio support includes stereo signals, as well as multichannel audio signals downmixed to stereo via any "DSP" type input card.[10] High-quality video and audio is maintained using high-performance H.264 video and AAC audio compression. The encoded video and audio can be output as independent RTP streams or encapsulated in an MPEG-TS (MPEG-2 Transport Stream) container. HDCP management ensures that protected content cannot be distributed via streaming.

Each streaming output is actually fed internally by two separate switcher outputs, allowing any two input sources to appear picture-in-picture or side-by-side in a single stream. Instant, single-frame switching between two full screen images is also possible. The audio signals from both input sources can also be mixed, allowing both signals to be heard simultaneously.

The DM-MD16X16 can receive streaming signals as well as transmit them. Streaming input capability enables IP cameras and other H.264 encoded sources to be distributed via DigitalMedia alongside HDMI and other non-streaming sources. It also allows DM switchers to be bridged together across a campus or around the world, enabling simplified routing of HD content between buildings and global offices.

DigitalMedia provides many deployment options to address a wide range of streaming applications and accommodate each organization's specific IT requirements. DM with streaming supports both unicast and multicast, with or without RTSP (Real Time Streaming Protocol). Streaming connections can be configured to stream directly to one or more specific IP addresses, or to use RTSP to manage the configuration of numerous connections automatically. Any streaming input or output may be configured to stream via the DM switcher's LAN port or via a dedicated "CONTENT LAN" port, allowing the option to combine control and content on a single network or isolate them onto separate networks.

Modular Architecture

The DM-MD16X16 features a modular architecture with 16 input card slots, and 8 dual output card slots. Each card slot on the DM-MD16X16 is field-installable, allowing for easy and flexible system configuration with the ability to make changes to the system as needs change. A wide selection of input cards is offered to support a complete range of digital and analog AV signal types including HDMI, DVI, Dual-Mode DisplayPort[11], SDI, RGB/VGA and analog video, SPDIF and analog audio, HDBaseT, H.264 streaming, and all types of DigitalMedia. Available outputs include all types of DigitalMedia, as well as HDBaseT, HDMI, analog audio, and H.264 streaming.[1]

Output Expansion

An HDMI "pass-through" output is provided on every input card to allow the inputs of up to 5 DM switchers to be daisy-chained, enabling the configuration of very large distribution systems with many outputs. Using five DM-MD16X16 switchers, it is possible to support up to 80 separate outputs.

QuickSwitch HD™

Handling high-definition digital media means handling HDCP (High-bandwidth Digital Content Protection), the encryption scheme that content providers use to protect their DVDs, Blu-ray™ discs, and broadcast signals against unauthorized copying. Viewing HDCP encrypted content requires a source device to "authenticate" each display and signal processor in the system and issue it a "key" before the content can be viewed. Ordinarily this causes a complete loss of signal for up to 15 seconds each time a new source or display is selected anywhere in the system. To make matters worse, every source device has a limited number of keys available, so connect too many displays and the source will simply stop outputting a signal without warning.

Not to worry — Crestron QuickSwitch HD manages the keys for every HDCP-compliant device in the system, maintaining continuous authentication for each device to ensure fast, reliable routing of any source to any number of display devices.

Auto-Locking® Technology

Crestron Auto-Locking Technology enables super fast signal switching by instantaneously configuring every device in the signal path as soon as the signal hits the first device. Whether switching between sources or TV channels, Auto-Locking significantly reduces the time it takes each device to sense the new signal and configure itself to handle the changes, virtually eliminating any noticeable gap while switching.

EDID Format Management

With all of today's varied AV sources comes a multitude of confusing video and audio formats to keep track of, and chances are not every device in your system supports all of the same formats. Such conflicts can wreak havoc any time you route one source to more than one display or audio component. The media source feeding your 1080p or Ultra HD projector in the theater may restrict itself to a lower resolution, or even shut off

Sample Product Cutsheets (Audio-Visual)

DM-MD16X16 16x16 DigitalMedia™ Switcher

completely, if someone decides to view the same signal on a smaller TV in another room. And, instead of enjoying your theater's incredible 7.1 surround sound, you may find yourself limited to 5.1 or even plain old stereo.

DigitalMedia eliminates such conflicts by managing the EDID (Extended Display Identification Data) that modern digital devices use to communicate their capabilities. Via Crestron Toolbox software, the format and resolution capabilities of each device can be assessed, allowing the installer to configure EDID signals appropriately for the most desirable and predictable behavior.

A Scaler for Every Display

High-performance scaling capability can be added to any DM system using select output cards and DM receivers with built in HD and 4K scalers. By placing an independent scaler at every display device, DigitalMedia truly delivers the most flexible and user-friendly solution for routing multiple disparate sources to many different display devices. This "Distributed Scaler Approach" ensures an optimal image on every screen no matter what sources are selected. Distributed scaling allows a high-res computer source to be viewed on any display in the building. It also allows an SD, HD, or Ultra HD video source to be viewed simultaneously on the 4K display in your theater and on lower-resolution displays throughout the house.

Versatile Audio Routing

HDMI is the key to handling 7.1 surround sound formats like Dolby TrueHD, Dolby Atmos, and DTS-HD Master Audio. Great for your high-end home theater, but how do you share that same source with other audio zones in the house?

DigitalMedia provides the answer, allowing for the simultaneous distribution of multichannel surround sound and two-channel stereo signals from the same HDMI source. Using a choice of "DSP" type input cards, the DM-MD16X16 employs onboard digital processing to derive a stereo downmix from the original multichannel signal. Both signals can be routed separately or simultaneously from any of the switcher's DM outputs, allowing either signal to be selected for output at each DM receiver location.

Back at the switcher, the digital stereo signal is also converted to analog to enable sharing with every other room in the house via a Sonnex® Multiroom Audio System or any other audio distribution system. The DM-MD16X16 also allows surround sound processors and amplifiers to be located centrally instead of at the display location via optional local HDMI outputs.

Built-in Ethernet Switch

In addition to transporting digital video and audio, DigitalMedia can also extend 10/100 Ethernet out to each display and source device via select DM receivers and transmitters, providing high-speed connectivity for any room device that requires a LAN connection. Ethernet is also utilized internally by the Crestron control bus to manage the DM devices in the system and provide display control in each room.

Private Network Mode

To streamline its implementation on a corporate or university LAN, the DM-MD16X16 employs Private Network Mode to provide a single-point connection for the complete system. Using Private Network Mode, the DM-MD16X16 requires just one IP address for the complete DM network including all connected DM receivers and transmitters.

USB Signal Routing

Along with video, audio, and Ethernet, DigitalMedia also provides for the routing of USB HID (Human Interface Device) signals, allowing a USB HID compliant keyboard and/or mouse at one location to control a computer or media server at another location. USB HID connectivity is provided through select DM receivers, transmitters, and input cards.

Crestron also offers USB extenders to enable the routing of virtually any type of USB peripheral to any host device, all managed through the DigitalMedia system. Connect a USB over Ethernet Extender host module (USB-EXT-DM-LOCAL [12]) to each computer, media server, game system, annotator, and any other host that you want to control or communicate with. Then, install a device module (USB-EXT-DM-REMOTE [12]) at every display location to connect keyboards, mice, game controllers, white-boards, flash drives, Web cameras, and mobile devices. Every module communicates with the DM switcher over the local Ethernet network or via a direct connection to the LAN port of a DM transmitter or receiver.

CEC Embedded Device Control

The primary objective of every Crestron system is to enable precisely the control desired for a seamless user experience. DigitalMedia provides an alternative to conventional IR and RS-232 device control by harnessing the CEC (Consumer Electronics Control) signal embedded in HDMI. Through its connection to the control system, the DM-MD16X16 provides a gateway for controlling many devices right through their HDMI or HDBaseT connections, potentially eliminating the need for any dedicated control wires or IR emitters.[13]

Easy Setup

Via the front panel or using Crestron Toolbox software, every step of the DM-MD16X16's setup process is designed to be quick and easy, configuring inputs and outputs automatically while letting the installer make intelligent design decisions along the way. The switcher even tests and measures the length of each DM cable, automatically making the appropriate calibrations for optimal signal transmission to every room. With DigitalMedia, an entire 16x16 system can be commissioned in under an hour.

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the DigitalMedia Switcher Configuration Tool.

Are you upgrading an existing DM switcher that has older "multi-gang" DMCO-series output cards? Use the online Output Card Additions and Upgrades Tool to update your existing output cards and switcher to the new "single-gang" output card format.

Please refer to the DigitalMedia Resources Webpage at http://www.crestron.com/dmresources/ *for additional design tools and reference documents.*

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SPECIFICATIONS

Maximum DM 8G® Cable Lengths

Cable Type: / Resolution:	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	3rd-Party CAT5e (or better) UTP or STP
1080p60 Full HD	330 ft (100 m) via any DM 8G+ cards		
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 2K DCI @24Hz			
2048x1080 2K DCI @60Hz	330 ft (100 m) via "4K" DM 8G+ cards	230 ft (70 m) via "4K" DM 8G+ cards	165 ft (50 m) via "4K" DM 8G+ cards
2560x1440 WQHD			
2560x1600 WQXGA			
3840x2160 Ultra HD			
4096x2160 4K DCI			

Cable Type: / Resolution:	CRESFIBER8G CresFiber® 8G Multimode Fiber	3rd-Party OM3 Multimode Fiber
1080p60 Full HD	1000 ft (300 m) via DM 8G Fiber cards	500 ft (150 m) via DM 8G Fiber cards
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @24Hz		

Cable Type: / Resolution:	CRESFIBER8G-SM CresFiber 8G Single-Mode Fiber	3rd-Party G.652.D (or better) Single-Mode Fiber
1080p60 Full HD	7.5 miles (12 km) via DM 8G SM Fiber cards	
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @24Hz		

Video

Switcher: 16x16 digital matrix, modular input/output cards, Crestron QuickSwitch HD™

Input Signal Types: Configurable via modular plug-in cards supporting HDMI® (DVI & Dual-Mode DisplayPort compatible [11]), DVI, 3G-SDI, RGB/VGA, component, S-Video, composite (NTSC & PAL), DM 8G+® & HDBaseT®, DM 8G Fiber, DM 8G SM Fiber, DM® CAT (legacy), DM Fiber (legacy), & H.264 streaming

Output Signal Types: Configurable via modular plug-in cards supporting HDMI (DVI compatible [14]), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs)

Backplane Data Rate: 12.5 Gbps

Note: For additional specifications, please refer to the spec sheet for each input and output card.

Audio

Switcher: 16x16 digital multichannel audio-follow-video matrix switching, plus independent 16x16 stereo matrix for audio breakaway

Input Signal Types: Configurable via modular plug-in cards supporting HDMI (Dual-Mode DisplayPort compatible [11]), 3G-SDI, analog (stereo 2-channel), SPDIF, DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming

Output Signal Types: Configurable via modular plug-in cards supporting HDMI, analog (stereo 2-channel), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs, and most digital audio input cards also include analog stereo pass-through audio outputs)

Note: For additional specifications, please refer to the spec sheet for each input and output card.

Communications

Ethernet: 10/100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP, Private Network Mode

USB: USB signal routing via select input cards, transmitters, receivers, and extenders [15]; USB computer console port for setup

DigitalMedia: DM 8G+, DM 8G Fiber, DM 8G SM Fiber, DM Fiber, DM CAT, DMNet™, HDCP 2.2 [3], EDID, CEC, PoDM, PoDM+, Ethernet

HDBaseT: HDCP 2.2 [3], EDID, CEC, RS-232, PoH, Ethernet

HDMI: HDCP 2.2 [3], EDID, CEC

NOTE: Supports management of HDCP and EDID; supports management of CEC between connected HDMI and HDBaseT devices and a control system.[13] For additional specifications, please refer to the spec sheet for each input and output card.

Card Slots

1 – 16: (16) DM switcher input card slots;
Each slot accepts (1) DMC-series input card

DM OUTPUTS 1 – 16: (8) DM switcher output card slots;
Each slot accepts (1) DMC-series output card

Connectors

LAN: (1) 8-pin RJ45 female;
10Base-T/100Base-TX/1000Base-T Ethernet port

24ABG / EIG 1 – 16: (16) sets of (1) 4-pin and (1) 3-pin 3.5 mm detachable terminal blocks;
Comprises (16) DMNet ports with "EIG" power selection ports, each set is associated with the corresponding DM CAT output port on any installed DM CAT output card;
Each DMNet port provides power and communications for a DM CAT device connected via DM cable;
Each EIG port connects to an external power supply [16], or to the internal power source via a jumper, to power the DM CAT device connected to the corresponding DMNet port;
Maximum Load: 40 Watts (1.66 Amps @ 24 Volts DC) per port, limited to

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the available DMNet power from the internal power supply (see "Power Requirements" below) or an external power supply [16]

100-250V~7.0A 50/60Hz: (1) IEC 60320 C14 main power inlet; Mates with removable power cord, included

G: (1) 6-32 screw, chassis ground lug

COMPUTER (front): (1) USB Type B female; USB computer console port (6 ft cable included)

Controls & Indicators

LCD Display: Green LCD dot matrix, 128 x 64 resolution, adjustable LED backlight, displays inputs/outputs by name, video & audio signal information, Ethernet configuration and setup menus
SOFTKEYS: (4) Pushbuttons for activation of LCD driven functions
HW-R: (1) Recessed pushbutton for hardware reset, reboots the switcher
ROUTE: (1) Pushbutton and red LED, selects ROUTE mode to allow routing changes
VIEW: (1) Pushbutton and red LED, selects VIEW mode for viewing current routes
INFO: (1) Pushbutton and red LED, selects INFO mode for viewing AV and device info
MENU: (1) Pushbutton, steps menu back one level
ENTER: (1) Pushbutton, executes highlighted menu or value
AUDIO: (1) Pushbutton & red LED, selects audio routing view
VIDEO: (1) Pushbutton & red LED, selects video routing view
USB: (1) Pushbutton & red LED, selects USB routing view
Quick-Adjust Knob: (1) Continuous turn rotary encoder, adjusts menu parameters
IN 1 – 16: (16) Pushbuttons and red LEDs, each selects the corresponding input for routing
OUT 1 – 16: (16) Pushbuttons and red LEDs, each selects the corresponding output for routing
LAN (rear): (2) LEDs, green LED indicates Ethernet link status, amber LED indicates Ethernet activity

Power Requirements

Main Power: 7 Amps @ 100-240 Volts AC, 50/60 Hz
Power Consumption: 440 Watts typical
Available DMNet Power: 110 Watts (4.6 Amps @ 24 Volts DC) from internal power supply
Available PoDM/PoH Power: Refer to the specifications for each DM 8G+ input and output card

Environmental

Temperature: 32° to 104° F (0° to 40° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 1500 BTU/hr
Ambient Noise: 31.5 to 36 dBA typical; 29 to 30 dBA idle

Enclosure

Chassis: Metal with black finish, vented sides, fan-cooled
Front Panel: Metal, black finish with polycarbonate label overlay
Mounting: Freestanding or 7 RU 19-inch rack-mountable (adhesive feet and rack ears included)

Dimensions

Height: 12.22 in (311 mm) without feet
Width: 17.28 in (439 mm), 19.06 in (485 mm) with rack ears
Depth: 15.67 in (398 mm) without cards

Weight

28.4 lb (12.9 kg) without cards

MODELS & ACCESSORIES

Available Models

DM-MD16X16: 16x16 DigitalMedia™ Switcher

Available Accessories

DMC Series: Input & Output Cards
DM-PSU-8: 8-Port PoDM Power Supply
DM-PSU-16: 16-Port PoDM Power Supply
DM-CBL-ULTRA-NP: DigitalMedia™ Ultra Cable, Non-Plenum Type CMR
DM-CBL-ULTRA-P: DigitalMedia™ Ultra Cable, Plenum Type CMP
DM-CBL-ULTRA-LSZH: DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen
DM-CONN: Connector for DM-CBL & DM-CBL-ULTRA
DM-CBL-8G-NP: DigitalMedia 8G™ Cable, non-plenum
DM-CBL-8G-P: DigitalMedia 8G™ Cable, plenum
DM-8G-CONN: Connector for DM-CBL-8G
DM-8G-CRIMP: Crimping Tool for DM-8G-CONN
DM-8G-CONN-WG: Connector with Wire Guide for DM-CBL-8G
DM-8G-CRIMP-WG: Crimping Tool for DM-8G-CONN-WG
CRESFIBER8G-NP: CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, non-plenum
CRESFIBER8G-P: CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, plenum
CRESFIBER-CONN-SC50UM-12: Connectors for CresFiber® 8G Multimode Fiber Optic Cable, SC 50µm, 12-Pack
CRESFIBER8G-SM-P: CresFiber® 8G Single-Mode Fiber Optic Cable, plenum
CRESFIBER8G-SM-CONN-LC-12: Connectors for CresFiber® 8G Single-Mode Fiber Optic Cable, LC, 12-Pack
CRESFIBER-TK: CresFiber® Termination Kit
USB-EXT-DM: USB over Ethernet Extender with Routing

Notes:

1. All output types are configured in pairs except for streaming (a single streaming output occupies the space of two outputs of any other type). To configure a complete DM switcher with output and input cards, please use the online DigitalMedia Switcher Configuration Tool. Current DM switchers use DMC-series "single-gang" output cards. For older DM switchers with DMCO-series "multi-gang" output cards, please use the online Output Card Additions and Upgrades Tool to update your existing output cards and switcher to the new single-gang output card format.

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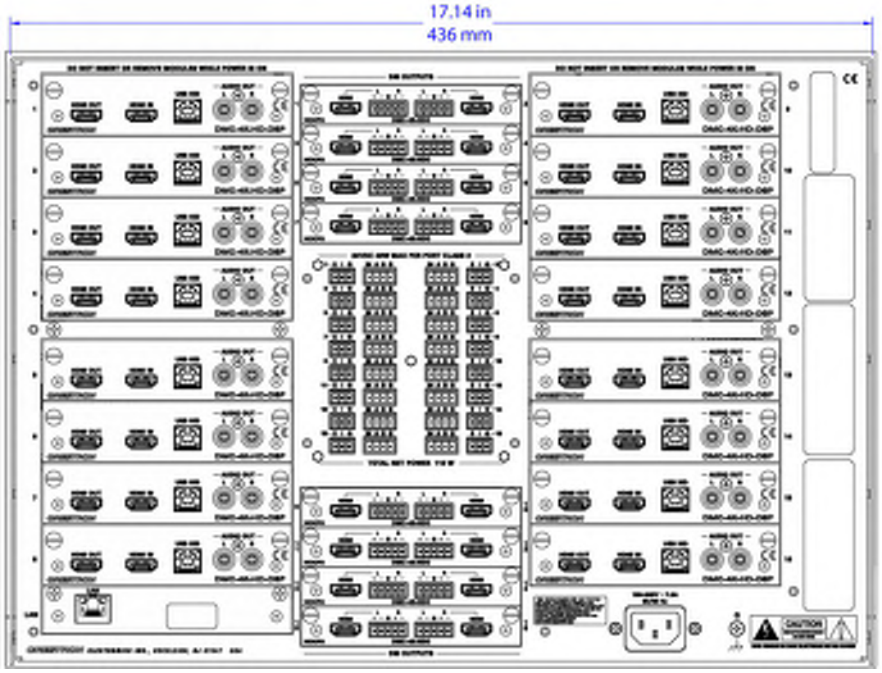
2. Crestron control via the DM network requires a Crestron control system, sold separately.
3. 4K, Ultra HD, and HDCP 2.2 are currently supported over HDMI, DM 8G+, and HDBaseT using select input and output cards. Refer to the specifications for each input/output card and each connected device for its full capabilities.
4. The maximum cable length for DigitalMedia 8G+ (DM 8G+) or HDBaseT is dependent upon the type of cable, the choice of input/output card, and the resolution of the video signal. Refer to the "Maximum DM 8G Cable Lengths" table for a detailed overview. Crestron legacy cable models DM-CBL DigitalMedia Cable and DM-CBL-D DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment.
5. The maximum cable length for DigitalMedia 8G Fiber (DM 8G Fiber) is 1000 ft (300 m) using CRESFIBER8G multimode fiber optic cable, or 500 ft (150 m) using CRESFIBER (legacy) or third-party OM3 multimode fiber optic cable.
6. The maximum cable length for DigitalMedia 8G Single-Mode Fiber (DM 8G SM Fiber) is 7.5 miles (12 km) using CRESFIBER8G-SM or third-party G.652.D (or better) single-mode fiber optic cable.
7. The maximum cable length for DigitalMedia CAT (DM CAT) is 450 ft (137 m) using DM-CBL DigitalMedia Cable. Actual cable length depends upon multiple factors. Up to two DM Repeaters (Model DM-DR) may be required.
8. The maximum cable length for DigitalMedia Fiber (DM Fiber) is 1000 ft (300 m) using CRESFIBER (legacy), CRESFIBER8G, or third-party OM2/OM3 duplex multimode fiber optic cable.
9. Refer to the Crestron DigitalMedia Design Guide, Doc. #4546 for complete system design guidelines. All wire and cables are sold separately.
10. Streaming output supports 2-channel stereo audio only. Multichannel surround sound audio sources cannot be streamed unless downmixed to stereo. Stereo downmix capability requires a "DSP" type DM switcher input card, sold separately.
11. Any HDMI input can support a DVI or Dual-Mode DisplayPort signal using a suitable adapter or interface cable.
12. Item(s) sold separately.
13. Control of third-party HDBaseT devices using CEC is only supported via "4K" DM 8G+ input and output cards.
14. DVI output is supported via an HDMI output port using a suitable adapter or interface cable. CBL-HD-DVI interface cables are available separately.
15. Manages the routing of USB HID signals between peripheral DM devices and input cards that are equipped with USB HID ports. Also programmable to manage the routing of USB signals between Crestron USB over Ethernet Extender modules (USB-EXT-DM, sold separately). Refer to the USB-EXT-DM spec sheet for more information.
16. For external DMNet power, use a Crestron CNPWS-75, C2N-SPWS300, or other Cresnet power supply as required. Do not interconnect DMNet with Cresnet.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at www.crestron.com/salesreps or by calling 800-237-2041.

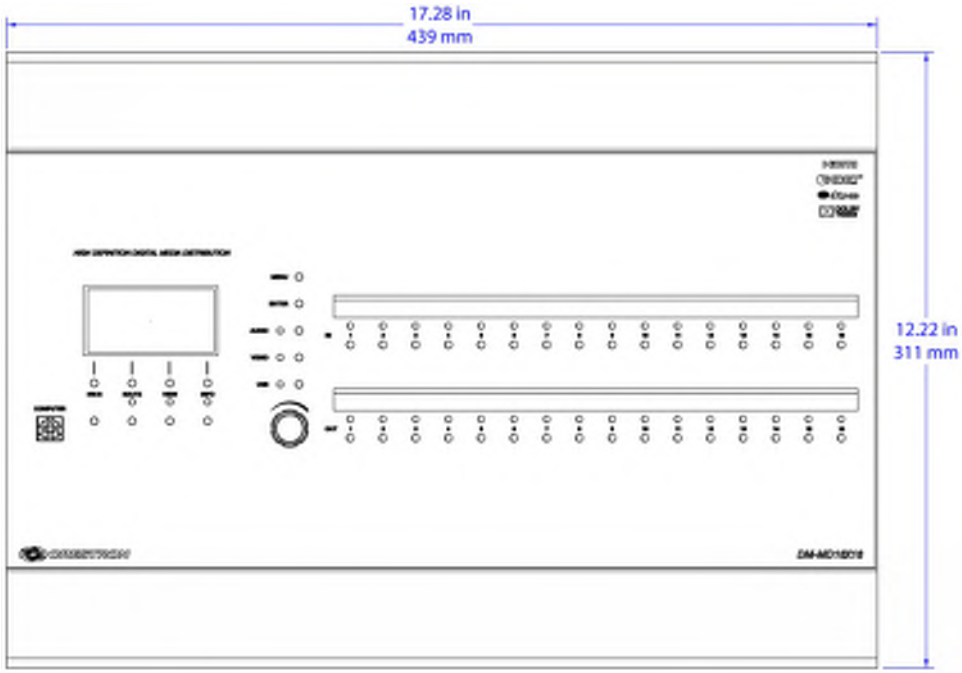
The specific patents that cover Crestron products are listed online at: patents.crestron.com.

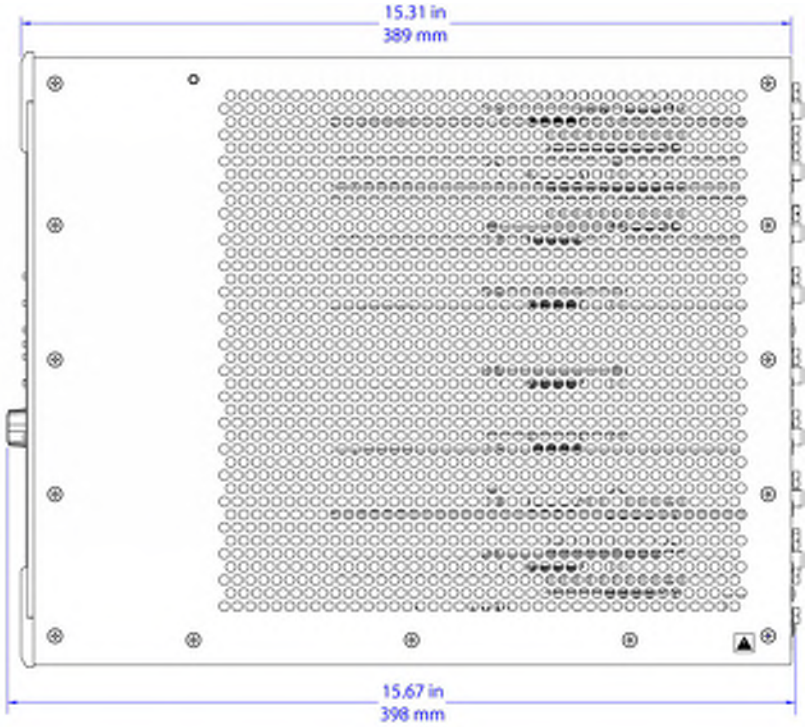
Certain Crestron products contain open source software. For specific information, please visit www.crestron.com/opensource.



Sample Product Cutsheets (Audio-Visual)

DM-MD16X16 16x16 DigitalMedia™ Switcher





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www.crestron.com

Specifications subject to change without notice. Revised 03/04/16

Sample Product Cutsheets (Audio-Visual)

DM-MD8X1-4K-C

4K Scaling Auto-Switcher w/DM 8G+® & HDBaseT® Output

The DM-MD8X1-4K-C from Crestron® provides an ultra high-definition presentation switcher with advanced features optimally suited for installation in a huddle room, conference room, or classroom. It integrates a multi-format auto-switcher, 4K video scaler, mic preamp, audio DSP, and control interface, all into one compact device that mounts conveniently under a table or in an equipment rack. Built-in Crestron Connect It™ functionality affords a complete collaboration solution that's easy and affordable to deploy in any meeting space. Built-in DM 8G+® and HDBaseT® connectivity affords a one-wire, long-distance wiring solution for a single display device, or for integration as part of a larger DigitalMedia™ distribution system.

The DM-MD8X1-4K-C works out-of-the-box to provide automatic switching between four HDMI® or VGA sources, plus on/off control of the display device. Outputs include HDMI, DM 8G+ or HDBaseT, and balanced stereo audio. Built-in 4K scaling ensures the highest possible image quality and compatibility with the widest range of sources and displays. Easy web browser setup allows for configuration of the microphone input, audio DSP, and other settings. Centralized monitoring is supported using Crestron Fusion® Cloud, and fully-programmable control can be enabled through integration with a 3-Series Control System®.[1]

Crestron Connect It™

Crestron Connect It is a cost-effective, simple-to-use presentation solution that works seamlessly with the DM-MD8X1-4K-C. Simply add up to four Crestron Connect It Cable Caddies (TT-100 series[2]) to provide BYOD connectivity and one-touch control for multiple participants around a conference table. Four USB ports on the DM-MD8X1-4K-C provide power and communications for each cable caddy.

- *Ultra high-definition, multi-format presentation switcher, scaler, mic preamp, audio DSP, and control interface*
- *Out of the box Crestron Connect It™ collaboration system functionality*
- *Supports up to four TT-100 series Crestron Connect It Cable Caddies[2]*
- *Includes four auto-switching HDMI®, VGA, and stereo analog audio inputs[5]*
- *Also supports Dual-Mode DisplayPort, DVI, and analog video sources[3,4]*
- *Input auto-detection configures each input automatically*
- *QuickSwitch HD™ technology manages HDCP keys for fast, reliable switching*
- *Performs automatic AV signal format management via EDID*
- *Provides adjustable input level compensation on each audio input*
- *Includes a single microphone input with EQ, gating, and compression*
- *Provides parallel HDMI and DM 8G+ outputs for one or more display devices*
- *DigitalMedia 8G+® connectivity enables long-distance wiring over CAT type twisted pair cable[8]*
- *Integrates with DigitalMedia™ matrix switchers to allow facility-wide signal distribution[9]*
- *HDBaseT Certified — Enables direct connection to other HDBaseT certified equipment*
- *Features a built-in, high-performance 4K scaler*
- *Upscales input signals to match the native resolution of any screen — including 4K and Ultra HD displays!*
- *Downscales 4K, UHD, and ultra high-resolution computer signals to fit 1080p and other lower-resolution displays*
- *Handles any input resolution from standard NTSC 480i or PAL 576i, to UHD and 4K*
- *Provides intelligent frame rate conversion, content-adaptive noise reduction, and motion-adaptive de-interlacing*
- *Provides 3D to 2D signal conversion, and passes 3D video (without scaling) to 3D displays[6]*
- *Provides a balanced stereo audio output with graphic EQ, limiting, and delay*
- *Enables analog-to-HDMI audio embedding and de-embedding[5]*
- *Handles Dolby® TrueHD, Dolby Atmos®, DTS-HD®, and uncompressed 7.1 linear PCM audio[7]*
- *Includes onboard IR and RS-232 control ports[10]*
- *Supports universal remotes via built-in RC-5 compatible IR receiver[10]*
- *Provides a 10/100 Ethernet LAN connection*
- *Includes front panel controls for switching and volume adjustment*
- *Includes customizable front panel label strips*
- *Allows complete AV setup and adjustment via a web browser*
- *Fully-controllable over Ethernet from a Crestron® 3-Series Control System®[1]*
- *Communicates natively with Crestron Fusion® Cloud*
- *Features an internal universal power supply for worldwide compatibility*
- *Furnishes Power over DM® or HDBaseT for PoDM/PoH-powered devices*
- *Mounts under the table or in a single 19" rack space*

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Sample Product Cutsheets (Audio-Visual)

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DM-MD8X1-4K-C — Rear View

4K Ultra HD

The DM-MD8X1-4K-C handles 4K and Ultra HD video signals, which is essential to ensure support for the latest generation of computers and monitors with native resolutions beyond 1080p and WUXGA.

Multi-Format Auto-Switcher

The DM-MD8X1-4K-C provides high-performance automatic switching between four groups of inputs, each including HDMI, VGA, and unbalanced stereo audio. The HDMI inputs are compatible with DVI and Dual-Mode DisplayPort sources [3], and the VGA inputs can handled RGB, composite, S-Video, and component video sources [4]. Digital audio is supported by the HDMI inputs, plus each analog audio input may be used in combination with its corresponding VGA or HDMI video input.[5] Input auto-detection eliminates the need to configure the inputs — simply connect your source and the DM-MD8X1-4K-C selects the right audio and video combination. The switched video signal is routed to one HDMI output and one DM 8G+ output simultaneously. The DM 8G+ output is compatible with HDBaseT.

4K Scaler

With its high-performance 4K video scaler on board, the DM-MD8X1-4K-C ensures an optimal image from every video source on practically any display device. It allows SD, HD, and all types of computer sources to look their best on Ultra HD and 4K displays, and it allows sources with resolutions above HD 1080p to be viewed reliably on 1080p and lower resolution displays. It accepts any input resolution, from standard definition NTSC 480i to ultra high-definition 4K DCI, and scales it perfectly to match the native resolution of any screen up to 4K DCI (4096 x 2160). Interlaced sources are converted to progressive scan using motion-adaptive deinterlacing. Intelligent frame rate conversion enables support for 24p and PAL format sources. And, 3D to 2D conversion allows 3D content to be viewed on 2D-only displays.[6] The output of the scaler feeds both the HDMI and DM 8G+ outputs.

Flexible Audio Outputs

The switched audio signal is routed to the HDMI output as well as to a separate balanced analog audio output, with individual level adjustments provided for each output. The HDMI output signal is also fed simultaneously to the DM 8G+ output. All inputs and outputs support stereo audio, with the option to configure the analog output for mono. Dolby® TrueHD, Dolby Atmos®, DTS-HD®, and 7.1 linear PCM audio signals can also be routed through the HDMI inputs and output, as well as the DM 8G+ output.[7]

Professional Audio DSP

The analog audio output includes professional digital signal processing, allowing the signal to be adjusted for optimum performance and sound quality. The analog output is ideally designed to be connected to an external power amplifier and used to drive a set of ceiling or wall mount speakers. In addition to volume, bass, treble, and mute controls, the DSP provides 10-band graphic equalization, fully-adjustable limiting, and up to 80 ms of delay. All settings are adjustable using the DM-MD8X1-4K-C's web browser user interface for easy setup. The output volume level is also adjustable using the front panel volume knob.

Microphone Input with DSP

A full-featured microphone preamp is included to support the connection of a single wired or wireless mic. Advanced features include fully-adjustable gating and compression, 4-band semi-parametric EQ, and switchable 48V phantom power. The microphone signal can be routed to the analog output, the digital output (HDMI and DM 8G+), or both, with separate level adjustments provided for each.

DigitalMedia 8G+®

Its DM 8G+ output endows the DM-MD8X1-4K-C with great potential for connecting to a display device and integrating with larger systems. DM 8G+ provides a true one-wire interface for transporting ultra high-definition video, audio, control, power, and networking signals over CAT type cable at distances up to 330 feet (100 meters).[8,9] Connecting a DM 8G+ receiver to the DM 8G+ output provides a streamlined AV and control interface for a single projector or flat panel display located anywhere in the room. DM 8G+ can also provide the interface to a centralized DigitalMedia matrix switcher, allowing the DM-MD8X1-4K-C's output signal to be distributed to multiple displays anywhere in the same room, other rooms, other buildings, or around the world.

HDBaseT® Certified

Crestron DM 8G+ technology is designed using HDBaseT Alliance specifications, ensuring interoperability with other HDBaseT certified products. Via DM 8G+, the DM-MD8X1-4K-C can be connected directly to an HDBaseT compliant display device without requiring a DM 8G+ receiver.

EDID Format Management

The DM-MD8X1-4K-C provides comprehensive management of the EDID (Extended Display Identification Data) information that passes between display devices and input sources, ensuring that each source gets displayed at its optimal resolution and format. Most applications require no changes to the default settings. For applications requiring custom configuration, the DM-MD8X1-4K-C allows for easy assessment of each device's format and resolution capabilities, with the ability to configure signals appropriately for the most desirable and predictable behavior.

QuickSwitch HD™ Technology

Handling digital media signals means handling HDCP (High-bandwidth Digital Content Protection), the encryption scheme used by content providers to protect their DVDs, Blu-ray™ discs, and broadcast signals against unauthorized copying. Viewing HDCP encrypted content requires a source device to "authenticate" each display and signal processor in the system and issue it a "key" before delivering an output signal. Crestron QuickSwitch HD manages these keys to ensure fast, reliable switching and

Sample Product Cutsheets (Audio-Visual)

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immunity to "blackouts," whether using a single display, or distributing to multiple displays through a larger DigitalMedia system.

Embedded Device Control

The DM-MD8X1-4K-C includes built-in IR and RS-232 control ports, which may be utilized through integration with a Crestron 3-Series Control System to enable programmable control of local AV equipment and other devices. Some video devices can also be controlled through their HDMI or HDBaseT connections using CEC (Consumer Electronics Control). Without a control system, control capability is limited to turning a single display device on and off via CEC, RS-232, or Ethernet based on detection of an active video signal.[1,10]

Note: For a version of the DM-MD8X1-4K-C with built-in 3-Series Control system, see model DMPS3-4K-100-C.

SPECIFICATIONS

Communications

Ethernet: 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP
USB: USB host ports for Crestron Connect It devices and firmware update via USB flash drive; USB device port for computer console (setup)
RS-232: 2-way device control and monitoring up to 115.2k baud with hardware and software handshaking [10]
IR/Serial: 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud; built-in RC-5 compatible IR receiver [10]
DigitalMedia™: DM 8G+®, HDCP, EDID, CEC, PoDM, Ethernet [9]
HDBaseT®: HDCP, EDID, CEC, PoH, Ethernet
HDMI®: HDCP, EDID, CEC

NOTE: Supports management of HDCP and EDID; supports management of CEC between the connected HDMI and HDBaseT devices and a 3-Series Control System®

Video

Switcher: 8x1 (organized as multi-format 4x1), auto-switching, auto-detecting multi-format digital/analog source inputs, QuickSwitch HD™ technology
Scaler: 4K video scaler, motion-adaptive deinterlacer, intelligent frame rate conversion, Deep Color support, 3D to 2D conversion [6], content-adaptive noise reduction, widescreen format selection (zoom, stretch, maintain aspect-ratio, or 1:1)
Input Signal Types: HDMI w/Deep Color, 3D, & 4K (DVI & Dual-Mode DisplayPort compatible [3]); RGB/VGA (RGBHV, RGBS, RGsB); component (YPbPr); S-Video (Y/C); composite (NTSC, PAL) [4]
Output Signal Types: HDMI w/Deep Color, 3D, & 4K (DVI compatible [3]); DM 8G+ & HDBaseT w/Deep Color, 3D, & 4K
Analog-To-Digital Conversion: 10-bit 165 MHz per each of 3 channels

Maximum Pass-Through Resolutions:

Input Type	Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
HDMI	Progressive	4096x2160 4K DCI or 3840x2160 Ultra HD	24 Hz	4:4:4	30 bit
			30 Hz	4:4:4	24 bit
			30 Hz	4:2:2	36 bit
			60 Hz	4:2:0	24 bit
		2560x1600 WQXGA	60 Hz	4:4:4	36 bit
		1920x1080 HD1080p	60 Hz	4:4:4	36 bit
	Interlaced	1920x1080 HD1080i	30 Hz	4:4:4	36 bit
RGB/VGA	Progressive	1600x1200 UXGA	60 Hz	n/a	
		1920x1200 WUXGA	60 Hz	n/a	
Component [4]	Progressive	1920x1080 HD1080p	60 Hz	n/a	
	Interlaced	1920x1080 HD1080i	30 Hz	n/a	
Composite or S-Video [4]	Interlaced	480i NTSC or 576i PAL	60 Hz	n/a	

Maximum Scaler Input Resolutions:

Input Type	Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
HDMI	Progressive	4096x2160 4K DCI or 3840x2160 Ultra HD	24 Hz	4:4:4	30 bit
			30 Hz	4:4:4	24 bit
			30 Hz	4:2:2	36 bit
		2560x1600 WQXGA	60 Hz	4:4:4	36 bit
		1920x1080 HD1080p	60 Hz	4:4:4	36 bit
	Interlaced	1920x1080 HD1080i	30 Hz	4:4:4	36 bit
RGB/VGA	Progressive	1600x1200 UXGA	60 Hz	n/a	
		1920x1200 WUXGA	60 Hz	n/a	
Component [4]	Progressive	1920x1080 HD1080p	60 Hz	n/a	
	Interlaced	1920x1080 HD1080i	30 Hz	n/a	
Composite or S-Video [4]	Interlaced	480i NTSC or 576i PAL	60 Hz	n/a	

Maximum Scaler Output Resolutions:

Output Type	Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
HDMI, DM, or HDBaseT	Progressive	4096x2160 4K DCI or 3840x2160 Ultra HD	24 Hz	4:4:4	30 bit
			30 Hz	4:4:4	24 bit
			30 Hz	4:2:2	36 bit
		2560x1600 WQXGA	60 Hz	4:4:4	36 bit
		1920x1080 HD1080p	60 Hz	4:4:4	36 bit

NOTE: Common resolutions are shown; other custom resolutions are supported at pixel clock rates up to 300 MHz for digital inputs and outputs, or 165 MHz for analog inputs

Sample Product Cutsheets (Audio-Visual)

DM-MD8X1-4K-C 4K Scaling Auto-Switcher w/DM 8G+® & HDBaseT® Output

Audio – General

Switcher/Mixer: 8x1 (organized as multi-format 4x1) stereo source switcher, auto-detecting digital/analog source inputs, single-channel gated mic preamp w/DSP, two independent mic/source mixers (one for analog output, one for digital outputs), stereo DSP for analog output, 4x1 multi-channel source switcher, digital audio mixer bypass mode for multichannel pass-through to digital outputs
Microphone input channel:
Analog-To-Digital Conversion: 24-bit 48 kHz
Digital-To-Analog Conversion: 24-bit 48 kHz
Frequency Response: 20 Hz to 20 kHz ±0.5 dB (digital source);
20 Hz to 20 kHz ±0.5 dB (analog line source);
20 Hz to 20 kHz ±0.7 dB (microphone source)
S/N Ratio: >108 dB, 1 kHz, A-weighted (digital source);
>103 dB, 1 kHz, A-weighted (analog line source)
THD+N: <0.002%, 20 Hz to 20 kHz (digital source);
<0.005%, 20 Hz to 20 kHz (analog line source);
<0.05%, 20 Hz to 20 kHz (microphone source)
Stereo Separation: >108 dB (digital source);
>103 dB (analog source)

Audio – Microphone Input

Input Signal Type: Mono analog mic level
Phantom Power: Enable/Disable
Gain: 0 to +60 dB Gain adjustment, plus Mute
EQ Center Frequencies: 50 to 200 Hz (Band 1); 200 to 800 Hz (Band 2); 800 to 3.2k Hz (Band 3); 3.2k to 12.8k Hz (Band 4)
EQ Gain: ±12.0 dB per band
Gating Threshold: -80 to 0 dB
Gating Depth (Attenuation): -80 to 0 dB
Gating Attack: 1 to 250 ms
Gating Release: 1 to 1000 ms
Gating Hold: 1 to 200 ms
Compression Threshold: -80 to 0 dB
Compression Ratio: 1:1 to 10:1
Compression Attack: 1 to 250 ms
Compression Release: 1 to 1000 ms
Compression Hold: 1 to 200 ms
Compression Curve: Hard or soft knee

Audio – Source Inputs

Typical of 8 source input channels (Audio Inputs 1 – 4 & HDMI Inputs 1 – 4)
Input Signal Types: Analog 2-channel [5], HDMI (Dual-Mode DisplayPort compatible [3])
Analog Formats: Stereo 2-channel
Digital Formats: Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby® TrueHD, Dolby Atmos®, DTS®, DTS-ES, DTS 96/24, DTS-HD High Res, DTS-HD Master Audio™, LPCM up to 8 channels [7]
Input Compensation: ±10.0 dB [7]

Audio – Analog Line Output

Output Signal Type/Format: Stereo 2-channel
Mic: -80 to +10 dB Level adjustment range, plus Mute and Pan
Source: -80 to +10 dB Level adjustment range, plus Mute and Balance
Master Volume: -80 to +10 dB Level adjustment range, plus Mute and Mono
Bass: ±12.0 dB
Treble: ±12.0 dB
Equalization: 10-band graphic
GEQ Center Frequencies: 31.5, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k Hz
GEQ Gain: ±12.0 dB per band
Delay: 0.0 to 80.0 ms
Limiter Threshold: -80 to 0 dBz
Limiter Ratio: 1:1 to 10:1
Limiter Attack: 1 to 250 ms
Limiter Release: 1 to 1000 ms
Limiter Curve: Hard or soft knee

Audio – Digital Output

Output Signal Types: HDMI, DM 8G+ & HDBaseT
Formats: Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS-ES, DTS 96/24, DTS-HD High Res, DTS-HD Master Audio, LPCM up to 8 channels [7]
Mic: -80 to +10 dB Level adjustment range, plus Mute and Pan [7]
Source: -80 to +10 dB Level adjustment range, plus Mute and Balance [7]
Master Volume: -80 to +10 dB Level adjustment range, plus Mute [7]

Connectors – Audio/Video Inputs

VGA IN 1 – 4: (4) HD15 female;
Analog VGA/RGB/video inputs;
Signal Types: VGA, RGB, component, S-Video, or composite [4];
Formats: RGBHV, RGBS, RGsB, YPbPr, Y/C, NTSC or PAL;
Input Level: 0.5 to 1.5 Vp-p with built-in DC restoration;
Input Impedance: 75 Ohms nominal;
Sync Detection: RGBHV, RGBS, RGsB, YPbPr;
Sync Input Level: 3 to 5 Vp-p;
Sync Input Impedance: 2.2k Ohms

AUDIO IN 1 – 4: (4) 3.5 mm TRS mini phone jacks;
Unbalanced stereo line-level analog audio inputs;
Input Impedance: 32k Ohms unbalanced;
Maximum Input Level: 2.8 Vrms unbalanced;
Note: If an HDMI input is selected but no digital audio signal is detected, the corresponding analog audio input is activated (AUDIO 1 for HDMI 1, etc.). Please note, the analog audio inputs do not pass audio if the HDMI video input resolution is higher than 1920x1200.

HDMI IN 1 – 4: (4) 19-pin Type A HDMI female;
Digital video/audio inputs;
Signal Types: HDMI, DVI, or Dual-Mode DisplayPort [3,4]

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MIC IN: (1) 3-pin 3.5 mm detachable terminal block;
Balanced microphone audio input;
Input Level: -60 to 0 dBV, 1 Vrms maximum;
Input Impedance: 6.5k Ohms balanced;
Phantom Power: 48 Volts DC, software enabled/disabled

Connectors – Audio/Video Outputs

HDMI OUT: (1) 19-pin Type A HDMI female;
Digital video/audio output;
Signal Types: HDMI, DVI [3]

DM OUT: (1) 8-pin RJ45 female, shielded;
DM 8G+ output, HDBaseT compliant;
PoH and PoDM PSE (Power Sourcing Equipment) port;
Connects to an HDBaseT device, or to the DM 8G+ input of a DM receiver or other DM device, via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable [8,9]

AUDIO OUT: (1) 5-pin 3.5 mm detachable terminal block;
Balanced/unbalanced stereo line-level audio output;
Output Impedance: 200 Ohms balanced, 100 Ohms unbalanced;
Maximum Output Level: 4 Vrms balanced, 2 Vrms unbalanced

Connectors - Control & Power

IR OUT: (1) 3.5 mm mini-phone jack, IR/Serial output port [10];
IR output up to 1.2 MHz;
1-way serial TTL/RS-232 (0-5 Volts) up to 115.2k baud

COM: (1) 5-pin 3.5 mm detachable terminal block;
Bidirectional RS-232 port [10];
Up to 115.2k baud, hardware and software handshaking support

LAN: (1) 8-pin RJ45 female;
10Base-T/100Base-TX Ethernet port

USB 1 – 4: (4) USB Type A female;
USB 2.0 host ports for TT-100 series Crestron Connect It Cable Caddies [2];
Also enables firmware update via USB flash drive

G: (1) 6-32 screw, chassis ground lug

100-240V~1.4A 50/60Hz: (1) IEC 60320 C14 main power inlet;
Mates with removable power cord, included

COMPUTER (front): (1) USB Type B female;
USB computer console port;
For setup only

IR IN (front): (1) Infrared sensor [10];
IR Frequency: 36 to 38 kHz;
IR Formats: Crestron format, RC5;
Allows control from IR wireless remotes using the Crestron or RC-5 command sets

Controls & Indicators

PWR: (1) Bi-color green/amber LED, indicates operating power supplied from AC line power, turns amber while booting and green when operating

MSG: (1) Red LED, indicates internal control system has generated an error message

HW-R: (1) Recessed pushbutton for hardware reset, reboots the control system

SW-R: (1) Recessed pushbutton for software reset, restarts the software program

AUTO INPUT SELECT: (1) Pushbutton and bi-color green/amber LED, selects auto-switching mode

VGA INPUT SELECT 1 – 4: (4) Pushbuttons for manual input selection, and (4) bi-color green/amber LEDs to indicate the current active input and signal presence at each corresponding VGA input

HDMI INPUT SELECT 1 – 4: (4) Pushbuttons for manual input selection, and (4) bi-color green/amber LEDs to indicate the current active input and signal presence at each corresponding HDMI input

VOLUME: (1) Continuous turn rotary encoder, adjusts the analog audio output volume

DM OUT (rear): (2) LEDs, green LED indicates DM link status, amber LED indicates video and HDCP signal presence, for the DM output

LAN (rear): (2) LEDs, bi-color LED (left) indicates Ethernet speed and activity, green LED (right) indicates Ethernet link status

Power Requirements

Main Power: 1.4 Amps @ 100-240 Volts AC, 50/60 Hz
Power Consumption: 36 Watts typical, 26 Watts idle
Power over HDBaseT (PoH): PoH PSE (Power Sourcing Equipment), each DM 8G+ port supplies up to 15.4W (Class 0-3) to one PoH PD (Powered Device)
Power over DM (PoDM): PoDM PSE (Power Sourcing Equipment), each DM 8G+ port supplies up to 15.4W (Class 0-3) to one PoDM PD (Powered Device)

Environmental

Temperature: 41° to 104° F (5° to 40° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 122 BTU/hr typical, 89 BTU/hr idle

Enclosure

Chassis: Metal, black finish, fan-cooled, vented sides
Front Panel: Metal, black finish with polycarbonate label overlay
Mounting: Freestanding, 1 RU 19-inch rackmount, or under-table mount (adhesive feet, rack ears, and under-table mounting brackets included)

Dimensions

Height: 1.74 in (45 mm) without feet
Width: 17.28 in (439 mm);
18.94 in (482 mm) with rack ears
Depth: 10.47 in (266 mm)

Weight

6.4 lb (2.9 kg)

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DM 8G+ & HDBaseT Maximum Cable Lengths

Cable Type: / Resolution:	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	CAT5e (or better) UTP or STP [8]
1080p60 Full HD	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 2K DCI			
2560x1440 WQHD		230 ft (70 m)	165 ft (50 m)
2560x1600 WQXGA			
3840x2160 Ultra HD			
4096x2160 4K DCI			

MODELS & ACCESSORIES

Available Models

DM-MD8X1-4K-C: 4K Scaling Auto-Switcher w/DM 8G+® & HDBaseT® Output

Available Accessories

TT-100 Series: Crestron Connect It™ Cable Caddy
AM-100: AirMedia™ Presentation Gateway
MP-AMP30: Media Presentation Audio Amplifier
MP-AMP40 Series: Media Presentation Audio Amplifiers, 70 or 100 Volt
AMP Series: Commercial Power Amplifiers
DM-RMC-4K-100-C-1G: Wall Plate 4K DigitalMedia 8G+® Receiver & Room Controller 100
DM-RMC-4K-100-C: 4K DigitalMedia 8G+® Receiver & Room Controller 100
DM-RMC-4K-SCALER-C: 4K DigitalMedia 8G+® Receiver & Room Controller w/Scaler
DM-RMC-4K-SCALER-C-DSP: 4K DigitalMedia 8G+® Receiver & Room Controller w/Scaler & Downmixing
DM-RMC-200-C: DigitalMedia 8G+® Receiver & Room Controller 200
DM-RMC-SCALER-C: DigitalMedia 8G+® Receiver & Room Controller w/Scaler
STIRP: IR Emitter Probe w/3.5mm Mini Phone Plug
CNSP-XX: Custom Serial Interface Cable
Crestron Fusion®: Enterprise Management Platform
DM-CBL-ULTRA-NP: DigitalMedia™ Ultra Cable, Non-Plenum Type CMR
DM-CBL-ULTRA-P: DigitalMedia™ Ultra Cable, Plenum Type CMP
DM-CBL-ULTRA-LSZH: DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen
DM-CONN: Connector for DM-CBL-ULTRA
DM-CBL-8G-NP: DigitalMedia 8G™ Cable, non-plenum
DM-CBL-8G-P: DigitalMedia 8G™ Cable, plenum
DM-8G-CONN: Connector for DM-CBL-8G
DM-8G-CRIMP: Crimping Tool for DM-8G-CONN
DM-8G-CONN-WG: Connector with Wire Guide for DM-CBL-8G
DM-8G-CRIMP-WG: Crimping Tool for DM-8G-CONN-WG

CBL Series: Crestron® Certified Interface Cables
MP-WP Series: Media Presentation Wall Plates
MPI-WP Series: Media Presentation Wall Plates - International Version

Notes:

1. Compatible with 3-Series® control systems only. Not compatible with 2-Series or prior generation control systems.
2. Item(s) sold separately.
3. HDMI requires an appropriate adapter or interface cable to accommodate a DVI or Dual-Mode DisplayPort signal. CBL-HD-DVI interface cables are available separately.
4. The VGA inputs can accept component, composite, and S-Video signals using an appropriate adapter (not included). However, input sync detection is not provided for composite or S-Video signal types.
5. When using an analog audio input in combination with an HDMI video input, the source's video resolution must be 1920x1200 or lower. The analog audio input will not pass audio if the source's video resolution is higher than 1920x1200.
6. Automatically passes 3D video if the display device supports it (reverts to pass-through mode without scaling). Provides automatic 3D-to-2D conversion (with scaling) if the display device does not support 3D.
7. Routing of a multichannel audio signal via a digital input and output (HDMI, HDBaseT, or DM) requires the input to be set for "mixer bypass" mode. When that input is selected, all audio controls on the digital output are disabled and the ability to route the microphone signal to that output is defeated. Mixer bypass mode also disables the Input Compensation control on that input.
8. The maximum cable length for DigitalMedia 8G+ (DM 8G+) or HDBaseT is dependent upon the type of cable and resolution of the video signal. Refer to the "DM 8G+ & HDBaseT Maximum Cable Lengths" table for a detailed overview. Crestron legacy cable models DM-CBL DigitalMedia Cable and DM-CBL-D DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. Refer to the Crestron DigitalMedia Design Guide, Doc. #4546 for complete system design guidelines. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment. All wire and cables are sold separately.
9. The DM-MD8X1-4K-C cannot connect to an Ethernet LAN over a DM connection. It must be connected using its onboard LAN port. Ethernet over DM is only utilized on the DM-MD8X1-4K-C for connecting a single DM receiver.
10. When used without a control system, the IR OUT port and IR IN sensor are not utilized, and the COM port supports only basic display device control. The IR OUT port, IR IN sensor, and COM port may all be utilized for fully-customizable applications through integration with an external 3-Series Control System with custom programming.

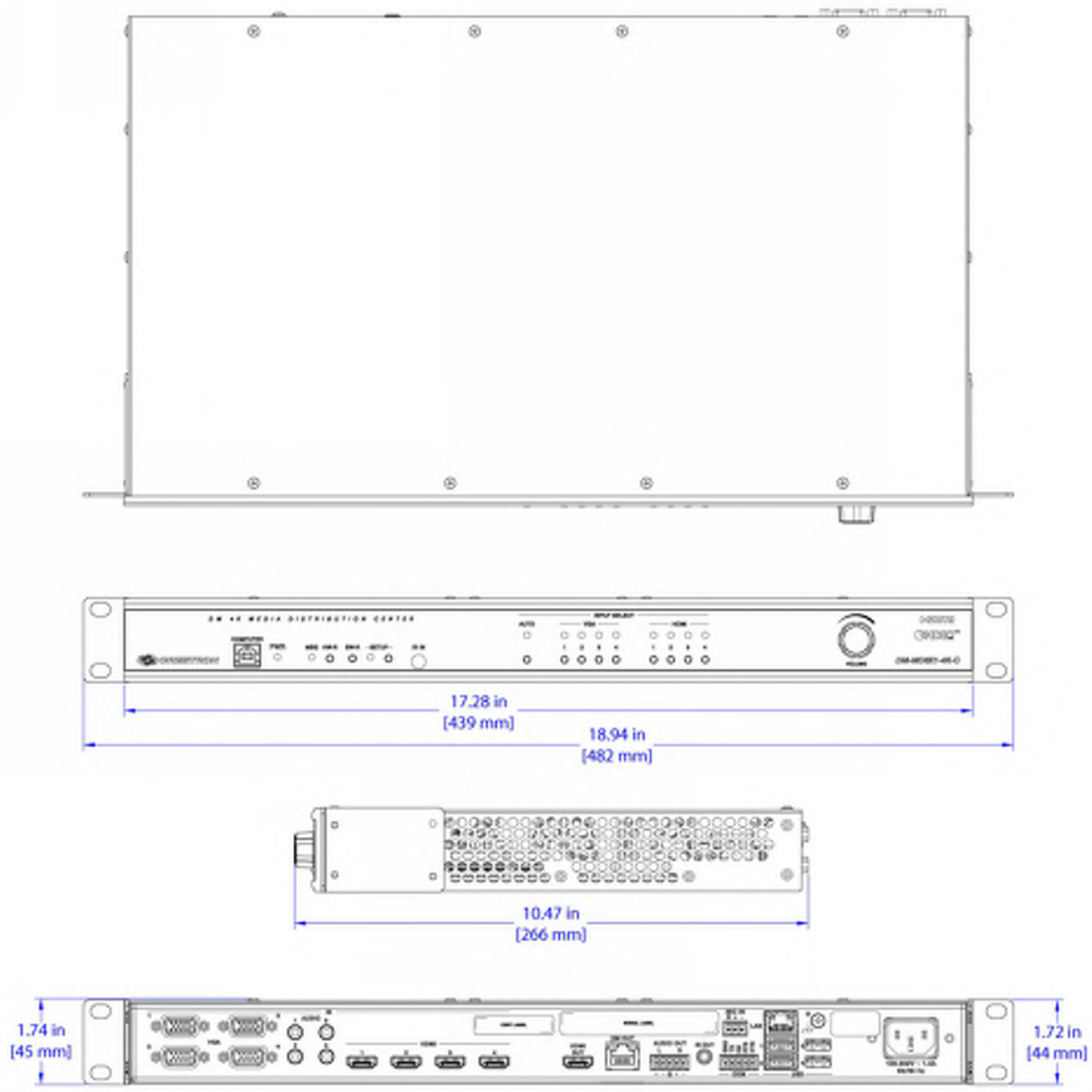
This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at www.crestron.com/salesreps or by calling 800-237-2041.

The specific patents that cover Crestron products are listed online at: patents.crestron.com.

Certain Crestron products contain open source software. For specific information, please visit www.crestron.com/opensource.

Sample Product Cutsheets (Audio-Visual)

DM-MD8X1-4K-C 4K Scaling Auto-Switcher w/DM 8G+® & HDBaseT® Output



Crestron Electronics, Inc. 15 Volvo Drive | Rockleigh, NJ 07647
Tel: 800.237.2041 / 201.767.3400 | Fax: 201.767.1903
www.crestron.com

Sample Product Cutsheets (Audio-Visual)

ARCHITECTURAL CONNECTIVITY

Cable Cubby 500

SERIES/2 CABLE ACCESS ENCLOSURE FOR AV CONNECTIVITY, REMOTE CONTROL, AND POWER

- **Accommodates one Series/2 AC or AC+USB Power Module, plus three Retractors, four AV cables, or two AAP- Architectural Adapter Plates**
- **Patented modular design for fast assembly and serviceability**
- **Retractor, Cable Pass-Through, and AAP brackets included**
- **AC Power and AC+USB Power Modules are available for US, Europe, and other major world markets**
- **Cable Cubby 500 CCB includes buttons that provide convenient control for Extron switchers and other devices that have contract closure control ports**
- **UL/c-UL listed and CE compliant**

The Extron **Cable Cubby 500** is a compact, modular furniture-mountable enclosure that provides convenient connectivity for AV signals, data, and power. It is ideal for use in training rooms or conference rooms where tabletop connectivity is needed within a user's reach.

Extron Electronics
INTERFACING, SWITCHING AND CONTROL

Sample Product Cutsheets (Audio-Visual)

DESCRIPTION

The Extron **Cable Cubby® 500** is a modular, furniture-mountable cable access enclosure for AV connectivity and power. It accommodates an AC or AC+USB power module and includes mounting brackets for Retractor cable retraction modules, AV cables or AAP - Architectural Adapter Plates. The enclosure's patented modular design allows cables and AAPs to be installed or serviced from the top of the enclosure. For fast installation, the Cable Cubby 500 has a simple, integrated clamp system that quickly secures the enclosure to the furniture surface without the need for additional parts or tools. The **Cable Cubby 500 CCB** includes buttons that provide convenient control for Extron switchers and other devices that have contract closure control ports. Three brushed stainless steel pushbutton switches feature a raised surface for ease of access and tactile feedback, and LED rings around the switches provide illumination for visual feedback. Power modules are available for the US, Europe, and other major world markets. The Cable Cubby 500 is available in a black anodized or brushed aluminum finish.

Cable Cubby 500 CCB

KEY FEATURES

- **Optional Retractor cable retraction system supports most AV and data signal types**
- **Integrated side clamps secure enclosure to the furniture surface**
- **Top surface is available in a black anodized or brushed aluminum finish**
- **Installation routing templates available:**
  – Cable Cubby 500 Routing Template; part #70-1048-80
  – Cable Cubby 500 CCB Routing Template; part #70-1049-80
- **Cable Cubby Builder is available at www.extron.com/cablecubbybuilder** – Intuitive online tool for enclosure selection, pricing, and cable and connectivity selection.

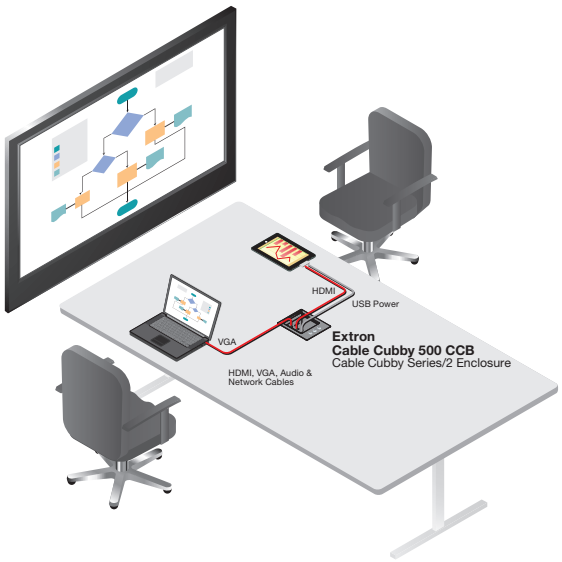
SPECIFICATIONS

SWITCH CONTACT CLOSURE – CABLE CUBBY 500 CCB ONLY	
Quantity/type	(3) momentary single pole, double throw switch
Connectors	(3) 5 pole, 3.5 mm captive screw connector on 4" pigtail
LED color	Blue
NOTE: Each switch can be used to select an input on a connected switcher with contact closure ports. See the Cable Cubby 500 and 700 Installation Guide for details.	
GENERAL	
Enclosure dimensions	
Cable Cubby 500	
Top plate (outer rim)	6.1" L x 6.1" W (15.6 cm L x 15.6 cm W)
Surface cutout (inside rim)	5.75" L x 5.75" W (14.6 cm L x 14.6 cm W)
Cable Cubby 500 CCB	
Top plate (outer rim)	6.4" L x 7.8" W (16.3 cm L x 19.8 cm W)
Surface cutout (inside rim)	5.75" L x 7.1" W (14.6 cm L x 18.1 cm W)
Mounting	
Furniture mount	Yes
Min./max. table thickness	0.50" to 2.50"
Enclosure type	Metal
Regulatory compliance	
Safety	UL, c-UL, CE

Model	Version Description	Part number
Cable Cubby 500	Black-with US AC Power Module	60-1404-02
Cable Cubby 500	Black-AC Module Not Included	70-1045-02
Cable Cubby 500	Brushed Aluminum-AC Module Not Included	70-1045-08
Cable Cubby 500 CCB	Black w 3 Buttons-AC Module Not Included	70-1125-02

For complete specifications, please go to www.extron.com
Specifications are subject to change without notice.

APPLICATION DIAGRAM



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Sample Product Cutsheets (Audio-Visual)

DENON PROFESSIONAL

www.denonpro.com PHONE: [401] 658.3131 November 9, 2017

DN-500BD Blu-Ray, DVD and CD Player

Key Features:

- Panel lock and IR remote lock functions prevent unwanted or accidental operation
- Power-on Play button eliminates extra steps, provides simplified, ultra-fast startup
- OSD (On Screen Display) hiding mode eliminates unwanted disc status updates
- Repeat mode offers an uninterrupted playback loop
- Supports BD-Video, BD-R, BD-RE, DVD-Video, DVD-Audio, DVD+R, DVD+RW
- Default repeat setting
- RS-232C and IP control capability
- XLR balanced audio output
- Discrete 7.1ch analog audio output
- Transport controls located conveniently on the front panel
- Occupies only a single rack space (1RU)

Overview:

DENON PROFESSIONAL'S VERSATILE DN-500BD BLU-RAY PLAYER

The Denon Professional DN-500BD Blu-ray disc player is a compact, high performance unit that handles all popular optical video playback formats for unrivaled capability from a single disc playback device.

The DN-500BD offers a tremendous amount of performance and flexibility in a space-saving single rack unit (1RU) chassis. It provides the wide range of connection and

Specifications:

- Digital System
  - System
    - Digital media player (Blu-ray Disc, DVD, CD, USB device [mass storage class]) AVCHD playback format
  - Supported Disc Formats
    - Blu-ray Disc: BD25, BD50, BD-ROM, BD-R, BD-RE
    - DVD: DVD, DVD+R, DVD-R, DVD+RW, DVD-RW
    - CD: CD, CD-R, CD-RW, DTS Music Disc (DTS Audio CD, 5.1 Music Disc), HDCD, Super Video CD (SVCD), Video CD (VCD)
  - Supported File Formats
    - Video: .3gp, .asf, .avi, .dat, .divx, .mkv, .mov, .mp4, .mpg, .m2ts, .ogm, .rmvb, .tp, .ts, .wmv
    - Subtitles: .ass, .smi, .srt, .ssa, .sub
    - Audio: .ape, .flac, .m4a (AAC), .mp3, .wav, .wma
    - Picture: .gif, .jpg (or .jpeg), .png
  - Supported File Systems
    - FAT16, FAT32, NTFS
    - USB drive (mass storage class) with < 2 TB total capacity
  - Video
    - Resolutions Auto, 480i/576i, 480p/576p, 720p, 1080i, 1080p
    - Aspect Ratios 16:9 Full, 16:9 Normal, 4:3 Pan & Scan, 4:3 Letterbox
    - System NTSC, PAL, Multi (if supported by TV)
    - HDMI Color Space: RGB PC Level, RGB Video Level, YCbCr (4:4:4), YCbCr 4:2:2
    - Output: HDMI > v1.4 (3D), HDCP 1.4
  - Decoding
    - Video: DivX 3, 4, 5, 6; DivX HD; MPEG-1; MPEG-2; MPEG-4; MPEG-4 AVC (H.264); VC-1 (Windows Media Video); Xvid
    - Audio: AAC; Dolby Digital; Dolby Digital Plus; Dolby TrueHD; DTS Digital Surround; DTS-HD; WMA
- Audio
  - Analog Outputs
    - Output Level (balanced XLR): +4 dBu = +1.786 dBV
    - Output Level (unbalanced RCA): +6 dBV

Sample Product Cutsheets (Audio-Visual)

control capabilities that are essential to the professional user, making it ideal for use in corporate A/V, education, theaters, house of worship, and more. These include RS-232C and IP controllability and XLR balanced audio outputs. The DN-500BD also has discrete 7.1 channel analog outputs for simple connection to powered speakers or signal management devices.

The Denon Professional DN-500BD will play virtually every Blu-ray, DVD, and audio CD format, making it easy to utilize multiple disc formats within a system. Supported formats include BD-Video, BD-R, BD-RE, DVD-Video, DVD-Audio, DVD+R, DVD+RW (Video mode, AVCHD format), DVD-R, DVD-RW (Video mode, AVCHD format) and Audio CD (CD-R, CD-RW). Using the built-in LAN port, users may optionally access additional content via BD Live. For even more versatility, a front-loading USB slot delivers access to MP3, WAV, FLAC, MP4, WMV, JPG, PNG, GIF files, and more.

In addition to its extremely high performance and wide range of format playback capabilities, the DN-500BD anticipates your requirements and operational patterns by providing features that maximize the unit's ease of use.

The Denon Professional DN-500BD combines no-compromise performance, wide-ranging connection and control capability, and compatibility with virtually every disc format there is—all in a compact single rack space unit. Its unique combination of performance, versatility and compact size is ideally suited to the professional user.

- Digital Output
  - Output Level (coaxial): 0.5V, 75Ω
  - Signal Format: AES/EBU
- Surround Audio
  - DTS-Master Audio, DTS-HD High Resolution Audio, DTS Digital Surround, Dolby TrueHD, Dolby Digital (AC-3), Dolby Digital Plus (7.1ch)
- Frequency Response: 20 Hz – 20 kHz (+0.5 dB)
- Signal-to-Noise Ratio: > 100 dB (A-weighted)
- Total Harmonic Distortion: < 0.05%
- Dynamic Range: > 100 dB (A-weighted)
- Headroom: 6 dB
- Channel Separation: > 90 dB

- Outputs
  - (2) XLR audio outputs (L/R, balanced)
  - (2) RCA audio outputs (L/R, unbalanced)
  - (8) RCA audio outputs (7.1 surround sound)
  - (1) Coaxial digital audio/visual output
  - (1) HDMI audio/visual output
  - (1) RJ-45 LAN port
  - (1) 9-pin D-Sub female RS-232C port
  - (1) IEC power connection
- Communication
  - Remote Control
    - Infrared protocol, > 200 mV transmission output level
  - Serial Remote
    - Connector: 9-pin D-Sub female, RS-232C
    - Mode: Full duplex
    - Baud Rate: 9600 or 38400 bps (selectable)
  - Ethernet
    - Connector: LAN port
    - Standards: Ethernet (10 Mbps), Fast Ethernet (100 Mbps)
- Environmental Conditions
  - Operating temperature: 41 – 95 °F (5 – 35 °C)
  - Operating humidity: 25 – 85%, no condensation
- General
  - Power
    - Connection: IEC
    - Requirement: 100–240 VAC, 50/60 Hz
    - Consumption: 15 W typical, < 0.5 W standby
  - Dimensions (width x depth x height, with rack ears)
    - 19.00" x 10.75" x 1.73" (483 mm x 273 mm x 44 mm)
  - Weight (with rack ears)
    - 5.9 lbs. (2.7 kg)

Sample Product Cutsheets (Audio-Visual)

Specifications

MAIN CAMERA

LENS	f=4.9mm - 78.4mm F2.7
FRAME RATE	30fps
SHOOTING AREA	max. 15.7" x 12.6" SXGA
ZOOM	16x Optical / 8x Digital
FOCUS	Auto / Manual/ Zoom Sync
IMAGE PICK-UP DEVICE	1/2.8" CMOS
TOTAL PIXELS	H: 2144, V: 1588
EFFECTIVE PIXELS	H: 1920, V: 1536
ANALOG RGB OUTPUT	SXGA, WXGA, XGA, 1080p, 720p
HDMI OUTPUT	1080p, 720p, Audio Output
WHITE BALANCE	Auto / One-Push / Manual
POSI/NEGA CONVERSION	Provided
COLOR/B&W SELECTION	Provided
BRIGHTNESS CONTROL	Auto / Manual
IMAGE ROTATION	180°
IMAGE MODE	Text1 / Text2 / Text3 / Grapics1 / Graphics2
GAMMA SETTING	Provided (Only for graphic mode)
EDGE EFFECT	Provided (Only for graphic mode)
PAUSE	Provided
STILL IMAGE STORAGE	Provided
MOVIE STORAGE	Provided
FLICKER CORRECTION	60Hz/50Hz
ILLUMINATION LIGHT	White LED

GENERAL

POWER SOURCE	12VDC (AC adapter AC100-240V)
POWER CONSUMPTION	21.6W
DIMENSIONS	W14.8" x D19" x H21.6" (Setup) W14.8" x D19" x 7.1" (Folded)
WEIGHT	10.4lbs
INPUT SELECTION	Main / External
OUTPUT TERMINAL	RGB Mini Dsub 15P conn. female x1 HDMI terminal x 1 Line Out terminal 3.5mm x 1
INPUT TERMINAL	RGB Mini Dsub 15P conn. female x1 Mic in/Line Out terminal 3.5mm x1
EXTERNAL CONTROL DEVICE	USB Device (2.0 compliant) x1
MEMORY INTERFACE	SD card slot x1 USB host (2.0 compliant) x1

Contact us

For more information visit
www.elmousa.com

Phone:
516.501.1400
1800.947.ELMO

Email:
elmo@elmousa.com

Sample Product Cutsheets (Audio-Visual)

Full HD

Along with a specially crafted lens, the P10HD is equipped with HDMI output to give you a full HD picture.

Platform

The P10HD comes with a large platform to accurately display your documents and objects, giving you the best view with no background distractions.

128x Zoom

The P10HD is equipped with 16x optical and 8x digital zoom giving you an incredible 128x zoom, allowing you to get up close and personal with objects.

Flexible

The P10HD is one of the most flexible platform cameras in its class. The arm, head and light can each bend to give you the view you want

Inputs/Outputs

HDMI Output / RGB Input & Output

Quick Navigation Buttons

Easy access to main menu options

USB/SD Storage

Store your lessons via USB or SD to review later

ELMO

For more information visit
www.elmousa.com

Sample Product Cutsheets (Audio-Visual)

Pod Specs and Reference Material

The Solstice Pod integrates Mersive's award-winning Solstice collaboration software with a dedicated hardware platform to deliver a turnkey wireless content sharing solution. The Solstice Pod connects to any room display via HDMI and attaches to your WiFi/Ethernet network(s). This guide covers all Pod reference material, including:

- Hardware and Technical Specs
- Solstice Network Port Diagram
- Security Specs
- Full Configuration Options
- Licensing and Maintenance Information
- Resetting the Pod to Factory Settings

If you are looking for instructions on how to evaluate, deploy, and manage your Pod(s), refer to the Pod Admin Guide.

Hardware and Technical Specs

Pod Hardware Ports

- Power connector, DC 12V at 3Amps
- HDMI 1.4
- Stereo out, 8-channel 7.1 surround sound
- Gigabit Ethernet
- 2x USB 2.0

Technical Specifications

Dimensions

Hardware Type	Compute Console
Size	126mm x 101mm x 25.8mm
Weight	0.65lbs

System Specifications

Processor	Qualcomm Snapdragon™ S805, Krait 450
Graphics Processor	Adreno™ 420
Internal Storage	3GB RAM, 16GB Flash Storage
Ethernet	RJ45 Gigabit
Wireless	Dual band, 802.11ac 2×2 MIMO
Output	HDMI 1.4 output with Audio, Stereo output (8-channel 7.1 surround sound)
Streaming Video Support	HD (1920×1080), SD (1280×720)

Sample Product Cutsheets (Audio-Visual)

Solstice Datasheet

I/O	2x USB 2.0

Power

Input	DC 12V @ 3A max
Efficiency Level	VI
Adaptor	Switching 100-240VAC, 50/60Hz, changeable plug type (international support)
Adaptor Region Support:	US, EU, AK, AUS

Testing and Certifications

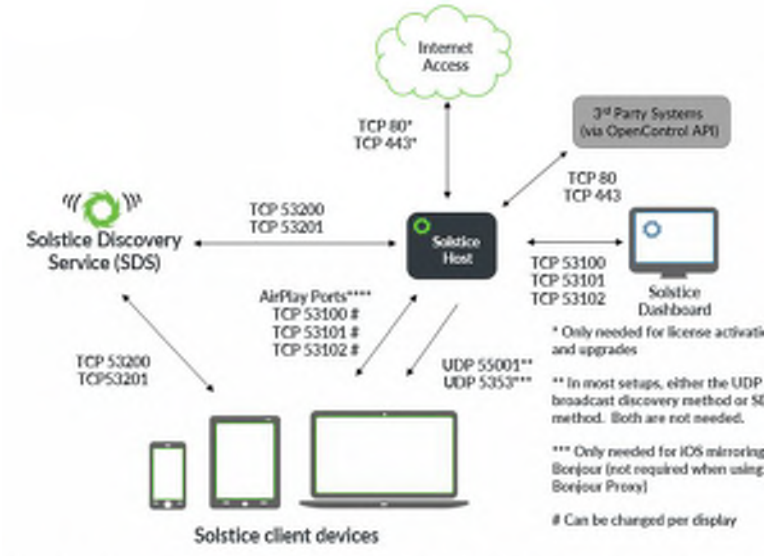
Safety	UL
Emissions Testing	FCC, CE (Home and Office Use)
Regional Certification Marks	USA, Canada, Europe, China, Australia/New Zealand, Singapore, Mexico
Accessibility	WCAG 2.0 AA Compliant. Full VPAT document available here.

Warranty

Hardware Warranty	The Solstice Pod includes a limited 1 year manufacturer's hardware warranty.

Network Port Diagram

Solstice uses standard TCP/IP network traffic to communicate across all the required and optional components of the Solstice system. Depending on your deployment configuration, certain network ports/routes must be open for Solstice to work correctly. The full list of Solstice network ports used can be found in the diagram below.



Inbound AirPlay® traffic to the Solstice Host should be allowed on TCP 6000-7000, 7100, 47000, and 47010, as well DP 6000-7000 and 7011. AirPlay ® traffic inbound to the Solstice client devices on TCP 7001 should also be allowed.

- **TCP ports 53100, 53101, and 53102** are used by default for basic communications between the Solstice host and both end user devices and the Solstice Dashboard. Three sequential ports are required, but the base port (53100 by default) may be changed on a per-host basis through the display's configuration panel or the Dashboard.
- **UDP port 55001** is used for display discovery if broadcast discovery mode is enabled.

Sample Product Cutsheets (Audio-Visual)

- **TCP ports 53200 and 53201** are used by the Solstice host and end user devices to communicate the Solstice Discovery Service (SDS) host if SDS discovery mode is enabled.
- **UDP port 5353** is required for iOS mirroring via the Bonjour protocol. It is not required when using the Solstice Bonjour Proxy.
- **TCP ports 6000-7000, 7001, 47000, and 47010** should allow inbound AirPlay® traffic to the Solstice host.
- **UDP ports 6000-7000 and 7011** should allow inbound AirPlay® traffic to the Solstice host.
- **TCP port 7001** should allow inbound AirPlay® traffic
- **TCP ports 80 and 443** are used if the Solstice host is allowed to connect to the internet for license activation and software upgrades.
- **TCP ports 80 and 443** are used by the OpenControl API to interface with 3rd party systems.

Security Specifications

The Pod was developed with important security features designed to prevent security breaches and minimize risk exposure. However, any network attached devices that are not configured properly can be vulnerable to user and network security breaches.

Prior to deploying Solstice in a security-sensitive environment, please read our Baseline Security Standard document.

Security Features

- **No installation of 3rd party applications** // Software updates must be signed by Mersive's secure certificate before they can be installed on a Pod.
- **Administrator password policy enforcement** // Enterprise password policies are enforced to ensure that Pods are locked with a password that is not susceptible to brute force attacks.
    - Passwords must be at least 8 characters in length, contain at least one uppercase and one lowercase letter, and contain at least one number or symbol. Any password will also not contain three consecutive characters.
    - When changing the password, a minimum of 3 characters must be changed in the new password.
    - When setting a new password, it must be different than the ten previously-used passwords.
- **In-room and web-based configuration access restriction** // Pods can be configured to disable in-room keyboard/mouse configuration as well as browser-based access. This limits configuration access to authorized users through the Solstice Dashboard.
- **Repeated password attempt lockouts** // Users who attempt to unlock a Pod with an invalid password more than 5 times within a 30-minute period will cause the Pod to ignore further login attempts for a period of 30 minutes.
- **Configuration lockout on untrusted networks** // When in dual-network mode, the Pod can be configured to disable any configuration access from one of the two connected networks. This can be used to disallow configuration attempts from installations that support guest wireless access.
- **Command Whitelist Enforcement** // Any command transmitted to the Pod over the network is compared to a whitelist before it is executed. This reduces vulnerabilities related to unauthorized commands and unexpected command payloads.
- **Code Obfuscation** // While access to a Pod's code has been disabled, the Solstice Pod is additionally protected through code obfuscation so that sensitive information cannot be captured even in the event that a Pod's source is compromised.
- **Connection Logging** // The Pod captures logs that include connection information, configuration changes, and other events. These logs can be used for diagnostics and security review.

Encryption

Network traffic between Solstice clients and (a) Solstice Enterprise Edition Pod(s) can be encrypted to provide additional security. This is enabled in the centralized IT management console: the Solstice Dashboard for Enterprise Edition. When enabled, traffic is encrypted using a 2048-bit length encryption key for all network traffic between the Pod and user devices. Encryption is also applied to traffic between the centralized dashboard and the Pod. Browser-based access for Pod Web Configuration utilizes OpenSSL and HTTPS when encryption is enabled.

Operating System Security Considerations

Sample Product Cutsheets (Audio-Visual)

Solstice Datasheet

The Pod appliance has been engineered for secure deployment behind the corporate firewall. Users are not able to access the Pod's underlying operating system or firmware and new software cannot be installed on the Pod unless it is a certified software update from Mersive.

Software Security and Access Options

In addition to system-level security, the Solstice Software itself provides users with the ability to secure their meetings. Both the Solstice Software and the Configuration Panel can be configured to enforce authentication through password access. Some of the security features include:

- **Disable/Enable Local Configuration:** Administrators can disallow configuration of the Solstice Software without the use of an administrator password.
- **Disable Guest Network Configuration:** All configuration options can be disabled for users on a guest network while remaining accessible to those on the enterprise network.
- **Screen Key**: An on-screen key must be entered by users at connection time. The on-screen key is a 4-digit alphanumeric code that is randomly generated. The alphanumeric code is re-generated when users disconnect.
- **Moderation Mode**: A user may choose to moderate a session to restrict which other users are approved into the meeting, and to preview all content posts before it is shared live to the display.

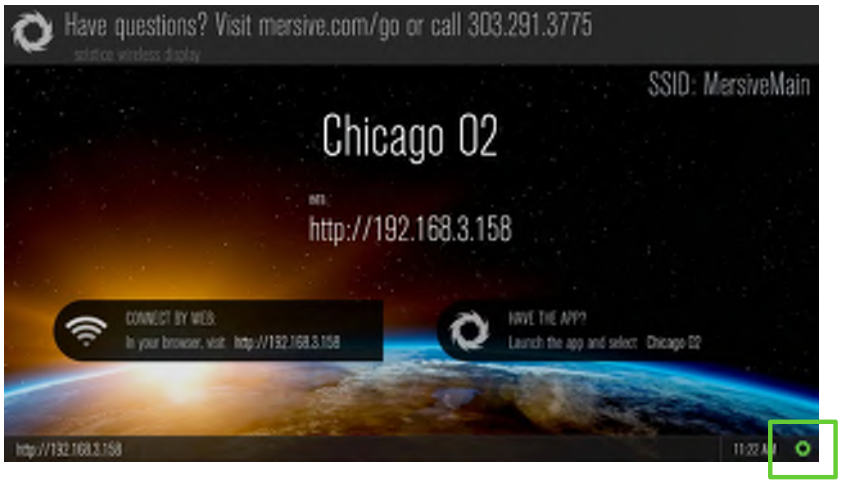
Full Configuration Options

The options below are listed in the order shown in the Pod's local configuration panel, but all these options and more may be managed in bulk through the Solstice Dashboard for large deployments.

The Pod's local configuration panel may be accessed in two ways:

Option 1:

Plug a USB keyboard and mouse into the Pod and click on the settings wheel in the lower righthand corner of the display:



This display menu also lets in-room users manually bring the display out of moderated mode, lock the display, or disconnect all users.

Sample Product Cutsheets (Audio-Visual)

Access Control allows a user with access to the configuration panel to manually remove the display from moderated mode. The display may be put into moderated mode through the Solstice client. This control can be used to manually override moderation in the case that the user with moderator control left the room without closing Solstice and forgot to release the display.

Lock is designed for use by end-user collaborators to use at during their meetings (if needed). Locking the display disables access to the display by any new users for the remainder of the session. Only users already connected to the display can share media.

Disconnect all Users disconnects all users from the session and removes all shared content.

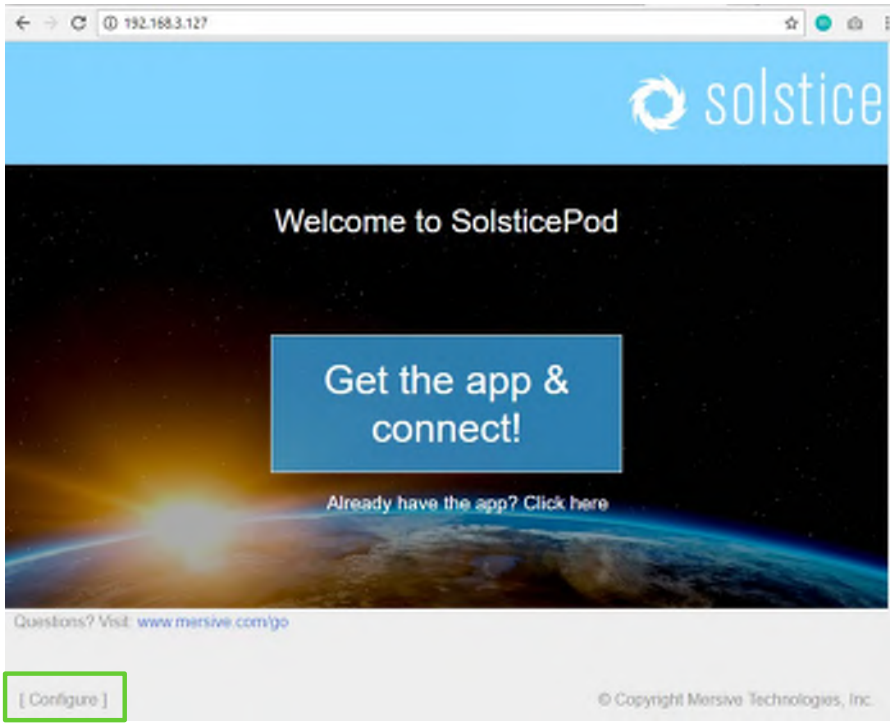
System>Configure provides local access to the Configuration Panel. This is used by admins to configure settings such as appearance and network.

Option 2:

Navigate to the Pod's IP address in a browser and click 'configure' in the lower left-hand corner of the screen:

Sample Product Cutsheets (Audio-Visual)

Solstice Datasheet



The Solstice Pod Configuration Panel

The **Display** tab allows the administrator of the display to change numerous settings and is divided into four sections:

- **Naming and Discovery** allows the administrator to name the Solstice display and configure how the name appears on the display interface and on the network. The Solstice display welcome screen can be customized with options for how and where the display name, IP, and screen key appear on the display interface. Additionally, options are available for how the display name is shared-to/visible-on user devices for users to connect. The options are to broadcast the display name on the network (utilizes UDP broadcast packets) and/or publish the display name to Solstice Discovery Service (for non-UDP-broadcast display discovery).
- **Appearance** (available from the web configuration and the Solstice Dashboard only) allows the Solstice display welcome screen background image to be customized by replacing the default Solstice welcome screen background image with a different image on the computer running the solstice Dashboard or used to access the Pod's web configuration. Standard .jpg and .png image file types can be used for the replacement welcome screen background image.
- **Access Control** designates how users will access the Solstice session, how users will post to the display, and controls user restrictions to accessing the display. The Access Control options include:
    - **Enable Screen Key** allows only those who can see the Screen Key in the bottom left corner of the Solstice display to connect to the session by entering the key. When the Browser Look-In feature is enabled for the display, users that attempt to utilize the browser look-in feature will be required to enter the display's Screen Key. If this is not enabled, anyone on the network that can see the display name may connect. Note that the Screen Key is required to use Multi-Room
    - **Disable Moderator Approval** removes the ability of a connected user to establish a moderated session. Moderation allows anyone to connect to the session, but only the moderator(s) have full sharing rights and control of the display. Non-moderator 'Guest' users can request to join the session, but both joining and sharing media posts must be approved by a Moderator, and Guest users do not have control of posts on the display.

Sample Product Cutsheets (Audio-Visual)

  - **Browser Look-In** allows users to view the Solstice session from a browser on their device without the need for Solstice client software app. This feature is useful when a user wants to view the Solstice display on their device and/or does not require the ability to share or control content on the display. When enabled, users can access the browser look-in via a link from the Solstice client software app or by browsing to the display IP address and selecting 'Browser Look-In' in the bottom left corner of the page.
- **Resource Restriction** enables the administrator to designate what types of posts users can share to the Solstice display, set the maximum number of user connections to the Solstice display, set the maximum number of content posts that may be simultaneously shared on the Solstice display, and elect a size at which Solstice will automatically resize images. For Solstice Small Group Edition (SGE), the maximum number of connections (devices) is limited to four. When the iOS mirroring post-type is enabled, there is an option to 'Enable AirPlay Discovery Proxy' which supports iOS mirroring without the use of broadcast/multicast network traffic. Contact your IT admin or refer to the Network Deployment Guide for more info.
- **System** allows the administrator to elect to automatically set time and date from an Internet time server, enable/disable 24-hour time format, designate a different time server, or set time zone, date, and time manually, and/or password protect the settings. Other options in the System section include customization of the Pod's system/network host name, designation of the admin password, and language selection (currently English and Japanese languages are supported).

The **Network** tab allows the administrator to configure the network settings for the Solstice Pod, including the Pod's Ethernet port, wireless capabilities, various network security options, and more. In addition to the information provided below, please contact your IT administrator and/or review the Network Deployment Guide for questions or assistance with network deployment of your Solstice Pod(s).

- **Ethernet Settings** allows an administrator to enable/disable the Pod's Ethernet port. When the Pod's Ethernet is enabled, configuration options include designating DHCP vs Static IP address. DHCP is recommended for small deployments and those companies/networks with no dedicated IT admin. Contact your network IT admin for questions about settings for Static IP address. When a Static IP address is enabled, additional configuration options include IP Address, Gateway, Network Prefix Length, DNS 1 and DNS 2.
- **Wireless Settings** allows an administrator to enable/disable the Pod's wireless capabilities, either as a standalone Wireless Access Point (WAP) – enabling users to connect directly to an SSID generated by the Pod – or attached to a separate existing network as a wireless client, providing users that have access to the existing network the ability to connect to the Pod.

Additional configuration options are exposed for each of the two wireless modes once that wireless mode is selected/enabled. In WAP mode, a wireless network name (SSID) can be designated, and access security options for users that want to connect to the Pod via the WAP may be configured. When the Pod will be wirelessly attached to an existing network, options to scan/add wireless networks and input a network password appear. The option to designate DHCP vs Static IP address appears again in this mode.

- **Firewall Settings** allows an administrator to block all traffic between the Pod's Ethernet and wireless connections (for network security) or to allow Internet access from the Ethernet port through to the wireless network via ports 80 and 443. This is useful when, for example, the Pod is connected via Ethernet to a corporate network and guest users join a meeting to collaborate alongside corporate users. The guest users can connect to the Pod's WAP and be granted Internet access without the guests compromising the security of the corporate network. This option does not appear unless both Ethernet and Wireless capabilities are enabled.
- **Web Server Proxy** provides a method for Pods to access Solstice software updates via a web server proxy. Both http and https options are available with web proxy IP address, port designation, and login credentials required for both.
- **Traffic and Ports** allows an administrator to specify the base network ports over which Solstice traffic will be transported. Solstice will use the port defined in this field as well as the next two in sequential order, plus port 80 for web configuration and some client-server traffic.

The **Tools** tab allows the administrator to download client Windows and Mac client software, download Windows SDS, and reboot the Pod if needed.

Sample Product Cutsheets (Audio-Visual)

- **Select platform to download client (available via browser Configuration Panel only)** provides an option to download Solstice client apps based on platform (Windows XP, Windows, or Mac). The client(s) can then be installed on the computer or saved to the hard drive and later installed on other devices. The admin can also elect to download versions of the client apps that automatically connect to the specific display/Pod. Note that client apps for iOS and Android devices must be downloaded through their respective app stores.

- **Windows SDS Installer (available via browser Configuration Panel only)** allows an administrator to download and install Solstice Discovery Service onto a Windows PC on the network to facilitate network-compliant (non-UDP broadcast) display discovery. For more information about SDS, refer to the Solstice Discovery Service Reference Guide.

- **Maintenance** allows an administrator to reboot the Pod if needed.

The **Updates and Licensing** tab provides details about your current Solstice software license, including version, release date, license type, installation date, maintenance expiration date, and info about the Pod including device ID, Ethernet MAC address and wireless MAC addresses that are available for both the display software and the different client versions. This tab also provides information about updates that are available, as well as an option to update your Solstice Pod software when a new update becomes available. Information about updates and the ability to update require Internet access. The 'Rollback' option reverts the Pod to the previously installed version of Solstice.

Licensing and Maintenance

The Solstice Software that runs on the Solstice Pod is a licensed Mersive product. Solstice licenses are available for purchase from Mersive and its authorized resellers. Solstice client apps are free. With a Solstice Unlimited software license (for Windows or Pod) an unlimited number of clients/users can connect to the display. With Solstice Small Group Edition (SGE) license (for Windows or Pod), up to four clients/users can connect to the display at one time. Mersive also offers Solstice Enterprise Edition licenses for both Solstice Pods and Windows Software, available in both Unlimited and SGE versions. The Solstice Enterprise Edition license provides support for the Solstice centralized IT management Dashboard and offers additional features designed for the enterprise deployment environment. Non-enterprise Solstice Pods and Windows Software licenses can be upgraded to Enterprise Edition through Solstice Dashboard via the licensing tab of the unit's configuration panel or by visiting https://www.mersive.com/land/enterprise-upgrades.
Solstice Pods include a licensed version of the Solstice Display Software that is activated upon purchase, so the unit is ready for use upon delivery. One-click software updates available through a software maintenance plan provide a continuous upgrade path for the Solstice Pod. You can see when updates are available for the Pod within the Configuration Panel. You will also be notified by email when updates are available at the email address associated with your account.

Reset the Solstice Pod to Factory Settings

The Solstice Pod can be reset to factory settings as needed. This function is used when configuration settings and/or admin passwords need to be reset. Please note that resetting the Pod to factory settings will reset all configuration options to factory, including network configuration settings. You will need to reconfigure your network settings after you complete the factory reset.
To reset your Pod to factory settings, follow these steps:

1. Connect a USB keyboard (wired or wireless) to the Pod via the USB port on the back of the unit.
2. On the keyboard, press and hold SHIFT-CONTROL-ALT. Tap 'R'.
3. After 2-3 seconds, a prompt will appear asking if you would like to reset the Pod to factory settings. Press the right arrow key on the keyboard to highlight the 'Yes' option and press ENTER on the keyboard.

The Pod should reboot and take you back to the Solstice display welcome screen. At this point the unit's factory settings are restored. You can now reconfigure the Pod's network and other settings starting from the default factory state.

Sample Product Cutsheets (Audio-Visual)

Panasonic

AW-HE40SW/SK (SDI Model)
AW-HE40HW/HK (HDMI Model)
HD Integrated Camera
For indoor use

AW-HE40SW/AW-HE40HW
Suspended (Hanging) style

Features 30x optical zoom lens
and support for PoE+*
for outstanding operability
and installation flexibility

AW-HE40SK/AW-HE40HK
Stand-alone (Desktop) style

*Abbreviation of Power over Ethernet Plus.

Sample Product Cutsheets (Audio-Visual)

Full HD camera with integrated pan-tilt for lectures, weddings and a wide variety of applications.

The AW-HE40 series of integrated full HD cameras performs in a wide variety of onsite shooting applications that require high-quality video, such as conferences, lecture capture and other events, thanks to its high-performance zoom, wide angle of view and outstanding color reproducibility.
The AW-HE40 series also offers the flexibility of not requiring any specific installation location thanks to IP transmission and support for PoE+*1, which allows power to be supplied via a LAN cable.

Newly Developed 1/2.3-type MOS Sensor

Equipped with a newly developed 1/2.3-type MOS sensor and DSP (Digital Signal Processor) for high sensitivity and high resolution.

High Performance Optical 30x Zoom Lens/ Super Resolution 40x Zoom

In addition to a 30x optical zoom, the AW-HE40 series can zoom up to 40x while maintaining high resolution thanks to Super Resolution technology. It also features a 16x digital zoom*2 and a 1.4x digital extender, which enables the AW-HE40 series to shoot in large conference halls and classrooms.

* Images are simulated.

Night Mode (supports automatic switching)

Switching to Night Mode makes shooting possible even in low light conditions in which shooting is normally difficult, such as when observing wildlife. *3
The AW-HE40 series can also be set to switch to the mode automatically depending on surrounding light levels.

* Images are simulated.

Equipped with High Dynamic Range (HDR) mode

In addition to conventional Dynamic Range Stretch (DRS) and Digital Noise Reduction (DNR), the AW-HE40 is newly equipped with High Dynamic Range (HDR) mode. When shooting and synthesizing two images with differing exposure times, the AW-HE40 series can create video with high visibility that corrects for halation and black defects even under backlit conditions.

* Images are simulated.

Outputs Still Image During Preset Movements; Supports One-Camera Operations

The new Freeze During Preset function may be enabled to freezes the video during preset playback. The immediately preceding still image is output during preset movements so that the swiveling movement is not displayed, making operations possible with one camera.

With Freeze During Preset function ON

Selection of SDI model/HDMI model and colors for flexible integration and application

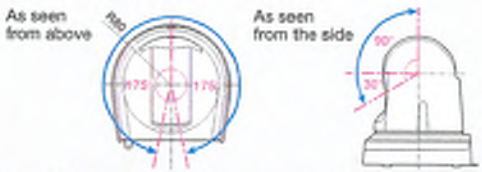
Supports 1080(59.94p (HDMI model only), 29.97p*4, 59.94i, 29.97PsF, 1080(50p (HDMI model only), 25p*4, 50i, 25PsF, 720(59.94p, and 50p video formats. Flexible operation in line with the application is made possible by a lineup that includes an SDI output model (AW-HE40SW/SK), optimal for video content production, and an HDMI output model (AW-HE40HW/HK), optimal for video streaming, both of which come in two body colors (white and black) that can be selected depending on the usage environment.

Audio input function

The AW-HE40 series also supports audio input, embedding and encoding. The input from the camera's switchable mic/line input can be combined with the HD-SDI, HDMI, and streaming outputs for mixing, recording or transmission.

Exceptional pan-tilt performance for smooth shooting over a wide area*5

The pan range of ±175 ° and the tilt range of -30 ° to +90 ° cover a wide shooting area*5. Pan and tilt operate at a maximum speed of 90°/second and respond quickly to remote control operation. They operate quietly at a sound level of NC35 or lower.

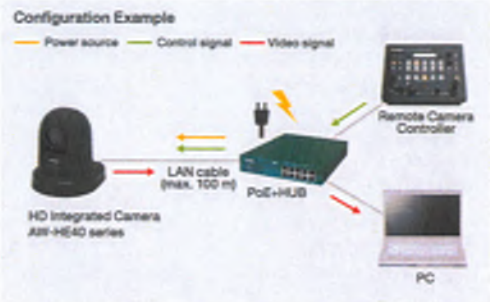


*1. Abbreviation of Power over Ethernet Plus. *2. Picture quality is lower with the digital zoom. *3. Video output is monochrome. *4. Native output. *5. Depending on the position of the pan and tilt, the unit itself may be reflected in the image.

Sample Product Cutsheets (Audio-Visual)

Supporting PoE+*1 for lower installation costs.

By connecting network devices that support the IEEE802.3at PoE+ standard, power can be supplied via LAN cable. Since it is not necessary to install a power supply or even a local AC outlet, installation costs can be significantly reduced.



IP control with image monitoring using PC, Mac and mobile terminals.

Equipped with image compression and IP transmission LSI.
IP video*3 can be transmitted to up to five terminals*2 per camera. Using an IP browser, the camera can be controlled from a remote location, and IP video monitoring and remote camera control can be performed from a PC, Mac or mobile terminals*4 such as an iPhone, iPad or Android device, enabling easy operations.

*For the latest information on supported OS/browsers, please refer to "service and support" section on the Panasonic website (http://pro-av.panasonic.net/en/).

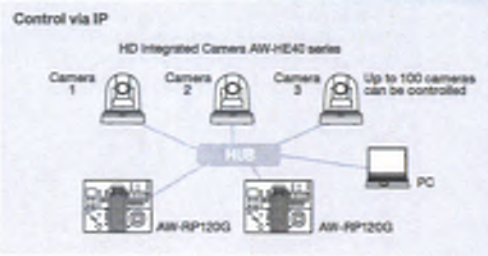
Camera Control Screen (PC)

Live Screen

Mobile Terminal Screen

Flexible IP Control Architecture Simplifies System Design and Operation*5

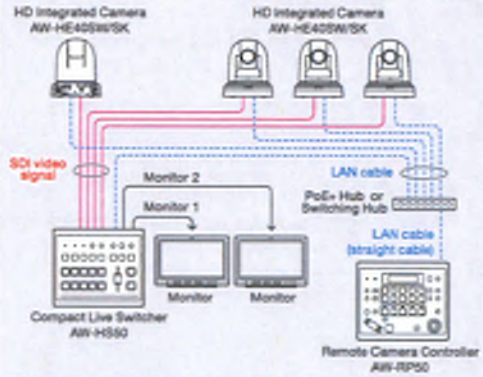
Up to 100 x AW-HE40 series cameras can be controlled via IP from a single AW-RP120G/RP50 or PC. An AW-HE40 series can also be simultaneously controlled by up to five AW-RP120G/RP50's via IP.



Other Functions

- Preset memory up to 100 positions.
- Functions such as freeze during preset, digital extender zoom and color temperature settings can be assigned to the user buttons on Panasonic controllers.
- Equipped with RS422 remote terminal; up to five units can be controlled via serial control from a controller.
- Equipped with RS232C remote terminal (standard serial communication support). Up to seven units can be controlled via daisy chain connection.
- Up to four units can be operated with a wireless remote controller (AW-RM50G sold separately).
- Easy installation thanks to use of turn-lock mechanism.

System configuration example



*The AC adaptor provided with the unit is not shown in the above figure.
*SDI output supported only by AW-HE40SW/SK.
*The camera unit automatically recognizes straight cables and cross cables connected to the LAN terminal.

System Camera Options

As of November 2014

Remote Camera Controller AW-RP50	Remote Camera Controller AW-RP120G (AC adaptor (DC12 V) is required separately.)	Remote Operation Panel AK-HRP200G (AC adaptor (DC12 V) is required separately.)
Wireless Remote Control AW-RM50G ("AA", "R6" or "LR6" battery x 2 are not included.)	Compact Live Switcher AW-HS50	Direct Ceiling Mount Bracket WV-Q105A

• 1: Abbreviation of Power over Ethernet Plus.
• 2: Depends on your network environment.
• 3: Supports only SD video output.
• 4: Only one Android™ device can be connected to one camera.
• 5: Controller upgrade required. For details, please refer to the "service and support" section on the Panasonic website (http://pro-av.panasonic.net).

Sample Product Cutsheets (Audio-Visual)

Specifications

As of November 2014

GENERAL	Power requirements	DC 12 V (Supplied AC adaptor) DC 42 to 57 V (PoE+ power supply)	
	Current consumption	1.2 A (Supplied AC adaptor) 0.4 A (PoE+ power supply)	
	Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)	
	Storage temperature	−20 °C to 50 °C (−4 °F to 122 °F)	
	Allowable humidity range	20 % to 90 % (no condensation)	
	Mass	Approx. 1.3 kg (3.30 lb)	
	Dimensions (W x H x D)	160 mm × 166 mm × 166 mm (6-3/16 inches x 7-45/128 inches x 6-13/32 inches) (including protrusions, direct ceiling mount bracket)	
	Finish	AW-HE40WW / AW-HE40SW: Pearl white AW-HE40WK / AW-HE40SK: Metallic black	
	Controller supported*1	AW-RP50, AW-RP120G, AK-HRP200G	
INPUT	Power	DC 12 V IN, PoE+ (IEEE802.3at standard)	
	MIC/LINE input	Stereo mini-jack (ø3.5 mm) Input impedance: Approx. 2 kΩ (unbalance) [Mic input] •Supported microphones: Stereo mic (plug-in power,on/off switching via menu) •Supplied voltage:2.5 V ± 0.5 V •Mic input level:−60 dBV ± 3 dBV [Line input] •Input level:−10 dBV ±3 dBV	
OUTPUT	Video Output: AW-HE40H HDMI	HDMI connector • HDCP is not supported. • Viera Link is not supported.	
	Video Output: AW-HE40S HD SDI	Compliant with the SMPTE292M standards/75 Ω (BNC x 1)	
INPUT/ OUTPUT	Video Output Connector: LAN	LAN connector for IP control (RJ-45) Equipped with straight/crossover cable auto detection function	
	Video Output Connector: RS-232C	Mini DIN 8-pin (IN) Mini DIN 8-pin (OUT)	
	Video Output Connector: RS-422	CONTROL IN RS422A (RJ-45)	
	Video Output Connector: USB	Mini-B port (Used for maintenance)	
	Video Output Connector: SD card	microSD card slot (Used for maintenance)	
FUNCTIONS AND PERFORMANCE	[Camera unit]		
	Imaging sensors	1/2.3-type MOS	
	Lens	Motorized 30x zoom, F1.8 to F4.7 f=4.3 mm (11/64 inches) to 129 mm (5-5/64 inches); 35 mm (1-3/8 inches) equivalent: 31.6 mm (1-31/128 inches) to 982.6 mm (38-7/8 inches)	
	Focus	Switching between auto and manual	
	Focus distance	Entire zooming range: 1.3 m (3.94 ft) Wide-end: 10 cm (3.93 ft)	
	Color separation optical system	On-chip color filter system	
	Minimum illumination	59.94 Hz: 0.7 lx (50 IRE, F1.6, 48 dB,1/60 without accumulation) 0.35 lx (50 IRE, F1.6, 48 dB,1/30 with accumulation (Frame Mix 6 dB))	
	Minimum illumination	50 Hz: 0.7 lx (50 IRE, F1.6, 48 dB,1/50 without accumulation) 0.35 lx (50 IRE, F1.6, 48 dB,1/25 with accumulation (Frame Mix 6 dB))	
	Horizontal resolution	1000 TV lines Typ. (Center area)	
	Gain selection*2	Auto, 0 dB to 48 dB (3 dB step)	
	Frame mix*3	Auto, Off, 6 dB, 12 dB, 18 dB, 24 dB	
FUNCTIONS AND PERFORMANCE	Electronic shutter speed	During Full Auto: 1/30 to 1/2000[59.94 Hz] 1/25 to 1/2000[50 Hz]	
	Electronic shutter speed	During Auto: 1/60 to 1/2000[59.94 Hz] 1/50 to 1/2000[50 Hz]	
	Electronic shutter speed	During Manual: 1/100, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000[59.94 Hz] 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000[50 Hz]	
	Synchro scan	59.94 Hz to 660.09 Hz[59.94 Hz] (255 steps) 50.00 Hz to 570.12 Hz[50 Hz] (255 steps)	
	Gamma	Off, Normal (Low, Mid, High), Cinema	
	White balance	ATW, AWB A, AWB B, 3200K, 5600K, VAR (2400K to 9990K)	
	Chroma amount variability	±3 step	
	Scene file	Full Auto, Manual1, Manual2, Manual3	
	Color bars	FULL BAR	
	Output format: HD	1080i: 59.94p/50p (AW-HE40H only) 1080i: 59.94i/50i 1080i: 29.97p/25p 1080i: 23.97PsF/25PsF 720: 59.94p/50p	
	Synchronization system	Internal synchronization	
	Image stabilization	Electronic	
	[Pan-tilt head unit]		
	Installation method	Stand-alone (Desktop) or suspended (Hanging)*4	
	Camera/pan-tilt head control	IP connecting cable When connecting through a hub: • LAN cable*5 (category 5 or above),max. 100 m (328 ft) When using a PoE+ hub: • LAN cable*5 (category 5e or above),max. 100 m (328 ft) When a hub is not used: • LAN cable*5 (category 5 or above),max. 100 m (328 ft)	
	Camera/pan-tilt head control	AW protocol connecting cable • LAN cable*5 (category 5 or above,straight cable), max. 1000 m (3280 ft)	
	Camera/pan-tilt head control	Standard protocol connecting cable • Mini DIN 8-pin cable, male	
	Pan-tilt operation speed	Maximum speed during preset:300°/s Maximum speed during manual:90°/s	
	Panning range	±175°	
	Tilting range*6	−30° to 90°	
	Quietness	During preset: NC40 or less During manual: NC35 or less	
	[Network]		
	Image resolution	JPEG VGA (640 x 360), QVGA (320 x 180) Max. 30 fps	
	Supported protocol	IPv4: TCP/IP, UDP/IP, HTTP, DHCP, DNS	
	I-OS, Android support	JPEG image display	

•1: It may be necessary to upgrade the version of the controller in order to support the unit. For the latest information on supported OS/browsers, please refer to "service and support" section on the Panasonic website (http://pro-av.panasonic.net/en/).
•2: During Auto, 6 dB to 48 dB (6 dB step) are available for AGC Max Gain setting. •3: During Auto, 0 dB, 6 dB, 12 dB and 18 dB are available for Auto F.Mix Max Gain setting. •4: To ensure safety, the unit must be secured using the mount bracket supplied. •5: Use of an STP (shielded twisted pair) cable is recommended. •6: Depending on the pan or tilt position, the camera may be reflected in the image.

Please refer to the latest information, etc. at the following Panasonic web site. http://pro-av.panasonic.net/

Panasonic

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Bahrain	+973 252292	Mexico	+52 55 5488 1000	Ukraine	+380 44 4903437
Brazil	+55 11 3889 4035	Netherlands, Belgium	+31 73 640 2729	U.K.	+44(0)1344 70 69 13
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France	+33 (0) 1 47 91 64 00	Portugal	+351 21 425 77 04		
Germany, Austria, Switzerland	+49 (0) 6103 313887	Romania, Albania, Bulgaria, Macedonia	+40 (0) 729 164 387		
Greece	+30 210 96 92 300	Russia & CIS	+7 495 9834206		
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Kazakhstan	+7 727 298 0891	Taiwan	+886 2 2227 6214		
Korea	+82 2 2106 6841	Thailand	+662 731 6888		
Kuwait	+96 22431385				

ISO 9001 JQA-0443

ISO 14001 JACO EC96J2010 UKAS 051

Factories of AVC Networks Company have received ISO14001:2004 the Environmental Management System certification. (Except for 3rd party's peripherals.)

SIP-HE40PE1

15K201410UP-1 Printed in Japan

Sample Product Cutsheets (Audio-Visual)

AV STREAMING

SMP 300 Series

H.264 STREAMING MEDIA PROCESSORS

Multipurpose Adaptable Platform for Streaming and Recording AV Presentations

- Process two high resolution AV sources from up to five available input signals
- Dual recording and streaming - SMP 352 only
- Stream and record simultaneously
- Produces MP4 media files that are compatible with virtually any media player
- Save recordings to internal solid state drive and external USB storage
- Automated transfer of recordings to network storage
- Stream concurrently at multiple resolutions and bit rates
- RTMP streaming protocol supports popular third party hosting services such as Facebook Live, YouTube Live, and Wowza Streaming Cloud

Works with these hosting services

USTREAM

YouTube LIVE

Extron Electronics
INTERFACING, SWITCHING AND CONTROL

Sample Product Cutsheets (Audio-Visual)

Introduction

The convergence of AV and IT continues to create new opportunities for AV systems. The scale, flexibility, and reach of IP networks offer an incredible opportunity to extend live presentations to individuals that are unable to attend an event due to time, distance or other physical barriers. Streaming and recording are effective methods for organizations to communicate and educate, by capturing the presentation experience and delivering the same information and insight that a local participant receives.

Streaming Solutions Require Flexibility

Any organization with a network and an AV presentation system can benefit from streaming. Today's streaming systems must be compatible with high resolution source signals, including high definition cameras. They must reliably interface, switch, and combine video with digital imagery and data to enhance a user's insight into the live experience. Streaming products must also conform to different network policies and operating requirements by supporting multiple transport protocols and session management methods. Additionally, streaming at more than one resolution and bit rate concurrently adds important flexibility, ensuring that media can be delivered to destinations with different viewing requirements or network bandwidth.

Recording Requirements for Presentations

To efficiently produce, manage, and distribute recorded presentations, a variety of requirements must be met. Effective systems record media that can be easily processed and transferred to a variety of storage formats. The recorded media must be efficiently processed with rights-managed user access, operating within an organization's standard network services and conforming to their IT policies. Lastly, the media must be published in a format that can be easily delivered and consumed.

Extron Streaming and Recording Processors

The SMP 300 Series of products are high performance streaming and recording processors for capturing and distributing AV sources and presentations as live streaming and recorded media. They incorporate Extron's FlexOS®, a flexible platform for automating system operation. Accepting HDMI, component, composite, and optional 3G-SDI signals, SMP 300 Series processors can record and stream simultaneously and can stream at two different resolutions and bit rates concurrently using a range of transport protocols and session management options.

- The SMP 351 creates a composited two-window stream and recording from its available sources.
  - An optional LinkLicense® upgrade unlocks SMP 352 functionality within the SMP 351.
- The SMP 352 can create composited or independent recordings and streams from two different sources with independent settings for each channel. It also has advanced audio DSP features for level control, filtering, and dynamics, as well as streaming presets that increase functionality and provide a simplified workflow.

A Cost-Effective Solution

Comprehensive control and configuration features make SMP 300 Series products integration-friendly and easy to control and operate. Requiring no recurring licensing fees, these H.264 processors have a low cost of ownership, making them a cost-effective solution for delivering presentations to a larger audience.

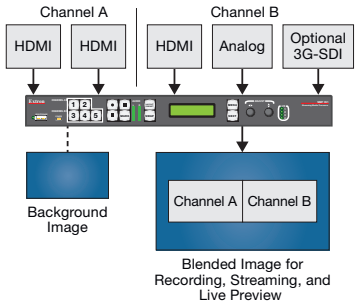
Many Applications Benefit from Streaming and Recording

SMP 300 Series products are ideal for use in virtually any professional environment where AV sources can be streamed live or recorded for future reference, especially when combining multiple AV sources will enhance the message. Streaming and recording AV presentations allows an organization to communicate and train employees and students that cannot be present at an event. Event recording provides everyone with the opportunity to review and gain insight into the live experience. SMP 300 Series products can be adapted to many applications, documenting virtually any meeting, conference, or activity that uses an AV source as a reference. They are ideal for use in corporate, education, government, healthcare, courtroom, house of worship, and rental and staging applications.

Sample Product Cutsheets (Audio-Visual)

Presentation Recording & Streaming

SMP 300 Series products provide a comprehensive combination of signal processing, switching, scaling, and control features that simplify the integration of streaming and recording into AV systems. The versatility of the FlexOS platform makes it easy to adapt them for various applications and their broad feature set delivers quality and performance, making them a superior choice for streaming and recording applications.



SMP 300 Series products provide AV signal processing that produces high quality recorded media and live streaming.

Flexible Source Inputs

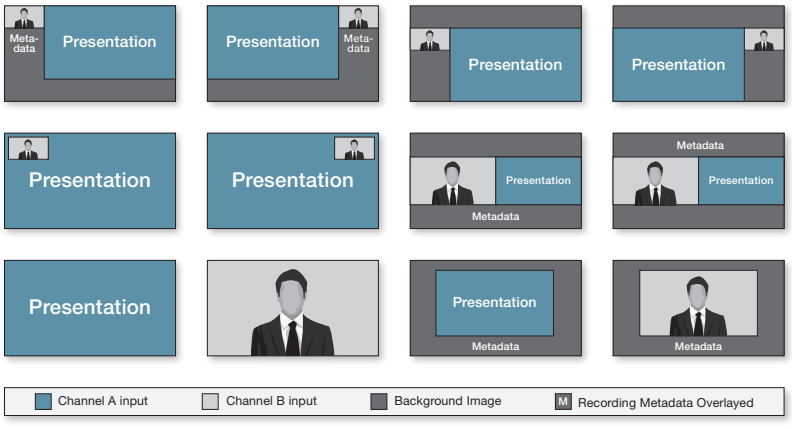
The SMP 300 Series processes two high resolution AV sources from up to five available connections. One of two HDMI signals can be selected from Channel A along with analog or HDMI-embedded stereo audio. Channel A also provides a loop through HDMI and audio connection, which can be passed directly to a presentation display. Channel B inputs support common camera formats including composite, component HD, and HDMI. The SMP 300 Series includes 3G-SDI models that accept serial digital video and audio signals supplied by cameras and other professional video sources. The Channel A and B input connections both support computer-video formats from 640x480 to 1920x1200, and video formats from 480p to 1080p/60. They can be switched live during a presentation.

Signal Processing Simplifies Source Management and Produces High Quality Content

Comprehensive scaling, picture control, aspect ratio management, and HDCP-compliant signal management features ensure that SMP 300 Series products present AV sources with quality and accuracy. Advanced de-interlacing and scaling produce high quality video for both standard definition and high resolution sources as they are scaled up or down. The recording format and HDMI output can be scaled to selectable resolutions from 480p to 1080p/30, and streaming resolutions are available from 512x288 to 1080p/30 supporting use of the optimal resolution for many different applications.

Multi-Source Window Processing

SMP 300 Series products offer highly flexible source presentation options. The Channel A and B input signals can be presented on the output individually at full screen or together in any two-window display arrangement including side-by-side. Up to sixteen customized window presets can be prepared, combining the Channel A and B inputs with a PNG background image and metadata. These flexible, multi-source processing features makes it easy to recreate the live presentation experience. They also provide viewers with greater insight into the event's context, facilitating interpretation and retention of the information presented.



Up to sixteen customizable window layout presets can be saved and quickly recalled from the front panel or an AV control system. Twelve are shown here.

Sample Product Cutsheets (Audio-Visual)

Presentation Recording & Streaming

Quality Multi-Source Audio Processing

SMP 300 Series products offer audio mixing and DSP features that simplify audio management and provide a high quality output. They select or mix the analog or digital signals from Channel A and B sources, based on the input configuration and the source layout. Audio signals are adjusted automatically during source switches, eliminating clicks, pops, and undesired effects, producing a quality audio experience without using external processing equipment. The SMP 352 offers additional control over volume levels, filtering, and dynamics for an enhanced audio experience.

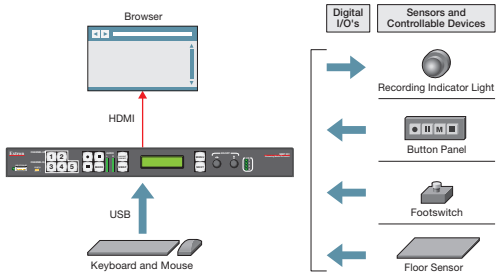
Effective User Control and Integration Options

SMP 300 Series products offer several control options. The front panel controls and LCD display provide an effective interface for configuration and control. The RS-232 port can be used to interface with a control system, and the Ethernet port is available as an additional control interface.

Versatility Delivered by the FlexOS Platform

The Extron FlexOS embedded operating system makes SMP 300 Series products highly adaptable to a multitude of streaming, recording, processing, and control requirements. It provides a platform from which applications can be installed and operated. An integrated web browser application can be viewed and managed using the HDMI output and USB keyboard and mouse connections. This browser application serves as a convenient method to access the embedded web page.

Extron FlexOS control applications can also be installed to automate system operation. These programs interface with four digital I/O ports, accepting triggers from push button controls and sensors to manage specific functions, such as enabling recording sessions or marking a chapter in a recording. The ports can also be used to manage digitally controlled devices such as a recording indicator light.



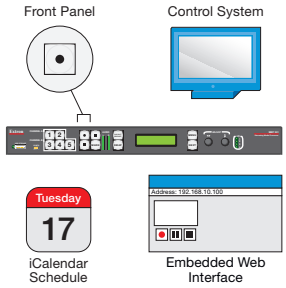
SMP 300 Series products can be directly controlled using a USB keyboard and mouse. Custom applications can be uploaded to manage four digital I/O ports that interface with digitally controlled devices.

Powerful Tools for Scheduling, Monitoring, and Management

Recording schedules can be automatically updated by configuring SMP 300 Series products to periodically upload a centrally managed iCalendar file. Simple Network Management Protocol – SNMP traps, email, and Simple Mail Transfer Protocol – SMTP can deliver messages to support staff or monitoring systems when signal errors or encrypted sources are detected, or when storage nears capacity, allowing for proactive service. Operational system data is logged continually, detailing recording sessions, storage directory use, file names, metadata, and storage capacity. This information provides valuable data for evaluating usage patterns and operating concerns.

Recorded Media Enhanced with Data

SMP 300 Series products produce an MP4 (M4V) file, which can be played from virtually any software media player application or mobile device with a web browser. They can record at 480p, 720p, or 1080p video resolutions as well as 1024x768 and 1280x1024 computer-video resolutions at rates from 1 to 30 frames per second. MP4 files can be recorded at video bit rates from 200 kbps to 10 Mbps, defined using a wide variety of encoding parameters.



Recording sessions can be initiated from the front panel, a control system, the embedded web page, or automatic recording can be scheduled using the iCalendar format.

Recorded file packages include metadata that identifies information such as: Title, Creator, Subject, Description, Publisher, Contributor, and Date. This information makes it easier to search and manage media files. In addition, chapter and event marks can be inserted into recordings, supporting efficient searching and scanning during playback from a media player. JPEG thumbnail images are captured periodically for every chapter or event mark, providing a "snapshot" preview of the video at that point in the timeline. Time-synchronized thumbnails enable efficient scanning and preview of content. They are integrated into the user interface of the **Extron Media Player**, a browser-based media player used for play back of media recorded by the SMP 300 Series products.

Sample Product Cutsheets (Audio-Visual)

RCP 101 Series - Remote Control Panels for SMP Series

RCP 101 D

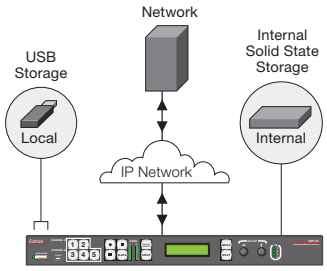
FLEX55 COMPATIBLE

RCP 101 EU

Extron **RCP 101 Series** remote control panels feature backlit transport controls for remote operation of Extron SMP Series products. A USB port provides convenient access to a thumb drive or external portable storage. RCP 101 panels have status and alarm indicator lights with an audible buzzer. A 15 foot (4.5 meter) USB cable is included. The RCP 101 panels may be used with Extron **USB Extender Plus** Series twisted pair extenders to support distances up to 330 feet (100 meters). Available in decorator-style, MK, and EU versions; the EU version is compatible with Flex55 enclosures or EU junction boxes. RCP 101 Series panels include black and a white faceplates to compliment a wide range of environments. MK model is available in white only.

Storage Options Serve Different Applications

Presentations can be saved to the internal solid state drive, to a connected USB drive, or uploaded to a network storage location. SMP 300 Series products can also be configured to limit storage to only the internal SSD drive, USB only, or Dual Recording to both devices simultaneously. When network storage is defined, reliable capture is ensured by first saving the recording internally before transferring it to a file server.



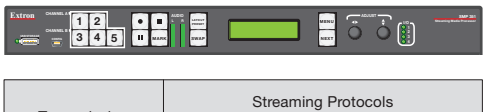
Save AV recordings to internal solid state storage, a locally connected USB storage device or it can transfer files to a network storage directory.

Extensive Streaming Capabilities

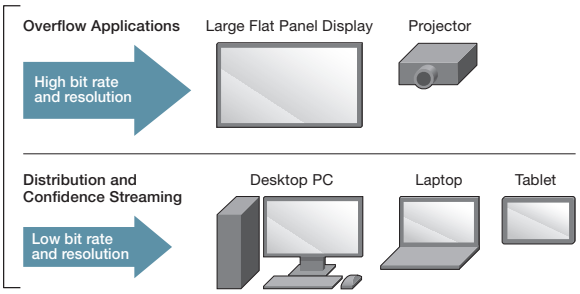
SMP 300 Series products offer extensive streaming capabilities. They can record and stream simultaneously. They can also stream at two different resolutions and bit rates concurrently. High resolution, high bit rate encoding delivers superior quality for large screen overflow applications. Lower bit rates and lower resolutions are more efficient for streaming distribution or confidence viewing applications. Streaming bit rates can range from 200 kbps to 10 Mbps for video and 16 kbps to 384 kbps for audio. SMP 300 Series products support both push and pull streaming session management, and a range of streaming transport protocols can be used to support unique decoding or network requirements.

RTMP Streaming Protocol

Extron's SMP 300 Series processors support live streaming to popular third party hosting services such as UStream, YouTube Live, Facebook Live, Wowza Streaming Cloud and more. Streaming to live services facilitates sharing of events and meetings to a much larger audience.



Transmission Method	Streaming Protocols	
	Transport	Session Management
• Unicast • Multiple Unicast • Multicast	• RTP • RTSP Interleaved • HTTP Tunnelled • TS/UDP • TS/RTP/UDP	• RTSP • SAP • SDP



SMP 300 Series products can support unicast and multicast streaming applications and can apply a variety of streaming transport protocols and session management methods supporting use with a wide variety of viewing applications, decoding devices and network conditions.

Sample Product Cutsheets (Audio-Visual)

Features

Supports input signal resolutions up to 1920x1200, including HDTV 1080p/60
SMP 300 Series products support a wide range of input resolutions, from standard definition up to the high resolutions commonly used for computer video and HDTV.

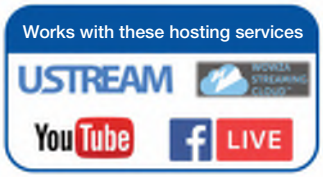
High Quality Scaling and De-interlacing
SMP 300 Series products use advanced de-interlacing and signal processing to create high quality images. The encoded output signals can be scaled to selectable resolutions from 640x480 to 1080p/30.

Flexible scaling and two window processing
Display one or two high resolution sources in user-defined window arrangements, including side-by-side for optimal interpretation.

Clean switching
Switch with a clean transition free of visual jumps, glitches, and distortion commonly experienced switching between computer and video signals.

Aspect ratio control
The aspect ratio of a source window can be controlled by selecting a FILL mode, which provides a full screen output, FOLLOW mode, which preserves the aspect ratio, or FIT mode which maintains image uniformity and zooms into the source.

RTMP streaming protocol supports popular third party hosting services
Supports RTMP push streaming with stream name or key, and user authentication for services like YouTube Live, Wowza Streaming Cloud, Facebook Live, Ustream, and more.



HDCP-compliant input and output signal management
Encrypted signals can be viewed on compliant displays connected to the loop through, but cannot be recorded. A green signal and HDCP warning message are presented on non-compliant displays and encoded media.

Supports HDMI-embedded audio or analog stereo audio
AV input connections are directly compatible with digital and analog audio signals.

Auto Input Memory
Automatically store size, position, and picture settings based on the incoming signal and recall these settings when the source is reconnected.

EDID Minder®
EDID Minder automatically manages EDID communications between devices, ensuring use of optimal signal formats.

Audio input gain and attenuation
Gain or attenuation can be adjusted for each input signal to eliminate noticeable differences when switching sources.

Integrated audio mixing and DSP
Produce a high quality audio experience without requiring the use of external mixing and DSP equipment.

Schedule streaming and recording using iCalendar
Upload a recording schedule manually, or automatically using the iCalendar format.

Internal test patterns for setup
SMP 300 Series processors include 15 test patterns as well as on-screen display - OSD data overlay including timestamp, average bit rate, frame rate, time and date, and system information to aid in calibration and setup of the encoder.

Extron FlexOS applications automate system operation
Install Extron FlexOS applications that automate system operation using four digital I/O ports interfaced to push button controls, sensors or digitally controlled devices.

Daily recording logs
Provide usage and operating data to aid in system diagnostics and troubleshooting.

Front panel security lockout
Locks out all front panel functions except for input selection; all functions however, are available through RS-232 control.

Window layout presets simplify control
Sixteen standard and customized layouts are available to be recalled quickly from the front panel or an external control system, even while recording and streaming.

Encoding presets for quick recall of specific compression and streaming configurations
Sixteen presets are available for saving specific encoding and streaming settings such as H.264 profile, resolution, GOP, and bit rate, session management configurations, transport protocols, and other network settings.

Dual Recording and Streaming
SMP 300 Series products can record from two different video sources independently, have advanced audio DSP features, and offer streaming presets that simplify workflows (LinkLicense® upgrade required for SMP 351).

Standards-based H.264/ MPEG-4 AVC video compression
SMP 300 Series processors support use of the Baseline, Main, or High Profiles at Levels 5, 4.x, or 3.x facilitating optimization of video encoding for use with various applications and decoding devices.

AES audio de-embedding
An embedded AES stereo audio signal can be extracted from the optional 3G-SDI input for recording and streaming.

Streaming protocol and session management options
Apply pull or push session management options and use a variety of transport protocols in unicast or multicast configurations based on system requirements or network conditions.

Adjustable recording and streaming bit rates
Select video bit rates from 200 kbps to 10 Mbps for video and 16 kbps to 384 kbps for audio based on the storage, streaming, or network requirements.

Metadata text overlay
Data such as title, presenter, course date and time can be presented and embedded within the source layout.

Video time stamping
Insert a time reference (HH:MM:SS format) in the on-screen display to document time and aid navigation during playback sessions.

Compatible with third party content management systems
Manually upload recordings to systems such as Kaltura, iTunes-U, Blackboard LMS, SharePoint, CaptionSync, YouTube, Moodle, and RSS feed.

Sample Product Cutsheets (Audio-Visual)

Overview

Front-mounted USB port
Front-panel USB port makes connecting portable storage devices easy for "capture and carry" recording sessions.

Audio level indicator
Left and right channel indicators provide a visual reference for signal level and aid in troubleshooting.

LCD control interface, direct access buttons and precise rotary controls
An intuitive LCD interface, direct access buttons, and precise rotary controls simplify system setup.

Front panel recording controls
Start, stop, and pause recordings using the front panel transport controls. Identify notable events using the Mark button to aid the search, playback and review of recordings.

Layout preset button
In Single Channel mode, select one of sixteen blended source arrangements, presenting Channel A, Channel B, metadata, and background image.

Enhanced audio DSP
Enhanced Audio DSP adds controls for Dynamics, Filtering, and Level Controls – SMP 352 only.

SMP 352 - Front

Configuration port
The front panel USB port provides convenient access to control the unit directly from a PC.

Input select buttons
Select the Channel A and Channel B source signals that are processed and displayed.

SWAP button
In Single Channel mode, quickly swap Channel A and Channel B source positions in the recording layout. In Dual mode, swaps within the HDMI preview output.

Internal solid state storage
Save recorded content to internal solid state storage and reliably transfer media files to USB or network storage

Digital I/O LED indicators
Highly visual front panel LEDs provide a quick indication of individual port status.

Digital I/O connection
Interface with simple push button controls, sensors, or digitally controlled devices to manage recording and streaming applications or AV devices.

Rear USB storage port
USB port provides no-fuss connection for rack-mounted storage devices.

HDMI, component HD, and composite inputs
Source signal options provide compatibility with commonly used AV and camera signals, and benefit from clean switching transitions across input signals.

Optional 3G-SDI input
SMP 300 Series 3G-SDI models accept serial digital video and audio signals supplied by cameras and other professional video sources.

SMP 352 - Back

USB keyboard and mouse connectors
Direct keyboard and mouse connections provide the means to directly control and configure the unit while viewing the embedded web page from the HDMI output.

Loop through connections
Loop through connections allow for easy integration of presentation sources into AV systems without the need for additional equipment.

HDMI output
In Single Channel mode, provides a local preview of the blended layout. In Dual mode, provides a local preview of Channel A or Channel B as selected by the Swap button.

Ethernet port
Multi-purpose Ethernet port for streaming transport and transfer of recordings to network storage directories. It also serves as the interface for AV control systems and the embedded web interface.

RS-232 serial port
Control and manage the unit from AV control systems and serial RS-232 devices in real-time.

HDCP-compliant signal management
Present encrypted sources on HDCP compliant displays. A green screen and HDCP message is presented if the destination is encoded media, the preview output, or a display that is not HDCP-compliant.

Sample Product Cutsheets (Audio-Visual)

Content Management

STREAMING CONTENT MANAGER

Extron **Streaming Content Manager – SCM** is multi-purpose software that manages the MP4 file, metadata, and JPEG thumbnails produced during SMP 300 Series recording sessions. SCM processes this media into file packages, which provide a rich data experience when played back from the **Extron Media Player – EMP**. SCM also manages recording packages, user groups, and access rights, and provides summary data to the administrator and users. SCM interfaces with standard network directory services to integrate users and access rights into the system.

Managing the Recording Workflow

A typical SCM recording session starts with a user entering a unique identifier, such as an email address, into an AV control system touchpanel. This information is transferred to the SMP 300 Series processor and included with the recording metadata.

When the recording session is complete, the media is transferred to a network storage directory where it is processed by SCM. Once SCM has processed the recording package, it is stored on a content server and user access permissions are applied.

Lastly, the email address obtained during the initiation of the recording session is used to notify the user that the recording package has been processed and is available for retrieval.

Users have access to recordings they've produced or to which they have group access privileges. Users can sort recordings based on filename, date and time, recording device, and processing status.

Recording packages are accessed using the Streaming Content Manager web portal.

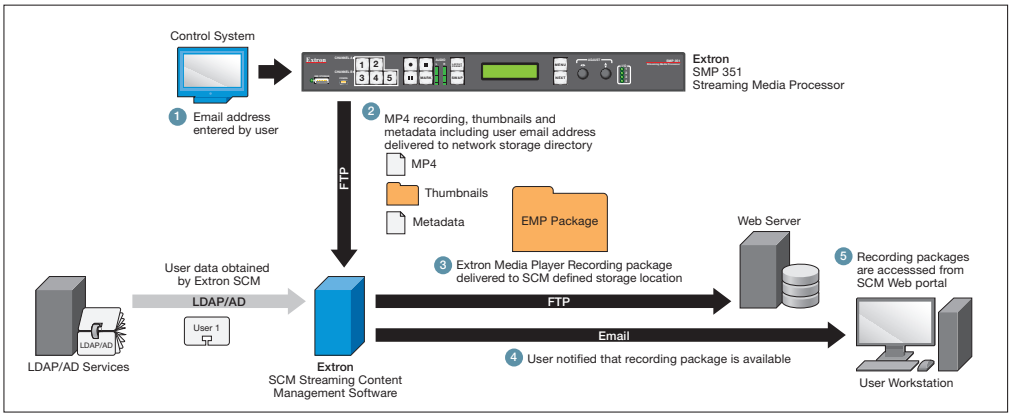
Administering Users and Recording Assets

SCM simplifies management of recorded media, operating within IT systems by leveraging existing network directory services. Administrators can establish user access permissions using data obtained from standard network Lightweight Directory Access Protocol/Active Directory - LDAP/AD services.

SCM can also define custom local user identifications and passwords to manage applications with special user groups that must operate separately from standard network services.

SCM provides summary recording data to administrators, including processing activity, user activity, filenames, storage locations, recording dates, and login activity.

Streaming Content Manager File Processing



Extron Streaming Content Manager processes recordings produced by SMP 300 Series processors. It prepares them into file packages for playback by Extron EMP, applies access rights and notifies the user that the recording package can be accessed from the SCM Web Portal.

Sample Product Cutsheets (Audio-Visual)

Media Playback

EXTRON MEDIA PLAYER

The **Extron Media Player – EMP**, is a browser-based media player developed to provide an enhanced playback experience for recordings produced by SMP 300 Series products. EMP requires no software installation and can be operated from any computer or mobile device using a wide variety of browser applications. The EMP user interface incorporates metadata, time-synchronized thumbnail images, and playback controls that support efficient navigation and review of recorded material. EMP is used exclusively with recording file packages that have been processed by Extron SCM software.

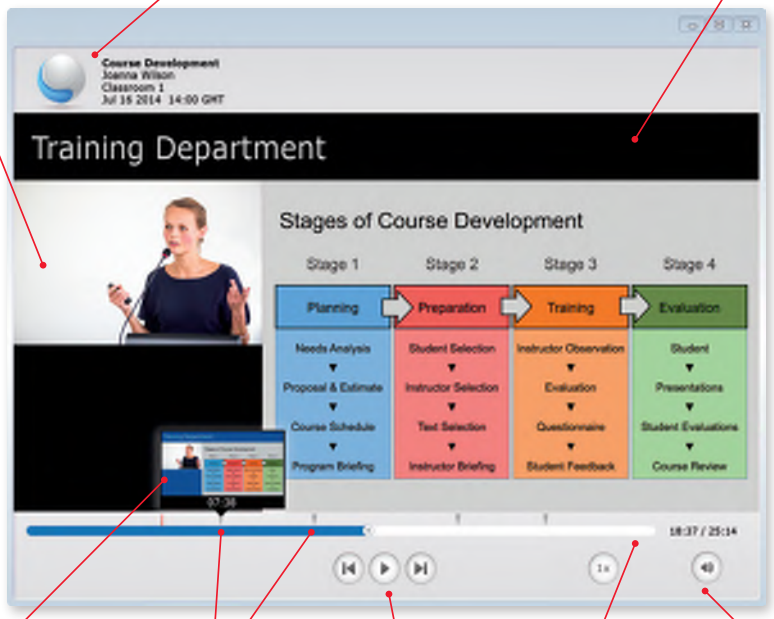
Customization and Accessibility

User interface components of the EMP such as the video playback window, transport controls, and the title banner can be repositioned and customized within the application to meet specific user requirements. The EMP also offers keyboard controls and assistive technology that fulfills Section 508 accessibility standards for individuals with physical impairments and disabilities. Alternative color palettes, high contrast, and zoom modes are available to improve content legibility and visibility, and the EMP can interface with screen reader software.

Standard and Customizable Player Templates
EMP layouts and player elements can be modified to conform to specific application requirements.

Title, Metadata and Banner Area
Present information that provides context to the recorded event such as the presenter, location, date, event title or course name. Identify and present branding for the organization or department.

Video Playback Window
EMP augments the video playback window with metadata and advanced playback controls.



Time-synchronized thumbnail images
A thumbnail image with time reference becomes visible when a user's mouse is placed at any position along the playback bar.

Chapter and Event Marks
Chapter and event marks are inserted into recordings to help identify notable points in time. They aid in efficient file navigation.

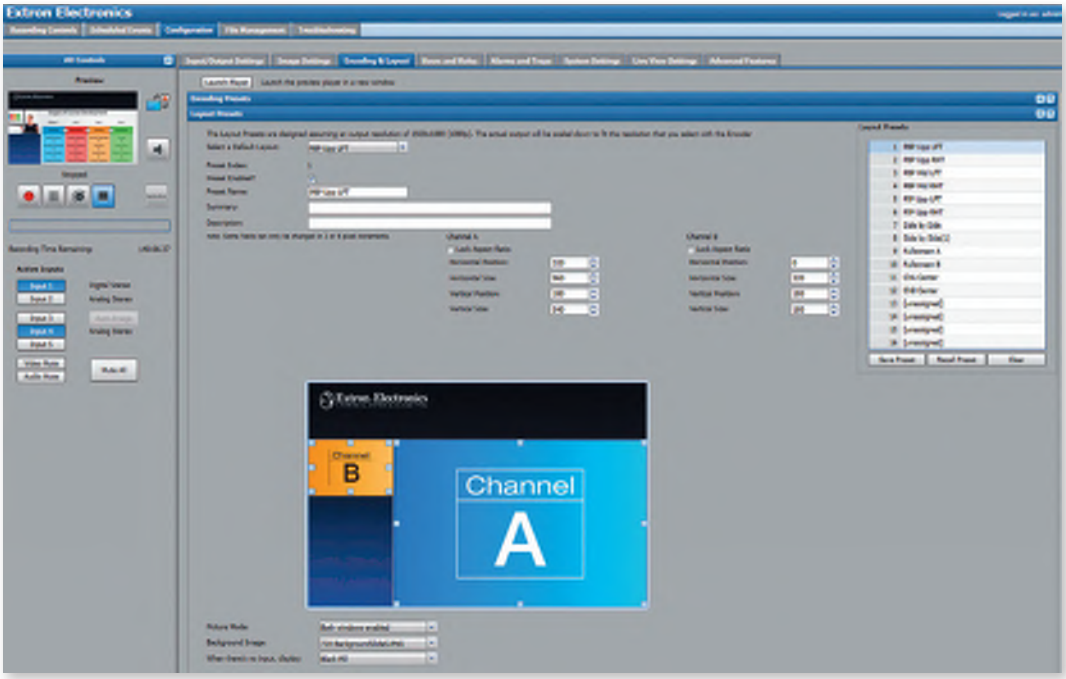
Transport Controls
Manage efficient playback using play, stop, chapter/mark advance and variable speed playback controls.

Playback bar
The playback bar identifies the current time and duration of a media file and allows a user to quickly change position by moving the slider throughout the timeline.

Audio Controls
Mute audio and adjust volume.

Sample Product Cutsheets (Audio-Visual)

Embedded Web Page



Source layouts are created from the embedded web page that integrate Channel A and Channel B inputs with a PNG background image and metadata.

Intuitive Interface for Configuration

SMP 300 Series processors have an embedded web interface, which makes navigating and configuring the wide array of signal processing, recording, streaming, scheduling, and control functions simple. The embedded web page provides a visual overview of recording activity and session schedules. It is used to configure publishing and file transfer parameters and provides valuable tools for managing, monitoring, and troubleshooting. The embedded web page makes it easy for AV support staff and IT departments to control and manage the processor.

Efficient Signal Management and Source Switching

The embedded web page interface clearly presents the controls for managing input and output signals. It identifies the signal type, resolution, AV format, and encryption status for all input signals and the output signal. Intuitive controls adjust brightness, contrast, and overscan values, and custom sampling values can be entered for analog sources as required. Additional signal processing controls are provided for: aspect ratio management, signal and format detection, and audio levels. A small preview window in the embedded web page decodes a live view of the current source layout. The preview window is accompanied by an arrangement of buttons for selecting input signals, analog or digital audio formats, and audio mixing configurations.

Preparing Layouts to Capture Effective Presentations

The recording layout page features the adjustments that produce the largest visual impact. Up to sixteen layouts can be customized and saved from this page.

Channel A and Channel B source windows are easily positioned and sized using a mouse, or by entering numeric values from a keyboard. Previously uploaded PNG image files can be selected to serve as the background image. Six common metadata element positions can be selected, typically near the sides, top, or bottom of the output image so the text does not distract from critical visual content.

A media player window can be launched from the layout page that decodes a live stream from the SMP 300 Series processor. This provides the user with a live view of the source layout during system programming and testing activities.

Sample Product Cutsheets (Audio-Visual)

Embedded Web Page

Encoding Presets Simplify Streaming Management

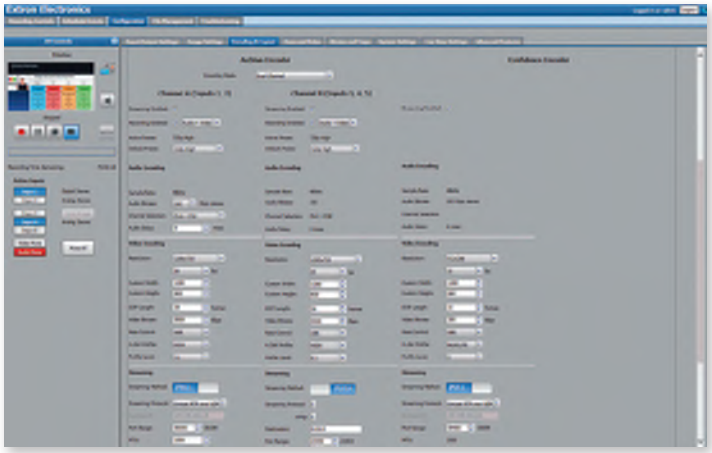
The many encoding parameters and protocols used in streaming applications can introduce undesirable complexity for system programmers. The embedded web page provides a simple interface to define two separate channels of live streaming. The Archive Encoder uses the same resolution and bit rate as the recording session. The Confidence Encoder typically uses a lower resolution and bit rate. Independent values can be defined for bit rate, frame rate, H.264 profile and level, and Group of Pictures – GOP for each encoder.

Unique menus define pull and push streaming configurations. Both must define unicast or multicast operation, transport protocol, maximum transmission unit – MTU, destination addresses, and application ports, where appropriate. The pull streaming menu also identifies the number of active client sessions. The push streaming menu provides additional configuration for Session Description Protocol – SDP and Session Announcement Protocol – SAP, Quality of Service – QoS, and Time to Live - TTL.

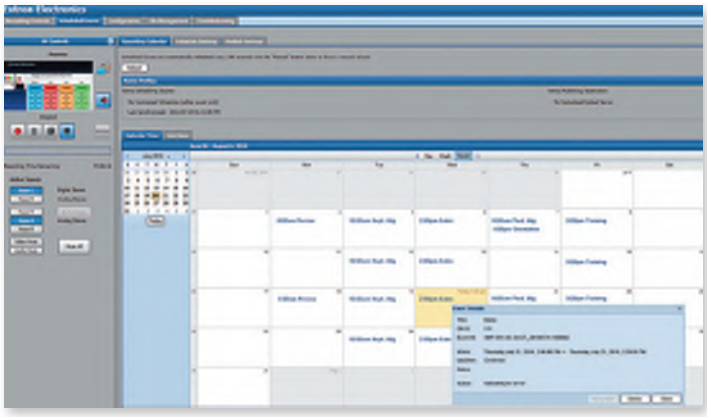
The encoding parameters are saved in a preset which can be recalled from an external control system, streamlining the number of variables to be managed by control systems.

Session Scheduling and Publishing Configuration

The embedded web interface includes an internal calendar, which identifies future recording sessions and references all past sessions. Recording schedules can be manually or periodically uploaded using the iCalendar file format with File Transfer Protocol - FTP from a defined file and pathname. The scheduling menu is also used to integrate with Opencast Matterhorn.



Parameters for two different streaming configurations are defined from the encoding preset page.



The embedded web page includes a calendar that identifies all past and future recording sessions.

System Data and Diagnostics Support Efficient Management from the Network

Diagnostic tools provided by the embedded web page aid AV and IT staff with support and troubleshooting activities. Daily system logs document recording sessions, usage conditions, and operating concerns, such as recording starts, or storage errors.

The embedded web page presents real-time streaming bit rates, and offers ICMP ping and traceroute diagnostics, giving AV and IT staff powerful tools and data for diagnosing network issues. Proactive service and maintenance activities can be supported by system alarms delivered to support staff or monitoring systems using email, SNMP traps or SMTP protocol.

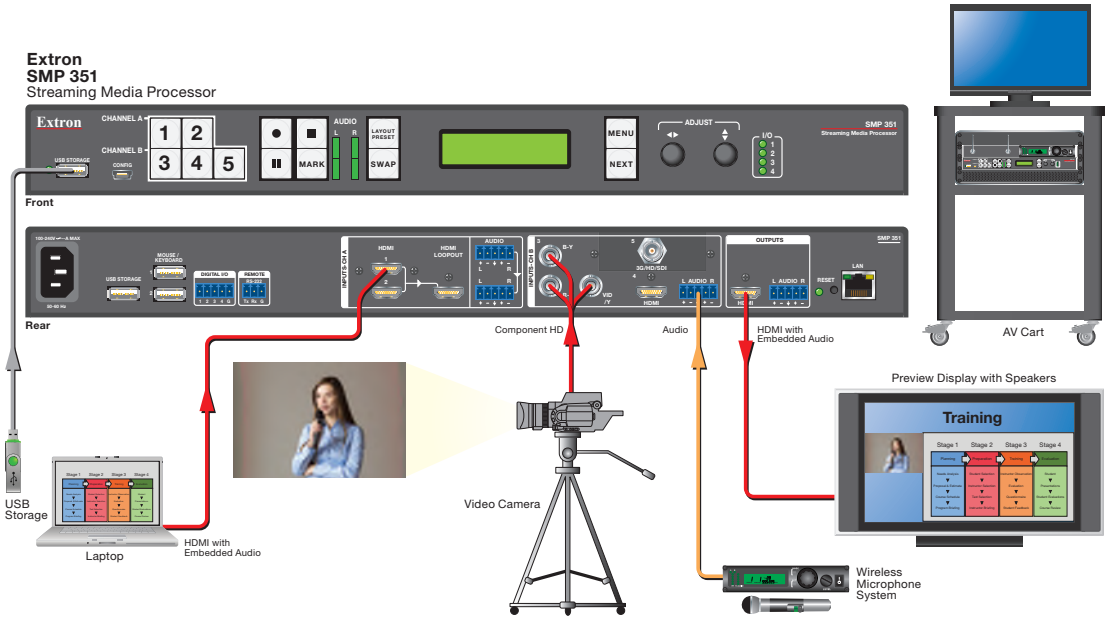
Sample Product Cutsheets (Audio-Visual)

Applications

PORTABLE AV RECORDING SYSTEM

Presentations that use AV sources can occur virtually anywhere within a building, however it may not be practical to install an AV recorder in every location a presentation may be held. An **SMP 351** can be combined with a microphone, wireless receiver and a small, flat panel display into a recording system that can accept a variety of source inputs and be moved from location to location on an AV cart.

The advanced AV signal processing, front panel controls, and HDMI confidence output from the SMP 351 make it an effective product to use in a portable recording system. It will quickly capture and process video and audio signals from computers, personal devices, cameras or AV systems. The portable system illustrated in this diagram has been connected to a laptop and camera to record a presentation from a guest speaker. When the presentation is complete, an MP4 file is saved to a USB storage device connected to the front panel. It can be immediately removed and replayed for others. A different source combination may be used for the next event.

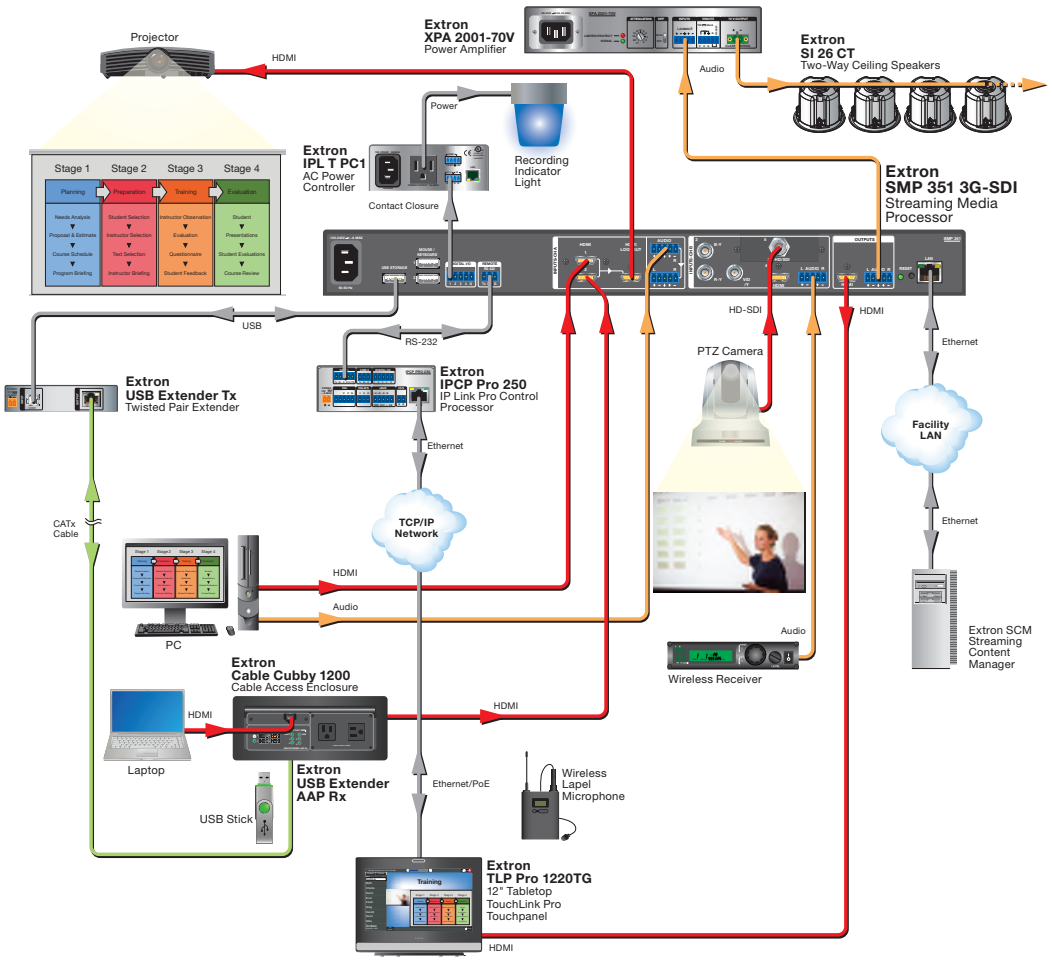


Sample Product Cutsheets (Audio-Visual)

Applications

AV PRESENTATION AND RECORDING SYSTEM

The **SMP 351** can serve as the central switching and processing device for an AV system. This system uses the **SMP 351 3G-SDI** to manage AV sources and record an HD-SDI camera, together with a PC or laptop source connected through an Extron **Cable Cubby 1200** enclosure. An Extron **TLP Pro 1220TG** touchpanel and **IPCP Pro 250** control processor provide an interface for the user to select the AV source to present and blended layout that will be used during a recording session. The HDMI output from the SMP-351 3G-SDI displays a preview of the recording layout. It is connected to the HDMI input on the TLP Pro 1220TG touchpanel. An Extron FlexOS application has been installed on the SMP 351 for managing a recording indicator light. The FlexOS application interfaces with the digital I/O port and triggers an Extron **IPL T PC1** power controller, supplying power to the light during a recording session. Mixed, processed audio is supplied from the SMP 351 to an Extron **XPA 2001-70V** amplifier and **SI 26CT** speakers. Users have the option to save MP4 files directly to a USB thumb drive, or they are processed by the Extron Streaming Content Manager – **SCM** software and saved to a network storage directory. SCM notifies the presenter that the recording package is available for retrieval using an email address that is obtained from the AV control system during preparation for the recording session. The recording package is accessed over the network through the SCM web portal.



Sample Product Cutsheets (Audio-Visual)

Applications

CLASSROOM PRESENTATION, RECORDING, AND STREAMING SYSTEM

The **SMP 352** Dual Recording H.264 Streaming Media Processor can be a valuable asset for any sizable classroom or auditorium. Live streaming and on-demand playback of recorded presentations and courses can capture and share an experience for individuals who cannot be present at the live event. This AV system includes a lectern that houses an Extron SMP 352 and an Extron **DTP CrossPoint 84 IPCP MA 70V**. Together, they manage the AV presentation system for local participants and distant observers. Lectures and presentations are recorded and manually uploaded to a content management system for on-demand access.

Presenters select from a variety of source devices to present supporting media from a Blu-ray player, a media player, and a PC. Additionally, support for personal devices is facilitated by an HDMI connection from an Extron **Cable Cubby 1200** located at the lectern. A high-definition camera with PTZ control provides a visual of the presenter and an Extron **DTP HDMI 230 D Tx** is used to extend the camera signal to the CrossPoint 84. Any source can be routed to the classroom projector through the CrossPoint 84 using an Extron **DTP HDMI 330 D Rx** extender. Two HDMI source signals are routed from the Crosspoint 84 to the SMP 351 to be processed, recorded, and streamed.

The CrossPoint 84 manages audio from the HDMI input connections and from a wireless microphone receiver incorporating lavalier or handheld microphones. The active audio signal is supplied to the internal amplifier, which distributes the signal to several Extron **SI 26CT** speakers equipped with 70V transformers. This audio signal is also embedded into one of the two HDMI signals fed to the SMP 352.

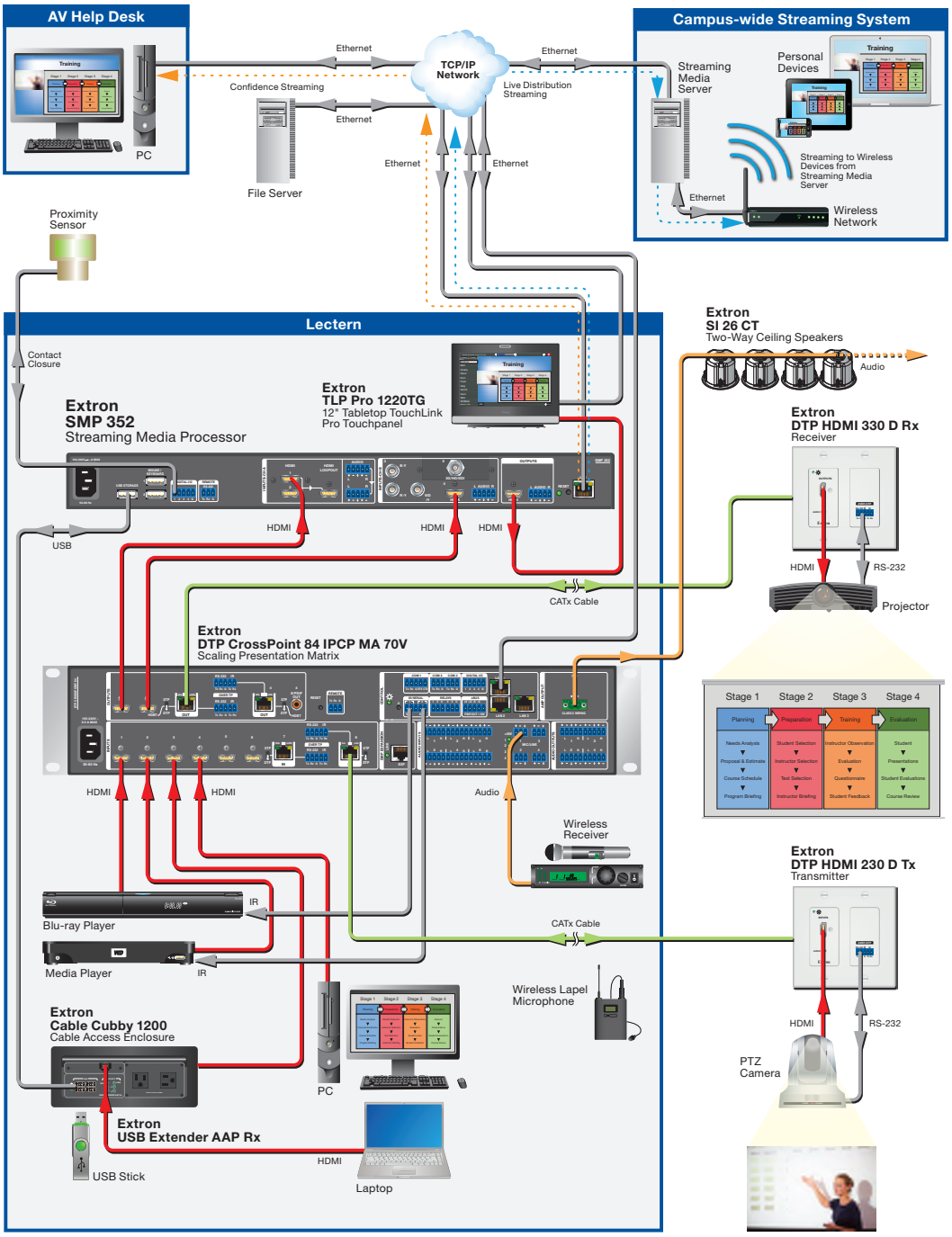
An iCalendar file with the classroom recording schedule is periodically uploaded to the SMP 352. This schedule initiates recording sessions during meetings and training courses. The SMP 352 receives two HDMI signals with embedded audio from the DTP CrossPoint 84, and simultaneously streams and records both signals independently at 720p, empowering users to select their preferred presentation layout. Typically, a PowerPoint presentation is placed in a large window and camera video of the presenter is placed in a smaller window arranged in a picture-by-picture or picture-in-picture layout. When the recording session is complete, a file package is prepared, which includes the MP4 files, metadata, and a folder with JPEG thumbnail images. This file package is then transferred to a defined storage directory on a file server. A custom application uploaded to the SMP 352 interfaces with a room sensor to ensure recording is not initiated if a presenter is not detected.

The SMP 352 also streams AV presentations to a media server at 720p for live unicast streaming to other meeting rooms or individuals across campus who could not attend the event. Live streaming is typically viewed from PCs or personal devices. IT and AV support staff can also access live streaming at a lower resolution, such as 512x288, to verify that the system is functioning properly. While HDCP-encrypted sources can be presented locally in the classroom from the CrossPoint 84, the SMP 352 will not stream or record HDCP-encrypted signals. Encrypted sources will appear as a green screen with an HDCP message indicating that the source image cannot be presented.

A **TLP Pro 1220TG** touchpanel serves as the user interface for this AV system. It provides source selection, source control, and other functions in addition to presenting a live preview of the SMP 352 encoded source layout. Thumb drives or portable USB storage devices can connect to the SMP 352 via the Cable Cubby 1200, giving presenters the ability easily “capture and carry” their presentations directly from the lectern rather than saving them to a file server.

Sample Product Cutsheets (Audio-Visual)

Applications



Sample Product Cutsheets (Audio-Visual)

Specifications

INPUT	
Number/signal type	3 HDMI digital video (HDCP compliant), 1 component video (Y, R-Y, B-Y; interlaced, progressive, HD), or composite video Optional: 1 SDI, HD-SDI, or 3G-SDI digital component video
Resolution range	640x480 to 1920x1200 (reduced blanking), 480p, 480i, 576p, 720p, 1080i, 1080p, NTSC, and PAL, sampled pixel for pixel
VIDEO PROCESSING	
Digital processing	4:2:2, 8-bits per color
Compression	H.264/AVC (ITU H.264, ISO/IEC 14496-10) 4:2:0, 8-bit color Encoding profiles: High, Main, Baseline; Encoding levels: 4.1, 4.0, 3.2, 3.1, 3.0; configurable GOP
Bit rate	200 kbps to 10 Mbps
VIDEO OUTPUT	
Number/signal type	
SMP 351, SMP 351 3G-SDI	2 H.264/AVC digital video over Ethernet 1 HDMI digital video (HDCP compliant)
SMP 351 Series with LinkLicense, SMP 352 Series	3 H.264/AVC digital video over Ethernet 1 HDMI digital video (HDCP compliant)
Scaled resolution	Archive/record: 480p, 720p, 1080p, 512x288, 1024x768, 1280x1024, custom Confidence: 480p, 720p, 1080p, 512x288, 1024x768, 1280x1024, custom
Frame rate	Up to 30 fps for all output rates
Formats	H.264/AVC (Profile type: High, Main, Baseline. Profile level: 4.1, 4.0, 3.2, 3.1, 3.0)
RECORDING AND STORAGE	
File system for USB storage	FAT32, NTFS, VFAT long file name extensions, EXT2, EXT3, EXT4
File types	H.264 and AAC in an MP4 container, JPEG, JSON, XML
File transfer protocols	FTP, SFTP, CIFS
Network file share protocols	CIFS/SMB, NFS
Internal storage capacity	
SMP 351 Series	80 GB (75 GB for recording files) or 400 GB (400 GB for recording files)
SMP 352 Series	400 GB (400 GB for recording files)
External USB ports	1 (front panel), 1 (rear panel), USB 2.0 (Each port is current limited to 1.5 A.)
AUDIO INPUT	
Analog	
SMP 351, SMP 351 3G-SDI	2 stereo, balanced or unbalanced, 1 with loop-through
SMP 351 Series with LinkLicense, SMP 352 Series	Ch. A: 1 stereo, balanced or unbalanced, with loop-through Ch. B: 1 stereo, balanced or unbalanced, or 2 mono, unbalanced
Digital	3 stereo, digital de-embedded from HDMI 1 loop-through from HDMI 1 stereo, digital de-embedded from SDI (optional)

AUDIO PROCESSING	
Sampling rate	16 bit, 48 kHz or 44.1 kHz sampling
Compression	AAC-LC MPEG-4 (ISO/IEC 14496-3:2005)
Bit rate	80 kbps to 320 kbps, stereo
AUDIO OUTPUT — ANALOG	
Number/signal type	1 stereo, balanced/unbalanced
AUDIO OUTPUT — DIGITAL	
Number/signal type	1 stereo, HDMI (re-embedded local preview) 1 AAC-LC digital audio over Ethernet
DIGITAL I/O CONTROL	
Number/signal type	4 digital input/output (configurable)
COMMUNICATION	
USB	
USB configuration ports	1 front panel female mini USB B
Mouse and keyboard port	2 rear panel USB type A
Serial control	
Serial control port	1 bidirectional RS-232, rear panel 3.5 mm captive screw connector, 3-pole
Ethernet control	
Ethernet host port	1 female RJ-45
Ethernet data rate	10/100/1000Base-T, half/full duplex with autodetect
Protocols	
Streaming	Pull:RTP/RTCP (RFC 3550), RTSP (RFC 2326), Interleaved RTSP (RTP/RTSP), RTP/RTSP tunneled through HTTP unicast or multicast Push:MPEG2-TS/UDP* (ISO/IEC 13818-1), MPEG2-TS/RTP* (RFC 2250, IPTV-ID-0087, ETSI TS 102 034), Direct RTP (RFC 3984), SAP (RFC2974), SDP (RFC4566), unicast or multicast, RTMP
Transport	TCP, UDP, multicast IGMPv3 (RFC 3376) or unicast
All supported	IGMPv3 (RFC 3376), IP, UDP, SSL, DHCP, HTTP, HTTPS, RTP, RTSP, SNMP V2 (RFC 1213), SAP (RFC2974), SDP (RFC4566), QoS (RFC 2474), NTPv4 (RFC 4330)
GENERAL	
Power supply	Internal Input: 100-240 VAC, 50-60 Hz
Power consumption	30 watts typical
Enclosure dimensions	1.7" H x17.5" W x 11.5" D (1U high, full rack wide) (4.3 cm H x 44.4 cm W x 29.2 cm D) (Depth excludes connectors.)
Regulatory compliance	
Safety	CE, c-UL, UL
EMI/EMC	
SMP 351 Series	CE, C-tick, FCC Class A, ICES, KCC, VCCI
SMP 352 Series	CE, C-tick, FCC Class A, ICES, VCCI

Model	Version Description	Part number
SMP 351	Standard Version – 80 GB SSD	60-1324-01
SMP 351 3G-SDI	with 3G-SDI Input – 80 GB SSD	60-1324-02
SMP 351	Standard Version – 400 GB SSD	60-1324-11
SMP 351 3G SDI	with 3G-SDI Input – 400 GB SSD	60-1324-12
SMP 352 - 400 GB SSD	Dual Recording – 400 GB SSD	60-1634-11
SMP 352 3G-SDI - 400 GB SSD	Dual Recording w/3G-SDI – 400 GB SSD	60-1634-12

For complete specifications, please go to www.extron.com
Specifications are subject to change without notice.

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Sample Product Cutsheets (Audio-Visual)

USB FOR PRO AV

MediaPort 200

HDMI AND AUDIO TO USB
SCALING BRIDGE

Pro AV Integration for Software
Videoconferencing Applications

Skype for Business · BlueJeans · Cisco webex
skype · GoToMeeting · zoom

- Seamlessly integrates pro AV sources or systems into software codec applications
- USB 2.0 device connection uses generic USB drivers for universal compatibility
- Video scaling provides USB output from 320x180 to 1080p/15 to match common software codec requirements
- Integrated audio DSP with AEC reference output
- HDMI input with HDCP-compliant loop through

Extron Electronics
INTERFACING, SWITCHING AND CONTROL

Sample Product Cutsheets (Audio-Visual)

Introduction

The Extron **MediaPort 200** is an HDMI to USB bridge for integrating pro AV sources or systems with software codec conferencing applications. It works seamlessly with a computer using generic USB video and audio drivers. The MediaPort 200 features an HDMI input with HDCP-compliant loop through, accepts signals up to 1920x1200, and scales video to a USB 2.0 output. Audio features include program and mic inputs, HDMI audio de-embedding, and USB bidirectional audio, plus AEC reference and line level outputs. The MediaPort 200 also includes DSP with EQ, filters, mixing, dynamics, and ducking. This allows the MediaPort 200 to serve as a complete soft codec interface, with the added flexibility of integrating into larger hardware codec or DSP systems. The MediaPort 200 enables versatile integration of conferencing computers into pro AV system designs.

The MediaPort 200 bridges the gap between simple Webcam-to-computer solutions and traditional hardware videoconferencing systems. For small meeting spaces with just a computer and display, the MediaPort 200 is ideal for enhancing audio and video quality by adding support for professional-grade equipment such as videoconferencing PTZ cameras, boundary microphones, and sound reinforcement systems.

In boardrooms and large conference rooms, the MediaPort 200 easily integrates a conferencing computer into a fully equipped AV system with a hardware codec, video distribution and processing, control, DSP, microphones, and full sound reinforcement. In addition to conferencing, the connected computer can be used with a software application to record meeting sessions, presentations, or lectures.

Streamlined Installation

The MediaPort 200 connects to Windows® or Mac®-based computers with USB plug-and-play simplicity, using industry standard UVC - USB Video Class and UAC - USB Audio Class drivers. It can be used with popular software and cloud-based communications platforms including Microsoft® Skype®/Skype® for Business, Adobe® Connect™, BlueJeans, Cisco® WebEx®, Citrix® GoToMeeting™, Zoom, and more.

Optimal Video Processing for Soft Codecs

To ensure an HDMI source is presented with the highest possible image quality to a soft codec, the MediaPort 200 incorporates video processing technology specifically engineered for optimized image scaling and frame rate conversion that preserves detail and legibility of source content. Output resolutions range from 320x180 to 1080p/15, and are dynamically configured by the software codec as it responds to real-time CPU usage and bandwidth conditions between near-end and far-end locations.

Versatile Audio Integration with DSP

The MediaPort 200 accepts a microphone input and program sources as analog audio and de-embedded HDMI two-channel audio. The USB connection provides a 4x2 channel audio interface with a personal computer, similar to a standard USB sound card with send and return audio capability. This allows the MediaPort 200 to send a two-channel mix of the microphone, analog program, HDMI audio, and USB playback audio to the computer. The interface also allows the MediaPort 200 to receive four audio channels from the computer, including program audio plus two-channel communication audio from the soft codec's far-end.

The audio DSP can be used to optimize mic and program source signals, as well as outgoing signals bound for the computer, sound reinforcement systems, or outboard DSPs. The MediaPort 200 also delivers far-end audio as a dedicated AEC reference output to an AEC-equipped DSP, such as the DMP 128 C.

Works with these and other conferencing applications:

Skype for Business · skype · BlueJeans · GoToMeeting · Cisco webex · zoom

Sample Product Cutsheets (Audio-Visual)

Features

OVERVIEW

Seamlessly integrates pro AV sources or systems into software codec applications
The MediaPort 200 sends AV signals from a presentation source or switcher to a computer, for integration with software and cloud-based communications platforms.

USB 2.0 device connection uses generic USB drivers for universal compatibility
Industry standard UVC - USB Video Class and UAC - USB Audio Class drivers provide compatibility with Windows®, Mac OS®, Linux, and other operating systems.

Supports popular software communications platforms including Microsoft® Skype®/ Skype® for Business, Adobe® Connect™, Apple FaceTime, BlueJeans, Cisco® WebEx®, Citrix® GoToMeeting™, Google Hangouts, Lifesize® Clearsea, and Zoom

Video scaling provides USB output from 320x180 to 1080p/15 to match common software codec requirements
Ensures optimal quality of camera or computer video content for far-end participants. The video output is delivered as an MJPEG-encoded stream over USB 2.0.

Integrated audio DSP
The MediaPort 200 provides audio mixing and signal processing capabilities, including mixing and routing for 4x2 audio. The DSP is optimized for integration with mic and program audio sources as well as software codecs, hardware codecs, external DSP, and sound reinforcement.

AEC reference output
This output provides far-end audio to an external AEC-equipped DSP. This audio is used by the external DSP as a reference signal for AEC - acoustic echo cancellation processing, to ensure echo-free conferencing for far-end participants.

HDCP-compliant HDMI input and loop-through
Provides an output signal for a local display, an AV system, or a hardware codec, enabling the content to be monitored or shared without the need for a separate distribution amplifier. Both the HDMI input and loop-through are HDCP compliant.

VIDEO

Accepts HDMI computer and video resolutions up to 1080p/60 and 1920x1200

Aspect ratio control
The aspect ratio of the video output can be controlled by selecting a FILL mode, which provides a full screen output, or a FOLLOW mode, which preserves the original aspect ratio of the input signal.

Auto Input Memory
When activated, the unit automatically stores size, position, and picture settings based on the incoming signal. When the same signal is detected, the image settings are automatically recalled from memory.

Internal video test patterns and pink noise generator for calibration and setup
The MediaPort 200 offers several video test patterns to facilitate proper system setup and calibration, and can provide an active output when an input video source is not available. The pink noise generator is selectable for all audio outputs, including USB audio to the computer, and aids in optimizing audio output signals.

Logo image display
The MediaPort 200 can be set to automatically display a user-supplied image file whenever no signal is present at the HDMI input.

High performance deinterlacing for signals up to 1080i
Features highly accurate deinterlacing for 480i/576i/1080i signals. This ensures absolute detail and fidelity in the reconstructed progressive video frames, including 3:2 and 2:2 pulldown for interlaced signals originating from film content.

HDCP Visual Confirmation
A full-screen green signal is sent when HDCP-encrypted content is routed to the USB output, or to a non-HDCP compliant display on the HDMI loop output, providing immediate visual confirmation that protected content cannot be viewed.

EDID Minder®
EDID Minder ensures that the source powers up properly and reliably outputs content for display.

AUDIO AND CONTROL

HDMI audio de-embedding
Embedded HDMI two-channel PCM audio can be extracted to the integrated DSP for processing and mixing.

USB 4x2 audio interface
The USB connection provides a 4x2 channel audio interface with a computer, similar to a USB sound card with send and return audio capability. This allows the MediaPort 200 to send a two-channel source mix to the computer, and the computer to deliver its program audio plus communication audio from the far-end to the MediaPort 200.

Gain, parametric EQ, filters, and dynamics on inputs and outputs
Essential DSP processing tools are included for room tuning, clip prevention, managing wide source signal variations, and setting proper gain structure.

Mic and USB audio ducking
Ducking automatically reduces program audio when a microphone or far-end USB audio signal is detected, eliminating the need for separate audio ducking.

Live DSP configuration
Using the Extron PCS software application, live parameter adjustments can be made while previewing or metering them in real-time. This avoids the need to compile and upload a configuration file to the device.

Two digital input and two digital output control ports
These ports allow external triggering such as mic activation and muting, as well as illuminating mic status LEDs. Digital inputs can also be used for recalling DSP presets and adjusting volume via contact closure.

Front panel LED indicators for HDMI and USB signal status
These LED indicators provide visual feedback for HDMI input and loop-through signal presence, HDCP status, plus USB signal presence for the host computer, video send, audio send, and audio return.

Extron PCS - Product Configuration Software
Extron PCS features an intuitive, user-friendly GUI which allows for expedited setup and commissioning, real-time operation and monitoring, firmware updates, plus full configuration of the DSP and its audio processing tools.

Sample Product Cutsheets (Audio-Visual)

Overview

HDMI status indicators
Provide video signal and HDCP presence status for input and loop-through connections.

Integrated audio DSP
Manage gain, mixing, EQ, filtering, dynamics, and ducking for HDMI, USB, and analog audio.

Front panel controls with LCD display
Allows convenient access to configuration and status of the MediaPort 200.

MediaPort 200 - Front

Front panel configuration port
Allows easy access for system configuration using Extron PCS software.

USB status indicators
Indicate host presence, video send, and audio send and return status.

Compact enclosure
The half rack width enclosure can be installed underneath a conference table, inside a credenza, or in a lectern. Under-table mounting hardware is available separately.

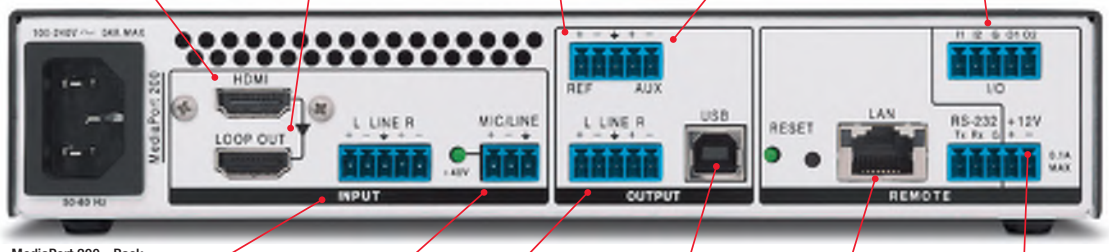
HDMI input
Accepts input signals up to 1080p/60 and 1920x1200, with 480i/576i/1080i deinterlacing and audio de-embedding.

HDCP compliant HDMI loop-through
Provides output signal for a local display, an AV system, or a hardware codec.

AEC reference output
Provides a dedicated output of the far-end audio to serve as an AEC reference signal for an external DSP.

Auxiliary output
Provides a dedicated output of the mic/line input for connection to a hardware codec.

Two digital input and two digital output control ports
Allow mic activation and muting, as well as mic status LED illumination.



MediaPort 200 - Back

Stereo line input
Accepts program audio from a source device, or an external audio mixer, switcher, or processor.

Mic/line input
Includes selectable 48 volt phantom power, allowing use of professional-grade condenser microphones.

Analog audio output
Provides a two-channel output signal for a hardware codec, an external DSP, or sound reinforcement.

USB 2.0 output
Delivers video and bidirectional audio to a computer using generic USB video and audio drivers.

Ethernet and RS-232 control
The MediaPort 200 can be controlled over Ethernet or RS-232, and configured or updated through the Ethernet port using Extron PCS software.

+12 VDC, 100 mA remote power
Provides remote power for various applications, including mic status LED illumination.

Sample Product Cutsheets (Audio-Visual)

Audio

The audio DSP in the MediaPort 200 includes essential processing features that facilitate sound quality optimization for participants in a conferencing session. The DSP allows an AV integrator, engineer, or technician to establish proper gain structure, normalize signal levels for microphones and other audio sources, and fine-tune frequency response in the room. Effective DSP implementation helps ensure clean, distortion-free audio presentations with intelligible speech – a very important foundation of a good conferencing experience.

DSP for Conferencing Applications

DSP is the core of traditional conferencing systems with hardware codecs, microphones, and sound reinforcement. The MediaPort 200 streamlines integration of videoconferencing computers into these AV systems with its own high performance DSP. It also simplifies designs for new, smaller meeting spaces without the need for dedicated audio processing. Additionally, the MediaPort 200 is ideal for upgrading a basic hardware codec installation to include soft codec capabilities and an audio system.

Versatile and Powerful Capabilities through User-Friendly Software

Audio processing tools, input and output gain, and mix levels are readily accessible through a user-friendly interface in the Extron PCS software application. Graphical sliders facilitate gain and level adjustments, while peak level meters allow signal monitoring in real-time. Any adjustment in gain or processing is also immediately audible through the system. The user interface provides direct controls for master volume at the near-end, incoming audio from the far-end, as well as mic and program level adjustments for the far-end. Soft limits can be set on master controls to ensure that end users can safely adjust levels as necessary.

The software provides intuitive access to all of the audio processing tools in the MediaPort 200, including parametric EQ, tone controls, low-pass and high-pass filters, compression, limiter, and ducking.

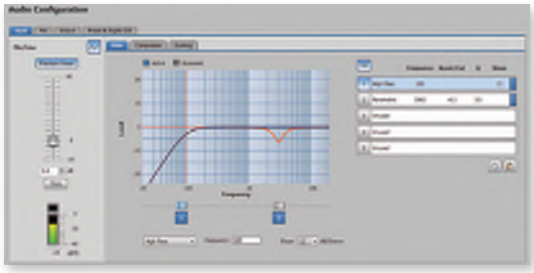
Saving DSP Configurations

DSP parameter adjustments can be stored to any of 16 preset locations, allowing quick recall of common audio configurations. Additionally, DSP, video processing, and other system settings can be saved to a configuration file, which can then serve as a system backup, or used to quickly set up additional units in a facility.

Control System Integration

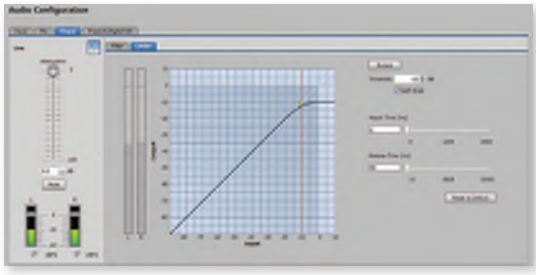
The MediaPort 200 can be integrated with a control system to enable user control of near-end and far-end audio levels, as well as recalling DSP presets. This allows easy access to essential audio conferencing controls as in a traditional hardware codec system.

Input Gain



Input EQ

Mixer



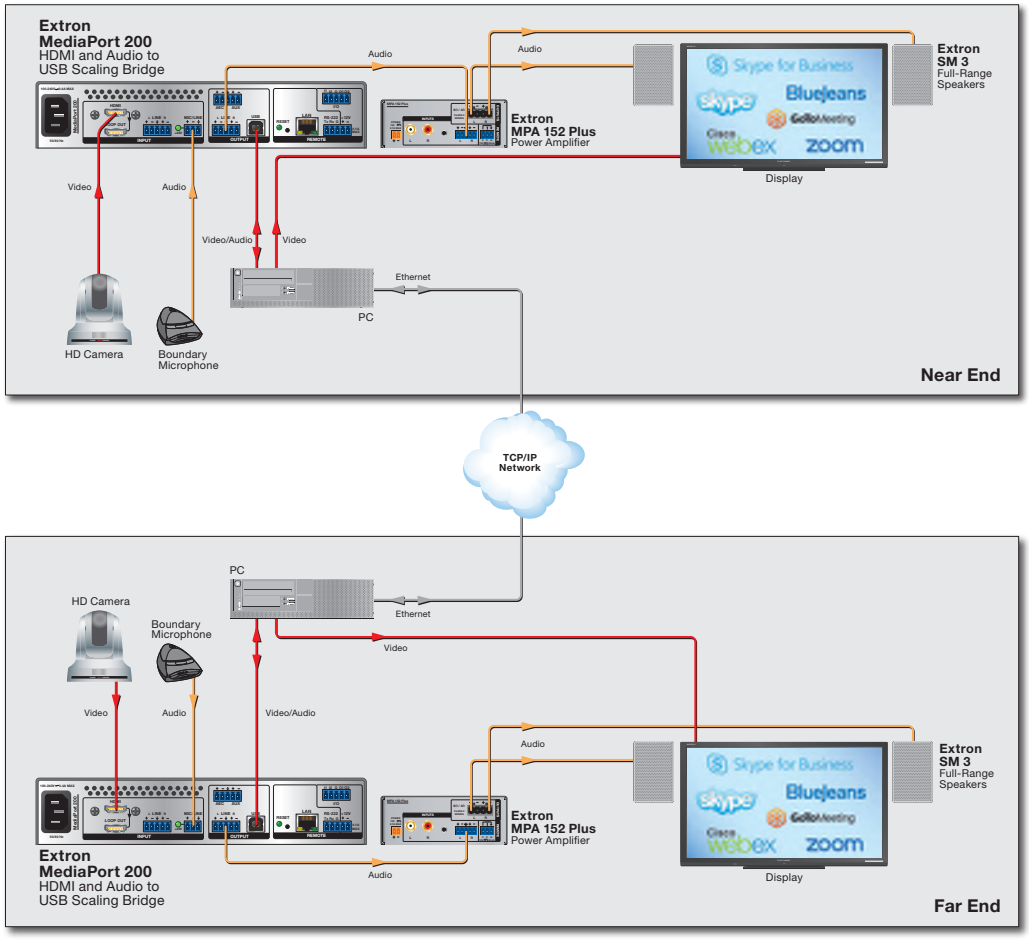
Output Limiter

Sample Product Cutsheets (Audio-Visual)

Applications

SMALL MEETING ROOM

A MediaPort 200 in a small meeting room provides a quality AV experience for software conferencing sessions with the incorporation of professional-grade conferencing sources and sound reinforcement. An HD camera at the near-end location provides sharp, detailed video content to the MediaPort 200, which scales the image to a size appropriate for the available CPU resource as well as network bandwidth to the far-end. A high quality boundary microphone delivers optimal audio fidelity to the far-end participants, enhanced by the audio DSP integrated into the MediaPort 200. The DSP also processes the far-end return audio before passing the signal to an Extron MPA 152 and SM 3 speakers. A similar system configuration at the far-end ensures all participants experience high performance video and audio during the conferencing session.



Sample Product Cutsheets (Audio-Visual)

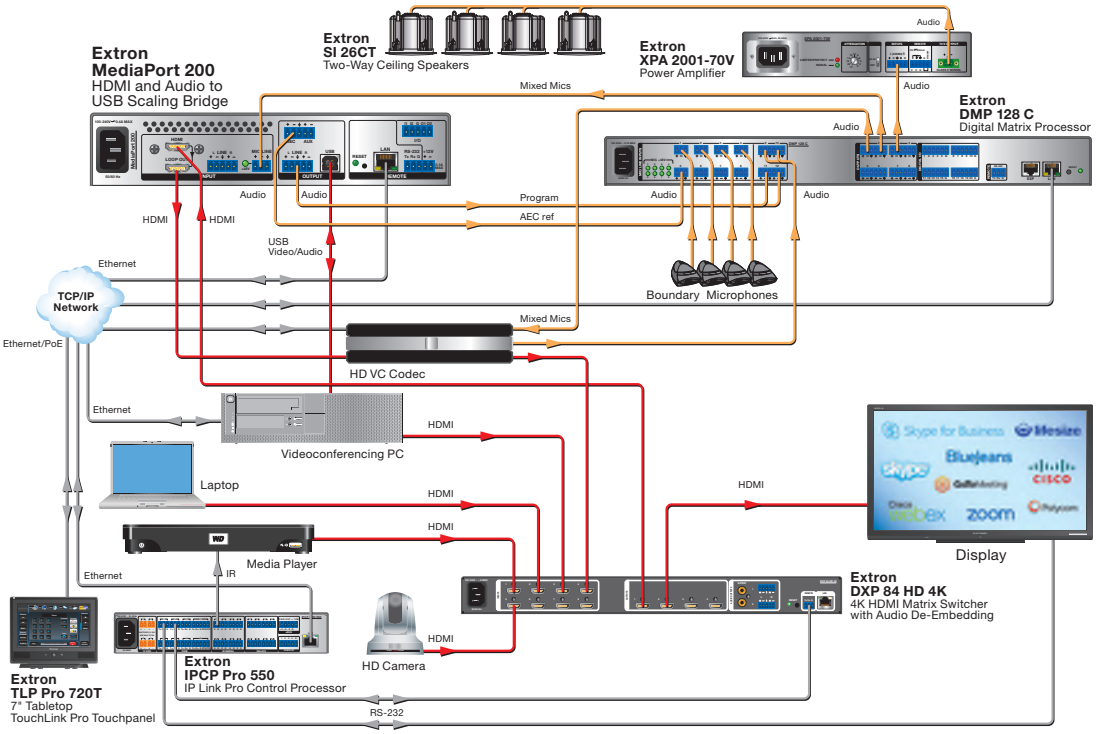
Applications

LARGE CONFERENCE ROOM

A large conference room system utilizes the MediaPort 200 and a matrix switcher to integrate hardware and software videoconferencing codecs into one system. Multiple room sources including a laptop, media player, and a high quality HD camera connect to an Extron DXP 84 HD 4K matrix switcher for routing signals to the MediaPort 200. The HDMI loop output of the MediaPort 200 makes the current source simultaneously available to the hardware codec.

The MediaPort 200 unit's USB 2.0 output provides video and audio to the videoconferencing computer, and receives return audio from the far-end conference session. The integrated audio DSP is augmented by an Extron DMP 128 C digital matrix processor, which provides an audio mix of the four room microphones to the MediaPort 200 and hardware videoconferencing codec, while receiving their program audio outputs. The unit's AEC reference output sends far-end audio to the DMP 128 C processor. This audio is used by the processor as a reference signal for AEC processing, to eliminate echo through the room's sound system.

Both the videoconferencing computer and the hardware videoconferencing codec can be routed to the local display. Source selection, audio management, and device control are simplified with an Extron TouchLink® touchpanel and IPCP Pro 550 control processor.



Sample Product Cutsheets (Audio-Visual)

Specifications

VIDEO INPUT AND LOOP THROUGH	
Number/signal type	1 HDMI/DVI (HDCP compliant) 1 HDMI/DVI loop-through (HDCP compliant)
Connectors	1 female HDMI 1 female HDMI loop-through
Horizontal frequency	15 kHz to 100 kHz
Vertical frequency	24 Hz to 75 Hz
Resolution range	640x480 through 1600x1200, 1920x1200 (with reduced blanking), 480i, 576i, 480p, 720p, 1080i, and 1080p
Digital pixel data bit depth	8, 10, and 12 bits per channel; 165 MHz pixel clock
Standards	DVI 1.0, HDMI 1.4, HDCP 1.3
VIDEO PROCESSING	
Colors	11 million (8-bit 4:2:2 processing)
VIDEO OUTPUT	
Number/signal type	1 USB digital video
Connectors	1 female USB type B
USB scaled resolutions	320x180[1,2], 320x240[1,2], 424x240[1,2], 640x360[1,2], 640x480[1,2], 848x480[1,2], 960x540[1,2], 720p[1,2], 1080p[1] [1] = at 15 Hz, [2] = at 30 Hz
USB ENCODING	
Number/signal type	1 USB (scaled, non-HDCP compliant)
Vertical frequency	15 Hz, 30 Hz
Video encoding	MJPEG
Resolution	320x180 through 1080p
Audio	PCM, 24-bit, 48 kHz
Bit rate	Up to 60 Mbps
USB standards	USB 2.0, high speed (USB 1.1 is not supported.)
AUDIO	
Gain	Unbalanced output, -6 dB; balanced output, 0 dB
Frequency response	20 Hz to 20 kHz, ±0.2 dB
THD + Noise	<0.03%, 20 Hz to 20 kHz at maximum level
S/N	>90 dB, 20 Hz to 20 kHz, at maximum balanced output (unweighted)
AUDIO INPUT	
Number/signal type	1 stereo, de-embedded from HDMI (PCM only) 1 stereo line level, balanced or unbalanced 1 mono mic/line level, balanced or unbalanced (with available phantom power) 2 stereo USB, embedded (communications and program audio)
Connectors	1 female HDMI (1) 3.5 mm, 5 pole captive screw, for line level (stereo) (1) 3.5 mm, 3 pole captive screw, for mic/line level 1 female USB B
Nominal level	Line inputs: +4 dBu, -10 dBV, adjustable Mic/line inputs: -60 dBV, +4 dBu, -10 dBV, adjustable
Maximum level	+21 dBu, balanced, when input gain is set to 0 dB, at rated THD+N
DC phantom power	+48 VDC ±10% (can be switched on or off for the mic/line input)

AUDIO OUTPUT	
Number/signal type	1 stereo, balanced or unbalanced, on a 3.5 mm, 5 pole captive screw connector. Can be configured as stereo or dual mono (variable). 2 mono, balanced or unbalanced (variable), on a shared 5 pole captive screw connector 1 stereo USB (embedded) 1 HDMI (loop output embedded)
Connectors	(2) 3.5 mm, 5 pole captive screw 1 female USB type B 1 female HDMI
THD	<0.03%, 20 Hz to 20 kHz at maximum level
Maximum level (Hi-Z)	>+21 dBu, balanced; >+15 dBu, unbalanced
Output volume range	-100 dB to 0 dB, in 0.1 dB increments
COMMUNICATIONS	
Serial control port	1 bidirectional RS-232 on (1) 3.5 mm, 5 pole captive screw connector, shared with +12 V remote power on rear panel
Digital I/O control	2 digital inputs on (1) 3.5 mm, 5-pole captive screw connector, shared with two digital outputs and a common ground 2 digital outputs on (1) 3.5 mm, 5-pole captive screw connector, shared with two digital inputs and a common ground
Remote power	(1) +12 V DC power on (1) 3.5 mm, 5 pole captive screw connector, shared with RS-232 port; 100 mA
USB control port	1 female USB mini-B (front panel Config port)
Ethernet control port	1 female RJ-45
Ethernet data rate	10/100/1000Base-T, half/full duplex with autodetect
Ethernet protocol	ARP, ICMP (ping), IP, TCP, DHCP, HTTP, SFTP, SNMP, Telnet
GENERAL	
Power supply	Internal Input: 100-240 VAC, 50-60 Hz
Temperature/humidity	Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operation: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Mounting	
Rack mount	Yes, with optional rack shelf
Furniture mount	Yes, with optional under-desk or through-desk mounting kit
Enclosure dimensions	1.66" H x 8.68" W x 9.5" D (1U high, half rack wide) (4.2 cm H x 22.1 cm W x 21.6 cm D) (Depth excludes connectors.)
DIM weight	7 lbs (3 kg)
Regulatory compliance	
Safety	CE, c-UL, UL
EMI/EMC	CE, C-tick, FCC Class A, ICES, VCCI
Environmental	Complies with the appropriate requirements of RoHS and WEEE.
Warranty	3 years parts and labor

NOTE: All nominal levels are at ±10%.

Model	Version Description	Part number
MediaPort 200	HDMI and Audio to USB Scaling Bridge	60-1488-01

For complete specifications, please go to www.extron.com
Specifications are subject to change without notice.

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03-2017
68-2855-01
REV. C
Letter - English - NP

Sample Product Cutsheets (Audio-Visual)

M55 HANGING CEILING MICROPHONE

OVERVIEW

The M55 is an innovative, hanging ceiling microphone system designed for applications where aesthetics, sound quality, and ease of installation are critical. The primary applications for the ceiling mounted M55 include Video Teleconferencing (VTC), distance learning, hospital rooms, surveillance and ambient room miking.

The M55 accommodates interchangeable capsules with cardioid, hypercardioid, omnidirectional and supercardioid (shotgun) coverage patterns. All electronics are fully integrated with high sensitivity and low noise. The signal output is balanced to eliminate RF interference caused by cell phones and mobile devices.

Installing the M55 requires drilling just one 5/8-inch hole in the ceiling, with no additional tools needed. The M55's mounting hardware easily adjusts the hanging height up to four feet from the ceiling surface without removing ceiling tiles. An optional aiming clip (MCHANGER) easily makes any additional angular adjustments. The cable assembly is equipped with terminal block connectors. For installations where plenum rated cable is to be used a UL rated, metal plenum junction box is available.

MODEL VARIATIONS

All M55 mics are manufactured in white finish with 4 ft cable terminating in terminal block connector. Several capsule configurations below.
M55W - cardioid (white)
M55WHC - hypercardioid (white)
M55WS - supercardioid (shotgun) (white)
M55WO - omnidirectional (white)

SUPPLIED ACCESSORIES

CONN170F - 1'integrated mic cable with terminal block connector
CONN170M - Mating terminal connector for solder-less connection
JBM55 - Metal plenum junction box with seismic and fire safety cable restraint where required by code.

OPTIONAL ACCESSORIES

MCHANGER - Clear plastic clip to adjust mic angle
WS20W - White foam windscreen to reduce wind noise


MCHANGER


Adjustable Cable


JBM55

FEATURES

- High output allows distance miking
- Optimized for voice recognition
- Immunity from RF interference
- Fingertip height adjustment and rotation control
- Low noise preamp circuitry
- Designed, assembled & tested in the USA
- 3 year warranty

APPLICATIONS

- Video Teleconferencing (VTC)
- Distance Learning
- Board Rooms
- Surveillance
- Hospital and medical procedures
- Ambient room miking

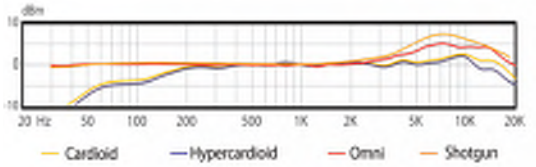
M55

Sample Product Cutsheets (Audio-Visual)

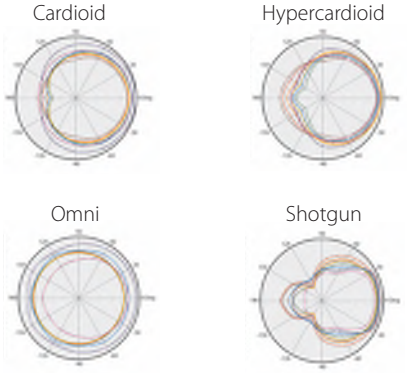
SPECIFICATIONS

Transducer Type	Condenser
Frequency Response	60 Hz - 10 kHz
Polar Pattern	Cardioid / Hypercardioid / Omni/ Supercardioid
Output Impedance	150 ohms
Sensitivity	38 mV (C), 32 mV (HC), 40mV (O), 60 mV (S) / Pa @ 1k
Equivalent Noise Level	22 dB (A-weighted)
Signal to Noise Ratio	72 dB
Maximum SPL	≥130 dB
Dynamic Range	108 dB
Power Requirements	18 - 52 V phantom
Connector	Terminal Block Connector
Polarity	Positive pressure on diaphragm produces positive voltage on pin 2 relative to pin 3 of output XLR connector
Materials / Finish	Aluminum & Zinc Alloy / White Finish
Weight	70 g / 2.4 oz (Mic & Cable) 499 g / 17.6 oz (Junction Box & Safety Cable)
Length	54 mm / 2.1 in

FREQUENCY RESPONSE



POLAR PATTERNS



ARCHITECT AND ENGINEER SPECIFICATIONS

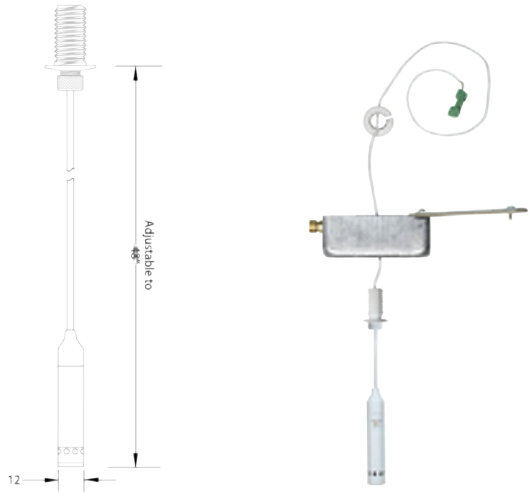
The microphone shall be of the condenser type with a modular threaded capsule available in cardioid, hypercardioid, omnidirectional and supercardioid polar patterns. The microphone shall be protected from RF interference. The microphone shall have a fully integrated preamp circuitry thereby eliminating the need for a remote preamplifier module. The microphone shall operate on 18 - 52 Volts DC and the nominal output impedance shall be equal to 150 Ohms at 1 kHz. The microphone shall have a sensitivity of 38 mV (C), 32 mV (HC), 40 mV (O), 60 mV (S) / Pa at 1 kHz. The microphone shall have a maximum SPL level of ≥ 130 dB with THD of 0.5%. The microphone shall be machined out of brass and the dimensions shall be 12 mm in diameter by 54 mm in length. The microphone shall be the Audix M55.

OPERATION AND MAINTENANCE

The M55 is a low impedance microphone and should be plugged into a mic level input on your console, mixer, or recording device. The M55 requires phantom power (18-52 V), which is available on most professional mic preamps and mixing devices. If phantom power is not available on your equipment, use an external phantom power source such as the Audix APS2. Avoid plugging the microphone into or removing it from the audio system unless the channel is muted or the relevant faders are turned down. Failure to do so may result in a loud popping noise that could seriously damage the speakers.

Further miking techniques may be found at www.audixusa.com.

DIMENSIONS (mm) EXPLODED VIEW



PRODUCT REGISTRATION: Please register your product online at www.audixusa.com/docs_12/about/product_registration.shtml.

SERVICE AND WARRANTY: This microphone is under warranty for a period of 3 years to be free of defects in material and workmanship. In the event of a product failure due to materials or workmanship, Audix will repair or replace said product at no charge with proof of purchase. Audix does not pay or reimburse shipping costs for warranty repairs or returns. The warranty excludes any causes other than manufacturing defects, such as normal wear, abuse, environmental damage, shipping damage or failure to use or maintain the product per the supplied instructions. No Implied Warranties: All implied warranties, including but not limited to implied warranties of merchantability and fitness for a particular purpose are hereby excluded. The liability of Audix, if any, for damages relating to allegedly defective products shall be limited to the actual price paid by Dealer for such products and shall in no event include incidental or consequential damages of any kind. Should your microphone fail in any way, please contact the Audix Service department at 503.682.6933. A Return Authorization is required before returning any product. OTHER THAN THIS WARRANTY, AUDIX MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCTS, THE USE OF THE PRODUCTS, THE PERFORMANCE OF THE PRODUCTS. AUDIX SHALL NOT BE LIABLE FOR SPECIAL INCIDENTAL, CONSEQUENTIAL, INDIRECT OR SIMILAR DAMAGES ARISING FROM OR BASED ON THE SALE, USE, STORAGE OR DISPOSAL OF THE PRODUCTS, AUDIX'S SERVICE WORK, BREACH OF WARRANTY, BREACH OF CONTRACT. NEGLIGENCE, OR ANY OTHER THEORY OF LIABILITY, EVEN IF AUDIX HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

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AUDIX®

ver 4.0 09-16

Sample Product Cutsheets (Audio-Visual)

M3 Tri-element Hanging Ceiling Microphone

OVERVIEW

The M3 is an innovative, tri-element hanging microphone system designed for applications where aesthetics, sound quality, and ease of installation are critical. The M3 is an ideal audio capture solution for video conferencing, distance learning, courtroom activities, and surgical procedures. It can also be used for ambient room miking and surveillance.

The M3 incorporates three phase coherent hypercardioid capsules with tailored frequency responses optimized for speech intelligibility. This is accomplished by minimizing frequencies caused by noise, vibration, paper shuffling, keyboard strokes, fans, and heating/air conditioning. Low noise preamp circuitry is employed for highest possible signal to noise and studio quality sound. A high-quality silicone jacketed microphone cable ensures a balanced, shielded signal and a very clean look. Electronics above the ceiling are housed within a plenum rated junction box and cable connections are made via an RJ45 connector embedded within a proprietary brass housing for an airtight seal.

The M3 connects to the input of a mixer or dsp console via a breakout cable (provided). The breakout cable consists of a female RJ45 connector that terminates in either three terminal blocks or XLR connectors (optional). A variety of optional shielded CAT7 cable lengths (from plenum rated junction box to break out cable) are available.

Installing the M3 requires drilling just one 5/8-inch hole in the ceiling, with no additional tools needed. The M3 mounting hardware easily adjusts the cable hanging height up to four feet from the ceiling surface without removing ceiling tiles. A wire safety cable provides additional seismic restraint.

MODEL VARIATIONS

M3 - Microphone and cable in charcoal grey color
M3W - Microphone and cable in white

SUPPLIED ACCESSORIES

JBM3 - Plenum rated junction box
ANCHRJB60V2 - Seismic/fire strain relief
CBLM3TERM - Breakout cable consisting of RJ45 female to 3 terminal block connectors

OPTIONAL ACCESSORIES

CBLM3XLR - Breakout cable consisting of RJ45 female to 3 XLR male connectors - 1.57 meters (40")
CBLM307 - CAT 7 Interface cable , 7 meters (23') RJ45 with Plenum cover , twisted shielded pairs
CBLM310 - as above , 10 meters (33')
CMBM315 - as above, 15 meters (49')
CBLM320 - as above , 20 meters (66')
CBLM325 - as above, 25 meters (82')
CLBM30 - as above, 30 meters (98')

FEATURES

- 100% RF shielding and immunity
- Gold diaphragm condenser capsules with studio quality sound
- Low impedance design allows for extremely long cable runs (if required) without cross talk or interference
- Frequency and pattern tailored for voice clarity and rejection of extraneous noise
- Evenly dispersed sound with undetectable phase
- High-quality silicone jacketed microphone cable with adjustable length and position
- Plenum rated junction box with RJ45 connector
- All visible components of the microphone and cable are same color: charcoal or white
- TAA compliant
- Very high output, low self-noise
- Easy to install

APPLICATIONS

- Zone Capture
- Video Conferencing
- Distance Learning
- Hospital and medical procedure
- Courtroom
- Ambient room miking

M3

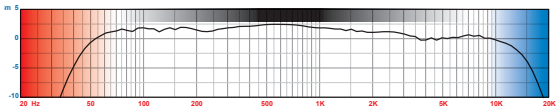
Sample Product Cutsheets (Audio-Visual)

M3

SPECIFICATIONS

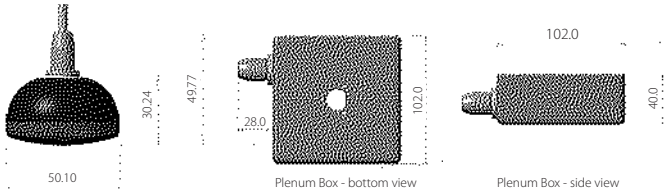
Transducer Type	Pre-Polarized Condenser
Frequency Response	30 Hz – 19 kHz
Optimized Response	70 Hz – 9 kHz (see chart)
Polar Pattern	Hypercardioid
Output Impedance	150 Ohms balanced
Sensitivity	34 mV / Pa @ 1k
Off Axis Rejection	1 capsule >23 dB at 180° relative to 0° 2 capsules >18 dB at 120° 3 capsules >9 dB at 60°
Signal/Noise Ratio (A-weighted)	72 dB
Equivalent Noise Level (A-weighted)	22 dB (A weighted)
Maximum SPL @ .5% THD	≥128 dB
Dynamic Range	106 dB
Power Requirements	18 – 52 Volts phantom
Cable/Connector	Terminal block or XLR
Polarity	Positive pressure on diaphragm produces positive voltage on pin 2 relative to pin 3
Weight	95 grams (mic only) / 3.32 ounces
Diameter	50mm (2 inches)
Length	30mm (1.2 inches)

Frequency Response (see key to the right)



ARCHITECT AND ENGINEER SPECIFICATIONS

The microphone shall be of the condenser type with three elements having a hypercardioid polar pattern. The microphone shall be protected from RF interference. The microphone shall have a fully integrated preamp circuitry housed within a plenum rated junction box. The microphone shall consist of three individual circuits each operating on 18-52 Volts DC and the nominal output impedance shall be equal to 150 Ohms at 1 kHz. The microphone shall have a sensitivity of 34 mV / Pa at 1 kHz and a maximum SPL level of ≥ 128 dB with THD of 0.5%. The microphone housing shall be machined out of brass with a steel mesh protective grill. The outer dimensions shall be 50mm in diameter by 30 mm in length. The microphone shall be the Audix M3. Further miking techniques may be found at www.audixusa.com.

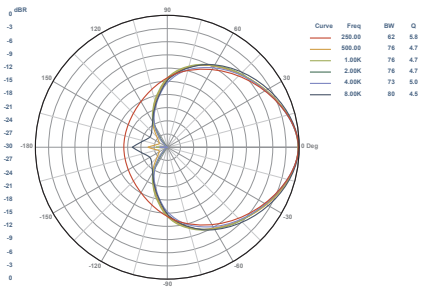


Low Frequency Noise
Frequencies below 70Hz minimized in order to reduce boominess, hum, rumble, table noises, HVAC, ambient interference.

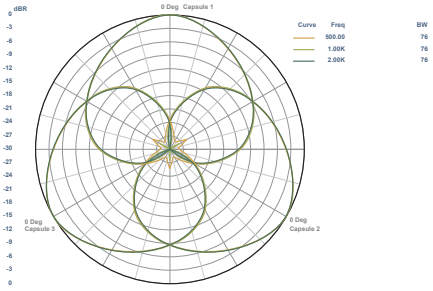
High Frequency Noise
Frequencies above 9 KHz minimized in order to reduce unwanted noise from paper shuffling, keyboards, HVAC, fan noise, ambient interference.

Ideal for Vocal Clarity and Voice Recognition
Frequencies between 200 Hz – 1kHz are optimized for speech.

M3 Polar x 1



M3 Polar x 3



PRODUCT REGISTRATION: Please register your product online at www.audixusa.com/docs_12/about/product_registration.shtml.
SERVICE AND WARRANTY: This microphone is under warranty for a period of 1 year to be free of defects in material and workmanship. In the event of a product failure due to materials or workmanship, Audix will repair or replace said product at no charge with proof of purchase. Audix does not pay or reimburse shipping costs for warranty repairs or returns. The warranty excludes any causes other than manufacturing defects, such as normal wear, abuse, environmental damage, shipping damage or failure to use or maintain the product per the supplied instructions. No Implied Warranties: All implied warranties, including but not limited to implied warranties of merchantability and fitness for a particular purpose are hereby excluded. The liability of Audix, if any, for damages relating to allegedly defective products shall be limited to the actual price paid by Dealer for such products and shall in no event include incidental or consequential damages of any kind. Should your microphone fail in any way, please contact the Audix Service department at 503.682.6933. A Return Authorization is required before returning any product. OTHER THAN THIS WARRANTY, AUDIX MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCTS, THE USE OF THE PRODUCTS, THE PERFORMANCE OF THE PRODUCTS. AUDIX SHALL NOT BE LIABLE FOR SPECIAL INCIDENTAL, CONSEQUENTIAL, INDIRECT OR SIMILAR DAMAGES ARISING FROM OR BASED ON THE SALE, USE, STORAGE OR DISPOSAL OF THE PRODUCTS, AUDIX'S SERVICE WORK, BREACH OF WARRANTY, BREACH OF CONTRACT. NEGLIGENCE, OR ANY OTHER THEORY OF LIABILITY, EVEN IF AUDIX HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

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AUDIX®

ver 2.0 10-15

Sample Product Cutsheets (Audio-Visual)

SHURE®
LEGENDARY PERFORMANCE™

MXA910 | Microflex®Advance™ Ceiling Array Microphone

Specifications

All specifications measured from narrow beam width. Values for all widths are within ± 3 dB of these specifications unless otherwise noted.

Beam Width

Adjustable	Narrow	35 degrees
	Medium	45 degrees
	Wide	55 degrees

Connector Type
RJ45

Power Requirements
Power over Ethernet (PoE), Class 0

Power Consumption
9W, maximum

Weight
4.26 kg (9.4 lbs)

Product Dimensions

MXA910xx	603.8 x 603.8 mm (23.77 x 23.77 in.)
MXA910xx-60CM	593.8 x 593.8 mm (23.38 x 23.38 in.)
A910-25MM	619.7 x 619.7 mm (24.4 x 24.4 in.)

Note: the adapter accessory converts the 600 mm model to fit into a 625 x 625 mm ceiling grid.

Control Application
HTML5 Browser-based

Plenum Rating
Requires Fyrewrap® fire protective wrap system (Included)
UL 2043 (Suitable for Air Handling Spaces)

Dust Protection
IEC 60529 IP5X Dust Protected

Operating Temperature Range
–6.7°C (20°F) to 40°C (104°F)

Storage Temperature Range
–29°C (-20°F) to 74°C (165°F)

Networking

Cable Requirements
Cat 5e or higher (shielded cable recommended)

Audio

Frequency Response
180 to 17,000 Hz

Dante Digital Output

Channel Count	9 total channels (8 independent transmit channels, 1 IntelliMix® Automatic mixing transmit channel)
Sampling Rate	48 kHz
Bit Depth	24

Sensitivity
at 1 kHz
0.75 dBFS/Pa

Maximum SPL
Relative to 0 dBFS overload
93.25 dB SPL

Signal-To-Noise Ratio
Ref. 94 dB SPL at 1 kHz
83 dB A-weighted

Latency
Not including Dante latency
6 ms

Self Noise
11 dB SPL-A

Dynamic Range
82.25 dB

Built-in Digital Signal Processing

Per Channel	Equalizer (4-band Parametric), Mute, Gain (140 dB range)
System	IntelliMix® Automatic mixing, Echo Reduction

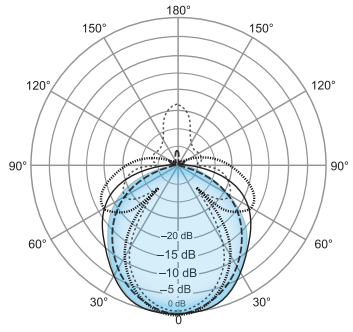
Intelligibility Scale
Equivalent acoustic performance, compared to a cardioid gooseneck microphone (environment dependent)
Cardioid distance multiplied by 1.6

[1] 1 Pa=94 dB SPL

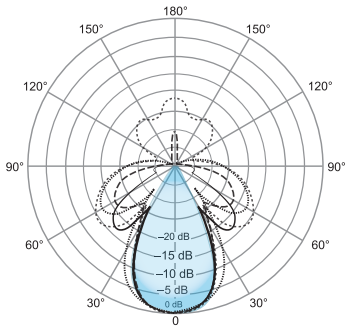
Polar Response

Polar response measured directly on-axis from a distance of 6 feet (1.83 m).

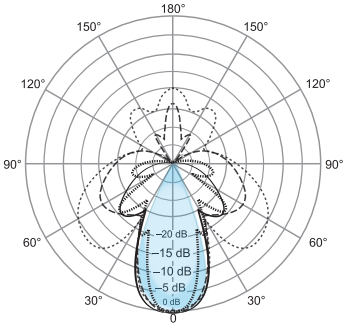
Wide



Medium



Narrow

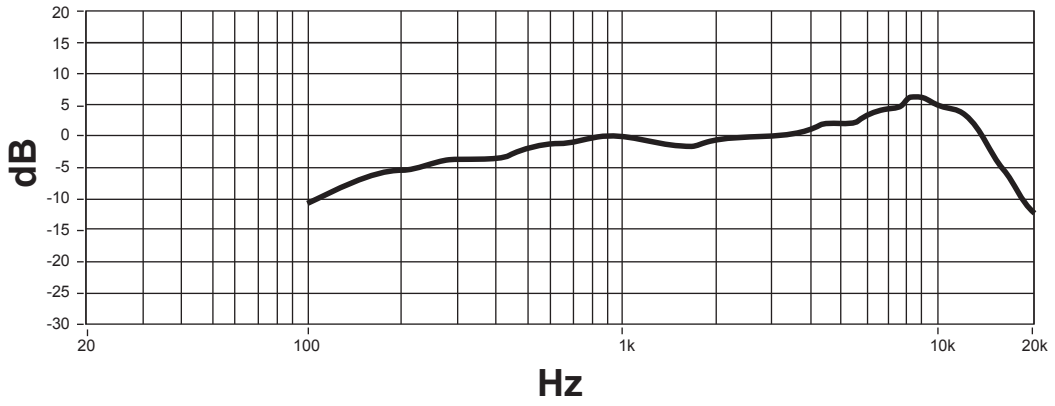


1,000 Hz
1,500 Hz
2,500 Hz
4,000 Hz

Sample Product Cutsheets (Audio-Visual)

Frequency Response

Frequency response measured directly on-axis from a distance of 6 feet (1.83 m).



IP Ports and Protocols

Shure Control

Port	TCP/UDP	Protocol	Description	Factory Default
21	tcp	FTP	Required for firmware updates (otherwise closed)	Closed
22	tcp	SSH	Not supported	Closed
23	tcp	Telnet	Standard console interface	Closed
68	udp	DHCP	Dynamic Host Configuration Protocol	Open
80*	tcp	HTTP	Required to launch embedded web server	Open
427	tcp/udp	SLP†	Required for inter-device communication	Open
443	tcp	HTTPS	Not supported	Closed
161	tcp	SNMP	Not supported	Closed
162	tcp	SNMP	Not supported	Closed
2202	tcp	ASCII	Required for 3rd party control strings	Open
5353	udp	mDNS†	Required for device discovery	Open
5568	udp	SDT†	Required for inter-device communication	Open
8023	tcp	Telnet	Debug console interface	Password
8180*	tcp	HTML	Required for web application	Open
8427	udp	Multcast SLP†	Required for inter-device communication	Open
64000	tcp	Telnet	Required for Shure firmware update	Open

Dante Audio & Controller

Port	TCP/UDP	Protocol	Description
162	udp	SNMP	Used by Dante
[319-320]*	udp	PTP†	Dante clocking
4321, 14336-14600	udp	Dante	Dante audio
[4440, 4444, 4455]*	udp	Dante	Dante audio routing
5353	udp	mDNS†	Used by Dante
[8700-8706, 8800]*	udp	Dante	Dante Control and Monitoring
8751	udp	Dante	Dante Controller
16000-65536	udp	Dante	Used by Dante

*These ports must be open on the PC or control system to access the device through a firewall.

†These protocols require multicast. Ensure multicast has been correctly configured for your network.

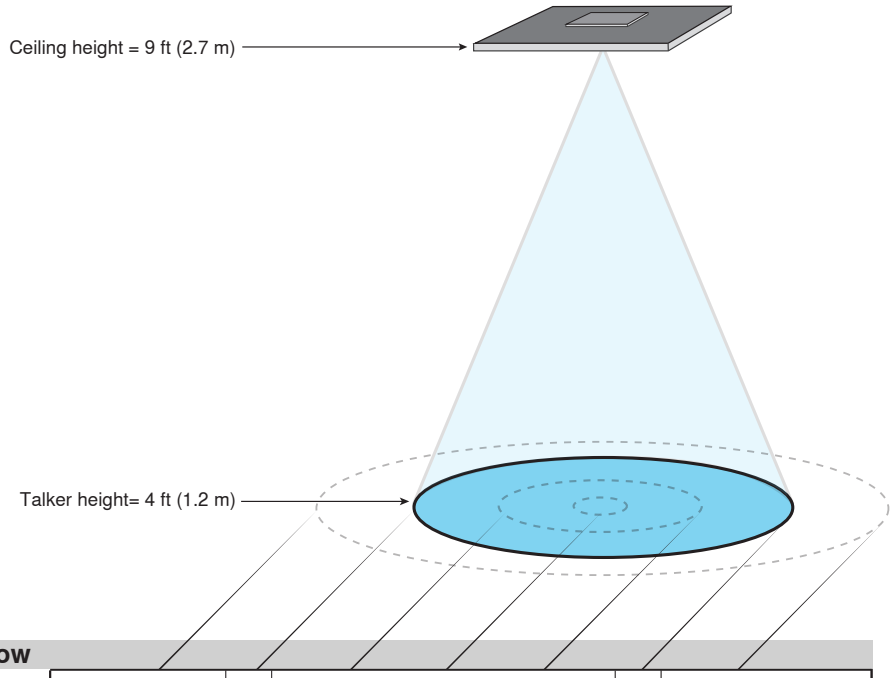
Sample Product Cutsheets (Audio-Visual)

Lobe Sensitivity

The edge of the blue coverage area for each channel in the web application represents where the sensitivity reaches -6 dB. Understanding how lobe sensitivity is displayed helps to:

- Provide complete coverage in a space, either by adding lobes or changing the lobe width. This ensures the sensitivity is within 6 dB in all areas. It is acceptable for lobes to slightly overlap.
- Ensure that spacing and isolation are adequate to reduce noise and maximize automatic mixing performance.

Measured at 1 kHz, on-axis



Narrow							
Centimeters	55	44	30	0	30	44	55
Inches	22	17	12	0	12	17	22
dB	-12	**-6**	-3	0	-3	**-6**	-12
Medium							
Centimeters	69	47	38	0	38	47	69
Inches	27	18	15	0	15	18	27
dB	-12	**-6**	-3	0	-3	**-6**	-12
Wide							
Centimeters	92	62	44	0	44	62	92
Inches	36	24	17	0	17	24	36
dB	-12	**-6**	-3	0	-3	**-6**	-12

Sample Product Cutsheets (Audio-Visual)

CP3N

3 SERIES

3-Series Control System®

- *Enterprise-class control system*
- *3-Series® Control Engine — substantially faster and more powerful than other control systems*
- *Exclusive modular programming architecture*
- *Onboard 512MB RAM & 4GB Flash memory*
- *Expandable storage up to 1TB*
- *Rear panel memory card slot*
- *High-speed USB 2.0 host port*
- *Industry-standard Ethernet and Cresnet® wired communications*
- *Control Subnet — provides a dedicated local network for Crestron® devices*
- *XPanel with Smart Graphics™ computer and web based control*
- *iPhone®, iPad®, and Android™ control app support*
- *Crestron Fusion® Cloud Enterprise Management Service support*
- *SNMP remote management support*
- *One RS-232/422/485 COM port with hardware and software handshaking*
- *Two RS-232 COM ports with software handshaking only*
- *Eight IR/serial, eight relay, and eight Versiport I/O ports*
- *Programmable event scheduling with astronomical time clock*
- *Native BACnet™/IP support[2]*
- *Installer setup via Crestron Toolbox™ software or web browser*
- *C#, symbol based, and drag-and-drop programming environments*
- *Full Unicode (multi-language) support*
- *Increased network throughput and security*
- *Secure access through full user/group management or Active Directory integration*
- *Hardware level security using 802.1X authentication*
- *TLS, SSL, SSH, and SFTP network security protocols*
- *FIPS 140-2 compliant encryption*
- *IIS v.6.0 Web Server*
- *IPv6 ready*
- *Front panel USB computer console port*
- *1-space rack-mountable*

The Crestron® CP3N is an enterprise-class control system with a dedicated Control Subnet port. Featuring the 3-Series® control engine, the CP3N forms the core of any modern networked home or commercial building, managing and integrating all the disparate technologies throughout your facility to make life easier, greener, more productive, and more enjoyable.

3-Series® Control Systems

Today's commercial buildings and custom homes comprise more technology than ever before, and all these systems need to be networked, managed, and controlled in fundamentally new ways. The IP based 3-Series platform is engineered from the ground up to deliver a network-grade server appliance capable of faithfully handling everything from boardroom AV and home theater control to total building management.

3-Series embodies a distinctively robust, dynamic, and secure platform to elevate your system designs to higher levels of performance and reliability. Compared to other control systems, Crestron 3-Series provides a pronounced increase in processing power and speed with more memory, rock solid networking and IP control, and a unique modular programming architecture.

Modular Programming Architecture

Designed for enhanced scalability, the CP3N affords high-speed, real-time multi-tasking to seamlessly run multiple programs simultaneously. This exclusive modular programming architecture lets programmers independently develop and run device-specific programs for AV, lighting, shades, HVAC, security, etc., allowing for the optimization of each program, and allowing changes to be made to one program without affecting the whole. Even as your system grows, processing resources can easily be shifted from one 3-Series processor to another without rewriting any code. The end benefit is dramatically simplified upgradability with minimal downtime, whether implementing changes on site or remotely via the network.

Robust Ethernet & IP Control

IP technology is the heart of 3-Series, so it should be no surprise that its networking abilities are second to none. Gigabit Ethernet connectivity enables integration with IP-controllable devices and allows the CP3N to be part of a larger managed control network. Whether residing on a sensitive corporate LAN, a home network, or accessing the Internet through a cable modem, the CP3N provides secure, reliable interconnectivity with IP-enabled touch screens, computers, mobile devices, video displays, media servers, security systems, lighting, HVAC, and other equipment — whether on premises or across the globe.

Dedicated Control Subnet

The Crestron Control Subnet is a Gigabit Ethernet network dedicated to Crestron devices. Via the CP3N's Control Subnet port, an installer may simply connect a single touch screen or wireless gateway, or add a Crestron PoE switch (CEN-SW-POE-5 or CEN-SWPOE-16)[1] to handle multiple touch screens, gateways, AV components, and other devices. Auto-configuration of the entire subnet is performed by the CP3N, discovering each device and assigning IP addresses without any extra effort from the installer.

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CRESTRON

Sample Product Cutsheets (Audio-Visual)

CP3N 3-Series Control System®

CP3N – Rear View

A separate LAN port on the CP3N provides a single-point connection to the customer's LAN, requiring just one IP address for the complete control system. The LAN port allows full interconnectivity between devices on the local subnet with other devices, systems, servers, and WAN/Internet connections outside the local subnet. For sensitive applications that require absolute security, the entire Control Subnet can be completely isolated from the customer's LAN using Isolation Mode.

Control Apps & XPanel

Years ago, Crestron pioneered the world's first IP-based control system unleashing vast new possibilities for controlling, monitoring, and managing integrated systems over a LAN, WAN, and the Internet. Today, Crestron offers more ways than ever to control your world the way you want. Using a computer, smartphone, or tablet device, Crestron lets you control anything in your home or workplace from anywhere in the world.

Native to every 3-Series control system, Crestron XPanel technology transforms any laptop or desktop computer into a virtual Crestron touch screen. Crestron control apps deliver the Crestron touch screen experience to iPhone®, iPad®, and Android™ devices, letting you safely monitor and control your entire residence or commercial facility using the one device that goes with you everywhere.

Crestron Fusion® Cloud

Crestron Fusion Cloud provides an integrated platform for creating truly smart buildings that save energy, enhance worker productivity, and prolong the life-span of valuable equipment. As part of a complete managed network in a corporate enterprise, college campus, convention center, or any other facility, the CP3N works integrally with Crestron Fusion Cloud to enable remote scheduling, monitoring, and control of rooms and technology from a central help desk. It also enables organizations to reduce energy consumption by tracking real-time usage and automating control of lighting, shades, and HVAC.

SNMP Support

Built-in SNMP support enables integration with third-party IT management software, allowing network administrators to manage and control Crestron systems on the network in an IT-friendly format.

Cresnet®

Cresnet provides a dependable network wiring solution for Crestron keypads, lighting controls, shade motors, thermostats, occupancy sensors, and other devices that don't require the higher speed of Ethernet. The Cresnet bus offers easy wiring and configuration, carrying bidirectional communication and 24VDC power to each device over a simple 4-conductor cable. To assist with troubleshooting, the CP3N includes our patent-pending Network Analyzer which continuously monitors the integrity of the Cresnet network for wiring faults, marginal performance, and other errors.

Onboard Control Ports

In addition to Ethernet, the CP3N includes three bidirectional COM ports and eight IR ports to interface directly with all of your centralized AV sources, video displays, and other devices. Eight programmable relay ports are included for controlling projection screens, lifts, power controllers, and other contact-closure actuated equipment. Eight "Versiport" I/O ports enable the integration of power sensors, motion detectors, door switches, alarms, or anything else that provides a dry contact closure, low-voltage logic, or 0-10 Volt DC signal.

BACnet™/IP

Native support for the BACnet/IP communication protocol provides a direct interface to third-party building management systems over Ethernet, simplifying integration with HVAC, security, fire & life safety, voice & data, lighting, shades, and other systems. Using BACnet/IP, each system runs independently with the ability to communicate together on one platform for a truly smart building.[2]

SPECIFICATIONS

Control Engine

Crestron 3-Series; real-time, preemptive multi-threaded/multitasking kernel; Transaction-Safe Extended FAT file system; supports up to 10 simultaneously running programs

Memory

SDRAM: 512 MB
Flash: 4 GB
Memory Card: Supports SD and SDHC cards up to 32 GB
External Storage: Supports USB mass storage devices up to 1 TB

Communications

Ethernet: 10/100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, BACnet/IP [2], IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client
Control Subnet: 10/100/1000 Mbps Ethernet, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP server, DNS Server, port forwarding, Isolation Mode
Cresnet: Cresnet master mode
USB: Supports USB mass storage class devices via rear panel USB 2.0 host port, supports computer console via front panel USB 2.0 device port
RS-232/422/485: For 2-way device control and monitoring, all ports

Sample Product Cutsheets (Audio-Visual)

CP3N 3-Series Control System®

support RS-232 up to 115.2k baud with software handshaking, one port also supports hardware handshaking, RS-422, and RS-485
IR/Serial: Supports 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud

Connectors & Card Slots

RELAY OUTPUT 1 – 8: (2) 8-pin 3.5 mm detachable terminal blocks;
Comprises (8) normally open, isolated relays;
Rated 1 Amp, 30 Volts AC/DC; MOV arc suppression across contacts

I/O 1 – 8: (1) 9-pin 3.5 mm detachable terminal block;
Comprises (8) "Versiport" digital input/output or analog input ports (referenced to GND);
Digital Input: Rated for 0-24 Volts DC, input impedance 20k Ohms, logic threshold >3.125V low/0 and <1.875V high/1;
Digital Output: 250 mA sink from maximum 24 Volts DC, catch diodes for use with "real world" loads;
Analog Input: Rated for 0-10 Volts DC, protected to 24 Volts DC maximum, input impedance 21k Ohms with pull-up resistor disabled;
Programmable 5 Volts, 2k Ohms pull-up resistor per pin

IR - SERIAL OUTPUT 1 – 8: (2) 8-pin 3.5 mm detachable terminal blocks;
Comprises (8) IR/Serial output ports;
IR output up to 1.2 MHz;
1-way serial TTL/RS-232 (0-5 Volts) up to 115.2k baud

COM 1: (1) 5-pin 3.5 mm detachable terminal block;
Bidirectional RS-232/422/485 port;
Up to 115.2k baud; hardware and software handshaking support

COM 2 – 3: (2) 3-pin 3.5 mm detachable terminal blocks;
Bidirectional RS-232 ports;
Up to 115.2k baud; software handshaking support

MEMORY: (1) SD memory card slot;
Accepts one SD or SDHC card up to 32 GB for memory expansion

USB: (1) USB Type A female; USB 2.0 port for storage devices

LAN: (1) 8-pin RJ45 jack;
10Base-T/100Base-TX/1000Base-T Ethernet port;
Connects to the customer's LAN

CONTROL SUBNET: (1) 8-pin RJ45 jack;
10Base-T/100Base-TX/1000Base-T Ethernet port;
Provides a dedicated local network for Crestron devices

NET: (1) 4-pin 3.5 mm detachable terminal block;
Cresnet master port;
Outputs power to Cresnet devices if a power pack is connected to the 24VDC power input jack;
Receives Cresnet network power if no power pack is connected to the 24VDC power input jack;
See "Power" section for additional specifications

24VDC 2.0A: (1) 2.1 x 5.5 mm DC power connector;
24 Volt DC power input; PW-2420RU power pack included;
Passes through to NET port to power Cresnet devices;
See "Power" section for additional specifications

G: (1) 6-32 screw;
Chassis ground lug

COMPUTER (front): (1) USB Type B female;
USB 2.0 computer console port (6 ft cable included);
For setup only

Controls & Indicators

PWR: (1) Green LED, indicates operating power supplied from power pack or Cresnet network
NET: (1) Amber LED, indicates communication with the Cresnet system
MSG: (1) Red LED, indicates control system has generated an error message
HW-R: (1) Recessed pushbutton for hardware reset
SW-R: (1) Recessed pushbutton for software reset
LAN (rear): (2) Bi-color green/amber LEDs, left LED indicates Ethernet link status and connection speed, right LED indicates Ethernet activity
CONTROL SUBNET (rear): (2) Bi-color green/amber LEDs, left LED indicates Ethernet link status and connection speed, right LED indicates Ethernet activity

Power

Power Pack: 2.0 Amps @ 24 Volts DC;
100-240 Volts AC, 50/60 Hz power pack, model PW-2420RU included

Available Cresnet Power: 24 Watts (1 Amp @ 24 Volts DC) when using power pack

Cresnet Power Usage: 15 Watts (0.625 Amp @ 24 Volts DC) when using Cresnet network power

Environmental

Temperature: 41° to 113° F (5° to 45° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 50 BTU/hr

Enclosure

Chassis: Metal, black finish
Faceplate: Extruded metal, black finish, polycarbonate label overlay
Mounting: Freestanding or 1 RU 19-inch rack-mountable (adhesive feet and rack ears included)

Dimensions

Height: 1.70 in (44 mm) without feet
Width: 17.28 in (439 mm);
19.00 in (483 mm) with rack ears
Depth: 6.56 in (167 mm)

Weight

3.1 lb (1.42 kg)

Sample Product Cutsheets (Audio-Visual)

CP3N 3-Series Control System®

MODELS & ACCESSORIES

Available Models

CP3N: 3-Series Control System®

Included Accessories

PW-2420RU: Power Pack, Desktop, 24VDC, 2A (50 Watts), Regulated, US/International (Qty. 1 included)

Available Accessories

PWE-4803RU: PoE Injector
CEN-SW-POE-5: 5-Port PoE Switch
CEN-SWPOE-16: 16-Port Managed PoE Switch
C2N-HBLOCK: Multi-type Cresnet Distribution Block
CNTBLOCK: Cresnet Distribution Block
CNSP-XX: Custom Serial Interface Cable
IRP2: IR Emitter Probe w/Terminal Block Connector
Crestron® App: Control App for Apple® iOS® & Android™
XPanel: Crestron Control® for Computers
myCrestron: Dynamic DNS Service for Crestron Systems
Crestron Fusion®: Enterprise Management Platform
3-Series® BACnet™/IP Support: 3-Series Native BACnet/IP Interface License
CSP-LIR-USB: IR Learner

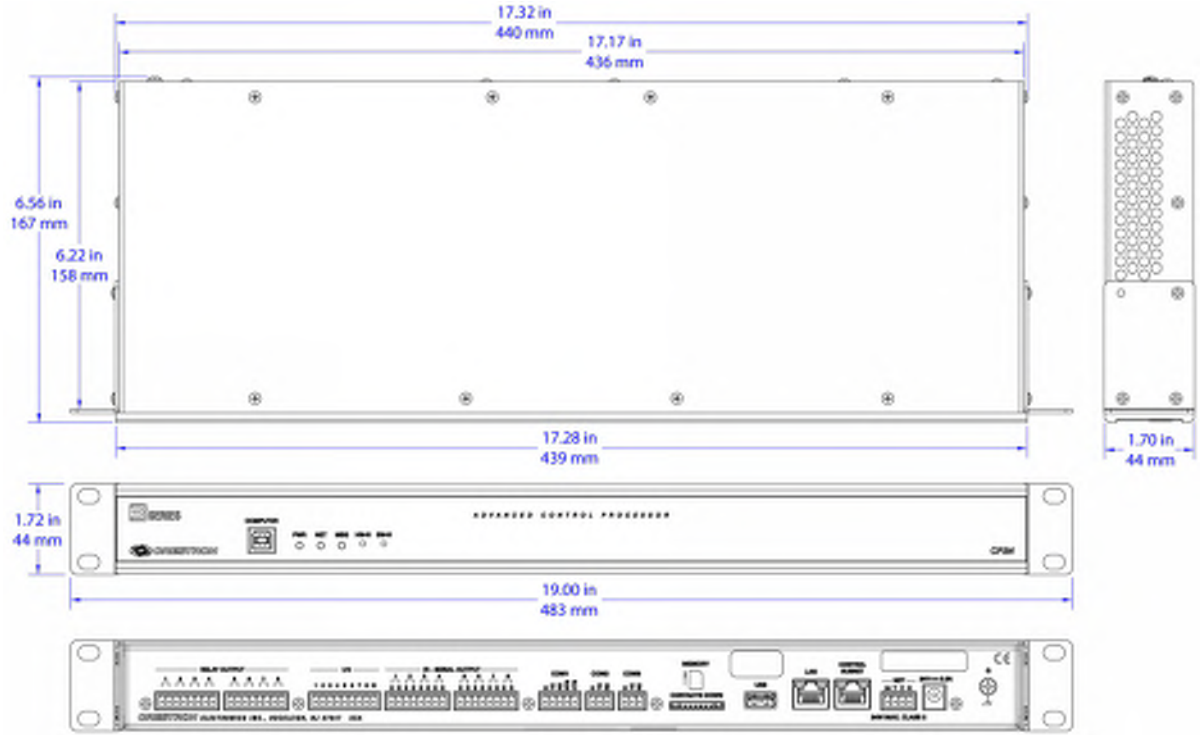
Notes:

1. Item(s) sold separately.
2. License required. The CP3N supports a maximum of 1000 BACnet objects when dedicated for BACnet use only. Actual capabilities are contingent upon the overall program size and complexity.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at www.crestron.com/salesreps or by calling 800-237-2041.

The specific patents that cover Crestron products are listed online at: patents.crestron.com.

Certain Crestron products contain open source software. For specific information, please visit www.crestron.com/opensource.



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Specifications subject to change without notice. Revised 10/18/16

Sample Product Cutsheets (Audio-Visual)

TSW-760

7” Touch Screen

- > *Ultra clean, modern appearance*
- > *Thin profile and compact footprint*
- > *Affordable and easy to install*
- > *7” widescreen active-matrix color display*
- > *1024 x 600 WSVGA display resolution*
- > *Capacitive touch screen technology*
- > *Multi-touch capable*
- > *Smart Graphics® performance*
- > *Backlit soft-touch capacitive buttons*
- > *Any/all button hide feature*
- > *Auto-brightness control*
- > *Voice recognition capability[1,2]*
- > *H.264 or MJPEG streaming video display*
- > *Built-in 5 MP H.264 IP camera[2]*
- > *Built-in microphone and speakers[2]*
- > *Rava® SIP intercom and phone technology[2]*
- > *Native Sonos® app*
- > *Crestron Fusion® room scheduling[4]*
- > *Built-in PinPoint™ beacon[2,5]*
- > *Customizable audio feedback*
- > *Built-in web browsing[1]*
- > *On-screen multi-language keyboard*
- > *Customizable screensaver*
- > *Single-wire Ethernet connectivity*
- > *PoE or PoE+ network powered (refer to specifications)*
- > *US, UK, or European electrical wall box mounting*
- > *Lectern mount over a rectangular cutout*
- > *Retrofit and masonry mounting options available[6]*
- > *Multi-surface and ADA compliance mounting options available[3]*
- > *Tabletop and swivel mount options available[3]*
- > *3 RU rack mount option available[3]*
- > *Available in smooth black or white finish*

Advanced Touch Screen Control

A Crestron® touch screen offers an ideal user-interface for controlling all the technology in your home, boardroom, classroom, courtroom, or command center. Touch screens simplify and enhance the way you use technology, doing away with those piles of remote controls, cluttered wall switches, disparate smartphone apps, and cryptic computer screens. For controlling audio, video, lighting, shades, HVAC, security, and other systems, Crestron touch screens are fully-customizable with easy-to-use controls and icons, true feedback and real-time status display, live streaming video, voice recognition, web browsing, and a full-featured media player for an enhanced multiroom entertainment experience.

With its clean, contemporary design highlighted by edge-to-edge glass and stunning color graphics, the Crestron TSW-760 touch screen makes an elegant statement on any wall, tabletop, lectern, or equipment rack.

Perfectly at home in the most contemporary residence or modern office building, its high-tech good looks underline its power for simplifying everyday tasks and functions throughout any facility.

The TSW-760 delivers the ultimate touch screen experience in an unobtrusive, space-saving design. It features a brilliant 7 inch capacitive touch screen display with Smart Graphics® and 5 soft-touch buttons. PoE connectivity and a range of mounting options make installation a breeze for both new and retrofit applications. Additional advanced features include the abilities to control any function using voice commands, view security cameras and other video sources, communicate using built-in video intercom and phone capabilities, manage meeting room scheduling, browse the Internet, and enjoy full access to your Sonos® Home Sound System.[1]

Smart Graphics®

Crestron touch screens use Smart Graphics to deliver the ultimate user experience *and* the ultimate value by enabling the creation of dynamically rich user interfaces with incredible efficiency and unparalleled functionality. Using Smart Graphics, programmers can swiftly integrate fluid gesture-driven controls, animated feedback, rich metadata, embedded apps and widgets, and full-motion video for a deeply engaging and ultra-intuitive touch screen experience.

Crestron Smart Graphics offers these enhancements and more:

- Cool-looking graphical buttons, sliders, knobs, and gauges that are intuitive and fun to use
- Kinetic effects to enhance the feeling of realism, with lists and toolbars that scroll with momentum at the flick of a fingertip
- Drag-and-drop objects that snap into place, offering an easy way to switch sources
- Dashboard widgets to personalize the touch screen with clocks, weather, news, and other information[1]
- A power-saving screensaver that allows display of time, temperature, and other text content at a reduced brightness level

Sample Product Cutsheets (Audio-Visual)

TSW-760 7" Touch Screen

TSW-760-W-S – Shown in White

TSW-760-B-S with TSW-760-TTK-B-S Tabletop Kit

- Customizable themes allowing a completely different look and feel for every user, event, or season
- Fully-developed SmartObjects® that enable sophisticated control over complex devices with minimal programming
- A consistent look and feel across multiple touch screens of varying sizes

Soft-Touch Buttons

The TSW-760 includes five backlit, soft-touch capacitive buttons for quick access to commonly used functions. These buttons are pre-labeled with icons for "Power", "Home", "Lights", "Up", and "Down" functions. Each button is programmable via the control system for custom functionality, and any unused button can be hidden by simply turning off its backlight.

Auto-Brightness Control

To ensure optimal visibility under varying lighting conditions, the TSW-760 includes a built-in light sensor, which regulates the brightness of the display and button backlighting according to the ambient light level in the room. Separate auto-brightness settings are provided for the display and buttons to allow each to be adjusted or defeated as needed.

Voice Recognition

Some things are easier *said* than *done*, so why not just *say* what you want and let Crestron *do* it for you? With built-in voice recognition, the TSW-760 provides the ability to use spoken commands to control virtually anything. Voice recognition can be used to quickly turn devices on or off, select and play a specific media title or playlist, change the channel, choose a lighting scene, lock the doors, arm the security system, or enter a password. Simply say a command and Crestron does the rest.[1,2]

Streaming Video

High-performance streaming video capability makes it possible to view security cameras and other video sources right on the touch screen. Native support for H.264 and MJPEG formats allows the TSW-760 to display live streaming video from an IP camera, a streaming encoder (Crestron CEN-NVS200, DM-TXRX-100-STR, or similar[3]), or a DigitalMedia™ switcher. Video is delivered to the touch screen over Ethernet, eliminating the need for any extra video wiring.

Rava® SIP Intercom

Rava SIP Intercom Technology enables hands-free VoIP communication with other Rava-enabled touch screens and door stations. Rava works over Ethernet, supporting 2-way intercom, video intercom, and paging without requiring any special wiring. VoIP phone capability is also possible through integration with a SIP-compatible IP phone system or SIP server, allowing hands-free telephone functionality complete with speed-dialing, caller ID, custom ringers, and other enhancements. Built-in echo cancellation affords full-duplex performance for clear, seamless voice communication using the TSW-760's integrated microphone and speakers.[2]

Built-in Camera

A 5 megapixel camera is built into the TSW-760 to support video intercom and room monitoring capabilities. This feature allows individuals to communicate both verbally and visually between two touch screens, or between one touch screen and a Rava-compatible video door station. It can also be used to visually monitor any room securely using an H.264 compatible decoder (Crestron DM-TXRX-100-STR, DM-RMC-100-STR, or similar[3]) or a third-party video monitoring system. When not needed, the camera feature can be turned off programmatically through the control system. A "no-camera" model is also available.[2]

Sonos® App

Merging technologies from Sonos and Crestron brings a whole-house music experience like no other. From any touch screen in the house, a family can effortlessly browse for tracks, artists, or playlists using all the services available from Sonos and instantly play them in any room using Sonos wireless speakers or a Crestron Sonnex® Multiroom Audio System. The Sonos app runs natively on the TSW-760, enabling enhanced control of Sonos products as part of a complete Crestron system. The app checks for updates nightly so it's always current.[1]

Room Scheduling

The TSW-760 can provide an invaluable productivity tool for corporate enterprises and other organizations that use Crestron Fusion®, Microsoft® Outlook®, Google Calendar™, or another calendaring application to schedule meetings and manage rooms. Mounted on the wall outside each room, the TSW-760 allows anyone to see at-a-glance if the room is

Sample Product Cutsheets (Audio-Visual)

TSW-760 7" Touch Screen

available or in use, and to view details about the current meeting. A swipe of the finger reveals the room's entire schedule for the day, displaying upcoming meetings and open time slots, and allowing the room to be reserved right on the spot.

Room scheduling functionality is enabled on the TSW-760 using the built-in room scheduling application, which syncs directly over the network with Crestron Fusion, Microsoft Exchange, Office 365®, Google Calendar, or G Suite™. A Room Availability Hallway Sign (model SSC or SSW [3]) can be added for enhanced visibility.[4]

PinPoint™ Beacon (Coming Soon)

The built-in PinPoint proximity detection beacon enhances the intelligence and personalization of a Crestron system by enabling a smartphone or tablet device to always know what room it's in. It works with the Crestron App or Crestron PinPoint App, using Bluetooth® technology to determine when the mobile device is in or near the same room as the beacon, and signals the mobile app to automatically display the appropriate controls and information for that location.[2,5]

Web Browsing

Using its built-in web browser, the TSW-760 provides quick access to online program guides and other web-based services at the touch of a button, allowing enhanced touch screen control of DVRs and other appliances without having to pick up a separate tablet or smartphone. If a device can be controlled or managed through a web browser, it can be integrated into the Crestron system through the TSW-760. Of course, the web browser may also be used to simply browse the Internet, check traffic conditions, or look up a recipe.[1]

On-Screen Keyboard

Typing in passwords, URLs, and text searches is facilitated using the on-screen multi-language keyboard.

Multi-Touch Support

The TSW-760's capacitive touch screen affords enhanced capabilities for browsing web pages using multi-touch gestures.

Audio Feedback

Customized audio files can be loaded to add another dimension to the touch screen graphics using personalized sounds, button feedback, and voice prompts.

Single-Wire Connectivity

A simple Ethernet LAN connection is all that is required to wire the TSW-760, containing all control, video, intercom, and power signals within a single wire.

Power over Ethernet

Using PoE technology, the TSW-760 gets its operating power right through the LAN wiring. PoE (Power over Ethernet) eliminates the need for a local power supply or any dedicated power wiring. A PoE Injector (PWE-4803RU [3]) simply connects in line with the LAN cable at a convenient location. Crestron PoE switches (CEN-SW-POE-5 or CEN-SWPOE-16 [3]) may also be used to provide a total networking solution with built-in PoE.

Note: Refer to the "Power" specifications for additional details.

Room scheduling application

Wall or Lectern Mounting Options

Using the bracket provided, the TSW-760 is easily installed over a 2-gang or 3-gang electrical box, or a 2-gang European or UK electrical box. The same bracket allows for installation in a wooden lectern or podium over a rectangular cutout. When installed, the touch screen protrudes just 1/2 inch from the mounting surface and latches firmly into its mounting bracket leaving no visible screws for an ultra clean appearance. A security latch option is included to deter unauthorized removal of the touch screen.

Additional mounting options are afforded using the TSW-UMB-60 Universal Mounting Bracket. By itself, the TSW-UMB-60 provides a post-construction solution for retrofitting the TSW-760 into existing drywall. For pre-construction applications that don't require a back box, the TSW-UMB-60 can be used along with a TSW-UMB-60-PMK Pre-Construction Mounting Kit. Masonry and concrete applications are accommodated using the TSW-UMB-60 along with a TSW-UMB-60-BBI back box. The TSW-UMB-60 is compatible with TSW-560, -760, and -1060 model touch screens, making it easy to change devices at any time.[6]

When installing the TSW-760 in place of an older Crestron touch screen (APAD, CT-1000, LC-1000, TPS-4L, or TPS-2000L), Crestron offers Retrofit Mounting Brackets (TSW-60-RMB series [3]), which facilitate replacement without having to tear out the old mounting hardware or patch the wall.[6]

For impenetrable surfaces, such as glass, granite, or marble, or for applications requiring ADA compliance, Crestron offers the Multi-Surface Mount Kit (TSW-760/1060-MSMK [3]). This option allows for attaching securely to virtually any smooth, flat surface without screws, providing an ideal solution for modern offices with glass walls or historically significant spaces where cutting and drilling is prohibited. It can also be mounted over a conventional electrical box. When installed, the touch screen is angled upwards at a 20° tilt to allow for mounting at an ADA approved height.

Tabletop Option

Using the optional Tabletop Kit (TSW-760-TTK [3]), the TSW-760 becomes a stylish, freestanding touch screen that fits perfectly on a table, desk, or countertop. It can even be permanently attached to the surface using the optional Swivel Mount Kit (TSW-560/760/1060-SMK [3]).

Rack Mount Option

The TSW-760 can be mounted in a 19" EIA equipment rack using the optional Rack Mount Kit (TSW-560/760-RMK-1 [3]). When rack mounted, the touch screen occupies three rack spaces.

Sample Product Cutsheets (Audio-Visual)

TSW-760 7" Touch Screen

SPECIFICATIONS

Touch Screen Display

Display Type: TFT active matrix color LCD
Size: 7 inch (178 mm) diagonal
Aspect Ratio: 17:10 WSVGA
Resolution: 1024 x 600 pixels
Brightness: 350 nits (cd/m²)
Contrast: 1100:1
Color Depth: 24-bit, 16.7M colors
Illumination: Edgelit LED w/auto-brightness control
Viewing Angle: ±80° horizontal, ±80° vertical
Touch Screen: Projected capacitive, 5-point multi-touch capable

Buttons

Hard Keys: (5) Projected capacitive pushbuttons, backlit w/auto-brightness control, per-button show/hide (backlight enable/disable), pre-labeled with icons for "Power", "Home", "Lights", "Up", and "Down"
Reset: (1) Miniature pushbutton on rear panel for hardware reset

Graphics Engine

Crestron Smart Graphics, multi-language web browser [1], multi-language on-screen keyboard, screensaver, single scalable streaming video window, native Sonos app [1], native room scheduling application [4], setup and diagnostics via web browser or onscreen UI

Languages

Smart Graphics: Arabic, Chinese (Simplified), Chinese (Traditional), Czech, Danish, Dutch, English (UK), English (US), Finnish, French, German, Greek, Hebrew, Hungarian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Portuguese (Brazilian), Romanian, Russian, Slovak, Spanish, Swedish, Thai
On-Screen Keyboard: Arabic, Chinese (Simplified), Croatian, Czech, Danish, Dutch, English (UK), English (US), Finnish, French (Canada), French (Switzerland), German, Hebrew, Hungarian, Italian, Japanese, Norwegian Bokmal, Polish, Portuguese, Russian, Serbian, Spanish, Swedish, Turkish
Voice Recognition: Afrikaans (South Africa); Chinese, Mandarin (China, Simplified); Chinese, Mandarin (Hong Kong, Simplified); Chinese, Mandarin (Taiwan, Traditional); Chinese, Yue (Hong Kong, Traditional); Czech (Czech Republic); Dutch (Netherlands); English (Australia); English (Canada); English (Generic); English (India); English (New Zealand); English (South Africa); English (UK); English (US); French (France); German (Germany); isiZulu (South Africa); Italian (Italy); Japanese (Japan); Korean (South Korea); Polish (Poland); Portuguese (Brazil); Russian (Russia); Spanish (Spain); Turkish (Turkey)
Web Browser: Arabic, Bulgarian, Catalan, Chinese, Croatian, Czech, Danish, Dutch, English, Filipino, Finnish, French, German, Greek, Hebrew, Hindi, Hungarian, Indonesian, Italian, Japanese, Korean, Latvian, Lithuanian, Norwegian Bokmal, Pashto, Persian, Polish, Portuguese, Romanian, Romansh, Russian, Serbian, Slovak, Slovenian, Spanish, Swedish, Thai, Turkish, Ukrainian, Vietnamese
Room Scheduling [4]: Chinese (Simplified), Chinese (Traditional), Danish, Dutch (Netherlands), English (US), English (UK), French, German, Hebrew, Italian, Japanese, Korean, Norwegian, Portuguese (Brazil), Portuguese (Portugal), Russian, Spanish, Swedish

Memory

RAM: 2 GB DDR3L
Storage: Firmware/Application: 4 GB Class 10 microSD card;
System: 4 GB eMMC
Maximum Project Size: 600 MB

Communications

Ethernet: 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, TCP/IP, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), IEEE 802.1X, SNMP, IPv4 or IPv6, IEEE 802.3at compliant
USB: USB 2.0 host for room availability hallway sign [3,4]
Bluetooth: Crestron PinPoint proximity detection beacon [2,5]

Streaming Decoder

Video Formats: H.264 (MPEG-4 part 10 AVC), MJPEG
Audio Formats: AAC stereo
Bitrates: Up to 25 Mbps (20 Mbps maximum recommended)
Streaming Input Resolutions: Up to 1920x1080@30fps
Streaming Protocol: RTSP

Streaming Encoder & Camera [2]

Camera Resolution: 5.0 MP
Field of View: 50º horizontal
Video Format: H.264 (MPEG-4 part 10 AVC)
Streaming Output Resolution: 1280x720
Streaming Protocol: RTSP, ONVIF discovery

Audio

Features: Built-in microphone and speakers, Rava SIP Intercom, multi-language voice recognition [1,2]
Audio Feedback Formats: MP3

Connectors

LAN PoE: (1) 8-pin RJ45 connector, female, with 2 LED indicators;
10Base-T/100Base-TX Ethernet port & PoE+ PD port;
Green and yellow LEDs indicate Ethernet port status

USB: (1) USB Type A connector, female;
USB 2.0 host port;
For optional room availability hallway sign [3,4]

Power

Power over Ethernet:
IEEE 802.3at Type 2 compliant PoE+ PD (Powered Device);
- Requests 15 Watts from an 802.3at Type 2 PSE with LLDP advanced power management;
- Requests 30 Watts (PoE+ Class 4) from an 802.3at Type 2 PSE without LLDP;

Sample Product Cutsheets (Audio-Visual)

TSW-760 7" Touch Screen

- Requests 15.4 Watts (PoE Class 0) from an 802.3af (or 802.3at Type 1) PSE

Environmental

Temperature: 32° to 112° F (0° to 45° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 44 BTU/hr

Enclosure

Construction: Plastic, smooth black or white finish, edge-to-edge glass with black or white surround
Mounting: Surface mount over a 2 or 3-gang US electrical box, 2-gang European (DIN 49073) electrical box, or 2-gang UK (BS 4662) electrical box; lectern mount over a 2-1/5" H x 3-3/4" W (56 mm H x 96 mm W) cutout; 1-3/8" (35 mm) minimum mounting depth; additional wall mount, surface mount, rack mount, and tabletop options available separately

Dimensions

Height: 4.79 in (122 mm)
Width: 7.61 in (194 mm)
Depth: 1.52 in (39 mm)
Dimensions do not include the mounting bracket

Weight

14.1 oz (400 g)

Compliance

UL Listed for US & Canada, IC, CE, FCC Part 15 Class B digital device

MODELS & ACCESSORIES

Available Models

TSW-760-B-S: 7" Touch Screen, Black Smooth
TSW-760-W-S: 7" Touch Screen, White Smooth
TSW-760-NC-B-S: 7" Touch Screen without Camera, Microphone, or PinPoint™ Beacon; Black Smooth
TSW-760-NC-W-S: 7" Touch Screen without Camera, Microphone, or PinPoint™ Beacon; White Smooth

Available Accessories

TSW-760-TTK: Tabletop Kit for TSW-760
TSW-560/760/1060-SMK: Swivel Mount Kit for TSW-760-TTK
TSW-UMB-60: Universal Mounting Bracket for TSW-x60 Series
TSW-UMB-60-PMK: Pre-Construction Mounting Kit for TSW-UMB-60
TSW-UMB-60-BBI: Wall Mount Back Box for TSW-UMB-60
TSW-760/1060-RMB-1: Retrofit Mounting Bracket – Converts APAD, CT/LC-1000, or TPS-2000L to TSW-760 or TSW-1060
TSW-760/1060-RMB-2: Retrofit Mounting Bracket – Converts TPS-4L to TSW-760 or TSW-1060
TSW-760/1060-MSMK: Multi-Surface Mount Kit for TSW-760 & TSW-1060
TSW-560/760-RMK-1: Rack Mount Kit for TSW-560 & TSW-760
PWE-4803RU: PoE Injector
CEN-SW-POE-5: 5-Port PoE Switch
CEN-SWPOE-16: 16-Port Managed PoE Switch
CEN-NVS200: Network Video Streamer
DM-TXRX-100-STR: HD Streaming Transmitter/Receiver
DM-RMC-100-STR: HD Streaming Receiver & Room Controller 100
SSC: Room Availability Hallway Sign, Ceiling Mount
SSW: Room Availability Hallway Sign, Wall Mount
SW-FUSION-C-3: Crestron Fusion® Cloud
SW-FUSION-P-L: Crestron Fusion® On-premises

Notes:

1. Voice recognition, web browsing, weather information, Sonos app, and certain other functions require an Internet connection.
2. The camera, microphone, and PinPoint beacon (Bluetooth) are included on models TSW-760-B-S and TSW-760-W-S only. To ensure privacy, the camera, microphone, and Bluetooth transceiver can each be defeated programmatically at any time. For applications demanding an extra measure of privacy, Crestron offers models TSW-760-NC-B-S and TSW-760-NC-W-S, which have no physical camera, microphone, or Bluetooth transceiver installed.
3. Item(s) sold separately. Refer to each product's spec sheet for complete information.
4. Room scheduling functionality and USB support for the SSC or SSW hallway sign can be enabled using the native room scheduling application or the Room Scheduling SmartObject®. The SmartObject provides a UI similar to the TSS-752 and requires Crestron Fusion. The native application features a newer, more customizable UI, and can be used with Crestron Fusion, or without Crestron Fusion via direct connection to MS Exchange, Office 365, Google Calendar, or G Suite. Refer to http://www.crestron.com/fusion for a list of other calendaring applications that are supported through Crestron Fusion. Using the native application, the TSW-760 must be designated exclusively for room scheduling use, which precludes use of certain other features and functions described in this spec sheet.
5. PinPoint beacon functionality will be enabled through a future update. When enabled, the TSW-760 will provide an integrated, equivalent alternative to the standalone PP-100 beacon. For more details, refer to the PP-100 spec sheet. Bluetooth technology is used solely for proximity detection and does not transmit or receive any control, multimedia, or personal data. PinPoint beacons are only visible to Bluetooth enabled devices that are specifically programmed and configured to work with your system.
6. The TSW-UMB-60, TSW-UMB-60-PMK, and TSW-UMB-60-BBI are all sold separately. The TSW-UMB-60 is also compatible with older TSW-UMB-PMK preconstruction mounting kits and TSW-550-BBI back boxes, allowing the TSW-760 touch screen to be installed in place of a previous generation TSW-5xx series touch screen, or any other device that was originally installed using the a TSW-UMB-PMK or TSW-550-BBI, without modification to the wall. If replacing an APAD, CT-1000, LC-1000, TPS-4L, or TPS-2000L device, use the appropriate TSW-60-RMB retrofit mounting bracket (sold separately).

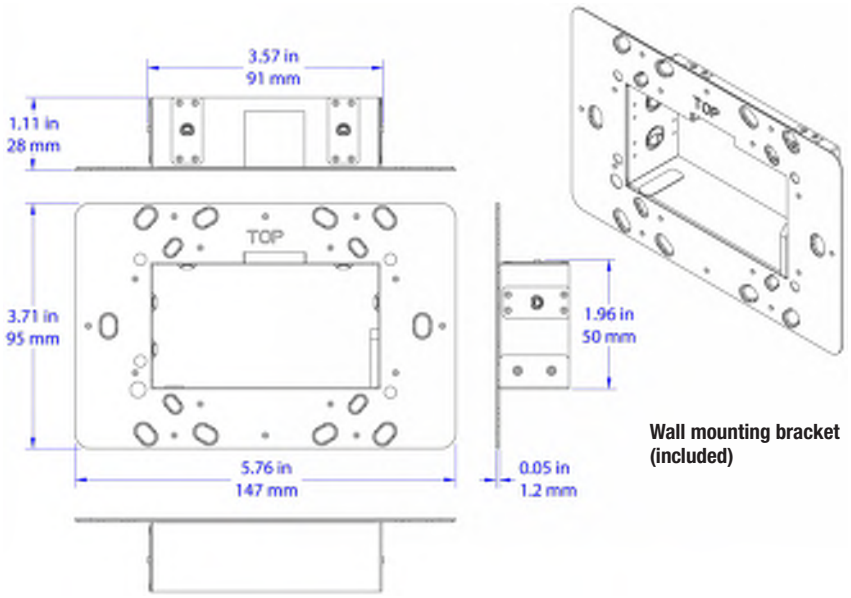
This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at www.crestron.com/salesreps or by calling 800-237-2041.

The specific patents that cover Crestron products are listed online at: patents.crestron.com.

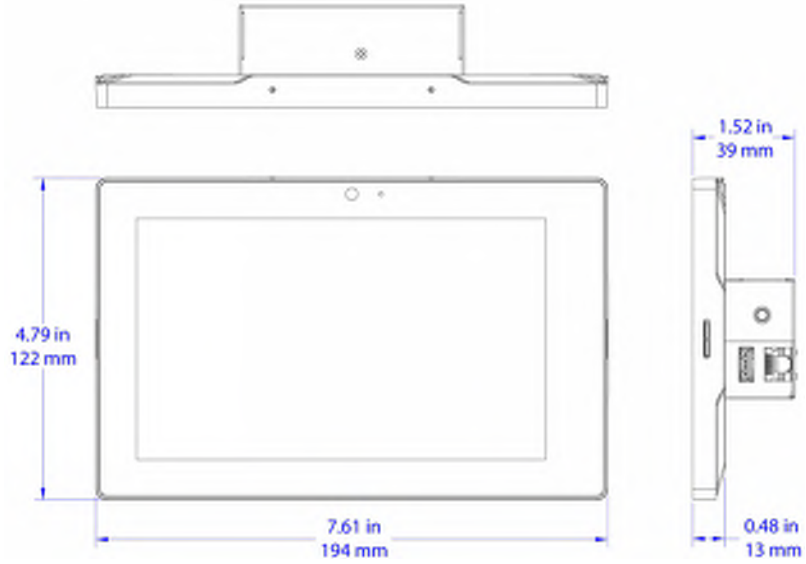
Certain Crestron products contain open source software. For specific information, please visit www.crestron.com/opensource.

Sample Product Cutsheets (Audio-Visual)

TSW-760 7” Touch Screen



Wall mounting bracket (included)



Crestron Electronics, Inc. 15 Volvo Drive | Rockleigh, NJ 07647
Tel: 800.237.2041 / 201.767.3400 | Fax: 201.767.1903
www.crestron.com

Sample Product Cutsheets (Audio-Visual)

AXS System
for steel racks

assembled in modified MRK, WRK-SA or ERK enclosures, our AXS system for steel racks allows equipment bays to be placed against walls or back-to-back, solving the challenge posed by space-limiting environments and saving six square feet of floor space per rack!

features:

- Simplifies cabinet installation
- Shortens installation and service time
- Various sizes available - see chart on page 2
- Available with 20" and 26" frame depths (front to rear rail)
- Articulating cable carriers provide effective cable management
- Rough-in pan pre-installed
- Service tracks and leveler are both quick and simple to use
- Gangable when purchased with MRK series gangable racks
- Ball bearings allow the rack frame to roll out effortlessly
- 650 lb. capacity with proper weight distribution
- AXS systems installed in MRK series are seismic certified (when used with included MRK-Z4) with an Ip value of 1.5

MRK-4426AXS shown in service position

Also Available:
WR Series rotating roll-out enclosure, does not require tracks or stands for servicing, please see A&E specification # 96-01005

specifications:

Patented EIA compliant 19" slide-out equipment rack shall be Middle Atlantic Products model # __ (refer to chart). Rack shall consist of outer frame with internal roll-out equipment rack. External frame dimensions shall be __" H x __" W x __" D (refer to chart). Useable rack height shall be __ rackspaces (refer to chart), useable depth shall be __" (20, 26, refer to chart). Entire rack assembly shall have a weight capacity of 650 lbs. External frame shall be constructed of 16-gauge steel with black powder coat finish. Internal frame shall be constructed of 13-gauge steel with black powder coat and 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing with black e-coat finish and marked rackspaces. Top and bottom trim panels shall be 11-gauge black brushed and anodized aluminum. Rack top shall have openings to accept up to 2 fans, model # AXS-FAN (one fan) or AXS-FAN-K (two fans). Cable carrier shall be constructed of the following materials: cable carrier and lower hinges shall be constructed of 16-gauge steel, center hinge shall be constructed of 10-gauge steel, cable carrier shall be finished in black powder coat. Specified MRK AXS Series enclosures shall satisfy the 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 520 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with the included (MRK-Z4) seismic floor anchor bracket. Service tracks shall be constructed of 13-gauge steel, model # TRACK50. Adjustable track leveler shall be model # TRACKL and shall level service tracks for equipment roll out and servicing. Slide-out equipment rack shall be GREENGUARD Gold Certified. Slide-out equipment rack shall be RoHS EU Directive 2002 / 95 / EC compliant. Slide-out equipment rackshall be manufactured by an ISO 9001 and ISO 14001 registered company. Slide-out equipment rack shall be warrantied to be free from defects in material or workmanship for a period of 3 years.

Customizable specification clips available at middleatlantic.com

options:

- Optional slim fan shall be model # AXS-FAN. Kit with 2 fans shall be model #AXS-FAN-K
- Optional 20" and 26" full-depth front and rear mount AXS rackshelf shall be model # SH-5A (20"), SH-5A-26 (26")
- Optional cable management tray shall be model # AXS-WT50

EIA/TIA COMPLIANT

SEISMIC CERTIFIED

RoHS

GREENGUARD GOLD

PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818

US PATENT# 5, 185, 818

what **great systems** are built on.™

A brand of legrand®

Middle Atlantic Products
middleatlantic.com | middleatlantic.ca

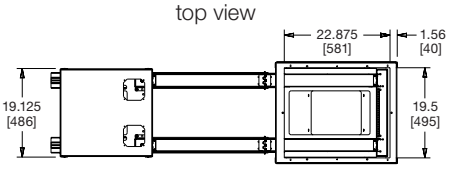
96-055S / rev h / 7-8-16

Sample Product Cutsheets (Audio-Visual)

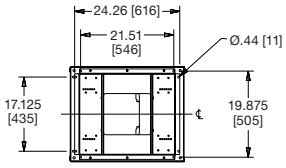
AXS System
basic dimensions

all dimensions in inches unless otherwise noted [all dimensions in brackets are in millimeters]

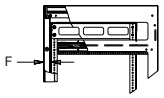
top view



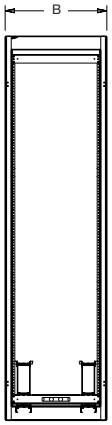
bottom view
floor mounting locations



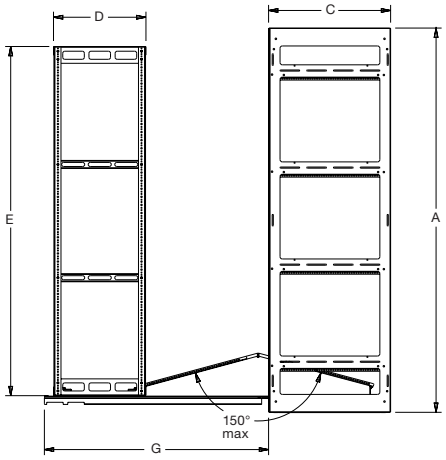
side view
cut away

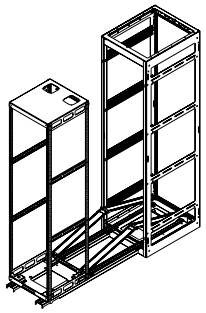


front view

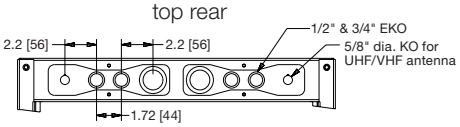


side view
fully extended

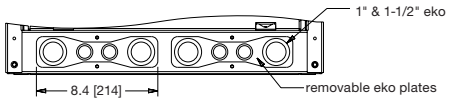




top rear



bottom rear



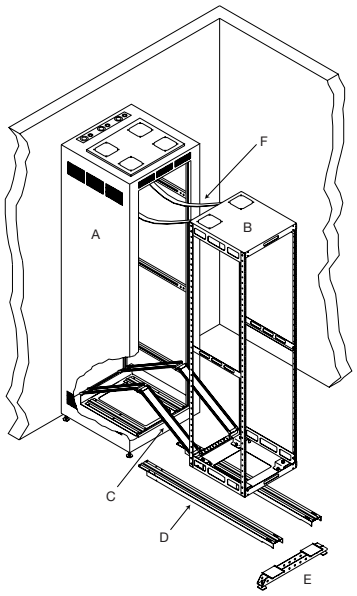
Part #	Useable Racking Height	A Overall Height	B Overall Width	C Overall Depth	D Frame Depth	E Frame Height	F Minimum Rail Setback	G Frame Roll Out*	Seismic Certified
MRK-4426AXS	41	83.125 [2111]	22.00 [559]**	26.40 [671]	20.00 [508]	75.5 [1919]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
MRK-4026AXS	37	76.125 [1934]	22.00 [559]**	26.40 [671]	20.00 [508]	68.5 [1740]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
MRK-3726AXS	34	70.875 [1800]	22.00 [559]**	26.40 [671]	20.00 [508]	63.25 [1607]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
MRK-4426AXS-Z4	41	83.125 [2111]	22.00 [559]**	26.40 [671]	20.00 [508]	75.5 [1919]	1.50 [38]	47.50 [1207] to 48.50 [1232]	yes
MRK-4026AXS-Z4	37	76.125 [1934]	22.00 [559]**	26.40 [671]	20.00 [508]	68.5 [1740]	1.50 [38]	47.50 [1207] to 48.50 [1232]	yes
MRK-3726AXS-Z4	34	70.875 [1800]	22.00 [559]**	26.40 [671]	20.00 [508]	63.25 [1607]	1.50 [38]	47.50 [1207] to 48.50 [1232]	yes
MRK-4431AXS-26	41	83.125 [2111]	22.00 [559]**	31.40 [798]	26.00 [660]	75.5 [1919]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
MRK-4031AXS-26	37	76.125 [1934]	22.00 [559]**	31.40 [798]	26.00 [660]	68.5 [1740]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
MRK-3731AXS-26	34	70.875 [1800]	22.00 [559]**	31.40 [798]	26.00 [660]	63.25 [1607]	1.50 [38]	47.50 [1207] to 48.50 [1232]	no
WRK-44SA-27AXS	41	83.125 [2111]	24.25 [616]	27.50 [699]	20.00 [508]	75.5 [1919]	.75 [19]	47.50 [1207] to 49.25 [1251]	no
WRK-44SA-32AXS-26	41	83.125 [2111]	24.25 [616]	32.50 [826]	26.00 [660]	75.5 [1919]	.75 [19]	47.50 [1207] to 49.25 [1251]	no
ERK-4425AXS	41	81.125 [2061]	22.00 [559]	25.00 [635]	20.00 [508]	75.5 [1919]	.625 [16]	47.50 [1207] to 49.37 [1254]	no
ERK-3525AXS	32	65.375 [1661]	22.00 [559]	25.00 [635]	20.00 [508]	59.75 [1518]	.625 [16]	47.50 [1207] to 49.37 [1254]	no

* This is the stock setback from the factory, for special knob clearance requirements for the front doors, please call.
** Side panels add .625" (16mm) to each side where applicable.

Sample Product Cutsheets (Audio-Visual)

AXS System
basic dimensions

all dimensions in inches unless otherwise noted [all dimensions in brackets are in millimeters]



exploded view
(extended with service stand)

[A] WRK-SA, MRK, or ERK enclosure

[B] Detachable rack frame

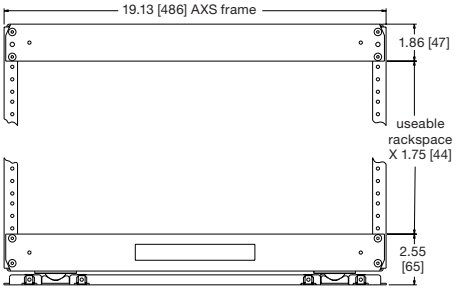
[C] Articulating cable carriers

[D] Service tracks

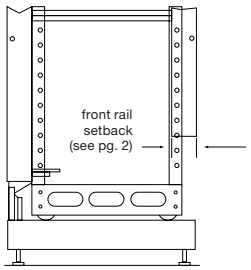
[E] Track leveler

[F] Restraining Straps

front view
(AXS inner frame)



setback

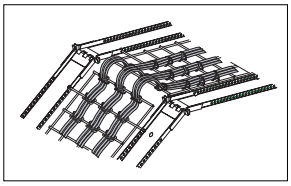


NOTE:
To calculate rail to door clearance, use the numbers in the chart on the previous page in conjunction with the door clearance found in the host cabinet's A&E Specification sheet.

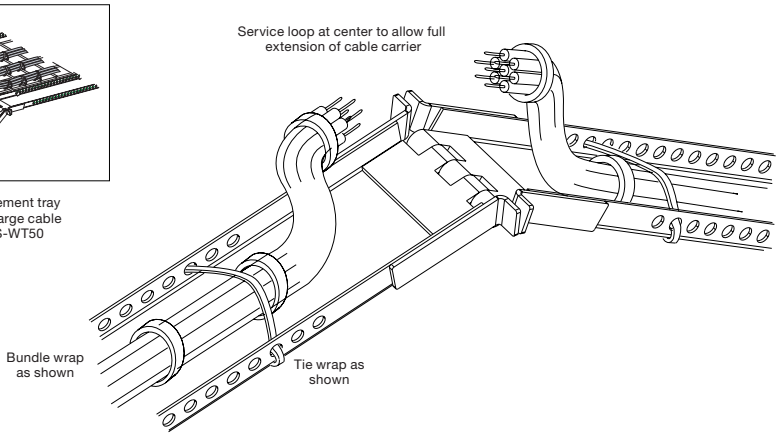
Sample Product Cutsheets (Audio-Visual)

AXS Cable Carrier
basic dimensions

all dimensions in inches unless otherwise noted [all dimensions in brackets are in millimeters]



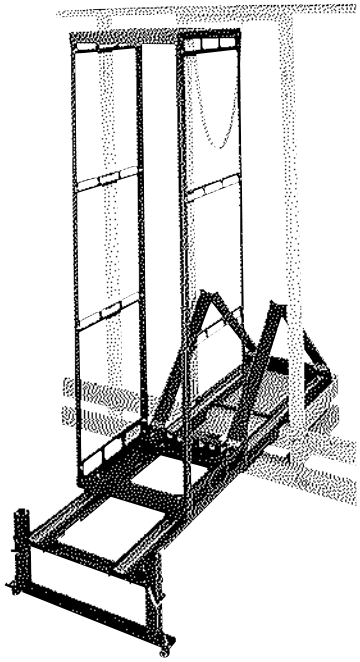
optional cable management tray is available to handle large cable bundles, part #AXS-WT50



also available

WR Series rotating roll-out enclosure, does not require tracks or stands for servicing, please see A&E specification # 96-01005.

AXS System for millwork and in-wall installations, please see A&E specification # 96-055M.



Sample Product Cutsheets (Voice/ Data)

ADVANCED NETWORK DEVICES

IPSWD-RWB

IP Speaker with LED Display and Flashers

IP Speaker Overview

The IP Speaker is a Power over Ethernet (PoE, PoE+) synchronized clock and intercom that requires only an RJ-45 connector to connect to existing data networks. Simultaneously, broadcast to both phones and speakers. The clock auto synchronizes and can be used as a scrolling text display. Standard built in microphone and speaker for two way communication.

Capabilities

Timer/Stopwatch:
- Display 4 or 6 digits
- Configurable fonts and colors
- Count up or down
- Count days, hours, minutes, seconds, 1/100ths of seconds
- Display timer and clock simultaneously
- Event based trigger

Flashers:
- Configurable for emergencies or alerts
- Three individually controlled: one Red, one White, one Blue

Clock:
- 3" numbers/text
- Atomic time
- Never needs setting
- Auto-adjust for Daylight Savings
- Display 4 or 6 digits
- Configurable fonts and colors

Scrolling Text:

Supports multiple types of messages:
- Custom Configuration
- Reminders
- Alerts
- Advertising
- RSS/Twitter/News/Weather/ Stock feeds
- Configurable fonts and colors
- 1 or 2 Line Display

Microphone:
- Monitoring
- Two way talking/Intercom
- Paging Supervision
- Hands-free talk back

Auto Dimming:

Automatically dim for different times of day. Reduce power usage at night to save energy

Audio:
- 8" High efficiency PA Speaker
- Optional ancillary 8-ohm speaker
- Bell scheduling, reminders and alarms
- Clock chimes
- Voice paging from a PC or IP phone, scheduled or ad hoc
- Use provided notifications, alarms, audio files (sport, holiday, traditional, etc.), or your own

Features

Built in Web Server:
- Send text messages to the device from the web page
- Configurable brightness, fonts and volume
- Configurable NTP time server, time zone
- Device Status
- Field upgradable

Line In/ Out:
- Independent line-in.
- Can be configured to send line in audio to the speaker and/or add additional speakers

Easy Installation:
- Only requires CAT 5 connection (up to 300ft) to network
- Power over Ethernet (no power cord or adapter). No other equipment needed

GPIO:
- 2 inputs, 1 output
- Can be activated multiple ways including via telephone or programmatically.

Multicast:
- Full multicast and broadcast support. Send audio and/or scrolling text to individual, multiple, or all devices simultaneously.

Sound Masking:
- Generate configurable pink noise via push button or programmatically.

Two Way Communication:
- Activate via push button
- Allows for full duplex hands free communication
- Optional button for hand-free push to talk capability
- Interoperates with Cisco and other VoIP network and phones

Advanced Network Devices • 3820 Ventura Dr. Arlington Hts. IL 60004 • Phone: 847-463-2236 • Fax: 847-359-5418
Website: www.anetd.com • E-Mail: sales@anetd.com

IPspeaker

Sample Product Cutsheets (Voice/ Data)

IPSWD-RWB

Software Options

- AND devices can operate standalone and do not require external software for atomic timekeeping and sending text messages from the device's web server. However, application software can be used to take advantage of the device capabilities which can then be integrated into applications like mass notification system, a phone network, etc.
- **AND Clockwise: Developed and Supported by AND.** Instantly finds and provide controls for all of you AND devices. The software provides a clock/alarm feature that supports scheduling events, alarms, stopwatch, timer with an optional sound library. It also send News/RSS/Twitter/Weather/Stock feeds, etc. messages to AND devices with a display.
- **Third Party Software:** AND has had a long standing relationship with various third party software providers. AND devices support Informacast (Singlewire), SA-Announce (Syn-Apps), IPSession (IPCelerate), MessageNet Systems, BellComander (Acro Vista), and others. AND devices will work with SIP-compatible products/PBX, such as Asterisk, 3CX, ShoreTel, etc.
- **NOTE: AND Clockwise and 3rd Party Software can run concurrently**

Mounting Options

IPSWD-RWB comes with a separate back box. Choose from surface mount (IPS-SM1) or flush mount (IPS-FM1) options.

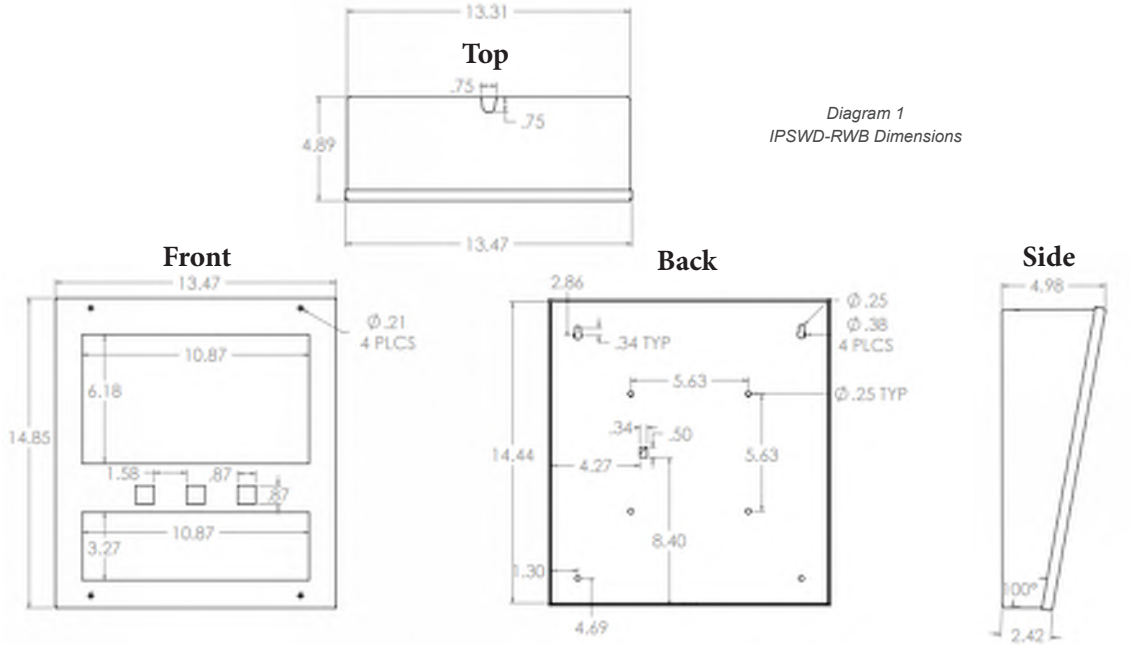


Diagram 1
IPSWD-RWB Dimensions

Specifications

- Weight: 8lbs
- Speaker Size: 8"
- Average Sensitivity: 95dB, 1W/1M
- Audio Power: 8 W/16 W
- Frequency Response: 60 Hz-17 kHz
- PoE (IEEE802.3af) 15.4 W or
- PoE+ (IEEE802.3at) 30.0 W
- 10/100 Mb network connection

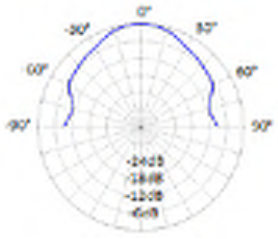


Diagram 2
8" Speaker Polar Plot
2 kHz Octave Band,
Grid Spacing = 6dB/Division

Supported Protocols

- SIP
- IPv4
- HTTP
- SLP
- TFTP
- NTP
- SNMPV1 & SNMPV2c
- DHCP
- IGMP
- ICMP
- TCP/IP
- UDP
- MDNS and MDNS-SD

Advanced Network Devices • 3820 Ventura Dr. Arlington Hts. IL 60004 • Phone: 847-463-2236 • Fax: 847-359-5418
Website: www.anetd.com • E-Mail: sales@anetd.com

Intertek

R1.2

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Campus Wayfinding Sign System V 1.0

DVC
DIABLO VALLEY COLLEGE

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

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Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: SW

DWG: 0.0.0 WEIDDIAB - INDEX - Sheet Index.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

INDEX
Sheet Index

0.0.0

Introduction

The Diablo Valley Branding and Wayfinding Master Sign System was established in 2018 as one of the ways we provide the best possible student experience and outcomes. This system can impact our college experience by:

- Introducing visitors and students to the DVC Brand and the values we stand for.
- Easing navigation of our facilities through consistent placement and use of signage.
- Decreasing costs through consistent use of standard elements.
- Increasing the overall college experience and increasing school spirit through the consistent application of our brand.
- Increasing student and visitor knowledge of what is available on campus and our campus history and culture.
- Increasing accessibility for all students.

Using this Manual

This manual is divided into sections detailing all aspects of how to apply the sign system and build quality signs.

Section 1 details why we created the system, the goals from the standpoint of the students we serve and the faculty who must deliver a quality experience, and how we specify signs.

Section 2 dictates the level of quality we require all signs to be built to so that over time we spend our money wisely on signs that will stand the test of time and showcase our brand at a high level. This section also contains all of our standard graphics and other design elements.

Section 3 shows all the signs that are available, their typical uses and reviews our sign placement methodology.

Section 4 reviews ADA and Accessibility requirements that must be adhered to at all times. Please note, that these are based mostly on existing California Building Code. This section does not replace building code. It is possible that code has changed, so review existing code prior to using this package.

Section 5 contains detailed design drawings of each sign shown in Section 3.

Section 6 details all of the possible mounting details for signs.

Section 7 details all of the possible fabrication details for signs.

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DWG: 1.0.0 WEIDDIAB - INTRO - Introduction.ai

Revisions:

How to Specify Signs

All of the information for a fabricator to bid, proof and produce signs is contained within a DVC Sign Package. For each project a DVC Sign Package needs to be produced.

A DVC Sign Package contains 5 items in this order (refer to the diagram on the right for examples):

1. **Cover Sheet**—A cover sheet indicating project details.
2. **Message Schedule**—A list of all signs, what they say, their unique number, their sign type, their mounting type, and any fabrication notes and detail references. This will be in a spreadsheet form so it can be quickly sorted by different columns. The schedule is the core of the package.
3. **Location Diagram**—Usually an architectural plan, or for exteriors a google maps satellite view showing the location of all signs needing to be fabricated via the use of sign tags.
4. **Custom Sign Details** (as needed)—At times it will be necessary to create specific details of where signs are located on buildings, or in relationship to landscape features, or create custom sign layouts based on a standard sign. This is where those details will be located.
5. **DVC Sign Standards**—A copy of the most recent DVC master Sign Program. This allows fabricators to access all the required details and fabrication requirements.

1. COVER SHEET

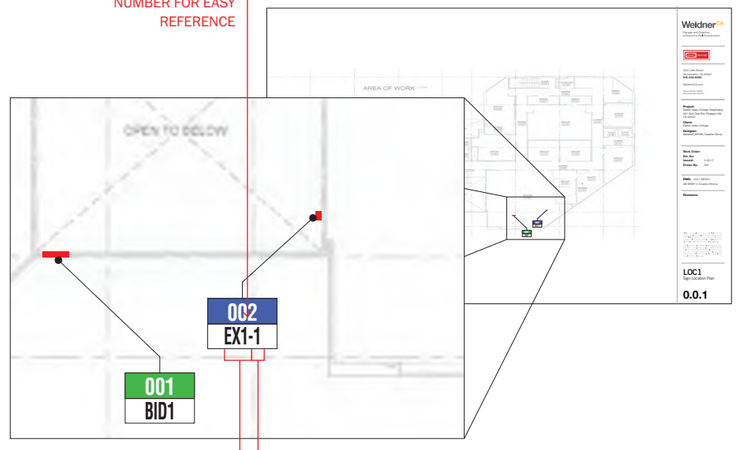
2. MESSAGE SCHEDULE

Message Schedule

Sign Type	Loc No.	Qty.	Level	Sign Copy	Insert Copy	Braille	Notes	Mounting	Ref. Details	Installation Notes
BID1	001	1	1	[LA] GYM Gymnasium		NO	Field locate. Place in planter to left of door, in front of sprinklerhead.	8	DVC Sheet 5.7.0 See 10.0.0 for Placement	INDICATE STANDARD AND NON-DVC STANDARD DETAILS HERE FOR EASY REFERENCE
EX1-1	002	1	1	EXIT		YES		1	DVC Sheet 8.1.0	

ASSIGN EACH SIGN A UNIQUE NUMBER FOR EASY REFERENCE

3. LOCATION DIAGRAM

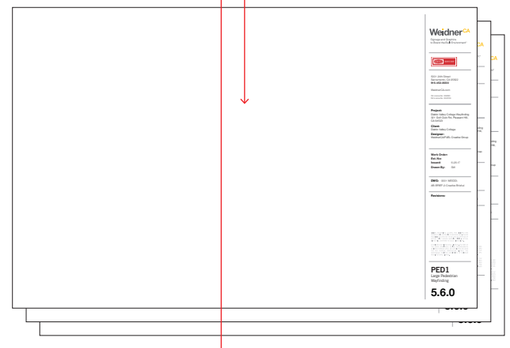


SIGN CODE CARRIES LAYOUT VARIATION AND MOUNTING INFORMATION

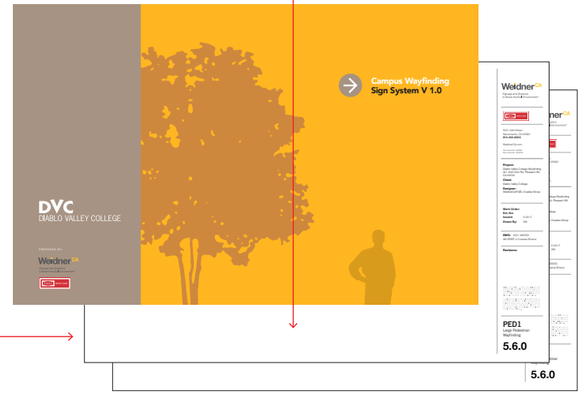
LAYOUT VARIATION # (IF APPLICABLE). USE '-C' FOR CUSTOM VARIATIONS

SIGN TYPE CODE (MATCHES STANDARD SIGN DETAIL SHEET TITLE)

4. CUSTOM SIGN DETAILS



5. DVC SIGN STANDARDS



TELLS FABRICATOR WHAT SIGN DESIGN DETAIL TO REFERENCE

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DWG: 1.1.0 WEIDDIAB - SPEC - How to Specify Signs.ai

Revisions:

SPEC
How to Specify Signs

1.1.0

Fabrication Requirements

This document was created by WeidnerCA and FUEL Creative Group (FUEL). It is expected that the builder of this sign package meet all of the following quality and performance requirements. Acceptance of these drawings by the Sign Builder constitutes agreement to comply with the following conditions.

1. General

A. Proprietary Information

All designs, instructions, layouts, and plans contained in these drawings are the property of the Owner (Diablo Valley College) for use on Diablo Valley College Campuses and Other Facilities. This information is confidential and may only be distributed in association with an active project, or to the Sign Builder selected to fabricate a final sign package. Permission from the Owner must be obtained in writing before disseminating this information to any other individuals.

B. Interpretation of Drawings

When reviewing these Drawings…

1. Written dimensions take precedence over any other implied dimension.
2. Material notes take precedence over materials visually implied on the drawings.

2. Pre-Fabrication

A. Responding to a Proposal

1. A proposal issued to DVC shall include all costs needed to complete sign removal, fabrication, and installation of all items in the final Signage Project Document (SPD), including but not limited to: materials, labor, engineering, permitting requirements and equipment. Proposals shall adhere to all fabrication, performance and material requirements detailed in this document.
2. For purpose of comparison, when bidding on a project, use all of the specific materials and fabrication methods called out in this document. Substitution of materials or methods specified in this package will make a bid non-responsive and subject to disqualification.

B. Construction Drawings

1. This package contains design drawings only. Builder must provide construction drawings to the Owner for review and acceptance prior to beginning sign fabrication for any project.

C. Submittals

1. The selected Sign Builder for a project is responsible for providing all submittals as specified in this bid package (See C2). The Owner will review all submittals to make sure design integrity is maintained. All other requirements are the responsibility of the Sign Builder.

   All materials and finishes are subject to revisions prior to final approval of all submittals. Submittals must be received with enough time to review and maintain schedule.
2. Sign Builder shall supply three (3) 8˝x8˝ samples of each material/color for approval prior to fabrication.

3. Removal/Fabrication/Installation Requirements

A. Removal of Existing Signs

The Sign Builder is responsible for the removal of existing signs at the location. Sign Builder is required to repair any walls where removed (if not being replaced by a new sign) to match surrounding area.

B. Permitting and Code Compliance Requirements

The Sign Builder will secure and pay for all required permits, inspections, insurances and tests required by Local, State and Federal agencies. The Sign Builder is also responsible for verifying that all elements of this document meet all code requirements including State CBC. Any revisions to this document or resulting shop drawings must be approved by the Owner prior to fabrication.

C. Sign Engineering/Structure Requirements/Additional Engineering Costs

Sign builder is responsible for all engineering required by law to build these signs. Bidder shall include engineering costs in their bid—engineering is not included or provided in this document.

D. Electrical Requirements

Sign builder is responsible for supplying all required electrical power and electrical conduits and conductors for these signs. It is recommended that the Sign Builder survey the site to ensure they include all needed electrical work as the Owner will be supplying the site as-is. All work must be in compliance with NEC and all other required codes. All components to be UL listed.

1. A list of electrical requirements will be provided to Owner along with all necessary location drawings etc. This will be provided in a timely manner that allows the project to maintain schedule. Sign builder is responsible for all electrical work, this list is FYI only.
2. All electrical hardware installed will be concealed (i.e. not detectable by any normal means from vehicular or pedestrian traffic). All components shall be easily accessible for servicing.
3. All electrical components shall be warranted against failure for at least 1 year. Within that period, defective components will be replaced by the Sign Builder within 48 hours of notification of the problem by the Owner. If the Sign Builder fails to replace the defective components within 48 hours, these items may be replaced by others at the Sign Builder's expense.

E. Lighting Requirements

The Sign builder is responsible for the design of all internal lighting elements and structures called for in these drawings.

1. All components will be easily accessible for servicing.
2. Unless otherwise specified, the internal space of all lit signs will be painted matte white to enhance reflectivity.
3. All components will comply with required codes or regulations and manufacturers recommendations.
4. All neon components shall be warranted against failure for at least three years. All other lighting components shall be warranted against failure for at least 1 year. Within that period, defective components will be replaced by the Sign Builder within 48 hours of notification of the problem by the Owner. If the Sign Builder fails to replace the defective components within 48 hours, these items may be replaced by others at the Sign Builder's expense.

F. Labeling Requirements

Unless otherwise required by code, labels (manufacturer's or otherwise) shall not appear on any completed element. Placement of required labels requires written approval from the Owner prior to application or installation.

G. Fonts and Other Artwork Requirements

Digital layouts for all signs in .pdf vector are available. All final layouts are the responsibility of the Sign Builder.

All fonts required shall be purchased by the Sign Builder. No substitution of fonts will be allowed.

All other artwork, photos or illustrations, will be purchased by the Sign Builder and licensed to the Owner. Upon job completion, all artwork will be removed from the Sign Builders computers or facilities and delivered to the Owner along with copies of the license information.

H. Site Coordination Requirements

Any supplied location plans are approximate. The Sign Builder is responsible for verifying all final locations. The sign builder will seek and receive written approval from owner/architect of locations prior to installation. If a discrepancy is found between this document and the actual site, or if field conditions prohibit sign placement or functionality the Sign Builder will notify the Owner, and suggest a resolution and receive written approval before beginning production.

1. All required footings, connections, electrical conduits, mounting and fasteners are the responsibility of the Contractor/Sign Builder.
2. Utilities and Irrigation Lines—Sign Builder will send proper notices, make necessary arrangements, perform other services required in construction, care, and maintenance of all existing utilities and irrigation lines, and assume all responsibility concerning the same. Provide necessary protection to existing utility services and irrigation lines as directed, and repair any work damaged as a result of operations of the Contract.

I. Safety and Responsibility Requirements

The Sign Builder is responsible for all necessary precautions to ensure public and property safety during sign installation.

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DWG: 2.0.0 WEIDDIAB - FAB1 - Fabrication Requirements 1.ai

Revisions:

FAB1
Fabrication Requirements 1

2.0.0

Fabrication Requirements (Continued)

4. Material Requirements

A. New Material Requirement

All materials used to fabricate any and all components will be new and taken from the newest of the Sign Builders supply of that material.

B. Free From Defect Requirement

All materials used to fabricate any and all components will be free from defects of any kind.

C. Paints and Finishes

All paints and finishes shall match exactly the color, finish, texture and manufacturer noted. All pretreats, primers, coatings, finishes, paints etc. shall be applied in strict accordance with the manufacturer's specifications and recommendations to ensure the highest possible level of UV light resistance, weatherability and overall longevity for both the materials indicated and any and all environmental conditions which exist at the final install locations.

1. All paints and finishes shall be warranted against failure (color fading, UV damage, cracking, peeling, blistering or any other defect) for at least five years from date of Owners acceptance.

D. Metals

Metals shall be free of defects impairing strength, durability or appearance. Unless otherwise noted all metals shall be the best commercial quality for the purposes specified, and all visible seams are to be continuously welded, filled and ground smooth. Any and all sheet metal shall have brake formed edges with radii not greater than sheet thickness. All metals must be treated to prevent corrosion and staining of other finishes.

E. Fasteners

Unless otherwise noted, all fasteners will be corrosion and oxidation resistant and tamper-proof. Unless noted, all fasteners will be painted to match adjacent surfaces. Concealed fasteners will be corrosion and oxidation resistant to prevent staining of other surfaces.

F. Vinyl

All vinyl shall match the colors and finishes noted exactly. Unless noted, all vinyl shall be applied in strict accordance with the manufacturer's specifications and recommendations to ensure the highest possible level of UV light resistance, weatherability and overall longevity for both the materials indicated and any and all environmental conditions which exist at the final install locations.

1. All vinyl shall be warranted against failure (color fading, UV damage, cracking, peeling, blistering or any other defect) for at least five years from date of Owners acceptance.

5. Project Completion

A. Punch List

The Sign Builder shall notify the Owner and the General Contractor in writing, when all work has been completed. Upon notice, the Owner will review all work in accordance with the sign builders contract with the Owner and prepare a punch list detailing any unsatisfactory items. The repair/replacement of any work detailed on the punch list will be coordinated between the Owner and the Sign Builder.

B. Final Deliverables

Upon final Owner acceptance of the work, the Sign Builder will provide the Owner with four copies of complete service and maintenance manuals for all products and finishes used in all components of the job. These manuals shall include, but are not limited to, warranty information, routine maintenance recommendations, manufacturer data and product specification etc.

C. Warranties

Unless stated differently above, all installed elements shall be warranted against manufacturers defects, and defects in installation or workmanship for a minimum of one year.

1. All warranty periods shall begin on the date of Owner's acceptance of the work.

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DWG: 2.0.1 WEIDDIAB - FAB2 - Fabrication Requirements 2.ai

Revisions:

FAB2
Fabrication Requirements 2

2.0.1

Fonts

Avenir Heavy

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
123456789

Avenir Medium

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
123456789

Highway Gothic Regular

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
123456789

Highway Gothic Condensed

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
123456789

Symbols

Trees

TREE 1A | TREE 1B | TREE 2A | TREE 2B | TREE 3

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DWG: 2.1.0 WEIDDIAB - SYMB - Type & Symbols.ai

Revisions:

SYMB
Type & Symbols

2.1.0

Colors & Finishes

Paint

COLOR 1
MATCH
PMS 7530
SATIN FINISH

COLOR 2
MATCH
PMS 1235
SATIN FINISH

COLOR 3
MATCH
PMS 3425
SATIN FINISH

COLOR 4
MATCH
PMS 2612
SATIN FINISH

COLOR 5
MATCH
#15090 in Fed Standard 595B
SATIN FINISH

COLOR 6
MATCH
PMS 409
SATIN FINISH

COLOR 7
MATCH
PMS 7510
SATIN FINISH

COLOR 8
MATCH
PMS 3302
SATIN FINISH

COLOR 9
MATCH
PMS 519
SATIN FINISH

COLOR 10
MATCH
PMS 418
SATIN FINISH

COLOR 11
MATCH
ICI
DARK SECRET
#00NN 05/000
SATIN FINISH

COLOR 12
MATCH
ICI
DEEP ONYX
#00NN 07/000
SATIN FINISH

COLOR 13
MATCH
ICI
DRIFTING SNOW
#10BB 83/014
SATIN FINISH

COLOR 14
MATCH
PMS 186
SATIN FINISH

Materials

MATERIAL A
GERBER 220—
OPAQUE
WHITE VINYL

MATERIAL B
GERBER 220—
OPAQUE
BLACK VINYL

MATERIAL C
GERBER 220—
OPAQUE
DARK GREEN
VINYL

MATERIAL D
GERBER 220—
OPAQUE
FOREST GREEN
VINYL

MATERIAL E
GERBER 220—
OPAQUE
IMITATION GOLD
VINYL

MATERIAL F
TELEGRAY
ORACAL 751
HIGH
PERFORMANCE
CAST VINYL

MATERIAL G
GERBER 220—
OPAQUE
SANDSTONE
VINYL

MATERIAL H
GERBER 220—
OPAQUE
VIVID BLUE
VINYL

MATERIAL I
GERBER 220—
OPAQUE
PERFECT MATCH
RED
VINYL

MATERIAL J
GERBER 280—
REFLECTIVE
WHITE
VINYL

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DWG: 2.2.0 WEIDDIAB - COLOR - Colors & Materials.ai

Revisions:

COLOR
Colors & Materials

2.2.0

MON1
Campus Entry Monument

MARQ
Banner Marquee

LOT1
Parking Lot ID

VEH1
Vehicular
Wayfinding

LOT2
Parking Lot
Pole ID

BAN1
Light
Standard
Banner

MAP
Campus Map

PED1
Large Pedestrian
Wayfinding

PED2
Post & Panel
Pedestrian
Wayfinding

PED3
Small Pedestrian
Wayfinding

PED4
On Building
Pedestrian
Wayfinding

PED5
Finger Post
Pedestrian
Wayfinding

PED6
Point of Interest Post
Pedestrian Wayfinding

BID2
On Building ID

BID1
Large On Building ID

BID3
Freestanding
Building ID

BID4
Secondary
Building ID

RID1
Tactile
Building ID

RID2
Tactile
Building ID
w/ Message

RID3
Tactile Classroom
Suite ID

RID4
Tactile
Room ID

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DWG: 3.0.0 WEIDDIAB - SIGNS - Wayfinding Signs in System.ai

Revisions:
R1. 01-26-18 MD
R2. 03-21-18 MD

SIGNS
Wayfinding Signs
in System

3.0.0

INFO1
Pedestrian
Information 1

INFO2
Pedestrian
Information 2

INFO3
Pedestrian
Information 3

EVI
Entry Door Prop 65

LOT3
Parking Pay Station
Pole ID

PKG
Accessible
Parking ID

PKG-V
Van Accessible
Parking ID

ACC-R
Parking Lot
Regulations

ACC-P
Accessible Path
Directional

RADA
Strike Side Tactile
Restroom ID

T24
On Door
Restroom ID

REST-W
Restroom
Directional

ELV1
Elevator
Accessibility

ELV2
Elevator in
Case of Fire

AUTO
Automatic
Door Sign

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DWG: 3.1.0 WEIDDIAB - SIGNS1 - Regulatory Signs in System.ai

Revisions:
R1. 01-26-18 MD
R2. 03-21-18 MD

SIGNS1
Regulatory Signs
in System

3.1.0

Sign Placement Methodology

A good signage systems acts as both a branding element and a wayfinding system. The signs on the outer perimeter of the campus are a branding opportunity; advertising the campus and inviting guests in. As you move into the campus, the brand gradually lets the wayfinding take the reigns. The brand is now the backdrop or "glue" — holding the informational pieces together so the user can easily understand the intent of the sign.

The wayfnding is made more usable and easier to understand by employing the theory of "progressive disclosure". This is a practice originally designed for complex airport wayfnding. It is now a standard for larger complexes like colleges and campuses. Simplified content is the key component that makes this work. Visitors are given only the information they need at each decision point to move to the next, until they reach their destination. As they come closer to that destination, the information becomes more detailed. The idea is that you should not try to direct to everything from everywhere. To make this work on the DVC campus, the pathway from the parking lot to the classroom destination has been divided in to digestible bits. This lets the visitor calmly move from one spot to the next (like following a breadcrumb trail). Here is how it works:

The Entry Point. Visitors are greeted by the DVC brand. At this point, the name of the college is also spelled out since first-time visitors may not be aware of the DVC brand. Here, the tree is also introduced to bring the lush landscape of the campus to the forefront.

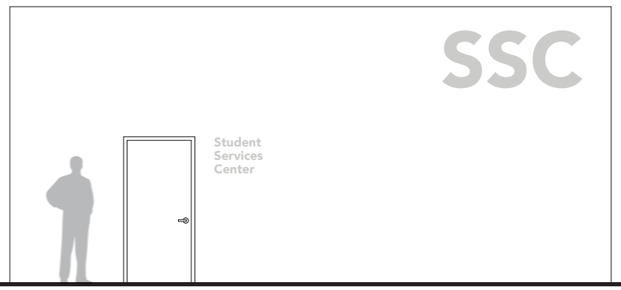
The Brand Perimeter. Banners surrounding the campus echo the DVC brand promise; setting expectations for the rest of the visit.

A Simple first impression. Parking is simpilied — only the name of the lot and the surrounding destinations are noted.

The Start of Progressive Disclosure. The campus map can be overwhelming to a first time visitor. To simplify this, main areas of the map are defined by a recognizable landmarks. Visitors can then take broad look at the campus and design their travel towards the particular landmark closest to their end destination.

The Landmarks. The landmarks are easy to see; they are the tallest of the wayfinding components and tower above all other items. The path to landmarks is reinforced by the addition of the tall multi-directional signs. These signs guide the visitor to the main areas — even when the visitor may have strayed off the path.

The Directions. Once a visitor reaches a landmark, they can start using the directional to easily find their exact destination point.



The Destination. The destination is easy to find with the main sign out front positioned within easy viewing. The destination call also be seen from a distance with the large initial letters for each build located high above everything else.

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DWG: 3.2.0 WEIDDIAB - METH - Sign Placement Methodology.ai

Revisions:
R1. 01-26-18 MD

MET
Sign Placement Methodology

3.2.0

ADA Compliance Requirements

Certain interior signs must meet the accessibility requirements of the Americans with Disability Act 2010 ADA Standards for Accessible Design AND the accessibility requirements in the current adopted edition of the California Building Code.

In general, any sign providing wayfinding to pedestrians, identifying permanent rooms or spaces, or identifying accessible features, pathways or access points is required to meet certain accessibility requirements.

A. Precedence of Existing Codes

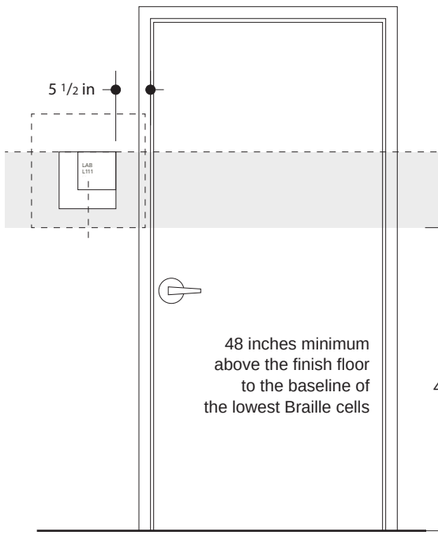
Nothing in these standards shall be interpreted to take precedence over compliance with the aforementioned accessibility requirements.

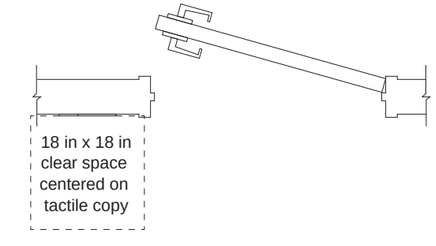
B. Responsibility of Compliance

It is the responsibility of the signage designer and sign fabricator/installer to assure compliance with all applicable accessibility requirements as they pertain to signage.

C. Tactile Sign Mounting Details

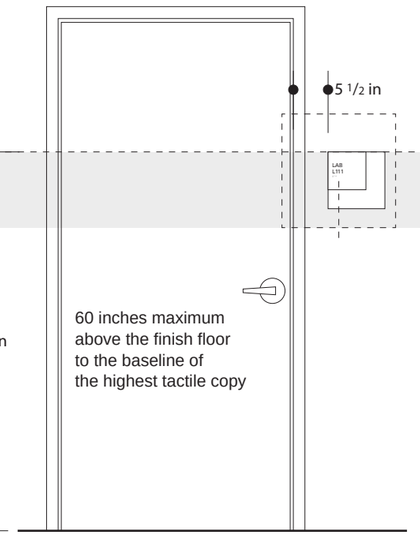
Provided here are tactile sign mounting details for right/left inswing/outswing doors.

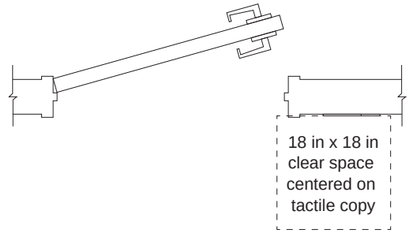




1. TACTILE SIGN PLACEMENT RIGHT HAND OUTSWING DOOR

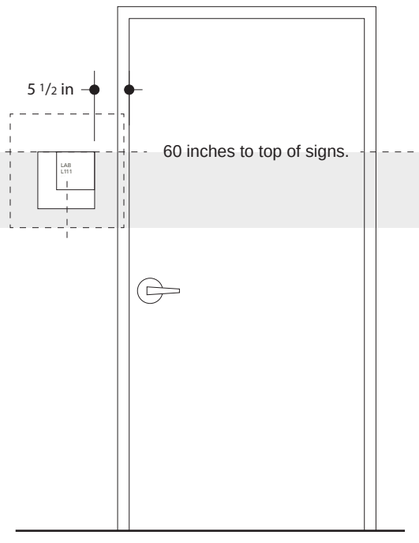
SCALE = 1/2˝ = 1˝

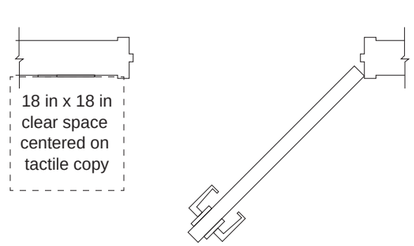




2. TACTILE SIGN PLACEMENT LEFT HAND OUTSWING DOOR

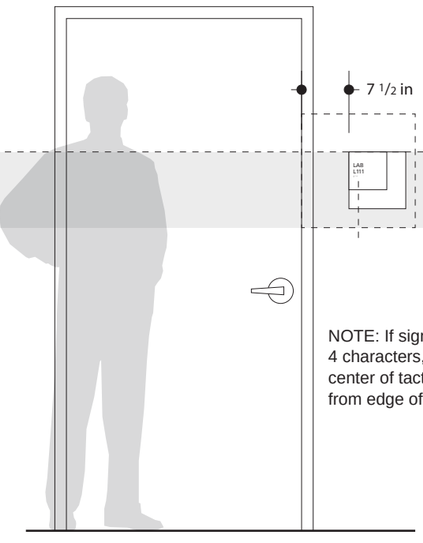
SCALE = 1/2˝ = 1˝

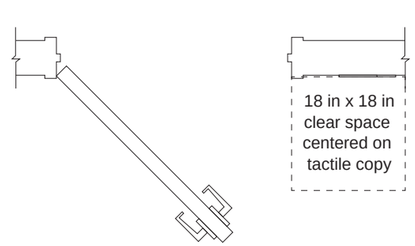




3. TACTILE SIGN PLACEMENT LEFT HAND INSWING DOOR

SCALE = 1/2˝ = 1˝





4. TACTILE SIGN PLACEMENT RIGHT HAND INSWING DOOR FOR SIGNS WITH 4 OR MORE CHARACTERS

SCALE = 1/2˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 1-15-18
Drawn By: SW

DWG: 4.0.0 WEIDDIAB - ADA - ADA Requirements.ai

Revisions:

ADA
ADA Compliance Requirements

4.0.0

DESIGN NOTES

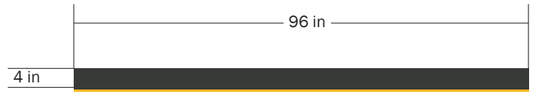
1. Square tube frame, painted Color 12
2. Aluminum panel. Front, surfaces and back painted Color 12, welded to frame.
3. Aluminum panel, painted Colors 2, 3 and 13
4. Aluminum panel with applied vinyl
5. Aluminum panel with applied vinyl
6. Fastener
7. Aluminum panel, painted Color 2
8. Text, set in Avenir Heavy, Material A
9. DVC logo, Material A, painted Color 3

FABRICATION NOTES

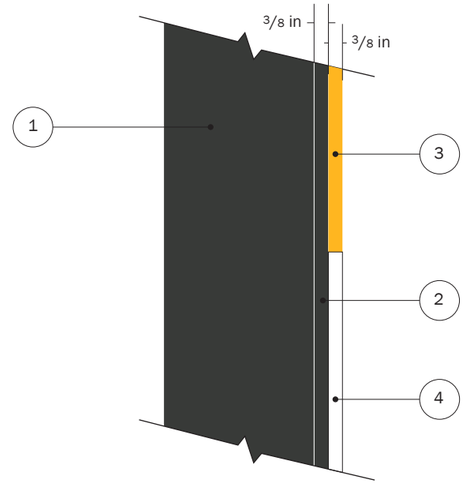
Sign fabricator to secure engineering as needed.

APPLICATION NOTES

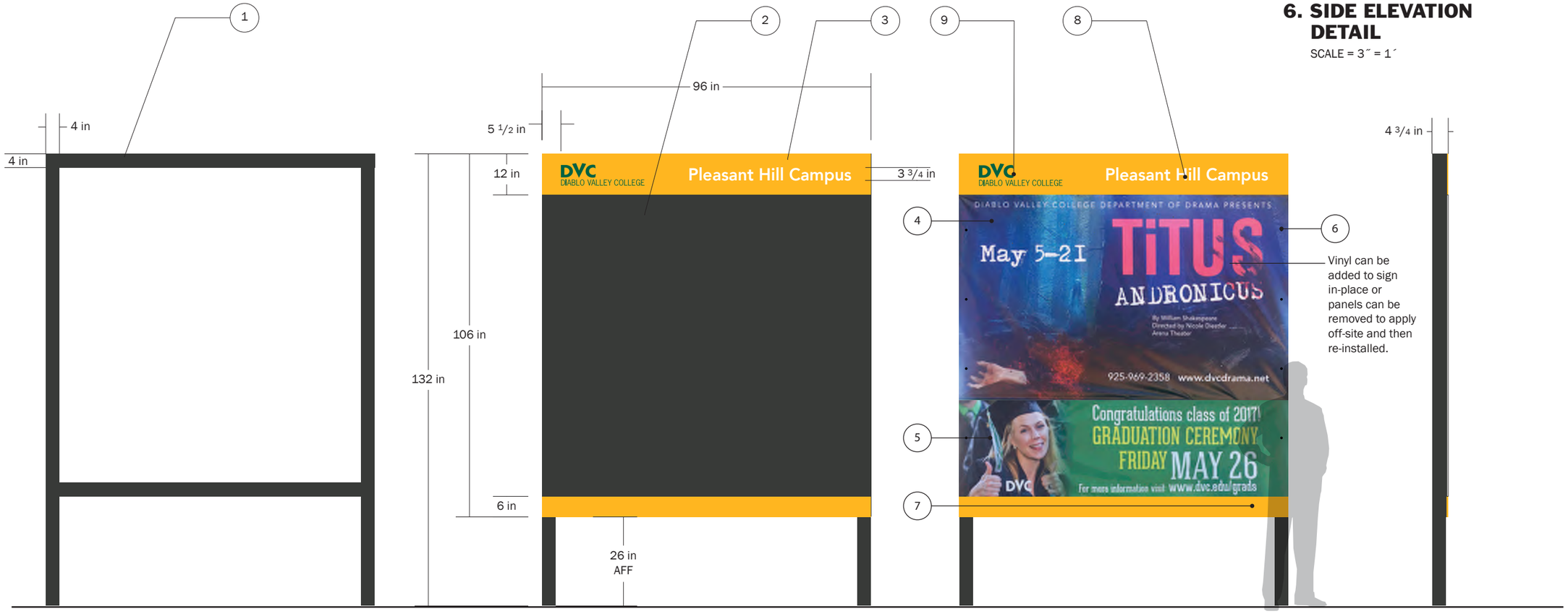
The MARQ sign should be placed adjacent to the main exterior campus entrance. Sign is intended to be placed in a landscaped area–not in a path of travel.



5. PLAN VIEW
SCALE = 1/2˝ = 1´



6. SIDE ELEVATION DETAIL
SCALE = 3˝ = 1´



1. ELEVATION: STRUCTURE
SCALE = 1/2˝ = 1´

2. ELEVATION: WITHOUT BANNERS
SCALE = 1/2˝ = 1´

3. ELEVATION: WITH BANNERS
SCALE = 1/2˝ = 1´

4. SIDE ELEVATION
SCALE = 1/2˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: BR

DWG: 5.0.0 WEIDDIAB - MARQ - Banner Marquee.ai

Revisions:
R1. 01-24-18 KO

MARQ
Banner Marquee

5.0.0

DESIGN NOTES

1. Concrete skim coat on all surfaces of existing sign to eliminate holes and for a smooth finish.
2. Aluminum letters painted color 11. Pinned off face.
3. Aluminum Letters painted color 11. Flush mounted to face.
4. Fabricated aluminum letters all surfaces painted color 3
5. Tree 2B, Stain light gray transparent stain

FABRICATION NOTES

Use existing concrete base. Remove existing letters on face.

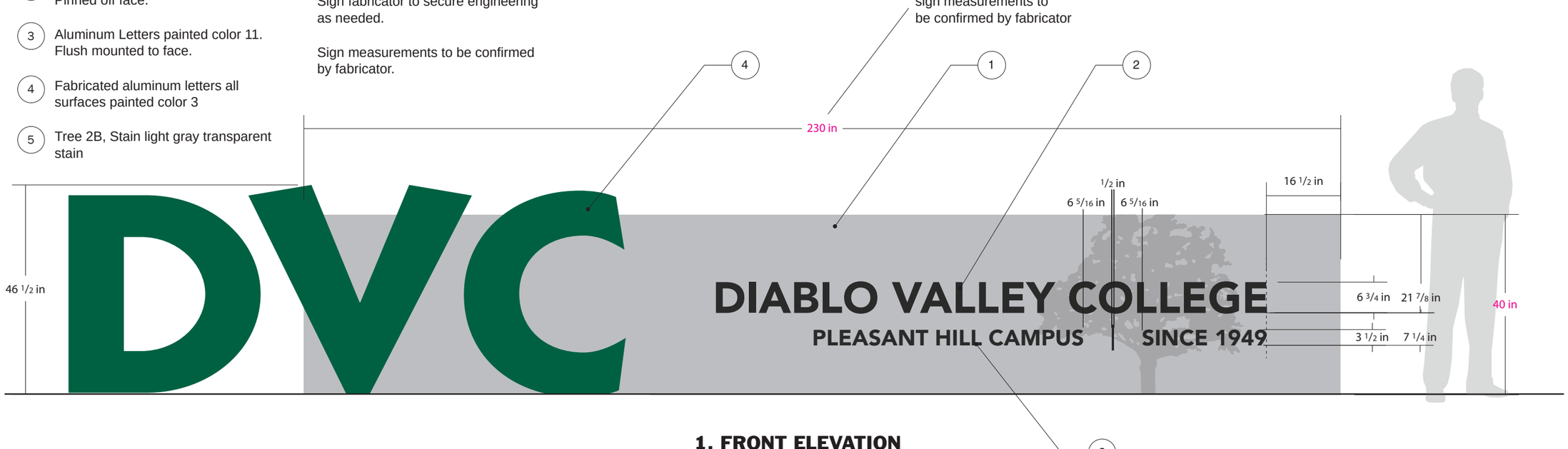
Sealant on concrete for anti-graffiti.

Sign fabricator to secure engineering as needed.

Sign measurements to be confirmed by fabricator.

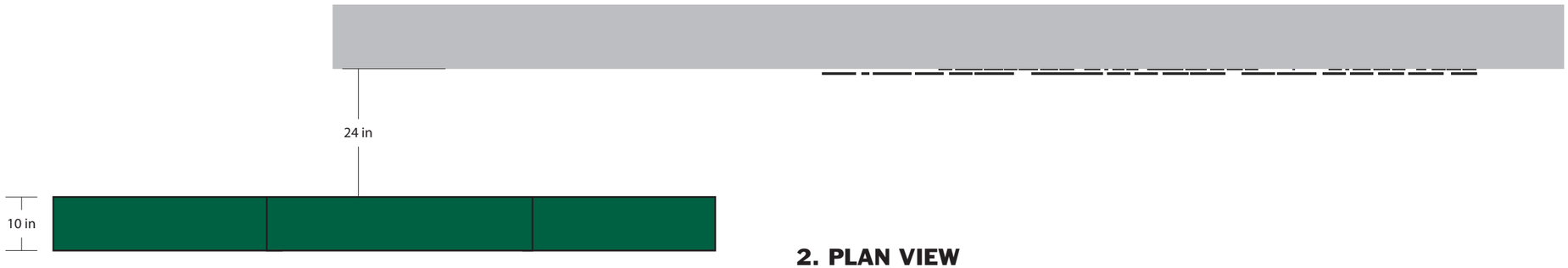
APPLICATION NOTES

The MON1 sign is a modification to the two main exterior entrance signs.



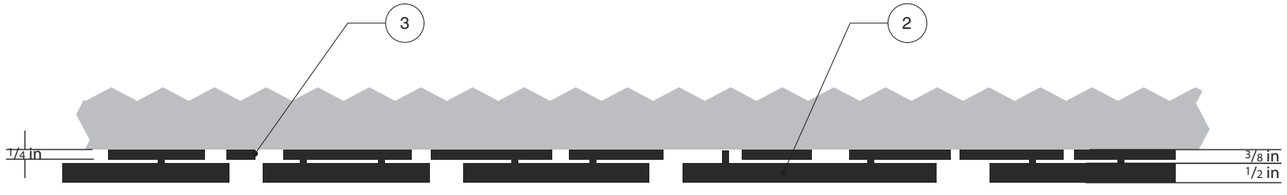
1. FRONT ELEVATION

SCALE = 1/2˝ = 1´



2. PLAN VIEW

SCALE = 1/2˝ = 1´



3. PLAN VIEW DETAIL

SCALE = 3˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.1.0 WEIDDIAB - MON1 - Campus Entry Monument.ai

Revisions:
R1. 01-24-18 KO

MON1
Campus Entry Monument

5.1.0

DESIGN NOTES

1. Fabricated aluminum cabinet, painted Color 1 and Color 3
2. DVC Logo, Material A
3. Text, set in Avenir Heavy, Material B
4. Text, set in Avenir Heavy, Material A
5. Rule, Material F
6. Accessibility symbol, Material A.
   Accessibility symbol must always be at the bottom of the list.
7. Accessibility symbol field, Material H
8. Tree 3, Material F
9. Text, set in Avenir Heavy, Material A

FABRICATION NOTES

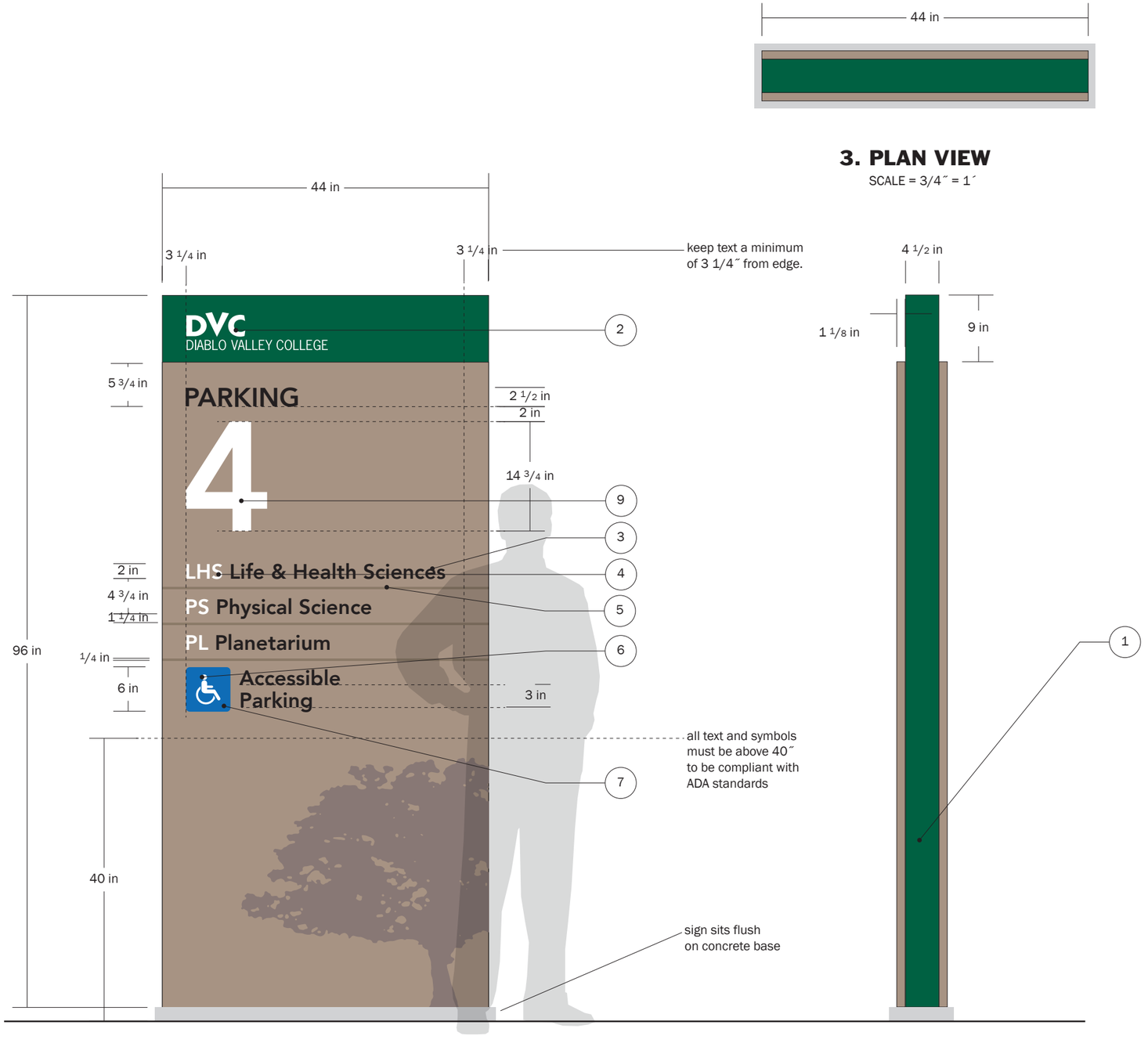
Sign is two-sided. Information is determined by location. Abbreviate building and department names so that they remain on one line.

Sign fabricator to secure engineering as needed.

See sheet 7.0.0 for concrete base detail.

APPLICATION NOTES

The LOT1 signs are to be placed along the exterior of parking lots viewable from the main vehicular path of travel.



3. PLAN VIEW
SCALE = 3/4˝ = 1´

1. FRONT ELEVATION
SCALE = 3/4˝ = 1´

2. SIDE ELEVATION
SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.2.0 WEIDDIAB - LOT1 - Parking Lot ID.ai

Revisions:
R1. 01-24-18 KO

LOT1
Parking Lot ID

5.2.0

DESIGN NOTES

1. Fabricated aluminum panel. all surfaces painted Color 1 and Color 3
2. DVC Logo, Material A
3. Text, set in Avenir Heavy, Material A
4. Rule, Material F
5. Text, set in Avenir Heavy, Material B
6. Circle symbol with cut out arrow, Material A
7. Tree 3, Material F
8. Square post painted Color 12
9. Tree 3, Material F

FABRICATION NOTES

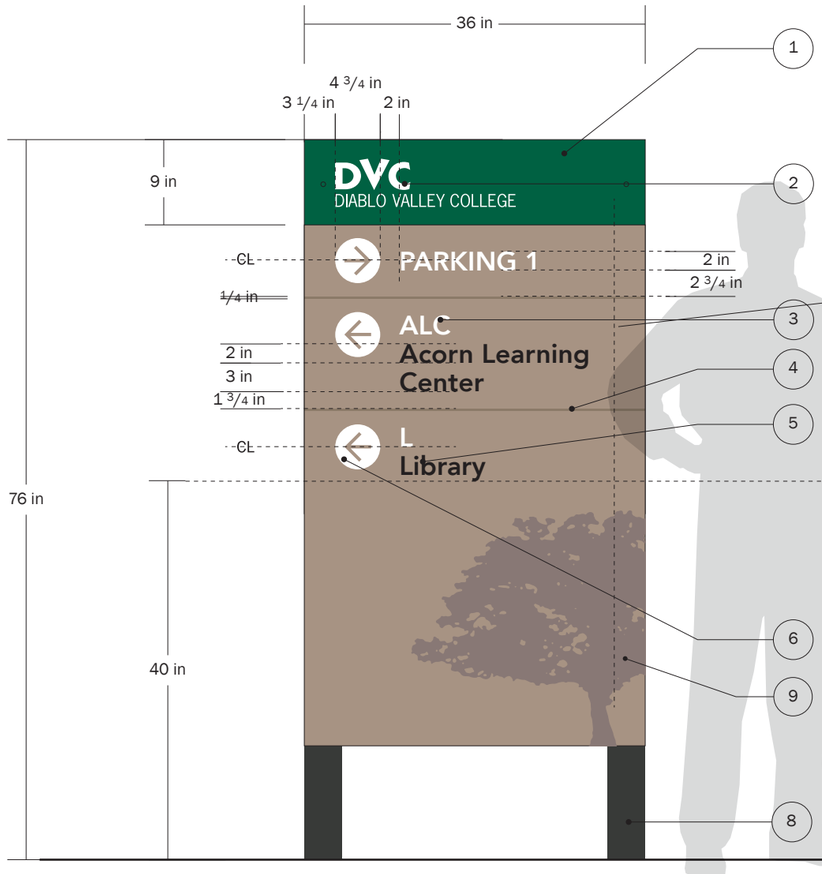
Sign is one or two-sided. Information is different on each side and is determined by location.

APPLICATION NOTES

Sign should be placed along roadways to direct drivers to important nearby parking lots, or buildings.

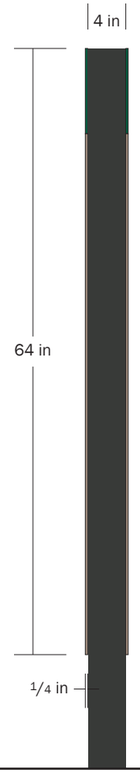
3. PLAN VIEW

SCALE = 3/4˝ = 1´



1. FRONT ELEVATION

SCALE = 3/4˝ = 1´



2. SIDE ELEVATION

SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.2.1 WEIDDIAB - VEH1 - Vehicular Wayfinding

Revisions:

VEH1
Vehicular Wayfinding

5.2.1

DESIGN NOTES

1. Aluminum panel. All sides painted Colors 1 and 2
2. DVC Logo, Material A, painted Color 3
3. Text, set in Avenir Heavy, Material B
4. Text, set in Avenir Heavy, Material B
5. Text, set in Avenir Heavy, Material A
6. Corners rounded to 1/2″ radius

FABRICATION NOTES

One sign should be mounted on each side of pole. Information is repeated on each side and is determined by location.

Sign fabricator to secure engineering as needed.

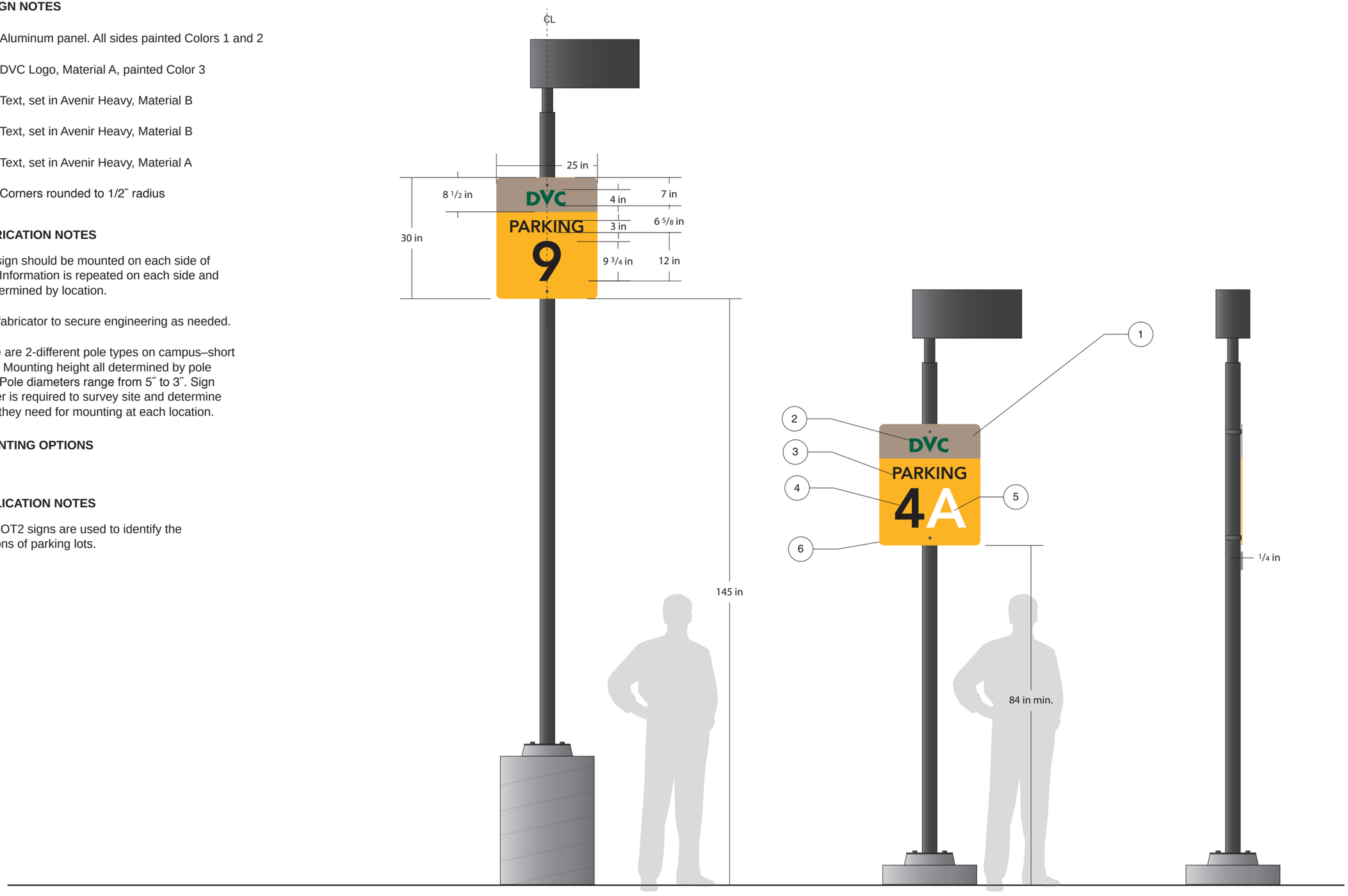
There are 2-different pole types on campus–short & tall. Mounting height all determined by pole type. Pole diameters range from 5″ to 3″. Sign builder is required to survey site and determine what they need for mounting at each location.

MOUNTING OPTIONS

3

APPLICATION NOTES

The LOT2 signs are used to identify the sections of parking lots.



1. TALL POLE ELEVATION
SCALE = 1/2″ = 1´

2. SHORT POLE ELEVATION
SCALE = 1/2″ = 1´

3. SIDE ELEVATION
SCALE = 1/2″ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.3.0 WEIDDIAB - LOT2 - Parking Lot Pole ID.ai

Revisions:
R1. 01-24-18 KO

LOT2
Parking Lot Pole ID

5.3.0

DESIGN NOTES

1. Aluminum Painted Color 3, with 1/8″ radius rounded corners
2. Round Galvanized Steel Pole with Press on Cap
3. Text, set in Avenir Heavy, Material A

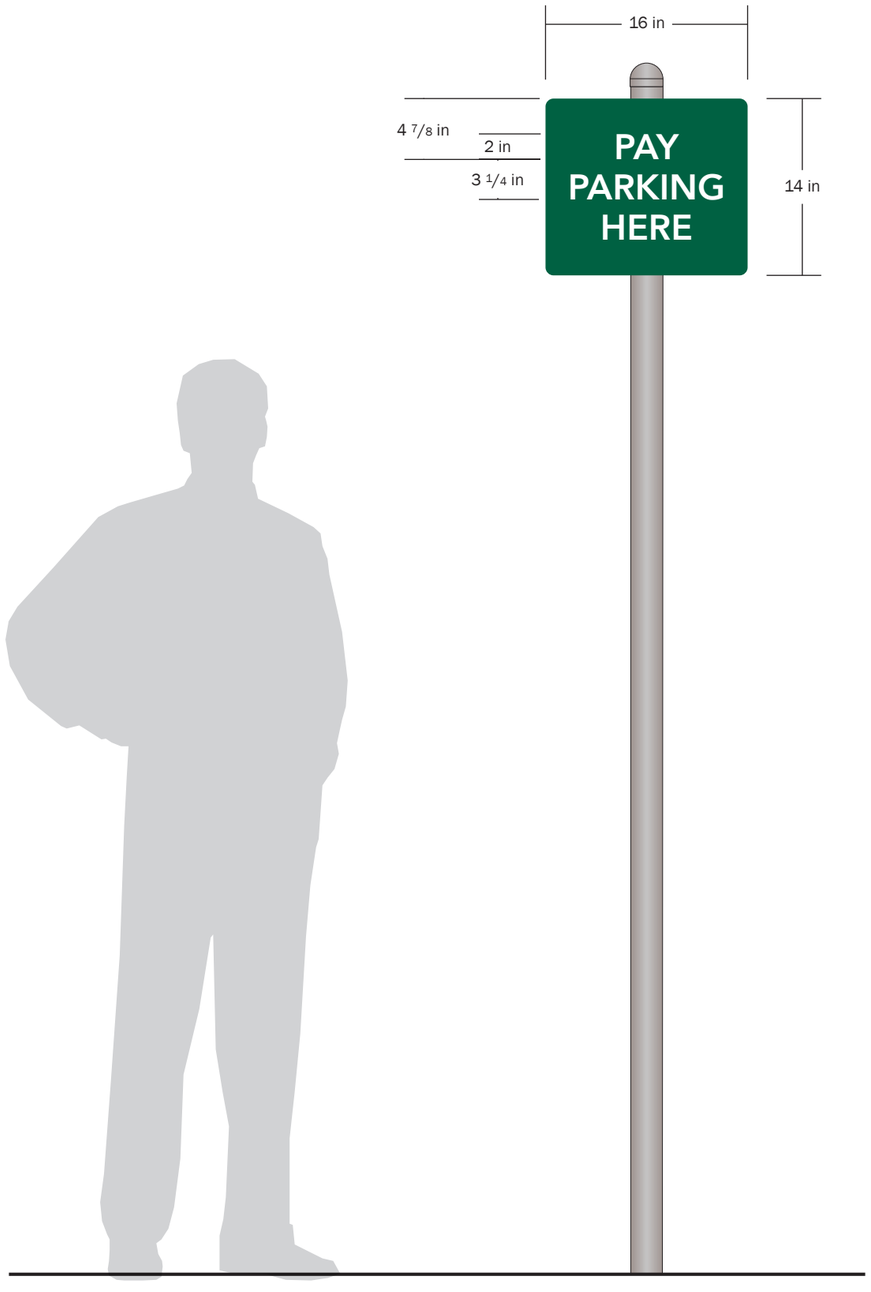
FABRICATION NOTES

Sign is one-sided.

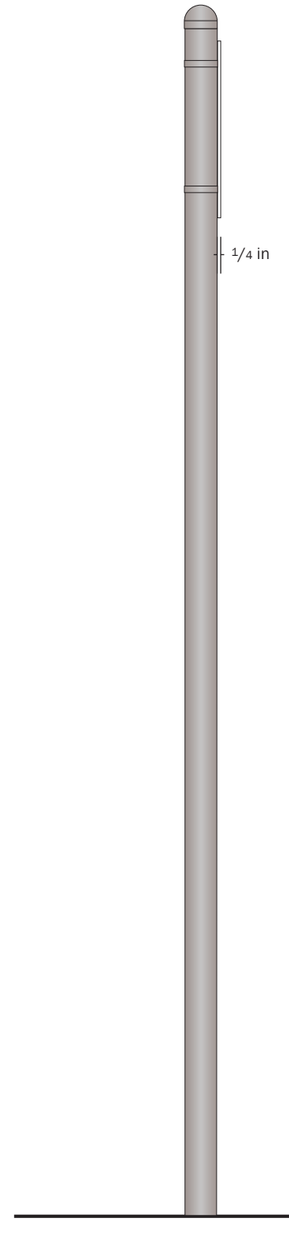
Sign fabricator to secure engineering as needed.

APPLICATION NOTES

The LOT3 signs are to identify the location of a parking pay station in a parking lot.



1. ELEVATION
SCALE = 1″ = 1′



2. SIDE ELEVATION
SCALE = 1″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 3-21-18
Drawn By: MD

DWG: 5.3.1 WEIDDIAB - LOT3 - Parking Pay Station Pole ID.ai

Revisions:

LOT3
Parking Pay Station
Pole ID

5.3.1

DESIGN NOTES

1. Banner Color 1
2. DVC Logo, Color 13
3. Text, set in Avenir Heavy, Color 11
4. Text, set in Avenir Heavy, Color 11
5. Text, set in Avenir Heavy, Color 13
6. Tree 2B, Color 6
7. Seamed pole pockets
8. Stainless steel pole strap with arm

FABRICATION NOTES

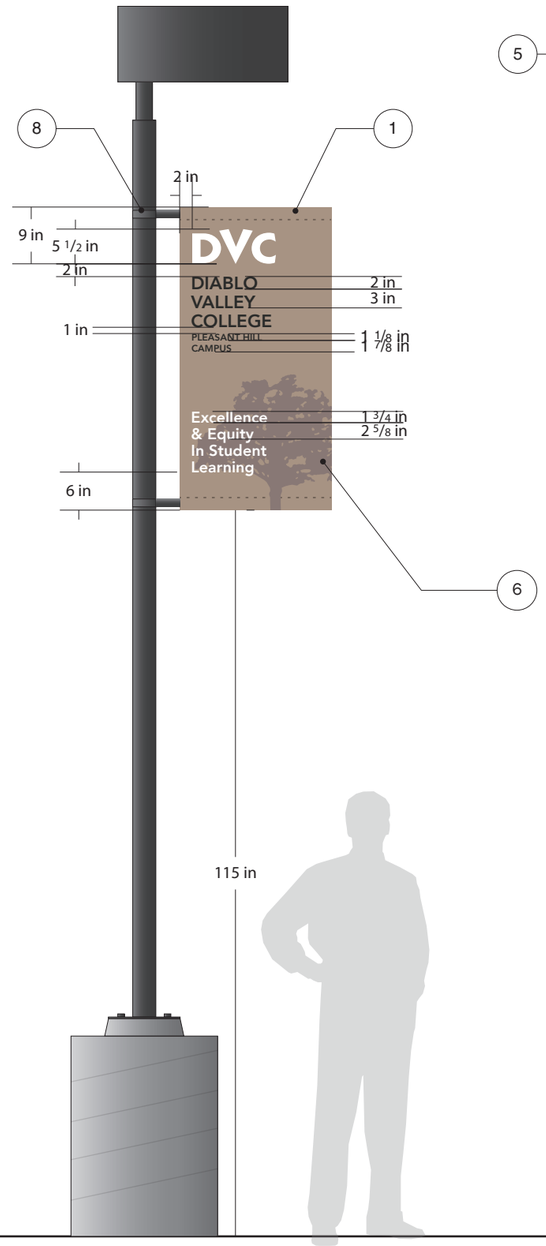
Sign is two-sided digitally printed banner. Information is repeated on each side.

There are 2-different pole types on campus–short & tall. Mounting height is determined by pole type. Pole diameters range from 5˝ to 3˝. Sign builder is required to survey site and determine what they need for mounting at each location. Banners will be hung on existing poles on campus.

For vector banner art see sheet 5.4.1

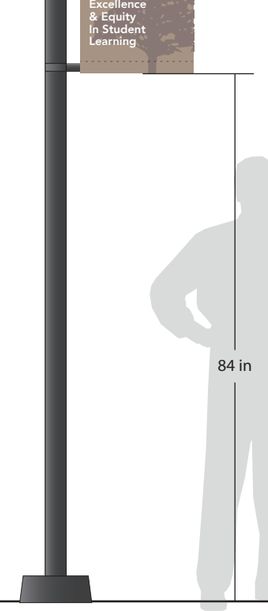
APPLICATION NOTES

The BAN1 signs are to be placed along the exterior of the campus or anywhere a branding presence is needed. Banner size is to be determined by pole height, the short pole banner is a reduced size version of the tall pole banner.



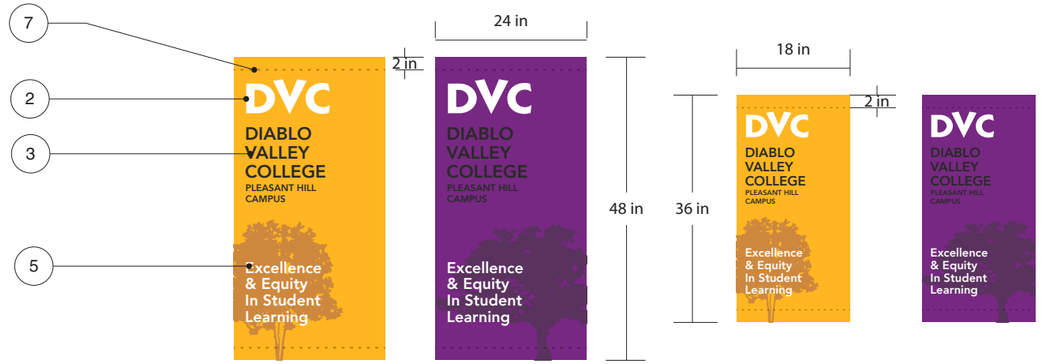
1. TALL POLE ELEVATION

SCALE = 1/2˝ = 1´



2. SHORT POLE ELEVATION

SCALE = 1/2˝ = 1´



3. ADDITIONAL TALL POLE BANNERS

SCALE = 1/2˝ = 1´

4. ADDITIONAL SHORT POLE BANNERS

SCALE = 1/2˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

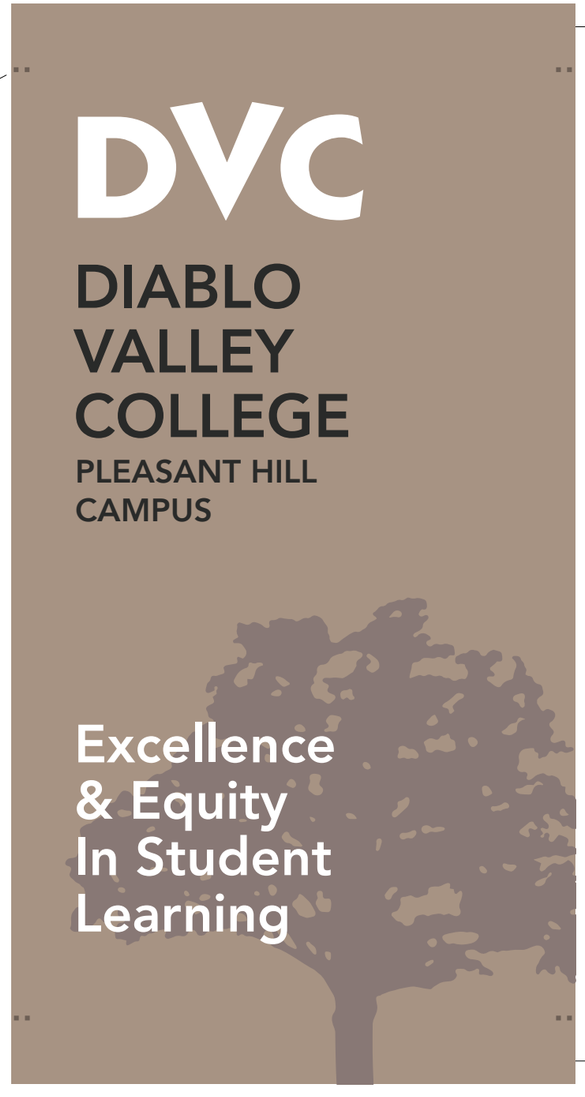
DWG: 5.4.0 WEIDDIAB - BAN1 - Light Standard Banner.ai

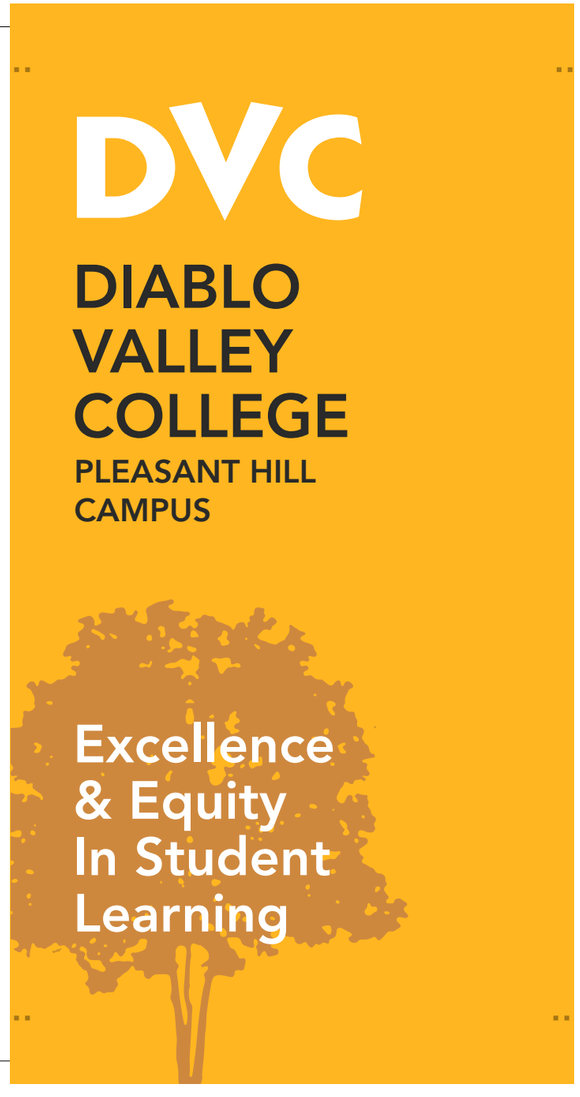
Revisions:
R1. 01-24-18 KO

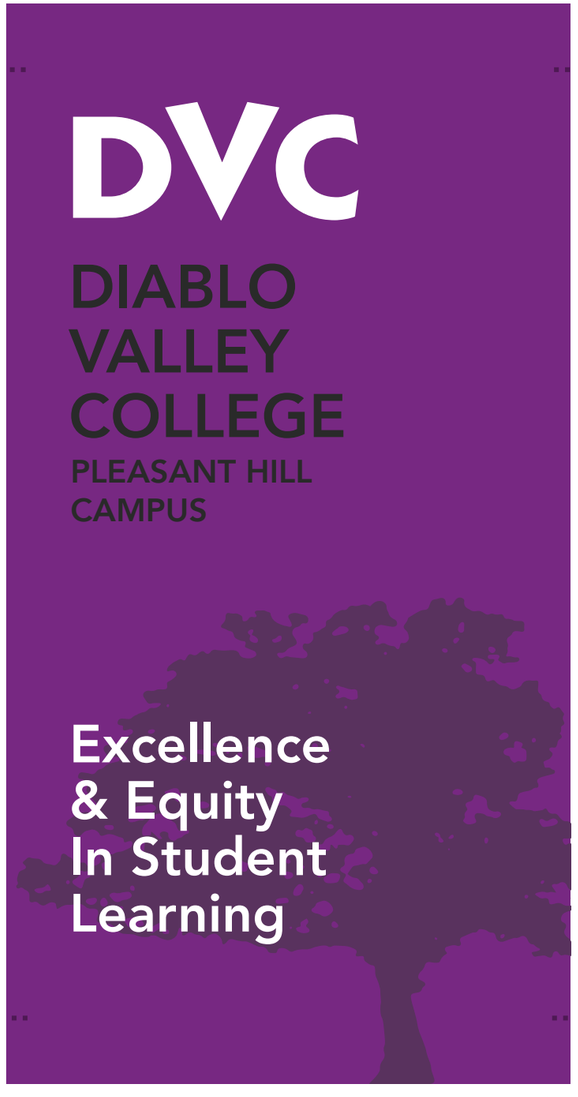
BAN1
Light Standard Banner

5.4.0

Stitched Pocket







1. BANNER ART

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.4.1 WEIDDIAB - BAN2 - Light Standard Banner Design.ai

Revisions:
R1. 01-24-18 KO

BAN2
Light Standard Banner Design

5.4.1

DESIGN NOTES

1. Fabricated aluminum cabinet, painted Color 1, Color 2 and Color 13
2. Text, set in Avenir Heavy, Material A
3. Text, set in Avenir Heavy, Material B
4. DVC Logo, Material A, painted Color 3
5. Map, applied vinyl, digitally printed. Match vinyl to Color 13
6. Tree 1A, Material F

FABRICATION NOTES

Sign is single-sided.

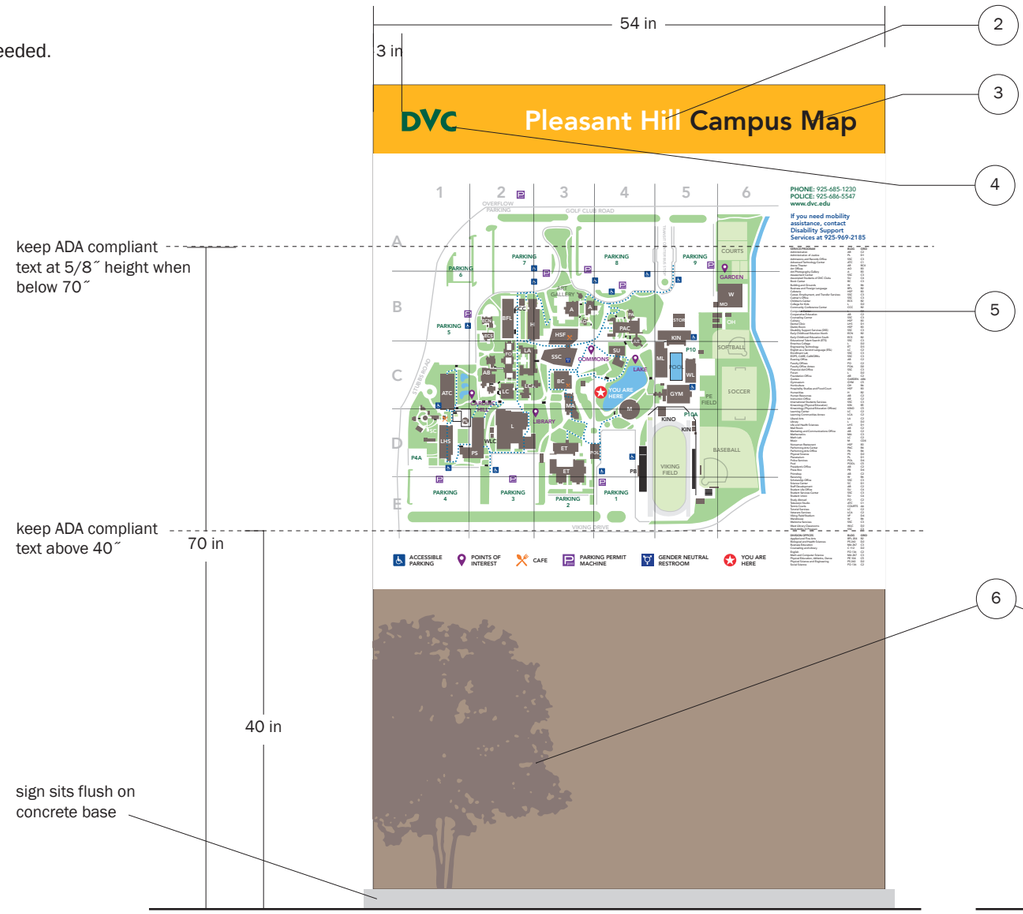
Sign fabricator to secure engineering as needed.

See sheet 7.0.0 for concrete base detail.

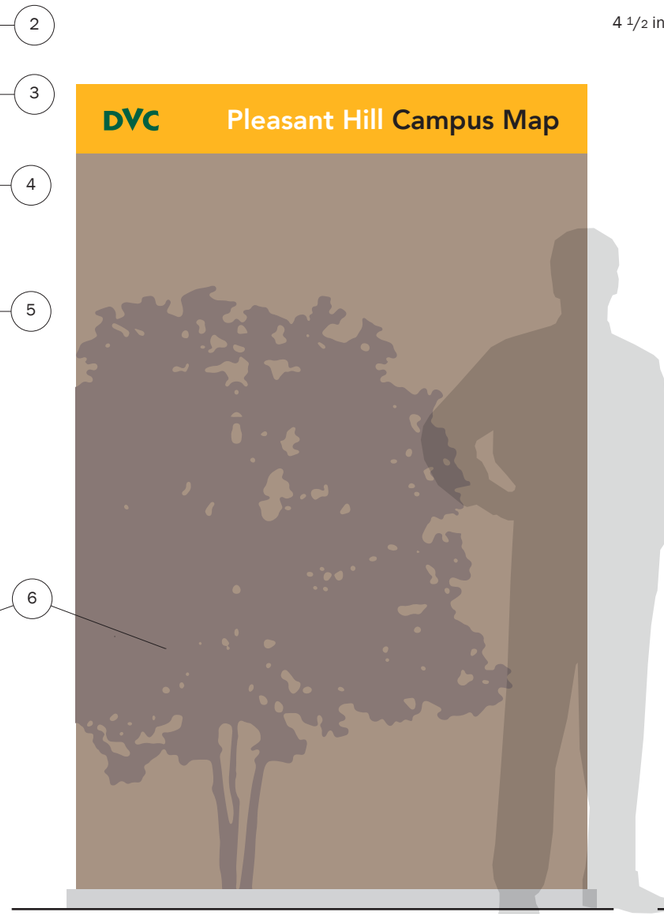
APPLICATION NOTES

The MAP signs are to be placed along primary paths of travel, particularly points of entrance to the campus. Additional MAP signs can be placed at primary decision points.

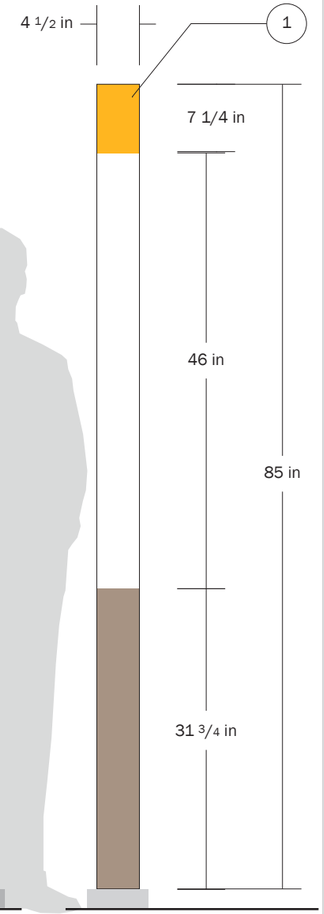
Map should rotate per direction individual is facing when viewing map.



1. FRONT ELEVATION
SCALE = 3/4˝ = 1´



2. BACK ELEVATION
SCALE = 3/4˝ = 1´



3. SIDE ELEVATION
SCALE = 3/4˝ = 1´

DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

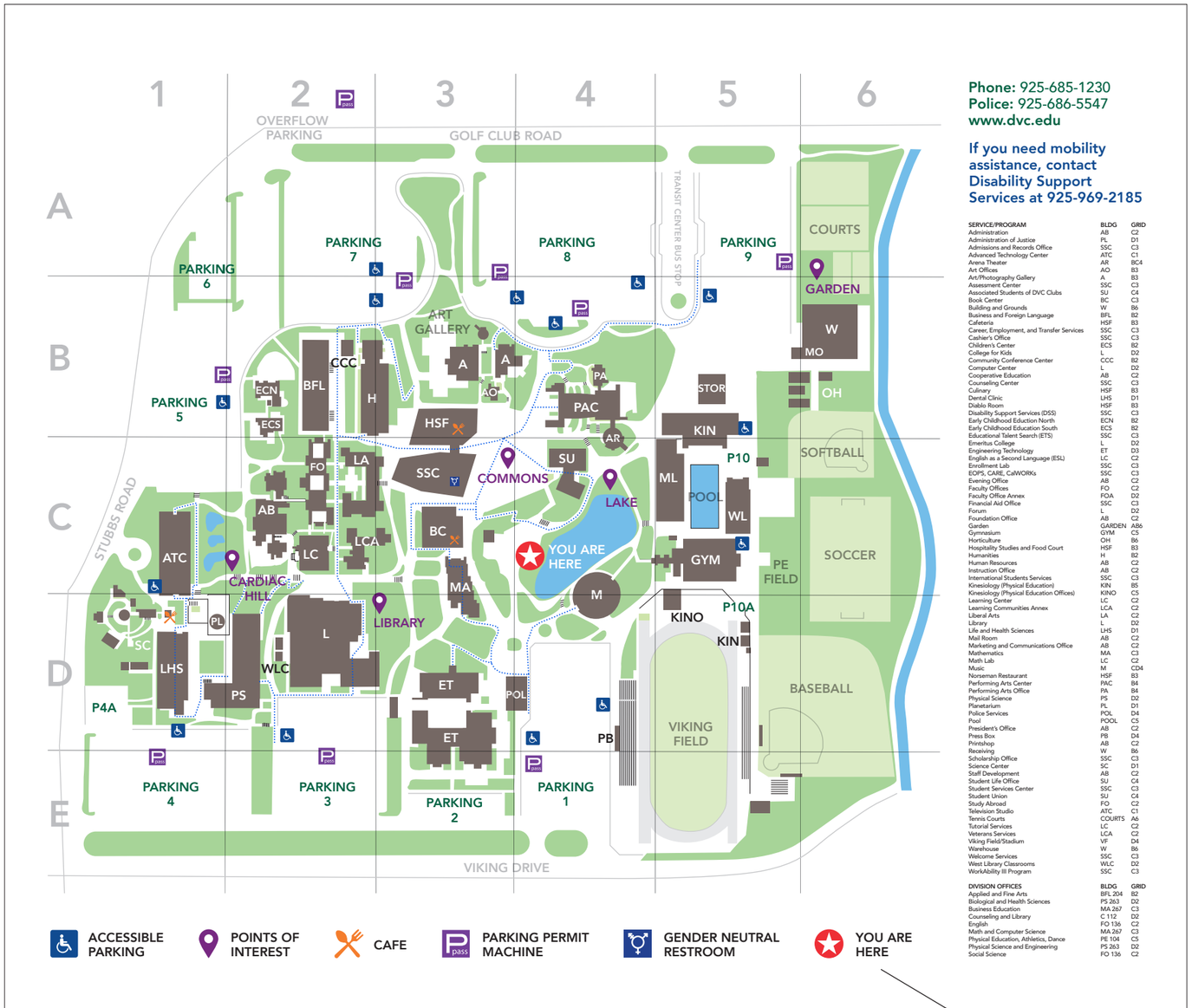
Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.5.0 WEIDDIAB - MAP1 - Campus Map.ai

Revisions:
R1. 01-24-18 KO

MAP1
Campus Map

5.5.0



Phone: 925-685-1230
Police: 925-686-5547
www.dvc.edu

If you need mobility assistance, contact Disability Support Services at 925-969-2185

SERVICE/PROGRAM	BLDG	GRID
Administration	AB	C2
Administration of Justice	PL	D1
Admissions and Records Office	SSC	C3
Advanced Technology Center	ATC	C1
Arena Theater	AR	BC4
Art Offices	AO	B3
Art/Photography Gallery	A	B3
Assessment Center	SSC	C3
Associated Students of DVC Clubs	SU	C4
Book Center	BC	C3
Building and Grounds	W	B6
Business and Foreign Language	BFL	B2
Cafeteria	HSF	B3
Career, Employment, and Transfer Services	SSC	C3
Cashier's Office	SSC	C3
Children's Center	ECS	B2
College for Kids	L	D2
Community Conference Center	CCC	B2
Computer Center	L	D2
Cooperative Education	AB	C2
Counseling Center	SSC	C3
Culinary	HSF	B3
Dental Clinic	LHS	D1
Diablo Room	HSF	B3
Disability Support Services (DSS)	SSC	C3
Early Childhood Eduction North	ECN	B2
Early Childhood Education South	ECS	B2
Educational Talent Search (ETS)	SSC	C3
Emeritus College	L	D2
Engineering Technology	ET	D3
English as a Second Language (ESL)	LC	C2
Enrollment Lab	SSC	C3
EOPS, CARE, CalWORKs	SSC	C3
Evening Office	AB	C2
Faculty Offices	FO	C2
Faculty Office Annex	FOA	D2
Financial Aid Office	SSC	C3
Forum	L	D2
Foundation Office	AB	C2
Garden	GARDEN	AB6
Gymnasium	GYM	C5
Horticulture	OH	B6
Hospitality Studies and Food Court	HSF	B3
Humanities	H	B2
Human Resources	AB	C2
Instruction Office	AB	C2
International Students Services	SSC	C3
Kinesiology (Physical Education)	KIN	B5
Kinesiology (Physical Education Offices)	KINO	C5
Learning Center	LC	C2
Learning Communities Annex	LCA	C2
Liberal Arts	LA	C2
Library	L	D2
Life and Health Sciences	LHS	D1
Mail Room	AB	C2
Marketing and Communications Office	AB	C2
Mathematics	MA	C3
Math Lab	LC	C2
Music	M	CD4
Norseman Restaurant	HSF	B3
Performing Arts Center	PAC	B4
Performing Arts Office	PA	B4
Physical Science	PS	D2
Planetarium	PL	D1
Police Services	POL	D4
Pool	POOL	C5
President's Office	AB	C2
Press Box	PB	D4
Printshop	AB	C2
Receiving	W	B6
Scholarship Office	SSC	C3
Science Center	SC	D1
Staff Development	AB	C2
Student Life Office	SU	C4
Student Services Center	SSC	C3
Student Union	SU	C4
Study Abroad	FO	C2
Television Studio	ATC	C1
Tennis Courts	COURTS	A6
Tutorial Services	LC	C2
Veterans Services	LCA	C2
Viking Field/Stadium	VF	D4
Warehouse	W	B6
Welcome Services	SSC	C3
West Library Classrooms	WLC	D2
WorkAbility III Program	SSC	C3

DIVISION OFFICES	BLDG	GRID
Applied and Fine Arts	BFL 204	B2
Biological and Health Sciences	PS 263	D2
Business Education	MA 267	C3
Counseling and Library	C 112	D2
English	FO 136	C2
Math and Computer Science	MA 267	C3
Physical Education, Athletics, Dance	PE 104	C5
Physical Science and Engineering	PS 263	D2
Social Science	FO 136	C2

NOTE: This needs to move for each map placement.

1. FRONT ELEVATION

SCALE = 2˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.5.1 WEIDDIAB - MAP2 - Campus Map Artwork.ai

Revisions:

MAP2
Campus Map Artwork

5.5.1

DESIGN NOTES

1. Fabricated aluminum cabinet, painted Color 1 and Color 2
2. DVC Logo, Material A, painted Color 3
3. Text, set in Avenir Heavy, Material A
4. Rule, Material E
5. Text, set in Avenir Heavy, Material B
6. Accessibility symbol, Material A.
   Accessibility symbol must always be at the bottom of the list.
7. Accessibility symbol field, Material H
8. Directional arrow, Material A
9. Directional arrow circular field, Material G
10. Tree 1B, Material E

FABRICATION NOTES

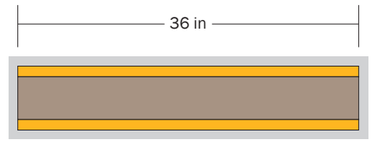
Sign is two-sided. Information is different on each side and is determined by location.

Sign fabricator to secure engineering as needed.

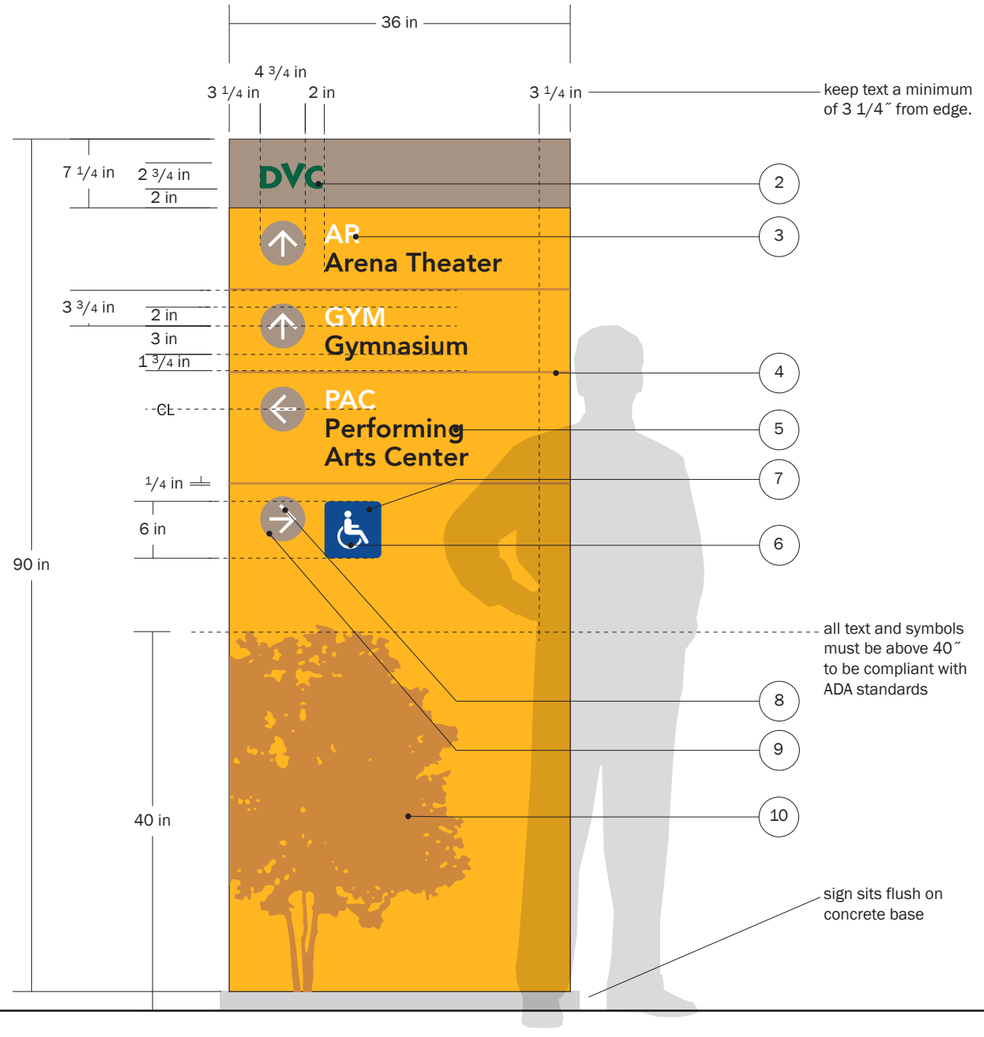
See sheet 7.0.0 for concrete base detail.

APPLICATION NOTES

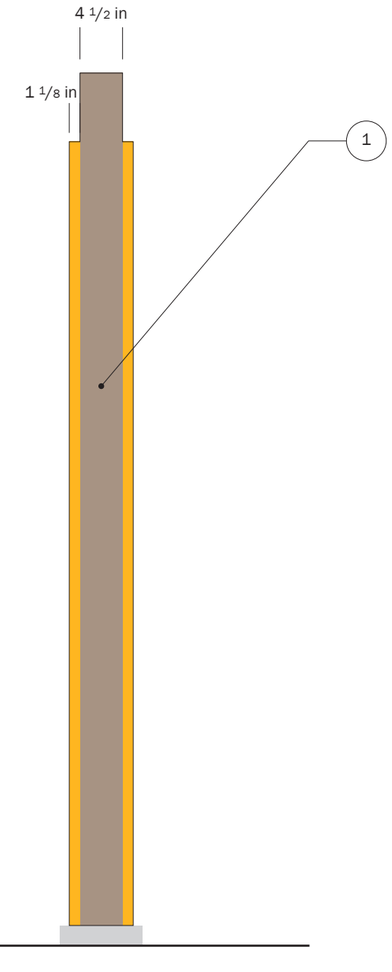
The PED1 signs are to be placed along primary paths of travel with high traffic and visibility.



3. PLAN VIEW
SCALE = 3/4˝ = 1´



1. FRONT ELEVATION
SCALE = 3/4˝ = 1´



2. SIDE ELEVATION
SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.6.0 WEIDDIAB - PED1 - Large Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 KO

PED1
Large Pedestrian Wayfinding

5.6.0

DESIGN NOTES

1. Fabricated aluminum panel, painted Color 1 and Color 2
2. DVC Logo, Material A, painted Color 3
3. Text, set in Avenir Heavy, Material A
4. Rule, Material E
5. Text, set in Avenir Heavy, Material B
6. Accessibility symbol, Material A.
   Accessibility symbol must always be at the bottom of the list.
7. Accessibility symbol field, Material H
8. Directional arrow, Material A
9. Directional arrow circular field, Material G
10. Tree 3, Material F
11. Square post painted Color 12

FABRICATION NOTES

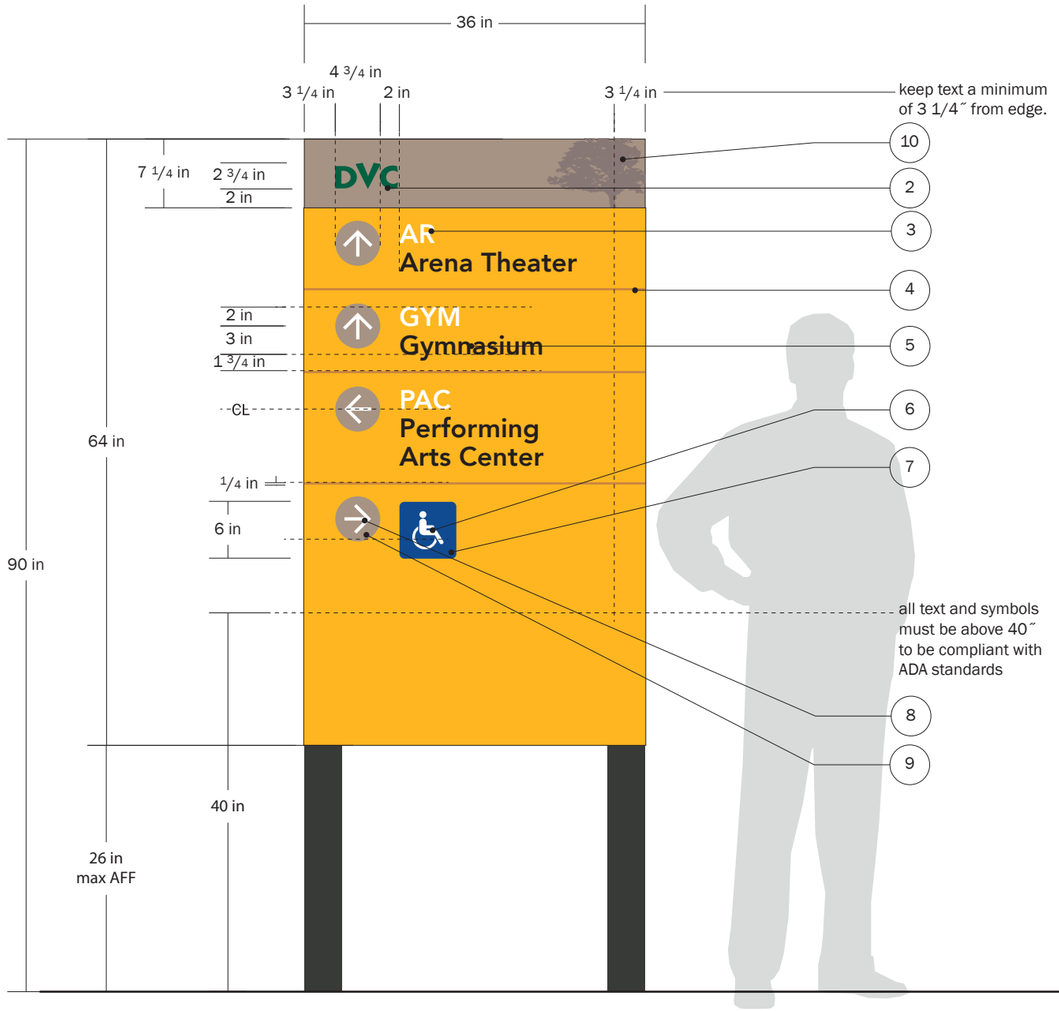
Sign is two-sided. Information is different on each side and is determined by location.

Sign fabricator to secure engineering as needed.

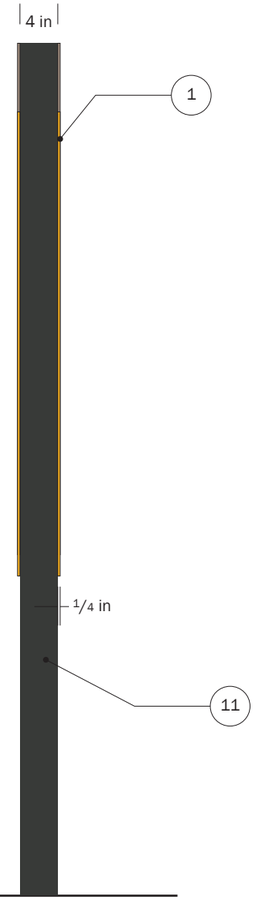
APPLICATION NOTES

The PED2 signs are to be placed along paths of travel with minimal traffic.

3. PLAN VIEW
SCALE = 3/4˝ = 1´



1. FRONT ELEVATION
SCALE = 3/4˝ = 1´



2. SIDE ELEVATION
SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: SW

DWG: 5.6.1 WEIDDIAB - PED2 - Medium Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 KO

PED2
Post & Panel
Pedestrian Wayfinding

5.6.1

DESIGN NOTES

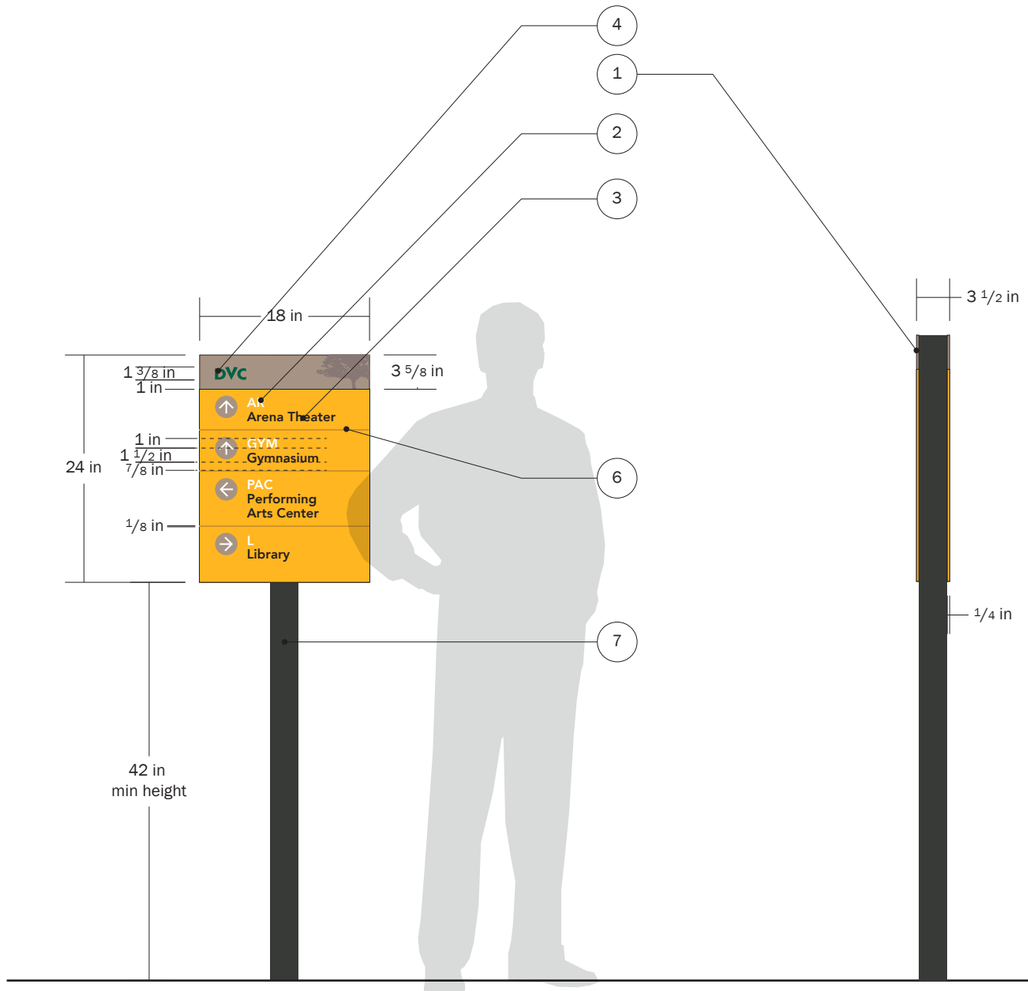
1. Aluminum panel. All sides painted Color 1 and Color 2
2. Text, set in Avenir Heavy, Material A
3. Text set in Avenir Heavy, Material B
4. DVC logo, Material A, painted Color 3
5. Tree 3, Material F
6. Rule, Material E
7. Square post painted Color 12

FABRICATION NOTES

Sign can be one or two-sided. Information determined by location.

APPLICATION NOTES

The PED3 signs are to be placed along paths of travel where either of the PED1 or PED2 signs would be too intrusive for the space.



1. FRONT ELEVATION

SCALE = 3/4˝ = 1´

2. SIDE ELEVATION

SCALE = 3/4˝ = 1´

3. PLAN VIEW

SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.6.2 WEIDDIAB - PED3 - Small Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 MD

PED3
Small Pedestrian Wayfinding

5.6.2

DESIGN NOTES

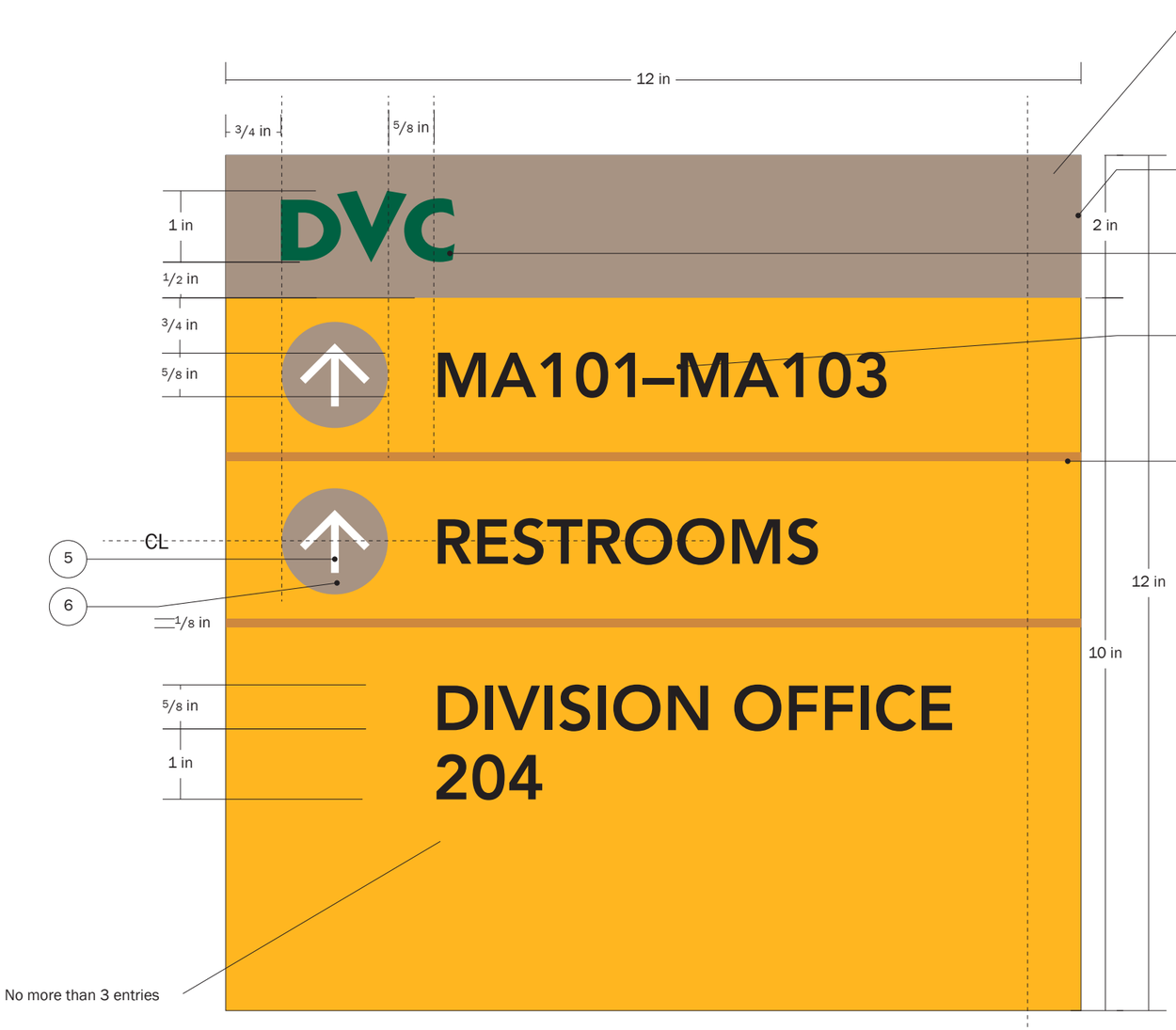
1. Aluminum, surface and returns painted Color 1 and 2
2. DVC Logo, Material A, painted Color 3
3. Text, set in Avenir Heavy, Material B
4. Rule, Material E
5. Directional arrow, Material A
6. Directional arrow circular field, Material G

MOUNTING OPTIONS

4

APPLICATION NOTES

The PED4 signs are to be placed on-building near an entrance and still viewable from the path of travel. They should identify and direct to inside the building.



1. ELEVATION
SCALE = 1/2˝ = 1´

2. SIDE ELEVATION
SCALE = 1/2˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.7.0 WEIDDIAB - PED4- On Building Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 KO

PED4
On Building
Pedestrian Wayfinding

5.7.0

DESIGN NOTES

1. Aluminum, all surfaces painted Color 4
2. Text, set in Avenir Heavy, Material A
3. Directional arrow, Material A
4. Directional arrow circular field, Material G
5. Continuous wrap around attachment, secured to pole with screws painted to match surface
6. Signs stack flush to one another
7. Aluminum pole painted Color 12 with flush cap

FABRICATION NOTES

Sign is two-sided. Information is repeated on each side and is determined by location.

All five locations must be included on sign.

Sign fabricator to secure engineering as needed.

APPLICATION NOTES

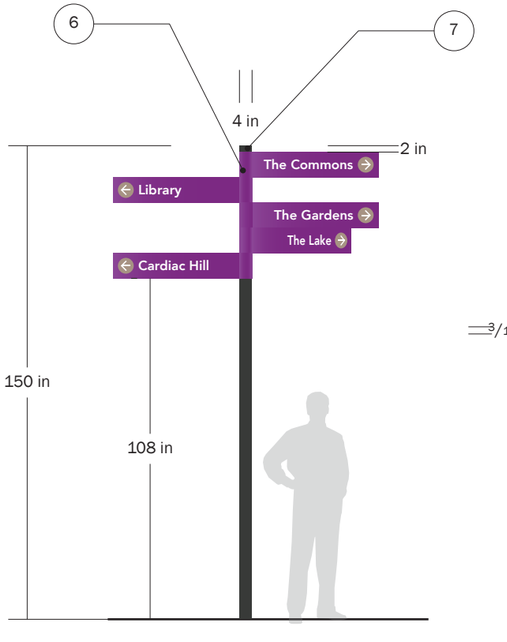
The PED5 signs are to be placed along primary paths of travel and at key decision points. They should be positioned so that they are viewable from a distance. Arrows should be oriented to point to corresponding destination.

1. SIDE A ELEVATION

SCALE = 3˝ = 1´

2. SIDE B ELEVATION

SCALE = 3˝ = 1´



4. LOCATION PLAN

SCALE = 3/8˝ = 1´

3. PLAN VIEW

SCALE = 3˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.8.0 WEIDDIAB - PED5- Finger Post Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 KO

PED5

Finger Post Pedestrian Wayfinding

5.8.0

DESIGN NOTES

1. Aluminum cabinet, all surfaces painted Color 4 and Color 2
2. Text, set in Avenir Heavy, Material A

FABRICATION NOTES

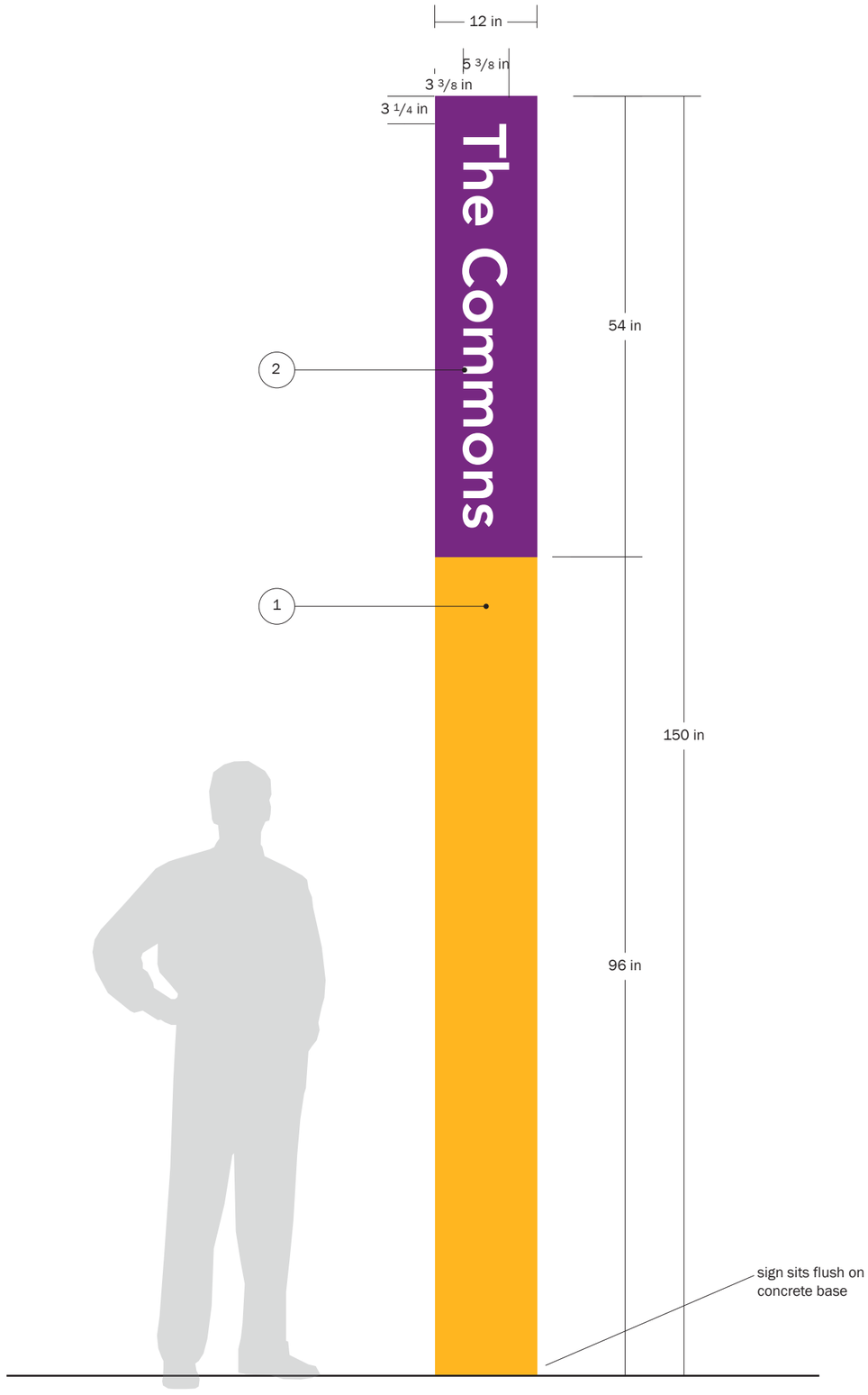
Sign is four-sided. Information is repeated on each side and is determined by location.

Sign fabricator to secure engineering as needed.

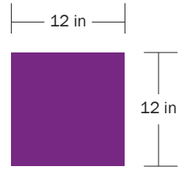
See sheet 7.0.0 for concrete base detail.

APPLICATION NOTES

The PED6 signs are to be placed at key landmarks along campus.They should be positioned so that they are viewable from a distance.



1. SIDE A ELEVATION
SCALE = 3/4˝ = 1´



2. PLAN VIEW
SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.9.0 WEIDDIAB - PED6 - Point of Interest Post Pedestrian Wayfinding.ai

Revisions:
R1. 01-24-18 KO

PED6
Point of Interest Post
Pedestrian Wayfinding

5.9.0

DESIGN NOTES

1. Aluminum letters, text set in Avenir Black, pinned off the wall.
2. Clear space, there shouldn't be any object or building edges encroaching on this space.

PLACEMENT NOTES

BID1 Signs will vary depending on the height of the building and the amount of space available for BID1 signage. Sign consultant will recommend appropriate sign.

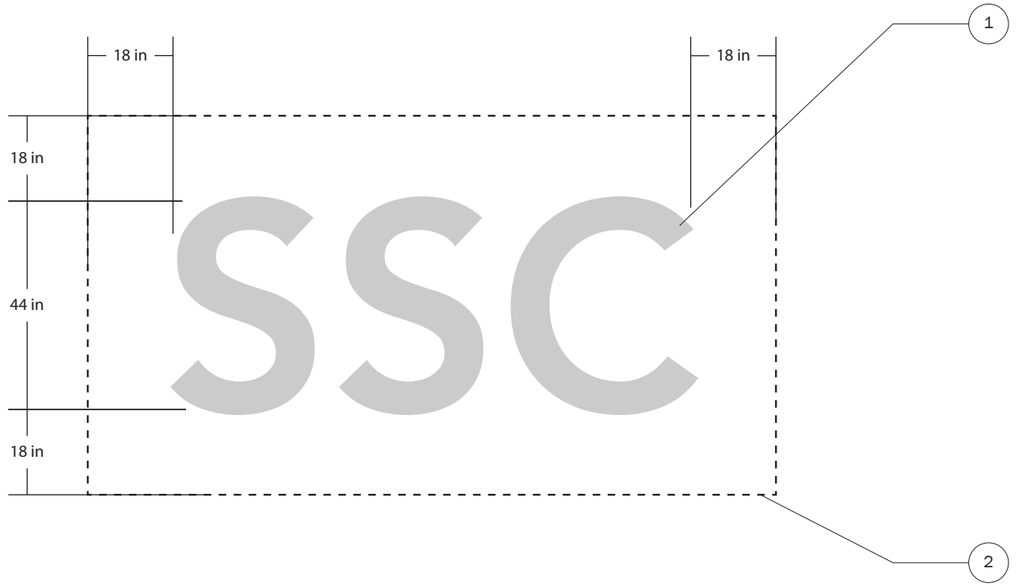
For placement on buildings under 13´ tall use 31˝–37˝ letters. For placement on buildings over 13´ tall use 38˝–44˝ letters.

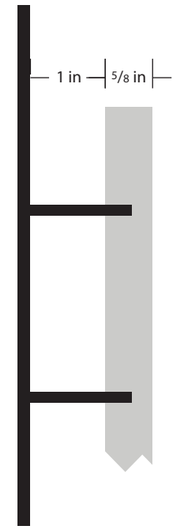
Once the appropriate BID1 sign is determined placement should be made on the upper corner of the most visible/trafficked pathway.

APPLICATION NOTES

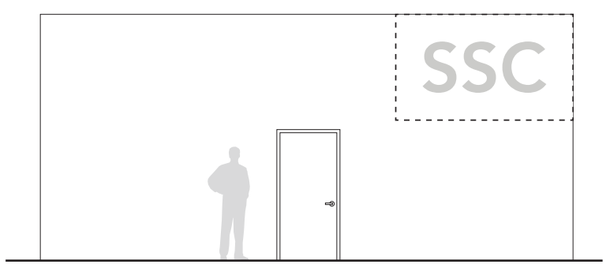
BID1 signs shall be paired with the appropriate BID2 sign. In cases where there is not ample space for a BID1 sign, the Sign Consultant may recommend only the BID2 sign.

Sign dimensions may be customized if needed. Signs should remain between 31˝–44˝ in height, sized in 1˝ increments and maintain appropriate clear space of 18˝, when possible.

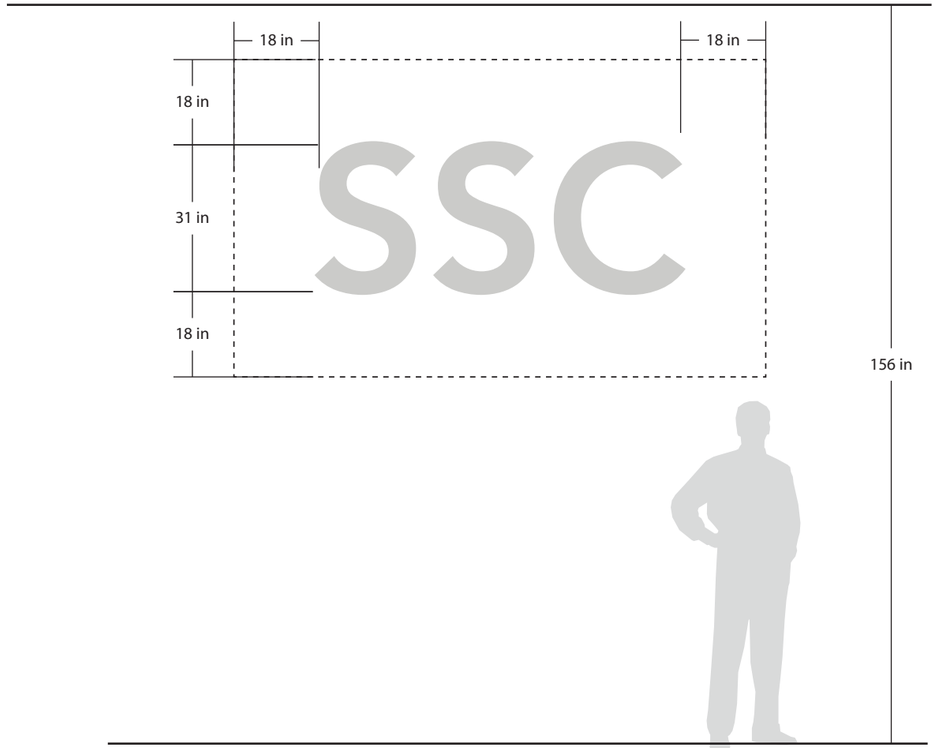




2. SIDE ELEVATION DETAIL
SCALE = 1/2˝ = 1˝



3. LOCATION PLAN
SCALE = 1/8˝ = 1´



1. FRONT ELEVATION
SCALE = 3/8˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.10.0 WEIDDIAB - BID1 - Large On-Building ID.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

BID1
Large On-Building ID

5.10.0

DESIGN NOTES

1. Aluminum letters, text set in Avenir Black, pinned off the wall.
2. In the case where there might be interior logos/departments that should be represented on the outside of the building, their placement should remain within this field.
3. Clear space. No items should encroach on this space

PLACEMENT NOTES

BID2 Signs will vary depending on the height of the buidling and the amount of space available for BID2 signage. Sign consultant will recommend appropriate sign.

8″–10″ letters can be used on buildings greater than 13′ tall. The baseline of the last line of text should be a minimum of 84″ above the ground.

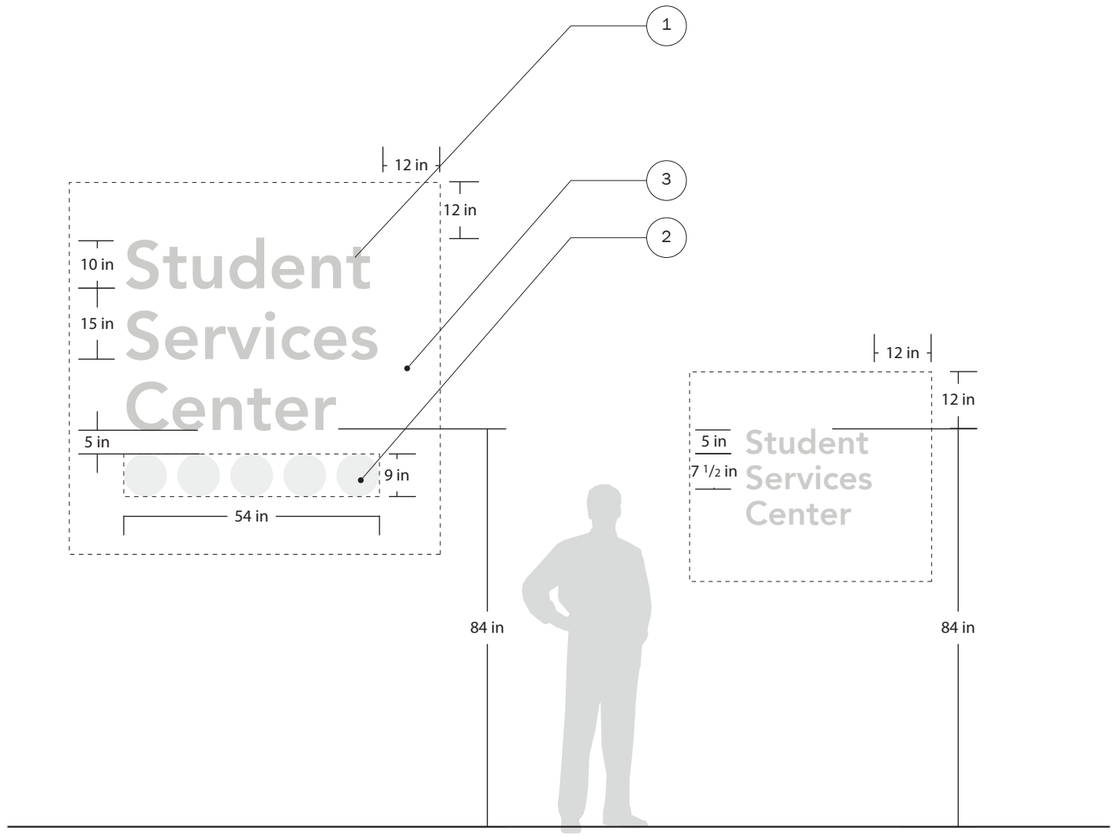
5″–7″ letters can be used on buildings less than 13′ tall. The top of the text should be a maximum of 84″ above the ground or align to the top of the adjacent door.

Sign should be placed at the main entrance of the building on the side of the door with the most traffic.

APPLICATION NOTES

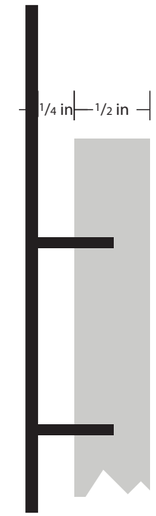
BID2 signs shall be paired with the appropriate BID1 sign. In cases where there is not ample space for a BID1 sign, the Sign Consultant may recommend only the BID2 sign.

Sign dimensions may be customized if needed. Sign text should remain between 5″–10″ in height, sized in 1/2″ increments and maintain appropriate clear space of 12″, when possible.



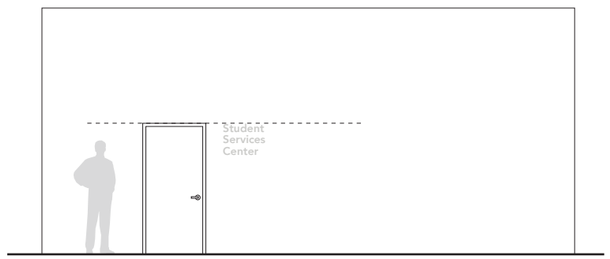
1. FRONT ELEVATION

SCALE = 3/8″ = 1′



2. SIDE ELEVATION DETAIL

SCALE = 1″ = 1″



3. LOCATION PLAN

SCALE = 1/8″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.11.0 WEIDDIAB - BID2 - On-Building ID.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

BID2
On-Building ID

5.11.0

DESIGN NOTES

1. Fabricated aluminum cabinet, painted Color 1 and Color 2
2. DVC Logo, Material A, painted Color 3
3. Text, set in Avenir Heavy, Material A
4. Text, set in Avenir Heavy, Material B
5. Rule, Material E
6. Tree 1B, Material E

FABRICATION NOTES

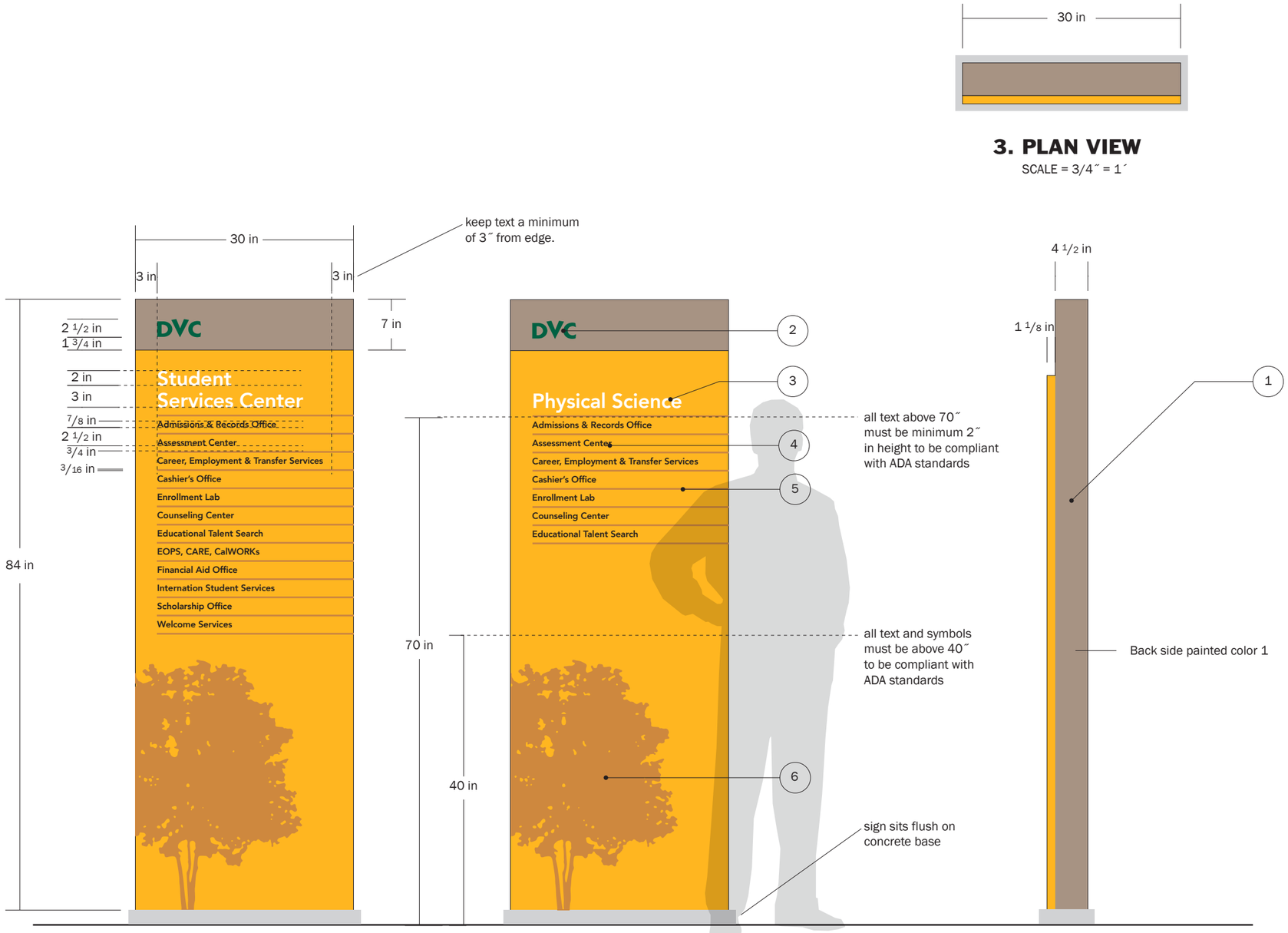
Sign is single-sided. Information is determined by location. Abbreviate department names as needed so that they remain on one line.

Sign fabricator to secure engineering as needed.

See sheet 7.0.0 for concrete base detail.

APPLICATION NOTES

The BID3 signs are to be placed adjacent to the main entrance of buildings with multiple departments inside.



1. FRONT ELEVATION
SCALE = 3/4˝ = 1´

2. SIDE ELEVATION
SCALE = 3/4˝ = 1´

3. PLAN VIEW
SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.12.0 WEIDDIAB - BID3 - Freestanding Building ID.ai

Revisions:
R1. 01-24-18 KO

BID3
Freestanding Building ID

5.12.0

DESIGN NOTES

1. Aluminum, surface and returns painted Color 13
2. Text, set in Avenir Heavy, Material B
3. Aluminum, surface and returns painted Color 6
4. Text, set in Avenir Heavy, Material A

PLACEMENT NOTES

For placement above 8 feet, use the larger version of the sign BID4.1 or BID4.2. For placement below 8 feet, use the smaller version of the sign BID4.3 or BID4.4.

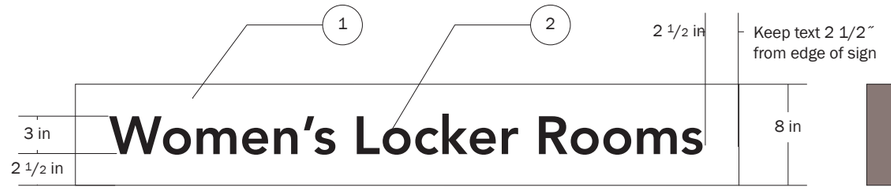
For placement on a dark background, use version BID4.1 or BID4.3. For placement on a light background, use version BID4.2 or BID4.4.

MOUNTING OPTIONS

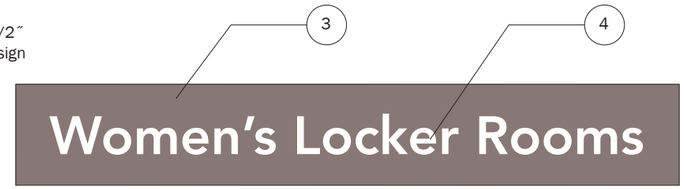
4

APPLICATION NOTES

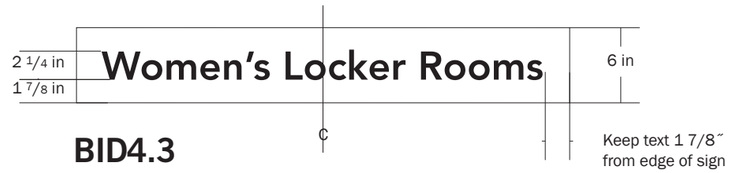
Displays the name of building, or sections within a building, where a smaller/secondary sign is needed. This is not intended to be used in place of the larger BID1 or BID2. They should be placed either above or adjacent to the entrance.



BID4.1

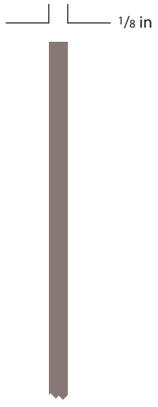


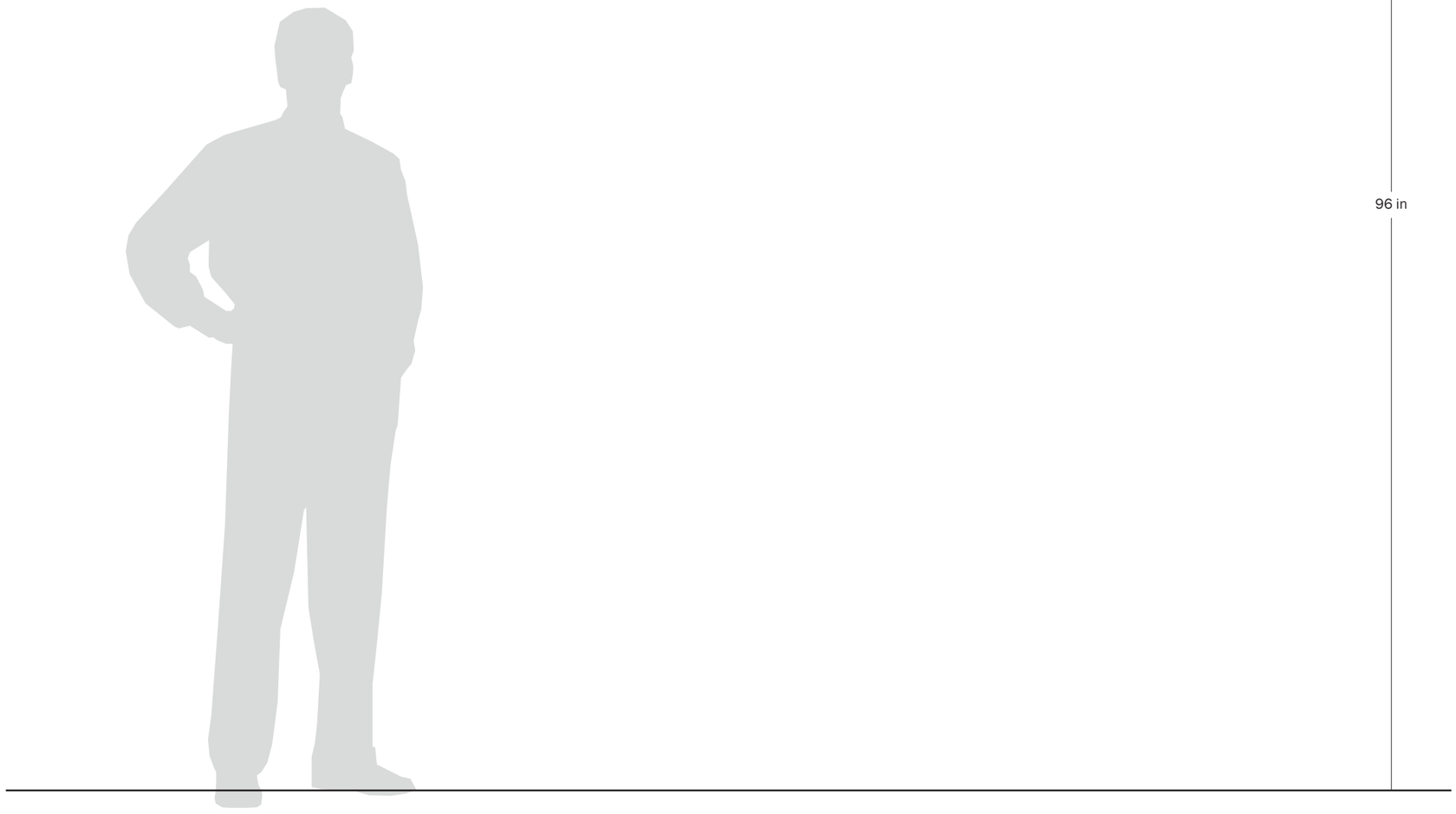
BID4.2



BID4.3

BID4.4





2. SIDE ELEVATION

SCALE = 1˝ = 1˝

1. FRONT ELEVATION

SCALE = 3/4˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: BR

DWG: 5.12.1 WEIDDIAB - BID4 - Secondary Building ID.ai

Revisions:
R1. 01-24-18 KO

BID4
Secondary Building ID

5.12.1

DESIGN NOTES

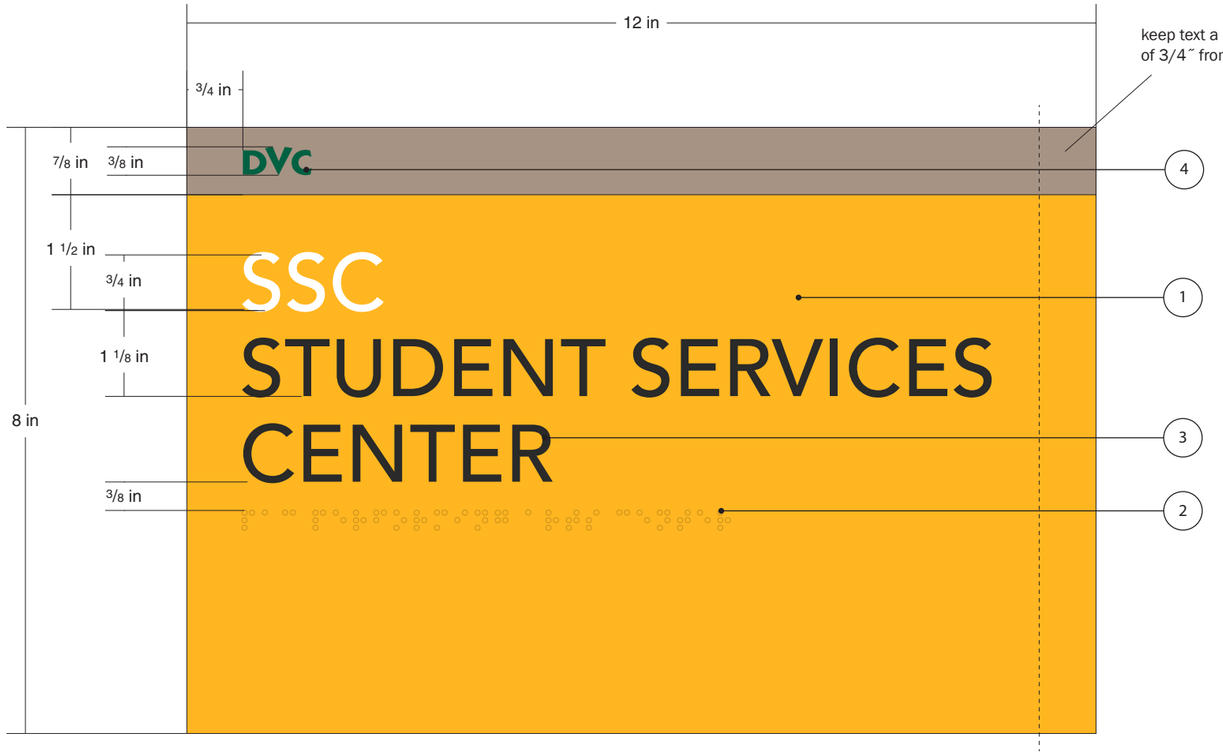
1. Zinc Plate, Surface and Returns Painted Color 1, Color 2, and Color 3.
2. Contracted Grade 2 Braille Painted Color 2
3. Tactile copy set in Avenir Medium, painted Color 11 and Color 13
4. DVC Logo, Material A, painted Color 3

MOUNTING OPTIONS

2, 4

APPLICATION NOTES

The RID1 signs are to be placed at the entrance of the building they are identifying. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.



1. FRONT ELEVATION
SCALE = 1/2˝ = 1˝

2. SIDE ELEVATION
SCALE = 1/2˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.13.0 WEIDDIAB - RID1 - Tactile Building ID.ai

Revisions:
R1. 01-24-18 KO
R2. 03-20-18 MD

RID1
Tactile Building ID

5.13.0

DESIGN NOTES

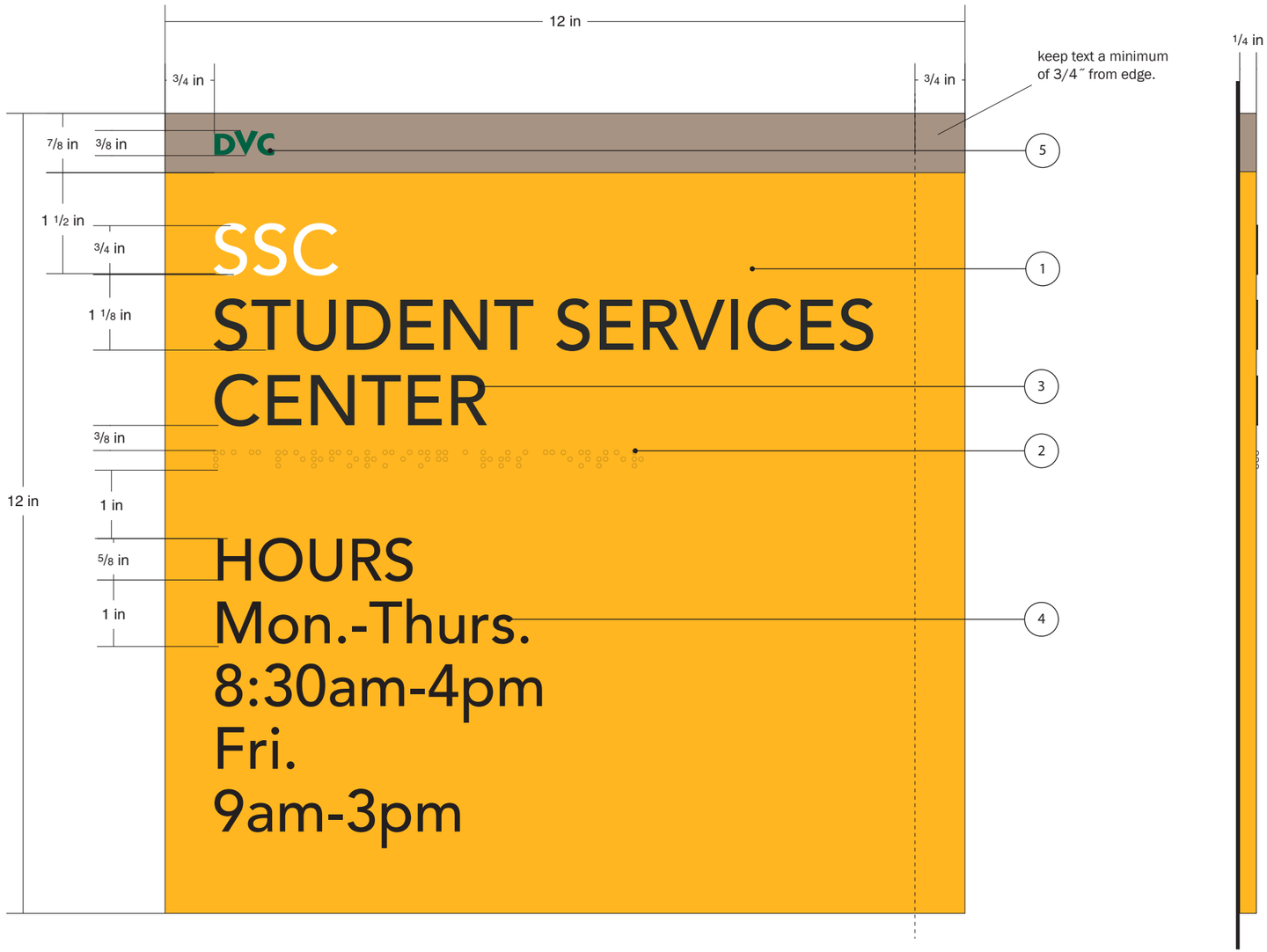
1. Zinc Plate, Surface and Returns Painted Color 1, Color 2, and Color 3.
2. Contracted Grade 2 Braille Painted Color 2
3. Tactile copy set in Avenir Medium, painted Color 11 and Color 13
4. Text, set in Avenir Medium, Material B
5. DVC Logo, Material A, painted Color 3

MOUNTING OPTIONS

2, 4

APPLICATION NOTES

The RID2 signs are to be placed at the entrance of the building they are identifying. Sign should be used when space for additional messaging, such as office hours, is needed. When additional messaging is not needed, use RID1. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.



1. FRONT ELEVATION
SCALE = 1/2˝ = 1˝

2. SIDE ELEVATION
SCALE = 1/2˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.13.1 WEIDDIAB - RID3 - Tactile Building ID w Message.ai

Revisions:
R1. 01-24-18 KO
R2. 03-20-18 MD

RID2
Tactile Building ID w/ Message

5.13.1

DESIGN NOTES

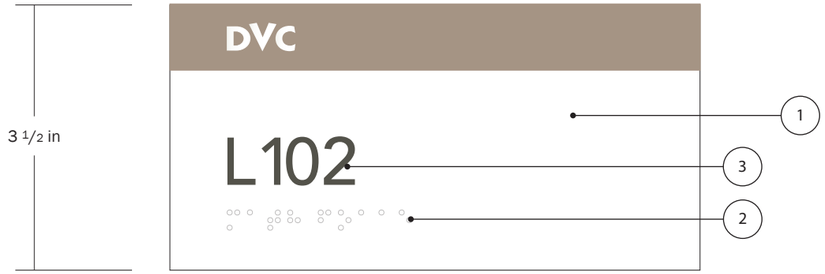
1. Zinc Plate, Surface and Returns Painted Color 13 and Color 1.
2. Contracted Grade 2 Braille Painted Color 13
3. Tactile copy set in Avenir Medium, painted Color 10
4. Optional BALT Tackless Paper Holder(cut to sign width) for holding room notices

MOUNTING OPTIONS

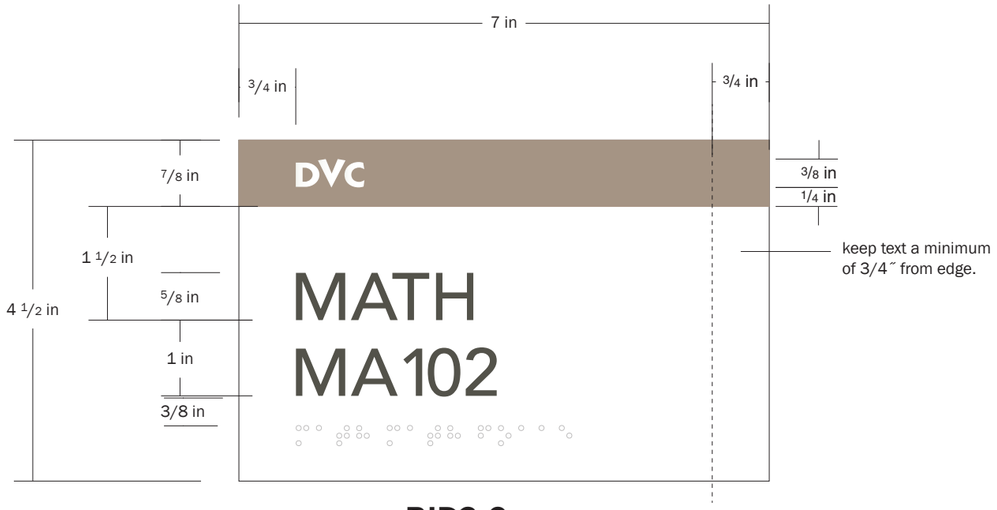
2, 4

APPLICATION NOTES

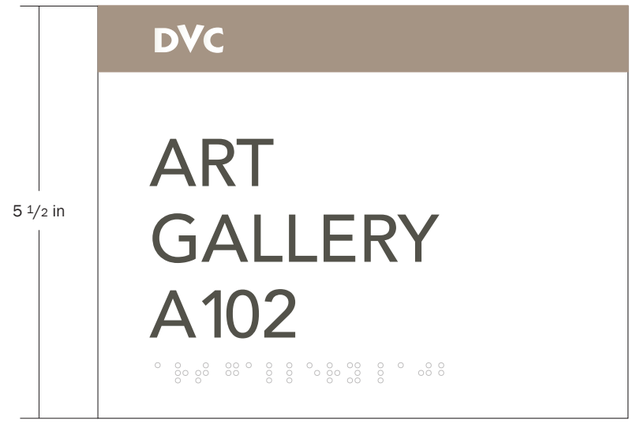
The RID3 signs are to be placed at the entrance of the rooms/spaces they are identifying. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.



RID3.1



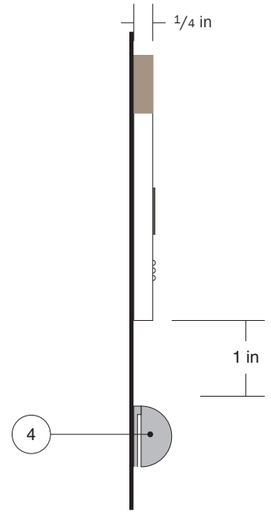
RID3.2



RID3.3

1. FRONT ELEVATION

SCALE = 1/2˝ = 1˝



2. SIDE ELEVATION

SCALE = 1/2˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 1-15-18
Drawn By: MD

DWG: 5.14.0 WEIDDIAB - RID3 - Tactile Classroom Suite ID.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

RID3
Tactile Classroom Suite ID

5.14.0

DESIGN NOTES

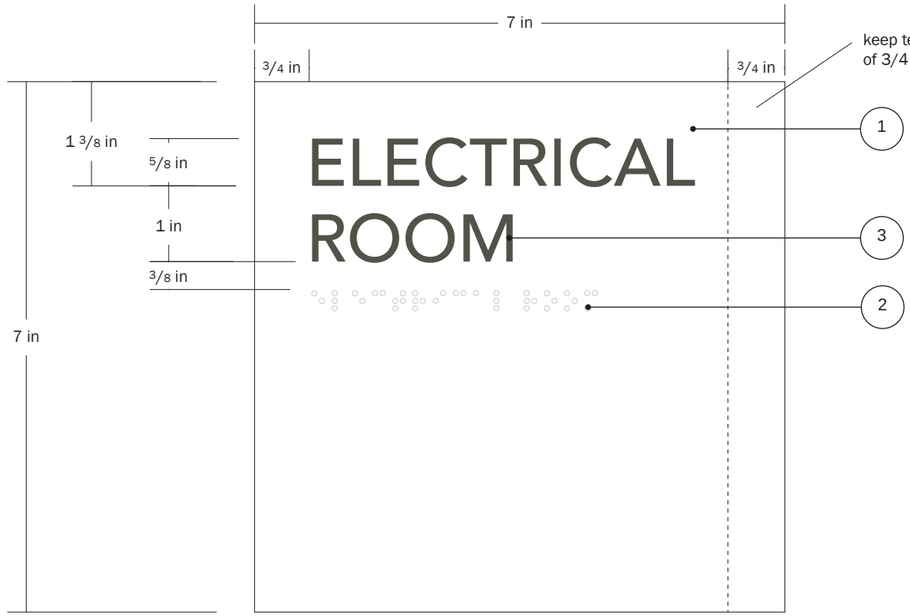
1. Zinc Plate, Surface and Returns Painted Color 13
2. Contracted Grade 2 Braille Painted Color 13
3. Tactile copy set in Avenir Medium, painted Color 10

MOUNTING OPTIONS

2, 4

APPLICATION NOTES

The RID4 signs are to be placed adjacent to the item they are identifying. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.



1. FRONT ELEVATION

SCALE = 1/2˝ = 1˝

2. SIDE ELEVATION

SCALE = 1/2˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 1-15-18
Drawn By: SW

DWG: 5.15.0 WEIDDIAB - RID4 - Tactile Room ID.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

RID4
Tactile Room ID

5.15.0

DESIGN NOTES

1. Aluminum, all sides painted Color 14
2. Text, set in Avenir Heavy, Material A
3. Corners rounded to 1/2″ radius
4. Text, set in Highway Gothic Condensed Regular, Material A

FABRICATION NOTES

Sign height and width varies based on text allowing for flexibility within the system and the spaces.

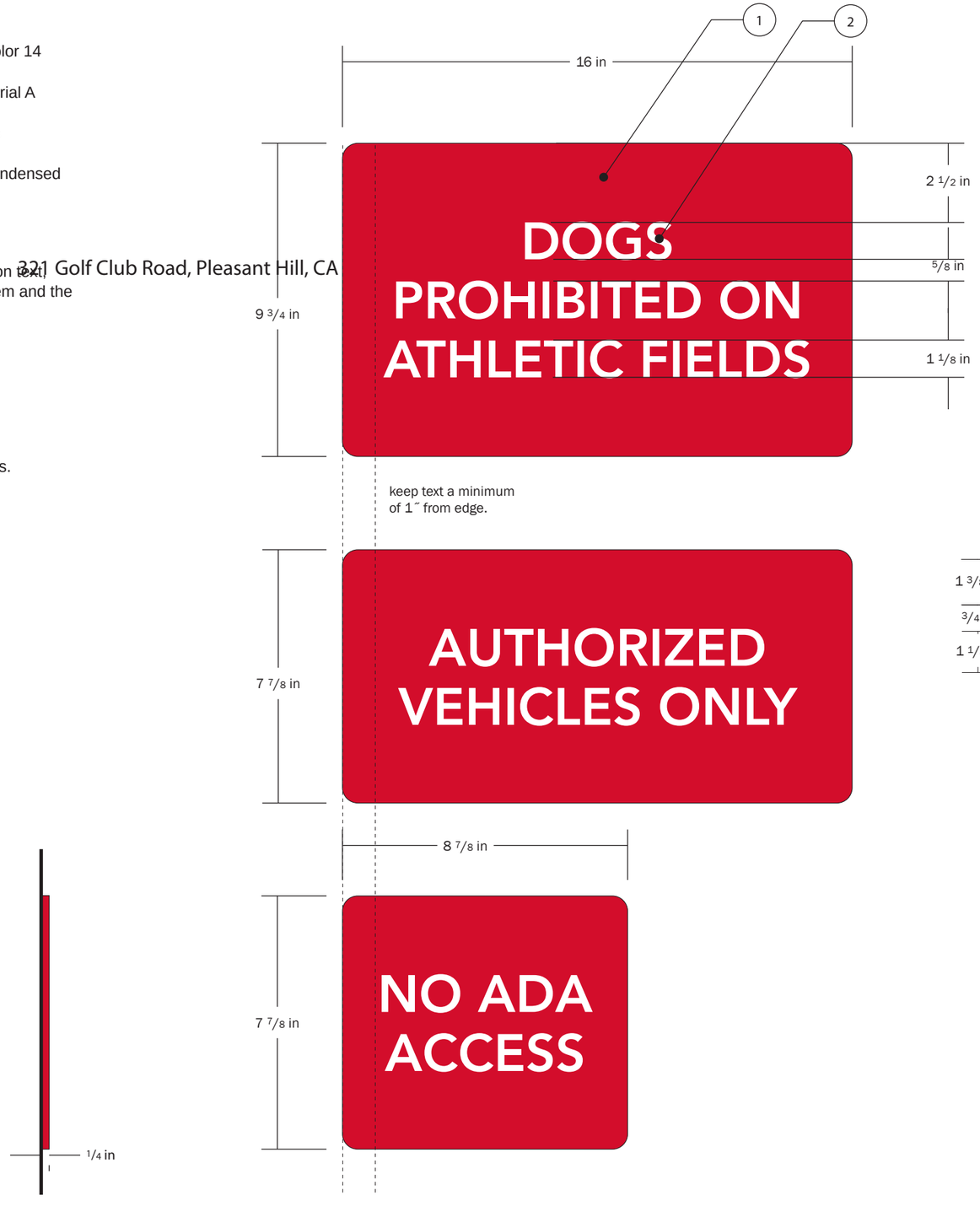
MOUNTING OPTIONS

3, 4, 5

APPLICATION NOTES

Use this sign for all prohibited actions.

321 Golf Club Road, Pleasant Hill, CA



2. SIDE ELEVATION
SCALE = 3″ = 1′

1. ELEVATION
SCALE = 3″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: BR

DWG: 5.16.0 WEIDDIAB - INFO1 - Pedestrian Information 1.ai

Revisions:
R1. 01-24-18 KO

INFO1
Pedestrian
Information 1

5.16.0

DESIGN NOTES

1. Aluminum, all surfaces painted Color 6
2. Text, set in Avenir Heavy, Material A
3. Corners rounded to 1/2″ radius
4. Circle symbol with cut out arrow, Material A
5. Aluminum all surfaces painted color 13
6. Text, set in Avenir Heavy, Material F
7. Symbol, Material F

FABRICATION NOTES

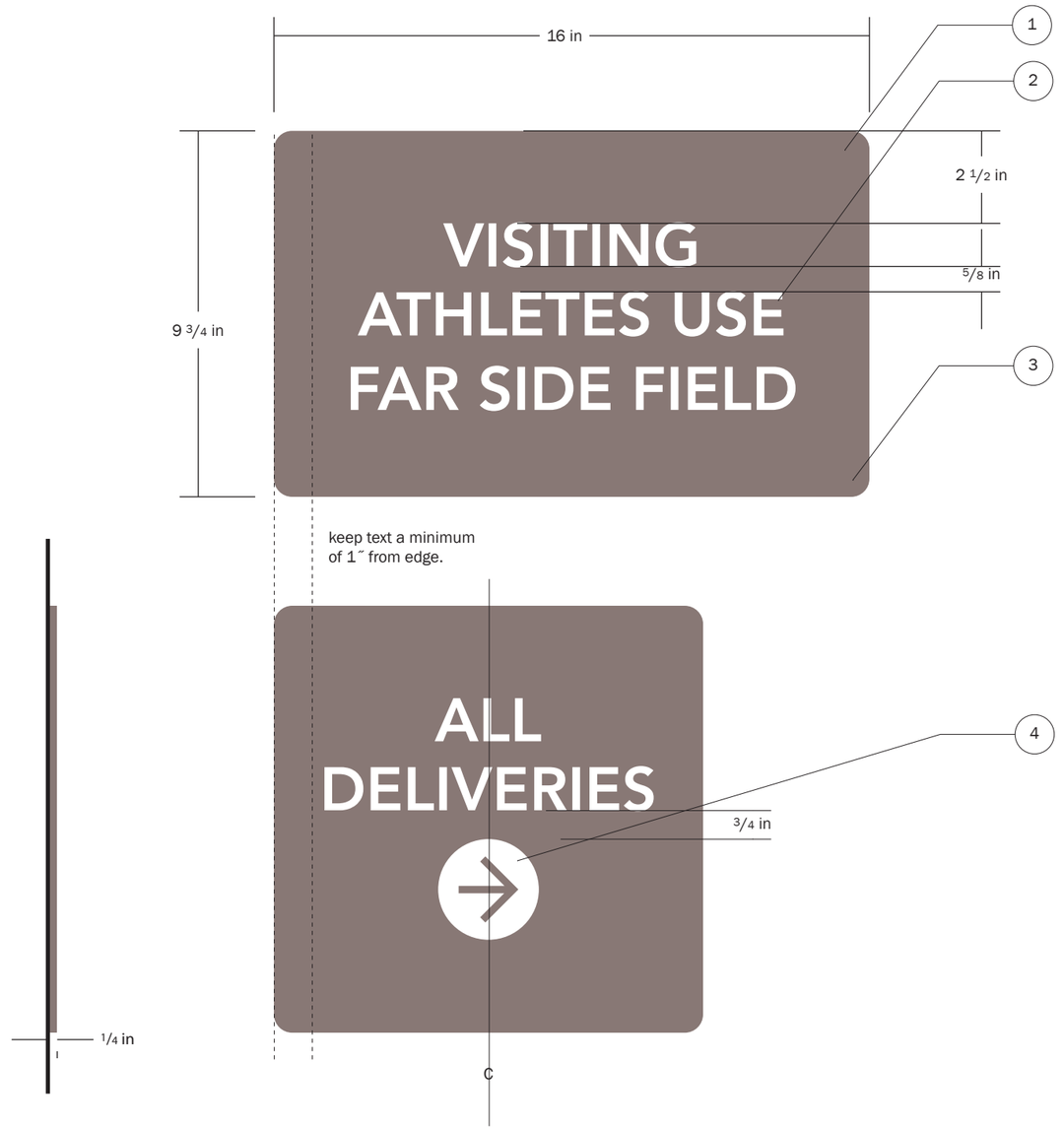
Sign height and width varies based on text allowing for flexibility within the system and the spaces.

MOUNTING OPTIONS

3, 4, 5

APPLICATION NOTES

Use this sign for general information. Either sign color can be used, provided there is ample contrast with it's placement.



2. SIDE ELEVATION
SCALE = 3″ = 1′

1. ELEVATION
SCALE = 3″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: BR

DWG: 5.17.0 WEIDDIAB - INFO2 - Pedestrian Information 2.ai

Revisions:
R1. 01-24-18 KO

INFO2
Pedestrian
Information 2

5.17.0

DESIGN NOTES

1. Aluminum with Material J
2. Material B or Material I depending on usage refer to CA MUTCD Section 2A.14.
3. Text set in Highway Gothic Regular Material B or Material I depending on usage refer to CA MUTCD Section 2A.14.
4. Text set in Highway Gothic Condensed Regular Material B or Material I depending on usage refer to CA MUTCD Section 2A.14.
5. Corners rounded to 1/2˝ radius.

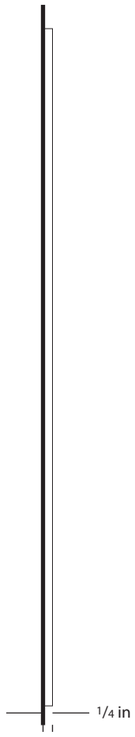
MOUNTING OPTIONS

3, 4, 5

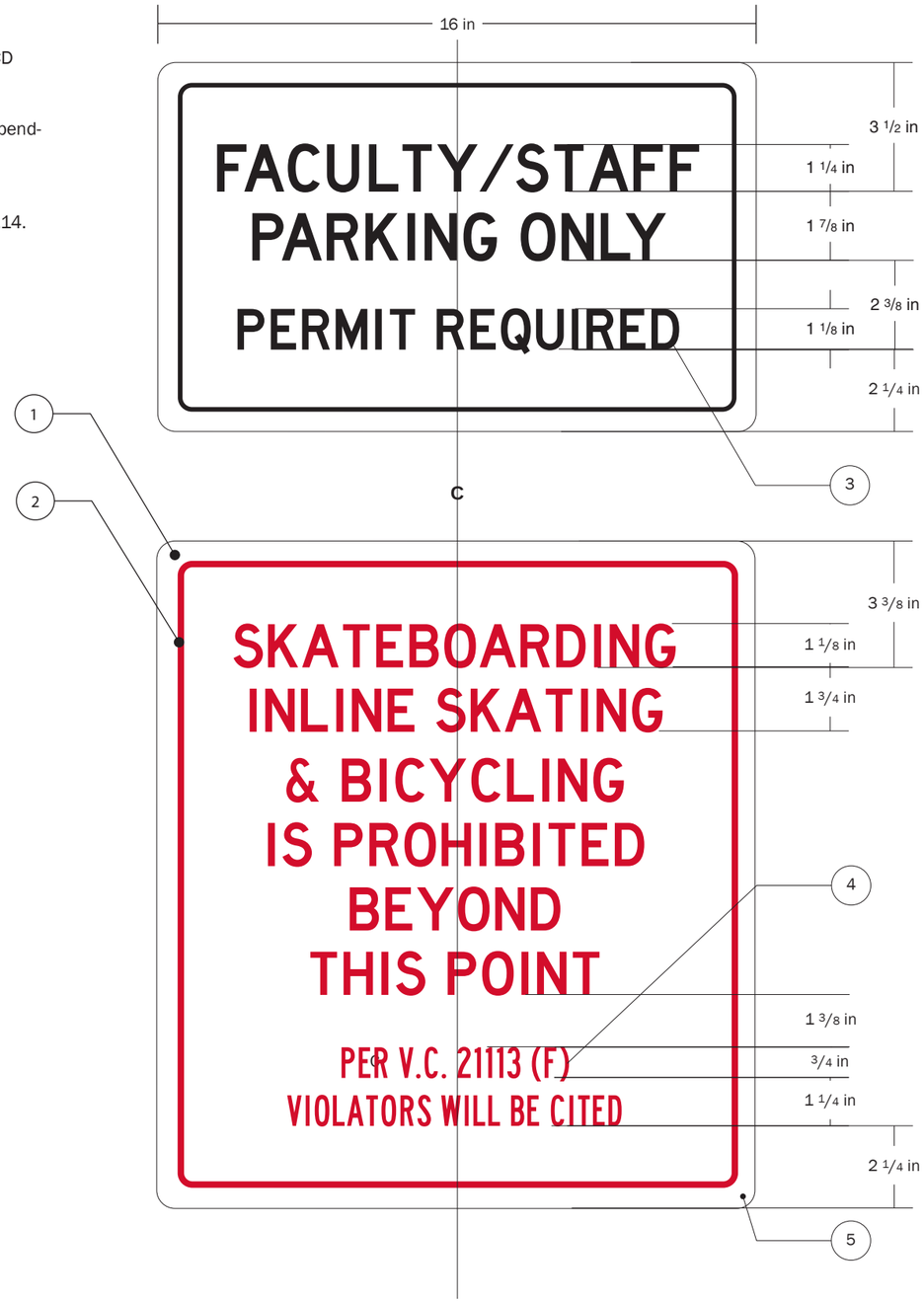
APPLICATION NOTES

Use this sign type for communication in parking lots and roadways.

Use signage guidelines for California Manual on Uniform Traffic Control Devices (CA MUTCD) Section 2A.14 for fabrication guidelines.



2. SIDE ELEVATION
SCALE = 3˝ = 1´



1. ELEVATION
SCALE = 3˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: BR

DWG: 5.18.0 WEIDDIAB - INFO3 - Pedestrian Information 3.ai

Revisions:
R1. 01-24-18 KO

INFO3
Pedestrian Information 3

5.18.0

DESIGN NOTES

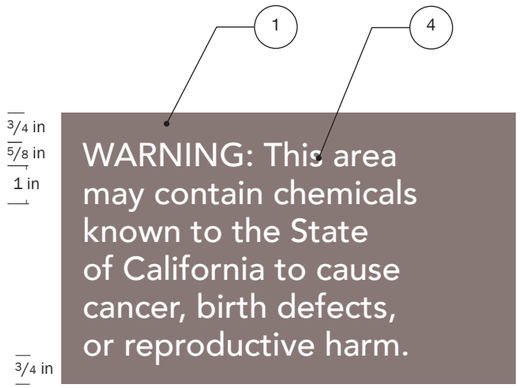
1. Acrylic Surface and Returns Painted Color 6
2. Acrylic Surface and Returns Painted Color 5
3. Acrylic Surface and Returns Painted Color 14
4. Text, set in Avenir Medium, Material A
5. Accessibility symbol, Material A
6. No smoking symbol, Material A

MOUNTING OPTIONS

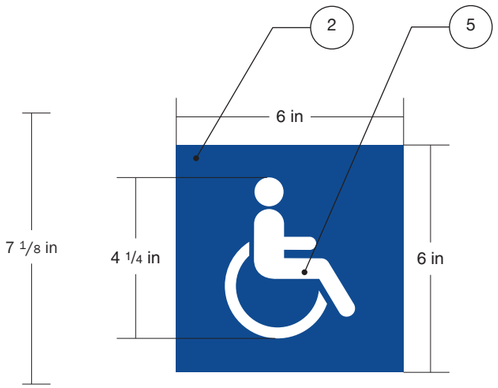
1, 2

APPLICATION NOTES

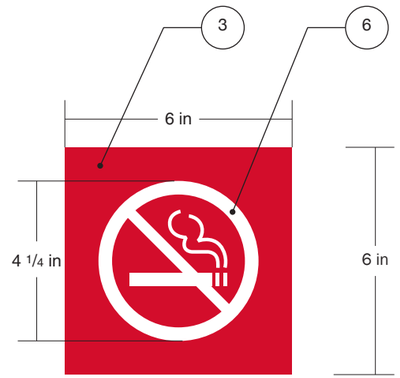
The EVI sign placement shall comply with Title 27 of the California Code of Regulations. Signs should at minimum be placed at the primary entrance. These signs can be used either separately or in the supplied lockup.



EVI.1



EVI.2



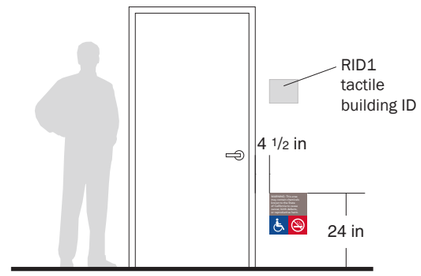
EVI.3

2. LOCKUP ELEVATION

SCALE = 1/4˝ = 1˝

3. LOCKUP SIDE ELEVATION

SCALE = 1/4˝ = 1˝



4. LOCATION DIAGRAM

SCALE = 1/4˝ = 1´

1. FRONT ELEVATION

SCALE = 1/4˝ = 1˝

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.19.0 WEIDDIAB - EVI - Entry Door Prop 65.ai

Revisions:
R1. 01-24-18 KO

EVI

Entry Door Prop 65

5.19.0

DESIGN NOTES

1. Aluminum Painted Color 5 and Color 13 with Reflective Coating, with 1/8″ radius rounded corners
2. Round Galvanized Steel Pole with Press on Cap
3. Symbol and text, set in Highway Gothic Condensed Regular, color 13

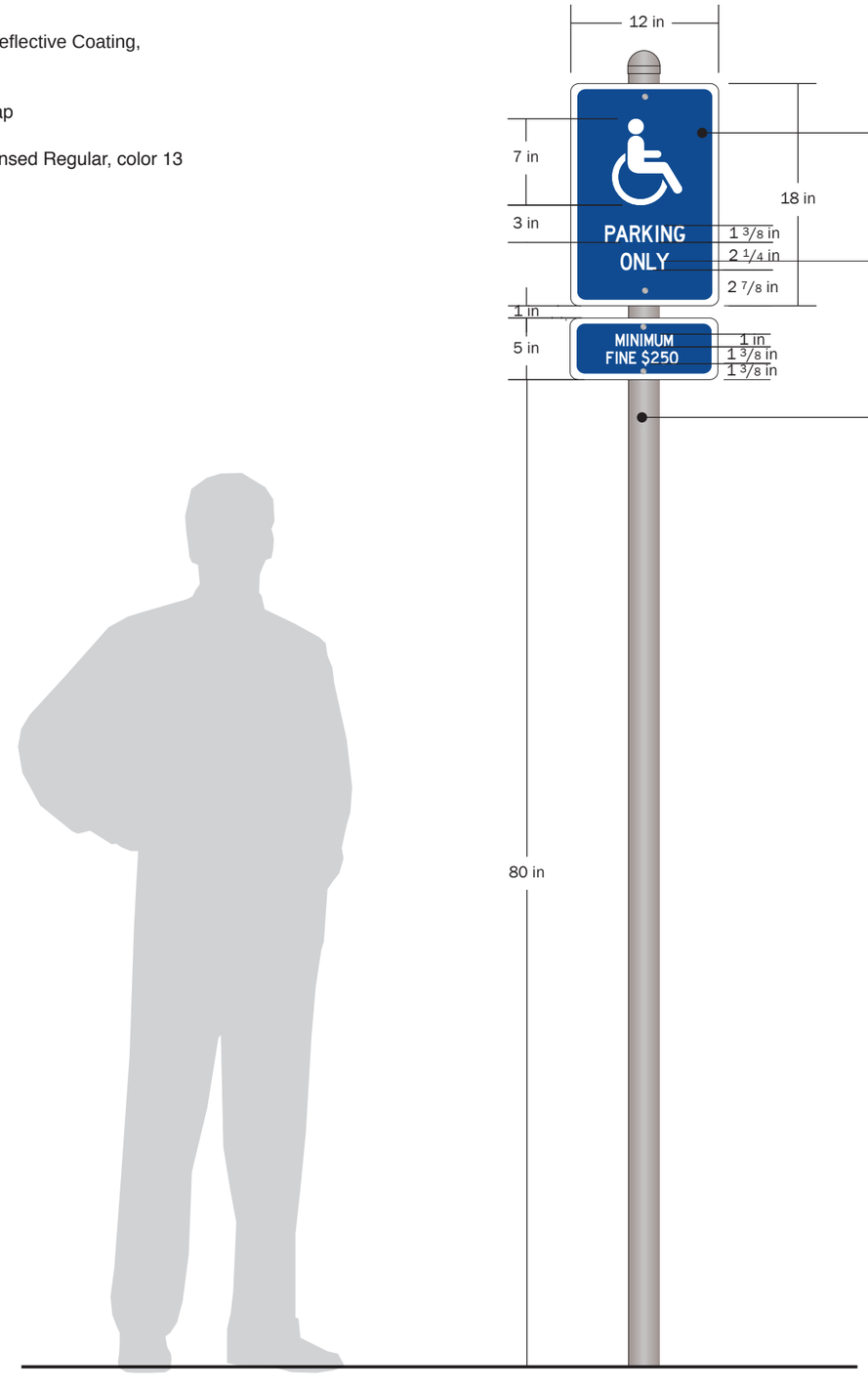
FABRICATION NOTES

Sign is one-sided.

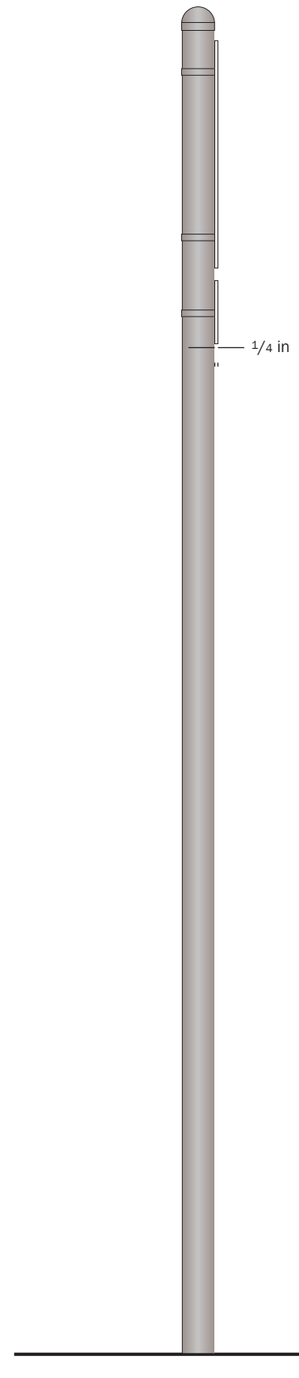
Sign fabricator to secure engineering as needed.

APPLICATION NOTES

The PKG signs are to identify accessible parking spaces.



1. ELEVATION
SCALE = 1″ = 1′



2. SIDE ELEVATION
SCALE = 1″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.20.0 WEIDDIAB - PKG - Accessible Parking ID.ai

Revisions:
R1. 01-24-18 KO

PKG
Accessible Parking ID

5.20.0

DESIGN NOTES

1. Aluminum Painted Color 5 and Color 13 with Reflective Coating, with 1/8″ radius rounded corners
2. Round Galvanized Steel Pole with Press on Cap
3. Accessibility symbol and text, set in Highway Gothic Condensed Regular, painted Color 13 with Relfective Coating

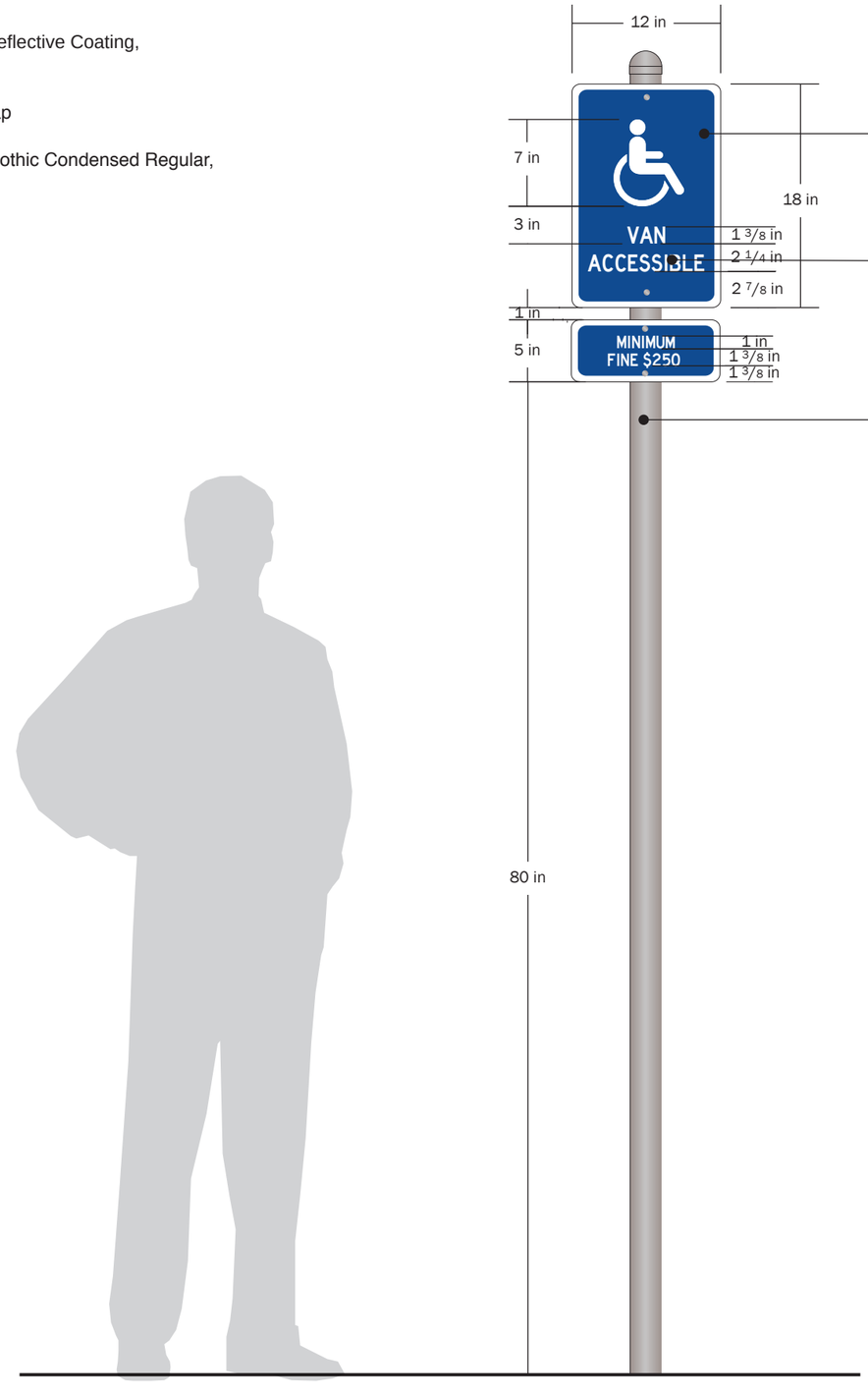
FABRICATION NOTES

Sign is one-sided.

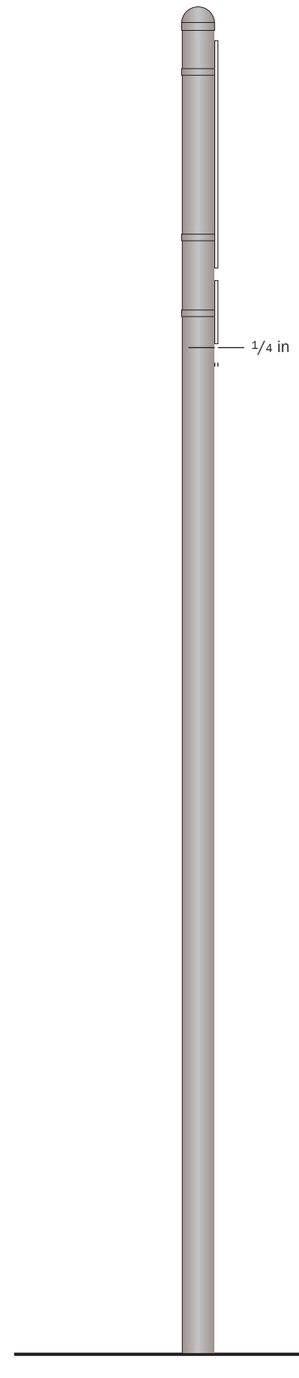
Sign fabricator to secure engineering as needed.

APPLICATION NOTES

The PKG-V signs are to identify van accessible spaces.



1. ELEVATION
SCALE = 1″ = 1′



2. SIDE ELEVATION
SCALE = 1″ = 1′

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.21.0 WEIDDIAB - PKG-V - Van-Accessible Parking ID.ai

Revisions:
R1. 01-24-18 KO

PKG-V
Van-Accessible Parking ID

5.21.0

DESIGN NOTES

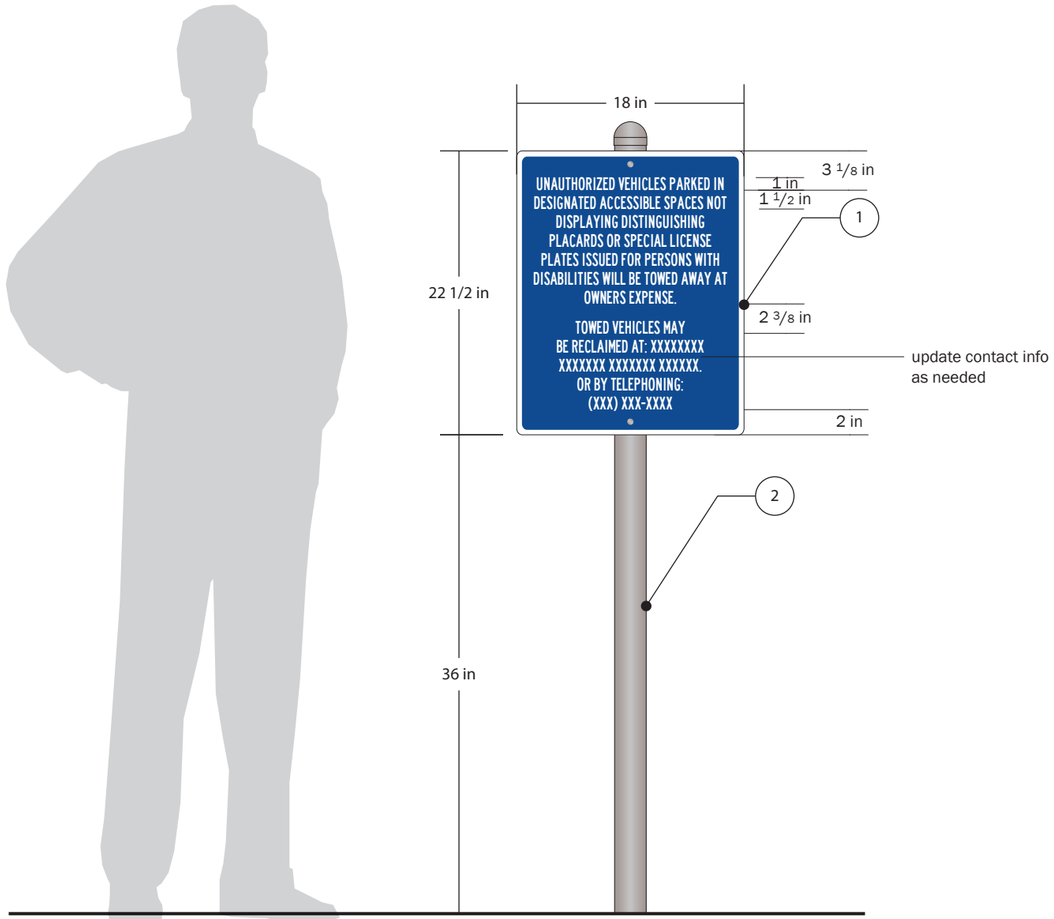
1. Aluminum Painted Color 13 and Color 5 with Reflective Coating, with 1/8″ radius rounded corners
2. Round Galvanized Steel Pole with Press on Cap
3. Text, set in Highway Gothic Condensed Regular, painted Color 13 with Relfective Coating

FABRICATION NOTES

Sign is one-sided.

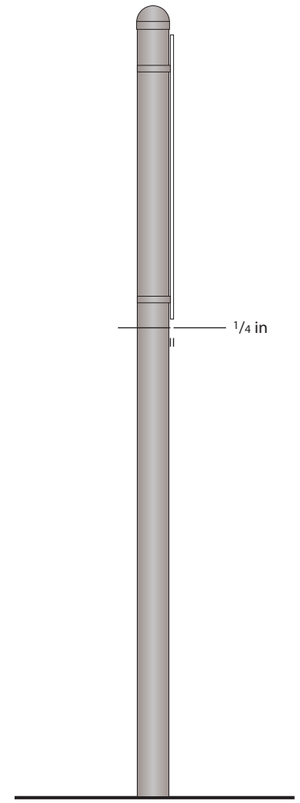
APPLICATION NOTES

The PKG-R signs are to be placed within the vicinity of accessible spaces.



1. ELEVATION

SCALE = 1˝ = 1´



2. SIDE ELEVATION

SCALE = 1˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.22.0 WEIDDIAB - PKG-R - Parking Lot Regulations.ai

PKG-R
Parking Lot Regulations

5.22.0

DESIGN NOTES

1. Aluminum Painted Color 5 and Color 13 with Reflective Coating, with 1/8″ radius rounded corners
2. Accessibility symbol and arrow, painted Color 13 with Reflective Coating
3. Round Galvanized Steel Pole with Press on Cap

FABRICATION NOTES

Sign is one-sided.

MOUNTING OPTIONS

3, 4

APPLICATION NOTES

The ACC-P signs are to identify accesible paths.

ACC-P.1

ACC-P.2

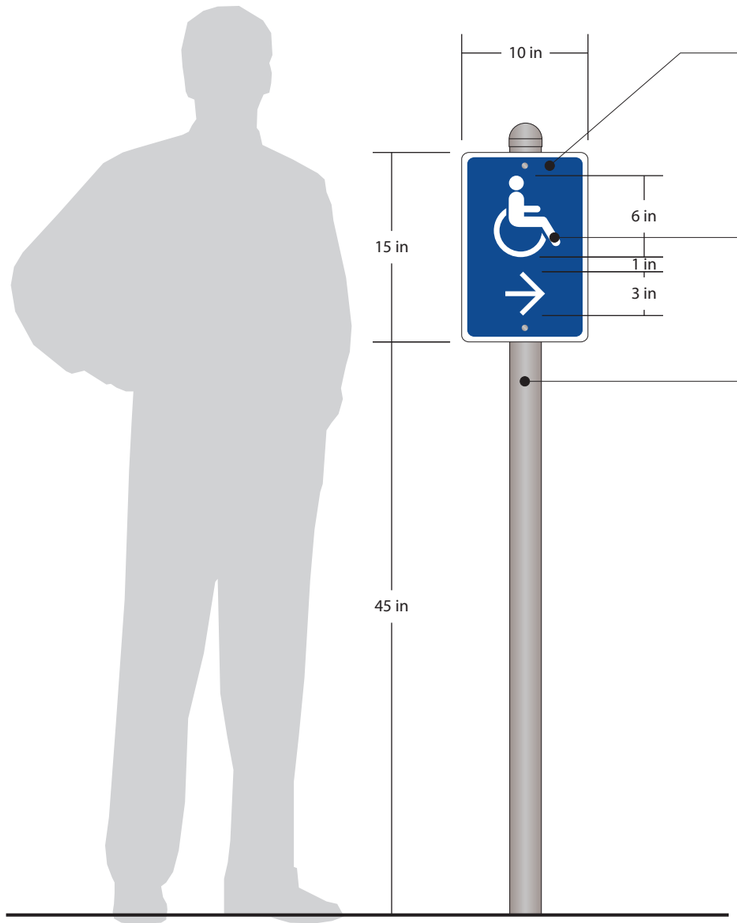
ACC-P.3

ACC-P.4

ACC-P.5

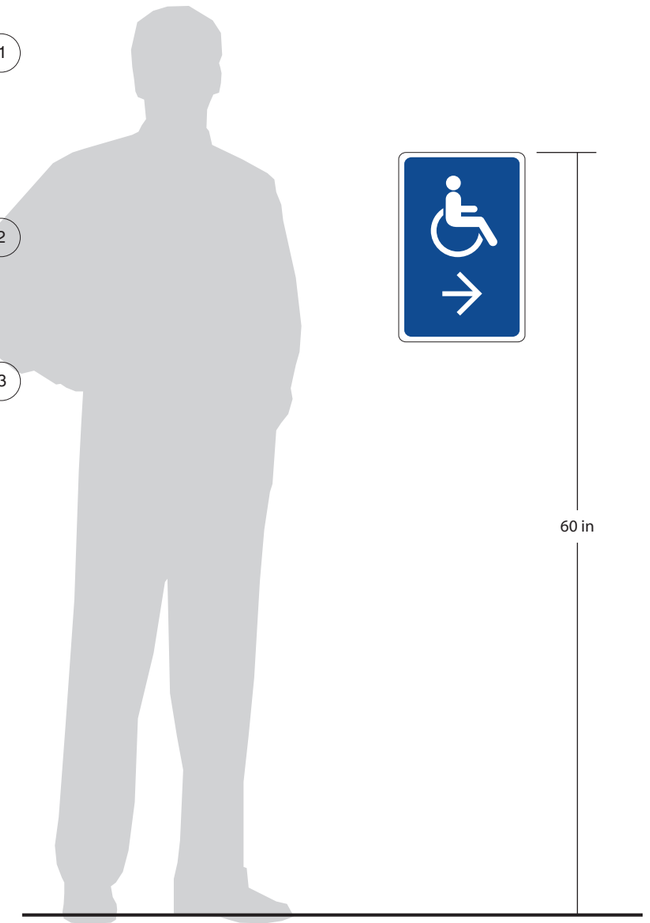
3. VERSIONS

SCALE = 1˝ = 1´



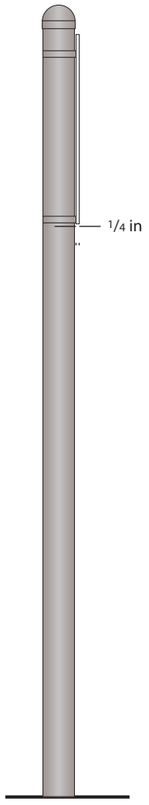
1. ELEVATION POLE

SCALE = 1˝ = 1´



2. ELEVATION WALL

SCALE = 1˝ = 1´



4. SIDE ELEVATION

SCALE =1˝ = 1´

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: SW

DWG: 5.23.0 WEIDDIAB - ACC-P - Accessible Path Directional.ai

Revisions:
R1. 01-24-18 KO

ACC-P
Accessible Path Directional

5.23.0

DESIGN NOTES

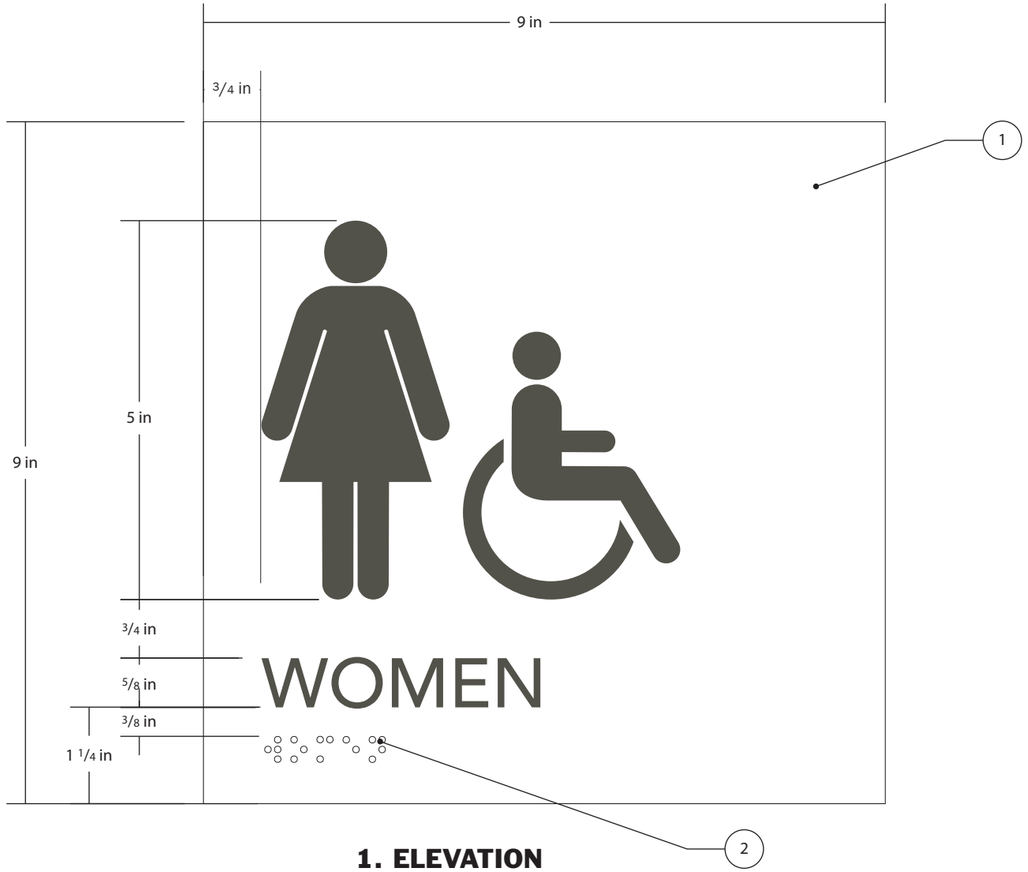
1. Zinc Plate, Surface and Returns Painted Color 13, With Tactile Copy and Symbols Painted Color 10
2. Contracted Grade 2 Braille Painted Color 13

MOUNTING OPTIONS

4

APPLICATION NOTES

The RADA signs are to identify restrooms. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.



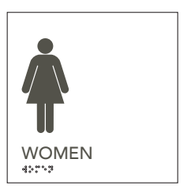
1. ELEVATION
SCALE = 1/2˝ = 1˝

2. SIDE ELEVATION
SCALE = 1/2˝ = 1˝

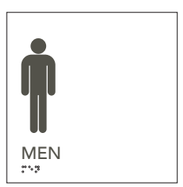
RADA.1

RADA.2

RADA.3



RADA.4



RADA.5

RADA.6

3. VERSIONS
SCALE = 1/8˝ = 1˝

Use RADA.4, RADA.5 and RADA.6 for non-accessible restrooms. Pair with REST-W.

DVC
DIABLO VALLEY COLLEGE

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Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.24.0 WEIDDIAB - RADA - Strike Side Tactile Restroom ID.ai

Revisions:
R1. 01-24-18 KO

RADA
Strike Side Tactile Restroom ID

5.24.0

DESIGN NOTES

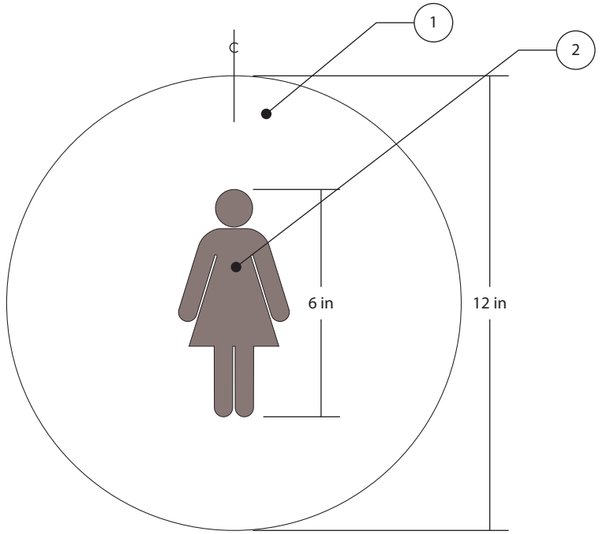
1. Acrylic Panel Surface and Returns Painted Color 13
2. Surface applied silk screened symbol, Color 6
3. Acrylic Panel Surface and Returns Painted Color 6
4. Surface applied silk screened symbols, Color 13
5. 1/8″ radius rounded corners

MOUNTING OPTIONS

1

APPLICATION NOTES

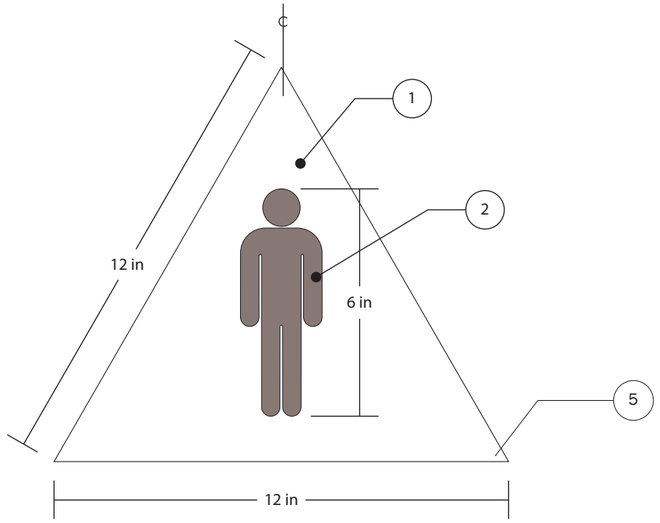
T24 signs identify restrooms, and are to be placed on the door leading into the space. T24.4-T24.6 are for use on light colored doors, colors on sign are reversed.



T24.1

1. WOMEN'S ELEVATION

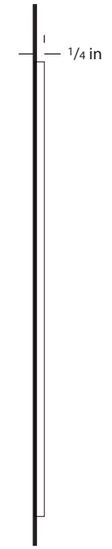
SCALE = 1/4″ = 1″



T24.2

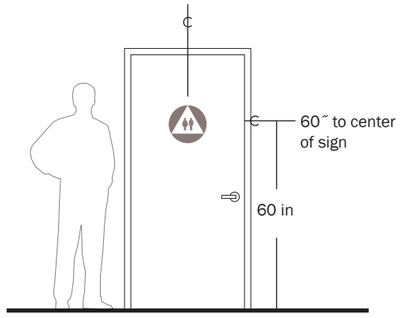
2. MEN'S ELEVATION

SCALE = 1/4″ = 1″



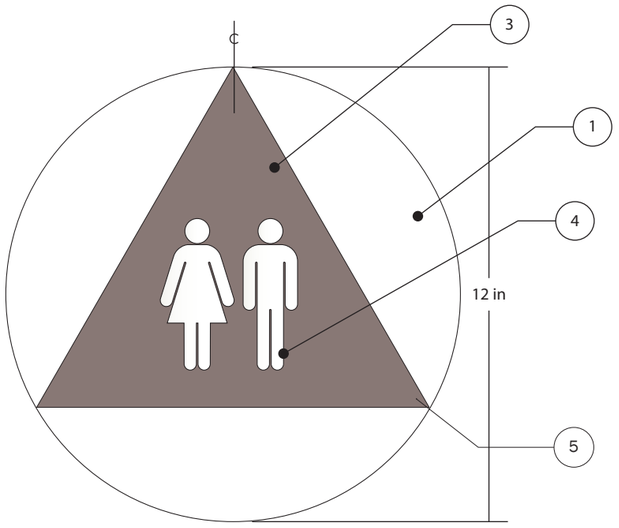
3. SIDE ELEVATION

SCALE = 1/4″ = 1″



7. LOCATION DIAGRAM

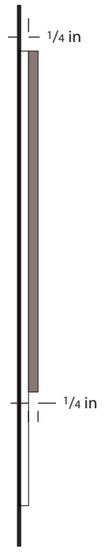
SCALE = 1/4″ = 1″



T24.3

4. UNISEX ELEVATION

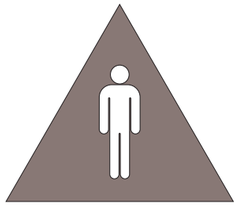
SCALE = 1/4″ = 1″



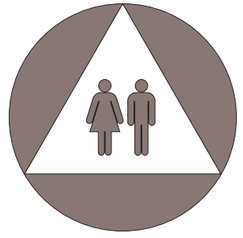
5. UNISEX SIDE ELEVATION

SCALE = 1/4″ = 1″

T24.4



T24.5



T24.6

6. VERSIONS

SCALE = 1/4″ = 1″

DVC
DIABLO VALLEY COLLEGE

Project:
Diablo Valley College Wayfinding
321 Golf Club Rd, Pleasant Hill, CA 94523

Client:
Diablo Valley College

Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: MD

DWG: 5.25.0 WEIDDIAB - T24 - On Door Restroom ID.ai

Revisions:
R1. 01-24-18 KO

T24
On Door Restroom ID

5.25.0

DESIGN NOTES

1. Acrylic panel, surface and returns painted Color 5
2. Surface applied silk screened Avenir Medium text and icons, Color 13

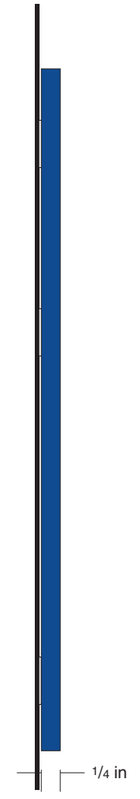
MOUNTING OPTIONS

1

APPLICATION NOTES

The REST-W signs are to be placed adjacent to restrooms that are not accessible. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.

1. ELEVATION
SCALE = 1/2" = 1"



2. SIDE ELEVATION
SCALE = 1/2" = 1"

DVC
DIABLO VALLEY COLLEGE

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Issued: 6-28-17
Drawn By: MD

DWG: 5.26.0 WEIDDIAB - REST-W - Restroom Directional.ai

Revisions:
R1. 01-24-18 KO

REST-W
Restroom Directional

5.26.0

DESIGN NOTES

1. Acrylic panel, surface and returns painted Color 5
2. Surface applied silk screened Avenir Medium text and icons, Color 13

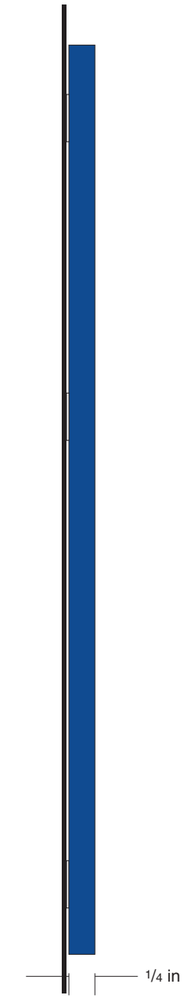
MOUNTING OPTIONS

1

APPLICATION NOTES

The ELV1 signs are to be placed adjacent to elevators. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.

1. ELEVATION
SCALE = 1/2" = 1"



2. SIDE ELEVATION
SCALE = 1/2" = 1"

DVC
DIABLO VALLEY COLLEGE

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Designer:
WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: SW

DWG: 5.27.0 WEIDDIAB - ELV1 - Elevator Accessibility.ai

Revisions:
R1. 01-24-18 KO

ELV1
Elevator Accessibility

5.27.0

DESIGN NOTES

1. Acrylic panel surface and returns painted Color 14

2. Surface applied silk screened text, set in Avenir Medium and icon, color 13

MOUNTING OPTIONS

1

APPLICATION NOTES

The ELV2 signs are to be placed adjacent to elevators. Refer to Sheet 4.0.0 and 6.0.0 for placement and mounting details.

1. ELEVATION
SCALE = 1/2˝ = 1˝

2. SIDE ELEVATION
SCALE = 1/2˝ = 1˝

DVC
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WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 6-28-17
Drawn By: KO

DWG: 5.28.0 WEIDDIAB - ELV2 - Elevator In Case of Fire.ai

Revisions:
R1. 01-24-18 KO

ELV2
Elevator In Case of Fire

5.28.0

DESIGN NOTES

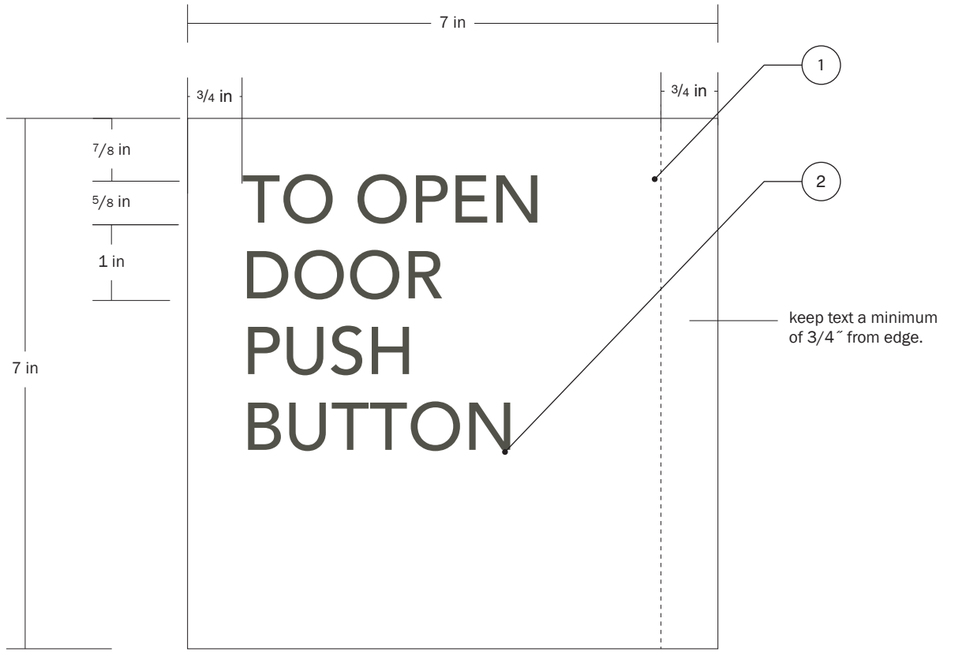
1. Acrylic panel, surface and returns painted Color 13
2. Surface applied silk screened Avenir Medium text and icons, Color 10

MOUNTING OPTIONS

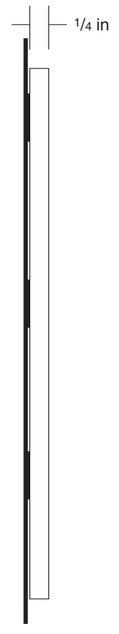
1, 2

APPLICATION NOTES

The AUTO signs are to be placed near the door to which an automatic door button will open.



1. FRONT ELEVATION
SCALE = 1/2˝ = 1˝



2. SIDE ELEVATION
SCALE = 1/2˝ = 1˝

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WeidnerCA/FUEL Creative Group

Work Order:
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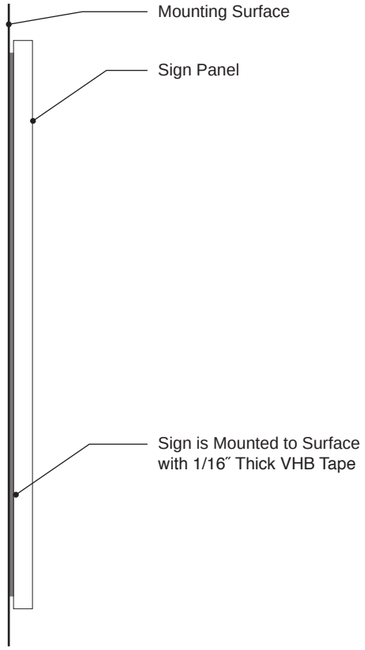
Issued: 6-28-17
Drawn By: SW

DWG: 5.29.0 WEIDDIAB - AUTO - Automatic Door Sign.ai

Revisions:
R1. 01-24-18 KO
R2. 03-21-18 MD

AUTO
Automatic Door Sign

5.29.0

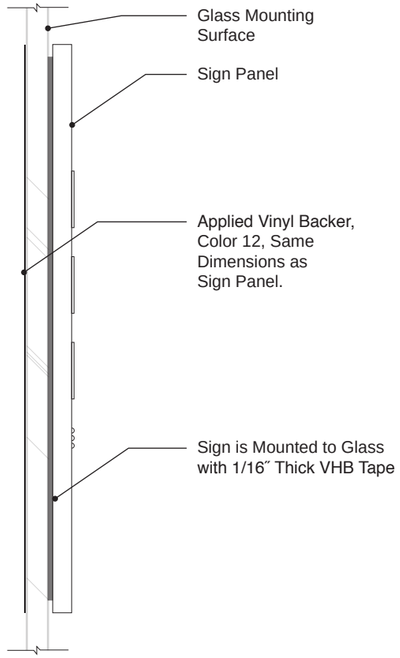


1. MOUNTING TYPE 1

WALL MOUNTED WITH VHB TAPE

SCALE = 1/2˝ = 1´

Use for acrylic or lightweight signs mounted to walls.

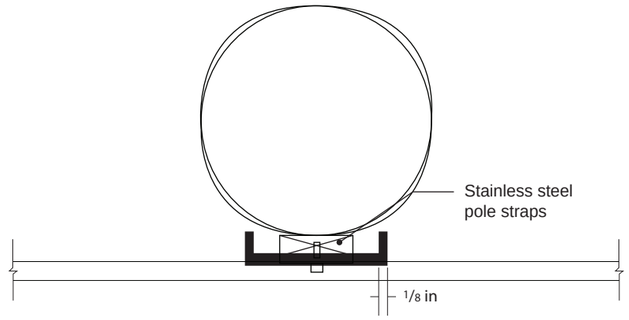


2. MOUNTING TYPE 2

GLASS MOUNTED WITH VHB TAPE & VINYL BACKER

SCALE = 1/2˝ = 1´

Use for signs mounted on glass.

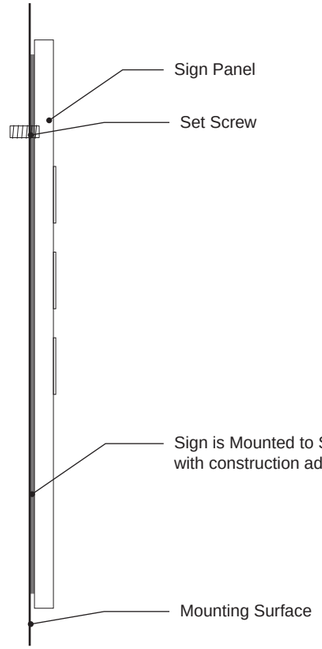


3. MOUNTING TYPE 3

POLE MOUNTED

SCALE = 1/2˝ = 1´

Use for signs mounted on round poles. Diameter of pole varies.



4. MOUNTING TYPE 4

BUILDING WALL MOUNTED

SCALE = 1/2˝ = 1´

Use for zinc signs or signs made from heavier materials, mounted to walls. Set screw helps prevent sagging.

Mounting hardware determined by sign fabricator

5. MOUNTING TYPE 5

CHAIN LINK FENCE MOUNTING

SCALE = 1/2˝ = 1´

Use for signs mounted on chain link fences.

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WeidnerCA/FUEL Creative Group

Work Order:
Est. No:
Issued: 1-15-18
Drawn By: SW

DWG: 6.0.0 WEIDDIAB - MOUNT1 - Sign Mounting Details.ai

Revisions:

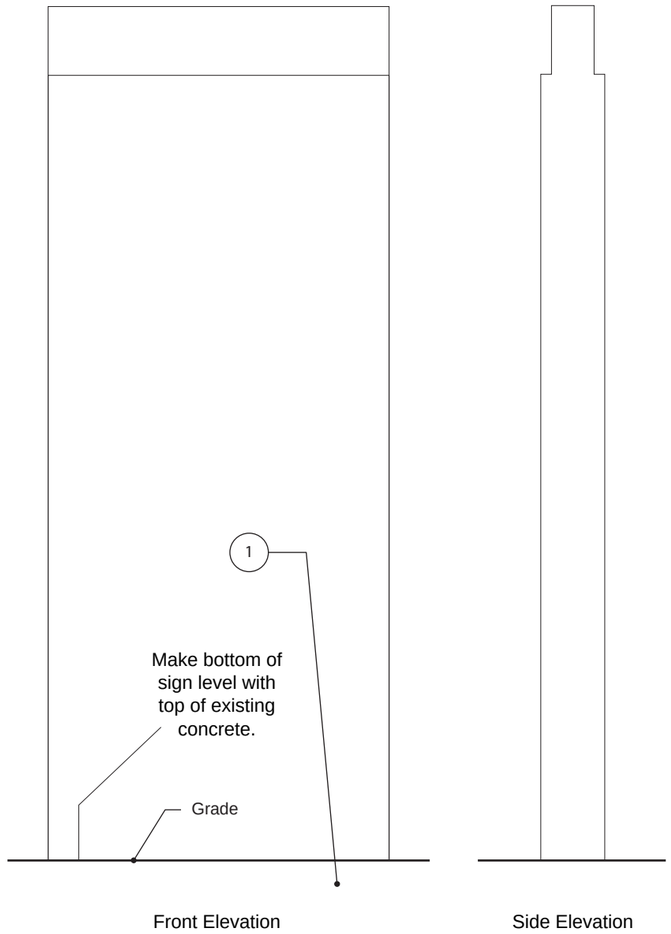
R2. 03-21-18 MD

MOUNT1
Sign Mounting Details

6.0.0

DESIGN NOTES

1. Trowel finished concrete base.

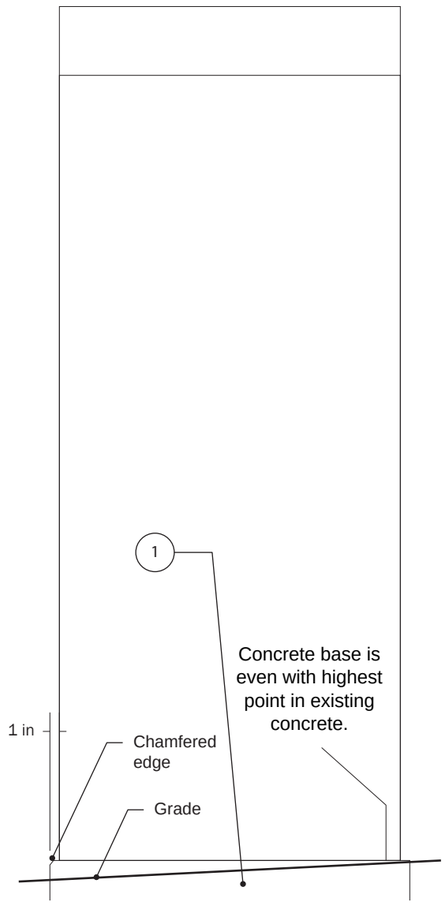


Front Elevation

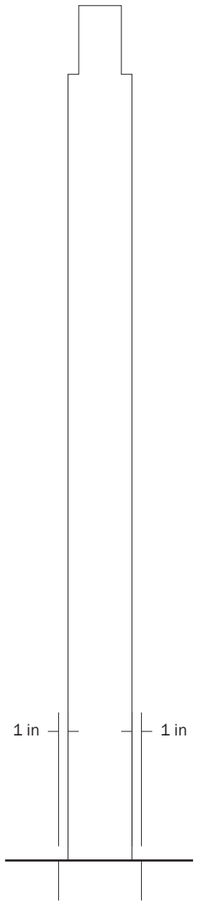
Side Elevation

1. CONCRETE BASE DETAIL
WHEN PLACED ON LEVEL CONCRETE

SCALE = 3/4˝ = 1´



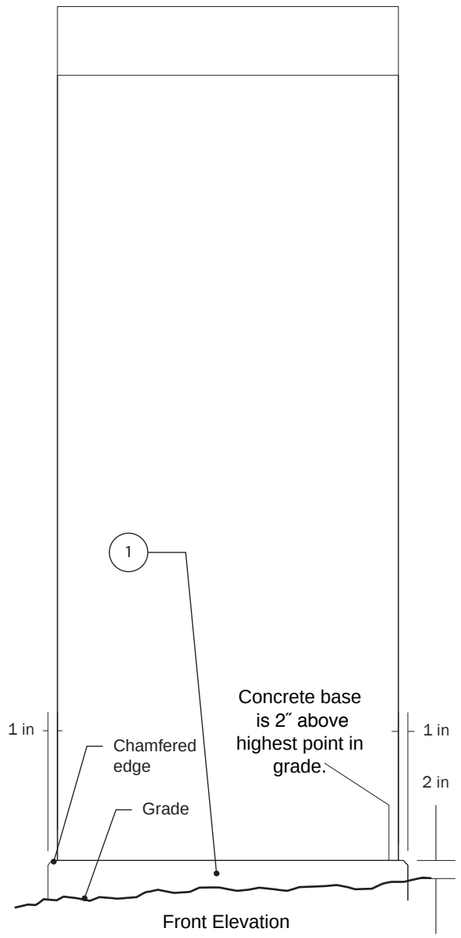
Front Elevation



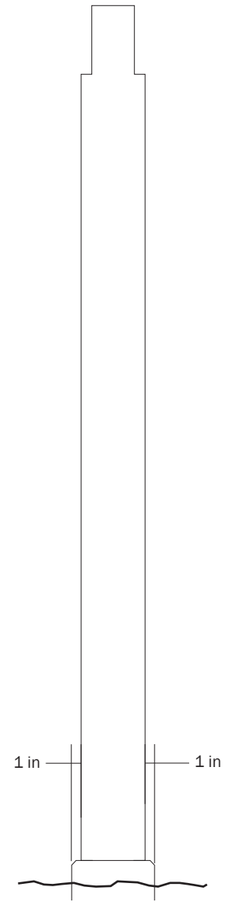
Side Elevation

2. CONCRETE BASE DETAIL
WHEN PLACED ON UNLEVEL CONCRETE

SCALE = 3/4˝ = 1´



Front Elevation



Side Elevation

3. CONCRETE BASE DETAIL
WHEN PLACED IN LANDSCAPED AREA

SCALE = 3/4˝ = 1´

DIABLO VALLEY COLLEGE

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Est. No:
Issued: 1-15-18
Drawn By: SW

DWG: 7.0.0 WEIDDIAB - BASE 1 - Concrete Base Details.ai

Revisions:

BASE1
Concrete Base Details

7.0.0

Contra Costa Community College District

Security Design Guidelines

March 2018

	1	DESIGN GUIDELINES
	2	REQUEST FOR PROPOSAL
	3	UNIT PRICING
	4	SECURITY SYSTEM SPECIFICATIONS
	5	PRODUCT INFORMATION
	6	TYPICAL BLOCK DIAGRAMS
	7	TYPICAL SECURITY SYSTEM DETAIL DRAWINGS
	8	SAMPLE SHOP DRAWINGS

Contra Costa Community College District
Security Design Guidelines

1.0 Revision Log

Date	Version	Description of Changes
March 7, 2012	B.2	Final Draft for Board Approval 1. Updates per 12/01/11 review meeting
March 1, 2018	B.3	Revised VSS Requirements and added ALPR capability Revised Security Device Requirements Added additional Access Control System Requirements (card reader override) Added data requirements for Emergency Notification System

Contra Costa Community College District
Security Design Guideline

1.0 OVERVIEW

Contra Costa Community College District plans to operate and maintain a consistent campus-wide electronic security systems program throughout its multiple campuses: Contra Costa College, Diablo Valley College, Los Medanos College. This also pertains to the District Office and the two satellite campuses: San Ramon Valley Campus and the Brentwood Center. To assist with the design and development of individual security projects, the following design guidelines were created.

Each new campus security project may include a blend of the following systems: Access Control and Alarm Monitoring System (ACAMS), an Intrusion Detection System (IDS), and a Video Surveillance System (VSS). Collectively the systems are an economical solution to provide security and safety while maintaining convenience and flexibility. Contractors proposing on new Contra Costa Community College District project must ensure that new security work utilizes the same software versions that are currently operating on the Contra Costa Community College District server(s) located at the District Office in Martinez, CA.

The standards are based around the following manufacturers:

- Access Control and Alarm Monitoring System: Software House CCURE 9000
- Intrusion Detection System: DSC PowerSeries
- Video Surveillance System: Salient Systems

This design guideline details the electronic security standards, system design criteria, implementation guidelines, and coordination requirements. It is not intended as a substitution for construction documents, but rather guides the engineer to design additions to the overall system during new and renovation construction projects. Included with the guidelines are a sample RFP, unit pricing, template construction technical specifications, typical product information, overall system topology diagrams, typical details, and example shop drawings.

1.1 Scope

The scope of the guideline includes the following information:

A. Access Control and Alarm Monitoring Design Criteria
B. Intrusion Detection System Design Criteria
C. Video Surveillance Design Criteria
D. Electronic Security Device Application Matrix
E. Architectural, Structural, Electrical, Mechanical, Elevator, and Telecommunication coordination and design requirements required to support the physical access control and security system during implementation.

1.2 Application

Physical security plays a critical role in providing a safe environment for staff and students. Security for the district consists of access control and alarm monitoring system (ACAMS), intdusion detection, and video surveillance system, which mitigate theft, vandalism, and general crimes of opportunity. Additionally the system automates the opening and closing of the buildings on schedule, increasing the effective utilization of staff.

The guidelines and criteria herin apply to each campus within the Contra Costa Community College District - Contra Costa College (CCC) located in San Pablo, Diablo Valley College (DVC) located in Pleasant Hill, and Los Medanos College (LMC) located in Pittsburg, as well as the District Office in Martinez. Even though the two satellite campuses: San Ramon Valley Campus and the Brentwood Center do not have the same facility structure as the other campuses, these guidelines and citeria shall apply to these locations.

1.3 Arrangement of Information

This document is arranged by design discipline. Best practice has the Architect and Design Engineers reading this document, the electronic security device application matrix, and the design coordination document, including related documents. The Design Team should study the specific sections related to their discipline and review the other sections.

The district and colleges should review and utilize the sample RFP, unit pricing, template construction technical specifications, typical product information, overall system topology diagrams, typical details, and example shop drawings as a reference for each project including electronic security systems.

1.4 Roles and Responsibilites

The successful design and implementation of any component of the electronic security systems requires coordination with the following entities throughout the delivery process:

A. Facilities Planning - Staff such as campus project managers will engage end-users in discussions regarding the security systems and operation, credential issuance, and access privileges. Architects and other design consultants and their agents shall not engage directly with end-users on system operational requirements. The project managers will ensure that a project's scope, schedule and budget goals are achieved.

B. Building and Grounds - Manage and maintain doors and hardware, including mechanically keyed hardware on each campus, connected to the electronic physical security systems.

C. Police Services - Operate the electronic security systems on each campus and on the district-wide level. Staff maintain credentials and control building access schedules.

D. Information Techology and Research - Coordinate all aspects of the ACAMS, intrusion, and video surveillance interfaces and connections with the LAN and/or WAN.

E. User Groups - Facility users who will interact with the mechanically keyed, ACAM'd and/or video surveilled facility. User group representatives will define specific program requirements for the systems, beyond the minimum standard deployed across all projects.

F. Security Design Engineer - Members of the design team who are designing the electronic physical security systems shall have a thorough understanding, knowledge and successful experience in designing similar systems in similar applications. The design team members (whether part of the prime consultant's design team or an associated consultant) shall be approved by CCCD prior to performing any design work. The Design Engineer shall provide services in accordance with these standards. The Design Team shall verify that all applicable portions of these standards are incorporated into the project's design, drawings, specification and final construction. Requests for variances from these standards are to be submitted in writing to the campus project manager, and will be scrutinized very carefully. Variances from any aspects of this physical access controls and security management system design standard will only be allowed with the explicit written consent of the District.

G. Security Systems Integrator

1. Integrator firms minimally provide the "parts and smarts" for the ACAMS system. They may sell the parts to a C-10 electrician who then installs the parts and wires them, and then the Integrator simply provides the programming of those devices (smarts). Integrators may also install the entire system (parts, smarts and wiring).
    a) In order to ensure that an Integrator is able to provide the level of service that the District requires, there are a number of qualifications that must be met. The District may, at its discretion, make exceptions based on demonstrated strengths in one area that outweigh a deficiency elsewhere.
    b) Documentation demonstrating compliance with the following criteria must be provided as a submittal prior to any work being done by the Integrator
2. Required Qualification Criteria:
    a) Personnel must have successful experience and demonstrated knowledge, skill and ability in working on a Software House ACAMS at the Global level. Personnel must also reside in the District's service area. Resumes of the proposed Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, tenure, product certifications and training, listing of similar projects the individual performed in the role proposed for this project, along with client contact information for each shall be reviewed by the District to ensure proposed personnel are qualified. In addition, each proposed technician's Software House Enterprise level certification or other proof of factory training must be provided; this requirement ensures that the manufacturer has certified that the technician is trained in Enterprise level Software House ACAMS installations.
    b) Integrator firms must be an authorized dealers for Software House, allowing the firm to act as a reseller, installer, and warranty provider of the Software House security system at the Enterprise Level. Certifications from Software House for lower tiered product offerings are not acceptable. This requirement ensures that the manufacturer has qualified the Integrator to conduct business at the Enterprise level that is installed across the District.

2.0 ACCESS CONTROL AND ALARM MONITORING SYSTEM (ACAMS)

2.1 Overview

The District selected Software House as its access control system provider. All district security projects must utilize this system to provide commonality in access card formats, system monitoring/reporting capabilities, and District-wide programming standards.

Each campus will include a Software House system comprised of access control panels, card readers, power supplies, access control cards, and interfaces to electrically controlled locking hardware. The individual campus control panels connect to the Enterpise Software House server software via the District LAN/WAN. The District IT department will provide and support application servers and District workstations including video badging workstations. The individual campus IT departements will support their respective security workstations. Police Services will manage the security system software on both the District and campus levels. Refer to the specific sections in the Design Specifications for recommendations regarding specific security products.

The District requires card readers capable of reading proximity and iCLASS dual technology access cards. All District security projects must utilize standardized control panels and a commpon manufacturer for card readers to ensure commonality in system performance, system monitoring/reporting capabilities, and District-wide programming standards. The District uses standard 125KHz proximity access control cards. The design for new projects should account for the use of 13.56 MHz “Smart” cards in the future. This will include memory/storage capabilities to support future applications including logical access, biometric templates, and debit card capabilities.

2.2 Application

A. ACAMS controls access into the buildings and select interior doors. Intrusion alarm monitoring comprised of door contacts, motion detectors, and duress buttons also monitored on the ACAMS system via integration with the IDS alarm panels.

B. ACAMS electronic locks are used on doors that are deemed critical to security of expensive assets subject to a high possibility of theft, confidential records, or other areas of critical nature. These doors are typically locked at all times by the ACAMS.

C. ACAMS locks may also be used on doors that are not deemed “critical”, but have other operational requirements that make ACAMS a good solution, such as building entrances. These doors are locked or unlocked based on a programmed schedule

D. Doors specified to have electronic access control must tie into the College’s existing Software House ACAMS. Create schedules to automate the opening and closing of the building including unlocking doors, bypassing alarms and enabling the auto operator at main entrances

E. No other security systems may be used in lieu of or in addition to the Software House ACAMS.

F. Card readers and card readers with integrated keypads are generally not used at the District at this time.

G. Interconnect ACAMS to auto operators for secure after hour’s operation

1. Interlock exterior ADA push plates (or motion sensor) with aux relay on local lock power supply.
2. When door is locked exterior push plate (or motion sensor) is disabled
3. When door unlocked, even momentarily, ADA push plate (or motion sensor) is enabled.

H. Security enclosures require tamper switches monitored by the ACAMS. Supervision of power supplies and batteries is required.

I. Utilize stranded, plenum-jacketed cable and route on dedicated security J-Hangers through the building's accessible ceiling. Home run cable to nearest security equipment hub typically located in telecommunications rooms. Do not share conduits with fire alarm or telecommunications systems. Utilize plenum jacketed cable when required.

J. Reference Specifications for additional application requirements.

2.3 ACAMS Door Typology

Table 2.3 lists standard ACAMS door typology used by the District. Each typology has an identifying number used to indicate the door's security function. All types include intrusion monitoring. When programming ACAMS design with end-user groups, use the Districts door typology as a starting point.

Door Type	Description	How it Works
1	Card Reader Door with Standard Proximity Reader (no keypad)	Can be programmed to unlock/lock on a schedule. When not scheduled unlocked, a card or fob must be presented to unlock the door. Door includes capability to disable card reader by using a push button or other override device on opposite side on interior of door. Activation of the push button or override device generates an alarm event and locks the door.
2	ADA Card Reader Door with Standard Proximity Reader	Uses a card reader, like "1", but in conjunction with an automatic door operator.
3	Scheduled Unlock Door	Automatically locks or unlocks on a schedule that has been programmed into the ACAMS. Door includes capability to lock the door by using a push button or other override device on opposite side on interior of door. Activation of the push button or override device generates an alarm event and locks the door.
4	Monitored Door with Authorized Exiting	Allows for egress without an alarm, no re-entry through these doors, typically no exterior trim on this type.
4.1	Emergency Exit Door with Local Alarm	Monitored like "4", exiting through this door will set off an audible alarm near the door as well as at the ACAMS and IDS.
4.2	Emergency Exit Door with Local Alarm	Monitored like "4", exiting through this door will set off an alarm at the ACAMS and IDS.

5	In/Out Standard Proximity Reader with Door Management Alarm	A card or fob must be presented to use this door to exit or enter, otherwise an audible alarm near the door will sound.
6	Proximity Reader Sliding Storefront	Card reader outside to enter, momentary key switch inside to exit, magnetic lock on the first sliding panel.

Table 2.3: ACAMS Door Type Naming Convention

The District security standard shall provide card readers at the following locations:

- Main perimeter entry/exit doors.
- Exterior elevator hall call buttons
- Other perimeter doors frequently used by staff
- MDF, IDF, and data rooms
- Lecture halls, laboratories, and rooms with high-value instructional technology
- Staff administrative spaces including: Administrative Offices, Accounts Receiveable, Financial Aid, Counseling, and Information Services Departments
- Other rooms where staff handle or store cash and other assets
- Smart classrooms and computer labs

Refer to the Electronic Security Device Matrix for additional security information.

2.4 Programming

A. The District, College CM, Design Engineer, and Contractor shall hold a meeting prior to the completion of construction to discuss the programming criteria and access to the District head end. Discuss the following topics
   1. Door Names
   2. Device Names
   3. Alarm groups
   4. Schedules and time codes
   5. Action/responses from individual input points
   6. Action response from card commands
   7. Alarm groupings for programming and reporting

B. Contractor shall program and setup all system hardware such that no additional programming other than entering new access cards, time codes, and adding doors to existing access privilege groups is required

C. Program any Type 3, scheduled unlock doors which access the same space as a Type 1 or 2, card reader door to unlock with when the space is switched to an unlocked/disarmed state via card reader conditional comands.

D. Program the ACAMS software to make conditional commands a control panel function instead of a server function. Conditional “if” statements shall have up to eleven “then” commands.

2.5 Coordination

A. The ACAMS can interface many different disciplines making coordination extremely important. Reference all other disciplines covered in these documents and coordinate ACAMS requirements for each project. Attend design team coordination meetings during design and hold a construction kick off meeting at the start of construction.

B. Refer to Paragraph 5.0, Coordination below for additional information.

2.6 Commissioning and Closeout

A. Refer to Paragraph 6.0, Testing, below for additional information.

3.0 INTRUSION DETECTION SYSTEM (IDS)

3.1 IDS Overview

The District selected Digital Security Controls (DSC) as its IDS for integration with the Software House access control system. The IDS is required to send security system alarms and alarm events to District and Campus selected listed Central Alarm Monitoring Station (CAMS). All security system devices monitored by the IDS are capable of being sent to the CAMS and have secondary monitoring through the ACAMS.

Help/duress buttons located at the public interaction desks and cash transation counters are wired directly to the IDS. The IDS system shall integrate to the ACAMS system to ensure that activation of a help/duress button reports to the ACAMS and IDS. The IDS includes a keypads located near main entry portals and also mounted on the cover of the control panel located in the designated telecommunication room. The keypad will allow activation, deactivation, and programming of the IDS system. Software integration will also allow the ACAMS to arm and disarm alarm partitions through the use of specific credentials or through the ACAMS workstation.

3.2 Application

Alarm initiating devices connected to the IDS are monitored via software thorugh the ACAMS. Each security device is monitored through the ACAMS server and logged in the software. The District security standard shall provide alarm devices at the following locations:

- Building perimeter consisting of all perimeter door contacts.
- Building perimeter spaces with exterior glazing include motion sensors within the space.
- Areas with assets and/or critical information consisting of alarm contacts on door to the space and motion sensors
- Duress buttons at cash transaction counters and other high-risk locations

3.3 Programming

Program the IDS to transmit help/duress button activations and forced door alarms to the CAMS at all times (24hrs/7days). Other alarm monitoring devices such as motion detectors and non-emergency exit-only doors will transmit alarms to the ACAMS when the IDS is activated. All security alarms report to both systems (ACAMS & IDS) through software integration. Review IDS schedules for each project with the campus project manager for specific operational requirements.

Refer to the Electronic Security Device Matrix for additional security information.

3.4 Coordination

A. The IDS interfaces with different disciplines, including door hardware, electrical, and campus IT, making coordination extremely important. Reference all other disciplines covered in these documents and coordinate the IDS requirements for each project. Attend design team coordination meetings during design and hold a construction kick off meeting at the start of construction.

B. Refer to Paragraph 5.0, Coordination below for additional information.

3.5 Commissioning and Closeout

A. Refer to Paragraph 6.0, Testing, below for additional information.

4.0 VIDEO SURVEILLANCE SYSTEM (VSS)

4.1 VSS Overview

The Distrcit requires a video recording and viewing software platform which integrates with the ACAMS via software interface. The District and individual campus security projects must utilize a consistent system to provide commonality in recording and viewing formats, along with District-wide programming standards. The video surveillance system will include monitoring client workstations utilized by Police Services on each campus.

The District selected to use megapixel color cameras with vari-focal lens for both interior and exterior locations. While current specifications reflect a few IP camera manufacturers, any comparable performing PoE IP camera may be acceptable for use upon review by the District and respective college campus IT department. Note that on typical new construction projects, the telecommunication contractor will provide IT cabling. This ensures that all IT cabling provided for the project falls under the certified IT structured cabling system. Please review District and specific campus IT standards as they relate to the VSS..

The District and individual campus IT departments will provide and maintain the required network video servers. These network videor servers will reside in a centralized telecommunications or server room on each campus. The existing server capacity shall be reviewed during the design and implementation of security cameras on every project.

4.2 Application

The District security standard advises to provide VSS cameras at the following locations:

- Main entry/exit doors
- Other perimeter doors including fire stairwell and exit-only doors
- High traffic or high value interior locations and corridors

Refer to the Electronic Security Device Matrix for additional security information. Also note, do not locate cameras to allow the viewing of staff or students within standard classrooms.

4.3 Coordination

A. The VSS interfaces heavily with the district and campus IT Department, making coordination extremely important for a successful installation. All projects will utilize existing central servers while large projects will require the installation of additional storage to existing servers to support the processing and storage requierments for the network video recorder software. The owner's IT department will provide the centrally located server.

B. Reference other disciplines covered in these documents and coordinate the IDS requirements for each project. Attend design team coordination meetings during design and hold a construction kick off meeting at the start of construction.
C. Refer to Paragraph 5.0, Coordination below for additional information.

4.4 Commissioning and Closeout

A. Refer to Paragraph 6.0, Testing, below for additional information.

5.0 COORDINATION

This design guideline document identifies general information required for implementation of new security work on any District facility. A significant amount of detailed coordination work is required for a completely functional and operational installation at a new location. Following is a list of some of the specific coordination activities required. Additional security coordination items are indicated in the following Security Design Coordination document.

- Coordinate with door and hardware specifier to ensure proper door preparation, voltages, and divisions of work.
- Electrical power locations for ACAMS and IDS control panels.
- Coordination with local Authority Having Jurisdiction (AHJ) regarding building fire alarm system interfaces, and local code requirements including Emergency Door releases and intercoms.

6.0 TESTING

The purpose of system commissioning and closeout is to ensure the security system operates properly when it is needed most. Security systems are very complex from both equipment and programming standpoints, and thorough testing is necessary to ensure correct operation prior to the building's occupancy.

The local security system integrator is required to perform 100% pre-functional testing of the ACAMS, IDS, and VSS prior to requesting witnessing of final acceptance testing by the District or their designated representative. The Contractor should be present and demonstrate the security system functionality during the punch walk. Refer to individual specification sections for specific testing/commissioning requirements. Refer to security system commissioning specification 28 08 00 for specific closeout procedures.

Contra Costa Community College District

pathways to success

New Project Security System Standards										
Electric Security Device Application										
Access Control			Alarm Monitoring					CCTV		Notes
Card[2] Reader	Sched Electric Lock	Entry Intercom	Alarm Contact	Arming Station Keypad[3]	Audible Local Alarm	Duress Button	Motion Detector	Fixed Camera	Multi Sensor Camera	
Site										
Vehicle Entry Points								❍	❍	
Pedestrian Entry Points								❍	❍	
Staff & Student Lots								❍	❍	
Student Assembly Areas								❍	●	
Critical Circulation Areas								❍	●	Trouble areas on campus
Building Perimeter										
Main Perimeter Entry	●			●	●			●	●	❍	
Perimeter Entrance	●	●		●				●	●	❍	
Employee Entrance	●			●	●				❍		
Emergency Exit-Only				●		●			❍		
Perimeter Exit-Only				●					❍		Include request-to-exit
Util Ent. w/ Bldg Access	●			●					❍		
Util Ent. w/o Bldg Access				●							
Rooms w/ Window								●	❍		
Loading Dock	●		●	●					●	❍	If applicable
Building Interior										
Cashier/Cash Handling	●			●			●		●	❍	
Student/Staff Counters							●		●	❍	
High Value Asset Areas	●			●	●			●	●	❍	
Counseling Entrance	●			●					❍		
Telecom Rooms	●			●							
Additional Interior										
Tiered Lecture Halls	●			●							
Staff Work Areas	●			●							
Smart Classrooms	●	●		●				●			Card reader on one door
Computer Labs	●	●		●				●			Card reader on one door
Instructional Labs	●	●		●						❍	
Corridors Adjacent to High Value / Sensitive Areas / Labs	●	●		●					❍	❍	

Notes:

1. (❍) Indicates an optional requirement. Determine requirements based on specific project requirements.
2. Card reader consists of magnetic door contacts, request-to-exit, and electrified locking hardware interface.
3. Alarm Arming Station Keypad only required if building/area does not have ACAMS present with alarm integration.
4. Where applicable, include Automated License Plate Recognition Camera at vehicle entry points.

Contra Costa Community College District
Security Design Coordination

1.0 INTRODUCTION

1.1 Scope

The scope of this design guideline coordination document includes the following information and should supplement the previous Security Design Guideline segment:

A. Architectural, Structural, Electrical, Mechanical, Elevator, and Telecommunication coordination and design requirements required to support the physical access control and security system during implementation.

1.2 Arrangement of Information

This document is arranged by design disciple. Best practice has the Architect and Design Engineers reading the entire document and related items within the security guidelines binder. The design team should review the specific sections related to their discipline and how this affects their work.

2.0 ARCHITECTURAL

2.1 Equipment Rooms

A. Coordinate the locations of security equipment panels in telecommunications rooms with the campus IT department, unless space constraints do not allow. Wall mount panels to plywood backboard and coordinate space requirements with telecommunication contractor with acceptance by campus IT department. Verify at least one segment of 4' wide x 8' high plywood is reserved in each typical telecommunication room for security equipment. Depending on the magnitude of the project, some installations will require more wall space.

B. Coordinate rack space for network security equipment. Take security equipment into consideration when sizing the telecommunication rooms. Some projects may require more rack space than others depending on the quantity of security devices.

C. When space constrains do not allow for security equipment panels in the telecommunication rooms, locate equipment in spaces suitable for low-voltage equipment. Spaces shall be free from moisture, excess dust & dirt, and secured from the general public. Equipment panels shall mount to plywood backboard following the same requirements in telecommunication rooms.

D. Typically telecommunication rooms and rooms with extremely critical infrastructure receive a card reader and associated security hardware.

2.2 Doors and Hardware

A. Exterior Door ADA Interface Requirements

1. The District is committed to providing access for our disabled community and when appropriate will implement beyond code requirements. As an example, auto operators at the major entries to each building may be provided even if not required.
    a) Operators shall be furnished with three-position rocker switches (on/off/hold open).
    b) Interlock the power assist's push plate actuators with the ACAMS when access control is required such that interior push plates unlock the door before swinging the door open. Exterior push plate actuators will not trigger the operator unless the door is in an unlocked state.
    c) In some cases automatic sliding doors with motion sensors may be used instead of push plate actuators. Interface the automatic sliding door's locking mechanism and motion sensor with the ACAMS.

B. Mechanical Override
    1. Card reader doors must have mechanical lock mechanisms.
        a) ACAMS electronic locks must have a manual override feature that allows for access in the event of ACAMS downtime due to extended power outages or other system failures.
        b) Card reader doors must be keyed to the College's master key system. Only a high level master should have the capability to unlock card reader doors.
        c) Card reader doors must have capability to disable the card reader and lock the door from the interior side using an electronic or mechanical pushbutton. Disabling the card reader using either method above generates an alarm event in the access control system and requires electronic reset by the access control system.
    2. This protocol facilitates emergency response, ease of use, departmental control, protection of assets, lockout capability and the safety and security of faculty, staff and students.

C. Application
    1. All doors must have mechanical lock mechanisms with key access, unless doors are exit only portals where no exterior trim exists.
        a) Locked doors must be keyed to the College's master key system.
        b) ACAMS electronic locks must have a manual override feature that allows for access in the event of ACAMS system downtime due to extended power outages or other system failures.
    2. This protocol facilitates emergency response, ease of use, departmental control, protection of the District's assets, and the safety and security of faculty, staff and students. No exceptions to this protocol are allowed.

2.3 Rated Doors and Frames

A. New Construction

1. Factory prepare fire rated assemblies for security devices by the manufacturer prior to installation. Factory-prepared doors should be ready for electrified locks via a transfer hinge and a factory-prepped cored chase for wiring to the lock. No modifications to door or frame are allowed in the field. Field modifications void rating and require replacement of the entire rated assembly.

B. Renovation

1. Existing rated assemblies use a different modification approach. Utilize tape wire around the edge of the door from the electrified hinge to the electrified lockset instead of drilling through the door. Create a notch 3/4" wide by 1/4" deep around the edge of the door for the tape wire. Backfill notch and conceal tape wire with additional wood to match original finish.
2. Coordinate color of security devices on walls and ceilings to best match the mounting surface finish. Devices should not stand out. This applies to security field devices such as card readers, request-to-exit sensors, contacts, glass break sensors, and camera housings.

3.0 STRUCTURAL

3.1 New Construction

A. Seismic Bracing of Security Equipment Racks, in Telecommunications Rooms

1. Equipment racks, possibly both floor-mounted and wall-mounted, will be installed into Telecommunications Rooms.
2. The Structural Engineer shall be responsible to confirm the seismic bracing designs (including structural calculations and details as required by the Project), and provide recommendations as necessary.

3.2 Renovation

A. Floor Anchoring for Equipment Racks

1. Floor-standing equipment racks and cabinets shall be anchored to the structural floor via devices pre-approved by DSA. Examples of such devices include Hilti Kwik-Bolt 3. The structural engineer shall determine the applicability of the anchoring device set in the floor system, including minimum embedment depth.

B. Wall Anchoring for Equipment Racks and Cabinets

1. Wall-mounted equipment racks and cabinets shall be anchored to the wall via fasteners pre-approved by Division of State Architect (DSA). Examples of such fasteners include woods screws into plywood backboard and expansion anchors into concrete wall.

2. The structural engineer shall determine the applicability of the fasteners depending upon the mounting substrate, including minimum embedment depth.

C. Typical Fasteners

1. The Chart 3.1 is a guide to the fasteners generally approved for mounting backboards, equipment, etc.

Wall Type	Fastener Required
Concrete Wall	TAPCON, 3/16" x 1¼" with 1" min embedment
CMU Wall	TAPCON, 3/16" x 1¼" with 1" min embedment
Metal Stud Framed Wall, 1 Layer Gypsum	Into metal stud: no. 8 x 2" self-tapping metal screw for metal studs
	Into gypsum wallboard: Toggler toggle bolt BA (3/16" x 24)
Wood Stud Framed Wall, 1 layer Drywall	Into wood stud: no. 8 x 2" wood screw
	Into gypsum wallboard: Toggler toggle bolt BA (3/16" x 24)
Plaster Wall	Toggler toggle bolt BA (3/16" x 24)
Plywood Backboard	no. 8 x 2" wood screw

Chart 3.1 - Approved Fasteners Chart

4.0 ELECTRICAL

4.1 Power Requirements

A. Security Equipment Hubs

1. Coordinate power at each wall-mounted security equipment hub location, typically in the telecommunication rooms. Provide two 120 VAC, 20 amp dedicated circuits to each security equipment hub location. Connections to security equipment transformers or power supplies are hardwired unless a receptacle is specifically indicated.
2. Network Video Recorders (NVR) require one 120 VAC, 20 amp dedicated circuit. NVR's are typically rack-mounted units. Verify load on new or existing UPS power supplies can accommodate NVRs. If centralized UPS power is not available, provide a rack-mount dedicated unit. Coordinate exact power requirements and locations.

B. Locking Hardware

1. Review door locking hardware requirements on the latest door hardware schedule. Verify if any hardware requires a local power supply or booster, such as a Von Duprin PS 873, provided by the door hardware installer. Power supplies are cabled no further than 25 feet from the electrified lock. Provide hardwired 120 VAC to each lock power supply.

C. Field Devices

1. Coordinate power at field locations for remote security device power supplies.

a) Review site security requirements and provide a 120 VAC, 20 amp circuit to each remote security power supply location. Security power supplies used to power cameras, detection devices, or remote security panels. Obtain locations from security Design Engineer.

b) Provide power to any vehicular gate operator system. These are typically not provided by the security Design Engineer or Integrator but may interface the ACAMS in several ways.

4.2 Pathways

A. Horizontal

1. Horizontal pathways consist of device boxes, conduit, j-hangers, and cable tray used to home run the security cable from each device to the closest telecommunication room. Security equipment typically requires a 4-square device box installed on a wall or ceiling. Conduit is run from the device to the closest accessible ceiling or directly into a cable tray when tray is utilized. Dedicated security j-hangers are used in accessible ceilings to support all security cable. Coordinate main j-hanger runs with other trades to minimize interference issues. Pathways shall be concealed in walls and accessible ceiling spaces wherever possible.
2. Site conduit for remote security devices such cameras shall be coordinated with the security system Design Engineer, Civil Engineer, and Telecommunication Engineer. Plan for conduits to run underground in a joint trench into the closest telecommunications equipment room.
3. Elevator Demarcation: In some cases where card access is required on an elevator, conduit is required between any elevator termination enclosures and the ACAMS equipment panels. The elevator termination enclosure is the termination point between the ACAMS and elevator controller. Refer to article 6.0 for additional requirements.

B. Riser/Equipment Rooms

1. Security equipment hubs should utilize a 6" high x 6" deep x 4' long screw cover metallic raceway above security equipment hub locations. Sizing of the raceway will vary from project to project. Provide EMT conduit from the security equipment hub raceways to the low voltage cable trays within the room or directly out of the room, to the nearest accessible ceiling for security devices located on the same floor.

4.3 Fire Detection/Life Safety

A. Means of Egress

1. When required by code, provide output from the fire alarm system to any ACAMS controlled door that falls in a path of egress. Connect the output directly to the ACAMS panel that controls these specific doors. ACAMS shall be programmed to unlock certain doors for egress in the event of a fire.

B. Magnetic Door Holders

1. Classrooms and instructional labs may have doors outfitted with hardware that allows it to be held open.

a) If the door is in a fire corridor, a magnetic door holder shall be tied into the fire alarm system to release the door during a life/safety event.

b) If the door is not in a fire corridor, a mechanical door holder may be used. However, mechanical door holders shall not be installed on doors with ACAMS; in these instances, use a magnetic door holder tied to the ACAMS (but not the fire alarm) system, or a door closer with an electronic hold open.

C. Corridor Separation doors should be outfitted with hardware that allows the doors to be held open.

1. If the corridor separation doors are not in a fire corridor, they can be outfitted with a mechanical door holder.

a) The exception to this is if the doors are to be used to secure part of the building off for operational purposes; in that case, magnetic door holders must be used and tied into the ACAMS to release and secure the corridor at the programmed time.

2. If the corridor separation doors are fire doors, the magnetic door holders shall be tied into the fire alarm system.

a) If the doors are to be used to secure an area of the building off, then the magnetic door holders must also be tied into the ACAMS to release at the programmed time.

5.0 MECHANICAL

5.1 Equipment rooms

A. Security equipment generates heat and may require cooling depending on the type of equipment. Wall-mount equipment such as access control panels and power supplies don't create as much heat as network video recorders. Calculate heat load for security equipment and coordinate with telecommunication engineer if equipment is located in a telecom room. These rooms typically have some form of environmental cooling.

6.0 ELEVATOR

6.1 Applications

A. In-Cab Reader

1. When specific floors require restricted access, interface ACAMS to the elevator controller to disable and enable specific floor select buttons. Surface mount card reader in the elevator cab either above or below the floor select buttons. Coordinate exact location with Owner and Design Team. Coordinate card reader cable requirements for the traveler cable and terminate cable to an elevator demarcation enclosure.

B. Hall-Call Reader

1. When elevator access is restricted on a specific floor by the ACAMS, a card reader shall be located adjacent to the elevator hall-call button. ACAMS should interface the elevator controller to disable the call button. Coordinate output from ACAMS to location of elevator demarcation enclosure.

C. Elevator Machine Room Connections

1. Cables from the elevator cab and controller do not terminate directly on ACAMS control panels. The elevator contractor or electrical contractor shall provide a demarcation enclosure with terminal strips for interface to ACAMS. This enclosure is usually mounted in a coordinated accessible space, just outside the elevator machine room. Conduit is required between the enclosure and both the elevator controller and the ACAMS equipment panels. Conduit sizing will vary depending on the level of ACAMS integration on each project.
2. Provide demarcation terminal strip. Coordinate with the elevator contractor. Terminate ACAMS cabling to one side of the terminal strip. The other side of the terminal strip is used for the elevator controller interface wiring terminated by the elevator contractor.

7.0 TELECOMMUNICATIONS

7.1 Network Connections

A. Connection to the District/Campus network is required at each ACAMS security equipment hub for primary communications to the existing District ACAMS server. This is typically a TCP/IP 10/100/1000 BASE-T connection. Provide active network port and coordinate IP address to security contractor.

B. Cameras will typically require one TCP/IP 10/100/1000 BASE-T connection to communicate back to the District/Campus network. Provide active network port with PoE for each camera location and coordinate IP addresses with security contractor.

C. IDS panels require one TCP/IP 10/100/1000 BASE-T connection for integration with the ACAMS server for local alarm monitoring. Coordinate active network port and coordinate IP address to security contractor.

1. IDS panels may require a second TCP/IP address if the District migrates to network based central station monitoring. Confirm network connections based on current project requirements.

D. Classroom and spaces with no telephones require one TCP/IP 10/100 /1000 BASE-T connection for District Standard Emergeny Notification System. Coordinate termination of TCP/IP connection with Emergency Notification System provider.

7.2 Voice Connections

A. Intrusion alarm/detection panels (IDS) require an analog phone line to communicate with an offsite central station. Provide an analog phone line to security enclosure for the IDS communications for after hours alarm monitoring.

~End of Document~

Contra Costa Community College District
Security Design Guidelines

SECURITY SYSTEM
REQUEST FOR PROPOSAL

PART 1 - PROJECT OVERVIEW

As part of this [remodel/new construction] project, Contra Costa Community College District (CCCD) wishes to incorporate their new District wide security system. This Request for Proposal document and associated bid form, drawings, specifications, unit price sheet, base building work rules and general contractor insurance requirements are provided to solicit a complete and competitive bid from authorized Software House dealers for this work.

SECURITY CONTRACTOR SELECTION PROCESS

1.01 Schedule of Events:

A. Date to be determined

RFP documents sent to selected bidders

B. Date to be determined

Mandatory pre-bid site walk **General Contractor**, (time to be determined) at the job site.

C. Date to be determined

Deadline for any final contractor requests for information (RFIs) needed to complete their response to the RFP. Email RFIs to **General Contractor** and cc: [Respective campus PM contact information], **all questions must be in writing.** CCCCD will provide responses to questions by the close of business on the **date to be determined**.

D. Date to be determined

Contractors submit RFP responses by noon on **date to be determined**.

Bid Interviews may be held during the evaluation period. The bid interview schedule will be determined at a later time.

E. Date to be determined

General Contractor [or CCCCD] to award security project to winning bidder

1.02 Bid Documents

A. RFP **Document Date**

B. Project schedule dated **Project Date**

C. Project drawings dated **Project Date**

D. Project specifications dated **Document Date**

E. Unit Price Sheet dated **Document Date**

F. Base Building work rules dated **Document Date**

G. General Contractor insurance requirements (Issued by **General Contractor** during Bid Walk)

PART 2 - CONSTRUCTION SCHEDULE

2.01 Contractor is to coordinate with General Contractor and Contra Costa Community College District to meet construction timelines for the project.

2.02 See attached Construction Schedule for project milestones and deadlines.

PART 3 - SPECIFIC REQUIREMENTS

3.01 Forms: Each proposal shall be made on the Bid Forms prepared by the Engineer and shall be submitted electronically via email. Where sufficient space is not provided in the forms for a complete answer, supplemental sheets shall be used and attached to the proposal.

3.02 Delivery of Proposals: Proposals shall be delivered electronically before **time and date to be determined** (fax is not acceptable). It is the sole responsibility of the Bidder to see that their proposal is received in proper time. Any proposal received after the scheduled closing time for receipt of Proposals shall not be considered.

3.03 Withdrawal: Any Bidder may withdraw his/her Proposal, either personally or by telegraphic or written request, at any time prior to the scheduled closing time for receipt of Proposals.

3.04 Award or Rejection: The contract will be awarded to the best-qualified responsible Bidder complying with these instructions. CCCCD reserves the right to reject any or all Proposals or to waive any formality or technicality in any Proposal in the interest of CCCCD. No Bidder may withdraw his Proposal for a period of 30 days after the date of opening thereof.

3.05 Interpretation of Documents: If any person contemplating submitting a Proposal is in doubt as to the true meaning of any part of the Contract Documents, they may submit to CCCCD/Engineer a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the documents will be made only by Addendum duly issued and a copy of the Addendum will be faxed or delivered to each person receiving a set of the Request for Proposal. Neither CCCCD nor the Engineer will be responsible for any other explanations or interpretations of the technical specifications and drawings. The written interpretation by the Engineer or CCCCD shall be final.

3.06 Addenda: Any addenda issued during the time of preparation of the Proposal, shall be covered in the Proposal, and shall be made a part of the Contract. Receipt of each addendum shall be acknowledged in the proposal.

PART 4 - PROPOSAL SUBMISSION

4.01 Submit proposal to each of the following people:

To: **General Contractor Contact Person**
General Contractor
(XXX) XXX-XXXX phone
TBD@TBD.com

cc: **Contra Costa Community College District Representative**
Contra Costa Community College District
email@4CD.edu

[Name of Campus] District Representative (if applicable)
Contra Costa Community College District
email@4CD.edu

PART 5 - STIPULATED AMOUNTS

The Undersigned hereby proposes and agrees to provide a completely operational and functional security system for CCCCD in accordance with the conditions and requirements outlined in this Request for Proposal for the following stipulated amounts. A completely functional system includes all required equipment, materials, labor including programming and training, software, coordination, submittals including detailed drawings and project management even if not specifically detailed in bid documents.

The bidder is required to document in writing any exclusions, exceptions, or errors that may impact the projects schedule or price. All security work is assumed to be included by the contractor. Failure to document any exclusions, exceptions, or errors will result in the contractor providing the additional work at no additional cost to CCCCD.

Note: Prices quoted shall include all charges, i.e. permit fees, includes tax, shipping, job expenses, permits, overhead, and profit, etc. All line items must be filled in.

5.01 Base Bid; Security System

	Materials	Labor	Tax	Total
Access Control System				
Intrusion Detection System				
Video Surveillance System				
Total				
Year 2 M/A				
Year 3 M/A				
Year 4 M/A				

5.02 Change Order Pricing

Change order pricing is for all work outside of the scope of the construction documents. This pricing shall be used for change order pricing during this contract that is not covered under Unit Pricing. Change order pricing shall also be valid for one year from the date of bid award.

Provide material and labor rates for the following:

Material Mark Up	Project ____%		Change Order ____%	
Hourly Rates	Normal	Overtime	Weekend	Shift
Project Manager	_____	_____	_____	_____
Lead Forman	_____	_____	_____	_____
Installer	_____	_____	_____	_____

All change orders shall be performed on normal time. The contractor shall add crew to complete change orders if required. Overtime work will be evaluated approved on a case-by-case basis by CCCCD.

PART 6 - SUPPLEMENTAL INFORMATION

6.01 Bill of Materials

A. Contractor shall attach a copy of the Bill of Materials for the project listing product description, model#, manufacturer and quantity.

6.02 Project Team

A. Contractor shall attach a resume for each individual specified below.

Sales/Account Manager: _____

Project Manager: _____

Lead Forman: _____

6.03 Certifications

Please attach a copy of the manufacturer's certification or provide letter from manufacturer confirm that the bidder is an authorized dealer of the specified products and the listed team members are certified in installation and repair of the specified products.

Insurance

See attached insurance requirements and provide written proof of required coverage's.

6.04 Specifications

The Undersigned hereby acknowledges receipt of the following Specification Sections:

Section 28 00 00, Section 28 05 13, Section 28 05 53, **[Section 28 08 00, Section 28 13 00, Section 28 23 00, TBD]**

PART 7 - DRAWINGS

The Undersigned hereby acknowledges receipt of the following Drawings:

Drawing sheets:

Drawing sheets to be determined

ADDENDA

The Undersigned hereby acknowledges receipt of the following Addenda:

Addendum Number	Dated
_____	_____
_____	_____
_____	_____

PART 8 - Exclusion, Exceptions, or Error

8.01 Document any exclusions, exceptions, or errors:

_____

_____

_____

_____

_____

_____

_____

_____

PART 9 - Value Engineering Ideas

9.01 The Contra Costa Community College District team is open to value engineering ideas that will save the Owner money and/or improve the operation of the proposed security system installation. Please provide any recommendations for our review.

_____

_____

_____

_____

PART 10 - THE PRECEDING PROPOSAL IS HEREBY RESPECTFULLY SUBMITTED BY

10.01 I understand that the Owner reserves the right to reject this bid, but that this bid shall remain open and not be withdrawn for a period of thirty (30) days from the date prescribed for its opening.

10.02 If written notice of the acceptance of this bid is mailed or delivered to the undersigned at any time before it is withdrawn, the undersigned will execute and deliver to the Owner Proof of Insurance coverage within five (5) days after notification of this bid.

10.03 Notice of Acceptance, or request for additional information, may be addressed to the undersigned at the addresses set forth below.

10.04 The names of all persons interested in the foregoing bid as principals are:

_____

_____

_____

_____

Licensed in accordance with the governing country, state, local board, and with License Number

_____

Sign Here: _____

_____

_____

Signature of Bidder

NOTE: If Bidder is a corporation or partnership, set forth the legal name of the corporation or partnership together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation or partnership.

Business Address: _____

Telephone Number: _____

Date of Bid: _____

Security System Unit Pricing

Contra Costa Community College District
Security Design Guidelines

❖ Security System Unit Pricing

Provide unit pricing to add or delete the following security system devices. Include all labor, materials including wiring, conduit and back boxes, software, programming, one-year warranty, and updating project As-Built drawings. Reference project specifications for individual manufacturer, model number, and device requirements. Do not include any hardware or software upgrades to head-end equipment and assume sufficient spare capacity to support new work on existing access control panels, network video recorders, PoE network switches and security system power supplies:

Access Control System

1. One software license for "client" access control system workstation.

   Cost to add: _____

   Cost to delete: _____

2. One interior card reader door including card reader, request-to-exit device, alarm contact(s), and interface to locking hardware. Do not include electric locking hardware.

   Cost to add: _____

   Cost to delete: _____

3. One perimeter card reader door including card reader, request-to-exit device, alarm contact(s), interface to locking hardware, and interface to ADA actuator or automated door system. Do not include electric locking hardware.

   Cost to add: _____

   Cost to delete: _____

4. One scheduled unlock door including request-to-exit device, alarm contact(s), and interface to locking hardware. Do not include electric locking hardware.

Cost to add: _____

Cost to delete: _____

5. One door alarm contact(s) for security monitored door.

   Cost to add: _____

   Cost to delete: _____

6. One local door alarm management unit and alarm contact(s). Do not include electric locking hardware.

   Cost to add: _____

   Cost to delete: _____

Intrusion Detection System

1. One wall-mounted alarm control keypad.

   Cost to add: _____

   Cost to delete: _____

2. One door alarm contact(s) for security monitored door.

   Cost to add: _____

   Cost to delete: _____

3. One wall/ceiling mounted motion detector.

   Cost to add: _____

   Cost to delete: _____

4. One under-counter duress (Help) button.

   Cost to add: _____

   Cost to delete: _____

Video Surveillance System

1. One interior fixed IP color camera, including software camera license.

   Cost to add: _____

   Cost to delete: _____

2. One exterior fixed IP color camera, including software camera license.

   Cost to add: _____

   Cost to delete: _____

3. One interior multi-sensor IP color camera, including software camera license.

   Cost to add: _____

   Cost to delete: _____

4. One exterior multi-sensor IP color camera, including software camera license.

   Cost to add: _____

   Cost to delete: _____

Security System Training

1. 4 hours of on site user training

   Cost to add: _____

Security System Programming

1. 4 hours on site programming.

   Cost to add: _____

End of Document

SECTION 28 00 00

BASIC SECURITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 28 and is intended to supplement, not supersede, the requirements specified in Division 1.

B. The requirements described herein include the following:

1. References
2. Definitions
3. System Description
4. Submittals
5. Quality Assurance
6. Project Management and Coordination Services
7. Product Delivery, Storage, and Handling
8. Warranty
9. Maintenance

C. Products furnished and installed under another section:

1. 120V power
2. Conduit and junction boxes
3. Door hardware
4. Network Connections

D. Related Sections:

1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
2. Section 28 05 13 – Security System Cabling
3. Section 28 05 53 – Security System Labeling
4. Section 28 08 00 – Security System Acceptance Testing
5. Section 28 13 00 – Access Control and Alarm Monitoring System
6. Section 28 16 00 – Intrusion Detection System
7. Section 28 23 00 – Video Surveillance System
8. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations.
9. Selective Demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations.

10. Concrete Work: Include forming, steel bar reinforcing, cast-in- place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs (also includes saw-cutting of existing slabs and grouting of conduits in saw-cut).

11. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices.

12. Miscellaneous Lumber and Framing Work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of security materials and equipment.

13. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade.

14. Locking Hardware: Include interface to electronic hardware and door controllers on security related doors.

15. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.

16. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9, Painting.

17. Elevators: Include interface to elevator floor and hall call on security related elevators.

1.02 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.

2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):
   a. Title 8, “Industrial Relations”
      1) Chapter 3.22, “California Occupational Safety And Health Regulations (CAL/OSHA)”
   b. Title 24, “California Building Standards Code”
      1) Part 1, “California Building Standards Administrative Code”
      2) Part 2, Volumes 1 and 2, “California Building Code” (CBC)

3) Part 3, "California Electrical Code" (CEC)

4) Part 11, "California Green Building Standards Code" (CALGeen)"

2. National Fire Protection Agency (NFPA)
   a. NFPA 70, "National Electrical Code" (NEC)
   b. NFPA 75, "Protection Of Information Technology Equipment"
   c. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials", 2006

3. National Fire Protection Agency (NFPA)
   a. NFPA 70, "National Electrical Code" (NEC)
   b. NFPA 75, "Protection of Information Technology Equipment"
   c. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces", 2007

4. International Code Council
   a. International Building Code (2009)
   b. International Fire Code (2009)

5. National, State, Local and other binding building and fire codes

6. Code of Federal Regulations (CFR) Title 47 "Telecommunication", Chapter I "Federal Communications Commission (FCC)":
   a. Part 15, Radio Frequency Devices

C. Standards: Perform Work and furnish materials and equipment under Division 137xx in accordance with the latest editions of the following standards as applicable:

1. Underwriter's Laboratories (UL): Applicable listing and ratings.
   a. UL 294: Access Control System Units
   b. UL 1076: Proprietary Burglar Alarm Units and Systems
   c. UL 2044 Commercial Closed-Circuit Television Equipment

1.03 DEFINITIONS

A. The Definitions of Division 1 apply to the 28xxxx sections

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:

1. "Owner" : Contra Costa Community College District

2. "Engineer": TEECOM Design Group

3. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.

4. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Complete installation and make ready for regular operation.

5. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.

6. "Connect": To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.

7. "As directed": As directed or instructed by the Owner, or their authorized representative.

8. "Cabling": A combination of cables, wire, cords, and connecting hardware (e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling).
9. "System": The access control, video surveillance, and intrusion detection systems
10. "SEC": Security Equipment Cabinet
11. "SJB": Security Junction Box
12. "ACAMS": Access Control & Alarm Monitoring System
13. "VSS": Video Surveillance System
14. "IDS": Intrusion Detection System

1.04 SYSTEM DESCRIPTION

A. Overview

1. The Owner intends to *construct/renovate* a *single/multi*-level building at *Contra Costa College / Diablo Valley College / Los Medanos College / District Office / San Ramon Valley Campus / the Brentwood Center*.
2. Security at the new facility will consist of *[video surveillance, access control and alarm monitoring, and intrusion detection systems]*.
3. The System will connect to the Owner's existing Software House CCure 9000 headend located at the District Office over the Owner's local/wide area network.
4. Provide a high level of coordination services to ensure the proper installation and functioning of the security system.
5. Coordinate the installation of the security system with other trades. This may include: review of other's subcontractor's shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.
6. Refer to Division 1 for detail building description.

B. Existing Conditions

1. [Perform a functional test of the existing security devices and provide a written list to the Owner and Engineer of deficiencies prior to the commencement of work. Security work not identified assumed as functional and contractor will repair at no additional cost to the Owner.] (only include if reusing existing security equipment with new security work)

C. Base Bid Work

1. Access Control and Alarm Monitoring System (ACAMS)
   a. The Owner requires an access control system to automate opening and closing of the building, restrict access after hours by cardholder privileges, and monitor specific spaces for intrusion.
   b. The ACAMS consists of card readers, control panels, power supplies, workstations, alarm monitoring devices, and interfaces to other security equipment.
   c. Refer to Section 28 13 00 for detailed description of system.
2. Intrusion Detection System (IDS)

a. The IDS consists of keypads, control panels, duress buttons, alarm monitoring devices, and interfaces to other security equipment.

b. The IDS will communicate with a remote, third-party central station for alarm monitoring and contact Police Services during day-time operation and dispatch of the local Police Department after hours.

c. Refer to Section 28 16 00 for detailed description of system.

3. Video Surveillance System (VSS)

a. The Owner requires a video surveillance to provide a photographic record of access control transactions and alarm events, some real-time monitoring of the facility, and integration with the access control and alarm monitoring system.

b. The VSS consists of a combination of analog and IP cameras, power supplies, IP encoders, and network video recorders.

c. Refer to Section 28 23 00 for detailed description of system.

4. *[The System includes integration with the Elevator conveying system to provide the following:*

a. Individual floor and/or hall call access control]

5. The System includes integration with the Fire/Life-Safety system to provide the following:

a. Automatically release locks upon fire alarm activation for doors within the path of egress

b. Disconnect power to magnetic door holders to automatically close doors after business hours

1.05 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Contractor Qualifications

1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.

2. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:

a. Software House CCure 9000

b. Salient Systems

C. Product Data

1. Obtain written approval from the Engineer for the product data submittal prior to the release of materials and equipment purchase order and prior to installation.

2. Quantity: Submit product data submittals as described in Division 1.

3. Format:

a. Minimum Format: Submit each product data submittal in an 8-1/2 x 11 inch folder. Product data submittal shall be in a 3-ring binder (or similar). If in a 3-ring binder, insert the submittal information the transparent front cover and spine pockets.

b. Clearly label the cover and spine of each submittal with the following information:
   1) Client Name
   2) Project Name and Address
   3) Project Submittal Number
   4) Submittal Name (e.g., “Product Data Submittal for Video Surveillance System”)
   5) Specification Section Number (e.g., “Section 28 23 00”)
   6) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
   7) Contractor Name

c. Include a Table of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., “2.02-A Network Video Recorders”).

d. Include tabbed separators for improved navigation through the submittal.

4. Content:

a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted. Have the person who prepared the submittal sign the document as well. Failure to comply with this requirement shall constitute grounds for rejection of submittal.

b. Product Information: Product Data submittal shall consist of manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product’s characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in the Division 28 specifications. Include relevant products that will be installed, which are not listed in the specifications.

c. Re-submittals: Provide a cover letter with the re-submittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any re-submittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the re-submittal package.

D. Shop Drawings

1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.

2. Quantity and Media: Submit shop-drawings as described in Division 1.

3. Format:

a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

b. Use the same size drawing sheet as the drawings of the Contract Documents.

c. Text: minimum of 3/32” high when plotted at full size.

d. Screen background information.

e. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

f. Scaling:

1) Scale floor plans at 1/8”=1’-0”

2) Scale enlarged room plans at 1/4”=1’-0”

3) Scale wall elevations at 1”=1’-0”

4. Content:

a. Submit shop drawings that represent proposed installation of security system.

b. Floor Plans: Scale floor plans at 1/8”=1’-0”. Floor plans shall show:

1) Locations and identifiers of security devices.

2) Size, quantity, location and proposed routes of security cabling.

3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).

c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.

d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.

e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

f. Proposed mounting details

E. As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 1 in both hard copy and electronic formats.

2. Format:

a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.

c. Text: minimum of 3/32” high when plotted at full size.

d. Use symbols identical to the symbols shown on the Drawings.

e. Screen background information.

f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

3. Content:

a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.

b. Floor Plans: Scale floor plans at 1/8”=1’-0”. Floor plans shall show:

1) Locations and identifiers of security devices.

2) Size, quantity, location and proposed routes of security cabling.

3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).

c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.

d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.

e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

f. Custom mounting details

F. Operation and Maintenance (O&M) Manuals

1. Quantity: Submit quantity of O&M Manuals as described in Division 1 in both hard copy and electronic formats.

2. Format:

a. Submit each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.

b. Clearly label the cover of each O&M Manual with the following information:

1) Client Name

2) Project Name and Address

3) Manual Name (e.g., "Operation and Maintenance Manual for Telecommunications Cabling System")

4) Date of Submittal Format: <month> <day>, <year> (e.g., "January 1, 2010")

5) Contractor Name

c. Include a Table of Contents at the beginning that lists the contents.

d. Include tabbed separators for improved navigation through the manual.

3. Content:

a. 11"x17" prints of as-built drawings, as described above

b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)

c. Warranty certificate from the manufacturer and the Contractor

d. Manufacturer's instructions for system or component use

e. Instructions and requirements for maintenance and warranty issues

4. Contents shall include requirements and methods for maintaining installed products.

1.06 QUALITY ASSURANCE

A. General

1. Provide new and unused materials, equipment, and parts comprising the units specified herein of current manufacturer and of highest grade.

2. Only use products and applications listed in this Division on the project

B. Substitutions

1. Conform to the general requirements and procedure outlined in Division 1 in the Request For Substitution.

2. Where products are noted as "or equal", a product of equivalent design, construction, and performance is considered. Include in the Product Data submittal: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified.

3. Only one substitution allowed for each product specified. Do not provide substituted material, processes, or equipment without written authorization from the Engineer.

Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

4. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Approved substitutions do not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.

5. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

6. Whenever material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit support test data to substantiate compliance at no additional cost.

7. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

C. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License

2. Minimum five years experience in installation and service of access control, video surveillance, and intrusion detection systems.

3. Minimum five completed projects similar to scope and cost.

4. Evidence of technicians qualified for the work in the form of current manufacturer’s training certification

D. Materials

1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials

2. Use specified products and applications, unless otherwise submitted and approved in writing.

E. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 28 shall confirm to the most stringent of the applicable codes.

2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

F. Drawings

1. Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.

2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.

3. The Drawings do not fully represent the entire installation for the security system. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

4. Complete the details necessary for point-to-point design. This allows the Contractor to achieve desired results applying their own procedures and methods. Submit shop drawings for review prior to installation.

1.07 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.

2. Review of Shop Drawings Prepared by Other Subcontractors:
   a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.
   b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 28 contract documents. Document discrepancies or deviations as follows:
      1) Prepare memo summarizing the discrepancy
      2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
   c. Prepare and maintain a shop drawing review log indicating the following information:
      1) Shop drawing number and brief description of the system/material
      2) Date of the review
      3) Name of the individual performing the review
      4) Indication if follow-up coordination is required

3. Request for Information (RFI)
   a. Thoroughly review the contract documents prior to the preparation and submission of an RFI. If an RFI is submitted, attach 8 1/2" x 11" copies of relevant documents to clarify the issue.
   b. Submit RFIs with your recommended solution.
   c. Prepare and maintain an RFI log using a Microsoft Excel spreadsheet indicating the following information:
      1) RFI number and brief summary of the issue.
      2) Date of issuance and receipt of response.

4. Scheduling of Work
   a. Prepare work schedules for each floor or building indicating the following information:

1) Cable Installation
2) SEC Build Out
3) Device Installation
4) Programming
5) Testing
6) Other tasks included under the alternate work section of these specifications

B. Role of the Engineer

1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.

2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.

3. In general, the Engineer will participate during the construction phase as follows:

a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.

b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.

c. Interpret field problems for Owner, and translate between Owner and Construction Team.

d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use of CAD Files

1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.

2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage

1. Store materials in a clean, dry, ventilated space free from temperature extremes.

2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.

3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle in accordance with manufacturer's written instructions.

2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.09 WARRANTY

A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner.

B. Include in the warranty package, at a minimum, the following:

1. Software support agreement for the ACAMS and VSS
2. Software upgrades and patches
3. Labor to install software upgrades and patches necessary to maintain the latest version
4. Emergency service on regular working hour basis
5. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

1.10 MAINTENANCE

A. Extra Materials

1. Deliver extra materials to a secured location determined by the Owner.
2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.
3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service

1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
   a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, ACAMS equipment, power supplies, and electrical and mechanical controls
   b. Clean system equipment, including interior and exterior surfaces
   c. Perform diagnostics on equipment
   d. Check and calibrate each device
   e. Run system software and correct diagnosed problems
   f. Resolve previous outstanding problems
2. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.

B. Remove manufacturer identification marks from visible equipment.

C. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.02 TAMPER RESISTANT HARDWARE

A. Provide pinned-allen type hardware for exposed hardware in public spaces.

1. Provide hardware used in specialty metal surfaces that posses a similar finish color.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.

C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, “True Tape” the conduits to verify cable distances.

3.02 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.

B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.03 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:

1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures

1. Install boxes, panels, and enclosures square and plumb.

2. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.

3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.

4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting

1. Custom paint devices as indicated on the drawings.

3.04 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.

B. Punch List:

1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.

2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:

1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.

2. Repair defects prior to system acceptance.

D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.05 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION

SECTION 28 05 13

SECURITY SYSTEM CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:

1. Wire and cable
2. Compression Seal BNC Connectors

C. Related Sections:

1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
3. Section 28 05 53 – Security System Labeling: includes label types and formats.
4. Section 26 05 33 – Raceways: includes pathway types in different areas of the project.

1.02 SUBMITTALS

A. Product Data: Submit product information, including:

1. Cable Description and Use
2. Jacket Rating
3. Outside Diameter (of the overall wire or cable)
4. Manufacturer and Part Number

PART 2 - PRODUCTS

2.01 WIRE AND CABLE

A. General

1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise.
2. Cable installed outdoors or in underground conduit must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test.
3. Cables installed indoors to contain a plenum rated jacket (type CMP).

B. Manufacturers:

1. West Penn
2. Belden
3. Or Equal

C. Access Control & Alarm Monitoring System

1. Plenum Jacketed Cable
   a. #18/2 AWG unshielded: West Penn #25224B, door contact cable
   b. #18/4 AWG unshielded: West Penn #25244B, REX and alarm device cable
   c. #18/6 AWG shielded (overall): West Penn #253186B, card reader cable
   d. #16/2 AWG unshielded: West Penn #25225B, lock power cable
   e. #14/2 AWG unshielded: West Penn #25226B, lock power cable from local power booster to exit device
   f. #24/4 AWG shielded (overall): West Penn #D4854, RS-485 communications cable

2. Water Blocked Cable
   a. #18/2 AWG unshielded with Aquaseal tape: West Penn #AQC224, door contact cable
   b. #18/4 AWG unshielded with Aquaseal tape: West Penn #AQC244, REX and alarm device cable
   c. #18/6 AWG shielded (overall) with Aquaseal tape: West Penn # AQC3186, card reader cable
   d. #16/2 AWG unshielded with Aquaseal tape: West Penn #AQC225, lock power cable
   e. #14/2 AWG unshielded with Aquaseal tape: West Penn #AQC226, lock power cable from local power booster to exit device

D. Intrusion Detection System

1. Plenum Jacketed Cable
   a. #22/2 AWG unshielded: West Penn #25221B, door contact cable
   b. #22/4 AWG unshielded: West Penn #25241B, keypad and alarm device cable
   c. #18/2 AWG unshielded: West Penn #25224B, control panel power cable

E. Video Surveillance System

1. Cabling for IP cameras provided by Telecommunications contractor. Refer to *Section 27 15 13* – Communications Horizontal Twisted Pair Cabling.

2. Provide minimum RG-59/U CCTV video coaxial cable between analog cameras and the monitoring equipment, with the following features:
   a. 95% percent copper braid
   b. Foam dielectric
   c. Solid copper core
   d. 75 ohm characteristic impedance
   e. Plenum jacket

3. Plenum Jacketed Cable
   a. #RG-59/U coaxial: West Penn #25815, analog camera video cable

b. #18/2 AWG unshielded: West Penn #25224B, power cable

c. #22/4 AWG 2 pair individually shielded (overall): West Penn #D25420, RS-422 communications cable for analog PTZ cameras

4. Water Blocked Cable

a. #RG-59/U coaxial with Aquaseal tape: West Penn #AQC815, analog camera video cable

b. #18/2 AWG unshielded with Aquaseal tape: West Penn #AQC224, power cable

c. #22/4 AWG 2 pair individually shielded (overall) with Aquaseal tape: West Penn #AQC430, RS-422 communications cable for analog PTZ cameras

2.02 MISCELLANEOUS COMPONENTS

A. Cable Ties

1. General

a. Provide Velco-style cable ties on security cabling within telecommunications spaces and covered wireways.

b. Dress and bind cabling with cable ties every 24" minimum.

c. Width: 0.75 inches

d. Color: Black

2. Manufacturer:

a. Panduit #HLS-15-R-0 Black, 15 feet roll, cut to length

b. Or Equal

B. Compression Seal BNC (Bayonet Neill Concelman) Connectors

1. General

a. Suitable for use on RG-59/U coaxial cable for CCTV systems.

b. Compression seal connection

c. Capable of accepting cable with outside diameters between 0.195 - 0.245 inches. Twist-on or crimp-on style connectors are not permitted.

2. Manufacturer:

a. GEM Electronics #302-10CSTP compression seal BNC connector

b. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Label cables in accordance with Section 28 05 53 – Security System Labeling.

B. Horizontal Cable Installation and Routing

1. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations. Splices not permitted.

2. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
5. Do not exceed manufacturer's limits for pulling tension.
6. Do not use cable-pulling compounds for indoor installations.
7. Route cables under building infrastructure (such as ducts, pipes, conduits, etc) so the installation results in easy accessibility to the cables in the future. Do not route cables over building infrastructure.
8. Dress and secure coaxial cables to preclude stress and/or deformation.
9. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements.
10. Place cables 6", minimum, away from power sources to reduce interference from EMI.
11. Do not run signal wire and cable in parallel to power (120VAC).
12. Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.
13. Follow manufacturers recommended guidelines for installation.
14. When exiting the primary pathway (such as basketway or cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

C. Cable Routing and Dressing within Telecommunication Rooms

1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.
2. Only use Velcro type cable ties within the IDF.
3. Neatly bundle (dress cable longitudinally) and support security cables within overhead cable runways.
4. Dress and bind cabling with cable ties every 12” minimum.
5. Provide 4 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within the screw cover gutter wireways.

3.02 CABLE SUPPORT

A. Horizontal Support

1. Concrete and Metal construction (Above Ceiling)
   a. Provide separate and dedicated cable support system for security cable runs. Anchor cable support system to structural ceiling. Support and tie cables at a maximum of 5-foot intervals.
2. Wood Construction (above ceiling and no ceiling)
   a. Support cable utilizing appropriately sized drive rings or "D" rings.
   b. Fasten rings to structural ceiling.

c. Install drive rings at approximately 5 foot intervals.

d. Route cable through drive rings and cable tie at 10 foot intervals, or every other drive.

B. Vertical Support

1. Riser Systems

a. Route cable through conduit in vertical riser systems.

b. Terminate conduit at each stacked closet in a lockable junction box. Refer to Section 28 00 00 – Basic Security Requirements for minimum sizing of junction boxes and equipment enclosures.

c. Fastened entire cable group to the inside of junction box at every other floor or approximately every 24 feet.

d. Fasten cable in Junction box utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method.

2. Vertical cable on floor space not in riser system

a. Route cable from below suspended ceiling devices to above ceiling when possible.

1) Provide conduit and firestoppping for cable routed in fire rated wall assemblies.

2) Provide conduit for cable routed from below ceiling devices to above ceiling on concrete tilt up style walls.

b. Cable routed vertically from devices with no suspended ceiling.

1) Provide conduit stub from device junction box to 14 feet above finished floor minimum.

END OF SECTION

SECTION 28 05 53

SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:

1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:

1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

1.02 SUBMITTALS

A. Product Data: Submit the following:

1. Product information for components specified herein.

2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.01 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.02 LABELS

A. Wire and Cable Labels:

1. General
   a. Self-laminating adhesive laser labels.
   b. Machine printable with a laser printer.
   c. Cable size: 0.16 – 0.32” OD
   d. Color: white with black lettering

2. Manufacturer:
   a. Panduit #R100X125V1T, #R100X150V1T, and R100X225V1T wire marking labels

b. Brady #WML–211-295 and #WML-311-292 wire marking labels
c. Or Equal

B. Device Labels:

1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Requirements

1. Label the security system components. The components include, but are not limited to, the following:
   a. Equipment Enclosures
   b. Conduits
   c. Security Devices
   d. Batteries
   e. Wires and Cables
   f. Equipment Racks
   g. Terminal Blocks
   h. Relays
   i. Patch panels, and the termination positions within the patch panels.
2. Labels to coincide with device IDs used on the record drawings.
3. Degrease and clean surfaces to receive nameplates and labels
4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets

1. Label SEC enclosures associated with the security system with a nameplate.
2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
3. Example: Line 1: “SEC-01” (1/2 inch high letters)
   Line 2: “Security Equipment Cabinet” (1/4 inch high letters)

C. Conduits

1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
2. Example: “To SEC-01”

D. Security Devices

1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
2. Label each device in a concealed location with the system point number and address.

E. Batteries

1. Label power supply batteries with the month and year they were installed.
2. Example: "April 2012"

F. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.02 CABLE LABEL FORMAT

A. From Panel to Field Device

1. Line 1: Device Type and Device Number
2. Line 2: Panel ID – Port Number
3. Example: CR 001
   PANEL 2 – CR5
4. Standard Device Types
   a. CR = Card Reader
   b. K = Camera
   c. ET = Entry Telephone
   d. R = Relay Output
   e. A = Alarm Point
5. Standard Port #s
   a. CR = Reader
   b. M = Monitored Input
   c. R = Relay Output

B. From Door Junction Box to Card Reader

1. Line 1: Device Type and Device Number
2. Line 2: Panel ID – Port Number
3. Example: CR 001
   PANEL 4 – CR3

C. Miscellaneous Examples:

1. From Door Junction Box to Door Contact
   a. CR001
   b. DC
2. From Door Junction Box to Rex Alarm
   a. CR001
   b. REX ALM
3. From Panel to Rex
   a. CR001
   b. REX PWR
   c. 12 VDC
4. From Panel to Lock
   a. CR001
   b. LCK PWR
   c. 24 VDC

D. Communications Cable

1. Line 1: Communication Type and Direction
2. Line 2: Panel ID
3. Example: RS-485 TO
   PANEL 2
4. Typical Communication Types
   a. RS-485
   b. RS-232
   c. RS-422

END OF SECTION

SECTION 28 08 00

SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to thoroughly test the completed security system installation as described in these specifications.

B. Base Bid Work

1. Full testing of a completed security system which includes:
   a. Develop, submit, and obtain Engineer's approval of security system Pre-functional and Functional testing forms.
   b. Complete 100% Pre-functional test of the security system. Submit Pre-functional testing documentation reflecting that all security devices, cabling, locking hardware, power, interfaces to other systems, IT switches, computer/servers and other components required for a completely functional security system are provided per project documents.
   c. Complete 100% Functional test of the security system. Submit Functional testing documentation reflecting that all security equipment, components, interfaces, and programming are functioning correctly per project documents. Upon receiving approval of functional testing documentation, schedule final acceptance testing activities to be witnessed by Engineer and/or Owner.
   d. Demonstrate 100% security system functionality to the Engineer and/or Owner. Document testing activities and submit with final As-Built drawing.

C. Related Sections:

1. Section 28 00 00 – Basic Security Requirements
2. Section 28 05 13 – Security System Cabling
3. Section 28 05 53 – Security System Labeling
4. Section 28 08 00 – Security System Acceptance Testing
5. Section 28 13 00 – Access Control and Alarm Monitoring System
6. Section 28 16 00 – Intrusion Detection System
7. Section 28 23 00 – Video Surveillance System

1.02 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

A. Overview

1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.

2. Perform testing activities after-hours or on weekends when the system is "quiet" and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Functional Test

1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Owner and Engineer.

2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

C. Functional Test

1. Perform a 100% functional test of system aspects to verify correct operation prior to scheduling the final test. The functional test will help to make the final test run smoothly when demonstrating the system's operation to the Owner and Engineer.

2. Document the results of the pre-test using approved test forms and submit a copy to the Engineer along with the system activity reports prior to final acceptance test.

D. Final Acceptance Test

1. Perform a final test of the system in the presence of the Engineer and/or Owner to demonstrate correct operation of the security system.

1.03 SUBMITTALS

A. Operation and Maintenance Manuals: Submit the following for review and comment at the completion of the project:

1. Functional Design Manual: Includes a detailed explanation of the operation of the system.

2. Hardware Manual which includes:
   a. Pictorial parts list and part numbers
   b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators
   c. Telephone numbers for the authorized parts and service distributors
   d. Include service bulletins

3. Software Manual which includes:
   a. Use of system and applications software
   b. Initialization, start-up, and shut down procedures
   c. Alarm Reports

4. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:
   a. Computers and peripherals
   b. System start up and shut down procedures
   c. Use of system, command, and applications software
   d. Recovery and restart procedures
   e. Graphic alarm presentation
   f. Use of report generator and generation of reports

g. Data entry operator commands

h. Alarm messages and reprinting formats

i. System access requirements

5. Maintenance Manual which includes:

a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.

b. Detailed instructions for repair of the security system.

c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.

d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.

6. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.

7. Record Drawings Manual which includes 11"x17" prints of record drawings as described below.

B. Record Drawings: Submit the following for review and comment at the completion of the project:

1. Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints.

2. Include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.

3. Include the following additional information:

a. Device addresses & IP address information.

b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)

4. Final acceptance will not be made until the Engineer approves the record drawings.

1.04 QUALITY ASSURANCE

A. Provide a project manager to coordinate the security system commissioning work with other trades.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 SCHEDULING

A. Coordinate security acceptance testing with the General Contractor, and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

3.02 TESTING REQUIREMENTS

A. Site Tests

1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.

2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.

3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.

4. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:

a.	Building Perimeter Test:	Test doors, cameras, and devices related to securing the perimeter of the building.
b.	MDF/IDF Test:	Test devices related to securing the MDF and IDF rooms. Inspect system panels, power supplies, and other related security equipment located in these areas.
c.	Access Control System Test:	Test the software for correct programming and setup. Test control and alarm communication through both campus and District security workstations. Verify correct integration with the IDS and Video Surveillance Systems.
d.	CCTV Recording System Test:	Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS and IDS system for alarm call-up. Test and verify CCTV system viewable from workstations.
e.	Intrusion Detection System Test:	Test the alarm dialer and duress stations for correct programming and operation. Verify correct arming/disarming functions from each keypad and alarm partitioning. Verify integration with ACAMS and Video Surveillance Systems.
f.	CCTV Camera Test:	Review cameras for proper coverage, video quality, physical installation, etc.
g.	Other Readers/Door Test:	Test remaining card readers, scheduled unlock doors, and exit-only doors not included in the above tests.
h.	Glass Break Test:	Test the glass break detectors for correct operation.
i.	Motion Detector Test:	Test the motion detectors for correct operation and coverage.
j.	Battery and UPS Load Test:	Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

B. Test Preparation

1. Provide device identification numbers that differ from or were not included on the original contract drawing set.
2. Provide a complete systems point list.
3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.
4. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
5. Provide radios for use by the Engineer and Owner during testing.
6. Provide pre-programmed access cards for use during testing. Provide one card for each access level.

3.03 TEST PROCEDURES

A. Refer to the test forms for testing procedures for each type of device/system.

3.04 DOCUMENTATION

A. Provide a full-sized blueline drawing containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each ACU & I/O Board) for each SEC. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.

B. Provide a service log on the inside door of each SEC. Include columns for the following information: date of service, description of work performed, service technician(s), service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

3.05 DEMONSTRATION

A. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system.

B. Utilize the database for the project during training to give the users a project specific example to learn from.

C. Provide a minimum of *12 (or more hours depending on scope and complexity of project)* hours of on-site training by a factory trained representatives. Maintain a sign in sheet with names and dates of persons trained and forwarded to owner upon completion of training.

D. Provide for two Owner’s representatives to attend factory certification training (off-site) for both the following systems:

1. Access Control System
2. Video Surveillance System

END OF SECTION

SECTION 28 13 00

ACCESS CONTROL & ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control & Alarm Monitoring system installation, as described in these specifications.

B. Section Includes:

1. *ACAMS client workstations*
2. ACAMS control panels, input/output modules, and card readers
3. ACAMS power supplies
4. Alarm initiating devices, including: magnetic switch contacts, and request-to-exit sensors.
5. Interface to electric door hardware and ADA door operators
6. *Interface to elevator controls*
7. *Interface to fire/life-safety system*
8. Interface to security subsystems to allow bi-directional communication with one another

C. Products Installed But Not Supplied Under This Section:

1. Electric feed-through power transfer hinges
2. Electrified locking hardware cable and termination to transfer hinge and security system

D. Products Specified but Not Installed Under this Section:

1. *Access control devices inside elevator cabs, including card readers, interface relays, and reader modules.*

E. Products Furnished and Installed Under another Section:

1. 120V power
2. Conduit, junction boxes, and *(telecom cable trays, if included in project)*
3. ADA door operators and push buttons
4. Fire/life-safety system interface relays
5. Electromagnetic door holders
6. Network connectivity for ACAMS devices via Owner's local/wide area network

F. Related Sections:

1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
2. Section 08 71 00 – Door Hardware*: for wireless card reader with integrated locking hardware product requirements.*

3. Section 28 00 00 – Basic Security Requirements: for submittal formats, warranty, general product requirements, and installation requirements.
4. Section 28 05 13 – Security System Cabling: for cable requirements related to the ACAMS.
5. Section 28 05 53 – Security System Labeling: for device labeling requirements.
6. Section 28 08 00 – Security System Acceptance Testing: for testing requirements.
7. Section 28 16 00 – Intrusion Detection: for interface requirement to the ACAMS.
8. Section 28 23 00 – Video Surveillance System: for interface requirement with the ACAMS.

1.02 SYSTEM DESCRIPTION

A. Overview

1. The ACAMS is a distributed network of control panels connected to and programmed from an existing host server and client workstations, one located at the District Office and the others at each respective campus.
2. The ACAMS is utilized for electronically controlling access to students, delivery personnel, and staff entrances to the building(s).
3. The ACAMS consists of an existing Software House CCURE 9000 server located at the District Office in Martinez, existing client workstations, control panels, card readers, *battery powered wireless card readers with integrated locking hardware, wireless interface modules* and alarm initiating devices. The host server communicates with the field panels via the Owner's local/wide area network.
4. Card reader doors must tie into the existing District-wide host server. Develop schedules to automate the opening and closing of the building(s), including unlocking doors, bypassing alarms, and enabling ADA actuation devices.
5. Card readers used in classrooms and/or additional locations as identified by the college must include emergency lockdown capability for shelter in place. The lockdown capability will:
   a. Disable the exterior reader and only allow excess via mechanical key only.
   b. Notify Police Services via the access control system and/or the intrusion detection system of emergency lockdown alarm event.
6. The ACAMS also provides secondary alarm monitoring and alarm partition control of the IDS control panels through software integration.

B. Access Control & Alarm Monitoring System

1. Provide ACAMS interface software license for IDS control panels and program to enable bidirectional alarm communication for alarm notification and partition arm/disarm control.
2. Provide ACAMS interface software to VSS network video recorders to enable alarm event recording and automatic call up of associated cameras upon alarm activation (forced door, door held open, etc).
3. Provide ACAMS control panels located in the telecommunication rooms as indicated on project drawings. Coordinate exact location of control panels with local IT department. Panels support up to 16 card readers with locking control outputs and multiple general-purpose input/output modules for automation.

4. Provide proximity wireless card readers with integrated locking hardware. Wireless readers are battery powered.

5. Provide wireless interface modules. Field determine the quantity and exact locations of the wireless interface modules for full coverage of wireless card readers.

6. Provide wireless survey kit to verify wireless interface module placement.

7. Provide input and output modules in a lockable enclosure to support the project specific security system requirements.

8. Provide multi-technology card readers with optical tampers on doors deemed critical to the security of assets subject to a high possibility of theft, sensitive information, or other areas of critical nature and doors with operational requirements such as building entrances, as noted on the project drawings.

9. Provide alarm contacts and request-to-exit motion detectors for card reader controlled doors. *Include output from ACAMS to indicate alarm contact status to IDS.*

10. Provide alarm contacts for non-card reader controller perimeter doors as indicated on project drawings.

11. Provide local audible alarms at monitored emergency exit-only doors and special card reader doors as indicated on project drawings. Local audible alarms to sound upon alarm activation (forced door, door held open, etc). Provide monitoring of the keyswitch and remote reset through the ACAMS.

12. Utilize IDS integration to monitor motion detector and duress alarms through the ACAMS workstation.

13. Provide interface to ADA automatic/power assist door operator and corresponding actuator push plates or optical motion detection actuators.
    a. When door locked, exterior push plate/optical sensor is disabled
    b. When door unlocked, even momentarily, push plate/optical sensor is enable.
    c. Interior push plate/optical sensor unlocks door and triggers automatic door operator at all times.

14. Provide 12/24VDC ACAMS device and lock power supplies as indicated on project drawings with enclosure tamper switches.

15. Provide battery backup of system components and power supplies.

C. Elevator Interface (if required on project)

1. Passenger and/or freight elevator card readers to control access to floors based on cardholder access levels after normal business hours and on weekends.

2. Provide card readers at elevator call stations as indicated on project drawings. Call station card readers to activate call buttons and control access to elevator cab.

3. Provide interface relays between ACAMS and elevator controller.

4. Furnish card readers to elevator contractor for installation inside elevator cabs with card access control.

5. Route security cabling from the ACAMS control panels to the security demarcation enclosures located in/adjacent to the elevator machine room as indicated on the project drawings.

6. Connections in the demarcation enclosure include landings, terminal blocks, and labels.

7. Provide coordination during installation of card reader and cable terminations. Elevator contractor responsible for elevator traveler cable, connection from elevator controller to security demarcation enclosure, and installation of card readers within the elevator cabs.

D. Fire/Life-Safety System Interface (if required on project)

1. Coordinate with Fire/Life-Safety system contractor to automatically drop power from stairwell, elevator lobby, and other doors within the path of egress upon alarm activation of the Fire/Life-Safety system.

2. Coordinate with Fire/Life-Safety system contractor for scheduled release of electromagnetic door holders on designated card reader doors as indicated on project drawings. Provide ACAMS output modules as necessary to interface with Fire/Life-Safety system.

3. Provide emergency door release pull stations with double pole, double throw contacts located in elevator vestibule lobbies as indicated on project drawings. First set of contacts to break power to electrified door hardware on adjacent card reader door. Second set of contacts to connect with ACAMS. Provide ACAMS input modules as necessary to monitor status of emergency door release pull stations.

E. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wireway (use unsupervised inputs for this purpose).
   b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).
   c. Tamper switches located within each door junction box.

1.03 SUBMITTALS

A. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:

1. Device placement on floor plans
2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
   a. ACAMS control panel
   b. ACAMS card reader and input/output modules
   c. ACAMS power supplies
   d. Card Readers
   e. Wireless Card Reader interface modules
   f. Alarm contacts and request-to-exit sensors
   g. Local audible alarms
   h. Interface to electrified door hardware
   i. Interface to ADA auto operators and actuators
   j. Interface to fire/life-safety system
   k. Interface to elevator controller
   l. Hardwired interfaces to IDS

m. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

3. Schedules: Provide schedules for ACAMS control panels that show each point ID with a description of the connected devices.

4. Block Diagram/Riser Diagram: Show the ACAMS components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

5. Custom mounting details

1.04 EXTRA MATERIALS

A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)

1. Card Readers

2. Fuses (Place five (5) of each type of fuse inside each SEC and power supply housing).

3. Relays

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Access Control & Alarm Monitoring System

1. Software House CCURE 9000 to match campus standards

2.02 ACAMS CONTROLLERS

A. General

1. An intelligent controller with integrated battery backup, database, and communication ports that supports 16 card readers.

2. Supports multiple communication channels to which a variety of devices can connect.

3. Supports hardware modules used for additional memory and/or for future feature enhancements.

4. Functions provided include:

a. Central control for attached devices and addressable modules

b. Makes decisions for access

c. Responds to monitor activity

d. Receives input to control its decision making

e. Reports activity to other devices

B. Features

1. Supports HID proximity, MIFARE, and DESFire card reader formats

2. Supports flash upgrades for firmware updates

3. Utilizes an onboard Ethernet NIC for TCP/IP communication, supporting IPv4 and IPv6

4. Global input/output and anti-passback functionality

5. Capable of utilizing keypad commands to activate/deactivate events

C. Supports RS-485 or RS-422connectivity to addressable modules:

1. Input Module: Supports 8 Class A supervised input points
2. Output Module: Supports 8 Form C dry contact relays
3. Reader Interface Module: Supports 2 or 4 card readers with associated alarm contacts, request-to-exit devices, and lock outputs

D. Manufacturer

1. Software House # iSTAR ULTRA 64MB control panel
   a. Accessories
      1) Software House # I8 input module
      2) Software House # R8 output module
      3) Software House # RM-4E reader interface module
      4) Allegion PIM400-485; Panel Interface Module

2.03 EQUIPMENT ENCLOSURES

A. General

1. Provide enclosures with butt hinged and lockable door containing a lock kit (keyed alike with other security enclosures on the project).
2. Provide perforated back panel for mounting control boards, relays, and terminal strips with enclosure.
3. Provide slotted wiring duct for routing security cabling within enclosure.
4. One tamper switch for each enclosure

B. Security Equipment Cabinets

1. Type: NEMA type 1 enclosure
2. Size: 36” x 24” x 6” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out
4. Manufacturer:
   a. Cooper B-Line # 36246-1PP with back panel and lock kit
   b. Hoffman #A36N24M with #A36N24MPP back panel and #A612AR lock kit
   c. Or Equal

C. Security Junction Boxes

1. Type: NEMA type 1 enclosure
2. Size: 12” x 12” x 6” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out
4. Manufacturer:
   a. Cooper B-Line # 12126-1PP with back panel and lock kit
   b. Hoffman # A12N126 with #A12N12PP back panel and # A612AR lock kit
   c. Or Equal

D. Slotted Wiring Duct

1. Type: Lead-free PVC with narrow finger design

2. Size: 1” x 1” minimum
3. Color: Light gray
4. Manufacturer:
   a. Panduit # Type-F narrow slot wiring duct
   b. Iboco # T1-1010 wiring duct
   c. Or Equal

2.04 WIREWAYS

A. General:

1. Provide screw cover wireway sections with open top assembly as shown on Security drawings.
2. Provide closure plates to secure end of wireway sections.

B. Screw Cover Gutter Wireways

1. Type: NEMA type 1 enclosure
2. Size: 4” x 4” x 48” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out
4. Manufacturer:
   a. Copper B-Line # 4448-G-NK lay-in painted wireway without knockouts
   b. Hoffman # F44T148GVP lay-in painted wireway without knockouts
   c. Or Equal
5. Accessories:
   a. Cooper B-Line # 44-E-NK closure plate without knockouts
   b. Hoffman # A44GCPNK closure plate without knockouts
   c. Or Equal

2.05 TERMINAL BLOCKS

A. General

1. Provide terminal blocks inside SEC for demarcation of elevator traveler and security cabling.
2. Provide DIN rails and other mounting accessories for a complete installation.

B. Modular Terminal Strips

1. Push-in style bridging system that utilizes the IDC termination method
2. Feed through style, single level
3. Modular design
4. Capable of mounting on standard 35mm DIN rails
5. Manufacturer:
   a. Phoenix Contact # QTC-1,5 terminal block
   b. Weidmuller
   c. Or Equal

6. Accessories:
   a. Phoenix Contact # NS-35/7,5 DIN rail
   b. Weidmuller
   c. Or Equal

2.06 CARD READERS

A. General

1. Presenting an access card to the reader initiates a single transmission to the ACAMS controller.
2. Rugged, weatherized polycarbonate enclosure, designed to withstand an operating temperatures of -22 to 120 degrees Fahrenheit (-30 to 65 degrees Celsius) and operating humidity of 5-95% non-condensing.
3. Utilizes a Wiegand protocol for communication for compatibility with standard access control systems.
4. Utilizes a multi-color LED and an audible sounder to indicate the status of the door.
5. Utilizes an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.
6. FCC and CE certified, and conform to the following ISO standards:
   a. 15693 (CSN read-only)
   b. 14443A (CSN read-only)
   c. 14443B (CSN read-only)
7. Capable of reading the following frequencies and card formats:
   a. 125kHz – HID, Indala, or AWID proximity
   b. 13.56MHz – MyD, ISO 15693 CSN (MyD, ICODE, Tag-it), ISO 14443A CSN (MIFARE, DESFire), ISO 14443B CSN, and US Government PIV

B. Manufacturer

1. HID # multiCLASS series
   a. Wall mount: HID # RP40 multi-technology card reader
   b. Wall mount with keypad: HID # RPK40 multi-technology card reader with integrated keypad
   c. Mullion style: HID # RP15 multi-technology card reader

2.07 ACCESS CARDS

A. General

1. Utilizes a graphics quality surface that supports direct-to-card printing.

2. Capable of being produced with holograms, ultra-violet fluorescent inks, or other anti-counterfeiting features.

B. Manufacturer

1. HID ISOProx II proximity card, Corporate 1000 Program; verify card format with College in writing prior to ordering.

2.08 SECURITY SYSTEM PRINTERS

A. Badging System Printer

1. Features

a. Print Method: Dye-sublimation, resin thermal transfer

b. Resolution: Up to 300 dpi

c. Colors: Up to 16.7 million, 256 shades per pixel

d. Accept card thickness from 0.020 inches to 0.060 inches

e. Capable of utilizing custom watermarks for additional security

f. Includes Ethernet NIC option

2. Manufacturer

a. HID # DTC550 card printer

b. Zebra # P430i card printer

c. Magicard # Tango 2e card printer

d. Or Equal

2.09 ACAMS SECURITY WORKSTATION & COMPONENTS

A. ACAMS Security Workstation

1. Document the cost of this hardware at time of bid due to price reductions and advancements in technology. Prior to placement of order, provide upgrades to the most current model as requested by the Owner up to the cost of the specified product.

2. Provide complete prepackaged unit containing:

a. Processor: Intel Core i7 Quad Core 870 2.93GHz, 8M L3Cache

b. Memory: 4GB, 1333MHz FSB, DDR3 SDRAM, Non-ECC (2 DIMMS)

c. Video Card: Dual 512MB, dual monitor compatible for support for up to 4 monitors

d. Monitors: Two 22" widescreen monitors, 1920x1080 resolution, with digital video inputs

e. Hard Drive: 250GB SATA, 7200 RPM and 8MB DataBurst Cache

f. OS: Microsoft Windows 7 Professional, or latest OS supported by manufacturer

g. Optical Drive: 16xDVD-RW

h. Network Adapter: Gigabit Ethernet NIC

3. Manufacturer

a. Dell # OptiPlex 980 series workstation

1) Dell # USB Multimedia Pro keyboard

2) Dell # USB optical mouse

b. Or Approved Equal

B. ACAMS Software

1. Include software licenses: Badging software license

2. Manufacturer

a. Software House # C-Cure 9000 client software

C. UPS:

1. Provide one UPS for each workstation furnished.

2. APC or equal by BEST for backup of one CPU and two monitors. Connect UPS alarm condition output relay to security system. Provide smart software interface with UPS and operating system to facilitate automatic shut-down. Provide a separate UPS for each required workstation.

2.10 MAGNETIC CONTACT SWITCHES

A. Wood, Steel, and Hollow Metal Doors

1. General
   a. Mounting: Recessed
   b. Contacts: Single Pole, Single Throw
   c. Gap Distance: 0.5” maximum
2. Manufacturer
   a. GE Security # 1078C 3/4” alarm contact switch
   b. GRI
   c. Or Equal

B. Local Audible Alarmed Doors

1. General
   a. Mounting: Recessed
   b. Contacts: Single Pole, Double Throw
   c. Gap Distance: 0.5” maximum
2. Manufacturer
   a. GE Security # 1076C 3/4" alarm contact switch
   b. GRI
   c. Or Equal

C. Overhead Roll-Up Doors

1. General
   a. Mounting: Surface
   b. Contacts: Single Pole, Single Throw
   c. Gap Distance: 3.0” maximum
   d. Wiring: Armor Cable, 12” minimum
2. Manufacturer
   a. GE Security # 2205 floor mounted contact switch with 3’ armored cable lead
   b. GRI
   c. Or Equal

2.11 REQUEST-TO-EXIT MOTION SENSORS

A. General

1. Power: 12 or 24VDC, 35mA
2. Relay Output: 2 form “C” contacts
3. Adjustable relay latch time

4. Programmable retrigger or non-retrigger mode
5. Programmable Fail Safe or Fail Secure Modes
6. Radio Frequency Interference (RFI) Immunity range from 26 to 1,000 MHz at 50 v/m

B. Manufacturer

1. Bosch #DS160 with TP160 trim plate
2. Honeywell #IS320WH with IS310WHTP trim plate
3. Or Equal

2.12 LOCAL AUDIBLE ALARMS

A. General

1. Panel operating voltage selectable 12 or 24VDC at 150mA.
2. Keyswitch operation using rim cylinder provided by Owner to match existing standard.
3. Utilizes 80 Db horn.
4. Input points for door switch, alarm shunt, door status, tamper switch, and key switch override.
5. Output points for door propped alarm, intrusion alarm, door status, tamper switch, and key switch override.
6. Timers for access period, warning period, and auto reset.
7. Tamper switch to detect the removal of the unit from the electrical back box.

B. Manufacturer

1. Designed Security # 4200 local alarm sounder
2. Or Equal

2.13 ACAMS POWER SUPPLIES

A. General

1. Provides a 120VAC to 12 and 24VDC output, fully supervised power supply to power ACAMS field devices.
2. Utilizes 16 fused Class 2 rated power limited outputs.
3. Short circuit and thermal overload protection.
4. Integrated charger for sealed lead acid or gel type batteries.
5. Capable of providing a 10 amp supply current.
6. Supports a fire alarm disconnect to relay that individually selects any or all of the 16 outputs.
7. Enclosure with integrated tamper switch

B. Manufacturer

1. Altronix # MAXIM75 power supply
2. Or Equal

2.14 BATTERIES

A. General:

1. Voltage: 12.00
2. Amps: 12.00
3. Chemistry: SLA or VRLA valve regulated
4. Termination: Spade protected terminals

B. Manufacturer:

1. Yuasa #RE12-12 sealed lead acid 12V 12Ah battery
2. Interstate Batteries #SLA1105 sealed lead acid 12V 12Ah battery
3. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. ACAMS Control Panels

1. Place power supply and associated hardware in same location.
2. Install supervisory and end-of–line (EOL) resistors as required. Refer to Section 28 00 00 – Basic Security Requirements for EOL supervision requirements.
3. Connect power supply tamper switches to ACAMS for SEC hub monitoring.

B. Wireless Interface Module

1. Field determine best location for wireless card reader interface module. Locate module above accessible ceiling, whenever possible to avoid damage to units.

2. Connect wireless interface module to ACAMS panel using the RS-485 data bus.

C. Remote Reader Modules

1. Locate remote reader module in accessible ceiling space unless otherwise noted on the project drawings.

2. Power remove reader modules from power supply located at centralized security hub.

D. Four-State End-of-Line (EOL) Supervision

1. Provide designated resistors at device end of line per manufacturer's EOL recommendation to provide four-state supervision of security device and cabling.
2. Provide EOL supervision for alarm contacts, local alarm sounders, motion detectors, help/duress buttons, and other designated security devices connected to the ACAMS and IDS.
3. Provide the following states of supervision:
   a. Contact closed = Secure
   b. Contact open = Alarm
   c. Short circuit = Line fault
   d. Open circuit = Line fault

E. Card Readers

1. Wire the card reader‘s multi-color LED to indicate the following status of the door.
   a. Red status indicates the door is secure (locked).
   b. Green status indicates the door is unsecured (unlocked).
   c. Yellow status indicates the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.
2. Utilize configuration card to enable optical tamper.
3. Wire the card reader’s optical tamper to spare input on the ACAMS reader module and jumper ground wire from door contact to provide a Normally Closed circuit.
4. The card reader to produce an audible beep tone to indicate to the user:
   a. The card was read and/or access was denied.
   b. Door is being held open and needs to be closed.

F. Elevator Readers

1. Furnish card reader to elevator contractor for installation,

2. Coordinate the installation and termination of the card reader inside the cab and in the elevator machine room.

3. Coordinate with elevator contractor to connect ACAMS output relays to elevator controller. Install terminal blocks in security demarcation enclosure as indicated on project drawings to separate security from elevator cabling.

G. Door Hardware

1. Route power to electrically controlled locks on life-safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
2. Setup and conduct a door hardware coordination meeting.
3. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

H. Door Contacts

1. Install on protected (secured) side of door.
2. Install 6” from leading edge at top of door.

I. Request-To Exit Motion Detectors

1. Mount motion detector on the secured (protected) side of door.
2. Install motion detector so that detection pattern is not obstructed by Exit Signs, light fixtures and other objects that would interfere with proper operation.
3. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
4. Adjust detection sensitivity to pulse.
5. Mask detector lens to provide a confined detection area limited to the door handle or pushbar.

6. Run wire inside structural tube steel frame into back of condulet for cage locations.

J. Local Alarm Sounders

1. Mount local alarm sounder as indicated on project drawings.

2. Install local, square, and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.

3. Mount so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.

3.02 PROGRAMMING

A. Prior to the completion of construction, schedule and hold a meeting with the Owner to determine the programming criteria. Discuss the following:

1. Door and device names
2. Access card levels and door groupings
3. Alarm priority levels
4. Alarm integration with IDS including arming and disarming protocol through the ACAMS card readers (for example valid card disarms alarm partition while presenting card two times arms alarm partition)
5. Schedules and time codes
6. Holidays and holiday types (priorities)
7. Action/responses from individual input points
8. Standard and custom (expanded) reports
9. Defining alarm messages and standard response messages applicable to site
10. Routing of alarm points to selected pagers
11. Routing of alarm points to operator's workstations, printers, and history files
12. Coordinate implementation of graphics with Owner. Develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.
13. System data base backup to external hard-drives

B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.

C. System Operation, Alarm and Reporting Function: Program door control panel tamper switches to immediately reported as a separate "tamper" point to the system resulting in an alarm condition displayed in both text and graphic form on the applicable workstation(s) and an alarm message transmitted to the appropriate pager(s).

D. Receive CAD drawing files of floor plans and perform the following relative to system graphics:

1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
2. Convert drawings to a graphic file format compatible with the Owner's access control and alarm monitoring system.
3. Load drawing files into the system.

4. Apply new and predefined icons and other points on each graphic to indicate point and control status.

5. Link graphic images to reader, monitor and control points.

E. Program routing of monitor and control points. Route activations and restore messages to one or more of the following locations as directed by the Owner's Representative:

1. One or more system workstations;

2. One or more system printers;

3. One or more alphanumeric pagers;

4. History files in addition to the above;

5. History files only.

F. Program the system such that reliance on a remote host for routine building operations, such as scheduled door commands and conditional events, are minimized to the greatest extent possible and decisions are made at the local building controller.

G. Program the system in a manner that minimizes the amount of time required for the users to make updates and maintain the system on a daily basis especially updates that impact card holder record updates. Nested programs, such as reader groupings used in access codes shall be used to the greatest extent possible such that single actions are required to update an entire card data population. If there is a question regarding the appropriate approach to programming, given the flexibility of most systems, contact the Engineer prior to any initial programming

H. Complete other programming as required for system operation.

I. Program and setup the system such that no additional programming other than entering new access cards is required. Include setup of available features of the software.

J. Use the point names provided on the system point schedule.

K. Perform 2 full system back-ups at completion of initial programming and deliver one copy to owner with letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second CD-ROM and store onsite. Perform back-ups on a regular basis through the remainder of the project.

L. Customize menus with the assistance of the factory to "gray-out" features not used on project (such as elevator control).

M. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

3.03 TESTING

A. Commission ACAMS in accordance with Section 28 08 00.

END OF SECTION

SECTION 28 16 00

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services required to make a complete working intrusion detection system installation as described in these specifications.

B. Section includes:

1. Intrusion Detection System, including digital communicator, keypad, and alarm devices.
2. Door contacts, glass break detectors, motion sensors
3. Duress alarm stations
4. Interfaces and connections between intrusion detection subsystems to allow communication with one another

C. Products furnished and installed under another section:

1. 120V power
2. Network connectivity for IDS Panel via Owner's local/wide area network
3. Phone line

D. Related sections:

1. Section 28 00 00 – Basic Security Requirements: for submittal format, warranty, general product requirements, and installation requirements
2. Section 28 13 00 – ACAMS: for interface requirement to the intrusion detection system
3. Section 28 05 13 – Security System Cabling: for cable requirements related to the IDS
4. Section 28 05 53 – Security System Labeling: for device labeling requirements
5. Section 28 08 00 – Security System Acceptance Testing: for testing requirements

1.02 SYSTEM DESCRIPTION

A. Overview

1. The IDS is comprised of multiple areas that can be armed and disarmed independently of each other *[through IDS keypads or through integration with the ACAMS]*.
2. The IDS is utilized for after hours monitoring of the building(s), interior partitions and alarm zones. The IDS will also be utilized for 24-hour monitoring of specific areas which include but are not limited to duress buttons, glass breaks, etc.
3. Activation of the IDS dials a remote, third party central station to first contact Police Services on campus during campus hours or dispatch the local *[San Pablo/Pleasant Hill/Pittsburg/other city]* Police Department after hours.
4. The IDS integrate with the ACAMS through software to send alarm information for secondary monitoring with the ACAMS and *hardwired input points for remote monitoring of ACAMS door alarm contact status.*

B. Intrusion Detection System

1. Provide an IDS control panel with integrated UL listed digital communicator shown on the project drawings. Panels support up to 8 areas and 64 zones by use of addressable input/output point modules.
2. Provide LCD command keypads as indicated on project drawings. Keypads allow for system arming and disarming by authorized users.
3. Provide wireless back up alarm communicator.
4. Provide under counter duress buttons as indicated on project drawings. Program duress alarm inputs as 24 hours zones.
5. Provide *motion and glass break* sensors as indicated on project drawings.
6. Provide alarm contacts on perimeter doors and operable windows as indicated on project drawings. *(if project does not include ACAMS or integration to existing ACAMS)*
7. *Provide local audible alarms on doors indicated on project drawings.*
8. *Provide double pole, double throw alarm contacts on doors with local alarm sounders. Wire one contact to alarm sounder and wire the other contact to the IDS.*
9. Provide 12VDC auxiliary power supply to support the field devices indicated on project drawings.
10. Provide battery backup of IDS components and power supplies for a minimum of 24 hours in the event of a power failure or emergency.

C. Interface with ACAMS

1. Connect ACAMS alarm outputs to the IDS control panel. Provide expansion modules as necessary to support the security devices shown on the project drawings.
2. Integrate IDS with ACAMS for alarm monitoring and alarm partition arming/disarming through ACAMS workstation(s).

D. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wireway (use unsupervised inputs for this purpose).
   b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).

1.03 SUBMITTALS

A. Product Data: Submit product information for the intrusion detection systems, including:

1. IDS control panel
2. Keypads
3. Cellular backup communicator
4. *Duress buttons*
5. *Motion sensors*
6. *Glass break sensors*
7. *Alarm contacts*

8. Local audible alarms

9. Power supplies

10. Calculations for backup batteries

B. Shop Drawings: Submit shop drawings containing the following:

1. Device placement on floor plans

2. Point-to-Point Wiring Diagrams: Include wiring, points of connect, and interconnecting devices between the following:

a. IDS control panel

b. IDS expansion modules and relays

c. Keypads

d. Motion sensors

e. Glass break sensors

f. Alarm contacts

g. Local audible alarms

h. Power supplies

i. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

3. Schedules: Provide schedules for the IDS control panel that show each alarm zone, applicable area or partition, and a description of the connected device.

4. Custom mounting details

1.04 EXTRA MATERIALS

A. Provide 10%, of the total installed, spare parts for the following: (Round up to the next complete device)

1. Motion sensors

2. Glass break sensors

3. Duress buttons

4. Alarm contacts

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Intrusion Detection System

1. DSC to match campus standard

2.02 IDS CONTROL PANELS

A. General

1. Integrated UL listed digital communicator with phone line monitor (loop or ground start).

2. Supports up to 64 alarm zones and 8 programmable areas or partitions.

3. Capable of utilizing multiple telephone numbers, primary and duplicate paths with main and alternate destinations.

4. Capable of utilizing a dual phone line switcher to monitor 2 phone lines.
5. Capable of sending daily automatic test and status reports.
6. Supports supervised expansion and relay output modules.
7. Supports RS-232 connectivity to third party devices for automation.
8. Capable of utilizing an TCP/IP converter for Ethernet connectivity.

B. Manufacturer

1. DSC PowerSeries #PC1864 8-64 zone control panel
   a. Accessories
      1) DSC #PC5200 Power Supply Module
      2) DSC #PC5204 Power Supply Module
   b. Expansion modules
      1) DSC # PC5100 Addressable Xone Expander
      2) DSC # PC5108 8-Hardwire Xone Expander
      3) DSC # PC 5208 Programmable Output Module
      4) DSC # IT-100 Integration Module
      5) Lantronix # UDS1100 w/ #500-163-R cable adapter
      6) DSC #TL250GS Internet Alarm Communicator
   c. Wireless back-up communication device
      1) DSC #GS3060; Universal Wireless Alarm Communicator

2.03 IDS KEYPADS

A. General

1. 32-character display
2. Keys light on entry or key press
3. Back lighted multi-key touch pad
4. User controlled brightness and loudness

B. Provide the ability to display for each detection point:

1. Alarm
2. Trouble
3. Supervisory
4. Faulted
5. Custom text

C. System wide displays include:

1. Local system test
2. Sensor reset
3. Event log

D. Manufacturer

1. DSC #PK5500 64-Zone LCD Full-Message Keypad

2.04 DURESS BUTTONS

A. General

1. Actuating lever, housing, and cover plate made of ABS fire-retardant plastic
2. Latching circuit with integrated LED
3. Contact: Normally Open or Normally Closed electrical loop, SPDT
4. Operating Voltage: 12VDC

B. Manufacturer:

1. GE Security # 3040 panic switch
2. Or Equal

2.05 MOTION SENSORS

A. General

1. Type: Passive infrared (PIR) detector with Fresnel type lens
2. Operating Voltage: 10-14VDC
3. Range: 35’ x 35’ minimum
4. Integrated tamper switch

B. Manufacturer

1. Wall mount
   a. Bosch # ISM-BLP1 blue line PIR detector
   b. Or Equal
2. Ceiling Mount
   a. Bosch # DS938Z panoramic PIR detector
   b. Or Equal

2.06 GLASS BREAK SENSORS

A. General

1. Type: Digital, utilizing DSP technology
2. Operating Voltage: 6-18 VDC
3. Range: 25’ maximum, omnidirectional
4. Integrated tamper switch

B. Manufacturer:

1. Honeywell # FG-1628T glass break sensor
2. Or Equal

2.07 MAGNETIC CONTACT SWITCHES

A. Wood, Steel, and Hallow Metal Doors

1. Mounting: Recessed

2. *Contacts: Single Pole, Single Throw*
3. *Gap Distance: 1.0" maximum*
4. *Manufacturer:*
   a. *GE Security # 1078 1" alarm contact switch*
   b. *Or Equal*

B. *Local Audible Alarmed Doors*

1. *Mounting: Recessed*
2. *Contacts: Double Pole, Double Throw*
3. *Gap Distance: 0.5" maximum*
4. *Manufacturer:*
   a. *GE Security # 1076D alarm contact switch*
   b. *Or Equal*

C. *Overhead Roll-Up Doors*

1. *Mounting: Surface*
2. *Contacts: Single Pole, Single Throw*
3. *Gap Distance: 3.0" maximum*
4. *Wiring: Armor Cable, 12" minimum*
5. *Manufacturer:*
   a. *GE Security # 2205 floor mounted contact switch with 3' armored cable lead*
   b. *Or Equal*

2.08 LOCAL AUDIBLE ALARMS

A. *General*

1. *Panel operating voltage selectable 12 or 24VDC at 150mA.*
2. *Keyswitch operation using rim cylinder provided by Owner to match existing standard.*
3. *Utilizes 80 Db horn.*
4. *Input points for door switch, alarm shunt, door status, tamper switch, and key switch override.*
5. *Output points for door propped alarm, intrusion alarm, door status, tamper switch, and key switch override.*
6. *Timers for access period, warning period, and auto reset.*
7. *Tamper switch to detect the removal of the unit from the electrical back box.*

B. *Manufacturer*

1. *Designed Security # 4200 local alarm sounder*
2. *Or Equal*

2.09 IDS POWER SUPPLIES

A. General

1. Provides a 120VAC to 12/24VDC output, fully supervised power supply to power IDS field devices.
2. Utilizes 16 PTC Class 2 rated power limited outputs.
3. Short circuit and thermal overload protection.
4. Integrated charger for sealed lead acid or gel type batteries.
5. Capable of providing 6 amp supply current.

B. Manufacturer

1. Altronix # AL600ULXPD16CB multi-output power supply/charger
2. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Follow manufacturers recommended guidelines for installation.

B. Components

1. IDS Control Panel
   a. Utilize dedicated *[or ACAMS]* power supplies to power control panel and associated expansion boards. Do not use plug-in transformers.
   b. Place power supply and associated hardware in same location.
   c. Install supervisory and end-of-line resistors on alarm initiating devices.
   d. Coordinate installation of phone jack and network connection in IDS control panel enclosure for communications to the contracted central station and integration with the ACAMS.
2. Keypads
   a. Mount keypads as indicated on project drawings.
3. Duress Buttons
   a. Mount duress buttons under work desks as indicated on the project drawings.
   b. Coordinate with architect and casework contractor to field determine exact placement prior to installation.
4. Motion Sensors
   a. Mount motion detectors as indicated on project drawings. Verify current location to maximize coverage prior to installation.
   b. Install motion detector so that detection pattern is not obstructed by exit signs, light fixtures, and other objects that would interfere with proper operation.
5. *Glass Break Sensors*
   a. Mount glass break detectors as indicated on drawing. Verify correct location to maximize coverage prior to installation.
6. Door Position Contacts *(if not installed with ACAMS)*
   a. Program input on IDS control panel to receive alarm output from ACAMS indicating card reader door forced or door held-open alarm.
   b. Install on protected (secured) side of door.

c. Install 6" from leading edge at top of door.

3.02 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner to determine the following programming criteria:

1. Zone or alarm point descriptions
2. User authority levels to arm/disarm areas or alarm partitions
3. Auto arm/disarm schedules
4. Arm/disarm requirements through the ACAMS using specific credentials.
5. Interface requirement with ACAMS
6. Central station response from individual alarm points
7. Central station password and call list information

B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests. Program and setup the system such that no additional programming other than entering new access codes is required.

3.03 TESTING

A. Commission the Intrusion Detection System in accordance with Section 28 08 00.

END OF SECTION

SECTION 13720

VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system installation, as described in this specification.

B. Section Includes:

1. VSS Monitoring and Recording System
2. VSS Fixed, Multi-sensor, and PTZ IP cameras, lens, mounts, and housing
3. VSS Power supplies
4. Integration with ACAMS
5. Interfaces and connections between VSS subsystems to allow communication with one another

C. Products Supplied But Not Installed Under This Section:

1. None

D. Products Installed But Not Supplied Under This Section:

1. None

E. Products Specified But Not Installed Under This Section:

1. None

F. Products Furnished and Installed Under another Section:

1. 120V power
2. Ethernet cable back to telecommunication for IP cameras
3. PoE switches in the telecommunications rooms for VSS connectivity via LAN/WAN

G. Related Sections:

1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
2. Section 280000 Basic Security System Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
3. Section 281300 Access Control & Alarm Monitoring System: includes product information for video integration with the ACAMS.
4. Section 280513 Security System Cabling: includes product information for wire and cable needed to support the video surveillance system.

5. Section 280553 Security System Labeling: includes label types and formats for security devices.

6. Section 280800 Security Acceptance Testing: includes the integrating testing/commissioning requirements for the video surveillance system.

1.02 DEFINITIONS

A. The Definitions of Division 1 apply to the 28 XX XX sections.

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:

1. "IP": Internet Protocol
2. "NVR": Network Video Recorder
3. "VMS": Video Management System
4. "PTZ": Pan-Tilt-Zoom
5. "NAS": Network Attached Storage
6. "PoE": Power-over-Ethernet
7. "VSS": Video Surveillance System

1.03 SYSTEM DESCRIPTION

A. Overview

1. The VSS is a network of IP cameras connected to and managed through a video management and recording server software and viewed on client workstations. The recording servers are managed and provided by District / Campus IT on centrally located servers.
2. The VSS consists of interior and exterior fixed and PTZ IP cameras, networked video recorders, management software, and dedicated client video monitoring workstations.
3. Cameras will integrate with the ACAMS through software and TCP/IP communication for alarm events which initiate video recording and tag video with specific alarms.

B. VSS Camera System - Base Bid

1. Provide VSS software and licenses capable of video motion detection and integration capabilities with the ACAMS software for alarm interface.
2. Provide the appropriate number of video licenses for IP cameras connected to the VSS video management system.
3. Coordinate installation of VSS camera licenses on centrally located network video server(s) hardware provided by the Owner. Provide District / Campus IT the bandwidth and storage requirements for cameras included under the project scope to ensure appropriate resources are available.
4. *Provide NVR client workstation software for monitoring and viewing capabilities in the Police Services Office. Load client software on existing workstation located in the security office.*
5. Coordinate network connection between IP cameras and existing security workstation at the Police Services Office with the District's IT department prior to installation.

6. Coordinate one static IP network connection for each camera *and/or IP video encoder*.
7. Provide IP fixed VSS cameras as indicated on the floor plans.
8. Provide IP multi-sensor VSS cameras as indicated on the floor plans.
9. Provide IP PTZ VSS site camera as indicated on the floor plans.
10. Provide day/night cameras in outdoor locations with low light levels. Coordinate field of view with exterior light sources to prevent poor image quality.
11. Provide VSS camera power supplies (if needed) for PTZ and exterior camera enclosures.
12. Provide software interface to the ACAMS for alarm call up of cameras and PTZ specific presets on predefined alarm events.

C. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wire way
   b. Supervision of power supplies and batteries

1.04 SUBMITTALS

A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:

1. Device placement on floor plans.
2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
   a. Video surveillance system, monitors, and recording equipment
   b. Devices connected to the system
   c. Miscellaneous control relays
   d. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
3. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
4. User interface graphics with icons and control buttons displayed.
5. Custom mounting details

1.05 EXTRA MATERIALS

A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)

1. Fuses (Place five (5) of each type of fuse inside each power supply).

1.06 WARRANTY

A. Camera Systems

1. Provide a manufacturer's warranty covering repair or replacement of defective parts for a period of one year from the date of shipment from the factory
2. Cameras and support devices
   a. Provide a manufacturer's warranty covering repair or replacement of defective parts for a period of one year from the date of shipment from the factory.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Video Surveillance System
   1. Network Video Recorder Software
      a. Salient Systems
   2. IP Cameras
      a. Sony
      b. Axis Communications
      c. Arecont Vision
      d. Or Equal
   3. Power Supplies
      a. Altronix
      b. Pelco
      c. Or Equal

2.02 CAMERA SYSTEMS

A. General
   1. Type: Color, solid-state CCD with DSP technology, unless otherwise noted
   2. Power: 24 VAC/VDC,
   3. Imager: 1/3 inch format, unless otherwise noted
   4. Lens Mount: Accept a "CS" mount auto or manual-iris lens
   5. Synch: Adjustable line lock for synchronizing camera to power line. No auxiliary sync cable required.
   6. Resolution: 640x480 minimum resolution (EIA RS-170), unless otherwise noted
   7. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted
   8. Lens: Field determine, unless otherwise noted
   9. Video transmission through IP or analog signals through IP encoder

B. Fixed IP Interior Dome Cameras
   1. Complete prepackaged unit containing:
      a. Minimum 1280x720 megapixel resolution for fixed cameras, with progressive scan

b. Resolution: 30 frames per second at all resolutions
c. Video streaming: Simultaneous Motion JPEG and H.264
d. Auto iris, varifocal lens of 2.5-6mm
e. Security: IP address filtering and HTTPS encryption
f. Power over Ethernet (IEEE 802.3af), Class 1
g. Connectors:
    1) Ethernet 10/100 BaseT, RJ-45
    2) Terminal block for alarm inputs, output, and RS-485/422
    3) Power - Mini DC
h. Dome housing

2. Manufacturer:
    a. Axis #P33 Series network dome megapixel camera
    b. Sony #SNCDH140 network dome megapixel camera
    c. Arecont Vision #AV1355 network dome megapixel camera
    d. Or Equal

3. Accessories:
    a. Axis In-Ceiling Mount #5502-361 or Surface Mounting Plate #5502-401
    b. Sony In-Ceiling Mount #YTICB45
    c. Arecont Vision Surface Mounting Plate #MD-EBA
    d. Or Equal

C. Exterior Fixed IP Mini-Dome Cameras

1. Complete prepackaged unit containing:
    a. Superior 1.3 megapixel image sensor quality with progressive scan
    b. Resolution: 12 frames per second at 1280x1024 and 30 frames per second at 640x480
    c. Video streaming: Simultaneous Motion JPEG and MPEG-4
    d. Auto iris, varifocal lens of 2.8-10mm
    e. Security: IP address filtering and HTTPS encryption
    f. Power over Ethernet (IEEE 802.3af), Class 1
    g. Connectors:
        1) Ethernet 10/100 BaseT, RJ-45
        2) Terminal block for alarm inputs, output, and RS-485/422
        3) Analog video, BNC composite output
        4) Audio line output, mini-jack
    h. Vandal resistant dome housing
    i. Manufacturer:
        1) Axis #P33 Series megapixel network mini-dome camera
        2) Or Equal
    j. Accessories:
        1) Axis #5502-321 Pendant kit
        2) Axis #5017-611 Wall Bracket
        3) Axis #5017-641 Corner Bracket

4) Axis #5017-671 Pole Bracket

D. PTZ IP Dome Camera

1. Provide IP PTZ camera with appropriate mount to flush mount into roof soffit
2. Complete prepackaged unit containing:
   a. 1/4” high-resolution color CCD camera & motorized zoom auto-iris lens
   b. Resolution: Supports 1280x720 resolution at 30 frames per second
   c. Resolution: 30 frames per second at all resolutions
   d. High-speed pan and tilt that is stepper motor driven (belt-driven not acceptable).
   e. Integral receiver/driver
   f. Color
   g. Integral 18X min optical zoom lens for exterior locations
   h. Exterior cameras: wide dynamic range and auto day/night switching between color and B/W
   i. Motion JPEG and H.264 video compression
   j. Integrated heater and blower for exterior locations
   k. Power over Ethernet plus (IEEE 802.3at) compatible
   l. Electronic Image Stabilizer
3. Provide seismic support of unit attached directly to roof soffit structure.
4. Manufacturer:
   a. Sony #SNCRH164
   b. Axis #P5534 Series
   c. Or Equal
5. Accessories:
   a. Sony #UNI#MB1 mounting bracket
   b. Axis #T91A Mounting Accessories
   c. Or Equal

E. Multi-sensor camera

1. Complete prepackaged unit containing:
   a. Minimum resolution: (4) 1920 x1080
   b. Video Compression format: H.264
   c. Power over Ethernet (IEEE 802.3af, Class 2)
   d. Frame Rate: 12.5 fps at H.264
   e. Sensor: Four 1/2.8” progressive scan RGB CMOS sensors
   f. Vandal Resistant Dome
2. Manufacturer, or equal:
   a. Axis P3707-PE
3. Accessories, or equal:
   a. AXIS T91D61 Wall Mount including weather shield

F. License plate capture camera

1. Integrated infrared imager for capture up to 50ft.

2. *Housing: NEMA4 Compliant*
3. *IP Video Transmission*
4. *Manufacturers:*
   a. *Inex-Tech ALPR Platform*
   b. *ARH ParkIT*
   c. *Hanwa with Arteco LPR Open Platform Application*

2.03 VIDEO MANAGEMENT SOFTWARE

A. NVR Video Management Software

1. Video surveillance software must have software integration with ACAMS. Hard-wired input/output alarms is not acceptable.
2. Include software licenses:
   a. Camera licenses to support devices shown on project drawings
   b. Client workstation licenses to support a minimum of 5 concurrent users
   c. Internet Explorer client browser license
3. Manufacturer:
   a. Salient Systems Complete View Enterprise (to match existing standard)
   b. Salient Systems LPR Tracker

2.04 POWER SUPPLIES/BATTERY CHARGERS

A. VSS System Power Supplies

1. 120 VAC input to 24 VAC output, continuous current, fully supervised power supplies for power to cameras.
2. Provide a separate fused connection to power supply per camera.
3. Exterior PTZ Camera
   a. Pelco #WCS 1-4 NEMA4X/IP66 rated for outdoor use
   b. AXIS #5000-001 24VAC Outdoor power supply
   c. Altronix
   d. Or Equal

2.05 VSS LIGHTNING PROTECTORS

A. Power Line Protectors

1. Provide on power lines serving exterior cameras.
2. Manufacturer:
   a. PolyPhaser Corp #IS-SPTV
   b. DITEK
   c. Or Equal

B. PTZ Data Line Protectors

1. Provide on data lines serving exterior IP cameras.

2. Manufacturer:
   a. PolyPhaser Corp #NX4-60-IG
   b. DITEK
   c. Or Equal

2.06 IP VIDEO ENCODER

A. General

1. Video Compression: Motion JPEG, MPEG-4 Part 2 (ISO/IEC 14496-3), Profiles: ASP and SP

2. Resolution: 4CIF, 2CIFExp, 2CIF, QCI

3. Frame Rate: Up to 30/25 per channel

4. Pan/Tilt /Zoom control

5. Alarm and event management

6. Channels: 4 minimum

B. Blade Video Server

1. Hot-swappable

2. Built-in, universal power supply

3. Security: IP address filtering and HTTPS encryption

4. Manufacturer:
   a. Axis #243Q blade video server
   b. Or equal

C. Video Server Rack Enclosure

1. High density rack-mount solution

2. Capable of storing a minimum of 3 interchangeable and hot-swappable blade video servers

3. Manufacturer:
   a. Axis #291 1U video server rack
   b. Or equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. VSS Cameras

1. Provide outdoor housing and mounts for exterior cameras.

2. Field determine exact placement of cameras to ensure complete coverage.

3. Coordinate location with obstructions such as columns or exceedingly high shelving units to avoid concealment opportunity.

4. Field determine fixed camera lens size to ensure complete coverage.

5. Route watertight flex from junction box to camera housing from below on exterior cameras.
6. Provide 25 foot cable loop at PTZ location for relocating unit if required post installation
7. Coordinate Network Data Drop with Telecom contractor for each IP Camera.
8. Coordinate camera IP address with District IT staff.

B. VSS Power supplies

1. Do not combine with Access Control & Alarm Monitoring System power supplies.

C. Network Video Recorder Storage

1. Coordinate installation of additional camera licenses and programming of cameras on owner provided network video server with District ITS

D. Surge Protection

1. Provide surge protection for video, power, and control cable on exterior cameras.
2. Provide protective device at the camera and encoder/recorder device.

3.02 PROGRAMMING

A. Coordinate a meeting with Owner's IT representative to determine IP addresses and LAN/WAN utilization of IP cameras and NVRs.

B. Prior to the completion of construction schedule a meeting with the Owner and the Engineer to determine the programming criteria. Discuss the following:

1. Camera naming
2. PTZ Presets
3. Schedules and recording parameters including quality and frame rate (including video motion detection)
4. ACAMS alarm and event integration requirements for workstation pop-ups and recording.
5. Video archiving schedule
6. Live viewing requirements
7. System data base backups

C. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.

D. Setup and program the system such that no additional programming required.

E. Use the camera naming convention agreed upon at in the programming meeting when programming point names into the system.

F. Perform a full system back-ups at completion of initial programming and deliver one copy to the Owner with a Letter of Transmittal explaining information included in back-up and brief description of recovery procedures.

G. Customize menus with the assistance of the factory to "gray-out" features not used on project (such as elevator control).

H. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

3.03 TESTING

A. Commission the video surveillance system in accordance with Section 280800.

END OF SECTION

SOFTWARE HOUSE

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C•CURE 9000 Enterprise

Taking C•CURE 9000 further with advanced distributed architecture

Features That Make a Difference:

- Advanced distributed architecture for enterprise scalability
- Maintain independent control at each remote location
- Optimize local performance by limiting WAN traffic and latency
- Synchronize full database across all servers
- Manage entire enterprise across multiple geographical areas from one central location
- Monitor alarms from multiple sites on one workstation
- Global reporting for efficient, consolidated data tracking

C•CURE 9000 Enterprise provides advanced distributed architecture for enterprise scalability. Whether your organization consists of a few facilities that are locally dispersed or many that span the globe, this solution grows as your company grows.

C•CURE 9000 Enterprise gives corporate security personnel and IT managers central control over the entire system, while each local facility maintains independent control of its individual operation. It also allows system administrators at the main facility to configure and monitor all locations from that central site.

Each local server may be positioned near its relevant field hardware which limits traffic to the main server and optimizes performance. Each facility maintains a local SQL database which increases system reliability as there is no dependence on the master database or WAN connection for normal operations.

Data from each local server is synchronized with the main server via the WAN to ensure data consistency throughout your entire organization. All database information, including cardholder and access control information, is sent to the central server. In addition, when updates are made to the main server, those updates are distributed to the local servers to ensure local data is current.

C•CURE 9000 Enterprise allows system operators to simultaneously monitor alarms from multiple facilities from one workstation. You can manage your entire enterprise from a single client providing one source of critical information. Additionally, you can compile global journal and audit reports at the main facility for efficient, consolidated tracking of personnel or event information. These reports can be used for internal investigations or to comply with company mandates.

Features

Advanced Distributed Architecture for Enterprise Scalability

The C•CURE 9000 Enterprise architecture supports a master application server (MAS), and up to 20 satellite application servers (SAS) without limiting system functionality. All communication is performed across a WAN, which allows real time two-way communication between the MAS and each SAS.

Independent Control at Each Remote Location

Each SAS communicates directly with the MAS but is not dependent on the MAS for access control in the area in which the local hardware resides. Each satellite system administrator has total control over all access control field hardware and system information related to his/her respective location. This gives regional system administrators autonomous control over their individual regions independent of the MAS and corporate WAN. Each location retains its own database and has full local reliability. This prevents unnecessary system downtime should the SAS lose communication with the MAS.

Optimize Local Performance

By connecting a SAS to a Local Area Network (LAN) along with relevant access control hardware, local performance may be optimized in the event of latency from the WAN. The SAS may communicate directly with the hardware that is part of that particular LAN. There is no reliance on the MAS or any other SAS for functionality. Placement of the SAS within a LAN can decrease the time it takes to transmit data to the relevant hardware since there is no dependence on the WAN for operation. Much less bandwidth may be required, thereby increasing efficiency. Local performance is further optimized since the MAS performs substantial reporting for all SASs. This allows each SAS to allocate additional resources to perform important access control functions.

Synchronize Full Database Across All Servers

All access control information, not just cardholder data, from each SAS is synchronized with the MAS. The MAS then distributes any changes received from each SAS, so that all servers are equipped and operating with up-to-date information. This is all done in real time. Consistent synchronization of each local database to the master database ensures data consistency. This provides information that is necessary to make certain the organization is secure and its employees are well protected. Synchronization of a full database also gives security personnel the ability to compile global personnel and configuration reports quickly and efficiently.

Manage Entire Enterprise from One Central Location

Since all cardholder and access control field data collected from each SAS is synchronized and communicated to the MAS, you can manage and perform central monitoring operations. Viewing all data across all SASs gives you a full view of your entire operation.

Monitor Alarms from Multiple Sites on One Workstation

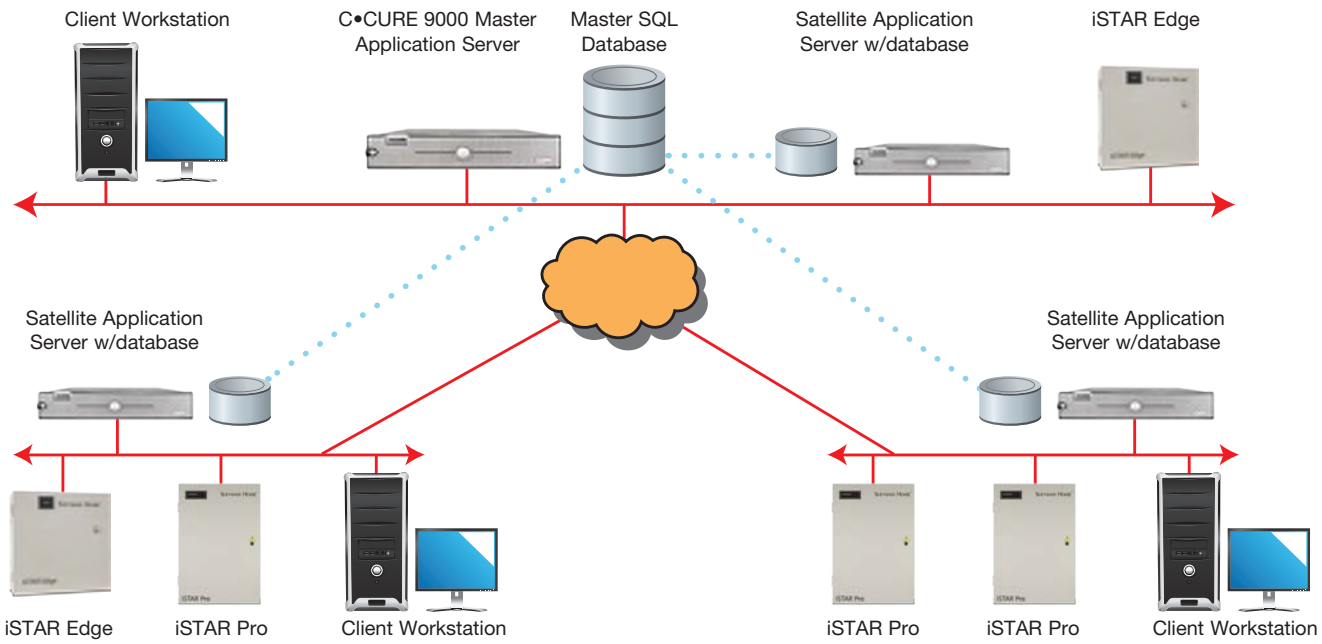
The power of C•CURE 9000 Enterprise allows you to simultaneously monitor alarms in multiple locations from one convenient workstation. Central monitoring of alarms from multiple sites means more flexibility. Operators might share the responsibility of monitoring various sites during different time periods.

Global Reporting for Efficient Consolidated Data Tracking

With C•CURE 9000 Enterprise's global reporting functionality, you can retrieve personnel, configuration, hardware, journal, and audit data from all facilities within the organization. This data can be used for a variety of reasons such as investigating unauthorized entries, analyzing hardware positioning across the organization, and complying with specific company mandates. You can save valuable time searching for data and compiling critical reports since all global information is replicated on the MAS where you can quickly run reports on pertinent information.

Features

C•CURE 9000 Enterprise Architecture Diagram



C•CURE 9000 Enterprise System Capacities[1, 2]

Master Application Server					
	MAS 1	MAS 2	MAS 3	MAS 4	MAS 5
Global Personnel Records	1,000	10,000	25,000	100,000	250,000
Simultaneous Clients (admin, monitoring or web)	5	5	5	10	10
Badging Clients	1	1	1	2	2

Satellite Application Server								
	SERIES L	SERIES M	SERIES N	SERIES P	SERIES Q	SERIES R	SERIES R PLUS	SERIES S
Online Readers	16	32	64	128	256	512	1,000	2,500+
Online Inputs	64	128	256	512	1,024	2,500	5,000	10,000+
Online Outputs	64	128	256	512	1,024	2,500	5,000	10,000+
Local Personnel Records	7,000	12,000	40,000	45,000	250,000	250,000	250,000	500,000
Simultaneous Clients	5	5	5	10	10	10	10	10
Badging Clients	1	1	1	2	2	2	2	2

(1) Capacities shown are default values. Additional connections may be purchased separately.
(2) Additional clients and badging clients may be added to a system license. Simultaneous client connections are tabulated by C•CURE 9000 Administration, Alarm Monitoring, and Web Client connections.

SOFTWARE HOUSE
A Tyco International Company

In addition to the essential C•CURE 9000 features, C•CURE 9000 Enterprise offers these powerful features[3]:

- Global Database Synchronization
- Global Alarm and Event Monitoring
- Global Journal and Audit Reporting
- Global Configuration Reporting
- Full Operation at Local Satellite

Maximum Concurrent Satellite Application Servers per Master Application Server	20
Authentication	Windows Authentication on Domain and Trusted Domain

C•CURE 9000 Master Application Server Minimum Hardware and Software

Processor	Intel® Quad-Core Xeon (2.4 GHz or greater); Xeon 5500 Series or greater
Hard Disk Drives	Dual drives: primary drive = 250 GB (9000 Runtime) secondary drive = 250 GB (data backups)
Drive Speed	15K RPM or greater
Memory	8 GB
Network Adapter Card	100/1000 MB/sec
DVD Drive	Required
Operating System	Windows® Server 2008 R2 Standard and Enterprise (64-bit only)
Web Server	IIS v6.0 or higher for C•CURE 9000 Web Client, if required
Database	SQL Server 2008 Standard and Enterprise (64-bit only)
Video Card	Dedicated 256 MB accelerated video card

C•CURE 9000 Satellite Application Server Minimum Hardware and Software

Processor

Series L-N	Intel Pentium Dual-Core or greater (2.5 GHz or greater)
Series P-S	Intel Quad-Core Xeon (2.4 GHz or greater); Xeon 5500 Series or greater

Hard Disk Drives

Series L-N	Dual drives: primary drive = 80 GB (9000 Runtime); secondary drive = 80 GB (data backups) Drive speeds: 7200 RPM or greater
Series P-S	Dual drives: primary drive = 250 GB (9000 Runtime); secondary drive = 250 GB (data backups) Drive speeds: 10,000 RPM or greater

Memory

Series L-N	4 GB
Series P-S	4 GB[4]
Network Adapter Card	100/1000 MB/sec
DVD Drive	Required
Operating System	Windows 7 Professional (32- and 64-bit) Windows Server 2008 R2 Standard and Enterprise (64-bit) Windows Server 2008 Standard and Enterprise (32-bit) Windows Server 2003 Standard and Enterprise SP2 (32-bit) Windows XP Professional SP3 (32-bit)
Web Server	IIS v6.0 or higher
Database	SQL Server 2008 R2 Express, Standard, and Enterprise (32- and 64-bit); SQL Server 2005 Express, Standard, and Enterprise (32-bit)
Video Card	Dedicated 256 MB accelerated video card

C•CURE 9000 Client Workstation Minimum Hardware and Software

Processor	Intel Pentium Dual-Core or greater (2.5 GHz or greater)
Hard Disk Drive	Single 100 GB; Drive speed: 7200 RPM or greater
Memory	2 GB
Network Adapter Card	100/1000 MB/sec
DVD Drive	Required
Operating System	Windows 7 Professional and Enterprise (32-bit) Windows Vista Business and Enterprise (32-bit) Windows 2003 Standard (32-bit) Windows 2003 Enterprise SP2 (32-bit) Windows XP Professional SP3 (32-bit)
Video Card	Dedicated 256 MB accelerated video card

Supported Languages

English, Arabic, Brazilian Portuguese, Dutch, French, German, Italian, Polish, Simplified Chinese, Spanish

(3) Refer to the C•CURE 9000 Security and Event Management data sheet for essential features
(4) 8 GB recommended for Windows Professional and Windows Server 2008 R2 (64-bit)

Related Products


C•CURE 9000


iSTAR Controllers


C•CURE 9000 SiteServer


C•CURE 9000 Web Client

Approvals

RoHS 2002/95/EC

SECURITY UL LISTED

CE

www.swhouse.com

SOFTWARE HOUSE

A Tyco International Company

C•CURE 9000 v2.0

Security and Event Management System

Features That Make a Difference:

- **NEW!** C•CURE 9000 Enterprise provides advanced distributed architecture for enterprise scalability
- Control and monitor areas with anti-passback, Occupancy Restrictions, and N-man Rule
- Easily create your own custom personnel data fields to capture information specific to your company
- Enhance security by requiring operator confirmation before manual activation of events
- Trigger automatic changes in access rights based on threat levels with Dynamic Clearance Filters
- Control security objects directly from the monitoring station or from graphical CAD-based maps
- Dynamically change views, reorder columns, and modify and filter data from a single screen
- Easily drag and drop cameras directly to the interface
- Share a single database while retaining security and privacy of your own information
- Significantly enhance security with intrusion zones and keypad commands
- Remotely manage and monitor the system using C•CURE 9000 Web Client
- Access and leverage LDAP-compliant data sources
- Create a virtual hub of integrated applications with robust Software Development Kit (SDK)
- Supports the entire suite of iSTAR and apC controllers[1], and SimplexGrinnell Ethernet ISC panels
- Integrates with American Dynamics solutions as well as other video systems
- FIPS 201 compliant

C•CURE 9000 is a powerful security and event management system that provides IT-standard tools and innovative distributed architecture. By leveraging .NET v3.5 technology, C•CURE 9000 offers native encryption and XML data transfer, making it one of the fastest, most secure systems in the industry.

C•CURE 9000 provides unsurpassed integration capabilities, advanced alarm routing, and remote access for system administration and monitoring via a light client. For extremely effective information management, C•CURE 9000 supports multiple layouts and monitoring station panes in the same windows. This enables you to focus on system activity, while another window displays your live video.

Integrate an unlimited number of security and business applications using the same GUI, navigation, driver interfaces, etc. with the C•CURE 9000 Kit (SDK). This kit is available through the “Software House Connected” platform integration program. The SDK provides the essential tools to develop hardware and software applications that communicate seamlessly with C•CURE 9000.

C•CURE 9000 provides advanced security with a built-in LDAP general connection. This allows a user to connect to many external data sources including industry-leading Microsoft Active Directory.

With C•CURE 9000 Web Client, you can manage personnel, display dynamic views, and monitor system activity directly from any PC with a web browser from anywhere in the world. C•CURE 9000 Web Client allows you to perform a wide range of tasks such as creating/modifying cardholders, and monitoring alarms/events while away from the workstation. Refer to the C•CURE 9000 Web Client data sheet on www.swhouse.com for more detailed information.

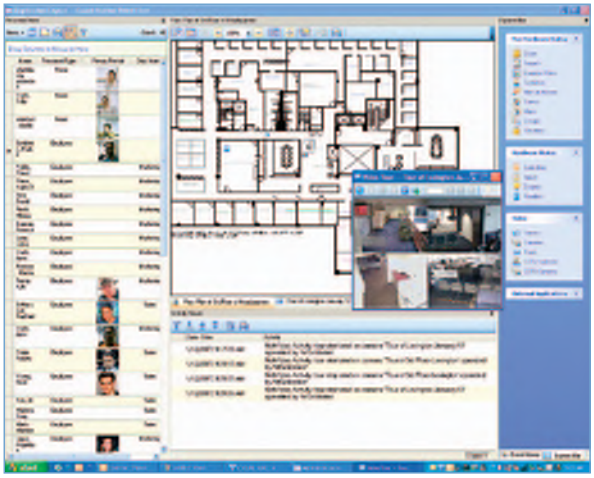
The new C•CURE 9000 Enterprise provides advanced distributed architecture for enterprise scalability. Whether your organization consists of a few facilities that are locally dispersed or many that span the globe, this solution grows as your company grows. Refer to the C•CURE 9000 Enterprise data sheet on www.swhouse.com for more detailed information.

(1) Minimum memory specification for apCs: 512k for apC/L and 1 MB for apC and apC/8X

Features

Customizable Integrated Monitoring Station

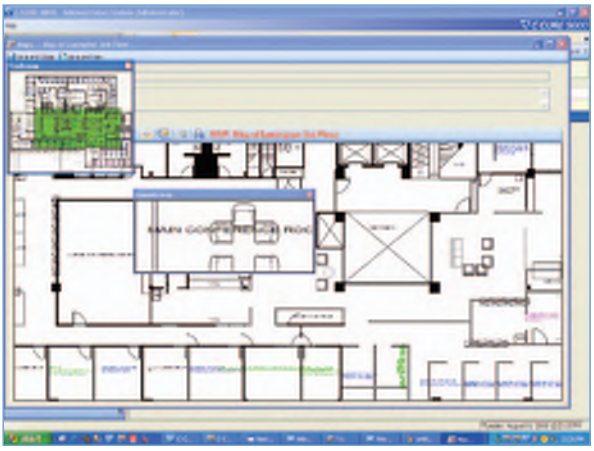
C•CURE 9000 offers preconfigured layouts or an empty palette for each administrator to customize. Drag and drop different viewers - some that represent objects like video tours and specific types of activities, live camera views, dynamic views of system activity, or configuration data, even the Windows Explorer bar to make navigation very easy.



The most powerful thing about the monitoring station is that each pane is live and interactive. With appropriate permissions, you can manipulate data fields and change views, navigate around maps, launch a video tour, perform quick searches and queries—all in real time, all from one interface.

Scalable, Editable Maps

Import CAD (.dwg, .dxf) or raster files (.bmp, .jpg, etc.) and populate complex floor plans with your security objects. All original CAD layers are immediately visible or can be hidden for easy viewing. Create new layers, and drag and drop security objects such as cameras, tours, inputs/outputs, and more directly to your drawing with scalable icons. One-click magnification and tracking views provide the ability to manage and navigate around your floor plans. For expansion projects, easily update or replace your CAD drawings without having to add security icons again.



Control Areas and Monitor Occupancy

Easily configure all areas across your facility to enforce anti-passback to prevent cardholders from passing their credentials to others to gain access to secured areas. You can further configure the system with time restrictions and to activate events such as sounding an alarm for anti-passback entry and exit violations.

Occupancy restrictions let you quickly define a maximum number of people, by role, that are permitted into a specified area. This type of control is essential in highly-classified areas such as those in government facilities or hospitals. An event can be triggered if the limit is violated. Similarly, a minimum occupancy level or N-man Rule limits access to an area based on a minimum required occupancy. For example, in order to grant access to a computer lab that stores highly classified data, a minimum of two people must present their credentials to unlock the door.

Intrusion Zones and Keypad Commands Enhance Security

To enhance security, grouping inputs and doors into intrusion zones allows you to arm/disarm alarm inputs as well as lock/unlock groups of doors while displaying their current mode and status in a defined area. To enforce operator accountability and prevent misuse of the system, you can configure C•CURE 9000 to require the operator to verify his/her credentials before manual activating events.

Leveraging the intrusion zone feature, keypad commands give you the ability to remotely activate cameras, doors, and other events as well as trigger a duress call right from a reader key pad. Keypad commands can be configured to require card presentation and/or a PIN to validate the command.

Highly Secure Database Partitioning

Independent companies can share a single database while, at the same time, partitioning that database to maintain the security and privacy of their individual organization. Users can specify to which multiple partitions they share privileges - doors, clearances, etc. The partitioning of information includes everything from personnel to video and hardware configuration.

Exceptionally Reliable Security

C•CURE 9000 provides FIPS 197-approved encrypted communication between the client and server, Microsoft Windows single sign-on, field-level audit, and authentication of historical log content feature a digital signature on each event. This allows administrators to detect additions, modifications, or deletions of data which is critical in order to maintain compliance with regulations, such as Sarbanes-Oxley, HIPAA, and 21-CFR Part 11. Distributed architecture and support for Microsoft SQL Server 2005 and 2008 provide powerful inherent data redundancy.

C•CURE 9000 addresses the U.S. Government's HSPD-12 and, specifically, Federal Information Processing Standards (FIPS) 201. A key component of the FIPS 201 credentialing for

Take a closer look

all government employees and contractors is the Cardholder Unique Identifier (CHUID). Support for extended card numbers allows users in government applications to comply with certain federal guidelines that require a multi-field CHUID. Additionally, C•CURE 9000 can be used in environments that use a Transportation Worker Identification Credential (TWIC) system to ensure individuals who pose a threat do not gain access to secure areas of the nation's maritime transportation system.

Complete Flexibility and Scalability Answers the Evolving Needs of an Enterprise

C•CURE 9000 Enterprise gives corporate security personnel central control over the entire system, while each local facility maintains independent control of its individual operation. Its power gives system administrators at the main facility the ability to configure and monitor all locations from that single site. You can manage your entire enterprise from a central client providing one source of critical information.

Additionally, you can compile global journal and audit reports at the main facility for efficient, consolidated tracking of personnel or event information. These reports can be used for internal investigations or to comply with company mandates. Refer to the C•CURE 9000 Enterprise data sheet for further details.

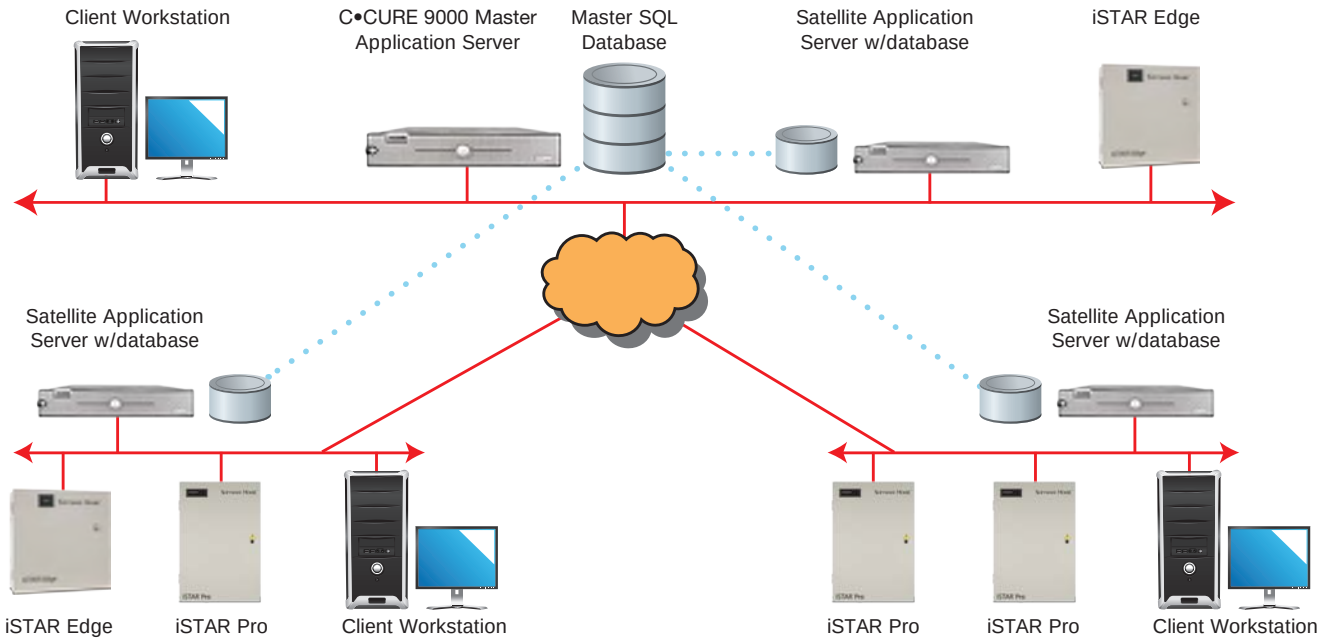
Sophisticated Badging with C•CURE ID

Leveraging a WYSIWYG badge designer, this solution offers superior control over color and easy manipulation of graphics. With a powerful Expression Builder, you can easily create expressions that simplify badge creation. Uncomplicated query features allow you to query a common field and then print those cards found by the query in one batch.

With the smart card enrollment solution, you can read and/or reprogram multiple smart card formats such as MIFARE® (1K & 4K cards), iCLASS®, and DESFire®. These cards can be programmed with a wide range of data depending on the protocol of each card type for critical security purposes and/or value add-ons such as vending, parking, etc. Refer to the C•CURE ID datasheet on www.swhouse.com for more detailed information.

Easily Migrate C•CURE 800/8000 Data

The optional C•CURE 9000 migration utility allows you to easily bring your important C•CURE 800/8000 data into C•CURE 9000. Data includes: cardholder information (including credentials and images), clearances, time specifications, readers, inputs, outputs, iSTAR and apC panels, doors, door groups, events, and actions.



C•CURE 9000 Enterprise Diagram

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C•CURE 9000 System Capacities

	SERIES L	SERIES M	SERIES N	SERIES P	SERIES Q	SERIES R	SERIES R PLUS	SERIES S
# of Online Readers	16	32	64	128	256	512	1,000	2,500+
# of Online Inputs	64	128	256	512	1,024	2,500	5,000	10,000+
# of Online Outputs	64	128	256	512	1,024	2,500	5,000	10,000+
# of Credentials	7,000	12,000	40,000	45,000	250,000	250,000	250,000	500,000
# of Simultaneous Clients[2] (Admin., Monitoring, or Web)	5	5	5	10	10	10	10	10
# Badging Clients	1	1	1	2	2	2	2	2

Note - Additional input/output capacity and additional clients and badging clients may be added to a system license.

Features Included with All C•CURE 9000 Series

- Activity Journal
- Anti-Passback
- Automated Import
- CCTV Integration
- Clearance Filters
- Configuration Templates
- Double Swipe
- Elevator Support
- Extended Card Number Support (Government Cards)
- Field Level Auditing
- Graphical Maps
- Keypad Commands
- Intrusion Zones
- Manual Action Challenge
- Multiple Card Support
- Multiple Guard Station GUIs
- Multiple Time Zones
- N Man Rule
- NetVue Integration with Intellex DVRs and VideoEdge NVRs
- Notification by Email
- Occupancy Restrictions
- Partitioning
- Personnel Views
- Push Install of Clients
- RM LCD Messages
- Single Sign-On Authentication
- Smart Card Program/Enrollment
- System Backup of Database and Journals
- User-Defined Fields

Options that Expand the Power of C•CURE 9000

- C•CURE 9000 Enterprise Server[3]
- Tools for In-Country Localization[4]
- Web Client
- C•CURE Mobile[5]
- Built-in LDAP Connection
- Migration Tool for Cardholder Data
- "Software House Connected" Program Drivers[6]
- Integration with Wireless Access System

(2) Client License = single monitoring station application, administration application, or Web Client
(3) See C•CURE 9000 Enterprise data sheet for more details
(4) Included with Series S
(5) C•CURE Mobile requires Windows Server 2003
(6) Contact sales for a complete list of available "Software House Connected" program drivers
(7) 8 GB recommended for for Windows 7 Professional and Windows Server 2008 R2 (64-bit)
(8) Version 1.93 and higher
(9) For multiple screen display or other display applications, additional video cards required

C•CURE 9000 Server Recommended Hardware and Software

Processor

Series L-N. . . . . Intel® Pentium Dual-Core or greater (2.5 GHz or greater)
Series P-S . . . . . Intel Quad-Core Xeon (2.4 GHz or greater); Xeon Series 5500 or greater)

Hard Disk Drives

Series L-N. . . . . Dual drives: primary drive = 80 GB (9000 Runtime); secondary drive = 80 GB (data backups)
Drive speeds: 7200 RPM or greater
Series P-S . . . . . Dual drives: primary drive = 250 GB (9000 Runtime)
secondary drive = 250 GB (data backups)
Drive speeds: 10,000 RPM or greater

Memory

Series L-N. . . . . 4 GB
Series P-S . . . . . 4 GB[7]

Network Adapter Card 100/1000 MB/sec
DVD Drive . . . . . Required

Operating System

Series L-N. . . . . Windows 7 Professional and Enterprise (32- and 64-bit)[8]
Windows Server 2008 R2 Standard and Enterprise (64-bit)[8]
Windows Server 2008 Standard and Enterprise (32-bit)
Windows Vista Business and Enterprise, SP1 or later (32-bit)
Windows Server 2003 Standard and Enterprise, SP2 or later (32-bit)
Windows XP Professional SP3 or later (32-bit)

Series P-S . . . . . Windows Server 2008 R2 Standard and Enterprise (64-bit)[8]
Windows Server 2008 Standard and Enterprise (32-bit)
Windows Server 2003 Standard and Enterprise, SP2 or later (32-bit)
Web Server . . . . . IIS v6.0 or higher

Database

Series L-N. . . . . SQL Server 2005 and 2008 R2 Express (32-bit)
Series P-S . . . . . SQL Server 2005 and 2008 R2 Standard and Enterprise (32-bit)
Video Card . . . . . Dedicated 256 MB accelerated video card[9]

C•CURE 9000 Client Workstation Recommended Hardware and Software

Processor . . . . . Intel Pentium Dual-Core or greater (2.5 GHz or greater)
Hard Disk Drive . . . . . 100 GB at 7200 RPM or greater
Memory. . . . . 2 GB
Network Adapter Card 100/1000 MB/sec
DVD Drive . . . . . Required
Operating System . . . . Windows 7 Professional and Enterprise (32-bit)[8]
Windows Vista Business and Enterprise, SP1 or later (32-bit)
Windows Server 2003 Standard and Enterprise, SP2 or later (32-bit)
Windows XP Professional, SP3 or later (32-bit)
Video Card . . . . . Dedicated 256 MB accelerated video card[9]

Supported Languages

Arabic, Brazilian Portuguese, Dutch, French, German, Italian, Polish, Simplified Chinese, Spanish

Related Products

C•CURE 9000 Enterprise

C•CURE 9000 SiteServer

C•CURE 9000 Web Client

iSTAR Controllers

Approvals

Microsoft GOLD CERTIFIED Partner | ISV/Software Solutions Networking Infrastructu

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C•CURE 9000 Web Client

Web Client User Interface

Features That Make a Difference:

- Provides remote access to C•CURE 9000 from virtually any computer with an Internet browser
- Manage personnel, display dynamic views, monitor system activity and generate reports
- Lock/unlock doors and activate events using manual actions
- Easily create and setup email for simple reports of card access activity and operator actions
- Show journal history and audit trail activity through pre-configured dynamic views
- Intuitive icon-driven user interface
- Easy deployment and installation
- Share a single database while retaining security and privacy of data through database partitioning
- Simple management of access-level permissions
- 128-bit AES encryption using SSL for secure communication between server and clients
- Single sign-on utilizes Microsoft® Windows Authentication to maintain integrity of IT security
- Up to 10 simultaneous users
- Built using latest Microsoft standards and platforms

C•CURE 9000 Web Client provides simplicity and portability of your C•CURE 9000 security and event management system by giving you remote access to C•CURE 9000 using an Internet browser. With C•CURE 9000 Web Client you can manage personnel records, display dynamic views of doors, readers, inputs/outputs, and controllers, and monitor system activity from within a facility or anywhere in the world. You can perform a wide-range of tasks such as creating/modifying cardholders and monitoring alarms/events while away from your workstation. And, for a permanent log of system activity, you can quickly and easily create reports from historical journal and audit trail data. It's a simple and secure way to deploy, monitor, and control the C•CURE 9000 system from any location.

Built using the latest Microsoft® standard tools and platforms, C•CURE 9000 Web Client is easy to administer and navigate with an intuitive layout and clear, consistent navigation panes. There is no need to install additional software.

You can log on to the Web Client using the same unique logon/password you use for C•CURE 9000, which reduces management of user accounts. You can add, delete, and modify personnel records, clearances, and credentials, as well as enable and disable cards. Validating whether an individual has or does not have access to a facility, a particular area within a facility, or a particular door has never been easier.

To streamline productivity and balance both responsibility and workload, corporate security administrators can disseminate control to individual department managers. This allows them to grant access in the physical areas for which they are responsible. The managers can assign or remove access privileges for each employee thereby eliminating the need for intervention by security administration.

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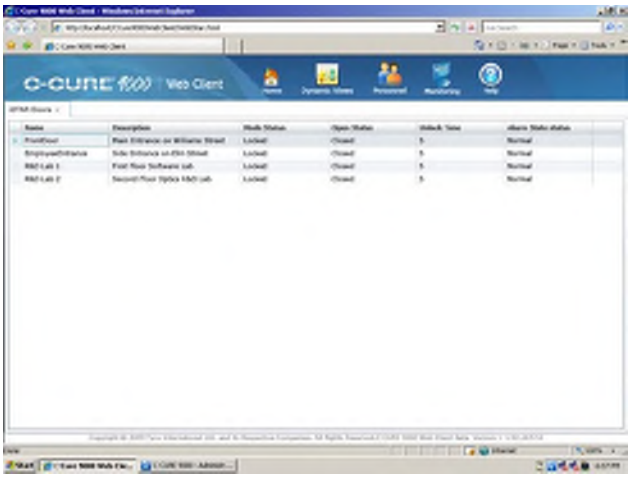
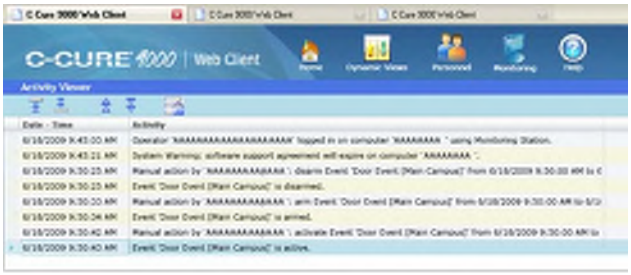
Personnel Management

Dynamic Views



Activity Viewer



C•CURE 9000 Web Client Minimum System Requirements

Supported Browsers . . . . . Microsoft Internet Explorer 7 and 8
Mozilla® Firefox®
Google™ Chrome

Supported Client
Operating System . . . . . Windows 7; Windows Vista;
Windows XP SP2; any client that supports Silverlight™ 3.0

Microsoft Silverlight . . . . . Version v3.0 and higher

C•CURE 9000 Server Minimum System Requirements

Supported Server
Operating System . . . . . Windows 7; Windows Server 2008;
Windows Server 2003 Standard SP2;
Windows XP SP2

Supported Web Server . . . . . MS IIS v5.10, v6.0, v7.0

C•CURE 9000. . . . . Version 1.93 and higher

Maximum Simultaneous
Client Connections to Server. .Up to 10 (C•CURE 9000 license must include the same number of simultaneous Web Clients)

Maximum Number of
Configured Users. . . . . Unlimited

Client to Server Encryption . . SSL, 128-bit AES

Authentication . . . . . Single Sign-on using Windows Authentication

Audit Trail . . . . . User activities logged in central C•CURE 9000 database

Database Partitioning . . . . . Yes

Ordering Information

C•CURE 9000 Web Client licenses are included in the overall C•CURE 9000 client license count – no special part numbers are required. To order addition C•CURE 9000 client licenses use the part numbers listed below.

CC9000-ADDCLI. . . . . One additional C•CURE 9000 client license
CC9000-ADD5CLI. . . . . Five additional C•CURE 9000 client licenses

Related Products

C•CURE 9000

C•CURE 9000 Enterprise

C•CURE 9000 SiteServer

iSTAR Edge

Approvals

RoHS 2002/95/EC

www.swhouse.com

SOFTWARE HOUSE™

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DATA SHEET

C•CURE® ID

Intuitive Badging Solution

Features That Make a Difference:

- Read and reprogram multiple smart card formats such as MIFARE® (1K & 4K cards), iCLASS®, and DESFire® for more secure badging
- What You See Is What You Get (WYSIWYG) layout editor lets you design badges exactly the way they'll appear
- Intuitive graphical user interface (GUI) displays badge changes instantaneously
- Design badge layout and edit cards in one convenient window
- Expression Builder lets you easily add customized dynamic fields to badges
- Choose from sample data templates for quick and easy badge design
- Supports 1D or 2D barcodes for biometric data encoding; also supports magnetic stripe encoding
- Access text and layout properties on both sides of badge for tremendous flexibility
- Signature capture adds unique security characteristic to badge
- Supports a variety of image formats (.bmp, .jpg, .tif, and .wmf) and automatically assigns a format to any unsupported, imported image
- Easily import customized badge templates from C•CURE 800/8000 to C•CURE 9000

Software House C•CURE® ID is an intuitive, .NET based badging solution that provides high performance, cost-effective, and secure identification management. C•CURE ID allows you to read and/or reprogram multiple smart card formats with a wide range of vital personnel information for more stringent security protocols.

Access control cards can also be a powerful way to communicate your company's message to employees and the public. C•CURE ID utilizes Microsoft® .NET guidelines for the GUI letting you create professional-looking badges.

C•CURE ID offers a WYSIWYG badge designer which provides complete control over color, graphics, text, and backgrounds on both sides of the credential. With a powerful Expression Builder, C•CURE ID lets you easily create expressions that simplify badge creation and organization.

In many instances a company can have hundreds, even thousands of employee and personnel records in its security system. The C•CURE ID query functions allow you to query a common field and then print those cards found in a single batch rather than one record at a time, making it faster and easier to manage your badges. Credentials can also be organized for sheet printing, facilitating the layout of a year book making it easier to manage a watch list or disallowed list.

For a complete badging solution, C•CURE ID provides a state-of-the-art, fully integrated photo imaging application that runs on C•CURE 9000 and C•CURE 800/8000.

C•CURE ID makes it easy to migrate from C•CURE 800/8000 to C•CURE 9000. Customized badge templates in C•CURE 800/8000 can be easily merged into a C•CURE 9000 system without losing valuable information and formatting.

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SPECIFICATIONS

Smart Card Enrollment and Provisioning

Read and reprogram multiple smart card formats such as MIFARE (1K and 4K cards), iCLASS, and DESFire. These cards can be programmed with a wide range of data depending on the protocol of each card type for critical security purposes and/or value add-ons such as vending, parking, etc. Using a USB based desktop encoder/decoder or the card encoding and decoding capabilities built into the printer lines of Fargo®, Magicard, or NiSCA printers, you can provision data onto a smart card or enroll data from the card into the C•CURE system. Those same printers can then be used to easily print cards in a specified layout.

With the powerful enrollment process, you can digitally store encrypted credentials onto the card for more stringent identity authentication and authorization.

Pre and Post Processing of Captured Images Provides Superior Photos

Easily control the iris and zoom of TWAIN compliant digital cameras before the image is captured ensuring you get exactly the photo you want.

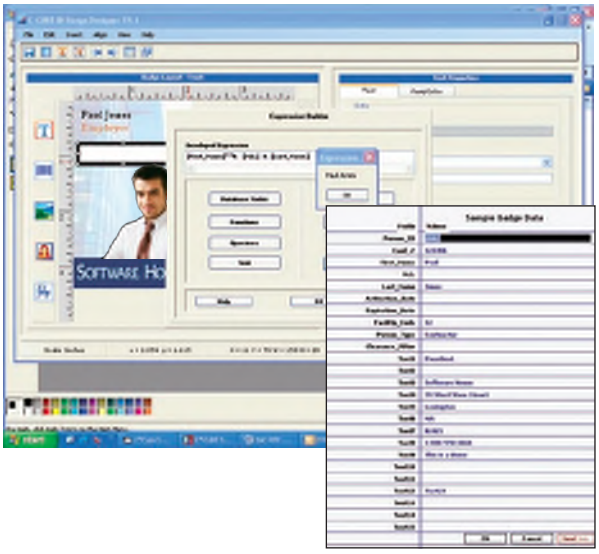
Once the image is captured, the lighting, sharpness, and clarity of the image can easily be modified within C•CURE ID. The post-processing image settings can be saved within the application so that future captured images are uniform in those same settings.

Intuitive GUI of Badge Layout Editor

The badge layout editor lets you construct and manipulate all aspects of the badge layout. Create and apply numerous badge layouts to individuals or groups of cardholders. All objects, images, and text can be moved, sized, rotated, and altered to meet your specific needs. Other effects can be achieved through “ghosting” and “transparency”.

Powerful Expression Builder

C•CURE ID offers an Expression Builder which allows you to easily meet specialized layout needs. Simply pick the fields and formats from a template list to build sophisticated expressions. Save layout time by importing data in one format and then transforming it to another format to suit your specific badge design. For example, if your personnel data imported from a human resources database appears in upper/lower case, you can use Expression Builder to easily change how you want the information displayed on the badge by selecting from a list of pre-configured formats.



C•CURE ID Client Workstation Recommended System Requirements[1]

CPU	1.5 GHz
Memory	1 GB
Video Card	SVGA, 16 MB RAM
Resolution	1024 x 768
Operating System	Windows® XP Professional
Qualified Printers	Magicard Rio 2e, Magicard Tango 2e, Fargo DTC400e, Fargo DTC550, Fargo HDP5000, and NiSCA PR5350

(1) The system should have enough USB ports to support keyboard, mouse, camera, signature capture tablets, and other input devices utilized in the station. Additionally, if a dedicated video capture card (either the FlashBus® MV Lite or FlashBus MV Plus) is being utilized, the system should have the appropriate video ports available.

SOFTWARE HOUSE

From Tyco Security Products

iSTAR Ultra SE

Special Edition iSTAR Ultra, Compatibility and Future-Proofing with Pro Mode and Ultra Mode

Features That Make a Difference:

- Powerful network-ready door controller for up to 32 readers (16 from ACMs)
- Dedicated DIP switch allows you to go from “Pro mode” for use with C•CURE 800/8000 and C•CURE 9000 to “Ultra mode” for use with C•CURE 9000
- Dual GigE network ports for redundant network operation
- Hardened Linux embedded OS for improved security and scalability
- Enables wireless locks to communicate with C•CURE 9000 providing a fully integrated and managed lock solution
- Includes global anti-passback and advanced peer-to-peer clustering
- Native intrusion zone functionality
- Manages up to 500,000 cardholders in local memory
- Socketed relays improve serviceability
- Dedicated input for fire alarm interlock overrides door locks during fire conditions (Ultra mode only)[1]
- Onboard 256-bit AES network encryption (Ultra mode only)
- Rack-mount models provide flexibility in mounting options
- Flexible adapter plate to mount in existing iSTAR Pro enclosures
- Great solution for enterprise and government installations

iSTAR Ultra SE is a powerful, intelligent network-ready controller that supports up to 32 readers. With a strong iSTAR Ultra feature set, the iSTAR Ultra SE provides an extra level of compatibility (“Pro mode”) to ensure all Software House systems can take advantage of its enhanced capabilities. The controller features the same General Controller Module (GCM) as iSTAR Ultra, and one or two Access Control Modules (ACM) to accommodate field wiring from readers, inputs, and outputs. The iSTAR Ultra SE ACM size, footprint, and connectors are identical to the iSTAR Pro ACM allowing for an easy upgrade to the iSTAR Ultra SE.

In “Pro mode”, iSTAR Ultra SE has the feature set of the iSTAR Pro providing compatibility with C•CURE 800/8000. In “Ultra mode”, additional high end features such as AES encryption and ASSA ABLOY Aperio wireless lock support are enabled. Changing between “Pro mode” and “Ultra mode” is accomplished via a dedicated DIP switch on the GCM board.

iSTAR Ultra SE was designed with flexibility and compatibility in mind. When your project calls for a controller with a smaller footprint, an upgrade from an earlier Software House controller, or when the project does not require the additional embedded lock power management features of iSTAR Ultra, iSTAR Ultra SE gets the job done.

Supports up to 32 Readers

iSTAR Ultra SE uniquely combines support for traditional hardwired access control doors with support for wireless lock sets, all in the same controller. Up to 32 readers are supported by the iSTAR Ultra SE, of which 16 may come from the I/O units of the ACM – the rest can be made up of IP-ACM Ethernet Door Modules and/or wireless lock sets and devices.

iSTAR Ultra SE is ideal for areas that require many readers in close proximity to the panel. For more distributed installations, iSTAR Ultra SE includes up to 16 RS-485 ports, allowing the installer to run longer distances to each door.

Networking Strength and Security

iSTAR Ultra SE includes two onboard gigabit network ports for primary and secondary communications to the host. AES 256-bit FIPS 140-2 network encryption, with custom key management and denial-of-service protection, secures the controller from potential network threats. iSTAR Ultra SE supports both static and dynamic IP addresses, using DHCP and DNS to simplify network installation. In addition, the powerful iSTAR Configuration Utility (ICU) reduces startup time by allowing you to view online controllers, change configuration parameters, and download new firmware from a single interface.

iSTAR Ultra SE uses a GCM which includes standard 2GB RAM and 16GB SD card for memory.Database backups and all buffered transactions are stored to non-volatile SD card memory. A real-time clock battery keeps the clock powered during a power failure.

[1] Available with C•CURE 9000 v2.50 or higher

Features

Ultra Mode vs Pro Mode

iSTAR Ultra SE provides the ultimate compatibility with the ability to be used with both C•CURE 800/8000 and C•CURE 9000 systems. For C•CURE 800/8000 systems, the controller is set to “Pro mode” and will operate as an iSTAR Pro. It can cluster with other iSTAR Pros and even supports a dial-up connection back to the C•CURE 800/8000 host. “Pro mode” is also very useful when upgrading iSTAR hardware ahead of a C•CURE 9000 upgrade – it allows you to upgrade the hardware first, while still on the previous access control software.

For C•CURE 9000 v2.50 and greater, you can set the Ultra SE to “Ultra mode” to take advantage of additional high end features. When the controller is in “Ultra mode”, it has all of the powerful iSTAR Ultra features including AES encryption, 32-reader connectivity, ASSA ABLOY and Schlage wireless lock integration, and configurable input circuit types. It can also cluster with iSTAR Ultra, iSTAR Edge, iSTAR eX, or iSTAR Pro (non-encrypted).

	Ultra Mode	Pro Mode
Compatibility	C•CURE 9000, v2.50 and above	C•CURE 800/8000 v10.3, C•CURE 9000 v2.30 and above
10/100/1Gb Ethernet, Full Duplex	Yes	Yes
Dual Network Ports	Yes	Yes
AES 256 Encryption, FIPS 197	Yes	No
Dialup Support	No	Yes
Selectable Input Circuit Types	Yes	No
Total # of Readers Supported	32	16
# of Supervised Inputs per ACM	16	16
# of Relay Outputs per ACM	8	8
# Wiegand Readers per ACM	8	8
# RM Readers per ACM	8	8
# I/O Modules per ACM	16-I8 & 16-R8	8-I8 & 8-R8
Schlage Wireless Locks per GCM	32	16
Aperio Wireless Locks per GCM	32	none
# Personnel, 10 clearances/per, 5 cards/per, long card #s	500,000	500,000

Ensure Reliable Communication with Clusters

iSTAR Ultra SE supports peer-to-peer communications across clusters meaning that the controllers communicate with one another without needing host intervention. Clusters are user-defined groups of up to 16 controllers and can be created to enhance security by separating a widely dispersed facility into different controlled areas. For example, events linking inputs on one controller to outputs on another controller will still be active without the host.

Local and Global Anti-Passback Provides Effective System-Wide Security

Anti-passback prevents cardholders from passing their credentials back to others in order to gain access to secured areas. Global anti-passback is critical for ensuring uncompromised security on a large scale. Building upon cluster-based anti-passback as described above, the controllers are able to send an anti-passback violation notice to the C•CURE server. Tailgating, or following another cardholder into a secured area without presenting a separate badge, can easily be flagged within the C•CURE monitoring station.

Rack Mount Flexibility

iSTAR Ultra SE is available in a modular rack mount configuration, reducing the space requirements and costs associated with installing a panel on the wall. Separate GCM and ACM modules can be arranged in the rack to optimize your server room installation. For example, the GCM can be mounted in the front of a four-post rack, while the ACM and field wiring can be located in the rear of the rack. Field wiring on the ACM is easily routed through the top and/or bottom of the enclosure, with the ACM board mounted front and center for convenient servicing.

Keypad Commands Provide the Ultimate in Control

iSTAR Ultra SE supports custom keypad commands which provide a powerful way to easily activate events in C•CURE. These commands include anything from triggering a duress call and sounding an alarm, to locking and unlocking doors directly from an RM reader keypad. Commands can be configured to require a card presentation and/or a card and PIN to validate the command. Keypad commands can also be used to arm and disarm intrusion zones.

Arm and Disarm Intrusion Zones to Enhance Security

For your most critical areas, iSTAR Ultra SE features built-in intrusion zone functionality allowing you to monitor and respond to intrusion alarms quickly, without relying on a third-party intrusion panel. Any door or input on the iSTAR Ultra SE, including inputs from I8 expansion modules, can be configured as part of an intrusion zone, either as a 24/7 monitored input such as a glass break detector, or as a controlled input such as a motion sensor or door. Zones can be armed and disarmed using a combination of card and/or PIN, and/or from the C•CURE 800/8000 or C•CURE 9000. Entrance and exit delays, bypass, and custom triggers and commands are all configurable per zone for the utmost in flexibility.

Extended Card Formats, Multiple Credentials Enhance Flexibility

iSTAR Ultra SE supports extended card formats of up to 256 with multiple data fields, providing the utmost in flexibility when configuring custom card formats. Longer card numbers and formats offer greater protection against card duplication, and are especially valuable to customers who require card numbers that exceed 10 digits.

Features

iSTAR Ultra SE allows administrators to assign up to five active cards per cardholder record rather than having to create a separate record for each card. This simplifies the management and maintenance of personnel records. For additional flexibility, iSTAR Ultra SE can support up to 128 card formats systemwide and ten card formats per reader.

Built-in Diagnostics to Easily Test and Troubleshoot

iSTAR Ultra SE includes both built-in web diagnostics pages and a local LCD to test and troubleshoot inputs, outputs, reader ports, and last card read. In addition, via the network, you can retrieve real-time status and diagnostics of:

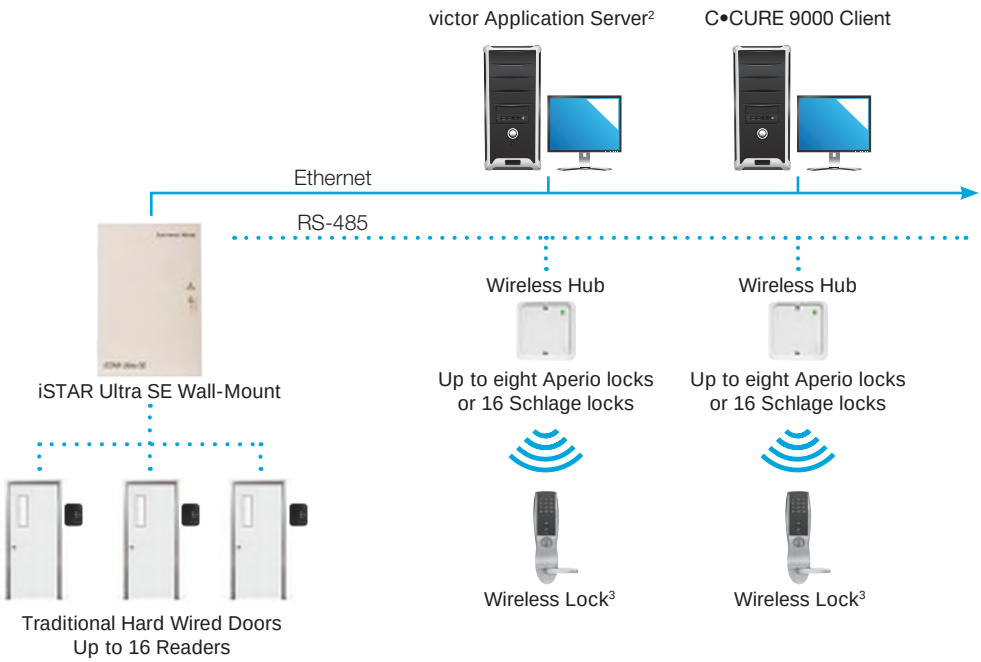
- controller time/boot time
- total/available memory
- connection status
- firmware and OS versions
- hardware (MAC) and IP addresses
- downloaded clearances and cardholders

Fully Integrated and Managed Lock Solution

Utilizing iSTAR Ultra SE, wireless locks from ASSA ABLOY or Schlage communicate with C•CURE 9000, providing a fully integrated and managed lock solution. Up to 32 ASSA ABLOY Aperio or Schlage AD300 and AD400 locksets can be managed by a single iSTAR Ultra SE (in Pro mode - up to 16 Schlage locks, no Aperio support). In addition to traditional locksets, the Aperio line also includes cabinet and data center locks, allowing you to extend the breadth of your access control system to non-traditional openings. Each lockset communicates using AES 128-bit encrypted wireless technology to an a wireless hub, which is then connected to the iSTAR Ultra SE with a simple RS-485 communications bus. Each hub can accommodate up to eight Aperio or 16 Schlage wireless locks.

All activity and alarms from each wireless device are sent to the iSTAR Ultra SE and then up to the C•CURE 9000 in real time, guaranteeing a high level of control and visibility of door actions. Besides standard card access transactions, each device also communicates low battery, tamper, and communications status to the system.

iSTAR Ultra SE and Wireless Lock System Layout



[2] The C•CURE 9000 Server component is now called the victor Application Server.
[3] ASSA ABLOY Aperio or Schlage AD300 or AD400 but not both.

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Specifications

Physical

Dimensions (H x W x D)	
Wall-Mount	61.6 x 41.9 x 10.2 cm (24.25 x 16.5 x 4.0 in)
Rack Mount GCM	86 x 445 x 252 mm (3.4 x 17.5 x 10 in) (2U rack height)
Rack Mount ACM	175 x 445 x 125 mm (6.9 x 17.5 x 4.9 in) (4U rack height)
GCM Board	165 x 266 x 26 mm (6.5 x 10.5 x 1.02 in)
ACM Board	121 x 311 x 38 mm (4.75 x 12.25 x 1.5 in)
Weight	
Wall-Mount	10.6 kg (23.3 lbs)
Rack Mount GCM	4.3 kg (9.5 lbs)
Rack Mount ACM	4.1 kg (9.0 lbs)
Enclosure Material	16 gauge cold rolled steel, with tamper switch
Environmental	
Operating Temperature	0 - 50°C (32 - 122°F)
Operating Relative Humidity	5 - 95% RH non-condensing
Storage Temperature	-20 - 60°C (- 4 - 140°F)

Electrical

Power Requirements, GCM	12 VDC +/- 20%, 0.5 A plus up to 1.5 A per RS-485 port
Power Requirements, Each ACM	12V DC +/- 20%, 0.5A for core board; 1.5A per RS-485 port; 0.8A per Wiegand; 12V DC (Wiegand 5V max, 1.25A total); Total ACM core board plus outputs not to exceed 5A.
Power Supply (Optional)	
Power Input	90 to 240V AC, 47 to 63 Hz, 1.7A
Power Output	12V DC at 5.0 A maximum
Heat Dissipation	GCM: 20.5 BTU/hr, each ACM: 20.5 BTU/hr
Memory and RTC Backup	CR 2032 lithium battery provides RTC backup; database and buffered transactions stored in non-volatile memory

System and Network

CPU	Freescale i.MX6 1 GHz dual core Cortex-A9
System Memory	2 GB RAM
SD Storage	16 GB SD card
Primary Network Port	10/100/1000 Mbps, full duplex, auto-negotiate
Secondary Network Port	10/100/1000 Mbps, full duplex, auto-negotiate
Network Encryption	Optional AES 256-bit, with custom key Management (Ultra mode only); Pro mode does not support RSA RC4 encryption
Indicators and Switches	LCD for diagnostics, LEDs for power, LAN activity, serial port activity, output status, encryption-enable switch (Ultra mode only), Ultra mode/Pro mode switch
Modem Port thru USB Modem	Supported on C•CURE 800/8000, C•CURE 9000 v2.50 (Pro mode only)

Memory Capacity[4]

Ten clearances, five cards/ person, 40-digit card.	500,000 cardholders
Transaction Buffer Size	10,000 minimum, 500,000 maximum

Inputs, GCM

Dedicated Inputs	Cabinet tamper, AC fail, low battery
Distance, GCM to ACM	Up to 1.83 m (6 ft)

[4] Memory allocation is dynamic and shared between cardholders, event storage, and configuration information.
[5] iSTAR Ultra SE (Ultra mode only) supports 32 readers (ACM and/or wireless) total of which 16 may come from ACMs

Specifications for Wireless Lockset Support[5]

Wireless Lockset Technologies Support	ASSA ABLOY Aperio (ultra mode only), Schlage AD300 & AD400, WA Series[6]
GCM RS485 Ports to Connect Wireless Hubs	2 (Ultra mode), 1 (Pro mode, Schlage only)
Max # of Locksets per RS485 Port	16
Max # of Wireless Hubs/PIMs per RS485 Port	15 (Aperio); 16 (Schlage)
Max # of Locksets per Wireless Hub	8 (Aperio); 16 (Schlage)

Specifications per ACM Board[7]

Readers

Number of Readers Supported, per ACM Board	8
Types of Readers Supported	Wiegand signaling and RM (RS-485)
Reader Technologies Supported	Multi-Technology, Proximity, Smart Card (incl. PIV II & TWIC), Wiegand, and Magnetic Stripe (RM only)
Maximum Data Distance to Door	RM: 1,219 m (4,000 ft); Wiegand: 150 m (500 ft)
Reader Power Status Indication	On/off indication per port, through C•CURE 9000
RM Bus Communications	Eight ports, RS-485 half duplex, two wire, plus optional two wires for device power

Inputs

Number of General Purpose Inputs per ACM	16 supervised inputs, configurable EOL circuit per input when in Ultra mode
Additional Dedicated Inputs	Cabinet tamper (standard); fire alarm interlock, fire alarm key switch override, supervision supported (Ultra mode only)[8]
Input Expansion	64 per ACM (Pro mode); 128 per ACM (Ultra mode) using I8 modules on RM bus

Outputs

Number of Relay Outputs per ACM	8
Output Rating, Dry Contact	0 to 30V AC/DC, 5 A max
Output Protection	Snubber and transzorb (outputs use socketed relays)
Output Expansion	64 per ACM (Pro mode); 128 per ACM (Ultra mode) using R8 modules on RM bus

Regulatory

Access Control	UL 294, CSA C22.2 No. 205 (Canada);
Burglar Alarm	UL 1076, ULc 1076 (Canada)
CE	EN 55022 (EMI), EN 55024 (EMC), EN 60950-1(Safety)
Safety	IEC 60950-1
EMI	FCC Part 15 Class A, EN 55022, ICES-003 (Canada), VCCI Class A ITE (Japan), C-Tick (AS/NZS CISPR 22 - Australia/New Zealand)
EMC	EN 55024, EN 50130-4, IEC 62599-2, EN 61000-6-1
Encryption	FIPS 197 (Utra mode only); Pro mode does not support RSA RC4 encryption

[6] Only 16 Schlage PIMs and readers are supported on one RS485 port in Pro mode
[7] Up to two ACM boards per iSTAR Ultra
[8] Available with C•CURE 9000 v2.50 or higher

Related Products

iSTAR Pro

iSTAR Edge

C•CURE 9000

Approvals

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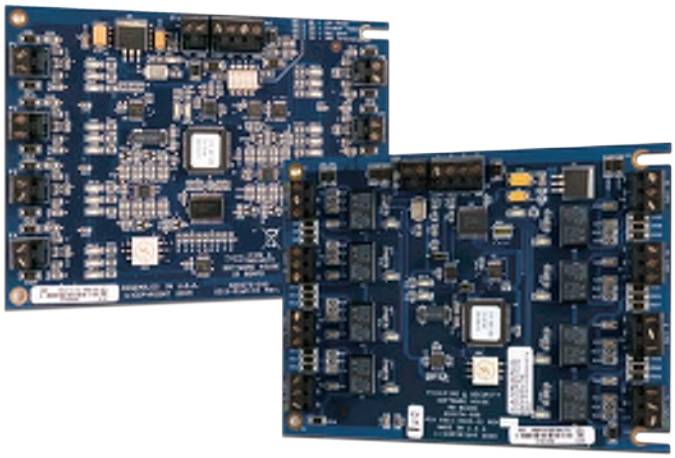
SOFTWARE HOUSE®

DATA SHEET

Input/Output Modules



Features That Make a Difference:

- Provides cost-effective expansion of input and output capacity
- Compatible with full range of Software House® iSTAR and apC access control panels
- Locate modules up to 1,220 m (4,000 ft) away from controllers using flexible two-wire RS-485 RM bus
- Reduces length of sensor and control wiring to save installation costs
- I8 provides eight Class A supervised inputs
- R8 provides eight Form C relay outputs
- I8-CSI, configurable supervised input model, allows use of existing input wiring without changing end-of-line (EOL) resistors
- Three status LEDs per input (red/yellow/green) and one per output enable quick diagnostics and troubleshooting
- Small, modular size requires minimal panel space
- Dedicated tamper input included on each module
- Optional UL-listed enclosure available

The Software House I8, R8, and I8-CSI modules provide a flexible, cost-effective means to expand the input and output functionality of any iSTAR or apC access controller. Common applications include alarm monitoring and control and elevator control.

The I8 input module provides eight Class A supervised inputs. Three LEDs per input help the installer commission and troubleshoot each input circuit – red if the input is in alarm, green for normal, and yellow for a supervision error. LEDs may be turned off via a DIP switch setting.

The I8-CSI module enhances the functionality of the standard I8 module by supporting numerous supervised circuit types and EOL resistance values. This allows the I8-CSI to accommodate existing field wiring without changing EOL resistors. More than 20 different circuit types are supported. The circuit type is selected via a bank of DIP switches and applies to all eight inputs on the I8-CSI.

The R8 output module provides eight Form C dry contact relay outputs. A red status LED per output shows the state of the relay.

All modules feature a dedicated input for an external cabinet tamper switch and mount easily in the Software House RM-CAN or RM-DCM-CAN enclosure. The modules communicate with iSTAR or apC controllers via the two-wire RM bus that allows total wiring distances of up to 1,220 m (4,000 ft). Up to eight I8s and eight R8s can be connected to each apC, iSTAR eX, and iSTAR Pro eight-reader model; up to 16 of each module can be connected to the iSTAR Pro 16-reader model.

The modules are fully compatible with both C•CURE® 800/8000 and C•CURE 9000.

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SPECIFICATIONS

General

Dimensions (H x W) . . . . .11.0 x 15.0 cm (4.3 x 5.9 in)
Environmental. . . . . .0° to 50° C (32° to 122° F); 5 to 85% relative humidity, non-condensing
Power Input Voltage . . . . .12 VDC +/- 10%
Tamper . . . . . .Dedicated input for external tamper switch
Weight. . . . . .0.23 kg (8 oz)
Regulatory . . . . . .UL 294, UL 1076, FCC Part A
CE, EN 50133, ROHS

I8 Input Module

Power Requirements . . . .180 mA @ 12 VDC
Inputs . . . . . .Eight Class A supervised
LEDs per Input . . . . . .Red (alarm), green (normal), and yellow (supervision error)

I8-CSI Input Module

Power Requirements . . . .180 mA @ 12 VDC
Inputs . . . . . .Eight Class A supervised, configurable via DIP switch
LEDs per Input . . . . . .Red (alarm), green (normal) and yellow (supervision error)
Circuits Supported . . . . .Single resistor: 1K, 5K, 10K
Double resistor: 1K, 5K, 10K, 1K/2K, 6.8K/18K, 200/10K
Unsupervised: NO, NC

R8 Output Module

Power Requirements . . . .45 mA @ 12 VDC plus 32 mA per active relay
Outputs. . . . . .Eight Form C dry contact relays
LED per Output. . . . . .Red (relay active)
Relay Contact Ratings . . .30 VDC, 2.0 A resistive
30 VDC, 1.0 A inductive
125 VAC, 4.0 A

Optional Metal Enclosures with Tamper Switch

RM-DCM-CAN
Dimensions. . . . . .356 x 305 x 89 mm (14 x 12 x 3.5 in)
Capacity . . . . . .Up to four input or output modules

RM-CAN
Dimensions. . . . . .210 x 184 x 83 mm (8.25 x 7.25 x 3.25 in)
Capacity . . . . . .One input or output module

Model Numbers

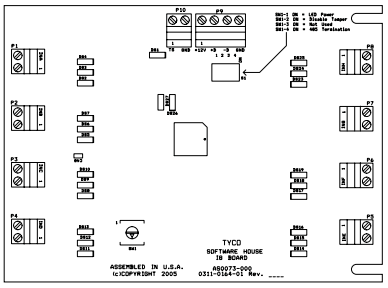
AS0073-000 . . . . . .I8 input module
AS0073-CSI . . . . . .I8-CSI input module
AS0074-000 . . . . . .R8 output module
RM-DCM-CAN . . . . . .Large metal enclosure with tamper switch
RM-CAN . . . . . .Small metal enclosure with tamper switch

Wiring Summary

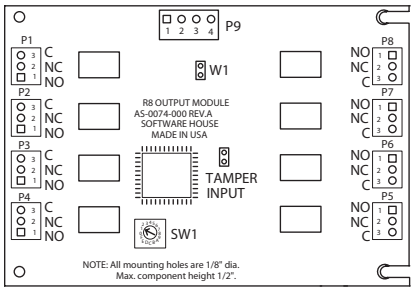
Signal	From	To	Belden #	Gauge	# of Pairs	Shielded	Maximum Length
Comm (two-wire RS485)	apC/iSTAR	I8/R8	9841*	24	1	Yes	1,220 m (4,000 ft)
Power	apC/iSTAR	I8/R8	9841*	24	1	No	Based on voltage drop
Control Point	R8	Strike, Siren, etc.	8442/8461	18	1	No	Based on voltage drop
Supervised Input	I8	REX or Door Contact	8442/8461	22/18	1	No	610 m (2,000 ft)

Wiring Configuration Diagram

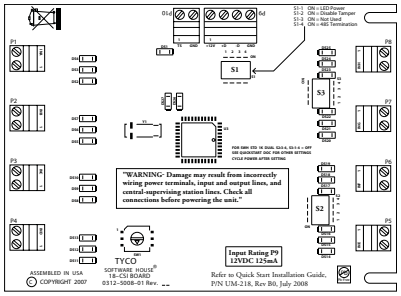
I8 Input Module Configuration



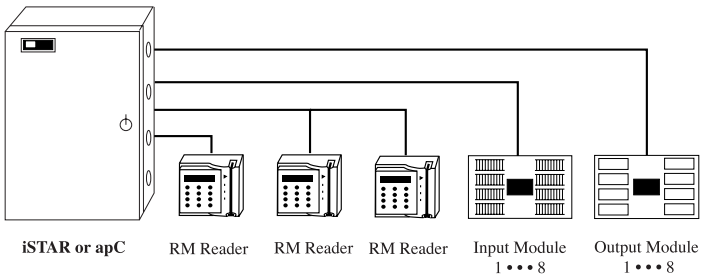
R8 Output Module Configuration



I8-CSI Input Module Configuration



Sample System Configuration: Combination Bus/Star Wiring Diagram



(*) For plenum or underground applications, use Belden 89182 for one pair 22 AWG, 100 ohm 12.95 pf/ft.
Note: Control, supervised, and unsupervised input cables must be shielded for FCC Class B operation.

Product offerings and specifications are subject to change without notice. Actual products may vary from photos. Not all products include all features. Availability varies by region; contact your sales representative. Certain product names mentioned herein may be trade names and/or registered trademarks of other companies.

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DATA SHEET

RM-DCM-2

Door Control Module with Enclosure

Shown with optional I8 input module, R8 output module, and battery

Features That Make a Difference:

- Full-featured local door control module lowers wiring costs
- Complete set of inputs and outputs to control one door
- Flexible control options for reader LEDs and beep patterns
- Easily expandable
- Additional internal etch connections support magnetic lock features and accommodate local bypass switch
- Optional LCD provides clear instructions that help simplify startup and diagnostics
- Status LEDs on inputs and outputs for quick troubleshooting
- Built-in tamper switch provides secure installation
- Plug-in screw terminals reduce installation time

Put a full-featured RM-4E door control module in a UL listed, tamper-protected enclosure and you have the powerful Software House® RM-DCM-2. RM-DCM-2 is designed to support up to two RM-4Es and a choice of up to two I8 input boards or R8 output boards, providing a single enclosure for doors with IN and OUT readers.

RM-DCM-2 supports both Wiegand and magnetic stripe readers and provides additional wiring to magnetic locks if required.

The RM-4E modules create the connectivity between a reader and a control panel when third party card readers are used on a C•CURE® system. In addition, the RM-4E modules provide two supervised inputs and two SPDT relays (no ARM-1s are necessary). The LEDs and optional LCD display provide diagnostics to simplify the installation.

RM-DCM-2 provides standby power with its built-in uninterruptible power supply (UPS).

With its robust feature set, RM-DCM-2 is designed to handle the most demanding access control applications with ease while offering numerous installation and service features that lower its life cycle cost.

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SPECIFICATIONS

Physical

Enclosure Dimensions (H x W x D) . . .356 x 305 x 89 mm (14 x 12 x 3.5 in)
RM-4E Board-Only
Dimensions (H x W) . . . . . .136 x 181 mm (5.375 x 7.125 in)
Weight (with 4Ah battery) . . . . . .5.9 kg (11 lbs)
Weight (without battery) . . . . . .4.5 kg (8 lbs)
Construction. . . . . .20 AWG metal wall mounted locking cabinet with tamper switch on door

Environmental

Operating and Storage
Temperature . . . . . .0 ° to 50°C (32° to 122°F)
5 to 95% RH, non-condensing

Electrical

Power Requirements
without Reader or Relays . . . . . .+12 VDC +/- 5% or +24 VDC +/-10%, 280 mA max
Power Requirements, Maximum,
with Reader and Relays . . . . . .+12 VDC +/- 5% or +24 VDC +/-10%, 550 mA max
Output Relay Power Ratings. . . . . .Up to 30 VAC/DC, 5A maximum
Reader LED Output Controls . . . . . .4.0 volts to 5.25 volts, 20mA max
Power Available for Reader. . . . . .5 VDC +/- 10% or 12 VDC +/- 10%, 125mA max (at 5V or 12V)
Optional Battery . . . . . .12V/4Ah battery provides nominal 4 hours backup time

Regulatory

UL 294
CE, including EN50081-1, EN50130-4, EN50133
FCC Part 15 Class A
RoHS

Communications

Communications Bus . . . . . .RM bus from iSTAR controller or apC/8X panel
Communications Type . . . . . .RS-485 half duplex, two-wire
Maximum Distance. . . . . .1,219 m (4,000 ft)

Reader, Inputs & Outputs

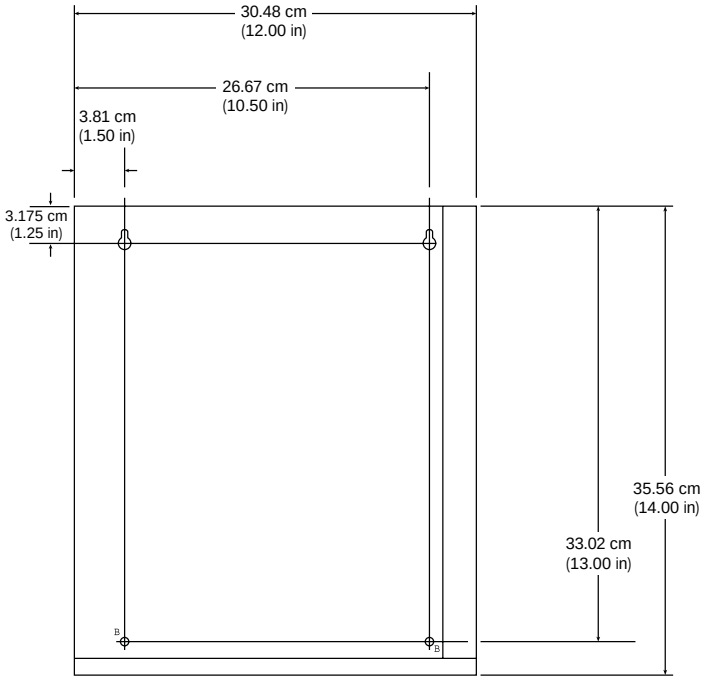
Reader Ports . . . . . .One
Reader Support . . . . . .Wiegand or magnetic stripe
Reader Control Lines Available . . . . .Red LED, green LED, yellow LED, beeper
Keypad Support. . . . . .Terminals provided for external 3x4 matrix keypad
Supervised Inputs. . . . . .Two, double-resistor
Output Relays. . . . . .Two, Form C, dry contact
Tamper Input . . . . . .One

Indicators and Switches

Three status LEDs for each supervised input
LED on each relay output
LEDs for RS-485 transmit and receive
LED for power-on
Optional LCD for diagnostics
Eight position dipswitch for feature selection:

- Wiegand/magnetic stripe reader type
- Tamper bypass
- LED pattern
- RM bus termination
- Input LED disable

Mounting Specifications



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RoHS 2002/95/EC

Type 1 Locking Hinge Cover Enclosure w/ Perforated Panel

Data Sheet

Application

- Houses electrical and electronic controls and instruments in an environment which does not require oil, dust, or water tight specifications
- Protects against contact with enclosed equipment

Standards

- UL 50 listed, Type 1
- CSA C22.2 No. 40 certified, Type 1
- Conforms to NEMA standard for Type 1
- IEC 60529, IP30

Construction

- Covers and bodies are fabricated from code gauge steel (see chart)
- Includes panel grounding hardware kit
- Cover has keyed quarter turn lock, two (2) keys are included
- Cover includes foam corner padding
- Includes removable 16 gauge white perforated panel
- Enclosure body has mounting holes on the back which are accessible with or without the panel installed.
- Cover is secured to the body with a continuous hinge on one side and a flush latch on the opposite side

Finish

- Wash and phosphate undercoat
- ANSI 61 gray acrylic electro-coat finish

Accessories

- Touch-up paint (84034)
- Self-tapping screws (10168)

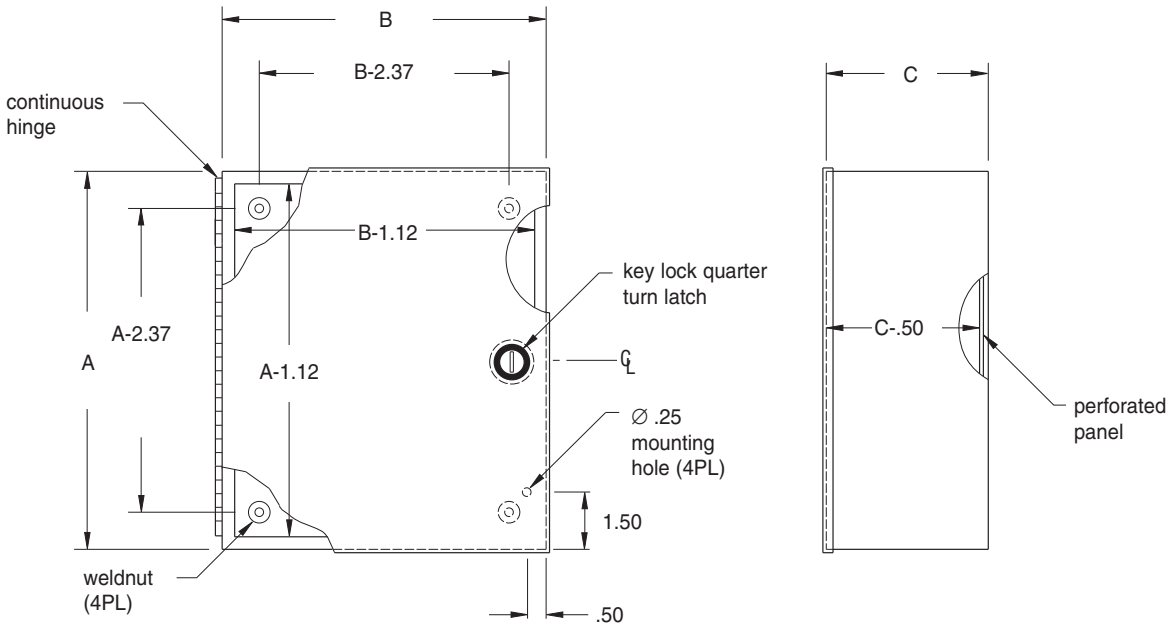
Catalog Number	Height x Depth x Length A x B x C		Gauge		Perforated Panel Size	
	in.	mm	in.	mm	in.	mm
12126-1PP	12.00x12.00x6.00	305x305x152	16	1.4	10.25x10.25	260.3x260.3
16126-1PP	16.00x12.00x6.00	406x305x152	16	1.4	13.00x10.50	260.3x260.3
20166-1PP	20.00x16.00x6.00	508x406x152	16	1.4	17.00x14.50	431.8x368.3
24206-1PP	24.00x20.00x6.00	610x508x152	14	1.9	21.00x18.50	5333.4x469.9
36246-1PP	36.00x24.00x6.00	914x610x152	14	1.9	32.00x22.50	812.8x571.5
36306-1PP	36.00x30.00x6.00	914x762x152	14	1.9	32.00x28.50	812.8x723.9

Notes: Cooper B-Line can provide special sizes, finishes and other modifications. Consult the factory for your special requirements.

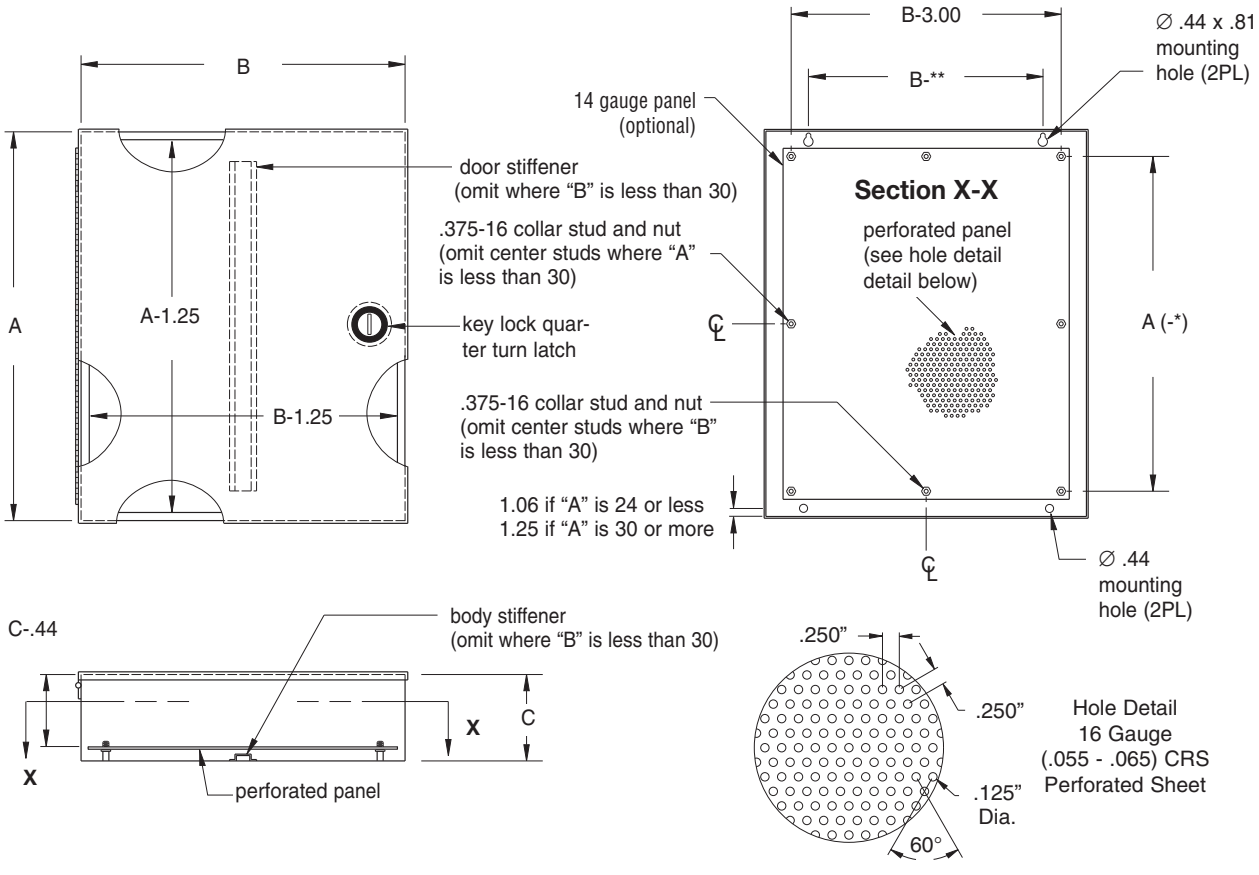
Type 1 Locking Hinge Cover Enclosure w/ Perforated Panel

Illustration Sheet

Drawings for 12126-1PP



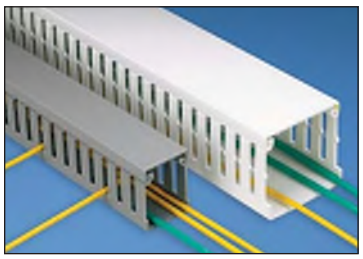
Drawings for 16126-1PP, 20166-1PP, 24206-1PP, 36246-1PP, 36306-1PP

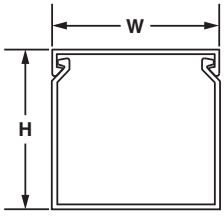


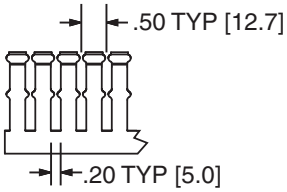
Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Panduct® Type F Narrow Slot Wiring Duct

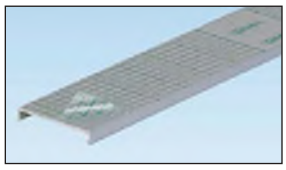
- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Multiple slot restrictors present with 2" and greater duct wall height.



To order cover with protective film add "-F" to part number. 6" cover not available with film.

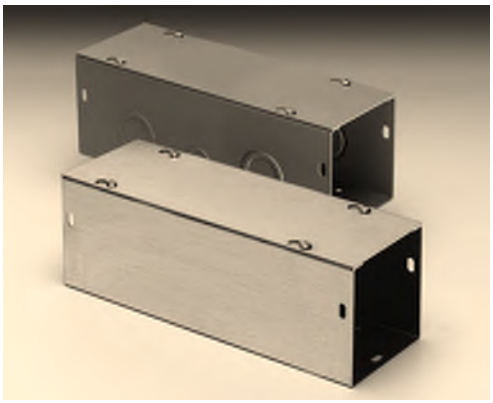
NEW!

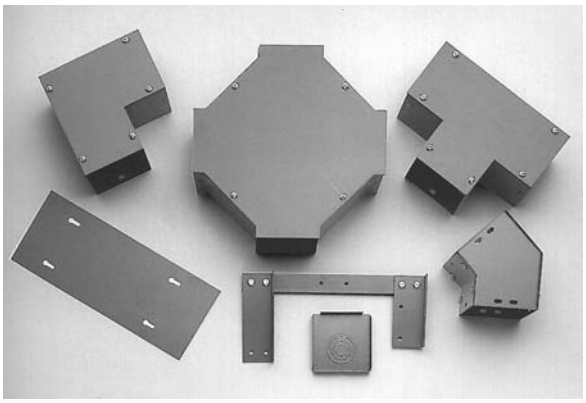
Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	**C.5LG6**	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	**C.5LG6**	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	**C.75LG6**	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	**C.75LG6**	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	**C1LG6**	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	**C1LG6**	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	**C1LG6**	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	**C1LG6**	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	**C1LG6**	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	**C1.5LG6**	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	**C1.5LG6**	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	**C1.5LG6**	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	**C1.5LG6**	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	**C1.5LG6**	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	**C2LG6**	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	**C2LG6**	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	**C2LG6**	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	**C2LG6**	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	**C2LG6**	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	**C2LG6**	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	**C2.5LG6**	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	**C3LG6**	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	**C3LG6**	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	**C3LG6**	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	**C3LG6**	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	**C3LG6**	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	**C4LG6**	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	**C4LG6**	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	**C4LG6**	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	**C4LG6**	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	**C6LG6**	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Type 1 Screw Cover Wireway - Painted & Galvanized

Data Sheet





Application

- Houses runs of control and power cable
- Used for cable and wire junction, distribution and termination

Standards

- UL 870 listed, Type 1
- CSA C22.2 No. 26 certified, Type 1
- Conforms to NEMA standard for Type 1
- IEC 60529, IP30

Finish

- Wash and phosphate undercoat or galvanized steel
- ANSI 61 gray acrylic electrocoat finish

Accessories

- Sealing devices
- Touch-up paint
- See Accessories section

Construction

- Wireway body and cover are fabricated from code gauge steel or galvanized steel, (see table)
- Wireway body has mounting holes on the back
- Wireway is available with or without knockouts on the top and bottom sides
- Wireway fittings have no knockouts, ends are available with or without knockouts
- Cover is secured to the body with plated screws
- Keyhole slots are furnished on the wireway cover which allow easy access to the inside without removing the screws
- Flush and surface wireway covers are available
- Wireway exceeding 72 inches in length has two overlapping covers
- Variety of fittings allow runs which can change direction, junction and terminate
- Standard wireway connectors (sold separately) have a unique gate feature which can swing completely open allowing for continuous runs of wire and cable
- Universal connectors are also available for adapting to other manufacturer's wireway, (see table, page 16)
- Completely interchangeable with Type 1 Hinge Cover Wireway and Fittings

Notes: Cooper B-Line can provide special sizes, finishes and other modifications. Consult the factory for your special requirements.

Type 1 Screw Cover Wireway - Painted & Galvanized

Catalog Number

Wireway Catalog Number				Wireway Size Height x Depth x Length A x B x C		D			Knockout Quantity	
Painted		Galvanized								
KO	No KO	KO	No KO	in.	mm	in.	mm	Gauge	Top	Bottom
2212 G	2212 G NK	2212 GGV	2212 GGV NK	2.50x2.50x12.00	64x64x305	1.25	32	16	3	3
2218 G	2218 G NK	2218 GGV	2218 GGV NK	2.50x2.50x18.00	64x64x457	1.25	32	16	5	5
2224 G	2224 G NK	2224 GGV	2224 GGV NK	2.50x2.50x24.00	64x64x610	1.25	32	16	7	7
2236 G	2236 G NK	2236 GGV	2236 GGV NK	2.50x2.50x36.00	64x64x914	1.25	32	16	11	11
2248 G	2248 G NK	2248 GGV	2248 GGV NK	2.50x2.50x48.00	64x64x1219	1.25	32	16	15	15
2260 G	2260 G NK	2260 GGV	2260 GGV NK	2.50x2.50x60.00	64x64x1524	1.25	32	16	19	19
2272 G	2272 G NK	2272 GGV	2272 GGV NK	2.50x2.50x72.00	64x64x1829	1.25	32	16	23	23
22120 G	22120 G NK	22120 GGV	22120 GGV NK	2.50x2.50x120.00	64x64x3048	1.25	32	16	39	39
3312 G	3312 G NK	3312 GGV	3312 GGV NK	3.00x3.00x12.00	76x76x305	1.50	38	16	3	3
3318 G	3318 G NK	3318 GGV	3318 GGV NK	3.00x3.00x18.00	76x76x457	1.50	38	16	5	5
3324 G	3324 G NK	3324 GGV	3324 GGV NK	3.00x3.00x24.00	76x76x610	1.50	38	16	7	7
3336 G	3336 G NK	3336 GGV	3336 GGV NK	3.00x3.00x36.00	76x76x914	1.50	38	16	11	11
3348 G	3348 G NK	3348 GGV	3348 GGV NK	3.00x3.00x48.00	76x76x1219	1.50	38	16	15	15
3360 G	3360 G NK	3360 GGV	3360 GGV NK	3.00x3.00x60.00	76x76x1524	1.50	38	16	19	19
3372 G	3372 G NK	3372 GGV	3372 GGV NK	3.00x3.00x72.00	76x76x1829	1.50	38	16	23	23
33120 G	33120 G NK	33120 GGV	33120 GGV NK	3.00x3.00x120.00	76x76x3048	1.50	38	16	39	39
4412 G	4412 G NK	4412 GGV	4412 GGV NK	4.00x4.00x12.00	102x102x305	2.75	70	16	3	3
4418 G	4418 G NK	4418 GGV	4418 GGV NK	4.00x4.00x18.00	102x102x457	2.75	70	16	5	5
4424 G	4424 G NK	4424 GGV	4424 GGV NK	4.00x4.00x24.00	102x102x610	2.75	70	16	7	7
4436 G	4436 G NK	4436 GGV	4436 GGV NK	4.00x4.00x36.00	102x102x914	2.75	70	16	11	11
4448 G	4448 G NK	4448 GGV	4448 GGV NK	4.00x4.00x48.00	102x102x1219	2.75	70	16	15	15
4460 G	4460 G NK	4460 GGV	4460 GGV NK	4.00x4.00x60.00	102x102x1524	2.75	70	16	19	19
4472 G	4472 G NK	4472 GGV	4472 GGV NK	4.00x4.00x72.00	102x102x1829	2.75	70	16	23	23
44120 G	44120 G NK	44120 GGV	44120 GGV NK	4.00x4.00x120.00	102x102x3048	2.75	70	16	39	39
6412 G	6412 G NK	6412 GGV	6412 GGV NK	6.00x4.00x12.00	152x102x305	4.25	108	16	3	3
6418 G	6418 G NK	6418 GGV	6418 GGV NK	6.00x4.00x18.00	152x102x457	4.25	108	16	5	5
6424 G	6424 G NK	6424 GGV	6424 GGV NK	6.00x4.00x24.00	152x102x610	4.25	108	16	7	7
6436 G	6436 G NK	6436 GGV	6436 GGV NK	6.00x4.00x36.00	152x102x914	4.25	108	16	11	11
6448 G	6448 G NK	6448 GGV	6448 GGV NK	6.00x4.00x48.00	152x102x1219	4.25	108	16	15	15
6460 G	6460 G NK	6460 GGV	6460 GGV NK	6.00x4.00x60.00	152x102x1524	4.25	108	16	19	19
6472 G	6472 G NK	6472 GGV	6472 GGV NK	6.00x4.00x72.00	152x102x1829	4.25	108	16	23	23
64120 G	64120 G NK	64120 GGV	64120 GGV NK	6.00x4.00x120.00	152x102x3048	4.25	108	16	39	39
6612 G	6612 G NK	6612 GGV	6612 GGV NK	6.00x6.00x12.00	152x152x305	4.25	108	16	3	3
6618 G	6618 G NK	6618 GGV	6618 GGV NK	6.00x6.00x18.00	152x152x457	4.25	108	16	5	5
6624 G	6624 G NK	6624 GGV	6624 GGV NK	6.00x6.00x24.00	152x152x610	4.25	108	16	7	7
6636 G	6636 G NK	6636 GGV	6636 GGV NK	6.00x6.00x36.00	152x152x914	4.25	108	16	11	11
6648 G	6648 G NK	6648 GGV	6648 GGV NK	6.00x6.00x48.00	152x152x1219	4.25	108	16	15	15
6660 G	6660 G NK	6660 GGV	6660 GGV NK	6.00x6.00x60.00	152x152x1524	4.25	108	16	19	19
6672 G	6672 G NK	6672 GGV	6672 GGV NK	6.00x6.00x72.00	152x152x1829	4.25	108	16	23	23
66120 G	66120 G NK	66120 GGV	66120 GGV NK	6.00x6.00x120.00	152x152x3048	4.25	108	16	39	39

See page 14 for 8”x8” through 12”x12” wireway.

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Type 1 Screw Cover Wireway - Painted & Galvanized

Catalog Number

Wireway Catalog Number				Wireway Size Height x Depth x Length A x B x C		D			Knockout Quantity	
Painted		Galvanized								
KO	No KO	KO	No KO	in.	mm	in.	mm	Gauge	Top	Bottom
8812 G	8812 G NK	8812 GGV	8812 GGV NK	8.00x8.00x12.00	203x203x305	6.00	152	14	3	3
8818 G	8818 G NK	8818 GGV	8818 GGV NK	8.00x8.00x18.00	203x203x457	6.00	152	14	5	5
8824 G	8824 G NK	8824 GGV	8824 GGV NK	8.00x8.00x24.00	203x203x610	6.00	152	14	7	7
8836 G	8836 G NK	8836 GGV	8836 GGV NK	8.00x8.00x36.00	203x203x914	6.00	152	14	11	11
8848 G	8848 G NK	8848 GGV	8848 GGV NK	8.00x8.00x48.00	203x203x1219	6.00	152	14	15	15
8860 G	8860 G NK	8860 GGV	8860 GGV NK	8.00x8.00x60.00	203x203x1524	6.00	152	14	19	19
8872 G	8872 G NK	8872 GGV	8872 GGV NK	8.00x8.00x72.00	203x203x1829	6.00	152	14	23	23
88120 G	88120 G NK	88120 GGV	88120 GGV NK	8.00x8.00x120.00	203x203x3048	6.00	152	14	39	39
101012 G	101012 G NK	101012 GGV	101012 GGV NK	10.00x10.00x12.00	254x254x305	8.00	203	14	3	3
101024 G	101024 G NK	101024 GGV	101024 GGV NK	10.00x10.00x24.00	254x254x610	8.00	203	14	7	7
101036 G	101036 G NK	101036 GGV	101036 GGV NK	10.00x10.00x36.00	24x254x914	8.00	203	14	11	11
101048 G	101048 G NK	101048 GGV	101048 GGV NK	10.00x10.00x48.00	254x254x1219	8.00	203	14	15	15
101060 G	101060 G NK	101060 GGV	101060 GGV NK	10.00x10.00x60.00	254x254x1524	8.00	203	14	19	19
101072 G	101072 G NK	101072 GGV	101072 GGV NK	10.00x10.00x72.00	254x254x1829	8.00	203	14	23	23
1010120 G	1010120 G NK	1010120 GGV	1010120 GGV NK	10.00x10.00x120.00	254x254x3048	8.00	203	14	39	39
121212 G	121212 G NK	121212 GGV	121212 GGV NK	12.00x12.00x12.00	305x305x305	10.00	254	14	3	3
121224 G	121224 G NK	121224 GGV	121224 GGV NK	12.00x12.00x24.00	305x305x610	10.00	254	14	7	7
121236 G	121236 G NK	121236 GGV	121236 GGV NK	12.00x12.00x36.00	305x305x914	10.00	254	14	11	11
121248 G	121248 G NK	121248 GGV	121248 GGV NK	12.00x12.00x48.00	305x305x1219	10.00	254	14	15	15
121260 G	121260 G NK	121260 GGV	121260 GGV NK	12.00x12.00x60.00	305x3051524	10.00	254	14	19	19
121272 G	121272 G NK	121272 GGV	121272 GGV NK	12.00x12.00x72.00	305x305x1829	10.00	254	14	23	23
1212120 G	1212120 G NK	1212120 GGV	1212120 GGV NK	12.00x12.00x120.00	305x305x3048	10.00	254	14	39	39

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Type 1 Screw Cover Wireway Fittings - Painted & Galvanized

Catalog Number

Connector

Catalog Number	A		B	
	in.	mm	in.	mm
22 C	2.50	64	2.50	64
33 C	3.00	76	3.00	76
44 C	4.00	102	4.00	102
64 C	6.00	152	4.00	102
66 C	6.00	152	6.00	152
88 C	8.00	203	8.00	203
1010 C	10.00	254	10.00	254
1212 C	12.00	305	12.00	305

Reducer

Catalog Number		A1		B1		A2		B2		C	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
2233 FR	2233 FRGV	2.50	64	2.50	64	3.00	76	3.00	76	6.00	152
3344 FR	3344 FRGV	3.00	76	3.00	76	4.00	102	4.00	102	8.00	203
4466 FR	4466 FRGV	4.00	102	4.00	102	6.00	152	6.00	152	10.00	254
6688 FR	6688 FRGV	6.00	152	6.00	152	8.00	203	8.00	203	12.00	305
881010 FR	881010 FRGV	8.00	203	8.00	203	10.00	254	10.00	254	12.00	305
10101212 FR	10101212 FRGV	10.00	254	10.00	254	12.00	305	12.00	305	16.00	406

Wireway End Flange

Catalog Number		A		B		E		F	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
22 GF	22 GFGV	2.50	64	2.50	64	4.00	102	4.00	102
33 GF	33 GFGV	3.00	76	3.00	76	4.50	114	4.50	114
44 GF	44 GFGV	4.00	102	4.00	102	5.50	140	5.50	140
64 GF	64 GFGV	6.00	152	4.00	102	7.50	191	5.50	140
66 GF	66 GFGV	6.00	152	6.00	152	7.50	191	7.50	191
88 GF	88 GFGV	8.00	203	8.00	203	9.50	241	9.50	241
1010 GF	1010 GFGV	10.00	254	10.00	254	11.50	292	11.50	292
1212 GF	1212 GFGV	12.00	305	12.00	305	13.50	343	13.50	343

90° Elbow

Catalog Number		A		B		C		E		F	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
22 L COMBO	22 L COMBOGV	2.50	64	2.50	64	5.59	142	4.28	109	4.28	109
33 L COMBO	33 L COMBOGV	3.00	76	3.00	76	6.09	155	4.50	114	4.50	114
44 L COMBO	44 L COMBOGV	4.00	102	4.00	102	7.09	180	5.00	127	5.00	127
64 L COMBO	64 L COMBOGV	4.00	102	6.00	152	10.09	256	5.00	127	5.00	127
66 L COMBO	66 L COMBOGV	6.00	152	6.00	152	10.09	256	7.00	178	7.00	178
88 L COMBO	88 L COMBOGV	8.00	203	8.00	203	12.09	307	8.00	203	8.00	203
1010 L COMBO	1010 L COMBOGV	10.00	254	10.00	254	14.09	358	9.00	229	9.00	229
1212 L COMBO	1212 L COMBOGV	12.00	305	12.00	305	16.09	409	10.00	254	10.00	254
22 L SIDE	22 L SIDEGV	2.50	64	2.50	64	5.59	142	4.28	109	4.28	109
33 L SIDE	33 L SIDEGV	3.00	76	3.00	76	6.09	155	4.50	114	4.50	114
44 L SIDE	44 L SIDEGV	4.00	102	4.00	102	7.09	180	5.00	127	5.00	127
64 L SIDE	64 L SIDEGV	6.00	152	4.00	102	10.09	256	7.00	178	7.00	178
66 L SIDE	66 L SIDEGV	6.00	152	6.00	152	10.09	256	7.00	178	7.00	178
88 L SIDE	88 L SIDEGV	8.00	203	8.00	203	12.09	307	8.00	203	8.00	203
1010 L SIDE	1010 L SIDEGV	10.00	254	10.00	254	14.09	358	10.00	254	9.00	229
1212 L SIDE	1212 L SIDEGV	12.00	305	12.00	305	16.09	409	10.00	254	10.00	254
22 L SWEEP	22 L SWEEPGV	2.50	64	2.50	64	5.63	143	4.25	108	4.25	108
33 L SWEEP	33 L SWEEPGV	3.00	76	3.00	76	8.41	214	6.84	174	6.84	174
44 L SWEEP	44 L SWEEPGV	4.00	102	4.00	102	9.41	239	7.34	186	7.34	186
64 L SWEEP	64 L SWEEPGV	6.00	152	4.00	102	11.41	290	8.34	212	8.34	212
66 L SWEEP	66 L SWEEPGV	6.00	152	6.00	152	11.41	290	8.34	212	8.34	212
88 L SWEEP	88 L SWEEPGV	8.00	203	8.00	203	13.41	341	9.34	237	9.34	237
1010 L SWEEP	1010 L SWEEPGV	10.00	254	10.00	254	15.41	391	10.34	263	10.34	263
1212 L SWEEP	1212 L SWEEPGV	12.00	305	12.00	305	17.41	442	11.34	288	11.34	288

Telescopic Fitting

Catalog Number		A		B1		B2		C	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
22 FTF	22 FTFGV	2.75	70	1.75	44	1.12	28	12.00	305
33 FTF	33 FTFGV	3.25	83	2.25	57	1.12	28	12.00	305
44 FTF	44 FTFGV	4.25	108	3.25	83	1.12	28	12.00	305
64 FTF	64 FTFGV	6.25	159	3.25	83	1.12	28	12.00	305
66 FTF	66 FTFGV	6.25	159	5.25	133	1.12	28	12.00	305
88 FTF	88 FTFGV	8.25	210	7.25	184	1.12	28	12.00	305
1010 FTF	1010 FTFGV	10.25	260	9.25	235	1.12	28	12.00	305
1212 FTF	1212 FTFGV	12.25	311	11.25	286	1.12	28	12.00	305

End

Catalog Number				A		B	
KO	No KO	KO	No KO				
Painted		Galvanized		in.	mm	in.	mm
22 E	22 E NK	22 EGV	22 EGV NK	2.50	64	2.50	64
33 E	33 E NK	33 EGV	33 EGV NK	3.00	76	3.00	76
44 E	44 E NK	44 EGV	44 EGV NK	4.00	102	4.00	102
64 E	64 E NK	64 EGV	64 EGV NK	6.00	152	4.00	102
66 E	66 E NK	66 EGV	66 EGV NK	6.00	152	6.00	152
88 E	88 E NK	88 EGV	88 EGV NK	8.00	203	8.00	203
1010 E	1010 E NK	1010 EGV	1010 EGV NK	10.00	254	10.00	254
1212 E	1212 E NK	1212 EGV	1212 EGV NK	12.00	305	12.00	305

See drawing for KO sizes.

Wireway Hanger

Catalog Number		G		H		J		K	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
22 FH	22 FHGV	8.50	216	6.50	165	6.50	165	2.87	73
33 FH	33 FHGV	10.50	267	8.50	216	9.00	229	3.87	98
44 FH	44 FHGV	12.50	318	10.50	267	10.37	263	4.87	124
66 FH	66 FHGV	16.50	419	14.50	368	13.50	343	5.87	149
88 FH	88 FHGV	20.50	521	18.50	470	16.75	425	6.87	174
1010 FH*	1010 FHGV*	24.50	622	22.50	572	19.75	502	7.87	200
1212 FH*	1212 FHGV*	28.50	724	26.50	673	22.75	578	8.87	225

*Hangers are shipped welded in the top cover assembly position.

90° Elbow - Tee - Cross

Catalog Number		A		B		C	
Painted	Galvanized	in.	mm	in.	mm	in.	mm
22 LTX	22 LTXGV	2.50	64	2.50	64	4.50	114
33 LTX	33 LTXGV	3.00	76	3.00	76	5.00	127
44 LTX	44 LTXGV	4.00	102	4.00	102	6.00	152
64 LTX	64 LTXGV	6.00	152	4.00	102	8.00	203
66 LTX	66 LTXGV	6.00	152	6.00	152	8.00	203
88 LTX	88 LTXGV	8.00	203	8.00	203	10.00	254
1010 LTX	1010 LTXGV	10.00	254	10.00	254	12.00	305
1212 LTX	1212 LTXGV	12.00	305	12.00	305	14.00	356

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Type 1 Screw Cover Wireway Fittings - Painted & Galvanized

Catalog Number

45° Elbow

Catalog Number		A		B		E		F	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
2245 L COMBO	2245 L COMBOGV	2.50	64	2.50	64	1.72	44	1.72	44
3345 L COMBO	3345 L COMBOGV	3.00	76	3.00	76	2.56	65	2.56	65
4445 L COMBO	4445 L COMBOGV	4.00	102	4.00	102	2.75	70	2.75	70
6445 L COMBO	6445 L COMBOGV	4.00	102	6.00	153	2.75	70	2.75	70
6645 L COMBO	6645 L COMBOGV	6.00	153	6.00	153	3.18	81	3.18	81
8845 L COMBO	8845 L COMBOGV	8.00	203	8.00	203	3.62	92	3.62	92
101045 L COMBO	101045 L COMBOGV	10.00	254	10.00	254	4.06	103	4.06	103
121245 L COMBO	121245 L COMBOGV	12.00	305	12.00	305	4.50	114	4.50	114
2245 L SIDE	2245 L SIDEGV	2.50	64	2.50	64	1.97	50	1.97	50
3345 L SIDE	3345 L SIDEGV	3.00	76	3.00	76	2.56	65	2.56	65
4445 L SIDE	4445 L SIDEGV	4.00	102	4.00	102	2.75	70	2.75	70
6445 L SIDE	6445 L SIDEGV	6.00	153	4.00	102	3.18	81	3.18	81
6645 L SIDE	6645 L SIDEGV	6.00	153	6.00	153	3.18	81	3.18	81
8845 L SIDE	8845 L SIDEGV	8.00	203	8.00	203	3.62	92	3.62	92
101045 L SIDE	101045 L SIDEGV	10.00	254	10.00	254	4.06	103	4.06	103
121245 L SIDE	121245 L SIDEGV	12.00	305	12.00	305	4.50	114	4.50	114

Tee

Catalog Number		A		B		E		F	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
22 T	22 TGV	2.50	64	2.50	64	4.25	108	4.25	108
33 T	33 TGV	3.00	76	3.00	76	4.50	114	4.50	114
44 T	44 TGV	4.00	102	4.00	102	5.00	127	5.00	127
64 T	64 TGV	6.00	153	4.00	102	7.00	178	7.00	178
66 T	66 TGV	6.00	153	6.00	153	7.00	178	7.00	178
88 T	88 TGV	8.00	203	8.00	203	8.00	203	8.00	203
1010 T	1010 TGV	10.00	254	10.00	254	9.00	229	9.00	229
1212 T	1212 TGV	12.00	305	12.00	305	10.00	254	10.00	254

Cross

Catalog Number		A		B		E		F	
Painted	Galvanized	in.	mm	in.	mm	in.	mm	in.	mm
22 X	22 XGV	2.50	64	2.50	64	4.25	108	4.25	108
33 X	33 XGV	3.00	76	3.00	76	5.62	143	5.62	143
44 X	44 XGV	4.00	102	4.00	102	6.12	155	6.12	155
64 X	64 XGV	6.00	152	4.00	152	7.12	181	7.12	181
66 X	66 XGV	6.00	152	6.00	152	7.12	181	7.12	181
88 X	88 XGV	8.00	203	8.00	203	8.12	206	8.12	206
1010 X	1010 XGV	10.00	254	10.00	254	9.12	232	9.12	232
1212 X	1212 XGV	12.00	305	12.00	305	10.12	257	10.12	25

Barrier Kit, 60" Bolt-On

Catalog Number	Size		Length		H	
	in.	mm	in.	mm	in.	mm
22-12BK*	2.50x2.50	64x64	60.00	1524	1.88	48
33-12BK*	3.00x3.00	76x76	60.00	1524	2.25	57
44-12BK*	4.00x4.00	102x102	60.00	1524	3.00	76
66-12BK*	6.00x6.00	152x152	60.00	1524	4.50	114
88-12BK*	8.00x8.00	203x203	60.00	1524	6.00	152
1010-12BK*	10.00x10.00	254x254	60.00	1524	8.00	203
1212-12BK*	12.00x12.00	305x305	60.00	1524	10.50	267

*Not UL or CSA listed fitting.

Type 1 Wireway Competitor Adapters

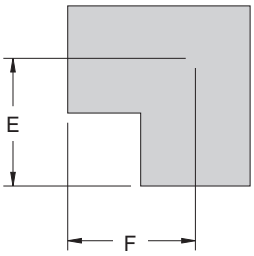
Wireway Size		Hoffman®[1]	Wiegmann®[2]	Square D®[3]	Unity®[4]	Electrical Box and Enclosures®[5]	Austin®[6]
in.	mm						
2.5x2.5	64x64	22 CA	22 CA	22 CA	22 CA	-	22 ACA
4x4	102x102	44 CA	44 CA	44 CA	44 CA	44 CA	44 ACA
6x6	152x152	66 CA	66 CA	66 CA	66 CA	66 CA	66 ACA
8x8	203x203	88 CA	88 CA	88 SCA	88 CA	88 CA	88 ACA
10x10	254x254	1010 CA	1010 CA	1010 SCA	1010 CA	1010 CA	1010 ACA
12x12	305x305	1212 CA	1212 CA	1212 SCA	1212 CA	1212 CA	1212 ACA

1. HOFFMAN® is the registered trademark of Hoffman Engineering Company, Anoka, Minnesota.
2. WIEGMANN® is the registered trademark of Hubbell Incorporated, Orange, Connecticut.
3. SQUARE D® is the registered trademark of Square D Company, Palatine, Illinois.
4. UNITY® is the registered trademark of Unity Manufacturing, Garland, Texas.
5. ELECTRICAL BOX AND ENCLOSURES® is the registered trademark of Electrical Box and Enclosures, Alabaster, Alabama.
6. AUSTIN® is the registered trademark of The Austin Co., Yadkinville, North Carolina.

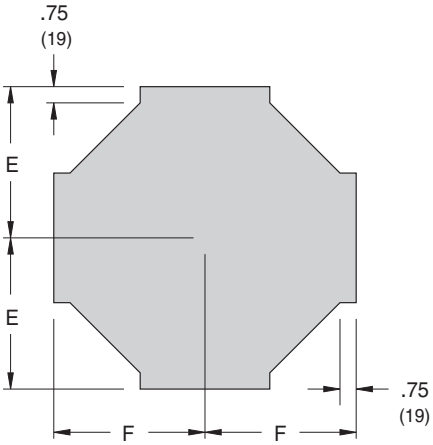
Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Type 1 Screw Cover Wireway - Painted & Galvanized

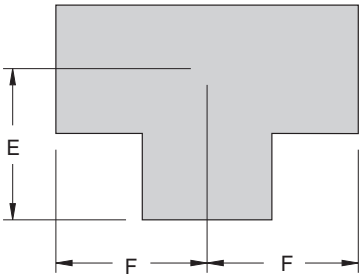
Illustration Sheet



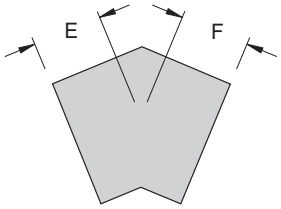
90˚ Elbow



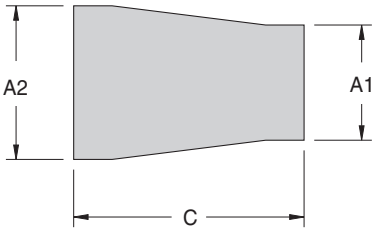
Cross



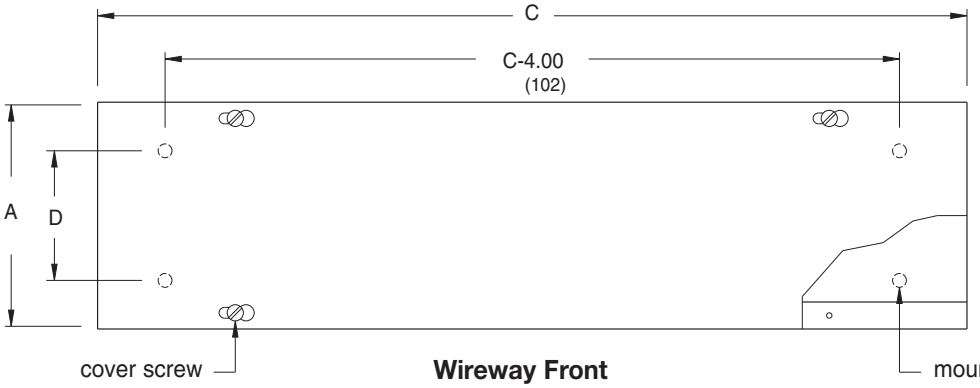
Tee



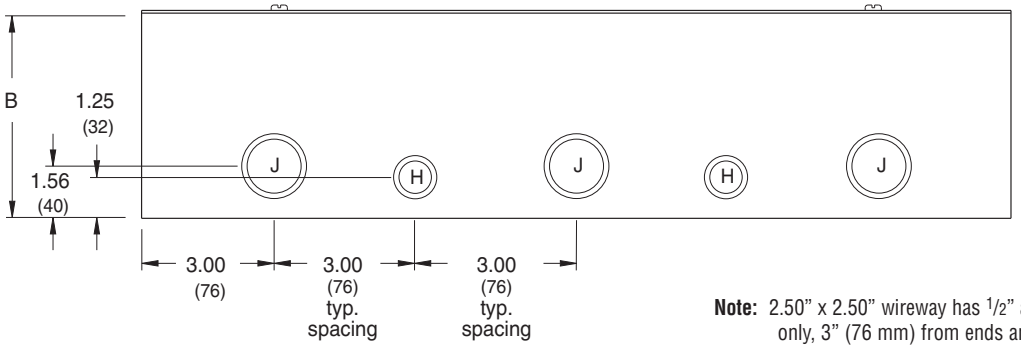
45˚ Elbow



Reducer Fitting



Wireway Front



Wireway Side

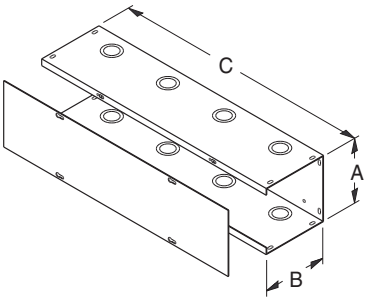
Knockout sizes:
H = 3/4" or 1/2" conduit
J = 1 1/4" or 1" conduit

Note: 2.50" x 2.50" wireway has 1/2" and 3/4" 2-way knockouts (H) only, 3" (76 mm) from ends and 3" (76 mm) on center. Additional mounting holes are furnished when C dimension is over 60.00" (1524 mm).

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Type 1 Screw Cover Wireway - Painted & Galvanized

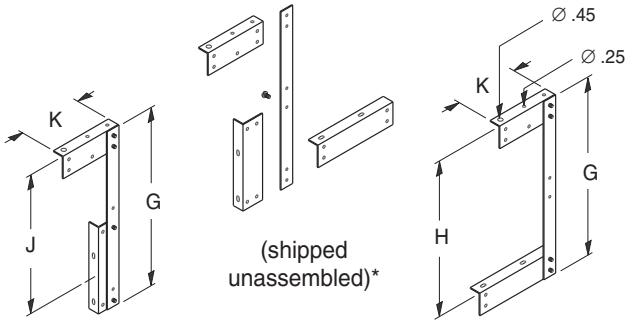
Illustration Sheet



Wireway Section

Lengths from 12.00” (305 mm) to 120.00” (3048 mm). Wireway exceeding 72.00” (1829 mm) has two covers. Shown with KO’s also available without.

Wireway Hangers

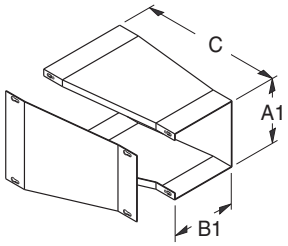


Side Cover Assembly

For those installations where the wireway cover must be removed from the side. *1010 FH & 1212 FH are shipped welded in the top cover assembly position.

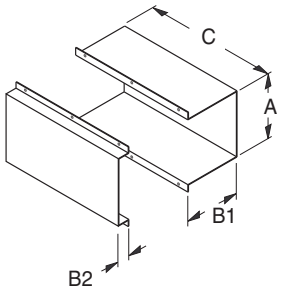
Top Cover Assembly

For those installations where the wireway cover must be removed from the top.*1010 FH & 1212 FH are shipped welded in the top cover assembly position.



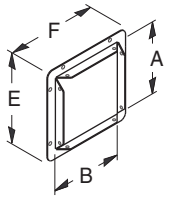
Reducer

A2 and B2 dimensions (see catalog table), correspond to the large end opening. Used to reduce or enlarge wireway runs.



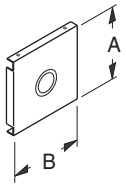
Telescopic Fitting

Adjustable length up to 10.00” (254 mm). Wraps around the two near joining wireway lengths to achieve a continuous run.



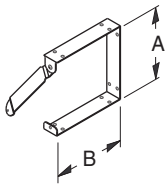
Wireway End Flange

Allows for a secure connection of wireway to an adjoining enclosure or wall.



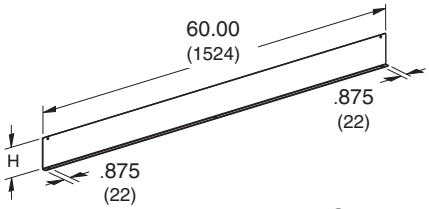
End

Used to terminate wireway or fitting. 2.50”x2.50” (64 mm x 64 mm) through 8.00”x8.00” (203 mm x 203 mm) ends have a 1.50”-1.25” concentric 2-way KO. 10.00” x 10.00” (254 mm x 254 mm) ends and larger have a 3.00”-2.50” concentric 2-way KO for terminating on pipe or conduit. Also available without KO.



Connector

Swing gate allows for continuous runs of wire and cable.



Barrier, Bolt-On

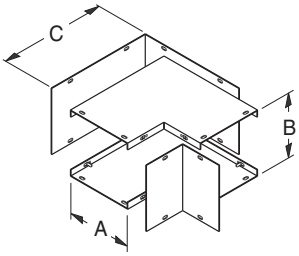
For those installations that require separated wiring compartments.

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

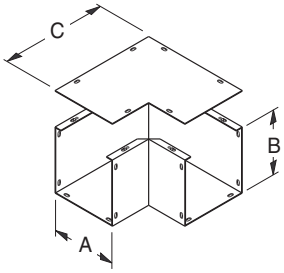
Type 1 Screw Cover Wireway - Painted & Galvanized

Illustration Sheet

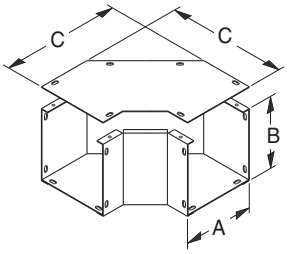
Wireway 90˚ Elbows



Combo Opening
Specially designed for removing either the inside or outside cover to allow a continuous run with 90˚ turns.

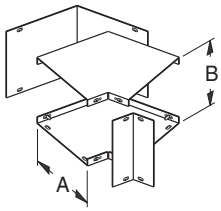


Side Opening
Side cover is removable to allow a continuous run on designs with 90˚ turns.

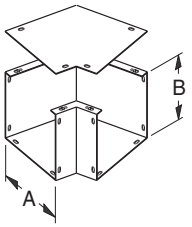


Sweep Elbow
Side cover design with a larger radius for 90° sweeping turns.

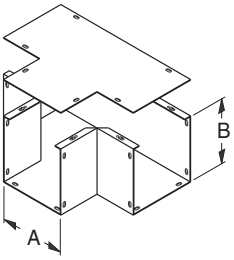
Wireway 45˚ Elbows



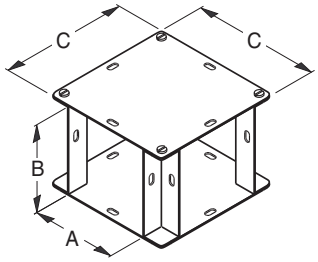
Combo Opening
Similar to the 90˚ elbow design except a 45˚ turn. Both inside and outside covers removable.



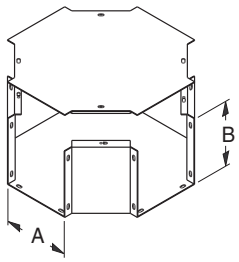
Side Opening
Similar to the 90˚ side opening design except for a 45˚ turn. Excellent for combining two to make a gradual sweeping 90˚ turn.



Tee
Side cover design where a “T” junction is necessary.



90° Elbow-Tee-Cross
Designed for left or right 90° turns or as a tee or cross by removing closure plates. Includes two (2) closure plates and hardware.



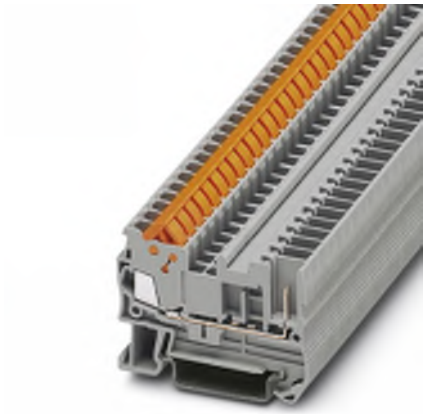
Cross
Side cover and broad body design to junction cable run in four directions.

Notes: Dimensions are in inches. Millimeters shown are for reference only. Data subject to change without notice.

Extract from the online catalog

QTC 1,5/ 1P

Order No.: 3050073



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sales group	A770
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Customs tariff	85369010
Catalog page information	Page 316 (CL1-2011)

Product notes

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Technical data

General

Number of levels	1
Number of connections	2
Color	gray
Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions	
Width	5.2 mm
Length	53.5 mm
Height NS 35/7.5	39.3 mm
Height NS 35/15	46.8 mm

Technical data	
Maximum load current	17.5 A (with 1.5 mm^2 conductor cross section)
Rated surge voltage	6 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 61984
Nominal current I_N	17.5 A
Nominal voltage U_N	500 V
Open side panel	ja

Connection data	
Conductor cross section solid min.	0.25 mm²
Conductor cross section solid max.	1.5 mm²
Conductor cross section stranded min.	0.25 mm²
Conductor cross section stranded max.	1.5 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	16
Connection method	Fast/plug-in connection
Internal cylindrical gage	A3
Material wire insulation	PVC / PE

Certificates / Approvals

Certification	CSA, CUL, GL, GOST, UL

Accessories

Item	Designation	Description
Assembly		
3206209	ATP-QTC	Partition plate, Length: 64.4 mm, Width: 2 mm, Height: 46 mm, Color: gray
3206322	D-QTC 1,5/1P	End cover, Length: 53.5 mm, Width: 2.2 mm, Height: 39.3 mm, Color: gray
Bridges		
3030161	FBS 2-5	Plug-in bridge, Number of positions: 2, Color: red
3030174	FBS 3-5	Plug-in bridge, Number of positions: 3, Color: red
3030187	FBS 4-5	Plug-in bridge, Number of positions: 4, Color: red
3030190	FBS 5-5	Plug-in bridge, Number of positions: 5, Color: red
3030213	FBS 10-5	Plug-in bridge, Number of positions: 10, Color: red
3030226	FBS 20-5	Plug-in bridge, Number of positions: 20, Color: red
3038930	FBS 50-5	Plug-in bridge, Number of positions: 50, Color: red
Marking		
3040588	PC	Keying star, Length: 3 mm, Width: 3 mm, Height: 6 mm, Color: red
0818108	UC-TM 5	UniCard materials for labeling terminal blocks with a marker groove,96-section, can be labeled with BLUEMARK and CMS-P1-PLOTTER, color: white
0824581	UC-TM 5 CUS	UniCard sheets, for labeling terminal blocks with a zack marker strip groove, can be printed as per customer requirements
0818153	UC-TMF 5	UniCard materials for labeling terminal blocks using a flat marker groove, 96-section, can be labeled with BLUEMARK and CMS-P1-PLOTTER, color: white
0824638	UC-TMF 5 CUS	UniCard sheets, for labeling terminal blocks with a flat zack marker sheet groove, can be printed as per customer requirements
0828734	UCT-TM 5	UniCard materials for thermal transfer printer, for labeling terminal blocks with a marker groove, 72-section, can be labeled with THERMOMARK CARD and BLUEMARK LED, color: white
0829595	UCT-TM 5 CUS	Terminal block marking, can be labeled as per customer specifications
0828744	UCT-TMF 5	UniCard materials for thermal transfer printer, for labeling terminal blocks with a horizontal marker groove, 72-section, can be labeled with THERMOMARK CARD and BLUEMARK LED, color: white
0829658	UCT-TMF 5 CUS	Terminal block marking, can be labeled as per customer specifications

1050004	ZB 5 :UNBEDRUCKT	Zack strip, unprinted, 10-section, for individual labeling with M-PEN, ZB-T or CMS system, pack is sufficient for 100 terminal blocks, for a terminal width of 5.2 mm, color: White

Plug/Adapter

3030925	PAI-4	Test adapter, Color: gray
3036709	PS-4/E	Test adapter, Color: red
3030983	PS-5	Test adapter, Color: red

Tools

1204517	SZF 1-0,6X3,5	Actuation tool, for ST terminal blocks, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip

Additional products

Item	Designation	Description

Plug/Adapter

3040258	SP 2,5/ 1	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: gray
3040698	SP 2,5/ 1 BU	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: blue
3040708	SP 2,5/ 1 GNYE	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: green-yellow
3040261	SP 2,5/ 2	Connectors, Connection method: Spring-cage connection, Number of positions: 2, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 10.4 mm, Height: 39 mm, Color: gray
3040274	SP 2,5/ 3	Connectors, Connection method: Spring-cage connection, Number of positions: 3, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 15.6 mm, Height: 39 mm, Color: gray
3040287	SP 2,5/ 4	Connectors, Connection method: Spring-cage connection, Number of positions: 4, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 20.8 mm, Height: 39 mm, Color: gray
3040290	SP 2,5/ 5	Connectors, Connection method: Spring-cage connection, Number of positions: 5, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 26 mm, Height: 39 mm, Color: gray
3040300	SP 2,5/ 6	Connectors, Connection method: Spring-cage connection, Number of positions: 6, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 31.2 mm, Height: 39 mm, Color: gray
3040313	SP 2,5/ 7	Connectors, Connection method: Spring-cage connection, Number of positions: 7, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 36.4 mm, Height: 39 mm, Color: gray

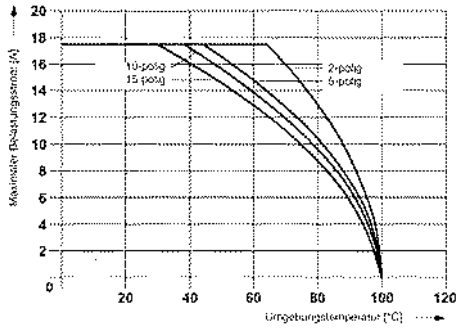
3040326	SP 2,5/ 8	Connectors, Connection method: Spring-cage connection, Number of positions: 8, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 41.6 mm, Height: 39 mm, Color: gray
3040339	SP 2,5/ 9	Connectors, Connection method: Spring-cage connection, Number of positions: 9, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 46.8 mm, Height: 39 mm, Color: gray
3040342	SP 2,5/10	Connectors, Connection method: Spring-cage connection, Number of positions: 10, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 52 mm, Height: 39 mm, Color: gray
3040355	SP 2,5/11	Connectors, Connection method: Spring-cage connection, Number of positions: 11, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 57.2 mm, Height: 39 mm, Color: gray
3040368	SP 2,5/12	Connectors, Connection method: Spring-cage connection, Number of positions: 12, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 62.4 mm, Height: 39 mm, Color: gray
3040371	SP 2,5/13	Connectors, Connection method: Spring-cage connection, Number of positions: 13, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 67.6 mm, Height: 39 mm, Color: gray
3040384	SP 2,5/14	Connectors, Connection method: Spring-cage connection, Number of positions: 14, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 72.8 mm, Height: 39 mm, Color: gray
3040397	SP 2,5/15	Connectors, Connection method: Spring-cage connection, Number of positions: 15, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 78 mm, Height: 39 mm, Color: gray
3040106	SPB 2,5/ 1	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: gray
3040724	SPB 2,5/ 1 BU	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: blue
3040711	SPB 2,5/ 1 GNYE	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: green-yellow
3040119	SPB 2,5/ 2	Connectors, Connection method: Spring-cage connection, Number of positions: 2, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 10.4 mm, Height: 39 mm, Color: gray
3040122	SPB 2,5/ 3	Connectors, Connection method: Spring-cage connection, Number of positions: 3, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 15.6 mm, Height: 39 mm, Color: gray
3040135	SPB 2,5/ 4	Connectors, Connection method: Spring-cage connection, Number of positions: 4, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 20.8 mm, Height: 39 mm, Color: gray
3040143	SPB 2,5/ 5	Connectors, Connection method: Spring-cage connection, Number of positions: 5, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 26 mm, Height: 39 mm, Color: gray
3040151	SPB 2,5/ 6	Connectors, Connection method: Spring-cage connection, Number of positions: 6, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 31.2 mm, Height: 39 mm, Color: gray

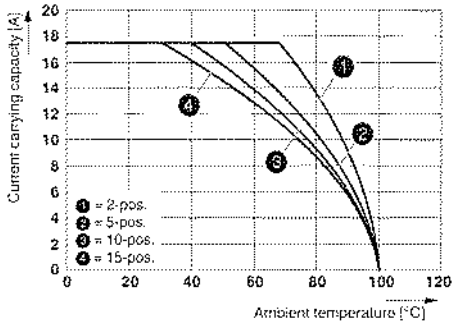
3040164	SPB 2,5/ 7	Connectors, Connection method: Spring-cage connection, Number of positions: 7, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 36.4 mm, Height: 39 mm, Color: gray
3040177	SPB 2,5/ 8	Connectors, Connection method: Spring-cage connection, Number of positions: 8, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 41.6 mm, Height: 39 mm, Color: gray
3040180	SPB 2,5/ 9	Connectors, Connection method: Spring-cage connection, Number of positions: 9, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 46.8 mm, Height: 39 mm, Color: gray
3040193	SPB 2,5/10	Connectors, Connection method: Spring-cage connection, Number of positions: 10, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 52 mm, Height: 39 mm, Color: gray
3040203	SPB 2,5/11	Connectors, Connection method: Spring-cage connection, Number of positions: 11, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 57.2 mm, Height: 39 mm, Color: gray
3040216	SPB 2,5/12	Connectors, Connection method: Spring-cage connection, Number of positions: 12, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 62.4 mm, Height: 39 mm, Color: gray
3040229	SPB 2,5/13	Connectors, Connection method: Spring-cage connection, Number of positions: 13, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 67.6 mm, Height: 39 mm, Color: gray
3040232	SPB 2,5/14	Connectors, Connection method: Spring-cage connection, Number of positions: 14, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 72.8 mm, Height: 39 mm, Color: gray
3040245	SPB 2,5/15	Connectors, Connection method: Spring-cage connection, Number of positions: 15, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 78 mm, Height: 39 mm, Color: gray
3040407	SPDB 2,5/ 1	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: gray
3040737	SPDB 2,5/ 1 BU	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: blue
3040740	SPDB 2,5/ 1 GNYE	Connectors, Connection method: Spring-cage connection, Number of positions: 1, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 5.2 mm, Height: 39 mm, Color: green-yellow
3040410	SPDB 2,5/ 2	Connectors, Connection method: Spring-cage connection, Number of positions: 2, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 10.4 mm, Height: 39 mm, Color: gray
3040423	SPDB 2,5/ 3	Connectors, Connection method: Spring-cage connection, Number of positions: 3, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 15.6 mm, Height: 39 mm, Color: gray
3040436	SPDB 2,5/ 4	Connectors, Connection method: Spring-cage connection, Number of positions: 4, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 20.8 mm, Height: 39 mm, Color: gray
3040449	SPDB 2,5/ 5	Connectors, Connection method: Spring-cage connection, Number of positions: 5, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 26 mm, Height: 39 mm, Color: gray

3040452	SPDB 2,5/ 6	Connectors, Connection method: Spring-cage connection, Number of positions: 6, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 31.2 mm, Height: 39 mm, Color: gray
3040465	SPDB 2,5/ 7	Connectors, Connection method: Spring-cage connection, Number of positions: 7, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 36.4 mm, Height: 39 mm, Color: gray
3040478	SPDB 2,5/ 8	Connectors, Connection method: Spring-cage connection, Number of positions: 8, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 41.6 mm, Height: 39 mm, Color: gray
3040481	SPDB 2,5/ 9	Connectors, Connection method: Spring-cage connection, Number of positions: 9, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 46.8 mm, Height: 39 mm, Color: gray
3040494	SPDB 2,5/10	Connectors, Connection method: Spring-cage connection, Number of positions: 10, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 52 mm, Height: 39 mm, Color: gray
3040504	SPDB 2,5/11	Connectors, Connection method: Spring-cage connection, Number of positions: 11, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 57.2 mm, Height: 39 mm, Color: gray
3040517	SPDB 2,5/12	Connectors, Connection method: Spring-cage connection, Number of positions: 12, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 62.4 mm, Height: 39 mm, Color: gray
3040520	SPDB 2,5/13	Connectors, Connection method: Spring-cage connection, Number of positions: 13, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 67.6 mm, Height: 39 mm, Color: gray
3040533	SPDB 2,5/14	Connectors, Connection method: Spring-cage connection, Number of positions: 14, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 72.8 mm, Height: 39 mm, Color: gray
3040546	SPDB 2,5/15	Connectors, Connection method: Spring-cage connection, Number of positions: 15, Cross section: 0.08 mm² - 4 mm², AWG 28 - 12, Width: 78 mm, Height: 39 mm, Color: gray

Diagrams/Drawings

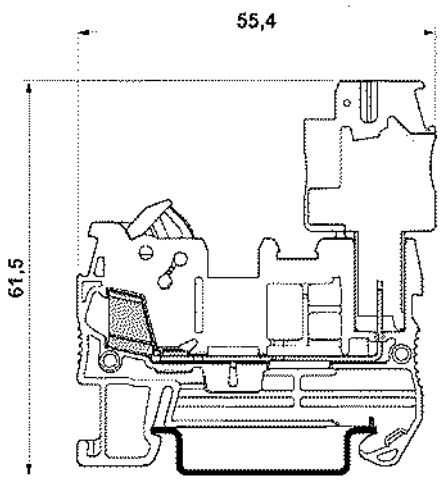
Diagram

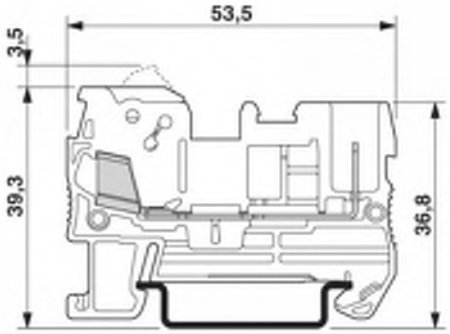




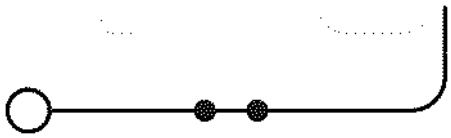
The figure shows the derating curve of the QTC 1,5/ 1P... terminal block in connection with the QP 1,5 connector

Dimensioned drawing





Circuit diagram



Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

Extract from the online catalog

NS 35/ 7,5 WH PERF NZ3178S120A4

Order No.: 0800925

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0800925

DIN rail, Width: 35 mm, Height: 7.5 mm

Commercial data	
GTIN (EAN)	4 017918 254438
Note	Made-to-order
sales group	B202
Pack	1 m
Customs tariff	72166190

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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multiCLASS™ RP15, RP40 and RPK40 Readers

13.56 MHz Contactless and 125 kHz Proximity Card Readers • 6125, 6136, 6145

- Simple Migration – From the most popular proximity technologies to iCLASS®.
- GSA-approved – Included in the U.S. General Services Administration (GSA) FIPS 201 Approved Products List.
- Dual Factor Authentication (RPK40 only) – Combine contactless card presentation with a PIN.

ACCESS upgrade.

The multiCLASS™ family of card readers is designed for customers upgrading their current card system from the most popular proximity technologies to iCLASS® credentials. With the RP40, RPK40 and RP15 readers, the customer has the ability to transition to smart cards over time while incorporating the use of multiple card technologies within a single building or across multiple facilities.

The multiCLASS reader line provides enhanced security through mutual authentication and data encryption. HID, Indala and other popular proximity technologies are supported by multiCLASS. Save on system configuration costs by keeping system upgrade simple. Whether reading proximity, iCLASS or multi-technology cards, identical user identification data formats are sent to the panel. Unlike competitor products, HID multiCLASS readers support all HID and Indala Proximity formats, including Corporate 1000, long and FlexSecur.

Only the multiCLASS family of products provides true iCLASS security, the ease of proximity technology, the power of smart cards and the confidence of choosing HID, the worldwide leader in access control.

Unique Read Selection

- Enable iCLASS, proximity or both technologies at the same time.
- Multiple data outputs available when multi-technology card is presented depending on preference.
- Configuration cards configure the reader to custom installation requirements.
- Reads: 125 kHz – HID, Indala or AWID Proximity
  13.56 MHz – iCLASS, ISO 15693 CSN (MyD, ICODE, Tag-it), ISO 14443A CSN (MIFARE® DESFire®), US Government PIV, ISO 14443B CSN, FeliCa™ IDm, CEPAS CAN or CSN

Seamless Upgrade

- Same HID and Indala Proximity reader features and format compatibilities.
- Matching Reader and Credential formats for EM4102 and iCLASS.
- Same wiring, power and interface as many popular proximity readers in the market today.
- All Corporate 1000 formats can be migrated.
- For additional security, our iCLASS Elite program is available with iCLASS credentials.
- Wiegand or Clock-and-Data outputs easily interface with existing access control panels.
- The RPK40 combines a contactless card presentation with a personal identification number (PIN) to support dual factor authentication of identity.
- The RP15 is a mullion form factor drop-in replacement for the HID MiniProx.

Features

Security
64-bit authentication keys are extremely secure. Readers and cards require matching keys to function. All RF data transmission between the card and reader is encrypted, using a secure algorithm. The key management system reduces the risk of compromised data or duplicated cards.

Elite Custom Keys
Custom keys provide the highest level of security, where cards and readers are uniquely matched to individual sites or customers, and are non-interchangeable. Combining Elite custom keys with our Corporate 1000 can offer companies a scalable solution that can be implemented in facilities worldwide.

Audiovisual Indication
Audio sounder provides various tone sequences to signify access granted, access denied, power up and diagnostics. Visually impaired cardholders can easily distinguish between access granted and access denied. A high-intensity light bar provides a clear visual status indication in red, green or amber, even in bright sunlight. (Note: Light bar will illuminate amber when a PIV/FIPS 201 card is read.)

Easily Interfaced
The reader's Wiegand output easily interfaces with most existing Wiegand protocol access control panels. The reader reads standard HID format data and will output data as encoded. When reading MIFARE® cards, the reader can be configured to output 26-bit, 32-bit, 34-bit, 37-bit, 40-bit, or 56-bit Wiegand formats, based on the card serial number.

Indoor/Outdoor Design
Rugged, weatherized polycarbonate enclosure, designed to withstand harsh environments, provides reliable performance and resistance to vandalism. A tamper switch in reader housing facilitates the notification of a tamper alarm.

Options
Colors - Black or Gray
Key Management - Standard or Elite
Selectable Output Type (for MIFARE cards)
Termination Options: 18" (46 cm) Pigtail
Programmable LED/Beeper operation
Accessory - Security Tool; 04-0001-03
Prox - HID and AWID or Indala
Transit - Enable FeliCa IDm

	RP40 multiCLASS™ Reader	RPK40 multiCLASS™ Reader with Keypad	RP15 multiCLASS™ Mullion-mount Reader
***Model Number**	6125C (Wiegand) 6123C (Clock-and-Data) 6124C (Transit)	6136C (Wiegand) 6133C (Clock-and-Data) 6134C (Transit)	6145C (Wiegand) 6143C (Clock-and-Data) 6144C (Transit)
****Read Range**	iCLASS Card: 4.0 - 4.5" (10.2 - 11.4 cm) iCLASS Key/Tag: 1.0 - 2.0" (2.5 - 5.0 cm) HID Prox ISO Card: 2.5 – 3.5" (6.5 - 9.0 cm) HID Prox Clamshell Card: 3.5 – 4.0" (9.0 - 10.0 cm) HID Prox Keyfob/Tag: 1.0 – 2.25" (2.5 - 5.5 cm) Indala Proximity ISO Card: 1.5 – 2.0" (4.0 - 5.0 cm) Indala Proximity Clamshell Card: 1.75 – 2.25" (4.5 - 5.5 cm) Indala Proximity Keyfob/Tag: 1.0 – 1.75" (2.5 - 4.5 cm)	iCLASS Card: 3.5 – 4.25" (9.0 - 11.0 cm) iCLASS Key/Tag: 1.0 – 1.5" (2.5 - 4.0 cm) HID Prox ISO Card: 2.5 – 3.5" (6.5 - 9.0 cm) HID Prox Clamshell Card: 3.5 – 4.0" (9.0 - 10.0 cm) HID Prox Keyfob/Tag: 1.25 – 1.75" (3.2 - 4.5 cm) Indala Proximity ISO Card: 1.5 – 2.0" (4.0 - 5.0 cm) Indala Proximity Clamshell Card: 1.75 – 2.25" (4.5 - 5.5 cm) Indala Proximity Keyfob/Tag: 1.0 – 1.25" (2.5 - 3.2 cm)	iCLASS Card 3.0 - 3.25" (7.5 - 8.3 cm) iCLASS Key/Tag: 1.0 – 1.5" (2.5 - 4.0 cm) HID Prox ISO Card: 2.5 – 3.5" (6.5 - 9.0 cm) HID Prox Clamshell Card: 3.5 – 4.0" (9.0 - 10.0 cm) HID Prox Keyfob/Tag: 1.25 – 1.75" (3.2 - 4.5 cm) Indala Proximity ISO Card: 1.5 – 2.0" (4.0 - 5.0 cm) Indala Proximity Clamshell Card: 1.75 – 2.25" (4.5 - 5.5 cm) Indala Proximity Keyfob/Tag: 1.0 – 1.25" (2.5 - 3.2 cm)
Mounting	A three-part reader makes installation easier. Mounting plate attaches to U.S./EU/Asian back box, 52-60 mm screw hole spacing (vertical or horizontal), or to any flat surface. Reader body fits onto mounting plate. Cover fits over reader body, secured with a screw. An auto-tuning circuit provides consistent read ranges on various mounting surfaces with minimal reduction on metal surfaces.	Mounting plate attaches to U.S./EU/Asian back box, 52-60 mm screw holespacing (vertical or horizontal). Keypad reader housing latches onto mounting plate, secured with a screw. An optional spacer can be used for surface mount installations. Mounting on metal can affect optimal read range and we recommend the use of our spacer to maximize read range.	Mounting plate attaches to mullion, door frame, U.S. single-gang J-box or any flat surface. (Reader will not cover junction box.) Reader body snaps onto mounting plate, secured with a screw. Identical mounting holes as the HID MiniProx.
Dimensions	3.3" x 4.8" x .95" (8.4 cm x 12.2 cm x 2.4 cm)	3.3" x 4.8" x 1.05" (8.4 cm x 12.2 cm x 2.7 cm)	6.1" x 1.9" x 0.9" (15.6 cm x 4.8 cm x 2.3 cm)
Weight	8.8 oz (249.5 g)	9.1 oz (258 g)	5.9 oz (166 g)
Power Supply	5 to 16 VDC. Linear supply recommended		
***** Current Requirements**	55 mA AVG, 141 mA PEAK @ 12 VDC	85 mA AVG, 169 mA PEAK @ 12 VDC	55 mA AVG, 114 mA PEAK @ 12 VDC
Operating Temperature	-31° to 150° F (-35° to 65° C)		
Operating Humidity	5% to 95% relative humidity non-condensing		
Transmit Frequency	125 kHz and 13.56 MHz		
Cable Distance	Wiegand/Clock-and-Data Interface 500 ft (150 m) 22 AWG		
Card Compatibility	**125 kHz Proximity** • HID or Indala proximity cards, keyfobs, and tags • AWID Credentials • EM4102 Credentials **13.56 MHz contactless smart cards** • ISO 15693 - read only; 2k bit (256 Byte), 16k bit (2k Byte) and **32k bit (4k Byte) iCLASS Credentials, serial number** • ISO 14443A - read only; MIFARE and DESFire® (serial number) • ISO 14443B - read only; 2k bit (256 Byte), **2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials, serial number** • FeliCa IDm, CEPAS CAN/CSN • US Government (PIV) ****		
Certifications	UL294/cUL (US), FCC Certification (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRC (China), MIC (Korea), NCC (Taiwan), MIC (Japan), iDA (Singapore), RoHS		
Housing Material	UL94 Polycarbonate		
Environmental	IP55		
Family Model	RP40N-6408-300, RP40D-6408-300, RP15N-6407-300, RP15D-6407-300, 6136AxN, 6136AxD and 6136AxA		
Warranty	Warrantied against defects in materials and workmanship for life. (See complete warranty policy for details.)		

*Consult How to Order Guide for specific ordering instructions.
**Dependent upon installation conditions
*** Add 25 mA to AVG current when reader is populated with HID Prox module; add 40 mA to AVG current when reader is populated with Indala Prox module.
**** iCLASS RPK40 Revision C readers are not currently approved for FIPS 201 functionality. See iCLASS RPK40 Revision B readers for US Government compliant readers.

MKT-iCLASS_RP-SERIES_C_DS-EN

HID

ACCESS experience.

hidglobal.com

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Phoenix Road
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CB9 7AE
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Tel: +44 1440 714 850
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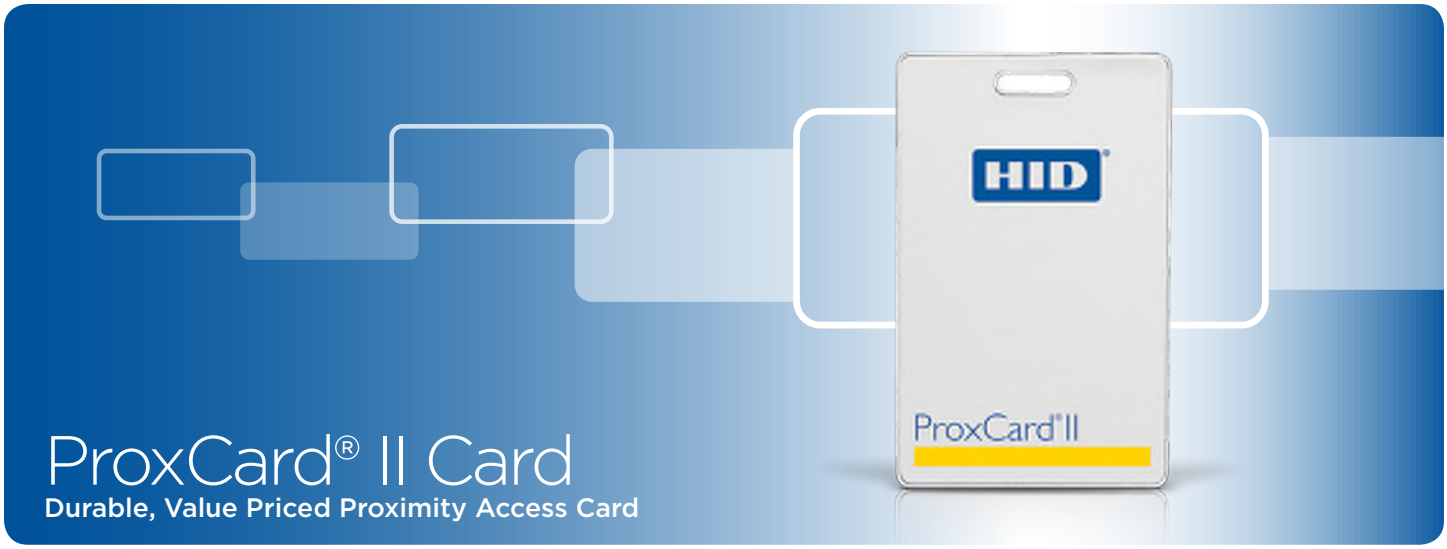
PHYSICAL ACCESS SOLUTIONS



ProxCard® II Card

Durable, Value Priced Proximity Access Card

Features:

- Offers universal compatibility with all HID proximity readers.
- Provides durable packaging and consistent read range.
- Provides an external number for easy identification and control.
- Supports formats up to 85 bits, with over 137 billion codes.
- Custom pre-printed artwork available.
- A PVC overlay allows for on-site photo ID using most direct image printers.
- Using HID's ProxProgrammer®, card vendors can ship ProxCard II proximity cards, custom programmed to their customers' requirements, from their own inventory. Enables smaller order quantities and overnight delivery. (Check with vendor for availablilty.)

THE RF-PROGRAMMABLE PROXCARD® II PROXIMITY ACCESS CARD IS THE INDUSTRY CHOICE FOR A COST-EFFECTIVE SOLUTION TO PROXIMITY ACCESS CONTROL.

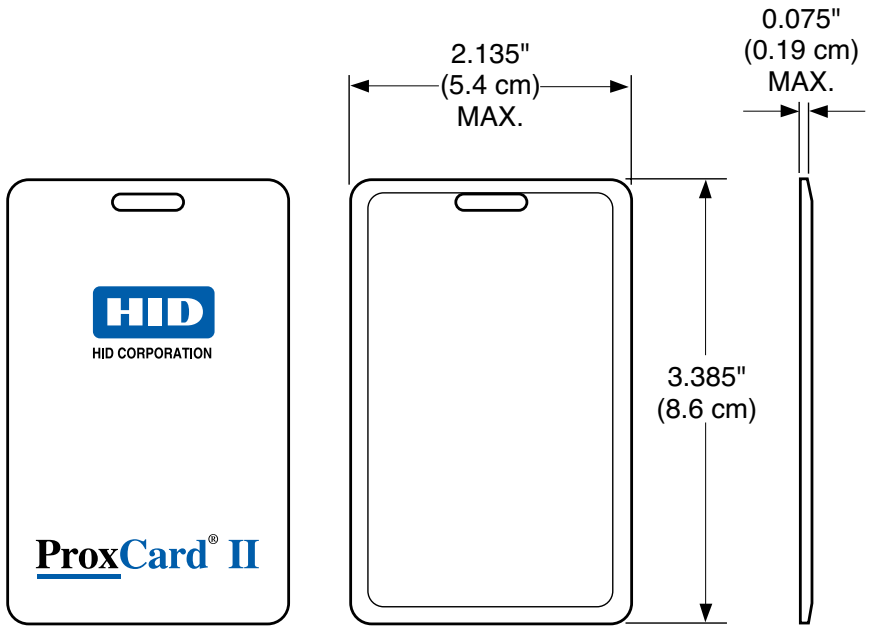
- **Proven, Reliable Technology** – Offers extremely consistent read range. Unaffected by body shielding or variable environmental conditions, even when close to keys and coins.
- **Convenient To Use** – Can fit into a wallet or purse. Use with a strap and clip as a photo ID badge.
- **Cross-reference** – A cross-reference list correlating the external card number and the programmed ID number is provided for easy system administration.
- **Security** – Offers over 137 billion unique codes.
- **Long Life** – Passive, no-battery design allows for an infinite number of reads.
- **Durability** – Strong, flexible and resistant to cracking and breaking.
- **Companion Products**– 1321 Photo pouch overlay
  1324 PVC Direct print overlay

The RF-programmable ProxCard® II proximity access card is the industry choice for a cost-effective solution to proximity access control.

SPECIFICATIONS

	ProxCard® II Card
Base Part Number	1326
Typical Maximum* Read Range	ProxPoint® Plus reader-up to 3" (7.5 cm) MiniProx® reader-up to 5.5" (14 cm) ThinLine® II reader-up to 5.5" (14 cm) ProxPro® reader-up to 8" (20 cm) ProxPro® II reader-up to 9"(22.9 cm) Prox80™-up to 5.5" (14 cm) MaxiProx® reader-up to 24" (60 cm)
Dimensions	2.135" x 3.385" x 0.075" MAX. (5.4 x 8.6 x 0.19 cm)
Operating Temperature	-50° to 160° F (-45° to 70° C)
Options	External card numbering (inkjet only; no laser engraving) Custom artwork (text or graphics)
Weight	0.24 oz. (6.8 gm)
Warranty	Lifetime

NOTES:
*Dependent on local installation conditions.



ProxCard II Artwork (front)

All dimensions are nominal

North America: +1 949 732 2000
Toll Free: 1 800 237 7769
Europe, Middle East, Africa: +44 1440 714 850
Asia Pacific: +852 3160 9800
Latin America: +52 55 5081 1650

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2012-05-14-hid-proxcardii-cards-ds-en

Steel Door Contact

3/4" and 1" contacts
1078/1076 Series

Overview

The GE Interlogix 1078 Series Steel Door contacts are designed specifically for use in the steel doors commonly found in commercial building applications. The unique housing design features a rugged unibody construction with flexible ribbed sides for quick, secure installation without gluing. The magnet housing isolates the magnet from the surrounding steel for maximum gap distances, both make and break. Over seven models including: Wide Gap, SPDT, DPDT, and Biased for High Security applications make the 1078 Series the most widely used and comprehensive line available.

On available models a terminal connection (T) makes installation easier. Simply strip the wire, insert it into the terminal block and tighten. The terminal accepts any wire size from 14 to 22 gauge, and has a unique one piece design for added strength.

An optional Rare Earth Magnet is available. It is designed for use in metal entry/exit doors with a channel in the top of the door. The magnet eliminates the need to cut a mounting hole in the door channel. The flexible magnet housing can be compressed to accommodate a variety of channel widths for quick, easy installation. Adhesive is recommended.

Optional 1840 Rare Earth Magnet

Architectural and Engineering Specifications

The contact contains a hermetically sealed magnetic reed switch. The reed shall be potted in the contact housing with a polyurethane based compound. Contact and magnet housing shall snap-lock into a 3/4" or 1" dia. hole. Housings shall be molded of flame retardant ABS plastic. Color of housings shall be off-white, grey or mahogany brown. The magnet shall be made of Alnico V. Rare Earth Magnet shall be made of neodymium iron boron.

Designed for use in Steel Doors

Snap-lock insulation bushing for tight fit and maximum gap in steel.

Both contact and magnet plastic housings are constructed of one piece of thick-walled ABS plastic for maximum strength and durability.

Standard Features

- ***Fly leads and terminal options available***
- ***Designed specifically for use in steel doors***
- ***Special ribbed sides allow for easy installation***
- ***Rugged unibody construction for maximum durability and reliability***
- ***Terminal models available for easier installation***
- ***Regular, Wide Gap, SPDT, DPDT, and High Security models available***
- ***Rare Earth Magnet designed for steel door with top channel available***

Model numbers

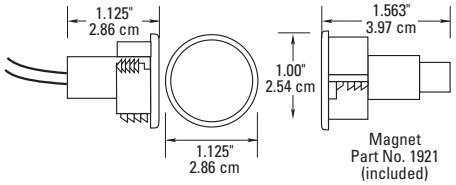
1076, 1076W, 1076C, 1076CW, 1076D, 1078, 1078W, 1078C, 1078CT, (R)1078, 1078CTW

Steel Door Contact

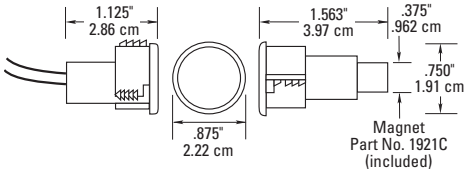
¾" and 1" contacts
1078/1076 Series

Dimensions

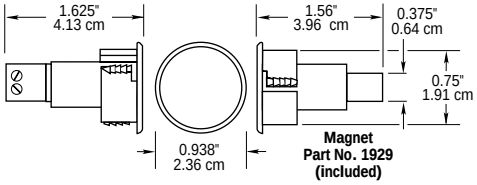
Models:
(R)1078, 1078W, 1076, 1076W, 1076D



Models:
1078C, 1076C, 1076CW, 1076CH



Models:
1078CT, 1076CTW,



(R) prefix indicates Rare Earth Magnet

Specifications

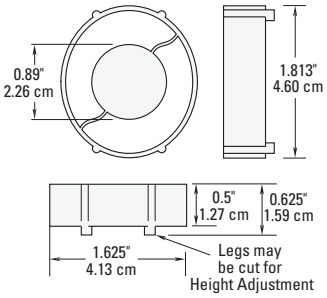
Form A: (R)1078, 1078W, 1078C, 1078CT, 1078CTW

Voltage	*100V AC/DC max.*
Current	*0.5 A max.*
Power	*7.5 W max.*

Form C: 1076, 1076W, 1076D, 1076C(D), 1076CW, 1076CH

Voltage	*30V AC/DC max.*
Current	*0.25 A max.*
Power	*3.0 W max.*

Rare Earth Magnet



Protected by U.S. Patent 5,844,458.

c UL us LISTED

Ordering Information

Model	Dia.	Loop Type	Electrical Config.	Hole Required		Gap Distance*			Color
				Contact	Magnet	Wood*	Steel*	Rare Earth	
1076	1"	Open or Closed	SPDT	1" x 1.125"	1" x 1.563"	1"	Up to 1/2"	Up to 5/8"	M, N, G
1076W	1"	Open or Closed	SPDT	1" x 1.125"	1" x 1.563"	2"	Up to 1"		M, N, G
1076D	1"	Open or Closed	DPDT	1" x 1.125"	1" x 1.563"	3/4"	Up to 3/8"	Up to 5/8"	M, N, G
1078	1"	Closed	N/O	1" x 1.125"	1" x 1.563"	1"	Up to 1/2"	Up to 5/8"	M, N, G
1078W	1"	Closed	N/O	1" x 1.125"	1" x 1.563"	2"	Up to 1"		M, N, G
1076C	3/4"	Open or Closed	SPDT	.75" x 1.125"	.75" x 1.563"	7/8"	Up to 3/8"	Up to 5/8"	M, N, G
1076CW	3/4"	Open or Closed	SPDT	.75" x 1.125"	.75" x 1.563"	2"	Up to 3/4"		M, N
1078C	3/4"	Closed	N/O	.75" x 1.125"	.75" x 1.563"	1/2"	N/A		M, N, G
(R)1078	1"	Closed	N/O	1" x 1.125"	1" x 1.563"	1"	Up to 1/2"	Up to 5/8"	M, N
1078CT	3/4"	Closed	N/O	.75" x 1.625"	.75" x 1.56"	7/8"	1/2"	5/8"	M, N
1078CTW	3/4"	Closed	N/O	.75" x 1.625"	.75" x 1.56"	5/8"	3/4"	N/A	N

* *Gap distances are nominal make distance ±20%. Gap specifications are for switch to make. Break distance is approximately 1.1 to 1.5 times make.*

GE Interlogix

www.GE-Interlogix.com

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USA & Canada: 800-547-2556
Technical Service: 800-648-7424
Faxback: 800-483-2495

2266 Second Street North
North St. Paul, MN 55109
Phone: 651-777-2690
USA & Canada: 800-777-5484
Technical Service: 800-777-2624

C-3617-FLG10K-0403

GE Security

Product Data Sheet

www.GESecurity.com

2202 Series Overhead Door Magnetic Contacts

Surface/floor mount contacts with armored cable

Overview

The GE Security 2202 Series overhead door magnetic contact is for use in the rigorous environments of commercial and industrial installations.

The floor mount units are constructed with a low profile heavy cast aluminum housing. The reed switch assembly is fully encased in GE Security's exclusive polyurethane potting material to prevent damage due to moisture or humidity. A wide operating gap distance of up to 3 inches makes installation easy and helps prevent false alarms caused by door movement or damaged and loose fitting doors.

The 2202 Series is available with a universal style magnet that allows for greater installation flexibility.

Standard Features

- **Wide 3-inch operating gap**
- **Fully sealed switch**
- **Form C unit available**
- **Mounting hardwire included**

2202 Series Overhead Door Magnetic Contacts

Surface/floor mount contacts with armored cable

Specifications

Electrical, 2202

- Voltage: 100 VAC/DC max.
- Current: 0.5 A max.
- Power: 7.5 W max.

Electrical, 2204

- Voltage: 30 VAC/DC max.
- Current: 0.25 A max.
- Power: 3.0 W max.

Features, 2202

- Loop type: Closed
- Electrical configuration: Normally open
- Gap distance: Up to 3 in.
- Lead type: 18 in. flexible stainless steel cable

Features, 2204

- Loop type: Open or closed
- Electrical configuration: SPDT
- Gap distance: Up to 3 in.
- Lead type: 18 in. flexible stainless steel cable
- Lead colors: Black - common; white - closed loop (N.O.); red - open loop (N.C.)

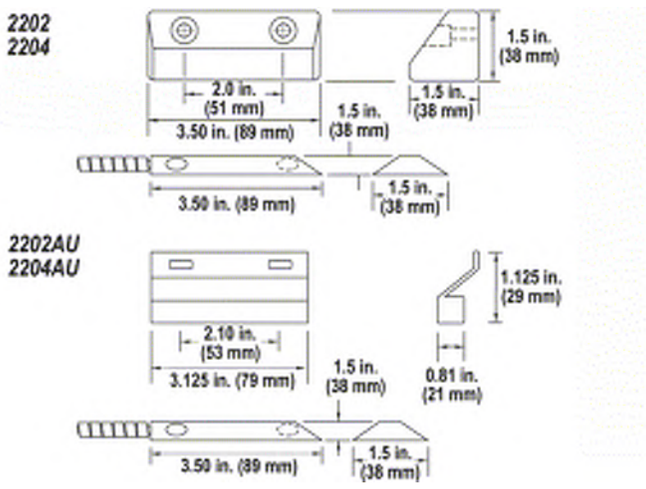
Physical

- Dimensions, 2202A (LxWxD): 3.50 x 1.50 x 1.50 in. (89 x 38 x 38 mm)
- Dimensions, 2202AU and 2204AU (LxWxD): 3.125 x 2.125 x 0.81 in. (79 x 54 x 21 mm)
- Construction: Cast aluminum
- Color: Aluminum

Regulatory

- C-UL-US

Related Diagram



Ordering Information

2202A-L	Floor-mount magnetic contact for overhead doors, aluminum housing, 3 in. gap size, closed loop, includes 18 in. stainless steel armored cable
2202AU-L	Floor-mount magnetic contact for overhead doors, universal magnet, 3 in. gap size, closed loop, includes 18 in. stainless steel armored cable
2204A-L	Floor-mount magnetic contact for overhead doors, aluminum housing, 3 in. gap size, SPDT, includes 18 in. stainless steel armored cable
2204AU-L	Floor-mount magnetic contact for overhead doors, universal magnet, 3 in. gap size, SPDT, includes 18 in. stainless steel armored cable

GE Security

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Latin America
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IPS-2202 Series Overhead Door Magnetic Contacts-2005-07-20 02:17:38 Released : 20.07.2005

BOSCH
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DS160 Series High Performance Request-to-exit Detectors

- **Door monitor with sounder alert**
- **Sequential Logic Input (SLI)**
- **Internal vertical pointability**
- **Wrap-around coverage pattern with precise pattern control**
- **Up to 64 second adjustable latch time**
- **Selectable relay trigger mode**
- **Selectable fail-safe or fail-secure modes**
- **Adjustable sounder volume**
- **Activation LED**

The DS160 Series consists of the DS160 Detector (light gray) and the DS161 Detector (black) specifically designed for Request-to-exit (REX) applications. With features such as timers, door monitor with sounder alert, and pointable coverage, the DS160 and DS161 have the flexibility to meet the most stringent REX requirements. The exclusive Sequential Logic Input (SLI) provides added security that is not offered in any other REX device.

Functions

Sequential Logic Input (SLI)
The SLI terminal allows connection of a second device to require sequential detection. This eliminates the possibility that an object that is slid through the door or underneath the door will activate the detector. This input can also be used to lock the sensor if motion is present outside the premises.

Door Monitor
The sensor can monitor a door contact to allow special control of the internal relay. For example, if the door is opened within the relay time period, the sensor can be programmed to halt the timer. If the door is not opened within a specific time period, the relay can be programmed to deactivate.

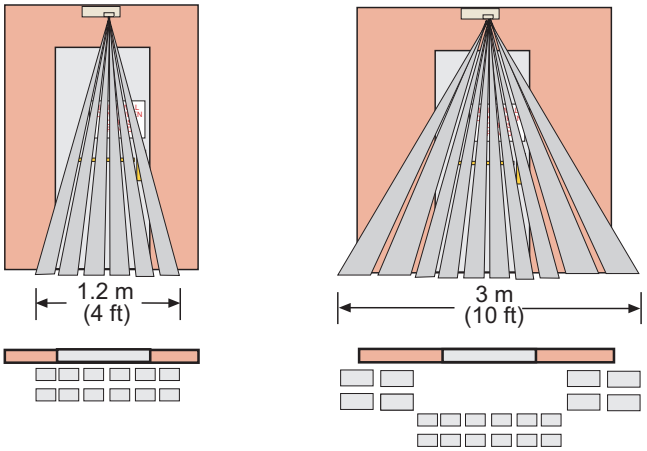
Sounder Alert
An integrated sounder can be programmed to activate if the door is left open too long. The sounder volume is fully adjustable to 85 dB.

Keycard Input
The keycard input allows the sensor relay to be controlled from an external source, such as an access control system or card reader.

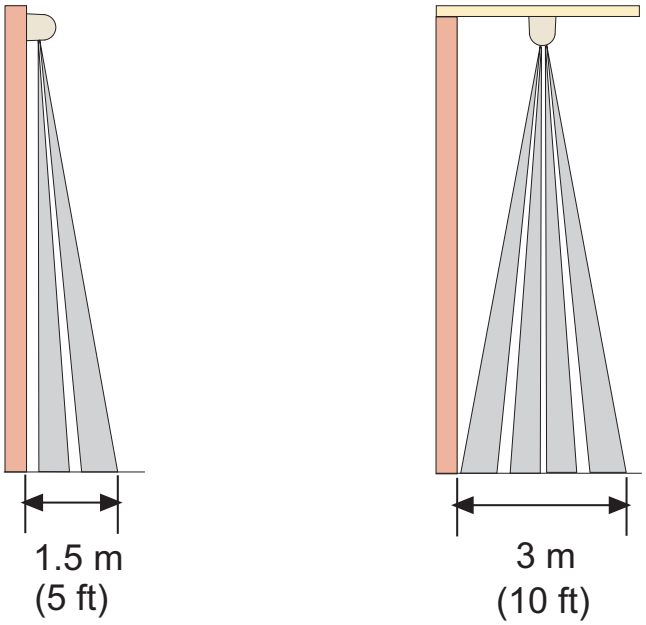
Certifications and Approvals

Region	Certification	
Europe	CE	89/336/EEC, EN55022: 1998 +A1: 2000 +A2: 2003, EN50130-4: 1996 +A1: 1998 +A2: 2003, EN61000-4-2: 1995 +A1: 1998 +A2: 2001, EN61000-4-3: 2002 +A1: 2003, EN61000-4-4: 1995 +A1: 2000 +A2: 2001, EN61000-4-5: 1995 +A1: 2001, EN61000-4-6: 1996 +A1: 2001 +A2: 2001, EN61000-4-11:1994 +A1: 2001, EN60950-1: 2001 2004/108/EC; EN 50130-4:1996 +A1:1998 +A2:2003; EN 60950-1:2006
USA	UL	ALVY: Access Control Systems Units (UL294)
Europe	Complies with EN50131-1 Grade 2	

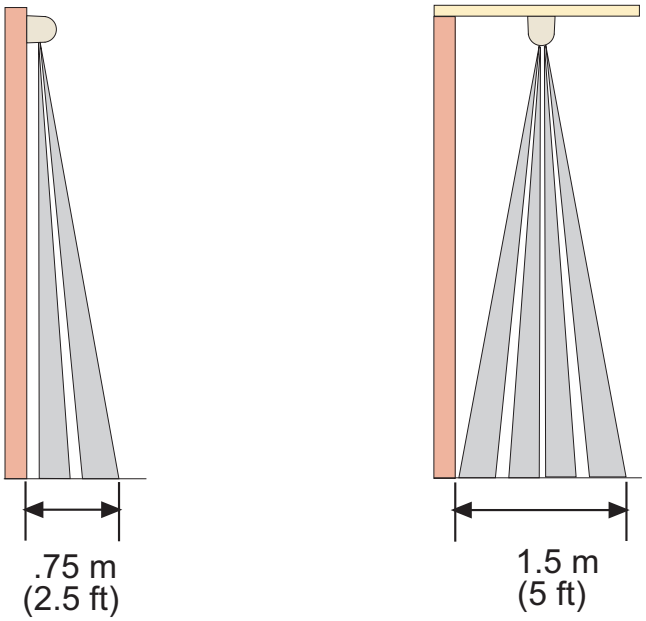
Installation/Configuration Notes



Front View
Mounted on wall above door and mounted on ceiling .75 m (2.5 ft) in front of the door.



Side View
The higher that you mount the unit, the larger the coverage area. Do not mount the DS160/DS161 more than 4.6 m (15 ft) above the floor.
Side view of coverage pattern with the unit mounted at 4.6 m (15 ft) above the floor with the lens pointed straight down.



Side View
The higher that you mount the unit, the larger the coverage area. Do not mount the DS160/DS161 more than 4.6 m (15 ft) above the floor.
Side view of coverage pattern with the unit mounted at 4.6 m (15 ft) above the floor with the lens pointed straight down.

Coverage Information

The coverage (detection area) varies depending on the mounting height above the floor, angle of the lens, and whether the unit is mounted on a wall above the door or on the ceiling. The coverage is 2.4 m x 3 m (8 ft x 10 ft) The coverage patterns for the detector at a height of 2.3 m (7.5 ft) are shown. The coverage pattern increases or decreases with height and detector alignment.

Note When you mount the unit on the wall and the lens points straight down, some detection zones point toward the wall and do not detect movement.

The diagrams depict views of the coverage pattern with the detector mounted at 2.3 m (7.5 ft) above the floor with the lens pointed straight down. Zones that are pointed toward the wall are not shown.

Technical Specifications

Environmental

Operating Temperature:	-29°C to +49°C (-20°F to +120°F) For UL Certificated installations, 0°C to +49°C (+32°F to +120°F)
Radio Frequency Interference (RFI) Immunity:	No alarm or setup on critical frequencies in the range from 26 MHz to 1000 MHz at 50 V/m

Complies with Environmental Class II (EN50130-5)

Mechanical

Dimensions:	4.5 cm x 17.1cm x 4.4 cm (1.80 in. x 6.75 in. x 1.75 in.)
Material:	High impact ABS plastic enclosure

Modes

Power Loss Default:	Programmable fail-safe or fail-secure modes.
Timer:	Programmable reset accumulative or non-reset counting mode.

Electrical

Current Draw:	8 mA nominal standby current, 39 mA at 12 VDC in alarm
Voltage:	12 VAC or VDC to 30 VAC or VDC
Alarm Output:	Two Form C relay contacts each rated 1 A at 30 VAC or VDC for resistive loads
Indicators:	1 activation LED
Relay Latch Time:	Adjustable from 0.5 sec to 64 sec.

Ordering Information

DS160 Request-to-exit Detector Light gray enclosure. For use in request-to-exit (REX) applications. Provides 2.4 m x 3 m (8 ft x 10 ft) coverage, timers, door monitor with sounder alert, and pointable coverage.	**DS160**
DS161 Request-to-exit Detector Black enclosure. For use in request-to-exit (REX) applications. Provides 2.4 m x 3 m (8 ft x 10 ft) coverage, timers, door monitor with sounder alert, and pointable coverage.	**DS161**
Accessories	
TP160 Trim Plate A light gray trim plate used when mounting the detector over a standard single-gang box.	**TP160**
TP161 Trim Plate A black trim plate used when mounting the sensor over a standard single-gang box.	**TP161**

Americas:
Bosch Security Systems, Inc.
130 Perinton Parkway
Fairport, New York, 14450, USA
Phone: +1 800 289 0096
Fax: +1 585 223 9180
security.sales@us.bosch.com
www.boschsecurity.us

Europe, Middle East, Africa:
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P.O. Box 80002
5600 JB Eindhoven, The Netherlands
Phone: + 31 40 2577 284
Fax: +31 40 2577 330
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www.boschsecurity.com

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Robert Bosch (SEA) Pte Ltd, Security Systems
11 Bishan Street 21
Singapore 573943
Phone: +65 6258 5511
Fax: +65 6571 2698
apr.securitysystems@bosch.com
www.boschsecurity.com

Represented by

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TP160 Trim Plate

A light gray trim plate used when mounting the detector over a standard single-gang box.

Ordering Information

TP160 Trim Plate A light gray trim plate used when mounting the detector over a standard single-gang box.	**TP160**

Americas:
Bosch Security Systems, Inc.
130 Perinton Parkway
Fairport, New York, 14450, USA
Phone: +1 800 289 0096
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Fax: +65 6571 2698
apr.securitysystems@bosch.com
www.boschsecurity.com

Represented by

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BOSCH
Invented for life

TP161 Trim Plate

A black trim plate used when mounting the sensor over a standard single-gang box.

Ordering Information

TP161 Trim Plate A black trim plate used when mounting the sensor over a standard single-gang box.	**TP161**

Americas:
Bosch Security Systems, Inc.
130 Perinton Parkway
Fairport, New York, 14450, USA
Phone: +1 800 289 0096
Fax: +1 585 223 9180
security.sales@us.bosch.com
www.boschsecurity.us

Europe, Middle East, Africa:
Bosch Security Systems B.V.
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5600 JB Eindhoven, The Netherlands
Phone: + 31 40 2577 284
Fax: +31 40 2577 330
emea.securitysystems@bosch.com
www.boschsecurity.com

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11 Bishan Street 21
Singapore 573943
Phone: +65 6258 5511
Fax: +65 6571 2698
apr.securitysystems@bosch.com
www.boschsecurity.com

Represented by

T1655467915 | Cur: en-US, V7, 2 Dec 2010

ES4200

Door Management Alarm

New!

The ES4200 is a multifunctional door monitoring device that combines the best features and functions of DSI's door prop and exit alarm product lines into one easy-to-use master unit. Field selectable alarm timing, delay, and input/output options are sure to make the NEW ES4200 the product of choice.

FEATURES & BENEFITS

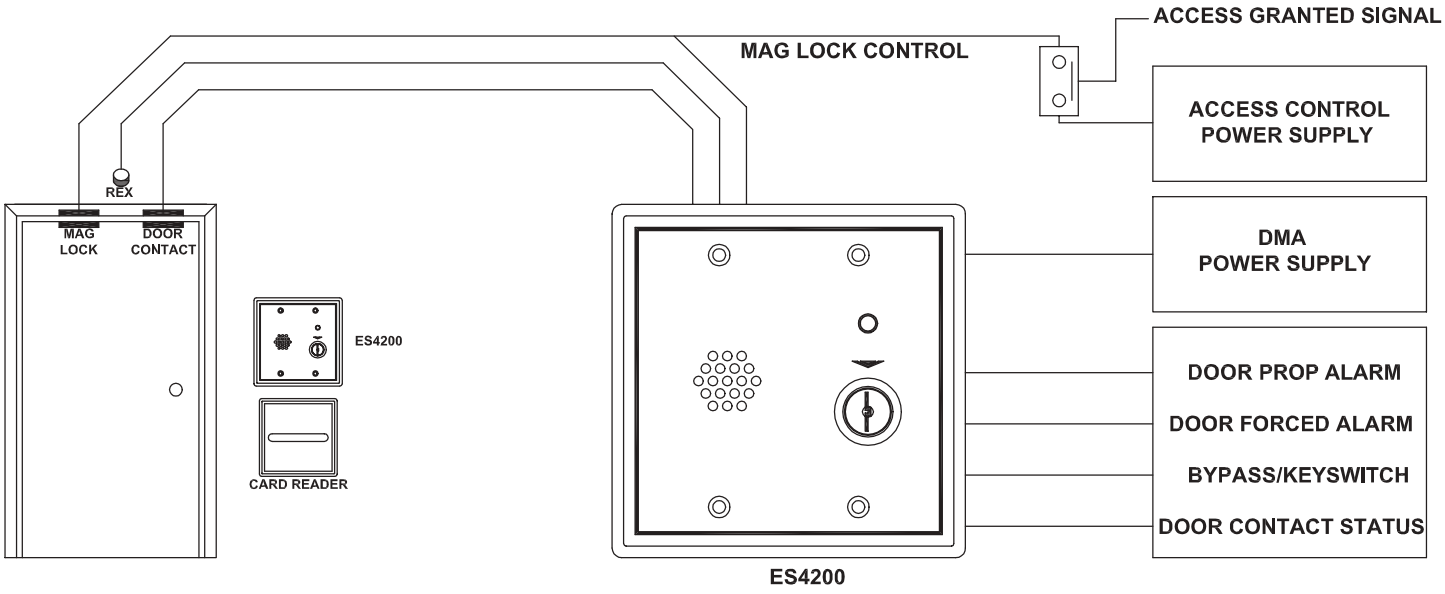
- Aesthetically pleasing design
- Compatible with all access control systems
- Can be used as a stand-alone product
- Field selectable alarm timing and alarm delay option
- Field selectable high or low level sounder
- 12-24 VDC/VAC operation
- Easy installation
- Encourages employees to maintain access control procedures
- Reset/bypass keyswitch and remote input
- Visual status indicator
- Tamper resistant
- Incorporates form C output relays
- Supports door supervision

ES4200 Series

DSI™
DESIGNED SECURITY, INC.
A Detex Company

1402 Hawthorne St.
Bastrop, TX 78602
Voice: 1-800-272-3555
Fax: 512-321-9181
E-mail: dsi@dsigo.com
www.dsigo.com

ES4200 Door Management Alarm — Typical Application



ELECTRICAL SPECIFICATIONS

Power:	12-24 VDC/VAC @ 250 mA
Local Control:	Keyswitch for Unit Reset/Bypass
Control Input:	N/O or N/C Alarm Shunt N/C Door Contact N/O Remote Reset/Bypass Voltage Sense Shunt
Control Output:	N/O and N/C Door Contact Status N/O and N/C Door Prop Alarm Status N/O and N/C Intrusion/Tamper Alarm Status N/O and N/C Bypass/Keyswitch Status Remote LED
Adjustment:	Auto Reset 0 sec. – 5 min. or Manual Reset Alarm Delay 0 sec. – 5 min. or Infinite Silent Time 0 sec. – 90 min.
Audible Alarm:	Field Selectable High – 103 dB@ 3 ft. Low – 96 dB@ 3 ft.

MECHANICAL SPECIFICATIONS

Dimensions:	2 Gang Plate with Standard Key 4.6”W x 4.5”H x 2.32”D 3 Gang Plate with Rim Hardware 6.4”W x 4.5”H x 2.32”D
Keyswitch:	Double Bitted Rim Hardware with or without Cylinder
Finish:	Painted – DSI Beige

PRODUCT DESCRIPTION

The ES4200 provides complete monitoring of access control points by offering door prop/door held and intrusion/door forced detection. These alarms are designed to complement card reader and access control systems and will interface with electronic locks, produce audible warnings and reduce nuisance alarms by encouraging user compliance with access control procedures.

DSI™
DESIGNED SECURITY, INC.
A Detex Company

1402 Hawthorne St.
Bastrop, TX 78602
Voice: 1-800-272-3555
Fax: 512-321-9181
E-mail: dsi@dsigo.com
www.dsigo.com

Maximal75
Access Power Controller

Rev. DSMaximal75 - A19K

Overview

Maximal75

This unit distributes and switches power to access control systems and accessories. Unit converts a 115VAC 60Hz input into eight (8) 12VDC and eight (8) 24VDC independently controlled fuse protected outputs. These Fail-Safe/Fail-Secure power outputs may be converted to dry form "C" contacts. The outputs are activated by an open collector sink or normally open (NO) dry trigger input from an Access Control System, Keypad, Push Button, REX PIR, etc. Units will route power to a variety of access control hardware devices including: Mag Locks, Electric Strikes, Magnetic Door Holders, etc. The FACP Interface enables Emergency Egress, Alarm Monitoring, or may be used to trigger other auxiliary devices. The fire alarm disconnect feature is individually selectable for any or all of the sixteen (16) outputs. All interconnecting equipment must be UL Listed.

Specifications

- 12VDC and 24VDC outputs.
- Maximum output current: 19.2 amp total.

Option	P/S 1	P/S 2
A	12VDC @ 9.5 amp	24VDC @ 9.7 amp

- 115VAC 60Hz, 10.0 amp input.
- Input fuse ratings:
  AL1012ULXB 3.5 amp/250V.
  AL1024ULXB 10 amp/250V.
- Power supply input options:
  a) Two (2) common power input for either ACM8 and lock power (factory installed).
  b) Two (2) isolated power inputs (external power supply is required), (current is determined by the power supply connected, not to exceed a maximum of 10 amp total).
- Sixteen (16) Access Control System trigger inputs. Input options:
  a) Sixteen (16) normally open (NO) inputs.
  b) Sixteen (16) open collector inputs.
  c) Any combination of the above.
- Sixteen (16) independently controlled outputs. Output options:
  a) Sixteen (16) Fail-Safe and/or Fail-Secure power outputs.
  b) Sixteen (16) form "C" 5 amp rated relay outputs.
  c) Any combination of the above.
- Sixteen (16) auxiliary power outputs (unswitched) (outputs are rated 2.5 amp).
- ACM8 boards main fuse is rated at 10 amp. Output fuses are rated @ 3.5 amp.
- Red LEDs indicate outputs are triggered (relays energized).
- Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the sixteen (16) outputs.
- Fire Alarm disconnect input options:
  a) Normally open (NO) or normally closed (NC) dry contact input.
  b) Polarity reversal input from FACP signaling circuit.
- Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC).
- Green LED indicates FACP disconnect is triggered.
- Filtered and electronically regulated outputs (built-in power supply).
- Built-in charger for sealed lead acid or gel type batteries.
- Maximum charge current
  AL1012ULXB is 0.7 amp.
  AL1024ULXB is 3.6 amp.
- Automatic switch over to stand-by battery when AC fails.
- Zero voltage drop when unit switches over to battery backup (AC failure condition).
- Thermal and short circuit protection with auto reset.
- AC input and DC output LED indicators.
- AC fail supervision (form "C" contact).
- Low battery and battery presence supervision (form "C" contact).
- Enclosure accommodates up to four (4) 12AH batteries.
- Product weight: 40.65 lbs.
- Shipping weight: 44.65 lbs.

Agency Approvals

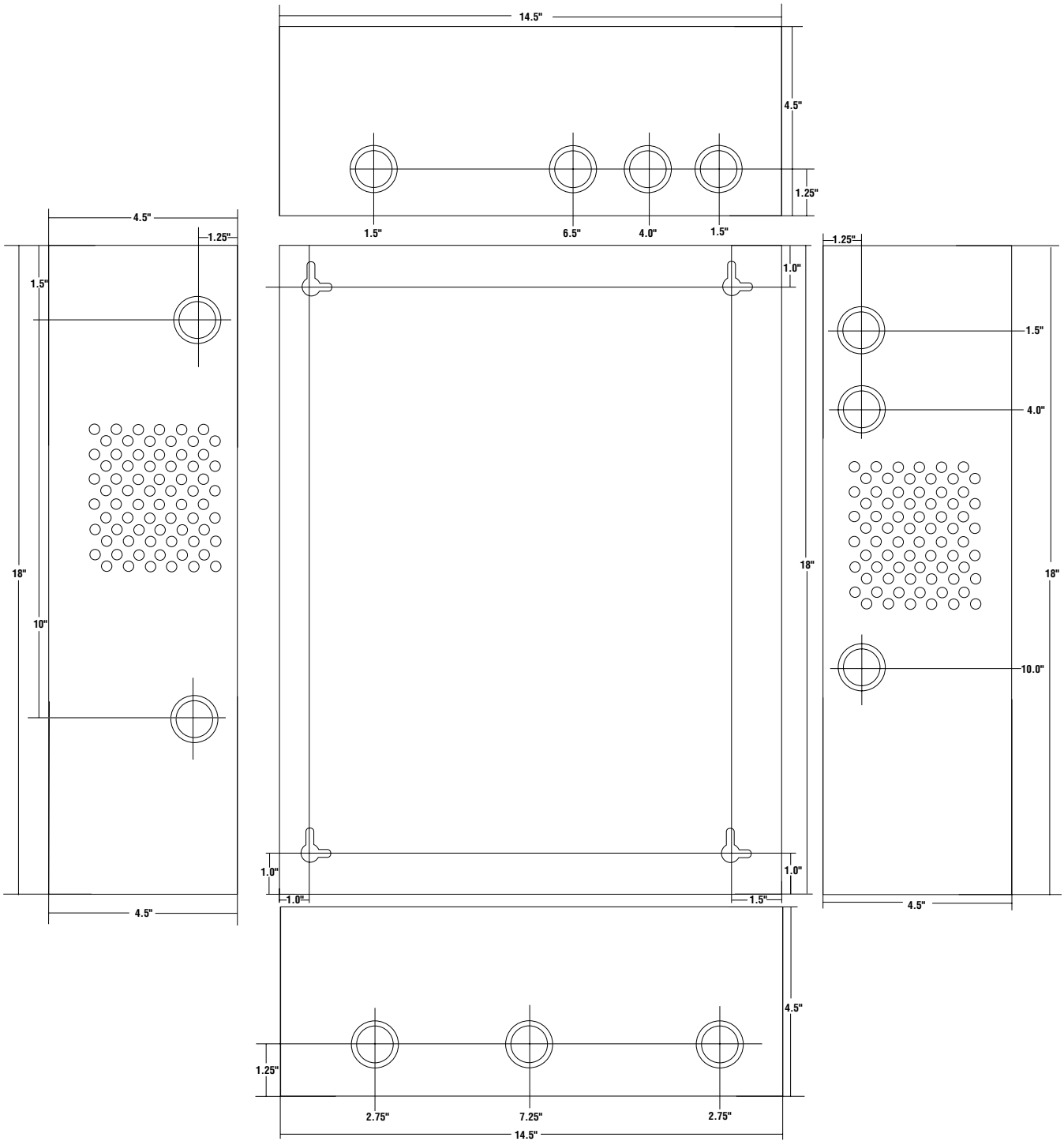
UL Listed for Access Control System Units (UL 294).

CUL Listed - CSA Standard C22.2 No.205-M1983, Signal Equipment.

CSFM
California State Fire Marshal Approved.

Enclosure Dimensions (approximate)

26”H x 19”W x 6.25”D



NP SERIES - **NP 12-12**

Data Sheet

Reliability is your Security

Utilizing the latest advance design Oxygen Recombination Technology, Yuasa have applied their 80 years experience in the lead acid battery field to produce the optimum design of Sealed Lead Acid batteries.

FEATURES

- Superb recovery from deep discharge.
- Electrolyte suspension system.
- Gas Recombination.
- Multipurpose: Float or Cyclic use.
- Usable in any orientation.
- Superior energy density.
- Lead calcium grids for extended life.
- Manufactured World wide.
- Application specific designs.

Technical Features

Sealed Construction

Yuasa's unique construction and sealing technique ensures no electrolyte leakage from case or terminals.

Electrolyte Suspension System

All NP batteries utilize Yuasa's unique electrolyte suspension system incorporating a microfine glass mat to retain the maximum amount of electrolyte in the cells. The electrolyte is retained in the separator material and there is no free electrolyte to escape from the cells. No gels or other contaminants are added.

Control of Gas Generation

The design of Yuasa's NP batteries incorporates the very latest oxygen recombination technology to effectively control the generation of gas during normal use.

Low Maintenance Operation

Due to the perfectly sealed construction and the recombination of gasses within the cell, the battery is almost maintenance free.

Terminals

NP batteries are manufactured using a range of terminals which vary in size and type. Please refer to details as shown.

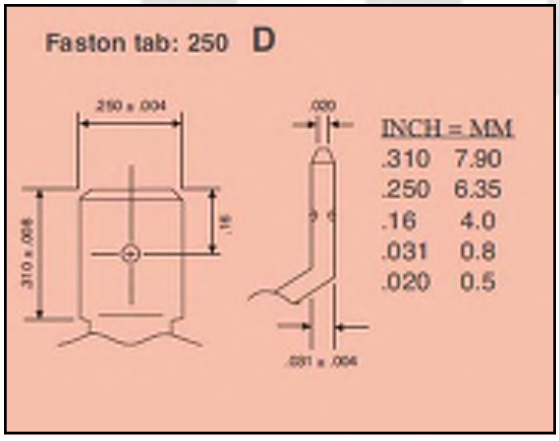
Operation in any Orientation

The combination of sealed construction and Yuasa's unique electrolyte suspension system allows operation in any orientation, with no loss of performance or fear of electrolyte leakage.

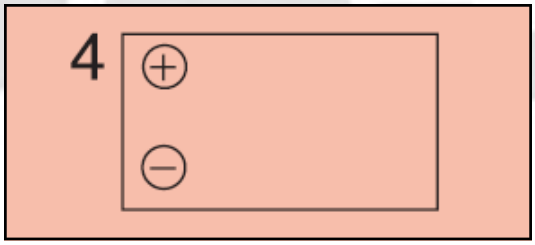
Valve Regulated Design

The batteries are equipped with a simple, safe, low pressure venting system which releases excess gas and automatically reseals should there be a build up of gas within the battery due to severe overcharge. Note. On no account should the battery be charged in a sealed container.

Terminals



Layout



General Specifications

Nominal Capacity (Ah)	NP12-12
20hr to 1.75vpc 30ºC	12
10hr to 1.75vpc 20ºC	11.1
5hr to 1 .70vpc 20ºC	10
1 hr to 1 .60vpc 20ºC	7.2
Voltage	12
Energy Density (Wh.L.20hr)	1 04
Specific Energy (Wh.kg.20hr)	36
Int. Resistance (m.Ohms)	1 6
Maximum discharge (A)	75
Short Circuit current (A)	360
Dimensions (mm)	
Length	151
Width	98
Height overall	97.5
Weight (Kg)	4.05
Terminal	D
Layout	4
Terminal Torque Nm	-

Data Sheet

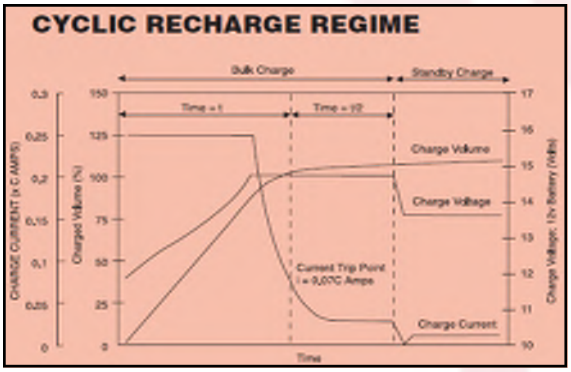
NP SERIES - **NP 12-12**

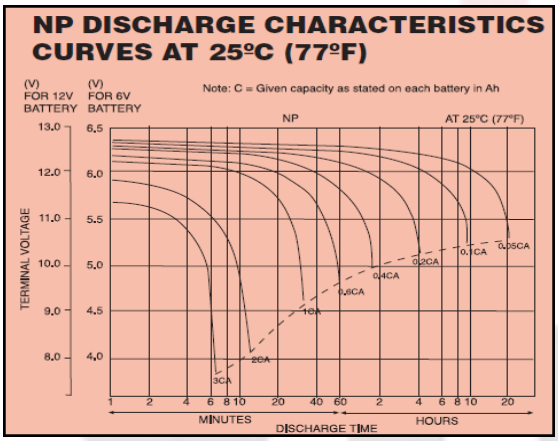
Lead Calcium Grids
The heavy duty lead calcium alloy grids provide an extra margin of performance and life in both cyclic and float applications and give unparalleled recovery from deep discharge.

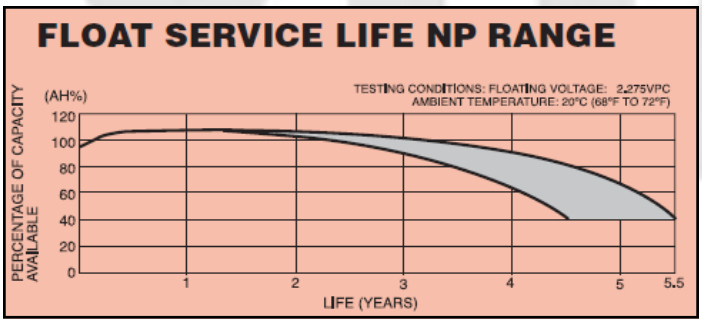
Long Cycle Service Life
Depending upon the average depth of discharge, over a thousand discharge/charge cycles can be expected.

Float Service Life
The expected service life is five years in float standby applications.

Separators
The use of the special separator material provides a very efficient insulation between plates preventing inter-plate short circuits and prohibiting the shedding of active materials.



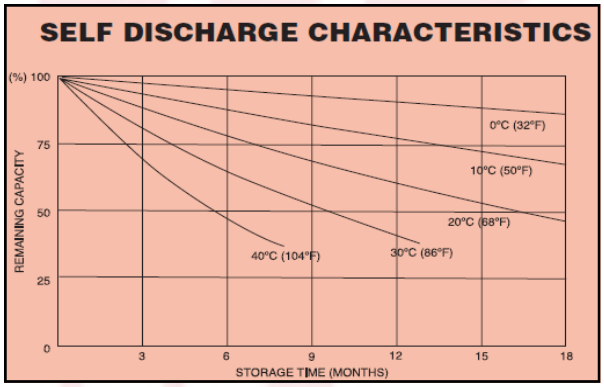


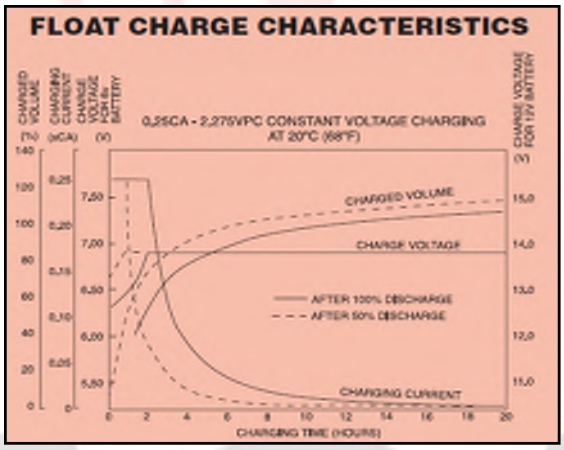


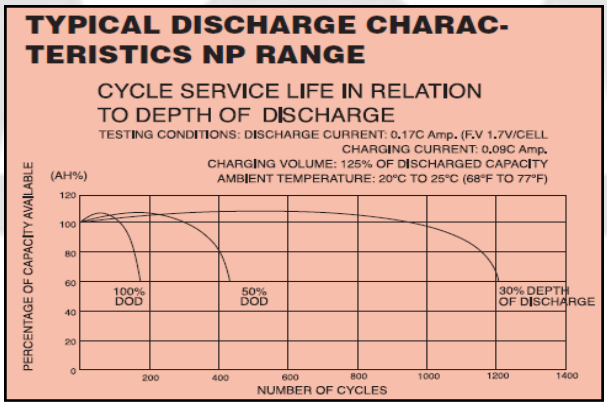
Long shelf Life
The extremely low self discharge rate allows the battery to be stored for extended periods up to one year at normal ambient temperatures with no permanent loss of capacity.

Operating Temperature Range
The batteries can be used over a broad temperature range permitting considerable flexibility in system design and location.

Charge – 15°C to 50°C
Discharge – 20°C to 60°C
Storage – 20°C to 50°C (fully charged battery)







YUASA

Yuasa Battery Inc.
2901 Montrose Ave
Laureldale, PA 19605
www.yuasabatteries.com

Registered number 1548820

Cat. No.	NP 12-12 March 09

Distributed by

DATASHEET

AXIS P33 Network Camera Series

Fixed domes for any environment with remote focus and zoom.

- > Superb video quality including HDTV 1080p
- > Multiple H.264 video streams
- > Remote focus and zoom
- > Outdoor ready
- > Digital PTZ and multi-view streaming
- > P-Iris control

AXIS P33 Network Cameras constitute a series of indoor and outdoor-ready fixed domes. These cameras are ideal for unobtrusive video surveillance in exposed areas such as airports, subways, retail stores, schools and university campuses.

AXIS P33 Series offers models from SVGA resolution up to 3 megapixel, including support for HDTV 720p and 1080p in compliance with the SMPTE standard in resolution, color representation and frame rate. All models provide day and night functionality with removable infrared-cut filter for increased light sensitivity.

The remote focus feature allows for convenient installation eliminating the need for hands-on focusing at the camera, and the remote zoom and pixel counter features ensure that the camera's angle of view is optimized for the scene and pixel resolution.

AXIS P33 Series provides multiple, individually configurable H.264 and Motion JPEG video streams. All AXIS P33 cameras offer digital pan/tilt/zoom, and the 3-megapixel AXIS P3346 models additionally provide multi-view streaming.

AXIS P3346 cameras offer the unique and revolutionary P-Iris control, which allows the cameras to precisely control the iris position to optimize depth of field and lens resolution for optimal image sharpness.

AXIS P33 Series ranges from indoor cameras to vandal-resistant outdoor models, supplied by standard Power over Ethernet (IEEE 802.3af). Weather-proof models operate in temperatures from -40 °C to 55 °C (-40 °F to 131 °F).

Fixed domes designed for efficient installation – indoors or outdoors

AXIS P33 Series is the perfect choice for a wide range of demanding video applications in outdoor and indoor environments. AXIS P33 Network Cameras are designed for professional video surveillance with easy and reliable installation in focus.

Outdoor-ready installation for extreme temperatures

The outdoor models of AXIS P33 Series are specially designed for reliable, vandal-resistant and weather-proof installation, with pre-installed heater and fan, and an integrated dehumidifying membrane eliminating any humidity caught in the camera casing during installation. These cameras come with a 5 m (16 ft.) Ethernet cable with a pre-mounted, specially designed gasket, enabling flush wall mounting and requiring no additional sealant. A weather shield is also included for effective protection against reflections from sunlight, or build-ups of rain or snow.

Mounting options

AXIS P33 Series offers a wide range of optional kits for indoor and outdoor installations, for example, for mounting on a wall, pole or corner. The IP51-rated drop ceiling mount kit protects the camera from condensation and dust that may exist in the plenum space above the drop ceiling. Both indoor and outdoor camera models include a smoked transparent cover as an alternative to the clear cover, for additional flexibility.

Easy installation with remote focus and zoom

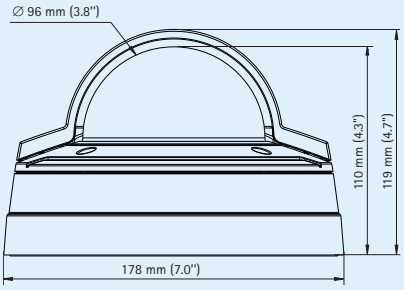
AXIS P33 Network Cameras offer unique installation capabilities with remote focus and zoom. The remote focus feature enables convenient focusing over the network, eliminating the need for hands-on fine-tuning at the camera. The remote zoom functionality ensures that the viewing angle is optimized for the area to be monitored.

Unique pixel counter feature

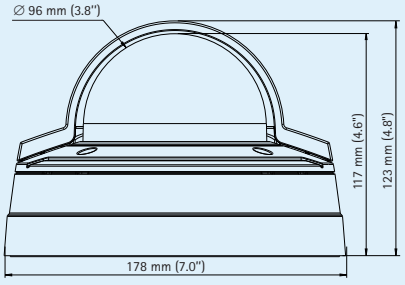
The unique pixel counter offered in Axis cameras allows the installer to easily verify that the camera installation fulfills any regulatory or specific customer requirements, for example, calculating the pixel resolution of the face of a person passing a doorway monitored by the camera.

Unique pixel counter feature

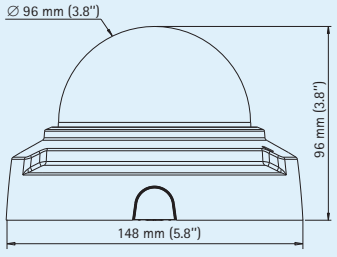
AXIS P3343-VE /P3344-VE
Weight: 1.6 kg (3.5 lb.) with weather shield



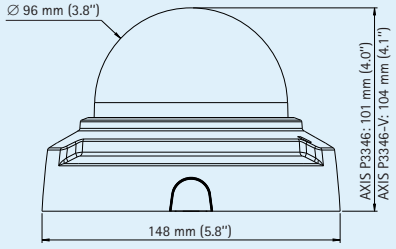
AXIS P3346-VE
Weight: 1.7 kg (3.7 lb.) with weather shield



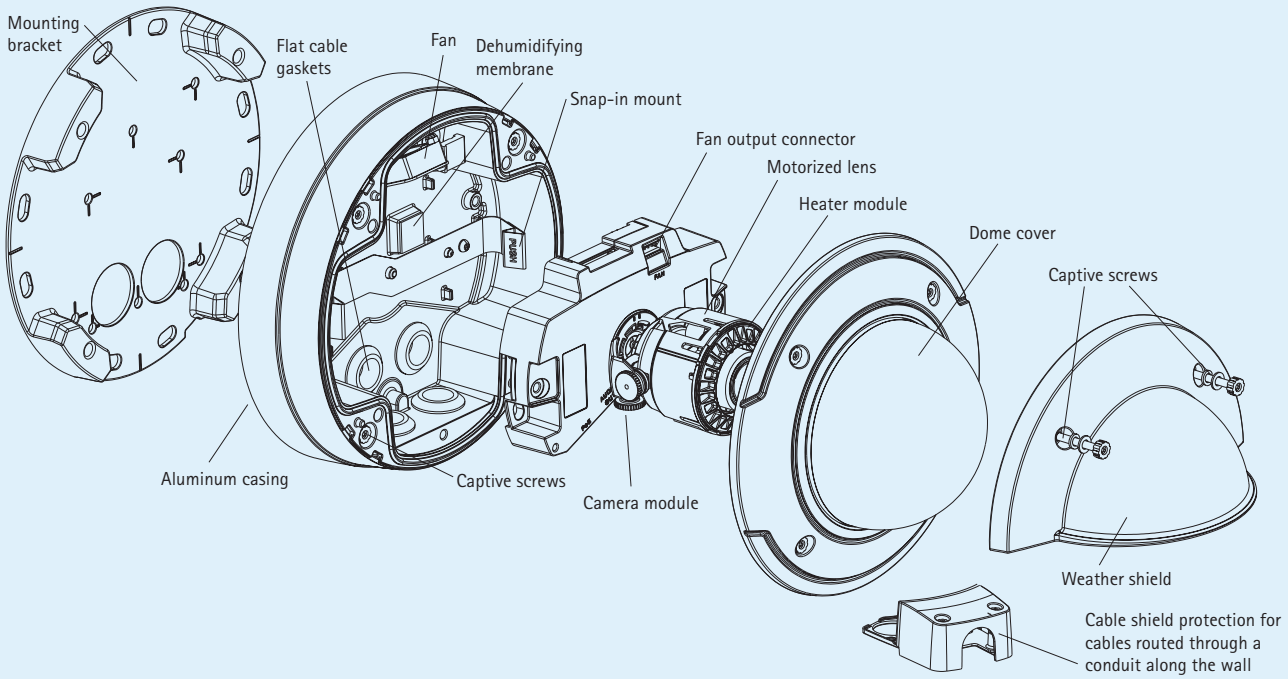
AXIS P3343/-V/P3344/-V
AXIS P3343/P3344 weight: 450 g (1.0 lb.)
AXIS P3343-V/P3344-V weight: 660 g (1.5 lb.)



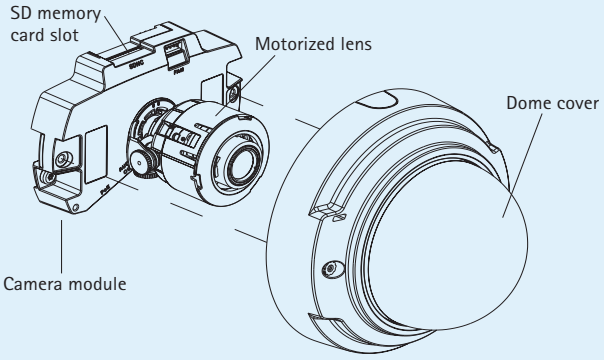
AXIS P3346/-V
AXIS P3346 weight: 490 g (1.1 lb.)
AXIS P3346-V weight: 700 g (1.6 lb.)



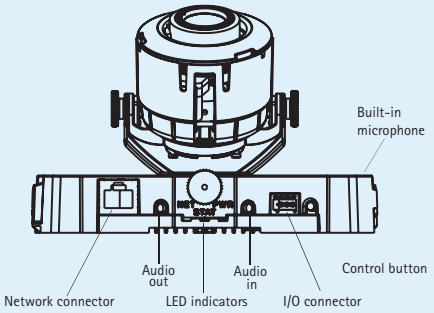
AXIS P3343-VE/P3344-VE/P3346-VE



AXIS P3343/-V/P3344/-V/P3346-V



Camera module



Optional accessories for outdoor models

Pendant adapter kit including weather shield

AXIS T91A Brackets

Wall Corner

I/O audio cable, 5 m (16 ft.)

AXIS T90A Illuminators

Optional accessories for indoor models

Pendant adapter kit

AXIS T91A Brackets

Ceiling Wall

Mounting bracket

IP51-rated drop-ceiling mount kit with transparent or smoked cover

For information on AXIS Camera Station and video management software from Axis' Application Development Partners, see www.axis.com/products/video/software/

Technical Specifications – AXIS P33 Network Camera Series

43493/EN/R1/1106

Camera

Models	**AXIS P3343:** SVGA, tamper-resistant, indoor **AXIS P3343-V:** SVGA, vandal-resistant, indoor **AXIS P3343-VE:** SVGA, vandal-resistant, outdoor **AXIS P3344:** 1MP/HDTV 720p, tamper-resistant, indoor **AXIS P3344-V:** 1MP/HDTV 720p, vandal-resistant, indoor **AXIS P3344-VE:** 1MP/HDTV 720p, vandal-resistant, outdoor **AXIS P3346:** 3MP/HDTV 1080p, tamper-resistant, indoor **AXIS P3346-V:** 3MP/HDTV 1080p, vandal-resistant, indoor **AXIS P3346-VE:** 3MP/HDTV 1080p, vandal-resistant, outdoor 6mm or 12mm as suffix specifies lens option Note: AXIS P3301/-V and AXIS P3304/-V are not part of AXIS P33 Series
Image sensor	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** Progressive scan RGB CMOS 1/4" **AXIS P3346/-V/-VE:** Progressive scan RGB CMOS 1/3" (effective)
Lens	Varifocal with remote zoom and focus, IR corrected, megapixel resolution **AXIS P3343/-V/-VE 6 mm:** 2.5-6 mm, 72°-34° view*, F1.2, DC-iris **AXIS P3343/-V/-VE 12 mm:** 3.3-12 mm , 54°-17° view*, F1.4, DC-iris **AXIS P3344/-V/-VE 6 mm:** 2.5-6 mm, 87°-40° view*, F1.4, DC-iris **AXIS P3344/-V/-VE 12 mm:** 3.3-12 mm, 70°-20° view*, F1.6, DC-iris **AXIS P3346/-V/-VE:** 3-9 mm, 84°-30° view*, F1.2, P-Iris *horizontal angle of view
Day and night	Automatically removable infrared-cut filter
Minimum illumination	**AXIS P3343/-V/-VE 6 mm:** Color: 0.2 lux, F1.2, B/W: 0.04 lux, F1.2 **AXIS P3343/-V/-VE 12 mm:** Color: 0.3 lux, F1.4, B/W: 0.05 lux, F1.4 **AXIS P3344/-V/-VE 6 mm:** Color: 0.3 lux, F1.4, B/W: 0.05 lux, F1.4 **AXIS P3344/-V/-VE 12 mm:** Color: 0.4 lux, F1.6, B/W: 0.06 lux, F1.6 **AXIS P3346/-V/-VE:** Color: 0.5 lux, F1.2, B/W: 0.08 lux, F1.2
Shutter time	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** 1/25000 s to 1/6 s **AXIS P3346/-V/-VE:** 1/35500 s to 1/6 s
Camera angle adjustment	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** Pan 360°, tilt 170°, rotation 340° **AXIS P3346/-V/-VE:** Pan 360°, tilt 160°, rotation 340°

Video

Video compression	H.264 (MPEG-4 Part 10/AVC) Motion JPEG
Resolutions	**AXIS P3343/-V/-VE:** 800x600 to 160x90 **AXIS P3344/-V/-VE:** 1280x800 to 160x90* **AXIS P3346/-V/-VE:** 2048x1536 to 160x90 *1440x900 (1.3 MP) scaled resolution available via VAPIX®
Frame rate H.264	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** 30 fps in all resolutions **AXIS P3346/-V/-VE:** 3MP mode: 20 fps in all resolutions, HDTV 1080p (1920x1080) and 2MP 4:3 (1600x1200) modes: 30 fps in all resolutions
Frame rate Motion JPEG	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** 30 fps in all resolutions **AXIS P3346/-V/-VE:** 3MP mode: 20 fps in all resolutions, HDTV 1080p (1920x1080) and 2MP 4:3 (1600x1200) modes: 30 fps in all resolutions
Video streaming	Multiple, individually configurable streams in H.264 and Motion JPEG Controllable frame rate and bandwidth VBR/CBR H.264
Multi-view streaming	AXIS P3346/-V/-VE: Up to 8 individually cropped out view areas. When streaming 5 view areas in VGA resolution, the frame rate is 20 fps per stream in H.264/Motion JPEG (3 MP capture mode) Digital PTZ, preset positions, guard tour
Image settings	Compression, color, brightness, sharpness, contrast, white balance, exposure control, exposure zones, backlight compensation, wide dynamic range - dynamic contrast, fine tuning of behavior at low light Rotation: 0°, 90°, 180°, 270°, including Corridor Format™ Text and image overlay, privacy mask, mirroring of images

Audio

Audio streaming	Two-way
Audio compression	AAC LC 8/16 kHz G.711 PCM 8 kHz G.726 ADPCM 8 kHz Configurable bit rate
Audio input/ output	External microphone input or line input, line output **AXIS P3343/-V, AXIS P3344/-V and AXIS P3346/-V:** Built-in microphone

Network

Security	Password protection, IP address filtering, digest authentication, user access log, IEEE 802.1X** network access control, HTTPS** encryption
Supported protocols	IPv4/v6, HTTP, HTTPS**, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

System integration

Application Programming Interface	Open API for software integration, including the ONVIF specification available at www.onvif.org, as well as VAPIX® and AXIS Camera Application Platform from Axis Communications, specifications available at www.axis.com Support for AXIS Video Hosting System (AVHS) with One-Click Camera connection
Intelligent video	Video motion detection, active tampering alarm, audio detection Support for AXIS Camera Application Platform enabling installation of additional applications
Alarm triggers	Intelligent video, external input
Alarm events	File upload via FTP, HTTP and email Notification via email, HTTP and TCP External output activation Video and audio recording to local storage Pre- and post-alarm video buffering
Installation aids in software	Remote zoom, remote focus, pixel counter

General

Casing	Polycarbonate transparent cover Aluminum inner camera module with encapsulated electronics Color: white NCS S 1002-B **AXIS P3343/P3344/P3346:** Tamper-resistant polycarbonate casing **AXIS P3343-V/P3344-V:** 1000 kg (2200 lb.) impact-resistant aluminum casing **AXIS P3346-V:** IK10 impact-resistant aluminum casing **AXIS P3343-VE/P3344-VE:** IP66- and NEMA 4X-rated, 1000 kg (2200 lb.) impact-resistant aluminum casing with integrated dehumidifying membrane **AXIS P3346-VE:** IP66- and NEMA 4X-rated, IK10 impact-resistant aluminum casing with integrated dehumidifying membrane
Processor and memory	**AXIS P3343/-V/-VE and AXIS P3344/-V/-VE:** ARTPEC-3, 128 MB RAM, 128 MB Flash **AXIS P3346/-V/-VE:** ARTPEC-3, 256 MB RAM, 128 MB Flash
Power	Power over Ethernet IEEE 802.3af **AXIS P3343/-V, AXIS P3344/-V and AXIS P3346/-V:** Class 2 **AXIS P3343-VE/P3344-VE/P3346-VE:** Class 3
Connectors	RJ-45 10BASE-T/100BASE-TX PoE Terminal block for 1 alarm input and 1 output 3.5 mm mic/line in, 3.5 mm line out
Local storage	SD/SDHC memory card slot (card not included)
Operating conditions	**AXIS P3343/-V, AXIS P3344/-V and AXIS P3346/-V:** 0 °C to 50 °C (32 °F to 122 °F), humidity 15 - 85% RH (non-condensing) **AXIS P3343-VE/P3344-VE/P3346-VE:** -40 °C to 55 °C (-40 °F to 131 °F), humidity 15 - 100% RH (condensing)
Approvals	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, EN 60950-1 **AXIS P3346-V:** IEC 62262 IK10 **AXIS P3343-VE/P3344-VE.:** IEC 60529 IP66, NEMA 250 Type 4X **AXIS P3346-VE:** IEC 60529 IP66, NEMA 250 Type 4X, IEC 62262 IK10
Included accessories	Mounting and connector kits, Installation Guide, CD with installation tools, recording software and User's Manual, Windows decoder 1-user license, smoked transparent cover **AXIS P3343-VE/P3344-VE/P3346-VE:** mounting bracket, weather shield, cable shield, 5 m (16 ft.) network cable with pre-mounted gasket

** *This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (www.openssl.org)*

More information is available at www.axis.com

AXIS® COMMUNICATIONS

DATASHEET

AXIS Q6032 PTZ Dome Network Camera

Advanced, high-speed indoor PTZ dome with 35x zoom.

- > 35x optical zoom, day/night
- > IP52-rated protection against dust and dripping water
- > Extended D1 resolution, H.264
- > Active Gatekeeper and tour recording
- > Power over Ethernet Plus (IEEE 802.3at)

AXIS Q6032 PTZ Dome Network Camera offers 35x optical zoom and high-speed pan/tilt performance, enabling coverage of large indoor areas and great detail when zooming in. It is ideal for use in airports, train stations, stadiums and warehouses.

AXIS Q6032 supports a wider picture with an extended D1 resolution of 752x480 in 60 Hz and 736x576 in 50 Hz. Videos in H.264 and Motion JPEG can be sent at full frame rate. Day and night functionality, progressive scan, 128x wide dynamic range and electronic image stabilization contribute to the camera's superb video quality.

The camera's tour recording functionality enables easy setup of an automatic tour using a device such as a joystick to record an operator's pan/tilt/zoom movements. With Active Gatekeeper, the camera can automatically move to a preset position upon motion detection in a pre-defined area, and track the detected object.

AXIS Q6032 offers easy and reliable installation. The IP52-rated camera provides protection against dust and dripping water, enabling video to be taken even when a sprinkler system is activated. Support for Power over Ethernet Plus (PoE+) also simplifies installation since only one cable is needed for carrying power, as well as video and PTZ controls.

When an optional multi-connector cable is used, AXIS Q6032 supports two-way audio, I/O ports for external devices and AC/DC power. The camera's SD/SDHC slot enables recordings to be stored locally.

43051/EN/R1/1106

Technical specifications – AXIS Q6032 PTZ Dome Network Camera

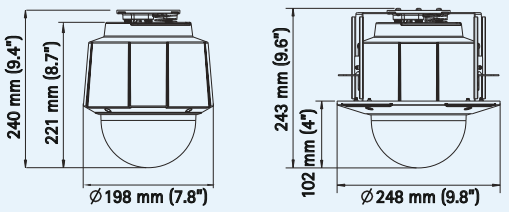
Camera	
Models	AXIS Q6032 60 Hz, AXIS Q6032 50 Hz
Image sensor	1/4" ExView HAD progressive scan CCD
Lens	f 3.4 – 119 mm, F1.4 – 4.2, autofocus, automatic day/night, horizontal angle of view: 55.8° - 1.7°
Minimum illumination	Color: 0.5 lux at 30 IRE F1.4 B/W: 0.008 lux at 30 IRE F1.4
Shutter time	1/30000 s to 0.5 s (60 Hz), 1/30000 s to 1.5 s (50 Hz)
Pan/tilt/zoom	E-flip, 100 preset positions Pan: 360° endless, 0.05° – 450°/s, Tilt: 180°, 0.05° – 450°/s 35x optical zoom and 12x digital zoom, total 420x zoom
Pan/tilt/zoom functionalities	Tour recording, guard tour, control queue On-screen directional indicator
Video	
Video compression	H.264 (MPEG-4 Part 10/AVC) Motion JPEG
Resolutions	Extended D1 752x480 to 176x120 (60 Hz) Extended D1 736x576 to 176x144 (50 Hz)
Frame rate	H.264: Up to 30/25 fps (60/50 Hz) in all resolutions Motion JPEG: Up to 30/25 fps (60/50 Hz) in all resolutions
Video streaming	Multiple, individually configurable streams in H.264 and Motion JPEG Controllable frame rate and bandwidth VBR/CBR H.264
Image settings	Wide Dynamic Range (WDR), Electronic Image Stabilization (EIS), manual shutter time, compression, color, brightness, sharpness, white balance, exposure control, exposure zones, rotation, backlight compensation, fine tuning of behavior at low light, text and image overlay, 3D privacy mask, image freeze on PTZ
Audio	
Audio streaming	Two-way
Audio compression	AAC-LC 8/16 kHz, G.711 PCM 8 kHz, G.726 ADPCM 8 kHz Configurable bit rate
Input/output	Requires multi-connector cable (not included) for external microphone or line input, and line output
Network	
Security	Password protection, IP address filtering, HTTPS encryption*, IEEE 802.1X network access control*, digest authentication, user access log
Supported protocols	IPv4/v6, HTTP, HTTPS*, SSL/TLS*, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

System integration	
Application Programming Interface	Open API for software integration, including VAPIX® and AXIS Camera Application Platform from Axis Communications; specifications available at www.axis.com ONVIF, specifications available at www.onvif.org AXIS Video Hosting System (AVHS) with One-Click Camera Connection
Intelligent video	Video motion detection, audio detection, auto-tracking, Active Gatekeeper, AXIS Camera Application Platform
Alarm triggers	Video motion detection, audio detection, auto-tracking, external input, PTZ preset, temperature, memory card full, AXIS Camera Application Platform
Alarm events	File upload via FTP, HTTP and email Notification via email, HTTP and TCP External output, PTZ preset, guard tour, play audio clip, local storage Pre- and post-alarm video buffering
General	
Casing	IP52-rated, metal casing (aluminum), acrylic (PMMA) clear dome
Processors and memory	ARTPEC-3, 256 MB RAM, 128 MB Flash
Power	Power over Ethernet Plus (PoE+) IEEE 802.3at, max. 30W 24-34 V DC, max. 19 W; 20-24 V AC, max. 27 VA AXIS T8123 High PoE Midspan 1-port included: 100-240 V AC
Connectors	RJ-45 for 10BASE-T/100BASE-TX PoE Multi-connector (cable not included) for AC/DC power, 4 configurable alarm inputs/outputs, mic in, line mono input, line mono output to active speaker
Local storage	SD/SDHC memory card slot (card is not included)
Operating conditions	0 °C to 50 °C (32 °F to 122 °F) Humidity 20 - 80% RH (non-condensing)
Approvals	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 61000-6-1, EN 61000-6-2, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, KCC Class B IP52 IEC 60529 IEC 60721-4-3 Class 3K3, 3M3, EN/IEC 60068-2 Midspan: EN 60950-1, GS, UL, cUL, CE, VCCI, CB, KCC, CSA, UL-AR
Weight	Camera: 2.6 kg (5.7 lb.) Camera with drop-ceiling mount: 3.2 kg (7.1 lb.)
Included accessories	AXIS T8123 High PoE Midspan 1-port, mounting kit for hard and drop ceilings, clear and smoked dome cover, Installation Guide, CD with User's Manual, recording software, installation and management tools, Windows decoder 1-user license

** This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (www.openssl.org)*

More information at www.axis.com

Dimensions

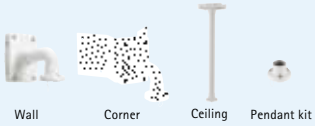


Hard ceiling mount

Drop ceiling mount

Optional accessories

AXIS T91A Mounting Accessories



AXIS T90A Illuminators

AXIS T8310 Video Surveillance Control Board

Multi-connector cable for AC/DC power, I/Os and audio

AXIS Camera Station and video management software from Axis' Application Development Partners. For more information, see www.axis.com/products/video/software/

AXIS P3707-PE Network Camera

Flexible, 360° multisensor camera

AXIS P3707-PE Network Camera is an 8-megapixel multisensor fixed camera with four varifocal lenses that enable overview and detailed surveillance. With one IP address, one network cable, PoE support, IP66 and IP67 ratings, the four-camera-in-one unit provides a flexible, cost-effective solution for multidirectional surveillance in large indoor and outdoor areas, and at the intersection of hallways and roads. Each camera head can be moved along a circular track. The tilt angle and the field of view of each lens are adjustable, and each camera head can rotate to support Axis' Corridor Format. The specially designed clear cover, with no sharp edges, ensures undistorted views in all directions.

- > 8 MP, 360° multisensor camera, one IP address
- > Flexible positioning of four varifocal camera heads
- > 1080p videos at 12.5/15 fps; 720p videos at 25/30 fps; quad view stream
- > Axis' Zipstream technology

AXIS P3707-PE Network Camera

Camera	
Image sensor	4 x 1/2.8" progressive scan RGB CMOS
Lens	Varifocal, 2.8–6 mm, F2.0 **4x1080p capture mode:** Horizontal field of view: 108°–54° Vertical field of view: 57°–30° **4xHDTV 720p capture mode:** Horizontal field of view: 67°–36° Vertical field of view: 37°–20° Adjustable focus and zoom, fixed iris
Minimum illumination	**Color:** 0.3 lux, F2.0
Shutter time	720p: 1/28000 s to 2 s 1080p: 1/22500 s to 2 s
Video	
Video compression	H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles Motion JPEG
Resolutions	4 x 1920x1080 (1080p) to 160x90 Quad view 1920x1440 to 480x270
Frame rate	25/30 fps (50/60 Hz) with 720p capture mode 12.5/15 fps (50/60 Hz) with 1080p capture mode
Video streaming	Multiple, individually configurable streams in H.264 and Motion JPEG Axis Zipstream technology in H.264 Controllable frame rate and bandwidth VBR/MBR H.264
Image settings	Color, brightness, sharpness, contrast, white balance, exposure control, exposure zone, fine tuning of behavior at low light, rotation: 0°, 90°, 180°, 270° including Corridor Format, text and image overlay, privacy mask, Local contrast
Camera angle adjustment	Pan ±90° Tilt 28°-92° Rotate ±90°
Network	
IP address	One IP address for all channels
Security	Password protection, IP address filtering, HTTPS[a] encryption, IEEE 802.1X[a] network access control, digest authentication, user access log, centralized certificate management
Supported protocols	IPv4/v6, HTTP, HTTPS[a], SSL/TLS[a], QoS Layer 3 DiffServ, FTP, CIFS/SMB, SMTP, Bonjour, UPnP™, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, SFTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS, SSH
System integration	
Application Programming Interface	Open API for software integration, including VAPIX® and AXIS Camera Application Platform; specifications at *www.axis.com* AXIS Video Hosting System (AVHS) with One-Click Connection ONVIF® Profile S and ONVIF® Profile G, specification at *www.onvif.org*
Analytics	**Included** AXIS Video Motion Detection, active tampering alarm Support for AXIS Camera Application Platform enabling installation of third-party applications, see *www.axis.com/acap*
Event triggers	Analytics, edge storage events
Event actions	Overlay text, pre- and post-alarm video buffering, video recording to edge storage, SNMP trap File upload: FTP, SFTP, HTTP, HTTPS network share and email Notification: email, HTTP, HTTPS and TCP
Data streaming	Event data
Built-in installation aids	Pixel counter
General	
Casing	IP66-, IP67-, NEMA 4X- and IK09-rated Die-casted aluminum, polycarbonate dome
Sustainability	PVC free
Memory	1 GB RAM, 256 MB Flash
Power	Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 2 Typical 4.8 W, max 5.5 W
Connectors	RJ45 10BASE-T/100BASE-TX PoE
Storage	Support for microSD/microSDHC/microSDXC card Support for SD card encryption Support for recording to network-attached storage (NAS) For SD card and NAS recommendations see *www.axis.com*
Operating conditions	-30 °C to 60 °C (-22 °F to 140 °F) Humidity 10–100% RH (condensing)
Storage conditions	-40 °C to 65 °C (-40 °F to 149 °F)
Approvals	**EMC** EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, EN 61000-6-1, EN 61000-6-2, FCC Part 15 Subpart B Class A+B, ICES-003 Class B, VCCI Class B, RCM AS/NZS CISPR 22 Class B, KCC KN32 Class B, KN35, EN 50121-4, IEC 62236-4 **Safety** IEC/EN/UL 60950-1, IEC/EN/UL 60950-22 **Environment** IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14, IEC 60068-2-27, IEC/EN 62262 IK09, IEC/EN 60529 IP66/IP67, NEMA 250 Type 4X
Dimensions	Diameter: ø 270 mm (10 5/8 in), Height: 91.5 mm (3 5/8 in)
Weight	2.2 kg (4.9 lb)
Included accessories	RJ45 mounting tool, Installation Guide, Windows decoder 1-user license
Optional accessories	AXIS T8415 Wireless Installation Tool, AXIS T94M02D Pendant Kit including weather shield, AXIS P3707-PE Clear Dome Kit, AXIS T91 Mounting Accessories, AXIS T8120 15 W Midspan 1-port For more accessories, see *www.axis.com*
Video management software	AXIS Camera Companion, AXIS Camera Station, Video management software from Axis' Application Development Partners available on *www.axis.com/techsup/software*
Languages	English, German, French, Spanish, Italian, Russian, Simplified Chinese, Japanese, Korean, Portuguese, Traditional Chinese
Warranty	Axis 3-year warranty and AXIS Extended Warranty option, see *www.axis.com/warranty*

a. *This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (www.openssl.org), and cryptographic software written by Eric Young (eay@cryptsoft.com).*

Environmental responsibility:

www.axis.com/environmental-responsibility

1531595/EN/M2.2/022017

CompleteView Video Management Software

SALIENT SYSTEMS

Simple.Scalable.Security™

SALIENT SYSTEMS

Salient Systems is a leading provider of network friendly video surveillance software and hybrid video management systems.

CompleteView VIDEO MANAGEMENT SOFTWARE

- Comprehensive and Flexible
- Network Friendly
- Suppports IP and Analog Cameras
- Open Architecture
- Easy to Install - Easy to Learn - Easy to Use
- Fully Scalable - One Server to Multi-Site

Simple.Scalable.Security™

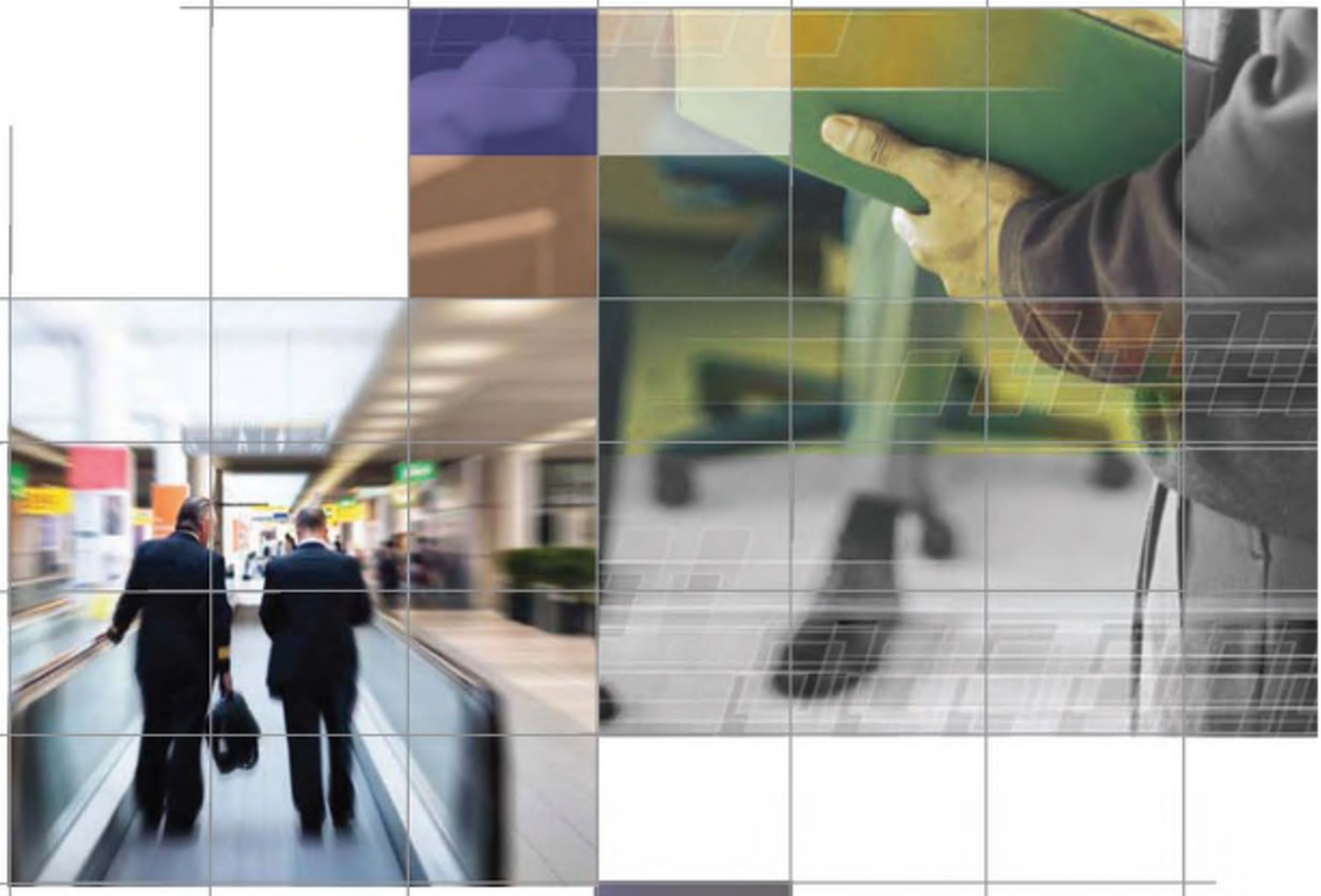
Secure your investment. Secure your world.

CompleteView Video Management Software contains everything you need to enable and optimize your security system. CompleteView stands apart from traditional Video Management Systems by adding a suite of features to reduce bandwidth impact on the IP network and facilitate system administration.

CompleteView comes in three editions: ONE, Pro and Enterprise. CompleteView ONE has the full power of Pro and Enterprise editions but is designed for up to 25 cameras on a single server, at an attractive price. CompleteView Pro is a fully expandable Video Management Software platform providing support for unlimited cameras, users and servers. CompleteView Enterprise provides the full feature set and additional components such as Active Directory support.

CompleteView protects your investment. As your needs change and grow, the software can scale from ONE to Pro or Pro to Enterprise without losing your original investment. With support for analog and IP cameras, fixed or PTZ and a number of access control platforms, CompleteView is just that: Complete.

CompleteView



With CompleteView enabling your enterprise you can monitor, maintain, and manage from anywhere at any point at any time.

- Users
- Cameras
- Servers
- Configurations
- Software Updates

Comprehensive and Flexible

The CompleteView suite of applications provides everything you need to manage your single-server or multi-server enterprise video system from a single desktop, whether it's local or remote. Powerful Client Applications such as Video Client, Alarm Client, Web Client and Mapping Interface are included.

Video Client provides powerful live video viewing features, access to video recordings, maps and more. Access cameras across any number of servers and allow unlimited clients to be active simultaneously* to support multi-monitor display or populate a video wall. Display cameras simultaneously, tile cameras in any configuration or pre-define views. Sequence switching between multi-camera views and use Quick Review instant replay on any video source.

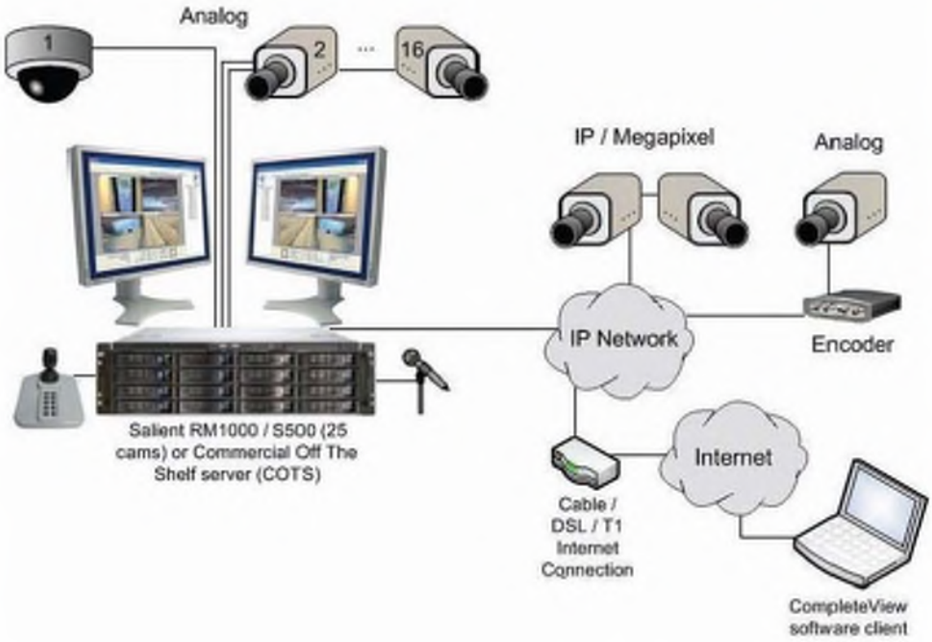
Alarm Client monitors only relevant security events to make the best use of monitoring resources and reduces operator fatigue. Video displays instantly on an event to catch the attention of the security operator. Live and recorded video can be displayed at the same time with full camera control.

Monitor video without installing software using CompleteView Web Interface client. **Web Client** allows anyone from any location to instantly monitor the security system. Allow first responders to view video in an emergency, display video at configurable frame rates and resolutions, drag and drop cameras to customize view layouts and view up to 16 cameras simultaneously.

Utilizing CompleteView's **Mapping Client**, security system operators and law enforcement personnel are able to view camera placement on facility maps and see field of view information assigned to each camera. Icons are overlaid on imported map files so operators can gain an instant understanding of the security situation. Configurable cones show camera's field of view, direction and alarm or motion activity. Additionally, system operators are able to view live video on any camera from the mapping interface.

*Available in CompleteView Pro and Enterprise editions.

Network Connected, Standalone Hybrid System



CompleteView ONE System Architecture

CompleteView ONE supports a mix of analog and IP cameras for a true hybrid installation. Up to 16 analog cameras and a mix of standard resolution, Megapixel and High Definition IP cameras can record to the server.

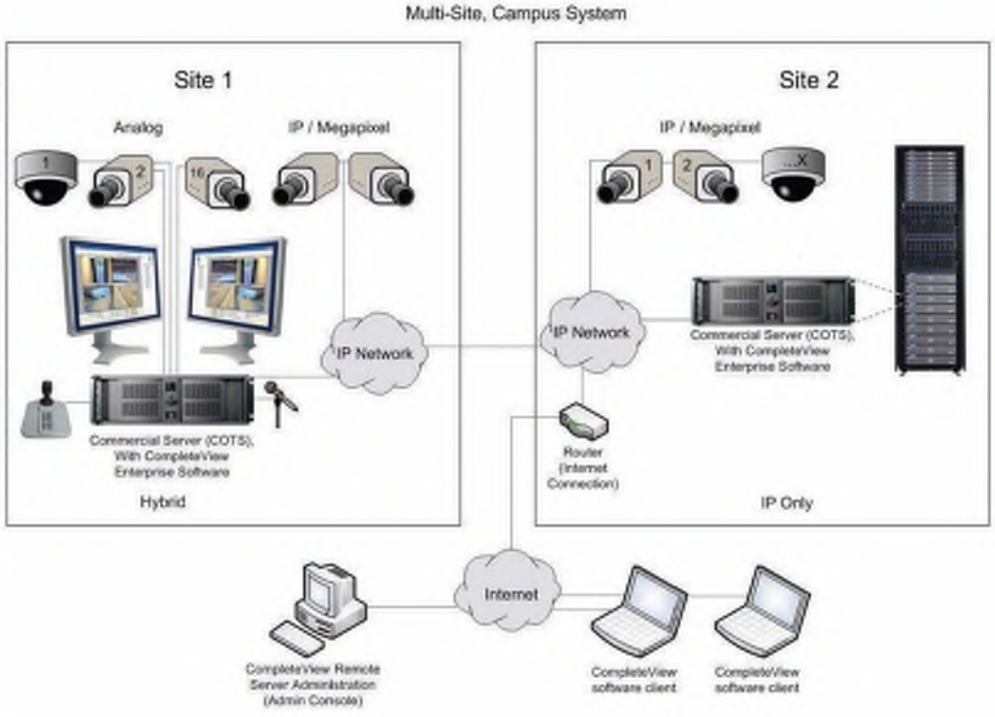
CompleteView ONE supports up to 25 cameras on one server simultaneously. As the need for cameras grows, CompleteView ONE can be software upgraded to Pro or Enterprise.

Cameras can be viewed remotely with connections over a local IP network or the Internet. All client software applications are included and server settings can be managed locally or remotely.

CompleteView Pro & CompleteView Enterprise System Architecture

With CompleteView Pro and Enterprise all sites and cameras can be viewed simultaneously by security system operators. The software scales to any number of servers, clients and cameras system-wide. A mix of standard resolution, megapixel and PTZ cameras are supported.

A unique component of CompleteView Pro and Enterprise is **Admin Console** which offers multi-server management. Admin Console is used to manage all servers simultaneously. In the event of a problem with storage, cameras, or servers, the administrator can instantly see and proactively respond to troubleshoot issues. Administration and live viewing can be done from any workstation on the local network, or, if enabled can be accessed over the Internet.



CompleteView easily scales from a few cameras on one server to thousands of cameras on multiple servers.

A true hybrid system, CompleteView supports virtually all leading IP and analog cameras and encoder manufacturers.

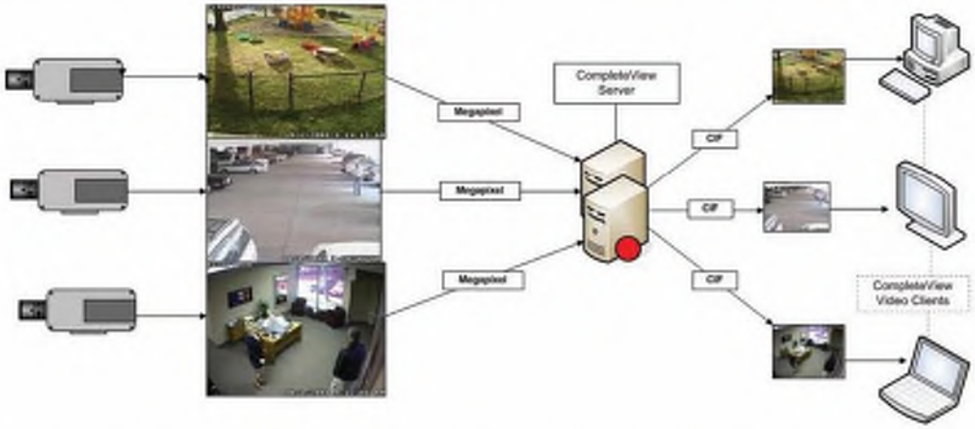
More Facts & Features

Stable Recording Architecture CompleteView is built from the ground up using a unique recording architecture. Many traditional Video Management Systems store all video, audio and associated meta data to a database file. In a Video management System, a power outage, hardware failure or other unexpected interruption of the applications can cause the database to become corrupted. If the repair fails, all video contained in the database is lost. CompleteView separates the video and stores it in a flat file structure, outside of its database, avoiding the potential of database corruption and long database rebuilds.

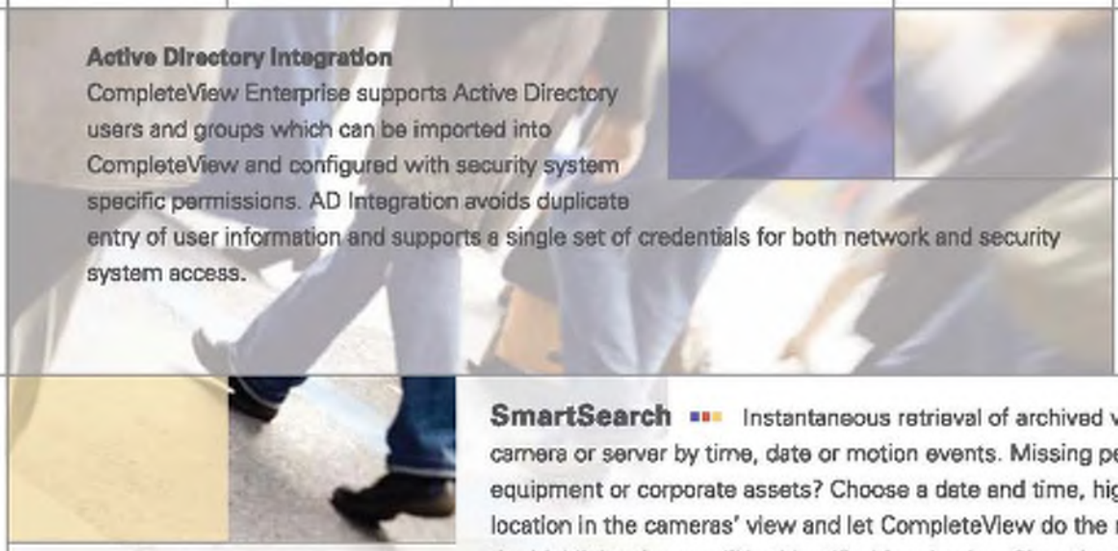
Alarm Console Designed to display live video for active alarm conditions. Display up to 4 live video sources simultaneously, list up to 100 most recent alarms and do on-screen analysis of live video and archived event video concurrently.

Automated Attendant The most advanced automatic control feature in CompleteView. When motion occurs on a fixed camera, that camera can automatically instruct a PTZ camera to move to a preset location. When motion occurs on multiple fixed cameras those cameras can control multiple PTZ cameras. The system has the ability to give 'high priority' status to important locations so a PTZ camera can hold the view even if motion is detected in lower priority locations. The flexibility of Automated Attendant gives you security coverage in multiple locations with multiple views.

Network Friendly CompleteView was designed to 'play nice in the IT world'. It doesn't interfere with existing applications, out of band management tools, anti-virus software or firewalls. Special features have been added to minimize the footprint of digital video on your network and reduce the bandwidth consumed by remote users.



CompleteView includes **Dynamic Resolution Scaling**, a powerful feature to manage bandwidth and network resources. Video is always recorded at the preconfigured resolution on the CompleteView Server. If video is displayed in the CompleteView Video Client at a small size, the CompleteView Server will send a lower resolution copy of the video stream to reduce bandwidth consumption. When video is displayed at a larger size on the CompleteView Video Client, video is automatically streamed at the higher resolution for high quality display.



Active Directory Integration
CompleteView Enterprise supports Active Directory users and groups which can be imported into CompleteView and configured with security system specific permissions. AD Integration avoids duplicate entry of user information and supports a single set of credentials for both network and security system access.

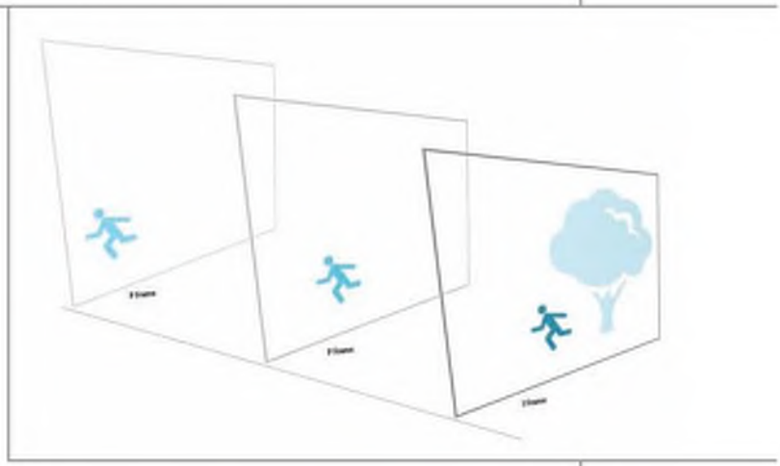
SmartSearch Instantaneous retrieval of archived video from any camera or server by time, date or motion events. Missing personal items, equipment or corporate assets? Choose a date and time, highlight any location in the cameras' view and let CompleteView do the rest. All motion in the highlighted area will be identified for viewing. Slow the video down, speed it up, see it frame by frame or create an AVI file for viewing on any PC.

Multi Compression Support: Motion JPEG, MPEG4 & H.264

CompleteView's recording engine supports Motion JPEG, MPEG4 and H.264 compression. Supported formats allow for live view, recording and playback in all major non-proprietary compression formats.

- Recording, Live View & Playback of Motion JPEG, MPEG4 & H.264*
- Optionally transcode between compression formats for reduced storage cost
- Supports native compression from IP Cameras without transcoding
- Different compression formats can be used for recording and live view

*available on all analog and select IP Cameras



CompleteView Config Server

Config Server is an optionally installable component of CompleteView Pro and Enterprise which allows for centralized storage of client configuration. Config Server allows users to log into any workstation or monitoring center and maintain their configured views, camera access and other settings. For security operations with multiple monitoring centers this can be an especially useful tool for scheduling guards at different stations. Security does not have to be sacrificed in situations where a user without access to certain cameras needs to log into the security system from a workstation configured to access normally unauthorized cameras and views.

Config Server also allows the administrators to centrally distribute new client software releases. When new versions of CompleteView client applications become available, the administrator can push the new release to the Config Server. The next time a client logs in, the user is prompted to upgrade with no further administrator intervention.

Lower Total Cost of Ownership

Dramatically lower your total cost of ownership. CompleteView enables you to implement a comprehensive video management strategy and cut the costs of managing your enterprise.

Open Architecture, IP or Analog cameras & Acess Control supported

CompleteView takes the complexity out of designing and implementing your surveillance system by supporting differing camera technologies in a seamless manner. Enhance your security by integrating video and access control with a number of supported access control products.

A true hybrid system with seamless integration of analog and IP technologies, CompleteView supports virtually all leading IP, analog and encoder manufacturers, allowing you to choose from a wide variety.

Flexible Purchase and Delivery

CompleteView can be delivered in three ways:

- Pre-installed on Salient Systems' purpose-built workstations and servers.
- Pre-installed on tier one industry standard platforms such as Dell, HP or other leading hardware vendors.
- Available as software only.

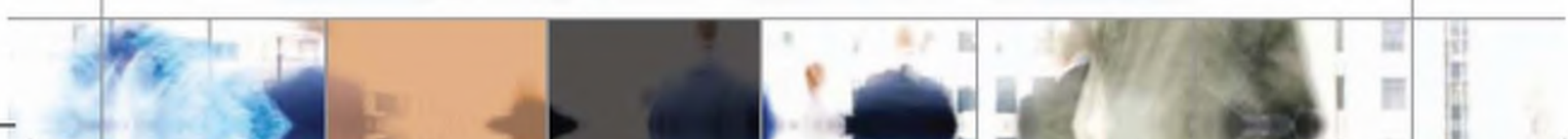
Easy Installation

Lower your manpower costs with CompleteView integrated systems pre-loaded with application software and documentation. An intuitive user interface guides users through set-up, log on and camera viewing. Full documentation is shipped with each system or copy of software.

Pain Free Licensing

Camera licenses can be transferred from one system to another and replaced with identical units, different models, or with a camera from a completely different manufacturer – all without extra license costs or penalties.

Worldwide Enterprise Capability



Your choice is complete.

CompleteView

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(512) 617-4800
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Simple.Scalable.Security™

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E-mail: saleshelp@tripplite.com

Model #: SU3000RTXL3U

SmartOnline 3kVA On-Line Double-Conversion UPS, 3U Rack/Tower, 110/120V NEMA outlets

Highlights

- 3000VA / 3kVA / 2400 watt on-line double-conversion 3U rack/tower UPS
- 110/120V +/-2% output at 50/60Hz, high efficiency economy mode option
- Expandable runtime, Hot-swappable battery modules
- USB, RS232 & EPO ports; support for SNMP/WEB card options
- Front panel status LEDs with detailed load and battery metering
- 2 independently switchable output load banks
- NEMA L5-30P input; L5-30R, 5-15/20R & 5-15R outlets

Description

3000VA on-line, double-conversion UPS system for critical server, network and telecommunications equipment. 3U rackmount form factor with an installed depth of 26 inches. Expandable battery runtime with optional BP72V15-2U (limit 1) and BP72V28RT-3U (multi-pack compatible) external battery packs. Full time sine wave 110 or 120V output with +/-2% voltage regulation. Online, double-conversion Uninterruptible Power Supply (UPS) actively converts raw incoming AC power to DC, then re-converts output back to completely regulated, filtered AC output. Operates continuously without using battery power during brownouts to 65V and overvoltages to 150V. Highly efficient operation in optional economy mode saves BTU heat output and energy costs. NEMA L5-30P input plug. NEMA 5-15, NEMA 5-15/20R and NEMA L5-30R output receptacles. Network-grade AC surge and noise suppression. Zero transfer time between AC and battery operation. Network management interfaces support simultaneous communications via USB port, DB9 serial port and SNMPWEBCARD slot. Built-in DB9 port offers both enhanced RS-232 enabled monitoring data, plus contact closure monitoring ability. HID-compliant USB interface enables integration with built-in power management and auto shutdown features of Windows and Mac OS X. Supports simultaneous detailed monitoring of equipment load levels, self-test data and utility power conditions via all 3 network interfaces. Includes PowerAlert monitoring software and complete cabling. Emergency Power Off (EPO) interface. Integrated two-bank PDU switching supports load shedding and remote reboot of connected equipment. 3-stage metered current monitoring and battery charge status LEDs. LED display panel easily rotates for viewing in rackmount or tower configurations. Dataline surge suppression for dialup, DSL or network Ethernet connection. Utility power and voltage regulation LEDs. Audible alarm. Self-test. Fault-tolerant auto-bypass mode. 4-post rackmount accessories included; 2-9USTAND tower kit and 2POSTRMKITWM 2-post rackmount accessories available. Field-replaceable, hot-swappable internal batteries and external battery packs. Attractive all-black color scheme. 2-year warranty and $250,000connected equipment insurance; extended warranty and service contracts available.

Package Includes

- SU3000RTXL3U UPS System
- PowerAlert Software and Cabling
- Mounting hardware for 4 post rack enclosures
- Instruction manual

Features

- SmartOnline high performance UPS system is ideal for critical voice, data, medical and industrial network applications
- True on-line, double-conversion UPS provides perfectly regulated sine wave output within 2% of 110/120V (user selectable) under all usage

conditions
- Maintains continuous operation through blackouts, voltage fluctuations and surges with zero transfer time
- Highly efficient operation in optional economy mode setting, saving BTU heat output and energy costs
- Removes harmonic distortion, fast electrical impulses, frequency variations and other hard to solve power problems not addressed by other UPS types
- Corrects line voltage conditions as low as 65V and as high as 150V back to selectable 110/120V (+/-2%) values
- Standard internal battery set offers 14 minutes runtime at half load (1200W) and 5 minutes at full load (2400W)
- Expandable battery runtime with optional BP72V15-2U (limit 1) and BP72V28RT-3U (no limit) external battery packs
- Compact rackmount form factor installs using only 3 rack spaces (3U) with a maximum installed depth of 26 inches
- Ships with all mounting accessories for 4 post rackmount installation
- Optional 2POSTRMKITWM enables 2 post rackmount installation (not wallmount compatible)
- Optional 2-9USTAND accessory enables small-footprint upright tower placement
- Fault tolerant electronic bypass maintains utility output during a variety of UPS fault conditions
- Network interfaces support simultaneous communications via built-in USB, DB9 serial / contact-closure and SNMPWEBCARD slot
- HID compliant USB interface enables integration with built-in power management and auto shutdown features of Windows and Mac OS X
- Included PowerAlert UPS monitoring software supports safe unattended shutdown, monitoring and control via local connected servers, plus any number of additional servers over IP
- UPS interface supports on-battery, low-battery, power-restored, AC-voltage, DC-voltage, output current monitoring, battery charge current, battery capacity, AC line frequency, timed inverter shutoff, activate self-test, load bank output power control and remote reboot, UPS nominal voltage adjustment and UPS line to battery power voltage setpoints
- Built-in Emergency Power Off (EPO) interface with cable
- NEMA L5-30P input plug; NEMA 5-15/20R & L5-30R output receptacles
- Integrated 2 bank switched PDU enables remote outlet management for load shedding or remote reboot of individual load banks (each bank has four outlets)
- Front panel LEDs offer current monitoring and battery charge level information
- UPS ships fully assembled in full compliance with DOT regulations; no time consuming connection of internal batteries by user required
- Single line TEL/DSL or network ethernet line surge suppression
- 2 year manufacturer's product warranty, $250,000 Ultimate Lifetime Insurance

Specifications

OUTPUT	
Output Volt Amp Capacity (VA)	3000
Output kVA capacity (kVA)	3
Output Watt Capacity (watts)	2400
Output kW capacity	2.4
Output power factor	0.8
Crest Factor	3:1
Nominal Output Voltage(s) Supported	110V; 120V
Nominal Voltage details	120V default
Frequency compatibility	50 / 60 Hz
Frequency compatibility details	Output frequency matches input nominal on startup, defaults to 60 Hz on cold-start
Output voltage regulation (line mode)	+/- 2%

Output voltage regulation (Economy line mode)	+/- 10%
Output voltage regulation (Battery mode)	+/- 2%
Built-in UPS output receptacles	4 5-15R outlet(s); 4 5-15/20R outlet(s); 1 L5-30R outlet(s)
Built-in controllable switched load banks	Two switchable four-outlet load banks, (bank 1 - four 5-15/20R, bank 2 - four 5-15R outlets)
Output circuit breaker	15A branch rated (x2) - each breaker protects 4 outlets, L5-30R is unbreakered
Output AC waveform (AC mode)	Sine wave
Output AC waveform (battery mode)	Pure Sine wave
INPUT	
Rated input current (at maximum load)	24A
Nominal Input Voltage(s) Supported	110V AC; 120V AC
UPS input connection type	L5-30P
Input circuit breaker	40A
UPS Input cord length (ft.)	10
UPS Input cord length (m)	3
Recommended Electrical Service	30A 120V
BATTERY	
Full load runtime (minutes)	5 min. (2400w)
Half load runtime (minutes)	14 min. (1200w)
Expandable battery runtime	Supports extended runtime with optional external battery packs
External battery pack compatibility	BP72V15-2U (limit 1); BP72V28RT-3U (multi-pack compatible)
DC system voltage (VDC)	72
Battery recharge rate (included batteries)	Less than 6 hours from 10% to 80%
Replacement battery cartridge (internal UPS battery replacement)	RBC96-3U (quantity 1)
Battery Access	Front panel battery access door

Battery replacement description	Hot-swappable, user replaceable batteries
VOLTAGE REGULATION	
Voltage regulation description	Online, double-conversion power conditioning
Overvoltage correction	2% output voltage regulation during overvoltages to 150
Undervoltage correction	2% output voltage regulation during undervoltages to 80
Severe undervoltage correction	2% output voltage regulation during undervoltages to 65 (under 70% load only)
LEDS ALARMS & SWITCHES	
LED Indicators	14 LEDs indicate line power, online mode, economy/bypass mode, on-battery, overload, battery low, replace battery and fault status information; 4-LED meter displays load and battery charge levels; LED panel rotates for viewing in rack/tower formats
Alarms	Audible alarm indicates UPS startup, power-failure, low-battery, overload, UPS fault and remote shutdown conditions
Alarm cancel operation	Power-fail alarm can be silenced using alarm-cancel switch
Switches	2 switches control off/on power status and alarm-cancel/self-test operation
SURGE / NOISE SUPPRESSION	
UPS AC suppression joule rating	510
UPS AC suppression response time	Instantaneous
UPS Dataline suppression	1 line TEL/DSL (1 in / 1 out); 10/100Base T Ethernet
EMI / RFI AC noise suppression	Yes
PHYSICAL	
Installation form factors supported with included accessories	4 post 19 inch rackmount (mounting rail kit included)
Installation form factors supported with optional accessories	2 post rackmount (2POSTRMKITWM); Tower (2-9USTAND)
Optional mounting accessory notes	Wallmount installation not recommended
Primary form factor	Rackmount
UPS / Power Module dimensions in primary form factor (height x width x depth / inches)	5.2 x 17.8 x 26
UPS / Power Module dimensions in primary form factor (height x width x depth / cm)	13.3 x 45.1 x 66

Installed whole system total rack space height (rack spaces)	3U
Secondary form factor	Tower (requires 2-9USTAND)
UPS / Power Module weight (lbs)	73.8
UPS / Power Module weight (kg)	33.5
UPS Shipping dimensions (height x width x depth / inches)	11.2 x 23 x 31.5
UPS Shipping dimensions (height x width x depth / cm)	28.6 x 58.4 x 80
Shipping weight (lbs)	112.4
Shipping weight (kg)	51
UPS housing material	Steel
Cooling method	Fan
ENVIRONMENTAL	
Operating Temperature Range	+32 to +104 degrees Fahrenheit / 0 to +40 degrees Celsius
Storage Temperature Range	+5 to +122 degrees Fahrenheit / -15 to +50 degrees Celsius
Relative Humidity	0 to 95%, non-condensing
AC mode BTU / hr. (full load)	1112.7
AC economy mode BTU / hr. (full load)	520.9
Battery mode BTU / hr. (full load)	1219.3
AC economy mode efficiency rating (100% load)	94%
COMMUNICATIONS	
Communications interface	USB (HID enabled); DB9 Serial; Contact closure; EPO (emergency power off); Slot for SNMP/Web interface
Network monitoring port description	Supports detailed monitoring of UPS and site power conditions; DB9 port supports RS232 and contact closure communications
PowerAlert software	Included
Communications cable	USB and DB9 cabling included
WatchDog compatibility	Supports Watchdog application, OS and hard-reboot restart options for remote applications
LINE / BATTERY TRANSFER	
Transfer time	No transfer time (0 ms.) in online, double-conversion mode

Low voltage transfer to battery power (setpoint)	80V (100% load), 65V (
High voltage transfer to battery power (setpoint)	150
SPECIAL FEATURES	
Cold Start (startup in battery mode during a power failure)	Cold-start operation supported
High availability UPS features	Automatic inverter bypass; Hot swappable batteries
Green & high efficiency features	High efficiency economy mode operation; Individually controllable load banks; Schedulable daily hours of economy mode operation
CERTIFICATIONS	
UPS Certifications	Tested to UL1778 (USA); Tested to CSA (Canada); Tested to NOM (Mexico); Meets FCC Part 15 Category A (EMI)
WARRANTY	
Product Warranty Period (U.S., Canada & Puerto Rico)	2-year limited warranty
Connected Equipment Insurance (U.S., Canada & Puerto Rico)	$250,000 Ultimate Lifetime Insurance

Related Items

Optional Products

Product Type	Related Model	Description	Qty.
SNMP Accessories	SNMPWEBCARD	For remote monitoring and control via SNMP, Web, or Telnet.	-
SNMP Accessories	ENVIROSENSE	Monitors temperature, humidity and contact-closure inputs. (Requires SNMPWEBCARD or switched PDU.)	-
UPS Accessories	RELAYIOCARD	Programmable Relay I/O Card	-
UPS Accessories	MODBUSCARD	For remote monitoring and control via MODBUS protocol	-
Shutdown Cable Kits	AS400CABLE KIT	Power Management Tools - UPS Communication Cable Kit for System i / AS400 / iSeries Servers	-
Tower Stands	2-9USTAND	Enables Tower Placement of Rackmount UPS Systems	-
Rackmount/Wallmount Kits	2POSTRMKITHD	Enables 2-Post Rackmount Installation of 3U and Larger UPS, Transformer and Battery Pack Components	-
External Battery Packs	BP72V15-2U	BP72V15-2U - External Battery Pack for UPS System	-
External Battery Packs	BP72V28RT-3U	BP72V28RT-3U - External Battery Pack for UPS System	-
Extended Warranties	WEXT3-2200-3000	3-Year Extended Warranty - For Smart Line-Interactive and Online Tower or Rack models, 2200-3000VA	-
Extended Warranties	WEXT5-2200-3000	5-Year Extended Warranty - For Smart Line-Interactive and Online Tower or Rack models, 2200-3000VA or less	-
Power Distribution	PDUB30	Dual source Power Distribution Unit / PDU with Manual Transfer Switch enables Hot-swappable UPS Replacement in Critical Network Applications	-
Power Distribution	PDU2430	Basic PDU / Power Distribution Unit - Safe, reliable power distribution for critical networking equipment	-

Power Distribution	PDUMV30	Metered 0U Vertical Rack PDU - Metered Power Distribution Unit for Network Applications	-
Power Distribution	PDUMV30NET	Switched, Metered PDU with Remote Monitoring - 0U Vertical Rackmount Power Distribution Unit for Networks with Individually Switchable Outlets, Current Metering, Remote Monitoring and Control	-
Power Distribution	PDUMH30NET	Switched, Metered PDU with Remote Monitoring - 2U Rackmount Power Distribution Unit for Networks with Individually Switchable Outlets, Current Metering, Remote Monitoring and Control	-
Power Distribution	PDUMNV30	Monitored PDU / Power Distribution Unit supports real-time remote monitoring of load level, voltage and frequency with options for remote environmental and security monitoring	-
Power Cables	P043-002	2-ft. 10AWG Heavy Duty Power Cord with 20 AMP Breaker, (NEMA L5-30P to NEMA L5-20R)	-
Power Distribution	P044-06I	6-inch 12AWG Heavy Duty Power Adapter cord (NEMA-L5-20R to NEMA-5-20P)	-
Power Distribution	P049-010	10-ft. 12AWG Heavy Duty Power cord (IEC-320-C19 to NEMA 5-20P)	-

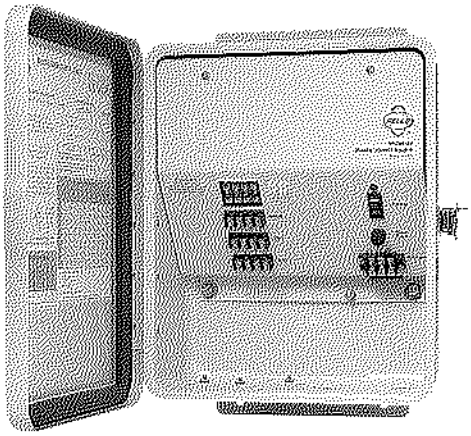
More information, including related products, owner's manuals, and additional technical specifications, can be found online at www.tripplite.com/en/products/model.cfm?txtModelID=3023.

WCS Series Power Supply

24 VAC POWER SUPPLY, OUTDOOR

Product Features

- 4 A or 20 A Capacities
- 1–4 Outputs
- Selectable Input Voltage
- 24 VAC Output or 28 VAC Output for Longer Wire Runs
- Meets NEMA Type 4X/IP66 Standards for Weatherproof Enclosure
- AC Power Indicator with Power On/Off Switch
- Compatible with Cameras, Domes, and Pan/Tilts
- WCS4-20B Has Class 2 Rated Outputs



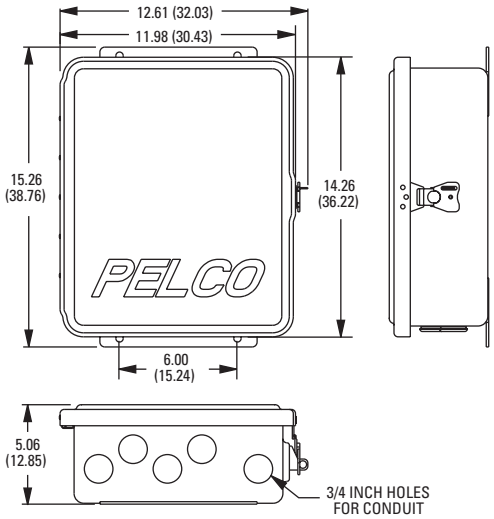
WCS4-20/WCS4-20B

Power supplies in the **WCS Series** offer a variety of configurations for powering up to four outdoor units from a single power source.

The power supplies provide 24 VAC output for 1–4 units, depending on the model selected. To compensate for voltage losses over long wire runs, 28 VAC outputs are available on all models. The input voltage of all models is also selectable.

For integrated systems such as Spectra® and Esprit®, the power supplies are capable of handling pan/tilt, heater, and blower operation in addition to the camera.

The **WCS1-4** has one fused output and is capable of handling up to 4 A (100 VA) of total load. The WCS4-20 has four fused outputs and is capable of handling up to 20 A (480 VA) of total load. The **WCS4-20B** has four protected outputs with self-resetting circuit breakers and is capable of handling up to 12 A (288 VA) of total load. Fuses provide a greater degree of protection for the unit because they are faster acting and more precise. Circuit breakers will self-reset when the fault is corrected, eliminating the need for replacing fuses. However, the amount of current required to trip a circuit breaker can vary as much as 100 percent, depending on temperature. In the fused models, the values of fuses can be changed depending upon the specific current requirements of the equipment connected.



NOTE: VALUES IN PARENTHESES ARE CENTIMETERS; ALL OTHERS ARE

TECHNICAL SPECIFICATIONS

MODELS

WCS1-4	Outdoor camera power supply, 100/120/240 VAC input. One 24/26/28 VAC output, total current capacity of 4 A (100 VA).
WCS4-20	Outdoor multiple camera power supply, 120/240 VAC input. Four fused 24/28 VAC outputs, total current capacity of 20 A (480 VA).
WCS4-20B	Outdoor multiple camera power supply, 120/240 VAC input. Four protected 24/28 VAC outputs, total current capacity of 12 A (288 VA) with circuit breakers.

Product Capacity Chart

A partial list of compatible products and the number of units that may be powered by each power supply are listed below. Capacity is based on the VA rating of each product to be used with the power supply.

Product	Power Supply Model		
	WCS1-4 (100 VA)	WCS4-20 (480 VA)	WCS4-20B (288 VA)
CCD Camera (12 VA max)	1	4	4
Indoor Spectra (25 VA)	1	4	4
Outdoor Spectra (70 VA)	1	4	4
Outdoor DF5 (62 VA)	1	4	4
Esprit (70 VA)	1	4	4

MECHANICAL

Cable Entry	Hole plugs for 0.75-inch (1.9 cm) conduit
Latch	Stainless steel link-lock latch; can be secured with padlock (not supplied)

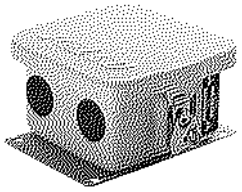
ELECTRICAL

Input Voltage	
WCS1-4	100/120/240 VAC, 50/60 Hz
WCS4-20/WCS4-20B	120 or 240 VAC, 50/60 Hz
Output Voltage	
WCS1-4	24/26/28 VAC
WCS4-20, WCS4-20B	24/28 VAC
Required Input Current	
WCS1-4	1 A
WCS4-20/WCS4-20B	4.40/2.30 A
Output Fuse Ratings	
WCS1-4	4 A*
WCS4-20	8 A*
Output Circuit Breaker Ratings	
WCS4-20B	3A*
Input Connectors	Screw-type barrier strips
Output Connectors	Screw-type barrier strips; WCS4-20B is suitable for Class 2 wiring
Input Wire Size	12–16 gauge solid wire
Output Wire Size	
WCS1-4	16–20 gauge solid or stranded wire
WCS4-20/-20B	16–22 gauge solid or stranded wire

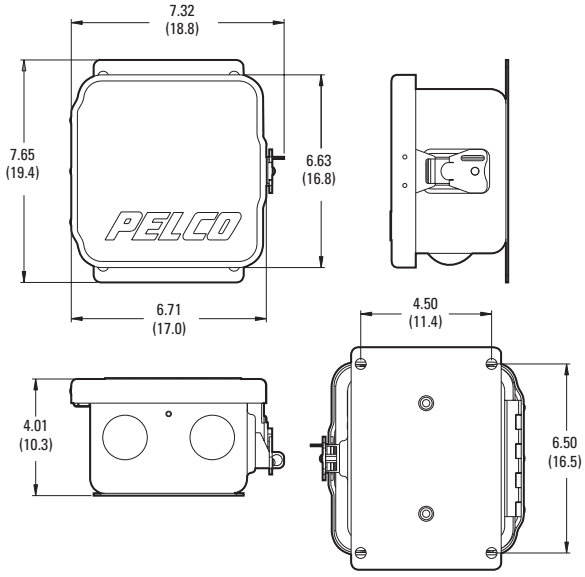
GENERAL

Environment	Outdoor	
Operating Range	–50° to 122°F (–45.56° to 50°C)	
Construction	Aluminum	
Finish	Gray polyester powder coat	
Weight	Unit	Shipping
WCS1-4	6.8 lb (3.1 kg)	8 lb (3.6 kg)
WCS4-20/4-20B	16.2 lb (7.3 kg)	18 lb (8.1 kg)

*Individual output cannot exceed this rating, and the total of all outputs cannot exceed the overall rating of the power supply (refer to *Models*).



WCS1-4 POWER SUPPLY



NOTE: VALUES IN PARENTHESES ARE CENTIMETERS; ALL OTHERS ARE INCHES.

The following are the recommended maximum distances (transformer to load) and are calculated with a 10 percent voltage drop. (Ten percent is generally the maximum allowable voltage drop for AC-powered devices.) Distances are calculated in feet; values in parentheses are meters.

Recommended Wiring Distance Chart

Input Voltage	Total VA Consumed	Wire Gauge					
		20 AWG (0.5 mm²)		18 AWG (1.0 mm²)		16 AWG (1.5 mm²)	
24 VAC	25	113	(34)	180	(55)	287	(87)
	50	56	(17)	90	(27)	143	(43)
	70	41	(12)	64	(19)	102	(31)
26 VAC	25	133	(40)	212	(64)	337	(103)
	50	66	(20)	105	(32)	168	(51)
	70	49	(15)	78	(24)	124	(38)
28 VAC	25	155	(47)	246	(75)	392	(119)
	50	77	(23)	122	(37)	195	(59)
	70	55	(17)	88	(27)	135	(41)

CERTIFICATIONS/RATINGS

- CE
- UL/cUL Listed
- Meets NEMA Type 4X and IP66 standards

Pelco, Inc. Worldwide Headquarters:
3500 Pelco Way, Clovis, California 93612-5699 USA
USA & Canada Tel: (800) 289-9100 • FAX: (800) 289-9150
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www.pelco.com

DTK-DP4P Series

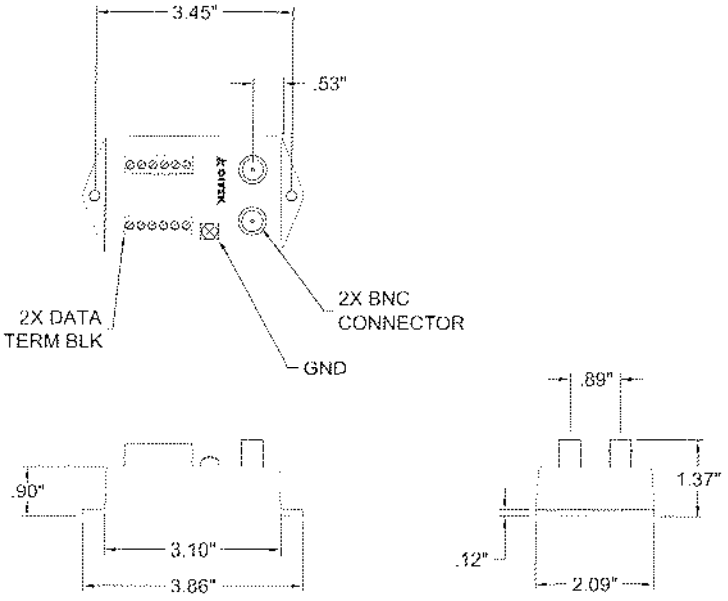
Pan/Tilt/Zoom Camera Surge Protector
General Product Specifications

DITEK's DP4P protects all the sensitive feeds to critical Pan/Tilt/Zoom cameras, not just the video cable. Simple to install, the DP4P protects 24 Volt power conductors, 5 Volt RS-422 data pairs, and video conductors – all in one compact package. With the lowest video let through voltage (and best surge protection) on the market, the DP4P provides ideal surge protection for today's sensitive, sophisticated PTZ cameras. Three different DP4P models protect coaxial, twisted pair, or Balun video circuits. The DP4PBP includes passive Balun conversion.

DTK-DP4P
DTK-DP4PBP
DTK-DP4PTPV

Product Features

- Protects power, video and four data conductors in one package
- 5 Amp, 24V circuit protects power feeds to camera, heater, blower, defroster
- Multi-stage, SAD technology, hybrid design provides the best possible protection
- Single point ground improves protection and speeds installation
- Protect standard Coax (DP4P), Balun (DP4P BP), or Twisted Pair (DP4PTPV) video connections
- Ten Year Limited Warranty



Product Selector

- Coax connected PTZ camera: **DTK-DP4P**
- Balun connected PTZ camera: **DTK-DP4PBP**
- Twisted pair video PTZ camera: **DTK-DP4PTPV**

One DITEK Center
1720 Starkey Road
Largo, FL 33771

1-800-753-2345 Direct: 1-727-812-5000
Technical Support: 1-888-472-6100
www.ditekcorp.com

Document: SPS-100061-001 Rev 5 05-11

DTK-MRJ45C5E

Gigabit Ethernet Surge Protection
General Product Specifications

DITEK's MRJ45C5E protects the data lines to vital business equipment. Its low voltage clamping protects sensitive 5 Volt data circuits. All four pairs are protected. The MRJ45C5E is suitable for use on data networks, network appliances, IP Video cameras, Point of Sale terminals, DSL lines, and any other piece of networked equipment.

DTK-MRJ45C5E
Product Features

- Protects all four pairs
- RJ45 connection with external grounding screw
- Multi-stage, SAD technology, hybrid design provides the best possible protection
- Conforms to EIA/TIA standards for data transmission
- Automatically resets to protect against multiple surges

Specifications

Standards Compliance: EIA/TIA568A, EIA/TIA568B
Connection Method: RJ45 In/Out, 8 pins
Data rate: Gigabit Ethernet (using all four pairs)
Service Voltage: <5V
MCOV: 6.5V
Surge Current Capacity: 268 A/pair (10/1000µs impulse)
Max Continuous Current: 0.3A
Attenuation: -1dB per pair (maximum)
Near End Crosstalk: -39.3dB per pair (maximum)
Protection Modes: Line-Ground (All)
Operating Temperature: -40°F - 158°F (-40°C - 70°C)
Maximum Humidity: 95% non-condensing
Dimensions: 1.7" x 3.0" x 1.2"
(43mm x 76mm x 30mm)
Weight: 4oz (113g)
Housing: ABS
Warranty: Ten Year Limited Warranty

Options & Complementary Products

- **DTK-MRJ45C5EGP** – RJ45 surge protector with receptacle ground pin, Gigabit Ethernet data rate

- **DTK-MRJ45DSL** – Business or Residential DSL line protection. Specifications are same as the DTK-MRJ45C5E with the following exceptions:
  - **Service Voltage**: <105V
  - **MCOV**: 150V
  - **Surge Current Capacity**: 100 A/pair
  - **Max Continuous Current**: N/A

- **DTK-RM12C5** – Gigabit Ethernet, 12-port 110 In/RJ45 Out, 1U rack mount surge protector

- **DTK-RM16C5** – Gigabit Ethernet, 16-port RJ45 In/Out, 2U rack mount surge protector

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Doc. Number: SPS-100042-003 Rev 7 02-11

DATASHEET

AXIS 243Q Blade Video Server

Full frame rate, high-density video encoder.

- > Full frame rate
- > High-quality, de-interlaced video
- > Simultaneous MPEG-4 and Motion JPEG
- > Video motion detection and pre-/post-alarm buffer
- > Support for PTZ and dome cameras

AXIS 243Q Blade Video Server is a high performance, four-channel video encoder blade enabling four analog cameras to be integrated into an IP-based video surveillance system. The video encoder is the ideal choice for casinos, airports, traffic surveillance and prisons – where the advantages of networked video are required as added benefits to analog surveillance systems.

AXIS 243Q Blade Video Server enables high resolution, full frame rate video surveillance and remote monitoring in MPEG-4 or Motion JPEG on all four channels. The video encoder converts analog video into high quality, de-interlaced digital video, and can deliver the highest resolution, 4CIF, at 30/25 (NTSC/PAL) frames per second.

AXIS 243Q Blade Video Server in combination with Axis video encoder racks are specially made for applications involving a large number of cameras. Axis video encoder rack offers flexibility and support for an expanding video surveillance system.

Offering high-resolution professional video surveillance and remote monitoring, the AXIS 243Q Blade offers a number of advanced features, such as video motion detection, active tampering alarm, and alarm buffering. Pre- and post-image alarm buffering secures images just before and after an alarm.

AXIS 243Q Blade Video Server connects to all leading brands of video analog pan/tilt/zoom (PTZ) cameras to allow for easy operation of these PTZ cameras across the IP network.

42212/EN/R1/1105

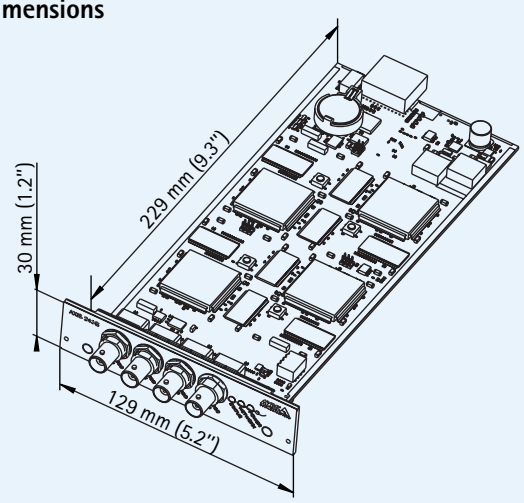
Technical specifications – AXIS 243Q Blade Video Server

Video encoder	
Models	AXIS 243Q Blade Video Server Requires Axis video encoder rack
Video compression	MPEG-4 Part 2 (ISO/IEC 14496-2) Motion JPEG
Resolutions	704x576 to 160x120
Frame rate MPEG-4	Up to 30/25 (NTSC/PAL) per channel in all resolutions
Frame rate Motion JPEG	Up to 30/25 (NTSC/PAL) per channel in all resolutions
Video streaming	Simultaneous MPEG-4 and Motion JPEG Controllable frame rate and bandwidth VBR/CBR MPEG-4
Image settings	Compression, color Rotation: 90°, 180°, 270° Aspect ratio correction Text and image overlay Privacy mask Deinterlace filter
Network	
Security	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control
Supported protocols	IPv4/v6, HTTP, HTTPS, QoS layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

More information is available at www.axis.com

System integration	
Application Programming Interface	Open API for software integration, including VAPIX® from Axis Communications available at www.axis.com
Intelligent video	Video motion detection, active tampering alarm
Alarm triggers	Intelligent video, external inputs, video loss, on boot, PTZ preset
Alarm events	File upload via FTP, HTTP and email Notification via email, HTTP and TCP External output activation
Video buffer	9 MB pre- and post-alarm per channel
Pan/Tilt/Zoom	Wide range of analog PTZ cameras supported (drivers available for download at www.axis.com) 20 presets/camera, guard tour, PTZ control queue Supports Windows compatible joysticks
General	
Processor and memory	4x ETRAX 100LX, 4x ARTPEC-2, 4x 32 MB RAM, 4x 8 MB Flash
Power	Powered from AXIS 291 1U Video Server Rack or AXIS Q7900 Rack
Connectors	4 analog composite video BNC input, NTSC/PAL auto-sensing RJ-45 10BASE-T/100BASE-TX Terminal block for 4 inputs, 4 outputs and RS-485 half duplex
Operating conditions	0 – 45 °C (32 – 113 °F) Humidity 20 – 80% RH (non-condensing)
Approvals	EN 61000-6-1, EN 61000-6-2, EN 55024, EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, FCC Part 15 Subpart B Class B, AS/NZS CISPR 22, ICES-003, VCCI Class B, ITE, UL EN 60950-1
Weight	270 g (0.6 lbs)
Included accessories	Installation Guide, CD with installation and management tools, software and User's Manual, 1 Windows decoder user license

Dimensions



Required hardware

AXIS Q7900 Rack

AXIS 291 1U Video Server Rack

Optional accessories

AXIS T8310 Video Surveillance Control Board

For information on AXIS Camera Station and video management software from Axis' Application Development Partners, see www.axis.com/products/video/software/

DATASHEET

AXIS 291 1U Video Server Rack

Full frame rate, high-density video encoder rack solution.

- > High density
- > 1U 19" industry standard rack
- > 3 expansion slots for video encoder blades
- > Built-in universal power supply
- > Compatible with all Axis Blades

AXIS 291 1U Video Server Rack is a high-density solution for seamless and professional installation of video encoders. AXIS 291 1U is designed for expanding applications and is ideal for airports, hotels and train stations – premises where analog cameras are already installed.

AXIS 291 1U Video Server Rack combines high reliability and functionality with quick, flexible and professional installation. The rack is designed to migrate from 4 to 18 analog cameras into high performance, IP-based, digital solutions, using only one Ethernet port.

AXIS 291 1U is designed for applications that need to be able to expand, not only by adding more channels, but also by using different types of cameras.

AXIS 291 1U is a 19" video encoder rack that holds up to 3 interchangeable and hot-swappable blades. Together with the video encoder blades, this rack provides MPEG-4 and Motion JPEG video at 25/30 frames per second at up to 4CIF resolution on all channels simultaneously. AXIS 291 1U can also provide H.264, dependent on the blade version.

The video encoder enables pan/tilt/zoom control over the network of all leading brands of analog video cameras on the market.

42220/EN/R1/1105

Technical specifications – AXIS 291 1U Video Server Rack

291 1U Video encoder rack	
Expansion slots	3 slots for Axis video encoder blades
Casing	Metal casing for standalone or rack mounting
Power	100 – 240 V AC, 1.9 A max 80 W (with 3x243Q)
Connectors	Ethernet 10BASE-T/100BASE-TX/1000BASE-T, RJ-45 (Gigabit Ethernet) 3 terminal blocks: 4 alarm inputs 4 outputs RS-485/422 half-duplex

Operating conditions	0 – 45 °C (32 – 113 °F) Humidity 20 – 80% RH (non-condensing)
Approvals	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, EN 61000-6-1, EN 61000-6-2, FCC Part 15 Subpart B Class B, VCCI Class B, AS/NZ CISPR 22, ICES-003, ITE, UL, cUL, EN 60950-1, CB-certificate, KTL
Weight	3.7 kg (8.2 lbs) excluding blades
Included accessories	Installation Guide, mounting kit, AC power cable

More information is available at www.axis.com

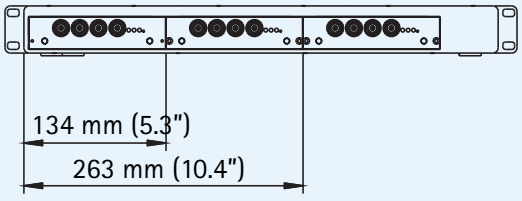
Compatible video encoder blades

Blade	No. of channels	Video compression*	Frames per second in max. resolution	External inputs/outputs	PTZ support
AXIS Q7406	6	H.264	Multiple streams at 30/25 in D1 per channel	8 configurable	•
		Motion JPEG			
AXIS 243Q	4	MPEG-4	30/25 in 4CIF per channel	4/4	•
		Motion JPEG			
AXIS 241Q	4	MPEG-4	21/17 in 4CIF using 1 channel, 20/17 in CIF per channel using 4 channels	4/4	•
		Motion JPEG	30/25 in 4CIF using 1 channel, 30/25 in CIF per channel using 4 channels		
AXIS 240Q	4	Motion JPEG	6/5 in 4CIF per channel	4/4	•
AXIS 241S	1	MPEG-4	21/17 in 4CIF, 30/25 in 2CIF	4/4	•
		Motion JPEG	30/25 in 4CIF		

*H.264 is also known as MPEG-4 Part 10/AVC. In the table, MPEG-4 refers to MPEG-4 Part 2.

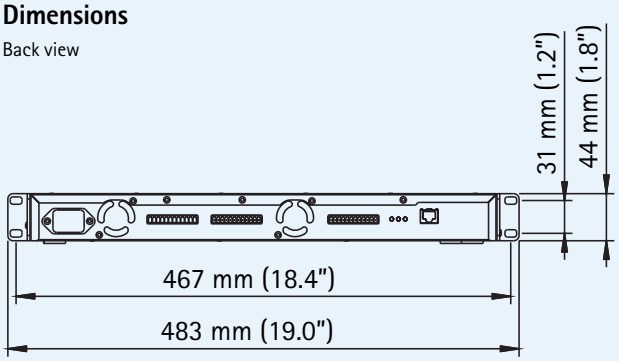
Dimensions

Front view



Dimensions

Back view



DSC POWERSERIES CONTROL PANELS v4.2

DSC is a recognized leader in the design and manufacturing of reliable, feature-rich intrusion alarm control panels that easily integrate with an array of alarm communicators, verification modules and cabling solutions. From their clean unobtrusive look to their advanced technologies, DSC panels are a favorite of both users and installers.

ENHANCE YOUR CUSTOMERS' EXPERIENCE WITH THE NEW, EASY-TO-INSTALL POWERSERIES™ V4.2 FROM DSC

New PowerSeries v4.2 control panels from DSC make installation easy, simple and fast. They feature template programming for new users and a programming interface that experts will be familiar with. This product also features independent end-of-line (EOL) configuration that makes installation faster than ever before. Each zone can be independently matched to a devices EOL configuration, reducing the time required to get a common EOL configuration across all devices.

PowerSeries v4.2 gives the user more control, thereby enhancing the functional experience. The user can Arm Away, Arm Stay or Disarm all partitions with just one operation.

If you're worried about scalability, don't be. PowerSeries v4.2 doubles the supported wireless zones on the PC1616 which allows up to 32 wireless zones.

PowerSeries v4.2 has been designed with commercial applications in mind. Featuring additional user codes, global arming and disarming, and scheduled auto arming and disarming, DSC control panels are the preferred choice of installers.

This product is RoHS compliant

RoHS 2002/95/EC

DSC®

DSC POWERSERIES CONTROL PANELS **V4.2**

PowerSeries™ control panels have a proven reputation for providing the value and dependability that security professionals expect. The modular design of PowerSeries control panels provides both versatility and flexibility in any application, from small residential to medium-sized commercial. Packed with features, they are easy to install, easy to program and easy to use.

New Features of the PowerSeries v4.2

- Up to 3 Times More User Codes
  - PC1616 increases from 32 to 48
  - PC1832 increases from 32 to 72
  - PC1864 increases from 32 to 95
- Duress and Supervisory Code Attributes
- Template Programming
- PC1616 Supports 32 Wireless Zones
- Auto Connect PC-Link
- Automatic Arm/Disarm
- Holiday Schedules
- Zone Bypass Reporting Codes
- Global Away Arm Function Key
- Global Stay Arm Function Key
- Global Disarm Function Key
- Independent Zone End of Line Configuration
- 24Hr Non-Latching Tamper Zone
- Identification of 1st Zone-in Alarm
- Scheduled DLS Batch Upload
- Telephone Line Monitored (TLM) Troubles Reporting Code sent via T-Link

Configurable Features

- Enable Latching or Non-Latching Troubles
- User Option [*][6] Accessible by all Users
- Keyswitch Disarming During Entry Delay
- Keyswitch Arms in Away Mode
- Access Code Required for Zone Bypass [*1], View Troubles [*2] and Alarm Memory [*3]
- Master Code Bypasses Hold-up Zones Only
- Trouble Beeps are Silent (Excluding Fire)
- Account Code Follows Phone Number
- Residential Dial Does Not Require Handshake

New PGMs

- Zone Follower PGM Supported by all 64 Zones
- Tamper Output Timer
- Hold-Up Output
- Battery Test Output
- Alternative Communicator Output
- Open After Alarm (Abort Code)
- Away Armed with no Zone Bypasses Status Output

PowerSeries Features

Features	PC1616	PC1832	PC1864
On-Board Zones	6	8	8
Hardwired Zones	16 (1 x PC5108)	32 (3 x PC5108)	64 (7 x PC5108)
Wireless Zones	32	32	32
Keypad Zone Support	Yes	Yes	Yes
On-Board PGM Outputs	PGM 1 = 50 mA PGM 2 = 300 mA	PGM 1 = 50 mA PGM 2 = 300 mA	PGM 1, 3, 4 = 50 mA PGM 2 = 300 mA
PGM Expansion	8 x 50 mA (PC5208) 4 x 500 mA (PC5204)	8 x 50 mA (PC5208) 4 x 500 mA (PC5204)	8 x 50 mA (PC5208) 4 x 500 mA (PC5204)
Keypads	8	8	8
Partitions	2	4	8
User Codes	47+ Master Codes	71+ Master Codes	94+ Master Codes
Event Buffer	500 Events	500 Events	500 Events
Battery Required	4 Ah / 7 Ah / 14 AHr	4 Ah / 7 Ah / 14 AHr	4 Ah / 7 Ah / 14 AHr
Bell Output	12 V / 700 mA (cont)	12 V / 700 mA (cont)	12 V / 700 mA (cont)

CP-01 Compliant

All PowerSeries control panels are compliant with the Security Industry Association (SIA) CP-01 standard. As more and more cities begin to incorporate this standard into their alarm ordinances for new installations, the occurrence of invalid alarm activations will be significantly reduced or eliminated.

Specifications

Power Supply ..... 16.5 VAC/40 VA @ 50/60 Hz
Current Draw (Panel) ..... 110 mA (Nominal)
Auxiliary + Output ..... 13.75 ± 5% VDC/700 mA
Bell Output ..... 13.75 ± 5% VDC/700 mA
Operating Environment ..... 32° to 120° F (0° to 49° C)
Relative Humidity 93%

Ordering Information:

PC1616 ..... PowerSeries 6-16 Zone Control Panel
PC1832 ..... PowerSeries 8-32 Zone Control Panel
PC1864 ..... PowerSeries 8-64 Zone Control Panel

P/N 30000798 Printed in Canada

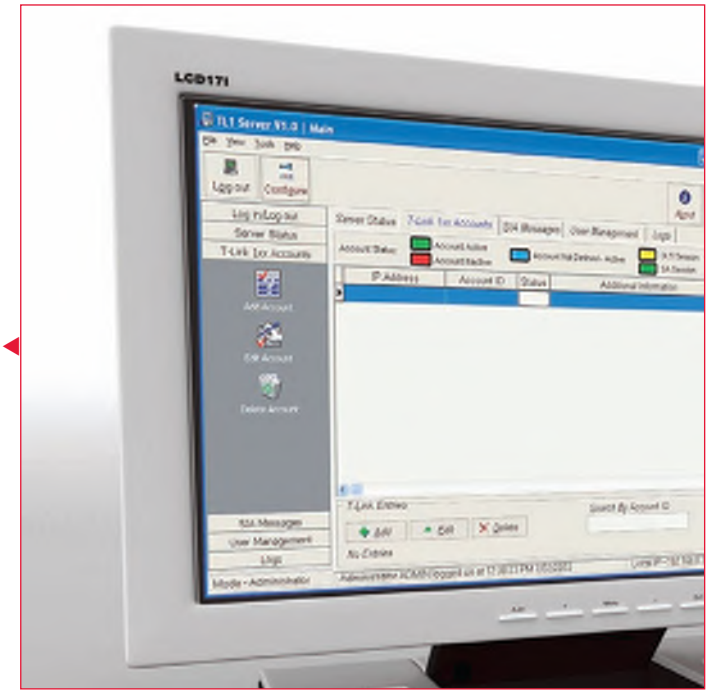
DSC

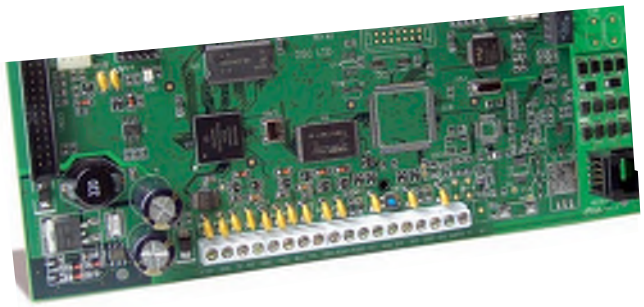
For product information
www.dsc.com

DSC T-Link™ Internet Alarm Communicator

TL250

T-Link TL250 Internet alarm communicators create fully supervised security solutions between protected premises and central monitoring stations. The simple-to-install modules save end-users money by taking advantage of their existing networks to provide secure Internet communications over a private network (LAN/WAN) or the Internet, between the control panel and the Sur-Gard™ System II/III central station receivers. This method provides flexibility and an always-on, two-way line of communication. The TL250 communication stream is small and requires only a limited amount of network bandwidth. This ensures that the integrity of the data being transferred never becomes compromised. To reduce security risks, the TL250 utilizes industry-leading, 128-bit AES encryption, polling and hardware substitution protection.





Product Features:

- Supported by PC1864, PC1832, PC1616, Power864™ and MAXSYS® control panels via built-in PC-Link, or stand-alone mode for all other control panels
- 2-way, always-on IP communication
- Works over local LAN/WAN network or the Internet
- 128-bit AES encryption (NIST approved)
- Supports DHCP (dynamic IP addresses)
- Reports events to 2 different receiver IP addresses
- Polling and hardware substitution protection
- Programmable heartbeat timer allows you to adjust the interval that the heartbeat signal is sent from the TL250 module to the central station IP receiver
- Low network bandwidth requirements
- Compatible with 10/100BaseT networks
- 4 on-board programmable inputs (expandable to 12 using PC5108 zone expander module)
- 2 programmable voltage outputs
- Programmable through the panel keypad or T-Link Console software
- Software upgrades via network
- Download control panel via Internet with DLS2002SA software
- UL AA High-Line Security and ULC Level 3/4/5 listed

DSC T-Link™ Internet Alarm Communicator

TL250

Value Added

To ensure dependable and timely event notification, the TL250 is capable of reporting to two different receiver IP addresses—a back-up feature that allows communication to continue in the event one of the IP addresses is inaccessible. The TL250 can also be programmed to communicate events to two different e-mail addresses. These e-mail addresses can be associated with a personal computer, pager, enabled mobile phone or PDA.

Flexibility

Programming the TL250 can be accomplished locally using the control panel keypad or T-Link Console software over the IP network connection made directly to TL250's Ethernet port.

By interfacing to TL250's four on-board programmable inputs, the unit can be configured to operate as a stand-alone communicator for interfacing existing third-party control equipment. Full two-way communication with the TL250 is achieved using the Sur-Gard System II or the Sur-Gard System III and its IP line card, the SG-DRL3-IP.

Secure Communication

The TL250 utilizes industry-leading 128-bit AES encryption, polling, hardware substitution protection, and application-specific hardware to help eliminate security risks.

Because the TL250 communication stream is minimal and draws only small amounts of network bandwidth, data transfer remains timely and accurate.

Ordering Information:

TL250	Internet Alarm Communicator
PC5108	8 Hardwire Zone Expander

DLS2002SA Download Software

Simple installation of the TL250 is assured through utilization of the built-in PC-Link and T-Link Console software. Administration of accounts can be accomplished over the Internet from anywhere in the world using DLS2002SA download software—no other software application is required.

Software updates can be downloaded remotely from any personal computer as the hardware platform of the TL250 features flash upgradeable memory.

Compatibility

The TL250 is compatible with the following control panels via the built-in PC-Link:

- PC1864 PowerSeries 8-64 zone control panel
- PC1832 PowerSeries 8-32 zone control panel
- PC1616 PowerSeries 6-16 zone control panel
- Power864 PC5020 (version 3.2 or higher)
- MAXSYS PC4020 (version 3.31 or higher)

Direct trigger inputs of the TL250 can be controlled by outputs on any control panel.

Central station IP receivers:

- Sur-Gard System III with SG-DRL3-IP line card
- Sur-Gard System II

Specifications

Dimensions	3.25" x 5.25" (83 mm x 133 mm)
Input Voltage	12 VDC
Current Draw	250 mA (275 mA with PGM or PC5108)
Operating Environment	32° to 120° F (0° to 49° C)
Relative Humidity	5% to 93%

P/N 29007074 R003 Printed in Canada

Distributed by:

tyco / Fire & Security

DSC

For product information
www.dsc.com

DSC GSM Universal Wireless Alarm Communicator
GS3060

The GS3060 GSM universal wireless alarm communicator can be used in a backup or primary role.

The GS3060 connects the alarm control panel to the GSM network and reports alarm signals directly to a monitoring station receiver (Sur-Gard™ System II/System III). The GS3060 uses the GPRS data channel of the GSM network to ensure low-cost, high-speed and reliable alarm communications and is compatible with control panels that communicate using the Contact ID format.

Product Features:

- Compatible with control panels that communicate using the Contact ID format
- Full event reporting
- Uses GPRS data channel for high-speed, reliable and low-cost communications to an IP receiver
- 4 on-board inputs
- 4 on-board outputs (open collector)
- SIM card (included)
- Activation and initialization via automated telephone activation system (VRU) or web-user interface provided by CONNECT 24™
- Panel transmission monitors capability
- Compatible with Sur-Gard System II/III monitoring station receivers
- UL/ULC listed

How it Works

The GS3060 is installed between the telephone connection of a control panel and telephone line. When used in a backup role, the communicator assesses the connection to the PSTN phone line, and if that has failed, it then connects to the GSM network to send an alarm signal to the monitoring station. In a primary role, the communicator simply sends the alarm transmission over the GSM network immediately.

Alarm signals are transmitted directly to the IP linecard of the monitoring station receiver (Sur-Gard System II/System III) without the need of clearinghouse involvement.

Activating & Initializing the Unit

Activating and initializing the GS3060 can be done using the automated telephone activation system (VRU) or web-user interface provided by CONNECT 24. No special tools are required.

Advance Panel Transmission Monitoring

The GS3060 can intelligently monitor the panel transmission and switch over to the GSM network when the phone line is down. This function will occur for both traditional POTS and newer digital technologies (i.e. VoIP).

UL Listing

The GS3060 has been listed by UL for Residential Fire and Burglary and Commercial Burglary installations. The device has been investigated under the requirements of UL985, UL1023 and UL1610 standards.

Rate Plan

Cost-effective rate plans have been negotiated and are available through authorized master resellers. Contact your monitoring station or visit www.connect24.com to find a master reseller.

Specifications

Dimensions	$8^{14/16"}$ x $5^{1/2"}$ x $2^{3/16"}$ (225 mm x 138 mm x 55 mm)
Input Voltage	13.8 VDC
Current Draw	(Jumper ON) . . . .700 mA (Jumper OFF) . . .100 mA
Operating Environment	40° to 104° F (5° to 40° C)
Weight	29 oz (900 g)

Ordering Information:

GS3060 USA	GSM Universal Wireless Alarm Communicator (U.S. Model/SIM Card Included)
GS3060 CDN	GSM Universal Wireless Alarm Communicator (Canadian Model/SIM Card Included)

P/N 30000793 R001 Printed in Canada

DSC

For product information
www.dsc.com

DSC POWERSERIES™ KEYPADS

PK5500 **PK5516** **PK5501** **PK5508**
RFK5500 **RFK5516** **RFK5501** **RFK5508**

PowerSeries high-quality, slim-profile keypads use advanced plastics technology to achieve a clean, unobtrusive look that homeowners welcome and installers will appreciate for their easy programming and installation. The keypads feature an input/output terminal that can be programmed to operate as a zone input, programmable output or as a low temperature sensor. The keypads also include adjustable backlit keys that address low-light situations and five programmable keys for simple one-button activation of system functions. PK5500/ RFK5500 64-zone full-message keypads support eight languages, global partition status and full, 32-character programmable phrases.

Features Common to all Keypads:

- Modern, slim-line landscape keypad
- Large, backlit keypad buttons
- 5 programmable function keys
- Input/Output terminal can be programmed to operate as a zone input, programmable output or as a low temperature sensor
- Individual FAP keys
- Multiple door chime per zone
- Adjustable backlight and keypad buzzer
- Available in black or white bezels
- Wire channel
- Dual wall-mount and front cover tamper
- Easy-to-install mounting hinge
- Surface or single-gang box mount

DSC

DSC POWERSERIES™ KEYPADS

Easy To Use

To simplify usage, the keypads feature five programmable keys for easy one-button activation of system functions. The default tasks assigned to the five function keys are stay arming, away arming, door chime, smoke detector reset and quick exit. With the quick exit function there's no need to disarm and rearm the system every time an occupant leaves the house or lets the dog out, for example.

Integrated Temperature Sensor

The keypads' integrated temperature sensor can be programmed to activate when room temperature dips below 43° F (6° C) and restores at 47° F (8° C). Built-in logic prevents the panel from cycling in and out of alarm mode during minor temperature fluctuations, helping to reduce false alarms.

Flexibility

RF versions of the keypads are available. They include all of the same features as their hardwired equivalents and are able to support 32 wireless zones and 16 wireless keys without taking up a wireless zone slot.

Compatibility

The keypads are compatible with all PowerSeries control panels.

Specifications

Dimensions . . . . . 6 1/16" x 4 7/16" x 13/16"
(154 mm x 113 mm x 20.5 mm)

LCD Viewable Area . . . . . 3 9/10" x 15/16"
(99 mm x 24 mm)

Current Draw . . . . . 125 mA (Max)

Voltage . . . . . 12 VDC Nominal

Operating Environment . . . . . 32° to 120° F
(0° to 49° C)

Relative Humidity . . . . . 5 to 93%

Ordering Information:

PK5500	64-Zone Full-Message Keypad
RFK5500	Wireless 64-Zone Full-Message Keypad
PK5501	64-Zone LCD Picture ICON Keypad
RFK5501	Wireless 64-Zone LCD Picture ICON Keypad
PK5516	16-Zone LED Keypad
RFK5516	Wireless 16-Zone LED Keypad
PK5508	8-Zone LED Keypad
RFK5508	Wireless 8-Zone LED Keypad

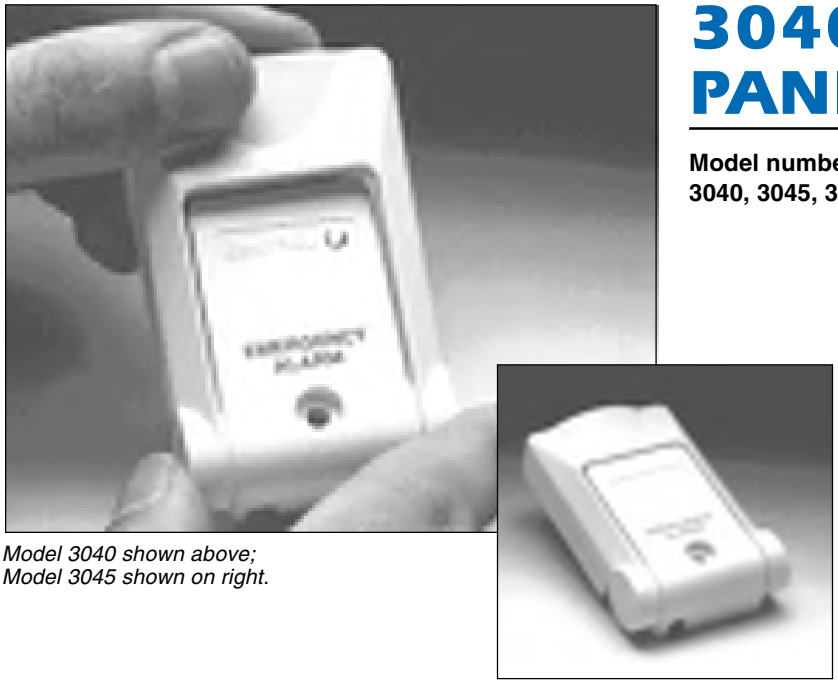
P/N 30000364 R002 Printed in Canada

Distributed by:

tyco / Fire & Security

DSC

For product information
www.dsc.com



Model 3040 shown above;
Model 3045 shown on right.

3040 SERIES PANIC SWITCH

Model numbers:
3040, 3045, 3050, 3055

- **Easy installation**
- **Latching LED and non-LED models available**
- **3050 and 3055 feature glowing LED for low light visibility**

The Sentrol 3040 Series Panic Switch activates the SPDT switch (SPST on the 3045 model) when the user pulls the actuating lever. On the 3040 model, an external LED lights and latches, indicating that the alarm circuit has been activated. The lever is closed first to rearm the alarm switch, then the latching LED circuit is reset externally at the host panel. The 3045 model has no LED or latching circuit.

The 3050 and 3055 feature a glowing LED for low light visibility. The LED glows green when powered up, turns red upon activation. The 3050 contains a latching LED, the 3055 is non-latching.

Applications

Mounted out of sight but within easy reach for manual activation, such as under desks or counters in banks, jewelry stores and other facilities where people or property are at risk. The 3045 and 3055 models can be used in residential installations when a panic switch is needed. Models with the LED and latching circuit, can be used as a panic switch in medical care facilities. All models provide low-profile and reliable alarm protection.

continued

Sentrol 3040 Series Panic Switch

Architect and Engineering Specifications

The unit consists of a housing that contains the electrical circuitry and magnetic reed contacts, a cover plate to protect the internal electronics and an actuating lever with an Alnico V magnet installed in a cradle in the lever. When the lever is fully closed, the magnet — in proximity to the reed — triggers the circuit. The alarm occurs when the actuating lever is moved 20° to 45° past the fully closed position (approximately 1" from the fully closed position). On the latching models, an LED on the unit flashes and latches when the lever is opened. It can be reset only at the alarm panel.

The actuating lever, housing and cover plate are made of ABS fire-retardant plastic. Dimensions of the unit are 1.77" W x 2.90" L x 0.76" H (4.50 cm W x 7.37 cm L x 1.93 cm H). The unit has 12 feet of jacket lead. The device mounts to the surface with two No. 6 combo-head screws, 5/8" and 1 1/4". Available in white.

Specifications:

Model 3040, 3050, 3055

Nominal Voltage ..... 12 V DC @ 6 mA
Current ..... Max 8 mA
Operational Voltage ..... 7 V DC to 15 V DC
Temperature Range ..... 0° to 110°F (-17.8°C to 43.3°C)
Dimensions ..... 1.77" W x 2.90" L x 0.76" H
(4.50 cm W x 7.37 cm L x 1.93 cm H)
Weight ..... 1.5 oz.
Housing Material ..... ABS plastic

Form C: 3040 only

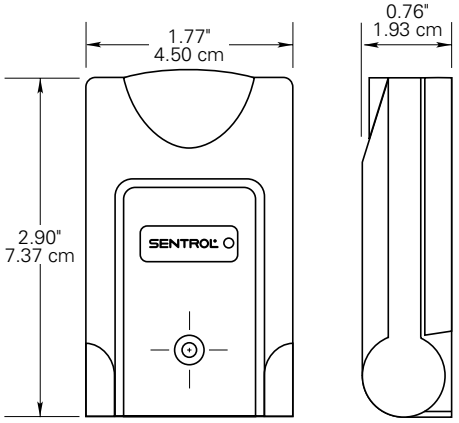
Voltage: ..... 30 V
DC max.Current: ..... 0.25 A max.
Power: ..... 3 W max.

Model 3045

Temperature Range ..... -40° to 150°F (-40°C to 65.6°C)
Dimensions ..... 1.77" W x 2.90" L x 0.76" H
(4.50 cm W x 7.37 cm L x 1.93 cm H)
Weight ..... 1.5 oz.
Housing Material ..... ABS plastic

Form A: 3045 only

Voltage: ..... 100 V DC max.
Current: ..... 0.5 A max.
Power: ..... 7.5 W max.



3040, 3050, 3055
(No LED on 3045)

Ordering Information

Model Number	LED	Latching Circuit	Electrical Loop Type	Configuration	Color
3040	Red	Yes	Open or Closed	SPDT	White
3045	None	No	Closed	SPST	White
3050	Bi-color	Yes	Open or Closed	SPDT	White
3055	Bi-color	No	Open or Closed	SPDT	White

SENTROL

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Tel.: 503.692.4052 Fax: 503.691.7566
http://www.sentrol.com
U.S. & Canada: 800.547.2556
Technical Service: 800.648.7424
FaxBack: 800.483.2495

C-3813-FG5k-0599

BOSCH
Invented for life

ISM-BLP1 Blue Line PIR Detector

- **11 m x 11 m (35 ft x 35 ft) broad coverage**
- **EN50131-2-2 Grade 2 compliant**
- **First Step Processing (FSP)**
- **Flexible mounting height from 2.3 m to 2.7 m (7.5 ft to 9 ft)**
- **No range or height adjustments required**
- **Installation-friendly two-piece design**
- **Easy wiring access with plug-in terminals**
- **Draft and insect immunity**
- **Eight detection layers including optional look-down zone**
- **Temperature compensation**

The ISM-BLP1 Detector uses a high-density (77 zone) Fresnel lens designed to produce sharply-focused images throughout the field of view providing superior response to intruders. Easy installation and flexible mounting options provide state-of-the-art detection.

Functions

Signal Processing

First Step Processing (FSP) almost instantly responds to human targets without producing false alarms from other sources. FSP adjusts the detector's sensitivity based on signal amplitude, polarity, slope, and timing. This eliminates the need for the installer to select the sensitivity level.

Test Features

The externally-visible alarm LED can be disabled after installation.

Draft and Insect Immunity

The sealed optical chamber prevents drafts and insects from affecting the detector.

Temperature Compensation

The detector adjusts its sensitivity so that it can identify human intruders at critical temperatures.

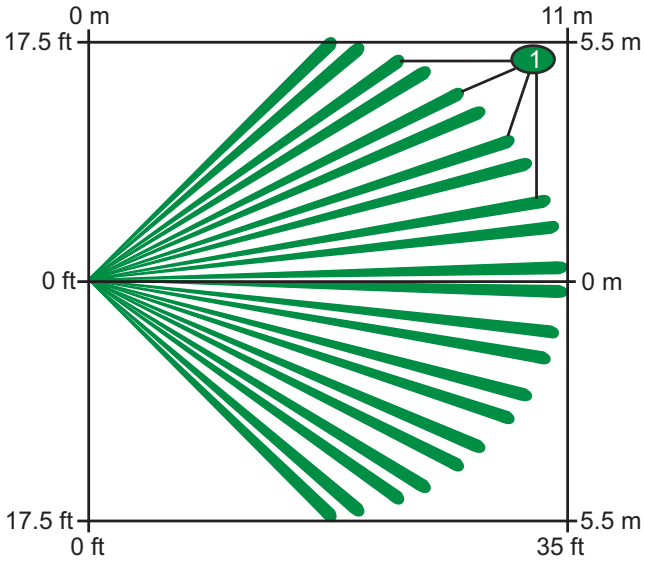
Certifications and Approvals

Region	Certification	
Europe	CE	2004/108/EC EMC Directive (standards: EN55022:2006; EN50130-4:1996 +A1:1998 +A2:2003; EN60950-1:2006)
	EN50131	EN 50131-1, TS 50131-2-2 August 2004, EN 50130-4, EN 50130-5
Belgium	INCERT	B-509-0009/a B-509-0009/b
Russia	GOST	IEC 60839-1-3-2001, IEC 60839-2-2-2001, IEC 60839-2-6-2001, GOST 26342-84, GOST 27990-88 GOST 12997-84, GOST R 50009-2000, GOST R 51317.3.2-99, GOST R 51317.3.3-99, GOST R MEK 60065-2002
USA	UL	ANSR: Intrusion Detection Units (UL639), ANSR7: Intrusion Detection Units Certified for Canada (cULus)
Italy	IMQ	
France	AFNOR	NF, A2P (262262-00)
Sweden	INTYG	05-132; SBSC larmklass 3, miljöklass 2

Australia	C-tick
Ukraine	IEC 60839-1-3-2001, IEC 60839-2-2-2001, IEC 60839-2-6-2001, GOST 26342-84, GOST 27990-88
Europe	Complies with EN50131-2-2 Grade 2

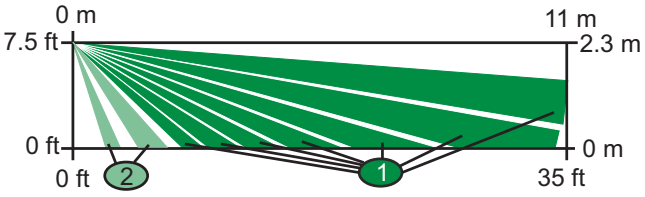
Installation/Configuration Notes

Coverage Patterns



Top View Broad: 11 m x 11 m (35 ft x 35 ft)

1 PIR coverage pattern



Side View Broad: 11 m x 11 m (35 ft x 35 ft)

1 PIR coverage pattern 2 Two look-down zones

Mounting

The recommended mounting height is 2.3 m to 2.7 m (7.5 ft to 9 ft).

The detector can be mounted:

- On a flat wall (surface, semi-flush) with the optional B335 Swivel-mount Bracket, or with the optional B328 Gimbal-mount Bracket,
- In the junction of two perpendicular walls, or
- On the ceiling with the optional B338 Ceiling-mount Bracket.

Note The use of optional mounting brackets can reduce the detector's range and increase the dead zone areas.

Power Considerations

Power Limits

Input power must be provided by an Approved Limited Power Source. All outputs must be connected to SELV (safety extra-low voltage) circuits only.

Standby Power

This detector has no internal standby battery. *For UL Listed product installations, 4 hr (40 mAh) of standby power must be supplied by the control unit or by a UL Listed burglary power supply.*

Parts Included

Quant.	Component
1	Detector
1	Hardware pack
1	Literature pack

Technical Specifications

Environmental Considerations

Designed to comply with EN50131-2-2 Environmental Class II, Security Grade 2

Relative Humidity:	0 to 85%, non-condensing
Temperature (operating):	-29°C to +49°C (-20°F to +120°F) *For UL Listed product installations, 0°C to +49°C (+32°F to +120°F)*

Mechanical Properties

Color:	White
Dimensions:	10.7 cm x 6.1 cm x 4.8 cm (4.2 in. x 2.4 in. x 1.9 in.)
Material:	High-impact ABS plastic
Radio Frequency Interference (RFI) Immunity	No alarm or setup on critical frequencies in the range from 26 MHz to 950 MHz at field strengths less than 50 V/m.

Outputs

Digital Alarm:	5 V normally, grounded for 4 sec during alarm.
Relay:	Solid state, supervised, Form A normally-closed (NC) contacts rated for 125 mA, 28 VDC, 3 W.
Tamper:	Normally-closed (NC) contacts (with cover on) rated at 28 VDC, 125 mA maximum. Connect tamper circuit to 24-hour protection circuit.

Power Requirements

Current (Alarm):	18 mA
Current (Standby):	10 mA maximum at 12 VDC
Voltage (Operating):	10 VDC to 14 VDC

Ordering Information

ISM-BLP1 Blue Line PIR Detector Produces sharply-focused images throughout the field of view providing superior response to intruders	**ISM-BLP1**
Accessories	
ISM-BLA1-CC Blue Line Color Camera Module (NTSC format) NTSC format	**ISM-BLA1-CC-N**
ISM-BLA1-CC Blue Line Color Camera Module (PAL format) PAL format	**ISM-BLA1-CC-P**
ISM-BLA1-LM Blue Line Nightlight Module Fits all Blue Line detectors	**ISM-BLA1-LM**
ISM-BLA1-SM Blue Line Sounder Module Fits all Blue Line detectors	**ISM-BLA1-SM**
B328 Gimbal-mount Bracket Mounts on a single-gang box and allows rotation of a detector. Wires are hidden inside.	**B328**
Swiveling B335-3 low-profile mount Swiveling, low-profile, plastic mount for wall mounting. The vertical swivel range is +10° to -20°, while the horizontal swivel range is ±25°. Available in triple packs.	**B335-3**
B338 Universal Ceiling-mount Bracket Swiveling plastic mount for ceiling mounting. The vertical swivel range is +7° to -16°, while the horizontal swivel range is ±45°.	**B338**

Americas:
Bosch Security Systems, Inc.
130 Perinton Parkway
Fairport, New York, 14450, USA
Phone: +1 800 289 0096
Fax: +1 585 223 9180
security.sales@us.bosch.com
www.boschsecurity.us

Europe, Middle East, Africa:
Bosch Security Systems B.V.
P.O. Box 80002
5600 JB Eindhoven, The Netherlands
Phone: + 31 40 2577 284
Fax: +31 40 2577 330
emea.securitysystems@bosch.com
www.boschsecurity.com

Asia-Pacific:
Robert Bosch (SEA) Pte Ltd, Security Systems
11 Bishan Street 21
Singapore 573943
Phone: +65 6258 5511
Fax: +65 6571 2698
apr.securitysystems@bosch.com
www.boschsecurity.com

Represented by

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BOSCH
Invented for life

DS938Z and ZX938Z Series Panoramic PIR Detectors

- **Motion Analyzer II processing**
- **Motion Monitor**
- **Self-test supervision systems**
- **Changeable mirrors**
- **360° x 18 m (60 ft) diameter pattern**
- **2.5 m to 6 m (8 ft to 18 ft) mounting height**

These ceiling mount, 18 m (60 ft) panoramic PIR Detectors use Motion Analyzer II processing to reduce false alarms. The series consists of the:

- DS938Z Panoramic Detector
- ZX938Z Panoramic Detector with POPIT

Several unique self-test features, including Motion Monitor, provide coverage integrity. Field replaceable mirrored optics allow them to be mounted on ceilings from 2.5 m to 6 m (8 ft to 18 ft) in height.

Functions

Motion Analyzer II Processing

Motion Analyzer II uses multiple thresholds and timing windows to analyze timing, amplitude, duration, and polarity of signals to make an alarm decision. It will not alarm on extreme levels of thermal and illumination disturbances caused by heaters and air conditioners, hot and cold drafts, sunlight, lightning, and moving headlights. Provides three sensitivity settings.

PIR Supervision

PIR supervision provides trouble output in the event that PIR circuitry fails.

Motion Monitor

Switch-selectable four or thirty day Motion Monitor supervision timers provide the detector with the ability to verify that there is a clear view of the protection area and that it has not been blocked.

Test Features

Three externally visible high output alarm LEDs visible from any angle, flash to indicate trouble condition. Internal noise voltage test pins provide precise pattern location and background disturbance evaluation using a standard analog meter.

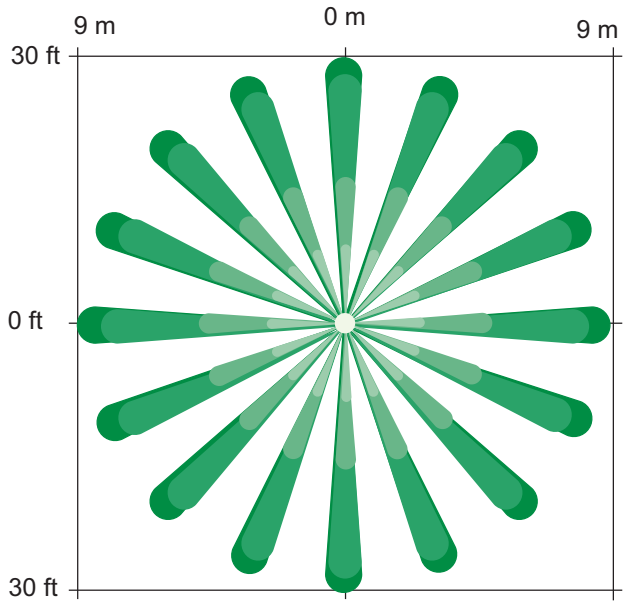
Certifications and Approvals

Region	Certification	
Europe	CE	DS938Z, DS938Z-CHI, and DS938Z-FRA: 89/336/EEC, EN55022: 1998 +A1: 2000 +A2: 2003, EN50130-4: 1996 +A1: 1998 +A2: 2003, EN61000-4-2: 1995 +A1: 1998 +A2: 2001, EN61000-4-3: 2002 +A1: 2003, EN61000-4-4: 1995 +A1: 2000 +A2: 2001, EN61000-4-5: 1995 +A1: 2001, EN61000-4-6: 1996 +A1: 2001 +A2: 2001, EN61000-4-11:1994 +A1: 2001, EN60950-1: 2001 +A11: 2004
Poland	TECHOM	DS938Z: 98/07 Klasy "C"
USA	UL	DS938Z: ANSR: Intrusion Detection Units (UL639) ZX938Z: ANSR: Intrusion Detection Units (UL639)
China	CCC	DS938Z: 2002031901000002 DS938Z-CHI: 2004031901000036
Sweden	INTYG	DS938Z only: 04-683

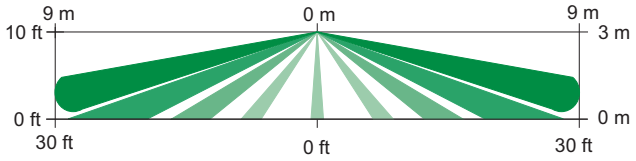
These detectors have also been designed to meet the requirements of:

Europe	DS938Z complies with EN50131-1, Grade 2	
France	AFNOR	NF, A2P

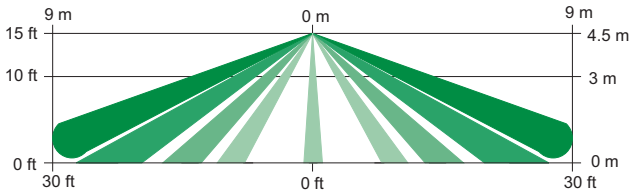
Installation/Configuration Notes



Top View
360° x 18 m (60 ft) diameter



AR8-13 Side View
360° x 18 m (60 ft) diameter



AR13-18 Side View
360° x 18 m (60 ft) diameter

Technical Specifications

Enclosure Design

Material:	High impact ABS plastic enclosure
Dimensions:	8.4 cm x 13.3 cm (3.3 in. x 5.25 in.)

Environmental Considerations

Operating Temperature:	-29°C to +49°C (-20°F to +120°F) *For UL Listed Applications,* *0°C to + 49°C (+32°F to +120°F)*
Radio Frequency Interference (RFI) Immunity:	No alarm or setup on critical frequencies in the range from 26 MHz to 950 MHz at 50 V/m.
DS938Z:	Complies with Environmental Class II (EN50130-5)

Mounting

Height (recommended):	2.5 m to 6 m (8 ft to 18 ft)
Location:	Mounts directly to ceiling or to standard octagonal electrical box.
Internal Pointability:	Coverage is adjustable ±10° horizontally, +2° to -18° vertically.

Outputs (DS models)

Alarm:	Form C reed relay at 3.0 W, 125 mA at 28 VDC for resistive loads
Tamper:	Normally-closed. Contacts rated at 28 VDC, 125 mA maximum.

Outputs (ZX model)

Alarm:	Signal through POPEX data bus.
Tamper:	Signal through POPEX data bus. Signaled as missing.
Trouble:	Signal through POPEX data bus.

Power Requirements (DS models)

Current:	18 mA at 12 VDC
Voltage:	6 VDC to 15 VDC

Power Requirements (ZX model)

Current:	< 0.5 mA nominal, 2 mA in alarm with LED enabled
Voltage:	Power comes from two-wire POPEX bus.

Note: Do not leave Walk Test LEDs enabled.

Ordering Information

DS938Z Panoramic Detector Provides Motion Analyzer II processing, movable mirrors, and 360° x 18 m (60 ft) diameter coverage.	**DS938Z**
DS938Z-FRA Panoramic Detector For use in France. Provides Motion Analyzer II processing, movable mirrors, and 360° x 18 m (60 ft) diameter coverage.	**DS938Z-FRA**
ZX938Z Panoramic Detector Provides an internal POPIT, Motion Analyzer II processing, movable mirrors, and 360° x 18 m (60 ft) diameter coverage.	**ZX938Z**
Accessories	
AR13-18-3 Optical Module Designed for 4 m (13 ft) to 6 m (18 ft) mounting height. Shipped in packages of three.	**AR13-18-3**
TC6000 Test Cord Test cord for connecting a compatible detector's test pins to a voltmeter. It is 4.6 m (15 ft) long.	**TC6000**

Americas:
Bosch Security Systems, Inc.
130 Perinton Parkway
Fairport, New York, 14450, USA
Phone: +1 800 289 0096
Fax: +1 585 223 9180
security.sales@us.bosch.com
www.boschsecurity.us

Europe, Middle East, Africa:
Bosch Security Systems B.V.
P.O. Box 80002
5600 JB Eindhoven, The Netherlands
Phone: + 31 40 2577 284
Fax: +31 40 2577 330
emea.securitysystems@bosch.com
www.boschsecurity.com

Asia-Pacific:
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11 Bishan Street 21
Singapore 573943
Phone: +65 6258 5511
Fax: +65 6571 2698
apr.securitysystems@bosch.com
www.boschsecurity.com

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Honeywell

FG-1625/1625T

GLASSBREAK DETECTOR

The FG-1625 Glassbreak Detector uses the latest technology to provide faster response and increased false alarm immunity. The FG-1625 is specifically designed to allow fast, easy installation, while the adjustable sensitivity settings can compensate for the acoustics of any room. Optimum operation can be quickly verified using the FG-701 Glassbreak Simulator.

FEATURES

- **FlexCore™ Signal Processor**
  The FlexCore Signal Processor is an Application-Specific Integrated Circuit (ASIC), which processes sound data in parallel rather than sequentially for faster, more accurate detection decisions. The combination of proven FlexGuard® performance with the speed of FlexCore processing provides unmatched false alarm immunity without compromising detection.
- **Easy Installation and Setup**
  Honeywell's patented technology allows remote activation of Test Mode (with simulator). The FG-1625 has a centered wire entry hole, 45° terminal blocks and EOL terminals. A hand-clap feature verifies that the detector is functioning.
- **Selectable Sensitivity**
  Two DIP switches on the FG-1625 make it easy to set the sensitivity to match the acoustics of the room. Four different sensitivity levels are available, ranging from very low to high. The range can then be verified remotely with the FlexGuard FG-701 Glassbreak Simulator.
- **Mount the Detector Anywhere**
  Mounts on any wall, in the window frame, or on the ceiling, with no minimum range and a maximum range of 25' (7.6m) to the glass.
- **Covers All Glass Types**
  The FG-1625 works on all glass types, including plate, tempered, laminated, wired, film-coated and sealed insulating glass.
- **Multiple Domain Signal Analysis**
  The FG-1625 performs Multiple Domain Signal Analysis in which time, frequency and amplitude characteristics are evaluated for signal qualification. This enables the detector to accurately discriminate false alarms from true glassbreak events.
- **Enclosed PC Board**
  The PCB is protected from potential damage during installation.
- **Patented Remote Test Mode**
  The Patented Remote Test Mode can enabled or disable the indicator LEDs using the FG-701 Glassbreak Simulator. The unit automatically resets from Test Mode in five minutes.
- **Mounting Locations**
  The FG-1625 can be mounted on the ceiling, opposite wall, adjoining wall or the same wall as the glass.

FG-1625/1625T

GLASSBREAK DETECTOR

SPECIFICATIONS

Physical Dimensions

- White high impact ABS plastic housing
- 3 7/8" H x 2 2/5" W x 7/8" D (98mm x 62mm x 21.8mm)

Weight

- Product Only: 3.2oz (90g)
- Pkgd Product: 4.1oz (116g)

Range

- 25' (7.6m) maximum, omnidirectional. Range is adjustable; no minimum range

Alarm Relay

- FG-1625: Form A, 125mA max, 25VDC max
- FG-1625T: Form C, 125mA max, 25VDC max

Tamper Switch (FG-1625T only)

- Combination cover/wall tamper 25mA max, 24VDC max

Alarm Duration

- Five seconds (unaffected by alarm LED latching)

ESD Immunity

- 10kV discharges of either polarity to exposed surfaces

Power Requirements

- 6 - 18VDC, 12mA typical at 12VDC; 22mA max (Latched LED)
- AC ripple: 4V peak-to-peak at nominal 12VDC

RFI Immunity

- 30V/m, 10MHz - 1000MHz

Operating Temperature

- 14° to 122° F (-10° to 50° C)
- Storage: -4° to 122° F (-20° to 50° C)

Approvals and Listings

- FCC and IC verified
- CE
- C-Tick
- UL Listed
- ULC Listed

Glass Type/Thickness

Type*	Minimum	Maximum
Plate 3a	2.4mm (3/32")	10mm (3/8")
Tempered	3mm (1/8")	10mm (3/8")
Laminated	3mm (1/8")	14mm (9/16")
Wired	6mm (1/4")	6mm (1/4")
Coated 2,3b	3mm (1/8")	6.4mm (1/4")
Sealed	3mm (1/8")	6mm (1/4")
Insulating 1,3b	(Maximum overall 7/16")	

* Minimum size for all types is 28cm (11") square; glass must be framed in the wall or mounted in a barrier at least 0.9m (36") wide.

1 Protected only if both plates of the unit are broken.

2 Coated glass with security films, including films for solar protection, up to 12mil. thick may be used. Film Technologies International, Inc.'s GLASS-GUARD® GGLL 1200 has been evaluated with this product by Underwriters Laboratories, Inc.

3 In compliance with Underwriters Laboratories of Canada's Standard for Intrusion Detection Units (CAN/ULC-S306-M89):
   a. Plate glass 3mm to 10mm can be used.
   b. ULC recognizes a maximum range for protecting sealed insulated glass and coated glass of 12.5ft. (3.8m).

Note: The FG-1625/1625T detects shattering of framed glass by direct impact. It may not consistently detect breakage by blows that only crack the glass, by high velocity projectiles such as bullets, or glass broken without an impact.

Accessories Description

- FG-701 P/N 0-000-701-0 Glassbreak Simulator

FlexGuard® Glassbreak Simulator/Tester

- The sound of breaking glass is digitally simulated by the FG-701. The FG-701 is compatible for testing all Honeywell glassbreak detectors. Honeywell highly recommends testing glassbreak detectors before final installation.

ORDERING

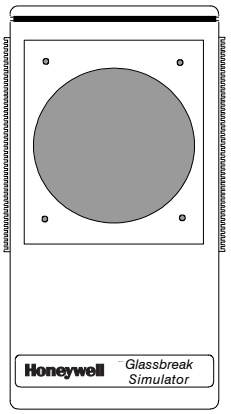
FG-1625	Glassbreak Detector
FG-1625T	Glassbreak Detector with Tamper

Honeywell Security & Custom Electronics
Honeywell International Inc.
PO Box 9035
Syosset, NY 11791
www.honeywell.com

Honeywell

L/FG1625/D
January 2007

Honeywell



OPERATING INSTRUCTIONS

FG-701

Glassbreak Simulator

WARNING: The FG-701 Simulator produces extremely loud sounds and can be hazardous to hearing when used at close range. Never operate the FG-701 with it pointed toward someone's head.

FEATURES

- Digital audio produced glass-break sound
- MANual and FLEX test modes
- Sound activation of test mode for FG-1000 series detectors
- Low battery voice announcement
- Automatic turn-off to conserve battery life
- Compatible with all FlexGuard® glassbreak detectors

OPERATING THE SIMULATOR

Model FG-1000 or higher glassbreak detectors must be activated for testing.

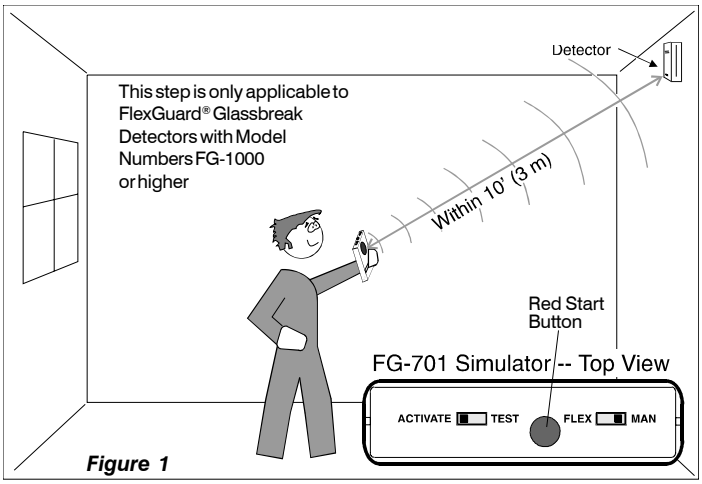


Figure 1

To Activate the Model FG-1000 (or higher) Glassbreak Detector:

1. Install the glassbreak detector in an appropriate location (refer to the detector's installation instructions).
2. Stand within 10' (3 m) of the detector.
3. Set the FG-701 switches to the ACTIVATE and MANual modes (see Figure 1).
4. Aim the front speaker of the FG-701 Glassbreak Simulator at the detector.
5. Press the red start button for the ACTIVATE sound.

The green LED on FG-1000 series detectors will flash rapidly to indicate the detector is in test mode.

Note: Pressing the red button again will deactivate the detector test mode. The FG-1000 series test mode also turns off automatically after ten minutes.

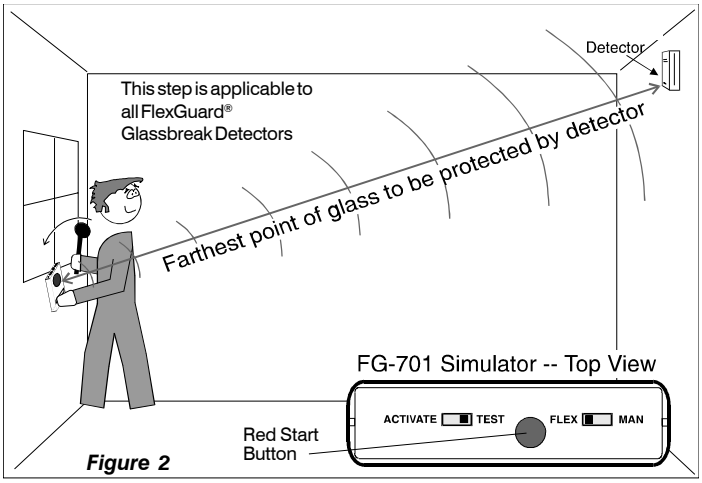


Figure 2

Testing in FLEX mode:

1. Set the FG-701 switches to the TEST and FLEX modes. (See Figure 2.)
2. Press the red start button. The simulator will "click" on and start an eight-second armed period.
3. Position the FG-701 near the farthest point of the protected glass, and point the speaker directly at the glassbreak detector.
4. Generate a flex signal by carefully striking the glass with a cushioned tool. The FG-701 will respond by producing a burst of glass-break audio.

   If both the flex and audio are received properly, the red alarm LED on the detector will light.

After the simulator is triggered by a flex signal, there is a one-second hold-off period during which the FG-701 will not retrigger. This prevents repeated triggering due to continued vibration of the glass.

Successfully triggering the simulator with a flex signal generates a new eight-second armed period. If you do not generate a flex signal within eight seconds, the simulator will automatically "click" off. Press the start button to re-arm the simulator.

The FG-701 may be turned off by either waiting for it to "click" off in FLEX mode, or by selecting MANual mode.

Important: If window coverings are present, close them fully and hold the FG-701 **behind** the window coverings for testing.

Testing in MANual mode:

If the glassbreak detector fails to signal an alarm when testing in the FLEX mode, switch the FG-701 to the MANual mode. This will enable you to determine if the problem is flex or audio detection.

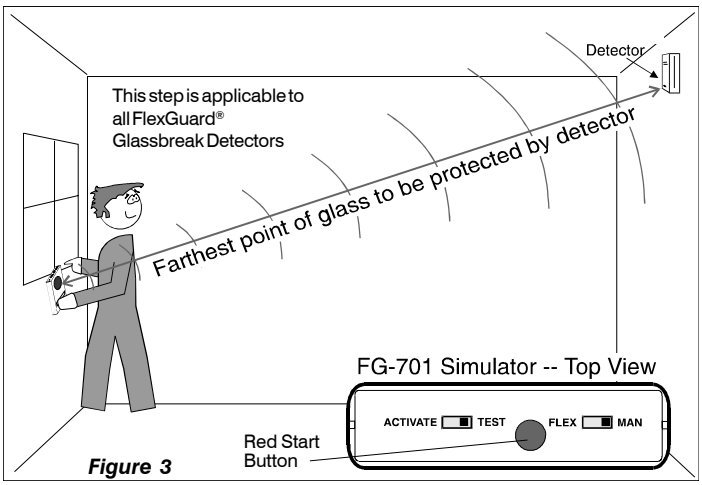


Figure 3

Testing in the MANual Mode (Continued):

1. Set the FG-701 switches to the TEST and MANual modes. (See Figure 3.)
2. Position the FG-701 near the protected glass and point the speaker directly at the glassbreak detector. Watch the green LED on the detector.
3. Press the red start button and the FG-701 will generate a burst of glass-break audio.

   If the LED on the detector flashes, the range is acceptable for audio. If the LED does not flash, move the detector closer to the glass and try again. (On FG-1000 series detectors, the green LED will momentarily turn off.)

TECHNICAL NOTES

When a pane of glass is broken by an impact, many variables affect the sound it produces. Depending on the type of glass, its size and thickness, type of mounting, the breaking instrument, and the force with which it is struck, the sound it produces varies. In addition, the sounds will be modified by absorptive or reflective surfaces in the room where the glassbreak detector is located.

While no simulator can account for all possible conditions, the sound produced by the FG-701 is carefully designed to represent the more difficult cases. The sound is an enhanced digital recording of a small pane of tempered glass broken in a controlled environment. The output level of the simulator is correlated with the original sound to insure an equivalent response in FlexGuard® detectors. In production, the acoustic output is factory-calibrated to insure uniform performance.

Room characteristics greatly affect the apparent detection range indicated by the simulator. In a room with hard walls, floor, and ceiling, the audio range will be much greater than in a room with absorbing surfaces such as carpets and acoustic tiles. This is because hard surfaces reflect the sound back into the room, reinforcing it at points far from the simulator. Actual glassbreak sound is affected in the same way as the simulator sound, since it has the same frequency content and originates from the same location in the room. Thus the audio range achieved with the FG-701 is a good indication of glassbreak detection range, independent of the room characteristics.

In FLEX mode, the low-frequency signal is generated by striking the protected glass. If sufficient flex can be generated by a safe, non-breaking blow to the glass, there is good assurance that an actual break will be detected.

Range indicated by the simulator should be considered the safe detection range for an individual detector. Because of component tolerances, it should not be assumed that a substitute detector will work at the same range. If a detector is changed, the replacement should also be tested with the FG-701.

BATTERY ANNOUNCEMENT

When the battery is low, the simulator sound will be interrupted by the word "BATTERY." The battery should then be replaced.

Use only 9V alkaline batteries. Do not use carbon-zinc or rechargeable Ni-Cd batteries because they don't have sufficient peak power capacity.

PRODUCT SPECIFICATIONS

Temperature Range
Operating: 32° F to 122° F (0° C to +50° C)
Storage: -4° F to +140° F (-20° C to +60° C)

Battery Type:
9V Alkaline, Duracell MN1604 or equivalent

Estimated Battery Life:
2500 operations (MANual mode)

Output Spectral Range:
1.5 - 16 kHz

Output Level:
Peak SPL of 102 dB at 1 meter, on axis

Dimensions:
3.25" W x 6.3" H x 0.9" D (83 mm x 160 mm x 23 mm)

Weight:
8 oz. (.23 kg)

Approvals/listings:
CE
C-Tick

Customers in European Union countries are advised to dispose of this product, at the end of its useful life, as per applicable local laws, regulations and procedures.

To obtain applicable EU compliance Declaration of Conformities for this product, please refer to our Website, http://www.security.honeywell.com/hsce/international/index.html.

For any additional information regarding the compliance of this product to any EU specific requirements, please contact:

Quality Assurance Department,
Honeywell Security & Custom Electronics,
Newhouse Industrial Estate
Motherwell,
Lanarkshire ML1 5SB,
Scotland,
United Kingdom.
Tel: +44(0)1698 738200
Email: UK64Sales@Honeywell.com

Honeywell

5-051-320-00 Rev C

AL600ULXPD16(R), AL600ULXPD16CB(R) Multi-Output Power Supply/Charger

Rev. DSAL600ULXPD16 - B23F

Overview

- These multi-agency approved multi-output power supply/chargers convert a 115VAC/60Hz input to sixteen (16) Class 2 rated 12VDC or 24VDC power limited outputs.

AL600ULXPD16
- Fuses are rated @ 3.5 amp/250V
- Grey enclosure.

AL600ULXPD16R
- Red enclosure

AL600ULXPD16CB
- PTCs are rated @ 2.5 amp.
- Grey enclosure.

AL600ULXPD16CBR
- Red enclosure

Specifications

- 12VDC or 24VDC selectable outputs.
- 6 amp supply current.
- Class 2 Rated power limited outputs.
- Sixteen (16) protected outputs.
- Input 115VAC / 60Hz, 1.9 amp.
- Input fuse rated @ 3.5 amp/250V.
- Filtered and electronically regulated outputs.
- Short circuit and thermal overload protection.
- Built-in charger for sealed lead acid or gel type batteries.
- Maximum charge current .7 amp.
- Automatic switch over to stand-by battery when AC fails (zero voltage drop).
- AC fail supervision (form "C" contacts).
- Low battery supervision (form "C" contacts).
- Battery presence supervision (form “C” contacts).
- AC input and DC output LED indicators.
- Enclosure:
  - Combination knockouts are 1/2” and 3/4”
  - Accommodates up to two (2) 12VDC/12AH batteries.
- Product weight:
  - AL600ULXPD16: 10.3 lbs.
  - AL600ULXPD16R: 8.7 lbs.
  - AL600ULXPD16CB: 10.3 lbs.
  - AL600ULXPD16CBR: 8.7 lbs.
- Shipping weight:
  - AL600ULXPD16: 10.3 lbs.
  - AL600ULXPD16R: 8.7 lbs.
  - AL600ULXPD16CB: 10.3 lbs.
  - AL600ULXPD16CBR: 8.7 lbs.

Agency Approvals

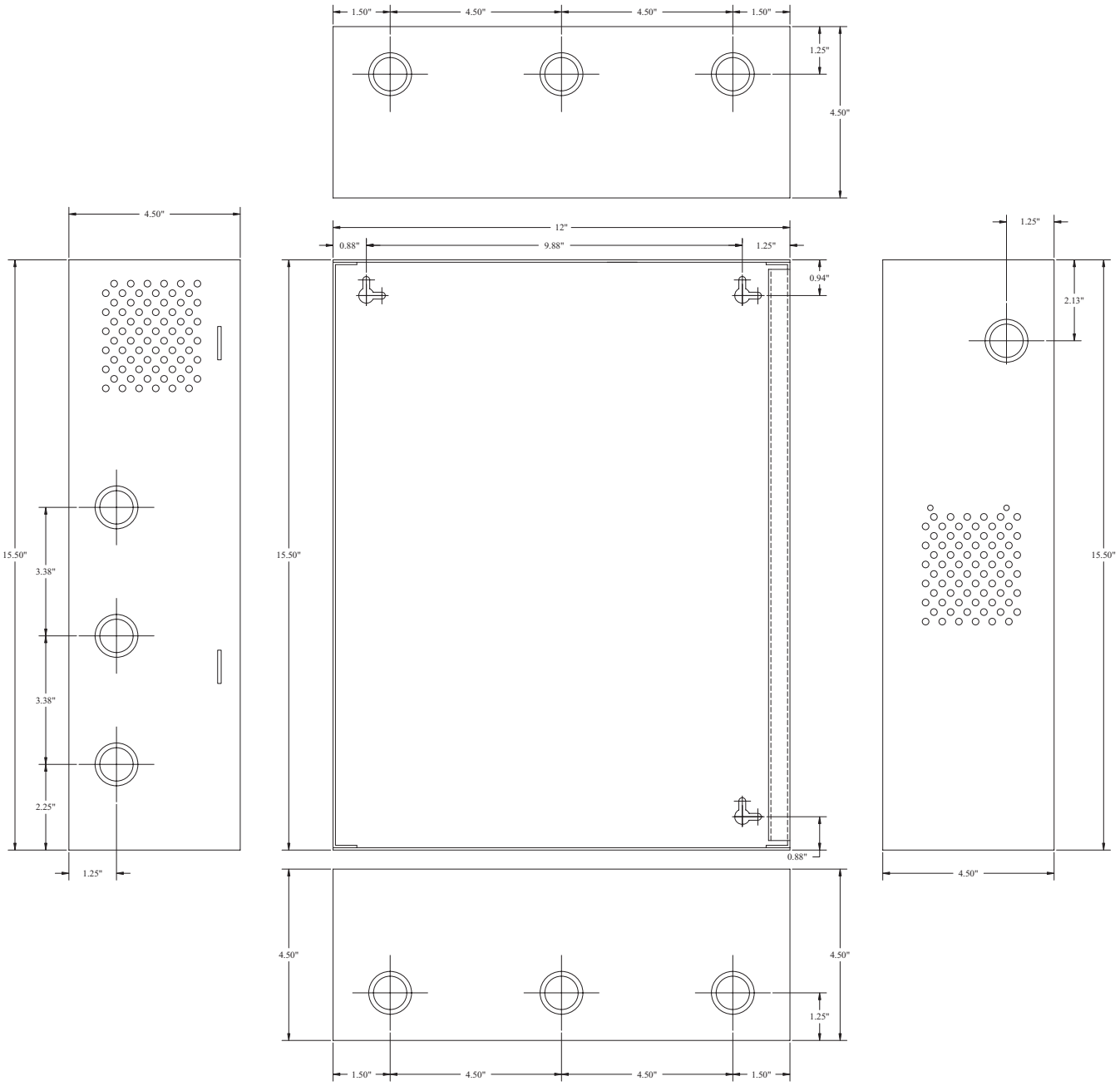
UL 294 — UL Listed for Access Control System Units.

UL 1481 — UL Listed Standard for Safety for Fire Protective Signaling Systems.

CUL Listed - CSA Standard C22.2 No.205-M1983, Signal Equipment.

Enclosure Dimensions

15.5”H x 12”W x 4.5”D



Technical Data Sheet
Plenum Communication Cables

2833 West Chestnut Street
Washington, PA 15301
Toll Free: (800) 245-4964
Fax: (724) 222-6420
www.westpenn-wpw.com

PART NUMBER: **25224B**

DESCRIPTION: 18/2 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Intercom Systems, Security Systems, Sound, Audio, Background Music)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC
Insulation Thickness	0.008" Nom.
Number of Conductors	2
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.154" Nom.
Approximate Cable Weight	17 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	30 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.2 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray, Black, Brown, Orange, Green White, Yellow
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	42 lbs
Min. Bend Radius (Install)	1.4”

Specification Issue Date: 7/06

Standard Lengths are 1000ft.
The Jacket is sequentially footmarked.
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Technical Data Sheet
Plenum Communication Cables

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Toll Free: (800) 245-4964
Fax: (724) 222-6420
www.westpenn-wpw.com

PART NUMBER: **25244B**

DESCRIPTION: 18/4 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Pro Audio, Intercom Systems, Security Systems, Sound, Background Music)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC
Insulation Thickness	0.008" Nom.
Number of Conductors	4
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.180" Nom.
Approximate Cable Weight	32 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	30 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.2 Ohms/1M' Nom.
Insulation Colors	Black, Red, White, Green
Jacket Color	Gray
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	84lbs
Min. Bend Radius (Install)	1.9”

Specification Issue Date: 7/06

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PART NUMBER: **253186B**

DESCRIPTION: 18/6 Stranded bare copper conductors, shielded with an overall jacket.

RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Intercom Systems, Security Systems, Sound, Audio, Background Music)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC
Insulation Thickness	0.008" Nom.
Number of Conductors	6
Shield	100% Aluminum Polyester Foil
Drain	Stranded Tinned Copper
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.221" Nom.
Approximate Cable Weight	50 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	68 pf/ft Nom.
Capacitance Between Conductors to Shield @ 1 KHz	122 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.2 Ohms/1M' Nom.
Insulation Colors	Black, Red, White, Green, Brown, Blue
Jacket Color	Gray
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	141 lbs
Min. Bend Radius (Install)	2.25”

Specification Issue Date: 7/06

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PART NUMBER: **25225B**

DESCRIPTION: 16/2 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums and other spaces used for environmental air for: (Intercom, Security, Sound, Audio, Background music)

Construction Parameters:

Conductor	16 AWG Bare Copper
Stranding	19x29
Insulation Material	PVC
Insulation Thickness	0.008" Nom.
Number of Conductors	2
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.176" Nom.
Approximate Cable Weight	25 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	33 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	4.2 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray, Black, Green
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	54 lbs
Min. Bend Radius (Install)	1.8”

Specification Issue Date: 7/06

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PART NUMBER: **25226B**

DESCRIPTION: 14/2 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CL2P, NEC Article 725

APPROVALS: (UL) or (ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Intercom Systems, Security Systems, Sound, Audio, Background Music)

Construction Parameters:

Conductor	14 AWG Bare Copper
Stranding	19x27
Insulation Material	PVC
Insulation Thickness	0.010" Nom.
Number of Conductors	2
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.218" Nom.
Approximate Cable Weight	36 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	150 V RMS
Max.Capacitance Between Conductors @ 1 KHz	34 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	2.7 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray, Black
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	84 lbs
Min. Bend Radius (Install)	2.25”

Specification Issue Date: 7/06

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Technical Data Sheet
Data Grade RS-485 Cables

WEST PENN WIRE

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PART NUMBER: **D4854**

DESCRIPTION: 4 Pair 24 Awg. Stranded tinned copper conductors, shielded with an overall jacket.

NEC RATING: CM, NEC Article 800

APPROVALS: (UL) Listed

APPLICATION: Indoor data cable for: Computer Application, Low-Capacitance Data.

Construction Parameters:

Conductor	24 AWG Tinned Copper
Stranding	7x32
Insulation Material	Polyolefin
Insulation Thickness	0.035" Nom.
Number of Conductors	8 (4 pair)
Shield	100% Aluminum Polyester Foil
Drain	Stranded Tinned Copper
Jacket Material	PVC
Jacket Thickness	0.032" Nom.
Overall Cable Diameter	0.345" Nom.
Approximate Cable Weight	81 Lbs/1M' Nom.
Flame Rating	UL 1685

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	12.8 pf/ft Nom.
Capacitance Between Conductors to Shield @ 1 KHz	23 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	24 Ohms/1M' Nom.
Velocity of Propagation	66% Nom.
Impedance	120Ω Nom
Insulation Colors	1. Blue- White/Blue, 2. Orange-White/Orange, 3. Green-White/Green, 4. Brown- White/Brown
Jacket Color	Gray
RoHS Compliant	--

Mechanical Properties:

Max. Recommended Pull Tension	110 lbs.
Min. Bend Radius (Install)	3.4”

Specification Issue Date: 7/06

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Technical Data Sheet
Aquaseal® Communication Cables

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PART NUMBER: **AQC224**

DESCRIPTION: 18/2 Stranded bare copper conductors, unshielded with an Aquaseal tape and overall jacket.

NEC RATING: CM or CL3, NEC Article 800 and 725

APPROVALS: (UL) C(UL) Listed, (ETL)us Listed

APPLICATION: Materials suitable for outdoor use, and indoor trays, allows a variety of uses for (Intercom, Security, Sound, Audio, Background music)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC
Insulation Thickness	0.010" Nom.
Number of Conductors	2
Shield	N/A
Drain	N/A
Water-Blocking Tape	2 ply water swellable tape
Jacket Material	Sunlight/Moisture Resistance PVC
Jacket Thickness	0.025" Nom.
Overall Cable Diameter	0.194" Nom.
Approximate Cable Weight	37 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	32pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.2 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	42 lbs.
Min. Bend Radius (Install)	1.9”

Specification Issue Date: 7/06

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Technical Data Sheet
Aquaseal® Fire-Alarm Cables

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PART NUMBER: **AQ244**

DESCRIPTION: 18/4 Stranded bare copper conductors, overall unshielded with Aquaseal tape and overall jacket.

NEC RATING: FPL – PLTC, NEC Article 760 And 725

APPROVALS: (UL) or (ETL)us Listed- Direct Burial

APPLICAT Materials suitable for outdoor use(direct burial), and indoor trays, allows a variety of uses for (Low voltage industrial process control circuits, Power-Limited circuits, Power-Limited fire alarm circuits, Power-Limited tray cable PLTC)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC with Nylon
Insulation Thickness	PVC 0.015" Nom. Nylon .005” Nom.
Number of Conductors	4
Shield	None
Drain	None
Water-Blocking Tape	2 Ply water swellable tape
Jacket Material	Sunlight/ Moisture Resistant PVC
Jacket Thickness	0.040" Nom.
Overall Cable Diameter	0.327" Nom.
Approximate Cable Weight	64 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	25 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.4 Ohms/1M' Nom.
Insulation Colors	Black, Red, Brown, Blue
Jacket Color	Black
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	98 lbs.
Min. Bend Radius (Install)	3.2”

Specification Issue Date: 7/06

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PART NUMBER: **AQC3186**

DESCRIPTION: 18/6 Stranded bare copper conductors, shielded with an Aquaseal tape and overall jacket.

NEC RATING: CM or CL3, NEC Article 800 and 725

APPROVALS: (UL) C(UL) Listed, (ETL)us Listed

APPLICATION: Materials suitable for outdoor use, and indoor trays, allows a variety of uses for (Intercom, Security, Sound, Audio, Background music)

Construction Parameters:

Conductor	18 AWG Bare Copper
Stranding	7x26
Insulation Material	PVC
Insulation Thickness	0.010" Nom.
Number of Conductors	6
Shield	100% Aluminum Polyester Foil
Drain	Stranded Drain Wire
Water-Blocking Tape	2 ply water swellable tape
Jacket Material	Sunlight/Moisture Resistance PVC
Jacket Thickness	0.025" Nom.
Overall Cable Diameter	0.323" Nom.
Approximate Cable Weight	54 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	68 pf/ft Nom.
Capacitance Between Conductors to Shield @ 1 KHz	122 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	6.2 Ohms/1M' Nom.
Insulation Colors	Black, Red, White, Green, Brown, Blue
Jacket Color	Gray
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	141 lbs.
Min. Bend Radius (Install)	3.2”

Specification Issue Date: 7/06

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PART NUMBER: **AQC225**

DESCRIPTION: 16/2 Stranded bare copper conductors, unshielded with an Aquaseal tape and overall jacket.

NEC RATING: CM or CL3, NEC Article 800 and 725

APPROVALS: (UL) C(UL) Listed, (ETL)us Listed

APPLICATION: Materials suitable for outdoor use, and indoor trays, allows a variety of uses for (Intercom, Security, Sound, Audio, Background music)

Construction Parameters:

Conductor	16 AWG Bare Copper
Stranding	19x29
Insulation Material	PVC
Insulation Thickness	0.010" Nom.
Number of Conductors	2
Shield	None
Drain	None
Water-Blocking Tape	2 ply water swellable tape
Jacket Material	Sunlight/Moisture Resistance PVC
Jacket Thickness	0.025" Nom.
Overall Cable Diameter	0.228" Nom.
Approximate Cable Weight	48 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	33 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	4.2 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	54 lbs.
Min. Bend Radius (Install)	2.2”

Specification Issue Date: 7/06

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Technical Data Sheet
Aquaseal ® Fire-Alarm Cables

WEST PENN WIRE

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PART NUMBER: **AQ226**

DESCRIPTION: 14/2 Stranded bare copper conductors, overall unshielded with Aquaseal tape and overall jacket.

NEC RATING: FPL – PLTC, NEC Article 760 And 725

APPROVALS: (UL) or (ETL)us Listed – Direct Burial

APPLICATION: Materials suitable for outdoor use (direct burial), and indoor trays, allows a variety of uses for (Low voltage industrial process control circuits, Power-Limited circuits, Power-Limited fire alarm circuits, Power-Limited tray cable PLTC)

Construction Parameters:

Conductor	14 AWG Bare Copper
Stranding	19x27
Insulation Material	PVC with Nylon
Insulation Thickness	PVC 0.015" Nom. Nylon .005” Nom.
Number of Conductors	2 (1 Pair)
Shield	None
Drain	None
Water-Blocking Tape	2 Ply water swellable tape
Jacket Material	Sunlight/ Moisture Resistant PVC
Jacket Thickness	0.040" Nom.
Overall Cable Diameter	0.310" Nom.
Approximate Cable Weight	59 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	32 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	2.7 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Black
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	84 lbs.
Min. Bend Radius (Install)	2.7”

Specification Issue Date: 7/06

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PART NUMBER: **25221B**

DESCRIPTION: 22/2 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Intercom Systems, Security Systems, Sound, Audio, Background Music)

Construction Parameters:

Conductor	22 AWG Bare Copper
Stranding	7x30
Insulation Material	PVC
Insulation Thickness	0.007" Nom.
Number of Conductors	2
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.116" Nom.
Approximate Cable Weight	11 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	27 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	10.5 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	24 lbs
Min. Bend Radius (Install)	1.4”

Specification Issue Date: 7/06

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PART NUMBER: **25241B**

DESCRIPTION: 22/4 Stranded bare copper conductors, unshielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within ducts, plenums, and other spaces used for environmental air for (Intercom Systems, Security Systems, Sound, Audio, Background Music)

Construction Parameters:

Conductor	22 AWG Bare Copper
Stranding	7x30
Insulation Material	PVC
Insulation Thickness	0.007" Nom.
Number of Conductors	4
Shield	None
Drain	None
Jacket Material	PVC
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.136" Nom.
Approximate Cable Weight	17 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10°C To +60°C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	25 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	16.1 Ohms/1M' Nom.
Insulation Colors	Black, Red, White, Green
Jacket Color	Gray
RoHS Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	36 lbs
Min. Bend Radius (Install)	1.4”

Specification Issue Date: 7/06

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Technical Data Sheet
RG59/U Type CCTV Coaxial Cable

WEST PENN WIRE

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Toll Free: (800) 245-4964
Fax: (724) 222-6420
www.westpenn-wpw.com

PART NUMBER: **25815**

DESCRIPTION: RG59/U – 1 Conductor 20AWG Solid, 95% Bare copper braid and an overall Flex Plenum Jacket.

NEC RATING: CMP

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor within duct, plenum and other spaces used for environmental air for: CCTV

Construction Parameters:

Conductor	20 AWG Bare Copper
Stranding	Solid
Insulation Material	Foam FEP – Teflon
Insulation Thickness	.138” Nom.
Number of Conductors	1 Center Conductor
Shield	95% BC Braid
Jacket Material	Flex Plenum PVC
Overall Cable Diameter	0.207" Nom.
Approximate Cable Weight	30 Lbs/1M' Nom.
Flame Rating	UL NFPA262

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Max. Capacitance Between Conductors @ 1 KHz	16.2 pf/ft Nom.
Velocity of Propagation	82% Nom.
Impedance	75 ohms Nom.
DC Resistance per Conductor @ 20deg C	10.1 Ohms/1M' Nom.
Jacket Color	Ivory
RoHS Compliant	Yes

Mhz	db/100ft
1	.30
10	1.03
50	1.80
100	2.52
400	5.30
700	7.34
1000	8.76

Mechanical Properties:

Max. Recommended Pull Tension	52 lbs.
Min. Bend Radius (Install)	2.1”

Connectors and Accessories

75 ohm BNC Crimp	CN-BM74-32	Crimp Tool: TL-104	Strip Tool: TL-121
1 Pc. Compression BNC 75 ohm	CN-FS59BNCPL4	Comp. Tool: TL-SNSA	Strip Tool: TL-CSST
Compression RCA	CN-FS59RCAPL4	Comp. Tool: TL-SNSA	Strip Tool: TL-CSST

Specification Issue Date: 7/06

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Technical Data Sheet
Data Grade Cables

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PART NUMBER: **D25420**

DESCRIPTION: 2 Pair 22 Awg. Solid tinned copper conductors, individually shielded with an overall jacket.

NEC RATING: CMP, NEC Article 800

APPROVALS: (UL)- C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor data cable for: Control, Signaling, Electronic, Microprocessor Based.

Construction Parameters:

Conductor	22 AWG Tinned Copper
Stranding	Solid
Insulation Material	Teflon
Insulation Thickness	0.012" Nom.
Number of Conductors	4
Shield	100% Aluminum Polyester Foil
Drain	Stranded Tinned Copper
Jacket Material	Copolymer
Jacket Thickness	0.015" Nom.
Overall Cable Diameter	0.185" Nom.
Approximate Cable Weight	24 Lbs/1M' Nom.
Flame Rating	NFPA 262 Flame Test

Electrical & Environmental Properties:

Temperature Rating	-10deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	15.5 pf/ft Nom.
Capacitance Between Conductors to Shield @ 1 KHz	28 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	17.5 Ohms/1M' Nom.
Velocity of Propagation	69% Nom.
Impedance	100Ω Nom
Insulation Colors	1. Black/Yellow, 2. Red/Green
Jacket Color	Gray Tint
RoHS Compliant	--

Mechanical Properties:

Max. Recommended Pull Tension	56 lbs.
Min. Bend Radius (Install)	1.8”

Specification Issue Date: 7/06

Cold Environment Precautions: Due to the nature of PVC Compounds to become non-pliable when stored or handled in ambient temperatures of 32 deg. F or less, we recommend the following:

“Prior to installation, condition the cable for at least 24 hours at room temperature to provide the best flex properties for ease of installation.”

Standard Lengths are 1000ft.
The Jacket is sequentially footmarked.
The information presented here is, to the best of our knowledge, is true and accurate. However, since conditions of use are beyond our control, all recommendations or suggestions are presented without guarantee or responsibility on our part. We disclaim all liability in connection with the use of information contained herein or otherwise.

Technical Data Sheet- Indoor/Outdoor RG59/U Type CCTV Coaxial Cable

WEST PENN WIRE

2833 West Chestnut Street
Washington, PA 15301
Toll Free: (800) 245-4964
Fax: (724) 222-6420
www.westpenn-wpw.com

PART NUMBER: **AQC815**

DESCRIPTION: RG59/U – 1 Conductor 20AWG Solid, 95% Bare copper braid waterblocking tape and an overall Sunlight Resistant PVC Jacket.

NEC RATING: CM, CL2

APPROVALS: (UL) C(UL) Listed or c(ETL)us Listed

APPLICATION: Indoor/Outdoor for: Security Cable - CCTV

Construction Parameters:

Conductor	20 AWG Bare Copper
Stranding	Solid
Insulation Material	Gas Injected Polyethylene
Insulation Thickness	.142” Nom.
Number of Conductors	1 Center Conductor
Shield	95% Bare Copper Braid
Waterblocking Tape	2 Ply
Jacket Material	Sunlight Resistant PVC
Overall Cable Diameter	0.242" Nom.
Approximate Cable Weight	17 Lbs/1M' Nom.
Flame Rating	UL 1685

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Max.Capacitance Between Conductors @ 1 KHz	16.2 pf/ft Nom.
Velocity of Propagation	82% Nom.
Impedance	75 ohms Nom.
DC Resistance per Conductor @ 20deg C	10.1 Ohms/1M' Nom.
Jacket Color	Black
RoHS Compliant	Yes

Mhz	db/100ft
1	.5
10	.68
50	1.80
100	3.0
400	4.71
700	6.40
1000	7.80

Mechanical Properties:

Max. Recommended Pull Tension	41 lbs.
Min. Bend Radius (Install)	2.5”

Connectors and Accessories

75 ohm BNC Crimp	CN-BM74-32	Crimp Tool: TL-104	Strip Tool: TL-121
1 Pc. Compression BNC 75 ohm	CN-CSBNC-59	Comp. Tool: TL-SNSA	Strip Tool: TL-CSST
Compression RCA	CN-CSRCA-59	Comp. Tool: TL-SNSA	Strip Tool: TL-CSST

Specification Issue Date: 7/06

Standard Lengths are 1000ft.
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Technical Data Sheet
Aquaseal® Communication Cables

2833 West Chestnut Street
Washington, PA 15301
Toll Free: (800) 245-4964
Fax: (724) 222-6420
www.westpenn-wpw.com

PART NUMBER: **AQC430**

DESCRIPTION: 2 Pair 22 Awg. Stranded bare copper conductors, individually shielded with an Aquaseal tape and overall jacket.

NEC RATING: CM or CL3, NEC Article 800 and 725

APPROVALS: (UL) C(UL) Listed, (ETL)us Listed

APPLICATION: Materials suitable for outdoor use, and indoor trays, allows a variety of uses for (Intercom, Security, Sound, Audio, Background music)

Construction Parameters:

Conductor	22 AWG Bare Copper
Stranding	7x30
Insulation Material	PVC
Insulation Thickness	0.010" Nom.
Number of Conductors	4 (2 Pair)
Shield	100% Aluminum Polyester Foil
Drain	Stranded Tinned Copper
Water-Blocking Tape	2 ply water swellable each pair Overall 2 Ply water swellable tape
Jacket Material	Sunlight/Moisture Resistance PVC
Jacket Thickness	0.025" Nom.
Overall Cable Diameter	0.380" Nom.
Approximate Cable Weight	29 Lbs/1M' Nom.
Flame Rating	UL 1685 Vertical Tray

Electrical & Environmental Properties:

Temperature Rating	-20deg C to 60deg C
Operating Voltage	300 V RMS
Max.Capacitance Between Conductors @ 1 KHz	55 pf/ft Nom.
Capacitance Between Conductors to Shield @ 1 KHz	99 pf/ft Nom.
DC Resistance per Conductor @ 20deg C	17 Ohms/1M' Nom.
Insulation Colors	Black, Red
Jacket Color	Gray
RoHS Compliant	--
TIA455-82B Water Infiltration Test Compliant	Yes
UL 444 & 13 Compliant	Yes

Mechanical Properties:

Max. Recommended Pull Tension	58 lbs.
Min. Bend Radius (Install)	3.8”

Specification Issue Date: 7/06

Standard Lengths are 1000ft.
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PANDUIT®

PRODUCT BULLETIN

Hook and Loop Cable Ties

The comprehensive family of hook and loop cable ties delivers reliability by protecting against over-tensioning of high performance fiber and copper cables. These ties are adjustable, releasable, and reusable to effectively support frequent moves, adds, and changes (MACs). A wide range of designs, sizes, and colors provides flexibility and an aesthetically pleasing appearance.

Key Features	Benefits
Soft hook and loop material	**Reliability** – Safe way to effectively bundle cables while maintaining network data integrity by protecting against over-tensioning; minimal installation time; no tools required
Releasable design	**Scalability** – Adjustable, releasable, and reusable to accommodate frequent moves, adds, and changes (MACs) which supports evolving changes to equipment and cabling for future growth; supports rapid deployment
Wide range of designs, sizes, and colors	**Aesthetics** – Allows design flexibility and provides a professional, finished appearance
Plenum rated styles	UL listed cable ties can be safely applied in plenum or air handling spaces per NEC, Section 300-22 (C) and (D)
Comprehensive product offering	Supports a wide range of applications; allows maximum installation flexibility

TAK-TY® **Loop Ties**
Slot allows for pre-wrapping of bundles

TAK-TY® **Strip Ties**
Rolls perforated in convenient 6", 12" or 18" strips

TAK-TY® **Stacked Strips**
Eliminates cutting and staging 7" Strips (100 pieces)

TAK-TY® **Rolls**
Lengths: 15' and 75' can be cut to any length

TAK-TY® **Cable Ties – Plenum-rated**
UL Listed loop style and strip style

ULTRA-CINCH™ **Ties**
Cinch ring provides extra strength

ULTRA-CINCH™ **Ties**
Grommet styles for mounting applications

TAK-TAPE™ **Rolls**
General purpose fastener

- Soft, premium material is safe to use on high performance cabling
- Adjustable, releasable, and reusable up to hundreds of times
- Broad selection of durable designs and sizes
- Select ties are UL listed for use in plenum or air handling spaces (such as ceiling voids and under floor areas) per NEC, Section 300-22 (C) and (D); flammability rating: UL 94V-2
- A full range of colors; see Color Chart on page 4

Rack application
X-Out for #10 Truss Head Screw
Loop Tie: HLT2I-X0

Available in eight colors

Ordering Information

Overhead application
Continuous rolls
HLS-15R6

Convenient packaging (100 pcs.)
HLB2S-CO

Underfloor (Plenum application)
HLSP3S-X12
HLTP3I-X12

Rack application
Continuous rolls
HLS-15R10, HLS-15R6

Part Number	Length In.	Length mm	Width In.	Width mm	Max. Bundle Dia. In.	Max. Bundle Dia. mm	Min. Loop Tensile Str.* Lbs.	Min. Loop Tensile Str.* N	Std. Pkg. Qty.	Std. Ctn. Qty.
Loop Ties – Slot allows for pre-wrapping of bundles; X-Out allows for use with #10 truss head screw										
HLT2I-X0	8.0	203	.500	12.7	1.91	49	40	178	10	100
HLT3I-X0	12.0	305	.500	12.7	3.18	81	40	178	10	100
UL Listed Loop Ties (Maroon) for plenum applications										
HLTP2I-X12	8.0	203	.500	12.7	1.91	49	40	178	10	100
HLTP3I-X12	12.0	305	.500	12.7	3.18	81	40	178	10	100
UL Listed Loop Ties (Black) for plenum applications										
HLTP2I-X0	8.0	203	.500	12.7	1.91	49	18	80	10	100
HLTP3I-X0	12.0	305	.500	12.7	3.18	81	18	80	10	100
Strip Ties – Perforated in convenient 6", 12", and 18" strips										
HLS1.5S-X0	6.0	152	.750	19.1	1.50	38	50	222	10	100
HLS3S-X0	12.0	305	.750	19.1	3.20	81	50	222	10	100
HLS5S-X0	18.0	457	.750	19.1	5.00	127	50	222	10	100
NEW! **Stacked Strip Ties – Eliminates cutting ties to length and staging them for each job Rounded edges for installer safety - 100 pcs.**										
HLB2S-C0	7.0	178	.750	19.1	1.60	41	50	222	1	10
UL Listed Strip Ties (Maroon) for plenum applications										
HLSP1.5S-X12	6.0	152	.750	19.1	1.50	38	50	222	10	100
HLSP3S-X12	12.0	305	.750	19.1	3.20	81	50	222	10	100
HLSP5S-X12	18.0	457	.750	19.1	5.00	127	50	222	10	100
UL Listed Strip Ties (Black) for plenum applications										
HLSP1.5S-X0	6.0	152	.750	19.1	1.50	38	18	80	10	100
HLSP3S-X0	12.0	305	.750	19.1	3.20	81	18	80	10	100
HLSP5S-X0	18.0	457	.750	19.1	5.00	127	18	80	10	100

Part Number	Length Ft.	Length m	Width In.	Width mm	Max. Bundle Dia. In.	Max. Bundle Dia. mm	Min. Loop Tensile Str.* Lbs.	Min. Loop Tensile Str.* N	Std. Pkg. Qty.	Std. Ctn. Qty.
Continuous Rolls – 15' and 75' Lengths – Can be cut to desired length, eliminating waste										
HLM-15R0	15	4.6	.330	8.4	Various	Various	18	80	1	10
HLS-15R0	15	4.6	.750	19.1	Various	Various	50	222	1	10
HLS-75R0	75	22.9	.750	19.1	Various	Various	50	222	1	10

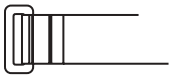
*Minimum 2" overlap required to achieve loop tensile rating.

- Soft, premium material is safe to use on high performance cabling
- Adjustable, releasable, and reusable multiple times
- Unique material with hooks and loops on same side allows user to secure a greater range of bundle diameters, including smaller diameter bundles
- Low profile contoured cinch ring provides extra strength and bundle tightness, while reducing overall bundle size
- Grommet styles offer strength and assure reliable installations that resist pullout when bundling and mounting cables within cabinet applications
- Tapered tip facilitates easy, snag-free threading
- A full range of colors; see Color Chart on page 4

Three styles available in eight colors

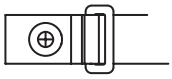
Cinch tie on bundle
UCT3S-X0

Design Styles



Cinch Tie (UCT)

Cinch Tie – Center Mount Grommet (UGCTC)



Cinch Tie – End Mount Grommet (UGCTE)

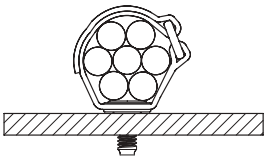
Ordering Information

Cinch Tie mounted on rack
UGCTC3S-X0

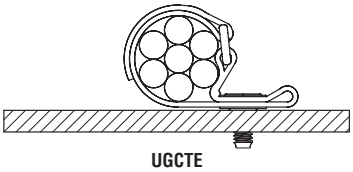
Cinch Tie mounted within cabinet
UGCTC3S-X10

Part Number	Length In.	Length mm	Width In.	Width mm	Max. Bundle Dia. In.	Max. Bundle Dia. mm	Min. Loop Tensile Str.* Lbs.	Min. Loop Tensile Str.* N	Std. Pkg. Qty.	Std. Ctn. Qty.
Cinch Ties										
UCT3S-X0	12.0	305	.850	21.6	3.00	76	50	222	10	100
UCT5S-X0	18.0	457	.850	21.6	5.00	127	50	222	10	100
Cinch Ties – Center Mount Grommet (Bundle is centered over mounting point)										
UGCTC3S-X0	12.0	305	.850	21.6	3.00	76	50	222	10	100
UGCTC5S-X0	18.0	457	.850	21.6	5.00	127	50	222	10	100
Cinch Ties – End Mount Grommet (Bundle is offset from mounting point)										
UGCTE3S-X0	12.0	305	.850	21.6	3.00	76	50	222	10	100
UGCTE5S-X0	18.7	475	.850	21.6	5.00	127	50	222	10	100

Note: 1/4" (6mm) diameter mounting hole on grommet style cinch ties.
*Minimum 2" overlap required to achieve loop tensile rating.



UGCTC
Bundle is centered over mounting point



UGCTE
Bundle is offset from mounting point

Part Number	Part Description	Std. Pkg. Qty.	Std. Ctn. Qty
Flat Head Screws for Grommet Cinch Ties			
UCTGS1224-X	12-24 UNC x 5/8mm (.625") flat head phillips screw.	10	100
UCTGSM5-X	M5 x 16mm flat head phillips screw.	10	100
UCTGSM6-X	M6 x 16mm flat head phillips screw.	10	100

TAK-TAPE™ Hook & Loop Cable Tie Rolls

- Strong, low profile flexible material; safe to use on high performance cabling
- Adjustable, releasable, and reusable
- Cost effective for general purpose bundling
- Continuous rolls can be easily cut to size
- Leaves no residue
- Available in black color

Convenient packaging


TTS-35RX0

Ordering Information

Part Number	Length		Width		Max. Bundle Dia.		Min. Loop Tensile Str.*		Packaging Description	Std. Pkg. Qty.	Std. Ctn. Qty.
	Ft.	m	In.	mm	In.	mm	Lbs.	N			
TTS-20R0	20	6.1	.750	19.1	Various	Various	40	178	One 20' roll in reusable plastic case.	1	10
TTS-35R3-0	35	10.7	.750	19.1	Various	Various	40	178	One package of three 35' rolls shrink wrapped.	1	8
TTS-35RX0	35	10.7	.750	19.1	Various	Various	40	178	One package of ten 35' rolls shrink wrapped; *PANDUIT* cutter included.	1	10

*Minimum 2" overlap required to achieve loop tensile rating.

Color Chart for Hook and Loop Cable Ties

	Black	Red	Orange	Yellow	Green	Blue	Gray	White	Maroon
Part Prefix	0	2	3	4	5	6	8	10	12
HLT, HLS, HLB, HLM	•	•	•	•	•	•	•	•	
HLTP, HLSP (Plenum)	•								•
UCT, UGCTC, UGCTE	•	•	•	•	•	•	•	•	
TTS	•								

Related Network Bundling Products

Elastomeric Cable Ties

- Elastic, flexible tie; safe on network cables and installers
- UL 94V-0 flammability rating meets telecommunication requirements
- Releasable and reusable

Cable Bundle Organizing Tool

- Reduces cable installation time up to 50%
- Arranges 24 cables optimizing bundle size and improving installed appearance
- Accommodates a wide range of data cable diameters

Cable Tie Mounts

- For use with hook and loop cable ties
- Unique cradle design provides maximum stability for cable bundle
- Choice of adhesive backed or screw mount styles provides installer flexibility

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For a copy of *PANDUIT* product warranties, log on to www.panduit.com/warranty

PANDUIT®

For more information

Visit us at www.panduit.com

Contact Customer Service by email: cs@panduit.com or by phone: 800-777-3300 and reference CTCB34

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Product Bulletin Number **SA-CTCB34**
3/2008

PANDUIT®

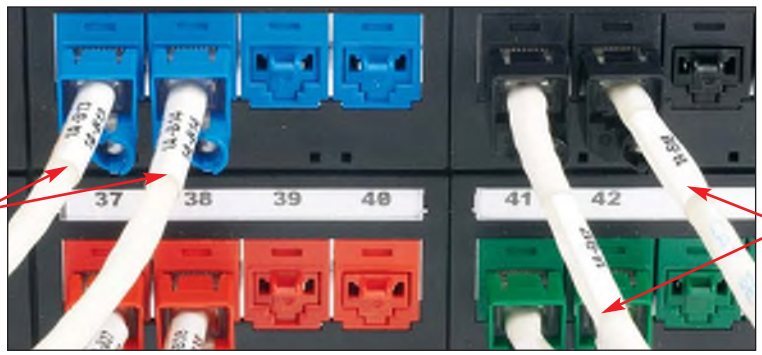
PRODUCT BULLETIN

NEW! Turn-Tell™ Labels

Panduit innovative Turn-Tell™ Labels provide a unique identification solution to meet the application needs of data centers, industrial automation, and other structured cabling infrastructures. These new pressure-sensitive, self-laminating labels improve visibility, placement, aesthetics, and flexibility of the labeling application. The labels are unique because they can rotate on the wire/cable after installation to allow visibility from any angle. In addition, they allow repositioning along the length of the cable which further improves ease of installation and flexibility in high density or space restrained applications. Installers will save time and material by being able to reposition the label after pulling the wire/cable and cutting it to final length for termination.

Offered in a wide range of sizes, the new Turn-Tell™ Labels are available in P1™ Cassettes for the PanTher™ LS8E and LS8EQ Hand-Held Thermal Transfer Printers. They are also offered in computer printable rolls, ready to print on demand using Panduit® Easy-Mark™ Labeling Software and desktop thermal transfer printers.

Key Features	Benefits
Innovative design allows label to be moved after installation	Allows labels to rotate for visibility from any angle, and allows repositioning on the wire/cable to align legends for improved aesthetics Labels can be easily repositioned once installed on the wire/cable to save time and cost associated with relabeling; ideal for use in high density or space constrained cable applications
Wrap-around wire/cable label	Permits labels to be installed on terminated wires/cables without disconnecting for increased productivity, performance, and cost savings
Perforated adhesive backed anchor	Facilitates easy installation; prevents unintended movement in vertical or high vibration applications for superior performance
On-demand labeling solution	Labels can be printed in the office using desktop thermal transfer printers or in the field using the PanTher™ LS8E or LS8EQ Hand-Held Thermal Transfer Printers; more cost effective than pre-printed solutions
Thermal transfer print technology	Provides crisp, clear, and durable legends for a reliable, high performance identification solution



"See the difference" with Turn-Tell™ Labels

Turn-Tell™ Labels

Part Number	Part Description	Width In.	Width mm	Length In.	Length mm	Print-on Height In.	Print-on Height mm	Cable Diameter Range In.	Cable Diameter Range mm	Std. Pkg. Qty.
Labels on Rolls for Use with Easy-Mark ™ Labeling Software and Desktop Thermal Transfer Printers										
R100X075V1T	White, 18-14 AWG wire/cable.	1.00	25.4	0.75	19.1	0.25	6.4	0.12 – 0.16	3.0 – 4.0	2500
R100X125V1T	White, 12-10 AWG wire/cable.	1.00	25.4	1.25	31.8	0.38	9.7	0.16 – 0.22	4.1 – 5.6	2500
R100X150V1T*	White, Cat 5/5e/6 cable.	1.00	25.4	1.50	38.1	0.50	12.7	0.22 – 0.28	5.6 – 7.1	2500
R100X225V1T*	White, 8-4 AWG wire/cable.	1.00	25.4	2.25	57.2	0.75	19.1	0.28 – 0.39	7.1 – 9.9	2500
R100X400V1T	White, 2 AWG – 250 MCM wire/cable.	1.00	25.4	4.00	101.6	1.00	25.4	0.39 – 0.95	9.9 – 24.1	1000
R200X225V1T	White, 8-4 AWG wire/cable.	2.00	50.8	2.25	57.2	0.75	19.1	0.28 – 0.39	7.1 – 9.9	1000
R200X400V1T	White, 2 AWG – 250 MCM wire/cable.	2.00	50.8	4.00	101.6	1.00	25.4	0.39 – 0.95	9.9 – 24.1	1000

*For other colors replace suffix V1T (White) with V2T (Blue), V3T (Green), V7T (Red), or V8T (Yellow).

P1 ™ Label Cassettes for Use with the PanTher ™ LS8E and LS8EQ Hand-Held Thermal Transfer Printers										
R100X075V1C	White print-on, 18-14 AWG wire/cable, 150/cassette.	1.00	25.4	0.75	19.1	0.25	6.4	0.12 – 0.16	3.1 – 4.1	1
R100X125V1C	White print-on, 12-10 AWG wire/cable, 100/cassette.	1.00	25.4	1.25	31.8	0.38	9.7	0.16 – 0.22	4.1 – 5.6	1
R100X150V1C	White print-on, Cat 5/5e/6 cable, 100/cassette.	1.00	25.4	1.50	38.1	0.50	12.7	0.22 – 0.28	5.6 – 7.1	1
R100X225V1C	White print-on, 8-4 AWG wire/cable, 75/cassette.	1.00	25.4	2.25	57.2	0.75	19.1	0.28 – 0.39	7.1 – 9.9	1

How It Works

1.

Remove the label from the liner by lifting it at the non-adhesive middle section.

2.

Apply the top adhesive backed anchor section to the cable. For proper operation, the label should be applied squarely to the cable to avoid an uneven wrap.

3.

Wrap the label around the cable repeatedly until completely wrapped.

4.

Once the label is completely applied to the cable, pinch lightly and rotate it in the same direction as you wrapped it. This will break the label perforation and separate the label from the anchor.

5.

After the label is installed and detached from the anchor, it is free to rotate and slide on the cable. The anchor can be used as a stop to prevent unintended label movement in vertical or high vibration applications.

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Jalisco, Mexico
cs-la@panduit.com
Phone: 52.33.3777.6000

PANDUIT AUSTRALIA PTY. LTD.
Victoria, Australia
cs-aus@panduit.com
Phone: 61.3.9794.9020

For a copy of Panduit product warranties, log on to www.panduit.com/warranty

PANDUIT®

For more information

Visit us at www.panduit.com

Contact Customer Service by email: cs@panduit.com or by phone: 800-777-3300 and reference IDCB54

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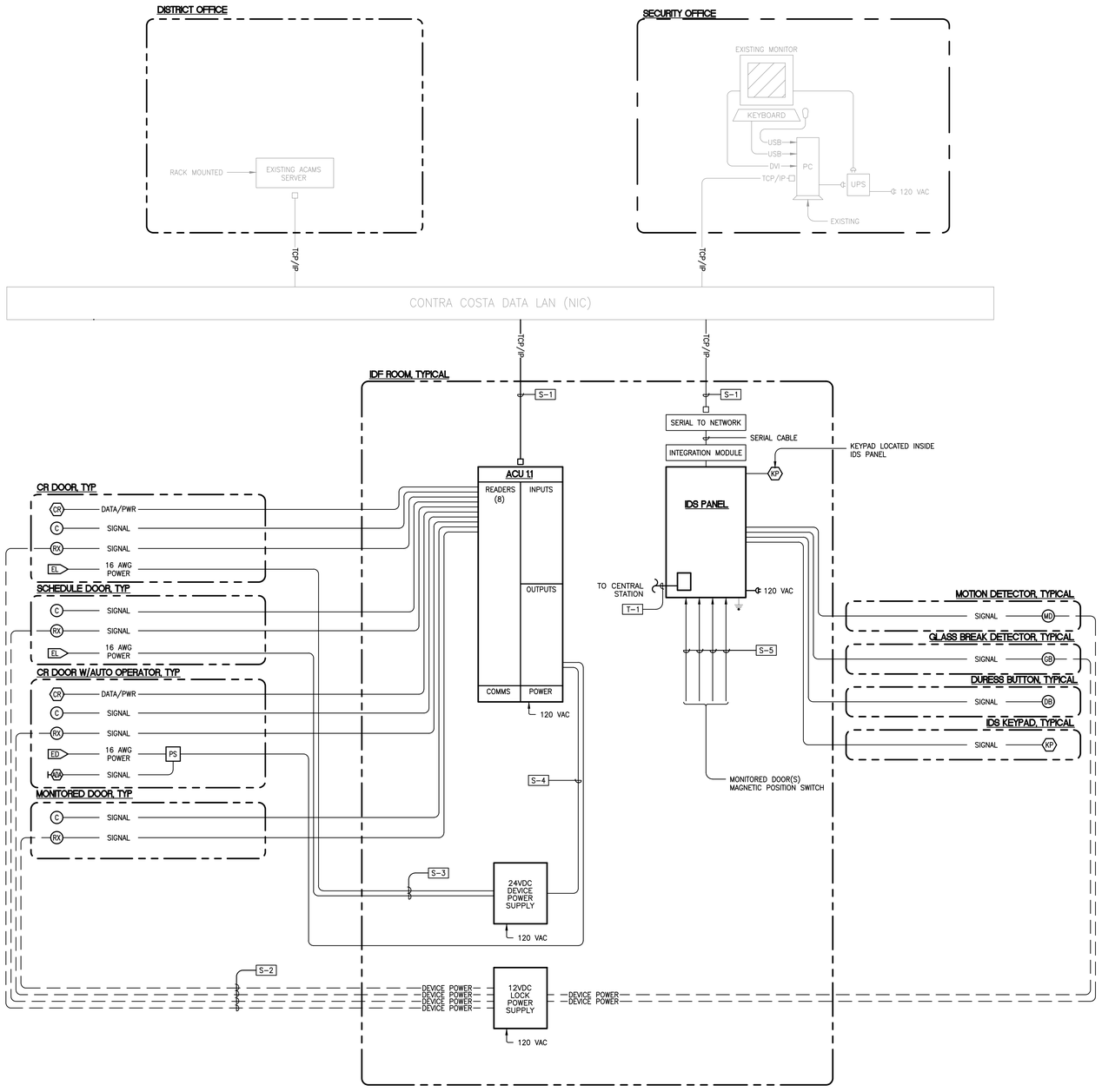
Product Bulletin Number **SA-IDCB54**
Replaces WW-IDCB54
8/2010



GENERAL SHEET NOTES

1. COORDINATE TCP/IP ADDRESS FOR CLIENT WORKSTATION WITH CONTRA COSTA IT DEPARTMENT REPRESENTATIVE.
2. ACAMS BLOCK DIAGRAM IS DIAGRAMMATIC ONLY. PROVIDE ACU PANELS AND POWER SUPPLIES TO SUPPORT THE FIELD DEVICES SHOWN ON FLOOR PLANS.

NUMBERED SHEET NOTES

SECURITY:

- S-1 PROVIDE PATCH CORD FROM OWNER PROVIDED SWITCH TO DEVICE.
- S-2 PROVIDE INDIVIDUAL POWER FEED TO EACH 12VDC FIELD DEVICE.
- S-3 PROVIDE INDIVIDUAL POWER FEED FOR EACH LOCK.
- S-4 INTERCONNECT LOCK OUTPUTS FOR EACH CARD READER DOOR WITH DRY CONTACT INPUT ON LOCK POWER SUPPLY. DO NOT SWITCH LOCK COIL LOAD THROUGH ACU RELAYS.
- S-5 THESE ALARMS REPRESENT INPUTS FROM MONITORED FIELD DEVICES AND SHOULD BE SUPERVISED. NOT REPRESENTED ARE TAMPERS WHICH CAN BE UNSUPERVISED.

TELECOMMUNICATIONS:

- T-1 TELECOMMUNICATIONS CONTRACTOR TO PROVIDE DEDICATED ANALOG PHONE LINE FOR ALARM PANEL.

- CR CARD READER, MOUNTED +42" AFF UON.
- EL ELECTRIC MORTISE LOCK
- ED ELECTRIC EXIT DEVICE
- HOW AUTOMATIC DOOR OPERATOR ACTUATOR
- C MAGNETIC DOOR CONTACT
- RX REX MOTION DETECTOR, WALL OR CEILING MOUNTED ABOVE DOOR
- PS LOCAL DOOR HARDWARE POWER SUPPLY
- XP IDS KEYPAD
- MD MOTION DETECTOR
- GB GLASS BREAK DETECTOR
- DB DURESS BUTTON

CONTRA COSTA COMMUNITY COLLEGE DISTRICT SECURITY DESIGN GUIDELINES

CONSULTANT

TEECOM

1333 Broadway
Suite 601
Oakland, CA 94612
510 337 2800
www.teecom.com

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KEY PLAN

GENERAL NOTES

NOT FOR CONSTRUCTION

REVISIONS

SHEET TITLE

BLOCK DIAGRAM - ACAMS

ISSUANCE

-

-

SCALE

NONE

DRAWN BY

BK

CHECKED BY

AA

PROJECT NO

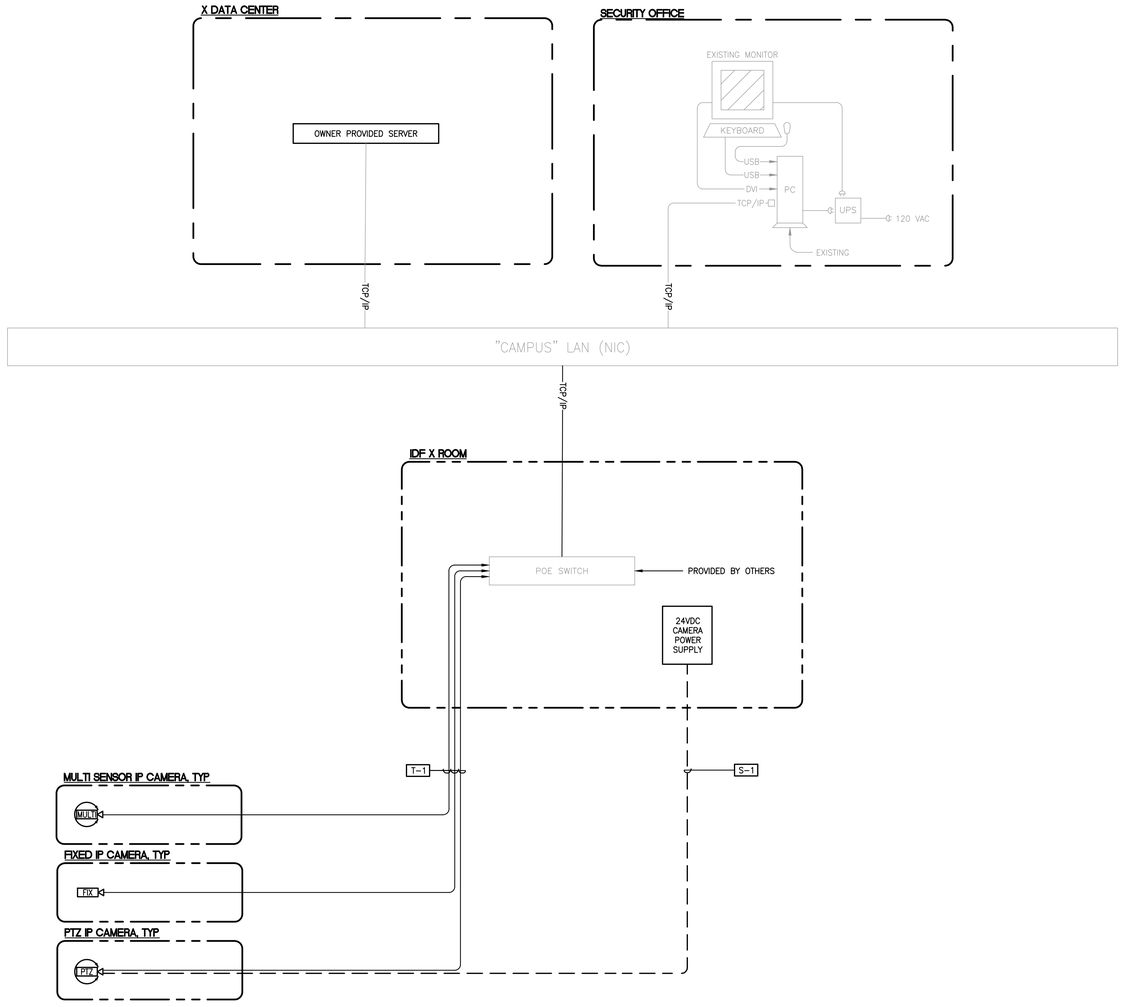
15002

DATE

10/2017

SHEET NUMBER

SY0.10



GENERAL SHEET NOTES

1. COORDINATE TCP/IP ADDRESS FOR NVRS AND IP CAMERAS WITH CCC IT DEPARTMENT REPRESENTATIVE.
2. VSS BLOCK DIAGRAM IS DIAGRAMMATIC ONLY. PROVIDE IP CAMERAS, ANALOG CAMERAS, NVRS / VXRAIL NODES AND POWER SUPPLIES TO SUPPORT THE FIELD DEVICES SHOWN ON FLOOR PLANS.

NUMBERED SHEET NOTES

SECURITY:

S-1 PROVIDE INDIVIDUAL 24VAC POWER FEED TO EACH IP PTZ CAMERA.

TELECOM:

T-1 PATCH CORD FROM OWNER PROVIDED SWITCH TO DEVICE BY TELECOMMUNICATIONS CONTRACTOR.

PTZ FIXED CAMERA

PTZ PAN-TILT-ZOOM CAMERA

MULTI MULTI SENSOR CAMERA - 360, 180, AND 270

CONTRA COSTA COMMUNITY COLLEGE DISTRICT
SECURITY DESIGN GUIDELINES

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KEY PLAN

GENERAL NOTES

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REVISIONS

SHEET TITLE

BLOCK DIAGRAM - VSS

ISSUANCE

-
-

SCALE

NONE

DRAWN BY

RN

CHECKED BY

AG

PROJECT NO

15002

DATE

10/2017

SHEET NUMBER

SY0.11

GENERAL SHEET NOTES

1. COORDINATE TCP/IP ADDRESS FOR CLIENT WORKSTATION WITH CONTRA COSTA IT DEPARTMENT REPRESENTATIVE.
2. ACAMS BLOCK DIAGRAM IS DIAGRAMMATIC ONLY. PROVIDE ACU PANELS AND POWER SUPPLIES TO SUPPORT THE FIELD DEVICES SHOWN ON FLOOR PLANS.

NUMBERED SHEET NOTES

SECURITY:

S-1 PROVIDE PATCH CORD FROM OWNER PROVIDED SWITCH TO DEVICE.

S-2 THESE ALARMS REPRESENT INPUTS FROM MONITORED FIELD DEVICES AND SHOULD BE SUPERVISED. NOT REPRESENTED ARE TAMPERS WHICH CAN BE UNSUPERVISED.

TELECOMMUNICATIONS:

T-1 TELECOMMUNICATIONS CONTRACTOR TO PROVIDE DEDICATED ANALOG PHONE LINE FOR ALARM PANEL.

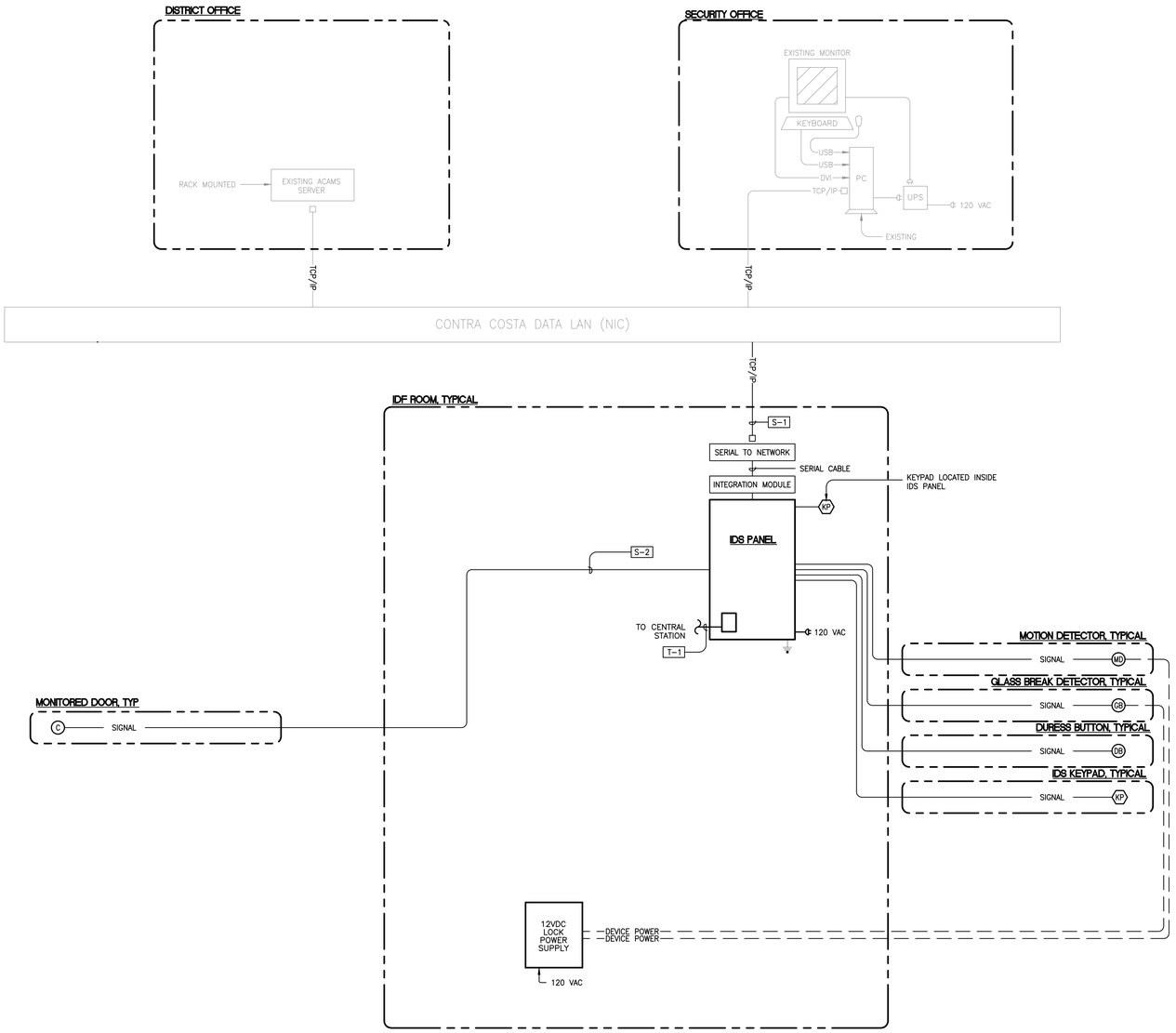
(C) MAGNETIC DOOR CONTACT

(KP) IDS KEYPAD

(MD) MOTION DETECTOR

(GB) GLASS BREAK DETECTOR

(DB) DURESS BUTTON



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KEY PLAN

GENERAL NOTES

NOT FOR CONSTRUCTION

REVISIONS

SHEET TITLE

BLOCK DIAGRAM - IDS

ISSUANCE

-

-

SCALE

NONE

DRAWN BY

BK

CHECKED BY

AA

PROJECT NO

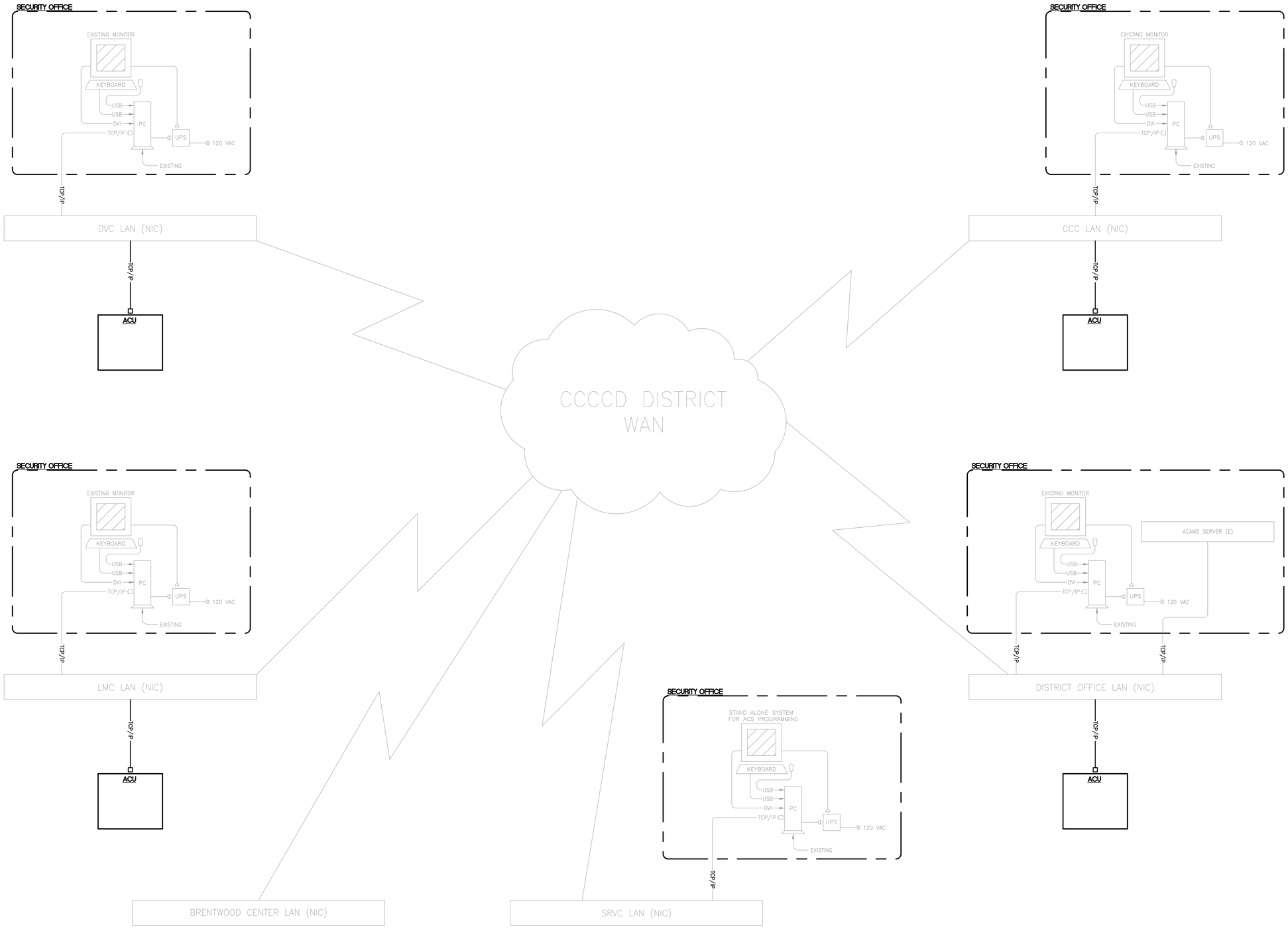
15002

DATE

10/2017

SHEET NUMBER

SY0.12



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KEY PLAN

GENERAL NOTES

NOT FOR CONSTRUCTION

REVISIONS

SHEET TITLE

NETWORK TOPOLOGY DIAGRAM

ISSUANCE

-

-

SCALE

NONE

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AA

PROJECT NO

15002

DATE

10/2017

SHEET NUMBER

SY0.13

CARD READER, MOUNTED +42" AFF UON.

DOOR RELEASE BUTTON

ELECTRIC MORTISE LOCK

ELECTRIC EXIT DEVICE

TRANSFER HINGE
C = DOOR POSITION & FEED–THROUGH
E = ELECTRIC FEED–THROUGH

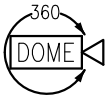
REX MOTION DETECTOR, WALL OR CEILING MOUNTED ABOVE DOOR

POWER SUPPLY

MAGNETIC DOOR CONTACT MOUNTED IN DOOR HEADER

DURESS BUTTON

FIXED CCTV CAMERA



PTZ DOME CCTV CAMERA

(P) INDICATES THE PROTECTED SIDE OF A DOOR.

KEYPAD, MOUNTED +42" AFF UON.

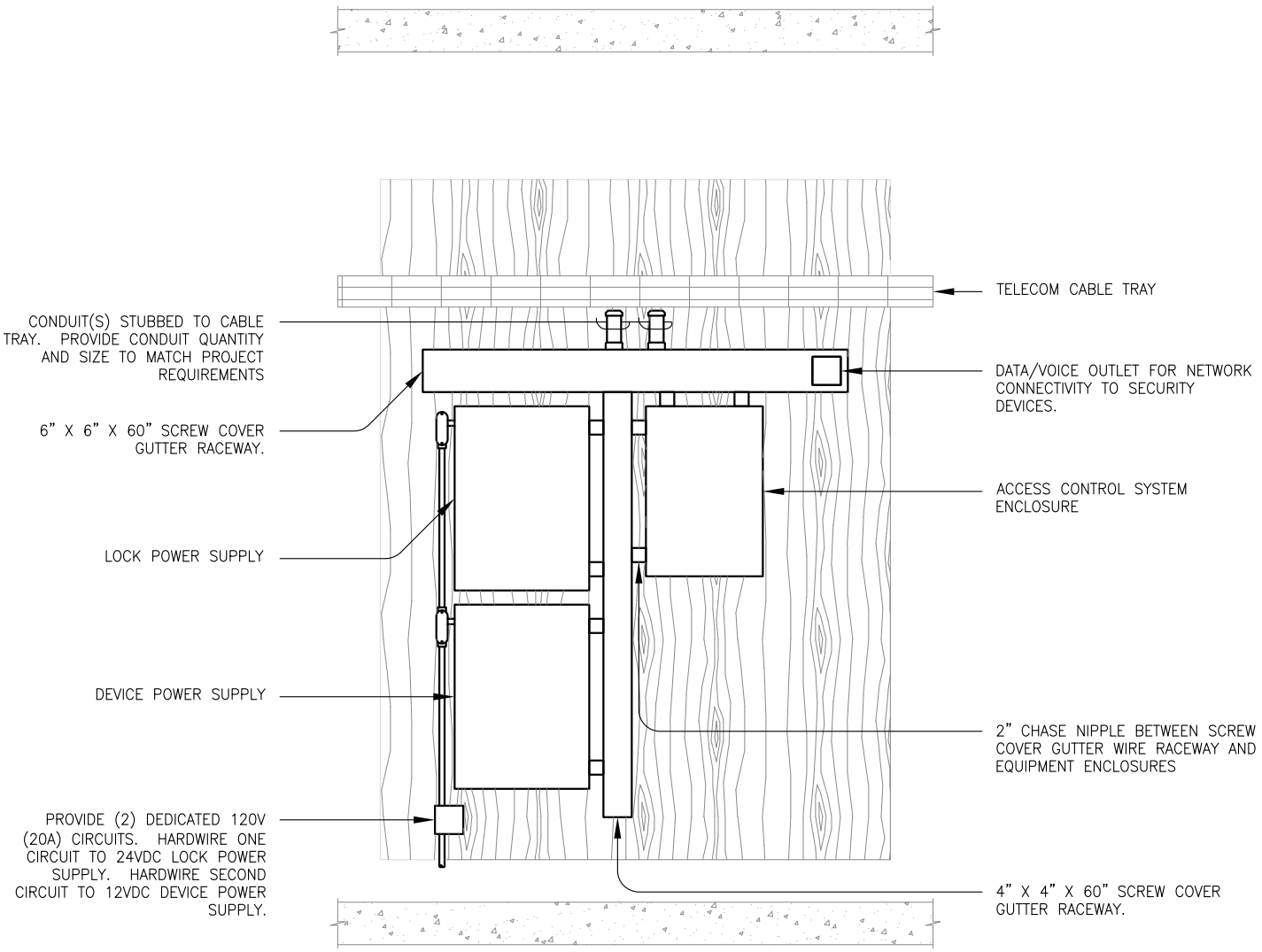
MOTION DETECTOR
W = WALL MOUNT
C = CEILING MOUNT

GLASS BREAK SENSOR
W = WALL MOUNT
C = CEILING MOUNT

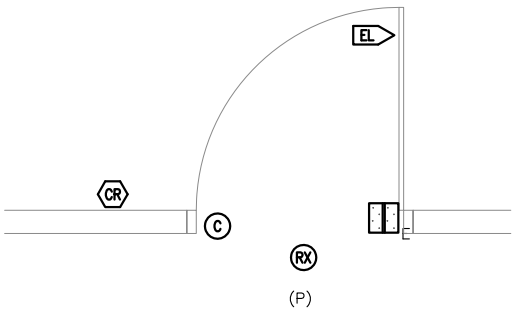
LOCAL AUDIBLE ALARM

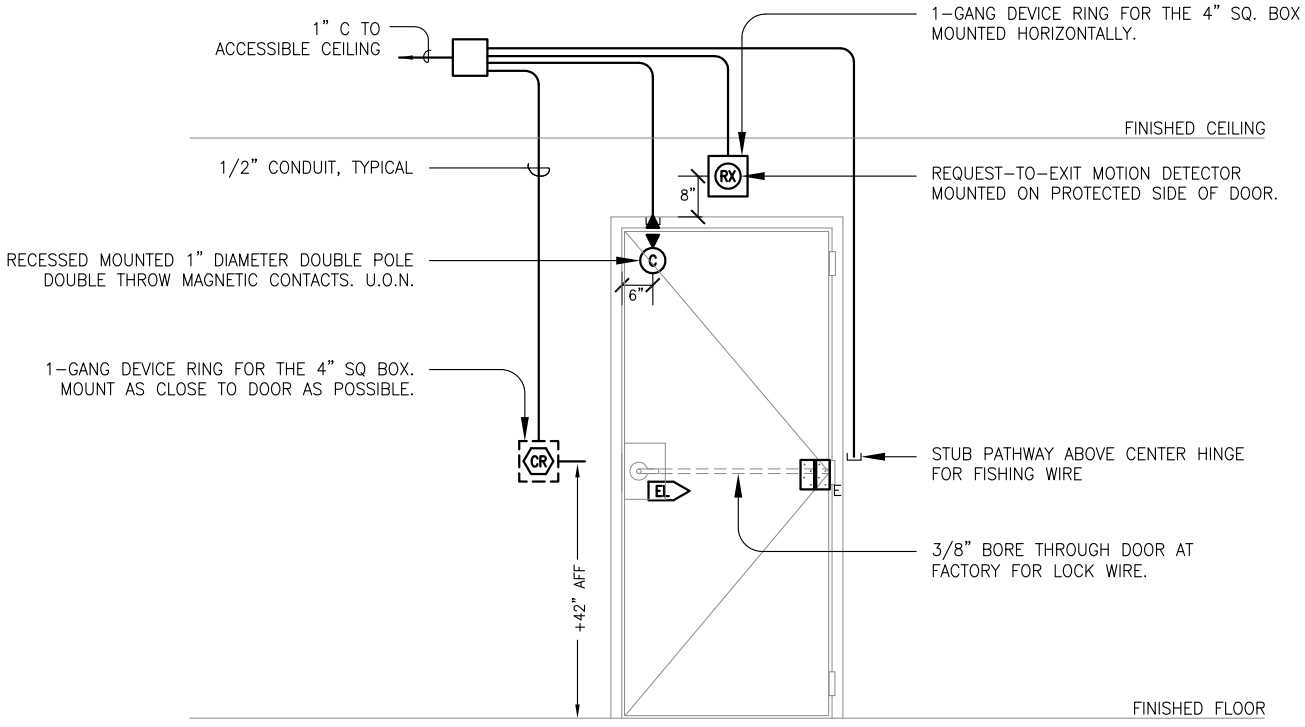
SECURITY/CCTV EQUIPMENT CABINET

Contra Costa Community College District — pathways to success	**CONTRA COSTA COMMUNITY COLLEGE DISTRICT**	DESCRIPTION: SYMBOLS LIST	SKETCH No: SY0.00
			DATE: 07.05.11
			REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES			SCALE: NONE



Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL SECURITY EQUIPMENT ELEVATION
PROJECT NAME: SECURITY DESIGN GUIDELINES		SKETCH No: SY0.01
		DATE: 07.05.11
		REVISION:
		SCALE: NTS

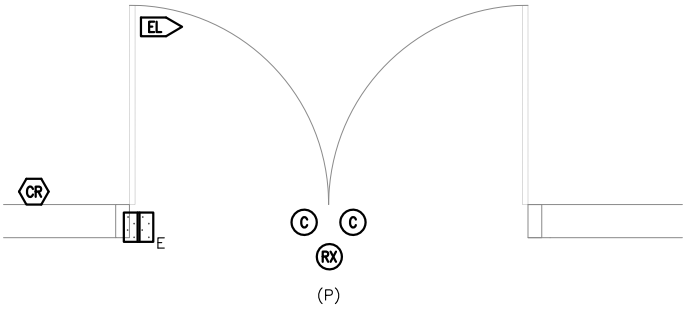


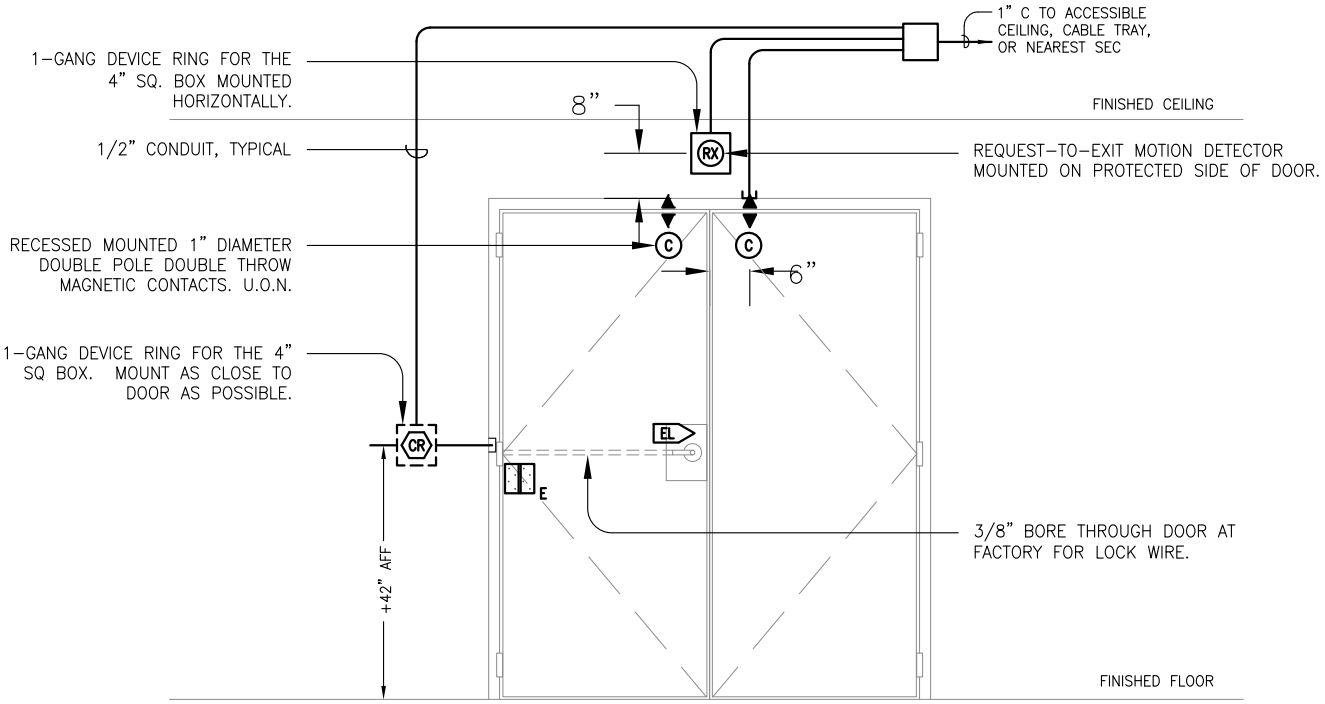


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AT ALL TIMES
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL CARD READER DOOR [LOCKSET]	SKETCH No: SY0.02
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS

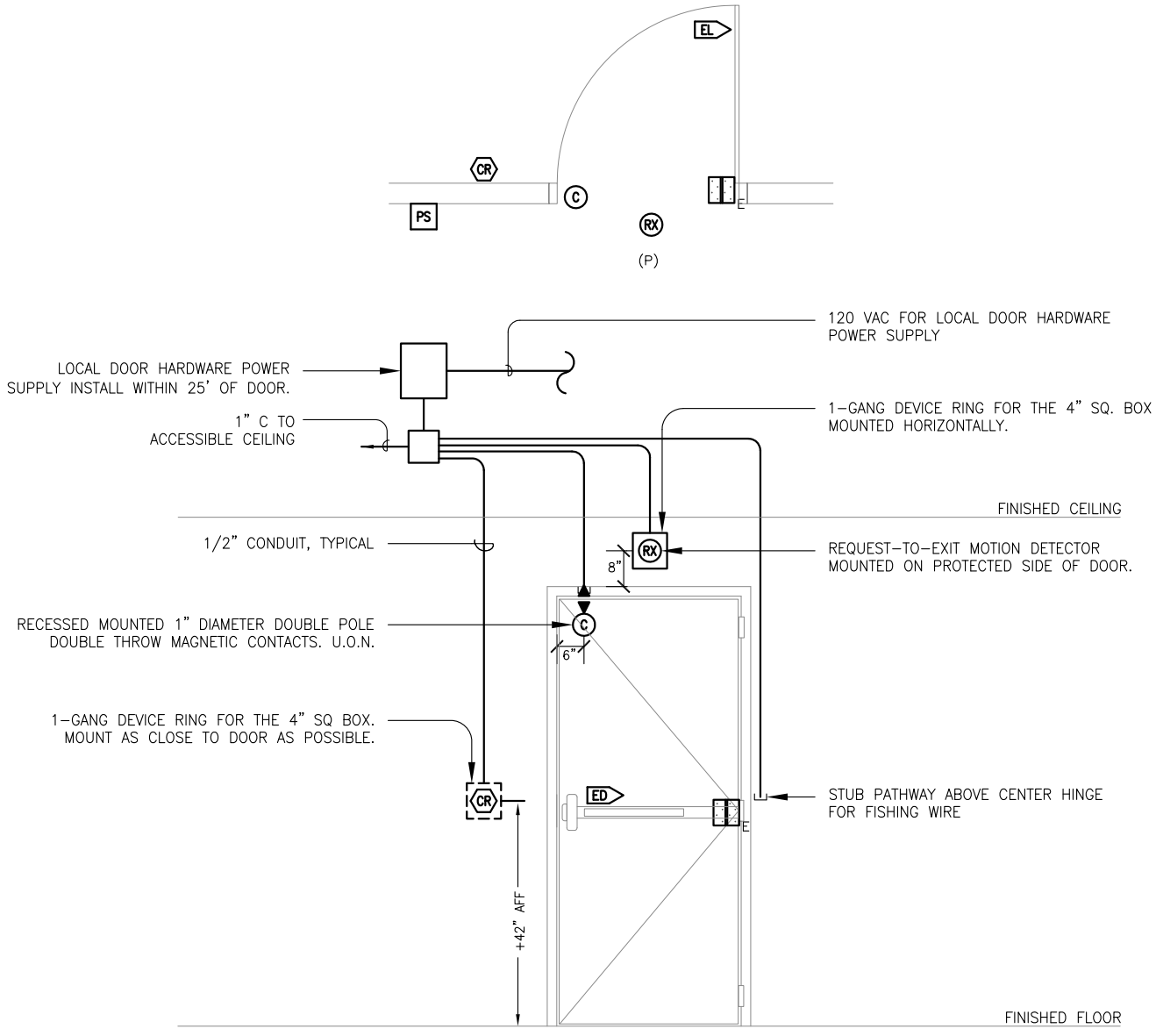




THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

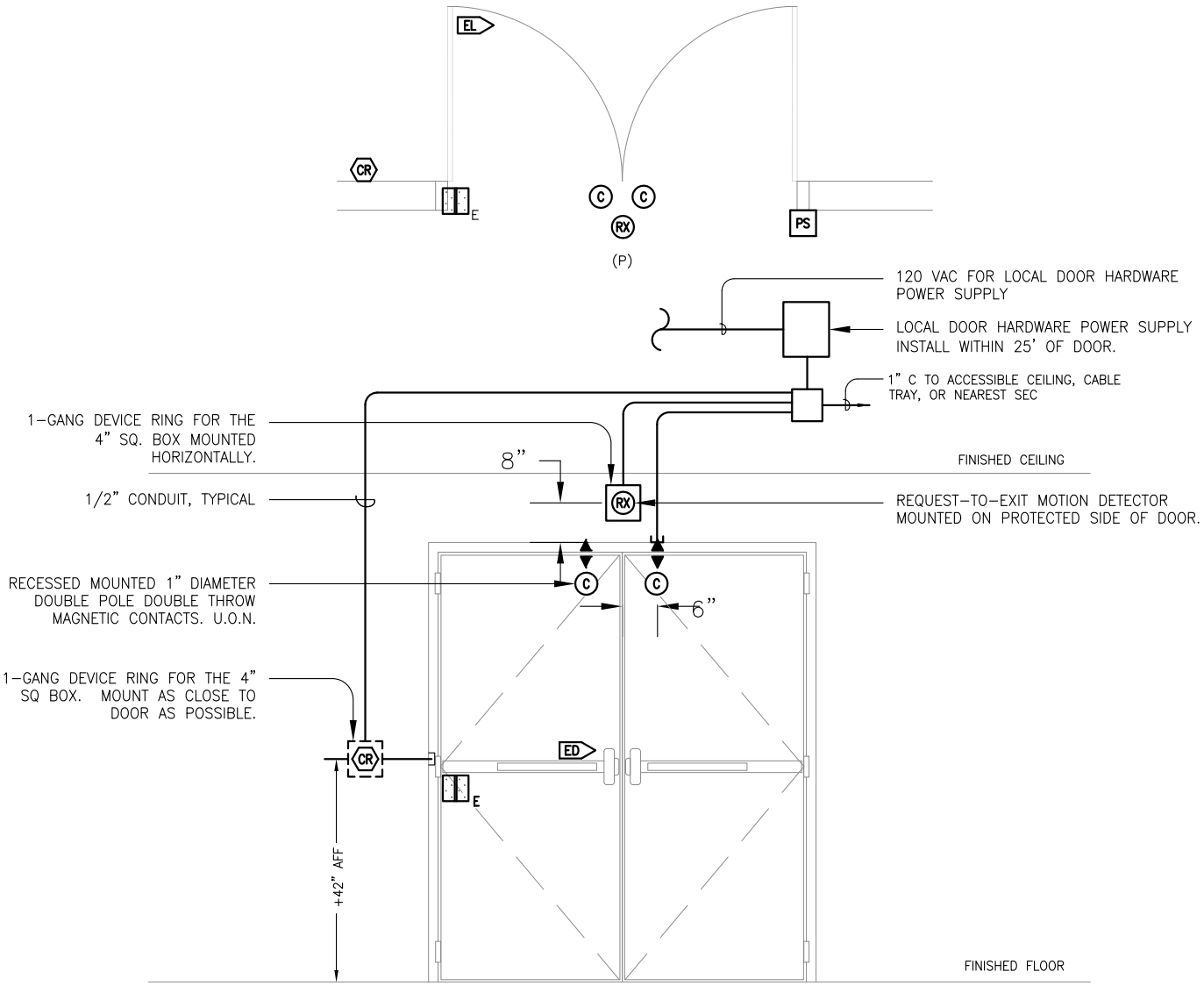
Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL CARD READER PAIR [LOCKSET]
PROJECT NAME: SECURITY DESIGN GUIDELINES		SKETCH No: SY0.03
		DATE: 07.05.11
		REVISION:
		SCALE: NTS



THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AT ALL TIMES
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

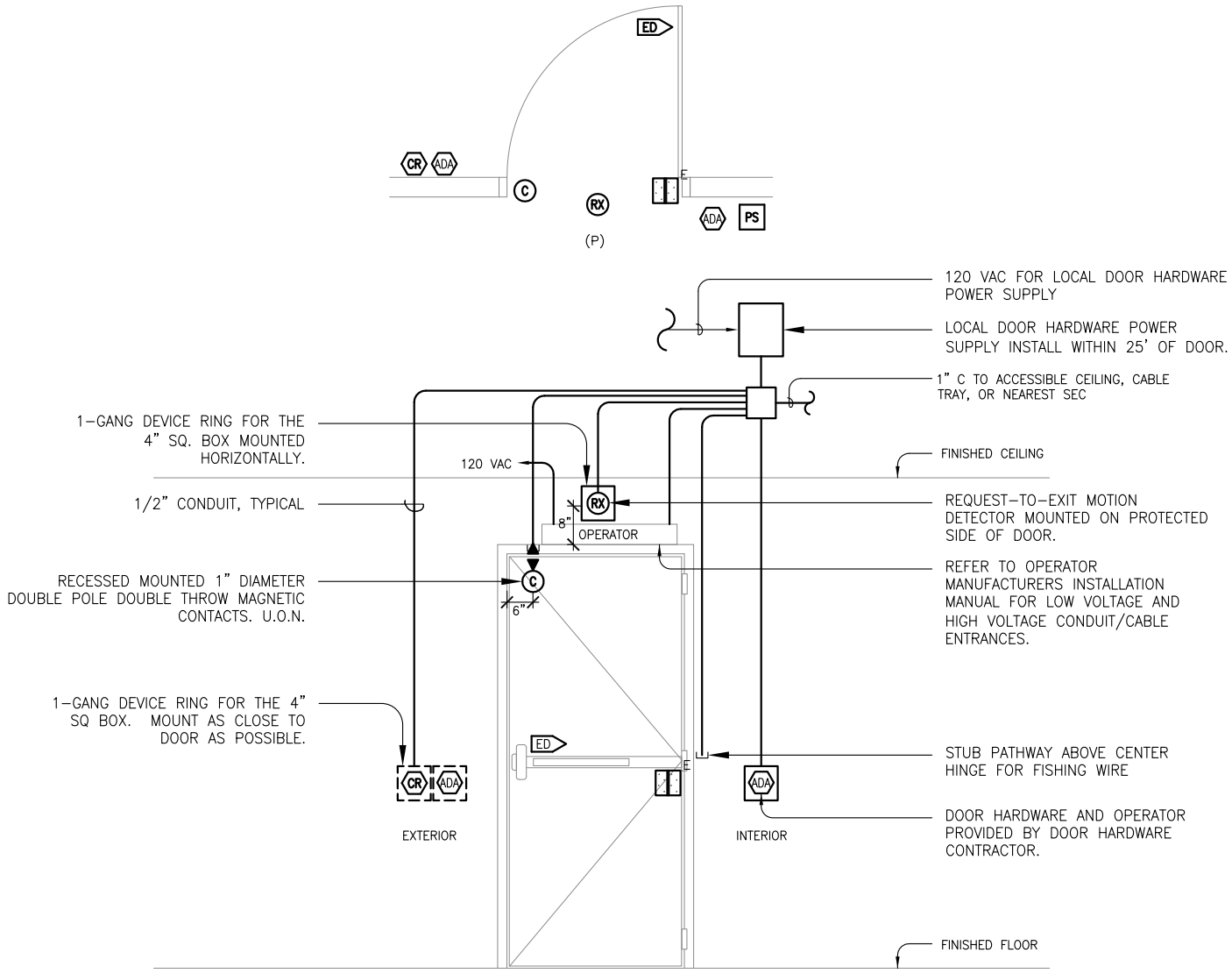
Contra Costa Community College District — pathways to success **CONTRA COSTA COMMUNITY COLLEGE DISTRICT**	DESCRIPTION: TYPICAL CARD READER DOOR SINGLE [EXIT DEVICE W/PS]	SKETCH No: SY0.04 DATE: 07.05.11 REVISION: SCALE: NTS
PROJECT NAME: SECURITY DESIGN GUIDELINES		



THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AT ALL TIMES
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR SHUNTS DOOR CONTACT ALARM THUS ALLOWING VALID EXIT.

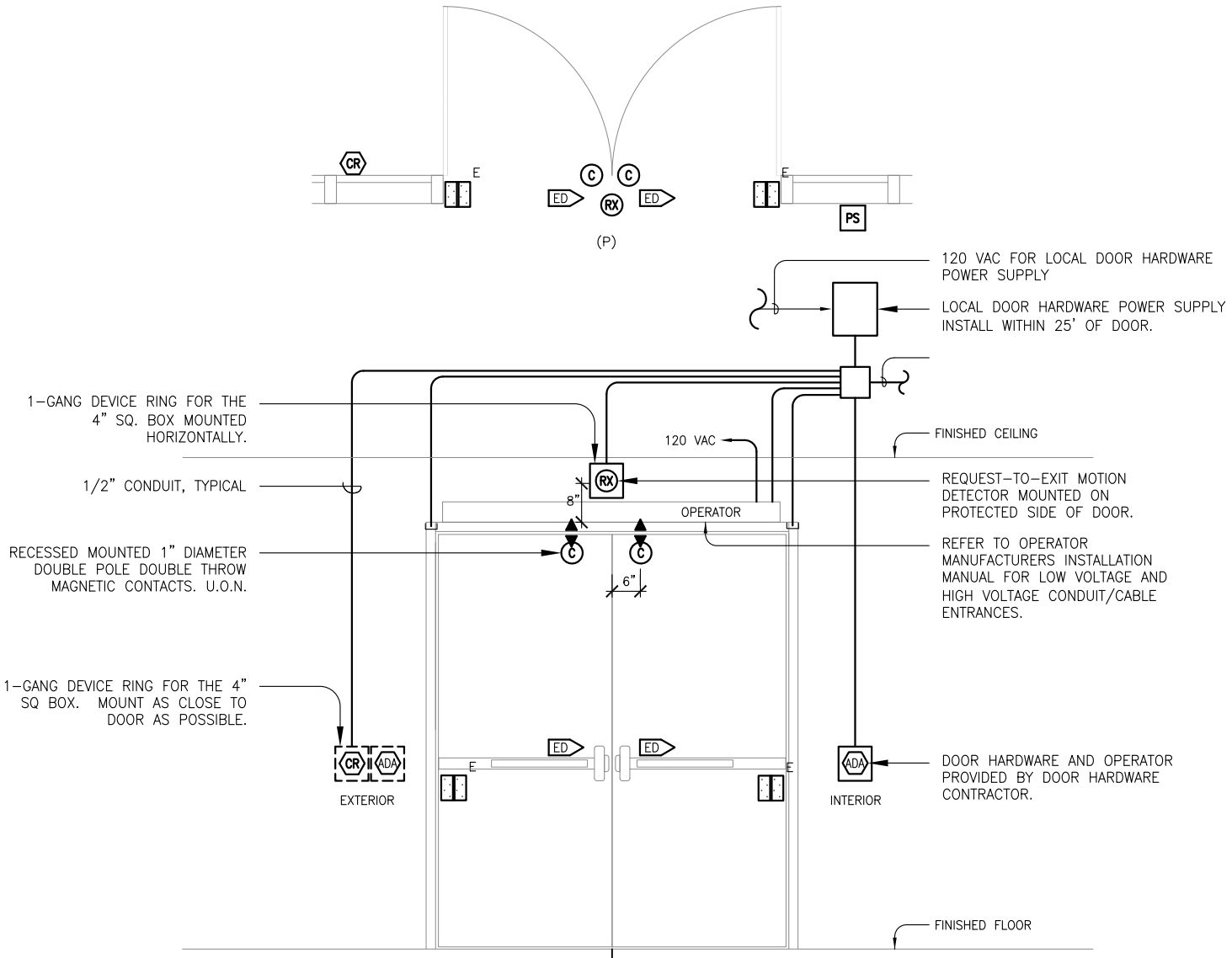
Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL CARD READER PAIR [EXIT DEVICE WITH POWER SUPPLY]
PROJECT NAME: SECURITY DESIGN GUIDELINES		SKETCH No: SY0.05
		DATE: 07.05.11
		REVISION:
		SCALE: NTS



THEORY OF OPERATION:

- DOOR IS UNLOCKED DURING BUSINESS HOURS AND LOCKED AFTER HOURS.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM THE NON-PROTECTED SIDE AFTER HOURS, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.
- EXTERIOR ADA ACTUATOR IS INTERLOCKED WITH DOOR LOCKS AND DISABLED WHEN LOCKED.
- INTERIOR ADA ACTUATOR BYPASSES ALARM CONTACT AND OPERATES DOOR AT ALL TIMES.
- REFER TO WIRING SCHEMATIC FOR INTEGRATION TO OPERATOR.

Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL CARD READER SINGLE [EXIT DEVICE W/POWER SUPPLY AND AUTO OPERATOR]
PROJECT NAME: SECURITY DESIGN GUIDELINES		SKETCH No: SY0.06
		DATE: 07.05.11
		REVISION:
		SCALE: NTS



THEORY OF OPERATION:

- DOOR IS UNLOCKED DURING BUSINESS HOURS AND LOCKED AFTER HOURS.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM THE NON-PROTECTED SIDE AFTER HOURS, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.
- EXTERIOR ADA ACTUATOR IS INTERLOCKED WITH DOOR LOCKS AND DISABLED WHEN LOCKED.
- INTERIOR ADA ACTUATOR BYPASSES ALARM CONTACT AND OPERATES DOOR AT ALL TIMES.
- REFER TO WIRING SCHEMATIC FOR INTEGRATION TO OPERATOR.

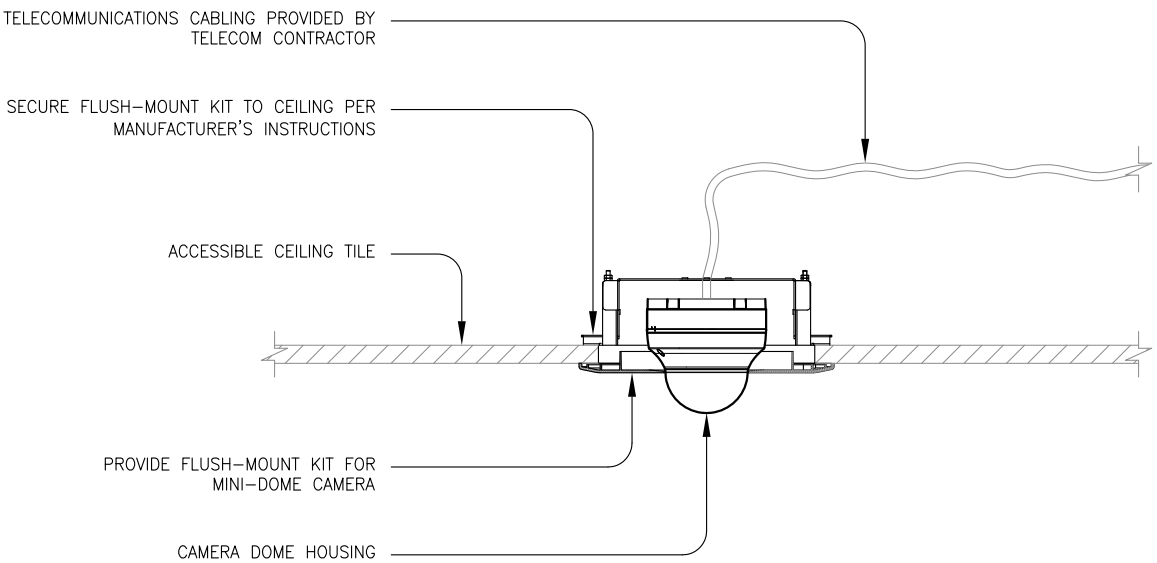
Contra Costa Community College District
pathways to success

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

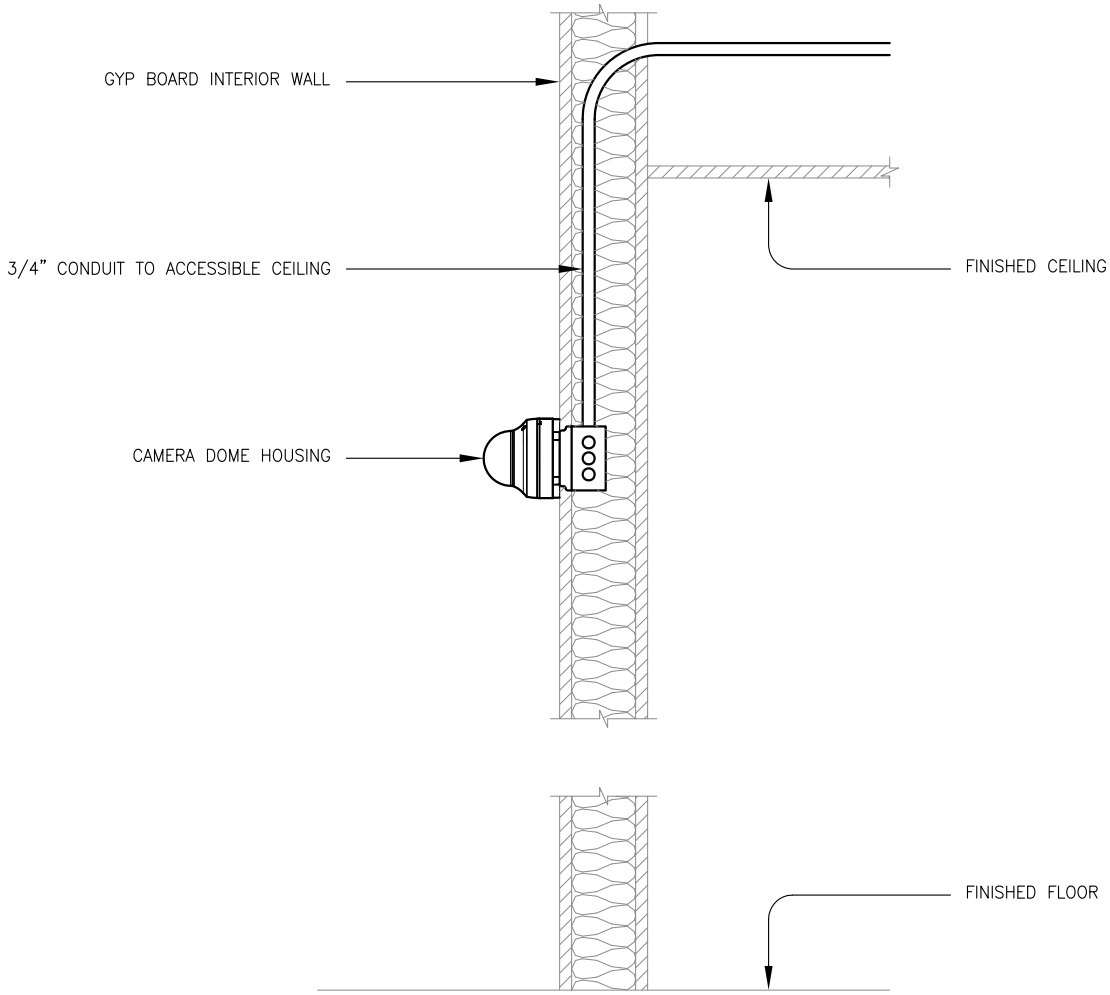
PROJECT NAME:
SECURITY DESIGN GUIDELINES

DESCRIPTION:
TYPICAL CARD READER PAIR [EXIT DEVICE W/POWER SUPPLY AND AUTO OPERATOR]

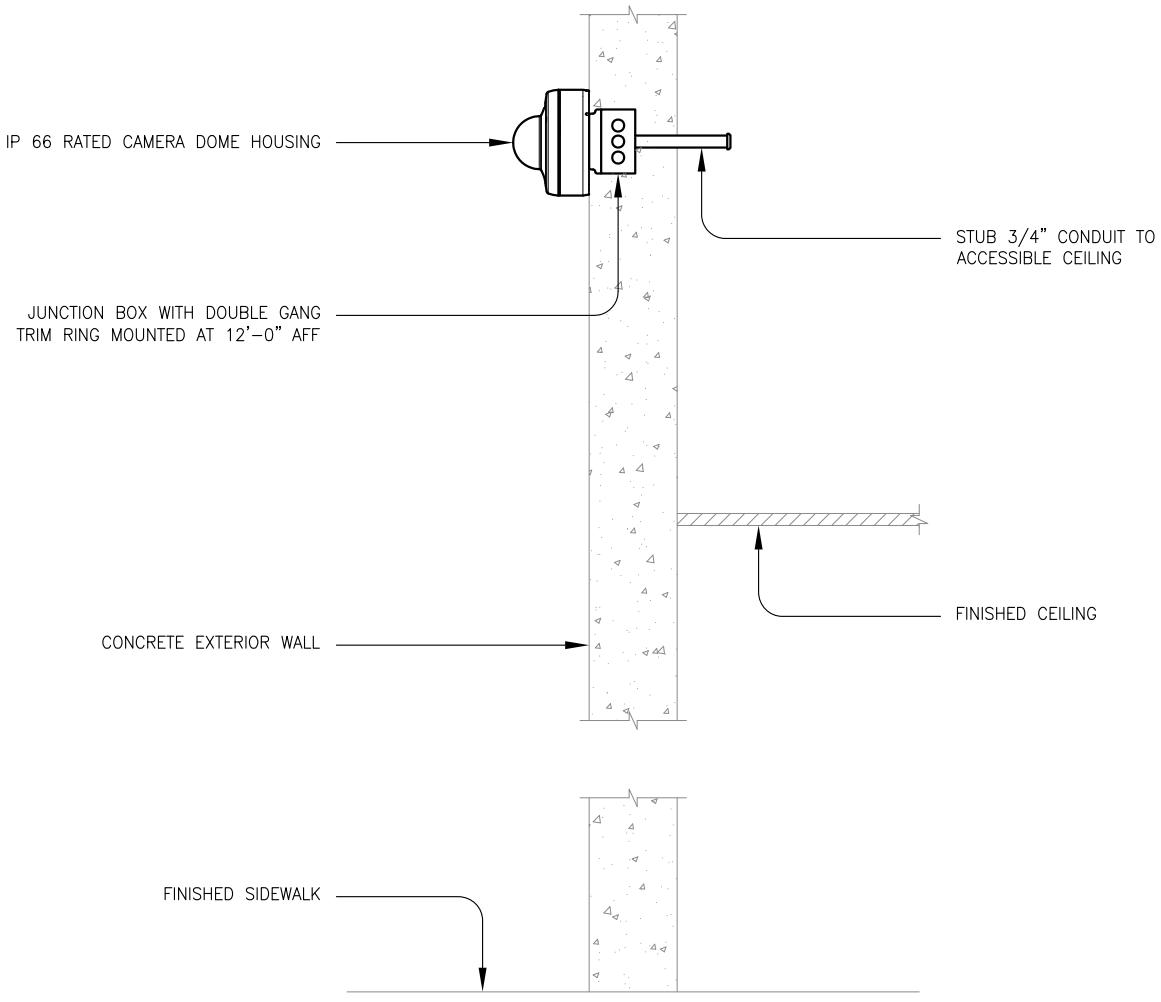
SKETCH No:	SY0.07
DATE:	07.05.11
REVISION:	
SCALE:	NTS



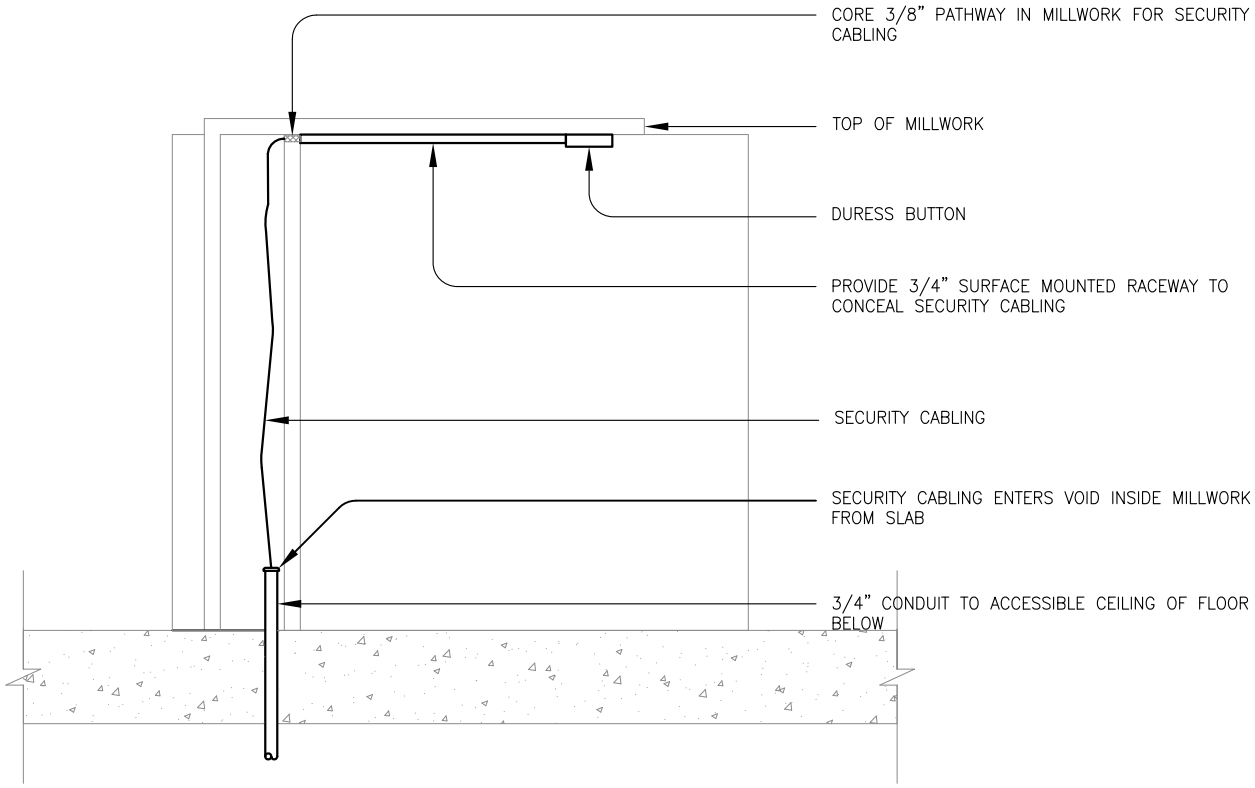
Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL INTERIOR CEILING FLUSH MOUNT IP CAMERA	SKETCH No: SY0.08
			DATE: 07.05.11
			REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES			SCALE: NTS



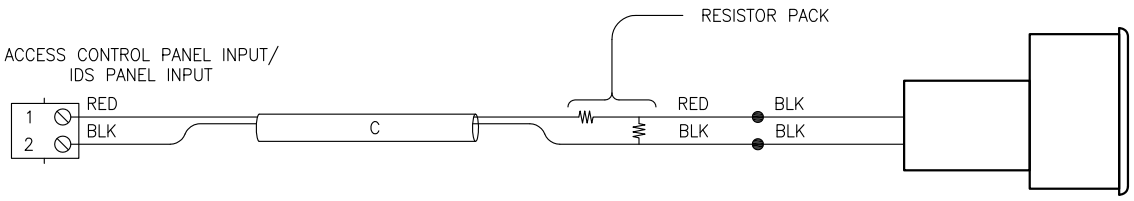
CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL INTERIOR WALL MOUNT FIXED IP DOME CAMERA	SKETCH No: SY0.09
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS



CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL EXTERIOR WALL MOUNT FIXED IP DOME CAMERA	SKETCH No: SY0.10
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS



CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL DURESS BUTTON DESK MOUNT	SKETCH No: SY0.11
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS

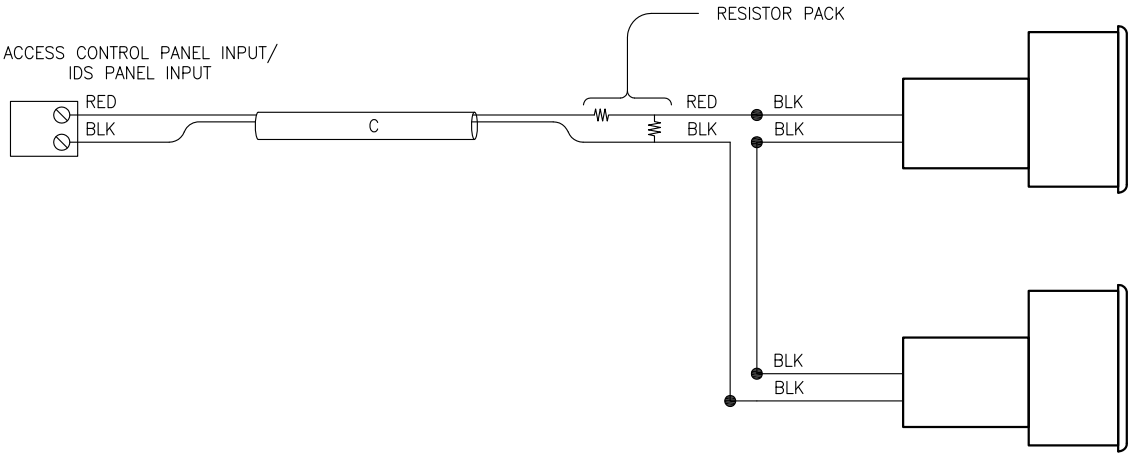


CONTRA COSTA COMMUNITY COLLEGE DISTRICT

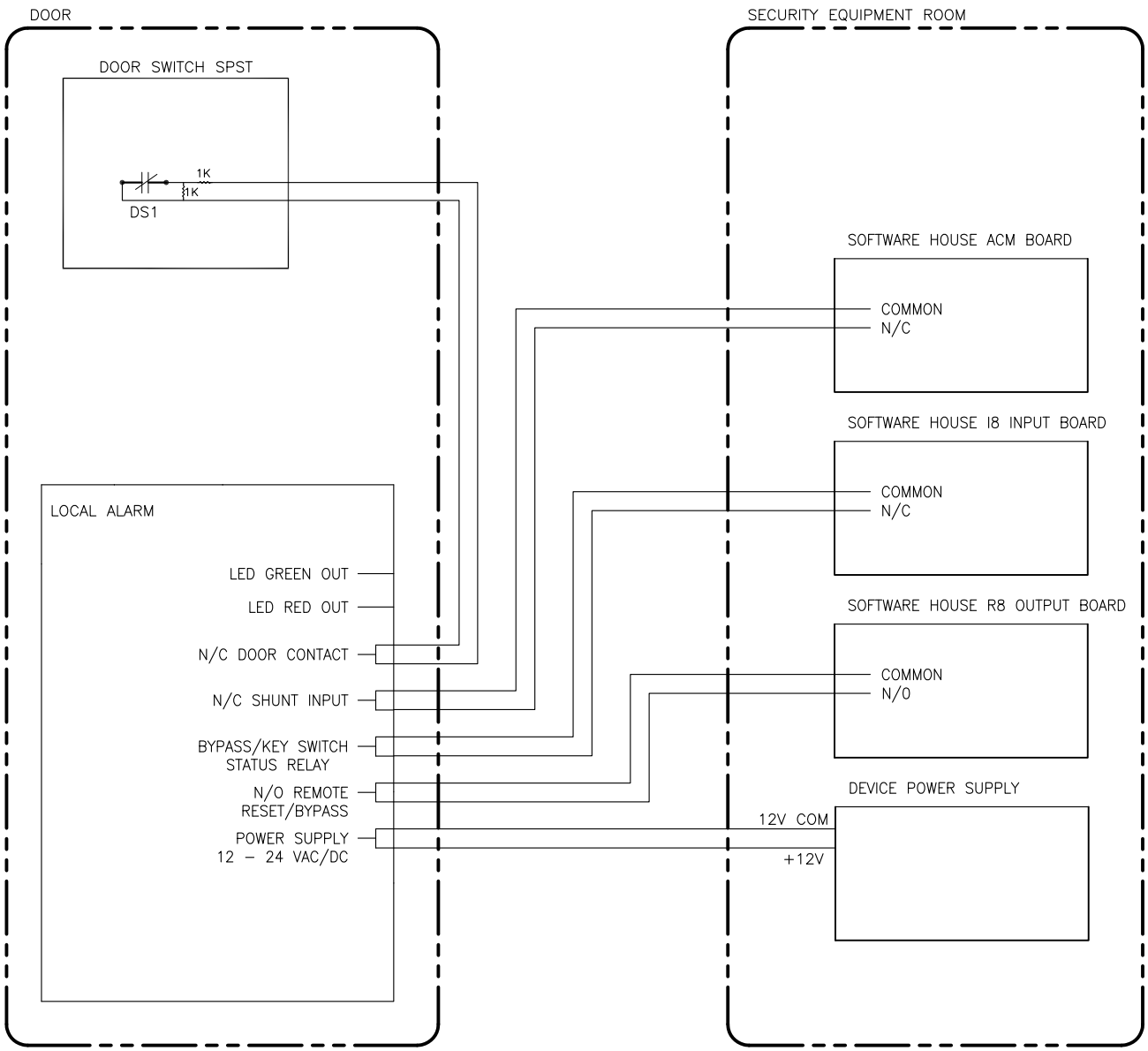
PROJECT NAME:
SECURITY DESIGN GUIDELINES

DESCRIPTION:
TYPICAL
SINGLE DOOR
CONTACT WIRING

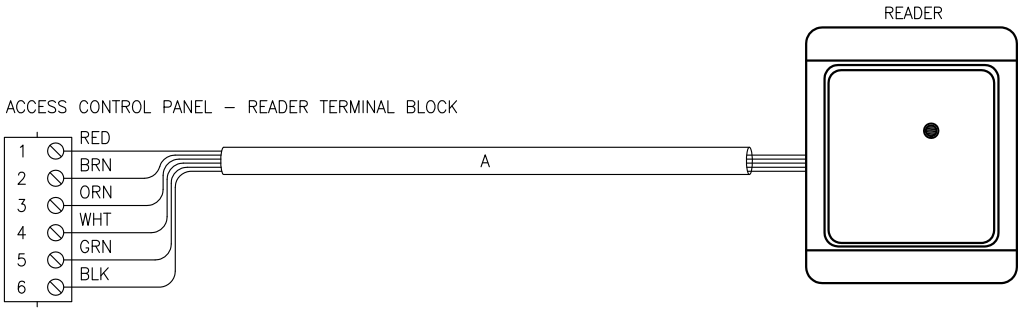
SKETCH No:	SY0.12
DATE:	07.05.11
REVISION:	
SCALE:	NTS



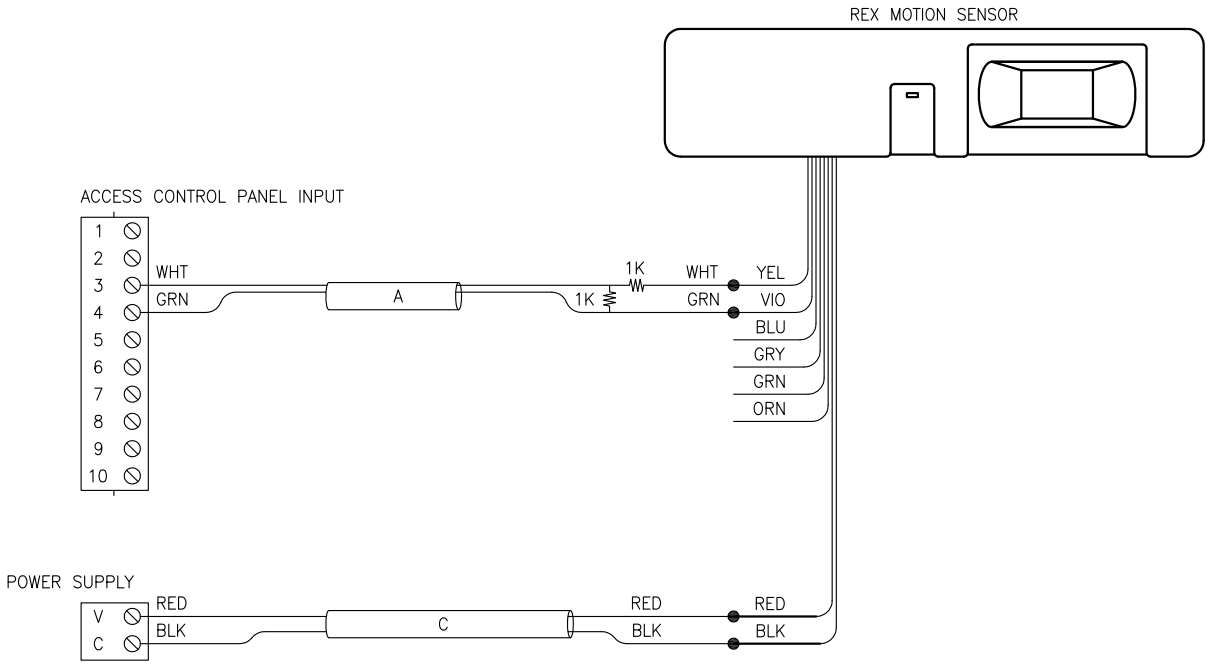
CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL DOUBLE DOOR CONTACT WIRING	SKETCH No: SY0.13
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS



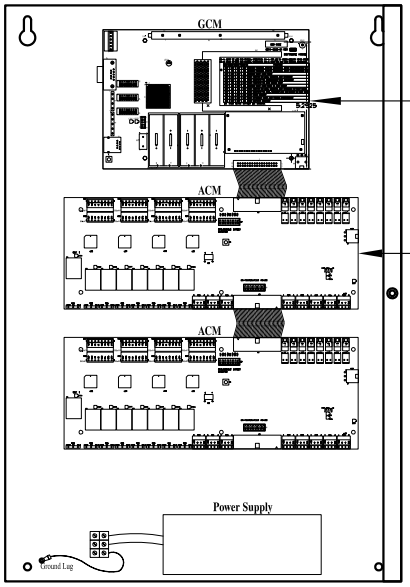
Contra Costa Community College District — pathways to success	CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL LOCAL ALARM WIRING
PROJECT NAME: SECURITY DESIGN GUIDELINES		SKETCH No: SY0.14
		DATE: 07.05.11
		REVISION:
		SCALE: NTS



CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL CARD READER WIRING	SKETCH No: SY0.15
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS



CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL REQUEST–TO–EXIT WIRING	SKETCH No: SY0.16
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: NTS



SOFTWARE HOUSE
GCM II MODULE

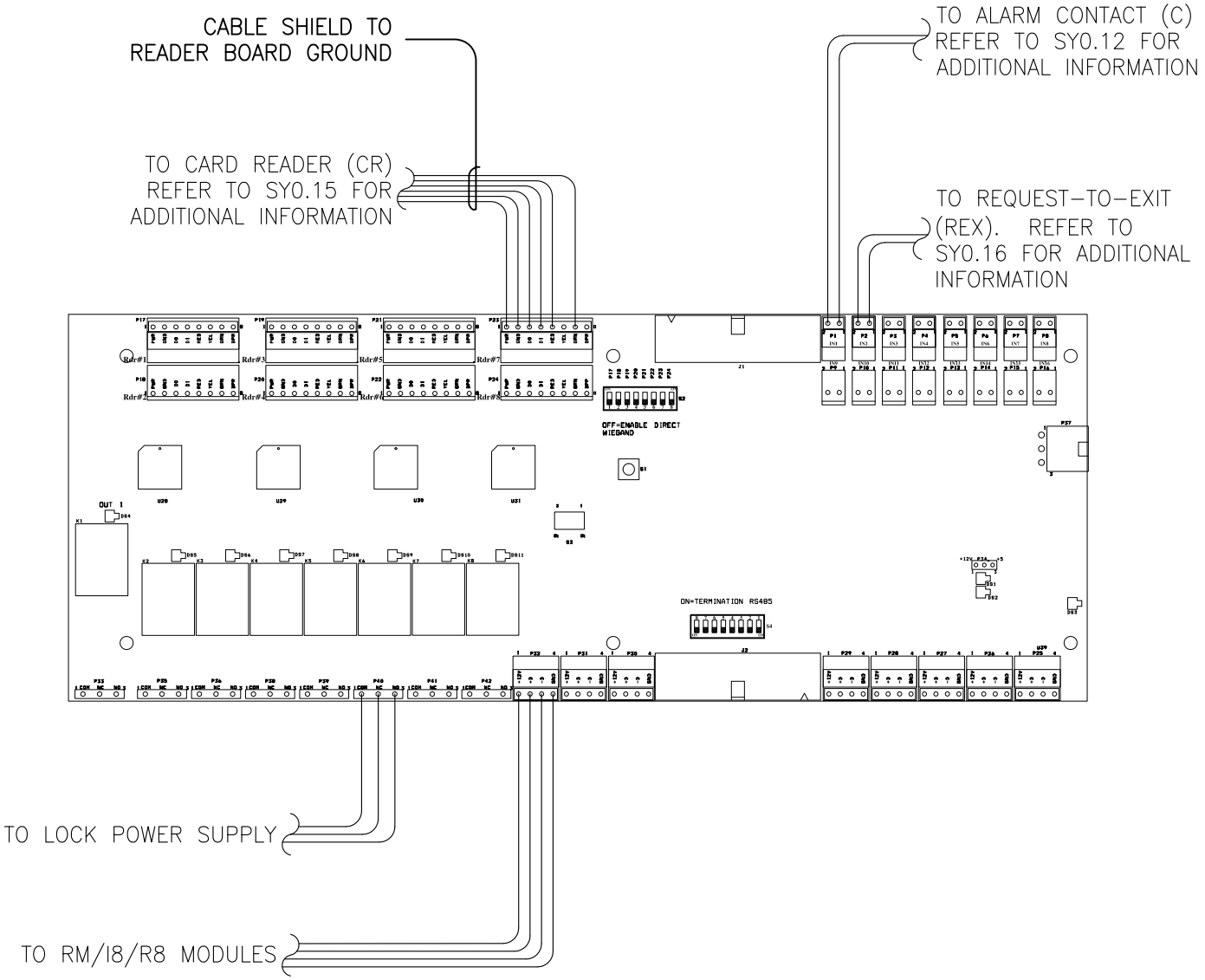
SOFTWARE HOUSE
ACM II MODULE

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

PROJECT NAME:
SECURITY DESIGN GUIDELINES

DESCRIPTION:
TYPICAL iSTAR PRO PANEL LAYOUT

SKETCH No:	SY0.17
DATE:	07.05.11
REVISION:	
SCALE:	1-1/2"=1'-0"



CONTRA COSTA COMMUNITY COLLEGE DISTRICT	DESCRIPTION: TYPICAL SOFTWARE HOUSE ACM II WIRING DIAGRAM	SKETCH No: SY0.18
		DATE: 07.05.11
		REVISION:
PROJECT NAME: SECURITY DESIGN GUIDELINES		SCALE: 6"=1'–0"

SECURITY SYMBOLS LIST

SOME OF THESE SYMBOLS SHOWN MAY NOT BE USED ON THIS PROJECT

SECURITY

SYMBOL	DESCRIPTION	MANUFACTURER	MODEL NO.
CR	CARD READER	–	–
EL	ELECTRIC MORTISE LOCK	–	–
TH	TRANSFER HINGE	–	–
RX	REQUEST TO EXIT MOTION SENSOR	–	–
C	MAGNETIC CONTACT	–	–
X	DOOR DETECTIVE; OPTICAL TURNSTILE	–	–
R	LIFE SAFETY REMOTE RELAY	–	–
LA	LOCAL AUDIBLE ALARM	–	–
E	EMERGENCY DOOR RELEASE	–	–
FIX	FIXED IP CAMERA	–	–
	SECURITY CABINET	–	–
(P)	INDICATES PROTECTED SIDE OF DOOR	–	–

POWER & LIGHTING

ALL BY EC

ELECTRICAL PANELBOARD, SURFACE MOUNTED.

DUPLEX CONVENIENCE OUTLET, WALL MOUNTED, +18" UON.

RACEWAYS

ALL BY EC, UON

CONDUIT RUN EXPOSED ON WALL OR CEILING.

CONDUIT RUN CONCEALED IN SLAB, UNDER SLAB OR UNDERGROUND.

CONDUIT RUN CONCEALED IN WALL OR CEILING.

CONDUIT HOMERUN, CONTINUOUS RUN TO PANEL OR EQUIPMENT CABINET.

CONDUIT TURNED UP.

CONDUIT TURNED DOWN.

MAIN J-HANGER CABLE ROUTING PATHWAY.

CONDUIT STUB THROUGH WALL OR FLOOR, NUMBERS INDICATE SIZE AND QUANTITY.

CONVENTIONS

001 — DOOR NUMBER

1 / SY1.1 — DETAIL REFERENCE
- SHEET NUMBER (T=TELECOM SY=SECURITY)
- DETAIL DESIGNATION

1 / SY11 — ELEVATION REFERENCE
- SHEET NUMBER (T=TELECOM SY=SECURITY)
- DETAIL DESIGNATION

SY.001 / CR001 — SECURITY DEVICE REFERENCE
- DETAIL DESIGNATION
- DEVICE ID
- SHEET NUMBER

CR001 — SECURITY DEVICE ID REFERENCE
- DEVICE NUMBER
- DEVICE TYPE
  - CR = CARD READER
  - A = ALARM INPUT
  - R = RELAY OUTPUT
  - IC = INTERCOM STATION
  - K = CCTV CAMERA

SECURITY GENERAL NOTES

APPLIES TO ALL SHEETS

1. MOUNTING HEIGHTS SHOWN ARE FROM FINISHED FLOOR TO THE CENTERLINE OF THE DEVICE. MOUNTING HEIGHTS SHALL BE AS SHOWN ON THE SYMBOLS LIST UNLESS OTHERWISE NOTED ON THE PLANS OR IN THE SPECIFICATIONS.
2. ELECTRICAL MATERIALS AND EQUIPMENT LISTED BY UNDERWRITERS LABORATORIES AND BEAR THEIR LABEL, UON.
3. CONDUIT AND RACEWAY PENETRATIONS THROUGH FIRE RATED WALLS AND FLOORS TO MAINTAIN THE FIRE SEPARATION RATING.
4. PROVIDE PLASTIC BUSHINGS ON EXPOSED ENDS OF CONDUIT AND SLEEVES.
5. SECURITY DOOR HARDWARE FAIL SECURE, UON.
6. EGRESS HARDWARE SHALL BE OPERABLE AT ALL TIMES. SECURITY HARDWARE SHALL NOT PROHIBIT EGRESS.
7. INTERFACE SECURITY CONTROLLED DOOR HARDWARE WITH THE FIRE ALARM SYSTEM AS TO NOT IMPEDE EXITING UNDER FIRE ALARM CONDITIONS
8. PROVIDE EXPANSION/DEFLECTION FITTING FOR CONDUITS CROSSING EXPANSION JOINTS.

WIRING DETAILS

CABLE	DESCRIPTION	MANUFACTURER	MODEL	CABLE O.D. (IN)	APPLICATION
A	16#18 AWG COMPOSITE CABLE	–	–	–	CR (6#18) / REX (4#) / DC (#2) / EL (#4)
B	4#22 AWG STRANDED CABLE PLENUM	–	–	–	DOOR CONTACT
C	2#18 AWG STRANDED CABLE PLENUM	–	–	–	INNER DEVICE CABLING

SHEET NUMBER / SHEET TITLE — ISSUE LOG

SHEET NUMBER	SHEET TITLE	SHOP DRAWINGS
SY0.01	SECURITY DRAWING INDEX & SYMBOLS LIST	X
SY0.11	SECURITY ACAMS BLOCK DIAGRAM	X
SY0.12	SECURITY ACAMS BLOCK DIAGRAM	X
SY0.13	SECURITY ACAMS BLOCK DIAGRAM	X
SY0.14	SECURITY CCTV BLOCK DIAGRAM	X
SY1.01	SECURITY RISER DIAGRAM	X
SY2.P1A	SECURITY PARKING LEVEL FLOOR PLAN NORTH	X
SY2.P1B	SECURITY PARKING LEVEL FLOOR PLAN SOUTH	X
SY2.01A	SECURITY GROUND FLOOR PLAN NORTH	X
SY2.01B	SECURITY SECOND FLOOR PLAN SOUTH	X
SY2.02A	SECURITY SECOND FLOOR PLAN NORTH	X
SY2.02B	SECURITY FOURTH FLOOR PLAN SOUTH	X
SY2.04A	SECURITY FOURTH FLOOR PLAN NORTH	X
SY2.04B	SECURITY FOURTH FLOOR PLAN SOUTH	X
SY3.01	PARKING LEVEL POINT-TO-POINT DIAGRAM	X
SY3.02	GROUND FLOOR POINT-TO-POINT DIAGRAM	X
SY3.03	SECOND FLOOR POINT-TO-POINT DIAGRAM	X
SY3.04	FOURTH FLOOR POINT-TO-POINT DIAGRAM	X
SY4.01	SECURITY EQUIPMENT ELEVATIONS	X
SY4.02	SECURITY EQUIPMENT ELEVATIONS	X
SY5.01	SECURITY DOOR DETAILS	X
SY5.02	SECURITY DOOR DETAILS	X
SY5.03	SECURITY CAMERA DETAILS	X
SY5.04	SECURITY DEVICE DETAILS	X
SY5.05	SECURITY DEVICE DETAILS	X
SY5.06	SECURITY DEVICE DETAILS	X
SY6.01	POINT-TO-POINT WIRING SCHEDULE	X

ISSUE LOG KEY:
" X " ISSUED AS PART OF A SET
" – " NOT A PART OF ISSUED SET

DATE: 08/24/07

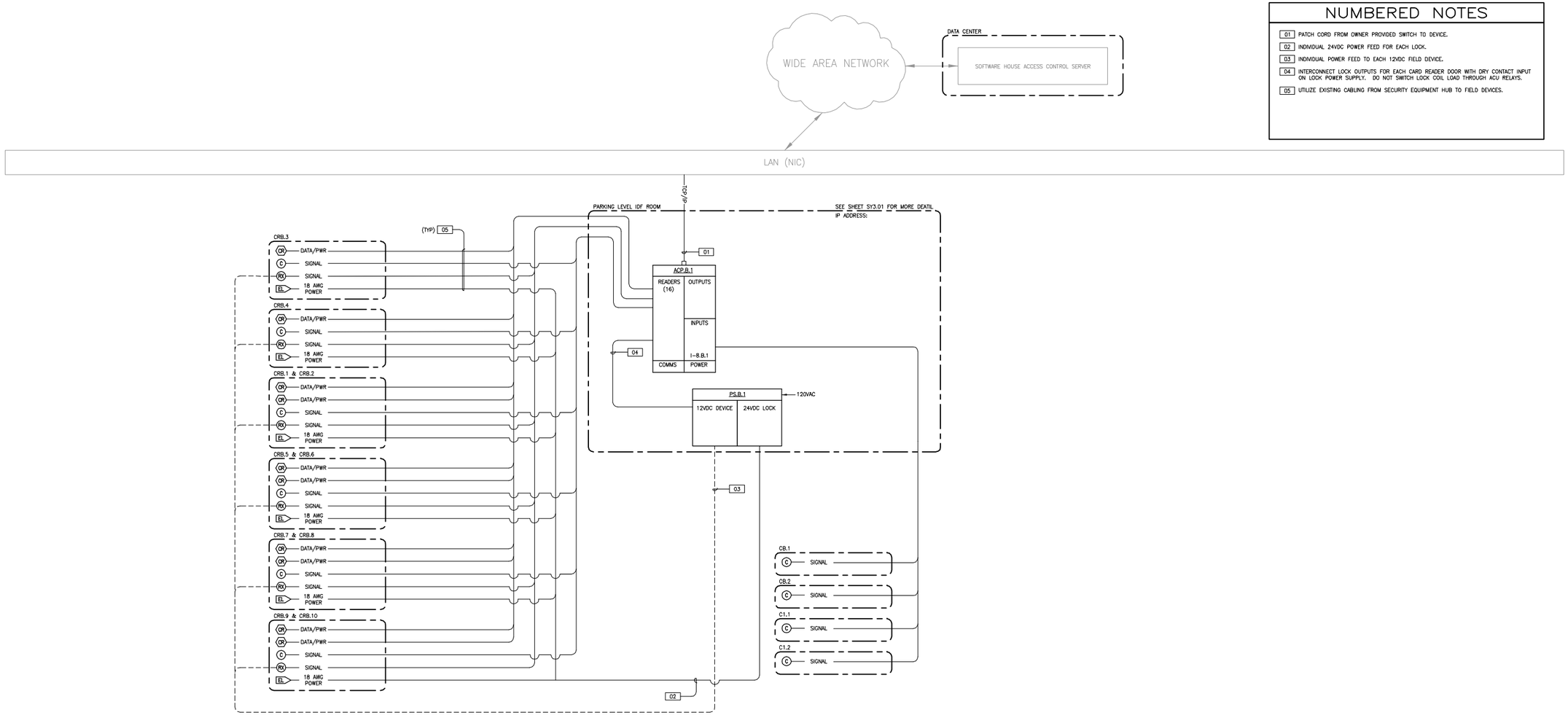
ABBREVIATIONS

A	AMPERES
ACS	ACCESS CONTROL AND ALARM MONITORING SYSTEM
AFF	ABOVE FINISHED FLOOR
AWG	AMERICAN WIRE GAUGE
BAS	BUILDING AUTOMATION SYSTEM
C	CONDUIT
CAT3	CATEGORY 3 (UTP CABLE)
CAT5	CATEGORY 5 (UTP CABLE)
CAT5E	CATEGORY 5E (UTP CABLE)
CAT6	CATEGORY 6 (UTP CABLE)
CATV	COMMUNITY ANTENNA TELEVISION
CEC	CCTV EQUIPMENT CABINET
DIV	DIVISION
(E)	EXISTING
EC	ELECTRICAL CONTRACTOR
EMS	ELECTRICAL MANAGEMENT SYSTEM
EMT	ELECTRIC METALLIC TUBING
(F)	FUTURE
FACP	FIRE ALARM CONTROL PANEL
FATC	FIRE ALARM TERMINAL CABINET
FO	FIBER OPTIC
GC	GENERAL CONTRACTOR
IDF	INTERMEDIATE DISTRIBUTION FACILITY
JB	JUNCTION BOX
LCP	LIGHTING CONTROL PANEL
MDF	MAIN DISTRIBUTION FACILITY
MH	MAINTENANCE HOLE
MPOE	MINIMUM POINT OF ENTRY
MT	EMPTY
(N)	NEW
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
OSP	OUTSIDE PLANT
PB	PULLBOX
PNL	PANEL
PR	PAIR (OF COPPER CONDUCTORS)
PVC	POLYVINYL CHLORIDE
SAD	SEE ARCHITECTURAL DRAWINGS
SEC	SECURITY EQUIPMENT CABINET
SM	SINGLEMODE
ScTP	SCREENED TWISTED PAIR
STR	STRANDS (OF FIBER)
STP	SHIELDED TWISTED PAIR
TBB	TELECOM BONDING BACKBONE
TBC	TELECOM BONDING CONDUCTOR
TGB	TELECOM GROUNDING BUSBAR
TMGB	TELECOM MAIN GROUNDING BUSBAR
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTIBLE POWER SUPPLY
UTP	UNSHIELDED TWISTED PAIR
V	VOLTS
WP	WEATHERPROOF

SAMPLE SHOP DRAWINGS

SECURITY DRAWING INDEX & SYMBOLS LIST

SY0.01



NUMBERED NOTES

01 PATCH CORD FROM OWNER PROVIDED SWITCH TO DEVICE.

02 INDIVIDUAL 24VDC POWER FEED FOR EACH LOCK.

03 INDIVIDUAL POWER FEED TO EACH 12VDC FIELD DEVICE.

04 INTERCONNECT LOCK OUTPUTS FOR EACH CARD READER DOOR WITH DRY CONTACT INPUT ON LOCK POWER SUPPLY. DO NOT SWITCH LOCK COIL LOAD THROUGH ACU RELAYS.

05 UTILIZE EXISTING CABLING FROM SECURITY EQUIPMENT HUB TO FIELD DEVICES.

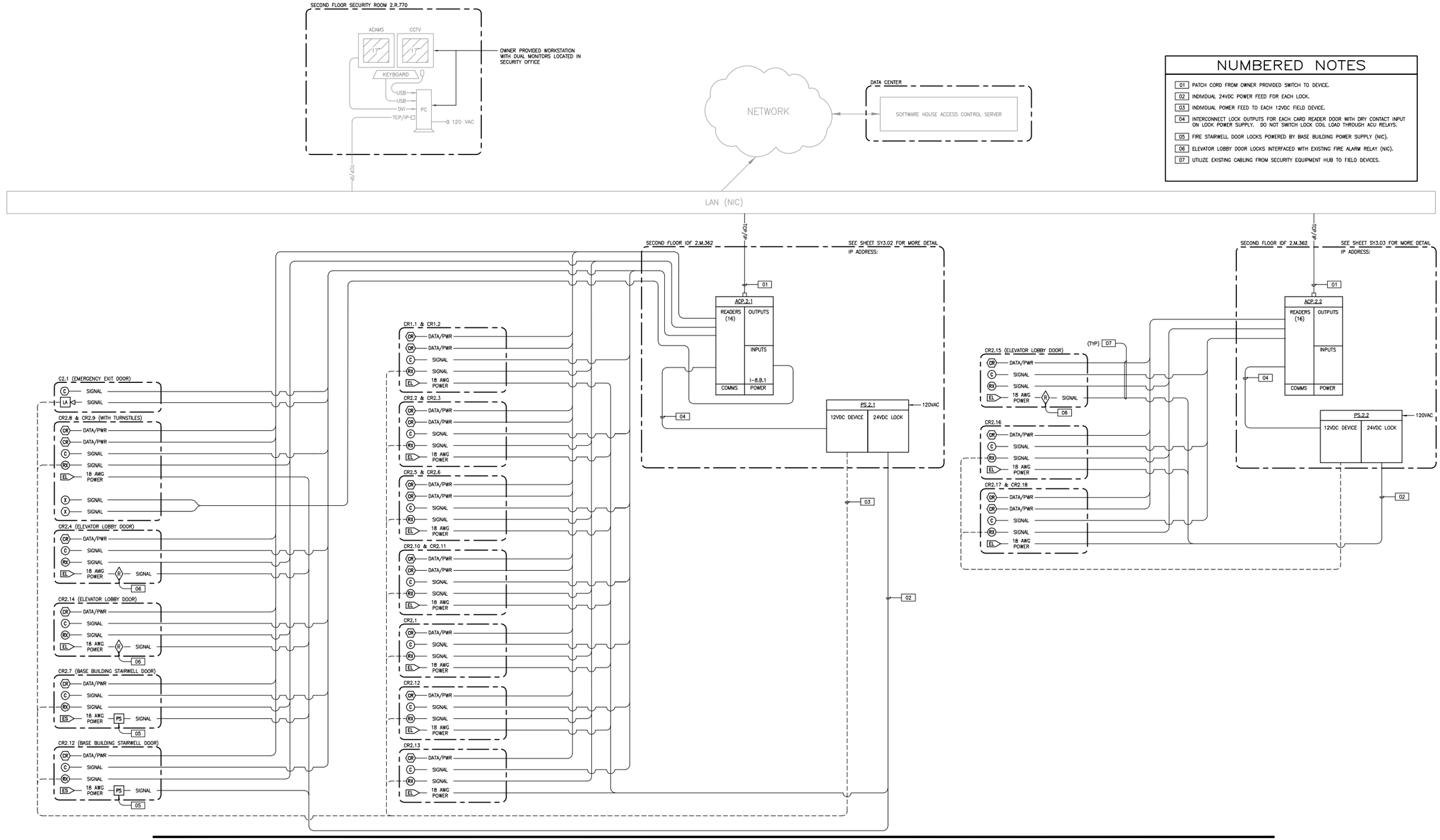
ACAMS BLOCK DIAGRAM (PARKING LEVEL)
SCALE: N.T.S.

1

SAMPLE
SHOP
DRAWINGS

SECURITY
ACAMS
BLOCK DIAGRAM

SY0.11



ACAMS BLOCK DIAGRAM (2ND FLOOR)

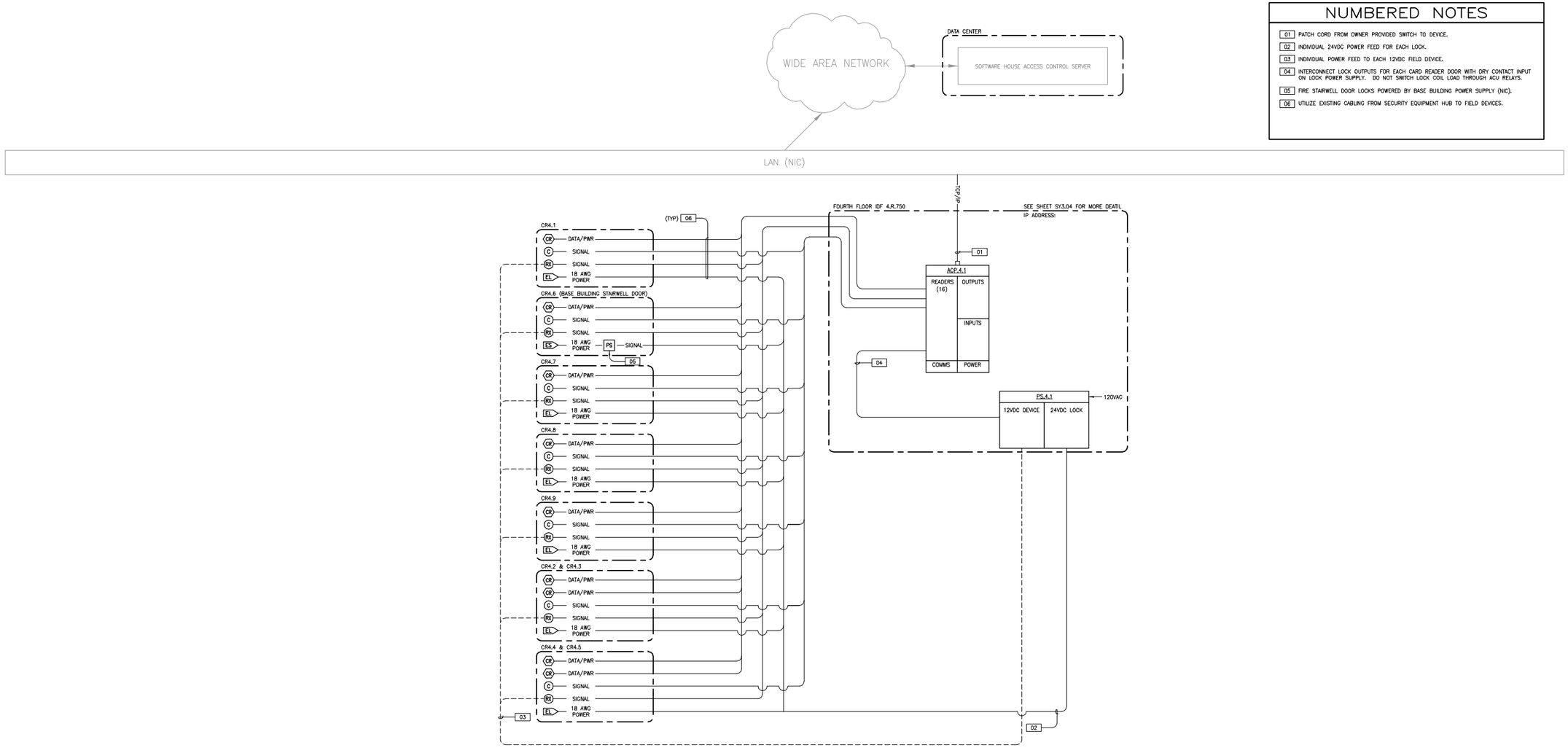
SCALE: N.T.S.

1

SAMPLE
SHOP
DRAWINGS

SECURITY
ACAMS
BLOCK DIAGRAM

SY0.12



NUMBERED NOTES

01 PATCH CORD FROM OWNER PROVIDED SWITCH TO DEVICE.

02 INDIVIDUAL 24VDC POWER FEED FOR EACH LOCK.

03 INDIVIDUAL POWER FEED TO EACH 12VDC FIELD DEVICE.

04 INTERCONNECT LOCK OUTPUTS FOR EACH CARD READER DOOR WITH DRY CONTACT INPUT ON LOCK POWER SUPPLY. DO NOT SWITCH LOCK COIL LOAD THROUGH ACU RELAYS.

05 FIRE STAIRWELL DOOR LOCKS POWERED BY BASE BUILDING POWER SUPPLY (NIC).

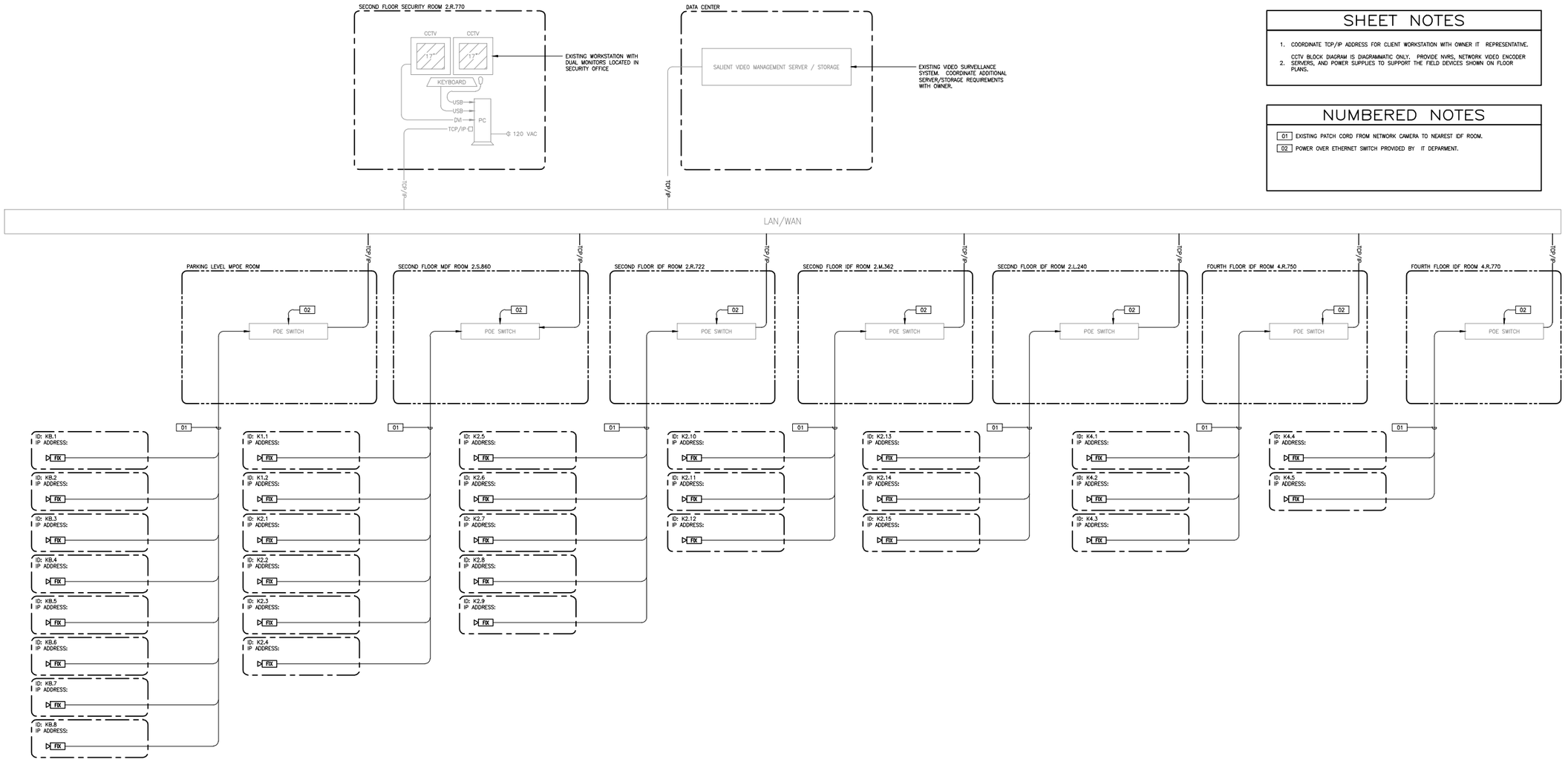
06 UTILIZE EXISTING CABLING FROM SECURITY EQUIPMENT HUB TO FIELD DEVICES.

ACAMS BLOCK DIAGRAM (FOURTH FLOOR) **1**
SCALE: N.T.S.

SAMPLE
SHOP
DRAWINGS

SECURITY
ACAMS
BLOCK DIAGRAM

SY0.13



SHEET NOTES

1. COORDINATE TCP/IP ADDRESS FOR CLIENT WORKSTATION WITH OWNER IT REPRESENTATIVE.
2. CCTV BLOCK DIAGRAM IS DIAGRAMMATIC ONLY. PROVIDE NVRS, NETWORK VIDEO ENCODER SERVERS, AND POWER SUPPLIES TO SUPPORT THE FIELD DEVICES SHOWN ON FLOOR PLANS.

NUMBERED NOTES

01 EXISTING PATCH CORD FROM NETWORK CAMERA TO NEAREST IDF ROOM.

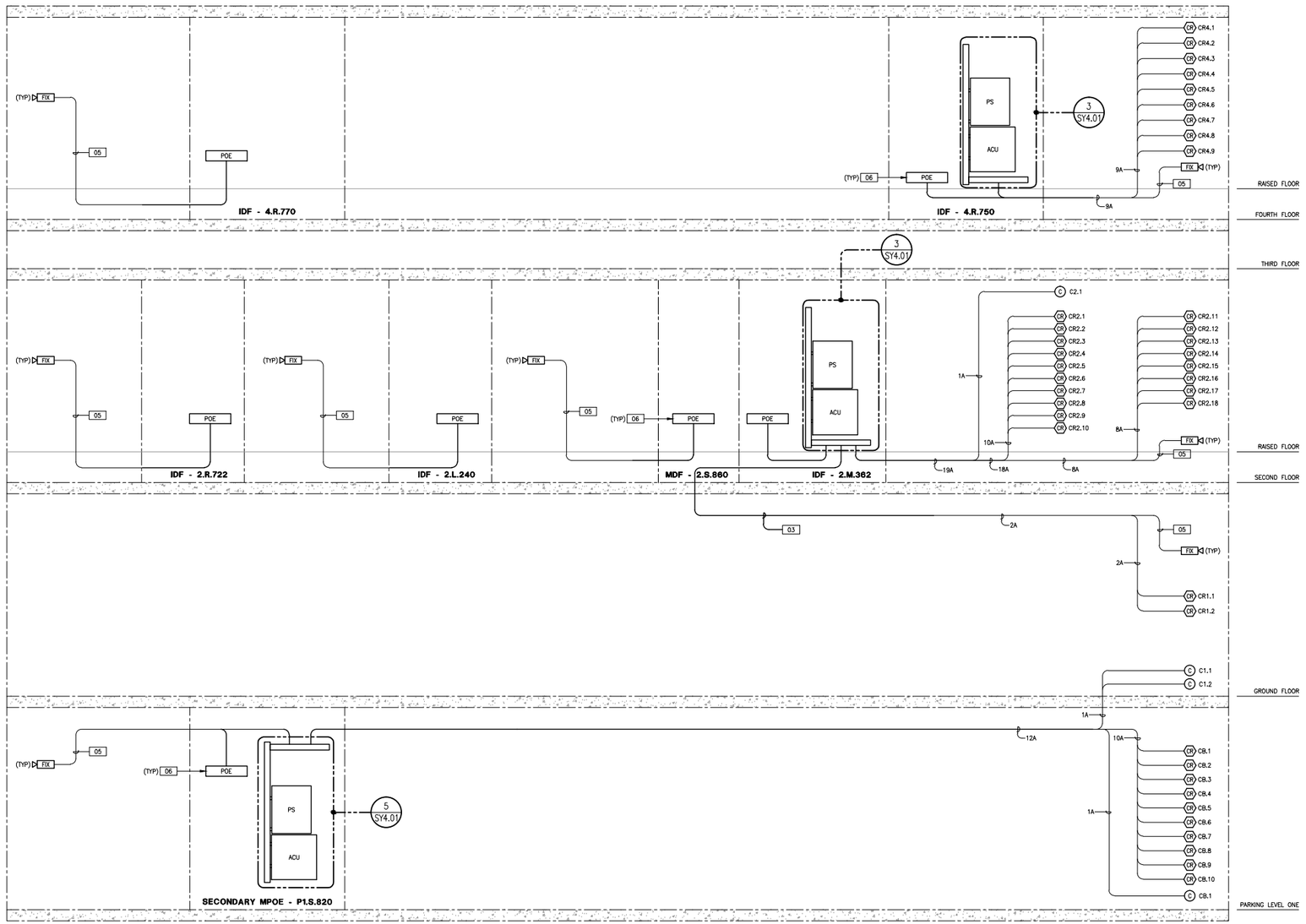
02 POWER OVER ETHERNET SWITCH PROVIDED BY IT DEPARMENT.

VSS BLOCK DIAGRAM 1
SCALE: N.T.S.

SAMPLE
SHOP
DRAWINGS

SECURITY
VSS
BLOCK DIAGRAM

SY0.14



SHEET NOTES

1. THIS DRAWING REPRESENTS A DIAGRAMMATIC OVERVIEW OF THE SECURITY SYSTEM. REFER TO FLOOR PLANS FOR ESTIMATING PATHWAY AND CABLE LENGTHS.
2. SECURITY SYSTEM RACEWAY, SEC ENCLOSURES, AND RISER PULL BOXES PROVIDED BY ELECTRICAL CONTRACTOR AS SHOWN ON TELECOM DRAWINGS. SHOWN FOR REFERENCE ONLY.

NUMBERED NOTES

01 UTILIZE JUNCTION BOX IN BASE BUILDING RISER ROOMS SHOWN ON TELECOM DRAWINGS.

02 UTILIZE 4" RISER CONDUITS SHOWN ON TELECOM DRAWINGS.

03 (1) 2" CONDUIT FROM GROUND FLOOR DEVICES ROUTED THROUGH SUB FLOOR OF MDF TO IDF ROOM 2.M.362.

04 (1) 2" CONDUIT STUBBED FROM FINISHED FLOOR INTO SECURITY OFFICE WALL FOR SECURITY MONITORS, JOYSTICK CONTROLLER, AND TO ALLOW FOR FUTURE EXPANSION. COORDINATE EXACT LOCATION WITH OWNER.

05 USE EXISTING CAT6A CABLE FOR IP CAMERA.

06 EXISTING POE SWITCH.

SECURITY RISER DIAGRAM

SCALE: NONE

1

SAMPLE
SHOP
DRAWINGS

SECURITY
RISER
DIAGRAM

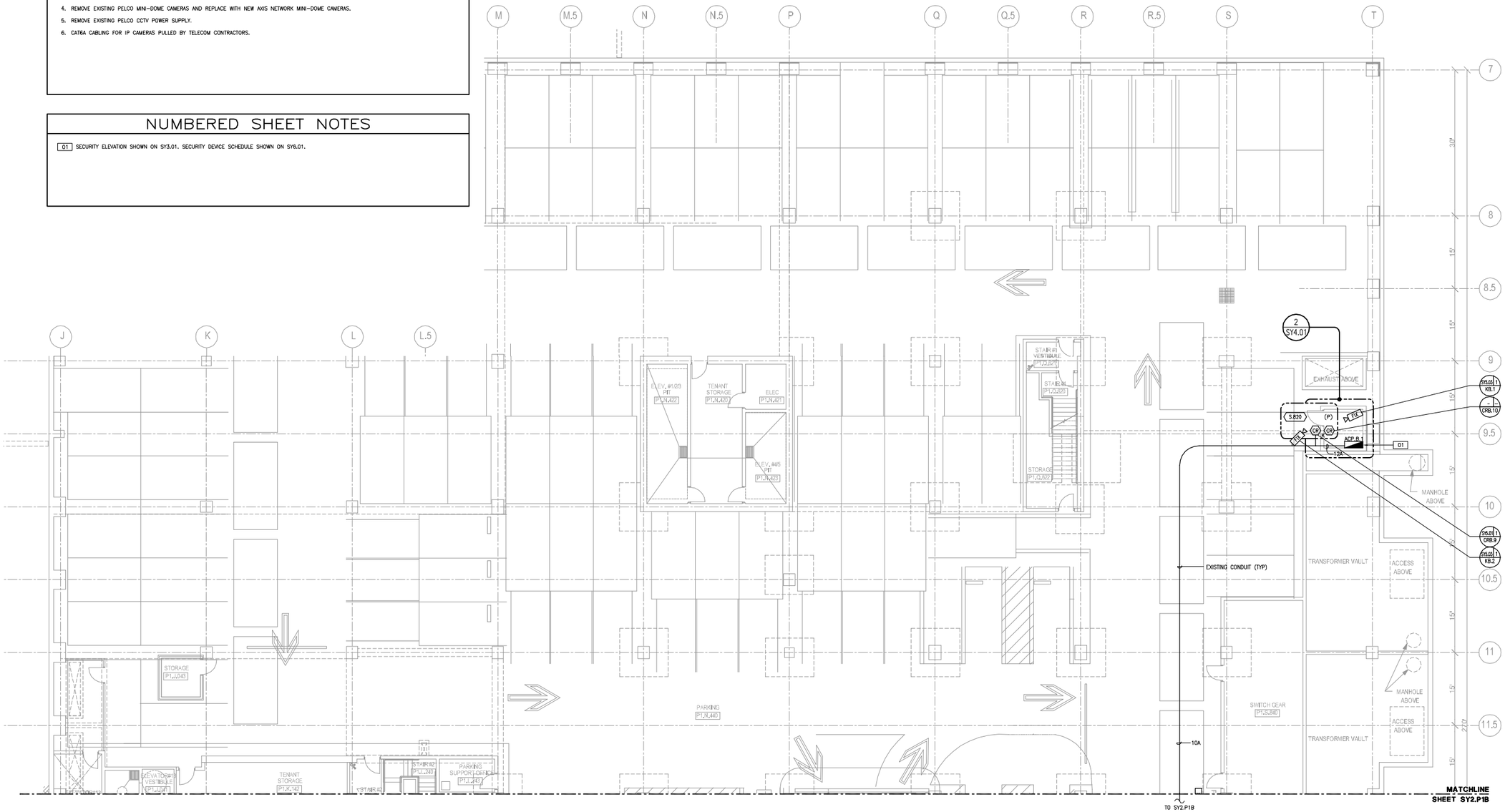
SY1.01

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM MPOE ROOM P1.S.820.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING GEOFFREY ACCESS CONTROL PANELS AND REPLACE WITH NEW SOFTWARE HOUSE PANELS.
4. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
5. REMOVE EXISTING PELCO CCTV POWER SUPPLY.
6. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTORS.

NUMBERED SHEET NOTES

01 SECURITY ELEVATION SHOWN ON SY3.01. SECURITY DEVICE SCHEDULE SHOWN ON SY6.01.



SECURITY PARKING LEVEL PLAN NORTH 1

SCALE: 1/8" = 1'-0"

SAMPLE SHOP DRAWINGS

SECURITY PARKING LEVEL PLAN NORTH

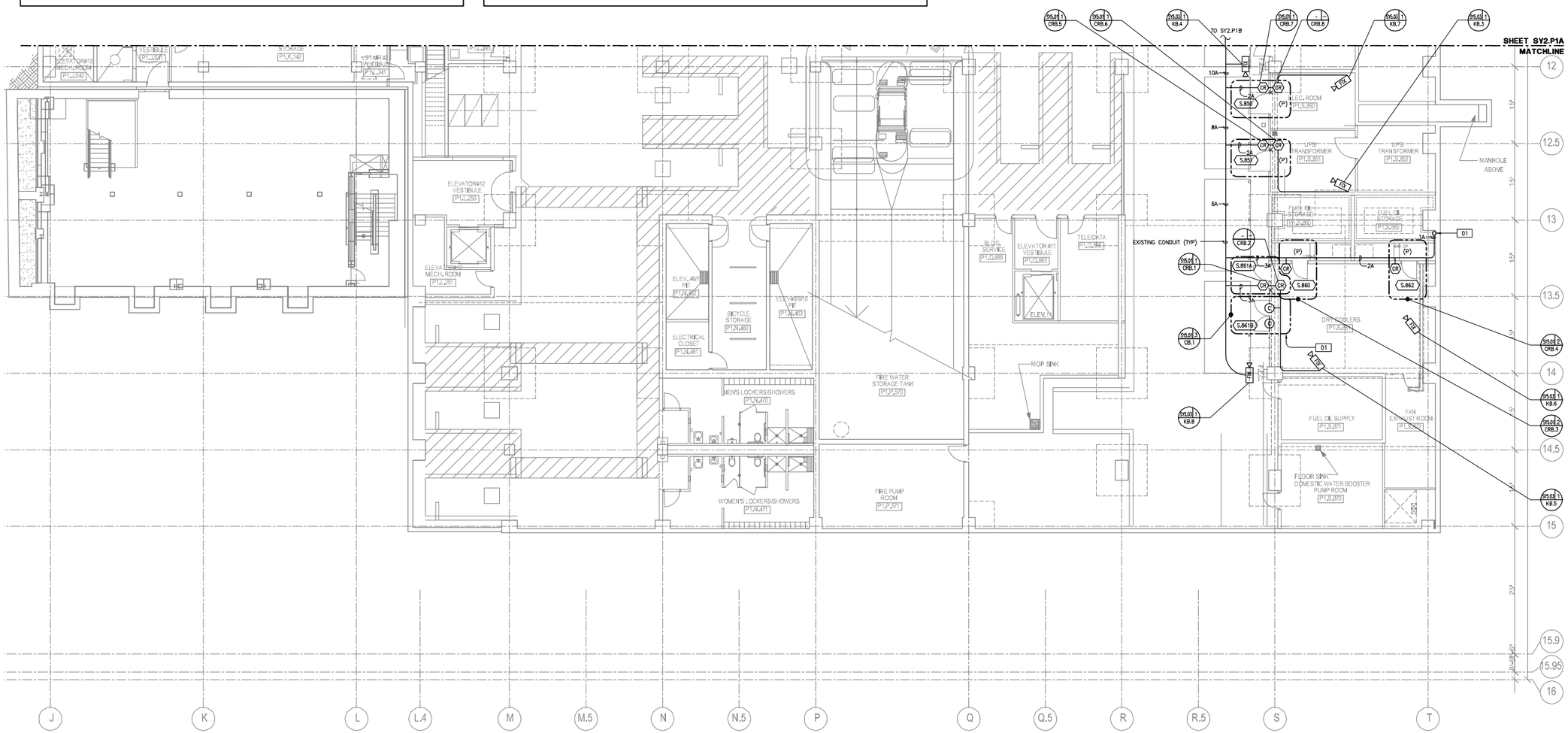
SY2.P1A

NUMBERED NOTES CONT.

01 EXISTING CONDUIT STUBBED TO GROUND FLOOR FOR EXTERIOR FUEL VAULT HATCH SECURITY CONTACTS. SHOWN FOR REFERENCE ONLY.

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM MPOE ROOM P1.S.820.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING GEOFFREY ACCESS CONTROL PANELS AND REPLACE WITH NEW SOFTWARE HOUSE PANELS.
4. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
5. REMOVE EXISTING PELCO CCTV POWER SUPPLY.
6. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.



SECURITY PARKING LEVEL PLAN SOUTH 1
SCALE: 1/8" = 1'-0"

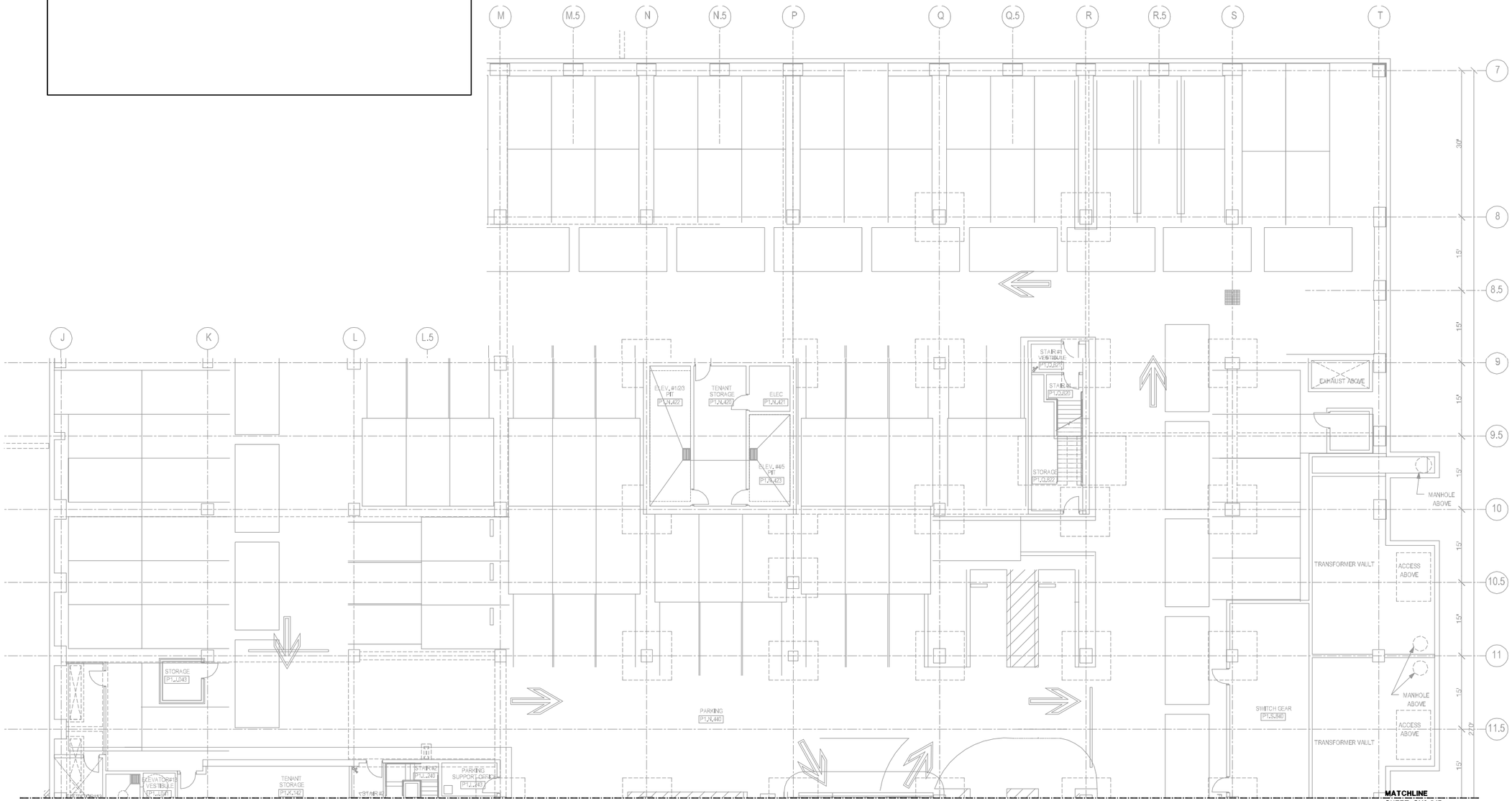
SAMPLE SHOP DRAWINGS

SECURITY PARKING LEVEL PLAN SOUTH

SY2.P1B

SHEET NOTES

1. NO SECURITY DEVICES ON THIS SHEET.



SECURITY GROUND FLOOR PLAN NORTH **1**
SCALE: 1/8" = 1'-0"

SAMPLE SHOP DRAWINGS

SECURITY GROUND FLOOR PLAN NORTH

SY2.01A

NUMBERED NOTES

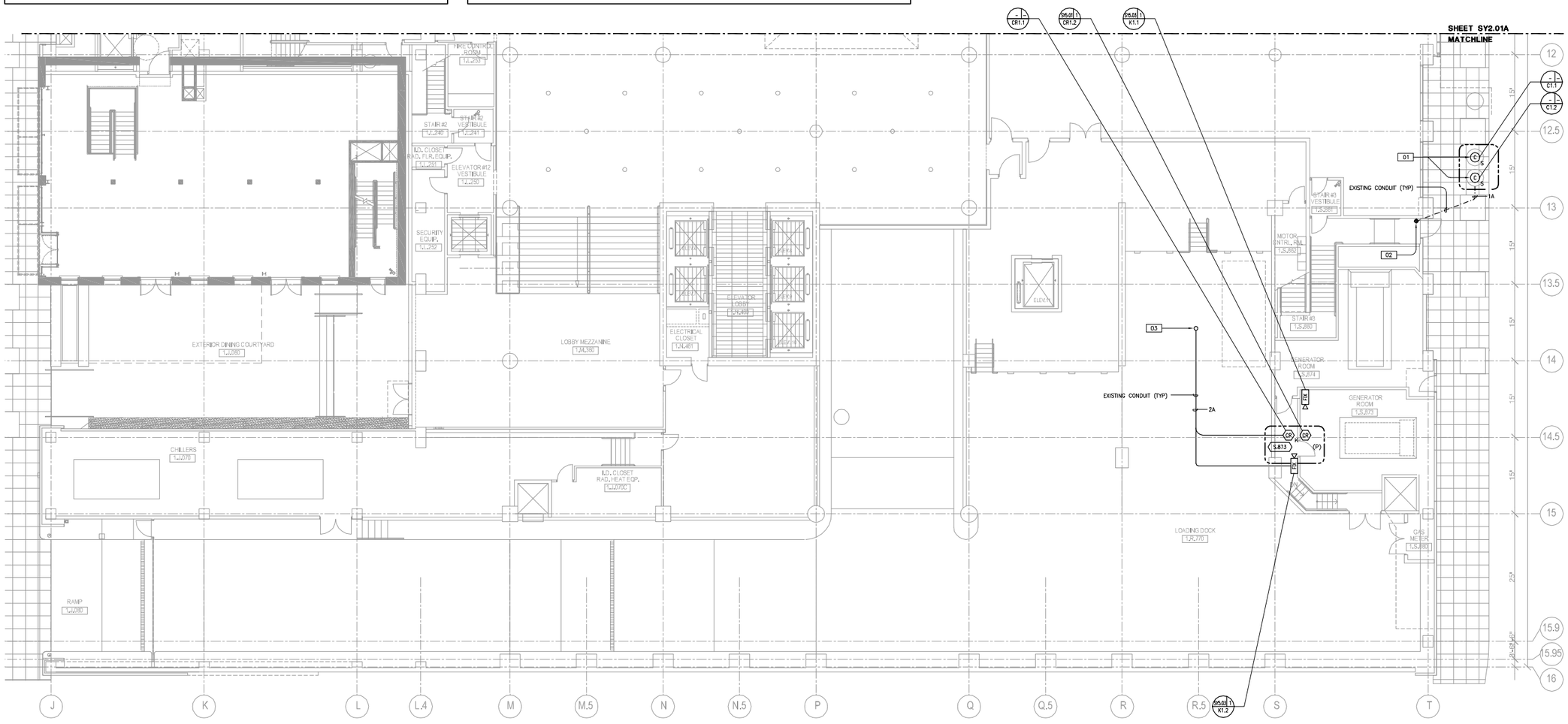
01 CONNECT EXISTING ALARM POINT(S) TO NEW SOFTWARE HOUSE ACCESS CONTROL PANELS. NO ADDITIONAL WORK IS NECESSARY AND ALARM POINT(S) ARE SHOWN FOR REFERENCE ONLY.

02 CONDUIT STUBBED DOWN TO PARKING LEVEL FUEL STORAGE AREA P1.S.862. REFER TO SY2.P1 FOR CONDUIT CONTINUATION.

03 CONDUIT STUBBED UP TO MDF ROOM 2.S.860 SUB FLOOR.

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM IDF ROOM 2.M.362.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
4. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.



SECURITY GROUND FLOOR PLAN 1
SCALE: 1/8" = 1'-0"

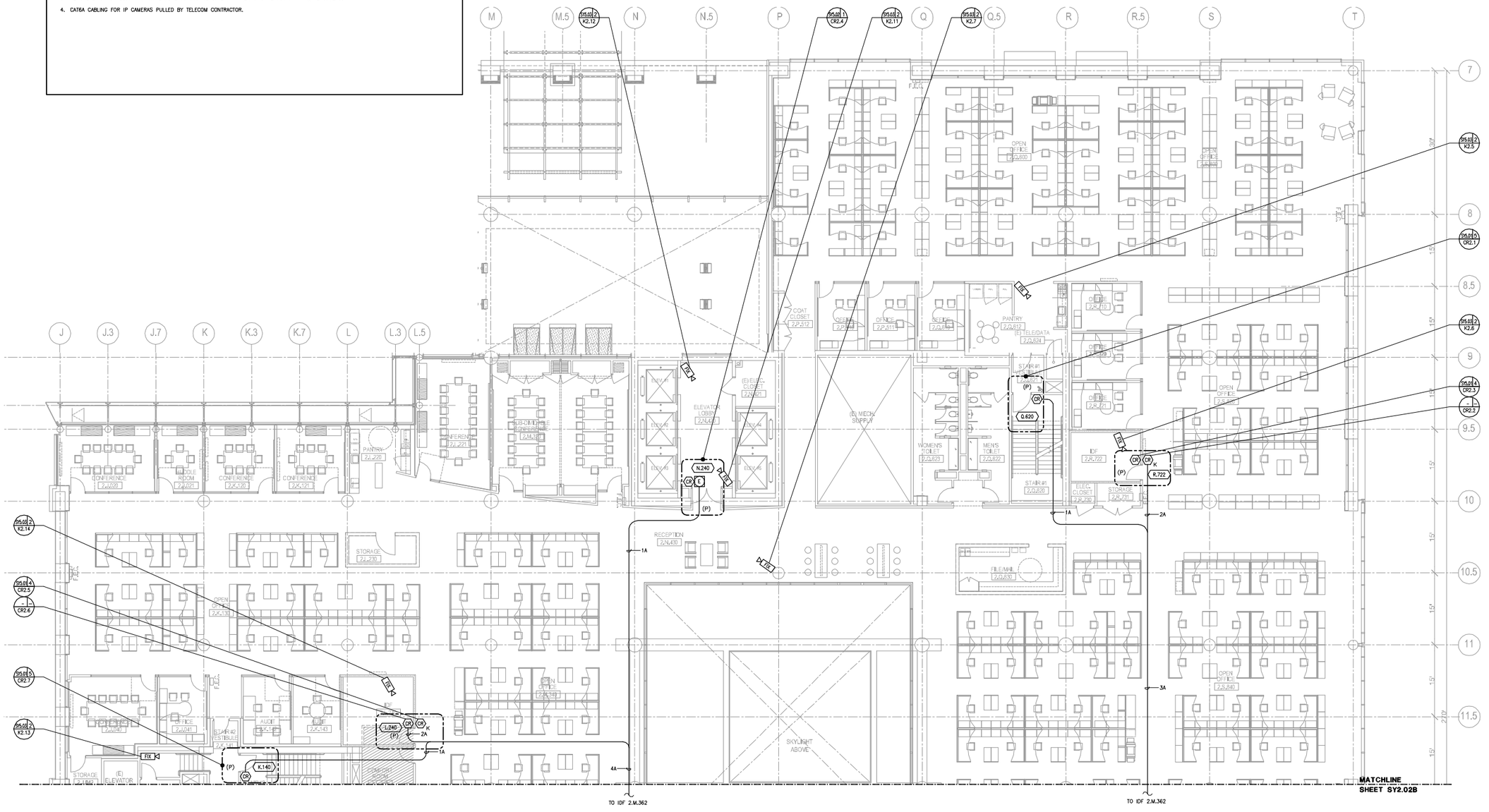
SAMPLE SHOP DRAWINGS

SECURITY GROUND FLOOR PLAN SOUTH

SY2.01B

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM IDF ROOM 2.M.362.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
4. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.



SECURITY SECOND FLOOR PLAN NORTH 1

SCALE: 1/8" = 1'-0"

SAMPLE SHOP DRAWINGS

SECURITY SECOND FLOOR PLAN NORTH

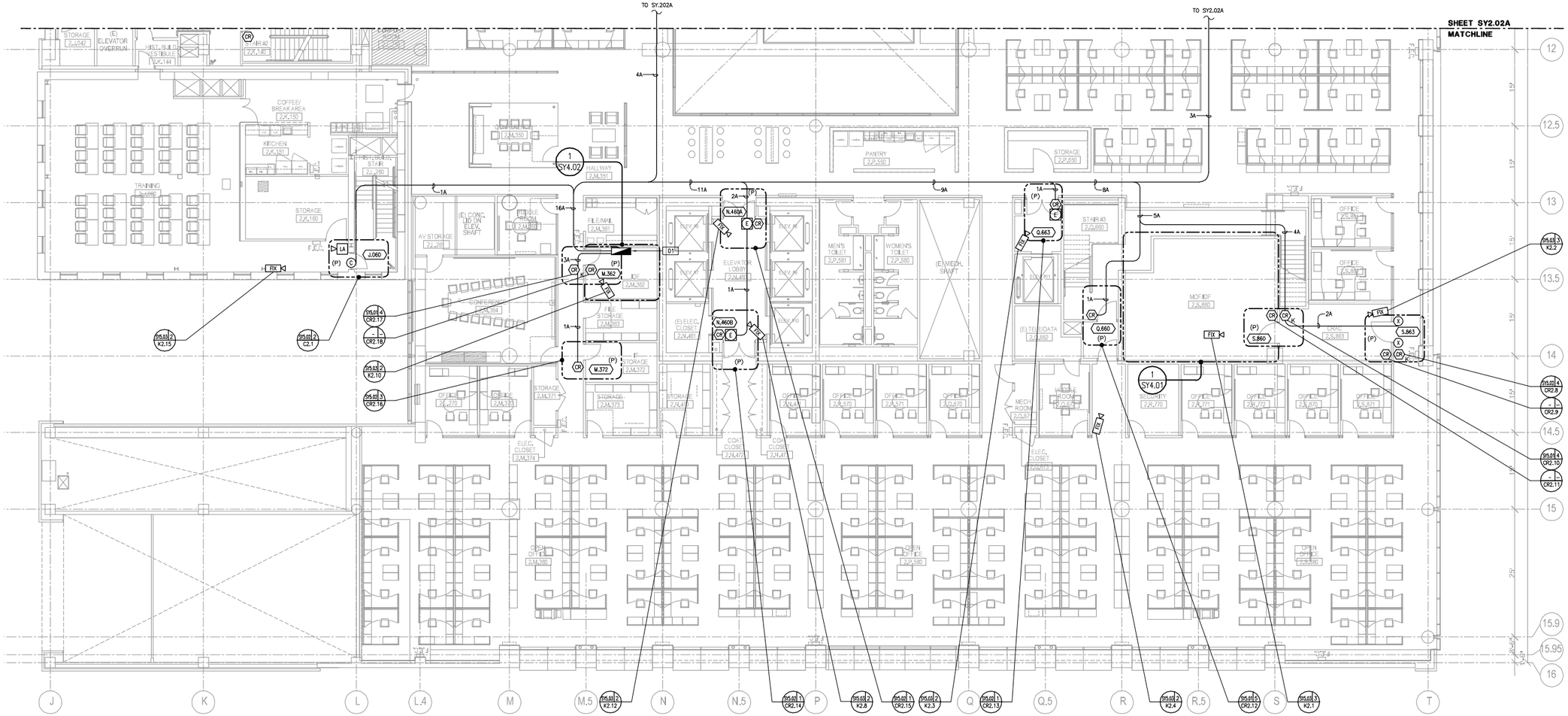
SY2.02A

NUMBERED SHEET NOTES

01 SECURITY ELEVATION FOR ACP.2.1 AND ACP.2.2 SHOWN ON SY3.02 AND SY3.03. SECURITY DEVICE SCHEDULE SHOWN ON SY6.01.

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM IDF ROOM 2.M.362.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
4. SECURITY CABINET ON THIS FLOOR CONTAINS I-STAR PRO AND OTHER PANELS. ASSOCIATED SCHEDULE ON SHEETS SY3.02 AND SY3.03.
5. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.



SECURITY SECOND FLOOR PLAN 1
SCALE: 1/8" = 1'-0"

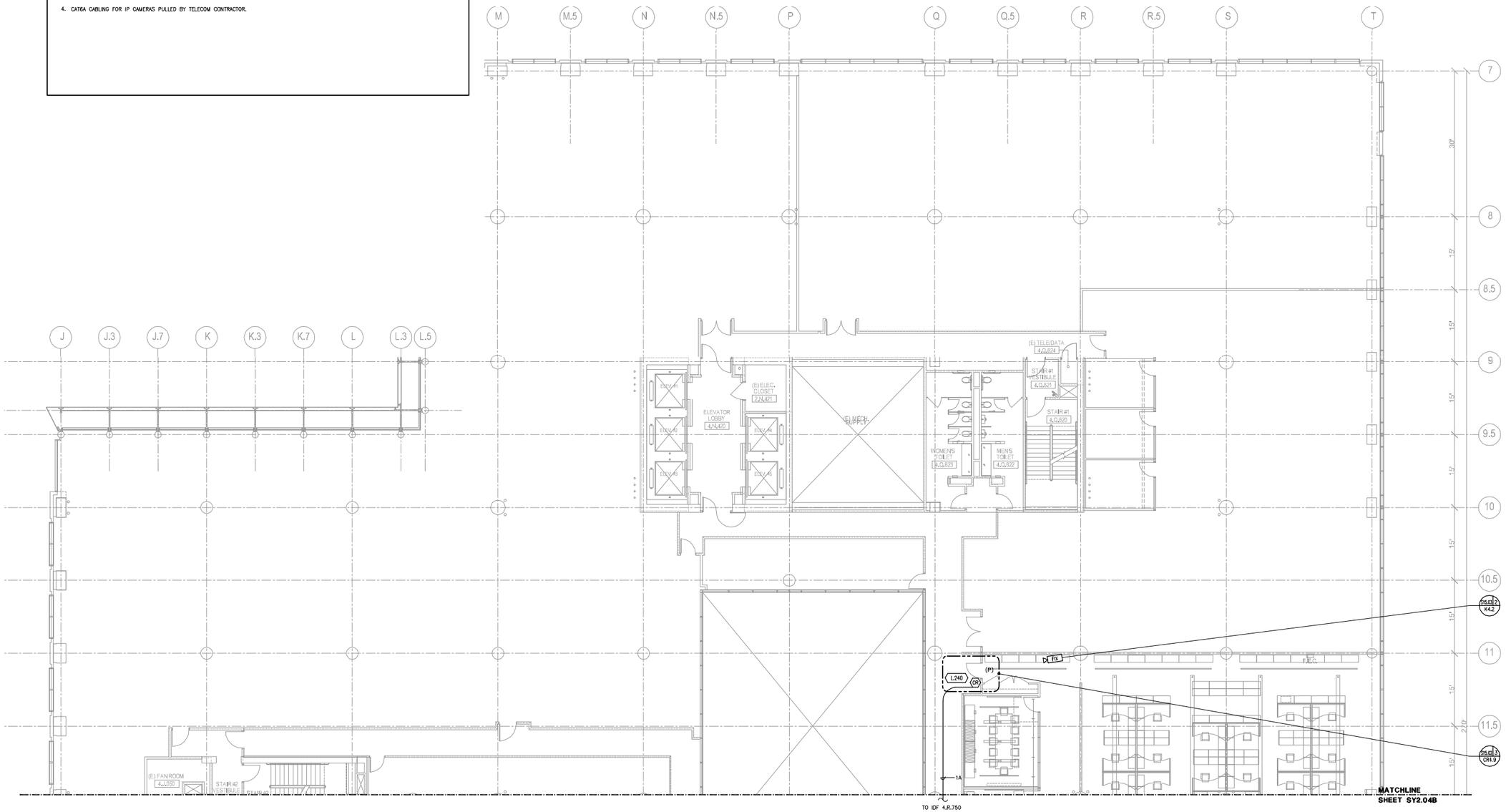
SAMPLE SHOP DRAWINGS

SECURITY SECOND FLOOR PLAN SOUTH

SY2.02B

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM IDF ROOM 4.R.750.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
4. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.



SECURITY FOURTH FLOOR PLAN NORTH **1**
SCALE: 1/8" = 1'-0"

SAMPLE
SHOP
DRAWINGS

SECURITY
FOURTH FLOOR PLAN
NORTH

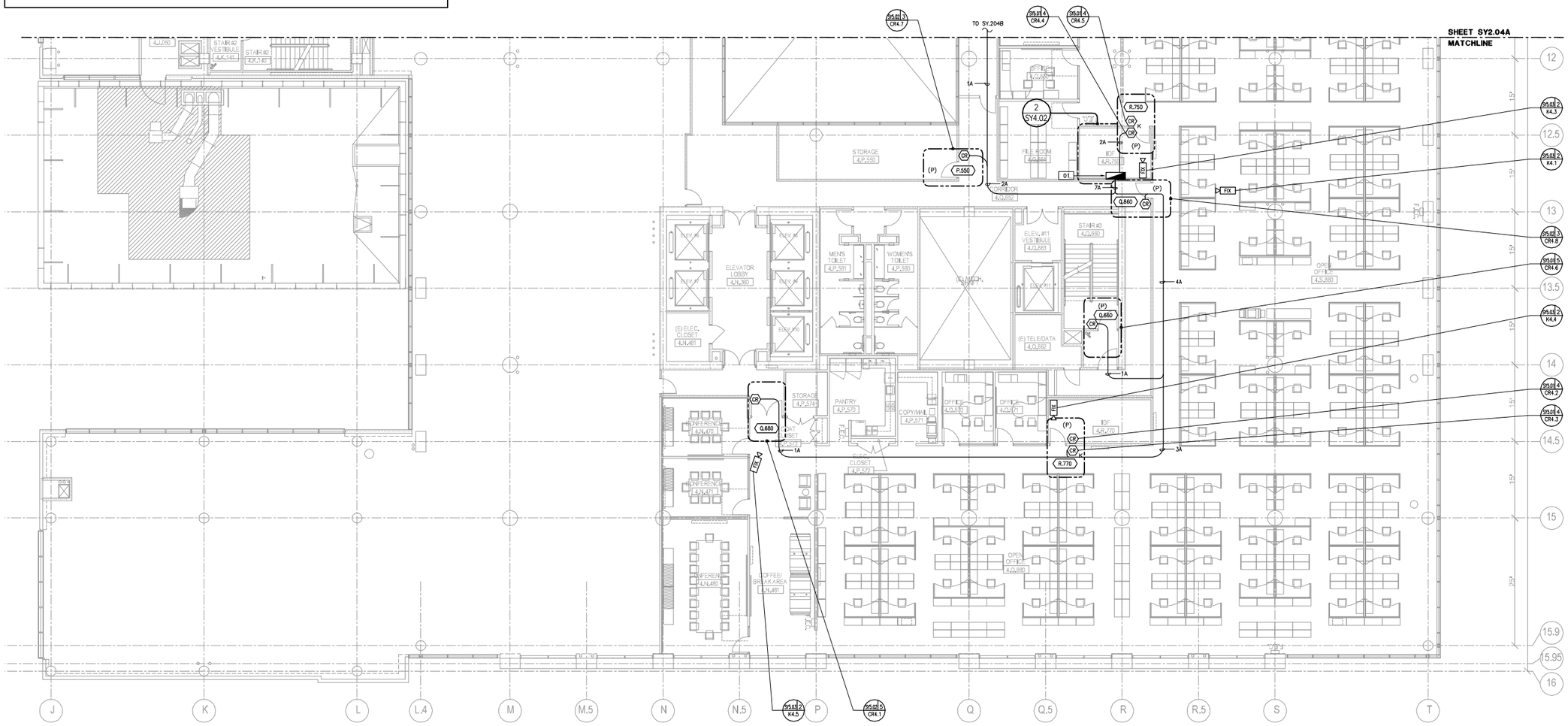
SY2.04A

SHEET NOTES

1. UTILIZE EXISTING ACCESS CONTROL CABLING HOMERUN FROM IDF ROOM 4.R.750.
2. REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER. REFER TO SECTION 13710.
3. REMOVE EXISTING PELCO MINI-DOME CAMERAS AND REPLACE WITH NEW AXIS NETWORK MINI-DOME CAMERAS.
4. SECURITY CABINET ON THIS FLOOR CONTAINS I-STAR PRO AND OTHER PANELS. ASSOCIATED SCHEDULE ON SHEET SY3.04.
5. CAT6A CABLING FOR IP CAMERAS PULLED BY TELECOM CONTRACTOR.

NUMBERED SHEET NOTES

01 SECURITY ELEVATION FOR ACP.4.1 SHOWN ON SY3.02 AND SY3.03. SECURITY DEVICE SCHEDULE SHOWN ON SY6.01.

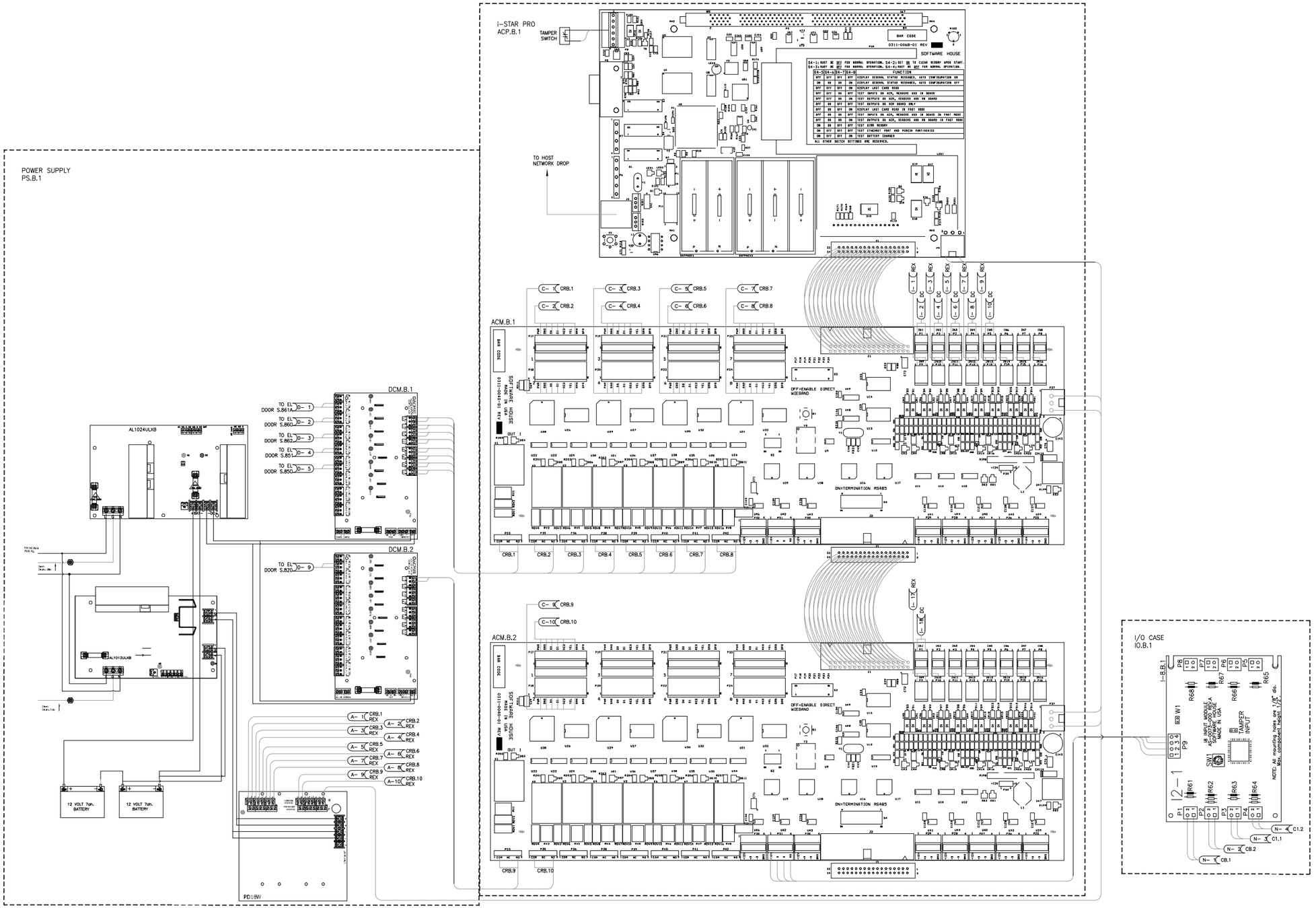


SECURITY FOURTH FLOOR PLAN 1
SCALE: 1/8" = 1'-0"

SAMPLE SHOP DRAWINGS

SECURITY FOURTH FLOOR PLAN SOUTH

SY2.04B



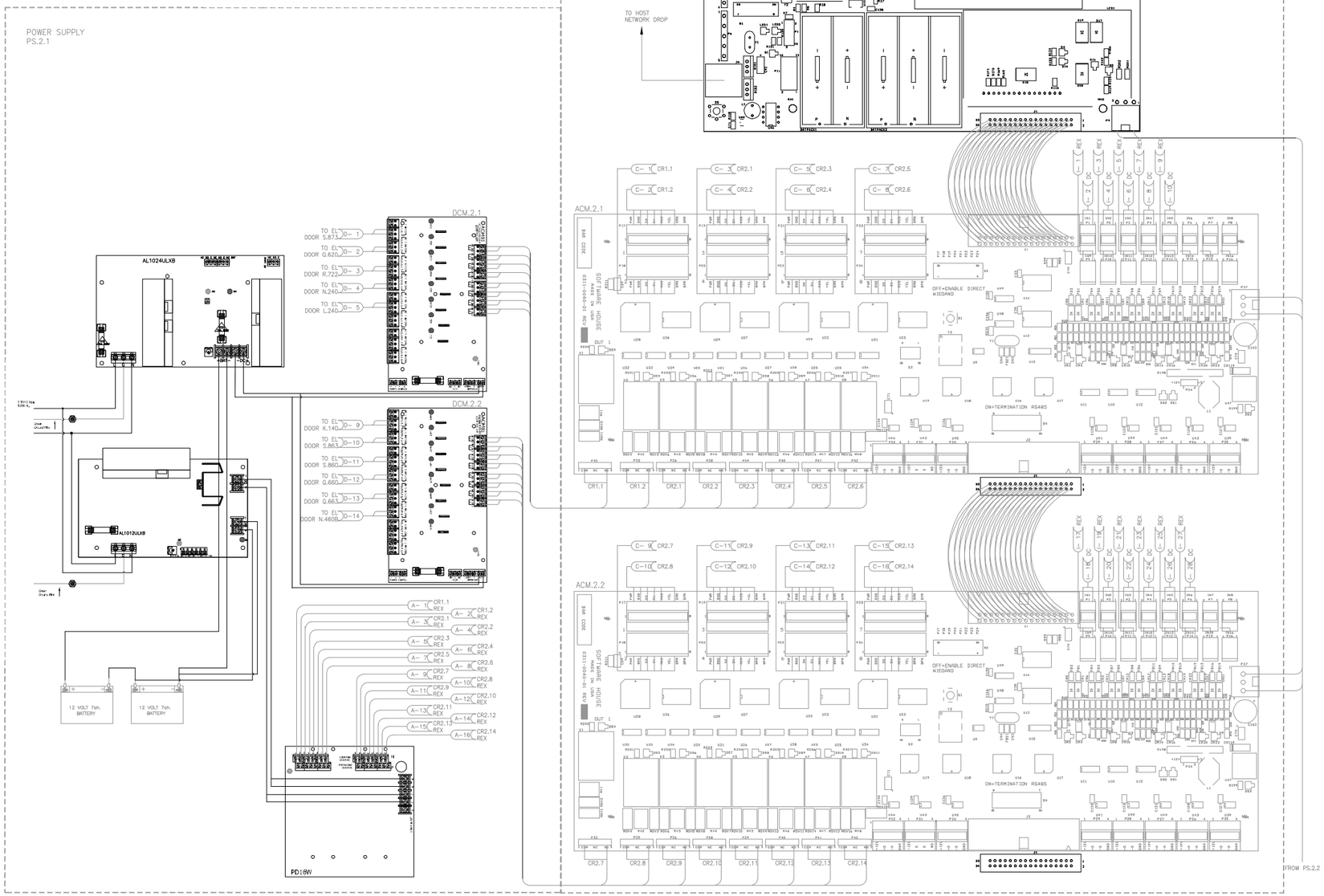
ACCESS CONTROL SYSTEM POINT - TO - POINT DIAGRAM (PARKING LEVEL)
SCALE: N.T.S.

1

SAMPLE
SHOP
DRAWINGS

SECURITY
ACCESS CONTROL SYSTEM
POINT TO POINT DIAGRAM

SY3.01



ACCESS CONTROL SYSTEM POINT - TO - POINT DIAGRAM

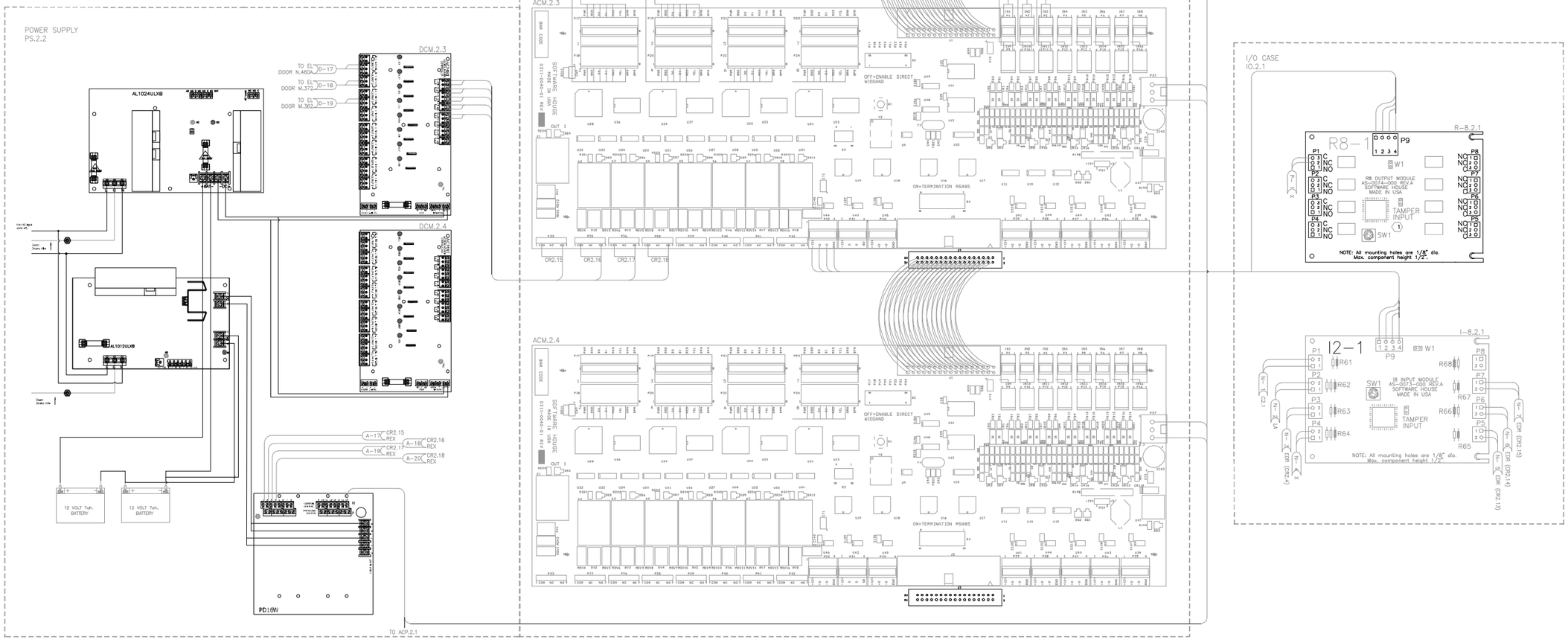
SCALE: N.T.S.

1

SAMPLE SHOP DRAWINGS

SECURITY
ACCESS CONTROL SYSTEM
POINT TO POINT DIAGRAM

SY3.02



ACCESS CONTROL SYSTEM POINT - TO - POINT DIAGRAM (SECOND FLOOR)

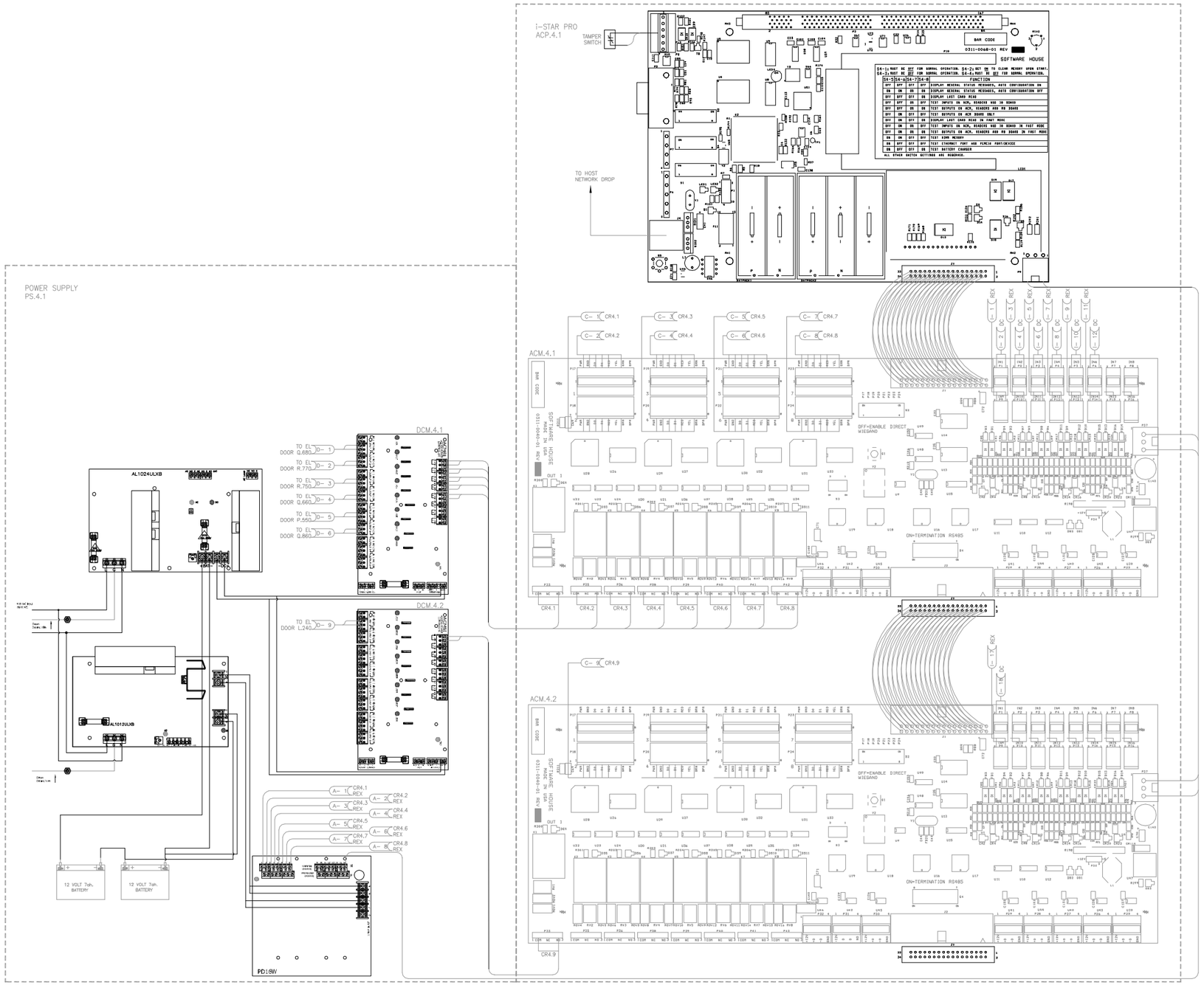
SCALE: N.T.S.

1

SAMPLE
SHOP
DRAWINGS

SECURITY
ACCESS CONTROL SYSTEM
POINT TO POINT DIAGRAM

SY3.03



ACCESS CONTROL SYSTEM POINT - TO - POINT DIAGRAM (FLOOR 4)
SCALE: N.T.S.

1

SAMPLE
SHOP
DRAWINGS

SECURITY
ACCESS CONTROL SYSTEM
POINT TO POINT DIAGRAM

SY3.04

SHEET NOTES

1. SECURITY DEVICE ELEVATION DIAGRAMMATIC. PROVIDE ACU'S AND POWER SUPPLIES AS REQUIRED TO HANDLE THE SECURITY FIELD EQUIPMENT SHOW ON THE FLOOR PLANS.
2. REMOVE EXISTING ACCESS CONTROL PANELS AND POWER SUPPLIES.
3. UTILIZE EXISTING CONDUIT, CHASE COUPLERS, AND CONDUIT WHEN POSSIBLE.

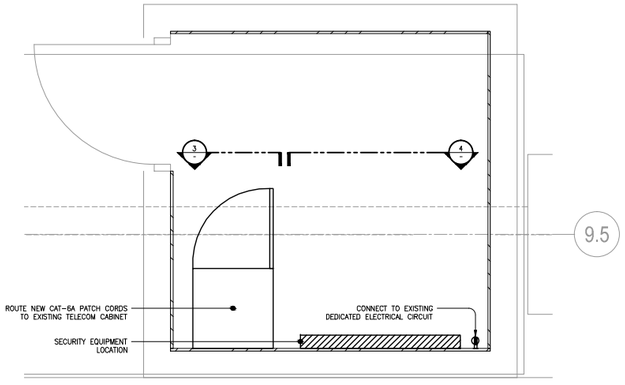
NUMBERED NOTES

01 SOFTWARE HOUSE ACCESS CONTROL UNIT.

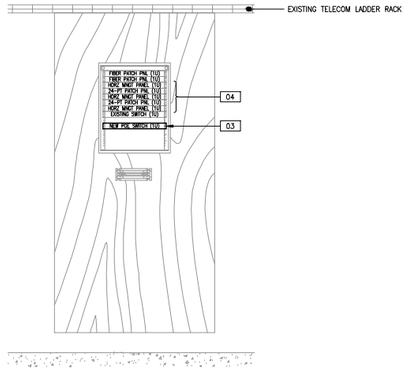
02 24VDC CONTINUOUS LOCK POWER SUPPLY; 12VDC CONTINUOUS DEVICE POWER SUPPLY

03 CAT-6A PATCH CORDS FROM AXIS NETWORK MINI DOME CAMERAS TO EXISTING MODULAR PATCH PANELS.

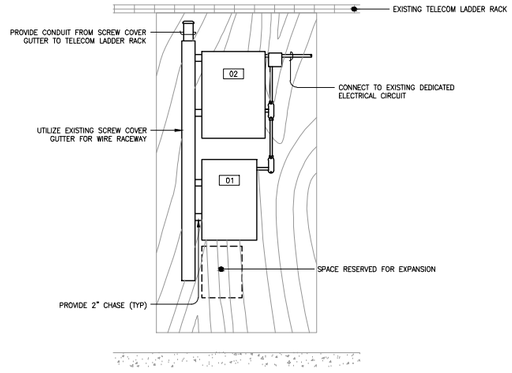
04 POE SWITCH PROVIDED BY IT DEPARTMENT. PATCH CORDS TO CONNECT FROM POE SWITCH TO PATCH PANELS.



PARKING LEVEL MPOE ROOM P1.S.820 1
SCALE: 3/4" = 1'-0"



EQUIPMENT ELEVATION 2
SCALE: 3/4" = 1'-0"

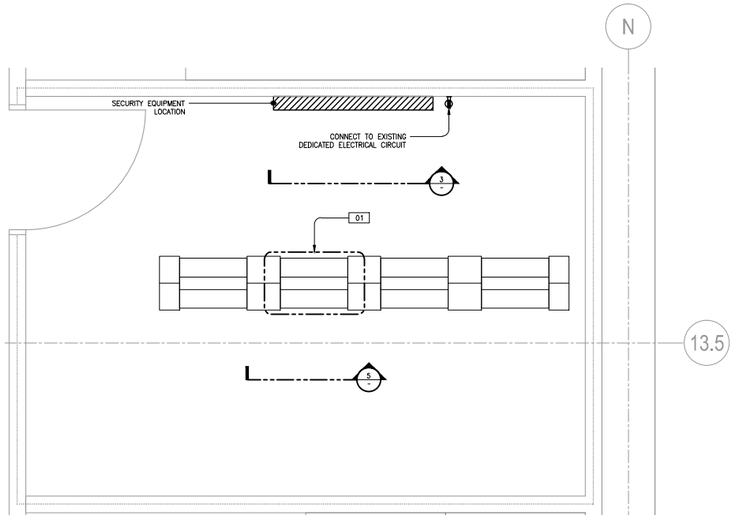


EQUIPMENT ELEVATION 3
SCALE: 3/4" = 1'-0"

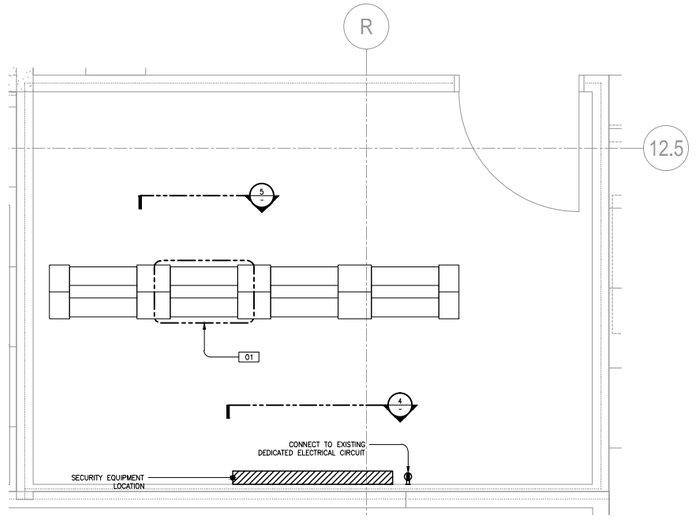
SAMPLE
SHOP
DRAWINGS

SECURITY EQUIPMENT ELEVATIONS

SY4.01



LEVEL 2 IDF ROOM 2.M.362 — **1**
SCALE: 3/4" = 1'-0"



LEVEL 4 IDF ROOM 4.R.750 — **2**
SCALE: 3/4" = 1'-0"

SHEET NOTES

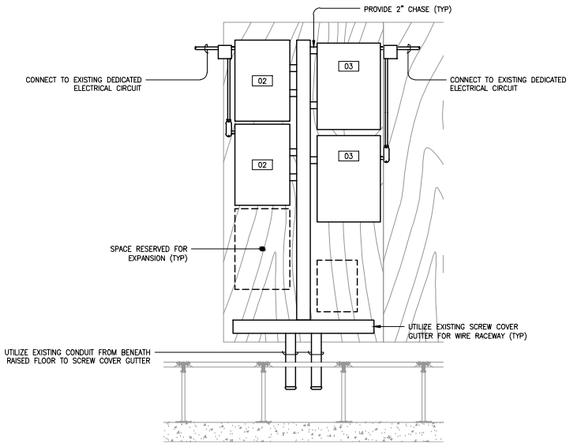
1. SECURITY DEVICE ELEVATION DIAGRAMMATIC. PROVIDE ACU'S AND POWER SUPPLIES AS REQUIRED TO HANDLE THE SECURITY FIELD EQUIPMENT SHOW ON THE FLOOR PLANS.
2. REMOVE EXISTING ACCESS CONTROL PANELS AND POWER SUPPLIES.
3. UTILIZE EXISTING CONDUIT, CHASE COUPLERS, AND CONDUIT WHEN POSSIBLE.

NUMBERED NOTES

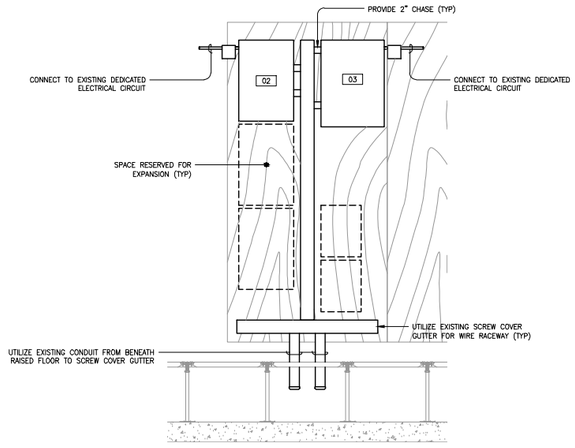
01 POE SWITCH PROVIDED BY IT DEPARTMENT. PATCH CORDS TO CONNECT FROM POE SWITCH TO PATCH PANELS.

02 SOFTWARE HOUSE ACCESS CONTROL UNIT.

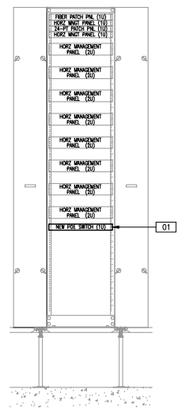
03 24VDC CONTINUOUS LOCK POWER SUPPLY; 12VDC CONTINUOUS DEVICE POWER SUPPLY



EQUIPMENT ELEVATION — **3**
SCALE: 3/4" = 1'-0"



EQUIPMENT ELEVATION — **4**
SCALE: 3/4" = 1'-0"

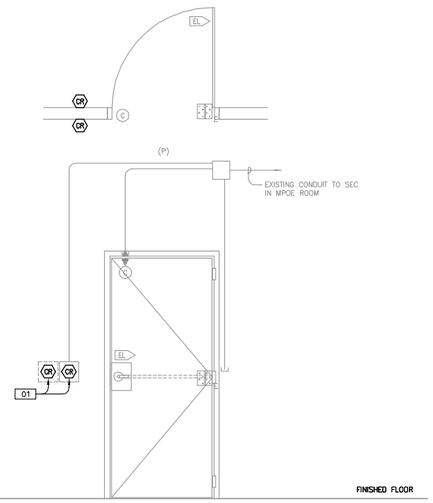


EQUIPMENT ELEVATION — **5**
SCALE: 3/4" = 1'-0"

SAMPLE SHOP DRAWINGS

SECURITY EQUIPMENT ELEVATIONS

SY4.02

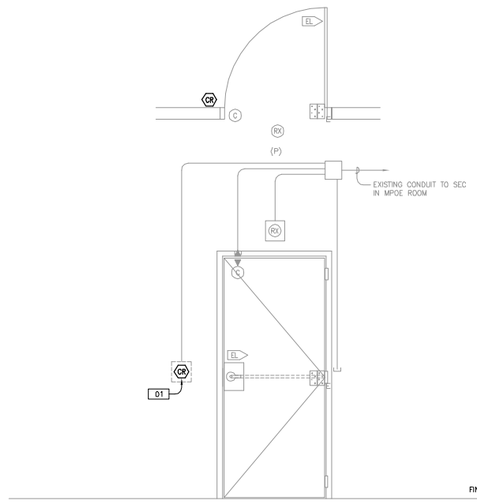


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- TO OPEN DOOR FROM PROTECTED SIDE, CARD MUST BE PRESENTED TO SHUNT LOCAL ALARM AND DOOR FORCED OPEN ALARM

CR IN/OUT SINGLE (LOCKSET) 1

SCALE: N.T.S.

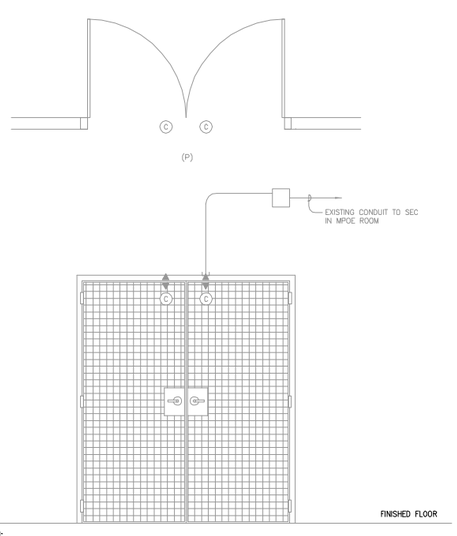


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AT ALL TIMES
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

CR SINGLE (LOCKSET) 2

SCALE: N.T.S.

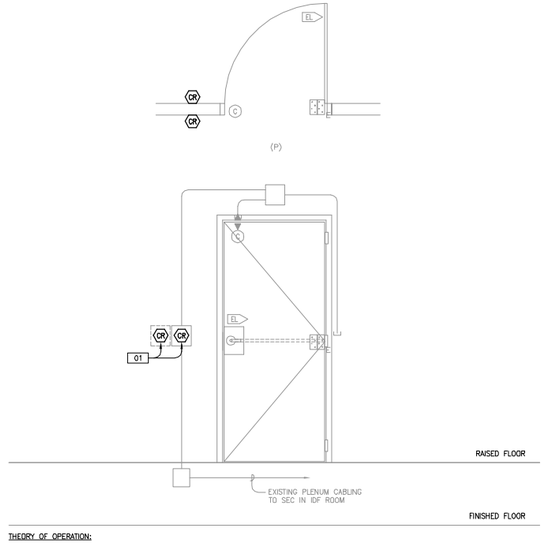


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES
- DOOR IS MONITORED FOR ENTRANCE AND EXIT AT ALL TIMES.

MONITORED GATE PAIR 3

SCALE: N.T.S.

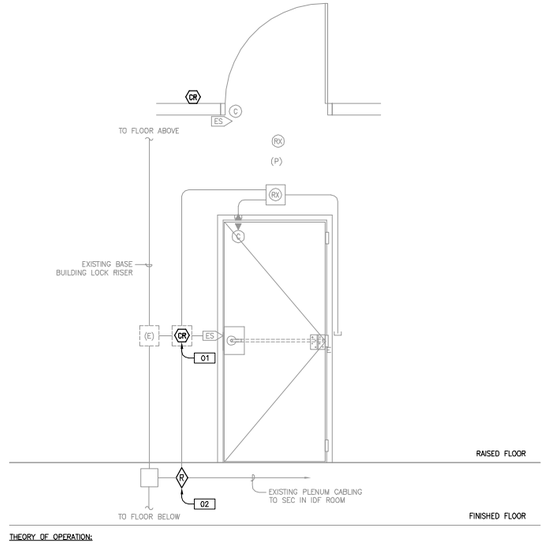


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- TO OPEN DOOR FROM PROTECTED SIDE, CARD MUST BE PRESENTED TO SHUNT LOCAL ALARM AND DOOR FORCED OPEN ALARM

CR IN/OUT SINGLE RAISED FLOOR (LOCKSET) 4

SCALE: N.T.S.



THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

CR SINGLE FIRE STAIRWELL (STRIKE) 5

SCALE: N.T.S.

SHEET NOTES

1. VIEW OF DOORS FROM PROTECTED SIDE, UON.
2. EXISTING JUNCTION BOXES ARE 4" SQ. X 2-1/8" D, UON.
3. DASHED SYMBOLS AND JUNCTION BOXES INDICATE DEVICES ON THE OPPOSITE SIDE OF THE WALL.
4. CENTER OF DEVICE JUNCTION BOXES ARE MOUNTED 6" AWAY FROM THE LATCH SIDE OF THE DOOR.
5. EXISTING DOOR CONTACTS MOUNTED 6" AWAY FROM THE LATCH SIDE OF THE DOOR, UON.
6. CONDUIT AND JUNCTION BOXES ARE EXISTING, UON.
7. ELECTRIFIED LOCKING HARDWARE AND LOCAL POWER SUPPLIES ARE EXISTING, UON.
8. SECURITY DOOR CONTACT SWITCHES AND REQUEST TO EXIT MOTION DETECTORS ARE EXISTING, UON.

NUMBERED NOTES

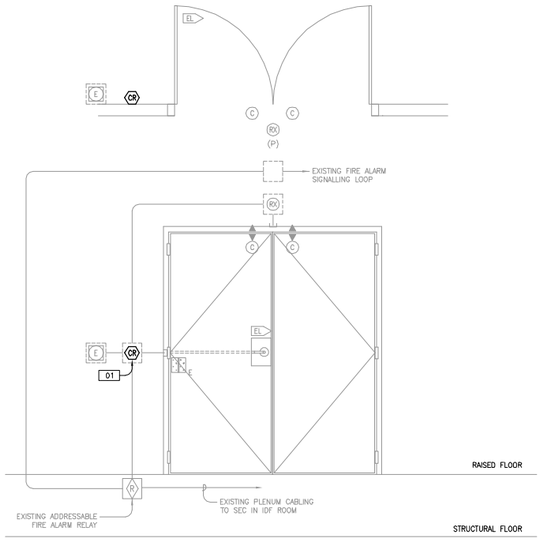
01 REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER.

02 VERIFY EXISTING INTERFACE RELAY WILL FUNCTION WITH SOFTWARE HOUSE ACCESS CONTROL PANEL. REPLACE WITH COMPATIBLE DEVICE IF NECESSARY.

SAMPLE
SHOP
DRAWINGS

SECURITY
DOOR
DETAILS

SY5.01

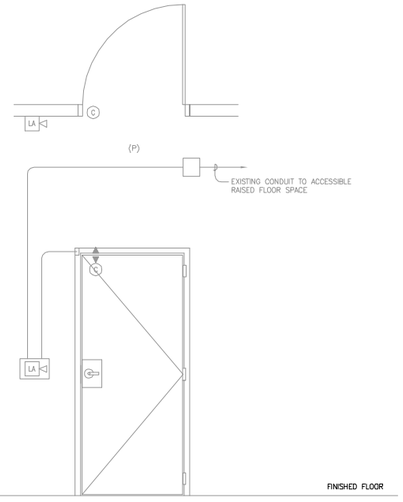


THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.
- FIRE ALARM CONTROL RELAY LOCATED BELOW RAISED FLOOR.
- UPON ACTIVATION OF BUILDING FIRE ALARM SYSTEM, FIRE ALARM RELAY INTERRUPTS LOCK POWER..

CR PAIR ELEVATOR LOBBY (LOCKSET) 1

SCALE: N.T.S.

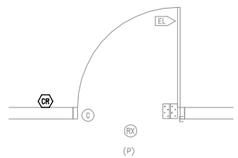


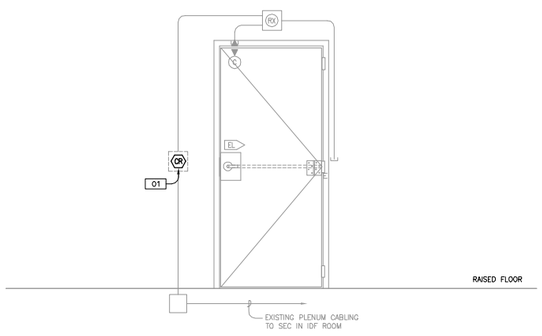
THEORY OF OPERATION:

- DOOR IS MONITORED FOR EXITING AT ALL TIMES AND IS FOR EMERGENCY EGRESS ONLY.
- LOCAL SOUNDER CAN BE TURNED VIA KEYSWITCH.
- PROGRAM SOUNDER TO TIME OUT AFTER 30 SECONDS.
- TURNING OFF SOUNDER WILL NOT AFFECT PERIMETER DOOR MONITORING FOR AFTER HOURS INTRUSION DETECTION.

EMERGENCY EXIT DOOR 2

SCALE: N.T.S.



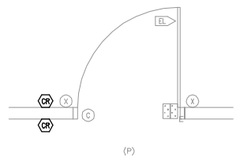


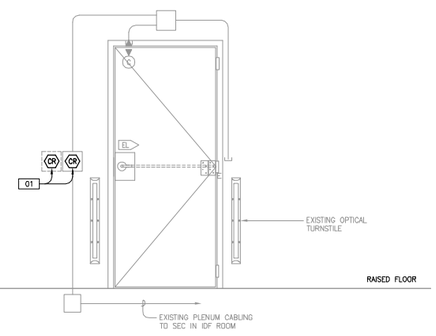
THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

CR SINGLE RAISED FLOOR (LOCKSET) 3

SCALE: N.T.S.



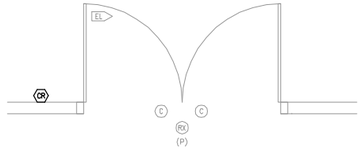


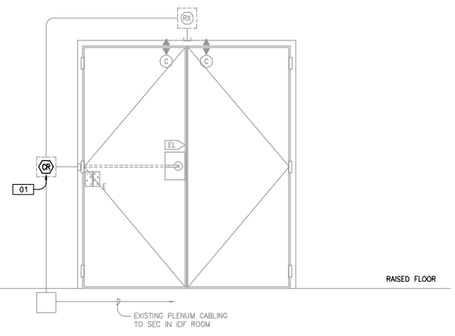
THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM PROTECTED SIDE, CARD MUST BE PRESENTED TO SHUNT LOCAL ALARM AND DOOR FORCED OPEN ALARM.
- ANY VIOLATION OF OPTICAL TURNSTILE WILL CAUSE AN ALARM AND DISABLE THE CARD READER TO THE MDF ROOM.

CR IN/OUT SINGLE W/ TURNSTILE (LOCKSET) 4

SCALE: N.T.S.





THEORY OF OPERATION:

- NORMAL DOOR STATE IS CLOSED AND LOCKED AT ALL TIMES.
- DOOR IS LOCKED ON THE NON-PROTECTED SIDE AND UNLOCKED ON THE PROTECTED SIDE.
- TO OPEN DOOR FROM NON-PROTECTED SIDE, CARD MUST BE PRESENTED TO UNLOCK DOOR.
- REQUEST TO EXIT MOTION DETECTOR BYPASSES ALARM ONLY ON EXIT.

CR PAIR RAISED FLOOR (LOCKSET) 5

SCALE: N.T.S.

SHEET NOTES

1. VIEW OF DOORS FROM PROTECTED SIDE, UON.
2. EXISTING JUNCTION BOXES ARE 4" SQ. X 2-1/8" D, UON.
3. DASHED SYMBOLS AND JUNCTION BOXES INDICATE DEVICES ON THE OPPOSITE SIDE OF THE WALL.
4. CENTER OF DEVICE JUNCTION BOXES ARE MOUNTED 6" AWAY FROM THE LATCH SIDE OF THE DOOR.
5. EXISTING DOOR CONTACTS MOUNTED 6" AWAY FROM THE LATCH SIDE OF THE DOOR, UON.
6. CONDUIT AND JUNCTION BOXES ARE EXISTING, UON.
7. ELECTRIFIED LOCKING HARDWARE AND LOCAL POWER SUPPLIES ARE EXISTING, UON.
8. SECURITY DOOR CONTACT SWITCHES AND REQUEST TO EXIT MOTION DETECTORS ARE EXISTING, UON.

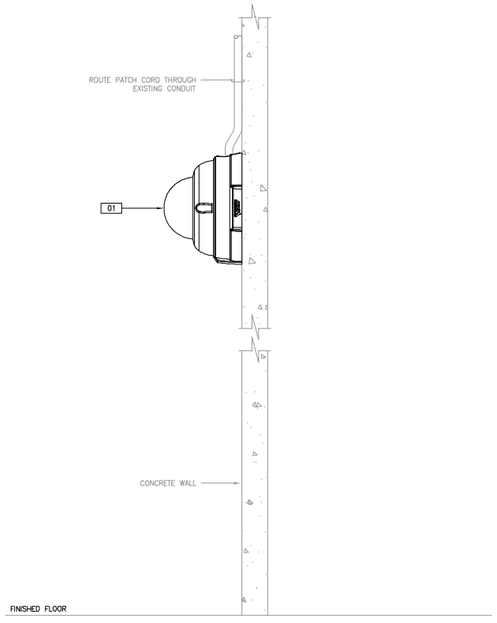
NUMBERED NOTES

01 REMOVE EXISTING CARD READERS AND REPLACE WITH NEW MULTI-FORMAT CARD READER.

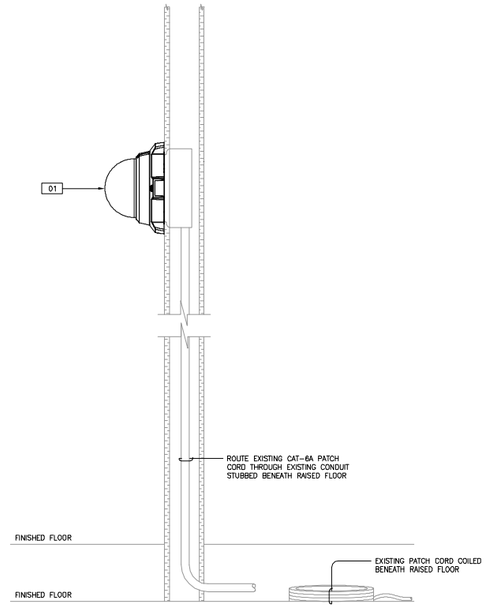
SAMPLE
SHOP
DRAWINGS

SECURITY
DOOR
DETAILS

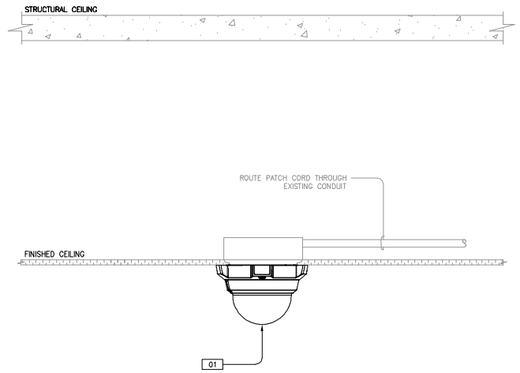
SY5.02



SURFACE WALL MOUNT (MINI DOME) **1**
SCALE: N.T.S.



FLUSH WALL MOUNT (MINI DOME) **2**
SCALE: N.T.S.



FLUSH CEILING MOUNT (MINI DOME) **3**
SCALE: N.T.S.

SHEET NOTES

1. EXISTING JUNCTION BOXES ARE 4" SQ. X 2-1/8" D, UON.
2. CONDUIT AND JUNCTION BOXES ARE EXISTING, UON.

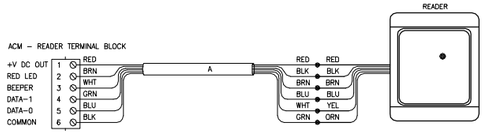
NUMBERED NOTES

01 REMOVE EXISTING ANALOG VIDEO AND POWER CABLING FOR CAMERAS. REPLACE EXISTING ANALOG CAMERA WITH NEW AXIS NETWORK MINI-DOME CAMERA.

SAMPLE
SHOP
DRAWINGS

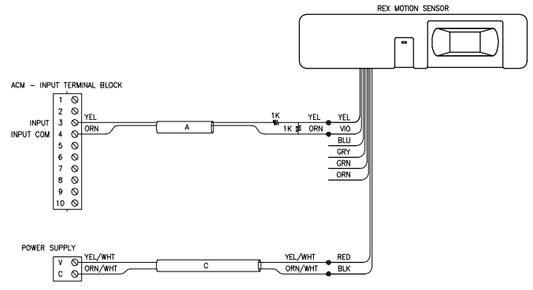
SECURITY
CAMERA DETAILS
DETAILS

SY5.03



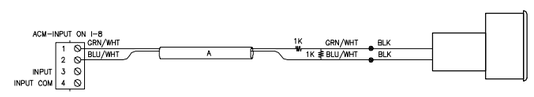
TYPICAL CARD READER WIRING 1

SCALE: N.T.S.



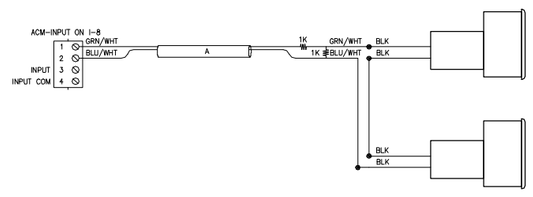
TYPICAL REQUEST-TO-EXIT WIRING 2

SCALE: N.T.S.



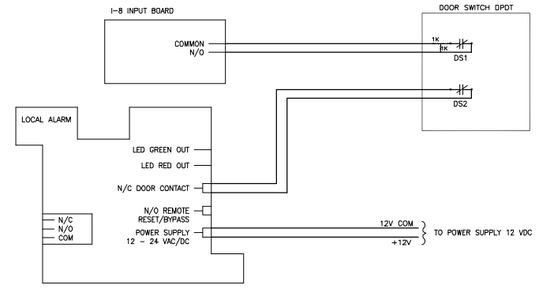
TYPICAL SINGLE DOOR CONTACT WIRING 3

SCALE: N.T.S.



TYPICAL DOUBLE DOOR CONTACT WIRING 4

SCALE: N.T.S.



LOCAL ALARM WIRING 5

SCALE: N.T.S.

SHEET NOTES

1. SECURE AND TAPE OFF ANY UNUSED WIRING.
2. CABLING TERMINATIONS ARE DIAGRAMMATIC ONLY, VERIFY ACTUAL TERMINATIONS WITH PROVIDED EQUIPMENT.

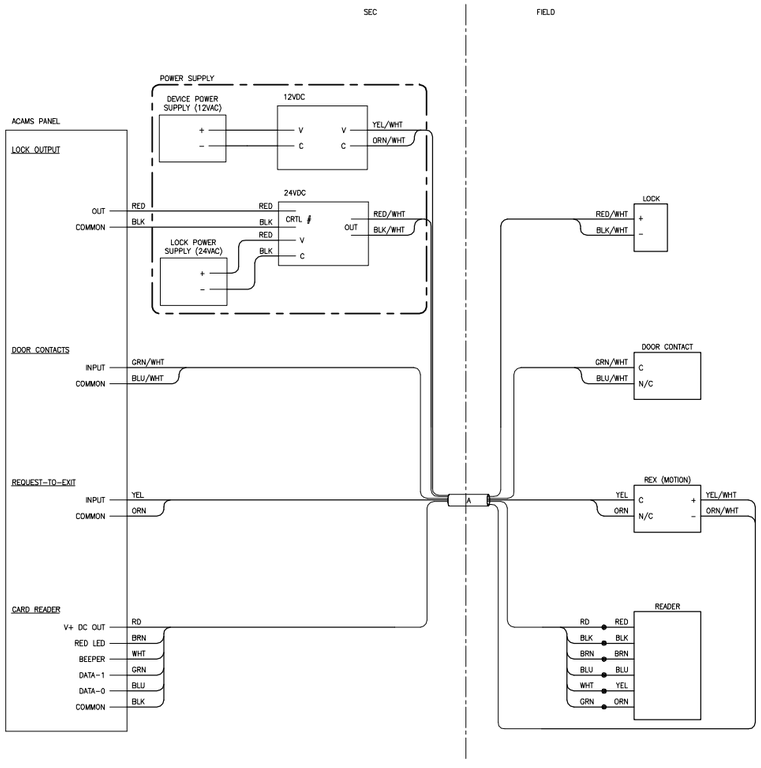
SAMPLE
SHOP
DRAWINGS

SECURITY
DEVICE DETAILS

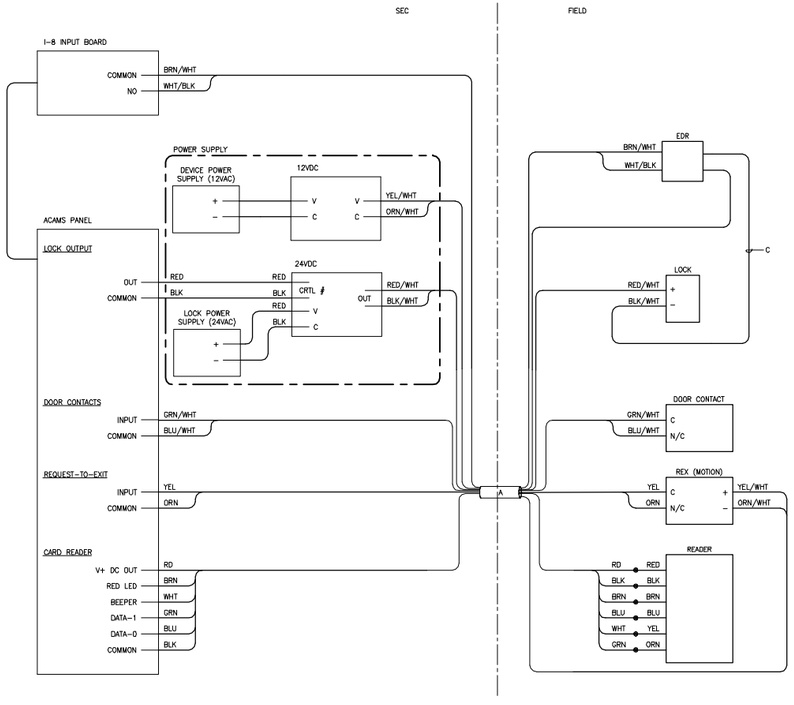
SY5.04

SHEET NOTES

1. SECURE AND TAPE OFF ANY UNUSED WIRING.
2. CABLING TERMINATIONS ARE DIAGRAMMATIC ONLY, VERIFY ACTUAL TERMINATIONS WITH PROVIDED EQUIPMENT.



TYPICAL CARD READER DOOR CABLING REQUIREMENTS **6**
SCALE: N.T.S.



TYPICAL CARD READER DOOR W/ EDR CABLING REQUIREMENTS **7**
SCALE: N.T.S.

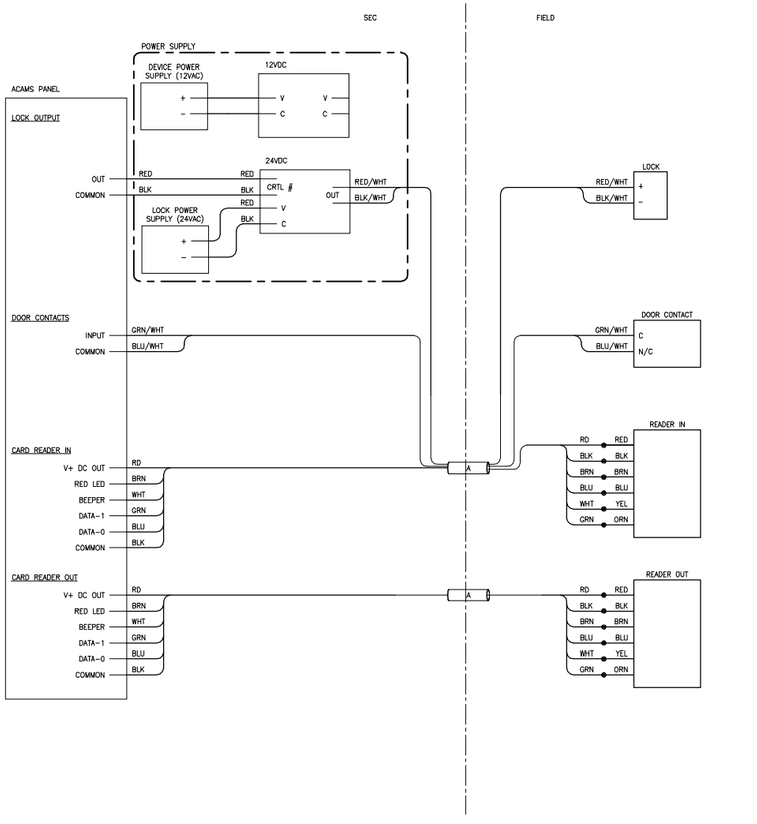
SAMPLE
SHOP
DRAWINGS

SECURITY
DEVICE DETAILS

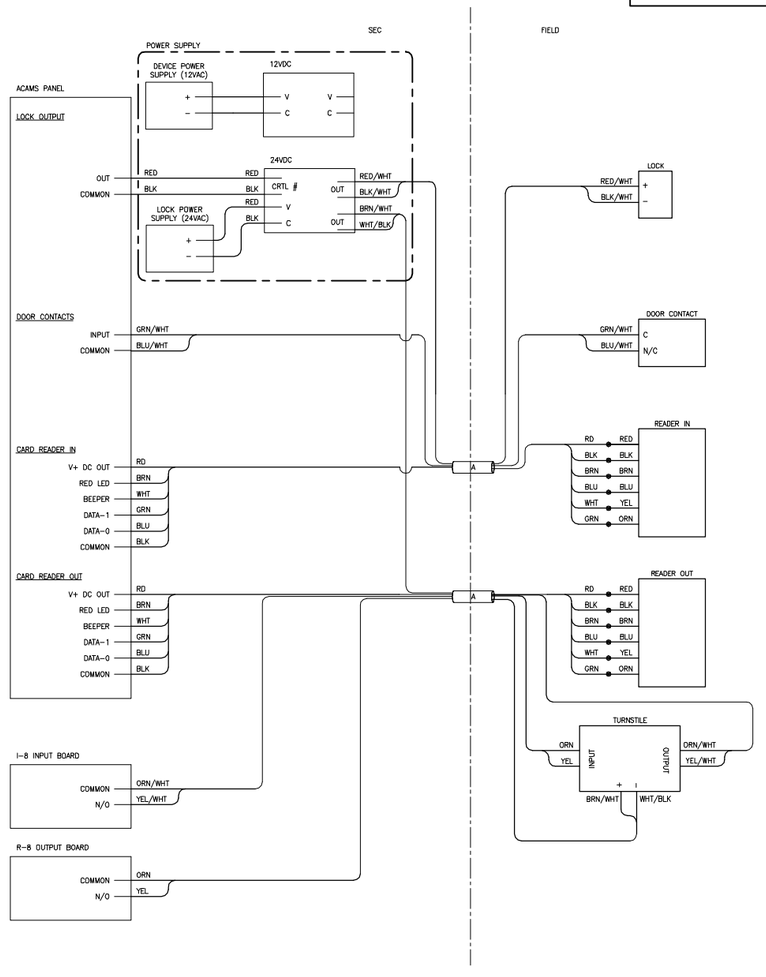
SY5.05

SHEET NOTES

1. SECURE AND TAPE OFF ANY UNUSED WIRING.
2. CABLING TERMINATIONS ARE DIAGRAMMATIC ONLY, VERIFY ACTUAL TERMINATIONS WITH PROVIDED EQUIPMENT.



TYPICAL CARD READER IN/OUT DOOR CABLING REQUIREMENTS **8**
SCALE: N.T.S.



TYPICAL CARD READER IN/OUT DOOR W/ TURNSTILE CABLING REQUIREMENTS **9**
SCALE: N.T.S.

PARKING LEVEL ACCESS CONTROL SYSTEM SCHEDULE

[illegible]

GROUND FLOOR ACCESS CONTROL SYSTEM SCHEDULE

[illegible]

SECOND FLOOR ACCESS CONTROL SYSTEM SCHEDULE

[illegible]

ACCESS CONTROL SYSTEM POINT TO POINT SCHEDULE 1

SCALE: N.T.S.

AMERICAN DYNAMICS IP CAMERA SCHEDULE

PARKING LEVEL 1

GROUND FLOOR

SECOND FLOOR

FOURTH FLOOR

[illegible]

IP CAMERAS POINT TO POINT SCHEDULE 2

SCALE: N.T.S.

ACCESS CONTROL PANEL SCHEDULE

PANEL	IP ADDRESS
[illegible]	
[illegible]	
[illegible]	
[illegible]	

ACCESS CONTROL PANEL SCHEDULE 3

SCALE: N.T.S.

SAMPLE
SHOP
DRAWINGS

SECURITY
ACCESS CONTROL SYSTEM
POINT TO POINT SCHEDULE

SY6.01

NOTE: THIS MASTER SPEC INCLUDES HIDDEN TEXT AND COMMENTS. TO SEE THEM, MAKE SURE MS WORD IS CONFIGURED TO SEE HIDDEN TEXT (GO TO TOOLS/OPTIONS/VIEW AND CLICK ON "HIDDEN TEXT" CHECK-BOX.) DELETE THIS PARAGRAPH WHEN EDITING SPEC FOR PROJECTS.

SECTION 250000

BUILDING AUTOMATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install a digital Building Automation System (BAS) as specified herein.

1.2 COORDINATION WITH OTHER TRADES

A. Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. This section is provided to assist Contractor in coordination of work scope but shall not be construed to limit Contractor's scope of work encompassed by the contract documents.

B. The following table is intended to assist the Contractors in coordinating the scope of work between Division 25 Building Automation System (indicated as 25), and other Divisions as indicated. However, the General Contractor is ultimately responsible for coordination among his subcontractors regardless of what is listed in this Section.

INTERFACE / RESPONSIBILITY MATRIX

System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
A. FIRE & LIFE SAFETY SYSTEMS					
1. Fire alarm controls	26	26	26	26	
2. Duct mounted & in-duct mounted smoke detectors	26	23	26	26	
3. Other smoke detectors	26	26	26	26	
4. Smoke control interlocks to HVAC fans	26	26	26	26	2
5. Smoke dampers with electric actuators	23	23	26	26	
6. Smoke damper end switches	23	23	26	26	
B. MECHANICAL EQUIPMENT					
1. Unitary mechanical equipment	23	23	26	25	3
2. Chillers	23	23	26	25	3, 7
3. Variable speed drives, field mounted	23	26	26	25	
4. Motors, 3 phase	23	23	26	–	

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
5. Motor starters, 3 phase	26	26	26	25	4
6. Motors, 1 phase	23	23	26	26	5, 6
7. Other powered equipment	23	23	26	25	
8. Disconnects/circuit breakers	26/23	26/23	26	–	8
9. Refrigerant leak detector	25	25	26	25	9
10. Cooling tower vibration switch	23	23	–	25	
11. Cooling tower water treatment system	23	23	26	25	10
C. BUILDING AUTOMATION SYSTEM (BAS)					
1. Central control workstations & servers	–	–	–	–	Existing
2. College IT local area network	27	27	26	27	11
3. Control system network	25	25	25	25	11
4. Line voltage control devices to 120V motors	25	26	26	26	6
5. Window switches	25	25	–	25	
6. Control panels	25	25	26/25	25	12
7. Control devices	25	25	25	25	
D. ELECTRICAL SYSTEMS					
1. Lighting Control BACnet gateway	26	26	26	25/27	13
2. Lighting relay panels and low voltage switches	26	26	26	26	
3. Lighting occupancy sensors	26	26	26	26	
4. Daylighting sensors and controls	26	26	26	26	
5. Power monitoring sensors and gateway	26	26	26	26/25 /27	14
E. PLUMBING SYSTEMS					
1. Gas and water flow meters	25	22	25	25	
2. Recirculation pumps or heat tape	22	22	26	25	
3. HHW to DHW heat exchangers	23	23	–	–	
4. HHW to DHW controls	25	22/23	25	25	
5. Pipe gauges, thermometers, test plugs	22	22	–	–	
6. Self-powered valves, pressure relief valves, liquid level controllers, etc.	22	22	–	–	
7. Sensor wells, meters and other pipe-mounted control devices	25	22	25	25	
F. HVAC HYDRONIC SYSTEMS					
1. Pipe gauges, thermometers, test plugs	23	23	–	–	
2. Self-powered valves, refrigerant powered head pressure control valves, pressure relief valves, liquid level controllers, etc.	23	23	–	–	
3. Automatic isolation and control valves	25	23	25	25	
4. Sensor wells, meters and other pipe-mounted control devices	25	23	25	25	
G. KITCHEN EXHAUST SYSTEMS					
1. Grease hoods	11	11	–	25	15

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	
2. Grease hood fire control/alarm systems	11	11	26	11	16
3. Grease hood automatic gas shut-off valve	11	22	11	11	16
4. Grease hood pollution control unit (PCU)	23	23	26	25	
5. Grease hood PCU fire control/alarm systems	11/23	11/23	26	11	17
H. HVAC SHEET METAL					
1. Duct mounted sensors	25	23	25	25	
2. Control dampers	23	23	–	–	18
3. Control damper actuators	25	25	25	25	18, 19
I. VAV PACKAGED AIR CONDITIONING SYSTEMS					
1. AC unit including all controls	23	23	23	25	
2. Gateway to BAS	23	23	23	25	20
J. VARIABLE REFRIGERANT FLOW SYSTEMS					
1. VRF fan-coils and condensing unit including all factory mounted controls	23	23	26	25	
2. VRF thermostats and field mounted control devices	23	25	25	25	
3. Gateway to BAS	23	25	25	25	20
A. LABORATORY HVAC SYSTEMS					
1. Laboratory air valves, actuators, and controllers	23	23	25	25	
2. Fume hoods	11	11	26	–	
3. Snorkels with manual dampers	11	23	–	–	
4. Snorkels with control dampers	11/23	23	25	25	21
5. Fume hood ASHRAE 110 tests	11	11	–	–	
6. Fume hood sash closer and associated sensors	11	11	26	11	
7. Fume hood monitors – CAV hoods	11	11	26	25	
8. Fume hood monitors – VAV hoods	23	23	25	25	22
9. Fume hood sash position sensors	23	23	25	25	
B. HVAC TERMINAL BOXES					
1. Terminal box control transformer panel	25	25	26/25	25	12, 23
2. Terminal box with damper	23	23	–	–	
3. Digital controller and damper actuator	25	25	25	25	
4. Air-flow measurement pickup	23	23	–	–	
5. Air-flow measurement transducer and piping	25	25	25	25	
6. Wall sensor module	25	25	25	25	
7. Terminal fan	23	23	26	25	
8. Electric reheat coil, including control transformer, safeties & contactors	23	23	26	25	24
9. HW control valve and actuator	25	23	25	25	
C. MISCELLANEOUS					
1. Ceiling and wall access doors and panels	8	8	–	–	
NUMBERED REMARKS:					

INTERFACE / RESPONSIBILITY MATRIX

System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	

1. Wiring includes raceway, fittings, wire, boxes and related items, all voltages.
2. Wiring and controls to start and stop fans based on smoke detector status and smoke control logic specified under Division 26 Electrical.
3. Factory installed starters and variable speed drives are specified under Division 23 HVAC. Prewired control panel is specified under Division 23 HVAC; single point power connection (unless otherwise noted on drawings) specified by Division 23 HVAC.
4. Applies to motors that are not covered by note 3. Integral starter control devices such as HOA switches, 120V control transformers specified under Division 26 Electrical.
5. Single phase 120V motors with integral motor overload protection specified under Division 23 HVAC.
6. Line voltage control device such as thermostat or switch specified under Division 25 BAS; wiring and conduit between control device and motor specified under Division 26 Electrical.
7. Factory installed and wired chilled and condenser water flow switches are specified under Division 23 HVAC; no work is required under Division 25 BAS. Bi-directional (read/write) factory installed BACnet gateway between the BAS and chiller control panel specified with chiller under Division 23 HVAC; control wiring specified under Division 25 BAS. Chiller vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across chiller points to the BAS.
8. Disconnects or circuit breakers are specified under Division 23 HVAC where specifically called for in equipment schedules or specifications to be factory installed with equipment. Otherwise all disconnects are specified under Division 26 Electrical.
9. Emergency override switches, status lights and other refrigerant machinery room controls as required by CMC are specified under Division 25 BAS.
10. TDS controller, bleed valve, injector pump, make-up water flow meter, and all other water treatment system controls are specified under Division 23 HVAC. Field wiring of all components is specified under Division 25 BAS.
11. See Paragraph 1.10A System Architecture for coordination between College IT LAN and BAS networks.
12. 120V power to BAS control panels is specified under Division 26 for the panels shown on Drawings. Power to all other control panels that may be required is specified under Division 25 BAS, coordinated with Division 26 contractor for available circuits. Power to all BAS control panels is specified under Division 25 BAS, coordinated with Division 26 contractor for available circuits.
13. BACnet/IP interface specified under Division 26 Electrical. IP network connection from interface to LAN specified under Division 25 BAS or Division 27 Communications as indicated in Paragraph 2.4C. Lighting control vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across lighting control points to the BAS.
14. Power measuring sensors, installation and wiring to a single central controller with BACnet/IP interface specified under Division 26 Electrical. IP network connection from interface to LAN specified under Division 25 BAS or Division 27 Communications as indicated in Paragraph 2.4C. Power monitoring control vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping across power monitoring control points to the BAS
15. Hoods, including all required fire protection devices and integral listed balancing dampers, are specified under Division 11 Food Service.
16. Ansul type fire protection system is specified under Division 11 Food Service including all control wiring between Ansul hood and fire suppression panel, power wiring to fire suppression panel, fire alarm system monitoring intertie, gas shut-off valve interlock, and circuit breaker shunt-trips for all equipment located under the hoods.

INTERFACE / RESPONSIBILITY MATRIX					
System	Division under which the following is specified				Remarks
	Equipment	Installation	Power wiring (remark 1)	Control & interlock wiring (remark 1)	

17. PCUs with factory pre-piped fire suppression nozzles and fusible link detector brackets for Ansul type fire protection system is specified under Division 23. Field connection, tanks, controls, fusible link detectors, and commissioning is specified under Division 11 Food Service as part of hood fire protection system.
18. Duct access doors required for access to control devices where required specified under Division 23 HVAC.
19. Actuators for motorized dampers supplied with fans or hoods where scheduled on HVAC drawings are specified under Division 23 HVAC, mounted but not wired.
20. BACnet gateway to BAS specified in the Division 23 HVAC, factory installed, with connection of gateway to BAS specified under Division 25 BAS. AC vendor to provide all necessary technical assistance to Division 25 BAS Contractor in mapping AC control points to the BAS.
21. Snorkel specified under Division 11. Snorkel damper/air valve specified under Division 23.
22. Hood manufacturer shall provide knockout on face for hood monitor.
23. Control transformers for terminal boxes shall be centralized in control panels specified under Division 25 BAS.
24. Factory wired control transformer, safeties and contactors with single point power wiring connection specified under Division 23 HVAC.

1.3 INTEGRATION WITH EXISTING SYSTEM

A. Include all services required to integrate this building into existing BAS for a fully operational system.

B. Procedure

1. Obtain a copy of the campus database with access privileges.

2. Perform a database review with the Owner's Representative to ensure uniformity of point naming, graphic layout and style, BACnet device instance numbering scheme, IP addresses, BACnet Distribution Tables and BACnet Broadcast Management Devices.

3. BACnet devices

a. Create new building database following the BACnet device instance numbering scheme specified under Paragraph 3.12B.4.

b. Double check existing database to ensure there are no duplicate BACnet device instance numbers. This includes 3rd party equipment such as VFDs.

4. Graphics

a. For standard applications, such as VAV boxes and VAV box summary pages, use the campus standard graphics file template, including using the same file template name.

b. For new or modified graphics custom to the new building, ensure file template name do not duplicate any existing file names.

5. Programming

   a. For standard sequences covered by ASHRAE Guideline 36, use the programming provided by Automated Logic, first ensuring they have been updated by the manufacturer to reflect the latest issue and all addenda published when programming work is initiated.

   b. For other typical applications, first review those used for similar applications in other campus buildings to use as a starting point, then edit to reflect sequences specified herein. The intent is to have standard programming throughout the campus to the extent possible.

   c. Double check existing database to ensure program file names do not duplicate any existing file names.

6. If a BACnet/IP Broadcast Management Device (BBMD) router is required, check the existing Broadcast Distribution Tables (BDT) to ensure that a BBMD router is not already assigned to the relevant network before adding a new one.

7. Install building database and control programming on a temporary portable operator's terminal provided by the Contractor. The POT shall be used for start-up, testing, and commissioning. The POT shall remain the property of the Contractor after final completion of the project.

8. Once the building BAS has been fully commissioned and accepted by the College:

   a. Create a new backup of the existing campus database.

   b. Merge the new building database with the existing campus database.

   c. Confirm that no communication issues (in the building and across the campus) have resulted from the merge.

   d. Confirm that all new controllers have successfully bound to the server and that alarms and trends are being sent to the server.

   e. Configure alarm page-out notifications (e.g. e-mail, SMS, etc.) per Paragraph 3.12F.

   f. Make another backup of the merged database.

   g. Load the merged database onto the campus Control System Server.

   h. Integrate graphic screens into the Central Plant graphics including adding appropriate hyperlinks so that the system operates as one integrated system.

   i. Confirm that the merge was successful by sample testing points and sequences

j. Perform a post-merge review 4 to 8 weeks following the merge. Review general system operation, problematic areas, alarms and trend histories. Identify and remediate any issues.

k. Receive College approve of the final installation in writing.

9. Provide high level password for College operator access to the system only at this point; College will not have access to the system prior to system acceptance and integration.

1.4 CONTRACTOR PROPOSALS

A. The system requirements described in this specification are generally performance based. Where requirements are prescriptive, the intent is to provide minimum quality, not to give unfair advantage to any given manufacturer or product. If a contractor finds that a certain requirement is unduly difficult or expensive to meet, contact the Engineer prior to bid due date and an addendum modifying the requirement will be considered.

B. Where requirements are unclear, the contractor shall clarify the requirements with the Engineer before the bid due date. Where requirements continue to be unclear, the contractor's proposal must accurately describe what is included and excluded.

C. By submitting a proposal, contractor guarantees that their proposal is in full compliance with these specifications except as specifically excluded in their proposal.

1.5 REFERENCE STANDARDS

A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.

B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the BAS design and installation as applicable.

C. State, Local, and City Codes

1. CBC − California Building Code

2. CMC − California Mechanical Code

3. CEC – California Electrical Code

4. Local City and County Codes

D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. ANSI/ASHRAE 135 – BACnet - A Data Communication Protocol for Building Automation and Control Networks

2. ANSI/ASHRAE Standard 135.1− Method of Test for Conformance to BACnet

3. ANSI/ASHRAE Standard 15 – Safety Standard for Refrigeration Systems

E. Electronics Industries Alliance

1. EIA-232 – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

2. EIA-458 – Standard Optical Fiber Material Classes and Preferred Sizes.

3. EIA-485 – Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.

4. EIA-472 – General and Sectional Specifications for Fiber Optic Cable.

5. EIA-475 – Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.

6. EIA-573 – Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.

7. EIA-590 – Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

F. Underwriters Laboratories

1. UL 916 – Energy Management Systems.

G. National Electrical Manufacturers Association

1. NEMA 250 – Enclosure for Electrical Equipment.

H. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems.

2. IEEE 802.3 – CSMA/CD (Ethernet – Based) LAN.

3. IEEE 802.4 – Token Bus Working Group (***ARCnet*** – Based) LAN.

1.6 DEFINITIONS

A. Acronyms

AAC	Advanced Application Controller
AH	Air Handler
AHU	Air Handling Unit
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASC	Application Specific Controllers

ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
A-to-D	Analog-to-Digital
BACnet	Data Communications Protocol for Building Automation and Control Systems
BC	Building Controller
BIBB	BACnet Interoperability Building Blocks
BTL	BACnet Testing Laboratory
CAD	Computer Aided Drafting
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
COV	Change of Value
CSS	Control Systems Server
CU	Controller or Control Unit
CV	Constant Volume
CW	Condenser Water
CWR	Condenser Water Return
CWS	Condenser Water Supply
DBMS	Database Management System
DDC	Direct Digital Control
DHW	Domestic Hot Water
DI	Digital Input
DO	Digital Output
D-to-A	Digital-to-Analog
BAS	Building Automation System
EMT	Electrical Metallic Tubing
EP	Electro-Pneumatic
ETL	Edison Testing Laboratories
GUI	Graphical User Interface
HHD	Hand Held Device
HOA	Hand-Off-Automatic
HVAC	Heating, Ventilating and Air-Conditioning
HTTP	Hyper-Text Transfer Protocol
I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
LANID	LAN Interface Device
MAC	Medium Access Control
MHz	Megahertz
MS/TP	Master-Slave/Token-Passing
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
ODBC	Open Database Connectivity

OI	Operator Interface
OWS	Operator Workstation
P	Proportional
PC	Personal Computer
PI	Proportional-Integral
PICS	Protocol Implementation Conformance Statement
PID	Proportional-Integral-Derivative
POT	Portable Operators Terminal
PTP	Point-to-Point
RAM	Random Access Memory
SOO	Sequence of Operation
SQL	Standardized Query Language
SSL	Secure Socket Layers
TAB	Test, Adjust, and Balance
TDR	Time Delay Relay
UFT	Underfloor Fan Terminal Box
UL	Underwriters' Laboratories, Inc.
XML	Extensible Markup Language

B. Terms

Term	Definition
Accessible	Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles.
BACnet Interoperability Building Blocks	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Change of Value	An event that occurs when a digital point changes value or an analog value changes by a predefined amount.
Client	A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
Concealed	Embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
Continuous Monitoring	A sampling and recording of a variable based on time or change of state (such as trending an analog value, monitoring a binary change of state).
Contract Documents	Specifications, drawings, and other materials provided with request for bids.

Term	Definition
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to BCs, AACs, and ASCs.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Building Automation System	The entire integrated building management and control system.
Equal	Approximately equal in material types, weight, size, design, quality, and efficiency of specified product.
Exposed	Not installed underground or concealed.
Furnish	To purchase, procure, acquire and deliver complete with related accessories.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Hand Held Device	Manufacturer's microprocessor based portable device for direct connection to a field Controller.
Inaccessible	Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles.
Indicated, shown or noted	As indicated, shown or noted on drawings or specifications.
Install	To erect, mount and connect complete with related accessories.
Instrumentation	Gauges, thermometers and other devices mounted in ductwork or piping that are not a part of the BAS.
College IT LAN	The Information Technology local area network furnished by the College or Division 27 Communications, used for normal business-related communication and may be used for interconnecting some BAS controllers and gateways where specified.
LAN Interface Device	Device or function used to facilitate communication and sharing of data throughout the BAS.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Motor Controllers	Starters, variable speed drives, and other devices controlling the operation of motors.
Native BACnet Device	A device that uses BACnet for communication. A device may also provide gateway functionality and still be described as a Native BACnet device.

Term	Definition
Native BACnet System	A network composed only of Native BACnet Devices without gateways.
Open Database Connectivity	An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data.
Open Connectivity	OPC is an interoperability standard developed for industrial applications. OPC compliant systems make it possible to access or exchange data from any application, regardless of which database management system is handling the data.
Operator Interface	A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
Operator Workstation	The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
College	The College or their designated representatives.
Piping	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items.
Points	All physical I/O points, virtual points, and all application program parameters.
Point-to-Point	Serial communication as defined in the BACnet standard.
Portable Operators Terminal	Laptop PC used both for direct connection to a controller and for remote dial up connection.
Primary LAN	High speed, peer-to-peer controller LAN connecting BCs, AACs, and ASCs as well as some gateways. See System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Provide	Furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
Protocol Translator	A device that converts BACnet from one network protocol to another.
Reviewed, approved, or directed	Reviewed, approved, or directed by or to College's Representative.
Router	A device that connects two or more networks at the network layer.
Secondary LAN	LAN connecting some gateways and networked sensors. See System Architecture below.

Term	Definition
Server	A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
Standardized Query Language	SQL - A standardized means for requesting information from a database.
Supervisory LAN	Ethernet-based LAN connecting Primary LANs with each other and OWSs, CSS, and THS. See System Architecture below.
Supply	Purchase, procure, acquire and deliver complete with related accessories.
Wiring	Raceway, fittings, wire, boxes and related items.
Work	Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.

1.7 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.1 for approved manufacturers.

B. Installer

1. The following are approved BAS contractors:

   a. Sunbelt. Marc Annicchero mannicchero@sunbeltcontrols.com

   b. Air Systems. Mike Putich Mike.Putich@airsystemsinc.com

   c. ASG: Tony Skibinski tskibinski@asgbms.com

2. BAS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.

3. BAS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.

4. BAS Contractor's Lead Installation Technician Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system installation for not less

than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Installers must show proof of having successfully completed the installation certification training offered by the vendor of the proposed product line.

5. BAS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. BAS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.

6. Installer's Response Time and Proximity

    a. Installer must maintain a fully capable service facility within 50 miles of the subject Project. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.

    b. Installer must demonstrate the ability to meet the emergency response times listed in Paragraph 1.13B.1.

7. Electrical installation shall be by manufacturer-trained electricians

    a. Exception: Roughing in wiring and conduit and mounting panels may be subcontracted to any licensed electrician.

1.8 SUBMITTALS

A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the College's Representative.

B. Submit drawings and product data as hereinafter specified. Conditions in this Section take precedence over conditions in Division 1 or Section 230501 Basic Mechanical Materials and Methods.

C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the College's Representative:

1. Allow 10 working days for approval, unless College's Representative agrees to accelerated schedule.

2. Submittal Package 0 (Qualifications) shall be submitted with bid.

3. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the College in bid documents.

4. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.

5. Submittal Package 3 (Pre-Functional Test Forms) shall be submitted no less than 30 days prior to conducting tests.

6. Submittal Package 4 (Pre-Functional Test Report) shall be submitted no less than 14 after conducting tests.

7. Submittal Package 5 (Post-Construction Trend Points List) shall be submitted 14 days prior to the start of the trend collection period.

8. Submittal Package 6 (Functional Test Report) shall be submitted no more than 7 days after conducting tests.

9. Submittal Package 7 (Training Materials) shall be submitted no less than 14 days prior to conducting first training class.

10. Submittal Package 8 (Post-Construction Trend Logs) shall be submitted after demonstration tests are accepted and systems are in full automatic operation.

D. Submission and Resubmission Procedure

1. Optional Pre-Submittals. At Contractor's option, electronic submittals indicated below may be submitted unofficially via email directly to the Engineer for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time.

2. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as SUBMITTAL 250000-01.

3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 250000-01 REVISION 1.

4. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.

5. Submittals shall have bookmarks for each subsection (e.g. Materials, Drawings) and for each drawing including drawing number and name.

6. College's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.

7. Make corrections

   a. Revise initial submittal to resolve review comments and corrections.

   b. Clearly identify resubmittal by original submittal number and revision number.

   c. The cover page of resubmittals shall include a summary of prior comments and how they were resolved in the resubmittal.

   d. Indicate any changes that have been made other than those requested.

8. Resubmit revised submittals until no exceptions are taken.

a. The cost of the Engineer's review of submittals after first resubmittal will be borne by Contractor at Taylor Engineering standard billing rates.

9. Once submittals are accepted with no exceptions taken, provide

a. Complete submittal of all accepted drawings and products in a single electronic file.

b. Photocopies or electronic copies for coordination with other trades, if and as required by the General Contractor or College's Representative.

E. Submittals Packages

1. Submittal Package 0 (Qualifications)

a. Provide Installer and Key personnel qualifications as specified in Paragraph 1.7B.

b. Format: Word-searchable format per Paragraph 1.9C.3.

2. Submittal Package 1 (Hardware and Shop Drawings)

a. Hardware

1) Organize by specification section and device tags as tagged in these specifications.

2) Do not submit products that are not used even if included in specifications.

3) Include a summary table of contents listing for every submitted device:

a) Tab of submittal file/binder where submittal is located

b) Device tag as tagged in these specifications (such as TS-1A, FM-1)

c) Specification section number (down to the lowest applicable heading number)

d) Whether device is per specifications and a listed product or a substitution

e) Manufacturer

f) Model number

g) Device accuracy (where applicable)

h) Accuracy as installed including wiring and A/D conversion effects (where applicable)

4) Submittal shall include manufacturer's description and technical data, such as performance data and accuracy, product specification sheets, and installation instructions for all control devices and software.

5) When manufacturer's cut-sheets apply to a product series rather than a specific product, the data specifically applicable to the Project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

6) A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface.

7) Format: Word-searchable format per Paragraph 1.9C.3.

b. Shop Drawings

1) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.

2) Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. The schematics provided on Drawings shall be the basis of the schematics with respect to layout and location of control points.

3) All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.

4) Label each input and output with the appropriate range.

5) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including:

a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical)

b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag

c) Description

d) Proposed manufacturer and model number

e) Range

f) Quantity

6) With each schematic or on separate valve sheet, provide valve and actuator information including pipe size, valve size, C_v, design flow, target pressure drop, actual design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of fail-safe valves and dampers.

7) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

8) Details of control panels, including controllers, instruments, and labeling shown in plan or elevation indicating the installed locations.

9) Floor plans: None required.

10) Format

a) Sheets shall be consecutively numbered.

b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.

c) Table of Contents listing sheet titles and sheet numbers.

d) Legend and list of abbreviations.

e) Schematics

1. Word searchable pdf format.

2. 21 inch x 15 inch or 17 inch x 11 inch.

c. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.

3. Submittal Package 2 (Programming and Graphics)

a. A detailed description of point naming convention conforming to Paragraph 3.12B to be used for all software and hardware points, integrated with existing database convention.

b. A list of all hardware and software points identifying their full text names, device addresses and descriptions.

c. Control Logic Documentation

1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.

2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.

3) Include a MS Word file of the specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. Also merge Guideline 36 sequences, where referenced, verbatim into the file; see Section 259000 Building Automation Sequences of Operation. SOOs shall be fully consistent with the graphical programming.

4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.

5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.

d. Graphic screens of all required graphics, provided in final colors.

e. Format

1) Points list: Word-searchable format per Paragraph 1.9C.3.

2) Programming: Native ALC Eikon.

3) Control sequences: MS Word

4) Programming and operating manual: Word-searchable format per Paragraph 1.9C.3.

5) Graphics: Graphical electronic format (pdf, png, etc.).

4. Submittal Package 3 (Pre-Functional Test Forms)

a. Provide pre-functional test forms as required by Paragraph 3.14D.2.a.

b. Format: Word-searchable format per Paragraph 1.9C.3.

5. Submittal Package 4 (Pre-Functional Test Report)

a. Provide Pre-Functional Test Report as required by Paragraph 3.14D.2.

b. Format: Word-searchable format per Paragraph 1.9C.3.

6. Submittal Package 5 (Post-Construction Trend Points List)

a. Provide a list of points being trended along with trend interval or change-of-value per Paragraph 3.14I.2.d.

b. Format: See Paragraph 2.11C.3.

7. Submittal Package 6 (Functional Test Report)

a. Provide completed functional test forms as required by Paragraph 3.14G.4.

b. Format: Word-searchable format per Paragraph 1.9C.3.

8. Submittal Package 7 (Training Materials)

    a. Provide training materials as required by Paragraph 3.15.

    b. Format: Word-searchable format per Paragraph 1.9C.3.

9. Submittal Package 8 (Post-Construction Trend Logs)

    a. Provide trend logs as required by Paragraph 3.14I.

    b. Format: See Paragraph 2.11C.3.

1.9 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this Section are submitted and approved, the system will not be considered accepted and final payment to Contractor will not be made.

2. Before requesting acceptance of Work, submit one set of completion documents for review and approval of College.

3. After review, furnish quantity of sets indicated below to College.

B. Completion Documents

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per Paragraph 1.9C.

    a. Include the as-built version of all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual. Submittal data shall be located in tabs along with associated maintenance information.

    b. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

    c. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.

    d. A list of recommended spare parts with part numbers and suppliers.

    e. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

f. Programming Manuals with a description of the programming language, control block descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the programming editor.

g. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

h. A listing and documentation of all custom software for the Project created using the programming language, including the set points, tuning parameters, and point and object database.

i. English language control sequences updated to reflect final programming installed in the BAS at the time of system acceptance. See Section 259000 Building Automation Sequences of Operation.

2. Complete original issue electronic copy for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

3. Complete electronic copy of BAS database, user screens, setpoints and all configuration settings necessary to allow re-installation of system after crash or replacement of server, and resume operations with the BAS in the same configuration as during College sign-off.

4. Project Record Drawings

a. As-built versions of the submittal drawings in reproducible paper and electronic format per Paragraph 1.9C.

b. As-built network architecture drawings showing all BACnet nodes including a description field with specific controller and device identification, description and location information.

5. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Paragraph 3.14A.9.

6. Copy of inspection certificates provided by the local code authorities.

7. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.

8. Training materials as required by Paragraph 3.15.

9. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

C. Format of Completion Documents

1. Provide the type and quantity of media listed in table below.

2. Project database, programming source files, and all other files required to modify, maintain, or enhance the installed system shall be provided in their source format and compiled format (where applicable).

3. Where electronic copies are specified, comply with the following:

   a. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf), and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.

   b. For submittals, provide separate file for each type of equipment.

   c. Control sequences shall be in MS Word.

	Document	Paper (binder or bound)	Electronic	
			Loaded onto Flash Drive	Loaded onto CSS
1.	O&M Manual	2	1	1
2.	Original issue software	–	1	1
3.	Project database including all source files	–	1	1
4.	Project Record Drawings	2	1	1
5.	Control sequences	1	1	1
6.	Commissioning Reports	2	1	1
7.	Inspection Certificates	1	–	–
8.	Warranty documents	1	–	–
9.	Training materials	1 per trainee	1	1
10.	Contact information	1	–	–

D. Permanent On-site Documentation

1. In each panel, provide the following stored in clear plastic sleeve taped to the back of the panel door:

   a. 8.5x11 printout of as-built points list

   b. 21 inch x 15 inch or 17 inch x 11 inch set of as-built shop drawings for devices in panel

1.10 BAS DESIGN

A. System Architecture

1. General

   a. The system provided shall incorporate hardware resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically

itemized in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Section.

b. The system shall be configured as a distributed processing network(s) capable of expansion as specified herein.

c. The existing Campus BAS consists of a control system server interconnected by the College IT LAN to each campus building and facility. This project includes integrating building level BCs and other control devices into the campus system.

1) Within the building, the BAS shall be standalone and not rely on any 3rd party networks, such as the College IT LAN, except as specifically allowed herein.

2) To communicate with the central CSS (and internet via VPN), the building Supervisory LAN shall connect via router, provided under Division 27, to the College IT LAN, provided by the Division 27. Locate in building ***MDF*** or other location as directed by the College IT group.

d. All control products provided for this Project shall comprise an interoperable Native BACnet System. All control products provided for this Project shall conform to ANSI/ASHRAE Standard 135.

e. Power-line carrier systems are not acceptable for BAS communications.

2. BAS Network Architecture

a. College IT LAN. Ethernet-based, 100 or 1000 Mbps network specified under Division 27 Communications.

NOTE: new 4CD standard: IP network is used to connect BCs – no longer allow ARCnet or MS/TP. Include alternate for Division 27 to install if applicable.

b. Supervisory LAN: Ethernet-based, 100 or 1000 Mbps BACnet/IP network interconnecting the server and OWS(s) to BCs and certain gateways as specified herein. LAN shall be IEEE 802.3 Ethernet with switches and routers that support 100 Mbps minimum throughput. This network shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet.

*NOTE: ARCnet is listed as optional here. This should only be used on new ALC jobs that cannot use ALC's new IP product line. If it's deleted, edit this section to pull Ethernet into the paragraph.*Primary LAN: High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs, and certain gateways and sensors where specified herein. Acceptable technologies include and are limited to:

1) Ethernet (IEEE802.3) per the Supervisory LAN

2) ***ARCnet (IEEE802.4***)

NOTE: new 4CD standard: MS/TP only used for gateways and sensors where spec'd. No longer allowed for interconnecting controllers. Secondary LAN: Network used only to connect certain gateways and sensors where specified herein. It shall not be used to interconnect BCs, AACs, and ASCs. Network speed

versus the number of devices on the LAN shall be dictated by the response time and trending requirements. Acceptable technologies include but are not limited to:

1) BACnet over Master Slave/ Token Passing (MS/TP)

2) Modbus RTU over RS-485

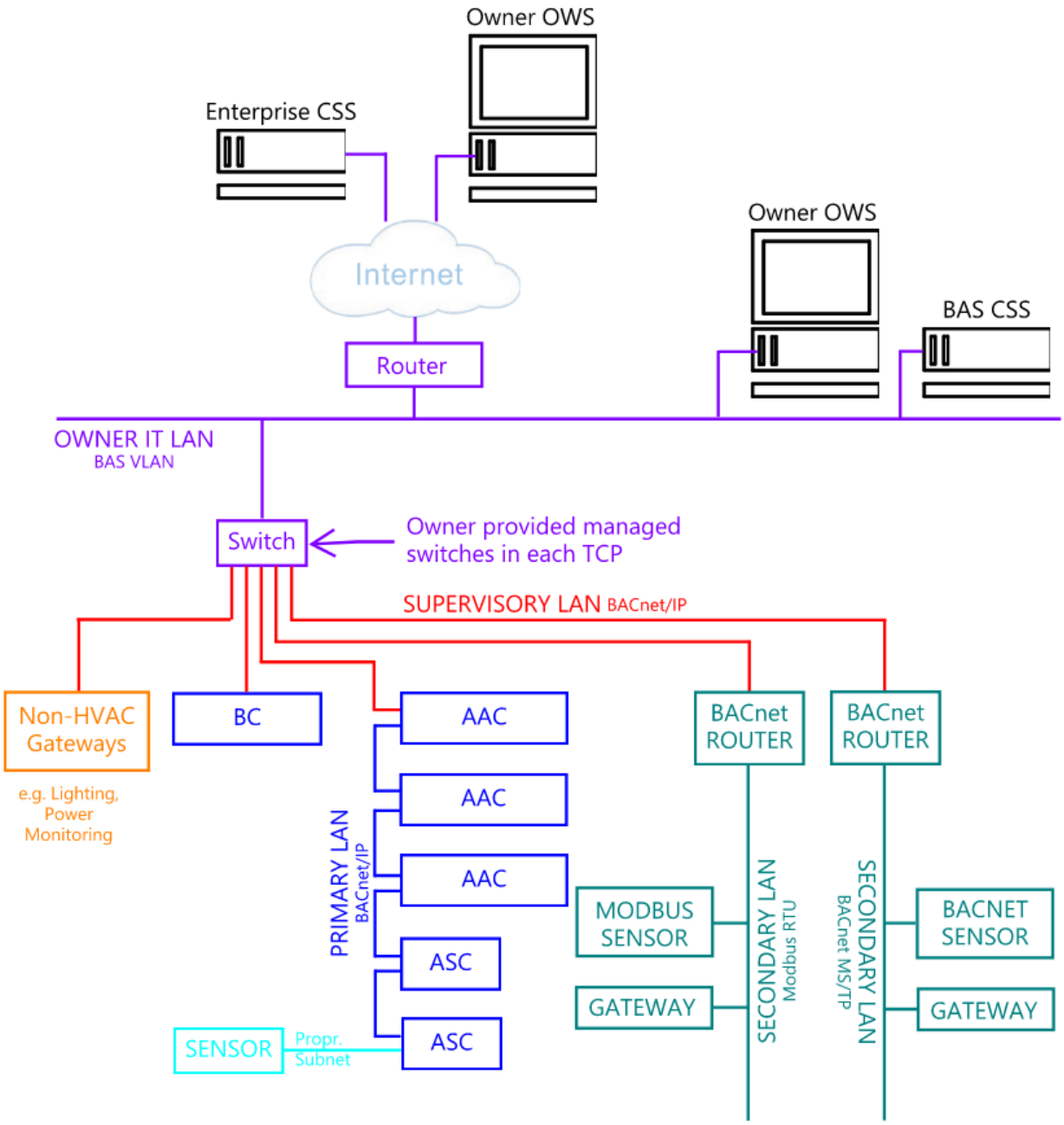
e. Subnets: Networks used to connect sensors and thermostats to AACs and ASCs. This network may as above for Secondary LANs or may be proprietary the manufacturer.

3. The figure below shows an example schematic of the desired network architecture. Note:

a. Not all devices shown will exist for this project.

b. Ethernet network installer shall be responsible for assigning IP addresses to all devices on the network.

c. The “Owner Provided Managed Switches” in the figure below may be assumed to exist in each TCP as shown on mechanical drawings. Final locations shall be determined by the contractor in coordination with Division 27. Any switches requested by the BAS Contractor that are in addition to those in TCPs shall be at the BAS Contractor’s expense.



4. Operator Interfaces and Servers

   a. The Control Systems Server (CSS) is existing. See Paragraph 1.3B.7 for temporary CSS requirements.

   b. OWSs or POTs are either existing or will be provided by the College.

   c. Remote monitoring and control shall be through use of a web browser through the College IT LAN and via the internet through the College IT LAN.

5. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified.

6. Gateways

   a. See Paragraph 2.4C for a list of gateways.

   b. Where gateways are used, critical points may also be hardwired from the BAS to the controlled device, rather than using the gateway, to avoid problems with gateway failures. Where listed in Hardware Points tables, these points shall be hardwired even when available through gateway.

B. System Performance

1. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. This includes when system is collecting trend data for commissioning and for long term monitoring. (See Paragraph 3.14I.) In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein, assuming no other simultaneous operator activity. Reconfigure LAN as necessary to accomplish these performance requirements. This does not apply to gateways and their interaction with non-BAS-vendor equipment.

   a. Object Command: The maximum time between an operator command via the operator interface to change an analog or binary point and the subsequent change in the controller shall be less than 5 seconds.

   b. Object Scan: All changes of state and change of analog values will be transmitted over the network such that any data used or displayed at a controller or workstation will have been current within the previous 10 seconds.

   c. Graphics Scan: The maximum time between an operator's selection of a graphic and it completely painting the screen and updating at least 10 points shall be less than 10 seconds.

   d. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation or broadcast (where so programmed) shall not exceed 10 seconds for a Level 1 alarm, 20 seconds for alarm levels 2 and 3, and 30 seconds for alarm levels 4 and 5. All workstations on the onsite network must receive alarms within 5 seconds of each other.

   e. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

   f. Control Loop Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

2. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

Measured Variable	**Reported Accuracy**
Space drybulb temperature	±1ºF
Ducted Air drybulb temperature	±0.5ºF
Mixed Air drybulb temperature	±1ºF
Outside Air drybulb temperature	±0.5ºF
Chilled and Condenser Water Temperature	±0.2ºF
Hot Water Temperature	±0.5ºF
Chilled/Hot Water Delta-T (supply to return) at building mains from central plant only	±0.15ºF
Relative Humidity − general	±5% RH
Relative Humidity − outdoor air	±3% RH
Water and Gas Flow	±1% of reading
Airflow (terminal)	±10% of reading
Airflow (measuring stations)	±5% of reading
Air Pressure (ducts)	±0.05 inches
Air Pressure (space)	±0.01 inches
Water Pressure	±2% of reading
Electrical power	1% of reading
Carbon Dioxide (CO_2)	±75 ppm

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the College. These include, but are not limited to:

1. Project graphic images

2. Record drawings

3. Project database

4. Project-specific application programming code

5. All documentation

1.12 WARRANTY

A. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the College and if all completion requirements per Paragraph 1.9B have been fulfilled, the College shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.

B. Guarantee all materials, equipment, apparatus and workmanship (including programming) to be free of defective materials and faulty workmanship for the following periods from date of acceptance:

1. BCs, AACs, and ASCs: two years

2. Valve and damper actuators: five years

3. All else: one year

C. Provide new materials, equipment, apparatus and labor to replace that determined by College to be defective or faulty.

D. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the College. Contractor shall respond to the College's request for warranty service within 24 hours during normal business hours.

E. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies shall be provided at no cost to the College during the warranty period.

F. Sequence of operation programming bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall be provided at no additional cost to the College during this period.

1.13 WARRANTY MAINTENANCE

A. The College reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the College, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

B. At no cost to the College, provide maintenance services for software and hardware components during the warranty period as specified below:

1. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

a. Response by telephone or via internet connection to the BAS to any request for service shall be provided within two hours of the College's initial request for service.

b. In the event that the malfunction, failure, or defect is not corrected, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within eight hours of the College's initial request for such services.

2. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.

a. Response by telephone to any request for service shall be provided within eight working hours (contractor specified 40 hr. per week normal working period) of the College's initial request for service.

b. In the event that the malfunction, failure, or defect is not, at least one technician, trained in the system to be serviced, shall be dispatched to the College's site within three working days of the College's initial request for such services, as specified.

3. College's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for College to call in the event of a need for service. At least one of the lines shall be attended continuously (24/7). Alternatively, pagers/SMS can be used for technicians trained in system to be serviced. One of the three paged/texted technicians shall respond to every call within 15 minutes.

4. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.

5. Documentation: Record drawings and software documentation shall be updated as required to reflect any and all changes made to the system or programming during the warranty period.

PART 2 PRODUCTS

2.1 PRIMARY BAS MANUFACTURER

A. Automated Logic Corp.

B. No Equal

2.2 GENERAL

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.

B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

C. All controllers, associated hardware (repeaters, routers, etc.), sensors, and control devices shall be fully operational and maintain specified accuracy at the anticipated ambient conditions of the installed location as follows:

1. Outdoors or in harsh ambient conditions: -20°C to 55°C (-4°F to 130°F), 10% RH to 90% RH noncondensing.

2. Conditioned spaces or mechanical rooms: 0°C to 40°C (32°F to 104°F), 10% RH to 80% RH noncondensing.

D. If controllers are not plenum rated and are mounted in an air plenum, e.g. ceiling return plenum, include a plenum kit or mount in a control panel.

2.3 CONTROLLERS

A. Building Controller (BC)

1. ALC OptiFlex line

B. Advanced Application Controller (AAC)

1. ALC OptiFlex line

2. ***ALC SE-series***

C. Application Specific Controller (ASC)

1. ALC OptiFlex line

2. ***ALC ZN-series***

2.4 COMMUNICATION DEVICES

A. Supervisory LAN Protocol Translators

1. ALC Optiflex line

B. BACnet Gateways & Protocol Translators

1. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this Paragraph is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

2. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the Points List using standard BACnet services.

C. Gateways and Protocol Translators

Equipment/System	Interface			
	Type	Specified Under Division:	Location	Connect to this Network:
Variable Speed Drives	BACnet/MSTP	23	Each VFD	Secondary
Electronically Commutated Motors	Modbus RS-485	23	Each ECM	Secondary
Chillers	BACnet/IP	23	Each Chiller	Supervisory
Chillers	BACnet/MSTP	23	Each Chiller	Secondary
Water-to-Water Heat Pumps	BACnet/IP	23	Each Heat Pump	Supervisory
Water-to-Water Heat Pumps	BACnet/MSTP	23	Each Heat Pump	Secondary
Air-to-Water Heat Pumps	BACnet/IP	23	Each Heat Pump	Supervisory
Air-to-Water Heat Pumps	BACnet/MSTP	23	Each Heat Pump	Secondary
Boilers	Modbus RS-485	23	Each Boiler	Secondary
Boilers	BACnet/MSTP	23	Each Boiler	Secondary

Equipment/System	Interface			
	Type	Specified Under Division:	Location	Connect to this Network:
Lighting Controls	BACnet/IP	26	Electrical Room xxxx	College IT LAN
Lighting Controls	BACnet/IP	26	Electrical Room xxxx	Supervisory
Automatic Shade Controls	BACnet/IP	12	Electrical Room xxxx	College IT LAN
Automatic Shade Controls	BACnet/IP	12	Electrical Room xxxx	Supervisory
Power Monitoring	BACnet/IP	26	Electrical Room xxxx	College IT LAN
Power Monitoring	BACnet/IP	26	Electrical Room xxxx	Supervisory
Power Monitoring	Modbus RS-485	26	Electrical Room xxxx	Secondary
Switchgear Digital Power Meters	BACnet/IP	26	Electrical Room xxxx	College IT LAN
Switchgear Digital Power Meters	BACnet/IP	26	Electrical Room xxxx	Supervisory
BTU meters	BACnet/MSTP	25	Each BTU meter	Secondary
Refrigerant monitor	Modbus RS-485	25	RM-1	Secondary
Lab Air Valves	BACnet/MSTP	23	Each Air Valve	Secondary
Water Treatment System	BACnet/IP	23	WTS-1	Supervisory
Variable refrigerant flow (VRF) system	BACnet/IP	23	Room xxxx	Supervisory
Hydronic Heat Pumps	BACnet/MSTP	23	Each AC unit	Secondary
AC Units	BACnet/MSTP	23	Each AC unit	Secondary
AC Units	BACnet/IP	23	Each AC unit	Supervisory
Emergency Generator	Modbus RS-485	26	Each generator	Secondary
UPS	Modbus RS-485	26	Each UPS	Secondary
DCW Booster pump	BACnet/MSTP	22	DCW Booster pump	Secondary
Wind Anemometer	Modbus RS-485	25	Roof	Secondary

2.5 BAS INTERFACE HARDWARE

A. Not required (existing)

2.6 AIR TUBING

A. Seamless copper tubing, Type L-ACR, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.

B. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.

2.7 ELECTRIC WIRING AND DEVICES

A. All electrical work shall comply with Division 26.

B. Communication Wiring

1. Provide all communication wiring between Building Controllers, Protocol Translators, Gateways, AACs, ASCs and local and remote peripherals (such as operator workstations and printers).

2. Ethernet LAN: Use Fiber or Category 5e or 6 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over 30 volts.

3. ***ARCnet and*** RS-485 LAN: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Analog Signal Wiring

1. Input and output signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, current or voltage analog outputs, etc. shall be twisted pair, 100% shielded if recommended or required by controller manufacturer, with PVC cover. Gauge shall be as recommended by controller manufacturer.

2.8 CONTROL CABINETS/PANELS

A. All control cabinets shall be fully enclosed with hinged door.

1. For panels in mechanical rooms and other spaces that are secure and accessible only to BAS/MEP operators, provide quarter-turn slotted latch.

2. For panels located in electrical rooms, IDF rooms, and other spaces that may be accessible by persons other than BAS/MEP operators, provide key-lock latch. A single key shall be common to all panels within each building. Provide 3 keys.

B. Construction

1. Indoor:

a. Mechanical or electrical rooms etc.: NEMA 1

b. Air plenums: NEMA 12

2. Outdoor: NEMA 4NEMA 4X with 316 stainless steel

C. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control-interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run

neatly and orderly in open slot wiring duct with cover. Control terminations for field connection shall be individually identified per control Shop Drawings.

D. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

E. Provide with

1. Framed, plastic-encased point list for all points in cabinet.

2. Nameplates for all devices on face.

2.9 SENSORS AND MISCELLANEOUS FIELD DEVICES

A. The listing of several sensors or devices in this section does not imply that any may be used. Refer to points list in Paragraph 2.12 Points List for device specification. Only where two or more devices are specifically listed in points list (such as “FM-1 or FM-4”) may the Contractor choose among listed products.

B. Control Valves

1. Manufacturers

a. Belimo

b. Siemens

c. Schneider

d. Delta

e. JCI

f. Bray

g. Or equal

2. ***Plug-Type Globe Valves***

a. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on top-and-bottom guided plugs.

b. Temperature Rating: 25ºF minimum, 250ºF maximum

c. Body: Cast Iron, flanged

d. Valve Trim: Bronze; Stem: Polished stainless steel

e. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting

f. Plug: Brass, bronze or stainless steel, Seat: Brass

g. Disc: Replaceable Composition or Stainless Steel Filled PTFE

h. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

i. Ambient Operating Temperature Limits: -10 to 150ºF

3. Butterfly Valves

a. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class bolt pattern to match specified flanges.

b. Seat: EPDM replaceable, non-collapsible, phenolic backed.

c. Disc: Polished aluminum bronze or stainless steel, pinned or mechanically locked to shaft. Sanded castings are not acceptable.

d. Bearings: Bronze or stainless steel.

e. Shaft: 416 stainless steel supported at three locations with PTFE bushings for positive shaft alignment.

f. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

4. Modulating Characterized Ball Valves

a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.

b. Industrial quality with nickel plated forged brass body and female NPT threads.

c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi rating (3-way valves). The stem packing shall consist of 2 lubricated O-rings designed for modulating service and requiring no maintenance.

d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.

e. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

f. Characterizing disk held securely by a keyed ring providing equal percentage characteristic

g. Ball: stainless steel

h. Stem: stainless steel

5. Two Position Ball Valves

a. Same as Modulating Characterized Ball Valves except no characterization disks

6. Six-way Characterized Ball Valves

a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.

b. Industrial quality with nickel plated forged brass body and NPT threads.

c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 230 psi rating. The stem packing shall consist of 2 lubricated O-rings designed for modulating service and requiring no maintenance.

d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.

e. Built-in pressure relief

f. Close off rating: 50 psi

g. Ball: chrome plated brass

h. Stem: nickel plated brass

i. Characterizing disk held securely by a keyed ring providing linear characteristic

7. Pressure Independent Control Valves

a. Manufacturers

1) Danfoss

2) Belimo

3) Bell & Gossett

4) Delta-P

5) Griswold

6) Bray

b. The modulating control valves shall be pressure independent.

1) The flow through the valve shall not vary more than ± 5% due to system pressure fluctuations across the valve in the selected operating range.

2) The control valves shall accurately control the flow from 0 to 100% full rated flow.

3) The valve shall have an equal percentage or linear characteristic.

4) Valve shall be regulator + valve type; ePICVs with flow meter shall not be acceptable.

c. No more than 5 psi differential pressure shall be required to operate the valve pressure independently.

d. Valves shall require no maintenance and shall not include replaceable cartridges.

e. Close off rating: Bubble-tight shutoff greater or equal to 125% of pump shut-off head.

f. Maximum flow rate setpoint shall be field adjustable.

8. Minimum valve assembly pressure ratings

a. Chilled water: 125 psi at 60ºF

b. Hot water: 125 psi at 200ºF

c. Condenser water: 125 psi at 100ºF

9. Valve Selection

a. Valve type

1) Modulating 2-way or 3-way valves

a) 6 inch and less: characterized ball type

b) 8 inch and greater: globe type

2) Bypass valve at primary-only variable flow pumping system outlet: Pressure independentSame as Modulating 2-way valve.

3) Chiller head pressure control: butterfly

4) Two-position isolation: butterfly or non-characterized ball type

5) Two-position 3-way changeover: butterfly or non-characterized ball type

b. Valve Characteristic

1) 2-way valves: equal percentage or modified equal percentage.

2) 3-way valves controlling cooling coils and condenser water heat exchangers: linear.

3) 3-way valves controlling heating coils: equal percentage or modified equal percentage.

4) 6-way valves: linear

5) Two-position valves: not applicable. For ball valves used for two-position duty, do not include characterizing disk.

c. Valve Sizing

1) Modulating Water: Size valve to achieve the following full-open pressure drop

a) Minimum pressure drop: equal to half the pressure drop of coil or exchanger.

b) Maximum pressure drop

1. Hot water at coils: 2 psi

2. Chilled water at coils: 5 psi

3. Chiller head pressure control: 1 psi

c) 3-way valves shall be selected for near minimum pressure drop. 2-way and 6-way valves shall be selected near maximum pressure drop.

d) Flow coefficient (C_v) shall not be less than 1.0 (to avoid clogging) ***unless protected by strainer. Verify from piping schematics that a strainer is being provided.***

e) Valve size shall match as close as possible the pipe size where C_v is available in that size.

2) Two-position valves: Line size unless otherwise indicated on Drawings.

3) Pressure independent valves: Line-size with flow limiting device selected for design flow maximum flow setpoint.

C. Control Dampers

1. See Section 233300 Duct Accessories and Section 237300 Air Handling Units & Coils.

D. Actuators

1. Manufacturers

a. Belimo

b. No equal

2. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.

3. Electric Actuators

a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.

b. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.

c. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.

d. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.

e. Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.

f. Noise from actuator while it is moving shall be inaudible through a tee-bar ceiling.

g. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.

h. Modulating Actuators. Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal converter are not acceptable.

i. Where indicated on Drawings or Points List, actuators shall include

    1) 2 to 10 VDC position feedback signal

    2) Limit (end) position switches

j. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.

k. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

l. Actuators shall be provided with a conduit fitting an a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

m. Where fail-open or fail-closed (fail-safe) position is required by Paragraph 2.9D.5, an internal mechanical, spring return mechanism shall be built into the actuator housing. Electrical capacitor type fail-safe are also acceptable. All fail-safe actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation. Spring return 2-position fail-safe valves shall not be u

sed in noise sensitive locations; use either electronic fail-safe where available, or use floating point type actuator with drive-open and drive-close wiring for normal open/close operation (spring shall only be used to cause valve to drive to fail-safe position upon a loss of power) including position feedback.

n. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.

o. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.

p. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.

q. Actuators shall provide clear visual indication of damper/valve position.

4. Electric Actuators for Large Butterfly Valves

a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.

b. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.

c. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications.

d. Output shaft shall be electroless nickel plated to prevent corrosion.

e. Actuator shall have a motor rated for minimum 75% duty cycle. Duty cycle shall be defined as running time divided by installed time at maximum torque.

f. Actuator shall be suitable for operation in ambient temperature ranging from -22°F to +150°F.

g. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.

h. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.

i. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator. When in manual operation electrical power to the actuator will be permanently interrupted.

j. The hand wheel will not rotate while the actuator is electrically driven.

k. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.

l. Provide limit (end) position switches where indicated on schematics.

m. Actuators shall provide clear visual indication of valve position.

5. Normal and Fail-Safe Position

a. Except as specified otherwise herein, the normal position (that with zero control signal) and the fail-safe position (that with no power to the actuator) of control devices and actuators shall be as indicated in table below. "Last" means last position. Actuators with a fail-safe position other than "Last" must have spring or electronic fail-safe capability.

Device	**Normal Position**	**Fail-Safe Position**
Outside air damper	CLOSED	CLOSED
Return air damper	OPEN	OPEN
Exhaust/relief air damper	CLOSED	CLOSED
Domestic hot water generator	CLOSED	CLOSED
Cooling tower makeup water valve	CLOSED	CLOSED
Cooling tower filtration water valves	CLOSED	CLOSED
Cooling tower filtration purge valve	CLOSED	CLOSED
AHU heating coil valves	OPEN	LAST
AHU cooling coil valves	CLOSED	LAST
Equipment isolation valves	OPEN	LAST
Hot water reheat coil valves	CLOSED	LAST
Minimum flow bypass valves	OPEN	LAST
Fan-coil HW and CHW valves	CLOSED	LAST
HW/CHW valves for changeover coils	Same as fail-safe	See Schematics
CRAH CHW valves	OPEN	LAST
HW/CHW 6-way valves for changeover coils	CLOSED to both	LAST
VAV box dampers	OPEN	LAST
Laboratory hood exhaust air valves	OPEN	LAST
Laboratory supply air valves	OPEN	LAST
Laboratory general exhaust valves	CLOSED	LAST
Laboratory fume hood exhaust minimum airflow damper	CLOSED	CLOSED

6. Valve Actuator Selection

a. Modulating actuators for valves shall have minimum rangeability of 50 to 1.

b. Water

1) 2-way, 6-way, and two-position valves

a) Tight closing against 125% of system pump shut-off head.

b) Modulating duty against 90% of system pump shut-off head.

2) 3-way shall be tight closing against twice the full open differential pressure for which they are sized.

7. Damper Actuator Selection

a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.

b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:

1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.

2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

E. General Field Devices

1. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

2. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

3. Field devices specified herein are generally two-wire type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with two-wire type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide a transmitter and necessary regulated DC power supply, as required.

4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

5. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device and as required by Paragraph 1.10B.2.

F. Temperature Sensors (TS)

1. General

a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.

b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3ºF (0.16 °C) (unless noted otherwise herein).

c. Sensors shall drift no more than 0.3ºF and shall not require calibration over a five-year period.

d. Manufacturers

1) Mamac

2) Kele Associates

3) Building Automation Products Inc.

4) Automated Logic Corp.

5) Or equal

2. Duct temperature sensors: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.

a. TS-1A: Single point (use where not specifically called out to be averaging in points list). Sensor probe shall be 304 stainless steel.

b. TS-1B: Averaging, flexible. Sensor length shall be at least 1 linear foot for each 2 square feet of face area up to 25 feet maximum. Sensor probe shall be bendable aluminum.

c. TS-1C: Averaging, rigid. Sensor length shall be at least 2/3 the width of the duct and include at least four sensing elements, or one per 6 inches, whichever is greater.

3. Water Temperature Sensors

a. TS-2A: Well mounted immersion sensor, ¼" stainless steel probe, double encapsulated sensor, with enclosure suitable for location.

b. TS-2B: Same as TS-2A except provide extra precision (XP) temperature sensors to meet accuracy specified Paragraph 1.10B.2.

c. TS-2C. See BTU-1.

d. All piping immersion sensors shall be in one-piece machined brass or stainless steel wells that allow removal from operating system, with lagging extension equal to insulation thickness where installed in insulated piping. Wells shall be rated for maximum system operating pressure, temperature and fluid velocity. The well shall penetrate the pipe by the lesser of approximately half the pipe diameter or eight inches. The use of direct immersion or strap-on type sensors is not acceptable.

4. Room Sensors

a. Thermostat tags refer to the following:

Type:	Tag	
ALC model	ZS2 Standard	ZS2 Pro
Distech model	EC-SmartAir	EC-SmartVue
Display	Blank	LCD
Temperature only	TS-3A	TS-3C
With humidity	TS-3AH	TS-3CH
With CO_2	TS-3AC	TS-3CC
With CO_2 and humidity	TS-3AHC	TS-3CHC

1) Display

a) Blank: Blank cover (or LCD display with display configured to be shut off and touchpad or keypad disabled)

b) LCD: LCD display of all sensors, temperature setpoint adjustment buttons, and schedule override button

2) Humidity Sensor

a) 10% to 90%/±2% accuracy

b) Where humidity sensor is not specified but included as standard, it shall be configured to not be displayed on the LCD or any graphics and not included in points list, as if it did not exist. (The purpose is to avoid the expense of having to keep the sensor in calibration.)

3) CO2 Sensor

a) 400 to 1250 PPM/ ±30PPM or 3% of reading, whichever is greater.

b) The sensor shall include automatic background calibration (ABC) logic to compensate for the aging of the infrared source and shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the Owner within 5 years of purchase date.

c) Meet Title 24 requirements including calibration interval

4) For room sensors connected to terminal box controllers (such as at VAV boxes) that require calibration: Include a USB port or some other means for connection of POT for terminal box calibration. Alternative means of terminal calibration are acceptable provided they result in no cost to Work performed under Section 230593 Testing, Adjusting, and Balancing.

b. TS-3E. “Button” temperature sensor. Titan Products TPWBS, or equal.

c. TS-3F. Radiant temperature sensor. Titan Products TPRS/BB, 4-20 mA signal.

d. See equipment schedules for thermostat type.

e. Unless otherwise indicated in points list or drawings, locate sensors as follows:

1) Lobbies, corridors, break rooms, and public spaces: TS-3C

2) Equipment rooms and other back-of-house spaces: TS-3A

3) Open offices: TS-3C

4) Private offices, labs: TS-3C

5) Conference rooms, meeting rooms, etc.: TS-3CC

6) Classrooms, training rooms, multi-purpose rooms, etc.: TS-3CC

7) DOAS Ventilation terminal with CO2: TS-3CC

8) Others not listed: Confirm with Engineer through RFI.

5. TS-4: Outdoor Air Sensor

a. Enclose in fan-aspirated radiation shield that combines both active and passive aspiration to minimize the effects of radiation.

1) Motor-driven fan draws air through the sensor chamber and exhausts it through the top of the shield.

2) Triple-walled sensor chamber shielded by flow-through plates.

3) Aspiration rate: minimum is 220 feet per minute.

b. Sensor

1) Electronics mounted in watertight gasketed enclosure to prevent water seepage

2) TS-1A where only drybulb temperature is specified in points list

3) TS-1A and HT-2 where drybulb temperature and relative humidity is specified in points list

c. Manufacturer

1) Davis Instruments 7747

2) Kele A21

3) Or equal

d. Outdoor air sensors shall have a weather shade/sun shield, utility box, and watertight gasket to prevent water seepage.

6. Temperature Transmitters: Where required by the Controller or to meet specified end-to-end accuracy requirements, sensors as specified above shall be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

G. BTU Meter (BTU-1)

1. Matched RTD or solid state temperature sensors with a differential temperature accuracy of +/-0.15°F.

2. Flow meter: FM-1 ***or FM-2***.

3. Unit accuracy shall be +/- 1% factory calibrated, traceable to NIST with certification.

4. NEMA 1 enclosure.

5. UL listed.

6. Provide BACnet/MSTP network connection that will allow all point data to be transmitted to BAS network.

7. I/O.

a. BACnet Points:

1) Supply Temperature

2) Return Temperature

3) Flow

4) Energy Rate (Btu/hr.)

8. Manufacturers

a. Onicon System 20

b. Siemens Sitrans

c. Or Equal

H. Pressure Transmitters (PT)

1. PT-1: Water, General Purpose

a. Fast-response stainless steel sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.5% full scale, includes non-linearity, repeatability, and hysteresis

d. Long Term Stability 0.5% FS per year

e. Pressure Limits

1) Rated pressure: see points list

2) Proof pressure = 3x rated pressure

3) Burst pressure = 5x rated pressure

f. Manufacturers

1) Setra 209

2) Kele & Associates P51 Series

3) Or equal

I. Differential Pressure Transmitters (DPT)

1. DPT-1: Water, General Purpose

a. Fast-response capacitance sensor

b. Two-wire transmitter, 4-20 mA output with zero and span adjustments

c. Accuracy

1) Overall Accuracy (at constant temp) ±0.25% full scale (FS).

2) Non-Linearity, BFSL ±0.22% FS.

3) Hysteresis 0.10% FS.

4) Non-Repeatability 0.05% FS.

d. Long Term Stability 0.5% FS per year

e. Only 316 stainless steel in contact with fluid

f. Pressure Limits

1) 0 to 100 psid range: 250 psig maximum static pressure rating, 250 psig maximum overpressure rating.

2) 100 to 300 psid range: 450 psig maximum static pressure rating, 450 psig maximum overpressure rating.

g. Include brass 5-valve assembly for single sensor devices. See Paragraph 3.11E.10.

h. Manufacturers

1) Setra 209 or 230

2) Modus W30

3) Or equal

2. DPT-2: Not used

3. DPT-3: Air, Duct Pressure:

a. General: Loop powered two-wire differential capacitance cell-type transmitter.

b. Output: two wire 4-20 mA output with zero adjustment.

c. Overall Accuracy: ±1% of range (not of maximum range/scale)

d. Switch selectable range:

1) ≥ 0.5 inches water column

2) ≤10 inches water column

3) Select range as specified in points list or, if not listed for specified setpoint to be between 25% and 75% full-scale.

e. Housing: Polymer housing suitable for surface mounting.

f. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301, Davis Instruments, or equal, with connecting tubing.

g. DPT-3A: Include LCD display of reading.

h. DPT-3B: Same as DPT-3 except with stainless steel pitot-type static pressure sensing tips similar to Dwyer model A-301-SS, or equal.

i. Manufacturers.

1) Setra

2) Modus

3) Dwyer

4) Or equal

4. DPT-4: Air, Low Differential Pressure

a. General: Loop powered, two-wire differential capacitance cell type transmitter.

b. Output: Two-wire 4-20 mA output with zero adjustment.

c. Overall Accuracy

1) General: ±1% FS

2) Underfloor: ±0.5% FS

3) Minimum outdoor air damper DP used for minimum outdoor airflow: ±0.25% FS

d. Range

1) Fixed (non-switch selectable)

2) Minimum Range: 0, -0.1, -0.25, -0.5, or -1.0 inches water column

3) Maximum Range: +0.1, 0.25, 0.5, or 1.0 inches water column

4) Range shall be as specified in points list or, if not listed, selected such that specified setpoint is between 25% and 75% full-scale.

e. Housing: Polymer housing suitable for surface mounting

f. Static Sensing Element

1) Ambient sensor: Dwyer A-306 or 420, BAPI ZPS-ACC-10, or equal

2) Space sensor:

a) Wall plate: Kele RPS-W, BAPI ZPS-ACC-01, Dwyer A-417 or 465 or equal

b) Ceiling or wall probe: BAPI ZPS-ACC06, Dwyer A-419A, Veris AA05 or equal

3) Filter or duct pressure sensor: Dwyer A-301 or equal

4) Plenum pressure sensor: Dwyer A-421 or equal

g. DPT-4A: Include LCD display of reading

h. Manufacturers

1) Setra 267

2) Modus

3) Air Monitor

4) Paragon

5) Or equal

5. DPT-5: VAV Velocity Pressure

a. General: Loop powered two-wire differential capacitance cell type transmitter.

b. Output: Two-wire, 4-20 mA output with zero adjustment.

c. Flow transducer (including impact of A-to-D conversion) shall be capable of stably controlling to a setpoint of 0.004 inches differential pressure or lower, shall be capable of sensing 0.002 inches differential pressure or lower, and shall have a ±0.001 inches or lower resolution across the entire scale.

d. Calibration software shall use a minimum of two field measured points, minimum and maximum airflow, with curve fitting airflow interpolation in between.

e. Range: 0 to 1 in.w.c.

f. Housing: Polymer housing suitable for surface mounting.

g. Manufacturer

1) Automated Logic

2) No equal

J. Flow switch (FS-1)

1. Calorimetric type or other device equally resistant to fouling and corrosion

2. Shall not require more than one pipe diameter (or 12 inches whichever is larger) of straight piping for proper operation

3. IFM or equal

K. Water Leak Detector (WLD)

1. Gold plated sensing probes

2. Encapsulated in epoxy or polymer – no exposed metals

3. Automatically resets when conductive fluid is no longer present

4. Relay contact outputs rated at 1amp at 24 Vdc

5. Powered with 12-24 Vac from BAS panel. Battery not acceptable.

6. Adjustable detection level

7. Manufacturers

a. Veris SD-R01 or MX-1V

b. Kele WD-1B

c. Or equal

L. Differential Pressure Switches (DPS)

1. DPS-1: Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0ºF to 160ºF operating temperature range.

2. DPS-2: Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Automatic reset. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

M. Level Sensor (LS)

1. Pressure Type

2. Wetted Materials:17-4 PH Stainless Steel.

3. Accuracy: RSS* (at constant temperature) ±0.25%. Non-linearity (BSFL) ±0.22% FS; Hysteresis 0.10% FS; Non-repeatability 0.05% FS

4. Temperature Limits:-40 to 185°F

5. Range 0-1 psi (0-2.31 feet)

6. Thermal Effects: Zero Shift: ±2.0% FS/100°F; Span Shift: ±1.5% FS/100°F; Warm-up Shift: ±0.1% FS total

7. Stability:0.5% FS/year

8. Response Time:5 ms

9. Power Requirements:9-30 VDC

10. Output:4-20 mA, 2-wire

11. Zero and Span Adjustment: Fixed

12. Loop Resistance:0 to 800 Ω.Shock:200

13. Vibration:20 g

14. Enclosure: Stainless Steel and Valox

15. Manufacturer

    a. Dwyer 673-1

    b. Equal

N. Current Switches (CS-1)

1. Clamp-on or solid-core

2. Range: as required by application

3. Trip Point: Automatic or adjustable

    a. Exception: Fixed setpoint (Veris H-600 or equal) may be used on direct drive constant speed fans that do not have backdraft or motorized shutoff dampers.

4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage

5. Lower Frequency Limit: 6 Hz

6. Trip Indication: LED

7. Approvals: UL, CSA

8. May be combined with relay for start/stop

9. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal

10. Manufacturers

    a. Veris Industries H-608/708/808/908

    b. Senva C-2320L

    c. RE Technologies SCS1150A-LED

    d. Or equal

O. Current Transformers (CT-1)

1. Clamp-On Design Current Transformer (for Motor Current Sensing)

2. Range: 1-10 amps minimum, 20-200 amps maximum

3. Trip Point: Adjustable

4. Output: 0-5 Vdc or 0-10 Vdc,

5. Accuracy: ±0.2% from 20 to 100 Hz.

6. Amperage range sizing and switch settings in accordance with the following and per manufacturer's instructions:

Motor HP	120V	277V	480V
≤1/2	0-10A	0-10A	–
3/4 – 1.5	–	0-10A	0-10A
2 – 5	–	–	0-10A
7.5 – 10	–	–	0-20A
15 – 20	–	–	0-30A

Motor HP	120V	277V	480V
25 – 30	–	–	0-40A

7. Manufacturers

    a. Veris Hx22 series

    b. Kele SC100

    c. Or equal

P. Flow Meter (FM)

1. FM-1: Magnetic Flow Tube Flow Meters

    a. General Requirements

        1) Sensor shall be a magnetic flow meter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flow meter shall consist of 2 elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.

        2) Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).

        3) Provide a four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used on HVAC applications provided accuracy is as specified.

            a) On applications where the output is wired to a BTU meter but flow is required also as a direct input to the DDC system, e.g. for minimum flow control loop, provide a secondary analog output for the DDC system.

        4) Flow Tube

            a) ANSI class 150 psig steel

            b) ANSI flanges

            c) Lined with

                1. Heating hot water, glycol: PTFE, PFA, or ETFE liner rated for ≤-4°F to ≥212ºF fluid temperature

                2. Chilled, condenser, domestic hot and cold water: Polypropylene, Ebonite, PTFE, PFA, or ETFE liner rated for ≤32°F to ≥140ºF fluid temperature

5) Electrode and grounding material

a) 316L Stainless steel or Hastelloy C

b) Electrodes shall be fused to ceramic liner and not require O-rings.

6) Electrical Enclosure: NEMA 4

7) Approvals

a) UL or CSA

b) NSF Drinking Water approval for domestic water applications

8) Performance

a) Accuracy shall be:

1. ±0.4% of reading from 3.3 to 33 ft/s

2. ±0.75% of reading from 1.3 to 3.3 ft/s

3. ±0.0075 ft/s at flow rates less than 1 ft/s

b) Stability: 0.1% of rate over six months.

c) Meter repeatability shall be ± 0.1% of rate at velocities > 3 feet per second.

d) Calibration: The sensor must be factory calibrated on an internationally accredited (such as NAMAS) water flow rig with accuracy better than 0.1%. Calibration shall be NIST traceable.

b. Manufacturers

1) Onicon F-3100 series

2) Siemens/Danfoss Magflo 3100

3) Krohne Optiflux 4000

4) Sparling TigermagEP FM656

5) Or equal

2. FM-2: Magnetic Insertion Type Flow Meters

a. Magnetic Faraday point velocity measuring device.

b. Insertion type complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown.

c. 4-20 mA transmitter proportional to flow or velocity.

d. Accuracy: ± 1% of reading from 0.25 to 20 fps

e. Flow range: 0.25 to 20 fps

f. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% and traceable to the U.S. National Institute of Standards and Technology (NIST).

g. Manufacturers:

1) Onicon F-3500

2) Onicon FSM-3

3) FloCat YD20-A

4) Marsh McBirney MultiMag 284

5) SeaMetrics 100/200 Series

6) Or equal

3. FM-3A: Displacement Gas Meter

a. Positive displacement, rotary type gas meter designed for volumetric measurement of widely varying flow rates of low pressure natural gas

b. Permanent, non-adjustable calibration, not affected by low or varying line pressure and independent of the gas specific gravity, temperature, and pressure

c. Manufactured in accordance with ANSI B109.3 for Rotary Type Gas Displacement Meters

d. Operating temperature range: -40°F to +140°F

e. Temperature compensating with a corrected reading for temperatures ranging from -20°F to +120°F

f. Low frequency pulse output

g. Rangeability at ±1% accuracy: Minimum 40 to 1

h. Glass enclosed 8 digit totalizer, re-zeroed with on-board device

i. Manufacturer

1) Dresser Roots B3

2) Or equal

4. FM-3B: Mass Flow Meter

a. Immersible thermal mass flow gas meter designed for measurement of widely varying flow rates of low pressure natural gas

b. Precision platinum resistance temperature detectors protected by a platinum-iridium sheath mounted in 316 SS probe

c. Operating temperature range: -40°F to +140°F

d. 4-20mA, 0-5 Vdc, or 0-10 Vdc output proportional to mass flow

e. NIST-traceable factory calibration

f. ±1% FS accuracy

g. Rangeability at ±1% accuracy: Minimum 40 to 1

h. Glass enclosed 8 digit totalizer, re-zeroed with on-board device

i. Manufacturer

1) Sierra Instruments 620S or 620S BT

2) Or equal

5. FM-4: Not used

6. FM-5: Not Used

7. FM-6: Domestic and makeup water meters

a. 2 inches and smaller: Multi-jet water meter

1) Multi-jet velocity type meter

2) Magnetic drive – no gearing exposed to water

3) 125 psi cast bronze body with integral strainer

4) Meet all requirements of AWWA C-708 Multi-Jet Meter

5) Accuracy: ±1.5% of reading

6) Hall affect low voltage pulse output, with configurable volume per pulse set to 1 gallon per pulse or smallest value the controller will accept

7) Odometer-type gallons totalizer dial face with cover

8) Designed for vertical or horizontal piping

9) For potable water: NSF-61 certified and in compliance with California Proposition 65

10) Manufacturers:

a) SeaMetrics MJE or MJHE

b) Elster Amco M700

c) Master Meter

d) Equal

b. 2.5 inches and larger: Compound-type water meter

1) Shall consist of a combination of a turbine-type, mainline meter for measuring high rates of flow and a bypass meter of an appropriate size for measuring low rates of flow. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter.

2) Comply with ANSI and AWWA C702 standards.

3) Comply with NSF/ANSI Standard 61, ANNEX G.

4) Maximum operating pressure of 150 psi and maximum operating temperature of 120°F continuous (220°F peak).

5) Low voltage pulse output, with configurable volume per pulse set to 1 gallon per pulse or smallest value the controller will accept

6) Odometer-type gallons totalizer dial face with cover

7) Manufacturers:

a) Badger Recordall Series Meter

b) Neptune

c) Or equal

8) Or equal

Q. Airflow Measuring Stations (AFMS)

1. General

a. AFMS provided under this Section shall be licensed to bear the AMCA Certified Rating Seal for Airflow Measuring Stations. Ratings shall be based on tests and procedures performed in accordance with AMCA Publication 611 and comply with requirements of the AMCA Certified Ratings Program.

b. Outdoor air AFMS shall be capable of adjusting for air density changes based on actual temperature and actual barometric pressure differences from the standard temperature and pressure used in Standard 62.1 outdoor air rates. i.e. the AFMS shall

be capable of measuring airflow at “standard” density (0.75 lbs./ft3 dry air), e.g. standard cfm (scfm), not actual cfm (acfm).

2. AFMS-1. Airflow measurement probes at fan inlet provided with air handling units. See Section 237300 Air Handling Units & Coils.

3. AFMS-1

    a. Transverse probes factory mounted in each inlet bell.

    b. The fan inlet airflow traverse probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probes and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows. The fan inlet airflow traverse probes shall have symmetrical averaging signal takeoffs, and shall be of aluminum construction with hard anodized finish with galvanized steel mounting hardware.

    c. The fan inlet airflow traverse probes shall not significantly impact fan performance or contribute to fan generated noise levels. The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.

    d. Provide with DPT selected as close as possible to design maximum velocity pressure to provide high accuracy at low airflow rates. See equipment schedules for design airflow rate.

    e. Manufacturers

        1) Air Monitor VOLU-probe/FI

        2) Paragon FE-1050

        3) Or equal

4. AFMS-2. Airflow measurement device provided with air handling units. See Section 237300 Air Handling Units & Coils.

5. AFMS-2

    a. The AFMS shall be an array of thermal mass flow sensors mounted across the entire area of the duct in which the AFMS is mounted.

    b. Analog outputs for “standard” airflow (0.075 lb_{da}/ft3 density) and temperature

    c. Operating limits

        1) Humidity: 0% to non-condensing

2) Temperature (devices in airstream): -20ºF to +120ºF

d. Performance

1) Sensors shall be calibrated to NIST-traceable standards for airflow/velocity.

2) The installed total accuracy for airflow shall be better than ±3% of reading over the sensor probe operating ranges when installed in accordance with manufacturers' guidelines. Installed accuracy shall include the probe itself plus the electronics for converting probe signal to an electronic signal proportional to airflow and shall be demonstrated at both maximum and minimum airflow rates of operating range. All tests shall be in accordance with AMCA 611 test procedures.

3) Operating Range: 100 to 4,000 FPM.

4) Pressure drop: The maximum allowable unrecovered pressure drop caused by the airflow measuring device shall not exceed .025 inches at 2000 FPM.

e. Sensor Density Requirements:

1) Published sensor density (#/area) data by the product manufacturer as required to achieve specified accuracy shall be submitted for approval.

2) Should there be no published document indicating these relationships for a particular product, the number of individual sensor nodes provided for each rectangular location shall be as follows:

Duct or Plenum Area (ft2)	Total number of Nodes
<= 1	1 or 2
>1 to <4	4
4 to < 8	6
8 to < 12	8
12 to <16	12
>=16	16

3) The number of individual sensor nodes provided for each round or oval duct location shall approximate the total required for rectangular locations or be detailed in published documentation by the manufacturer.

f. Manufacturers

1) Ruskin EAMS

2) Ebtron Gold Series

3) Or equal

6. AFMS-3. Airflow measurement device and control damper provided with air handling units. See Section 237300 Air Handling Units & Coils.

7. AFMS-3 (including control damper)

    a. Air monitoring station incorporates a low leakage control damper with air monitoring blades and air straightener section (where needed to meet accuracy requirements) in one unit, fully factory assembled.

    b. Damper construction

        1) See Paragraph 2.9C Control Dampers.

    c. Air Straightener Section: 3000 series aluminum alloy honeycomb contained in 5 inch long, 16 gage galvanized steel sleeve attached to monitoring blade frame.

    d. Airflow sensing

        1) Strategically placed airflow sensing blades measure airstream velocity.

        2) Air tubing and piping connections connect sensing blades to transducer.

        3) Transducer

            a) Accuracy: ± 1% full scale (includes non-linearity, hysteresis and non-repeatability)

            b) Range: 0 to 1 inch w.c.

            c) Can resolve less than 0.00001 inch w.c.

            d) Generates an analog signal (4-20mA or 0-10Vdc) proportional to airflow rate or velocity

            e) NEMA 4 enclosure

    e. Operating limits

        1) Humidity: 0% to non-condensing

        2) Temperature (devices in airstream): -20ºF to +120ºF

    f. Performance

        1) Accuracy: 5% of reading.

        2) Velocity range: 400 fpm to 2000 fpm.

        3) Bear AMCA Certified Ratings Seal for Airflow Measurement Performance

    g. Manufacturers

1) Ruskin Model AMS-050 with RU-274 transducer

2) Greenheck IAQ 42

3) Or equal

8. AFMS-4

a. Differential pressure type with uniframe DP sensor

1) Provide quantity of DP sensors per manufacturer's recommendations

b. Station mounted with expanded metal screen

c. Analog outputs for "standard" airflow (0.075 lb_{da}/ft3 density) and temperature

d. Manufacturers

1) Air Monitor

a) Transmitter: OAM-II-2121-1BMMM

b) Airflow Measuring System: OAM-II-AFS-(XX)A-111-013 where "XX" varies with the associated opening dimensions.

2) No known equal

9. AFMS-5. Venturi DP type with transmitter provided with lab exhaust fans. See Section 233400 Fans & Hoods.

10. AFMS-5

a. Venturi DP type with ports at inlet and outlet of venturi. Anemometers with probes in airstream not acceptable

b. Differential pressure sensor with LCD

1) NEMA-4 enclosure

2) Linear differential pressure output signal, 4-20 mA or 2-10 VDC

3) Accuracy: ± 0.5% of full scale at 77°F (25°C)

4) 24-volt AC or DC

c. Stainless steel compression fittings internally and brass fittings externally

d. Manufacturers

1) Greenheck SureAire

2) Or equal

R. Electric Control Components

1. Line-Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT contacts rated for 120V and current as required for application, temperature setpoint range of 50 to 90ºF.

2. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.

   a. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

      1) AC coil pull-in voltage range of +10%, -15% or nominal voltage.

      2) Coil sealed volt-amperes (VA) not greater than 4 VA.

      3) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.

      4) Pilot light indication of power-to-coil and coil retainer clips.

   b. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.

   c. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

3. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square D, Cutler-Hammer, or equal.

4. Control Transformers and Power Supplies

   a. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Mount in minimum NEMA-1 enclosure.

   b. Transformer shall be proper size for application. Limit connected loads to 80% of rated capacity.

   c. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

   d. Separate power transformer shall be used for controllers and for actuators and other end devices that use half wave rectification.

e. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.

f. Line voltage units shall be UL Recognized and CSA Approved.

5. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley, Kele, or equal.

6. Mechanical Timer Switch: Switch shall be mechanically spring wound with a N.O. contact or N.C. contacts as required. Timer shall be 0-60 minutes and shall not include a "hold" feature, which allows switch contacts to remain closed. Contacts shall be rated for minimum 120 VAC operation. Switch shall be C560M type, as manufactured by NSI Industries or equal.

7. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley, Kele, or equal.

8. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, Sonalert solid-state electronic signal, as manufactured by Mallory, Kele, or equal.

9. Potentiometer. Wall box mounted single turn with knob numbered 0 to 10 or 0 to 100. Wall plate cover to match electrical.

10. Window switch (WS)

a. Surface mount magnetic burglar alarm switch.

b. Screw mount, magnet on window, switch on frame.

c. Sealed to prevent dirt or dust contact.

d. Color to match electrical and lighting switch plates in the room. See Division 26 and Electrical Drawings.

S. Refrigerant Monitor (RM-1)

1. Non-dispersive or photo-acoustic infrared multi-point stationary refrigerant gas leak monitor system designed to continuously measure refrigerants used in chiller equipment installed under Division 23. The alarm system shall comply with Mechanical Code and ASHRAE Standard 15 requirements including:

a. The refrigerant detector shall perform automatic self-testing of sensors. Where a failure is detected, a trouble signal shall be activated.

b. The refrigerant detector as installed, including any sampling tubes, shall activate responses within a time not to exceed 30 seconds after exposure to refrigerant concentration exceeding the Alarm (Evacuate) setpoint value specified herein.

2. The refrigerant monitor shall be capable of monitoring refrigerant in concentrations of 0 PPM to a minimum of 1000 PPM. The Monitor shall have a low range resolution of 1 PPM and an accuracy of ±10 ppm in the range of 1 PPM through 100 PPM. Readings above 100 PPM must have an accuracy of ±10% of reading.

3. The refrigerant monitor shall have a minimum of one sample port or sensor for each chiller in the chiller room. See floor plans.

4. The monitor shall be factory tested and calibrated for the specified refrigerant or refrigerants. Factory certification of the calibrations shall be provided with the O&M manuals.

5. The display shall continuously display the refrigerant concentration level and alarm status.

6. The monitor shall be equipped with the following outputs.

    a. One binary output shall indicate a monitor malfunction alarm.

    b. A minimum of three alarm levels with separate binary outputs, each programmable to adjustable user-defined refrigerant concentration setpoints and user-defined reset (manual or auto).

    c. RS485 Modbus RS-485 with 16 or 32 bit registers, or BACnet MSTP interface, with read/write capability of all control points and setpoints.

7. The monitor shall have a NEMA-1 enclosure. The enclosure shall have a rust and corrosion resistant finish.

8. Include:

    a. Unit mounted strobe and alarm horn

    b. Remote strobe(s) and horn(s) for each chiller room entrance

    c. Break-glass fan switch(es) for the primary chiller room entrance

    d. Break-glass emergency off switch(es) for the primary chiller room entrance

    e. Fan on and off status pilot lights for the primary chiller room entrance

9. Alarm horns shall be capable of providing a sound pressure level of not less than 15 dB above the operating ambient noise sound pressure level of the space in which they are installed, 85 dBA minimum.

10. Manufacturer

    a. Bacharach

    b. MSA Chillgard

c. OI Analytical/General Analysis Corporation

d. Or equal

T. Wind Anemometer

1. Ultrasonic, solid state sensors

2. Accuracy

a. Wind Speed: ±3% up to 35 m/s

b. Wind Direction: Less than 3°RSME at 1.0 m/s or greater

3. Sensor Housing Protection Class: IP65 or greater

4. Mast per manufacturer's recommendations. See also Paragraph 3.11J.

5. RS-485 Serial Output

6. Manufacturers

a. Lufft WS200

b. Gill WindSonic

c. RM Young 86000

2.10 CALIBRATION & TESTING INSTRUMENTATION

A. Provide instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance.

B. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

C. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (for example if field device is ±0.5% accurate, test equipment shall be ±0.25% accurate over same range).

2.11 SOFTWARE

A. General

1. System software shall be the latest version of ALC WebCTRL.

B. Licensing

1. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.

2. Within the limitations of the server, provide licenses for any number of users to have web access to the CSS at any given time.

3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the College.

4. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.

C. Graphical User Interface Software

1. Graphics

a. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.

b. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.

c. Graphical display shall be 1280 x 1024 pixels or denser, 256 color minimum.

d. Links

1) Graphics shall include hyperlinks which when selected (clicked on with mouse button) launch applications, initiate other graphics, etc.

2) Screen Penetration: Links shall be provided to allow user to navigate graphics logically without having to navigate back to the home graphic. See additional discussion in Paragraph 3.12E.

3) Information Links

a) On each MEP system and subsystem graphic, provide links to display in a new window the information listed below.

1. English-language as-built control sequence associated with the system. See Paragraph 1.9B.

2. O&M and submittal information for the devices on the graphic. See Paragraph 1.9B. This includes links to electronic O&M and submittal information for mechanical equipment supplied under Section 230501 Basic Mechanical Materials and Methods.

b) The display shall identify the target of the link by file name/address.

c) Information shall be displayed in electronic format that is text searchable.

d) Window shall include software tools so that text, model numbers, or point names may be found. Source documents shall be read-only (not be editable) with this software.

e. Point Override Feature

1) Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.

2) When the point is selected to be commanded

a) Dialog box opens to allow user to override the point (Operator Mode) or release the point (Automatic Mode). Operator Mode will override automatic control of the point from normal control programs.

b) Dialog box shall have buttons (for digital points) or a text box or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.

c) When dialog box is closed, mode and value are sent to controller.

d) Graphic is updated upon next upload scan of the actual point value.

3) A list of points that are currently in an operator mode shall be available through menu selection.

f. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3A or if a point is in operator mode per Paragraph 2.11C.1.e) shall be clearly displayed on graphics for each point, such as by changing color or flag.

g. The color of symbols representing equipment shall be able to change color or become animated based on status of binary point to graphically represent on/off status.

2. Alarms

a. ALC WebCTRL Enterprise Integration advanced alarm package configured as indicated below.

3. Trends

a. ALC WebCTRL Enterprise Integration trend package configured as indicated below.

b. Trend Data Storage

1) The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS using SQL queries.

2) Data shall be stored in an SQL compliant database format and shall be available through the College's intranet or internet (with appropriate security clearance) without having to disable BAS access to the database.

3) The database shall not be inherently limited in size, e.g. due to software limitations or lack of a correct license. Database size shall be limited only by the size of the provided storage media (hard drive size).

4. Security Access

a. Standard ALC WebCTRL security package

5. Report Software

a. ALC WebCTRL Enterprise Integration advanced reporting package.

b. Standard reports. Prepare the following standard reports, accessible automatically without requiring definition by user.

1) Tenant or department after-hour usage. System must be capable of monitoring tenant override requests and generating a monthly report showing the daily total time in hours that each tenant has requested after-hours HVAC services.

2) Monthly and annual energy usage and cost. See Utility cost calculation in Paragraph 3.12.

3) Alarm events and status.

4) Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output, including date and time.

D. Control Programming Software

1. Standard ALC WebCTRL Eikon programming.

E. Miscellaneous Software

1. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide relevant data for the application or object that help is being called from.

2. Provide software for viewing (but not editing) electronic versions of as-built shop drawings of

a. Mechanical, electrical, and plumbing systems in Adobe pdf format

b. BAS drawings in Adobe pdf format

3. Automatic Demand Response (ADR) Control Software

a. Provide ALC WebCTRL Automated Demand Response Add-on or other certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN) software, as specified under Clause 11, Conformance, in the applicable OpenADR 2.02 Specification.

b. The software shall allow OpenADR communication from PG&E's Demand Response Automation Server through the College's LAN to the CSS, communicating at least the minimum points shown in Paragraph 2.12C.8.

2.12 CONTROL POINTS

A. Table Column Definitions

1. Point description

2. Type (number in point schedule after each type refers to tag on schematics)

a. AO: analog output

b. AI: analog input

c. DO: digital or binary output

d. DI: digital or binary input

3. Device description

a. See Paragraph 2.9 for device definition.

4. Trend Logging

a. Commissioning: Where listed, point is to be trended at the basis listed for commissioning and performance verification purposes.

b. Continuous: Where listed, point is to be trended at the basis listed continuously, initiated after system acceptance, for the purpose of future diagnostics.

c. Trend Basis

1) Where range of engineering units is listed, trend on a change of value (COV) basis (in other words record time stamp and value when point value changes by engineering unit listed).

2) Where time interval is listed, trend on a time basis (in other words record time stamp and value at interval listed). All points relating to a specific piece of equipment shall be trended at the same initiation time of day so data can be compared in text format.

5. Calibration

a. F = factory calibration only is required (no field calibration)

b. HH = field calibrate with handheld device. See Paragraph 3.14D.6.a.2)

B. Note that points lists below are for each system of like kind. Refer to drawings for quantity of each.

C. Points mapped through gateways and network interfaces. Note that points listed herein are intended to indicate the level of effort required for point mapping for bid purposes; the points lists are not exclusive and exhaustive. The exact point names and types may vary since the points available vary by equipment manufacturer and model. A final list of available points must be obtained from the manufacturer during the shop drawing development phase. If the available points differ from the points lists herein, the desired points to be mapped shall be confirmed by the Engineer prior to issuing Submittal Package 2. Unless the quantity of points is significantly different from those shown herein, the changes shall be made at no additional costs to the College.

1. Variable speed drives

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fault reset	DO	Through network	COV	COV	–
On/off status	DI	Through network	COV	COV	–
Fault (critical alarm)	DI	Through network	COV	COV	–
Minor alarm	DI	Through network	COV	COV	–
Fault text	AI	Through network (convert code to plain English text)	COV	COV	–
Alarm text	AI	Through network (convert code to plain English text)	COV	COV	–
Keypad in hand/auto	DI	Through network	COV	COV	–
Minimum frequency setpoint	AO	Through network	±5%	±5%	–
Maximum frequency setpoint	AO	Through network	±5%	±5%	–
Acceleration rate	AO	Through network	±5%	±5%	–
Deceleration rate	AO	Through network	±5%	±5%	–
Actual frequency	AI	Through network	1 min	15 min	–
DC bus voltage	AI	Through network	±10%	±10%	F
AC output voltage	AI	Through network	±10%	±10%	F
Current	AI	Through network	15 min	60 min	F
VFD temperature	AI	Through network	60 min	60 min	F
Power, kW	AI	Through network	1 min	15 min	F
Energy, MWh	AI	Through network	15 min	60 min	–

2. Electronically Commutated Motors

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fault reset	DO	Through network	COV	COV	–
Minimum speed setpoint	AO	Through network	±5%	±5%	–
Maximum speed setpoint	AO	Through network	±5%	±5%	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Acceleration rate	AO	Through network	±5%	±5%	–
Deceleration rate	AO	Through network	±5%	±5%	–
Actual speed	AI	Through network	1 min	15 min	–
DC-link voltage	AI	Through network	±10%	±10%	F
Current	AI	Through network	15 min	60 min	F
Fault text	AI	Through network (convert code to plain English text)	COV	COV	–
Warning text	AI	Through network (convert code to plain English text)	COV	COV	–
Motor temperature, °F	AI	Through network	15 min	60 min	F
Power, kW	AI	Through network	1 min	15 min	F

3. Chillers

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
On/off status	DI	Through network	COV	COV	–
Alarm	DI or AI	Through network. (May have multiple integer values depending on alarm type – see chiller BACnet panel submittal.)	COV	COV	–
Call for condenser water pump	DI	Through network	COV	COV	–
Condenser water flow status	DI	Through network	COV	COV	–
Call for chilled water pump	DI	Through network	COV	COV	–
Chilled water flow status	DI	Through network	COV	COV	–
Chiller in local mode	DI	Through network	COV	COV	–
Chiller in surge	DI	Through network	COV	COV	–
Chilled water temperature setpoint reset	AO	Through network	1 min.	±2°F	–
Demand limit setpoint	AO	Through network	±5%	±5%	–
Total number of surge events	AI	Through network	+1	+1	–
Chilled water supply temperature	AI	Through network	1 min.	10 min.	F
Chilled water return temperature	AI	Through network	1 min.	10 min.	F
Condenser water supply temperature	AI	Through network	1 min.	10 min.	F
Condenser water return temperature	AI	Through network	1 min.	10 min.	F

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Condenser temperature	AI	Through network	–	10 min.	F
Evaporator temperature	AI	Through network	–	10 min.	F
Condenser (head) pressure	AI	Through network	–	10 min.	F
Evaporator pressure	AI	Through network	–	10 min.	F
Anti-recycle time remaining	AI	Through network	–	10 min.	–
Variable speed drive speed	AI	Through network	1 min.	10 min.	–
Inlet guide vane signal	AI	Through network	1 min.	10 min.	–
Operating hours	AI	Through network	–	–	–
Oil pressure	AI	Through network	–	–	F
Oil sump temperature	AI	Through network	–	–	F
Power, kW	AI	Through network	1 min.	10 min.	F
Percent of full load current (%FLA)	AI	Through network	–	–	F
Chilled water differential pressure	AI	Through network	1 min.	10 min.	F
Condenser water differential pressure	AI	Through network	1 min.	10 min.	F

4. Heat Pump/Chillers: Not all points available with all manufacturers. Include points listed from each refrigerant circuit.

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Evap. outlet temperature	AI	Through network	10 min.	10 min.	F
Evap. inlet temperature	AI	Through network	10 min.	10 min.	F
Common Evap. outlet temperature	AI	Through network	10 min.	10 min.	F
Common Evap. inlet temperature	AI	Through network	10 min.	10 min.	F
Recovery outlet temperature	AI	Through network	10 min.	10 min.	F
Recovery inlet temperature	AI	Through network	10 min.	10 min.	F
External air temperature	AI	Through network	10 min.	10 min.	F
Refrigerant gas temperature	AI	Through network	10 min.	10 min.	F
Refrigerant liquid temperature	AI	Through network	10 min.	10 min.	F
System dead zone	AO	Through network	10 min.	10 min.	F
Recovery dead zone	AO	Through network	10 min.	10 min.	
Defrost current Delta LP	AI	Through network	10 min.	10 min.	F

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Auto. Differential HP only	AO	Through network	10 min.	10 min.	
Auto. Differential chiller only	AO	Through network	10 min.	10 min.	
Current system setpoint	AI	Through network	10 min.	10 min.	
Total recovery set-point	AO	Through network	10 min.	10 min.	
Total recovery differential	AO	Through network	10 min.	10 min.	
System summer differential	AO	Through network	10 min.	10 min.	
System winter differential	AO	Through network	10 min.	10 min.	
Setpoint summer	AO	Through network	10 min.	10 min.	
Setpoint winter	AO	Through network	10 min.	10 min.	
System On/Off Mode	AO	Through network	10 min.	10 min.	
Recovery On/Off Mode	AO	Through network	10 min.	10 min.	
Summer winter selection	AO	Through network	10 min.	10 min.	
Mode duration minimum time	AO	Through network	10 min.	10 min.	
System active power	AI	Through network	10 min.	10 min.	F
Recovery active power	AI	Through network	10 min.	10 min.	F
Unit state	AI	Through network	10 min.	10 min.	
Total power request	AI	Through network	10 min.	10 min.	
Fan speed	AI	Through network	10 min.	10 min.	
Total power request	AI	Through network	10 min.	10 min.	
defrost State	AI	Through network	10 min.	10 min.	
Unit On/Off	DI	Through network	COV	COV	
Summer/Winter request	DO	Through network	COV	COV	
Reset alarms	DO	Through network	COV	COV	
System On/Off	DO	Through network	COV	COV	
Recovery On/Off	DO	Through network	COV	COV	
Evaporative pump status	DI	Through network	COV	COV	
Recovery pump status	DI	Through network	COV	COV	
Compressor status	DI	Through network	COV	COV	
Fan status	DI	Through network	COV	COV	
Reversing valve	DI	Through network	COV	COV	
Defrost valve	DI	Through network	COV	COV	
All alarms	DI	Through network	COV	COV	

5. Boilers (not all points available with all manufacturers)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Status/fault code 1-47	AI	Through network	±1	±1	–
Unit Status code 0-5	AI	Through network	±1	±1	–

HW supply temperature	AI	Through network	1 min.	10 min.	F
HW return temperature	AI	Through network	10 min.	10 min.	F
Exhaust temperature	AI	Through network	10 min.	10 min.	F
FFWD temperature	AI	Through network	10 min.	10 min.	F
Firing rate %	AI	Through network	1 min.	10 min.	F
O2 level	AI	Through network	10 min.	10 min.	F
CO level	AI	Through network	10 min.	10 min.	F
Flame strength %	AI	Through network	10 min.	10 min.	F
Active HWST setpoint	AI	Through network	1 min.	10 min.	F
HWST Setpoint command	AO	Through network	±1°F	±1°F	–

1. Single Zone Packaged Heat Pumps/AC units

Description	**Type**	**Device**	**Trend Logging**		**Calibra-tion**
			Comm-issioning	**Contin-uous**	
Space temperature	AI	Through network	1 min	15 min	F
Discharge-air temperature	AI	Through network	1 min	15 min	F
Space temperature cooling setpoint	AO	Through network	±1ºF	±1ºF	–
Space temperature heating setpoint	AO	Through network	±1ºF	±1ºF	–
Cooling status	DI	Through network	COV	COV	–
Heating status	DI	Through network	COV	COV	–
Low temperature sensor alarm	DI	Through network	COV	COV	–
Low pressure sensor alarm	DI	Through network	COV	COV	–
High pressure switch alarm	DI	Through network	COV	COV	–
Condensate sensor alarm	DI	Through network	COV	COV	–
High/low voltage alarm	DI	Through network	COV	COV	–
Unoccupied/occupied command	DO	Through network	COV	COV	–
Cooling command	DO	Through network	COV	COV	–
Heating command	DO	Through network	COV	COV	–
Fan "ON/AUTO" command	DO	Through network	COV	COV	–
Fault reset command	DO	Through network	COV	COV	–
Itemized fault code revealing reason for specific shutdown fault	AI	Through network	COV	COV	–

2. Packaged VAV AC units

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Unit on/off	DO	Through network	COV	COV	–
Cooling enable	DO	Through network	COV	COV	–
Economizer enable	DO	Through network	COV	COV	–
Supply air temperature setpoint	AO	Through network	±0.5°F	±1°F	–
Supply static pressure setpoint	AO	Through network	±0.1”	±0.1”	–
Outdoor airflow cfm setpoint	AO	Through network	5 min	15 min	–
Building static pressure setpoint	AO	Through network	15 min	15 min	–
General trouble alarm	DI	Through network	COV	COV	–
Compressor #x status	DI	Through network, typical of each compressor	COV	COV	–
Supply fan status	DI	Through network	COV	COV	–
Relief fan status	DI	Through network	COV	COV	–
Communications alarm	DI	Through network	COV	COV	–
Supply air temperature	AI	Through network	5 min	15 min	F
Return air temperature	AI	Through network	5 min	15 min	F
Outdoor air temperature	AI	Through network	5 min	15 min	F
Supply duct static pressure	AI	Through network. Extend tip to ***bottom of shaft***.	5 min	15 min	F
Filter pressure drop	AI	Through network	5 min	15 min	F
Building static pressure	AI	Through network. Extend high port tube to ***2nd floor interior*** zone	1 min	15 min	F
Supply fan speed	AI	Through network	5 min	15 min	F
Relief fan speed	AI	Through network	5 min	15 min	F
Economizer damper position	AI	Through network	5 min	15 min	F
Conductivity Setpoint	AO	Through network	±10 µOhm	±10 µOhm	–
Water make-up enabled	DI	Through network	COV	COV	–
High conductivity alarm	DI	Through network	COV	COV	–
Bleed valve on/off	DI	Through network	COV	COV	–
Water treatment failure alarm	DI	Through network	COV	COV	–
Evaporative condenser fan status	DI	Through network	COV	COV	–
Condenser water pump status	DI	Through network	COV	COV	–
Water conductivity	AI	Through network	±10 µOhm	±10 µOhm	F
CWR temperature	AI	Through network	1 min.	15 min	F
CWS temperature	AI	Through network	1 min.	15 min	F
Condenser fan speed	AI	Through network	1 min.	15 min	–

3. Electrical System Monitoring. See Division 26 Drawings for quantity of meters and location of network connection.

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Real kW	AI	Through network	15 min	15 min	–
Volts (each phase)	AI	Through network	±10%	±10%	–
Power factor	AI	Through network	±10%	±10%	–
Amps (each phase)	AI	Through network	–	–	–

4. BTU Meter (BTU-1)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Return Temperature	AI	Through network	1 min	15 min	F
Supply Temperature	AI	Through network	1 min	15 min	F
Flow	AI	Through network	1 min	15 min	F
Btu/h	AI	Through network	1 min	15 min	–

5. Refrigerant Monitor

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Alarm Setpoint – caution	AO	Through network	±100 PPM	±100 PPM	–
Alarm Setpoint – warning	AO	Through network	±100 PPM	±100 PPM	–
Alarm Setpoint – alarm	AO	Through network	±100 PPM	±100 PPM	–
Temperature Tolerance	AO	Through network	±1°F	±1°F	–
Alarm condition – caution	DI	Through network	COV	COV	–
Alarm condition – warning	DI	Through network	COV	COV	–
Alarm condition – alarm	DI	Through network	COV	COV	–
Unit failure/trouble alarm	DI	Through network	COV	COV	–
Communications alarm	DI	Through network	COV	COV	–
Refrigerant concentration	AI	Through network	±50 PPM	±50 PPM	F

6. Water Treatment System

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Conductivity Setpoint	AO	Through network	±10 µOhm	±10 µOhm	–
Biocide 1 setpoint	AO	Through network	–	–	–
Biocide 2 setpoint	AO	Through network	–	–	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
High conductivity alarm	DI	Through network	COV	COV	–
Bleed on/off	DI	Through network	COV	COV	–
Inhibitor feed on/off	DI	Through network	COV	COV	–
Biocide 1 feed on/off	DI	Through network	COV	COV	–
Biocide 2 feed on/off	DI	Through network	COV	COV	–
Unit failure alarm	DI	Through network	COV	COV	–
Communications alarm	DI	Through network	COV	COV	–
Water conductivity	AI	Through network	±10 µOhm	±10 µOhm	F
Water make-up flow	AI	Through network	15 min	15 min	F
Bleed water flow	AI	Through network	15 min	15 min	F

7. Laboratory Air Valves

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Airflow Setpoint	AO	Through network	1 min	15 min	–
Alarm	DI	Through network	COV	COV	–
Hood Alarm (VAV hoods)	DI	Through network	COV	COV	–
Purge (VAV hoods)	DI	Through network	COV	COV	–
Actuator command	AI	Through network	1 min	15 min	–
Actual actuator position	AI	Through network	1 min	15 min	–
Measured airflow	AI	Through network	1 min	15 min	F

8. Automated Demand Response

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Demand Response Level	AI	Level 1, 2, or 3 from OpenADR Virtual End Node	±1	±1	–
Minutes until next occurrence of Demand Level 1	AI	From OpenADR Virtual End Node	±1 min	±1 min	–
Minutes until next occurrence of Demand Level 2	AI	From OpenADR Virtual End Node	±1 min	±1 min	–
Minutes until next occurrence of Demand Level 3	AI	From OpenADR Virtual End Node	±1 min	±1 min	–

9. Lighting Controls

a. Global

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Demand Shed 1	DO	Through network	COV	COV	–
Demand Shed 2	DO	Through network	COV	COV	–
Demand Shed 3	DO	Through network	COV	COV	–

b. For each lighting zone

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Occupancy Sensor State	DI	Through network	COV	COV	–

10. Emergency Generator

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Status normal power	DI	Through network	COV	COV	–
Status generator power	DI	Through network	COV	COV	–
Generator running	DI	Through network	COV	COV	–
Generator not in auto	DI	Through network	COV	COV	–
Shut-down summary alarm	DI	Through network	COV	COV	–
Fuel tank alarm – low level	DI	Through network	COV	COV	–
Fuel tank alarm – high level	DI	Through network	COV	COV	–
Fuel tank alarm – rupture	DI	Through network	COV	COV	–
Water temperature alarm	DI	Through network	COV	COV	–
Low DC battery voltage	DI	Through network	COV	COV	–
Battery charger malfunction	DI	Through network	COV	COV	–
Ground fault	DI	Through network	COV	COV	–
Low coolant level	DI	Through network	COV	COV	–
Pre-alarm Low fuel	DI	Through network	COV	COV	–
Pre-alarm high water temperature	DI	Through network	COV	COV	–
Pre-alarm low oil pressure	DI	Through network	COV	COV	–
Over-speed alarm	DI	Through network	COV	COV	–
Over-crank alarm	DI	Through network	COV	COV	–
High water temperature alarm	DI	Through network	COV	COV	–
Low oil pressure alarm	DI	Through network	COV	COV	–
Emergency stop alarm	DI	Through network	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pre-overload alarm	DI	Through network	COV	COV	–
Overload alarm	DI	Through network	COV	COV	–
AC current Phase 1	AI	Through network	±10%	±10%	–
AC current Phase 2	AI	Through network	±10%	±10%	–
AC current Phase 3	AI	Through network	±10%	±10%	–
AC voltage neutral	AI	Through network	±10%	±10%	–
AC voltage Phase 1	AI	Through network	±10%	±10%	–
AC voltage Phase 2	AI	Through network	±10%	±10%	–
AC voltage Phase 3	AI	Through network	±10%	±10%	–

11. UPS System

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Input phase A current	AI	Through network	±10%	±10%	_
Input phase B current	AI	Through network	±10%	±10%	_
Input phase C current	AI	Through network	±10%	±10%	_
Input phase A voltage	AI	Through network	±10%	±10%	_
Input phase B voltage	AI	Through network	±10%	±10%	_
Input phase C voltage	AI	Through network	±10%	±10%	_
UPS phase A current	AI	Through network	±10%	±10%	_
UPS phase B current	AI	Through network	±10%	±10%	_
UPS phase C current	AI	Through network	±10%	±10%	_
UPS neutral current	AI	Through network	±10%	±10%	_
UPS phase A voltage	AI	Through network	±10%	±10%	_
UPS phase B voltage	AI	Through network	±10%	±10%	_
UPS phase C voltage	AI	Through network	±10%	±10%	_
UPS frequency	AI	Through network	±10%	±10%	_
DC battery charge/discharge current	AI	Through network	±10%	±10%	_
DC battery voltage	AI	Through network	±10%	±10%	–
Battery elapsed time	AI	Through network	±10%	±10%	–
Peak kW demand	AI	Through network	±10%	±10%	–
Inverter output overload	DI	Through network	COV	COV	–
Overload shutdown	DI	Through network	COV	COV	–
Charger over-temperature	DI	Through network	±10%	±10%	–
Inverter over-temperature	DI	Through network	±10%	±10%	–
Charger fuse failure	DI	Through network	COV	COV	–
Inverter fuse failure	DI	Through network	COV	COV	–
Blower failure	DI	Through network	COV	COV	–
Battery disconnect open	DI	Through network	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Battery discharging	DI	Through network	COV	COV	–
Low battery voltage	DI	Through network	COV	COV	–
DC over voltage	DI	Through network	COV	COV	–
DC ground fault	DI	Through network	COV	COV	–
Input power failed	DI	Through network	COV	COV	–
Control power failed	DI	Through network	COV	COV	–
Emergency OFF	DI	Through network	COV	COV	–
Output over voltage/under voltage	DI	Through network	COV	COV	–
Summary alarm	DI	Through network	COV	COV	–
Loss of communication alarm	DI	Through network	COV	COV	–
Static switch failure	DI	Through network	COV	COV	–
Load on bypass	DI	Through network	COV	COV	–
Bypass not available	DI	Through network	COV	COV	–
Reverse power	DI	Through network	COV	COV	–
UPS input breaker open	DI	Through network	COV	COV	–
DC battery breaker open	DI	Through network	COV	COV	–
UPS output breaker open	DI	Through network	COV	COV	–
UPS output breaker open	DI	Through network	COV	COV	–
Module on	DI	Through network	COV	COV	–
Module OK	DI	Through network	COV	COV	–
AC Static Switch breaker open	DI	Through network	COV	COV	–
AC bypass breaker open	DI	Through network	COV	COV	–
AC output breaker open	DI	Through network	COV	COV	–

12. DCW Booster Pump

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pump 1 status	DI	Through network	COV	COV	–
Pump 2 status	DI	Through network	COV	COV	–
Alarm	DI	Through network	COV	COV	–
Unit failure/trouble alarm	DI	Through network	COV	COV	–
Communications alarm	DI	Through network	COV	COV	–
Pump 1 speed	AI	Through network	1 min	15 min	–
Pump 2 speed	AI	Through network	1 min	15 min	–
Pump 1 VFD kW	AI	Through network	1 min	15 min	–
Pump 2 VFD kW	AI	Through network	1 min	15 min	–
Difference pressure	AI	Through network	1 min	15 min	–
Difference pressure setpoint	AO	Through network	1 min	15 min	–

13. Wind Anemometer

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Alarm	DI	Through network	COV	COV	–
Wind speed	AI	Through network	1 min	15 min	–
Wind direction	AI	Through network	1 min	15 min	–

14. VRF Indoor Units (Fan-Coils)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Operation Mode	AO	Through network	COV	COV	–
On/off status	DI	Through network	COV	COV	–
Fan status	DI	Through network	COV	COV	–
Communication status	DI	Through network	COV	COV	–
Alarm status	DI	Through network	COV	COV	–
Filter status	DI	Through network	COV	COV	–
Fault reset command	DO	Through network	COV	COV	–
Room temperature	AI	Through network	1 min	15 min	F
Discharge air temperature	AI	Through network	1 min	15 min	F
Return temperature	AI	Through network	1 min	15 min	F
Occupied cooling setpoint	AO	Through network	±1ºF	±1ºF	–
Occupied heating setpoint	AO	Through network	±1ºF	±1ºF	–
Unoccupied cooling setpoint	AO	Through network	±1ºF	±1ºF	–
Unoccupied heating setpoint	AO	Through network	±1ºF	±1ºF	–
Minimum setpoint differential	AO	Through network	±1ºF	±1ºF	–
Fan Speed Setpoint	AO	Through network	1 min	15 min	–
Fan Speed Status	AI	Through network	1 min	15 min	–
Cooling status	DI	Through network	COV	COV	–
Heating status	DI	Through network	COV	COV	–
Condensate sensor alarm	DI	Through network, where applicable	COV	COV	–
Window switch status	DI	Through network, where applicable	COV	COV	–
Occupancy sensor status	DI	Through network, where applicable	COV	COV	–

15. VRF Outdoor Units

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Communication Status	DI	Through network	COV	COV	–
Operation Mode	AI	Through network	1 min	15 min	–
Outdoor Unit Alarm Status	DI	Through network	COV	COV	–
Defrost Mode	DI	Through network	COV	COV	–
Oil Return	AI	Through network	1 min	15 min	–
Electric Power	AI	Through network	1 min	15 min	–
Electric Current	AI	Through network	1 min	15 min	–
System Capacity Code	AI	Through network	1 min	15 min	–
Outdoor Air Temperature	AI	Through network	1 min	15 min	–
Condensing Pressure	AI	Through network	1 min	15 min	–
Evaporating Pressure	AI	Through network	1 min	15 min	–
Condensing Temperature	AI	Through network	1 min	15 min	–
Evaporating Temperature	AI	Through network	1 min	15 min	–
Inverter Compressor 1 Speed	AI	Through network	1 min	15 min	–
Inverter Compressor 2 Speed	AI	Through network	1 min	15 min	–
Fan Step	AI	Through network	1 min	15 min	–
EV Position 1	AI	Through network	1 min	15 min	–
EV Position 2	AI	Through network	1 min	15 min	–
Hot Gas Temperature (Compressor 1)	AI	Through network	1 min	15 min	–
Hot Gas Temperature (Compressor 2)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (HX Upper)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (HX Lower)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (Deicer)	AI	Through network	1 min	15 min	–
Gas Pipe Temperature (HX Upper)	AI	Through network	1 min	15 min	–
Gas Pipe Temperature (HX Lower)	AI	Through network	1 min	15 min	–
Suction Temperature	AI	Through network	1 min	15 min	–
Compressor Suction Temperature	AI	Through network	1 min	15 min	–
Subcool Inlet Temperature	AI	Through network	1 min	15 min	–
Subcool Outlet Temperature	AI	Through network	1 min	15 min	–

Subcool EV Position	AI	Through network	1 min	15 min	–
Condensing Pressure	AI	Through network	1 min	15 min	–
Evaporating Pressure	AI	Through network	1 min	15 min	–
Condensing Temperature	AI	Through network	1 min	15 min	–
Evaporating Temperature	AI	Through network	1 min	15 min	–
Inverter Compressor 1 Speed	AI	Through network	1 min	15 min	–
Inverter Compressor 2 Speed	AI	Through network	1 min	15 min	–
Fan Step	AI	Through network	1 min	15 min	–
EV Position 1	AI	Through network	1 min	15 min	–
EV Position 2	AI	Through network	1 min	15 min	–
Hot Gas Temperature (Compressor 1)	AI	Through network	1 min	15 min	–
Hot Gas Temperature (Compressor 2)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (HX Upper)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (HX Lower)	AI	Through network	1 min	15 min	–
Liquid Pipe Temperature (Deicer)	AI	Through network	1 min	15 min	–
Gas Pipe Temperature (HX Upper)	AI	Through network	1 min	15 min	–
Gas Pipe Temperature (HX Lower)	AI	Through network	1 min	15 min	–
Suction Temperature	AI	Through network	1 min	15 min	–
Compressor Suction Temperature	AI	Through network	1 min	15 min	–
Subcool Inlet Temperature	AI	Through network	1 min	15 min	–
Subcool Outlet Temperature	AI	Through network	1 min	15 min	–
Subcool EV Position	AI	Through network	1 min	15 min	–

D. Hardwired Points

1. VAV Box - Cooling only

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see §230593)
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F

2. Ventilation Zone VAV Box

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see §230593)
Window switch	DI	WS (where indicated on Drawings)	COV	COV	–
Zone CO2 Concentration	AI	TS-3CC where CO_2 is called for on Drawings	5 min	15 min	F

3. VAV Box with reheat

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
HW valve signal	AO	2-way valve (occasional 3-way valve – see equipment schedule)	1 min.	15 min	
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Window switch	DI	WS (where indicated on Drawings)	COV	COV	–
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see §230593)
Supply air temperature	AI	TS-1A	1 min	15 min	F
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Zone CO_2 Concentration	AI	TS-3x (see Paragraph 2.9F)	5 min	15 min	F

4. Fan-powered VAV Box (Parallel or Series) with reheat and constant volume fan

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Start Fan	DO	Dry contact to contactor on VAV box	COV	COV	–
VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
HW valve signal	AO	2-way valve (occasional 3-way valve – see equipment schedule)	1 min.	15 min	
Supply fan status	DI	CS-1 or CT-1	COV	COV	See 3.11G
Window switch	DI	WS (where indicated on Drawings)	COV	COV	–
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see §230593)
Supply air temperature	AI	TS-1A	1 min	15 min	F
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Zone CO_2 Concentration	AI	TS-3x (see Paragraph 2.9F)	5 min	15 min	F

5. “Slow” Lab Zone (Not Fume Hood Dominated)

   a. Use one controller per lab so that network operation does not affect lab performance. This can be a standard VAV box controller on the supply air VAV box with a dual duct auxiliary controller on the exhaust VAV box. Alternatively, standard VAV box controllers can be provided on both with exhaust setpoint hardwired from the supply air box controller to the exhaust controller and all setpoint logic residing in the supply air box controller.

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Hood alarm (any hood)	DI	Connect to hood monitor alarm contact, in parallel if more than one hood	COV	COV	–
Supply VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–
Exhaust VAV Box Damper Position	AO	Modulating actuator	1 min	15 min	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
CHW/HW valve position	AO	Modulating actuator, 6-way valve	1 min.	15 min	
Supply Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see 230593)
General Exhaust Airflow	AI	DPT-5 connected to box manufacturer supplied flow cross	1 min	15 min	HH (see 230593)
Hood Exhaust Airflow (each hood)	AI	Air valve CFM feedback	1 min	15 min	F
Supply air temperature	AI	TS-1A	1 min	15 min	F
Zone Temperature Setpoint Adjustment	AI	TS-3C	15 min	60 min	F
Zone Temperature	AI	TS-3C	1 min	15 min	F

6. "Fast" Lab Zone (Fume Hood Dominated)

    a. Laboratory Air Valves

    b. Sash Position Sensor

    c. Fume Hood Monitor

        1) Designed to integrate with air valve controller

        2) LCD with velocity indication

        3) Visual and audible low and high velocity alarms with message display and mute button

        4) Button to activate and deactivate emergency purge that causes air valve to operate at full airflow regardless of sash position

        5) Equal to Accutrol FHM3

    d. See Section 233600 Air Terminal Units for air valve controllers

    e. Use one controller per lab so that network operation does not affect lab performance.

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Close sash (all hoods)	DO	Wire to sash controller emergency close contact; include multi-pole relay if more than one hood	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Hood alarm (any hood)	DI	Connect to hood monitor alarm contact, in parallel if more than one hood	COV	COV	–
Supply airflow setpoint	AO	To air valve	1 min	15 min	–
General exhaust airflow setpoint	AO	To air valve	1 min	15 min	–
CHW/HW valve position	AO	Modulating actuator, 6-way valve	1 min.	15 min	
Supply Airflow	AI	Air valve CFM feedback	1 min	15 min	F
General Exhaust Airflow	AI	Air valve CFM feedback	1 min	15 min	F
Hood Exhaust Airflow (each hood)	AI	Air valve CFM feedback	1 min	15 min	F
Supply air temperature	AI	TS-1A	1 min	15 min	F
Zone Temperature Setpoint Adjustment	AI	TS-3C	15 min	60 min	F
Zone Temperature	AI	TS-3C	1 min	15 min	F

7. VAV Air Handler with Relief Fan

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Relief damper -1 open/close	DO	Two position actuator	COV	COV	–
Relief damper -2 open/close	DO	Two position actuator	COV	COV	–
Relief Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Relief Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control schematics for details	COV	COV	–
Economizer Outdoor Air Damper	AO	Modulating actuator	1 min	15 min	–
Relief Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Return Air Damper	AO	Modulating actuator	1 min	15 min	–
Hot Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Chilled Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Supply Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Outdoor Airflow	AI	AFMS-3 cfm output	1 min	15 min	F
Outdoor Air Temperature	AI	AFMS-3 temperature output	1 min	15 min	F

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Mixed Air Temperature	AI	TS-1B across filter bank	1 min	15 min	F
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Return Air Temperature	AI	TS-1A	1 min	15 min	F
Supply Air Temperature	AI	TS-1B	1 min	15 min	HH
Duct Static Pressure	AI	DPT-3A, 0 to 2 inches	1 min	15 min	F
Building Pressure	AI	DPT-4, ±0.25	1 min	15 min	F

8. VAV Air Handler with Return Fan

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Return Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Return Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Return fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control schematics for details	COV	COV	–
Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control schematics for details	COV	COV	–
Exhaust Air Damper	AO	Modulating actuator	1 min	15 min	–
Economizer Outdoor Air Damper	AO	Modulating actuator	1 min	15 min	–
Return Air Damper	AO	Modulating actuator	1 min	15 min	–
Return Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Hot Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Chilled Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Supply Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Return Fan Static Pressure	AI	DPT-3, 0 to 1 inch	1 min	15 min	F
Outdoor Airflow	AI	AFMS-3 cfm output	1 min	15 min	F
Outdoor Air Temperature	AI	AFMS-3 temperature output	1 min	15 min	F
Mixed Air Temperature	AI	TS-1B across filter bank	1 min	15 min	F
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Return Air Temperature	AI	TS-1A	1 min	15 min	F
Supply Air Temperature	AI	TS-1B	1 min	15 min	HH
Duct Static Pressure	AI	DPT-3A, 0 to 2 inches.	1 min	15 min	F
Building Pressure	AI	DPT-4, ±0.25	1 min	15 min	F

9. Dedicated Outdoor Air VAV Air Handler

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply Fan 1 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply Fan 2 Start/Stop	DO	Connect to VFD Run	COV	COV	–
Supply fan high static alarm reset	DO	Dry contact to 120V or 24V control circuit –see control sequences for details	COV	COV	–
Hot Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Chilled Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Supply Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Outdoor Air Temperature	AI	TS-1A	1 min	15 min	F
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Supply Air Temperature	AI	TS-1A	1 min	15 min	HH
Duct Static Pressure	AI	DPT-3A, 0 to 2 inches.	1 min	15 min	F

10. Single Zone VAV Air Handler

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply Fan Start/Stop	DO	Connect to VFD Run	COV	COV	–
Economizer Dampers	AO	Modulating actuator, linked to both return air and outdoor air parallel blade dampers	1 min	15 min	–
Hot Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Chilled Water Control Valve	AO	Modulating 2-way valve	1 min	15 min	–
Supply Fan Speed	AO	Connect to VFD Speed, all VFDs	1 min	15 min	–
Mixed Air Temperature	AI	TS-1B	1 min	15 min	F
Filter Pressure Drop	AI	DPT-3A, 0 to 1 inch	–	60 min	F
Supply Air Temperature	AI	TS-1A	1 min	15 min	HH

11. 2-Pipe ***4-Pipe*** Variable Speed Fan-Coil

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Fan on/off	DO	May be deleted if 0-10Vdc to ECM less than 2V shuts off fan	COV	COV	–
Fan speed	AO	0-10Vdc to ECM	1 min	15 min	–
CHW***/HW*** valve signal	AO	2-way ***6-way*** valve	1 min.	15 min	

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Supply fan status	DI	CS-1 or CT-1	COV	COV	See 3.11G
Supply air temperature	AI	TS-1A	1 min	15 min	F
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Window switch	DI	WS (where indicated on Drawings)	COV	COV	–
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Zone CO2 Concentration	AI	TS-3x (see Paragraph 2.9F)	5 min	15 min	F

12. Packaged Single Zone AC Units/Heat Pumps

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Start Fan	DO	Dry contact to contactor on control panel	COV	COV	–
Cooling stages	Multiple DOs	See AC/HP unit schedule and submittals for quantity	1 min	15 min	–
Heating stages	Multiple DOs	See AC/HP unit schedule and submittals for quantity	1 min	15 min	–
Supply fan status	DI	Current switch	COV	COV	See 3.11G
Supply air temperature	AI	TS-1A	1 min	15 min	F
Local Override	DI	TS-3x – where applicable (see Paragraph 2.9F).	COV	COV	–
Window switch	DI	WS (where indicated on Drawings)	COV	COV	–
Zone Temperature Setpoint Adjustment	AI	TS-3x – where applicable (see Paragraph 2.9F).	15 min	60 min	F
Zone Temperature	AI	TS-3x (see Paragraph 2.9F)	1 min	15 min	F
Zone CO2 Concentration	AI	TS-3x (see Paragraph 2.9F)	5 min	15 min	F

13. Packaged VAV AC Unit

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Start/stop	DO	Hard wired (dry contact to 24V control circuit)	COV	COV	–

14. Toilet Exhaust Fan

Description	**Type**	**Device**	**Trend Logging**		**Calibration**
			Commissioning	**Continuous**	
Fan Start/Stop	DO	Dry contact to 120V starter control circuit	COV	COV	–
Fan Status	DI	CS-1 or CT-1	COV	COV	See 3.11G

15. Laboratory Exhaust Air System

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Bypass control damper	AO	Connect to damper actuator	1 min.	±5%	–
Exhaust Fan Speed	AO	Connect to VFD speed, all VFDs	1 min.	±5%	–
LEF-1 start/stop	DO	Connect to VFD Run	COV	COV	–
LEF-2 start/stop	DO	Connect to VFD Run	COV	COV	–
LEF-1 Status	DI	Connect to VFD status contacts	COV	COV	–
LEF-2 Status	DI	Connect to VFD status contacts	COV	COV	–
Exhaust Plenum static	AI	DPT-3B transmitter, 0 to 5”	1 min.	10 min.	F
Duct static –x. See plans for quantity	AI	DPT-3B transmitter, 0 to 2.5”	1 min.	10 min.	F

16. Laboratory Exhaust Air System

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Bypass control damper	AO	Connect to damper actuator	1 min.	±5%	–
Exhaust Fan Speed	AO	Connect to VFD speed, all VFDs	1 min.	±5%	–
LEF-1 start/stop	DO	Connect to VFD Run	COV	COV	–
LEF-2 start/stop	DO	Connect to VFD Run	COV	COV	–
LEF-3 start/stop	DO	Connect to VFD Run	COV	COV	–
LEF-1 Status	DI	Connect to VFD status contacts	COV	COV	–
LEF-2 Status	DI	Connect to VFD status contacts	COV	COV	–
LEF-3 Status	DI	Connect to VFD status contacts	COV	COV	–
Exhaust fan cfm, LEF-1	AI	AFMS-4	1 min.	10 min.	F

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Exhaust fan cfm, LEF-2	AI	AFMS-4	1 min.	10 min.	F
Exhaust fan cfm, LEF-3	AI	AFMS-4	1 min.	10 min.	F
Exhaust Plenum static	AI	DPT-3B transmitter, 0 to 5”	1 min.	10 min.	F
Duct static –x. See plans for quantity	AI	DPT-3B transmitter, 0 to 2.5”	1 min.	10 min.	F

17. Water-Cooled Chiller Plant

Description	**Type**	**Device**	**Trend Logging**		**Calibration**
			Commissioning	**Continuous**	
CH-1 on/off	DO	Connect to chiller enable contact on chiller panel	COV	COV	–
CH-2 on/off	DO	Connect to chiller enable contact on chiller panel	COV	COV	–
Start CHP-1	DO	Connect to VFD Run	COV	COV	–
Start CHP-2	DO	Connect to VFD Run	COV	COV	–
Start CWP-1	DO	Connect to motor starter auto	COV	COV	–
Start CWP-2	DO	Connect to motor starter auto	COV	COV	–
Start CT-1	DO	Connect to VFD Run	COV	COV	–
Start CT-2	DO	Connect to VFD Run	COV	COV	–
CH-1 CW isolation valve	AO	Modulating butterfly valve, line size	1 min	5 min	–
CH-2 CW isolation valve	AO	Modulating butterfly valve, line size	1 min	5 min	–
CH-1 CHW isolation valve	AO	Modulating butterfly valve, line size	1 min	5 min	–
CH-2 CHW isolation valve	AO	Modulating butterfly valve, line size	1 min	5 min	–
CHW Bypass valve	AO	Modulating valve, sized for minimum flow of one chiller at 5 psi DP	1 min	5 min	–
CHP speed	AO	Connect to VFD Speed on CHP-1, 2	1 min	5 min	–
CT-1 speed	AO	Connect to VFD Speed on CT-1A, 1B	1 min	5 min	–
Chiller emergency off	DI	Break-glass switch	COV	COV	
CWP-1 status	DI	CS-1 or CT-1	COV	COV	See 3.11G
CWP-2 status	DI	CS-1 or CT-1	COV	COV	See 3.11G
CWS temperature from towers	AI	TS-2B	5 min	15 min	HH
CWR temperature from towers	AI	TS-2B	5 min	15 min	HH

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
CHWR temperature before bypass	AI	TS-2B	5 min	15 min	HH
CHW supply flow	AI	FM-1 (connected to FM-1 auxiliary output)	5 min	15 min	F
CHW differential pressure	AI	DPT-1, 0 to 20 psi, located at end of piping system	5 min	15 min	F
CHW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F

18. Air-Cooled Series Chiller Plant

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
CH-1 on/off	DO	Connect to chiller enable contact on chiller panel	COV	COV	–
CH-2 on/off	DO	Connect to chiller enable contact on chiller panel	COV	COV	–
Start CHP-1	DO	Connect to VFD Run	COV	COV	–
Start CHP-2	DO	Connect to VFD Run	COV	COV	–
CH-1 bypass valve	DO	2-position butterfly valve, line size	COV	COV	–
CH-2 bypass valve	DO	2-position butterfly valve, line size	COV	COV	–
CHW Bypass valve	AO	Modulating valve, sized for minimum flow of one chiller at 5 psi DP	1 min	5 min	–
CHP speed	AO	Connect to VFD Speed on CHP-1, 2	1 min	5 min	–
CHWR temperature before bypass	AI	TS-2B	5 min	15 min	HH
CHW supply flow	AI	FM-1 (connected to FM-1 auxiliary output)	5 min	15 min	F
CHW differential pressure	AI	DPT-1, 0 to 20 psi, located at end of piping system	5 min	15 min	F
CHW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F

19. 2-Pipe and 4-Pipe Air-Source Heat Pump/Chiller Plant

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
HRHP-1 cooling on/off	DO	Connect to 4-pipe HP/chiller enable contact on chiller panel	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
HRHP-1 heating on/off	DO	Connect to 4-pipe HP/chiller enable contact on chiller panel	COV	COV	–
HPCH-1 on/off	DO	Connect to 2-pipe HP/chiller enable contact on chiller panel	COV	COV	–
HPCH-1 mode	DO	Connect to 2-pipe HP/chiller heat/cool mode contact on chiller panel	COV	COV	–
HPCH-2 on/off	DO	Connect to 2-pipe HP/chiller enable contact on chiller panel	COV	COV	–
HPCH-2 mode	DO	Connect to 2-pipe HP/chiller heat/cool mode contact on chiller panel	COV	COV	–
Start HWP-1	DO	Connect to VFD Run	COV	COV	–
Start HWP-2	DO	Connect to VFD Run	COV	COV	–
Start CHWP-1	DO	Connect to VFD Run	COV	COV	–
Start CHWP-2	DO	Connect to VFD Run	COV	COV	–
HPCH-1 changeover valves	DO	2-position 2-way valves, line size, spring return	COV	COV	–
HPCH-2 changeover valves	DO	2-position 2-way valves, line size, spring return	COV	COV	–
HWP speed	AO	Connect to VFD Speed on HWP-1, 2	1 min	5 min	–
CHP speed	AO	Connect to VFD Speed on CHP-1, 2	1 min	5 min	–
HW differential pressure	AI	DPT-1, 0 to 20 psi, located at end of piping system	5 min	15 min	F
HW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F
CHW differential pressure	AI	DPT-1, 0 to 20 psi, located at end of piping system	5 min	15 min	F
CHW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F

20. Hot Water Plant

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Boiler B-1 enable	DO	Connect to boiler enable contact	COV	COV	–
Boiler B-2 enable	DO	Connect to boiler enable contact	COV	COV	–
Start HWP-1	DO	Connect to VFD Run	COV	COV	–
Start HWP-2	DO	Connect to VFD Run	COV	COV	–
B-1 HW isolation valve	DO	2-position valve, line size	COV	COV	–
B-2 HW isolation valve	DO	2-position valve, line size	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
HWP speed	AO	Connect to VFD Speed on HWP-1, 2	1 min	5 min	–
Minimum flow bypass	AO	Size for boiler minimum flow per submittal at 5 psi ΔP	1 min	5 min	–
Common HWS temperature	AI	TS-2A	1 min.	±2°F	HH
HWR temperature before bypass	AI	TS-2A	1 min.	±2°F	HH
HWR temperature downstream of bypass	AI	TS-2A	1 min.	±2°F	HH
HW flow	AI	FM-1	1 min.	10 min	F
Common gas flow	AI (pulse)	FM-3 – locate in common gas line serving both boilers	1 min.	10 min	F
HW differential pressure	AI	DPT-1, 0 to 20 psi, located at end of piping system	5 min	15 min	F
HW system gauge pressure	AI	PT-1, 0 to 60 psi (located near expansion tank)	15 min	1 hr	F

21. Radiant Zone Manifolds

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Manifold Flow Valve	DO	2-position 2-way valve	COV	COV	–
Slab temperature	AI	TS-2A. Mount in floor box between radiant piping	1 min	10 min	–
Zone Temperature (provide only if the radiant manifold zone is not also served by an airside VAV zone(s))	AI	TS-3C	1 min	10 min	–

22. Radiant Water Pump Loops

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pump Start/Stop	DO	Connect to contactor or Motor Starter	COV	COV	–
HW/TCHW Changeover Valve Command	DO	2-position 2-way valves with end switches, 1 control point to power all valves; see schematics	COV	COV	–

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pump Status	DI	CS-1 or CT-1	COV	COV	See 3.11G
Modulating HW/TCHW Control Valve Command	AO	Modulating 2-way valve with end switches sized per design flow rates, 1 control point for both; see schematics	1 min	10 min	–
Loop return temperature	AI	TS-2A	1 min	10 min	–
Loop supply temperature	AI	TS-2A	1 min	10 min	–

23. Domestic Water Heaters (gas, electric, or heat pump)

Description	Type	Device	Trend Logging		Calibration
			Commissioning	Continuous	
DHW-1 System Re-Circulation Pumps Start/Stop	DO	Line voltage contact to pump power circuit	COV	COV	–
DHW-2 System Re-Circulation Pumps Start/Stop	DO	Line voltage contact to pump power circuit	COV	COV	–
DHW-1 Supply Temperature	AI	TS-2A	5 min	15 min	F
DHW-2 Supply Temperature	AI	TS-2A	5 min	15 min	F
DHW-1 System Re-Circulation Pump Status	DI	CS-1 or CT-1	COV	COV	See 3.11G
DHW-2 System Re-Circulation Pump Status	DI	CS-1 or CT-1	COV	COV	See 3.11G
DHW-1 heater Alarm	DI	Install relay wired downstream of DHW heater safeties with NC relay contact wired as alarm input.	COV	COV	–
DHW-2 heater Alarm	DI	Install relay wired downstream of DHW heater safeties with NC relay contact wired as alarm input.	COV	COV	–

24. Domestic Hot Water Generator from Heating HW

Description	Type/Tag	Device	Trend Logging		Calibration
			Commissioning	Continuous	
DHW System Re-Circulation and Storage Re-Circulation Pumps Start/Stop	DO	Line voltage contact to pump power circuit	COV	COV	–

Description	Type/Tag	Device	Trend Logging		Calibration
			Commissioning	Continuous	
HW Valve	AO	2-way valve	1 min	15 min	–
DHW System Re-Circulation Pump Status	DI	CS-1 or CT-1	COV	COV	See 3.11G
DHW Storage Re-Circulation Pump Status	DI	CS-1 or CT-1	COV	COV	See 3.11G
HW Return Temperature	AI	TS-2A	5 min	15 min	F
DHW Supply Temperature	AI	TS-2A	1 min	15 min	F

25. Hot Water and Chilled Water Plant Connection

Description	Type/Tag	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Pump #1 Start/Stop	DO	Connect to VFD “Run”	COV	COV	–
Pump #2 Start/Stop	DO	Connect to VFD “Run”	COV	COV	–
Pump #1 and #2 Speed	AO	Connect to VFD Speed on P-1, 2	1 min	15 min	–
Central Plant CHW/HW System Differential Pressure	AI	DPT-1, 0 to 15 psi	5 min	15 min	F
Building Differential Pressure	AI	DPT-1, 0 to 25 psi	1 min	15 min	F

26. Miscellaneous Meters

Description	Type/Tag	Device	Trend Logging		Calibration
			Commissioning	Continuous	
Building domestic water flow	AI (pulse)	FM-6	1 min	15 min	F
Irrigation water flow	AI (pulse)	FM-6	1 min	15 min	F
Natural gas flow	AI (pulse)	FM-3	1 min.	10 min	F

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install systems and materials in accordance with manufacturer’s instructions, roughing-in drawings and details indicated on Drawings.

B. Coordinate Work and Work schedule with other trades prior to construction.

C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.

B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

A. General

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.

2. Identifiers shall match record documents.

3. All plug-in components shall be labeled such that removal of the component does not remove the label.

B. Wiring and Tubing

1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the BAS address or termination number.

2. Permanently label or code each point of field terminal strips to show the instrument or item served.

3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.

C. Equipment and Devices

1. Valve and damper actuators: None required.

2. Sensors: Provide 1 inch x 3 inches x 1/8 inches black micarta or lamacoid labels with engraved white lettering, ¼ inches high. Indicate sensor identifier and function (for example "CHWS Temp").

3. Panels

a. Provide 2 inches x 5 inches 1/8 inches black micarta or lamacoid labels with engraved white lettering, ½ inches high. Indicate panel identifier and service.

b. Provide permanent tag indicating the electrical panel and circuit number from which panel is powered.

4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CUTTING, CORING, PATCHING AND PAINTING

A. Provide canning for openings in concrete walls and floors and other structural elements prior to their construction.

B. Penetrations through rated walls or floors shall be filled with a listed material to provide a code compliant fire-stop.

C. All damage to and openings in ductwork, piping insulation, and other materials and equipment resulting from Work in this Section shall be properly sealed, repaired, or re-insulated by experienced mechanics of the trade involved. Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

D. At the completion of Work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired and repainted to original finish.

3.5 CLEANING

A. Clean up all debris resulting from its activities daily. Remove all cartons, containers, crates, and other debris generated by Work in this Section as soon as their contents have been removed. Waste shall be collected and legally disposed of.

B. Materials stored on-site shall be protected from weather and stored in an orderly manner, neatly stacked, or piled in the designated area assigned by the College's Representative.

C. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.

D. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.6 CONTROLLERS

A. General

1. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details indicated on Drawings.

2. Regardless of application category listed below, each Control Unit shall be capable of performing the specified sequence of operation for the associated equipment. Except as listed below, all physical point data and calculated values required to accomplish the sequence of operation shall reside within the associated CU. Listed below are point data and calculated values that shall be allowed to be obtained from other CUs via LAN.

a. Global points such as outdoor air temperature

b. Requests, such as heat/cool requests, used to request operation or for setpoint reset from zones to systems and systems to plants

c. Modes, such as system modes, used to change operating logic from plants to systems and systems to zones

3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

B. Controller Application Categories

1. Controllers shall comply with the application table below (X under controller type indicates acceptable controller type).

Application Category	Examples	Acceptable Controller		
		ASC	AAC	BC
0	Monitoring of variables that are not used in a control loop, sequence logic, or safety, such as status of sump pumps or associated float switches, temperatures in monitored electrical rooms.	X	X	X
1	Miscellaneous heaters Constant speed exhaust fans and pumps	X	X	X
2	Fan Coil Units Terminal Units (such as VAV Boxes) Unitary AC and HP units	X		
3	"Slow" Lab Zone –Non-Hood Dominated	X (note 1)	X	X
4	Air Handling Units Central Hot Water Plant "Fast" Lab Zone –Hood Dominated Air-Cooled Chilled Water Plant		X (note 1)	X
5	Water-Cooled Chilled Water Plant			X
Notes: Controller may be used only if all control functions and physical I/O associated with a given unit resides in one AAC/ASC				

2. ASC Installation

a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use if ceiling attic is used as a return air plenum.

b. ASCs that control equipment mounted in a mechanical room may either be mounted in or on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.

c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

3. AAC and BC Installation

a. AACs/BCs shall be located in a temperature control cabinets constructed per Paragraph 2.8.

3.7 COMMUNICATION DEVICES

A. General

1. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.

2. Provide all interface devices and software to provide an integrated system.

B. LANID and LAN Routers

1. Provide as required

2. Connect networks to both sides of device

3. Thoroughly test to ensure proper operation

4. Interruptions or fault at any point on any Primary LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate.

C. Gateways and Protocol Translators to Equipment Controllers

1. See Paragraph 2.4C for network connection of Gateways and Protocol Translators.

2. Wire to networks on both sides of device.

3. Map across all monitoring and control points listed in Paragraph 2.12C.

4. Thoroughly test each point to ensure that mapping is accurate.

5. Initiate trends of points as indication in Paragraph 2.12C.

D. External Communications

1. Provided through College IT LAN.

3.8 CONTROL AIR TUBING

A. Sensor air tubing shall be sized by the Contractor.

B. All control air piping shall be concealed except in equipment rooms or unfinished areas.

C. Installation methods and materials

1. Concealed and Inaccessible: Use copper tubing or FR plastic in metal raceway. Exception: Room thermostat drops in stud walls in areas with lay-in ceiling may be FR plastic tubing.

2. Concealed and Accessible tubing (including ceiling return air plenums) shall be copper tubing or FR plastic tubing, subject to the following limitations

a. FR tubing shall be enclosed in metal raceway when required by local code.

b. Quantity of FR tubing per cubic foot of plenum space shall not exceed manufacturer's published data for Class 1 installation.

3. Exposed to view or damage: Use hard-drawn copper or FR plastic in metal raceway.

a. Where copper tubing is used, a section 12 inches or less of FR plastic tubing is acceptable at final connection to control device.

D. Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum 1 inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.

E. Pneumatic tubing shall not be run in raceway containing electrical wiring.

F. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where pneumatic tubing exits control panels, provide bulkhead fittings. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.

G. All tubing shall be number coded on each end and at each junction for easy identification.

H. All control air piping shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.

I. Piping above suspended ceilings shall be supported from or anchored to structural members or other piping or duct supports. Tubing shall not be supported by or anchored to electrical raceways or ceiling support systems.

J. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped-over copper tubing is not acceptable.

K. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

3.9 CONTROL POWER

A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section unless specifically indicated on Division 26 Drawings or Specifications. See Paragraph 1.2.

B. Extend power to all BAS devices, including 120V power to panels, from an acceptable power panel.

1. See Division 26 Electrical Drawings for power locations pre-allocated for BAS system.

2. Where no power source is indicated on drawings, for bid purposes only, assume a dedicated circuit is available within an average of 20 feet of panel location. If this is not the case, request additional cost prior to submission of shop drawings or no additional costs will be reimbursed.

3. Coordinate with Division 26 during shop drawing development for final connection location.

C. General requirements for obtaining power include the following:

1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.

2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.

3. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).

4. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, or interruptible), the controller, and any associated switches and devices necessary its operation, shall be powered by the highest level of reliability served.

D. Unless transformers are provided with equipment as specified in related Division 23 and 26 equipment Sections, Contractor shall provide transformers for all low voltage control devices including non-powered terminal units such as cooling-only VAV boxes and VAV boxes with hot water reheat. Transformer(s) shall be located in control panels in readily accessible locations such as Electrical Rooms.

E. Power line filtering. Provide transient voltage and surge suppression for all workstations and BCs either internally or as an external component.

3.10 CONTROL AND COMMUNICATION WIRING

A. Control and Signal Wiring

1. Comply with Division 26.

2. Line Voltage Wiring

a. All line-voltage wiring shall meet NEC Class 1 requirements.

b. All Class 1 wiring shall be installed in UL Listed approved raceway per NEC requirements and shall be installed by a licensed electrician.

c. Class 1 wiring shall not be installed in raceway containing pneumatic tubing.

3. Low Voltage Wiring

a. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

b. Class 2 wiring shall be installed in UL Listed approved raceway as follows:

1) Where located in unconcealed or inaccessible locations, such as:

a) Equipment rooms

b) Exposed to weather

c) Exposed to occupant view

d) Inaccessible locations such as concealed shafts and above inaccessible ceilings

2) Class 2 wiring shall not be installed in raceway containing Class 1 wiring.

c. Class 2 wiring need not be installed in raceway as follows:

1) Where located in concealed and easily accessible locations, such as:

a) Inside mechanical equipment enclosures and control panels

b) Above suspended accessible ceilings (e.g. lay-in and spline)

c) Above suspended drywall ceilings within reach of access panels throughout

d) In shafts within reach of access panels throughout

e) Nonrated wall cavities

2) Wiring shall be UL Listed for the intended application. For example, cables used in floor or ceiling plenums used for air transport shall be UL Listed specifically for that purpose.

3) Wiring shall be supported from or anchored to structural members neatly tied at 10 foot intervals and at least 1 foot above ceiling tiles and light fixtures. Support or anchoring from straps or rods that support ductwork or piping is also acceptable. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceilings.

4) Install wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

d. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two (for example relays and transformers).

4. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

5. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.

6. Use coded conductors throughout with different colored conductors.

7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

8. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.

9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

10. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.

11. Include one pull string in each raceway 1 inch or larger.

12. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

13. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (for example steam pipes or flues).

14. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

15. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

16. Terminate all control or interlock wiring.

17. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.

18. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inches electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.

19. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings per code. Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

20. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated herein, wire to the NO contact except the following shall be wired to the NC contact

    a. Hot water pumps

    b. Coil recirculation pumps provided for freeze protection.

21. Hardwire Interlocks

    a. The devices referenced in this Section are hardwire interlocked to ensure equipment shutdown occurs even if control systems are down. Do not use software (alone) for these interlocks.

    b. Hardwire device NC contact to air handler fan starter upstream of HOA switch, or to VFD enable contact.

    c. Where multiple fans (or BAS DI) are controlled off of one device and the device does not have sufficient contacts, provide a relay at the device to provide the required number of contacts.

    d. Provide for the following devices where indicated on Drawings or in Sequences of Operation:

        1) Duct smoke detector

        2) High discharge static pressure

        3) Low mixing plenum pressure

        4) Freeze-stats

        5) Cooling tower vibration switch

22. Shielded cable shield shall be grounded only at one end. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

B. Communication Wiring

1. Adhere to the requirements of Paragraph 3.10A in addition to this Paragraph.

2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.10A only if noise immunity is ensured. Contractor is fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

3. IP networks

a. AACs and ASCs

1) Daisy chain wiring is acceptable for controllers with Ethernet pass-through capability.

2) No more than 20 controllers per connection to managed switch.

3) No more than 60 feet of CAT6 between two devices in the daisy chain.

b. BCs

1) Connect directly to LAN (no daisy chaining with other controllers).

4. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.

5. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

6. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

7. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

8. All runs of communication wiring shall be unspliced length when that length is commercially available.

9. All communication wiring shall be labeled to indicate origination and destination data.

10. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

11. Power-line carrier signal communication or transmission is not acceptable.

3.11 SENSORS AND MISCELLANEOUS FIELD DEVICES

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Sensors used as controlled points in control loops shall be hardwired to the controller to which the controlled device is wired and in which the control loop shall reside.

D. Temperature Sensors

1. Room temperature sensors and thermostats shall be installed with back plate firmly secured to the wall framing or drywall anchors.

   a. For sensors mounted in exterior walls or columns, use a back plate insulated with foam and seal all junction box openings with mastic sealant.

   b. For sensors on exposed columns, use Wiremold or equal enclosures that are the smallest required to enclose wiring (e.g. Wiremold 400 BAC or equal) and Wiremold or equal junction boxes that are the narrowest required to enclose the temperature sensor and wiring connections (e.g. Wiremold 2348S/51 or equal). Color or raceway and boxes shall be per the architect; submit for approval prior to installation.

2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

3. Flexible averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip. Where located in front of filters (such as mixed air sensors), access for filter removal shall be maintained.

4. Rigid averaging sensors shall be installed in the centerline of the duct from the side or bottom of the duct.

5. Temperature sensors downstream of coils shall be located as far from the coil fins as possible, 6 inches minimum. Temperature sensors upstream of coils shall be a minimum of 6 inches away from the coil fins. No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements. Discharge temperature sensors on VAV boxes shall be mounted as far from the coil as possible but upstream of the first diffuser with the probe located as near as possible to the center of the duct both vertically and horizontally.

6. For sensors specified to be calibrated using a dry well bath (see points list), install sensors with a sufficient wiring/flexible conduit lead that sensor may be removed from well or duct and placed in an ice bath or dry well for calibration. The spare wiring/flexible conduit shall be no less than 3 feet in length.

7. All pipe-mounted temperature sensors shall be installed in wells. For small piping, well shall be installed in an elbow into pipe length. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.

8. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats, humidity sensors/humidistats, CO_2 sensors, and other room wall mounted sensors shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the

finished floor where there are no adjacent electrical switches, and within ADA limitations.

9. Unless otherwise noted on Drawings or Points List, install outdoor air temperature sensors on north wall where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.

10. Slab Temperature Sensors

    a. Mount sensor in receptacle box flush with floor top and accessible from floor for ready access and replacement of sensor.

    b. Mount sensor in a thermowell with thermal-conducting grease or mastic; direct burial of sensor in slab shall not be acceptable.

    c. Locate thermowell equidistant between embedded hydronic tubing, a minimum of 1 inch deep and no deeper than the hydronic tubing embedded in the slab.

    d. Wiring from receptacle box shall be in conduit to wall or other interstitial space from which signal wiring can run to controller. Secure conduit before slab is poured.

E. Differential Pressure Sensors

1. Supply Duct Static Pressure

    a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

    b. Low pressure port of the pressure sensor

        1) Pipe to either

            a) Building pressure (high) signal of the building static pressure transmitter.

            b) Open to a conditioned space inside the building

            c) Open to the BAS panel in which the DPT is mounted provided the panel is inside the building envelope and not in an air plenum.

    c. High-pressure port of the pressure sensor

        1) Pipe to the duct using a static pressure tip located as indicated on Drawings; if no location is indicated, locate at end of duct riser or main as far out in the system as possible but upstream of all smoke and fire dampers.

        2) Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer’s installation instructions.

2. Return Fan Discharge Plenum Pressure

a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

b. Low pressure port of the pressure sensor

1) Pipe to either

a) Building pressure (low) signal of the building static pressure transmitter.

b) Separate ambient static pressure probe located on the outside of the relief damper through a high-volume accumulator or otherwise protected from wind fluctuations.

c. High-pressure port of the pressure sensor

1) Pipe to the duct using a static pressure tip located at the discharge of the return fan.

2) Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions.

3. Building Static Pressure

a. Mount transmitter in temperature control panel near or in BAS panel to which it is wired.

b. Low pressure port of the pressure sensor

1) Pipe to the ambient static pressure probe located on the outside and at high point of the building through a high-volume accumulator or otherwise protected from wind fluctuations.

c. High-pressure port of the pressure sensor

1) Pipe to either

a) Behind a BAS temperature sensor cover in an interior zone (provided sensor has openings to allow ambient air to freely flow through it)

b) Wall plate sensor or wall/ceiling probe sensor as scheduled

2) Do not locate near elevators, exterior doors, atria, or (for ceiling sensor applications) near diffusers.

4. Filter Differential Pressure

a. Install static-pressure tips upstream and downstream of filters with tips oriented in direction of flow. If there is a Magnehelic gauge installed by the AHU manufacturer, it may be removed and discarded with its pressure tips used for the DPT provided the DPT has an LCD so it can double as a visual gauge.

b. Mount transmitter on outside of filter housing or filter plenum in an accessible position with LCD display clearly visible. This sensor is used in lieu of an analog gauge and thus must be readily viewable.

5. Minimum Outdoor Air Damper Differential Pressure

   a. Install plenum static-pressure sensors upstream and downstream of minimum outdoor air damper in a location where air velocity is minimal.

   b. Mount transmitter on inside or outside of economizer plenum (whichever is most accessible while out of weather) in an accessible position with LCD display clearly visible.

6. High/Low Static Pressure Safeties

   a. High static

      1) Install DPS-2 on side of supply air duct in accessible location.

      2) High port shall be open to supply air duct downstream of fan.

      3) Reference low port pressure shall be that at DP location.

   b. Low static

      1) Install DPS-2 inside or outside of mixed air plenum whichever is most accessible.

      2) Low port shall be open to mixed air plenum.

      3) Reference high port pressure shall be pressure on other side of mixed air plenum with the highest pressure, e.g. ambient pressure for systems with relief fans or non-powered relief, or relief air plenum for systems with return fans.

7. Underfloor Plenum Pressure

   a. Mount transmitter under floor below low-pressure port location.

   b. Low-pressure port of the pressure sensor: Pipe to either

      1) Behind associated BAS temperature sensor cover (provided sensor has openings to allow ambient air to freely flow through it)

      2) Wall plate sensor located adjacent to associated temperature sensor

   c. High pressure port of the pressure sensor: open to plenum below associated temperature sensor. Do not locate near plenum supply outlet where velocity pressure can affect plenum pressure reading.

8. All pressure transducers, other than those controlling VAV boxes, shall be located where accessible for service without use of ladders or special equipment. If required, locate in field device panels and pipe to the equipment monitored or ductwork.

9. The piping to the pressure ports on all pressure transducers (both air and water) shall contain a capped test port located adjacent to the transducer.

10. Piping differential pressure transducers shall have one of the following:

    a. Five valve manifold, brass, two valves to allow removal of sensor without disrupting the hydronic system, an equalizing valve to allow the sensor to be zeroed and to prevent sensor from experiencing full static (as opposed to differential), and two valves used as air vents that also can be used as test plugs for calibration.

    b. For sensors using two separate sensors, install test plugs on each connection for calibration and also used as vents.

F. Flow Switches: Install per manufacturer's instructions.

G. Current Switches and Current Transformers for Motor Status Monitoring

1. For CTs, create a software binary point for fan status triggered at a setpoint determined below and ~10% deadband.

2. Adjust the setpoint so that it is below minimum operating current and above motor no load current. For fans with motorized discharge dampers, adjust so that fan indicates off if damper is closed while fan is running. For pumps, adjust so that pump indicates off if valve is closed while pump is running.

H. Airflow Measuring Stations

1. Install per manufacturer's recommendations for unobstructed straight length of duct both upstream and downstream of sensor.

2. Outdoor air AFMS shall be configured to measure and control to airflow at "standard" air density, e.g. scfm (not acfm).

I. Fluid Flow Meters: Install per manufacturer's recommendations for unobstructed straight length of pipe both upstream and downstream of sensor. Commission per the manufacturer's startup and commissioning recommendations. Complete all manufacturer's startup documentation and include this in prefunctional commissioning report.

J. Wind Anemometer

1. Mount to mast that terminates ***30 feet*** above the ***main roof***.

2. Secure to the ***west wall of the penthouse at column lines 06 and C.5***.

K. Window Switches

1. Wiring

a. All wiring concealed in mullions and wall cavity to the extent possible. Review wiring routing details in mullions with window manufacturer.

b. Wiring that cannot be enclosed in mullions and walls shall be installed in Wiremold; location shall be reviewed and approved by College prior to installation.

2. Where there is more than one switch in a zone, wire in series so that windows are indicated as open when any window is open and indicated as closed when all are closed.

L. Water Leak Detector

1. Adjust leak detection level per manufacturer's recommendations as follows:

a. Where located in a secondary drain pan or other location where water is not expected to be present (i.e. any water indicates an alarm), adjust the water level to be ~zero inches above the pan.

b. Where located in the primary drain pan or other location where water is expected to be present (i.e. only a high water level indicates an alarm), adjust the water level to be just below the overflow pipe or other high water level indicator.

M. Refrigerant Monitor

1. Meet all requirements of Chapter 11 of the CMC.

2. Monitor Installation and Configuration

a. Install in accordance with the manufacturer's instructions.

b. Piping (for pumped sample draw type): Materials and installation shall be as per pneumatic control piping.

c. Locate sample ports in likely locations for refrigerant leaks from chillers, one port per chiller. Locate port in accordance with chiller manufacturer installation instructions. Where these instructions do not recommend a location, locate port 18 inches off the floor adjacent to the chiller on the side closest to the exhaust intake and furthest from the makeup air supply.

d. Alarm Configuration

1) For each refrigerant in room, set the three refrigerant monitor alarm setpoints as follows:

	Caution (Leak)	Warning (Spill)	Alarm (Evacuate)
Action	Display	Display Horn Strobe	Display Horn Strobe Exhaust Fan
Reset	Auto	Manual	Manual
Refrigerant	Setpoint (ppm)		
1233zd(E)	50	300	600

11	40	100	110
12	50	300	700
22	50	300	700
123	25	35	50
134a	50	300	700
404A	50	300	700
407C	50	300	700
410A	50	300	700

2) Manual reset shall be only possible from panel face within chiller room.

3. Alarm Controls

a. Inside the chiller room, provide:

1) Visual and audible alarms. Alarms may be integral to the refrigerant monitor.

b. Outside each chiller room entrance, provide:

1) Visual and audible alarms

c. Outside the primary chiller room entrance, provide:

1) Visual and audible alarms

2) Manual fan-on break-glass

3) Manual emergency-chiller-off break-glass switch

4) Fan on (green) and off (red) status lights wired to current switch to indicate fan status

d. Hardwire refrigerant alarm contact and break-glass switch to start exhaust fan (on high speed if motor is multi-speed). The BAS shall not be used for this purpose.

e. Also wire manual wind-up timer on-off switch inside primary entry to start fan (for comfort ventilation) on low speed if motor is multi-speed. Provide label at switch indicating “Ventilation Fan”.

f. Hardwire a contact that indicates emergency- chiller-off break-glass manual alarm to the BAS. Program BAS to stop all refrigeration equipment in room when contact indicates alarm.

g. Generate trouble alarm when monitor detects a malfunction. Trouble alarm shall not initiate horn and strobe.

N. Actuators

1. Type: All actuators shall be electric.

2. Mount and link control damper actuators per manufacturer’s instructions.

3. Dampers

    a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage, or follow manufacturer's instructions to achieve same effect.

    b. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

    c. Provide all mounting hardware and linkages for actuator installation.

4. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, mount the valve so that the position indicator is visible from the floor or other readily accessible location. However, do not install valves with stem below horizontal or down. The preferred location for the valve and actuator is on lowest point in the valve train assembly for ease of access and inspection. If this is on the coil supply piping, the control valve may be located there even if schematics (and standard practice) show valves located on the coil return piping. This comment applies to both 2−way valves and 3-way valves (which would become diverting valves rather than mixing valves in this location).

O. Laboratory Fume Hoods:

1. See Section 233600 Air Terminal Units for fume hood air valves, hood monitors, and sash position sensors.

2. Install fume hoof monitor in knock-out opening provided with hood.

3. Install sash sensors on each VAV fume hood. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels.

3.12 SOFTWARE INSTALLATION

A. System Configuration

1. Thoroughly and completely configure BAS system software, supplemental software, network software etc. on OWS, POTs, and servers.

B. Point Structuring and Naming

1. The intent of this Paragraph is to require a consistent means of naming points across the BAS. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.

2. Point Summary Table

    a. The term "Point" includes all physical I/O points, virtual points, and all application program parameters.

b. With each schematic, provide a Point Summary Table listing

1) Building number and abbreviation

2) System type

3) Equipment type

4) Point suffix

5) Full point name (see Point Naming Convention Paragraph)

6) Point description

7) Ethernet backbone network number

8) Network number

9) Device ID

10) Device MAC address

11) Object ID (object type, instance number)

12) Engineering units

13) Device make and model number; include range of device if model number does not so identify.

14) Device physical location description; include floor and column line intersection to one decimal place (for example line 6.2 and line A.3).

c. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).

d. Coordinate with the College's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup.

e. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the College the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

3. Point Naming Convention

a. All point names shall adhere to the format as established below, unless otherwise agreed to by the College. New categories and descriptors may be created with approval of the College.

b. Format:

1) Building.Category.System.EquipmentTag.Component.Property.

2) Example: 001.HVAC.Heatplant.B-1.HWS.Temperature

Building	Category	System	Equipment Tag	Component	Property	Typical units
Building number	ELCT	Lighting Plug Generator Misc	(from equipment schedules)	SWITCH PHOTO CB CWS CWR HWS HWR CHWS CHWR OA SA RA EA GAS FLUID	Command Status Light Power Voltage Current ValvePos DamperPos Temperature Humidity Pressure Flow Energy Speed Signal	On/off On/off Footcandles Watts Volts Amps %open %open °F %RH Psig, "H_2O Cfm, gpm Btu %, Hz %
	HVAC	Airhandling Exhaust Heatplant Coolplant Misc				
	PLMB	Domwater Air Natgas N2 O2 Irrigation Waste Misc				
	MISC	Weather				

4. Device Addressing Convention

   a. BACnet network numbers and Device Object IDs shall be unique throughout the network.

   b. All assignment of network numbers and Device Object IDs shall be coordinated with the College to ensure there are no duplicate BACnet device instance numbers.

   c. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner: VVVNN, where: VVV = 0-999 for BACnet Vendor ID, NN = 00 - 99 for building network.

   d. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner: VVVNNDD , where: VVV = number 0 to 999 for BACnet Vendor ID , NN = 00 - 99 for building network, DD = 01-99 for device address on a network.

   e. Coordinate with the College or a designated representative to ensure that no duplicate Device Object IDs occur.

   f. Alternative Device ID schemes or cross-project Device ID duplication if allowed shall be approved before Project commencement by the College.

5. I/O Point Physical Description

a. Each point associated with a hardware device shall have its BACnet long-name point description field filled out with:

1) The device manufacturer and model number. Include range of device if model number does not so identify.

2) For space sensors, include room number in which sensor is located.

C. Point Parameters

1. Provide the following minimum programming for each analog input

a. Name

b. Address

c. Scanning frequency or COV threshold

d. Engineering units

e. Offset calibration and scaling factor for engineering units

f. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.

g. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the Primary or Secondary networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides or failure of any network over which the point value is transferred.

2. Provide the following minimum programming for each analog output

a. Name

b. Address

c. Engineering units

d. Offset calibration and scaling factor for engineering units

e. Output Range

f. Default value to be used when the normal controlling value is not reporting.

3. Provide the following minimum programming for each digital input

a. Name

b. Address

c. Engineering units (on/off, open/closed, freeze/normal, etc.)

d. Debounce time delay

e. Message and alarm reporting as specified

f. Reporting of each change of state, and memory storage of the time of the last change of state

g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

4. Provide the following minimum programming for each digital output

a. Name

b. Address

c. Output updating frequency

d. Engineering units (on/off, open/closed, freeze/normal, etc.)

e. Direct or Reverse action selection

f. Minimum on-time

g. Minimum off-time

h. Status association with a DI and failure alarming (as applicable)

i. Reporting of each change of state, and memory storage of the time of the last change of state.

j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

k. Default value to be used when the normal controlling value is not reporting.

D. Site-Specific Application Programming

1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:

a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.

b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.

c. Programs are thoroughly debugged before they are installed in the field.

2. Massage and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.

3. All site-specific programming shall be fully documented and submitted for review and approval

    a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.8.)

    b. At the completion of functional performance testing, and

    c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.13).

4. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the Project will be the property of the College and shall remain on the workstations/servers at the completion of the Project.

E. Graphic Screens

1. All site specific graphics shall be developed in a manner that will ensure graphic display quality and uniformity among the various systems.

2. Schematics of MEP systems

    a. Schematics shall be 2-D or 3-D and shall be based substantially on the schematics provided on Drawings.

    b. All relevant I/O points and setpoints being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse.

    c. Animation or equipment graphic color changes shall be used to indicate on/off status of mechanical components.

    d. Indicate all adjustable setpoints and setpoint high and low limits (for automatically reset setpoints), on the applicable system schematic graphic or, if space does not allow, on a supplemental linked-setpoint screen.

3. Displays shall show all points relevant to the operation of the system, including setpoints.

4. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

5. Show weather conditions (local building outside air temperature and humidity) in the upper left hand corner of every graphic.

6. CAD Files: The contract document drawings will be made available to the Contractor in AutoCAD format upon request for use in developing backgrounds for specified graphic screens, such as floor plans and schematics. However the College does not guarantee the suitability of these drawings for the Contractor's purpose.

7. Provide graphics for the following as a minimum

    a. Site homepage: Background shall be a campus map, approximately to scale. Include links to each building, central plant, etc.

    b. Building homepage: Background shall be a building footprint, approximately to scale, oriented as shown on the campus homepage architectural Drawings. Include links to each floor and mechanical room/area, and to summary graphics described below. Include real-time site utility data such as building electrical demand, domestic cold water flow, and natural gas demand shown roughly on the map where the utilities connect to the site.

    c. Electricity demand limiting

        1) Demand limit. Include entries for sliding window interval and a table of Off-Peak, On-Peak or Partial-Peak demand time periods, both Summer and non-Summer, with three adjustable demand level limits for each and adjustable deadband.

        2) Electricity demand calculation. For each month, show actual peak kW and kWh for each time-of-day rate period. Show side-by-side as month-this-year and month-last-year, and month-to-date and year-to-date data.

    d. Natural gas demand page. For each month, show actual peak therms/hr and therms for each rate period. Show side-by-side as month-this-year and month-last-year, and month-to-date and year-to-date data. Include adjustable conversion of gas volumetric flow rate to therms.

    e. Each occupied floor plan, to scale

        1) HVAC: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes. In each zone, provide links to associated terminal equipment.

        2) CO (garage levels): Floor plan graphic showing CO sensors throughout the garage with colors mapped to the CO levels in the area covered by each sensor. The colors shall be updated dynamically as the area's actual CO level changes. For each sensor, provide a link to a graphic for the fan and sensor group associated with that sensor.

        3) If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic

floor plan screen to the building key plan and to each of the other graphic floor plan screens.

f. Each equipment floor/area plan: To scale, with links to graphics of all BAS controlled/monitored equipment.

g. Each air handler and fan-coil: Provide link to associated HW and CHW plants where applicable.

h. Each trim & respond reset: Next to the display of the setpoint that is being reset, include a link to page showing all trim & respond points (see Section 259000) plus the current number of requests, current setpoint, and status indicator point with values "trimming," "responding," or "holding." Include a graph of the setpoint trend for the last 24 hours. Trim & respond points shall be adjustable from the graphic except for the associated device.

i. Each zone terminal

1) See Sample Graphics – VAV Reheat Zone

2) See Sample Graphics – VAV Cooling-Only Zone

3) Include a non-editable graphic (picture) showing the design airflow setpoints from the design drawings adjacent to the editable airflows setpoints. The intent is that the original setpoints be retained over time despite "temporary" adjustments that may be made over the years.

j. Each lab zone terminal:

1) Provide link to associated air handling unit where applicable and to floor plan where terminal is located.

2) Include supply air temperature from AHU serving terminal unit.

3) Include a non-editable graphic (picture) showing the design airflow setpoints from the design drawings adjacent to the editable airflows setpoints. The intent is that the original setpoints be retained over time despite "temporary" adjustments that may be made over the years.

4) Include room air change rate calculated from zone volume and either supply airflow rate if differential is positive, or exhaust airflow rate if differential is negative.

k. Electrical power monitoring system: Show a schematic of the electrical system based on one-line diagrams with meter current kW reading and month-to-date kWh shown in actual locations. Show side-by-side kWh and peak demand as month-this-year and month-last-year, and month-to-date and year-to-date data. Power flow shall change on the diagram (by changing line color or width) to show which power line is active.

l. Water meters: Show side-by-side gallons and peak demand gpm as month-this-year and month-last-year, and month-to-date and year-to-date data.

m. Central plant equipment including chilled water system, cooling tower system, hot water system, steam system, generators, etc.: The flow path shall change on the diagram (by changing piping line color or width) to show which piping has active flow into each boiler, chiller, tower, etc. as valve positions change.

n. Summary graphics: Provide a single text-based page (or as few as possible) for each of the following summary screens showing key variables listed in columns for all listed equipment. Include hyperlinks to each zone imbedded in the zone tag:

1) Air handling units: operating mode; on/off status; supply air temperature; supply air temperature setpoint; fan speed; duct static pressure; duct static pressure setpoint; outdoor air and return air damper position; coil valve positions; etc. (all key operating variables); Cooling CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (if HW coil)

2) Zone Groups

a) Separate zone terminal summary for each Zone Group.

b) See Sample Graphics –Zone Group Summary

3) VAV Zone terminal units: operating mode; airflow rate; airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; damper position; HW valve position (reheat boxes); supply air temperature (reheat boxes); supply air temperature setpoint (reheat boxes); CO2 concentration and CO2 loop output (where applicable); Fan start/stop command, speed, and status (fan-powered); Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier (HW reheat); Heating Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct); Heating SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier (dual duct).

4) Laboratory Supply Terminals: operating mode; airflow rate; airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; damper position; HW valve position; ***CHW valve position;*** supply air temperature; supply air temperature setpoint; Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; ***CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier***.

1) Laboratory Exhaust Terminals: differential airflow rate, differential airflow rate setpoint; general exhaust airflow rate, airflow rate setpoint, damper position, Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; hood exhaust airflow rate, airflow rate setpoint, damper

position, Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; any hood alarm.

2) Fan-coil units: operating mode; zone temperature; active heating setpoint; active cooling setpoint; supply air temperature; supply air temperature setpoint (where applicable); fan status; fan speed (where applicable); HW/CHW valve position; Cooling CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier.

3) AC and Heat Pumps: operating mode; zone temperature; active heating setpoint; active cooling setpoint; supply air temperature; fan status; fan speed (where applicable); Cooling stages; Heating stages.

4) UFT Zone terminal units: operating mode; fan speed (expressed as percentage of cooling maximum speed); zone temperature; active heating setpoint; active cooling setpoint; supply air temperature (reheat boxes); supply air temperature setpoint (reheat boxes); fan status; HW valve position; CO_2 concentration; CO_2 loop output; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Heating HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier.

5) Lab Zone terminal units: operating mode; supply airflow rate; supply airflow rate setpoint; zone temperature; active heating setpoint; active cooling setpoint; supply air temperature; supply air temperature setpoint; fume hood status; exhaust airflow rate; Supply Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Exhaust Static Pressure Reset current requests, cumulative %-request-hours, and request Importance Multiplier; Cooling SAT Reset current requests, cumulative %-request-hours, and request Importance Multiplier; CHWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier; HWST Reset current requests, cumulative %-request-hours, and request Importance Multiplier.

6) Electrical meters and switches: Volts, current, kW, switch positions.

o. For all equipment with runtime alarms specified, show on graphic adjacent to equipment the current runtime, alarm setpoint (adjustable), alarm light, date of last runtime counter reset, and alarm reset/acknowledge button which resets the runtime counter.

p. For all equipment with lead/lag or lead/standby operation specified, show on graphic adjacent to equipment the current lead/lag order and manual buttons or switches to allow manual lead switching by the operator per Section 259000 Building Automation Sequences of Operation.

q. For all controlled points used in control loops, show the setpoint adjacent to the current value of the controlled point.

r. All other BAS controlled/monitored equipment.

s. On all system graphics, include a “note” block that allows users to enter comments relevant to system operation.

t. All equipment shall be identified on the graphic screen by the unit tag as scheduled on the drawings.

F. Alarm Configuration

1. Program alarms and alarm levels per Sequence of Operations.

2. Each programmed alarm shall appear on the alarm log screen and shall be resettable or acknowledged from those screens. Equipment failure alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, fan alarm shall be shown on graphic air handling system schematic screen). For all graphic screens, display values that are in a Level 1 or 2 condition in a red color, Level 3 and higher alarm condition in a blue color, and normal (no alarm) condition in a neutral color (black or white).

3. For initial setup, Contractor shall configure alarms as follows:

	Level 1	**Level 2**	**Level 3**	**Level 4**
Criticality	Critical	Not Critical	Not Critical	Not Critical
Acknowledgement	Required	Required	Not Required	Not Required
Acknowledgement of Return to Normal	Not Required	Not Required	Not Required	Not Required
Print to alarm printer	Y	Y	N	N
Email to building engineer(s)	Y	Y	Y	N
SMS text to building engineer(s)	Y	Y	N	N
Pop-up dialog box on OWS	Y	Y	N	N
Remove from alarm log	After Acknowledged	After Acknowledged	After 2 weeks	After 2 weeks

3.13 SEQUENCES OF OPERATION

A. See Section 259000 Building Automation Sequences of Operation.

3.14 SYSTEM COMMISSIONING

A. Sequencing. The following list outlines the general sequence of events for submittals and commissioning:

1. Submit Submittal Package 0 (Qualifications) and receive approval.

2. Submit Submittal Package 1 (Hardware and Shop Drawings) and receive approval.

3. Initiate installation of BAS hardware, devices and wiring.

4. Develop point database and application software.

5. Simulate sequencing and debug programming off-line to the extent practical.

6. Submit Submittal Package 2 (Programming and Graphics) and receive approval.

7. Complete installation of BAS hardware, devices and wiring.

8. Install point database and application software in field panels.

9. Submit Submittal Package 3 (Pre-Functional Test Forms) and receive approval.

10. Perform BAS Pre-functional Tests (start up, calibration and tuning) and submit completed forms as Submittal Package 4 (Pre-Functional Test Report) for approval.

11. Receive BAS Pre-functional Test Report approval and approval to schedule Functional Tests.

12. Field test application programs prior to functional testing.

13. Submit Package 5 (Post-Construction Trend Points List) in format specified for review and approval.

14. Receive approval of successful Trend Log configuration, or reconfigure as required.

15. Prepare and initiate commissioning Trend Logs.

16. Perform and record functional tests and submit Submittal Package 6 (Functional Test Report) for approval.

    a. Some tests may not be possible due to weather conditions. These tests may be deferred to post-occupancy period.

17. Assist in TAB tests and determining setpoints as specified in Section 230593 Testing, Adjusting and Balancing.

18. Assist in Title 24 Acceptance Testing as specified in Section 230800 Mechanical System Commissioning.

19. Submit Package 7 (Training Materials) and receive approval.

20. Receive BAS Functional Test Report approval and approval to schedule Demonstration Tests.

21. Perform Demonstration Tests to Commissioning Provider and College’s Representatives and submit Demonstration Test Report.

22. Receive acceptance of Demonstration Tests.

23. Train College personnel on BAS operation and maintenance.

24. Substantial Completion

25. Submit Package 8 (Post-Construction Trend Logs) in format specified for review and approval.

26. Receive approval of successful Trend Log tests, or retest as required.

27. Complete all items in Completion Requirements per Paragraph 1.9B.

28. Provide administration level password access to the College.

29. Final Acceptance

30. Begin Warranty Period.

31. Prepare and initiate continuous Trend Logs per Paragraph 2.12A.4.

32. Perform deferred alternate season functional tests (see Paragraph 16.a and G.3.a) and submit amended Functional Test Report for approval.

33. Receive amended BAS Functional Test Report approval.

34. Update all software as specified.

35. End of Warranty Period

B. Assist Commissioning Provider/Coordinator as specified in Section 019100 Commissioning, including attending commissioning meetings.

C. Coordinate with Work specified in Section 230800 Mechanical Commissioning and Division 26 Electrical Commissioning.

D. Pre-functional tests

1. General

a. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.

b. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.

c. Verify integrity/safety of all electrical connections.

d. Verify that shielded cables are grounded only at one end.

e. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.

2. Test Documentation

a. Prepare forms to document the proper startup of the BAS components.

b. All equipment shall be included on test forms including but not limited to

1) Wiring: End-to-end checkout of all wiring at terminations. Power to all controllers and actuators. Confirmation of emergency power where specified.

2) Digital Outputs: Proper installation, normal position, response to command at CU

3) Digital Inputs: Proper installation, device test, response at CU

4) Analog Outputs: Proper installation of devices, verification of maximum and minimum stroke.

5) Analog Inputs: Proper installation of sensors, calibration

6) Panels: Confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified.

7) Alarms and Safeties: Verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.

8) Loop Tuning: Document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.

9) Network Traffic: Document speed of screen generation, alarm and signal propagation in system with all required commissioning trends active.

c. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.

d. Submit blank forms for approval in Submittal Package 3.

e. Complete work, document results on forms, and submit for approval as Submittal Package 4 (Pre-Functional Test Report).

3. Digital Outputs

a. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

4. Digital Inputs

a. Adjust setpoints, where applicable.

1) For current switches used as status on fans, adjust current setpoint so that fan status is OFF when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).

2) For current switches used as status on pumps, adjust current setpoint so that pump status is OFF when pump is dead-headed (temporarily close discharge valve).

3) For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).

5. Analog Outputs

a. Verify start and span are correct and control action is correct.

b. Check all control valves and automatic dampers to ensure proper action and closure. Make any necessary adjustments to valve stem and damper blade travel.

c. Check all normal positions of fail-safe actuators.

d. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.

6. Analog Input Calibration

a. Sensors shall be calibrated as specified on the points list. Calibration methods shall be one of the following:

1) Factory: Calibration by factory, to standard factory specifications. Field calibration is not required.

2) Handheld: Field calibrate using a handheld device with accuracy meeting the requirements of Paragraph 2.9T.

b. The calibrating parameters in software (such as slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician indicating date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.

c. Inaccurate sensors must be replaced if calibration is not possible.

7. Alarms and Interlocks

a. A log shall be kept and initialed by the technician indicating date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.

b. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

c. Coordinate with Division 26 to test fire and life safety systems alarm contacts.

d. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

e. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

8. Variable Frequency Drive Minimum Speed

a. Minimum speed for VFD-driven fans and pumps shall be determined in accordance with this Paragraph. Tests shall be done for each piece of equipment, except that for multiple pieces of identical equipment used for identical applications, only one piece of equipment need be tested with results applied to all. Note that for fans and pumps, there is no minimum speed required for motor cooling. Power drops with cube of speed, causing motor losses to be minimal at low speeds.

b. This work shall be done only after fan/pump system is fully installed and operational.

c. Determine minimum speed setpoint as follows:

1) Start the fan or pump.

2) Manually set speed to 6 Hz (10%) unless otherwise indicated in control sequences. For cooling towers with gear boxes, use 20% or whatever minimum speed is recommended by tower manufacturer.

3) Observe fan/pump in field to ensure it is visibly rotating.

a) If not, gradually increase speed until it is.

4) The speed at this point shall be the minimum speed setpoint for this piece of equipment.

5) Record minimum speeds in log and store in software point as indicated in Guideline 36.

9. Tuning

a. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted)

Controlled Variable	Control Accuracy
Duct Pressure	±0.1 inches w.g.
Building and relief plenum	±0.01 inches w.g.
Airflow and water flow	±10%
Space Temperature	±1.5ºF
Condenser Water Temperature	±2ºF
Chilled Water Temperature	±1ºF
Hot Water Temperature	±3ºF
Duct Temperature	±2ºF
Water Differential Pressure	±1.5 psi

Controlled Variable	Control Accuracy
Others	±2 times reported accuracy

10. Interface and Control Panels

    a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the Record Drawings.

    b. Ensure that terminations are safe, secure and labeled in accordance with the Record Drawings.

    c. Check power supplies for proper voltage ranges and loading.

    d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

    e. Check for adequate signal strength on communication networks.

    f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.

    g. Ensure that buffered or volatile information is held through power outage.

    h. With all system and communications operating normally, sample and record update and annunciation times for critical alarms fed from the panel to the Operator Interface.

    i. Check for adequate grounding of all BAS panels and devices.

11. Operator Interfaces

    a. Verify that all elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.

    b. Verify that the alarm ***printing,*** logging, paging, emailing etc. are functional and per requirements.

E. Testing, Adjusting, and Balancing (TAB) Coordination

1. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing. Some balancing procedures require the BAS to be operational and require Contractor time and assistance.

2. Calibration Software

a. Software shall be provided free of charge on at least a temporary basis to allow calibration of terminal box airflow controls and other Work specified under Section 230593 Testing, Adjusting, and Balancing.

b. Software shall be provided for installation on POT(s) provided by Others or Contractor shall loan a POT or handheld device with software installed for the duration of Work specified under Section 230593 Testing, Adjusting, and Balancing.

c. Provide sufficient training to those performing Work specified under Section 230593 Testing, Adjusting, and Balancing to allow them to use the software for balancing and airflow calibration purposes. Contractor shall include a single training session for this purpose.

3. Setpoint Determination

a. Perform pre-functional tests described in Paragraph 3.14D before assisting in setpoint determination.

b. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing to determine fan and pump differential pressure setpoints, outdoor air damper minimum positions and DP setpoints, etc. as indicated in Section 230593 Testing, Adjusting and Balancing.

4. Coil Valve Leak Check

a. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing to provide control valve leak check tests.

F. Cooling Tower Level Sensor

1. Coordinate with Work performed under Section 236500 Cooling Towers.

2. Test conditions

a. All pumps off

b. Towers filled to a level roughly between minimum level and overflow level, as specified by the tower manufacturer

c. All equalizer isolation valves open

d. Makeup water and bleed valves closed

3. Test and record

a. Through the BAS, record current level sensor reading. Convert psi to inches of water in all BAS displays.

b. Measure actual tower level inside the basin from the same point referenced in the tower manufacturer’s level recommendations

c. Calibrate level sensor to match actual reading

4. Configure tower level minimum alarm, maximum alarm, fill start level, and fill stop level setpoints in the BAS. These points shall be displayed and be adjustable from the cooling tower graphic.

G. Functional Tests

1. Test schedule shall be coordinated with the Commissioning Provider, Commissioning Coordinator, and College's Representative.

2. Functional tests may be witnessed by College's Representative at the College's option.

3. All approved Functional Tests shall be conducted by the Contractor with results confirmed and signed by the Contractor's start-up technician.

a. ***Seasonal Impacts: It shall be assumed that not all tests will be possible due to weather conditions. Those that are not possible shall be deferred until the next season, performed during the warranty period***.

4. Test documentation

a. College's Representatives will prepare functional testing forms after Submittal Package 2 has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.

b. Review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc. and provide to College's Representative.

c. Complete work, document results on forms, and submit for approval as Submittal Package 6 Functional Test Report. Tutorials for using the functional test Excel workbook can be found here.

H. Demonstration Test

1. Demonstration tests consist of a small representative sample of functional tests and systems randomly selected by the Commissioning Provider. Tests will be designed to occur over no longer than ***2*** working days.

2. Schedule the demonstration with the Commissioning Provider and College's Representative at least 1 week in advance. Demonstration shall not be scheduled until the Functional Test Report has been approved.

3. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.

4. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Commissioning Provider will supply the test forms at the site at the start of the tests.

5. Demonstration tests may be witnessed by College's Representative at the College's option.

6. Contractor shall conduct tests as directed by and in the presence of the Commissioning Provider and complete test forms. Commissioning Provider will document the test results as the Demonstration Test Report after tests are complete.

7. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

I. Trend Log Tests

1. Trends shall be fully configured to record and store data to the server for the points and at the interval listed in Paragraph 2.11 as follows:

   a. Commissioning: Configure trends prior to functional testing phase. Retain configuration until post-construction commissioning trend review has been completed successfully and accepted by the College's representative. Trends shall be deactivated after acceptance.

   b. Continuous: After system acceptance, configure trends for the purpose of long term future diagnostics. Configure trends to overwrite the oldest trends at the longest interval possible without filling the server hard disk beyond 80%.

2. Post-Construction Trend Test

   a. Trend logging shall not commence until Demonstration Tests are successfully completed.

   b. Hardware Points. Contractor shall configure points to trend as indicated in the Commissioning Trend column listed in Paragraph 2.11 points.

   c. Software Points. Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.

      1) All setpoints and limits that are automatically reset, such as supply air temperature and fan static pressure setpoints, plus the points that are driving the reset, such as zone level cooling and static pressure requests

      2) All setpoints that are adjustable by occupants

      3) Outputs of all control loops, other than those driving a single AO point that is already being trended

      4) System mode points (e.g. Warm-up, Occupied, etc.)

      5) Global overrides such as demand shed signals

      6) Calculated performance monitoring points, such as chiller efficiency

d. Submit for review and approval by the Commissioning Provider a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period, as Submittal Package 5.

e. Trends shall be uploaded to the CSS in data format specified in Paragraph 2.11C.3.

f. Trend logs of all points indicated above shall be collected for a ***3*** week Trend Period.

g. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the College in an electronic format agreed to by the College and Contractor (such as flash drive or via direct access to the CSS via the internet) as Submittal Package 8.

h. Data will be analyzed by the Commissioning Provider.

i. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps f to h above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.

j. After successfully completing the Post-Construction Trend Tests, the Contractor shall configure all points to trend as indicated in the Continuous Trend column listed in Paragraph 2.11 points list.

J. Remedial Work

1. Repair or replace defective Work, as directed by College's Representative in writing, at no additional cost to the College.

2. Restore or replace damaged Work due to tests as directed by College's Representative in writing, at no additional cost to the College.

3. Restore or replace damaged Work of others, due to tests, as directed by College's Representative in writing, at no additional cost to the College.

4. Remedial Work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the College's Representative, at no additional cost to the College.

5. Contractor shall compensate College's Representatives and Commissioning Provider on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional BAS trends beyond the initial tests, at no additional cost to the College.

3.15 TRAINING

A. Coordinate schedule and materials with Commissioning Provider.

B. Interim Training

1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.

C. Formal Training

1. Training shall be conducted after all commissioning is complete and systems are fully operational.

2. Training materials, including slides, shall be submitted prior to any training in Submittal Package 7.

3. ALC Training

   a. It may be assumed that College building engineers have been previously trained on the existing ALC system.

   b. Include training on ALC system operations only for new features installed at CSS/OWS as a part of this project.

4. Jobsite Training

   a. Include ***40*** hours total of on-site training to assist personnel in becoming familiar with job-specific issues, systems, control sequences, etc.

   b. College shall be permitted to videotape training sessions.

5. Training may be in non-contiguous days at the request of the College.

6. During the warranty period, provide unlimited telephone support for all trained operators.

END OF SECTION 250000

xx.x °F
xx %RH

Schedule

Zone Group Summary

Zone Group Name 1st Floor
Mode Occupied

AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied
Alarm OK

Heating Plant
HWST xxx °F
Status ON
Alarm OK

Chiller Plant
CHWST xxx °F
Status ON
Alarm OK

Mode Requests

Occupied	xxx
Warmup	xxx
Cooldown	xxx
Setback	xxx
Setup	xxx

System/Plant Requests

Cooling SAT Reset	xxx
Duct SP Reset	xxx
HW Plant	xxx
HWST Reset	xxx
Min OA CFM	xxx
Max CO2 DCV	xxx

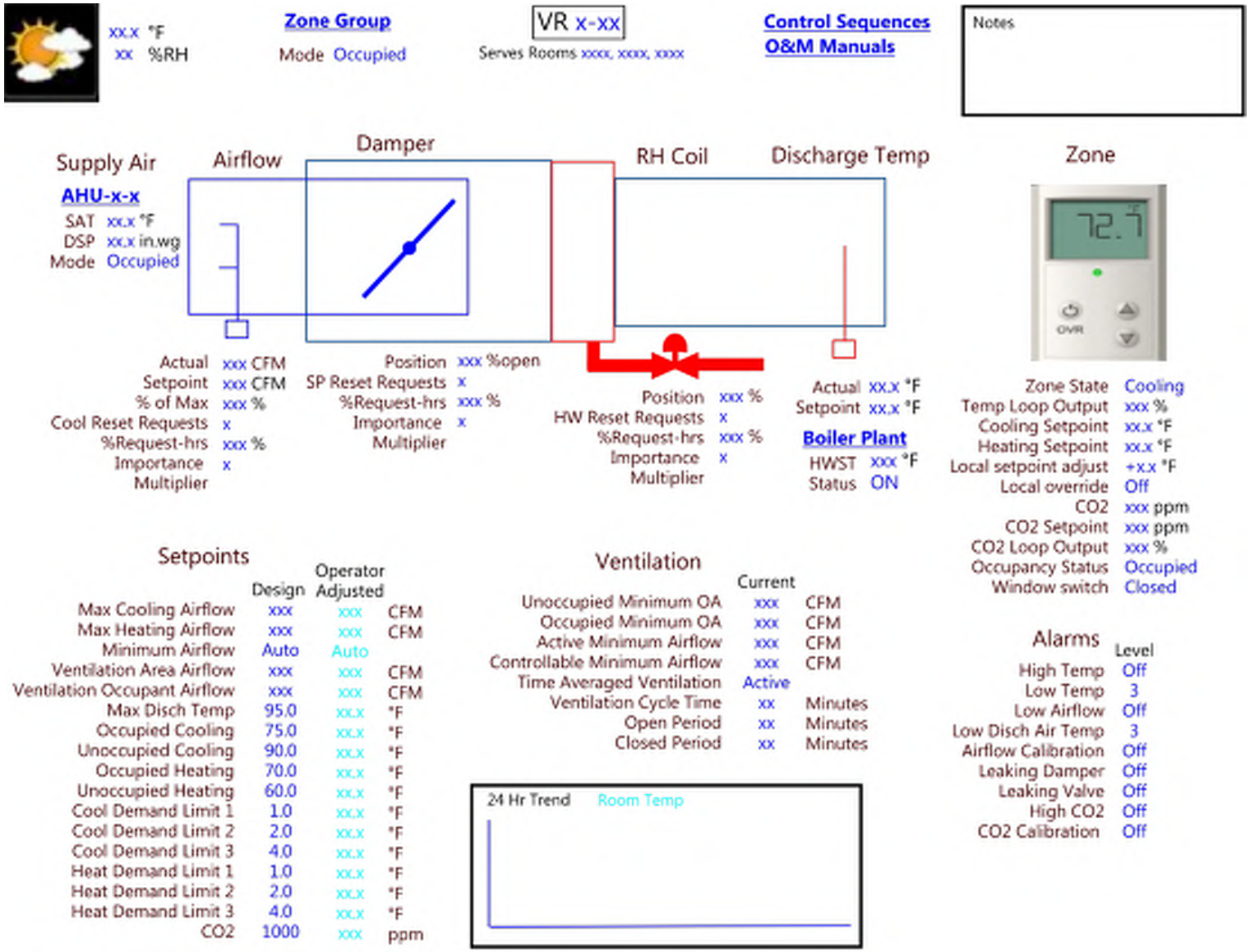
Total Airflow

Airflow Setpoints	xxx	cfm
Actual Airflow	xxx	cfm
Occupant OA	xxx	cfm
Area OA	xxx	cfm
Total OA	xxx	cfm

Zone Alarms

High Temp	xxx	Airflow Calibration	xxx
Low Temp	xxx	Leaking Damper	xxx
High CO2	xxx	Rogue SATSP	xxx
CO2 Calibration	xxx	Rogue DSPSP	xxx
Low Airflow	xxx	Rogue HWSTSP	xxx

Zone		Zone Temperature			Airflow			Discharge Air			CO2			Cool Reset Requests			Static Pressure Reset Requests			HWST Reset Requests		
Tag	Status	Actual °F	Heat Setpoint °F	Cool Setpoint °F	Actual CFM	Setpoint CFM	Damper Output	Temp °F	Setpoint °F	Min Flow Setpoint	Actual PPM	Setpoint PPM	Loop Output %	Requests	% Req hrs	Importance Multiplier	Requests	% Req hrs	Importance Multiplier	Requests	% Req hrs	Importance Multiplier
VK 2013	Heating	70	70	75	200	200	33	98	90	90	500	1000	0	0	21	1	0	14	1	1	80	1
VC 2013	Cooling	75	70	75	500	500	55							0	21	1	0	14	1			


xx.x °F
xx %RH
Zone Group
Mode Occupied
VR x-xx
Serves Rooms xxxx, xxxx, xxxx
Control Sequences
O&M Manuals
Notes
Supply Air
AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied
Airflow
Damper
RH Coil
Discharge Temp
Actual xxx CFM
Setpoint xxx CFM
% of Max xxx %
Cool Reset Requests x
%Request-hrs xxx %
Importance x
Multiplier
Position xxx %open
SP Reset Requests x
%Request-hrs xxx %
Importance x
Multiplier
Position xxx %
HW Reset Requests x
%Request-hrs xxx %
Importance x
Multiplier
Actual xx.x °F
Setpoint xx.x °F
Boiler Plant
HWST xxx °F
Status ON
Zone
72.7
OVR
Zone State Cooling
Temp Loop Output xxx %
Cooling Setpoint xx.x °F
Heating Setpoint xx.x °F
Local setpoint adjust +x.x °F
Local override Off
CO2 xxx ppm
CO2 Setpoint xxx ppm
CO2 Loop Output xxx %
Occupancy Status Occupied
Window switch Closed
Setpoints
Design
Operator Adjusted
Max Cooling Airflow xxx xxx CFM
Max Heating Airflow xxx xxx CFM
Minimum Airflow Auto Auto
Ventilation Area Airflow xxx xxx CFM
Ventilation Occupant Airflow xxx xxx CFM
Max Disch Temp 95.0 xx.x °F
Occupied Cooling 75.0 xx.x °F
Unoccupied Cooling 90.0 xx.x °F
Occupied Heating 70.0 xx.x °F
Unoccupied Heating 60.0 xx.x °F
Cool Demand Limit 1 1.0 xx.x °F
Cool Demand Limit 2 2.0 xx.x °F
Cool Demand Limit 3 4.0 xx.x °F
Heat Demand Limit 1 1.0 xx.x °F
Heat Demand Limit 2 2.0 xx.x °F
Heat Demand Limit 3 4.0 xx.x °F
CO2 1000 xxx ppm
Ventilation
Current
Unoccupied Minimum OA xxx CFM
Occupied Minimum OA xxx CFM
Active Minimum Airflow xxx CFM
Controllable Minimum Airflow xxx CFM
Time Averaged Ventilation Active
Ventilation Cycle Time xx Minutes
Open Period xx Minutes
Closed Period xx Minutes
24 Hr Trend Room Temp
Alarms
Level
High Temp Off
Low Temp 3
Low Airflow Off
Low Disch Air Temp 3
Airflow Calibration Off
Leaking Damper Off
Leaking Valve Off
High CO2 Off
CO2 Calibration Off

xx.x °F
xx %RH

Zone Group
Mode Occupied

VC x-xx
Serves Rooms xxxx, xxxx, xxxx

Control Sequences
O&M Manuals

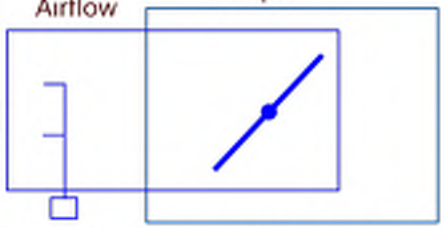
Notes

Supply Air

AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied

Airflow

Damper



Actual	xxx CFM	Position	xxx %open
Setpoint	xxx CFM	SP Reset Requests	x
% of Max	xxx %	%Request-hrs	xxx %
Cool Reset Requests	x	Importance Multiplier	x
%Request-hrs	xxx %		
Importance Multiplier	x		

Zone

Zone State	Cooling
Temp Loop Output	xxx %
Cooling Setpoint	xx.x °F
Heating Setpoint	xx.x °F
Local setpoint adjust	+x.x °F
Local override	Off
CO2	xxx ppm
CO2 Setpoint	xxx ppm
CO2 Loop Output	xxx %
Occupancy Status	Occupied
Window switch	Closed

Setpoints

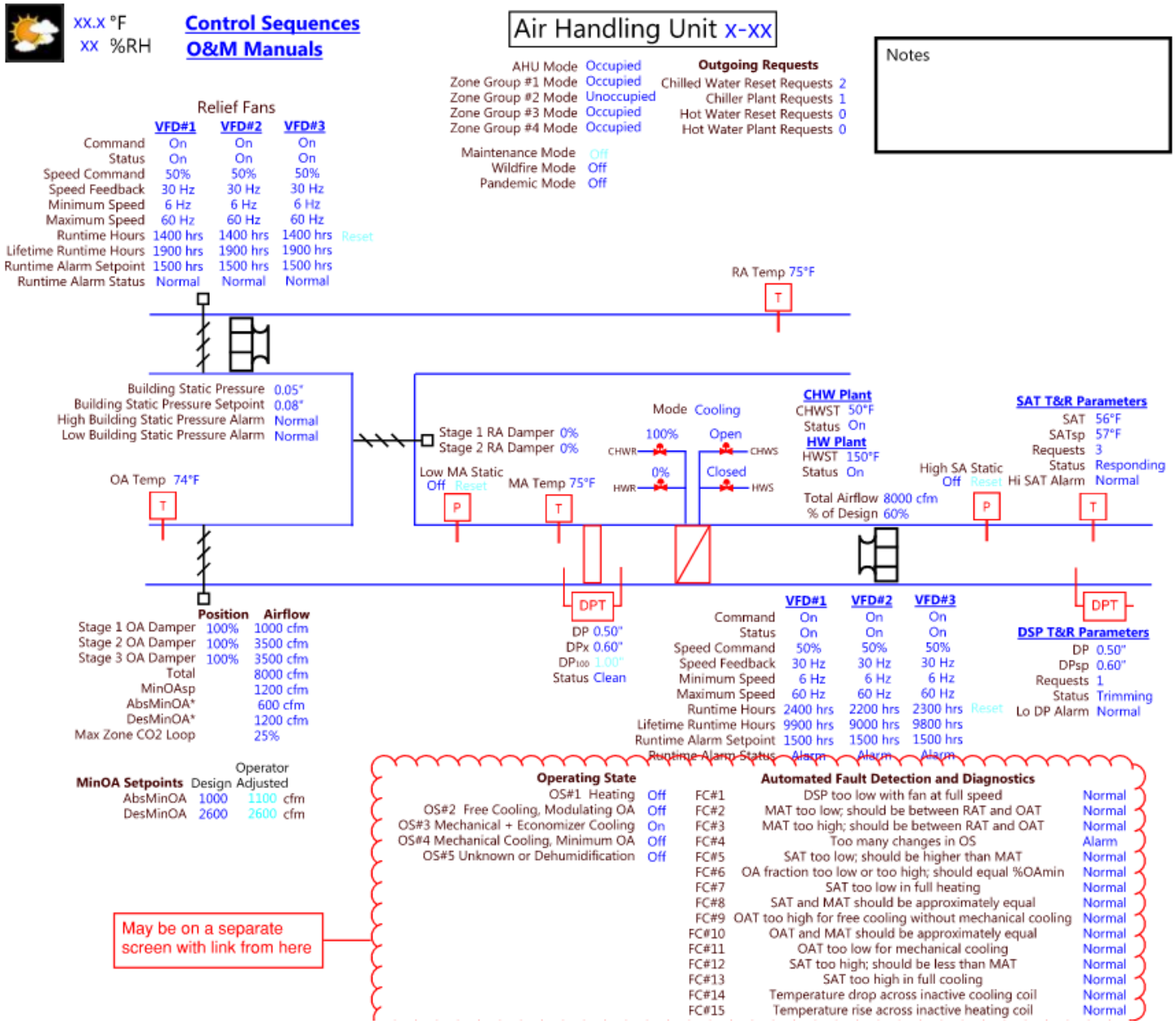
	Design	Operator Adjusted	
Max Cooling Airflow	xxx	xxx	CFM
Minimum Airflow	Auto	Auto	
Ventilation Area Airflow	xxx	xxx	CFM
Ventilation Occupant Airflow	xxx	xx.x	CFM
Occupied Cooling	75.0	xx.x	°F
Unoccupied Cooling	90.0	xx.x	°F
Occupied Heating	70.0	xx.x	°F
Unoccupied Heating	60.0	xx.x	°F
Cool Demand Limit 1	1.0	xx.x	°F
Cool Demand Limit 2	2.0	xx.x	°F
Cool Demand Limit 3	4.0	xx.x	°F
Heat Demand Limit 1	1.0	xx.x	°F
Heat Demand Limit 2	2.0	xx.x	°F
Heat Demand Limit 3	4.0	xx.x	°F
CO2	1000	xxx	ppm

Ventilation

	Current	
Unoccupied Minimum OA	xxx	CFM
Occupied Minimum OA	xxx	CFM
Active Minimum Airflow	xxx	CFM
Controllable Minimum Airflow	xxx	CFM
Time Averaged Ventilation	Active	
Ventilation Cycle Time	xx	Minutes
Open Period	xx	Minutes
Closed Period	xx	Minutes

Alarms

	Level
Low Airflow	Off
Airflow Calibration	Off
Leaking Damper	Off
High CO2	Off
CO2 Calibration	Off


xx.x °F
xx %RH
Control Sequences
O&M Manuals
Air Handling Unit x-xx
AHU Mode Occupied
Zone Group #1 Mode Occupied
Zone Group #2 Mode Unoccupied
Zone Group #3 Mode Occupied
Zone Group #4 Mode Occupied
Maintenance Mode Off
Wildfire Mode Off
Pandemic Mode Off
Outgoing Requests
Chilled Water Reset Requests 2
Chiller Plant Requests 1
Hot Water Reset Requests 0
Hot Water Plant Requests 0
Notes
Relief Fans
VFD#1 VFD#2 VFD#3
Command On On On
Status On On On
Speed Command 50% 50% 50%
Speed Feedback 30 Hz 30 Hz 30 Hz
Minimum Speed 6 Hz 6 Hz 6 Hz
Maximum Speed 60 Hz 60 Hz 60 Hz
Runtime Hours 1400 hrs 1400 hrs 1400 hrs Reset
Lifetime Runtime Hours 1900 hrs 1900 hrs 1900 hrs
Runtime Alarm Setpoint 1500 hrs 1500 hrs 1500 hrs
Runtime Alarm Status Normal Normal Normal
RA Temp 75°F
T
Building Static Pressure 0.05"
Building Static Pressure Setpoint 0.08"
High Building Static Pressure Alarm Normal
Low Building Static Pressure Alarm Normal
Stage 1 RA Damper 0%
Stage 2 RA Damper 0%
Mode Cooling
100%
Open
CHWR
CHWS
0%
Closed
HWR
HWS
CHW Plant
CHWST 50°F
Status On
HW Plant
HWST 150°F
Status On
Total Airflow 8000 cfm
% of Design 60%
SAT T&R Parameters
SAT 56°F
SATsp 57°F
Requests 3
Status Responding
Hi SAT Alarm Normal
High SA Static
Off Reset
Low MA Static
Off Reset
MA Temp 75°F
OA Temp 74°F
P
T
DPT
DP 0.50"
DPx 0.60"
DP100 1.00"
Status Clean
Position Airflow
Stage 1 OA Damper 100% 1000 cfm
Stage 2 OA Damper 100% 3500 cfm
Stage 3 OA Damper 100% 3500 cfm
Total 8000 cfm
MinOAsp 1200 cfm
AbsMinOA* 600 cfm
DesMinOA* 1200 cfm
Max Zone CO2 Loop 25%
MinOA Setpoints Design Operator Adjusted
AbsMinOA 1000 1100 cfm
DesMinOA 2600 2600 cfm
VFD#1 VFD#2 VFD#3
Command On On On
Status On On On
Speed Command 50% 50% 50%
Speed Feedback 30 Hz 30 Hz 30 Hz
Minimum Speed 6 Hz 6 Hz 6 Hz
Maximum Speed 60 Hz 60 Hz 60 Hz
Runtime Hours 2400 hrs 2200 hrs 2300 hrs Reset
Lifetime Runtime Hours 9900 hrs 9000 hrs 9800 hrs
Runtime Alarm Setpoint 1500 hrs 1500 hrs 1500 hrs
Runtime Alarm Status Alarm Alarm Alarm
DPT
DSP T&R Parameters
DP 0.50"
DPsp 0.60"
Requests 1
Status Trimming
Lo DP Alarm Normal
Operating State
OS#1 Heating Off
OS#2 Free Cooling, Modulating OA Off
OS#3 Mechanical + Economizer Cooling On
OS#4 Mechanical Cooling, Minimum OA Off
OS#5 Unknown or Dehumidification Off
Automated Fault Detection and Diagnostics
FC#1 DSP too low with fan at full speed Normal
FC#2 MAT too low; should be between RAT and OAT Normal
FC#3 MAT too high; should be between RAT and OAT Normal
FC#4 Too many changes in OS Alarm
FC#5 SAT too low; should be higher than MAT Normal
FC#6 OA fraction too low or too high; should equal %OAmin Normal
FC#7 SAT too low in full heating Normal
FC#8 SAT and MAT should be approximately equal Normal
FC#9 OAT too high for free cooling without mechanical cooling Normal
FC#10 OAT and MAT should be approximately equal Normal
FC#11 OAT too low for mechanical cooling Normal
FC#12 SAT too high; should be less than MAT Normal
FC#13 SAT too high in full cooling Normal
FC#14 Temperature drop across inactive cooling coil Normal
FC#15 Temperature rise across inactive heating coil Normal
May be on a separate screen with link from here

NOTE: THIS MASTER SPEC INCLUDES HIDDEN TEXT AND COMMENTS. TO SEE THEM, MAKE SURE MS WORD IS CONFIGURED TO SEE HIDDEN TEXT (GO TO TOOLS/OPTIONS/VIEW AND CLICK ON "HIDDEN TEXT" CHECK-BOX.) DELETE THIS PARAGRAPH WHEN EDITING SPEC FOR PROJECTS.

SECTION 259000

BUILDING AUTOMATION SEQUENCES OF OPERATION

PART 1 GENERAL

1.1 SUMMARY

A. Program and commission the Building Automation System (BAS) to execute the Sequences of Operation specified herein.

B. See Section 250000 Building Automation Systems for general requirements.

C. These control sequences include references to ASHRAE Guideline 36 and approved addenda. Where sequences are verbatim from Guideline 36, they are shown in green text. Not all informative text has been included. Sequences have been customized to include only Title 24 options where they take precedence over ASHRAE 90.1 and 62.1 requirements.

D. Guideline 36 sequences shall be programmed to exactly match the specified sequences verbatim. The Contractor may use "equivalent" alternative sequences only with formal approval by the Engineer. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

E. This file shall be maintained by the Contractor to include all approved changes to sequences made during testing and commissioning and shall become the final as-built sequences of operation installed on the CSS per Section 250000 Building Automation Systems.

1.2 INFORMATION PROVIDED BY DESIGNER

A. See equipment schedules on drawings for all setpoints unless otherwise noted below.

B. General Zone Information

1. Zone Temperature Setpoints

a. Default setpoints shall be based on zone type as shown in Table 3.1.1.1.

Table 3.1.1.1 Default Setpoints

	Occupied		Unoccupied	
Zone Type	Heating	Cooling	Heating	Cooling
General (unless listed below)	70ºF	75ºF	60ºF	90ºF
General with ceiling fans	70ºF	79ºF	60ºF	90ºF

Laboratory spaces	70ºF	75ºF	60ºF	80ºF
Server	–	80ºF	–	80ºF
IDF/MDF	–	78ºF	–	78ºF

2. Outdoor Air Ventilation Setpoints

    a. All zone minimum outdoor air setpoints are scheduled on Drawings.

        1) Vocc-min. Zone minimum outdoor airflow for occupants.

        2) Varea-min. Zone minimum outdoor airflow for building area.

        3) Indicate where occupied-standby mode is allowed based on the zone occupancy category.

3. CO2 Setpoints

    a. The CO2 setpoint for all occupancy types is 1000 ppm.

C. VAV Box Design Information

1. All VAV box setpoints are scheduled on Drawings except as indicated below.

2. VAV Cooling-Only Terminal Unit

    a. Zone maximum cooling airflow setpoint (Vcool-max)

    b. Zone maximum heating airflow setpoint (Vheat-max) = Vcool-max

    c. Zone minimum airflow setpoint (Vmin). This is an optional entry. If no value is scheduled, or a value of "AUTO" is scheduled, Vmin will be calculated automatically and dynamically to meet ventilation requirements.

3. VAV Reheat Terminal Unit

    a. Zone maximum cooling airflow setpoint (Vcool-max)

    b. Zone minimum airflow setpoint (Vmin. This is an optional entry. If no value is scheduled, or a value of "AUTO" is scheduled, Vmin will be calculated automatically and dynamically to meet ventilation requirements.

    c. Zone maximum heating airflow setpoint (Vheat-max)

    d. Zone maximum DAT above heating setpoint (MaxΔT) = 25ºF

    e. The heating minimum airflow setpoint (Vheat-min) = 0

4. Parallel Fan-Powered Terminal Unit, Variable-Volume Fan

a. Zone maximum cooling (primary) airflow setpoint (Vcool-max)

b. Zone minimum primary airflow setpoint (Vmin). This is an optional entry. If no value is scheduled, or a value of "AUTO" is scheduled, Vmin will be calculated automatically and dynamically to meet ventilation requirements.

c. Parallel fan maximum heating airflow setpoint (Pfan-htgmax)

d. Zone maximum DAT above heating setpoint (MaxΔT) = 15ºF

5. Series Fan-Powered Terminal Unit, Constant-Volume Fan

a. Zone maximum cooling airflow setpoint (Vcool-max)

b. Zone minimum airflow setpoint (Vmin). This is an optional entry. If no value is scheduled, or a value of "AUTO" is scheduled, Vmin will be calculated automatically and dynamically to meet ventilation requirements.

c. Zone maximum DAT above heating setpoint (MaxΔT) = 15ºF

D. Laboratory Zone Design Information

Pressurization airflow offset setpoints are often estimated during the design phase, e.g. based on the number of entry doors and wall area but it can also be adjusted empirically in the field. This can be done under TAB work scope, e.g.
A. Room Pressurization Balancing
1. The CFM Offset indicated in the schedule is only an initial value and the final value will be determined by work under this section.
2. Determine airflow offsets required to achieve the room pressurization of 0.02" to 0.05" positive or negative as indicated in the Laboratory Zone Room Schedules. In no case, however, shall the offset be larger than 200% of scheduled offset.
3. Coordinate with Division 250000 BAS contractor to determine and program required room offsets.
If this is not done, delete second sentence:

1. Pressurization offset (Voffset). Initial pressurization offsets shall be shown on schedules. For some zones, final pressurization offsets shall be determined as specified under Section 230593 Testing, Adjusting, and Balancing.

2. Supply air valve(s). For pressure zones with multiple supply air valves, the first listed supply air valve controller is the master and setpoint adjustments (e.g. Vmin*) only apply to that zone. The other zones respond to temperature controls only. Total supply air is the sum of all supply air rates.

a. Maximum airflow setpoint (Vmax)

b. Minimum occupied airflow setpoint (Vmin-occ)

c. Minimum unoccupied airflow setpoint (Vmin-unocc)

d. Zone maximum cooling airflow setpoint (Vcool-max)

e. Maximum heating airflow setpoint (Vheat-max)

f. Design heating coil leaving air temperature (SATmax)

g. Minimum zone discharge air temperature (SATmin)

3. Hood exhaust air valve

a. Hood exhaust is controlled by on-board controllers (with sash sensors and fume hood monitors, where specified). None of the control logic resides in the BAS, other than monitoring alarms, commissioning overrides, and setpoint adjustments where used, all performed via the BACnet connection.

b. The following setpoints must be configured in the exhaust air valve controller with the capability of being written to the controller via BACnet.

1) Maximum airflow setpoint (Vhex-max)

2) Minimum airflow setpoint (Vhex-min)

In hood dominated labs, the lab may become too negative for safe exiting door pressures if the supply air system is lost. There are various means to mitigate this problem, one of which is to temporarily reduce hood exhaust rates, often (and most safely) used with automatic sash closers. These reduced rates must be determined empirically in conjunction with the BAS and TAB subcontractors. Example language for Section 230593 Testing, Adjusting and Balancing specs:
A. Emergency Exit Tests
1. Tests shall be performed separately for each lab with fume hoods.
2. Coordinate with Division 250000 contractor to conduct tests.
3. Procedure:
a) Simulate failure of supply air to the lab by fully shutting off all supply air valves.
b) Verify that BAS causes hood closers to close hoods immediately after supply air failure is detected.
c) Test door opening force. If more than 15 pounds, gradually reduce minimum hood exhaust setpoints uniformly for all hoods until 15 pounds is reached.
4. Report
a) Initial door opening force at design hood exhaust rates
b) Percent of design hood exhaust rates needed to reduce door opening force to 15 pounds
c) Initials of BAS installer to indicate that percent hood multiplier was transmitted to them
If not specified, set %hood-reduction to 100%:

3) Percentage reduction multiplier to all fume hood exhaust setpoints to reduce zone pressure enough to allow for safe exit door pressures (%hood-reduction). See Section 230593 Testing, Adjusting and Balancing and Paragraphs 3.10G.3.a.3) and 3.11G.3.a.3).

4. General exhaust (GEX) air valve

a. Maximum airflow setpoint (Vgex-max)

5. Other exhaust airflows, e.g. canopy/cabinet/snorkel etc. if applicable, see plans for quantity and airflow rates (Vother)

E. Zone Group Assignments

1. Unless otherwise specified by Owner, the following Zone Groups shall be created:

Zone Group Name	AH Tag	Terminal Unit Tags	Miscellaneous Equipment Tags	Default Schedule
First-floor assembly	AH-1	VAV-1-1 through 11	EF-1	WD: 6 am to 8pm WE: 8 am to 10pm HOL: off
Second-floor office	AH-1	VAV-2-1 through 15	EF-2	WD: 7 am to 7 pm SAT: 9 am to 2 pm SUN: off HOL: off
IDF rooms	AH-1	VAV-1-12, VAV-2-16		ALL: 12 am to 12 am
First-floor lobby	AH-2		EF-1	WD: 6 am to 8 pm WE: 8 am to 10 pm HOL: off

F. 2-Pipe or 4-Pipe Fan Coil Unit (FCU) Design Information

1. Cool_SAT, lowest cooling supply air temperature setpoint = scheduled cooling coil leaving air temperature

2. Heat_SAT, highest heating supply air temperature setpoint = scheduled heating coil leaving air temperature

3. DP100, filter high limit differential pressure at design airflow = 0.5 in.w.c. or value from manufacturer's submittal whichever is lower

G. Multiple-Zone VAV Air-Handler Design Information

1. Temperature Setpoints

a. Min_ClgSAT, lowest cooling supply air temperature setpoint = scheduled cooling coil leaving air temperature plus 3°F

b. Max_ClgSAT, highest cooling supply air temperature setpoint = 65°F

c. OAT_Min, the lower value of the OAT reset range = 55°F

d. OAT_Max, the higher value of the OAT reset range = 70°F

2. Ventilation Setpoints

a. All AHU outdoor airflow setpoints are scheduled on Drawings.

1) AbsMinOA, the design outdoor air rate when all zones with CO2 sensors or occupancy sensors are unpopulated

2) DesMinOA, the design minimum outdoor airflow with areas served by the system are occupied at their design population, including diversity where applicable

3. Economizer High Limit

a. California Title 24 economizer high limit

1) California climate zone = ***3***

2) High limit option:

a) Fixed dry bulb + differential dry bulb

4. DP100, filter high limit differential pressure at design airflow = 1 in.w.c. or value from manufacturer's submittal whichever is lower

5. Pressure Zone Group Assignments

Return/relief fans and building pressure sensors must be assigned to pressure Zone Groups, using table below
A pressure zone is defined as an enclosed area with interconnected return paths. The appropriate boundaries for pressure zones, establishing which return/relief fan run together, and which building pressure sensors are used will need to be determined by the engineer based on building geometry.

Pressure Zone Group Name	AHU Tag	RF Tag	Building Pressure Sensor Location(s)
East Pressure Zone	AHU-1, AHU-2	RF-1, RF-2	Rm. 123E
West Pressure Zone	AHU-3, AHU-4	RF-3, RF-4	Rm. 112W, Rm. 124W

H. Single-Zone VAV Air-Handler Design Information

1. Temperature Setpoints

a. Cool_SAT, lowest cooling supply air temperature setpoint = scheduled cooling coil leaving air temperature plus 2°F

b. Heat_SAT, highest heating supply air temperature setpoint = scheduled heating coil leaving air temperature

c. MaxDPT, maximum supply air dew-point temperature = 75°F

2. Ventilation Setpoints

a. For projects complying with the California Title 24 Ventilation Standards:

1) MinOA, the design outdoor air rate when the zone with a CO2 sensor served by the system is unpopulated. MinOA shall equal Varea-min.

2) DesOA, the design outdoor air rate when the zone served by the system is occupied at its design population, including diversity where applicable. DesOA shall equal the larger of Varea-min and Vocc-min.

3. Economizer High Limit

a. California Title 24 economizer high limit

1) California climate zone = ***3***

2) High limit option:

a) Fixed dry bulb + differential dry bulb

4. DP100, filter high limit differential pressure at design airflow = 1 in.w.c. or value from manufacturer's submittal whichever is lower

I. Dedicated Outdoor Air-Handler Design Information

1. Temperature Setpoints

a. Heat_SAT = 50°F

b. Cool_SAT = 65°F

2. Economizer High Limit

a. California Title 24 economizer high limit

1) California climate zone = ***3***

2) High limit option:

a) Fixed dry bulb + differential dry bulb

3. DP100, filter high limit differential pressure at design airflow = 1 in.w.c. or value from manufacturer's submittal whichever is lower

J. Packaged Multiple Zone VAV AC Unit Design Information

1. Temperature Setpoints

a. Min_ClgSAT, lowest cooling supply air temperature setpoint: 55°F.

b. Max_ClgSAT, highest cooling supply air temperature setpoint: 65°F.

c. OAT_Min, the lower value of the OAT reset range: 50°F.

d. OAT_Max, the higher value of the OAT reset range: 70°F.

2. Ventilation Setpoints

   a. AbsMinOA: the design outdoor airflow rate when all zones with CO2 sensors or occupancy sensors are unpopulated: per AC unit schedule

   b. DesMinOA: the design minimum outdoor airflow with areas served by the system are occupied at their design population: per AC unit schedule

3. Economizer High Limit

   a. California Title 24 economizer high limit

      1) California climate zone = ***3***

      2) High limit option:

         a) Fixed dry bulb + differential dry bulb

A. Water Cooled Chilled Water Plant

1. Temperature Setpoints

   a. CHWSTminX, the lowest chilled water supply temperature setpoint for Chiller X = scheduled chiller leaving chilled water temperature

   b. CHWSTmax, the maximum chilled water supply temperature setpoint used in plant reset logic = 60°F

   c. CWRTdesX, the condenser water return (chiller condenser leaving) temperature at chiller selection conditions for Chiller X = scheduled chiller leaving condenser water temperature

   d. CWSTdesX, the condenser water supply (chiller condenser entering) temperature at chiller selection conditions for Chiller X= scheduled chiller leaving condenser water temperature

   e. CH-LOT, the outdoor air lockout temperature below which the chiller plant is prevented from operating = 60°F

The Lockout temperature is a safety to prevent plant operation when it should not be needed, e.g., due to Plant Request from a zone or AHU with unusually cold setpoint. It is typically 60°F for plants serving systems with airside economizers. To keep the plant enabled under all conditions, make the setpoint below the coldest expected outdoor air temperature.

2. Differential Pressure Setpoints

   a. CHW-DPmin, the minimum differential pressure setpoint used in plant reset logic = 5 psi

3. Chiller Flow Setpoints

   a. CHW-MinFlowX, the minimum chiller chilled water flowrate per manufacturer's recommendations for Chiller X, in gpm = scheduled chilled water minimum flow rate

b. CHW-DesFlowX, the design chiller chilled water flowrate for Chiller X, in gpm = scheduled design chilled water flow rate

4. Chiller Lift Setpoints

a. LIFTminX, the minimum allowable lift at minimum load for Chiller X, as determined from the manufacturer's recommendations, where lift is the difference between condenser water return temperature and chilled water supply temperature.

1) CH-1: 10°F

2) CH-2: 10°F

Except for some magnetic bearing chillers, a minimum differential pressure must be maintained between the condenser and evaporator, aka head pressure. These sequences require at a minimum that the user identify the minimum allowable lift at minimum load for each chiller, LIFTminX, per the chiller manufacturer's recommendations. These variables are used to reset condenser water temperature setpoint from the cooling tower.
LIFTminX values can also be used to control minimum head pressure indirectly when direct control head pressure control is not available. Most chillers have head pressure control loops built into the chiller's controller, but not all do.
When chillers have built in head pressure control, an analog head pressure output from the chiller panel can be used to control a device that reduces flow through the condenser when condenser water temperature is too cold, e.g., on initial start when the cooling tower basin is cold. The chiller's head pressure output should be hardwired to the control system, rather than directly to any device. This allows the control sequences to use this signal to maintain minimum lift via both tower speed limiting and condenser water flow control (e.g., via valve throttling or pump speed limiting for variable speed CW pumps), ensuring that the tower fan speed control sequence maintaining condenser water temperature and the head pressure control sequence do not "fight" one another. When chillers do not have built-in head pressure control, the BAS can instead run a head pressure control loop for each chiller that maintains lift at LIFTminX. This loop output is then used to limit tower speed, CW pump speed, and/or throttle CW isolation valve in the same way that a chiller's internal head pressure control loop otherwise would.

b. LIFTmaxX, design lift at design load for Chiller X = CWRTdesX minus CHWSTminX

5. Capacity

a. QchX, design capacity of Chiller X, in tons = scheduled chiller capacity

6. Minimum Cycling Load

a. MinUnloadCapX, the load below which Chiller X will engage hot gas bypass (HGB) or begin cycling (if the chiller does not have HGB), in tons.

1) CH-1: 10% of Qch1

2) CH-2: 10% of Qch1

MinUnloadCapX should be provided by the chiller manufacturer.

7. Cooling Tower Level Control

   a. T-level-high-alarm, maximum level just below overflow = level determined in the field by contractor in accordance with cooling tower IOM

   b. T-level-low-alarm, minimum level = level determined in the field by contractor in accordance with cooling tower IOM

   c. T-level-min-fill, lowest normal operating level = level determined in the field by contractor in accordance with cooling tower IOM

   d. T-level-max-fill, highest normal operating level = level determined in the field by contractor in accordance with cooling tower IOM

8. Headered Pump Design Quantities

   a. N-PCHWP, the number of primary chilled water pumps that operate at design conditions = ***2***

B. Air Cooled Chilled Water Plant

1. Temperature Setpoints

   a. CHWSTminX, the lowest chilled water supply temperature setpoint for Chiller X = scheduled chiller leaving chilled water temperature

   b. CHWSTmax, the maximum chilled water supply temperature setpoint used in plant reset logic = 60°F

   c. CH-LOT, the outdoor air lockout temperature below which the chiller plant is prevented from operating = 60°F

The Lockout temperature is a safety to prevent plant operation when it should not be needed, e.g., due to Plant Request from a zone or AHU with unusually cold setpoint. It is typically 60°F for plants serving systems with airside economizers. To keep the plant enabled under all conditions, make the setpoint below the coldest expected outdoor air temperature.

2. Differential Pressure Setpoints

   a. CHW-DPmin, the minimum differential pressure setpoint used in plant reset logic = 5 psi

3. Chiller Flow Setpoints

   a. CHW-MinFlowX, the minimum chiller chilled water flowrate per manufacturer's recommendations for Chiller X, in gpm = scheduled chilled water minimum flow rate

   b. CHW-DesFlowX, the design chiller chilled water flowrate for Chiller X, in gpm = scheduled design chilled water flow rate

4. Capacity

   a. QchX, design capacity of Chiller X, in tons = scheduled chiller capacity

5. Minimum Cycling Load

a. MinUnloadCapX, the load below which Chiller X will engage hot gas bypass (HGB) or begin cycling (if the chiller does not have HGB), in tons.

1) CH-1: 10% of Qch1

2) CH-2: 15% of Qch1

MinUnloadCapX should be provided by the chiller manufacturer.

6. Headered Pump Design Quantities

a. N-PCHWP, the number of primary chilled water pumps that operate at design conditions = ***2***

C. 2-Pipe and 4-Pipe Air-To-Water Chilled Water Plant

1. Cooling Parameters:

a. Temperature Setpoints

1) CHWSTmin, the lowest chilled water supply temperature setpoint = design CHWST as scheduled

2) CH-LOT, the outdoor air lockout temperature below which the chiller plant is prevented from operating = 60°F.

b. Cooling Capacity

1) QCdesign, design plant capacity in tons = QC1+QC2+QC3

2) QCchiller, design capacity in tons for each chiller:

a) QC1 = as scheduled

b) QC2 = as scheduled

c) QC3 = as scheduled

3) CHWFdesign, design primary loop flow in gpm = sum of CHW flow rates as scheduled

c. Minimum Cycling Load

1) MinUnloadTons, the load below which the chiller will begin cycling

a) MinUnloadTons1 = ***15%*** of QC1

b) MinUnloadTons2 = ***15%*** of QC2

c) MinUnloadTons3 = ***15%*** of QC3

2. Heating Parameters

a. Temperature Setpoints

1) HWSTmax, the highest hot water supply temperature setpoint = design HWST as scheduled

2) HW-LOT, the outdoor air lockout temperature above which the boiler plant is prevented from operating = 70°F

b. Capacity

1) QHdesign, design plant capacity in tons = QH1+QH2+QH3

2) QHchiller, design capacity in tons for each chiller:

a) QH1 = as scheduled

b) QH2 = as scheduled

c) QH3 = as scheduled

3) HWFdesign, design primary loop flow in gpm = sum of HW flow rates as scheduled

c. Minimum Cycling Load

1) MinUnloadTons, the load below which the chiller will begin cycling

a) MinUnloadTons1 = ***15%*** of QH1

b) MinUnloadTons2 = ***15%*** of QH2

c) MinUnloadTons3 = ***15%*** of QH3

D. Hot Water Plant

1. Temperature Setpoints

a. HWSTmax, the highest hot water supply temperature setpoint = scheduled leaving water temperature

HW-LOT, the outdoor air lockout temperature above which the boiler plant is prevented from operating = 75°F

The Lockout temperature is a safety to prevent plant operation when it should not be needed, e.g. due to a Plant Request from a zone or AHU with unusually high setpoint. It is typically 75°F for systems with zone level reheat. It can be lower, e.g. 65°F, for dual fan dual duct systems and systems that use fan powered terminal units to meet heating loads since they do not require reheat to prevent over-cooling zones with low, or no, cooling loads.
To keep the plant enabled under all conditions, make the setpoint above the hottest expected outdoor air temperature.

2. Boiler Flow Setpoints

   a. HW-MinFlowX, the design minimum Boiler water flowrate as recommended by the manufacturer for Boiler X, in gpm = scheduled boiler minimum flow rate

   HW-DesFlowX, the design boiler hot water flowrate for Boiler X, in gpm = scheduled boiler design flow rate

3. Minimum Boiler Firing Rate

   a. B-FiringMinX, the lowest %-firing rate of Boiler X before cycling = ***20%***

4. Capacity

   a. QbX, design output capacity of Boiler X, in KBtu/h = scheduled boiler capacity

   PHWFdesign, design primary loop flow, in gpm (each loop) = ***[typically the sum of scheduled primary pump flow rates excluding redundant pumps – designer to determine value since not always self-apparent from drawings especially is pumps sized for excess flow (e.g. 60% instead of 50%)]***

5. Headered Pump Design Quantities

   a. N-PHWP, the number of primary hot water pumps that operate at design conditions = ***2***

1.3 INFORMATION PROVIDED BY (OR IN CONJUNCTION WITH) THE TESTING, ADJUSTING, AND BALANCING CONTRACTOR

A. Coordinate with Section 230593 Testing, Adjusting and Balancing for setpoint determination. Any work not specifically listed in Section 230593 shall be provided under this Section.

B. 2-Pipe and 4-Pipe Fan Coil Unit Information

   a. MinHeatSpeed. The speed that provides supply airflow equal to the design heating minimum airflow scheduled on plans. If no minimum airflow is provided on plans, default to 20% of the maximum heating speed.

   b. MinCoolSpeed. The speed that provides supply airflow equal to the design cooling minimum airflow scheduled on plans. If no minimum airflow is provided on plans, default to 20% of the maximum cooling speed.

   c. DeadbandSpeed. If the fan is desired to operate when the zone is in deadband, set this value to less than or equal to MinSpeed. If the fan is to shut off when the zone is in deadband, set this value to 0.

   d. MaxHeatSpeed. The speed that provides supply airflow equal to the design heating airflow scheduled on plans. If no heating airflow is provided on plans, default to half of the maximum cooling speed.

   e. MaxCoolSpeed. The speed that provides supply airflow equal to the design cooling airflow scheduled on plans.

C. Multiple-Zone Air-Handler Information

1. Duct Design Maximum Static Pressure, Max_DSP

2. Minimum Fan Speed

a. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with Section 250000 Building Automation System specifications for the following, as applicable:

1) Supply fan

2) Return fan

3) Relief fan

3. Ventilation Plenum Pressures. (For minimum outdoor air control with separate outdoor air damper and differential pressure [DP] control, see Section 3.17D.)

a. For projects complying with California Title 24 Ventilation Standards:

1. AbsMinDP, the absolute minimum outdoor air damper DP that provides an outdoor airflow equal to the absolute minimum outdoor airflow AbsMinOA

2. DesMinDP, the design minimum outdoor air damper DP that provides the design minimum outdoor airflow DesMinOA.

4. Return-Fan Discharge Static Pressure Setpoints. (For return-fan direct building pressure control, see Section 3.17I.)

a. RFDSPmin. That required to deliver the design return air volume across the return air damper when the supply air fan is at design airflow and on minimum outdoor air. This setpoint shall be no less than 2.4 Pa (0.01 in. of water) to ensure outdoor air is not drawn backwards through the relief damper.

b. RFDSPmax. That required to exhaust enough air to maintain building static pressure at setpoint 12 Pa (0.05 in. of water) when the supply air fan is at design airflow and on 100% outdoor air.

5. Return-Fan Airflow Tracking Setpoints. (For return-fan airflow tracking control, see Section 3.17J.)

a. S-R-DIFF. The airflow differential between supply air and return air fans required to maintain building pressure at desired pressure (e.g., 12 Pa [0.05 in. of water]) using a handheld sensor if a permanent sensor is not provided. All exhaust fans that normally operate with the air handler should be on.

b. Vrf-max. The maximum return fan airflow rate, = scheduled design airflow rate

D. Single-Zone Air-Handler Information

1. Fan Speed Setpoints

a. MinSpeed. The speed that provides supply airflow equal to DesOA (see Section1.2H.2) with the economizer outdoor air damper fully open.

b. MaxHeatSpeed. The speed that provides supply airflow equal to the design heating airflow scheduled on plans. If no heating airflow is provided on plans, default to half of the maximum cooling speed.

c. MaxCoolSpeed. The speed that provides supply airflow equal to the design cooling airflow scheduled on plans.

2. Minimum Outdoor Air Damper Positions (for systems without outdoor airflow measuring stations; See Section 3.18F.2.)

a. MinPosMin. The outdoor air damper position required to provide MinOA when the supply fan is at MinSpeed.

b. MinPosMax. The outdoor air damper position required to provide MinOA when the supply fan is at MaxCoolSpeed.

c. DesPosMin. The outdoor air damper position required to provide DesOA when the supply fan is at MinSpeed.

d. DesPosMax. The outdoor air damper position required to provide DesOA when the supply fan is at MaxCoolSpeed.

3. Relief-Damper Positions (for relief using motorized dampers; see Section 3.18H.)

a. MinRelief. The relief-damper position that maintains a building pressure of 12 Pa (0.05 in. of water) while the system is at MinPosMin (i.e., the economizer damper is positioned to provide MinOA while the supply fan is at minimum speed).

b. MaxRelief. The relief-damper position that maintains a building pressure of 12 Pa (0.05 in. of water) while the economizer damper is fully open and the fan speed is at cooling maximum.

4. Return-Fan Speed Differential (for Return Fan Speed Tracking Control, see Section 3.18J). The speed differential between supply air and return air fans, S-R-SPD-DIFF, required to maintain building pressure at desired pressure (e.g., 12 Pa [0.05 in. of water]) using a handheld sensor if a permanent sensor is not provided. All exhaust fans that normally operate with the air handler should be on.

5. Return fan discharge static pressure setpoints (for Return Fan Direct Building Pressure Control, see Section 3.18J.2).

a. RFDSPmin: That required to deliver the design return air volume across the return air damper when the supply air fan is at design airflow and on minimum outdoor air. This setpoint shall be no less than 2.4 Pa (0.01 inches) to ensure outdoor air is not drawn backwards thru the relief damper.

b. RFDSPmax: That required to exhaust enough air to maintain building static pressure at setpoint 12 Pa (0.05 inches) when the supply air fan is at design airflow and on 100% outdoor air.

E. Dedicated Outdoor Air-Handler Information

1. Duct Design Maximum Static Pressure, Max_DSP

2. Minimum Fan Speed

a. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with Section 250000 Building Automation System specifications for the following, as applicable:

1) Supply fan

F. Packaged Multiple Zone VAV AC Unit Information

1. Duct Design Maximum Static Pressure, Max_DSP

2. Minimum Fan Speed

a. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with Section 250000 Building Automation System specifications for the following, as applicable:

1) Supply fan

2) Return fan

3) Relief fan

G. Water Cooled Chilled Water Plant

1. CHW-DPmax, the maximum chilled water differential pressure setpoint, in psi

2. MinCWVlvPos, minimum head pressure control valve position = 0%

Minimum head pressure can be maintained by modulating condenser water isolation valves (for constant speed CW pumps) or limiting pump speed (for variable speed CW pumps). If chillers are provided with condenser water flow switches, a minimum head pressure control valve position is needed to ensure minimum flow is maintained while the head pressure control loop is enabled. Performance is improved if calorimetric type switches are used since they can have a much lower flow setpoint than paddle switches and are more reliable when subjected to corrosive open condenser water. If condenser water flow switches are not provided, or they are jumpered out as allowed by many manufacturers, MinCWVlvPos can be set to 0%.

3. Minimum Speeds

a. Where minimum speeds are not required for flow control per other balancer provided setpoints above, minimum speed setpoints for all VFD-driven pumps and tower fans shall be determined in accordance with Section 250000 Building Automation System for the following as applicable:

1) Cooling Tower Fans

2) Condenser Water Pumps

3) Chilled Water Pumps

H. Air Cooled Chilled Water Plant

1. CHW-DPmax, the maximum chilled water differential pressure setpoint, in psi

2. Minimum Speeds

a. Where minimum speeds are not required for flow control per other balancer provided setpoints above, minimum speed setpoints for all VFD-driven pumps and tower fans shall be determined in accordance with Section 250000 Building Automation System for the following as applicable:

1) Chilled Water Pumps

I. 2-Pipe and 4-Pipe Air-To-Water Chilled Water Plant

1. CHW-DPmax = as determine under 230593 Testing, Adjusting and Balancing.

2. HW-DPmax = as determine under 230593 Testing, Adjusting and Balancing.

J. Hot Water Plant

1. HW-DPmax, the maximum hot water differential pressure setpoint, in psi

2. Minimum Speeds

a. Where minimum speeds are not required for flow control per other balancer provided setpoints above, minimum speed setpoints for all VFD-driven pumps and tower fans shall be determined for hot water pumps in accordance with Section 250000 Building Automation System.

1.4 INFORMATION DETERMINED BY CONTROL CONTRACTOR

A. VAV Box Controllable Minimum

1. This section is used to determine the lowest possible VAV box airflow setpoint (other than zero) allowed by the controls (Vm) used in VAV box control sequences. The minimums shall be stored as software points that may be adjusted by the user but need not be adjustable via the graphical user interface.

2. The minimum setpoint *Vm* shall be determined from the table below for the VAV box manufacturer from approved submittals:

Inlet	Titus	Krueger	Price	MetalAire High Gain	ETI	Greenheck
4	15	15	20	15	15	18
6	30	35	30	30	30	35
8	55	60	55	50	55	63
10	90	90	95	85	90	105
12	120	130	135	110	130	149
14	190	175	195	155	180	206

Inlet	Titus	Krueger	Price	MetalAire High Gain	ETI	Greenheck
16	245	230	260	210	235	259
24x16	455	445	490	N/A	415	N/A

B. Lab Air Valve Controllable Minimum

1. This section is used to determine the lowest possible valve airflow setpoint allowed by the controls used in lab control sequences. The minimums shall be stored as software points that may be adjusted by the user but need not be adjustable via the graphical user interface. If not listed, obtain data from manufacturer with review and approval by Engineer.

2. The valve controllable minimum shall be determined from the table:

Inlet	AccuValve
8	80
10	120
12	180
14	250
12x18	260
12x24	350
12x36	520
12x48	700

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be clearly identified and included as a part of Submittal Package 2.

B. Include costs for minor program modifications if required to provide proper performance of the system.

C. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.

D. When a control loop is enabled or reenabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value.

E. A control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.

F. When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.

1. Outdoor air temperature sensors at air-handler outdoor air intakes shall be considered valid only when the supply fan is proven on and the unit is in Occupied Mode or in any other mode with the economizer enabled.

2. The outdoor air temperature used for optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.

G. The term “proven” (i.e., “proven on”/“proven off”) shall mean that the equipment’s DI status point (where provided, e.g., current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

H. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).

I. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the guidelines in the following subsections shall be followed.

1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).

2. Do not use the derivative term on any loops unless field tuning is not possible without it.

J. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

K. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.

L. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point, and the software point shall be used in all sequences. Exceptions shall be made for machine or life safety.

M. Alarms

1. There shall be 4 levels of alarm

a. Level 1: Life-safety message

b. Level 2: Critical equipment message

c. Level 3: Urgent message

d. Level 4: Normal message

2. Maintenance Mode. Operators shall have the ability to put any device (e.g., AHU) in/out of maintenance mode.

   a. All alarms associated with a device in maintenance mode will be suppressed. Exception: Life safety alarms shall not be suppressed.

   b. If a device is in maintenance mode, issue a Level 3 alarm at a scheduled date and time indicating that the device is still in maintenance mode.

3. Exit Hysteresis

   a. Each alarm shall have an adjustable time-based hysteresis (default: 5 seconds) to exit the alarm. Once set, the alarm does not return to normal until the alarm conditions have ceased for the duration of the hysteresis.

   b. Each analog alarm shall have an adjustable percent-of-limit-based hysteresis (default: 0% of the alarm threshold, i.e., no hysteresis; alarm exits at the same value as the alarm threshold) the alarmed variable required to exit the alarm. Alarm conditions have ceased when the alarmed variable is below the triggering threshold by the amount of the hysteresis.

4. Latching. A latching alarm requires acknowledgment from the operators before it can return to normal, even if the exit deadband has been met. A nonlatching alarm does not require acknowledgment. Default latching status is as follows:

   a. Level 1 alarms: latching

   b. Level 2 alarms: latching

   c. Level 3 alarms: nonlatching

   d. Level 4 alarms: nonlatching

5. Post-exit Suppression Period. To limit alarms, any alarm may have an adjustable suppression period such that once the alarm is exited, its post-exit suppression timer is triggered and the alarm may not trigger again until the post-exit suppression timer has expired. Default suppression periods are as follows:

   a. Level 1 alarms: 0 minutes

   b. Level 2 alarms: 5 minutes

   c. Level 3 alarms: 24 hours

   d. Level 4 alarms: 7 days

N. VFD Speed Points

To avoid operator confusion, the speed command point (and speed feedback point, if used) for VFDs should be configured so that a speed of 0% corresponds to 0 Hz, and 100% corresponds to maximum speed set in the VFD, not necessarily 60 Hz. The maximum speed may be limited below 60 Hz to protect equipment, or it may be above 60 Hz for direct drive equipment. Drives are often configured such that a 0% speed signal corresponds to the minimum speed programmed into the VFD, but that causes the speed AO value and the actual speed to deviate from one another.

1. The speed AO sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz, and 100% speed corresponds to maximum speed configured in the VFD.

It is desirable that the minimum speed reside in the VFD to avoid problems when the VFD is manually controlled at the drive. But minimums can also be adjusted inadvertently in the VFD to a setpoint that is not equal to the minimum used in software. The following prevents separate, potentially conflicting minimum speed setpoints from existing in the BAS software and the drive firmware.

2. For each piece of equipment, the minimum speed shall be stored in a single software point; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS. See Section **Error! Reference source not found.** for minimum speed setpoints. The active minimum speed parameter shall be read every 60 minutes via the drive's network interface. When a mismatch between the drive's active minimum speed and the minimum speed stored in the software point is detected, the minimum speed stored in the software point shall be written to the VFD via the network interface to restore the active minimum speed parameter to its default value, and generate a Level 4 alarm.

The minimum speed parameter is read via the network interface to detect any changes in the minimum speed parameter. Upon detecting a change in the minimum speed setting, the correct minimum speed stored in a BAS software point is written back to the drive via the network interface to override any changes that are made locally to the minimum speed parameter at the VFD.

O. Trim & Respond Set-Point Reset Logic

1. T&R set-point reset logic and zone/system reset requests, where referenced in sequences, shall be implemented as described below.

2. A "request" is a call to reset a static pressure or temperature setpoint generated by downstream zones or air-handling systems. These requests are sent upstream to the plant or system that serves the zone or air handler that generated the request.

   a. For each downstream zone or system, and for each type of set-point reset request listed for the zone/system, provide the following software points:

      1) Importance-Multiplier (default = 1)

Importance-Multiplier is used to scale the number of requests the zone/system is generating. A value of zero causes the requests from that zone or system to be ignored. A value greater than one can be used to effectively increase the number of requests from the zone/system based on the critical nature of the spaces served.

2) Request-Hours Accumulator. Provided SystemOK (see Section 3.1R) is true for the zone/system, every x minutes (default 5 minutes), add x divided by 60 times the current number of requests to this request-hours accumulator point.

3) System Run-Hours Total. This is the number of hours the zone/system has been operating in any mode other than Unoccupied Mode.

Request-Hours accumulates the integral of requests (prior to adjustment of Importance-Multiplier) to help identify zones/systems that are driving the reset logic. Rogue zone identification is particularly critical in this context, because a single rogue zone can keep the T&R loop at maximum and prevent it from saving any energy.

4) Cumulative%-Request-Hours. This is the zone/system Request-Hours divided by the zone/system run-hours (the hours in any mode other than Unoccupied Mode) since the last reset, expressed as a percentage.

5) The Request-Hours Accumulator and System Run-Hours Total are reset to zero as follows:

a) Reset automatically for an individual zone/system when the System Run-Hours Total exceeds 400 hours.

b) Reset manually by a global operator command. This command will simultaneously reset the Request-Hours point for all zones served by the system.

6) A Level 4 alarm is generated if the zone Importance-Multiplier is greater than zero, the zone/system Cumulative% Request Hours exceeds 70%, and the total number of zone/system run hours exceeds 40.

b. See zone and air-handling system control sequences for logic to generate requests.

c. Multiply the number of requests determined from zone/system logic times the Importance-Multiplier and send to the system/plant that serves the zone/system. See system/plant logic to see how requests are used in T&R logic.

3. For each upstream system or plant setpoint being controlled by a T&R loop, define the following variables. Initial values are defined in system/plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control. See Table 5.1.14.3.

Table 5.1.14.3 Trim & Respond Variables

Variable	Definition
Device	Associated device (e.g., fan, pump)
SP0	Initial setpoint
SPmin	Minimum setpoint
SPmax	Maximum setpoint
Td	Delay timer

T	Time step
I	Number of ignored requests
R	Number of requests from zones/systems
SPtrim	Trim amount
SPres	Respond amount (must be opposite in sign to SPtrim)
SPres-max	Maximum response per time interval (must be same sign as SPres)

Informative Note: The number of ignored requests (I) should be set to zero for critical zones or air handlers.

4. Trim & Respond logic shall reset the setpoint within the range SPmin to SPmax. When the associated device is off, the setpoint shall be SP0. The reset logic shall be active while the associated device is proven on, starting Td after initial device start command. When active, every time step T, if R≤I, trim the setpoint by SPtrim. If there are more than I requests, respond by changing the setpoint by SPres*(R – I), (i.e., the number of requests minus the number of ignored requests) but no more than SPres-max. In other words, every time step T.

If R≤I, change Setpoint by SPtrim
If R > I, change setpoint by (R – I)*SPres but no larger than SPres-max

P. Equipment Staging and Rotation

1. Parallel equipment shall be lead/lag or lead/standby rotated to maintain even wear.

2. Two runtime points shall be defined for each equipment:

   a. Lifetime Runtime: The cumulative runtime of the equipment since equipment start-up. This point shall not be readily resettable by operators.

Lifetime Runtime should be stored to a software point on the control system server so the recorded value is not lost due to controller reset, loss of power, programming file update, etc.

   b. Staging Runtime: An operator resettable runtime point that stores cumulative runtime since the last operator reset.

Staging Runtime provides a resettable runtime counter, which allows for reset of the staging runtime hours used for lead/lag or lead/standby rotation between maintenance intervals or equipment replacement while maintaining a separate log of the Lifetime Runtime. If runtime were not resettable, and logic relied only on Lifetime Runtime for determining staging lead/lag position, newly added equipment could run for years as the lead equipment before swapping rotation positions with older equipment per the logic below.

3. Lead/lag equipment: Unless otherwise noted, identical parallel staged equipment (such as CHW pumps and cooling towers) shall be lead/lag alternated when more than one is off or more than one is on so that the equipment with the most operating hours as determined by Staging Runtime is made the last stage equipment and the one with the least number of hours is made the lead stage equipment.

This strategy effectively makes it such that equipment are not "hot swapped", e.g., a pump would not be started and another stopped during operation just for runtime equalization. For example, assume there are two equipment and only one is on, but the operating equipment has exceeded the run hours of the disabled equipment. The equipment will not rotate positions until either a stage up or down occurs. If the plant stages up, then both equipment will be on and lead/lag position will switch; when the plant next stages down, the former lead equipment with more run hours will then turn off.
Expanding further, for a plant with three equipment, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two equipment are on, the one with more hours will be set to be stage 2 while the other is set to stage 1; this may be the reverse of the operating order when the equipment were started. If two of the equipment are off, the one with the more hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the equipment were stopped.
Example with three pumps:

1. *P-1 (1000 hours), 2 (950 hours), and 3 (900 hours) are all off. Staging logic makes lead/lag order: 3, 2, 1.*
2. *P-3 starts. Logic does not change its order since it is on by itself.*
3. *P-3 runs for 51 hours. Since it is on and others off, the lead/lag order does not change. It can run this way indefinitely and the order does not change.*
4. *There is then a stage-up command. P-2 (the next in lead/lag order) is started. So, both P-2 and P-3 are on. P-3 now has more run hours than P-2. So, the Lead/lag order changes to: 2, 3, 1.*
5. *These two pumps run another 51 hours. Run times are P-1 (1000 hours), P-2 (1001), and P-3 (1002). No changes are made to lead/lag order because P-1 is off alone.*
6. *There is a stage down command. P-2 is now lead so it stays on. P-3 is shut off. The order for the two off pumps is now adjusted because P-1 has fewest run hours. Lead/lag order is now: 2, 1, 3.*
7. *P-2 runs for 100 more hours. It now has the longest runtime, but order does not change since it is on alone. Order is still 2, 1, 3.*
8. *There is a stage down or plant-off command. P-2 shuts off. Run times are P-1 (1000 hours), P-2 (1101), and P-3 (1002). Since all are off, order is switched to: 1, 3, 2.*

4. Lead/standby equipment:

   a. Unless equipment runs continuously, parallel equipment that are 100% redundant shall be lead/standby alternated when more than one of the equipment is off so that the equipment with the most operating hours as determined by Staging Runtime is made the last stage equipment and the one with the least number of hours is made the earlier stage equipment.

For example, assuming there are three equipment, if all three are off, the staging order will be based on run hours from lowest to highest.

   b. If equipment runs continuously, lead/standby positions shall switch at an adjustable day of the week and time (e.g., every Tuesday at 10:00 am) based on Staging Runtime; standby equipment shall first be started and proven on before former lead equipment is changed to standby and shut off.

1) Variable speed fans and pumps shall have a deceleration rate of 1 Hz/second or slower set in BAS logic when disabled to prevent nuisance trips of operating equipment (e.g., chillers).

5. Exceptions to Lead/lag and Lead/standby rotation

a. Operators with appropriate access level shall be able to manually command staging order via software points, but not overriding the In-Alarm or Hand-Operation logic in the following subsections.

1) Staging order changes initiated via operator override shall be instituted as part of normal staging events.

2) Staging order shall remain overridden until released by operators.

b. Faulted Equipment:

1) A faulted equipment is any equipment commanded to run that is either not running when it should or unable to perform its required duty. If an operating equipment has any fault condition described subsequently, a Level 2 alarm shall be generated and a response shall be triggered as defined below.

a) Fans and Pumps

1. Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the equipment is commanded on.

b) Chillers

1. Safety shutdown alarm condition either through network or hardwired alarm contact

2. Chiller is manually shut off as indicated by the status of the Local/Auto switch from chiller gateway, or

3. Chiller status remains off 5 minutes after command to start (note: this condition only applies when a chiller first starts, i.e., once status is proven, then status is no longer used as a fault condition because status will come and go if chiller cycles on low load), or

4. CHW isolation valve feedback indicates valve is not open 90 seconds after valve is commanded open, or

5. CHW isolation valve feedback indicates valve is not closed 90 seconds after valve is commanded closed, or

6. CW isolation valve feedback indicates valve is not open 90 seconds after valve is commanded open, or

7. For 10 minutes, chilled water return temperature has been at least 3°C (5°F) above the CHWST setpoint, and delta-T across the chiller, as determined based on the difference between chilled water return

temperature and chilled water supply temperature measured at the chiller (i.e., not common CHWST), has been less than 2°C (3°F).

c) Boilers

1. Safety shutdown alarm condition either through network or hardwired alarm contact, or

2. HW isolation valve feedback indicates valve is not open 90 seconds after valve is commanded open, or

3. If boiler leaving water temperature remains 8.3°C (15°F) below setpoint for 15 minutes and delta-T across the boiler, as determined based on the difference between hot water supply temperature and hot water return temperature measured at the boiler (i.e., not common HWST), has been less than 6°C (10°F).

d) Cooling Towers

1. Tower fan has failed as defined above, or

2. Inlet end switch indicates valve is not open 90 seconds after valve is commanded open, or

3. Outlet end switch indicates valve is not open 90 seconds after valve is commanded open.

2) Upon identification of a fault condition or when equipment is in Maintenance Mode:

a) For fans, pumps, and cooling towers:

1. The next commanded off equipment in the staging order, Equipment "B", shall be commanded on while alarming Equipment "A" remains commanded on.

2. If Equipment "B" fails to prove status (i.e., it also goes into alarm), it shall remain commanded on and the preceding step shall be repeated until the quantity of equipment called for by the current stage has proven on, or there are no more available equipment.

3. Set alarming equipment to the last positions in the lead/lag or lead/standby staging order sequenced reverse chronologically (i.e., the equipment that alarmed most recently is sent to last position).

4. Staging order of non-alarming equipment shall follow the even wear logic. Equipment in alarm can only automatically move up on the staging order if another equipment goes into alarm.

5. Equipment in alarm shall run if so called for by the lead/lag or lead/standby staging order and present stage.

b) For chillers and boilers:

1. The next commanded off equipment in the staging order, Equipment "B", shall be commanded on while alarming Equipment "A" is commanded off and set to the last position in the lead/lag staging order.

2. If Equipment B fails to prove status (i.e., it also goes into alarm), repeat the preceding step until the quantity of equipment called for by the lead/lag logic have proven on or until all equipment has been tried.

3. If all equipment has been tried and the quantity of non-alarming equipment is less than called for then the most recently alarmed equipment will remain commanded on.

4. Staging order of non-alarming equipment shall follow the even wear logic. Equipment in alarm can only automatically move up in the staging order if another equipment goes into alarm.

5. Equipment in alarm shall run if so called for by the lead/lag staging order and present stage.

The sequence for chillers and boilers differs from that used for pumps and cooling towers in that the alarming equipment does not remain commanded on until the next equipment proves status. The pump and tower logic mitigates the risk of lost loads and/or chain reaction trips of chillers and boilers by still taking advantage of any capacity the alarming equipment may provide until the lag equipment proves. This approach does not however typically work for chillers and boilers because bringing on the lag equipment while still commanding the alarming equipment to run may prevent a successful startup of the lag equipment. For example, in a parallel variable primary chilled water plant under low load conditions, starting a lag chiller while keeping the alarming chiller enabled may cause both chillers to trip on either low chilled water flow or low condenser water flow unless the minimum chilled water flow setpoint is changed to maintain minimum chilled water flow and condenser water pumps are staged to maintain minimum condenser flow through both chillers.
Example: For a set of (4) lead/lag equipment, the current staging order is Equipment A, B, C, then D. The current stage requires two equipment, so A and B are running. Then A goes into alarm. A is then commanded off at the same time as C is commanded on. If C then goes into alarm it is commanded off at the same time that D is commanded on. If D then goes into alarm it remains commanded on since all equipment has been tried. If B (the last equipment not in alarm) also goes into alarm then it remains commanded on (as the last alarming equipment with no non-alarming equipment available). At this point all equipment are in alarm and only B and D will remain commanded on until an equipment comes out of alarm. The staging order is B, D, A, C. Note that staging up/down is disabled in this condition per Sections 3.26C.9 and 3.29C.6.

c. Hand Operation. If a piece of equipment is on-in-hand (e.g., via an HOA switch or local control of VFD), the equipment shall be set to the lead device, and a Level 4 alarm shall be generated. The equipment will remain as lead until. Hand operation is determined by the following:

Any condition in which equipment appears to continue to run after being commanded off is considered a case of hand operation; in practice, this condition may arise due to other circumstances (e.g., a bad current transducer).

1) Fans and Pumps

a) Status point not matching its on/off point for 15 seconds after a time delay of 60 seconds when the equipment is commanded off.

Logic for hand operation of chillers, boilers, and cooling towers is not provided because sequences cannot stably respond to overrides by operators in all possible scenarios. For example, if a chiller is turned on in hand in a variable primary system with only one other chiller currently running, the control system would need to react by opening the isolation valves of the chiller placed in hand and either (1) immediately shutting down the former lead chiller or (2) changing the minimum chilled water flow setpoint, opening isolation valves, and possibly staging on condenser water pumps and cooling towers. Chillers, boilers, and cooling towers should only be placed in hand by changing the staging sequence manually via the control system interface; they cannot be safely or stably operated in hand at the chiller/boiler/tower controllers.

Q. Air Economizer High Limits

1. Economizer shall be disabled whenever the outdoor air conditions exceed the economizer high-limit setpoint as specified. Setpoints shall be automatically determined by the control sequences (to ensure they are correct and meet code) based on energy standard, climate zone, and economizer high-limit-control device type selected by the design engineer in Section 1.2G.3 or 1.2H.2. Setpoints listed below are for current California Energy Standards.

2. Title 24-2019

Device Type	California Climate Zones	Required High Limit (Economizer off when)
Fixed dry bulb	1, 3, 5, 11 to 16	TOA > 24°C (75°F)
	2, 4, 10	TOA > 23°C (73°F)
	6, 8, 9	TOA > 22°C (71°F)
	7	TOA > 21°C (69°F)
Differential dry bulb	1, 3, 5, 11 to 16	TOA > TRA
	2, 4, 10	TOA > TRA – 1°C (2°F)
	6, 8, 9	TOA > TRA –2°C (4°F)
	7	TOA > TRA – 3°C (6°F)
Fixed enthalpy + fixed dry bulb	All	hOA > 66 kJ/kg (28 Btu/lb) or TOA > 24°C (75°F)

R. Hierarchical Alarm Suppression

1. For each piece of equipment or space controlled by the BAS, define its relationship (if any) to other equipment in terms of “source,” “load,” or “system.”

a. A component is a “source” if it provides resources to a downstream component, such as a chiller providing chilled water (CHW) to an AHU.

b. A component is a “load” if it receives resources from an upstream component, such as an AHU that receives CHW from a chiller.

c. The same component may be both a load (receiving resources from an upstream source) and a source (providing resources to a downstream load).

d. A set of components is a “system” if they share a load in common (i.e., collectively act as a source to downstream equipment, such as a set of chillers in a lead/lag relationship serving air handlers).

1) If a single component acts as a source for downstream loads (e.g., an AHU as a source for its VAV boxes), then that single-source component shall be defined as a “system” of one element.

2) For equipment with associated pumps (chillers, boilers, cooling towers):

a) If the pumps are in a one-to-one relationship with equipment they serve, the pumps shall be treated as part of the system to which they are associated (i.e., they are not considered loads), as a pump failure will necessarily disable its associated equipment.

b) If the pumps are headered to the equipment they serve, then the pumps may be treated as a system, which is a load relative to the upstream equipment (e.g., chillers) and a source relative to downstream equipment (e.g., air handlers).

2. For each system as defined in Section 3.1R.1.d, there shall be a SystemOK flag, which is either true or false.

3. SystemOK shall be true when all of the following are true:

a. The system is proven on.

b. The system is achieving its temperature and/or pressure setpoint(s) for at least 5 minutes

c. The system is ready and able to serve its load

4. SystemOK shall be false while the system is starting up (i.e., before reaching setpoint) or when enough of the system’s components are unavailable (in alarm, disabled, or turned off) to disrupt the ability of the system to serve its load. This threshold shall be defined by the design engineer for each system.

a. By default, Level 1 through Level 3 component alarms (indicating equipment failure) shall inhibit SystemOK. Level 4 component alarms (maintenance and energy efficiency alarms) shall not affect SystemOK.

b. The operator shall have the ability to individually determine which component alarms may or may not inhibit SystemOK.

5. The BAS shall selectively suppress (i.e., fail to announce; alarms may still be logged to a database) alarms for load components if SystemOK is false for the source system that serves that load.

    a. If SystemOK is false for a cooling water system (i.e., chiller, cooling tower, or associated pump), then only high-temperature alarms from the loads shall be suppressed.

    b. If SystemOK is false for a heating water system (i.e., boiler or associated pump), then only low temperature alarms from the loads shall be suppressed.

    c. If SystemOK is false for an air-side system (air handler, fan coil, VAV box, etc.), then all alarms from the loads shall be suppressed.

6. This hierarchical suppression shall cascade through multiple levels of load-source relationship such that alarms at downstream loads shall also be suppressed.

7. The following types of alarms will never be suppressed by this logic:

    a. Life/safety and Level 1 alarms

    b. Failure-to-start alarms (i.e., equipment is commanded on, but status point shows equipment to be off)

    c. Failure-to-stop/hand alarms (i.e., equipment is commanded off, but status point shows equipment to be on)

S. Time-Based Suppression

1. Calculate a time-delay period after any change in setpoint based on the difference between the controlled variable (e.g., zone temperature) at the time of the change and the new setpoint. The default time delay period shall be as follows:

    a. For thermal zone temperature alarms: 18 minutes per °C (10 minutes per °F) of difference but no longer than 120 minutes

    b. For thermal zone temperature cooling requests: 9 minutes per °C (5 minutes per °F) of difference but no longer than 30 minutes

    c. For thermal zone temperature heating requests: 9 minutes per °C (5 minutes per °F) of difference but no longer than 30 minutes

T. Occupancy Sensor Status

1. Occupancy status of all spaces shall be via the Lighting Control BACnet interface.

2. Where a zone serves more than one room, “unoccupied” (or “unpopulated” per Guideline 36 terminology) means all rooms are unoccupied and “occupied” (populated) means any room is occupied.

3. In case of the network connection with the Lighting Controls is lost:

a. For lab zones, occupancy status shall default to “occupied” (for safety reasons)

b. For all other zones, occupancy status shall default to “occupied” if the Zone Group is in Occupied Mode and “unoccupied” for any other Zone Group Mode.

U. Pandemic Mode

1. Provide a software switch on the Home Page graphic for Pandemic Mode on/off. The switch shall include a timer that can be manually set by the operator for a period of up to 60 weeks, after which the Mode shall be shut off and control logic and setpoints returned to normal.

2. When the Pandemic Mode timer is on:

a. All CO2 DCV setpoints shall be set to 800 ppm.

b. Occupancy sensors used for Occupied Standby logic shall be not reset zone ventilation rates; with respect to ventilation, the zone shall be considered “populated”.

c. All Zone Group time schedules shall indicate Occupied Mode one hour prior to the scheduled time. This earlier time shall be reflected in optimum start logic.

V. Wildfire Mode

1. Provide a 2-position software switch on the Home Page graphic for Wildfire Mode:

a. Off. Locks Wildfire Mode off.

b. On. Turns Wildfire Mode on for a preset period of time, after which the Mode shall be shut off. The preset time shall be operator adjustable for up to 1 week.

2. Provide a 3-position software switch on the Home Page graphic for Wildfire Mode:

a. Off. Locks Wildfire Mode off.

b. On. Turns Wildfire Mode on for a preset period of time, after which the Mode shall be shut off. The preset time shall be operator adjustable for up to 1 week.

c. Auto. Turns Wildfire Mode on when PM2.5 as indicated by the APMS sensor is greater than a preset concentration limit for 15 minutes until it drops below that limit for 30 minutes, after which the Mode shall be shut off. The preset concentration limit shall default to 90 µg/m3 and be operator adjustable from 50 to 120 µg/m3.

To improve indoor air quality further during wildfire events, activated carbon filters should be installed in the prefilter rack upstream of the MERV 13/15 filters for the duration of the event, then discarded.
When the Wildfire Mode timer is on:

a. Disable all economizers (lock High Limit to off).

3.2 ELECTRICITY DEMAND LIMITING

*Automatic Demand Response is required by Title 24 for all non-healthcare systems with DDC to the zone.*Demand Response

1. On home page, provide three software switches: Demand Limit Level 1 to 3.

    a. These switches shall have AUTO, ON, and OFF positions. AUTO position shall set the Demand Limit Level's status to enabled or disabled based on an OpenADR 2.0 signal from the utility (see Section 250000 Building Automation Systems) or the Owner Initiated Electricity Demand Limiting logic below with enabled taking precedence; ON shall manually enable the Demand Limit Level; and OFF shall disable and lockout the Demand Limit Level.

    b. The Highest Demand Limit Level signal currently enabled, either via an ON or AUTO command, shall be given priority.

    c. These signals are used at the zone level (see Zone Control sequences) to adjust setpoints to reduce demand.

2. Include Demand Shed commands to the lighting control system via BACnet interface for each Demand Level. The response to each Demand Shed command shall be programmed into the lighting control system under Division 26.

3. When any Demand Limit Level is on, generate a Level 4 alarm.

B. Owner-Initiated Electricity Demand Limiting

1. Sliding Window: The demand control function shall utilize a sliding window method selectable in increments of one minute, up to 60 minutes, 15 minute default.

2. Demand Levels: Demand time periods shall be set up as per utility rate schedule. For each On/Off/Partial-Peak period, three demand kW thresholds can be defined and mapped to the Demand Limit Levels, 1 to 3. When the measured demand exceeds a threshold, and the software switch described above for the associated Demand Limit Level is set to AUTO, the Demand Limit Level shall be enabled; when demand is more than 10% (adjustable) below the limit for a minimum of 15 minutes, or the time is no longer within the On/Off/Partial-Peak window, the Demand Limit Level command shall be disabled.

3.3 GENERIC VENTILATION ZONES

A. Zone Minimum Outdoor Air and Minimum Airflow Setpoints

1. For every zone that requires mechanical ventilation, the zone minimum outdoor airflows and setpoints shall be calculated depending on the governing standard or code for outdoor air requirements.

2. See Section 1.2C for zone minimum airflow setpoint Vmin.

3. For compliance with California Title 24, outdoor air setpoints shall be calculated as follows:

    a. See Section 1.2B.2 for zone ventilation setpoints.

b. Determine the zone minimum outdoor air setpoints Zone-Abs-OA-min and Zone-Des-OA-min.

Zone-Abs-OA-min is used in terminal-unit sequences and air-handler sequences. Zone-Des-OA-min is used in air-handler sequences only.

1) Zone-Abs-OA-min shall be reset based on the following conditions in order from highest to lowest priority:

a) Zero if the zone has a window switch and the window is open.

b) Zero if the zone has an occupancy sensor and is unpopulated and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3).

c) Varea-min if the zone has a CO2 sensor.

d) Zone-Des-OA-min otherwise.

2) Zone-Des-OA-min is equal to the following, in order from highest to lowest priority:

a) Zero if the zone has a window switch and the window is open.

b) Zero if the zone has an occupancy sensor, is unpopulated, and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3).

c) The larger of Varea-min and Vocc-min otherwise.

c. Vmin

1) Shall be equal to Zone-Abs-OA-min if Vmin in Section 1.2C is “AUTO”;

2) Else shall be equal to Vmin as entered in Section 1.2C.

d. The occupied minimum airflow Vmin* shall be equal to Vmin except as noted below, in order from highest to lowest priority:

1) If the zone has an occupancy sensor and is permitted to be in occupied-standby mode per Section 1.2B.2.a.3), Vmin* shall be equal to zero when the room is unpopulated.

2) If the zone has a window switch, Vmin* shall be zero when the window is open.

3) If the zone has a CO2 sensor:

a) See Section 1.2B.2.a.3) for CO2 setpoints.

b) During Occupied Mode, a P-only loop shall maintain CO2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.

c) Loop is disabled and output set to zero when the zone is not in Occupied Mode.

d) For cooling-only VAV terminal units, reheat VAV terminal units, constant-volume series fan-powered terminal units, dual-duct VAV terminal units with mixing control and inlet airflow sensors, dual-duct VAV terminal units with mixing control and a discharge airflow sensor, or dual-duct VAV terminal units with cold-duct minimum control:

1. The CO2 control loop output shall reset the occupied minimum airflow setpoint Vmin* from the zone minimum airflow setpoint Vmin at 0% up to maximum cooling airflow setpoint Vcool-max at 50%, as shown in Figure 5.2.1.4-1. The loop output from 50% to 100% will be used at the system level to reset outdoor air minimum; see AHU controls.

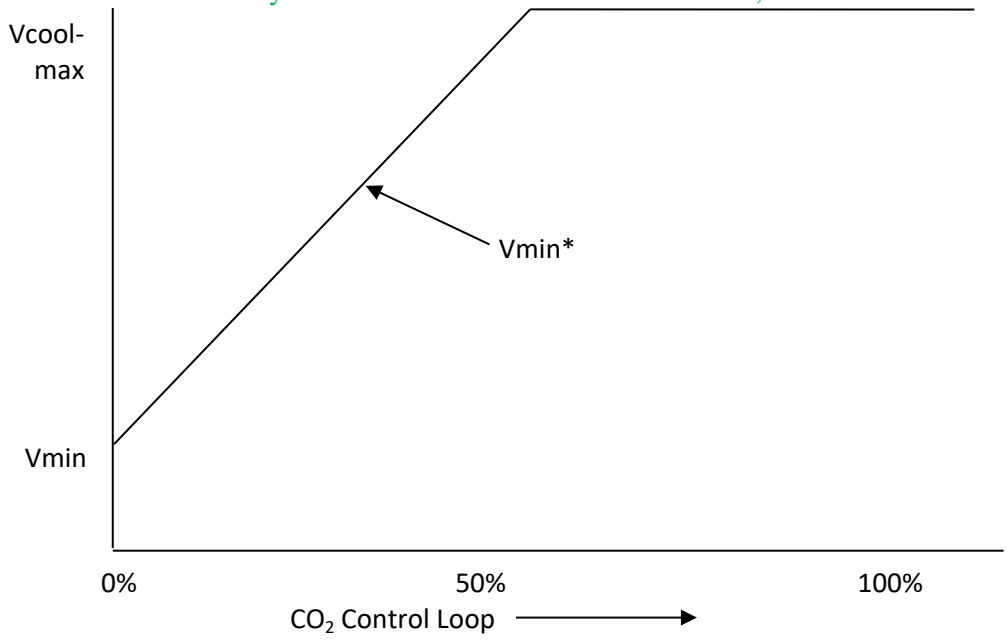


Figure 5.2.1.4-1 Vmin* reset with CO2 loop.

e) For parallel fan-powered terminal units:

1. Determine VCO2-max as follows:

   a. When the Zone State is cooling, VCO2-max is equal to the maximum cooling airflow setpoint Vcool-max.

   b. When the Zone State is heating or deadband, VCO2-max is equal to Vcool-max minus the parallel fan airflow

This logic prevents the total supply airflow from exceeding Vcool-max, which could create diffuser noise problems.

2. The CO2 control loop output shall reset the occupied minimum airflow setpoint Vmin* from the zone minimum airflow setpoint Vmin at 0% up to maximum cooling airflow setpoint VCO2-max at 50%, as shown in Figure 5.2.1.4-2. The loop output from 50% to 100% will be used at the system level to reset outdoor air minimum; see AHU controls.

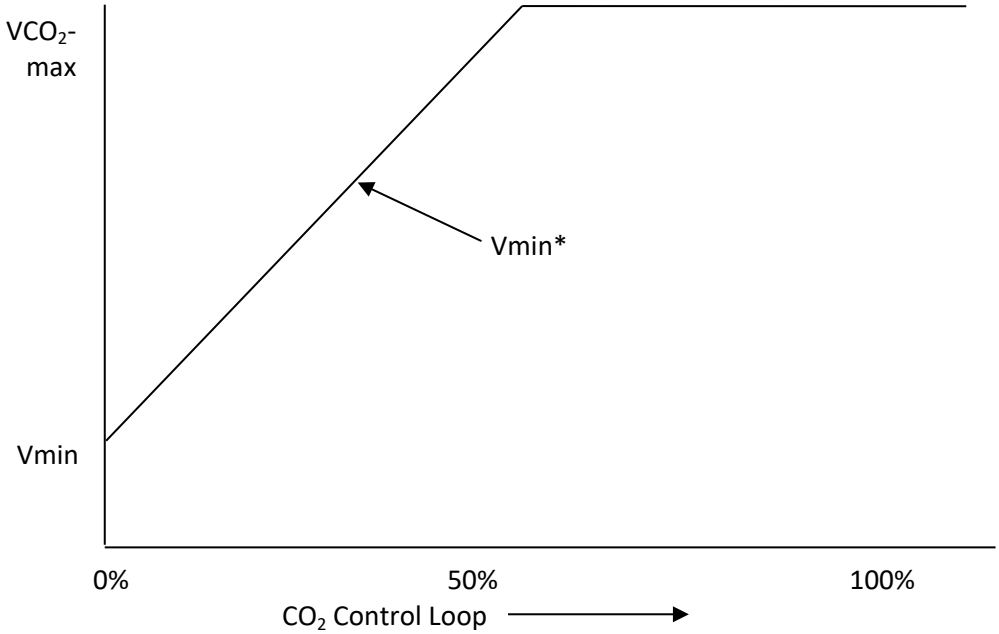


Figure 5.2.1.4-2 Vmin* reset with CO2 loop (parallel fan-powered).

f) For SZVAV AHUs:

1. The minimum outdoor air setpoint MinOAsp shall be reset based on the zone CO2 control-loop signal from MinOA at 0% signal to DesOA at 100% signal. See Figure 5.2.1.4-3.

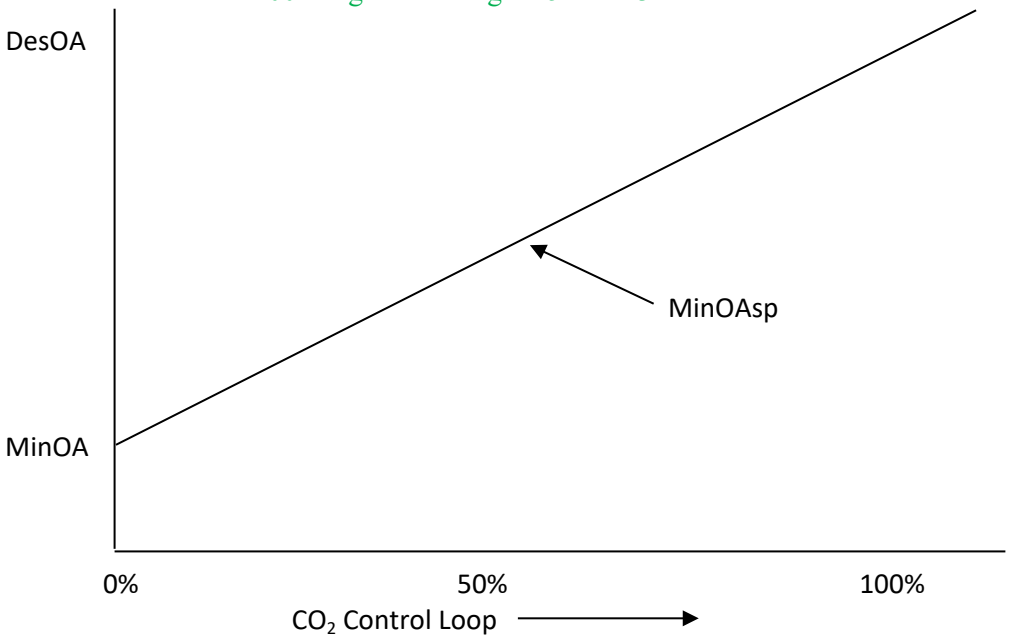


Figure 5.2.1.4-3 Vmin* reset with CO2 loop (SZVAV).

B. Time-Averaged Ventilation

ASHRAE Standard 62.1 and California Title 24 allow for ventilation to be provided based on average conditions over a specific period of time. This time-averaging method allows for zone airflows to effectively be controlled to values below the VAV box controllable minimum value,

which may reduce energy use and the risk of overcooling when the zone ventilation requirement is less than the VAV box controllable minimum.

1. When the active airflow setpoint Vspt is nonzero and is less than the lowest possible airflow setpoint allowed by the controls (Vm), the airflow setpoint shall be pulse width modulated as follows:

    a. The time-averaged ventilation (TAV) ratio shall be determined as TAVratio = Vspt/Vm

    b. The total cycle time (TCT) shall be 15 minutes (adjustable)

    c. Open period. During the open period, the TAV airflow setpoint Vspt* shall be equal to Vm for a period of time OP, which is the larger of the following:

    d. 1.5 minutes or

    e. TCT multiplied by TAVratio

    f. Closed period. During the closed period, Vspt* shall be set to 0 for a period of time CP, where CP = TCT – OP. The VAV damper control loop shall be disabled with output set equal to 0 during the closed period. At the end of each closed period, the VAV damper shall be commanded to the last position from the previous open period prior to reenabling the control loop.

    g. During TAV mode, each cycle shall consist of an open and closed period that alternate until Vspt is greater than Vm.

The following logic ensures that multiple zones do not enter TAV mode at the same time, avoiding the synchronized opening and closing of VAV dampers. Where there are a small number of zones and the majority may potentially be in TAV mode synchronously, avoiding this issue may be more reliably achieved by sequencing the VAV terminal units deterministically so that each VAV terminal unit always opens at a specific minute into the total cycle time. The aim of this sequencing is to ensure that the total airflow is as constant as possible over the total cycling time even if all of the VAV terminal units enter TAV mode at the same time (e.g., when a building-wide temperature setback occurs).
For example, the total open cycle for VAV terminal-unit A opens at minute 1 of the total cycle time, VAV terminal-unit B opens at minute x of the total cycle time, etc.
The random number for each terminal unit, RNDM, can be determined using a random number generator each time the unit enters TAV mode or set manually to a fixed value. If configured manually, set RNDM for each terminal unit to a unique value within the range of 0.0 to 1.0 such that the values are evenly distributed across the terminal units within a system.

    h. When first entering TAV mode, start with an initial open period of duration RNDM*OP, where RNDM is a random number between 0.0 and 1.0.

2. When in TAV mode, the active airflow setpoint, Vspt, shall be overridden to Vspt*.

C. For zones with CO2 sensors:

1. If the CO2 concentration is less than 300 ppm, or the zone is in Unoccupied Mode for more than 2 hours and zone CO2 concentration exceeds 600 ppm, generate a Level 3

alarm. The alarm text shall identify the sensor and indicate that it may be out of calibration.

2. If the CO2 concentration exceeds setpoint plus 10% for more than 10 minutes, generate a Level 3 alarm.

3.4 GENERIC THERMAL ZONES

A. This section applies to all single-zone systems and subzones of air-handling systems, such as VAV boxes, fan-powered boxes, etc.

B. Setpoints

1. See Section 1.2B.1 for zone temperature setpoints.

2. Each zone shall have separate occupied and unoccupied heating and cooling setpoints.

3. The active setpoints shall be determined by the operating mode of the Zone Group (see Section 3.5F).

The following is from addendum e to G36-2021:

a. During occupied mode:

1) The cooling set point shall be the occupied cooling set point.

2) The heating set point shall be the occupied heating set point.

b. During warm-up mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point until the time remaining until the zone group’s occupied start time is less than the zone's required warm-up time, tz-warmup, at which point the heating set point shall be the occupied heating set point.

c. During cool-down mode:

1) The cooling set point shall be the unoccupied cooling set point until the time remaining until the zone group’s occupied start time is less than the zone's required cool-down time, tz-cooldown, at which point the cooling set point shall be the occupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

d. During setback mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be 2°C (3°F) above the unoccupied heating set point.

e. During setup mode:

1) The cooling set point shall be 2°C (3°F) below the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

f. During unoccupied mode:

1) The cooling set point shall be the unoccupied cooling set point.

2) The heating set point shall be the unoccupied heating set point.

4. The software shall prevent the following:

a. The heating setpoint from exceeding the cooling setpoint minus 0.5°C (1°F) (i.e., the minimum difference between heating and cooling setpoints shall be 0.5°C [1°F]).

b. The unoccupied heating setpoint from exceeding the occupied heating setpoint.

c. The unoccupied cooling setpoint from being less than the occupied cooling setpoint.

5. Where the zone has a local setpoint adjustment knob/button:

a. The setpoint adjustment offsets established by the occupant shall be software points that are persistent (e.g., not reset daily), but the actual offset used in control logic shall be adjusted based on limits and modes as describe below.

b. The adjustment shall be capable of being limited in software.

These are absolute limits imposed by programming, which are in addition to the range limits (e.g., ±4°F) of the thermostat adjustment device.

1) As a default, the active occupied cooling setpoint shall be limited between 22°C (72°F) and 27°C (80°F).

2) As a default, the active occupied heating setpoint shall be limited between 18°C (65°F) and 22°C (72°F).

c. The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described in Sections 3.4B.3.a and 3.4B.5.b. If zone thermostat provides only a single set-point adjustment, then the adjustment shall move both the active heating and cooling setpoints upward or downward by the same amount, within the limits described in Section 3.4B.5.b.

d. The adjustment shall only affect occupied setpoints in Occupied Mode, Warmup Mode, and Cooldown Mode and shall have no impact on setpoints in all other modes.

e. At the onset of demand limiting, the local set-point adjustment value shall be frozen. Further adjustment of the setpoint by local controls shall be suspended for the duration of the demand-limit event.

6. Cooling Demand Limit Set-Point Adjustment. The active cooling setpoints for all zones shall be increased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BAS user interface. Changes due to demand limits are not cumulative.

a. At demand-limit Level 1, increase setpoint by 0.5°C (1°F).

b. At demand-limit Level 2, increase setpoint by 1°C (2°F).

c. At demand-limit Level 3, increase setpoint by 2°C (4°F).

7. Heating Demand-Limit Set-Point Adjustment. The active heating setpoints for all zones shall be decreased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BAS user interface. Changes due to demand limits are not cumulative.

   a. At demand-limit Level 1, decrease setpoint by 0.5°C (1°F).

   b. At demand-limit Level 2, decrease setpoint by 1°C (2°F).

   c. At demand-limit Level 3, decrease setpoint by 2°C (4°F).

Heating demand limits may be desirable in buildings with electric heat or heat pumps or in regions with limited gas distribution infrastructure.

8. Window Switches. For zones that have operable windows with indicator switches, when the window switch indicates the window is open, the heating setpoint shall be temporarily set to 4°C (40°F) and the cooling setpoint shall be temporarily set to 49°C (120°F). When the window switch indicates that the window is open during other than Occupied Mode, a Level 4 alarm shall be generated.

9. Occupancy Sensors. For zones that have an occupancy switch:

   a. When the switch indicates that the space has been unpopulated for 5 minutes continuously during the Occupied Mode, the active heating setpoint shall be decreased by 0.5°C (1°F) and the cooling setpoint shall be increased by 0.5°C (1°F).

   b. When the switch indicates that the space has been populated for 1 minute continuously, the active heating and cooling setpoints shall be restored to their previous values.

10. Hierarchy of Set-Point Adjustments. The following adjustment restrictions shall prevail in order from highest to lowest priority:

    a. Setpoint overlap restriction (Section 3.4B.3.a)

    b. Absolute limits on local setpoint adjustment (Section 3.4B.5.b)

    c. Window switches

    d. Demand limit

       1) Occupancy sensors. Change of setpoint by occupancy sensor is added to change of setpoint by any demand limits in effect.

       2) Local set-point adjustment. Any changes to setpoint by local adjustment are frozen at the onset of the demand limiting event and remain fixed for the duration

of the event. Additional local adjustments are ignored for the duration of the demand limiting event.

e. Scheduled setpoints based on Zone Group mode

C. Local Override. When thermostat override buttons are depressed, the call for Occupied Mode operation shall be sent to the Zone Group control for 60 minutes. Local Override shall be capable of being enabled and disabled separately for each thermostat via the graphical user interface; default to disabled.

Local overrides will cause all zones in the Zone Group to operate in Occupied Mode to ensure that the system has adequate load to operate stably.

D. Control Loops

1. Two separate control loops, the Cooling Loop and the Heating Loop, shall operate to maintain space temperature at setpoint.

   a. The Heating Loop shall be enabled whenever the space temperature is below the current zone heating set-point temperature and disabled when space temperature is above the current zone heating setpoint temperature and the loop output is zero for 30 seconds. The loop may remain active at all times if provisions are made to minimize integral windup.

   b. The Cooling Loop shall be enabled whenever the space temperature is above the current zone cooling set-point temperature and disabled when space temperature is below the current zone cooling set-point temperature and the loop output is zero for 30 seconds. The loop may remain active at all times if provisions are made to minimize integral windup.

2. The Cooling Loop shall maintain the space temperature at the active cooling setpoint. The output of the loop shall be a software point ranging from 0% (no cooling) to 100% (full cooling).

3. The Heating Loop shall maintain the space temperature at the active heating setpoint. The output of the loop shall be a software point ranging from 0% (no heating) to 100% (full heating).

4. Loops shall use proportional + integral logic or other technology with similar performance. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable by the operator.

5. See other sections for how the outputs from these loops are used.

E. Zone State

1. Heating. When the output of the space Heating Loop is nonzero and the output of the Cooling Loop is equal to zero.

2. Cooling. When the output of the space Cooling Loop is nonzero and the output of the Heating Loop is equal to zero.

3. Deadband. When not in either heating or cooling.

F. Zone Alarms

1. Zone Temperature Alarms

a. High-temperature alarm

1) If the zone is 2°C (3°F) above cooling setpoint for 10 minutes, generate a Level 4 alarm.

2) If the zone is 3°C (5°F) above cooling setpoint for 10 minutes, generate a Level 3 alarm.

b. Low-temperature alarm

1) If the zone is 2°C (3°F) below heating setpoint for 10 minutes, generate a Level 4 alarm.

2) If the zone is 3°C (5°F) below heating setpoint for 10 minutes, generate a Level 3 alarm.

Default time delay for zone temperature alarm (10 minutes) is intentionally long to minimize nuisance alarms. For critical zones, such as IT closets, consider reducing time delay or setting delay to zero.

c. Suppress zone temperature alarms as follows:

1) After zone setpoint is changed per Section 3.1S.

2) While Zone Group is in Warmup Mode or Cooldown Mode.

The following is from addendum e to G36-2021:

G. Zone Group Mode Requests

1. Zone Group Mode Requests shall be generated by the conditions in each zone and sent to the Zone Group of which the zone is a member.

2. Warm-up Mode Requests

a. An algorithm provided with the BAS shall calculate the required zone warm-up time, tz-warmup, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a heating mass/capacity factor for each zone.

b. The heating mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

c. If the zone group is in any mode other than occupied mode, zone window switch(es) indicate that all windows are closed, and the time remaining until the zone group's

occupied start time is less than the zone's required warm-up time, tz-warmup, send 1 Warm-up Mode Request; else, send 0 Warm-up Mode Requests.

3. Cooldown Mode Requests

   a. An algorithm provided with the BAS shall calculate the required zone cool-down time, tz-cooldown, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a cooling mass/capacity factor for each zone.

   b. The cooling mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

   c. If the zone group is in any mode other than occupied mode, zone window switch(es) indicate that all windows are closed, and the time remaining until the zone group's occupied start time is less than the zone's required cool-down time, t-cooldown, send 1 Cooldown Mode Request; else, send 0 Cooldown Mode Requests.

Warm-up and cooldown modes are used to bring the zone groups up to temperature based on their scheduled occupancy period. The algorithms used in these modes (often referred to as "optimal start") predict the shortest time to achieve occupied set point to reduce the central system energy use based on past performance.
It is recommended to use a global outdoor air temperature not associated with any AHU to determine warm-up start time. This is because unit-mounted OA sensors, which are usually placed in the outdoor air intake stream, are often inaccurate (reading high) when the unit is off due to air leakage from the space through the OA damper.

4. Setback Mode Requests

   a. If the zone group is in unoccupied or setback mode, zone window switch(es) indicate that all zone windows are closed, and zone temperature is less than the unoccupied heating setpoint for 5 minutes, send 1 Setback Mode Request; else, send 0 Setback Mode Requests.

5. Setup Mode Requests

   a. If the zone group is in unoccupied or setup mode, zone window switch(es) indicate that all zone windows are closed, and zone temperature is greater than the unoccupied cooling setpoint for 5 minutes, send 1 Setup Mode Requests; else, send 0 Setup Mode Requests.

3.5 ZONE GROUPS

Zone scheduling groups, or Zone Groups, are sets of zones served by a single air handler that operate together for ease of scheduling and/or in order to ensure sufficient load to maintain stable operation in the upstream equipment. A Zone Group is equivalent to an isolation area as defined in ASHRAE/IES Standard 90.1 and Title 24.

A. Each system shall be broken into separate Zone Groups composed of a collection of one or more zones served by a single air handler. See Section 1.2D for Zone Group assignments.

B. Each Zone Group shall be capable of having separate occupancy schedules and operating modes from other Zone Groups.

Note that, from the user's point of view, schedules can be set for individual zones, or they can be set for an entire Zone Group, depending on how the user interface is implemented. From the point of view of the BAS, individual zone schedules are superimposed to create a zone-group schedule, which then drives system behavior.
The schedule may govern operation of other integrated systems such as lights, daylighting, or other, in addition to the HVAC system.

C. All zones in each Zone Group shall be in the same zone-group operating mode as defined in Section 3.5F. If one zone in a Zone Group is placed in any zone-group operating mode other than Unoccupied Mode (due to override, sequence logic, or scheduled occupancy), all zones in that Zone Group shall enter that mode.

Occupied-standby mode applies to individual zones, is considered a zonal subset of Occupied Mode, and shall not be considered a zone-group operating mode.

D. A Zone Group may be in only one mode at a given time.

E. For each Zone Group, provide a set of testing/commissioning software switches that override all zones served by the Zone Group. Provide a separate software switch for each of the zone-level override switches listed under "Testing and Commissioning Overrides" in terminal unit sequences. When the value of a Zone Group's override switch is changed, the corresponding override switch for every zone in the Zone Group shall change to the same value. Subsequently, the zone-level override switch may be changed to a different value. The value of the zone-level switch has no effect on the value of the zone-group switch, and the value of the zone-group switch only affects the zone-level switches when the zone-group switch is changed.

The testing and commissioning overrides will be specified for each type of terminal unit and system in subsequent sequences. These overrides allow a commissioning agent to, for example, force a zone into cooling or drive a valve all the way open or closed.
Zone-group override switches allow a commissioning agent to apply a zone-level override to all zones in a Zone Group simultaneously. This greatly accelerates the testing and commissioning process.

F. Zone-Group Operating Modes. Each Zone Group shall have the modes shown in the following subsections.

The modes presented in this section are to enable different setpoints and ventilation requirements to be applied to Zone Groups based on their operating schedule, occupancy status, and deviation from current setpoint.
See ASHRAE Guideline 13 for best practices in locating zone-group operating mode programming logic based on network architecture.

1. Occupied Mode. A Zone Group is in the Occupied Mode when any of the following is true:

   a. The time of day is between the Zone Group's scheduled occupied start and stop times.

   b. The schedules have been overridden by the occupant override system.

c. Any zone local override timer (initiated by local override button) is nonzero.

The following is from addendum e to G36-2021:

2. Warm-Up Mode. Warm-up mode shall start when the number of Warm-Up Mode Requests > I (I = ignores, default = 5), and shall end at the zone group's scheduled occupied start time or Warm-Up Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

3. Cool-down Mode. Cool-down mode shall start when the number of Cool-down Mode Requests > I (I = ignores, default to 5), and shall end at the zone group's scheduled occupied start time or Cool-down Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

4. Setback Mode. Setback mode shall start when the number of Setback Mode Requests > I (I = ignores, default to 4), and shall end when Setback Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

5. Setup Mode. Setup mode shall start when the number of Setup Mode Requests > I (I = ignores, default to 4), and shall end when Setup Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

Setback and setup modes are used to keep zone temperatures (and mass) from straying excessively far from occupied set points so that the cooldown and warm-up modes can achieve set point when initiated. The number of ignored zones (set at 4 here) are to ensure that the central systems (fans, pumps, heating sources, or cooling sources) can operate stably. Obviously, the size of the zones and the characteristics of the central systems are a factor in choosing the correct number of zones in each group.

6. When zones in one Zone Group are generating requests for different modes, the hierarchy in Section 5.15.1 shall be used to determine Zone Group Operating Mode.

3.6 VAV TERMINAL UNIT—COOLING ONLY

A. See "Generic Thermal Zones" (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See "Generic Ventilation Zones" (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section 1.2C.1 for zone minimum airflow setpoint Vmin, zone maximum cooling airflow setpoint Vcool-max, and zone maximum heating airflow setpoint Vheat-max.

Delete if no IDF rooms also have VAV boxes to supplement auxiliary cooling:

D. For zones serving MDFs and IDFs etc. that are also served by fan-coils or AC units:

The next sequence is if the cooling load of the MDF/IDF was not included in the AHU loads to reduce costs.

1. If the static pressure setpoint of the VAV system serving the VAV box is at the maximum of the reset range DPmax, limit the airflow to 15% (adjustable) of the zone maximum until the setpoint is reset 0.15" (adjustable) below DPmax.

2. This zone shall have an Importance Multiplier of 0 for both Duct Static Pressure and Supply Temperature Reset so that it does not generate any System Requests.

E. Active endpoints used in the control logic depicted in Figure 5.5.5 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.5.4).

Table 5.5.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vcool-max	Vcool-max	0

F. Control logic is depicted schematically in Figure 5.5.5 and described in the following subsections.

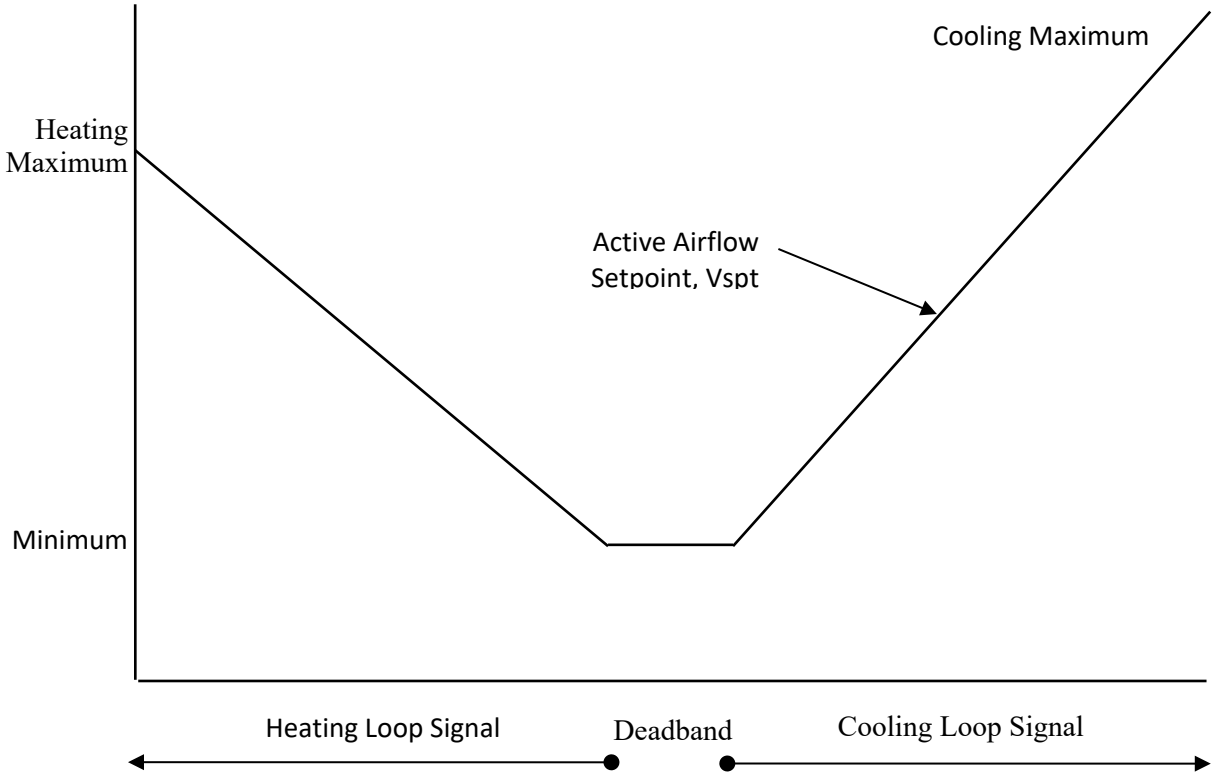


Figure 5.5.5 Control logic for cooling-only VAV zone.

1. When the Zone State is cooling, the cooling-loop output shall be mapped to the active airflow setpoint from the minimum endpoint to the cooling maximum endpoint.

   a. If supply air temperature from the air handler is greater than room temperature, the active airflow setpoint shall be no higher than the minimum endpoint.

2. When the Zone State is deadband, the active airflow setpoint shall be the minimum endpoint.

3. When the Zone State is heating, the Heating Loop output shall be mapped to the active airflow setpoint from the minimum endpoint to the heating maximum endpoint.

    a. If supply air temperature from the air handler is less than 3°C (5°F) above the room temperature, the active airflow setpoint shall be no higher than the minimum endpoint.

4. The VAV damper shall be modulated by a control loop to maintain the measured airflow at the active setpoint.

G. Alarms

1. Low Airflow

    a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

    b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 3 alarm.

    c. If a zone has an importance multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

3. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while the fan serving the zone is proven on, generate a Level 4 alarm.

H. Testing/Commissioning Overrides. Provide software switches that interlock to a system-level point to

    a. force zone airflow setpoint to zero,

    b. force zone airflow setpoint to Vcool-max,

    c. force zone airflow setpoint to Vmin,

    d. force damper full closed/open, and

    e. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

I. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

d. Else if the Cooling Loop is less than 95%, send 0 requests.

2. Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

3.7 VAV TERMINAL UNIT WITH REHEAT

A. See "Generic Thermal Zones" (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See "Generic Ventilation Zones" (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section 1.2C.3 for zone minimum airflow setpoints Vmin, zone maximum cooling airflow setpoint Vcool-max, zone maximum heating airflow setpoint Vheat-max, zone minimum heating airflow setpoint Vheat-min, and the maximum DAT rise above heating setpoint MaxΔT.

D. Active endpoints used in the control logic depicted in Figure 5.6.5 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.6.4).

Table 5.6.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Cooling minimum	Vmin*	0	0	0	0	0
Minimum	Vmin*	0	0	0	0	0

Heating minimum	Max (Vheat-min, Vmin*)	Vheat-min	0	Vheat-max	Vheat-max	0
Heating maximum	Max (Vheat-max, Vmin*)	Vheat-max	0	Vcool-max	Vcool-max	0

E. Control logic is depicted schematically in Figure 5.6.5 (modified from Guideline 36) and described in the following subsections.

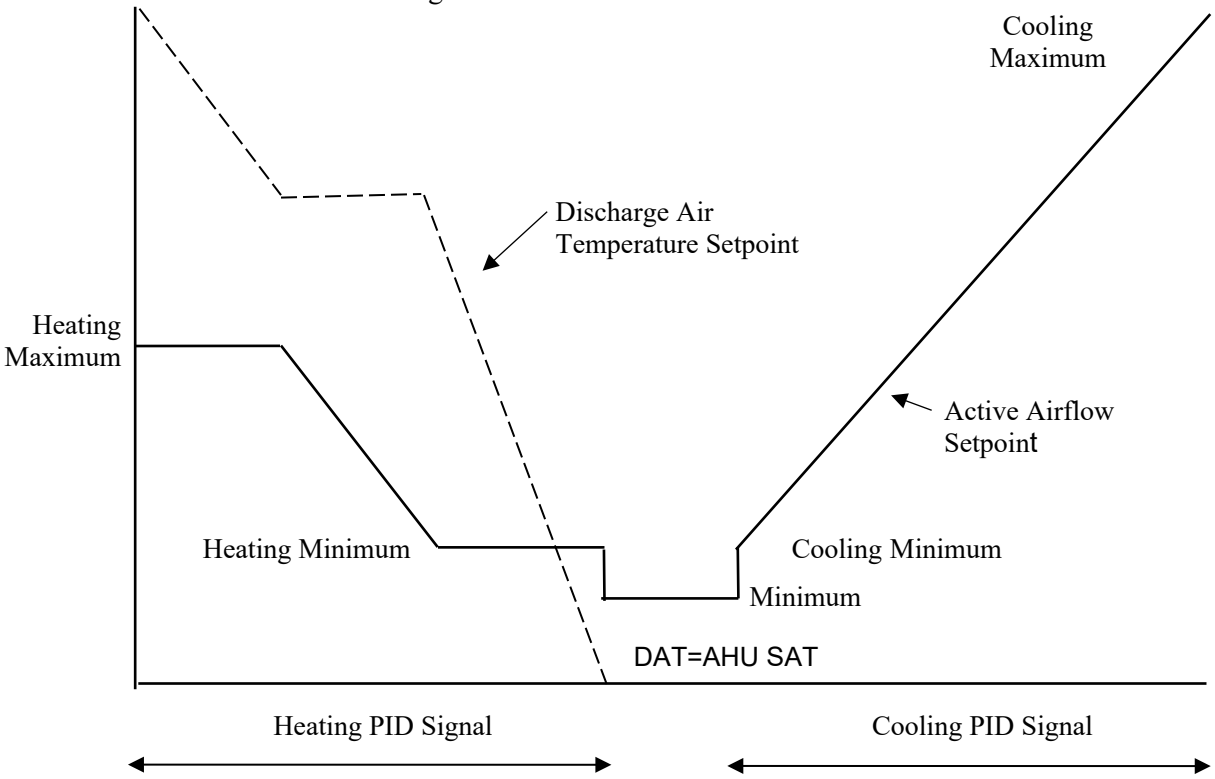


Figure 5.6.5 Control logic for VAV reheat zone modified from Guideline 36.

1. When the Zone State is cooling, the cooling-loop output shall be mapped to the active airflow setpoint from the cooling minimum endpoint to the cooling maximum endpoint. Heating coil is disabled unless the DAT is below the minimum setpoint (see Section 3.7E.4).

    a. If supply air temperature from the air handler is greater than room temperature, the active airflow setpoint shall be no higher than the minimum endpoint.

2. When the Zone State is deadband, the active airflow setpoint shall be the minimum endpoint. Heating coil is disabled unless the DAT is below the minimum setpoint (see Section 3.7E.4).

3. When the Zone State is heating, the Heating Loop shall maintain space temperature at the heating setpoint as follows:

a. From 0 to 33%, the Heating Loop output shall reset the discharge air temperature DAT from the current AHU SAT setpoint to a setpoint equal to MaxΔT above space temperature setpoint. The airflow setpoint shall be the Heating Minimum.

b. From 33% to 66%, if the DAT is greater than the room temperature plus 5ºF, the Heating Loop output shall reset the zone airflow setpoint from the Heating Minimum to the Heating Maximum endpoint.

c. From 66% to 100%, the Heating Loop output shall reset the DAT setpoint to 115°F.

d. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off the zone temperature control loop is not acceptable).

1) When the airflow setpoint is pulse-width modulated per Section 3.3B, the heating coil and PID loop shall be disabled, with output set to 0 during closed periods.

4. In Occupied Mode, the heating coil shall be modulated to maintain a DAT no lower than 10°C (50°F).

5. The VAV damper shall be modulated by a control loop to maintain the measured airflow at the active setpoint.

F. Alarms

1. Low Airflow

a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Low-Discharge Air Temperature

a. If heating hot-water plant is proven on, and the DAT is 8.3°C (15°F) less than setpoint for 10 minutes, generate a Level 4 alarm.

b. If heating hot-water plant is proven on, and the DAT is 17°C (30°F) less than setpoint for 10 minutes, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its hot-water reset T&R control loop, low-DAT alarms shall be suppressed for that zone.

3. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

4. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while the fan serving the zone is proven on, generate a Level 4 alarm.

5. Leaking Valve. If the valve position is 0% for 15 minutes, DAT is above AHU SAT by 3°C (5°F), and the fan serving the zone is proven on, generate a Level 4 alarm.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a system level point to

a. force zone airflow setpoint to zero,

b. force zone airflow setpoint to Vcool-max,

c. force zone airflow setpoint to Vmin,

d. force zone airflow setpoint to Vheat-max,

e. force damper full closed/open,

f. force heating to off/closed, and

g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

H. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

d. Else if the Cooling Loop is less than 95%, send 0 requests.

2. Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. If the DAT is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

b. Else if the DAT is 8°C (15°F) less than setpoint for 5 minutes, send 2 requests.

c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil and Heating Hot-Water Plant, Heating Hot-Water Plant Requests. Send the heating hot-water plant that serves the zone a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.8 PARALLEL FAN-POWERED TERMINAL UNIT −VARIABLE-VOLUME FAN

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See “Generic Ventilation Zones” (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section 1.2C.4 for zone minimum airflow setpoint Vmin, zone maximum cooling airflow setpoint Vcool-max, the parallel fan maximum heating airflow setpoint Pfan-htgmax, and the maximum DAT rise above heating setpoint MaxΔT.

1. Pfan-z is the lowest rate at which the fan will operate when it is turned on but has the lowest possible speed signal from the BAS.

D. Active endpoints used in the control logic depicted in Figure 5.8.5 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.8.4).

Table 5.8.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

E. Control logic is depicted schematically in Figure 5.8.5 and described in the following subsections. In Figure 5.8.5, OA-min is Zone-Abs-OA-min.

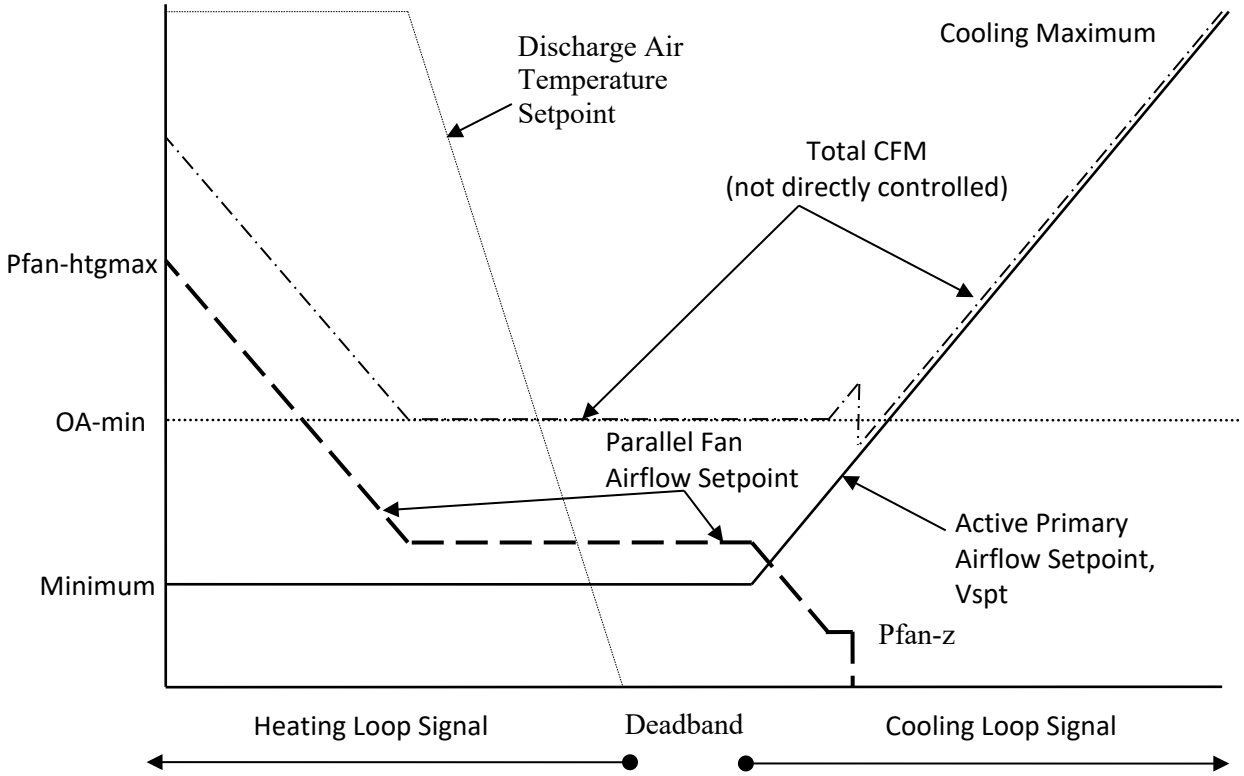


Figure 5.8.5 Control logic for variable-volume parallel fan-powered VAV zone.

1. When the Zone State Is Cooling

    a. The cooling-loop output shall be mapped to the active airflow setpoint from the minimum endpoint to the cooling maximum endpoint.

        1) If supply air temperature from the air handler is greater than room temperature, the active primary airflow setpoint shall be no higher than the minimum endpoint.

    b. Heating coil is off.

    c. If ventilation is according to California Title 24, in Occupied Mode only, parallel fan starts when primary airflow drops below Zone-Abs-OA-min minus one half of Pfan-z and shuts off when primary airflow rises above Zone-Abs-OA-min. Fan airflow rate setpoint is equal to Zone-Abs-OA-min minus the current primary airflow setpoint.

2. When the Zone State Is Deadband

    a. The active primary airflow setpoint shall be the minimum endpoint.

    b. Heating coil is off.

    c. If ventilation is according to California Title 24, in Occupied Mode only, parallel fan runs if the active primary airflow setpoint is below Zone-Abs-OA-min. Fan airflow rate setpoint is equal to Zone-Abs-OA-min minus the active primary airflow setpoint.

3. When Zone State is Heating

a. The active primary airflow setpoint shall be the minimum endpoint.

b. Parallel fan shall run.

c. From 0% to 50%, the Heating Loop output shall reset the discharge temperature from the current AHU SAT setpoint to a maximum of MaxΔT above space temperature setpoint.

d. From 50% to 100%, the Heating Loop output shall reset the parallel fan airflow setpoint from the airflow setpoint required in deadband (see above; this is Pfan-z if deadband setpoint is less than Pfan-z) proportionally up to the maximum heating-fan airflow setpoint (Pfan-htgmax).

4. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off zone temperature control loop is not acceptable).

5. The VAV damper shall be modulated to maintain the measured primary airflow at the primary airflow setpoint.

F. Alarms

1. Low Primary Airflow

a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Low-Discharge Air Temperature

a. If heating hot-water plant is proven on, and the DAT is 8.3°C (15°F) less than setpoint for 10 minutes, generate a Level 4 alarm.

b. If heating hot-water plant is proven on, and the DAT is 17°C (30°F) less than setpoint for 10 minutes, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its hot-water reset T&R control loop, low-DAT alarms shall be suppressed for that zone.

3. Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

a. Commanded on, status off Level 2

b. Commanded off, status on: Level 4

4. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

5. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while fan serving the zone is proven on, generate a Level 4 alarm.

6. Leaking Valve. If the valve position is 0% for 15 minutes, and DAT is above AHU SAT by 3°C (5°F), generate a Level 4 alarm.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a system level point to

   a. force zone airflow setpoint to zero,

   b. force zone airflow setpoint to Vcool-max,

   c. force zone airflow setpoint to Vmin,

   d. force damper full closed/open,

   e. force heating to off/closed,

   f. turn fan on/off, and

   g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

H. System Requests

   1. Cooling SAT Reset Requests

      a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

      b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

      c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

      d. Else if the Cooling Loop is less than 95%, send 0 requests.

   2. Static Pressure Reset Requests

      a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. If the DAT is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

b. Else if the DAT is 8.3°C (15°F) less than setpoint for 5 minutes, send 2 requests.

c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil and a Heating Hot-Water Plant, Heating-Hot Water Plant Requests. Send the heating hot-water plant that serves the zone a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.9 SERIES FAN-POWERED TERMINAL UNIT − CONSTANT-VOLUME FAN

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See “Generic Ventilation Zones” (Section 3.3) for calculation of zone minimum outdoor airflow.

C. See Section 1.2C.5 for zone minimum airflow setpoints Vmin, zone maximum cooling airflow setpoint Vcool-max, and the maximum DAT rise above heating setpoint MaxΔT.

D. Active endpoints used in the control logic depicted in Figure 5.9.5 shall vary depending on the mode of the Zone Group the zone is a part of (see Table 5.9.4).

Table 5.9.4 Endpoints as a Function of Zone Group Mode

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

E. Control logic is depicted schematically in Figure 5.9.5 and described in the following subsections.

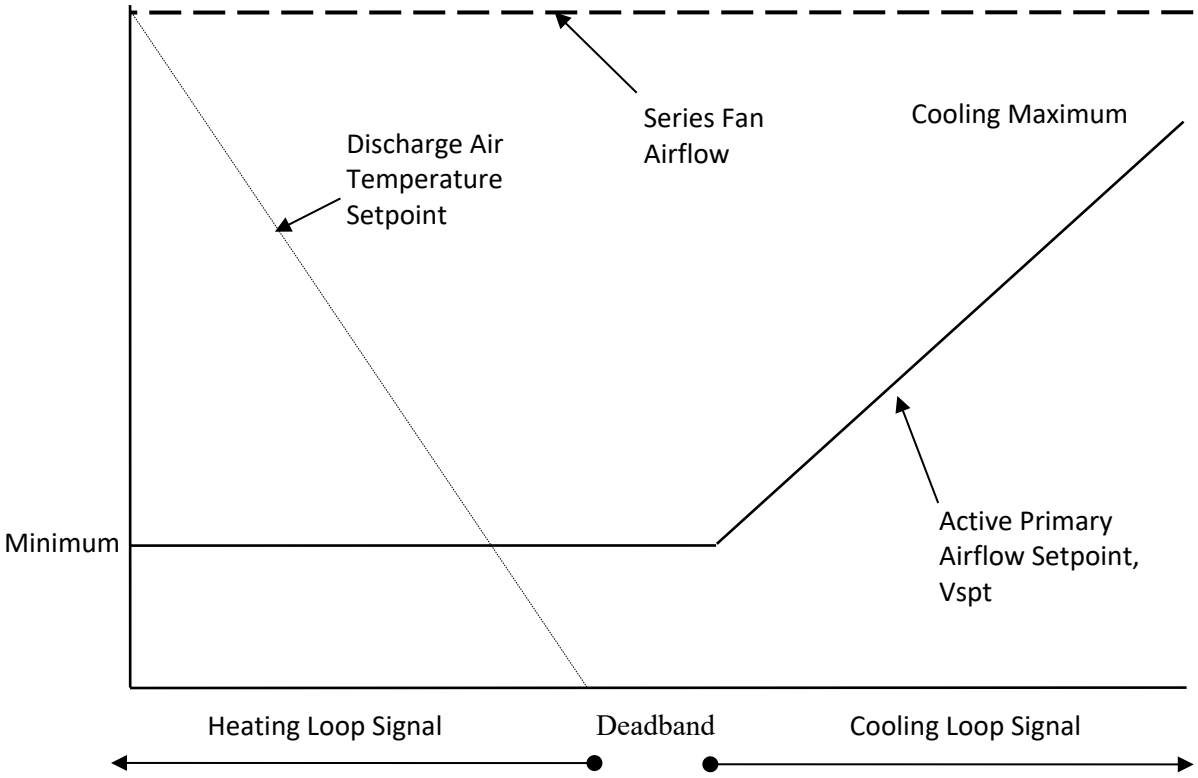


Figure 5.9.5 Control logic for constant-volume series fan-powered VAV zone.

1. When the Zone State Is Cooling

    a. The cooling-loop output shall be mapped to the active primary airflow setpoint from the minimum endpoint to the cooling maximum endpoint.

        1) If supply air temperature from the air handler is greater than room temperature, the active primary airflow setpoint shall be no higher than the minimum endpoint.

    b. Heating coil is off.

2. When the Zone State Is Deadband

    a. The active primary airflow setpoint shall be the minimum endpoint.

    b. Heating coil is off.

3. When Zone State Is Heating

    a. The active primary airflow setpoint shall be the minimum endpoint.

    b. The heating-loop shall reset the discharge temperature from the current AHU SAT setpoint to a maximum of MaxΔT above space temperature setpoint.

c. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off zone temperature control loop is not acceptable).

4. The VAV damper shall be modulated to maintain the measured airflow at setpoint.

5. Fan Control. Fan shall run whenever zone is in heating or cooling Zone State, or if the associated Zone Group is in Occupied Mode. Prior to starting the fan, the damper is first driven fully closed to ensure that the fan is not rotating backward. Once the fan is proven on for a fixed time delay (15 seconds), the damper override is released.

F. Alarms

1. Low Primary Airflow

a. If the measured airflow is less than 70% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 4 alarm.

b. If the measured airflow is less than 50% of setpoint for 10 minutes while setpoint is greater than zero, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.

2. Low-Discharge Air Temperature

a. If heating hot-water plant is proven on, and the DAT is 8.3°C (15°F) less than setpoint for 10 minutes, generate a Level 4 alarm.

b. If heating hot-water plant is proven on, and the DAT is 17°C (30°F) less than setpoint for 10 minutes, generate a Level 3 alarm.

c. If a zone has an Importance-Multiplier of 0 (see Section 3.1O.2.a.1)) for its hot-water reset T&R control loop, low-DAT alarms shall be suppressed for that zone.

3. Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

a. Commanded on, status off: Level 2

b. Commanded off, status on: Level 4

4. Airflow Sensor Calibration. If the fan serving the zone is off and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 30 minutes, generate a Level 3 alarm.

5. Leaking Damper. If the damper position is 0%, and airflow sensor reading is above the larger of 10% of the cooling maximum airflow setpoint or 50 cfm for 10 minutes while the fan serving the zone is proven on, generate a Level 4 alarm.

6. Leaking Valve. If the valve position is 0% for 15 minutes, and DAT is above AHU SAT by 3°C (5°F), generate a Level 4 alarm.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a system level point to

a. force zone airflow setpoint to zero,

b. force zone airflow setpoint to Vcool-max,

c. force zone airflow setpoint to Vmin,

d. force damper full closed/open,

e. force heating to on/closed,

f. turn fan on/off, and

g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).

H. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 3 requests.

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change per Section 3.1S, send 2 requests.

c. Else if the Cooling Loop is greater than 95%, send 1 request until the Cooling Loop is less than 85%.

d. Else if the Cooling Loop is less than 95%, send 0 requests.

2. Static Pressure Reset Requests

a. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

b. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

d. Else if the damper position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. If the DAT is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

b. Else if the DAT is 8.3°C (15°F) less than setpoint for 5 minutes, send 2 requests.

c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil and a Heating Hot-Water Plant, Heating Hot-Water Plant Requests. Send the heating hot-water plant that serves the zone a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.10 LABORATORY FOUR-PIPE VAV ZONE (FAST AND SLOW)

A. See “Generic Thermal Zones” (Section 3.4) for setpoints, loops, control modes, alarms, etc.

B. See Section 1.2D for airflow and discharge air temperature setpoints.

C. Lab air terminal controllable minimum

1. Supply air terminal controllable minimum (Vctrl-min) and general exhaust air valve controllable minimum (Vgex-ctrl-min) shall be determined in accordance with Paragraph 1.4B.

2. Where there is more than one terminal, rates shall be added together for control logic below.

D. Pressurization control

1. Sign conventions: All airflows have a positive sign, except for the room offset airflow which may be positive (for positively pressurized lab) or negative (for negatively pressurized lab.

2. The active supply air minimum Vmin* shall be equal to the larger of the following but no larger than Vmax:

a. Exhaust makeup air rate, Vmu

b. Minimum ventilation rate (Vvent) equal to

1) If the zone is unoccupied as indicated by its occupancy sensor and the lab is scheduled to be unoccupied, Vmin-unocc.

2) Otherwise, Vmin-occ

c. Vctrl-min

3. Vgex-step shall be equal to Vgex-ctrl-minimum

a. Exception: Vgex-step shall equal 0 if

1) The active airflow setpoint Vstp for temperature control is equal to Vmin*, and

2) The larger of Vvent and Vctrl-min has been less than or equal to the sum of the following for 30 seconds or more:

a) Sum of fume hood exhaust valve(s) airflow feedback

b) Vother

c) Voffset

4. The make-up airflow demand (Vmu) is equal to the sum of:

a. Sum of fume hood exhaust valve(s) airflow feedback

b. Vgex-step

c. Vother

d. Voffset

5. The active general exhaust valve setpoint Vgex-spt shall equal 0 when Vgex-step is equal 0; otherwise it shall equal the sum of the following but no larger than Vgex-max:

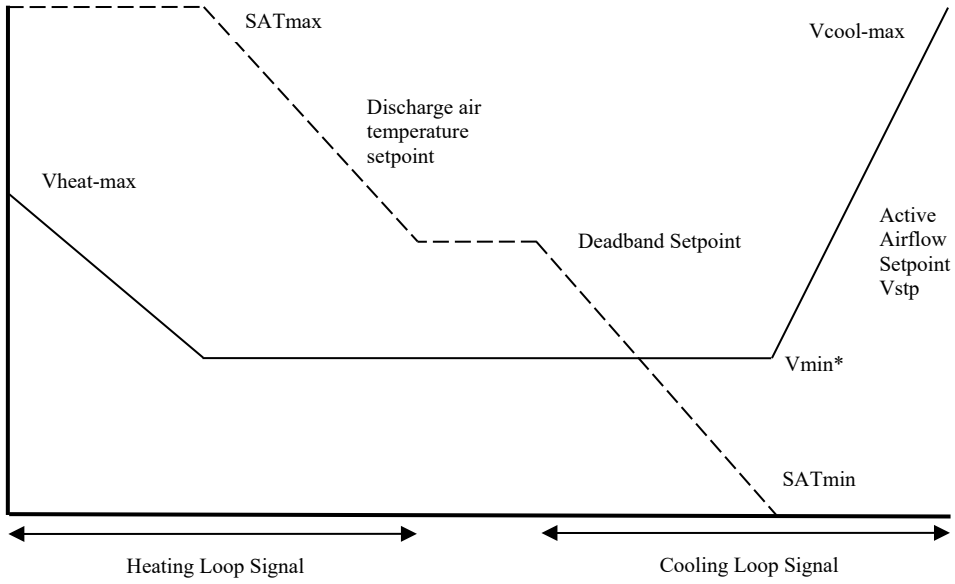
a. Supply valve feedback airflow minus Vmu

b. The general exhaust valve controllable minimum airflow, Vgex-ctrl-min

E. Supply air

1. Active endpoints used in the control logic depicted in the figure below shall not vary regardless of the Mode of the Zone Group the zone is a part of.

2. Control logic is depicted schematically in the figure below and described in the following sections.



3. When the Zone State is Cooling

    a. From 0-50%, the Cooling Loop output shall reset the discharge temperature setpoint from Deadband SAT Setpoint to SATmin. The active airflow setpoint shall be Vmin*.

    b. From 51%-100%, if the discharge air temperature is less than room temperature minus 0.5°C (1°F), the Cooling Loop output shall reset the active airflow setpoint from the Vmin* to Vcool-max, but no lower than Vmin*.

4. When the Zone State is Deadband

    a. The discharge temperature setpoint shall be the Deadband SAT Setpoint equal to the average of current cooling and heating space temperature setpoints.

    b. The active airflow setpoint shall be Vmin*.

5. When the Zone State is Heating

    a. From 0-50%, the Heating Loop output shall reset the discharge temperature setpoint from Deadband SAT Setpoint to SATmax. SATmin shall be 55ºF unless otherwise indicated on Drawings. The active airflow setpoint shall be Vmin*.

    b. From 51%-100%, if the discharge air temperature is greater than room temperature plus 3°C (5°F), the Heating Loop output shall reset the active airflow setpoint from the Vmin* to Vheat-max.

6. The hot water and chilled water valves shall be modulated in sequence using P+I loop to maintain the discharge temperature at setpoint. (Directly controlling valves off zone temperature PID loop is not acceptable.)

7. Where drawings indicate supply air valves have on-board controllers, the airflow setpoint is sent to the controller and the controller modulates the VAV damper to maintain the measured airflow at setpoint.

8. Where drawings indicate supply air valves are controlled by the BAS, the VAV damper shall be modulated to maintain the measured airflow at setpoint.

F. General exhaust

1. Where drawings indicate general exhaust air valves have on-board controllers, the active airflow setpoint Vgex-spt is sent to the controller and the controller modulates the VAV damper to maintain the measured airflow at setpoint.

2. Where drawings indicate general exhaust air valves are controlled by the BAS, the VAV damper shall be modulated to maintain the measured airflow at the active airflow setpoint Vgex-spt.

G. Alarms

1. Airflow alarm (except hoods for which setpoint is not known)

a. If the airflow feedback from any valve is 15% above or below setpoint for 5 minutes, generate a Level 3 alarm.

b. If the airflow feedback from any valve is 30% above or below setpoint for 5 minutes, generate a Level 2 alarm.

2. Room pressurization polarity alarm

a. Generate a Level 2 alarm if the airflow offset has incorrect polarity for 5 minutes based on sum of exhaust feedback signals and supply feedback signal:

1) For a room with negative offset, if exhaust minus supply < 0

2) For a room with positive offset, if exhaust minus supply > 0

3. Room low supply rate alarm

a. If the sum of exhaust feedback signals exceeds supply feedback signal by more than 4 times (adjustable) the offset for 1 minute:

1) Generate a Level 1 alarm (high level due to problems exiting)

2) All fume hood sashes in room shall be commanded closed.

3) All fume hood exhaust setpoints shall be reduced to a fixed percentage of the maximum hood rates, %hood-reduction.

4. Low supply air temperature

a. If boiler plant is proven on and the supply air temperature is 15°F less than setpoint for 10 minutes, generate a Level 3 alarm.

b. If boiler plant is proven on and the supply air temperature is 30°F less than setpoint for 10 minutes, generate a Level 2 alarm.

5. High supply air temperature

a. If chiller plant is proven on and the supply air temperature is 10°F more than setpoint for 10 minutes, generate a Level 3 alarm.

b. If chiller plant is proven on and the supply air temperature is 20°F more than setpoint for 10 minutes, generate a Level 2 alarm.

6. Fume hood

a. Fume hood alarm: Level 2

b. If average sash height (interpolated based on average cfm feedback through the hood and design maximum and minimum setpoints) during the last 24 hours is greater than 50% (adjustable), generate a Level 4 alarm

H. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to

1. Force supply airflow setpoint to zero

2. Force supply airflow setpoint to Vmax

3. Force supply airflow setpoint to Vmin

4. Force supply damper full closed/open

5. Force heating valve to closed/open

6. Force cooling valve to closed/open

7. Force hood exhaust airflow setpoint to Vhex-max

8. Force hood exhaust airflow setpoint to Vhex-min

9. Force general exhaust airflow setpoint to Vgex-max

10. Force general exhaust airflow setpoint to Vgex-ctrl-min

11. Reset request-hours accumulator point to zero (provide one point for each reset type listed below)

I. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change, send 3 Requests,

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change, send 2 Requests,

c. Else if the Cooling Loop is greater than 95%, send 1 Request until the Cooling Loop is less than 85%,

d. Else if the Cooling Loop is less than 95%, send 0 Requests

2. Exhaust or Supply Static Pressure Reset Requests (Venturi type valves; separately include all exhaust and supply air valves in zone)

a. If the air valve differential pressure is less than 0.25" for 30 seconds, send 3 request,

b. Else if the air valve differential pressure is less than 0.3" for 30 seconds, send 1 request,

c. Else if the air valve differential pressure is greater than 0.35", send 0 requests.

3. Exhaust or Supply Static Pressure Reset Requests (Feedback loop type valves; separately include all exhaust and supply air valves in zone)

a. If the measured airflow is less than 85% of setpoint for 30 seconds, send 3 requests,

b. Else if the Damper Loop is greater than 95%, send 1 request,

c. Else if the Damper Loop is less than 85%, send 0 requests.

4. Hot Water Reset Requests

a. If the discharge air temperature is 17°C (30°F) less than setpoint for 5 minutes, send 3 Requests,

b. Else if the discharge air temperature is 8°C (15°F) less than setpoint for 5 minutes, send 2 Requests,

c. Else if HW valve position is greater than 95%, send 1 Request until the HW valve position is less than 85%,

d. Else if the HW valve position is less than 95%, send 0 Requests

5. Heating Hot Water Plant Requests. Send the heating hot water plant that serves the zone a Heating Hot Water Plant Request as follows:

a. If the HW valve position is greater than 95%, send 1 Request until the HW valve position is less than 10%

b. Else if the HW valve position is less than 95%, send 0 Requests.

6. Chilled Water Reset Requests

a. If the supply air temperature is 10°F greater than setpoint for 5 minutes, send 3 requests,

b. Else if the supply air temperature is 5°F greater than setpoint for 5 minutes, send 2 requests,

c. Else if the CHW valve is greater than 95%, send 1 request,

d. Else if the CHW valve is less than 85%, send 0 requests.

7. Chiller Plant Requests. Send the chiller plant that serves the zone a Chiller Plant Request as follows:

a. If the CHW valve position is greater than 95%, send 1 Request until the CHW valve position is less than 10%

b. Else if the CHW valve position is less than 95%, send 0 Requests.

3.11 LABORATORY VAV REHEAT ZONE (FAST AND SLOW)

A. See “Generic Thermal Zones” (Section 3.4) for setpoints, loops, control modes, alarms, etc.

B. See Section 1.2D for airflow and discharge air temperature setpoints.

C. Lab air terminal controllable minimum

1. Supply air terminal controllable minimum (Vctrl-min) and general exhaust air valve controllable minimum (Vgex-ctrl-min) shall be determined in accordance with Paragraph 1.4B.

2. Where there is more than one terminal, rates shall be added together for control logic below.

D. Pressurization control

1. Sign conventions: All airflows have a positive sign, except for the room offset airflow which may be positive (for positively pressurized lab) or negative (for negatively pressurized lab.

2. The active supply air minimum Vmin* shall be equal to the larger of the following but no larger than Vmax:

a. Exhaust makeup air rate, Vmu

b. Minimum ventilation rate (Vvent) equal to

1) If the zone is unoccupied as indicated by its occupancy sensor and the lab is scheduled to be unoccupied, Vmin-unocc.

2) Otherwise, Vmin-occ

c. Vctrl-min

3. Vgex-step shall be equal to Vgex-ctrl-minimum

a. Exception: Vgex-step shall equal 0 if

1) The active airflow setpoint Vstp for temperature control is equal to Vmin*, and

2) The larger of Vvent and Vctrl-min has been less than or equal to the sum of the following for 30 seconds or more:

a) Sum of fume hood exhaust valve(s) airflow feedback

b) Vother

c) Voffset

4. The make-up airflow demand (Vmu) is equal to the sum of:

a. Sum of fume hood exhaust valve(s) airflow feedback

b. Vgex-step

c. Vother

d. Voffset

5. The active general exhaust valve setpoint Vgex-spt shall equal 0 when Vgex-step is equal 0; otherwise it shall equal the sum of the following but no larger than Vgex-max:

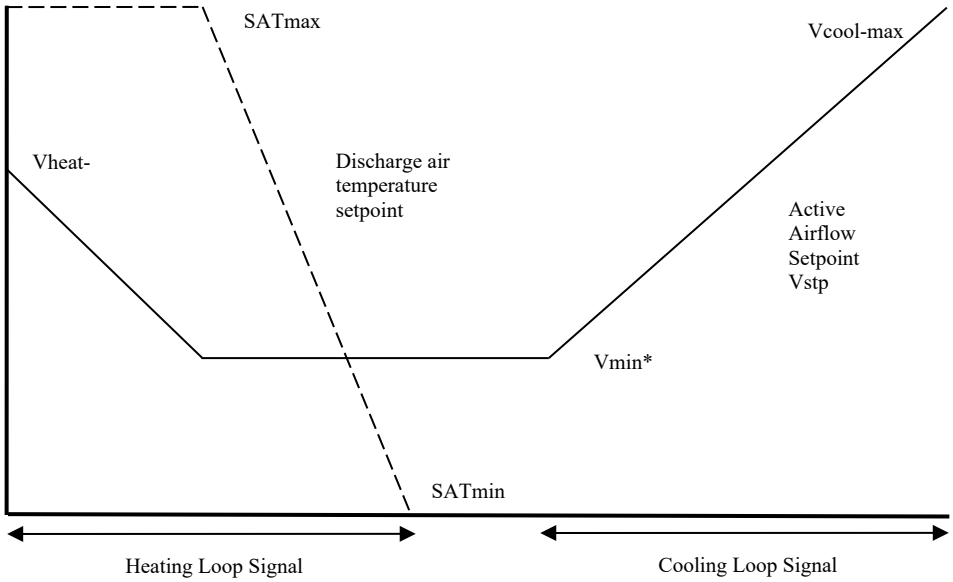
a. Supply valve feedback airflow minus Vmu

b. The general exhaust valve controllable minimum airflow, Vgex-ctrl-min

E. Supply air

1. Active endpoints used in the control logic depicted in the figure below shall not vary regardless of the Mode of the Zone Group the zone is a part of.

2. Control logic is depicted schematically in the figure below and described in the following sections.



3. When the Zone State is Cooling, the Cooling Loop output shall be mapped to the active airflow setpoint from the Vmin* to Vcool-max, but no lower than Vmin*..

    a. If supply air temperature from the air handler is greater than room temperature, the active airflow setpoint shall be no higher than Vmin*

4. When the Zone State is Deadband, the active airflow setpoint shall be Vmin*.

5. When the Zone State is Heating:

    a. From 0-50%, the Heating Loop output shall reset the discharge temperature setpoint from SATmin to SATmax. SATmin shall be 55ºF unless otherwise indicated on Drawings. The active airflow setpoint shall be Vmin*.

    b. From 51%-100%, if the discharge air temperature is greater than room temperature plus 3°C (5°F), the Heating Loop output shall reset the active airflow setpoint from the Vmin* to Vheat-max.

6. If the current supply air temperature from the AHU is less than the current heating coil discharge air setpoint, the heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off the zone temperature control loop is not acceptable).

7. Where drawings indicate supply air valves have on-board controllers, the airflow setpoint is sent to the controller and the controller modulates the VAV damper to maintain the measured airflow at setpoint.

8. Where drawings indicate supply air valves are controlled by the BAS, the VAV damper shall be modulated to maintain the measured airflow at setpoint.

F. General exhaust

1. Where drawings indicate general exhaust air valves have on-board controllers, the active airflow setpoint Vgex-spt is sent to the controller and the controller modulates the VAV damper to maintain the measured airflow at setpoint.

2. Where drawings indicate general exhaust air valves are controlled by the BAS, the VAV damper shall be modulated to maintain the measured airflow at the active airflow setpoint Vgex-spt.

G. Alarms

1. Airflow alarm

   a. If the airflow feedback from any valve is 15% above or below setpoint for 5 minutes, generate a Level 3 alarm.

   b. If the airflow feedback from any valve is 30% above or below setpoint for 5 minutes, generate a Level 2 alarm.

2. Room pressurization polarity alarm

   a. Generate a Level 2 alarm if the airflow offset has incorrect polarity for 5 minutes based on sum of exhaust feedback signals and supply feedback signal:

      1) For a room with negative offset, if exhaust minus supply < 0

      2) For a room with positive offset, if exhaust minus supply > 0

3. Room low supply rate alarm

   a. If the sum of exhaust feedback signals exceeds supply feedback signal by more than 4 times (adjustable) the offset for 1 minute:

      1) Generate a Level 1 alarm (high level due to problems exiting)

      2) All fume hood sashes in room shall be commanded closed.

      3) All fume hood exhaust setpoints shall be reduced to a fixed percentage of the maximum hood rates; this percentage shall be determined as specified in Section 230593 Testing, Adjusting and Balancing.

4. Low supply air temperature

   a. If boiler plant is proven on and the supply air temperature is 15°F less than setpoint for 10 minutes, generate a Level 3 alarm.

   b. If boiler plant is proven on and the supply air temperature is 30°F less than setpoint for 10 minutes, generate a Level 2 alarm.

5. High supply air temperature

   a. If chiller plant is proven on and the supply air temperature is 10°F more than setpoint for 10 minutes, generate a Level 3 alarm.

b. If chiller plant is proven on and the supply air temperature is 20°F more than setpoint for 10 minutes, generate a Level 2 alarm.

6. Fume hood

a. Fume hood alarm: Level 2

b. If average sash height (interpolated based on average cfm feedback through the hood and design maximum and minimum setpoints) during the last 24 hours is greater than 50% (adjustable), generate a Level 4 alarm

H. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to

1. Force supply airflow setpoint to zero

2. Force supply airflow setpoint to Vmax

3. Force supply airflow setpoint to Vmin

4. Force supply damper full closed/open

5. Force heating valve to closed/open

6. Force hood exhaust airflow setpoint to Vhex-max

7. Force hood exhaust airflow setpoint to Vhex-min

8. Force general exhaust airflow setpoint to Vgex-max

9. Force general exhaust airflow setpoint to Vgex-ctrl-min

10. Reset request-hours accumulator point to zero (provide one point for each reset type listed below)

I. System Requests

1. Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling setpoint by 3°C (5°F) for 2 minutes and after suppression period due to setpoint change, send 3 Requests,

b. Else if the zone temperature exceeds the zone's cooling setpoint by 2°C (3°F) for 2 minutes and after suppression period due to setpoint change, send 2 Requests,

c. Else if the Cooling Loop is greater than 95%, send 1 Request until the Cooling Loop is less than 85%,

d. Else if the Cooling Loop is less than 95%, send 0 Requests

2. Exhaust or Supply Static Pressure Reset Requests (Venturi type valves; separately include all exhaust and supply air valves in zone)

a. If the air valve differential pressure is less than 0.25” for 30 seconds, send 3 request,

b. Else if the air valve differential pressure is less than 0.3” for 30 seconds, send 1 request,

c. Else if the air valve differential pressure is greater than 0.35”, send 0 requests.

3. Exhaust or Supply Static Pressure Reset Requests (Feedback loop type valves; separately include all exhaust and supply air valves in zone)

a. If the measured airflow is less than 85% of setpoint for 30 seconds, send 3 requests,

b. Else if the Damper Loop is greater than 95%, send 1 request,

c. Else if the Damper Loop is less than 85%, send 0 requests.

4. If there is a hot water coil, Hot Water Reset Requests

a. If the discharge air temperature is 17°C (30°F) less than setpoint for 5 minutes, send 3 Requests,

b. Else if the discharge air temperature is 8°C (15°F) less than setpoint for 5 minutes, send 2 Requests,

c. Else if HW valve position is greater than 95%, send 1 Request until the HW valve position is less than 85%,

d. Else if the HW valve position is less than 95%, send 0 Requests

5. If there is a hot water coil, Heating Hot Water Plant Requests. Send the heating hot water plant that serves the zone a Heating Hot Water Plant Request as follows:

a. If the HW valve position is greater than 95%, send 1 Request until the HW valve position is less than 10%

b. Else if the HW valve position is less than 95%, send 0 Requests.

3.12 VENTILATION OUTDOOR AIR VALVES (FROM DOAS)

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See “Generic Ventilation Zones” (Section 3.3) for calculation of zone minimum outdoor airflow and Vmin*.

C. Active endpoints used in the control logic shall vary depending on the mode of the Zone Group the zone is a part of the Table below:

Endpoint	Occupied	Cooldown	Setup	Warmup	Setback	Unoccupied
Cooling maximum	Vcool-max	0	0	0	0	0

Minimum	Vmin*	0	0	0	0	0

D. Control logic is as described in the following subsections.

1. Airflow setpoint shall be the Minimum endpoint with the following exception:

a. If the zone the air valve is serving is in Cooling State and DOAS supply air temperature is less than the zone's space temperature, and window switches indicate windows are closed, the airflow setpoint shall be equal to the Cooling Maximum (to provide free cooling).

E. Alarms

1. See Paragraph 3.6G.

F. Testing/Commissioning Overrides

1. See Paragraph 3.6H.

G. System Requests

1. See Paragraph 3.6I.

3.13 2-PIPE OR 4-PIPE FAN COIL UNIT

A. See "Generic Thermal Zones" (Section 3.4) for setpoints, loops, control modes, alarms, etc.

B. See Section 1.2F for Cool_SAT, Heat_SAT, and DP100.

C. See Section 1.3B for MinSpeed, DeadbandSpeed, MaxHeatSpeed, and MaxCoolSpeed.

D. Supply Fan Speed and Supply Air Temperature Control

1. The supply fan shall run whenever the unit is in any mode other than Unoccupied Mode.

2. Provide a ramp function to prevent changes in fan speed of more than 10% per minute.

3. When the supply fan is proven on, fan speed and supply air temperature setpoints are controlled as shown in Figures 5.20.4.3. The points of transition along the x-axis shown and described are representative. Separate gains shall be provided for each section of the control map, that are determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 5.20.4.3 to provide stable control.

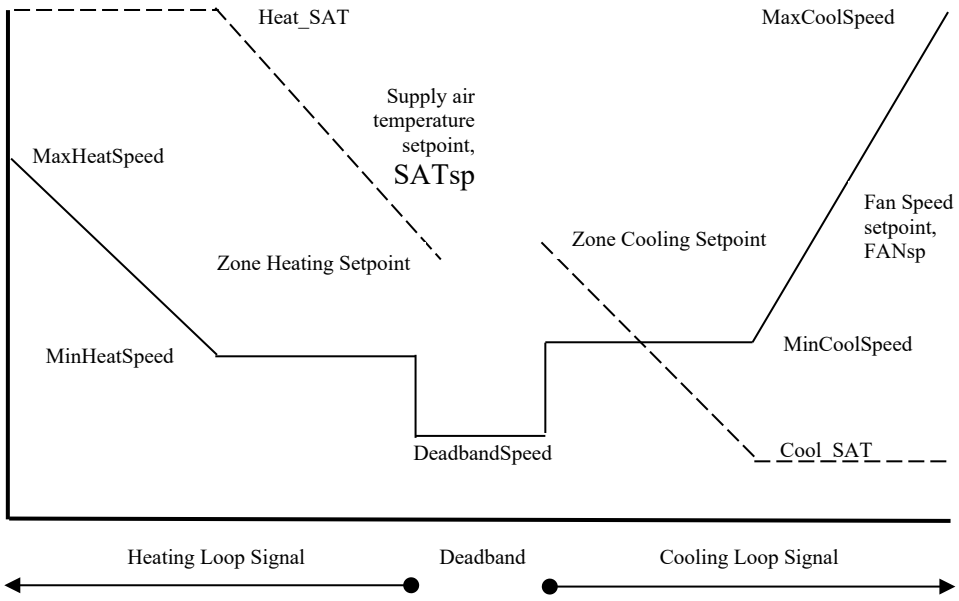


Figure 5.20.4.3 Control diagram for FCU.

a. If there is a heating coil, when Zone State is Heating

   1) For a heating-loop signal of 100% to 50%, FANsp is reset from MaxHeatSpeed to MinHeatSpeed.

   2) For a heating-loop signal of 50% to 0%, FANsp is MinHeatSpeed.

   3) For a heating-loop signal of 100% to 50%, SATsp is Heat_SAT.

   4) For a heating-loop signal of 50% to 0%, SATsp is reset from Heat_SAT to the active zone heating setpoint.

   5) The heating coil shall be modulated with a PID loop to maintain the discharge temperature at SATsp.

   6) Cooling coil off

b. When Zone State is Deadband

   1) FANsp shall be DeadbandSpeed. If DeadbandSpeed is zero, shut the fan off.

   2) Cooling coil off

   3) Heating coil off

c. If there is a cooling coil, when Zone State is Cooling

   1) For a cooling-loop signal of 0% to 50%, FANsp is MinCoolSpeed.

   2) For a cooling-loop signal of 50% to 100%, FANsp is reset from MinCoolSpeed to MaxCoolSpeed.

3) For a cooling-loop signal of 0% to 50%, SATsp is reset from the active zone cooling setpoint to Cool_SAT.

4) For a cooling-loop signal of 50% to 100%, SATsp is Cool_SAT.

5) The cooling coil shall be modulated with a PID loop to maintain the discharge temperature at SATsp.

6) Heating coil off

E. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

   a. Commanded on, status off: Level 2

   b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when fan speed exceeds 20% of MaxCoolSpeed: Level 4. The alarm limit shall vary with fan speed as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current fan speed x (expressed as a fraction). For instance, the setpoint at 50% of design speed would be (0.5)1.4 or 38% of the design high limit pressure drop. See Section 1.3E for MaxCoolSpeed and Section **Error! Reference source not found.** for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

F. Automatic Fault Detection and Diagnostics

The AFDD routines for FCUs continually assess FCU performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the OS of the AHU, as determined by the position of the cooling and heating valves. Time delays are applied to the evaluation and reporting of fault conditions to suppress false alarms. Fault conditions that pass these filters are reported to the building operator along with a series of possible causes.
These equations assume that the FCU is equipped with heating and cooling coils. If any of these components are not present, the associated tests and variables should be omitted from the programming.

1. AFDD conditions are evaluated continuously and separately for each operating FCU.

2. The OS of each FCU shall be defined by the commanded positions of the heating-coil control valve and cooling-coil control valve in accordance with Table 5.20.6.2 and Figure 5.20.6.2.

Table 5.20.6.2 FCU Operating States

Operating State	Heating Valve Position	Cooling Valve Position
#1: Heating	> 0	= 0
#2 No Heating or Cooling	= 0	= 0
#3: Cooling	= 0	> 0
#4 Unknown	No other OS applies	

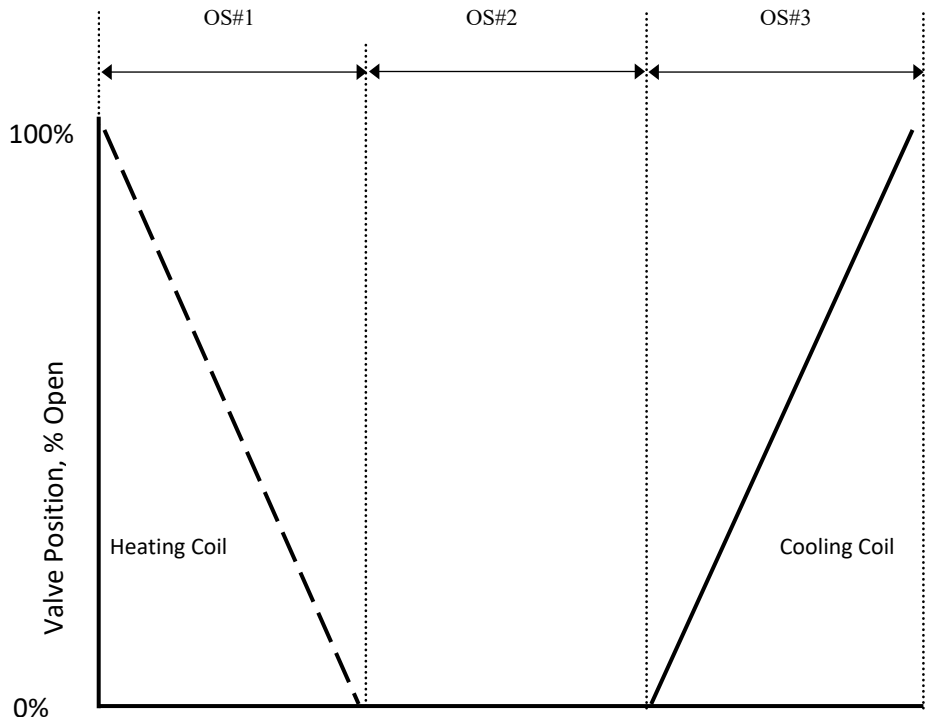


Figure 5.20.6.2 FCU operating states.

The OS is distinct from, and should not be confused with, the zone status (cooling, heating, deadband).
OS#1 through OS#3 (see Table 5.20.6.2) represent normal operation during which a fault may nevertheless occur if so determined by the fault condition tests in Section 3.18L.6. By contrast, OS#4 may represent an abnormal or incorrect condition (such as simultaneous heating and cooling) arising from a controller failure or programming error.

3. The following points must be available to the AFDD routines for each FCU:

For the AFDD routines to be effective, an averaging sensor is recommended for the supply air temperature but it is noted that in most cases a single point sensor will be provided with the FCU.

a. SAT = supply air temperature

b. RAT = return air temperature (if present)

c. SATsp = supply air temperature setpoint

d. HC = heating-coil valve position command; 0% ≤ HC ≤ 100%

e. CC = cooling-coil valve position command; 0% ≤ CC ≤ 100%

f. FS = fan-speed command; 0% ≤ FS ≤ 100%

4. The following values must be continuously calculated by the AFDD routines for each FCU:

   a. Five-minute rolling averages with 1-minute sampling of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently.

      1) SATavg = rolling average of supply air temperature

      2) RATavg = rolling average of return air temperature (if fitted)

      3) □OS = number of changes in OS during the previous 60 minutes (moving window)

5. The internal variables shown in Table 5.20.6.5 shall be defined for each FCU. All parameters are adjustable by the operator, with initial values as given below.

Default values are derived from NISTIR 7365 and have been validated in field trials. They are expected to be appropriate for most circumstances, but individual installations may benefit from tuning to improve sensitivity and reduce false alarms.
The default values have been intentionally biased toward minimizing false alarms, if necessary at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors such as fan heat, duct heat gain, and sensor error can be measured in the field or derived from trend logs. Likewise, the occupancy delay and switch delays can be refined by observing in trend data the time required to achieve quasi steady state operation.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false errors, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the heating coil, cooling coil, temperature, or flow thresholds.

Table 5.20.6.5 FCU Internal Variables

Variable Name	Description	Default Value
ΔTSF	Temperature rise across supply fan	0.5°C (1°F)
□SAT	Temperature error threshold for SAT sensor	1°C (2°F)
□RAT	Temperature error threshold for RAT sensor	1°C (2°F)

□OSmax	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	7
ModeDelay	Time in minutes to suspend Fault Condition evaluation after a change in mode	30
AlarmDelay	Time in minutes that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

The purpose of TestModeDelay is to ensure that normal fault reporting occurs after the testing and commissioning process is completed as described in Section 3.18L.12.

6. Table 5.20.6.6 shows potential fault conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The fault conditions to be evaluated at any given time will depend on the OS of the AHU.

The equations in Table 5.20.6.6 assume that the SAT sensor is located downstream of the supply fan and the RAT sensor is located upstream of the supply fan. If actual sensor locations differ from these assumptions, it may be necessary to add or delete fan heat correction factors.

Table 5.20.6.6 FCU Fault Conditions

FC #1	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #4
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC #2	Equation	SATAVG < SATSP - ƐSAT and HC ≥ 99%	Applies to OS #1
	Description	SAT too low in full heating	
	Possible Diagnosis	SAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat is unavailable DX cooling is stuck on	

FC #3	Equation	SATAVG > SATSP + ℇSAT and CC ≥ 99%	Applies to OS #3
	Description	SAT too high in full cooling	
	Possible Diagnosis	SAT sensor error Cooling coil valve stuck closed or actuator failure Fouled or undersized cooling coil CHW temperature too high or CHW unavailable DX cooling unavailable Gas or electric heat stuck on Heating coil valve leaking or stuck open	
FC#4	Equation	$SATAVG - RAT \geq \sqrt{\varepsilon_{RAT}^2 + \varepsilon_{SAT}^2} + \Delta TSF$	Applies to OS #2 (cooling only FCU with RAT)
	Description	Temperature drop across inactive cooling coil	
	Possible Diagnosis	RAT sensor error SAT sensor error Cooling coil valve stuck open or leaking DX cooling stuck on	
FC#5	Equation	$SATAVG - RAT \leq \sqrt{\varepsilon_{RAT}^2 + \varepsilon_{SAT}^2} + \Delta TSF$	Applies to OS #2 (heating only FCU with RAT)
	Description	Temperature rise across inactive heating coil	
	Possible Diagnosis	RAT sensor error SAT sensor error Heating coil valve stuck open or leaking Gas or electric heat stuck on	

7. A subset of all potential fault conditions is evaluated by the AFDD routines. The set of applicable fault conditions depends on the OS of the FCU.

   a. In OS#1 (Heating), the following fault conditions shall be evaluated:

      1) FC#1: Too many changes in OS

      2) FC#2: SAT too low in full heating

   b. In OS#2 (Deadband), the following fault conditions shall be evaluated:

      1) FC#5: Temperature drop across inactive heating coil (heating only FCU

      2) FC#4: Temperature drop across inactive cooling coil (cooling only FCU

   c. In OS#3 (Cooling), the following fault conditions shall be evaluated:

      1) FC#1: Too many changes in OS

      2) FC#3: SAT too high in full cooling

   d. In OS#4 (other), the following fault conditions shall be evaluated:

1) FC#1: Too many changes in OS

8. For each FCU, the operator shall be able to suppress the alarm for any fault condition.

9. Evaluation of fault conditions shall be suspended under the following conditions:

   a. When FCU is not operating

   b. For a period of ModeDelay minutes following a change in mode (e.g., from Warmup Mode or Cooldown Mode to Occupied Mode) of any Zone Group served by the FCU.

10. Fault conditions that are not applicable to the current OS shall not be evaluated.

11. A fault condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.

12. Test mode shall temporarily set ModeDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system and ensure normal fault detection occurs after testing is complete.

13. When a fault condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from Table 5.20.6.6.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a CHW and hot-water plant level to

   a. force HW valve full open if there is a hot-water coil,

   b. force HW valve full closed if there is a hot-water coil,

   c. force CHW valve full open if there is a CHW coil, and

   d. force CHW valve full closed if there is a CHW coil.

Per Section 5.1.10, all hardware points can be overridden through the BAS. Each of the following points is interlocked so that they can be overridden as a group on a plant level. For example, the CxA can check for valve leakage by simultaneously forcing closed all CHW valves at all coils served by the chiller plant and then recording flow at the chiller.

H. Plant Requests

1. If There Is a Chilled-Water Coil, Chilled-Water Reset Requests

   a. All requests shall be suppressed (send 0 requests) if fan is not at MaxCoolSpeed.

The previous sequence is to prevent CHWST reset until fan is at full speed since chiller plant energy is much larger than FC fan energy.

   b. If the supply air temperature is 10°F greater than setpoint for 5 minutes, send 3 requests,

   c. Else if the supply air temperature is 5°F greater than setpoint for 5 minutes, send 2 requests,

d. Else if the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 85%.

e. Else if the CHW valve position is less than 95%, send 0 requests.

2. If There Is a Chilled-Water Coil, Chiller Plant Requests. Send the chiller plant that serves the system a chiller plant request as follows:

a. If the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 10%.

b. Else if the CHW valve position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. All requests shall be suppressed (send 0 requests) if fan is not at MaxHeatSpeed.

The previous sequence is to prevent HWST reset until fan is at full speed since heating plant energy is much larger than FC fan energy.

b. If the supply air temperature is 17°C (30°F) less than SATsp for 5 minutes, send 3 requests.

c. Else if the supply air temperature is 8°C (15°F) less than SATsp for 5 minutes, send 2 requests.

d. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

e. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil, Heating Hot-Water Plant Requests. Send the heating hot-water plant that serves the FCU a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.14 VRF FAN COIL

A. See “Generic Thermal Zones” (Section 3.4) for setpoints, alarms, etc.

B. All fan-coils are controlled by built-in factory controls, not the BAS.

C. Fan coil factory logic shall be configured to stage fan speed as well as supply air temperature to achieve room temperature setpoint, and configured to go to minimum speed when in deadband.

D. All setpoints and scheduling shall be written from the BAS to the fan-coil controller via the BACnet interface.

1. Enable

a. Fan coils served by ventilation air valves shall be commanded to run in Occupied Mode by the BAS when the air valve is in Occupied Mode.

b. Otherwise, fan coils shall be enabled/disabled by internal logic based on difference between zone cooling and heating temperature setpoints and zone temperature.

3.15 CEILING FANS

A. Zone mode, zone state, cooling setpoint, and heating loop output shall be that of the associated VAV zone.

B. Setpoints (adjustable)

1. Cfan-min = the minimum speed signal that causes the fan to visibly rotate

2. Cfan-max = 60%

3. Tfan-min = current cooling setpoint temperature minus 3°F

4. Tfan-max = current cooling setpoint temperature

C. Ceiling fan shall be off except as follows:

1. In Occupied or Warmup Modes, if the VAV zone heating loop output is greater than 30% and the heating fan supply air temperature is greater than the room temperature by at least 5°F, the ceiling fan shall operate for destratification at Cfan-min.

2. In Occupied Mode, if the VAV zone heating loop output is 0 (Zone State is not Heating), the ceiling fan shall operate when the space temperature is above Tfan-min with speed varying proportionally from Cfan-min at Tfan-min up to Cfan-max at Tfan-max.

D. User override controls:

1. Local fan control includes a 0-2 hour windup timer and speed potentiometer.

2. While timer is on, and the VAV Zone Group is in Occupied Mode, fan shall run at the speed indicated by the potentiometer overriding other logic.

E. Alarms

1. Generate a Level 4 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status input being different from the output command for 15 seconds.

a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

F. Testing/Commissioning Overrides: Provide software points that interlock to a system level point to

1. Force ceiling fan to any user defined speed

3.16 AIR-HANDLING UNIT SYSTEM MODES

A. AHU system modes are the same as the mode of the Zone Group served by the system. When Zone Group served by an air-handling system are in different modes, the following hierarchy applies (highest one sets AHU mode):

a. Occupied Mode

b. Cooldown Mode

c. Setup Mode

d. Warmup Mode

e. Setback Mode

f. Unoccupied Mode

3.17 MULTIPLE ZONE VAV AIR HANDLERS

A. Supply Fan Control

1. Supply Fan Start/Stop

a. Supply fan shall run when system is in the Cooldown Mode, Setup Mode, or Occupied Mode.

b. If there are any VAV-reheat boxes on perimeter zones, supply fan shall also run when system is in Setback Mode or Warmup Mode (i.e., all modes except unoccupied).

c. Staged supply fan controls

1) VFD Fan groups shall be lead/lag controlled per Paragraph 3.1P.

2) When fans are enabled, start the lead supply fan. When %-supply airflow (totalized enabled VAV box setpoints (not readings) divided by design AHU airflow) exceeds stage-up setpoint (below) for 15 minutes (adjustable) then the next lag supply fan shall run. All VFDs receive the same speed signal. When %-airflow falls below the stage-up setpoint for 15 (adjustable) minutes then last lag

fan shall be staged off. Each stage shall have its own PID gains, separately tuned.

VFD Stage	Stage up Flow
1	0%
2	45%

VFD Stage	Stage up Flow
1	0%
2	30%
3	60%

VFD Stage	Stage up Flow
1	0%
2	25%
3	40%
4	75%

VFD Stage	Stage up Flow
1	0%
2	10%
3	25%
4	35%
5	55%
6	75%

d. Totalize current airflow rate from VAV boxes to a software point Vps.

VAV box airflow rates are summed to obtain overall supply air rate without the need for an airflow measuring station (AFMS) at the air-handler discharge. This is used for ventilation rate calculations and may also be used for display and diagnostics.

2. Static Pressure Set-Point Reset

a. Static pressure setpoint. Setpoint shall be reset using T&R logic (see Section 3.1O) using the parameters shown in Table 5.16.1.2.

Table 5.16.1.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	120 Pa (0.5 in. of water)
SPmin	25 Pa (0.1 in. of water)
SPmax	Max_DSP (see Section 1.3C.1)
Td	10 minutes
T	2 minutes
I	2
R	Zone static pressure reset requests

SPtrim	–12 Pa (–0.05 in. of water)
SPres	15 Pa (+0.06 in. of water)
SPres-max	32 Pa (+0.13 in. of water)

The T&R reset parameters in Table 5.16.1.2 are suggested as a starting point; they will most likely require adjustment during the commissioning/tuning phase.

3. Static Pressure Control

    a. Supply fan speed is controlled to maintain DSP at setpoint when the fan is proven on. Where the Zone Groups served by the system are small, provide multiple sets of gains that are used in the control loop as a function of a load indicator (such as supply-fan airflow rate, the area of the Zone Groups that are occupied, etc.).

High-pressure trips may occur if all VAV boxes are closed (as in Unoccupied Mode) or if fire/smoke dampers are closed (in some fire/smoke damper (FSD) designs, the dampers are interlocked to the fan status rather than being controlled by smoke detectors). Multiple sets of gains are used to provide control loop stability as system characteristics change.

B. Supply Air Temperature Control

1. Control loop is enabled when the supply air fan is proven on, and disabled and output set to deadband (no heating, minimum economizer) otherwise.

2. Supply Air Temperature Setpoint

The default range of outdoor air temperatures [21°C (70°F) –16°C (60°F)] used to reset the Occupied Mode SAT setpoint was chosen to maximize economizer hours. It may be preferable to use a lower range of OATs (e.g., 18°C [65°F] – 13°C [55°F]) to minimize fan energy if there is a 24/7 chiller plant that is running anyway; reheat is minimized, as in a VAV dual-fan dual-duct system, or the climate severely limits the number of available economizer hours.
If using this logic, the engineer should oversize interior zones and rooms with high cooling loads (design them to be satisfied by the warmest SAT) so these zones do not drive the T&R block to the minimum SAT setpoint.

    a. See Section 1.2G.1 for Min_ClgSAT, Max_ClgSAT, OAT_Min, and OAT_Max setpoints.

    b. During Occupied Mode and Setup Mode, setpoint shall be reset from Min_ClgSAT when the outdoor air temperature is OAT_Max and above, proportionally up to T-max when the outdoor air temperature is OAT_Min and below.

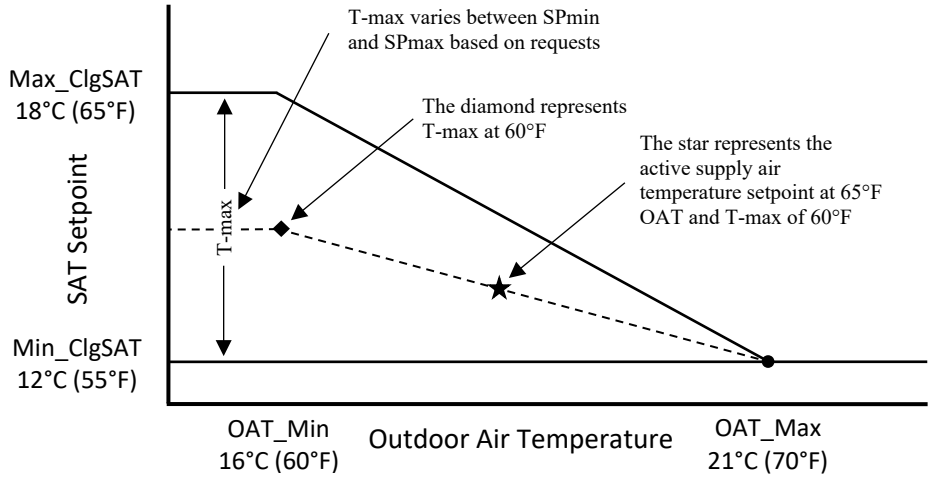
        1) T-max shall be reset using T&R logic (see Section 3.1O) between Min_ClgSAT and Max_ClgSAT. The parameters shown in Table 5.16.2.2 are suggested as a starting place, but they will require adjustment during the commissioning/tuning phase.

The T&R reset parameters in Table 5.16.2.2 are suggested as a starting place; they will most likely require adjustment during the commissioning/tuning phase.

Table 5.16.2.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	SPmax
SPmin	Min_ClgSAT
SPmax	Max_ClgSAT
Td	10 minutes
T	2 minutes
I	2
R	Zone cooling SAT requests
SPtrim	+0.1°C (+0.2°F)
SPres	–0.2°C (–0.3°F)
SPres-max	–0.6°C (–1.0°F)

The net result of this SAT reset strategy is depicted in the Figure 5.16.2.2 for Min_ClgSAT = 12°C (55°F), Max_ClgSAT = 18°C (65°F), OAT_Max = 21°C (70°F), and OAT_Min = 16°C (60°F).



Informative Figure 5.16.2.2 Example supply air temperature reset diagram.

c. During Cooldown Mode, setpoint shall be Min_ClgSAT.

d. During Warmup Mode and Setback Mode, setpoint shall be 35°C (95°F).

Raising the SAT setpoint in warmup will effectively lock out the economizer and cooling coil, which is desirable for warmup even if there is no heating coil at the AHU to meet the higher SAT.

This does not apply in the case of a DFDD AHU or if all the zones are equipped with fan-powered boxes such that the AHU is off in warmup and setback.

3. Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the heating coil (if applicable), outdoor air damper, return air damper, and cooling coil as shown in Figure 5.16.2.3.

    a. For units with return fans

        1) Return air damper maximum position MaxRA-P is modulated to control minimum outdoor air volume (see Sections 3.17D.3, 3.17E.3 and 3.17F.2).

    b. For units with relief dampers or relief fans

        1) Economizer damper minimum position MinOA-P and/or return air damper maximum position MaxRA-P are modulated to control minimum outdoor air volume (see Sections 3.17D.3, 3.17E.3 and 3.17F.2).

        2) For units with a separate minimum outdoor air damper, economizer damper minimum position MinOA-P is 0%, and return air damper maximum position MaxRA-P is modulated to control minimum outdoor air volume (see Sections 3.17D and 3.17E).

        3) For units with a single common minimum outdoor air and economizer damper, return air damper maximum position MaxRA-P and economizer damper minimum position MinOA-P are modulated to control minimum outdoor air volume (see Section 3.17F). Economizer damper maximum position MaxOA-P is limited during minimum outdoor air control (e.g., economizer lockout due to high OAT).

    c. The points of transition along the x-axis shown and described in Figure 5.16.2.3 are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer, cooling coil) that is determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 5.16.2.3 to provide stable control. Damper control depends on the type of building pressure control system.

For AHUs with relief fans, outdoor air and return air dampers are sequenced rather than complementary (as per traditional sequences) to reduce fan power at part loads.

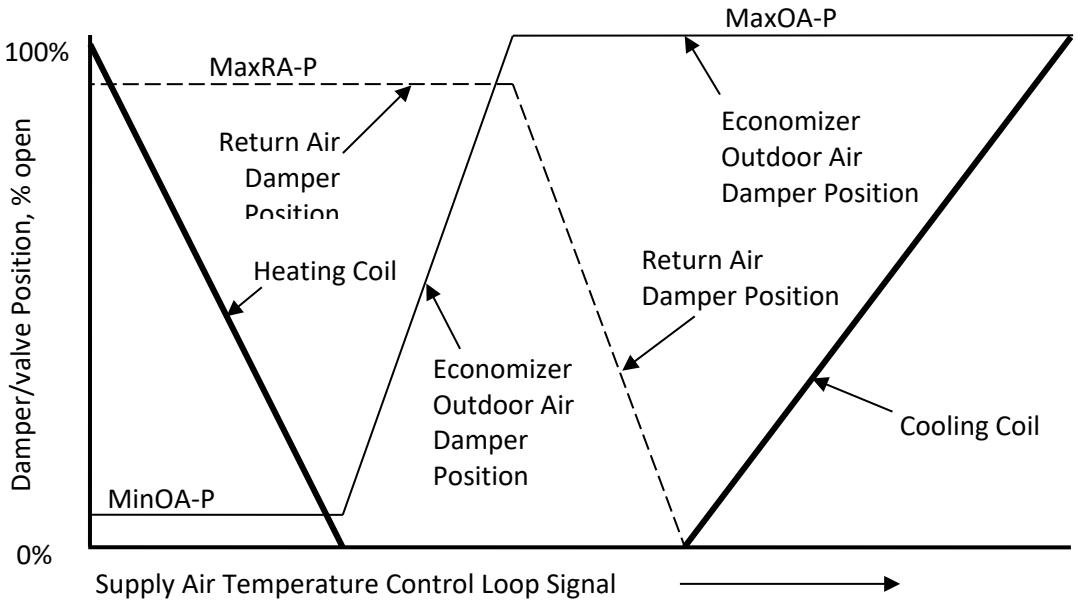


Figure 5.16.2.3-1 SAT loop mapping with relief damper or relief fan.

For AHUs with return fans and airflow tracking control, the SAT control loop makes the economizer outdoor air damper open fully whenever the AHU is on, while the return air damper modulates to maintain supply air temperature as shown below. Relief/exhaust damper position tracks inversely with the return damper position.
Outdoor air dampers on air handlers with return fans have no impact on the outdoor airflow rate into the mixing plenum. Instead, the return-fan and return-damper controls dictate outdoor air flow. See ASHRAE Guideline 16.
Note that the economizer damper will close (if there is a separate minimum outdoor air damper) or modulate to minimum position (if there is a single outdoor air damper) whenever minimum outdoor air control is active. See logic for Minimum Outdoor Air Control below.

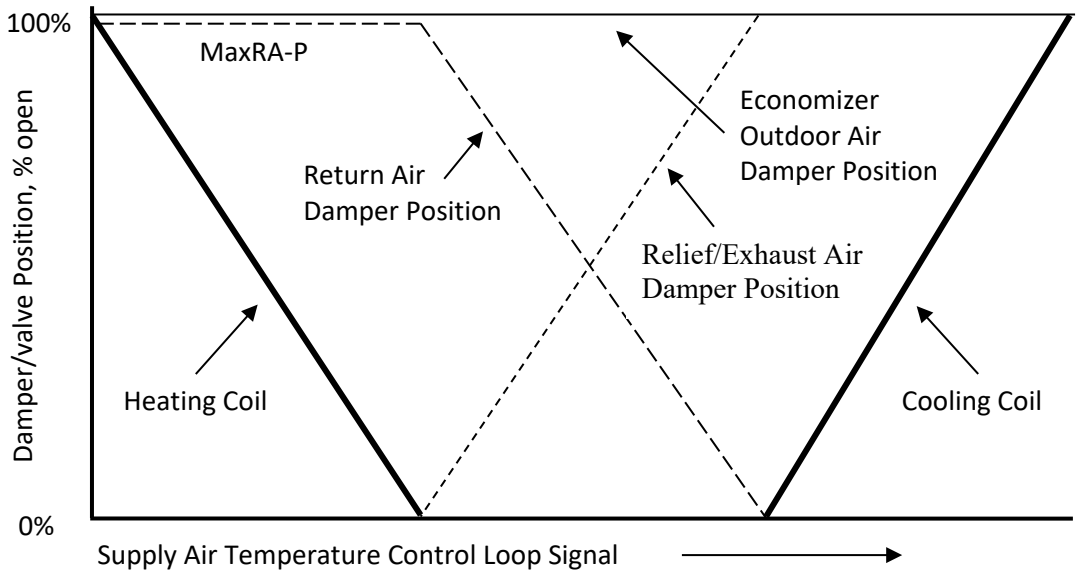


Figure 5.16.2.3-2 SAT loop mapping with return-fan control with airflow tracking.

For AHUs with return fans and direct building pressure controls, the SAT control loop makes the economizer outdoor air damper open fully whenever the AHU is on, while the return air damper modulates to maintain supply air temperature as shown below. Relief/exhaust damper position tracks inversely with the return damper position.
Outdoor air dampers on air handlers with return fans have no impact on the outdoor airflow rate into the mixing plenum. Instead, the return-fan and return-damper controls dictate outdoor air flow. See ASHRAE Guideline 16.
Note that the economizer damper will close (if there is a separate minimum outdoor air damper) or modulate to minimum position (if there is a single outdoor air damper) whenever minimum outdoor air control is active. See logic for Minimum Outdoor Air Control below.

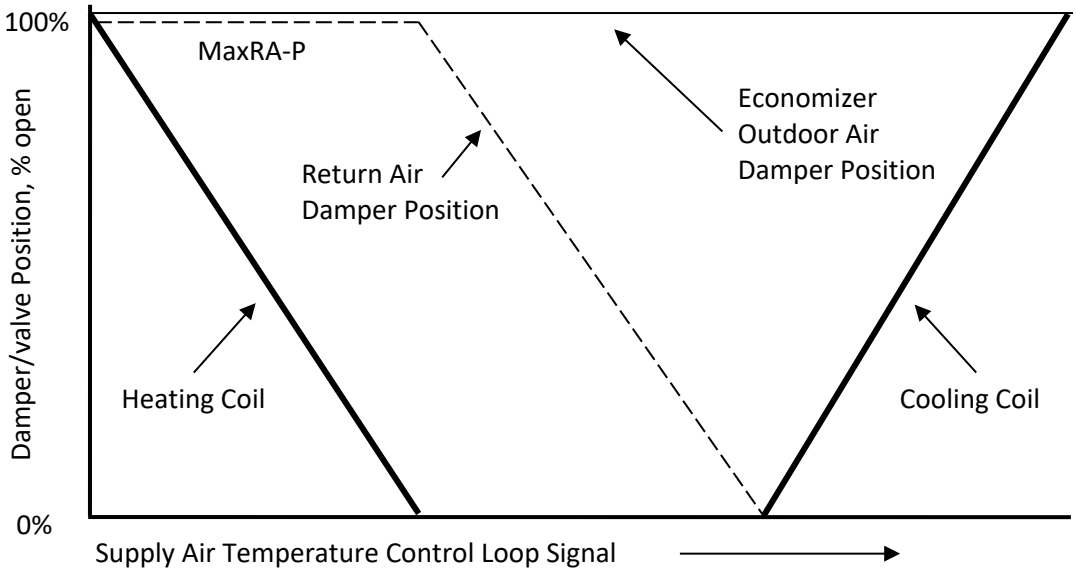


Figure 5.16.2.3-3 SAT loop mapping with return-fan control with direct building pressure controls.

C. Minimum Outdoor Airflow Setpoints

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

a. See Section 3.3A.3 for zone outdoor air rates Zone-Abs-OA-min and Zone-Des-OA-min.

b. See Section 1.2G.2.a for setpoints AbsMinOA and DesMinOA.

c. Effective outdoor air absolute minimum and design minimum setpoints are recalculated continuously based on the mode of the zones being served.

1) AbsMinOA* is the sum of Zone-Abs-OA-min for all zones in all Zone Groups that are in Occupied Mode but shall be no larger than the absolute minimum outdoor airflow AbsMinOA.

2) DesMinOA* is the sum of Zone-Des-OA-min for all zones in all Zone Groups that are in Occupied Mode but shall be no larger than the design minimum outdoor airflow DesMinOA.

D. Minimum Outdoor Air Control with a Separate Minimum Outdoor Air Damper and Differential Pressure Control

1. DP setpoint for California Title 24 Ventilation

a. See Section 1.1.1.1.a for design OA DP setpoints.

b. See Section 3.17C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

c. See zone CO2 control logic under terminal unit sequences.

d. The active minimum DP setpoints AbsDPsp* and DesDPsp* shall be determined by the following equations:

$$\text{AbsDPsp} *= \text{AbsMinDP}\left[\frac{\text{AbsMinOA} *}{\text{AbsMinOA}}\right]^2$$

$$\text{DesDPsp} *= \text{DesMinDP}\left[\frac{\text{DesMinOA} *}{\text{DesMinOA}}\right]^2$$

This equation prevents excess outdoor air from being supplied during periods of partial occupancy.

e. The minimum outdoor air DP setpoint MinDPsp shall be reset based on the highest zone CO2 control-loop signal from AbsDPsp* at 50% signal to DesDPsp* at 100% signal.

f. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Open minimum outdoor air damper when the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero. Damper shall be closed otherwise.

3. Outdoor Air and Return Air Dampers

a. For units with return fans

Minimum outdoor air control is enabled when return damper position exceeds MRA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
The 20% threshold can be increased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

2) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Qare exceeded.

b) When the minimum outdoor air damper is open and the return air damper position is greater than MRA-P.

3) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 3.17Bshall be suspended per the following sequence:

a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b) Wait 15 seconds, then close the economizer outdoor air damper; and

c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 3.17B. Economizer outdoor air damper remains closed.

d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at setpoint MinDPsp.

4) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are not exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

5) When minimum outdoor air control is disabled:

a) Economizer outdoor air damper shall be fully opened.

b) MaxRA-P shall be set to 100%.

c) Economizer and return air damper positions shall be controlled by the SAT control loop per Section 3.17B.

b. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.

The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2) When the supply air fan is proven on and the system is in Occupied Mode and MinDPsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

    a) The economizer high limit conditions in Section 3.1Q are exceeded.

    b) When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 3.17B shall be suspended per the following sequence:

    a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

    b) Wait 15 seconds, then close the economizer outdoor air damper; and

    c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 3.17B. Economizer outdoor air damper remains closed.

    d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at setpoint MinDPsp.

5) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

    a) The economizer high limit conditions in Section 3.1Q are not exceeded.

    b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6) When minimum outdoor air control is disabled:

a) MaxRA-P shall be set to 100%.

b) Economizer and return air damper positions shall be controlled by the SAT control loop per Section 3.17B.

E. Minimum Outdoor Air Control with a Separate Minimum Outdoor Air Damper and Airflow Measurement

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

a. See Section 3.17C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

b. See zone CO2 control logic under terminal unit sequences.

c. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Open the minimum outdoor air damper when the supply fan is proven ON, the AHU is in Occupied Mode and MinOAsp is greater than zero. Minimum outdoor air damper shall be closed otherwise.

3. Outdoor Air and Return Air Dampers

a. For units with return fans

Minimum outdoor air control is enabled when return damper position exceeds MRA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
The 20% threshold can be increased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in Occupied Mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

2) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are exceeded.

b) When the minimum outdoor air damper is open and the return air damper position is greater than MRA-P.

3) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section B shall be suspended per the following sequence:

a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b) Wait 15 seconds, then close the economizer outdoor air damper; and

c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section B. Economizer outdoor air damper remains closed.

d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at setpoint MinOAsp.

4) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

5) When minimum outdoor air control is disabled:

a) Economizer outdoor air damper shall be fully opened.

b) MaxRA-P shall be set to 100%.

c) Economizer and return air damper positions shall be controlled by the SAT control loop per Section B.

b. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.
The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1) When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2) When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed

proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3) Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are exceeded.

b) When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4) When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section B shall be superseded per the following:

a) Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b) Wait 15 seconds, then close the economizer outdoor air damper; and

c) Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section B. Economizer outdoor air damper remains closed.

d) The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at setpoint MinOAsp.

5) Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a) The economizer high limit conditions in Section 3.1Q are not exceeded.

b) The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6) When minimum outdoor air control is disabled:

a) MaxRA-P shall be set to 100%.

b) Economizer and return air damper positions shall be controlled by the SAT control loop per Section B.

F. Minimum Outdoor Air Control with a Single Common Damper for Minimum Outdoor Air and Economizer Functions and Airflow Measurement

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

a. See Section 3.17C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

b. See zone CO2 control logic under terminal unit sequences.

c. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

2. Minimum Outdoor Air Control Loop

a. Minimum outdoor air control loop is enabled when the supply fan is proven on and the AHU is in Occupied Mode, and disabled and output set to zero otherwise.

b. For units with return fans:

The following logic limits the return damper position to ensure that minimum outdoor air is maintained at all times, while the actual return damper position is modulated by the SAT control loop.

1) The outdoor airflow rate shall be maintained at the minimum outdoor damper outdoor airflow setpoint MinOAsp by a direct-acting control loop whose output is mapped to the return air damper maximum position endpoint MaxRA-P.

The following logic directly controls the return damper position to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

2) While the unit is in Occupied Mode, if the economizer high limit conditions in Section 3.1Q are exceeded for 10 minutes, outdoor air shall be controlled to the minimum outdoor airflow. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended, and the return air damper position shall be modulated directly to maintain measured airflow at MinOAsp (i.e. return damper position shall equal MaxRA-P). The economizer damper shall remain open.

3) If the economizer high limit conditions in Section 3.1Q are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, release return damper to control by the SAT control loop (i.e. return damper position is limited by MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

c. For units with relief dampers or relief fans:

The following logic limits the return and economizer damper positions to ensure that minimum outdoor air is maintained at all times, while the actual damper positions are modulated by the SAT control loop.

1) The outdoor airflow rate shall be maintained at the minimum outdoor air setpoint MinOAsp by a reverse-acting control loop whose output is mapped to economizer damper minimum position MinOA-P and return air damper maximum position MaxRA-P as indicated in Figure 5.16.6.3.

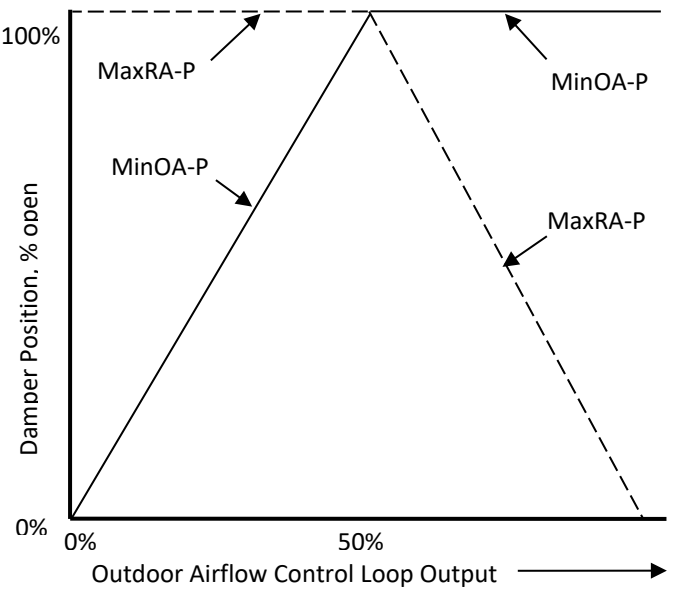


Figure 5.16.6.3 Minimum outdoor airflow control mapping with single damper.

The following logic directly controls the return and economizer damper positions to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

2) While the unit is in Occupied Mode, if the economizer high limit conditions in Section 3.1Q are exceeded for 10 minutes, outdoor airflow shall be controlled to the minimum outdoor airflow setpoint, MinOAsp. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended as follows:

   a) Fully open the return air damper

   b) Wait 15 seconds, then set MaxOA-P equal to MinOA-P

   c) Wait 3 minutes, then modulate the return air damper to maintain the measured airflow at MinOAsp (i.e. return air damper position shall equal MaxRA-P).

3) If the economizer high limit conditions in Section 3.1Q are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, set MaxOA-P = 100% and release the return air damper to control by the SAT control loop (i.e. return air damper position is limited by the MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

G. Control of Actuated Relief Dampers without Fans

1. Relief dampers shall be enabled when the associated supply fan is proven on, and disabled otherwise.

2. When enabled, use a P-only control loop to modulate relief dampers to maintain 12 Pa (0.05 in. of water) building static pressure. Close damper when disabled.

H. Relief-Fan Control

A pressure zone is defined as an enclosed area with interconnected return paths. The appropriate boundaries for pressure zones, establishing which relief fans run together and which building pressure sensors are used, will need to be determined by the engineer based on building geometry.
Relief fans are enabled and disabled with their associated supply fans, but all relief fans that are running and serve a pressure zone run at the same speed. All operating relief fans that serve a pressure zone shall be controlled as if they were one system, running at the same speed and using the same control loop, even if they are associated with different AHUs. For example, if two AHUs share a pressure zone, their relief fans should be controlled together as one system, while both AHUs are operating.
This prevents relief fans from fighting each other, which can lead to flow reversal or unstable fan speed control and space pressurization problems.
The appropriate boundaries between relief systems, establishing which relief fans run together, will need to be determined by the engineer based on building geometry.

1. See Section 1.2G.5 for pressure Zone Group assignments.

2. Relief fans or relief fan VFD Fan groups shall be lead/lag controlled per Paragraph 3.1P.

3. All operating relief fans that serve a pressure zone shall be grouped and controlled as if they were one system, running at the same speed when enabled and using the same control loop, even if they are associated with different AHUs.

4. A relief fan shall be enabled when its associated supply fan is proven on, and shall be disabled otherwise.

5. Building static pressure shall be time averaged with a sliding 5-minute window and 15 second sampling rate (to dampen fluctuations). The averaged value shall be that displayed and used for control.

    a. Where multiple building pressure sensors are used, each shall be time-averaged and the highest of the averaged values for sensors within a pressure zone shall be used for control.

6. A single P-only control loop for each pressure zone shall maintains the building pressure at a setpoint of 12 Pa (0.05 in. of water) with an output ranging from 0% to 100%. The loop shall be enabled when any supply fan within the pressure zone is proven ON. The loop is disabled with output set to zero otherwise.

The following is intended to use barometric relief as the first stage and then maintain many fans on at low speed to minimize noise and reduce losses through discharge dampers and louvers. Fans are staged off only when running at minimum speed.
For best results, fan speed minimums should be set as low as possible.

7. Fan speed signal to all operating fans in the relief system group shall be the same and shall be equal to the PID signal but no less than the minimum speed. Except for Stage 0, discharge dampers of all relief fans shall be open only when fan is commanded on.

In some installations, the relief fan inlet plenum may also be the return plenum to the AHU mixed air plenum, in which case the pressure in this plenum may be drawn negative relative to the outdoors by the supply air fan drawing return air from this plenum. This can occur when the return path has a fairly high pressure drop. If the engineer is concerned that this may occur, Stage 0 and references to it should be deleted.

a. Stage 0 (barometric relief). When relief system is enabled, and the control loop output is above 5%, open the motorized dampers to all relief fans serving the relief system group that are enabled; close the dampers when the loop output drops to 0% for 5 minutes.

b. Stage Up. When control loop is above minimum speed plus 15%, start stage-up timer. Each time the timer reaches 7 minutes, start the next relief fan (and open the associated damper) in the relief system group, per staging order, and reset the timer to 0. The timer is reset to 0 and frozen if control loop is below minimum speed plus 15%.

1) For systems where relief fans share a common relief fan inlet plenum: When staging from Stage 0 (no relief fans) to Stage 1 (one relief fan), the relief dampers of all nonoperating relief fans must be closed.

2) For systems where relief fans do not share a common relief fan inlet plenum: When staging from Stage 0 (no relief fans) to Stage 1 (one relief fan), the discharge dampers of all nonoperating relief fans shall remain open when the associated supply fan is proven ON.

c. Stage Down. When PID loop is below minimum speed, start stage-down timer. Each time the timer reaches 5 minutes, shut off lag fan per staging order and reset the timer to 0. The timer is reset to 0 and frozen if PID loop rises above minimum speed or all fans are off. If all fans are off, go to Stage 0 (all dampers open and all fans off).

8. For fans in a Level 2 alarm and status is off, discharge damper shall be closed when stage is above Stage 0.

I. Return-Fan Control − Direct Building Pressure

1. See Section 1.2G.5 for pressure Zone Group assignments.

2. Return fan or return fan VFD Fan groups shall be lead/lag controlled per Paragraph 3.1P.

3. Return fan operates whenever the associated supply fan is proven on and shall be off otherwise.

4. Return fans shall be controlled to maintain return-fan discharge static pressure at setpoint (Section 3.17I.6).

5. Building static pressure shall be time averaged with a sliding 5-minute window and 15 second sampling rate (to dampen fluctuations). The averaged value shall be that displayed and used for control.

a. Where multiple building pressure sensors are used, the highest of the averaged values for sensors within a pressure zone shall be used for control.

Due to the potential for interaction between the building pressurization and return-fan control loops, extra care must be taken in selecting the control loop gains. To prevent excessive control-loop interaction, the closed-loop response time of the building pressurization loop should not exceed 1/5 the closed-loop response time of the return-fan control loop. This can be accomplished by decreasing the gain of the building pressurization control loop.

6. A single P-only control loop for each pressure zone shall modulate to maintain the building pressure at a setpoint of 12 Pa (0.05 in. of water) with an output ranging from 0% to 100%. The loop shall be enabled when the supply and return fans for any unit within the pressure zone are proven ON and the minimum outdoor air damper is open. The exhaust dampers shall be closed with loop output set to zero otherwise. All exhaust damper and return fan static pressure setpoints for units in an associated pressure zone shall be sequenced based on building pressure control loop output signal, as shown in Figure 5.16.10.5.

A pressure zone is defined as an enclosed area with interconnected return air paths. All operating relief dampers and return fans that serve a pressure zone shall be controlled as if they were one system, using the same control loop, even if they are associated with different AHUs.
The appropriate boundaries for pressure zones, establishing which return fans run together, will need to be determined by the engineer based on building geometry.

   a. From 0% to 50%, the building pressure control loop shall modulate the exhaust dampers from 0% to 100% open.

   b. From 51% to 100%, the building pressure control loop shall reset the return-fan discharge static pressure setpoint from RFDSPmin at 50% loop output to RFDSPmax at 100% of loop output. See Section 1.3C.3 for RFDSPmin and RFDSPmax.

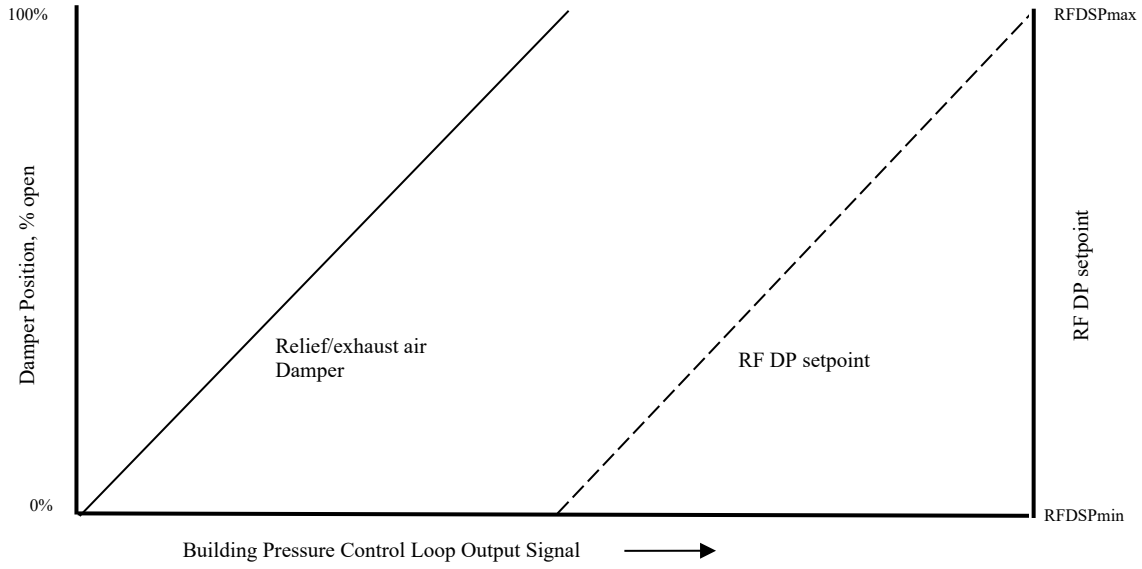


Figure 5.16.10.5 Exhaust damper position and return-fan DP reset

J. Return-Fan Control − Airflow Tracking

   1. Return fan operates whenever associated supply fan is proven on.

2. The active differential airflow setpoint S-R-DIFF* shall be S-R-DIFF for the entire system (see Section 1.3C.5) adjusted by the sum of the area component of the breathing zone outdoor air flow rate of zones in Zone Groups that are in Occupied Mode relative to that in all zones served by the system.

The equations below will result in S-R-DIFF set to zero if no zones are in Occupied Mode, e.g., during Warmup, Cooldown, Setback, and Setup Modes.

a. $$S-R-DIFF^{*} = S-R-DIFF\frac{\sum_{all\ Occupied\ Zones} V_{area-min}}{\sum_{all\ Zones} V_{area-min}}$$

3. Return-fan speed shall be controlled to maintain return airflow equal to supply airflow less differential S-R-DIFF*. Where multiple air handling units share a common return fan (i.e. dual fan dual duct), return fan speed shall be controlled to maintain return airflow equal to total supply airflow of all associated units less differential S-R-DIFF*.

The following logic will keep supply airflow from exceeding the capability of the return fan, which is often designed to be smaller than the supply fan, which can result in excess outdoor air intake. This becomes an issue when S-R-DIFF is zero during Warmup, Cooldown, Setback, and Setup Modes because the supply air fan can be at full speed due to VAV boxes operating at Vcool-max during these modes.*

4. Supply fan airflow shall be limited by a reverse-acting P-only loop whose setpoint is (Vrf-max + S-R-DIFF*) and whose output is maximum supply fan speed ranging from 0% to 100%.

5. Relief/exhaust dampers shall be enabled when the associated supply and return fans are proven on and closed otherwise. Exhaust dampers shall modulate as the inverse of the return air damper per Section 3.17B.3.

Airflow tracking requires a measurement of supply airflow and return airflow. Appendix A-9shows AFMS at both fans. These are actually not mandatory, although they may improve accuracy if properly installed. The supply airflow can be calculated by summing VAV box airflow rates. Return airflow can be approximated by return-fan speed if there are no dampers in the return air path (the geometry of the return air system must be static for speed to track airflow.)
S-R-DIFF is determined empirically during the TAB phase. If there are intermittent or variable-flow exhaust fans, this setpoint should be dynamically adjusted based on exhaust fan status or airflow/speed.
Freeze protection logic was deleted since it is buggy and not needed in Bay Area. .

K. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval count when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

a. Commanded on, status off: Level 2

b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when airflow (expressed as a percentage of design airflow or design speed if total airflow is not known) exceeds 20%: Level 4. The alarm limit shall vary with total airflow (if available; use fan speed if total airflow is not known) as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high-limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current airflow rate x (expressed as a fraction). For instance, the setpoint at 50% of design airflow would be (0.5)1.4, or 38% of the design high-limit pressure drop. See Section 1.2G.4 for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

4. High building pressure (more than 25 Pa [0.10 in. of water]) for 5 minutes: Level 3.

5. Low building pressure (less than 0 Pa [0.0 in. of water], i.e., negative) for 5 minutes: Level 4.

Automatic fault detection and diagnostics (AFDD) is a sophisticated system for detecting and diagnosing air-handler faults.
To function correctly, AFDD requires specific sensors and data be available, as detailed in the sequences below. If this information is not available, AFDD tests that do not apply should be deleted.

L. Automatic Fault Detection and Diagnostics

The AFDD routines for AHUs continually assess AHU performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the operating state (OS) of the AHU, as determined by the position of the cooling and heating valves and the economizer damper. Time delays are applied to the evaluation and reporting of fault conditions to suppress false alarms. Fault conditions that pass these filters are reported to the building operator along with a series of possible causes.
These equations assume that the air handler is equipped with hydronic heating and cooling coils, as well as a fully integrated economizer. If any of these components are not present, the associated tests and variables should be omitted from the programming.
Note that these alarms rely on reasonably accurate measurement of mixed air temperature. An MAT sensor is required for many of these alarms to work, and an averaging sensor is strongly recommended for best accuracy.

1. AFDD conditions are evaluated continuously and separately for each operating AHU.

2. For units with return fans:

   a. The OS of each Ahu shall be defined by the commanded positions of the heating coil control valve, cooling coil control valve and the return air damper in accordance with Table 2.

Table 2 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Return Air Damper Position

#1: Heating	> 0	= 0	= MaxRA-P
#2: Free cooling, modulating OA	= 0	= 0	MaxRA-P > x > 0%
#3: Mechanical + economizer cooling	= 0	> 0	= 0%
#4: Mechanical cooling, minimum OA	= 0	> 0	= MaxRA-P
#5: Unknown or dehumidification	No other OS applies		

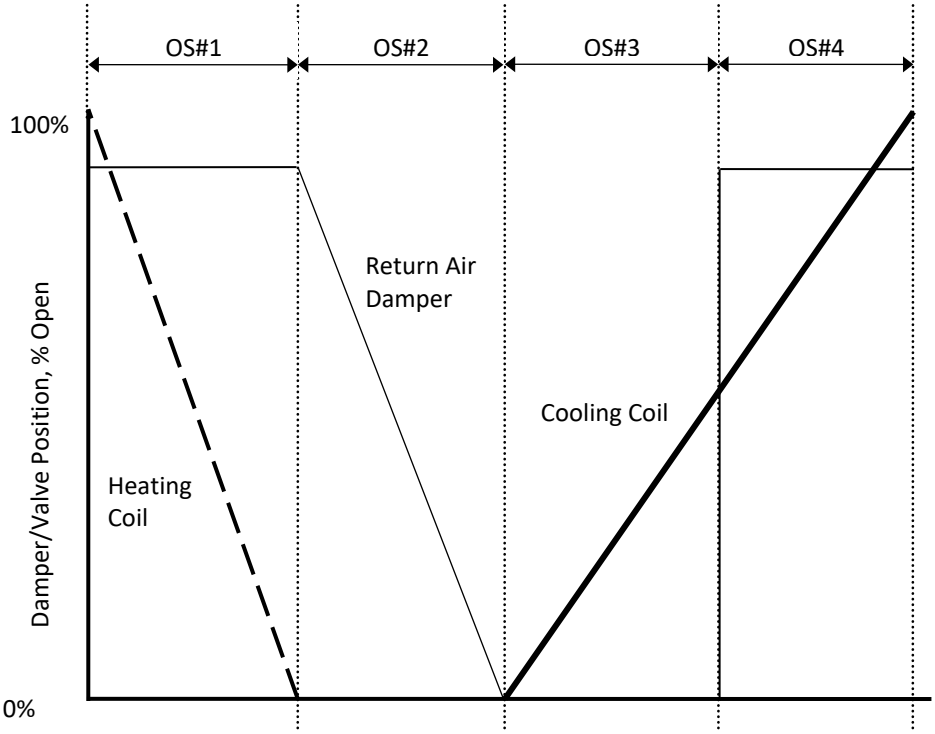


Figure 2 VAV AHU operating states.

3. For units with relief dampers or relief fans and a separate minimum outdoor air damper:

   a. The OS of each AHU shall be defined by the commanded positions of the heating-coil control valve, cooling-coil control valve, and economizer damper in accordance with Table 3 and Figure 3.

Table 3 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Economizer Outdoor Air Damper Position
#1: Heating	> 0	= 0	= 0%
#2: Free cooling, modulating OA	= 0	= 0	0% < x < 100%
#3: Mechanical + economizer cooling	= 0	> 0	= 100%
#4: Mechanical cooling, minimum OA	= 0	> 0	= 0%

#5: Unknown or dehumidification	No other OS applies

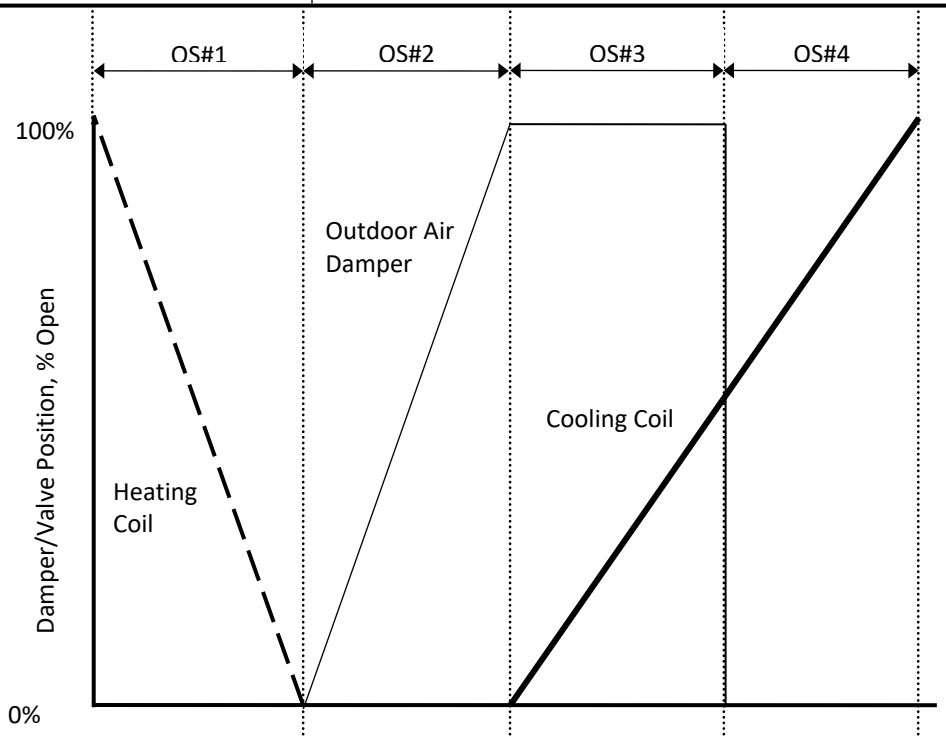


Figure 3 VAV AHU operating states.

4. For units with relief dampers or relief fans and a single common damper of minimum outdoor air and economizer functions.

    a. The OS of each AHU shall be defined by the commanded positions of the heating-coil control valve, cooling-coil control valve, and economizer damper in accordance with Table 4 and Figure 4.

Table 4 VAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Outdoor Air Damper Position
#1: Heating	> 0	= 0	= MinOA-P
#2: Free cooling, modulating OA	= 0	= 0	MinOA-P < x < 100%
#3: Mechanical + economizer cooling	= 0	> 0	= 100%
#4: Mechanical cooling, minimum OA	= 0	> 0	= MinOA-P
#5: Unknown or dehumidification	No other OS applies		

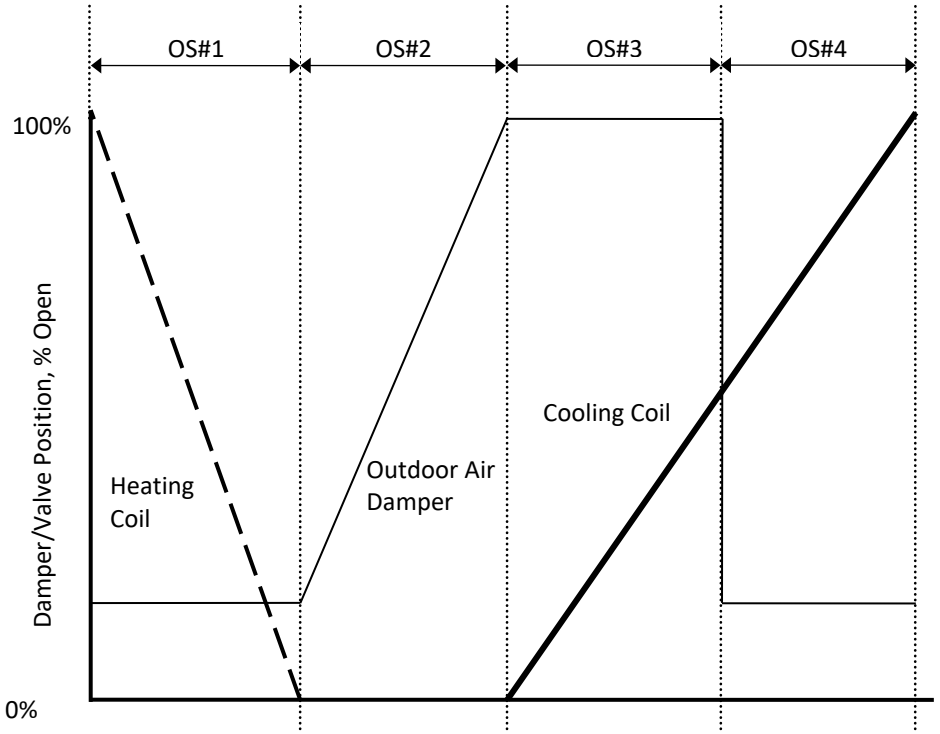


Figure 4 VAV AHU operating states.

The OS is distinct from, and should not be confused with, the zone status (cooling, heating, deadband) or Zone Group mode (occupied, warmup, etc.).
OS#1 through OS#4 (see Tables 2 through 4) represent normal operation during which a fault may nevertheless occur if so determined by the fault condition tests in Section 8. By contrast, OS#5 may represent an abnormal or incorrect condition (such as simultaneous heating and cooling) arising from a controller failure or programming error, but it may also occur normally, e.g., when dehumidification is active or during warmup.

5. The following points must be available to the AFDD routines for each AHU:

For the AFDD routines to be effective, an averaging sensor is recommended for SAT. An averaging sensor is essential for MAT, as the environment of the mixing box will be subject to nonuniform and fluctuating air temperatures. It is recommended that the OAT sensor be located at the AHU so that it accurately represents the temperature of the incoming air.

a. SAT = supply air temperature

b. MAT = mixed air temperature

c. RAT = return air temperature

d. OAT = outdoor air temperature

e. DSP = duct static pressure

f. SATSP = supply air temperature setpoint

g. DSPSP = duct static pressure setpoint

h. HC = heating-coil valve position command; 0% □ HC □ 100%

i. CC = cooling-coil valve position command; 0% □ CC □ 100%

j. FS = fan speed command; 0% □ FS □ 100%

k. CCET = cooling-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose.)

l. CCLT = cooling-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

m. HCET = heating-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose.)

n. HCLT = heating-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

6. The following values must be continuously calculated by the AFDD routines for each AHU:

a. Five-minute rolling averages with 1-minute sampling time of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently.

1) SATavg = rolling average of supply air temperature

2) MATavg = rolling average of mixed air temperature

3) RATavg = rolling average of return air temperature

4) OATavg = rolling average of outdoor air temperature

5) DSPavg = rolling average of duct static pressure

6) CCETavg = rolling average of cooling-coil entering temperature

7) CCLTavg = rolling average of cooling-coil leaving temperature

8) HCETavg = rolling average of heating-coil entering temperature

9) HCLTavg = rolling average of heating-coil leaving temperature

b. %OA = actual outdoor air fraction as a percentage = (MAT – RAT)/(OAT – RAT), or per airflow measurement station if available.

c. %OAmin = active minimum OA setpoint (MinOAsp) divided by actual total airflow (from sum of VAV box flows or by airflow measurement station) as a percentage.

d. OS = number of changes in operating state during the previous 60 minutes (moving window)

7. The internal variables shown in Table 5.16.14.5 shall be defined for each AHU. All parameters are adjustable by the operator, with initial values as shown.

Default values are derived from NISTIR 7365 and have been validated in field trials. They are expected to be appropriate for most circumstances, but individual installations may benefit from tuning to improve sensitivity and reduce false alarms.
The default values have been intentionally biased toward minimizing false alarms—if necessary, at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors, such as fan heat, duct heat gain, and sensor error, can be measured in the field or derived from trend logs. Likewise, the occupancy delay and switch delays can be refined by observing in trend data the time required to achieve quasi steady-state operation.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false errors, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the heating coil, cooling coil, temperature, or flow thresholds.

Table 7 VAV AHU AFDD Internal Variables

Variable Name	Description	Default Value
ΔTSF	Temperature rise across supply fan	1°C (2°F)
ΔTMIN	Minimum difference between OAT and RAT to evaluate economizer error conditions (FC#6)	6°C (10° F)
ℰSAT	Temperature error threshold for SAT sensor	1°C (2°F)
ℰRAT	Temperature error threshold for RAT sensor	1°C (2°F)
ℰMAT	Temperature error threshold for MAT sensor	3°C (5°F)
ℰOAT	Temperature error threshold for OAT sensor	1°C (2°F) if local sensor @ unit. 3°C (5°F) if global sensor.
ℰF	Airflow error threshold	30%
ℰVFDSPD	VFD speed error threshold	5%
ℰDSP	Duct static pressure error threshold	25 Pa (0.1”)
ℰCCET	Cooling coil entering temperature sensor error. Equal to ℰMAT or dedicated sensor error	Varies, see Description
ℰCCLT	Cooling coil leaving temperature sensor error. Equal to ℰSAT or dedicated sensor error	
ℰHCET	Heating coil entering temperature sensor error; equal to ℰMAT or dedicated sensor error	
ℰHCLT	Heating coil leaving temperature sensor error. Equal to ℰSAT or dedicated sensor error	

Variable Name	Description	Default Value
ΔOSMAX	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	7
ModeDelay	Time in minutes to suspend Fault Condition evaluation after a change in Mode	30
AlarmDelay	Time in minutes to that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

The purpose of ΔTmin is to ensure that the mixing box/economizer damper tests are meaningful. These tests are based on the relationship between supply, return, and outdoor air. If RAT ~ MAT, these tests will not be accurate and will produce false alarms.
The purpose of TestModeDelay is to ensure that normal fault reporting occurs after the testing and commissioning process is completed as prescribed in Section 14.

8. Table 8 shows potential fault conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The fault conditions to be evaluated at any given time will depend on the OS of the AHU.

The equations in Table 8 assume that the SAT sensor is located downstream of the supply fan and the RAT sensor is located downstream of the return fan. If actual sensor locations differ from these assumptions, it may be necessary to add or delete fan heat correction factors.
To detect the required economizer faults in California Title 24 section 120.2(i)7, use FC#2, #3, and #5 through #13 at a minimum. Other Title 24 AFDD requirements, including acceptance tests, are not met through these fault conditions.

Table 8 VAV AHU Fault Conditions

FC#1	Equation	DSPAVG < DSPSP - ƐDSP and VFDSPD ≥ 99% - ƐVFDSPD	Applies to OS #1 – #5
	Description	Duct static pressure is too low with fan at full speed	
	Possible Diagnosis	Problem with VFD Mechanical problem with fan Fan undersized SAT Setpoint too high (too much zone demand)	
FC#2 (omit if no MAT sensor)	Equation	MATAVG + ƐMAT < min[(RATAVG - ƐRAT), (OATAVG - ƐOAT)]	Applies to OS #1 – #5
	Description	MAT too low; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	

FC#3 (omit if no MAT sensor)	Equation	MATAVG - ƐMAT > max[(RATAVG + ƐRAT), (OATAVG + ƐOAT)]	Applies to OS #1 – #5
	Description	MAT too high; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	
FC#4	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #5
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC#5 (omit if no MAT sensor)	Equation	SATAVG + ƐSAT ≤ MATAVG - ƐMAT + ΔTSF	Applies to OS #1
	Description	SAT too low; should be higher than MAT	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat unavailable DX cooling stuck on	
FC#6	Equation	| RATAVG - OATAVG | ≥ ΔTMIN and | %OA - %OAMIN | > ƐF	Applies to OS #1, #4
	Description	OA fraction is too low or too high; should equal %OAMIN	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error Leaking or stuck economizer damper or actuator	
FC#7 (omit if no heating coil)	Equation	SATAVG < SATSP - ƐSAT and HC ≥ 99%	Applies to OS #1
	Description	SAT too low in full heating	
	Possible Diagnosis	SAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat unavailable DX cooling stuck on Leaking or stuck economizer damper or actuator	

FC#8 (omit if no MAT sensor)	Equation	$\lvert SATAVG - \Delta TSF - MATAVG \rvert > \sqrt{\varepsilon_{SAT}^2 + \varepsilon_{MAT}^2}$	Applies to OS #2
	Description	SAT and MAT should be approximately equal	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve leaking or stuck open Heating coil valve leaking or stuck open	
FC#9	Equation	$OATAVG - \varepsilon OAT > SATSP - \Delta TSF + \varepsilon SAT$	Applies to OS #2
	Description	OAT is too high for free cooling without additional mechanical cooling	
	Possible Diagnosis	SAT sensor error OAT sensor error Cooling coil valve leaking or stuck open	
FC#10 (omit if no MAT sensor)	Equation	$\lvert MATAVG - OATAVG \rvert > \sqrt{\varepsilon_{MAT}^2 + \varepsilon_{OAT}^2}$	Applies to OS #3
	Description	OAT and MAT should be approximately equal	
	Possible Diagnosis	MAT sensor error OAT sensor error Leaking or stuck economizer damper or actuator	
FC#11	Equation	$OATAVG + \varepsilon OAT < SATSP - \Delta TSF - \varepsilon SAT$	Applies to OS #3
	Description	OAT is too low for mechanical cooling	
	Possible Diagnosis	SAT sensor error OAT sensor error Heating coil valve leaking or stuck open Leaking or stuck economizer damper or actuator	
FC#12 (omit if no MAT sensor)	Equation	$SATAVG - \varepsilon SAT - \Delta TSF \geq MATAVG + \varepsilon MAT$	Applies to OS #2 – #4
	Description	SAT too high; should be less than MAT	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve stuck closed or actuator failure Fouled or undersized cooling coil CHW temperature too high or CHW unavailable DX cooling unavailable Gas or electric heat stuck on Heating coil valve leaking or stuck open	

FC#13	Equation	SATAVG > SATSP + ℇSAT and CC ≥ 99%	Applies to OS #3, #4
	Description	SAT too high in full cooling	
	Possible Diagnosis	SAT sensor error Cooling coil valve stuck closed or actuator failure Fouled or undersized cooling coil CHW temperature too high or CHW unavailable DX cooling unavailable Gas or electric heat stuck on Heating coil valve leaking or stuck open	
FC#14	Equation	$CCETAVG - CCLTAVG \geq \sqrt{\varepsilon_{CCET}^2 + \varepsilon_{CCLT}^2} + \Delta TSF^*$ *Fan heat factor included or not depending on location of sensors used for CCET and CCLT	Applies to OS #1, #2
	Description	Temperature drop across inactive cooling coil	
	Possible Diagnosis	CCET sensor error CCLT sensor error Cooling coil valve stuck open or leaking DX cooling stuck on	
FC#15	Equation	$HCLTAVG - HCETAVG \geq \sqrt{\varepsilon_{HCET}^2 + \varepsilon_{HCLT}^2} + \Delta TSF^*$ *Fan heat factor included or not depending on location of sensors used for HCET and HCLT	Applies to OS #2 – #4
	Description	Temperature rise across inactive heating coil	
	Possible Diagnosis	HCET sensor error HCLT sensor error Heating coil valve stuck open or leaking.	

9. A subset of all potential fault conditions is evaluated by the AFDD routines. The set of applicable fault conditions depends on the OS of the AHU:

   a. In OS#1 (heating), the following fault conditions shall be evaluated:

      1) FC#1: DSP too low with fan at full speed

      2) FC#2: MAT too low; should be between RAT and OAT

      3) FC#3: MAT too high; should be between RAT and OAT

      4) FC#4: Too many changes in OS

      5) FC#5: SAT too low; should be higher than MAT

      6) FC#6: OA fraction too low or too high; should equal %OAmin

      7) FC#7: SAT too low in full heating

8) FC#14: Temperature drop across inactive cooling coil

b. In OS#2 (modulating economizer), the following fault conditions shall be evaluated:

1) FC#1: DSP too low with fan at full speed

2) FC#2: MAT too low; should be between RAT and OAT

3) FC#3: MAT too high; should be between RAT and OAT

4) FC#4: Too many changes in OS

5) FC#8: SAT and MAT should be approximately equal

6) FC#9: OAT too high for free cooling without mechanical cooling

7) FC#12: SAT too high; should be less than MAT

8) FC#14: Temperature drop across inactive cooling coil

9) FC#15: Temperature rise across inactive heating coil

c. In OS#3 (mechanical + 100% economizer cooling), the following fault conditions shall be evaluated:

1) FC#1: DSP too low with fan at full speed

2) FC#2: MAT too low; should be between RAT and OAT

3) FC#3: MAT too high; should be between RAT and OAT

4) FC#4: Too many changes in OS

5) FC#10: OAT and MAT should be approximately equal

6) FC#11: OAT too low for mechanical cooling

7) FC#12: SAT too high; should be less than MAT

8) FC#13: SAT too high in full cooling

9) FC#15: Temperature rise across inactive heating coil

d. In OS#4 (mechanical Cooling, minimum OA), the following fault conditions shall be evaluated:

1) FC#1: DSP too low with fan at full speed

2) FC#2: MAT too low; should be between RAT and OAT

3) FC#3: MAT too high; should be between RAT and OAT

4) FC#4: Too many changes in OS

5) FC#6: OA fraction too low or too high; should equal %OAmin

6) FC#12: SAT too high; should be less than MAT

7) FC#13: SAT too high in full cooling

8) FC#15: Temperature rise across inactive heating coil

e. In OS#5 (other), the following fault conditions shall be evaluated:

1) FC#1: DSP too low with fan at full speed

2) FC#2: MAT too low; should be between RAT and OAT

3) FC#3: MAT too high; should be between RAT and OAT

4) FC#4: Too many changes in OS

10. For each air handler, the operator shall be able to suppress the alarm for any fault condition.

11. Evaluation of fault conditions shall be suspended under the following conditions:

a. When AHU is not operating

b. For a period of ModeDelay minutes following a change in mode (e.g., from Warmup Mode to Occupied Mode) of any Zone Group served by the AHU

12. Fault conditions that are not applicable to the current OS shall not be evaluated.

13. A fault condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.

14. Test mode shall temporarily set ModeDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system, and ensure normal fault detection occurs after testing is complete.

15. When a fault condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from the table in Section 8.

M. Testing/Commissioning Overrides. Provide software switches that interlock to a CHW and hot-water plant level to

a. force HW valve full open if there is a hot-water coil,

b. force HW valve full closed if there is a hot-water coil,

c. force CHW valve full open, and

d. force CHW valve full closed.

Per Section 3.1L, all hardware points can be overridden through the BAS. Each of the following points is interlocked so that they can be overridden together at a zone-group level, per Section 3.5E.
For example, the CxA can check for leaking dampers by forcing all VAV boxes in a Zone Group closed and then recording airflow at the AHU.

N. Plant Requests

1. Chilled-Water Reset Requests

   a. If the supply air temperature exceeds the supply air temperature setpoint by 3°C (5°F) for 2 minutes, send 3 requests.

   b. Else if the supply air temperature exceeds the supply air temperature setpoint by 2°C (3°F) for 2 minutes, send 2 requests.

   c. Else if the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 85%.

   d. Else if the CHW valve position is less than 95%, send 0 requests.

2. Chiller Plant Requests. Send the chiller plant that serves the system a chiller plant request as follows:

   a. If the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 10%.

   b. Else if the CHW valve position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

   a. If the supply air temperature is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

   b. Else if the supply air temperature is 8°C (15°F) less than setpoint for 5 minutes, send 2 requests.

   c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

   d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil, Heating Hot Water Plant Requests. Send the heating hot-water plant that serves the AHU a heating hot-water plant request as follows:

   a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

   b. Else if the HW valve position is less than 95%, send 0 requests.

3.18 SINGLE-ZONE VAV AIR-HANDLING UNIT

A. See “Generic Thermal Zones” (Section 3.3C) for setpoints, loops, control modes, alarms, etc.

B. See Section 1.2H.1 for Cool_SAT, Heat_SAT, and MaxDPT.

C. See Section 1.3D for MinSpeed, MaxHeatSpeed, MaxCoolSpeed, MinPosMin, MinPosMax, DesPosMin, DesPosMax, MinRelief, MaxRelief, and S-R-DIFF.

D. Supply Fan Speed Control and Supply Air Temperature Set-Point Reset

These sequences use two supply air temperature setpoints SATsp and SATsp-C that are reset at different rates but are controlled using the same sensor and control loop, as well as a supply-fan speed reset that varies depending on outdoor air temperature. The goal of this scheme is to maximize free cooling and avoid chiller use when the outdoor air is cool, while avoiding excessive fan energy use and using the cooling coil when outdoor air is warm.
For this to work, it is essential that both SATsp and SATsp-C are controlled off the same physical SAT sensor.
It is also critical that the minimum value of the setpoint that controls the economizer SATsp is lower than the minimum value of the setpoint that controls the CHW valve SATsp-C. Otherwise, a brief temperature excursion due to the cooling coil will lead to short cycling of the economizer and subsequent unnecessary energy use by the cooling coil.

1. The supply fan shall run whenever the unit is in any mode other than Unoccupied Mode.

2. Provide a ramp function to prevent changes in fan speed of more than 10% per minute.

3. Minimum, medium, and maximum fan speeds shall be as follows:

   a. Minimum speed MinSpeed, maximum cooling speed MaxCoolSpeed, and maximum heating speed MaxHeatSpeed shall be determined per Section 1.3A.

   b. Medium fan speed MedSpeed shall be reset linearly based on outdoor air temperature from MinSpeed when outdoor air temperature is greater or equal to Endpoint #1 to MaxCoolSpeed when outdoor air temperature is less than or equal to Endpoint #2.

      1) Endpoint #1: the lesser of zone temperature +0.5°C (1°F) and maximum supply air dew point MaxDPT.

      2) Endpoint #2: the lesser of zone temperature minus 6°C (10°F) and the maximum supply air dew point MaxDPT minus 1°C (2°F).

When outdoor air temperature is high, there is a potential for a high humidity ratio, and thus high space humidity, which can increase the risk of mold/mildew. Because dew point sensors are expensive and can quickly drift out of calibration, this sequence uses outdoor air dry-bulb temperature as a proxy for supply air dew point. When outdoor air temperature is above the maximum limit MaxDPT, the medium speed setpoint is kept at the minimum, which will reduce supply air temperature and thus lower supply air temperature setpoint.

4. Minimum and maximum supply air temperature setpoints shall be as follows:

   a. The Deadband values of SATsp and SATsp-C shall be the average of the zone heating setpoint and the zone cooling setpoint but shall be no lower than 21°C (70°F) and no higher than 24°C (75°F).

The deadband setpoint is intended to provide neutral temperature air when the Zone State is deadband. The values of this setpoint are limited to avoid the situation where an extreme value for zone temperature setpoint forces unnecessary heating or cooling, e.g., a cold-aisle setpoint of 32°C (90°F) in a datacenter could cause unnecessary heating if this limit were not in place.

5. When the supply fan is proven on, fan speed and supply air temperature setpoints are controlled as shown in Figures 5.18.4.5-1 through 5.18.4.5-3. The points of transition along the x-axis shown and described are representative. Separate gains shall be provided for each section of the control map, that are determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 5.18.4.5-1 to provide stable control.

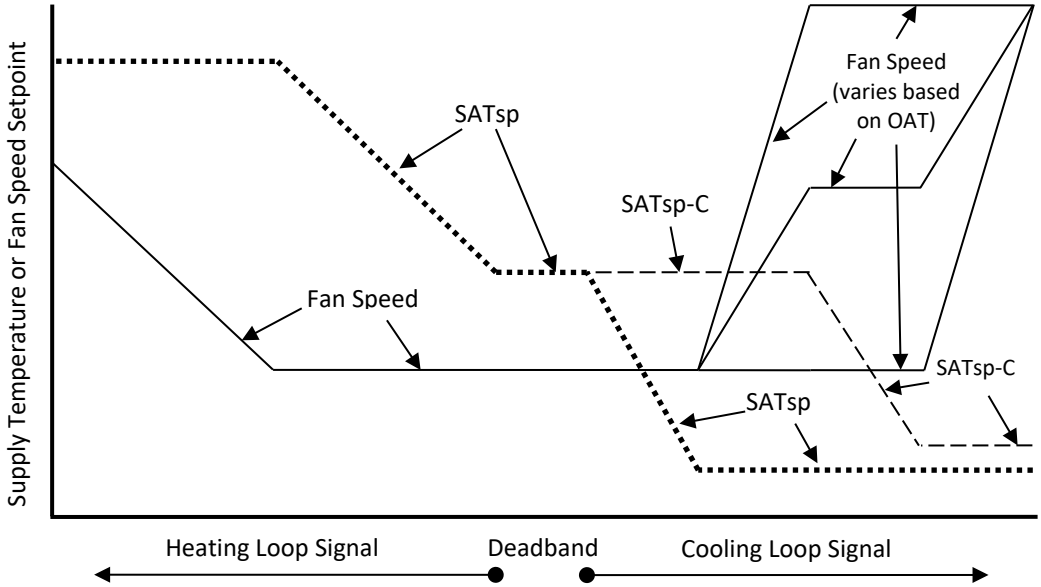


Figure 5.18.4.5-1 Control diagram for SZVAV AHU.

6. Figure 5.18.4.5-2 separates Figure 5.18.4.5-1 in two for clarity and to illustrate the relative setpoints. However, both fan speed and supply air temperature setpoints are reset simultaneously and by the same signal: the value of the Heating Loop or Cooling Loop.

    a. For a heating-loop signal of 100% to 50%, fan speed is reset from MaxHeatSpeed to MinSpeed.

    b. For a heating-loop signal of 50% to 0%, fan speed setpoint is MinSpeed.

    c. In deadband, fan speed setpoint is MinSpeed.

    d. For a cooling-loop signal of 0% to 25%, fan speed is MinSpeed.

    e. For a cooling-loop signal of 25% to 50%, fan speed is reset from MinSpeed to MedSpeed.

    f. For a cooling-loop signal of 50% to 75%, fan speed is MedSpeed.

    g. For a cooling-loop signal of 75% to 100%, fan speed is reset from MedSpeed to MaxCoolSpeed.

h. For a heating-loop signal of 100% to 50%, SATsp is Heat_SAT.

i. For a heating-loop signal of 50% to 0%, SATsp is reset from Heat_SAT to the deadband value.

j. In deadband, SATsp is the deadband value.

k. For a cooling-loop signal of 0% to 25%, SATsp is reset from the deadband value to Cool_SAT minus 1°C (2°F), while SATsp-C is the deadband value.

l. For a cooling-loop signal of 25% to 50%, SATsp and SATsp-C are unchanged.

m. For a cooling-loop signal of 50% to 75%, SATsp remains at Cool_SAT minus 1°C (2°F), SATsp-C is reset from the deadband value to Cool_SAT.

n. For a cooling-loop signal of 75% to 100%, SATsp and SATsp-C are unchanged.

In cooling, the economizer is controlled to a lower setpoint than the cooling coil (i.e., SATsp < SATsp-C) so that a low-temperature excursion does not cause the economizer to close inadvertently while cooling with mechanical cooling.

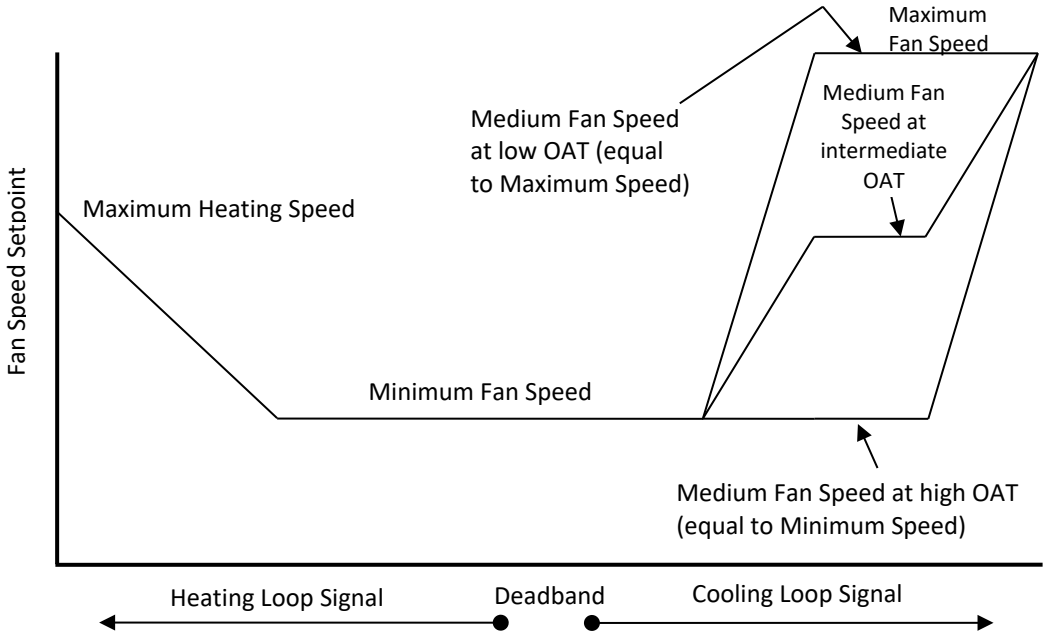


Figure 5.18.4.5-2 Control diagram for SZVAV AHU—fan speed.

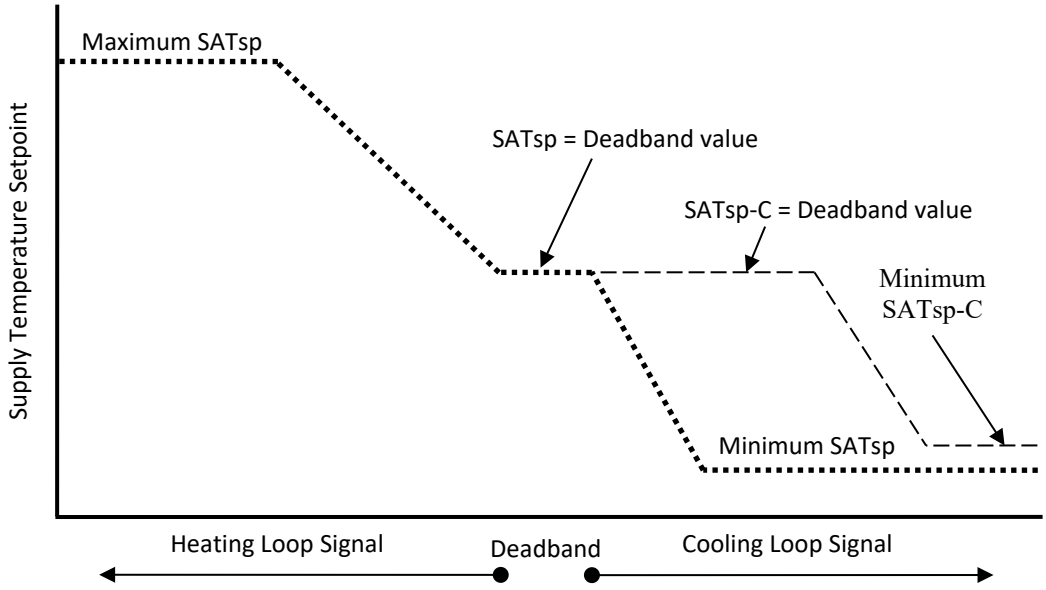


Figure 5.18.4.5-3 Control diagram for SZVAV AHU—supply air temperature.

E. Supply Air Temperature Control

1. There are two supply air temperature setpoints, SATsp and SATsp-C. Each setpoint is maintained by a separate control loop, but both loops use the same supply air temperature sensor.

2. The control loop for SATsp is enabled when the supply air fan is proven on and disabled and set to neutral otherwise.

    a. Supply air temperature shall be controlled to SATsp by a control loop whose output is mapped to sequence the heating coil (if applicable) and economizer dampers as shown in the Figure 5.18.5.2. Outdoor air damper minimum MinOA-P and maximum MaxOA-P positions are limited for economizer lockout and to maintain minimum outdoor airflow rate as described in Sections 3.18Fand 3.18F.3.

These sequences assume that the heat source can be modulated and thus control SAT to a setpoint in heating. If this is not the case (e.g., because heating is by multistage furnace or electric coil), then the following will need to be modified to add appropriate staging logic.

    b. The points of transition along the x-axis shown in Figure 5.18.5.2 are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer) that are determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 5.18.5.2 to provide stable control.

Dampers are complementary (rather than sequenced, as they are for multiple-zone VAV AHUs) to reduce equipment costs (avoiding multiple actuators) and to maintain a more-linear relationship between fan speed and outdoor air volume.
In order to make this relationship as linear as possible, the economizer should use parallel blade dampers.

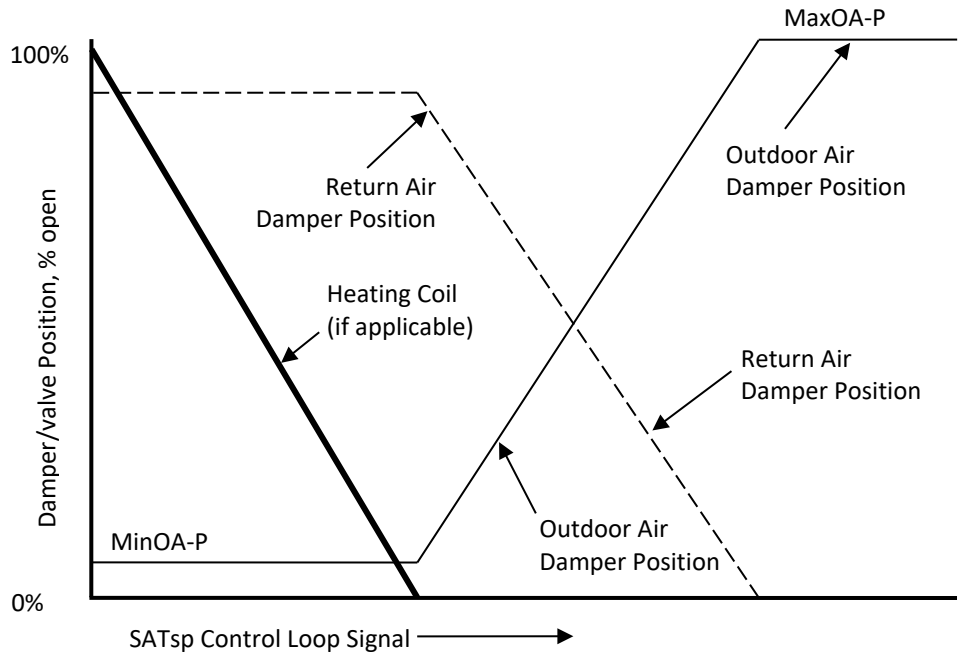


Figure 5.18.5.2 SZVAV AHU supply air temperature loop mapping.

3. The control loop for SATsp-C is enabled when the supply fan is proven on and the Zone State is cooling and disabled and set to neutral otherwise. When enabled, supply air temperature shall be controlled to SATsp-C by modulating the cooling coil.

F. Minimum Outdoor Air Control

1. See Section 3.3 for calculation of zone minimum outdoor airflow setpoint.

2. Outdoor Air Damper Control for Units without an Outdoor Airflow Measurement Station

This section describes minimum outdoor air control logic for a unit with a single common minimum OA and economizer damper (i.e., no separate minimum OA damper) and Demand Control Ventilation.
This logic assumes that there is no airflow measurement station across the outdoor air intake and controls OA volume indirectly via damper position setpoints. This works for a single zone unit because there are no downstream dampers that would change the relationship between OA damper position and OA airflow. This logic is not appropriate for a system with actuated dampers downstream of the AHU.
Other configurations are possible and would require modifications to the points list (above) and the control logic below.

a. See Section 1.3D.2 for minimum damper position setpoints.

b. At least once per minute while the zone is in Occupied Mode, the BAS shall calculate MinPos* as a linear interpolation between MinPosMin and MinPosMax based on the current fan speed.

c. At least once per minute while the zone is in Occupied Mode, the BAS shall calculate DesPos* as a linear interpolation between DesPosMin and DesPosMax based on the current fan speed.

d. If MinOAsp is zero, MinOA-P shall be zero (i.e., outdoor air damper fully closed).

e. If MinOAsp is nonzero, then the outdoor air damper minimum position MinOA-P shall be the value between MinPos* and DesPos* that is proportional to the value of MinOAsp between MinOA and DesOA. Figure 5.18.6.2 illustrates this (points are chosen arbitrarily and are not meant to be representative).

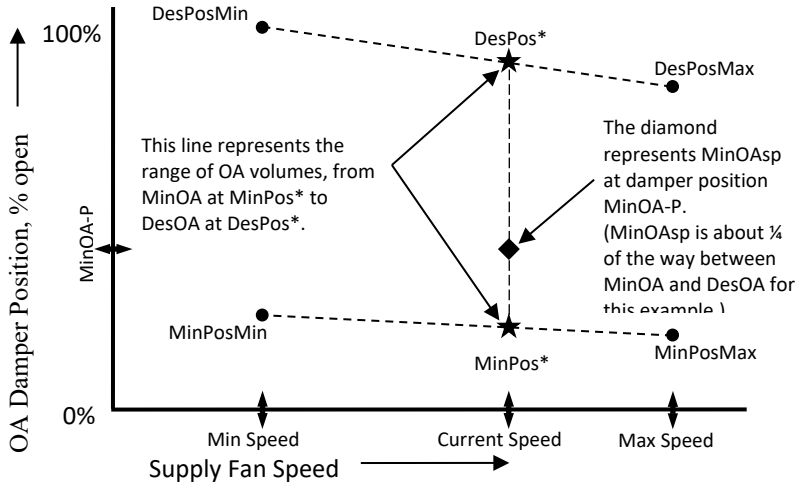


Figure 5.18.6.2 SZVAV AHU minimum outdoor air control.

3. Outdoor Air Damper Control for Units with an Outdoor Airflow Measurement Station

This section describes minimum outdoor air control logic for a unit with a single common minimum OA and economizer damper (i.e., no separate minimum OA damper) and Demand Control Ventilation.
This logic assumes that there is an airflow measurement station across the outdoor air intake and controls OA volume directly via control over the minimum OA damper position.
Other configurations are possible and would require modifications to the points list (above) and the control logic below.

a. Minimum outdoor air control loop is enabled when the supply fan is proven on and in Occupied Mode and disabled and output set to zero otherwise.

b. The minimum outdoor airflow rate shall be maintained at the minimum outdoor air setpoint MinOAsp by a reverse-acting control loop whose output is mapped to MinOA-P.

G. Economizer Lockout

This section describes economizer lockout logic for a unit with a common minimum OA and economizer damper (i.e., no separate minimum OA damper). Other configurations are possible, and would require modifications to the points list (above) and the control logic below.

1. The normal sequencing of the economizer dampers shall be disabled in accordance with Section 3.1Q.

2. Once the economizer is disabled, it shall not be reenabled within 10 minutes and vice versa.

3. When economizer is enabled, MaxOA-P = 100%. When economizer is disabled, set MaxOA-P equal to MinOA-P. See Section 3.17E, "Supply Air Temperature Control," and Section 3.18F, "Minimum Outdoor Air Control," for outdoor air damper minimum setpoint.

H. Control of Actuated Relief Dampers without Fans

1. Direct Building Pressure Control

a. Relief dampers shall be enabled when the associated supply fan is proven on, and disabled otherwise.

b. When enabled, use a P-only control loop to modulate relief dampers to maintain 12 Pa (0.05 in. of water) building static pressure. Close damper when disabled.

2. Passive Building Pressure Control

a. See Section **1.3D.3** for relief-damper position setpoints.

b. Relief dampers shall be enabled when the associated supply fan is proven on and any outdoor air damper is open, and disabled and closed otherwise.

c. Relief-damper position shall be reset linearly from MinRelief to MaxRelief as the minimum outdoor airflow setpoint, MinOAsp, is reset from MinOA to DesOA.

I. Relief-Fan Control

1. Refer to Section 3.17H, "Relief-Fan Control" for multiple-zone air handlers.

J. Return-Fan Control

1. Return-Fan Control – Speed Tracking

a. Exhaust damper shall open whenever associated supply fan and return fan are proven on and shall be closed otherwise.

b. Return fan shall run whenever associated supply fan is proven on.

c. The active differential airflow setpoint S-R-SPD-DIFF* shall be S-R-SPD-DIFF (see Section 1.3D.4) adjusted by the active minimum outdoor airflow setpoint, MinOAsp relative to the design outdoor airflow setpoint, DesOA.

$$S-R-SPD-DIFF^{*} = S-R-SPD-DIFF\,\frac{MinOAsp}{DesOA}$$

d. Return-fan speed shall be the controlled to maintain return fan speed equal to supply fan speed less differential S-R-SPD-DIFF*.

2. Return Fan Control – Direct Building Pressure

    a. Refer to Section 3.17I Return Fan Control – Direct Building Pressure for multiple-zone air handlers.

K. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

    a. Commanded on, status off: Level 2

    b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when fan speed exceeds 20% of MaxCoolSpeed: Level 4. The alarm limit shall vary with fan speed as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current fan speed x (expressed as a fraction). For instance, the setpoint at 50% of design speed would be (0.5)1.4 or 38% of the design high limit pressure drop. See Section 1.3D.1 for MaxCoolSpeed and Section **Error! Reference source not found.** for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

L. Automatic Fault Detection and Diagnostics

The AFDD routines for AHUs continually assess AHU performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the OS of the AHU, as determined by the position of the cooling and heating valves and the economizer damper. Time delays are applied to the evaluation and reporting of fault conditions to suppress false alarms. Fault conditions that pass these filters are reported to the building operator along with a series of possible causes.
These equations assume that the air handler is equipped with hydronic heating and cooling coils, as well as a fully integrated economizer. If any of these components are not present, the associated tests and variables should be omitted from the programming.
Note that these alarms rely on reasonably accurate measurement of mixed air temperature. An MAT sensor is required for many of these alarms to work, and an averaging sensor is strongly recommended for best accuracy. If an MAT sensor is not installed, omit Fault Conditions #2, #3, #5, #8, #10, and #12. If a heating coil is not installed, omit Fault Condition #7.

1. AFDD conditions are evaluated continuously and separately for each operating AHU.

2. The OS of each AHU shall be defined by the commanded positions of the heating-coil control valve, cooling-coil control valve, and economizer damper in accordance with Table 5.18.13.2 and Figure 5.18.13.2.

Table 5.18.13.2 SZVAV AHU Operating States

Operating State	Heating Valve Position	Cooling Valve Position	Outdoor Air Damper Position
#1: Heating	> 0	= 0	= MinOA-P
#2: Free cooling, modulating OA	= 0	= 0	MinOA-P < x < 100%
#3: Mechanical + economizer cooling	= 0	> 0	= 100%
#4: Mechanical cooling, minimum OA	= 0	> 0	= MinOA-P
#5: Unknown or dehumidification	No other OS applies		

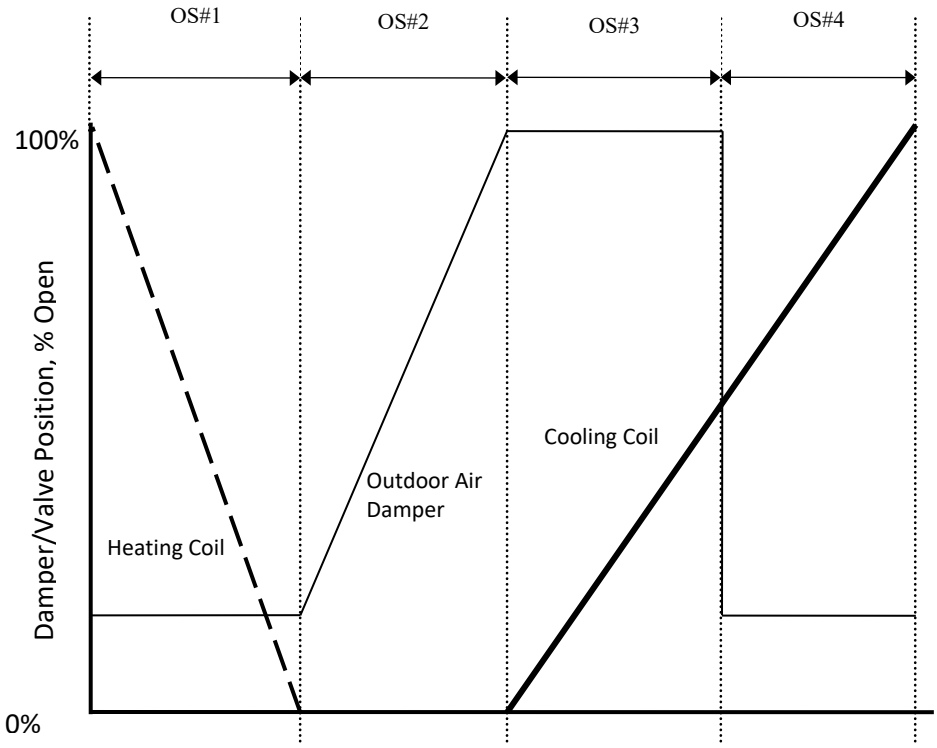


Figure 5.18.13.2 SZVAV AHU operating states.

The OS is distinct from, and should not be confused with, the zone status (cooling, heating, deadband) or Zone Group mode (occupied, warmup, etc.).
OS#1 through OS#4 (see Table 5.18.13.2) represent normal operation during which a fault may nevertheless occur if so determined by the fault condition tests in Section 3.18L.6. By contrast, OS#5 may represent an abnormal or incorrect condition (such as simultaneous heating and cooling) arising from a controller failure or programming error, but it may also occur normally, e.g., when dehumidification is active or during warmup.

3. The following points must be available to the AFDD routines for each AHU:

For the AFDD routines to be effective, an averaging sensor is recommended for supply air temperature. An averaging sensor is essential for mixed air temperature, as the environment of the mixing box will be subject to nonuniform and fluctuating air temperatures. It is

recommended that the OAT sensor be located at the AHU so that it accurately represents the temperature of the incoming air.

a. SAT = supply air temperature

b. MAT = mixed air temperature

c. RAT = return air temperature

d. OAT = outdoor air temperature

e. DSP = duct static pressure

f. SATsp = supply air temperature setpoint for heating coil and economizer control

g. SATsp-C = supply air temperature setpoint for cooling coil control

h. HC = heating-coil valve position command; 0% □ HC □ 100%

i. CC = cooling-coil valve position command; 0% □ CC □ 100%

j. FS = fan-speed command; 0% □ FS □ 100%

k. CCET = cooling-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose).

l. CCLT = cooling-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

m. HCET = heating-coil entering temperature (Depending on the AHU configuration, this could be the MAT or a separate sensor for this specific purpose.)

n. HCLT = heating-coil leaving temperature (Depending on the AHU configuration, this could be the SAT or a separate sensor for this specific purpose.)

4. The following values must be continuously calculated by the AFDD routines for each AHU:

a. Five-minute rolling averages with 1-minute sampling of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently.

1) SATavg = rolling average of supply air temperature

2) MATavg = rolling average of mixed air temperature

3) RATavg = rolling average of return air temperature

4) OATavg = rolling average of outdoor air temperature

5) CCETavg = rolling average of cooling-coil entering temperature

6) CCLTavg = rolling average of cooling-coil leaving temperature

7) HCETavg = rolling average of heating-coil entering temperature

8) HCLTavg = rolling average of heating-coil leaving temperature

9) □OS = number of changes in OS during the previous 60 minutes (moving window)

5. The internal variables shown in Table 5.18.13.5 shall be defined for each AHU. All parameters are adjustable by the operator, with initial values as given below.

Default values are derived from NISTIR 7365 and have been validated in field trials. They are expected to be appropriate for most circumstances, but individual installations may benefit from tuning to improve sensitivity and reduce false alarms.
The default values have been intentionally biased toward minimizing false alarms, if necessary at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors such as fan heat, duct heat gain, and sensor error can be measured in the field or derived from trend logs. Likewise, the occupancy delay and switch delays can be refined by observing in trend data the time required to achieve quasi steady state operation.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false errors, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the heating coil, cooling coil, temperature, or flow thresholds.

Table 5.18.13.5 SZVAV AHU Internal Variables

Variable Name	Description	Default Value
ΔTSF	Temperature rise across supply fan	0.5°C (1°F)
ΔTMIN	Minimum difference between OAT and RAT to evaluate economizer error conditions (FC#6)	6°C (10°F)
□SAT	Temperature error threshold for SAT sensor	1°C (2°F)
□RAT	Temperature error threshold for RAT sensor	1°C (2°F)
□MAT	Temperature error threshold for MAT sensor	3°C (5°F)
□OAT	Temperature error threshold for OAT sensor	1°C (2°F) if local sensor @ unit. 3°C (5°F) if global sensor.
□CCET	Cooling coil entering temperature sensor error. Equal to □MAT or dedicated sensor error	Varies; see description.

□CCLT	Cooling coil leaving temperature sensor error. Equal to □SAT or dedicated sensor error	
□HCET	Heating coil entering temperature sensor error; equal to □MAT or dedicated sensor error	
□HCLT	Heating coil leaving temperature sensor error. Equal to □SAT or dedicated sensor error	
□OSmax	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	7
ModeDelay	Time in minutes to suspend Fault Condition evaluation after a change in mode	30
AlarmDelay	Time in minutes that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

The purpose of □Tmin is to ensure that the mixing box/economizer damper tests are meaningful. These tests are based on the relationship between supply, return, and outdoor air. If RAT □ MAT, these tests will not be accurate and will produce false alarms.
The purpose of TestModeDelay is to ensure that normal fault reporting occurs after the testing and commissioning process is completed as described in Section 3.18L.12.

6. Table 5.18.13.6 shows potential fault conditions that can be evaluated by the AFDD routines. (At most, 14 of the 15 fault conditions are actively evaluated, but numbering was carried over from multiple-zone AHUs for consistency.) If the equation statement is true, then the specified fault condition exists. The fault conditions to be evaluated at any given time will depend on the OS of the AHU.

The equations in Table 5.18.13.6 assume that the SAT sensor is located downstream of the supply fan and the RAT sensor is located downstream of the return fan. If actual sensor locations differ from these assumptions, it may be necessary to add or delete fan heat correction factors.
To detect the required economizer faults in California Title 24 section 120.2(i)7, use FC#2, #3, and #5 through #13 at a minimum. Other Title 24 AFDD requirements, including acceptance tests, are not met through these fault conditions.

Table 5.18.13.6 SZVAV AHU Fault Conditions

FC #1	This fault condition is not used in single zone units, as it requires a static pressure setpoint.		Applies to OS #1 – #5
FC #2 (omit if no MAT sensor)	Equation	MATAVG + ℰMAT < min[(RATAVG - ℰRAT), (OATAVG - ℰOAT)]	Applies to OS #1 – #5
	Description	MAT too low; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	
FC #3 (omit if no MAT sensor)	Equation	MATAVG - ℰMAT > min[(RATAVG + ℰRAT), (OATAVG + ℰOAT)]	Applies to OS #1 – #5
	Description	MAT too high; should be between OAT and RAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error	
FC #4	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #5
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC #5 (omit if no MAT sensor)	Equation	SATAVG + ℰSAT ≤ MATAVG - ℰMAT + ΔTSF	Applies to OS #1
	Description	SAT too low; should be higher than MAT	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat unavailable	

FC #6	Equation	| RATAVG - OATAVG | ≥ ΔTMIN and | RATAVG - MATAVG | > | OATAVG - MATAVG |	Applies to OS #1, #4
	Description	OA fraction is too high; MAT should be closer to RAT than to OAT	
	Possible Diagnosis	RAT sensor error MAT sensor error OAT sensor error Leaking or stuck economizer damper or actuator	
FC #7 (omit if no heating coil)	Equation	SATAVG < SATSP - ƐSAT and HC ≥ 99%	Applies to OS #1
	Description	SAT too low in full heating	
	Possible Diagnosis	SAT sensor error Cooling coil valve leaking or stuck open Heating coil valve stuck closed or actuator failure Fouled or undersized heating coil HW temperature too low or HW unavailable Gas or electric heat is unavailable DX cooling is stuck on Leaking or stuck economizer damper or actuator	
FC #8 (omit if no MAT sensor)	Equation	$\lvert SATAVG - \Delta TSF - MATAVG \rvert > \sqrt{\varepsilon_{SAT}^2 + \varepsilon_{MAT}^2}$	Applies to OS #2
	Description	SAT and MAT should be approximately equal	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve leaking or stuck open DX cooling stuck on Heating coil valve leaking or stuck open Gas or electric heat stuck on	

FC #9	Equation	OATAVG + ƐOAT > SATSP - ΔTSF + ƐSAT	Applies to OS #2
	Description	OAT is too high for free cooling without additional mechanical cooling	
	Possible Diagnosis	SAT sensor error OAT sensor error Cooling coil valve leaking or stuck open DX cooling stuck on	
FC #10 (omit if no MAT sensor)	Equation	$\lvert MATAVG - OATAVG \rvert > \sqrt{\varepsilon_{MAT}^2 + \varepsilon_{OAT}^2}$	Applies to OS #3
	Description	OAT and MAT should be approximately equal	
	Possible Diagnosis	MAT sensor error OAT sensor error Leaking or stuck economizer damper or actuator	
FC #11	Equation	OATAVG + ƐOAT < SATSP - ΔTSF - ƐSAT	Applies to OS #3
	Description	OAT is too low for mechanical cooling	
	Possible Diagnosis	SAT sensor error OAT sensor error Heating coil valve leaking or stuck open Gas or electric heat stuck on Leaking or stuck economizer damper or actuator	
FC #12 (omit if no MAT sensor)	Equation	SATAVG - ƐSAT - ΔTSF ≥ MATAVG + ƐMAT	Applies to OS #2 – #4
	Description	SAT too high; should be less than MAT	
	Possible Diagnosis	SAT sensor error MAT sensor error Cooling coil valve stuck closed or actuator failure Fouled or undersized cooling coil CHW temperature too high or CHW unavailable DX cooling unavailable Gas or electric heat stuck on Heating coil valve leaking or stuck open	

FC #13	Equation	SATAVG > SATSP-C + ℰSAT and CC ≥ 99%	Applies to OS #3, #4
	Description	SAT too high in full cooling	
	Possible Diagnosis	SAT sensor error Cooling coil valve stuck closed or actuator failure Fouled or undersized cooling coil CHW temperature too low or CHW unavailable DX cooling unavailable Gas or electric heat stuck on Heating coil valve leaking or stuck open	
FC#14	Equation	$\text{CCETAVG} - \text{CCLTAVG} \geq \sqrt{\varepsilon_{CCET}^2 + \varepsilon_{CCLT}^2 + \Delta TSF}$* *Fan heat factor included or not depending on location of sensors used for CCET and CCLT	Applies to OS #1, #2
	Description	Temperature drop across inactive cooling coil	
	Possible Diagnosis	CCET sensor error CCLT sensor error Cooling coil valve stuck open or leaking DX cooling stuck on	
FC#15	Equation	$\text{HCLTAVG} - \text{HCETAVG} \geq \sqrt{\varepsilon_{HCET}^2 + \varepsilon_{HCLT}^2 + \Delta TSF}$* *Fan heat factor included or not depending on location of sensors used for HCET and HCLT	Applies to OS #2 – #4
	Description	Temperature rise across inactive heating coil	
	Possible Diagnosis	HCET sensor error HCLT sensor error Heating coil valve stuck open or leaking Gas or electric heat stuck on	

7. A subset of all potential fault conditions is evaluated by the AFDD routines. The set of applicable fault conditions depends on the OS of the AHU. If an MAT sensor is not installed, omit FCs #2, #3, #5, #8, #10, and #12. If there is no heating coil, omit FC#7:

   a. In OS#1 (Heating), the following fault conditions shall be evaluated:

      1) FC#2: MAT too low; should be between RAT and OAT

2) FC#3: MAT too high; should be between RAT and OAT

3) FC#4: Too many changes in OS

4) FC#5: SAT too low; should be higher than MAT

5) FC#6: OA fraction too high; MAT should be closer to RAT than to OAT

6) FC#7: SAT too low in full heating

7) FC#14: Temperature drop across inactive cooling coil

b. In OS#2 (modulating economizer), the following fault conditions shall be evaluated:

1) FC#2: MAT too low; should be between RAT and OAT

2) FC#3: MAT too high; should be between RAT and OAT

3) FC#4: Too many changes in OS

4) FC#8: SAT and MAT should be approximately equal

5) FC#9: OAT too high for free cooling without mechanical cooling

6) FC#12: SAT too high; should be less than MAT

7) FC#14: Temperature drop across inactive cooling coil

8) FC#15: Temperature rise across inactive heating coil

c. In OS#3 (mechanical + 100% economizer cooling), the following fault conditions shall be evaluated:

1) FC#2: MAT too low; should be between RAT and OAT

2) FC#3: MAT too high; should be between RAT and OAT

3) FC#4: Too many changes in OS

4) FC#10: OAT and MAT should be approximately equal

5) FC#11: OAT too low for mechanical cooling

6) FC#12: SAT too high; should be less than MAT

7) FC#13: SAT too high in full cooling

8) FC#15: Temperature rise across inactive heating coil

d. In OS#4 (mechanical cooling, minimum OA), the following fault conditions shall be evaluated:

1) FC#2: MAT too low; should be between RAT and OAT

2) FC#3: MAT too high; should be between RAT and OAT

3) FC#4: Too many changes in OS

4) FC#6: OA fraction too high; MAT should be closer to RAT than to OAT

5) FC#12: SAT too high; should be less than MAT

6) FC#13: SAT too high in full cooling

7) FC#15: Temperature rise across inactive heating coil

e. In OS#5 (other), the following fault conditions shall be evaluated:

1) FC#2: MAT too low; should be between RAT and OAT

2) FC#3: MAT too high; should be between RAT and OAT

3) FC#4: Too many changes in OS

8. For each air handler, the operator shall be able to suppress the alarm for any fault condition.

9. Evaluation of fault conditions shall be suspended under the following conditions:

a. When AHU is not operating

b. For a period of ModeDelay minutes following a change in mode (e.g., from Warmup Mode to Occupied Mode) of any Zone Group served by the AHU

10. Fault conditions that are not applicable to the current OS shall not be evaluated.

11. A fault condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.

12. Test mode shall temporarily set ModeDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system and ensure normal fault detection occurs after testing is complete.

13. When a fault condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from Table 5.18.13.6.

M. Testing/Commissioning Overrides. Provide software switches that interlock to a CHW and hot-water plant level to

a. force HW valve full open if there is a hot-water coil,

b. force HW valve full closed if there is a hot-water coil,

c. force CHW valve full open if there is a CHW coil, and

d. force CHW valve full closed if there is a CHW coil.

Per Section 3.1K, all hardware points can be overridden through the BAS. Each of the following points is interlocked so that they can be overridden as a group on a plant level. For example, the CxA can check for valve leakage by simultaneously forcing closed all CHW valves at all AHUs served by the chiller plant and then recording flow at the chiller.

N. Plant Requests

1. Chilled-Water Reset Requests

   a. If the supply air temperature exceeds SATsp-C by 3°C (5°F) for 2 minutes, send 3 requests.

   b. Else if the supply air temperature exceeds SATsp-C by 2°C (3°F) for 2 minutes, send 2 requests.

   c. Else if the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 85%.

   d. Else if the CHW valve position is less than 95%, send 0 requests.

2. Chiller Plant Requests. Send the chiller plant that serves the system a chiller plant request as follows:

   a. If the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 10%.

   b. Else if the CHW valve position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

   a. If the supply air temperature is 17°C (30°F) less than SATsp for 5 minutes, send 3 requests.

   b. Else if the supply air temperature is 8°C (15°F) less than SATsp for 5 minutes, send 2 requests.

   c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

   d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil, Heating Hot-Water Plant Requests. Send the heating hot-water plant that serves the AHU a heating hot-water plant request as follows:

   a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

   b. Else if the HW valve position is less than 95%, send 0 requests.

3.19 DEDICATED OUTDOOR AIR (DOAS) VAV AIR HANDLERS

A. See Section 1.2I for Cool_SAT, Heat_SAT, and MaxDSP.

B. See Section 1.3E for MinSpeed.

C. Supply Fan Control

1. Supply Fan Start/Stop

a. Supply fan shall run when system is in Occupied Mode only.

b. Staged supply fan controls

1) VFD Fan groups shall be lead/lag controlled per Paragraph 3.1P.

2) When fans are enabled, start the lead supply fan. When %-supply airflow (totalized enabled VAV box setpoints (not readings) divided by design AHU airflow) exceeds stage-up setpoint (below) for 15 minutes (adjustable) then the next lag supply fan shall run. All VFDs receive the same speed signal. When %-airflow falls below the stage-up setpoint for 15 (adjustable) minutes then last lag fan shall be staged off. Each stage shall have its own PID gains, separately tuned.

VFD Stage	Stage up Flow
1	0%
2	45%

VFD Stage	Stage up Flow
1	0%
2	30%
3	60%

VFD Stage	Stage up Flow
1	0%
2	25%
3	40%
4	75%

VFD Stage	Stage up Flow
1	0%
2	10%
3	25%
4	35%
5	55%
6	75%

c. Totalize current airflow rate from ventilation CAV/VAV boxes to a software point Vps.

VAV box airflow rates are summed to obtain overall supply air rate without the need for an airflow measuring station (AFMS) at the air-handler discharge. This is used for ventilation rate calculations and may also be used for display and diagnostics.

2. Static Pressure Set-Point Reset

   a. Static pressure setpoint. Setpoint shall be reset using T&R logic (see Section 3.1O) using the parameters shown in Table 5.16.1.2.

Table 5.16.1.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	120 Pa (0.5 in. of water)
SPmin	25 Pa (0.1 in. of water)
SPmax	Max_DSP (see Section 1.3C.1)
Td	10 minutes
T	2 minutes
I	2
R	Zone static pressure reset requests
SPtrim	–12 Pa (–0.05 in. of water)
SPres	15 Pa (+0.06 in. of water)
SPres-max	32 Pa (+0.13 in. of water)

The T&R reset parameters in Table 5.16.1.2 are suggested as a starting point; they will most likely require adjustment during the commissioning/tuning phase.

3. Static Pressure Control

   a. Supply fan speed is controlled to maintain DSP at setpoint when the fan is proven on. Where the Zone Groups served by the system are small, provide multiple sets of gains that are used in the control loop as a function of a load indicator (such as supply-fan airflow rate, the area of the Zone Groups that are occupied, etc.).

High-pressure trips may occur if all VAV boxes are closed (as in Unoccupied Mode) or if fire/smoke dampers are closed (in some fire/smoke damper (FSD) designs, the dampers are interlocked to the fan status rather than being controlled by smoke detectors). Multiple sets of gains are used to provide control loop stability as system characteristics change.

D. Supply Air Temperature Control

1. Control loop is enabled when the supply air fan is proven on, and disabled and output set to deadband otherwise.

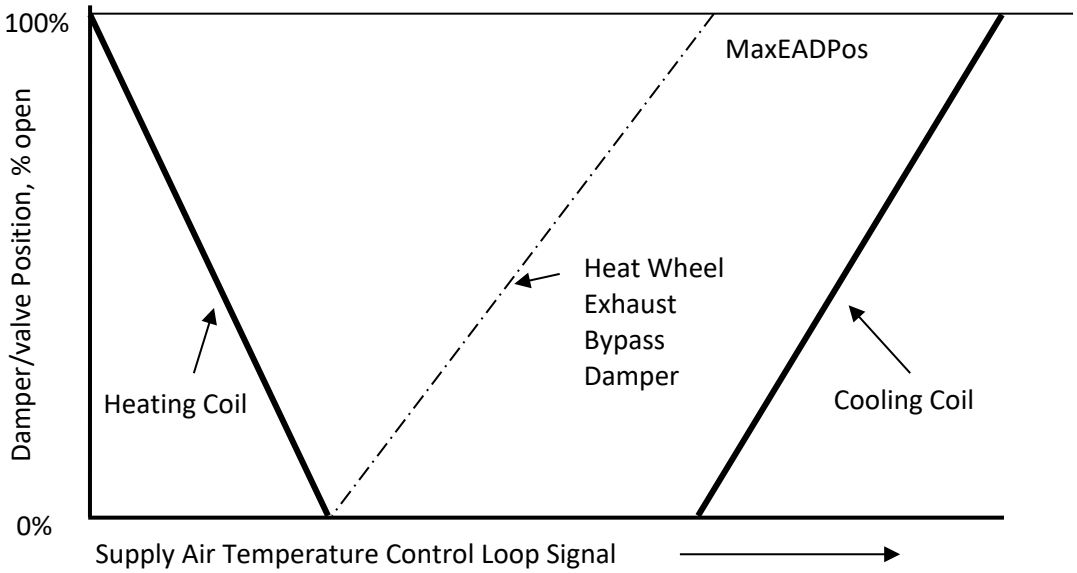
2. Supply Air Temperature Setpoint

   a. When the outdoor air temperature is below Heat_SAT, the supply air temperature setpoint shall be Heat_SAT

   b. When the outdoor air temperature is above Cool_SAT, the supply air temperature setpoint shall be Cool_SAT

c. When the outdoor air temperature is between Heat_SAT and Cool_SAT, heating and cooling systems shall be locked off.

3. Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the heating coil, heat recovery bypass damper, and cooling coil as shown in the Figure below:



a. The heat wheel shall run, supply air bypass damper shall close, and bypass damper enabled to modulate per Figure above from 0% to MaxEADPos open when

1) Supply fan is proven on, and

2) Heat wheel exhaust fan is proven on, and

3) Either

a) Outdoor air temperature is below the supply air temperature setpoint. In this mode, MaxEADPos = 100%.

b) Or the outdoor air temperature is above the economizer high limit temperature per Paragraph 3.1Q. In this mode, MaxEADPos = 0%.

The HR coils will save some heating or cooling energy any time the economizer (if there were one) is off.

b. The heat wheel shall shut off after minimum 5 minutes runtime if all of the above is false. When the heat wheel is off, the wheel supply and exhaust bypass dampers shall fully open.

E. Relief Air Control

F. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval count when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

   a. Commanded on, status off: Level 2

   b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when airflow (expressed as a percentage of design airflow or design speed if total airflow is not known) exceeds 20%: Level 4. The alarm limit shall vary with total airflow (if available; use fan speed if total airflow is not known) as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high-limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current airflow rate x (expressed as a fraction). For instance, the setpoint at 50% of design airflow would be (0.5)1.4, or 38% of the design high-limit pressure drop. See Section 1.2G.4 for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

4. High building pressure (more than 25 Pa [0.10 in. of water]) for 5 minutes: Level 3.

5. Low building pressure (less than 0 Pa [0.0 in. of water], i.e., negative) for 5 minutes: Level 4.

G. Testing/Commissioning Overrides. Provide software switches that interlock to a CHW and hot-water plant level to

   a. force HW valve full open if there is a hot-water coil,

   b. force HW valve full closed if there is a hot-water coil,

   c. force CHW valve full open, and

   d. force CHW valve full closed.

Per Section 3.1L, all hardware points can be overridden through the BAS. Each of the following points is interlocked so that they can be overridden together at a zone-group level, per Section 3.5E.
For example, the CxA can check for leaking dampers by forcing all VAV boxes in a Zone Group closed and then recording airflow at the AHU.

H. Plant Requests

1. If There Is a Chilled-Water Coil, Chilled-Water Reset Requests

   a. If the supply air temperature exceeds the supply air temperature setpoint by 3°C (5°F) for 2 minutes, send 3 requests.

b. Else if the supply air temperature exceeds the supply air temperature setpoint by 2°C (3°F) for 2 minutes, send 2 requests.

c. Else if the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 85%.

d. Else if the CHW valve position is less than 95%, send 0 requests.

2. If There Is a Chilled-Water Coil, Chiller Plant Requests. Send the chiller plant that serves the system a chiller plant request as follows:

a. If the CHW valve position is greater than 95%, send 1 request until the CHW valve position is less than 10%.

b. Else if the CHW valve position is less than 95%, send 0 requests.

3. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. If the supply air temperature is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

b. Else if the supply air temperature is 8°C (15°F) less than setpoint for 5 minutes, send 2 requests.

c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

d. Else if the HW valve position is less than 95%, send 0 requests.

4. If There Is a Hot-Water Coil, Heating Hot Water Plant Requests. Send the heating hot-water plant that serves the AHU a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.20 GENERAL CONSTANT SPEED EXHAUST FAN

A. Exhaust Fan Control

1. Exhaust Fan Start/Stop

a. Scheduled fans

1) Exhaust fan shall operate when any of the associated system supply fans is proven on and any associated Zone Group is in the Occupied Mode. See Section 1.2D for Zone Group assignments.

b. Fans controlled by space temperature

1) Exhaust fan shall run when zone temperature rises above the active cooling setpoint until zone temperature falls more than 1°C (2°F) below the active cooling setpoint for 2 minutes.

The room temperature control method should only be used in non-occupied spaces where ventilation is not required (e.g., equipment rooms).

B. Alarms

1. Maintenance interval alarm when fan has operated for more than 3,000 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

a. Commanded on, status off: Level 2

b. Commanded off, status off: Level 4

3.21 RADIANT ZONE MANIFOLDS

A. Radiant manifold serve one or more space temperature sensors if the radiant zone overlaps with several VAV zones. See Drawings. If more than one:

1. The control heating loop output shall be the highest heating loop output from the radiant zones served by the manifold.

2. The control cooling loop output shall be the highest cooling loop output from the radiant zones served by the manifold.

B. Slab Temperature Setpoints

1. Maximum Slab Temperature Setpoint, STSPmax, shall equal 85°F (adj.).

2. Minimum Slab Temperature Setpoint, STSPmin, shall equal the greater of 65°F (adj.) and 1°F (adj.) more than the present outdoor air dew point temperature.

3. Neutral Temperature Setpoint, STSPneut, shall equal the average of the active radiant zone heating and cooling setpoints for the zone served by the manifold.

C. Slab Temperature Setpoint Reset

1. Upper and lower limits of the reset range shall be STSPmax and STSPmin.

2. When the Radiant Water Loop serving the manifold is indexed to Heating Mode, Slab Temperature Setpoint shall be reset from STSPmin at 0% control heating loop output to STSPmax at 100% control heating loop output.

3. When the Radiant Water Loop serving the manifold is indexed to Cooling Mode, Slab Temperature Setpoint shall be reset from STSPmax at 0% control cooling loop output to STSPmin at 100% control cooling loop output.

D. Slab Temperature Control

1. When in Heating Mode, the 2-position manifold valve shall open when slab temperature falls 1°F below setpoint and close when slab temperature exceeds setpoint.

2. When in Cooling Mode, the 2-position manifold valve shall open when the slab temperature is 1°F above setpoint and close when slab temperature falls below setpoint.

3. Valve Lockout: When valve lockout logic is triggered, it shall override all preceding valve control logic.

    a. When in Heating Mode and all radiant zones served by the manifold are above zone heating setpoint for 5 minutes continuously, manifold valve shall be closed. Valve shall remain locked out until any radiant zone served by the manifold falls below its heating setpoint.

    b. When in Cooling Mode and all radiant zones served by the manifold are below cooling setpoint for 5 minutes continuously, manifold valve shall be closed. Valve shall remain locked out until any radiant zone served by the manifold rises above its cooling setpoint.

    c. When the radiant loop changes modes, the manifold valve shall not be allowed to open until it has been closed for at least 3 hours (e.g. if the manifold valve were last open in Heating Mode 120 minutes prior to the loop switching to Cooling Mode, the valve would remain shut for another 60 minutes before being unlocked for cooling control).

E. Alarms

1. Slab temperature drops to 62°F for 15 minutes (adj.) continuously. Level 2.

2. Slab temperature rises above 90°F for 15 minutes (adj.) continuously. Level 2.

F. Testing/Commissioning Overrides: Provide software points that interlock to a physical IO point to

1. Force manifold control valve full open

2. Force manifold control valve full closed

G. Radiant Water Loop Requests

1. If the manifold control valve is open for 1 minute continuously, send 1 request.

2. If the manifold control valve is closed, send 0 requests.

3.22 RADIANT WATER PUMP LOOPS

A. Radiant Water Loop Mode

1. Definitions

    a. CoolAvg = The average Radiant Zone Cooling Loop output from all radiant zones served by the loop.

b. HeatAvg = The average Radiant Zone Heating Loop output from all radiant zones served by the loop.

2. When the system is first enabled (e.g. following a control system shutdown), index the loop to Heating Mode.

3. Thereafter, index the Radiant Water Loop to Cooling Mode if all of the following are true:

   a. CoolAvg > HeatAvg for 20 minutes (adj.) continuously.

   b. CoolAvg > 10% for 20 minutes (adj.) continuously.

   c. There are no active Radiant Heating Mode Requests.

   d. The zone generating the highest cooling loop output is not being set from occupied mode to unoccupied mode within the next 120 minutes (adj.).

The goal is to avoid cooling the floor in the afternoon if the zone is about to go unoccupied.

4. Index the Radiant Water Loop to Heating Mode if:

   a. Either:

      1) Both of the following are true:

         a) HeatAvg > CoolAvg for 20 minutes (adj.) continuously.

         b) HeatAvg > 10% for 20 minutes (adj.) continuously.

      2) There is at least 1 active Radiant Heating Mode Request.

   b. AND the zone generating the highest heating loop output is not being set from occupied mode to unoccupied mode within the next 60 minutes (adj.).

The goal is to avoid heating the floor in the evening if the zone is about to go unoccupied. A less aggressive delay is appropriate for heating than cooling since some zones only have radiant heating.

B. Loop Changeover Control

1. When changing over from heating to cooling,

   a. First command the heating control valve shut.

   b. Wait 15 minutes to allow heat from water loop to dissipate in the slab, then command the changeover valves from open to the hot water loop to open to the chilled water loop.

   c. After 2 minutes, release the tempered chilled water control valve to control Radiant Loop Supply Water Temperature.

2. When changing over from cooling to heating, logic shall operate identically to heating to cooling switchover, but in reverse.

C. Radiant Loop Supply Water Temperature Control

1. Loop Supply Water Temperature Setpoint

a. When the loop is in Cooling Mode, supply water temperature setpoint shall be the greater of:

1) 10°F below the lowest Slab Temperature Setpoint for a manifold served by the loop; and

2) The plant tempered chilled water supply temperature plus 1°F.

b. When the loop is in Heating Mode, supply water temperature shall be the lesser of:

1) 15°F above the highest Slab Temperature Setpoint for a manifold served by the loop; and

2) The plant hot water minus 2°F.

2. Loop supply water temperature shall be controlled to setpoint by a PID loop that modulates the enabled (heating or cooling) 2-way control valve. In Heating Mode, loop shall be reverse acting; in Cooling Mode, loop shall be direct acting.

3. 2-way control valve for enabled mode shall be shut whenever Radiant Water Pump status is off.

D. Radiant Water Pump (RWP) Control

1. Enable pump whenever there is 1 or more Radiant Water Loop requests from manifolds served by the loop.

2. Disable pump whenever there are 0 Radiant Water Loop requests from manifolds served by the loop for 1 minute (adj.) continuously.

E. Alarms

1. Maintenance interval alarm when pump has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

2. Pump alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

a. Commanded on, status off: Level 2

b. Commanded off, status on: Level 4

3. Loop supply water temperature alarm if supply temperature is more than 3°F off setpoint for 15 minutes continuously: Level 3. Suppress alarm if RWP is off.

F. Testing/Commissioning Overrides: Provide software points that interlock to a physical IO point to

1. Force hot water valve full open
2. Force hot water valve full closed
3. Force changeover valves from one position to the other
4. Force tempered chilled water valve full open
5. Force tempered chilled water valve full closed

G. Plant Requests

1. Cooling TCHWST Reset Requests

a. Whenever Loop Supply Water Temperature Setpoint is equal to TCHWST plus 1°F:

1) Send 0 requests when the TCHW valve is closed.

2) Send 1 request for each manifold control valve open for 30 minutes continuously when the TCHW valve is greater than 10% open, up to a maximum of 2.

3) Requests from a given manifold control valve shall clear when that manifold valve is closed.

b. Otherwise:

1) If the TCHW valve is greater than 85%, send 0 requests.

2) If the TCHW valve is greater than 95%, send 1 request.

3) If the loop supply water temperature is 3°F greater than set point for 5 minutes, send 2 requests.

2. Tempered Chilled Water Loop Requests. Send the chiller plant that serves the system a Tempered Chilled Water Loop Request as follows:

a. If the TCHW valve is less than 10%, send 0 requests.

b. If the TCHW valve is greater than 95%, send 1 request.

3. Heating HWST Reset Requests

a. Whenever Loop Supply Water Temperature Setpoint is equal to HWST minus 2°F:

1) Send 0 requests when the HW valve is closed.

2) Send 1 request for each manifold control valve open for 30 minutes continuously when the HW valve is greater than 10% open, up to a maximum of 2.

3) Requests from a given manifold control valve shall clear when that manifold valve is closed.

b. Otherwise:

1) If the HW valve is greater than 85%, send 0 requests.

2) If the HW valve is greater than 95%, send 1 request.

3) If the loop supply water temperature is 3°F less than set point for 5 minutes, send 2 requests.

4. Heating Hot-Water Plant Requests. Send the boiler plant that serves the system a Heating Hot-Water Plant Request as follows:

a. If the HW valve is less than 10%, send 0 requests.

b. If the HW valve is greater than 95%, send 1 request.

3.23 PACKAGED SINGLE ZONE HEAT PUMP OR GAS/ELECTRIC AC UNIT WITH BACNET

A. See “Generic Thermal Zones” (Section 3.4) for setpoints, alarms, etc.

B. Each of the AC units operates independently through its factory installed controller.

C. All setpoints and scheduling shall be written from the BAS to the AC unit controller via the BACnet interface.

D. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

2. AC unit alarm: Level 2 to 4 based on severity.

3.24 PACKAGED SINGLE ZONE HEAT PUMP OR GAS/ELECTRIC AC UNIT WITH DDC

A. See “Generic Thermal Zones” (Section 3.4) for setpoints, loops, control modes, alarms, etc.

B. Supply fan control

1. For occupied areas: The unit fan shall run when system is in any mode other than Unoccupied Mode.

2. For IDF rooms and other unoccupied areas: The unit fan shall run only when zone is in Cooling State or Heating State and off in Deadband State.

C. Cooling control

1. Cooling is enabled when the zone is in Cooling State.

2. The zone Cooling Loop output shall be mapped to stage the two stages of cooling as follows. Each stage shall have a 5 minute minimum on time and a 5 minute minimum off-time:

    a. Stage 1 of cooling shall be enabled when the loop output is at 50 and staged off when the loop output is at 0. Note the economizer (where applicable) is enabled by the unit controls whenever the first stage of cooling is engaged.

    b. Stage 2 of cooling shall be enabled when the loop output is at 100 and staged off when the loop output is at 50.

    c. Each stage shall have a 5 minute minimum on time and a 5 minute minimum off-time

D. Heating control

1. Heating is enabled when the zone is in Heating Mode.

2. The zone Heating Loop output shall be mapped to stage the two stages of heating as follows. Each stage shall have a 5 minute minimum on time and a 5 minute minimum off-time:

    a. Stage 1 of heating shall be enabled when the loop output is at 40 and staged off when the loop output is at 0.

    b. Stage 2 of heating shall be enabled when the loop output is at 70 and staged off when the loop output is at 30.

    c. The electric auxiliary heat shall be enabled when the outdoor air temperature is below 40°F and the loop output is at 100, and staged off when the loop output is below 60 or the outdoor air rises above 45°F.

E. Outdoor air and return air damper control.

1. Outdoor air and return air dampers are controlled internally by the AC unit.

2. Set minimum outdoor air damper position using the potentiometer on the packaged economizer, or two-position actuator if no economizer. Minimum outdoor air is enabled by the outdoor air enable contact from the DDC system only when the system is in the Occupied Mode.

3. Set economizer high limit in AC unit to disable economizer when outdoor air temperature is above the high limit per Paragraph 3.1Q for this climate zone.

F. Alarms

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status input being different from the output command for 15 seconds.

a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

3. Generate a Level 3 alarm if:

a. Heating outputs are on and supply air fan is proven on and supply air temperature is below 80°F for more than 3 minutes indicating heating system failure.

b. Cooling outputs are on and supply air fan is proven on and supply air temperature is above 65°F for more than 3 minutes indicating cooling system failure.

4. Filter pressure drop exceeds adjustable alarm limit. Level 4

3.25 PACKAGED MULTIPLE ZONE VAV AC UNIT

A. AC Unit shall be configured to disable any internal scheduling, start/stop, and mode control. All operating modes and setpoints shall be determined by the BAS as described herein. The AC unit shall be configured to operate only when enabled by BAS commands and to maintain the setpoints determined by the BAS below. All commands and setpoints shall be passed from the BAS to the to the AC unit's internal controls via the gateway.

B. AC System Modes. See Paragraph 3.16 for Modes which are generated by Zone Group Requests.

C. Supply Fan Control

1. Supply Fan Start/Stop

a. Supply fan shall run when system is in the Cooldown Mode, Setup Mode, or Occupied Mode.

b. If there are any VAV-reheat boxes on perimeter zones, supply fan shall also run when system is in Setback Mode or Warmup Mode (i.e., all modes except unoccupied).

c. Totalize current airflow rate from VAV boxes to a software point Vps.

VAV box airflow rates are summed to obtain overall supply air rate without the need for an airflow measuring station (AFMS) at the air-handler discharge. This is used for ventilation rate calculations and may also be used for display and diagnostics.

2. Static Pressure Set-Point Reset

a. Static pressure setpoint. Setpoint shall be reset using T&R logic (see Section 3.1O) using the parameters shown in Table 5.16.1.2.

Table 5.16.1.2 Trim & Respond Variables

Variable	Value

Device	Supply fan
SP0	120 Pa (0.5 in. of water)
SPmin	25 Pa (0.1 in. of water)
SPmax	Max_DSP (see Section 1.3C.1)
Td	10 minutes
T	2 minutes
I	2
R	Zone static pressure reset requests
SPtrim	–12 Pa (–0.05 in. of water)
SPres	15 Pa (+0.06 in. of water)
SPres-max	32 Pa (+0.13 in. of water)

The T&R reset parameters in Table 5.16.1.2 are suggested as a starting point; they will most likely require adjustment during the commissioning/tuning phase.

3. Static Pressure Control

   a. Static pressure tip shall be extended in field to location shown on plans.

   b. Supply fan shall be controlled by AC unit internal controls to maintain supply duct static pressure setpoint.

   c. VFD ramp rate shall be configured to rise very slowly to prevent high pressure trips in case all VAV boxes are closed (they should close during unoccupied periods) or in case fire/smoke dampers are closed (in some FSD designs, the dampers are interlocked to the fan status rather than being controlled by smoke detectors).

D. Supply Air Temperature Control

1. Control loop is enabled when the supply air fan is proven on, and disabled and output set to deadband (no heating, minimum economizer) otherwise.

2. Supply Air Temperature Setpoint

The default range of outdoor air temperatures [21°C (70°F) –16°C (60°F)] used to reset the Occupied Mode SAT setpoint was chosen to maximize economizer hours. It may be preferable to use a lower range of OATs (e.g., 18°C [65°F] – 13°C [55°F]) to minimize fan energy if there is a 24/7 chiller plant that is running anyway; reheat is minimized, as in a VAV dual-fan dual-duct system, or the climate severely limits the number of available economizer hours.
If using this logic, the engineer should oversize interior zones and rooms with high cooling loads (design them to be satisfied by the warmest SAT) so these zones do not drive the T&R block to the minimum SAT setpoint.

   a. See Section 1.2G.1 for Min_ClgSAT, Max_ClgSAT, OAT_Min, and OAT_Max setpoints.

b. During Occupied Mode and Setup Mode, setpoint shall be reset from Min_ClgSAT when the outdoor air temperature is OAT_Max and above, proportionally up to T-max when the outdoor air temperature is OAT_Min and below.

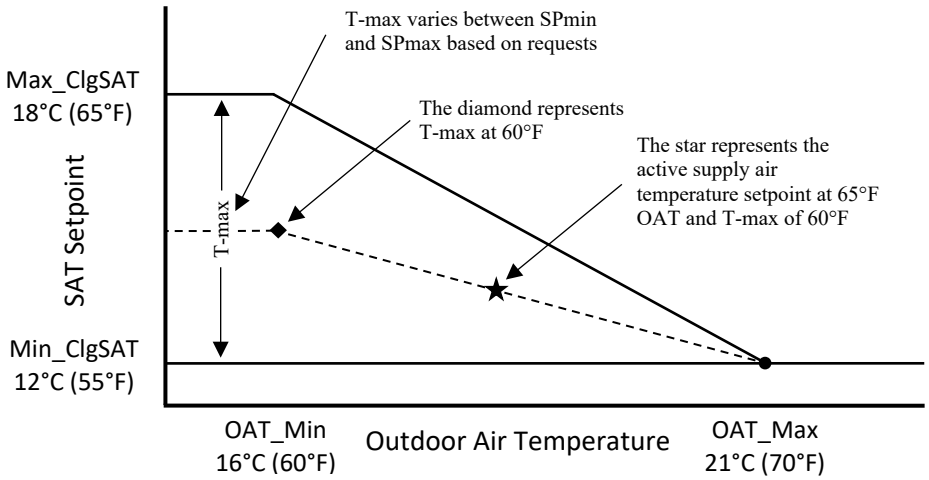
1) T-max shall be reset using T&R logic (see Section 3.1O) between Min_ClgSAT and Max_ClgSAT. The parameters shown in Table 5.16.2.2 are suggested as a starting place, but they will require adjustment during the commissioning/tuning phase.

The T&R reset parameters in Table 5.16.2.2 are suggested as a starting place; they will most likely require adjustment during the commissioning/tuning phase.

Table 5.16.2.2 Trim & Respond Variables

Variable	Value
Device	Supply fan
SP0	SPmax
SPmin	Min_ClgSAT
SPmax	Max_ClgSAT
Td	10 minutes
T	2 minutes
I	2
R	Zone cooling SAT requests
SPtrim	+0.1°C (+0.2°F)
SPres	–0.2°C (–0.3°F)
SPres-max	–0.6°C (–1.0°F)

The net result of this SAT reset strategy is depicted in the Figure 5.16.2.2 for Min_ClgSAT = 12°C (55°F), Max_ClgSAT = 18°C (65°F), OAT_Max = 21°C (70°F), and OAT_Min = 16°C (60°F).



Informative Figure 5.16.2.2 Example supply air temperature reset diagram.

c. During Cooldown Mode, setpoint shall be Min_ClgSAT.

d. During Warmup Mode and Setback Mode, setpoint shall be 35°C (95°F).

Raising the SAT setpoint in warmup will effectively lock out the economizer and cooling coil, which is desirable for warmup even if there is no heating coil at the AHU to meet the higher SAT.
This does not apply in the case of a DFDD AHU or if all the zones are equipped with fan-powered boxes such that the AHU is off in warmup and setback.

3. Supply air temperature shall be controlled by the AC unit internal controls to sequence the ***heating***, economizer, and compressors.

   a. Adjust the damper actuators so that dampers sequence rather than overlap, e.g. from 0 Vdc to 5 Vdc, the outdoor air damper goes from full closed to full open and from 5 Vdc to 10 Vdc the return air damper goes from full open to full closed.

   b. Set economizer high limit in AC unit to disable economizer when outdoor air temperature is above the high limit per Paragraph 3.1Q for this climate zone.

E. Minimum Outdoor Air Control

1. Outdoor Airflow Setpoint for California Title 24 Ventilation

   a. See Section 3.17C.1 for calculation of current setpoints AbsMinOA* and DesMinOA*.

   b. See zone CO2 control logic under terminal unit sequences.

   c. The minimum outdoor air setpoint MinOAsp shall be reset based on the highest zone CO2 control-loop signal from AbsMinOA* at 50% signal to DesMinOA* at 100% signal.

d. Minimum outdoor air control shall be controlled by the AC unit internal controls to maintain minimum outdoor air at setpoint. Setpoint shall be set to MinOAsp when the AC unit is in Occupied Mode and set to zero otherwise.

e. Minimum Outdoor Air Control Loop

1) Minimum outdoor air control loop is enabled when the AC unit is in Occupied Mode and disabled and output set to zero otherwise.

2) The measured outdoor airflow rate shall be maintained at the minimum outdoor air setpoint MinOAsp by a PID loop whose output is written to the AC unit internally controlled minimum damper position input.

F. Relief Fans

1. Building pressure sensor shall be field installed in location indicated on Drawings.

2. Relief fans shall be controlled by AC unit internal controls to maintain building pressure at setpoint (0.05" adjustable).

G. Return Fans

1. Building pressure sensor shall be field installed in location indicated on Drawings.

2. Return fans shall be controlled by AC unit internal controls to track supply air fans to maintain building pressure at approximately 0.05".

H. Alarms:

1. Maintenance interval alarm when fan has operated for more than 1500 hours: Level 4. Reset interval count when alarm is acknowledged.

2. Fan alarm is indicated by the status being different from the command for a period of 15 seconds.

a. Commanded on, status off: Level 2

b. Commanded off, status on: Level 4

3. Filter pressure drop exceeds the larger of the alarm limit or 12.5 Pa (0.05") for 10 minutes when airflow (expressed as a percentage of design airflow or design speed if total airflow is not known) exceeds 20%: Level 4. The alarm limit shall vary with total airflow (if available; use fan speed if total airflow is not known) as follows:

$$DP_x = DP_{100}(x)^{1.4}$$

where DP100 is the high-limit pressure drop at design airflow (determine limit from filter manufacturer) and DPx is the high limit at the current airflow rate x (expressed as a fraction). For instance, the setpoint at 50% of design airflow would be (0.5)1.4, or 38% of the design high-limit pressure drop. See Section 1.2G.4 for DP100.

The constant value threshold for the filter pressure drop alarm is a function of the transducer and A/D converter used to measure filter differential pressure. The value used shall be determined as the minimum accuracy of the transducer and A/D converter combination.

4. High building pressure (more than 25 Pa [0.10 in. of water]) for 5 minutes: Level 3.

5. Low building pressure (less than 0 Pa [0.0 in. of water], i.e., negative) for 5 minutes: Level 4.

6. AC unit failure alarm: Level 2

7. Cooling compressors operate when the outdoor air is below 55°F. Level 4.

I. Plant Requests

1. If There Is a Hot-Water Coil, Hot-Water Reset Requests

a. If the supply air temperature is 17°C (30°F) less than setpoint for 5 minutes, send 3 requests.

b. Else if the supply air temperature is 8°C (15°F) less than setpoint for 5 minutes, send 2 requests.

c. Else if HW valve position is greater than 95%, send 1 request until the HW valve position is less than 85%.

d. Else if the HW valve position is less than 95%, send 0 requests.

2. If There Is a Hot-Water Coil, Heating Hot Water Plant Requests. Send the heating hot-water plant that serves the AHU a heating hot-water plant request as follows:

a. If the HW valve position is greater than 95%, send 1 request until the HW valve position is less than 10%.

b. Else if the HW valve position is less than 95%, send 0 requests.

3.26 WATER COOLED CHILLED WATER PLANT

A. See Section 1.2I for Design Setpoints. See Section 1.3E for TAB setpoints.

B. Plant Enable/Disable

1. The chiller plant shall include an enabling schedule that allows operators to lock out the plant during off-hours, holidays, or any other scheduled event, e.g., to allow off-hour operation of HVAC systems except the chiller plant. The default schedule shall be 24/7 (adjustable).

2. Enable the plant in the lowest stage when the plant has been disabled for at least 15 minutes and:

a. Number of Chiller Plant Requests > I (I = Ignores shall default to 0, adjustable), and

b. OAT>CH-LOT, and

c. The chiller plant enable schedule is active.

3. Disable the plant when it has been enabled for at least 15 minutes and:

   a. Number of Chiller Plant Requests ≤ I for 3 minutes, or

   b. OAT<CH-LOT – 1°F, or

   c. The chiller plant enable schedule is inactive.

4. When the plant is enabled:

   a. Open the CHW isolation valve of the lead chiller.

   b. Open the CW isolation valve of the lead chiller.

   c. Stage on lead primary CHW pump, CW pump, and cooling towers per Sections 3.26E, 3.26G, and 3.26I respectively.

   d. Once the lead pumps are proven on, enable the lead chiller.

5. When the plant is disabled:

   a. Shut off the enabled chiller(s).

Where chillers have a CHW request network point, consider increasing the delay to 10 minutes to ensure that flow is not cut off too soon. Where chillers do not have this point (e.g., older chillers without network interfaces), the default delay is appropriate.

   b. For each enabled chiller, close the CHW isolation valve after 3 minutes or the chiller is not requesting CHW flow.

Where chillers have a CW request network point, consider increasing the delay to 10 minutes to ensure that flow is not cut off too soon. Where chillers do not have this point (e.g., older chillers without network interfaces), the default delay is appropriate.

   c. For each enabled chiller, close the CW isolation valve after 3 minutes or the chiller is not requesting CW flow.

   d. Disable the operating primary CHW pump(s), CW pump(s), and cooling tower(s) per Sections 3.26E, 3.26G, and 3.26I respectively.

C. Chiller Staging

1. Chiller stages shall be defined as follows:

Chiller Stage	Enabled Chillers
0	None
1	CH-1 or CH-2
2	CH-1 and CH-2

2. Interchangeable chillers indicated with "or" in the table above shall be lead/lag controlled per Section 3.1P.3. If a chiller is in alarm per Section 3.1P.5.b, its CHW and CW isolation valves shall be closed.

3. Chillers are staged in part based on required capacity, Qrequired, relative to design capacity of a given stage, which is the sum of the design capacity of each chiller active in each stage. This ratio is the operative part load ratio, OPLR.

4. Qrequired is calculated based on chilled water return temperature (CHWRT) entering the chillers, active chilled water supply temperature setpoint (CHWSTSP), and measured flow through the primary circuit flow meter (FLOWP), as shown in the equation below. Qrequired used in logic shall be a 5-minute rolling average of instantaneous values sampled at a minimum of every 30 seconds.

$$Q_{required} = \frac{FLOW_P(CHWRT - CHWST_{SP})}{24} \; [tons]$$

Required capacity, as opposed to actual load, is used to provide more stable staging since chilled water supply temperature setpoint changes less dynamically than actual chilled water supply temperature. Note that using entering return temperature, as opposed to temperature upstream of waterside economizers or chilled water minimum flow bypasses as applicable, is critical for calculations to be executed properly.

5. When a stage up or stage down transition is initiated, hold Qrequired fixed at its last value until the longer of the successful completion of the stage change (e.g., lag chiller proven on) and 15 minutes.

As staging occurs, flowrate and return temperature may fluctuate, so Qrequired may be unstable. As detailed subsequently, Qrequired impacts plant part load ratio, which drives condenser water return temperature setpoint and tower control. As such, if Qrequired is unstable, so too would be condenser water return temperature, and thus chiller lift.

6. OPLR shall be calculated as follows:

$$OPLR = \frac{Q_{required}[tons]}{Sum\ of\ QchX\ for\ Chillers\ in\ stage}$$

7. Minimum cycling part load ratio, OPLRMIN, shall be calculated as:

$$OPLR_{MIN,stage} = \frac{Sum\ of\ MinUnloadTonsX\ for\ Chillers\ in\ stage}{Sum\ of\ QchX\ for\ Chillers\ in\ stage}$$

8. Stage up events are initiated in part based on current stage OPLR exceeding a stage up part load ratio, SPLRUP; stage down events are initiated in part based on OPLR for the next lower stage falling below a stage down part load ratio, SPLRDN.

9. Staging events require that a chiller stage be available. A stage shall be deemed unavailable if the stage cannot be achieved because a chiller required to operate in the

stage is faulted per Section 3.1P.5.b.1)b) or a chilled water or condenser water pump dedi**Error! Reference source not found.**; otherwise, the stage shall be deemed available.

10. SPLRUP and SPLRDN reset based on the types of chillers operating in the current stage and the types of chillers operating in the next higher and lower available stages per the subsequent logic. The rules below are organized in order of precedence from most important to least important; more important rules supersede less important rules.

The above section effectively means the rules for staging constant speed centrifugal chillers supersede the rules for staging positive displacement chillers, and the rules for staging positive displacement chillers supersede the rules for staging variable speed centrifugal chillers. These rules assume the following staging hierarchy applies globally across chiller plants based on current industry best practice:

(1) If the plant has any positive displacement machines, those are staged on first since they are generally sized to handle low load conditions.

(2) Variable speed centrifugal machines are staged on next.

(3) Constant speed centrifugal machines are staged on last.

a. Set SPLRUP as follows:

1) When all chillers operating in the current stage are positive displacement, SPLRUP shall be 80%.

Positive displacement chillers utilize a fixed staging PLR because screw and scroll compressors have a fixed compression ratio (most commercial screw chillers typically do not employ variable volume ratio technology, though some are coming to market). Positive displacement chiller efficiency at a given load is therefore not as sensitive to changes in lift as centrifugal chiller efficiency, and the relative efficiencies at different chiller load percentages (e.g., 30% for two chiller operation vs. 60% for one chiller operation) hold reasonably constant as lift changes. As such, resetting staging PLR with lift is not necessary to optimize screw chiller plant performance. This is in contrast to variable speed centrifugal chiller reset logic described below.
Positive displacement machines are typically used as low load chillers in larger plants. It therefore makes sense to load them nearly fully prior to staging on larger variable speed centrifugal machines (where used). As such, positive displacement machine staging criteria take precedence over variable speed centrifugal machine staging criteria.

2) When any chillers in the current operating stage are variable speed centrifugal, SPLRUP shall be calculated as the 5 minute rolling average of the following equation sampled at least every 30 seconds:

$$SPLR_{UP} = Min(Max(0.45, E * LIFT + F), 0.9)$$

$$LIFT = CWRT - CHWST_{SP}$$

$$E = \frac{0.9}{(LIFT_{MAX} - LIFT_{MIN})}$$

$$F = E * (0.4 * LIFT_{MAX} - 1.4 * LIFT_{MIN})$$

a) LIFTmin and LIFTmax shall be calculated as the averages of LIFTminX and LIFTmaxX for all variable speed centrifugal chillers operating in the current stage respectively.

Centrifugal chiller efficiency varies significantly with lift. As lift increases for a given load, centrifugal compressors must run faster to avoid surge. Capacity trimming under such conditions is accomplished using inlet guide vanes or variable geometry diffusers, which reduces chiller efficiency. The above equation resets the centrifugal staging point up when lift is high to minimize throttling of surge control devices and keep chillers operating near to their optimal efficiency. Engineers should consult with the chiller manufacturer to obtain part load efficiency data and adjust the optimal staging bounds for each application. See the ASHRAE Fundamentals of Design and Control of Central Chilled-Water Plants Self-Directed Learning Course for how E and F can be optimally determined. The E and F values above are the simplified coefficients from this SDL, Appendix A normalized for a plant with any number of chillers.
Upper and lower limits of 0.45 and 0.9 are placed on SPLR to ensure stable plant staging irrespective of the optimal staging point indicated by the lift reset curve. Using a two chiller plant with equally sized machines as the simplest example, bounding SPLR to a minimum of 0.45 ensures that the logic does not stage on the second machine if doing so would cause the chillers to be less than 22.5% loaded (0.45 OPLR divided by 2). Bounding SPLR to a maximum of 0.9 ensures that the logic does not delay staging once the operating chiller is more than 90% loaded (OPLR > 0.9) since doing so could risk losing the load.

b. Set SPLRDN as follows:

In the sections below, the stage down SPLR values appear identical to the stage up values. It is important to remember, per Section 3.26C.8, that these values are applied against the OPLR values of different plant stages, so they yield different tonnage thresholds.
Note also that the stage down conditions below do not yield a hysteresis band. I.e., if the positive displacement chiller rules were applied to a plant with only two screw chillers sized at 200 tons each, the plant stage up and stage down points would both be 160 tons. This is acceptable because the stages have minimum run times to prevent cycling. Furthermore, plant load for most applications generally trends in one direction for multiple hours before beginning to trend the opposite direction. As such, there is little risk of repeated stage cycling.

1) When all chillers operating in the next lower stage are positive displacement, SPLRDN shall be 80%.

2) When a variable speed centrifugal chiller operates in the next lower stage, SPLRDN shall be calculated as the 5 minute rolling average of the following equation sampled at least every 30 seconds:

$$SPLR_{DN} = Min(Max(0.45, E * LIFT + F), 0.9)$$

$$LIFT = CWRT - CHWST_{SP}$$

$$E = \frac{0.9}{(LIFT_{MAX} - LIFT_{MIN})}$$

$$F = E * (0.4 * LIFT_{MAX} - 1.4 * LIFT_{MIN})$$

a) LIFTmin and LIFTmax shall be calculated as the averages of LIFTminX and LIFTmaxX for all variable speed centrifugal chillers operating in the next lower stage respectively.

11. Staging shall be executed per the conditions below subject to the following requirements.

a. Each stage shall have a minimum runtime of 15 minutes.

b. Timers shall reset to zero at the completion of every stage change.

c. Any unavailable stage (see Section 9) shall be skipped during staging events, but staging conditionals in the current stage shall be evaluated as per usual.

d. Chilled water supply and return temperatures used in staging logic shall be those located in common supply and return mains hardwired to plant controllers.

e. Stage up if any of the following is true:

1) Availability Condition: The equipment necessary to operate the current stage are unavailable. The availability condition is not subject to the minimum stage runtime requirement. Or

2) Efficiency Condition: Current stage OPLR > SPLRUP for 15 minutes and current stage OPLR is not decreasing at a rate greater than 2.5% per minute averaged over 5 minutes; or

3) Failsafe Condition:

a) CHW DP is 2 psi < setpoint for 15 minutes; or

b) CHW supply temperature is 2°F > setpoint for 15 minutes.

f. Stage down if both of the following are true:

1) Next available lower stage OPLR < SPLRDN for 15 minutes and next lower stage OPLR is not increasing at a rate greater than 2.5% per minute averaged over 5 minutes; and

2) The failsafe stage up condition is not true.

The first stage up condition stages the chillers at the optimum load point, SPLR, to maximize chiller efficiency. The second stage up condition acts as a failsafe bringing on the lag chiller if one or more coils is starved because chilled water differential pressure is below setpoint or chilled water supply temperature is above setpoint for an extended period. The former may occur if chilled water delta-T is degraded from design or one pump is down for maintenance and the pump(s) are unable to drive additional flow through the operating chiller; the latter may occur if the lead chiller has an active fault condition that is not generating a failure alarm. It is also possible that the OPLR calculation could go out of calibration due to a failed flow meter and/or return temperature sensor, thus necessitating fallback on the failsafe conditions. Note that the DP failsafe condition does not apply to series chiller plants since bringing on an additional chiller would only increase pressure drop in a series chiller plant.
At various points in all of the staging sequences, there is a requirement to wait for requests for CHW and CW flow to clear, or 3 minutes to elapse, before moving on to the next step in staging. Where chillers have CHW and CW request network points, consider increasing the delay to 10 minutes to ensure that flow is not cut off too soon. Where chillers do not have these points (e.g., older chillers without network interfaces), the default delay is appropriate.

12. Whenever there is a stage-up command:

a. Command operating chillers to reduce demand to 75% of their current load. Wait until actual demand <80% of current load up to a maximum of 5 minutes before proceeding.

The above section is recommended for applications where a sudden change in load may induce a chiller trip. This was commonly true of older chillers but has often proven unnecessary for modern machines with more robust capacity controls. Leave it if unsure.

b. For any stage change, reset the minimum flow bypass setpoint to that appropriate for the new stage as indicated in Section 3.26F.1. After new setpoint is achieved, wait 1 minute to allow loop to stabilize.

If the bypass valve opens quickly, then the chiller load will suddenly drop and the chiller(s) could trip. Suddenly opening a chilled water isolation valve will also destabilize the chilled water DP control loop.
For stage up transitions during which one chiller is enabled while another is disabled, it is necessary to temporarily set the minimum flow bypass setpoint to that necessary to satisfy both the chiller to be enabled and the chiller to be disabled because the newly enabled chiller is brought online prior to disabling a currently operating chiller to avoid dropping the load.

c. Start the next CW pump and/or change CW pump speed to that required of the new stage per Section 3.26G and after 10 seconds enable head pressure control for the chiller being enabled. Wait 30 seconds.

d. Slowly open CHW isolation valve of the chiller being enabled. Determine valve timing in the field as that required to prevent nuisance trips.

Slowly opening the chilled water isolation valve prevents a sudden disruption in flow through the active chiller.

e. Start the next stage chiller after the CHW isolation valve is fully open (as determined by end switch status, or nominal valve timing if end switches are not provided).

f. Release the demand limit.

13. Whenever there is a stage-down command:

a. If staging down from any other stage, shut off the last stage chiller.

b. When the controller of the chiller being shut off indicates no request for chilled water flow or 3 minutes has elapsed, slowly close the chiller’s CHW isolation valve to avoid a sudden change in flow through other operating chillers.

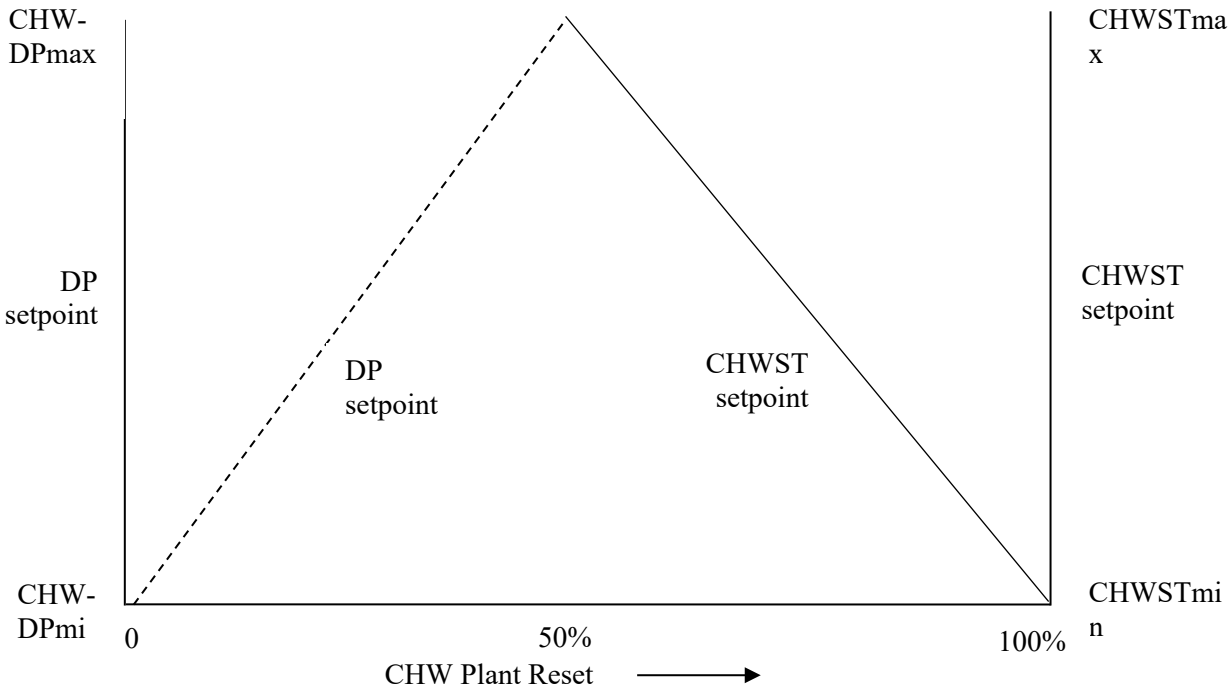
c. When the controller of the chiller being shut off indicates no request for condenser water flow or 3 minutes has elapsed, disable the chiller's head pressure control loop. When the CW isolation/head pressure control valve is fully closed (as determined by end switch status, or nominal valve timing if end switches are not provided), shut off the last lag CW pump and/or change CW pump speed to that required of the new stage per Section 3.26G.

d. Change the chilled water minimum flow bypass control setpoint to that appropriate for the new stage as indicated in Section 3.26F.1.

D. Chilled Water Plant Reset

1. CHWSTmin in the following logic shall be the lowest CHWSTminX of chillers in the plant.

2. Differential Pressure Controlled Loops: Chilled water supply temperature setpoint CHWSTsp and pump differential pressure setpoint CHW-DPsp shall be reset based on the current value of the logic variable called "CHW Plant Reset" as shown below and described subsequently.



The recommended logic first resets differential pressure setpoint to maximum before resetting chilled water supply temperature setpoint down towards design. Parametric plant analysis performed in a variety of climate zones during the development of ASHRAE's "Fundamentals of Design and Control of Central Chilled-Water Plants" Self-Directed Learning Course showed that the pump energy penalty incurred with this approach is more than offset by chiller energy savings resulting from keeping the chilled water supply temperature setpoint as high as possible.
Engineers may nonetheless adjust the CHW Plant Reset loop mapping based on unique project constraints. For plants with very low design CHW delta-Ts (<12°F) and high pump heads (>120 ft) it may be advisable to overlap the resets—e.g., reset DP setpoint from 0% to 75% loop output and CHWST setpoint from 25% to 100% loop output—instead of fully resetting CHWST setpoint up before beginning to lower resetting pump DP setpoint down.

a. From 0% loop output to 50% loop output, reset DP setpoint from CHW-DPmin to CHWP-DPmax.

b. From 50% loop output to 100% loop output, reset CHWST setpoint from CHWSTmax to CHWSTmin.

c. CHW Plant Reset variable shall be reset using Trim & Respond logic with the following parameters:

Variable	Value
Device	Any CHW Pump Distribution Loop
SP0	100%
SPmin	0%
SPmax	100%
Td	15 minutes
T	5 minutes
I	2
R	Cooling CHWST Reset Requests
SPtrim	-2%
SPres	+3%
SPres-max	+7%

The reset starts at CHWSTmin because starting at a high temperature often causes the chiller to bring down CHWST too quickly and pass the CHWST setpoint, leading the chiller to cycle off. Additionally, if the loop reset starts at a CHWST that cannot satisfy the load at startup (e.g., CHWST setpoint = 60°F, but an AHU requires 55°F supply air), there is a resultant delay in satisfying the load as the reset loop winds up before CHWST setpoint resets down.

d. CHWST Plant Reset loop shall be enabled when the plant is enabled and disabled when the plant is disabled.

e. When a plant stage change is initiated, CHW Plant Reset logic shall be disabled and value fixed at its last value for the longer of 15 minutes and the time it takes for the plant to successfully stage.

Locking out continued reset during a staging event prevents CHW loop instability resulting from staging from driving the plant reset.

E. Primary Chilled Water Pumps

1. Primary CHW pumps shall be lead/lag controlled per Section 3.1P.3.

2. Enable lead primary CHW pump when any chiller CHW isolation valve is commanded open. Disable the lead primary CHW pump when all chiller CHW isolation valves are commanded closed.

3. CHW pumps shall be staged as a function of CHWFR, the ratio of current chilled water flow, FLOWP, to design primary pump flow, PCHWFdesign. and the number of pumps, N-PCHWP, that operate at design conditions. Pumps are assumed to be equally sized.

$$\text{CHWFR} = \frac{FLOW_P}{PCHWF_{design}}$$

Flow is used, as opposed to speed, to keep the chilled water pumps operating near their best efficiency point. Staging at slightly less than design flowrate for operating pumps yields good results for most applications (note that when fewer than design pumps are enabled, pumps will be able to produce greater than design flow since they will be operating further out their curves). If desired, the stage down flow point can be offset slightly below the stage up point to prevent cycling between pump stages in applications with highly variable loads.

a. Start the next lag pump whenever the following is true for 10 minutes:

$$\text{CHWFR} > \frac{Number\ of\ Operating\ Pumps}{N} - .03$$

b. Shut off the last lag pump whenever the following is true for 10 minutes:

$$\text{CHWFR} \leq \frac{Number\ of\ Operating\ Pumps - 1}{N} - .03$$

4. When any pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the differential pressure signal at a setpoint CHW-DPsp determined by the reset scheme described herein. All pumps receive the same speed signal.

5. Where multiple DP sensors exist, a PID loop shall run for each sensor. CHW pumps shall be controlled to the high signal output of all DP sensor loops.

F. Chilled Water Minimum Flow Bypass Valve

1. Bypass valve shall modulate to maintain minimum flow as measured by the chilled water flow meter at a setpoint that provides minimum flow through all operating chillers, determined as follows:

a. For the chillers operating in the stage, identify the chiller with the highest ratio, MinFlowRatio, of CHW-MinFlowX to CHW-DesFlowX.

b. Calculate the minimum flow setpoint as MinFlowRatio multiplied by the sum of CHW-DesFlowX for the operating chillers.

If the chillers have different minimum flow to design flow ratios, just maintaining the sum of the minimum flows will not satisfy the chiller(s) with the highest relative minimum flows. Note that this also requires that chillers be balanced to distribute flow proportional to their design flow.

2. When any CHW pump is proven on, the bypass valve PID loop shall be enabled. The valve shall be opened 100% otherwise. When enabled, the bypass valve loop shall be biased to start with the valve 100% open.

Biasing the loop to 100% upon start up ensures that the valve does not slam shut upon enabling the loop. Starting with the valve fully open is appropriate because flows are often very low when the plant is first turned on.

G. Condenser Water Pumps

1. Condenser water pumps shall be lead/lag controlled per Section 3.1P.3.

2. Enable lead CW pump when any chiller CW isolation valve is commanded open. Disable the lead CW pump when all chiller CW isolation valves are commanded closed.

3. The number of operating condenser water pumps shall match the number of operating

4. See Section 3.26C for lag condenser water pump on/off staging timing.

Most water-cooled chillers require a minimum refrigerant head (lift) between the evaporator and condenser to ensure trouble-free chiller starts and to maintain oil circulation. However, centrifugal chillers serving air handlers with air-side economizers (and without waterside economizers) often are not provided with head pressure control, and some oil-free chillers with magnetic or ceramic bearings, can operate with zero or even negative lift (as measured by water temperatures).

H. Head Pressure Control

1. Head pressure control signal shall be that output from the chiller controller whenever available. Otherwise, if a head pressure control signal is not available from the chiller controller, a reverse acting PID loop shall maintain the temperature differential between the chiller's condenser water return temperature and chilled water supply temperature at LIFTminX.

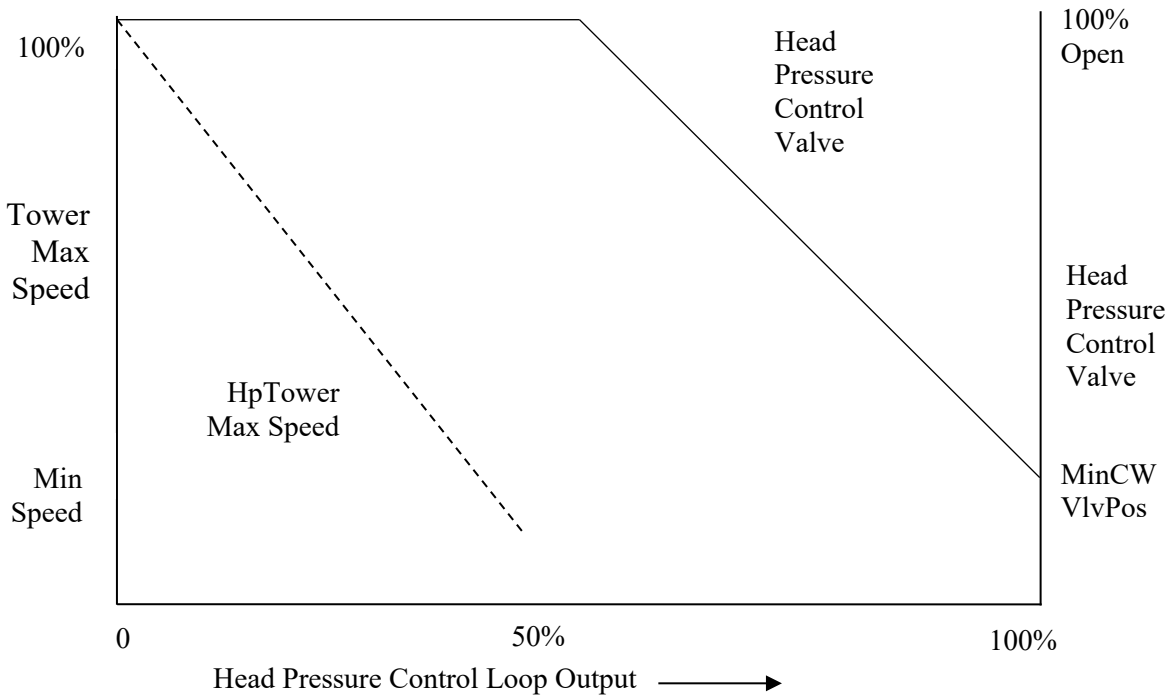
Subsequent sequences assume that the head pressure control signal, where output from the chiller controller is not wired directly to the head pressure control valve, but rather hardwired to an AI on the plant BAS controller. This allows monitoring of the head pressure control signal for stability, as well as remapping the signal as specified herein to avoid fighting between the head pressure control and tower speed control loops.
Note that the above BAS loop maintaining LIFTminX, if required, relies on the chiller's sensors, not common loop sensors. If hardwired sensors are available, they should be used; otherwise use network points through the chiller interface.

2. Each operating chiller shall have its own head pressure control loop. Head pressure control loop is enabled and disabled per chiller staging logic in Section 3.26C.

3. For each chiller, map loop output as follows:

   a. From 0-50%, the loop output shall reset maximum cooling tower speed point, HpTowerMaxSpd, from 100% to minimum speed.

   b. From 50-100%, the loop output shall reset head pressure control valve position from 100% open to MinCWVlvPos.



4. When the head pressure control loop is disabled per Section 3.26C.13, the CW isolation/head pressure control valve shall be closed.

I. Cooling Towers

1. Fan Control

a. Condenser Water Return Temperature (CWRT) Control

1) Tower fan control is in part dictated by plant part load ratio, PLRplant, which is the ratio of current plant required capacity, Qrequired, to plant design capacity:

$$PLR_{plant} = \frac{Q_{required}}{Q_{design}}$$

2) CWRTdes in the subsequent logic shall be the lowest CWRTdesX of all chillers.

This sequence controls condenser water return temperature, as opposed to supply, since CWRT more closely correlates to chiller lift, which drives chiller efficiency and surge conditions.

3) Maximum tower speed shall be limited based on OPLR. Reset the variable PlrTowerMaxSpd linearly from 100% at 50% OPLR down to 70% at 0% OPLR.

Maximum tower speed is limited at low plant part load ratios to prevent tower energy waste when either (1) CHWST is reset low at low PLRs or (2) wet bulb is elevated at low PLRs. Both conditions can cause the CWRT setpoint output from the following equation to be unachievable.

4) CWRT setpoint, CWRTsp, shall be the output of the following equation.

$$CWRTsp = CHWSTsp + LIFTtarget$$

$$LIFTtarget = Max(LIFTmin, Min(LIFTmax, A * PLR_{Plant} + B))$$

$$A = 1.1 * (LIFTmax - LIFTmin)$$

$$B = LIFTmax - A$$

a) Where chillers have different LIFTminX values, LIFTmin in the above equation shall reset dynamically to equal the highest LIFTminX of enabled chillers.

b) Where chillers have different LIFTmaxX values, LIFTmax in the above equations shall reset dynamically to equal the lowest LIFTmaxX of enabled chillers.

5) When any condenser water pump is proven on, CWRT shall be maintained at setpoint by a direct acting PID loop. The loop output shall be mapped to the variable CWRTTowerSpd. Map CWRTTowerSpd from minimum tower speed at 0% loop output to 100% speed at 100% loop output.

6) Tower speed command signal shall be the lowest value of CWRTTowerSpd, HpTowerMaxSpd from each chiller head pressure control loop, and PlrTowerMaxSpd. All operating fans shall receive the same speed signal.

7) Disable the tower fans if either

a) Any enabled chiller's HpTowerMaxSpd has equaled tower minimum speed for 5 minutes, or

b) Tower fans have been at minimum speed for 5 minutes and CWRT drops below setpoint minus 1°F.

8) Enable the tower fans if

a) They have been off for at least 1 minute, and

b) CWRT rises above setpoint by 1°F, and

c) All enabled chillers' HpTowerMaxSpd are greater than tower minimum speed.

9) When all condenser water pumps are commanded off, disable the PID loop and stop all tower fans.

10) Upon plant startup, hold CWRTsp at 10°F degrees less than CWRTdes for 10 minutes before ramping the setpoint to the calculated value above over 10 minutes.

This logic gives plant load an opportunity to stabilize prior to releasing control to the reset logic.

J. Tower Make-up Water

1. Make-up water valve shall cycle based on tower water fill level sensor. The valve shall be modulated with a P-only loop from 0% open when water level is at T-level-max-fill and 100% when tower level is at T-level-min-fill.

K. Cooling tower filtration system

1. Each tower filter supply isolation valve shall be enabled within a 5-hour window between 10 PM to 3 AM (adjustable) if its tower pumps had operated during the previous 24 hours. After the valve has been commanded open for 1 hour (adjustable), the valve shall be disabled and closed until the next day.

2. The cooling tower filtration pump shall run when any tower supply isolation valve is enabled and open.

3. While the pump is commanded on, the isolation valves on each cell shall open (while the others close) every 1 hour (as listed above), rotating so that each enabled valve is open 1 hour (as listed above).

4. When the pump is ready to shut off after all cells have been filtered, open the purge valve for 25 seconds, then stop pump.

L. Emergency Chiller Off

1. Chillers shall be locked off (start/stop points overridden to off at highest protocol priority) upon closing of emergency chiller off switch located at chiller room entry. After 5 minutes, shut off all pumps and towers.

M. Performance Monitoring

1. All calculations listed below shall be performed at least once every 30 seconds. Time averaged values shall be recorded at least once every 5 minutes. The averaging period shall equal the trending interval.

2. Total plant power. Calculate total plant power as the sum of chiller power, pump power, and cooling tower fan power. For motors with VFDs, power shall be actual power as read through the VFD network interface. For fixed speed motors (e.g., CW pumps without VFDs), power shall be assumed to be fixed at BHP (from equipment schedule) * 0.746 / 0.93 (approximate motor efficiency).

3. Total Plant Load. Calculate plant load using flowrate through the primary circuit, FLOWP; chilled water return temperature upstream of the first HX or chiller, CHWRT; and primary loop chilled water supply temperature leaving the plant, CHWST.

$$Q_{Plant} = \frac{FLOW_P\,(CHWRT - CHWST)}{24}\,[tons]$$

4. Equipment Load. Calculate load for each operating chiller using flowrate through the equipment, FLOWD; chilled water return temperature entering the equipment, CHWRTD; and chilled water supply temperature leaving the equipment, CHWSTD. Inputs to the below equation shall be determined per the following rules.

$$Q_D = \frac{FLOW_D\,(CHWRT_D - CHWST_D)}{24}\,[tons]$$

1) FLOWD shall be assumed proportional to design flow through all operating chillers in the circuit.

2) CHWRTD shall be the return temperature entering the equipment as read by a hardwired sensor if available. If a hardwired sensor is unavailable for a chiller, temperature shall be read from a sensor internal to the chiller through its network interface.

3) CHWSTD shall be a hardwired temperature sensor at the outlet of the equipment if available. If a hardwired sensor is unavailable for a chiller, temperature shall be read from a sensor internal to the chiller through its network interface. Only if neither of the above is available shall a common supply temperature sensor (i.e., one measuring the output from multiple chillers), be used.

5. Calculate plant efficiency as total plant power divided by plant load. Calculate efficiency for each chiller as chiller power divided by chiller load.

6. Summary Data. For each chiller, and for the total plant, statistics shall be calculated for runtime, kWh, average actual efficiency (kW/ton), peak demand (tons), average demand (tons) and average load (ton-hours), all on an instantaneous, year-to-date, and previous-year basis.

Below is an example summary of the performance monitoring parameters. Summary table should be edited based on plant configuration, available statistics and desired units of measurement.

	Instantaneous				Year-to-date						Previous Year				
	Lifetime Runtime (hours)	Electrical Demand (kW)	CHW Demand (ton)	Efficiency (kW/ton)	Runtime (hours)	Avg Daily Energy Use (kWh)	Avg Daily CHW Load (ton-hr)	Avg CHW Demand (ton)	Peak CHW Demand (ton)	Avg Efficiency (kW/ton)	Runtime (hours)	Avg Daily Energy Use (kWh)	Avg Daily CHW Load (ton-hr)	Avg CHW Demand (ton)	Peak CHW Demand (ton)
CH-1															
CH-2															
Total Plant															

N. Alarms

1. Maintenance interval alarm when pump has operated for more than 3000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

2. Maintenance interval alarm when chiller has operated for more than 1000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

3. Chiller alarm: level 2

4. Emergency off switch: Level 1

5. Tower level

   a. If tower water level sensor indicates water level below T-level-low-alarm, generate a Level 2 alarm.

b. If tower water level sensor indicates water level above T-level-high-alarm, generate a Level 3 alarm.

6. Pump or tower fan alarm is indicated by the status input being different from the output command for 15 seconds.

   a. Commanded on, status off: Level 2. Do not evaluate alarm until the equipment has been commanded on for 15 seconds.

   b. Commanded off, status on: Level 4. Do not evaluate the alarm until the equipment has been commanded off for 60 seconds.

7. Sensor Failure:

   a. Sensor shall be deemed outside of its widest possible operating range if any of the following are true:

      1) Feedback less than 2 mA from any 4 to 20 mA transducer; or

      2) Temperature reading less than 0°F from any temperature sensor.

   b. Any sensor that goes outside of its widest possible operating range.

      1) If the sensor is used for monitoring only: Level 3.

      2) If the sensor is used for control: Level 2.

O. Automatic Fault Detection and Diagnostics

The Automatic Fault Detection and Diagnostics (AFDD) routines for chilled water plants continually assess plant performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the Operating State of the plant, as determined by the positions of the isolation valves and statuses of pumps. Time delays are applied to the evaluation and reporting of fault conditions, to suppress false alarms. Fault conditions that pass these filters are reported to the building operator as alarms along with a series of possible causes.
These equations assume that the plant is equipped with isolation valves, as well as a pump status monitoring. If any of these components are not present, the associated tests, and variables should be omitted from the programming.
Note that these faults rely on reasonably accurate measurement of water temperature. Extra precision sensors installed in thermowells with thermal paste are strongly recommended for best accuracy.

1. AFDD conditions are evaluated continuously for the plant.

2. The Operating State (OS) of the plant shall be defined by the commanded positions of the valves and status feedback from the pumps in accordance with the following table.

The Operating State is distinct from and should not be confused with the chilled water plant stage.
OS#1 – OS#3 represent normal operating states during which a fault may nevertheless occur if so determined by the fault condition tests below.

Operating State	Chiller CHW Isolation Valves	Chiller CW Isolation Valves	CHW Pump Status	CW Pump Status
#1: Disabled	All Closed/Off	All Closed/Off	All Off	All Off
#2: One Chiller Enabled	One Open/On, All Others Closed/Off	One Modulating, All Others Closed/Off	Any On	Any On
#3: More than one Chiller Enabled	More than one Open/On	More than one modulating	Any On	Any On

3. The following points must be available to the AFDD routines for the chilled water plant:

   a. DP = Chilled water loop differential pressure (each loop, where applicable)

   b. DPSP = Chilled water loop differential pressure setpoint (each loop, where applicable)

   c. FLOWP = Primary chilled water flow

   d. MFBPV = Chilled water minimum flow bypass valve command; 0% ≤ MFBPV ≤ 100%

   e. CHW-MinFlowSP = Effective minimum chilled water flow setpoint (MinFlowRatio multiplied by the sum of CHW-DesFlowX of enabled chillers).

   f. SpeedCT = Cooling tower speed command; 0% ≤ SpeedCT ≤ 100%

   g. StatusCWP = Lead condenser water pump status

   h. StatusPCHWP = Lead primary chilled water pump status

   i. CHWST = Common chilled water supply temperature leaving the chillers

   j. CHWSTSP = Chilled water supply temperature setpoint

   k. CHWRT = Common chilled water return temperature entering the chillers

   l. CWST = Condenser water supply temperature

   m. CWSTdes = Lowest condenser water supply temperature at chiller selection conditions for chillers; CWSTdes shall be the lowest CWSTdesX of all chillers

   n. CHWSTCH-x = CH-x chilled water supply temperature (each chiller)

   o. CHWRTCH-x = CH-x chilled water return temperature (each chiller)

   p. CWSTCH-x = CH-x condenser water supply temperature (each chiller)

q. CWRTCH-x = CH-x condenser water return temperature (each chiller)

r. RefrigEvapTempCH-x = CH-x refrigerant evaporating temperature (each chiller)

s. RefrigCondTempCH-x = CH-x refrigerant condensing temperature (each chiller)

t. CHW-ISOCH-x = CH-x chilled water isolation valve commanded position (each chiller)

u. CW-ISOCH-x = CH-x condenser water isolation valve commanded position; 0% ≤ CW-ISOCH-x ≤ 100% if modulating, open/closed if two-position (each chiller)

v. PGAUGE = Chilled water system gauge pressure

4. The following values must be continuously calculated by the AFDD routines:

a. 5-minute rolling averages with 1-minute sampling time of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently

1) CHWSTAVG = rolling average of the common chilled water supply temperature

2) CHWRTAVG = rolling average of the common chilled water return temperature

3) CWSTAVG = rolling average of the common condenser water supply temperature

4) CWRTAVG = rolling average of the common condenser water return temperature

5) CWSTCH-x, AVG = rolling average of CH-x condenser water supply temperature (each chiller)

6) CWRTCH-x, AVG = rolling average of CH-x condenser water return temperature (each chiller)

7) CHWSTCH-x, AVG = rolling average of CH-x chilled water supply temperature (each chiller)

8) CHWRTCH-x, AVG = rolling average of CH-x chilled water return temperature (each chiller)

9) PGAUGE, AVG = rolling average of chilled water system gauge pressure

10) FLOWP, AVG = rolling average of primary chilled water flow

11) RefrigCondTempCH-x, AVG = rolling average of CH-x refrigerant condensing temperature (each chiller)

12) RefrigEvapTempCH-x, AVG = rolling average of CH-x refrigerant evaporating temperature (each chiller)

b. CHW-FlowCH-X (each chiller)

1) For plants with parallel chillers and headered primary chilled water pumps: 1 if CHW-ISOCH-x > 0, 0 if CHW-ISOCH-X = 0

c. CW-FlowCH-X (each chiller)

1) For plants with headered condenser water pumps and if condenser water isolation valve is modulating: 1 if CW-ISOCH-x > 0% open, 0 if CW-ISOCH-X = 0% open (each chiller)

d. ΔOS = number of changes in Operating State during the previous 60 minutes (moving window)

e. ΔStage = number of chilled water plant stage changes during the previous 60 minutes (moving window)

f. StartsCH-x = number of CH-x starts in the last 60 mins (each chiller)

5. The following internal variables shall be defined. All parameters are adjustable by the operator, with initial values as given below:

The default values have been intentionally biased towards minimizing false alarms at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors such as pump heat and sensor error can be measured in the field or derived from trend logs and hardware submittals. Likewise, the switch delays can be refined by observing the time required to achieve quasi steady state operation in trend data.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false alarms, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the temperature, pressure or flow thresholds.

Variable Name	Description	Default Value
ℇCHWT	Temperature error threshold for chilled water temperature sensors	2°F
Retain the following variable for water-cooled plants. Delete otherwise.		
ℇCWT	Temperature error threshold for condenser water temperature sensors	2°F
Retain the following variable for primary-secondary and primary-only plants where pump speed is controlled to maintain differential pressure. Delete otherwise.		
ℇDP	Differential pressure error threshold for DP sensor	2 psi
Retain the following variable for plants with a flow meter. Delete otherwise.		
ℇFM	Flow error threshold for flow meter	20 gpm
ℇVFDSPD	VFD speed error threshold	5%

Variable Name	Description	Default Value
Retain the following variable for primary-only plants with a minimum flow bypass valve. Delete otherwise.		
ℰMFBVP	Minimum flow bypass valve position error threshold	5%
Retain the following variable for plants where system gauge pressure is monitored. Delete otherwise.		
CHW-ETPreChargePress	Chilled water system expansion tank pre-charge pressure	See mechanical schedule (psig)
Retain the following variable for water-cooled plants. Delete otherwise.		
ApproachCOND	Condenser approach threshold	4°F
ApproachEVAP	Evaporator approach threshold	3°F
CHStartsMAX	Maximum number of chiller starts during the previous 60 minutes (moving window)	2
ΔOSMAX	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	2
ΔStageMAX	Maximum number of chilled water plant stage changes during the previous 60 minutes (moving window)	2
StageDelay	Time in minutes to suspend Fault Condition evaluation after a change in stage	30
AlarmDelay	Time in minutes that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

TestModeDelay ensures that normal fault reporting occurs after the testing and commissioning process is completed as prescribed in Section 3.26O.11.

6. The following are potential Fault Conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The Fault Conditions to be evaluated at any given time will depend on the Operating State of the chilled water plant.

FC#1	Equation	DPAVG > ℰDSP and StatusCHWP = Off	Applies to OS #1
	Description	Differential pressure is too high with the chilled water pumps off	
	Possible Diagnosis	DP sensor error	

FC#2	Equation	FLOWP, AVG > ƐFM and StatusPCHWP = Off	Applies to OS #1
	Description	Primary chilled water flow is too high with the chilled water pumps off	
	Possible Diagnosis	Flow meter error	
FC#5	Equation	FLOWP, AVG < CHW-MinFlowSp – ƐFM and MFBPV ≥ 99% - ƐMFBPV	Applies to OS #2, #3
	Description	Primary chilled water flow is too low with the minimum flow bypass valve fully open.	
	Possible Diagnosis	Problem with minimum flow bypass valve Problem with chiller CHW isolation valves Minimum loop differential pressure setpoint too low	
FC#6	Equation	CHWSTAVG - ƐCHWT ≥ CHWSTSP	Applies to OS #2 – #3
	Description	Chilled water supply temperature is too high	
	Possible Diagnosis	Mechanical problem with chillers Primary flow is higher than the design evaporator flow of the operating chillers	
FC#7	Equation	CHW-PGAUGE, AVG < 0.9 * CHW-ETPreChargePress	Applies to OS #1 – #3
	Description	Chilled water system gauge pressure is too low	
	Possible Diagnosis	Possible chilled water system leak	
FC#8	Equation	ApproachCOND ≥ RefrigCondTempCH-x, AVG - CWRTCH-x, AVG	Applies to OS #2, #3
	Description	Condenser approach is too high	
	Possible Diagnosis	Possible condenser fouling or blocked condenser tubes Low condenser water temperature Low condenser water flow	
FC#9	Equation	ApproachEVAP ≥ CHWSTCH-x, AVG - RefrigEvapTempCH-x, AVG	Applies to OS #2, #3
	Description	Evaporator approach is too high	
	Possible Diagnosis	Possible evaporator fouling or blocked evaporator tubes Low refrigeration charge Contaminated refrigeration charge	

FC#10	Equation	| (∑(CHW-FlowCH-X * CHWSTCH-X) / ∑CHW-FlowCH-X) - CHWSTAVG | > ƐCHWT and ∑CHW-FlowCH-X = 1	Applies to OS #2
	Description	Deviation between the active chiller chilled water supply temperature and the common chilled water supply temperature is too high.	
	Possible Diagnosis	A chilled water supply temperature sensor is out of calibration	
FC#11	Equation	| (∑(CHW-FlowCH-X * CHWRTCH-X) / ∑CHW-FlowCH-X) - CHWRTAVG | > ƐCHWT and ∑CHW-FlowCH-X = 1	Applies to OS #2
	Description	Deviation between the active chiller chilled water return temperature and the common chilled water return temperature is too high.	
	Possible Diagnosis	A chilled water return temperature sensor is out of calibration	
FC#12	Equation	| (∑(CW-FlowCH-X * CWSTCH-X) / ∑CW-FlowCH-X) - CWSTAVG | > ƐCWT and ∑CW-FlowCH-X = 1	Applies to OS #2
	Description	Deviation between the active chiller condenser water supply temperature and the common condenser water supply temperature is too high.	
	Possible Diagnosis	A condenser water supply temperature sensor is out of calibration	
FC#13	Equation	| (∑(CW-FlowCH-X * CWRTCH-X) / ∑CW-FlowCH-X) - CWRTAVG | > ƐCWT and ∑CW-FlowCH-X = 1	Applies to OS #2
	Description	Deviation between the active chiller condenser water return temperature and the common condenser water return temperature is too high.	
	Possible Diagnosis	A condenser water return temperature sensor is out of calibration	

FC#14	Equation	CWSTAVG - ƐCWT ≥ DesCWSTdes and SpeedCT ≥ 99% - ƐVFDSPD	Applies to OS #2, #3
	Description	Condenser water supply temperature is too high with cooling tower(s) at full speed.	
	Possible Diagnosis	Problem with cooling tower VFD Mechanical problem with cooling tower(s) Cooling tower(s) undersized	
FC#18	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #3
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC#19	Equation	ΔStartsCH-x > ΔCHStartMAX	Applies to OS #2, #3
	Description	Too many chiller starts	
	Possible Diagnosis	Chiller is cycling due to load loads. Chiller is oversized and/or has insufficient turndown capability. Chiller stage-up threshold may be set too low.	
FC#20	Equation	ΔStage > ΔStageMAX	Applies to OS #1 – #3
	Description	Too many stage changes	
	Possible Diagnosis	Staging thresholds and/or delays need to be adjusted	

7. For each chiller, the operator shall be able to suppress the alarm for any Fault Condition.

8. Evaluation of Fault Conditions shall be suspended under the following conditions:

   a. When no pumps are operating.

   b. For a period of StageDelay minutes following a change in plant stage.

9. Fault Conditions that are not applicable to the current Operating State shall not be evaluated.

10. A Fault Condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.

11. Test Mode shall temporarily set StageDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system and to ensure normal fault detection occurs after testing is complete.

12. When a Fault Condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from the table in Section 3.26O.6.

3.27 AIR COOLED SERIES CHILLED WATER PLANT

A. See Section 1.2I for Design Setpoints. See Section 1.3E for TAB setpoints.

B. Plant Enable/Disable

1. The chiller plant shall include an enabling schedule that allows operators to lock out the plant during off-hours, holidays, or any other scheduled event, e.g., to allow off-hour operation of HVAC systems except the chiller plant. The default schedule shall be 24/7 (adjustable).

2. Enable the plant in the lowest stage when the plant has been disabled for at least 15 minutes and:

   a. Number of Chiller Plant Requests > I (I = Ignores shall default to 0, adjustable), and

   b. OAT>CH-LOT, and

   c. The chiller plant enable schedule is active.

3. Disable the plant when it has been enabled for at least 15 minutes and:

   a. Number of Chiller Plant Requests ≤ I for 3 minutes, or

   b. OAT<CH-LOT – 1°F, or

   c. The chiller plant enable schedule is inactive.

4. When the plant is enabled:

   a. Close the CHW isolation valve of the lead chiller.

   b. Stage on lead primary CHW pump per Section 3.26E.

   c. Once the lead pumps are proven on, enable the lead chiller.

5. When the plant is disabled:

   a. Shut off the enabled chiller(s).

   b. For each enabled chiller, open the CHW isolation valve after 3 minutes or the chiller is not requesting CHW flow.

   c. Disable the operating primary CHW pump(s) per Section 3.26E.

C. Chiller Staging

1. Chiller stages shall be defined as follows:

Chiller Stage	Enabled Chillers
0	None
1	CH-1 or CH-2
2	CH-1 and CH-2

2. Interchangeable chillers indicated with "or" in the table above shall be lead/lag controlled per Section 3.1P.3. If a chiller is in alarm per Section 3.1P.5.b, its CHW valve shall be opened.

3. Chillers are staged in part based on required capacity, Qrequired, relative to design capacity of a given stage, which is the sum of the design capacity of each chiller active in each stage. This ratio is the operative part load ratio, OPLR.

4. Qrequired is calculated based on chilled water return temperature (CHWRT) entering the chillers, active chilled water supply temperature setpoint (CHWSTSP), and measured flow through the primary circuit flow meter (FLOWP), as shown in the equation below. Qrequired used in logic shall be a 5-minute rolling average of instantaneous values sampled at a minimum of every 30 seconds.

$$Q_{required} = \frac{FLOW_P(CHWRT - CHWST_{SP})}{24} \; [tons]$$

Required capacity, as opposed to actual load, is used to provide more stable staging since chilled water supply temperature setpoint changes less dynamically than actual chilled water supply temperature. Note that using entering return temperature, as opposed to temperature upstream of waterside economizers or chilled water minimum flow bypasses as applicable, is critical for calculations to be executed properly.

5. When a stage up or stage down transition is initiated, hold Qrequired fixed at its last value until the longer of the successful completion of the stage change (e.g., lag chiller proven on) and 15 minutes.

As staging occurs, flowrate and return temperature may fluctuate, so Qrequired may be unstable. As detailed subsequently, Qrequired impacts plant part load ratio, which drives condenser water return temperature setpoint and tower control. As such, if Qrequired is unstable, so too would be condenser water return temperature, and thus chiller lift.

6. OPLR shall be calculated as follows:

$$OPLR = \frac{Q_{required}[tons]}{Sum\ of\ QchX\ for\ Chillers\ in\ stage}$$

7. Minimum cycling part load ratio, OPLRMIN, shall be calculated as:

$$OPLR_{MIN,stage} = \frac{Sum\ of\ MinUnloadTonsX\ for\ Chillers\ in\ stage}{Sum\ of\ QchX\ for\ Chillers\ in\ stage}$$

8. Stage up events are initiated in part based on current stage OPLR exceeding a stage up part load ratio, SPLRUP; stage down events are initiated in part based on OPLR for the next lower stage falling below a stage down part load ratio, SPLRDN.

9. Staging events require that a chiller stage be available. A stage shall be deemed unavailable if the stage cannot be achieved because a chiller required to operate in the

stage is faulted per Section 3.1P.5.b.1)b) or a chilled water or condenser water pump dedi**Error! Reference source not found.**; otherwise, the stage shall be deemed available.

a. Set SPLRUP as follows:

1) When all chillers operating in the current stage are positive displacement, SPLRUP shall be 80%.

Positive displacement chillers utilize a fixed staging PLR because screw and scroll compressors have a fixed compression ratio (most commercial screw chillers typically do not employ variable volume ratio technology, though some are coming to market). Positive displacement chiller efficiency at a given load is therefore not as sensitive to changes in lift as centrifugal chiller efficiency, and the relative efficiencies at different chiller load percentages (e.g., 30% for two chiller operation vs. 60% for one chiller operation) hold reasonably constant as lift changes. As such, resetting staging PLR with lift is not necessary to optimize screw chiller plant performance. This is in contrast to variable speed centrifugal chiller reset logic described below.
Positive displacement machines are typically used as low load chillers in larger plants. It therefore makes sense to load them nearly fully prior to staging on larger variable speed centrifugal machines (where used). As such, positive displacement machine staging criteria take precedence over variable speed centrifugal machine staging criteria.

b. Set SPLRDN as follows:

In the sections below, the stage down SPLR values appear identical to the stage up values. It is important to remember, per Section 3.26C.8, that these values are applied against the OPLR values of different plant stages, so they yield different tonnage thresholds.
Note also that the stage down conditions below do not yield a hysteresis band. I.e., if the positive displacement chiller rules were applied to a plant with only two screw chillers sized at 200 tons each, the plant stage up and stage down points would both be 160 tons. This is acceptable because the stages have minimum run times to prevent cycling. Furthermore, plant load for most applications generally trends in one direction for multiple hours before beginning to trend the opposite direction. As such, there is little risk of repeated stage cycling.

1) When all chillers operating in the next lower stage are positive displacement, SPLRDN shall be 80%.

10. Staging shall be executed per the conditions below subject to the following requirements.

a. Each stage shall have a minimum runtime of 15 minutes.

b. Timers shall reset to zero at the completion of every stage change.

c. Any unavailable stage (see Section 3.26C.9) shall be skipped during staging events, but staging conditionals in the current stage shall be evaluated as per usual.

d. Chilled water supply and return temperatures used in staging logic shall be those located in common supply and return mains hardwired to plant controllers.

e. Stage up if any of the following is true:

1) Availability Condition: The equipment necessary to operate the current stage are unavailable. The availability condition is not subject to the minimum stage runtime requirement. Or

2) Efficiency Condition: Current stage OPLR > SPLRUP for 15 minutes and current stage OPLR is not decreasing at a rate greater than 2.5% per minute averaged over 5 minutes; or

3) Failsafe Condition:

a) CHW supply temperature is 2°F > setpoint for 15 minutes.

f. Stage down if both of the following are true:

1) Next available lower stage OPLR < SPLRDN for 15 minutes and next lower stage OPLR is not increasing at a rate greater than 2.5% per minute averaged over 5 minutes; and

2) The failsafe stage up condition is not true.

The first stage up condition stages the chillers at the optimum load point, SPLR, to maximize chiller efficiency. The second stage up condition acts as a failsafe bringing on the lag chiller if one or more coils is starved because chilled water differential pressure is below setpoint or chilled water supply temperature is above setpoint for an extended period. The former may occur if chilled water delta-T is degraded from design or one pump is down for maintenance and the pump(s) are unable to drive additional flow through the operating chiller; the latter may occur if the lead chiller has an active fault condition that is not generating a failure alarm. It is also possible that the OPLR calculation could go out of calibration due to a failed flow meter and/or return temperature sensor, thus necessitating fallback on the failsafe conditions. Note that the DP failsafe condition does not apply to series chiller plants since bringing on an additional chiller would only increase pressure drop in a series chiller plant.

11. Whenever there is a stage-up command:

a. If the chiller to be started is the upstream chiller, command the operating chiller to reduce demand to 75% of its current load. Wait until actual demand <80% of current load up to a maximum of 5 minutes before proceeding.

b. If the chiller to be started is the downstream chiller, ramp the CHWST setpoint of the operating chiller from the current plant CHWST setpoint to the average of the current plant CHWST setpoint and the current CHW return temperature over 5 minutes.

c. Slowly close CHW bypass valve of the chiller that is to be started. Determine valve timing in the field as that required to prevent nuisance trips.

d. Start the next stage chiller after the CHW bypass valve is fully shut (as determined by end switch status, or nominal valve timing if end switches are not provided).

1) If the newly enabled chiller is the upstream chiller, set its CHWST setpoint to the average of the current plant CHWST setpoint and current CHW return temperature.

2) If the newly enabled chiller is the downstream chiller, set its CHWST setpoint equal to the plant CHWST setpoint.

e. Release the demand limit on the lead chiller (if enabled).

12. Whenever there is a stage-down command:

a. Shut off the last stage chiller.

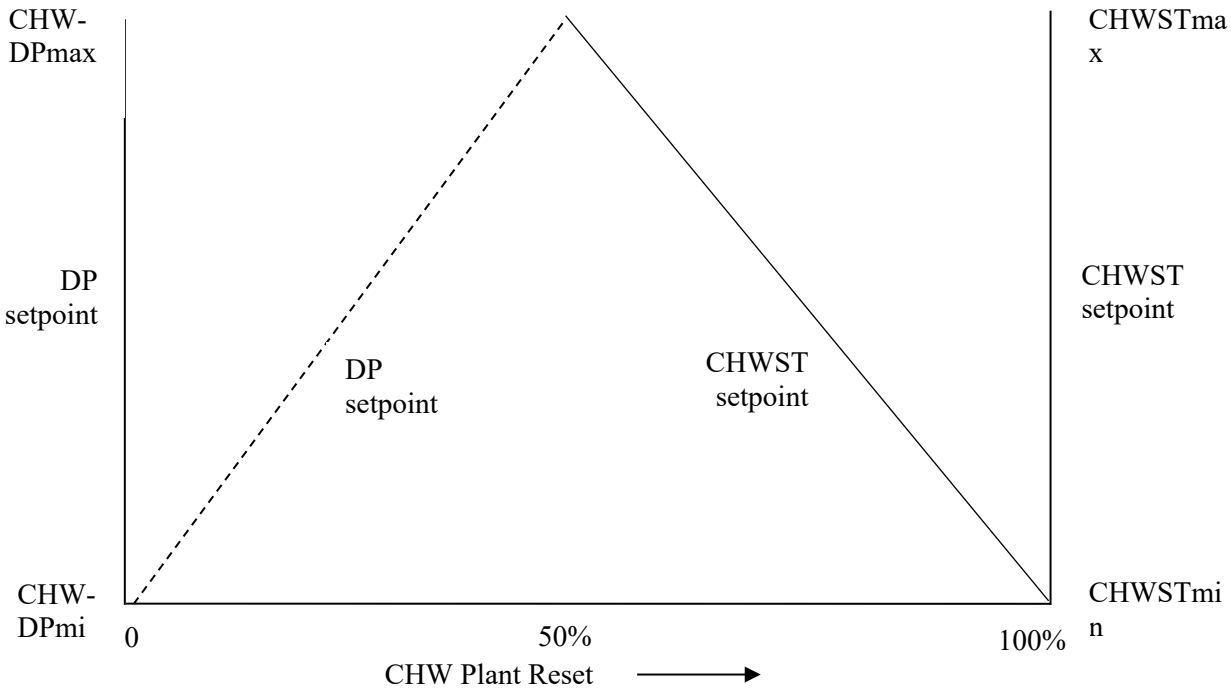
b. If the disabled chiller is the downstream chiller, reset the upstream chiller's CHWST setpoint to the current plant CHWST setpoint (do not ramp).

c. When the controller of the chiller being shut off indicates no request for chilled water flow or 3 minutes has elapsed, slowly open the chiller's CHW bypass valve to avoid a sudden change in flow through the other operating chiller.

D. Chilled Water Plant Reset

1. CHWSTmin in the following logic shall be the lowest CHWSTminX of chillers in the plant.

2. Differential Pressure Controlled Loops: Chilled water supply temperature setpoint CHWSTsp and pump differential pressure setpoint CHW-DPsp shall be reset based on the current value of the logic variable called "CHW Plant Reset" as shown below and described subsequently.



The recommended logic first resets differential pressure setpoint to maximum before resetting chilled water supply temperature setpoint down towards design. Parametric plant analysis performed in a variety of climate zones during the development of ASHRAE's "Fundamentals of Design and Control of Central Chilled-Water Plants" Self-Directed Learning Course

showed that the pump energy penalty incurred with this approach is more than offset by chiller energy savings resulting from keeping the chilled water supply temperature setpoint as high as possible.
Engineers may nonetheless adjust the CHW Plant Reset loop mapping based on unique project constraints. For plants with very low design CHW delta-Ts (<12°F) and high pump heads (>120 ft) it may be advisable to overlap the resets—e.g., reset DP setpoint from 0% to 75% loop output and CHWST setpoint from 25% to 100% loop output—instead of fully resetting CHWST setpoint up before beginning to lower resetting pump DP setpoint down.

a. From 0% loop output to 50% loop output, reset DP setpoint from CHW-DPmin to CHWP-DPmax.

b. From 50% loop output to 100% loop output, reset CHWST setpoint from CHWSTmax to CHWSTmin.

c. CHW Plant Reset variable shall be reset using Trim & Respond logic with the following parameters:

Variable	Value
Device	Any CHW Pump Distribution Loop
SP0	100%
SPmin	0%
SPmax	100%
Td	15 minutes
T	5 minutes
I	2
R	Cooling CHWST Reset Requests
SPtrim	-2%
SPres	+3%
SPres-max	+7%

The reset starts at CHWSTmin because starting at a high temperature often causes the chiller to bring down CHWST too quickly and pass the CHWST setpoint, leading the chiller to cycle off. Additionally, if the loop reset starts at a CHWST that cannot satisfy the load at startup (e.g., CHWST setpoint = 60°F, but an AHU requires 55°F supply air), there is a resultant delay in satisfying the load as the reset loop winds up before CHWST setpoint resets down.

d. CHWST Plant Reset loop shall be enabled when the plant is enabled and disabled when the plant is disabled.

e. When a plant stage change is initiated, CHW Plant Reset logic shall be disabled and value fixed at its last value for the longer of 15 minutes and the time it takes for the plant to successfully stage.

Locking out continued reset during a staging event prevents CHW loop instability resulting from staging from driving the plant reset.

3. When only one chiller is enabled, CHWST setpoint shall be the setpoint resulting from the plant reset loop(s).

4. When the upstream and downstream machines are enabled:

   a. Downstream chiller CHWST setpoint shall be the setpoint resulting from the plant reset loop(s).

   b. Upstream chiller CHWST setpoint shall be the 5-minute rolling average of the following calculation:

$$\text{CWHST}_{\text{upstream}} = CHWRT - (CHWRT - CHWSTsp_{downstream}) * \frac{QchX_{upstream}}{QchX_{upstream} + QchX_{downstream}}$$

Using a rolling average avoids sudden fluctuations in chiller setpoint that may induce plant instability. Weighting the setpoint by the design capacity ratio of the series chillers improves efficiency when the upstream chiller is selected to provide more of the load. The efficiency of even identical chillers in series can be optimized by shifting load to the upstream chiller which is more efficient due to the warmer CHWST. This is usually determined by iteratively varying this setpoint to minimize combined chiller power using chiller selection software.

E. Primary Chilled Water Pumps

1. Primary CHW pumps shall be lead/lag controlled per Section 3.1P.3.

2. Enable lead primary CHW pump when any chiller CHW isolation valve is commanded closed. Disable the lead primary CHW pump when all chiller CHW isolation valves are commanded open.

3. CHW pumps shall be staged as a function of CHWFR, the ratio of current chilled water flow, FLOWP, to design primary pump flow, PCHWFdesign. and the number of pumps, N-PCHWP, that operate at design conditions. Pumps are assumed to be equally sized.

$$\text{CHWFR} = \frac{FLOW_P}{PCHWF_{design}}$$

Flow is used, as opposed to speed, to keep the chilled water pumps operating near their best efficiency point. Staging at slightly less than design flowrate for operating pumps yields good results for most applications (note that when fewer than design pumps are enabled, pumps will be able to produce greater than design flow since they will be operating further out their curves). If desired, the stage down flow point can be offset slightly below the stage up point to prevent cycling between pump stages in applications with highly variable loads.

   a. Start the next lag pump whenever the following is true for 10 minutes:

$$\text{CHWFR} > \frac{Number\ of\ Operating\ Pumps}{N} - .03$$

   b. Shut off the last lag pump whenever the following is true for 10 minutes:

$$\text{CHWFR} \leq \frac{Number\ of\ Operating\ Pumps - 1}{N} - .03$$

4. When any pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the differential pressure signal at a setpoint CHW-DPsp determined by the reset scheme described herein. All pumps receive the same speed signal.

5. Where multiple DP sensors exist, a PID loop shall run for each sensor. CHW pumps shall be controlled to the high signal output of all DP sensor loops.

6. Pump speed of all primary CHW pumps proven on shall be reset using Trim & Respond logic with the following parameters:

Variable	Value
Device	Any primary pump proven on
SP0	100%
SPmin	CH-MinPriPumpSpdStage
SPmax	100%
Td	15 minutes
T	2 minutes
I	0
R	Primary Pump Speed Reset Requests
SPtrim	-2%
SPres	+3%
SPres-max	+6%

F. Chilled Water Minimum Flow Bypass Valve

1. Bypass valve shall modulate to maintain minimum flow as measured by the chilled water flow meter at a setpoint equal to the largest CHW-MinFlowX of the operating series chillers.

2. When any CHW pump is proven on, the bypass valve PID loop shall be enabled. The valve shall be opened 100% otherwise. When enabled, the bypass valve loop shall be biased to start with the valve 100% open.

Biasing the loop to 100% upon start up ensures that the valve does not slam shut upon enabling the loop. Starting with the valve fully open is appropriate because flows are often very low when the plant is first turned on.

G. Performance Monitoring

1. All calculations listed below shall be performed at least once every 30 seconds. Time averaged values shall be recorded at least once every 5 minutes. The averaging period shall equal the trending interval.

2. Total plant power. Calculate total plant power as the sum of chiller power, pump power, and cooling tower fan power. For motors with VFDs, power shall be actual power as read through the VFD network interface. For fixed speed motors (e.g., CW pumps without VFDs), power shall be assumed to be fixed at BHP (from equipment schedule) * 0.746 / 0.93 (approximate motor efficiency).

3. Total Plant Load. Calculate plant load using flowrate through the primary circuit, FLOWP; chilled water return temperature upstream of the first HX or chiller, CHWRT; and primary loop chilled water supply temperature leaving the plant, CHWST.

$$Q_{Plant} = \frac{FLOW_P\,(CHWRT - CHWST)}{24}\,[tons]$$

4. Equipment Load. Calculate load for each operating chiller and using flowrate through the equipment, FLOWD; chilled water return temperature entering the equipment, CHWRTD; and chilled water supply temperature leaving the equipment, CHWSTD. Inputs to the below equation shall be determined per the following rules.

$$Q_D = \frac{FLOW_D\,(CHWRT_D - CHWST_D)}{24}\,[tons]$$

   1) CHWRTD shall be the return temperature entering the equipment as read by a hardwired sensor if available. If a hardwired sensor is unavailable for a chiller, temperature shall be read from a sensor internal to the chiller through its network interface.

   2) CHWSTD shall be a hardwired temperature sensor at the outlet of the equipment if available. If a hardwired sensor is unavailable for a chiller, temperature shall be read from a sensor internal to the chiller through its network interface. Only if neither of the above is available shall a common supply temperature sensor (i.e., one measuring the output from multiple chillers), be used.

5. Calculate plant efficiency as total plant power divided by plant load. Calculate efficiency for each chiller as chiller power divided by chiller load.

6. Summary Data. For each chiller, and for the total plant, statistics shall be calculated for runtime, kWh, average actual efficiency (kW/ton), peak demand (tons), average demand (tons) and average load (ton-hours), all on an instantaneous, year-to-date, and previous-year basis.

Below is an example summary of the performance monitoring parameters. Summary table should be edited based on plant configuration, available statistics and desired units of measurement.

	Instantaneous				Year-to-date						Previous Year				
	Lifetime Runtime (hours)	Electrical Demand (kW)	CHW Demand (ton)	Efficiency (kW/ton)	Runtime (hours)	Avg Daily Energy Use (kWh)	Avg Daily CHW Load (ton-hr)	Avg CHW Demand (ton)	Peak CHW Demand (ton)	Avg Efficiency (kW/ton)	Runtime (hours)	Avg Daily Energy Use (kWh)	Avg Daily CHW Load (ton-hr)	Avg CHW Demand (ton)	Peak CHW Demand (ton)
CH-1															
CH-2															
Total Plant															

H. Alarms

1. Maintenance interval alarm when pump has operated for more than 3000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

2. Maintenance interval alarm when chiller has operated for more than 1000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

3. Chiller alarm: level 2

4. Emergency off switch: Level 1

5. Pump or tower fan alarm is indicated by the status input being different from the output command for 15 seconds.

   a. Commanded on, status off: Level 2. Do not evaluate alarm until the equipment has been commanded on for 15 seconds.

   b. Commanded off, status on: Level 4. Do not evaluate the alarm until the equipment has been commanded off for 60 seconds.

6. Sensor Failure:

   a. Sensor shall be deemed outside of its widest possible operating range if any of the following are true:

      1) Feedback less than 2 mA from any 4 to 20 mA transducer; or

      2) Temperature reading less than 0°F from any temperature sensor.

   b. Any sensor that goes outside of its widest possible operating range.

      1) If the sensor is used for monitoring only: Level 3.

      2) If the sensor is used for control: Level 2.

I. Automatic Fault Detection and Diagnostics

The Automatic Fault Detection and Diagnostics (AFDD) routines for chilled water plants continually assess plant performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the Operating State of the plant, as determined by the positions of the isolation valves and statuses of pumps. Time delays are applied to the evaluation and reporting of fault conditions, to suppress false alarms. Fault conditions that pass these filters are reported to the building operator as alarms along with a series of possible causes.
These equations assume that the plant is equipped with isolation valves, as well as a pump status monitoring. If any of these components are not present, the associated tests, and variables should be omitted from the programming.
Note that these faults rely on reasonably accurate measurement of water temperature. Extra precision sensors installed in thermowells with thermal paste are strongly recommended for best accuracy.

1. AFDD conditions are evaluated continuously for the plant.

2. The Operating State (OS) of the plant shall be defined by the commanded positions of the valves and status feedback from the pumps in accordance with the following table.

The Operating State is distinct from and should not be confused with the chilled water plant stage.
OS#1 – OS#3 represent normal operating states during which a fault may nevertheless occur if so determined by the fault condition tests below.

Operating State	Chiller CHW Isolation Valves	CHW Pump Status
#1: Disabled	All Open	All Off
#2: One Chiller Enabled	One Closed, All Others Open	Any On
#3: More than one Chiller Enabled	Both Closed	Any On

3. The following points must be available to the AFDD routines for the chilled water plant:
    a. DP = Chilled water loop differential pressure (each loop, where applicable)
    b. DPSP = Chilled water loop differential pressure setpoint (each loop, where applicable)
    c. FLOWP = Primary chilled water flow
    d. MFBPV = Chilled water minimum flow bypass valve command; 0% ≤ MFBPV ≤ 100%
    e. CHW-MinFlowSP = Effective minimum chilled water flow setpoint (MinFlowRatio multiplied by the sum of CHW-DesFlowX of enabled chillers).
    f. StatusPCHWP = Lead primary chilled water pump status
    g. CHWST = Common chilled water supply temperature leaving the chillers
    h. CHWSTSP = Chilled water supply temperature setpoint
    i. CHWRT = Common chilled water return temperature entering the chillers
    j. CHWSTCH-x = CH-x chilled water supply temperature (each chiller)
    k. CHWRTCH-x = CH-x chilled water return temperature (each chiller)
    l. RefrigEvapTempCH-x = CH-x refrigerant evaporating temperature (each chiller)
    m. CHW-ISOCH-x = CH-x chilled water isolation valve commanded position (each chiller)
    n. PGAUGE = Chilled water system gauge pressure
4. The following values must be continuously calculated by the AFDD routines:

a. 5-minute rolling averages with 1-minute sampling time of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently

1) CHWSTAVG = rolling average of the common chilled water supply temperature

2) CHWRTAVG = rolling average of the common chilled water return temperature

3) CHWSTCH-x, AVG = rolling average of CH-x chilled water supply temperature (each chiller)

4) CHWRTCH-x, AVG = rolling average of CH-x chilled water return temperature (each chiller)

5) PGAUGE, AVG = rolling average of chilled water system gauge pressure

6) DPAVG = rolling average of loop differential pressure (each loop, where applicable)

7) FLOWP, AVG = rolling average of primary chilled water flow

8) RefrigEvapTempCH-x, AVG = rolling average of CH-x refrigerant evaporating temperature (each chiller)

b. CHW-FlowCH-X (each chiller)

1) For plants with series chillers: 1 if CHW-ISOCH-x <100, 0 if CHW-ISOCH-X = 100 (each chiller)

c. ΔOS = number of changes in Operating State during the previous 60 minutes (moving window)

d. ΔStage = number of chilled water plant stage changes during the previous 60 minutes (moving window)

e. StartsCH-x = number of CH-x starts in the last 60 mins (each chiller)

5. The following internal variables shall be defined. All parameters are adjustable by the operator, with initial values as given below:

The default values have been intentionally biased towards minimizing false alarms at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors such as pump heat and sensor error can be measured in the field or derived from trend logs and hardware submittals. Likewise, the switch delays can be refined by observing the time required to achieve quasi steady state operation in trend data.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false alarms, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the temperature, pressure or flow thresholds.

Variable Name	Description	Default Value
ƐCHWT	Temperature error threshold for chilled water temperature sensors	2°F
ƐDP	Differential pressure error threshold for DP sensor	2 psi
ƐFM	Flow error threshold for flow meter	20 gpm
ƐVFDSPD	VFD speed error threshold	5%
ƐMFBVP	Minimum flow bypass valve position error threshold	5%
CHW-ETPreChargePress	Chilled water system expansion tank pre-charge pressure	See mechanical schedule (psig)
ApproachEVAP	Evaporator approach threshold	3°F
CHStartsMAX	Maximum number of chiller starts during the previous 60 minutes (moving window)	2
ΔOSMAX	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	2
ΔStageMAX	Maximum number of chilled water plant stage changes during the previous 60 minutes (moving window)	2
StageDelay	Time in minutes to suspend Fault Condition evaluation after a change in stage	30
AlarmDelay	Time in minutes that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

TestModeDelay ensures that normal fault reporting occurs after the testing and commissioning process is completed as prescribed in Section 3.26O.11.

6. The following are potential Fault Conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The Fault Conditions to be evaluated at any given time will depend on the Operating State of the chilled water plant.

FC#1	Equation	DPAVG > ƐDSP and StatusCHWP = Off	Applies to OS #1
	Description	Differential pressure is too high with the chilled water pumps off	
	Possible Diagnosis	DP sensor error	

FC#2	Equation	FLOWP, AVG > ƐFM and StatusPCHWP = Off	Applies to OS #1
	Description	Primary chilled water flow is too high with the chilled water pumps off	
	Possible Diagnosis	Flow meter error	
FC#4	Equation	DPAVG < DPSP – ƐDP and SpeedCHWP ≥ 99% - ƐVFDSPD	Applies to OS #2 – #3
	Description	Chilled water loop differential pressure is too low with chilled water pump(s) at full speed.	
	Possible Diagnosis	Problem with VFD Mechanical problem with pump(s) Pump(s) are undersized Differential pressure setpoint is too high CHWST is too high Primary flow is higher than the design evaporator flow of the operating chillers	
FC#5	Equation	FLOWP, AVG < CHW-MinFlowSp – ƐFM and MFBPV ≥ 99% - ƐMFBPV	Applies to OS #2, #3
	Description	Primary chilled water flow is too low with the minimum flow bypass valve fully open.	
	Possible Diagnosis	Problem with minimum flow bypass valve Problem with chiller CHW isolation valves Minimum loop differential pressure setpoint too low	
FC#6	Equation	CHWSTAVG - ƐCHWT ≥ CHWSTSP	Applies to OS #2 – #3
	Description	Chilled water supply temperature is too high	
	Possible Diagnosis	Mechanical problem with chillers Primary flow is higher than the design evaporator flow of the operating chillers	
FC#7	Equation	CHW-PGAUGE, AVG < 0.9 * CHW-ETPreChargePress	Applies to OS #1 – #3
	Description	Chilled water system gauge pressure is too low	
	Possible Diagnosis	Possible chilled water system leak	

FC#9	Equation	ApproachEVAP ≥ CHWSTCH-x, AVG - RefrigEvapTempCH-x, AVG	Applies to OS #2, #3
	Description	Evaporator approach is too high	
	Possible Diagnosis	Possible evaporator fouling or blocked evaporator tubes Low refrigeration charge Contaminated refrigeration charge	
FC#18	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #3
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC#19	Equation	ΔStartsCH-x > ΔCHStartMAX	Applies to OS #2, #3
	Description	Too many chiller starts	
	Possible Diagnosis	Chiller is cycling due to load loads. Chiller is oversized and/or has insufficient turndown capability. Chiller stage-up threshold may be set too low.	
FC#20	Equation	ΔStage > ΔStageMAX	Applies to OS #1 – #3
	Description	Too many stage changes	
	Possible Diagnosis	Staging thresholds and/or delays need to be adjusted	

7. For each chiller, the operator shall be able to suppress the alarm for any Fault Condition.

8. Evaluation of Fault Conditions shall be suspended under the following conditions:

   a. When no pumps are operating.

   b. For a period of StageDelay minutes following a change in plant stage.

9. Fault Conditions that are not applicable to the current Operating State shall not be evaluated.

10. A Fault Condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.

11. Test Mode shall temporarily set StageDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system and to ensure normal fault detection occurs after testing is complete.

12. When a Fault Condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from the table in Section 3.26O.6.

3.28 2-PIPE AND 4-PIPE AIR-TO-WATER CHILLED WATER PLANT

A. Cooling Parameters:

1. Temperature Setpoints

a. CHWSTmin, the lowest chilled water supply temperature setpoint = 54°F

b. CH-LOT, the outdoor air lockout temperature below which the chiller plant is prevented from operating = 60°F.

2. Cooling Capacity

a. QCdesign, design plant capacity in tons = 195 tons

b. QCchiller, design capacity in tons for each chiller:

1) Q1 = 65 tons

2) Q2 = 65 tons

3) Q3 = 65 tons

c. CHWFdesign, design primary loop flow in gpm = 570 gpm

3. Minimum Cycling Load

a. MinUnloadTons, the load below which the chiller will begin cycling

1) MinUnloadTons1 = 16.3 tons

2) MinUnloadTons2 = 16.3 tons

3) MinUnloadTons3 = 16.3 tons

4. CHW Pump DP setpoint

a. CHW-DPmax = as determine under 230593 Testing, Adjusting and Balancing.

B. Heating Parameters

1. Temperature Setpoints

a. HWSTmax, the highest hot water supply temperature setpoint = 110°F

b. HW-LOT, the outdoor air lockout temperature above which the boiler plant is prevented from operating = 70°F

2. Capacity

a. QHdesign, design plant capacity = 2400 KBtu/h

b. QHstage, design capacity in KBtu/h for each heat pump

1) Q1 = 800

2) Q2 = 800

3) Q2 = 800

c. HWFdesign, design primary loop flow = 320

3. Minimum Cycling Load

a. MinUnloadMBH, the load below which the chiller will begin cycling

1) MinUnloadMBH1 = 200

2) MinUnloadMBH2 = 200

3) MinUnloadMBH3 = 200

4. HW Pump DP setpoint

a. HW-DPmax = as determine under 230593 Testing, Adjusting and Balancing.

C. Cooling Plant Enable/Disable

1. The Cooling Plant shall include an enabling schedule that allows operators to lock out the plant during off-hours, e.g. to allow off-hour operation of HVAC systems except the chiller plant. The default schedule shall be 24/7 (adjustable).

2. Enable the Cooling Plant in the lowest stage when the plant has been disabled for at least 15 minutes and:

a. Number of Chiller Plant Requests > I (I= Ignores = 0, adjustable), and

b. OAT>CH-LOT, and

c. The cooling plant enable schedule is active.

3. Disable the Cooling Plant when it has been enabled for at least 15 minutes and:

a. Number of Chiller Plant Requests ≤ I for 3 minutes, or

b. OAT<CH-LOT – 1°F, or

c. The cooling plant enable schedule is inactive.

D. Heating Plant Enable/Disable

1. The Heating Plant shall include an enabling schedule that allows operators to lock out the plant during off-hours, e.g. to allow off-hour operation of HVAC systems except the heating plant. The default schedule shall be 24/7 (adjustable).

2. Enable the Heating Plant in the lowest stage when the plant has been disabled for at least 15 minutes and:

a. Number of Heating Hot-Water Plant Requests > I (I = Ignores shall default to 0, adjustable), and

b. OAT<HW-LOT, and

c. The heating plant enable schedule is active.

3. Disable the Heating Plant when it has been enabled for at least 15 minutes and:

a. Number of Heating Hot-Water Plant Requests ≤ I for 3 minutes, or

b. OAT>HW-LOT – 1°F, or

c. The heating enable schedule is inactive.

E. Lead/Lag Alternation

1. 2-pipe heat pump/chillers (AWHP) shall be lead/lag controlled per Paragraph 3.1P, both in heating and cooling modes.

2. If the Heating Plant and Cooling Plant are both enabled, the 4-pipe air-to-water heat recovery (AWHR) heat pump/chiller shall operate in Stage 1 for both Plants. Else it shall operate in Stage 3 and the 2-pipe AWHPs shall operate in Stages 1 and 2 based on lead/lag order.

3. 2-pipe AWHPs

a. If a AWHP is on in one heating/cooling mode, it is removed from the staging order of the opposite mode until it has been off for 15 minutes.

b. If a AWHP is commanded on in a desired heating/cooling mode:

1) Open changeover valves for desired cooling/heating mode.

2) Enable AWHP

c. If a AWHP is commanded off:

1) Disable AWHP and wait 3 minutes or as required for internal shutdown cycle to time out (determine empirically).

2) Close all four changeover valves.

F. Cooling Plant

1. Staging

a. Chillers are staged in part based on required capacity, $Q_{required}$, relative to nominal capacity of a given stage, Q_{stage}. This ratio is the operative part load ratio, *OPLR.*

b. If both primary and secondary chilled water temperatures and flow rates are available, use those in the primary for calculating $Q_{required}$.

c. All chillers are assumed to have integral primary pumps controlled by chiller controller.

d. $Q_{required}$ is calculated based on chilled water return temperature (*CHWRT*), active chilled water supply temperature setpoint ($CHWST_{SP}$), and measured flow through the associated circuit flow meter (*GPM*), as shown in the equation below. $Q_{required}$ used in logic shall be a 5-minute rolling average of instantaneous values sampled at a minimum of every 30 seconds.

$$Q_{required} = \frac{GPM(CHWRT - CHWST_{SP})}{24} \; [tons]$$

e. When a stage up or stage down transition is initiated, hold $Q_{required}$ fixed at its last value until the longer of the successful completion of the stage change (e.g. lag chiller proven on) and 15 minutes.

f. Q_{stage} is calculated as the sum of the design capacities of the chillers in a given stage.

g. *OPLR* shall be calculated as follows:

$$OPLR_{stage} = \frac{Q_{required}[tons]}{Q_{stage}[tons]}$$

h. Staging part load ratio, *SPLR,* shall be 90%:

i. Staging shall be executed per the table below subject to the following requirements.

1) Each stage shall have a minimum runtime of 15 minutes.

2) Timers shall reset to zero at the completion of every stage change.

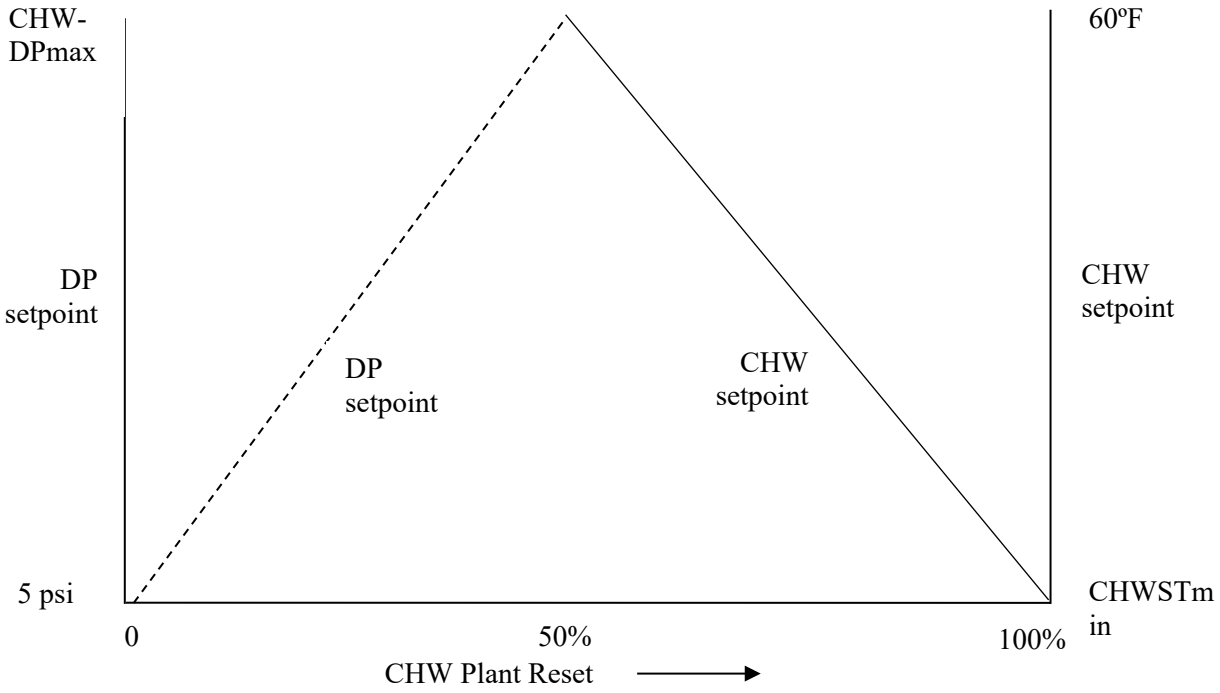
3) Stage up and down conditionals may depend on *OPLR* calculated relative to the current stage, next lower stage, or next higher stage. This is denoted with stage subscripts on OPLR in the table below. E.g. $OPLR_1$ means *OPLR* calculated using Stage 1 nominal capacity.

Chiller Stage	**Chillers on**	**Stage up to next stage if either:**		**Stage down to lower stage if:**
1	Lead	**Efficiency Condition:** for 15 minutes current stage *OPLR* greater than *SPLR*	**Failsafe Condition:** [for 15 minutes secondary CHW flow > the design primary flow for Stage 1] or [for 5 minutes secondary CHWST > primary CHWST + 2°F]	
2	Lead + Lag1	**Efficiency Condition:** for 15 minutes current stage *OPLR* greater than *SPLR*	**Failsafe Condition:** [for 15 minutes secondary CHW flow > the design primary flow for Stage 2] or [for 5 minutes secondary CHWST > primary CHWST + 2°F]	for 15 minutes next available lower stage *OPLR* less than $SPLR_{DN}$ and the next available lower stage failsafe condition is not true.

Chiller Stage	Chillers on	Stage up to next stage if either:		Stage down to lower stage if:
3	Lead + Lag1 and Lag2	–	–	for 15 minutes next available lower stage *OPLR* less than $SPLR_{DN}$ and the next available lower stage failsafe condition is not true.

2. Chilled Water Plant Reset

   a. Differential Pressure Controlled Loops: Chilled water supply temperature setpoint CHWSTsp and pump differential pressure setpoint CHW-DPsp shall be reset based on the current value of the logic variable called "CHW Plant Reset" as shown below and described subsequently.



   b. CHW Plant Reset shall be reset using Trim & Respond logic (see Guideline 36) with the following parameters:

Variable	Value
Device	Any CHW Pump
SP_0	100%
SP_{min}	0%
SP_{max}	100%
T_d	15 minutes

T	5 minutes
I	2
R	Chilled Water Reset Requests
SP_{trim}	-2%
SP_{res}	+3%
$SP_{res-max}$	+7%

c. CHWST Plant Reset loop shall be enabled when the plant is enabled and disabled when the plant is disabled.

d. When a plant stage change is initiated, CHW Plant Reset logic shall be disabled and value fixed at its last value for the longer of 15 minutes and the time it takes for the plant to successfully stage.

3. Secondary Chilled Water Pumps

a. CHW pumps shall be lead/lag controlled per Paragraph 3.1P.

b. Run lead CHW pump when Cooling Plant is enabled and shut off otherwise.

c. CHW pumps shall be staged as a function of CHWFR, the ratio of current secondary water flow, GPM_{CHW}, to design flow.

$$\text{CHWFR} = \frac{GPM_{CHW}}{CHWF_{design}}$$

1) Start the lag pump whenever the CHWFR>0.47 for 10 minutes:

2) Shut off the lag pump whenever the CHWFR≤0.47 for 10 minutes:

d. When any pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the differential pressure signal at a setpoint CHW-DPsp determined by the reset scheme described herein. All pumps receive the same speed signal. PID loop output shall be mapped from minimum pump speed (10%) at 0% to maximum pump speed at 100%.

e. Remote secondary loop DP shall be maintained at a setpoint of CHW-DPsp determined by the reset scheme described herein. CHW-DPsp shall be maintained by a reverse acting PID loop running in the controller to which the remote sensor is wired; the loop output shall be a DP setpoint for the local secondary loop DP sensor hardwired to the secondary pump controller. Reset local DP from 5 psi at 0% loop output to LocalCHW-DPmax at 100% loop output.

f. When any secondary CHW pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the local secondary DP signal at the DP setpoint output of the remote sensor control loop. All pumps receive the same speed signal. PID loop output shall be mapped from minimum pump speed at 0% to maximum pump speed at 100%.

g. Where multiple remote DP sensors exist, a PID loop shall run for each sensor. The DP setpoint for the local DP sensor shall be the highest DP setpoint output from each of those remote loops.

G. Heating Plant

1. Staging

a. Heat pumps are staged in part based on required capacity, $Q_{required}$, relative to nominal capacity of a given stage, Q_{stage}. This ratio is the operative part load ratio, *OPLR*.

b. If both primary and secondary hot water temperatures and flow rates are available, use those in the primary for calculating $Q_{required}$.

c. All heat pumps are assumed to have integral primary pumps controlled by heat pump controller.

d. $Q_{required}$ is calculated based on hot water return temperature (*HWRT*), active hot water supply temperature setpoint ($HWST_{SP}$), and measured flow through the associated circuit flow meter (*GPM*), as shown in the equation below. $Q_{required}$ used in logic shall be a 5-minute rolling average of instantaneous values sampled at a minimum of every 30 seconds.

$$Q_{required} = 0.5 * GPM(HWRT - HWST_{SP})\ [MBH]$$

e. When a stage up or stage down transition is initiated, hold $Q_{required}$ fixed at its last value until the longer of the successful completion of the stage change (e.g. lag heat pump proven on) and 15 minutes.

f. Q_{stage} is calculated as the sum of the design capacities of the heat pumps in a given stage.

g. *OPLR* shall be calculated as follows:

$$OPLR_{stage} = \frac{Q_{required}[MBH]}{Q_{stage}[MBH]}$$

h. Staging part load ratio, *SPLR,* shall be 90%:

i. Staging shall be executed per the table below subject to the following requirements.

1) Each stage shall have a minimum runtime of 15 minutes.

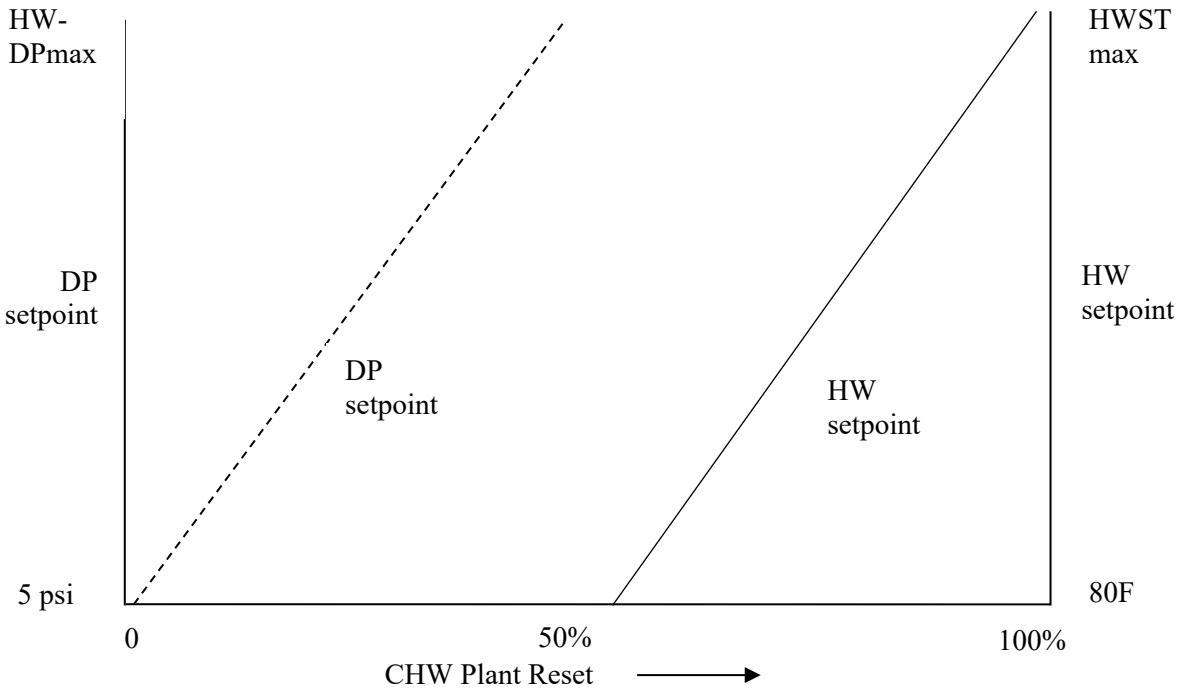
2) Timers shall reset to zero at the completion of every stage change.

3) Stage up and down conditionals may depend on *OPLR* calculated relative to the current stage, next lower stage, or next higher stage. This is denoted with stage subscripts on OPLR in the table below. E.g. $OPLR_1$ means *OPLR* calculated using Stage 1 nominal capacity.

Heat pump Stage	Heat pumps on	Stage up to next stage if either:		Stage down to lower stage if:
1	Lead	**Efficiency Condition:** for 15 minutes current stage *OPLR* greater than *SPLR*	**Failsafe Condition:** [for 15 minutes secondary HW flow > the design primary flow for Stage 1] or [for 5 minutes secondary HWST > primary HWST + 2°F]	
2	Lead + Lag1	**Efficiency Condition:** for 15 minutes current stage *OPLR* greater than *SPLR*	**Failsafe Condition:** [for 15 minutes secondary HW flow > the design primary flow for Stage 2] or [for 5 minutes secondary HWST > primary HWST + 2°F]	for 15 minutes next available lower stage *OPLR* less than $SPLR_{DN}$ and the next available lower stage failsafe condition is not true.
3	Lead + Lag1 and Lag2	–	–	for 15 minutes next available lower stage *OPLR* less than $SPLR_{DN}$ and the next available lower stage failsafe condition is not true.

2. Hot Water Plant Reset

    a. Differential Pressure Controlled Loops: Hot water supply temperature setpoint HWSTsp and pump differential pressure setpoint HW-DPsp shall be reset based on the current value of the logic variable called “HW Plant Reset” as shown below and described subsequently.



b. HW Plant Reset shall be reset using Trim & Respond logic (see Guideline 36) with the following parameters:

Variable	Value
Device	Any HW Pump
SP_0	100%
SP_{min}	0%
SP_{max}	100%
T_d	15 minutes
T	5 minutes
I	2
R	Heating HWST Reset Requests
SP_{trim}	-2%
SP_{res}	+3%
$SP_{res-max}$	+7%

c. HWST Plant Reset loop shall be enabled when the plant is enabled and disabled when the plant is disabled.

d. When a plant stage change is initiated, HW Plant Reset logic shall be disabled and value fixed at its last value for the longer of 15 minutes and the time it takes for the plant to successfully stage.

3. Secondary Hot Water Pumps

a. HW pumps shall be lead/lag controlled per Paragraph 3.1P.

b. Run lead HW pump when Heating Plant is enabled and shut off otherwise.

c. HW pumps shall be staged as a function of HWFR, the ratio of current secondary water flow, GPM_{HW}, to design flow.

$$\text{HWFR} = \frac{GPM_{CHW}}{HWF_{design}}$$

1) Start the lag pump whenever the HWFR>0.47 for 10 minutes:

2) Shut off the lag pump whenever the HWFR≤0.47 for 10 minutes:

d. When any pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the differential pressure signal at a setpoint HW-DPsp determined by the reset scheme described herein. All pumps receive the same speed signal. PID loop output shall be mapped from minimum pump speed (10%) at 0% to maximum pump speed at 100%.

e. Remote secondary loop DP shall be maintained at a setpoint of HW-DPsp determined by the reset scheme described herein. HW-DPsp shall be maintained by a reverse acting PID loop running in the controller to which the remote sensor is wired; the loop output shall be a DP setpoint for the local secondary loop DP sensor hardwired to the secondary pump controller. Reset local DP from 5 psi at 0% loop output to LocalHW-DPmax at 100% loop output.

f. When any secondary HW pump is proven on, pump speed will be controlled by a reverse acting PID loop maintaining the local secondary DP signal at the DP setpoint output of the remote sensor control loop. All pumps receive the same speed signal. PID loop output shall be mapped from minimum pump speed at 0% to maximum pump speed at 100%.

g. Where multiple remote DP sensors exist, a PID loop shall run for each sensor. The DP setpoint for the local DP sensor shall be the highest DP setpoint output from each of those remote loops.

H. Alarms

1. Maintenance interval alarm when pump has operated for more than 1500 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Maintenance interval alarm when heat pump/chiller has operated for more than 1000 hours: Level 4. Reset interval counter when alarm is acknowledged.

3. Heat pump/chiller alarm: level 2

4. High chiller leaving chilled water temperature (more than 5°F above setpoint) for more than 15 minutes when chiller has been enabled in cooling mode for longer than 15 minutes: Level 3

5. Low heat pump leaving hot water temperature (more than 5°F below setpoint) for more than 15 minutes when heat pump has been enabled in heating mode for longer than 15 minutes: Level 3

6. Pump alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.

    a. Commanded on, status off: Level 2

    b. Commanded off, status on: Level 4

7. CHW System low gauge pressure

    a. if CHW system gauge pressure falls 1 psig below the scheduled expansion tank pre-charge pressure for 5 minutes, (indicating need to fill): Level 3.

    b. if CHW system gauge pressure falls below 0.9 times the scheduled expansion tank pre-charge pressure for 1 minute, (indicating possible leak): Level 2.

8. HW System low gauge pressure

    a. if HW system gauge pressure falls 1 psig below the scheduled expansion tank pre-charge pressure for 5 minutes, (indicating need to fill): Level 3.

    b. if HW system gauge pressure falls below 0.9 times the scheduled expansion tank pre-charge pressure for 1 minute, (indicating possible leak): Level 2.

3.29 HOT WATER PLANT

A. See Section 1.2C for HWSTmax, HW-LOT, HW-MinFlowX, HW-DesFlowX, QbX, B-FiringMinX, PHWFdesign, and SHWFdesign. See Section 1.3I for HW-DPmax, LocalHW-DPmax, and B-MinPriPumpSpdStage.

B. Plant Enable/Disable

1. The Boiler plant shall include an enabling schedule that allows operators to lock out the plant during off-hours, e.g. to allow off-hour operation of HVAC systems except the Boiler plant. The default schedule shall be 24/7 (adjustable).

2. Enable the plant in the lowest stage when the plant has been disabled for at least 15 minutes and:

    a. Number of Heating Hot-Water Plant Requests > I (I = Ignores shall default to 0, adjustable), and

    b. OAT<HW-LOT, and

    c. The Boiler plant enable schedule is active.

3. Disable the plant when it has been enabled for at least 15 minutes and:

    a. Number of Heating Hot-Water Plant Requests ≤ I for 3 minutes, or

b. OAT>HW-LOT + 1°F, or

c. The Boiler plant enable schedule is inactive.

4. When the plant is enabled:

a. Open the HW isolation valve of the lead boiler.

b. Stage on lead primary HW pump per Section E.

c. Once the lead pump has proven on, enable the lead boiler.

5. When the plant is disabled:

a. Shut off the enabled boiler(s).

b. For each enabled boiler with headered primary HW pumps, close the HW isolation valve(s) after 3 minutes and disable the operating HW pump(s) per Section E.

C. Boiler Staging

1. Boiler stages shall be defined as follows:

Boiler Stage	Enabled Boilers
0	None
1	B-1 or B-2
2	B-1 and B-2

2. Interchangeable boilers indicated with "or" in the table above shall be lead/lag controlled per Section 3.1P.3.

3. If a boiler is in alarm, the boiler shall be disabled and after 3 minutes, its HW isolation valve shall be closed.

4. Boilers are staged in part based on required capacity, Qrequired. Qrequired is calculated based on hot water return temperature (HWRT), active hot water supply temperature setpoint (HWSTSP), and measured flow through the primary circuit flow meter (FLOWP), as shown in the equation below. Qrequired used in logic shall be a 5-minute rolling average of instantaneous values sampled at a minimum of every 30 seconds.

$$Q_{required} = 0.49 * FLOW_P(HWST_{SP} - HWRT)\ [\frac{\text{kbtu}}{\text{h}}]$$

5. Boilers are staged in part based on the minimum output of a given stage, B-STAGEMIN. Calculate B-STAGEMIN as the largest B-FiringMinX of all boilers in the stage times design capacity of all boilers in the stage. Note that B-FiringMin and capacity may vary for each boiler, e.g. for unequally sized boilers with different minimum turndowns.

B-STAGEMIN defines the minimum load boilers can operate at in a given stage without any of them cycling. If minimum capacities of all boilers (e.g. B-FiringMinX for a given boiler times its design capacity) were summed directly instead of correcting for the highest B-FiringMinX among all enabled boilers in a stage, boilers with a higher B-FiringMinX would still cycle.

6. Staging events require that a boiler stage be available. A stage shall be deemed unavailable if the stage cannot be achieved because a boiler required to operate in the stage is faulted per Section 3.1P.5.b.1)c) or a hot water pump dedicated to that boiler is faulted per Section 3.1P.5.b.1)a); otherwise the stage shall be deemed available.

7. Staging shall be executed per the conditions below subject to the following requirements:

    a. Each stage shall have a minimum runtime of 10 minutes.

    b. Timers shall reset to zero at the completion of every stage change.

    c. Any unavailable stage (see Section 6) shall be skipped during staging events, but staging conditionals in the current stage shall be evaluated as per usual.

    d. Hot water supply and return temperatures used in staging logic shall be those located in common supply and return mains hardwired to plant controllers.

    e. Stage up if any of the following is true:

        1) Availability Condition: The equipment necessary to operate the current stage are unavailable. The availability condition is not subject to the minimum stage runtime requirement. Or

        2) Efficiency Condition: Both of the following are true:

            a) Qrequired exceeds 200% of B-STAGEMIN of the next available stage for 10 minutes

            b) Hot water flowrate exceeds the minimum flow setpoint of the next available stage (see Section 3.29F).

        3) Failsafe Condition: HW supply temperature is 10°F < setpoint for 15 minutes.

    f. Stage down if all of the following are true:

        1) Either:

            a) Qrequired falls below 110% of B-STAGEMIN of the current stage for 5 minutes; or

            b) The minimum flow bypass valve, if provided, is greater than 0% open for 5 minutes.

        2) The failsafe stage up condition is not true.

        3) Qrequired is less than 80% of the design capacity, QbX, of the boilers in the next available lower stage for 5 minutes.

Condensing boilers are generally more efficient at low load since the ratio of heat transfer surface area to thermal mass flowrate is maximized, increasing flue gas condensation. Staging on boilers at low load therefore maximizes plant efficiency. However, the energy penalty from cycling losses due to staging on lag equipment prematurely, only to have them cycle off, may more than offset the part load efficiency gains.

Staging is delayed until the current stage output exceeds the minimum output of the next stage by 100% to avoid boiler short cycling following stage up, which dramatically decreases plant efficiency. The default stage up threshold for the efficiency condition is set to ensure sufficient load to prevent boilers from short cycling and to create an adequate hysteresis to prevent unnecessary boiler staging, but the optimal threshold will depend in part on the boiler turndown. The designer should consider adjusting this threshold based on plant attributes: higher for boilers with more turndown, lower for boilers with less turndown.
Staging is also dependent on minimum flow requirements. If minimum flowrate of the next stage is not satisfied under current operating conditions, then supply water will need to be bypassed to the return following a stage up, which raises return temperature. Elevated return temperature decreases condensation and boiler efficiency as a result, so staging up is inhibited under these conditions. For the same reason, a stage down is triggered if the minimum flow bypass valve is opened with more than one boiler in operation.

8. Whenever a lag boiler is enabled:

    a. Reset the minimum flow bypass setpoint to that appropriate for the new stage as indicated in Section 3.26F.1.

A stabilization delay does not apply in this case since flowrate will already be at least the stage minimum per staging logic.

    b. Open the next lag boiler's isolation valve.

    c. Start the next lag primary pump and simultaneously open the next lag boiler's isolation valve.

    d. After 30 seconds, enable the lag boiler.

        1) After 3 minutes, close the smaller boiler's isolation valve.

        2) Change the minimum flow bypass setpoint to that appropriate for the new stage as indicated in Section 3.29F.1.

9. Whenever a lag boiler is disabled:

    a. Disable the last stage boiler.

    b. After 3 minutes, close the disabled boiler's isolation valve.

    c. Change the minimum flow bypass setpoint to that appropriate for the new stage as indicated in Section 3.29F.1.

D. Hot Water Supply Temperature Reset

1. Plant hot water supply temperature setpoint shall be reset using Trim & Respond logic with the following parameters:

Variable	Value
Device	Any HW Pump Distribution Loop
SP0	SPmax
SPmin	90ºF

SPmax	HWSTmax
Td	10 minutes
T	5 minutes
I	2
R	Hot-Water Reset Requests
SPtrim	-2ºF
SPres	+3ºF
SPres-max	+7ºF

Hot water supply temperature is reset downwards under low load conditions to minimize piping heat losses, improve controllability, and maximize condensing operation.

E. Primary Hot Water Pumps

1. Primary hot water pumps shall be lead/lag controlled per Section 3.1P.3.

2. Enable lead primary hot water pump when any boiler isolation valve is commanded open. Disable the lead hot water pump when all boiler isolation valves are commanded closed.

3. HW pumps shall be staged as a function of the ratio of current hot water flow, FLOWP, to design flow, PHWFdesign, and the number of pumps, N-PHWP, that operate at design conditions. Pumps are assumed to be equally sized.

$$\text{HWFR} = \frac{FLOW_P}{PHWF_{design}}$$

Flow is used, as opposed to speed, to keep the hot water pumps operating near their best efficiency point. Staging at slightly less than design flowrate for operating pumps yields good results for most applications (note that when fewer than design pumps are enabled, pumps will be able to produce greater than design flow since they will be operating further out their pump curves). If desired, the stage down flow point can be offset slightly below the stage up point to prevent cycling between pump stages in applications with highly variable loads.

a. Start the next lag pump whenever the following is true for 10 minutes:

$$\text{HWFR} > \frac{Number\ of\ Operating\ Pumps}{N} - .03$$

b. Shut off the last lag pump whenever the following is true for 10 minutes:

$$\text{HWFR} < \frac{Number\ of\ Operating\ Pumps - 1}{N} - .03$$

Note: VFDs are not required on HW pumps by Title 24 and only required on large HW pumps used in fossil fuel boiler plants by Standard 90.1. These provisions exist because pump energy is converted to heat through friction losses at the pump and in pipe, coils, valves; reductions in HW pump energy are made up by the boilers. Energy costs are reduced because fossil fuel costs less per BTU than electricity, but savings are minor. However, constant speed pumps are not recommended on pumps with design head greater than about 50 feet due to increased noise from control valves, reduced controllability, and increased valve and pump wear.

4. When any pump is proven on, pump speed shall be controlled by a reverse acting PID loop maintaining differential pressure at HW-DPmax. All pumps receive the same speed

signal. PID loop output shall be mapped from minimum pump speed at 0% to maximum pump speed at 100%.

5. Where multiple DP sensors exist, a PID loop shall run for each sensor. HW pumps shall be controlled to the high signal output of all DP sensor loops.

HW pump DP setpoint is not reset by valve position because valve position is already used to reset HWST, which saves much more energy than DP reset. As noted above, pump energy is ultimately turned into heat so reductions in HW pump energy are made up by the boilers.

F. Minimum Flow Bypass Valve

1. Bypass valve shall modulate to maintain minimum flow as measured by the hot water flow meter at a setpoint that provides minimum flow through all operating boilers, determined as follows:

   a. For the boilers operating in the stage, identify the boiler with the highest ratio, MinFlowRatio, of HW-MinFlowX to HW-DesFlowX.

   b. Calculate the minimum flow setpoint, HW-MinFlowSP as MinFlowRatio multiplied by the sum of HW-DesFlowX for the operating boilers.

If the boilers have different minimum flow to design flow ratios, just maintaining the sum of the minimum flows will not satisfy the boiler(s) with the highest relative minimum flows. Note that this also requires that boilers be balanced to distribute flow proportional to their design flow.

2. A reverse acting PID loop shall maintain minimum flow as measured by the hot water flow meter at setpoint. Reset valve position from 0% open at 0% loop output to 100% open at 100% loop output.

3. When any HW pump is proven on, the bypass valve control loop shall be enabled. The valve shall be opened otherwise. When enabled, the bypass valve minimum flow PID loop shall be biased 100% (valve 100% open).

Biasing the minimum flow PID loop to 100% upon start up ensures that the valve does not slam shut upon enabling the loop. Starting with the valve fully open is appropriate because flows are often very low when the plant is first turned on.

G. Performance Monitoring

1. All calculations listed below shall be performed at least once every 30 seconds. Time averaged values shall be recorded at least once every 5 minutes. The averaging period shall equal the trending interval.

2. Total Plant Gas Use. Convert measured gas usage to Btu/h by a user adjustable conversion factor (default value = 1000 Btu/h per ft3 of gas; actual value set by user from utility bill).

3. Total Plant Load. Calculate plant load using flowrate through the primary circuit, FLOWP; primary hot water return temperature, PHWRT; and primary hot water supply temperature, PHWST.

$$Q_{actual} = 0.49 * FLOW_P(PHWST - PHWRT) \left[\frac{\text{kbtu}}{\text{h}}\right]$$

4. Boiler Load. Calculate load for each operating boiler (as applicable) using flowrate through the boiler, FLOWB; hot water return temperature entering the boiler, HWRTB; and hot water supply temperature leaving the boiler, HWSTB. Inputs to the below equation shall be determined per the following rules.

$$Q_D = 0.49 * FLOW_B(HWST_B - HWRT_B)[\frac{kbtu}{h}]$$

   a. FLOWB shall be assumed proportional to design flow through all operating boilers in the circuit.

   b. HWRTB shall be the return temperature entering the boiler as read by a hardwired BAS sensor if available. If a hardwired sensor is unavailable, temperature shall be read from a sensor internal to the boiler through its network interface. If multiple boilers are enabled, the temperature shall be the average return temperature read from the operating boilers through the network interface.

   c. HWSTB shall be a hardwired temperature sensor at the outlet of the equipment if available. If a hardwired sensor is unavailable, temperature shall be read from a sensor internal to the boiler through its network interface. Only if neither of the above is available shall a common supply temperature sensor (i.e. one measuring the output from multiple boilers), be used.

5. Calculate plant thermal efficiency as equal to measured plant load divided by measured gas consumption.

6. Summary Data

   a. For each boiler, statistics shall be calculated for runtime, cumulative load (btu), average demand (btu/h), and peak demand (btu/h). All statistics shall be presented on an instantaneous, year-to-date, and previous year basis.

   b. For the total plant, statistics shall be calculated for runtime, energy use (btu), cumulative load (btu), average demand (btu/h), peak demand (btu/h), and actual efficiency (btu/btu). All statistics shall be presented on an instantaneous, year-to-date, and previous year basis.

Below is an example summary of the performance monitoring parameters. Summary table should be edited based on plant configuration, available statistics and desired units of measurement.

	Instantaneous				Year-to-date						Previous Year					
	Lifetime Runtime (hours)	Gas Demand (kBtu/h)	HW Demand (kBtu/h)	Efficiency	Runtime (hours)	Gas Use (MMBtu)	HW Load (MMBtu)	Avg HW Demand (kBtu/h)	Peak HW Demand (kBtu/h)	Avg Efficiency	Runtime (hours)	Gas Use (MMBtu)	HW Load (MMBtu)	Avg HW Demand (kBtu/h)	Peak HW Demand (kBtu/h)	A Effic
B-1																
B-2																
Total Plant																

H. Alarms

1. Maintenance interval alarm when pump has operated for more than 3000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

2. Maintenance interval alarm when boiler has operated for more than 2000 hours as indicated by the Staging Runtime: Level 4. Reset the Staging Runtime interval counter when alarm is acknowledged.

3. Boiler alarm: Level 2

4. Low boiler leaving hot water temperature (more than 15°F below setpoint) for more than 15 minutes when boiler has been enabled for longer than 15 minutes: Level 3

5. Pump alarm is indicated by the status input being different from the output command for 15 seconds.

   a. Commanded on, status off: Level 2. Do not evaluate alarm until the equipment has been commanded on for 15 seconds.

   b. Commanded off, status on: Level 4. Do not evaluate alarm until the equipment has been commanded off for 60 seconds.

6. Sensor Failure:

   a. Sensor shall be deemed outside of its widest possible operating range if any of the following are true:

      1) Feedback less than 2 mA from any 4 to 20 mA transducer; or

      2) Temperature reading less than 0°F from any temperature sensor.

   b. Any sensor that goes outside of its widest possible operating range.

      1) If the sensor is used for monitoring only: Level 3.

      2) If the sensor is used for control: Level 2.

I. Automatic Fault Detection and Diagnostics

The Automatic Fault Detection and Diagnostics (AFDD) routines for hot water plants continually assess plant performance by comparing the values of BAS inputs and outputs to a subset of potential fault conditions. The subset of potential fault conditions that is assessed at any point depends on the Operating State of the plant, as determined by the positions of the isolation valves and statuses of pumps. Time delays are applied to the evaluation and reporting of fault conditions, to suppress false alarms. Fault conditions that pass these filters are reported to the building operator as alarms along with a series of possible causes.
These equations assume that the plant is equipped with isolation valves, as well as a pump status monitoring. If any of these components are not present, the associated tests, and variables should be omitted from the programming.
Note that these faults rely on reasonably accurate measurement of water temperature. Extra precision sensors installed in thermowells with thermal paste are recommended for best accuracy.

1. AFDD conditions are evaluated continuously for the plant.

2. The Operating State (OS) of the plant shall be defined by the commanded positions of the valves and status feedback from the pumps in accordance with the following table. For hybrid plants, determine the Operating State for each primary loop.

The Operating State is distinct from and should not be confused with the hot water plant stage. OS#1 – OS#3 represent normal operation during which a fault may nevertheless occur, if so determined by the fault condition tests below.

Operating State	Boiler Isolation Valve	PHW Pump Status
#1: Disabled	All Closed/Off	All Off
#2: One boiler enabled	One Open/On, All Others Closed/Off	Any On
#3: More than one boiler enabled	Any Open/On	Any On

3. The following points must be available to the AFDD routines for the hot water plant:

   a. DP = Hot water loop differential pressure (each loop, where applicable)

   b. DPSP = Hot water loop differential pressure setpoint (each loop, where applicable)

   c. FLOWP = Primary hot water flow (each primary loop, where applicable)

   d. MFBPV = Hot water minimum flow bypass valve command; 0% ≤ MFBPV ≤ 100%

   e. HW-MinFlowSP = Effective minimum hot water flow setpoint (equal to MinFlowRatio multiplied by the sum of HW-MinFlowX of operating boilers)

   f. SpeedHWP = Hot water pump speed command; 0% ≤ SpeedHWP ≤ 100%

   g. StatusPHWP = Lead primary hot water pump status (each primary loop, where applicable)

   h. HWST = Common hot water supply temperature

   i. HWSTSP = Hot water supply temperature setpoint

   j. HWRT = Average boiler entering water temperature (each loop)

   k. HWISOB-x = B-x hot water isolation valve commanded position (each boiler)

   l. PGAUGE = Hot water system gauge pressure

4. The following values must be continuously calculated by the AFDD routines:

   a. 5-minute rolling averages with 1-minute sampling time of the following point values; operator shall have the ability to adjust the averaging window and sampling period for each point independently

      1) HWSTAVG = rolling average of the common hot water supply temperature (each primary loop, where applicable)

2) HWRTAVG = rolling average of the average boiler entering water return temperature.

3) PGAUGE, AVG = rolling average of hot water system gauge pressure

4) DPAVG = rolling average of loop differential pressure (each loop, where applicable)

5) FLOWP, AVG = rolling average of primary hot water flow (each loop, where applicable)

6) HWSTB-x = rolling average of B-x hot water supply temperature (each boiler)

7) HWRTB-x = rolling average of B-x hot water return temperature (each boiler)

b. HWFlowB-X (each boiler)

1) For plants with headered primary hot water pumps: 1 if HWISOB-X = open, 0 if HWISOB-X = closed

c. ΔOS = number of changes in Operating State during the previous 60 minutes (moving window)

d. ΔStage = number of hot water plant stage changes during the previous 60 minutes (moving window)

e. StartsB-x = number of B-x starts in the last 60 mins (each boiler)

5. The following internal variables shall be defined. All parameters are adjustable by the operator, with initial values as given below:

The default values have been intentionally biased towards minimizing false alarms at the expense of missing real alarms. This avoids excessive false alarms that will erode user confidence and responsiveness. However, if the goal is to achieve the best possible energy performance and system operation, these values should be adjusted based on field measurement and operational experience.
Values for physical factors such as pump heat and sensor error can be measured in the field or derived from trend logs and hardware submittals. Likewise, the switch delays can be refined by observing the time required to achieve quasi steady state operation in trend data.
Other factors can be tuned by observing false positives and false negatives (i.e., unreported faults). If transient conditions or noise cause false alarms, increase the alarm delay. Likewise, failure to report real faults can be addressed by adjusting the temperature, pressure or flow thresholds.

Variable Name	Description	Default Value
ℇHWT	Temperature error threshold for hot water temperature sensors	5°F
ℇDP	Differential pressure error threshold for DP sensor	2 psi
ℇFM	Flow error threshold for flow meter	20 gpm

Variable Name	Description	Default Value
ƐVFDSPD	VFD speed error threshold	5%
ƐMFBVP	Minimum flow bypass valve position error threshold	5%
ETPreChargePress	Hot water system expansion tank pre-charge pressure	See mechanical schedule (psig)
CondTemp	Boiler condensing temperature threshold	135°F
BStartsMAX	Maximum number of boiler starts during the previous 60 minutes (moving window)	2
ΔOSMAX	Maximum number of changes in Operating State during the previous 60 minutes (moving window)	2
ΔStageMAX	Maximum number of hot water plant stage changes during the previous 60 minutes (moving window)	2
StageDelay	Time in minutes to suspend Fault Condition evaluation after a change in stage	30
AlarmDelay	Time in minutes that a Fault Condition must persist before triggering an alarm	30
TestModeDelay	Time in minutes that Test Mode is enabled	120

TestModeDelay ensures that normal fault reporting occurs after the testing and commissioning process is completed as prescribed in Section 3.29I.11.

6. The following are potential Fault Conditions that can be evaluated by the AFDD routines. If the equation statement is true, then the specified fault condition exists. The Fault Conditions to be evaluated at any given time will depend on the Operating State of the hot water plant.

FC#1	Equation	DPAVG > ƐDSP and StatusHWP = Off	Applies to OS #1
	Description	Differential pressure is too high with the hot water pumps off	
	Possible Diagnosis	DP sensor error	
FC#2	Equation	FLOWP, AVG > ƐFM and StatusPHWP = Off	Applies to OS #1
	Description	Primary hot water flow is too high with the hot water pumps off	

	Possible Diagnosis	Flow meter error	
FC#4	Equation	DPAVG < DPSP – ƐDP and SpeedHWP ≥ 99% - ƐVFDSPD	Applies to OS #2, #3
	Description	Hot water loop differential pressure is too low with hot water pump(s) at full speed.	
	Possible Diagnosis	Problem with VFD Mechanical problem with pump(s) Pump(s) are undersized Differential pressure setpoint is too high HWST is too low Primary flow is higher than the design flow of the operating boilers	
FC#5	Equation	FLOWP, AVG < HW-MinFlowSp – ƐFM and MFBPV ≥ 99% - ƐMFBPV	Applies to OS #2, #3
	Description	Primary hot water flow is too low with the minimum flow bypass valve fully open.	
	Possible Diagnosis	Problem with minimum flow bypass valve Problem with boiler isolation valves Minimum loop differential pressure setpoint too low	
FC#7	Equation	PGAUGE, AVG < 0.9 * ETPreChargePress	Applies to OS #1 – #3
	Description	Hot water system gauge pressure is too low	
	Possible Diagnosis	Possible hot water system leak	
FC#8	Equation	HWRTAVG - ƐHWT > CondTemp	Applies to OS #2, #3
	Description	Hot water return temperature is too high for condensing to occur.	
	Possible Diagnosis	Hot water supply temperature setpoint is too high. Hot water load is too low. High bypass flow is raising the entering water temperature. Hot water coils are not designed for condensing at current loads.	
FC#10	Equation	| (∑(HW-FlowB-X * HWSTB-X) / ∑HW-FlowB-X) - HWSTAVG | > ƐHWT	Applies to OS #2
	Description	Deviation between the active boiler hot water supply temperature and the common hot water supply temperature is too high.	
	Possible Diagnosis	A hot water supply temperature sensor is out of calibration	

FC#11	Equation	| (∑(HW-FlowB-X * HWRTB-X) / ∑HW-FlowB-X) - HWRTAVG | > ƐHWT	Applies to OS #2
	Description	Deviation between the active boiler hot water return temperature and the common boiler entering water temperature is too high.	
	Possible Diagnosis	A hot water return temperature sensor is out of calibration	
FC#12	Equation	ΔOS > ΔOSMAX	Applies to OS #1 – #3
	Description	Too many changes in Operating State	
	Possible Diagnosis	Unstable control due to poorly tuned loop or mechanical problem	
FC#13	Equation	ΔStartsB-x > ΔBStartMAX	Applies to OS #2, #3
	Description	Too many boiler starts	
	Possible Diagnosis	Boiler is cycling due to load loads Boiler is oversized and/or has insufficient turndown. Boiler stage-up threshold may be set too low.	
FC#14	Equation	ΔStage > ΔStageMAX	Applies to OS #1 – #3
	Description	Too many stage changes	
	Possible Diagnosis	Staging thresholds and/or delays need to be adjusted	

7. For each boiler, the operator shall be able to suppress the alarm for any Fault Condition.
8. Evaluation of Fault Conditions shall be suspended under the following conditions:
    a. When no pumps are operating.
    b. When all equipment associated with a fault condition in maintenance mode.
    c. For a period of StageDelay minutes following a change in plant stage.
9. Fault Conditions that are not applicable to the current Operating State shall not be evaluated.
10. A Fault Condition that evaluates as true must do so continuously for AlarmDelay minutes before it is reported to the operator.
11. Test Mode shall temporarily set StageDelay and AlarmDelay to 0 minutes for a period of TestModeDelay minutes to allow instant testing of the AFDD system and to ensure normal fault detection occurs after testing is complete.

12. When a Fault Condition is reported to the operator, it shall be a Level 3 alarm and shall include the description of the fault and the list of possible diagnoses from the table in 3.29I.6.

3.30 BUILDING CHILLED WATER PUMPS

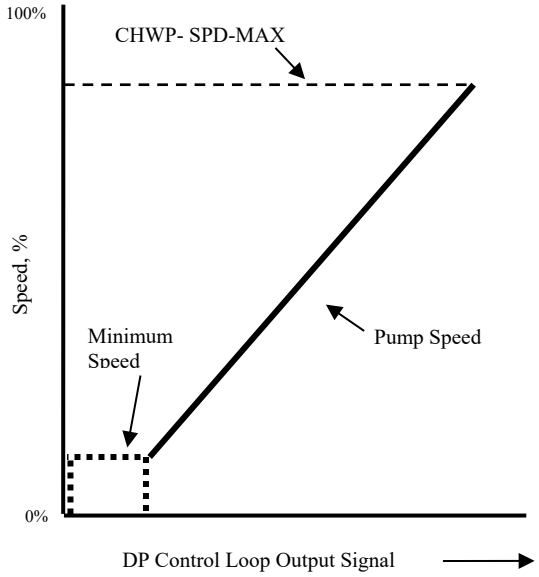
A. Pumps shall be lead/lag controlled per Paragraph 3.1P.

B. Enable/Disable

1. Enable the pumping system when it has been disabled for at least 15 minutes and the number of Chiller Plant Requests > I (I = Ignores shall default to 0, adjustable

2. Disable the pumping system when it has been enabled for at least 5 minutes and the Number of Chiller Plant Requests ≤ I for 3 minutes

C. When the pumping system is enabled, the DP control loop is enabled. The loop shall be a reverse-acting loop maintaining the differential pressure (DP) sensor at setpoint. The output of the loop shall range from 0 to 100%, mapped to pump speed up to a maximum speed of software point CHWP-SPD-MAX as shown in the figure and described below. The pressure from the plant may satisfy the building DP requirements via the check valve bypass, in which case the pumps will stay off. They will start only when the plant pressure is not adequate.



1. Pump speed will be controlled by a PID loop maintaining the differential pressure signal at a setpoint determined by the reset scheme described below. All pumps receive the same speed signal.

2. When the DP loop output is equal to the lead pump minimum speed setpoint (see Section 250000 Building Automation Systems), the lead pump shall start. Its speed shall be equal to the DP loop output up to a maximum speed of CHWP-SPD-MAX, set below. The lead pump shall stop when the pump has run for a minimum speed for 5 minutes. It shall stay off for a minimum of 5 minutes before restarting.

D. Pumps shall be staged as a function of CHW flow ratio (CHWFR = actual flow divided by total design flow). When CHWFR is above 47% for 10 minutes, start the lag pump. When CHWFR is below 47% for 15 minutes, or the lead pump is commanded off, shut off the lag pump.

E. Differential pressure setpoint shall be reset using Trim & Respond logic (see Guideline 36) with the following parameters. DP-MAX is the design DP setpoint determined under 230593 Testing, Adjusting and Balancing.

Variable	Value
Device	Any CHW Pump
SP_0	DP-MAX
SP_{min}	1 psi
SP_{max}	DP-MAX
T_d	15 minutes
T	5 minutes
I	2
R	Chilled Water Reset Requests
SP_{trim}	-2%
SP_{res}	+3%
$SP_{res-max}$	+7%

F. CHW Flow Limit

1. Flow limit %setpoint shall be the total pump design flow rate listed on drawings. The limit will ensure that one building does not take more flow than they are entitled to, starving other buildings.

2. When the pumping system is enabled, a proportional-only flow limiting loop shall be enabled to maintain measured flow at the flow limit setpoint. The output of the loop shall be a software point CHWP-SPD-MAX ranging from 0 to 100%.

3.31 BUILDING HOT WATER PUMPS

A. Pumps shall be lead/lag controlled per Paragraph 3.1P.

B. Building HW system enable/disable

1. Enable the building HW system when they have been disabled for at least 10 minutes and:

a. Number of building Heating Hot-Water Plant Requests > I (I = Ignores shall default to 0, adjustable), and

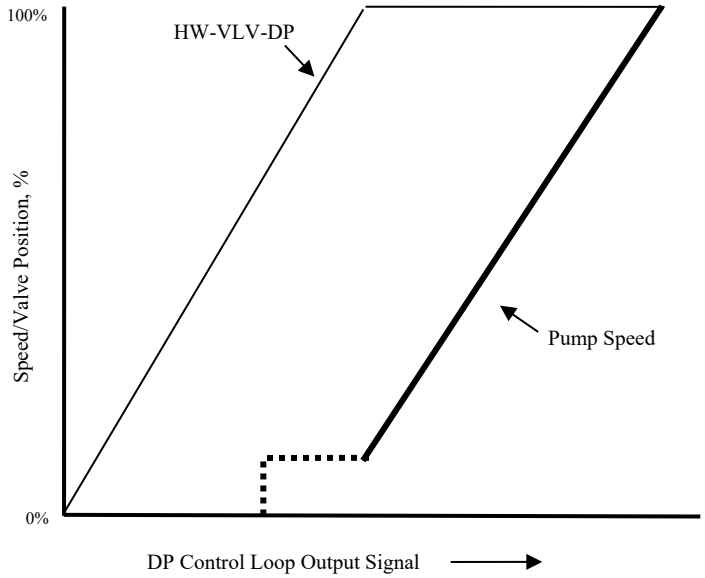
b. OAT<HW-LOT (default to 70F, adjustable)

2. Disable the building HW system when they have been enabled for at least 3 minutes and:

a. Number of Heating Hot-Water Plant Requests ≤ I for 3 minutes, or

b. OAT>HW-LOT + 1°F

C. When the HW system is enabled, the building DP control loop shall be enabled. The loop shall be a reverse-acting loop maintaining the differential pressure (DP) sensor at setpoint. The output of the loop shall range from 0 to 100% and mapped to pump speed and the hot water control valve software point HW-VLV-DP as shown in the figure and described below:



1. Point HW-VLV-DP is mapped from 0% to 100% as the DP loop output ranges from 0% to 50%.

2. Once the valve is wide open (DP loop at 50%), the lead pump shall start and its speed mapped from its minimum speed (see Paragraph 3.1N) to 100% as the DP Loop signal ranges from 50% to 100% as shown in the figure. The lead pump shall stop when the valve is below 50% open and the pump has run for a minimum of 5 minutes.

3. Lag pump shall be staged as a function of HW flow ratio (HWFR = actual flow divided by total plant design flow). When HWFR is above 47% for 10 minutes, start the lag pump. Both pumps shall receive the same speed signal when both are on. When HWFR is below 47% for 15 minutes, or the lead pump is commanded off, shut off the lag pump.

4. Differential pressure setpoint shall be DP-MAX, the design DP setpoint determined under 230593 Testing, Adjusting and Balancing.

D. HW Flow Limit

1. Flow limit setpoint shall be the total pump design flow rate listed on drawings. The limit will ensure that one building does not take more flow than they are entitled to, starving other buildings.

2. When the pumping system is enabled, a proportional-only flow limiting loop shall be enabled to maintain measured flow at the flow limit setpoint. The output of the loop shall be a software point HW-VLV-FL ranging from 0 to 100%.

E. The signal to the HW valve from the central plant shall be the smaller of the signal determined from the pressure control HW-VLV-DP and the flow limiting loop HW-VLV-FL.

F. Alarms

1. Generate a Level 4 maintenance alarm when pump has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.

2. Pump alarm is indicated by the status input being different from the output command for 15 seconds.

a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

3. Low differential pressure, below setpoint by 2 psi for 10 minutes with system enabled for 15 minutes.

3.32 DOMESTIC WATER HEATING PLANT

A. Hot water recirculation pumps shall be lead/lag alternated per Paragraph 3.1P.

B. Recirculation pump shall operate when any AH unit serving the area that includes the toilet rooms served by the recirc pump is in Occupied Mode.

C. Alarms

1. Generate a Level 4 maintenance alarm when pump has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.

2. Pump alarm is indicated by the status input being different from the output command for 15 seconds.

a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

3. Hot water supply temperature less than 110°F when recirculation pump is proven on: Level 2.

4. DHW heater alarm: Level 2

3.33 LABORATORY EXHAUST SYSTEM CONTROL

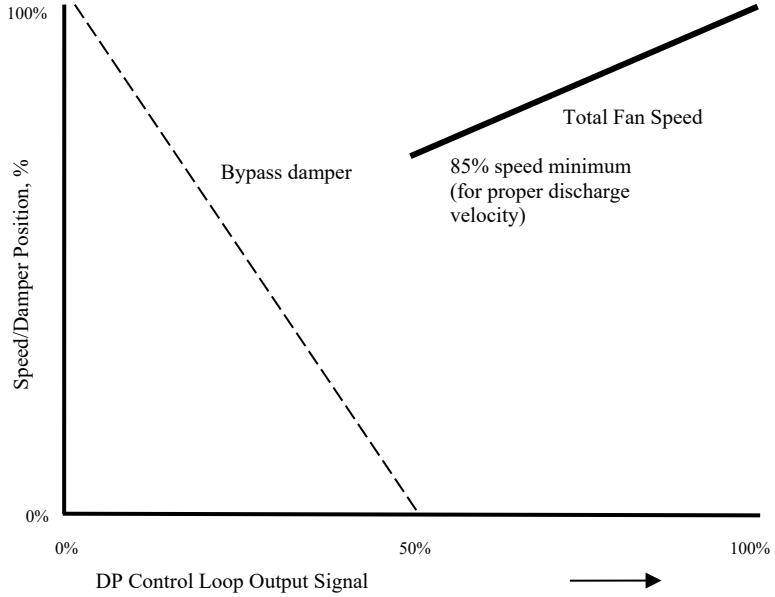
A. Both lab exhaust fans shall run continuously. During normal operation each fan will run at approximately half design airflow.

B. Exhaust Plenum Pressure Control

1. Static pressure setpoint: Setpoint shall be reset using Trim & Respond logic per Guideline 36 with the following parameters:

Variable	Value
Device	Either EF
SP0	-1.0 inches
SPmax	-0.1 inches
SPmin	-2.0 inches
Td	10 minutes
T	2 minutes
I	2
R	Zone Exhaust Static Pressure Reset Requests
SPtrim	+0.05 inches
SPres	-0.06 inches
SPres-max	-0.13 inches

2. A PID loop shall maintain the main DP sensor at setpoint, the output of which shall be mapped to fan speed and bypass damper position as indicated below.



3. Fan speed to each fan shall be equal to Total Fan Speed divided by the number of exhaust fans proven on, e.g. if Total Fan Speed is 80% and both fans are proven on, each runs at 40% speed.

C. Alarms

1. Maintenance interval alarm when fan has operated for more than 2000 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status input being different from the output command for 15 seconds.

    a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

    b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

3. Low static pressure (< 0.2" below setpoint) when fan control loop is active for longer than 5 minutes. Level 2.

3.34 LABORATORY EXHAUST SYSTEM CONTROL

A. Lab exhaust fans shall be lead/lag controlled per Paragraph 3.1P.

B. Lab Exhaust Fan Minimum Stack Airflow

1. Minimum airflow for each enabled lab exhaust fan, EFStackMin, shall vary as a function of wind speed and direction per the table below.

Wind Direction		**Anemometer Wind Speed**														
Min	**Max**	<1	1	2	3	4	5	6	7	8	9	10	11	12	13	14
350	**10**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
10	**30**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
30	**50**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
50	**70**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
70	**90**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
90	**110**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
110	**130**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
130	**150**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
150	**170**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
170	**190**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
190	**210**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
210	**230**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
230	**250**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
250	**270**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
270	**290**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
290	**310**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
310	**330**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
330	**350**	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

2. Wind Measurement by Sonic Anemometer

    a. Anemometer shall report wind speed and direction with minimum frequency of once every 5 seconds.

    b. BAS shall record any error codes received from anemometer.

c. For every one minute of data, calculate the average wind speed (meters per second) and average wind direction (degrees).

1) Average wind speed shall be a straight arithmetic average

2) Average wind direction must account for wind direction passing through zero degrees (i.e., the average of 355° and 5° is 0 degrees, not 180°). Vector averaging is recommended if EMCS supports trigonometry functions. Confirm calculation method with mechanical engineer.

3) Check data quality. If any of the following conditions are met, set "null signal" for average wind speed and direction for this period and discard remaining data for this one minute period.

a) If an error code is received from the anemometer during the one minute period.

b) If the wind speed is greater than 0.0 meters per second AND the difference between minimum and maximum wind speed is less than 0.05 meters per second (adjustable) during the one minute period.

c) If the wind speed is greater than 0.0 meters per second AND the difference between lowest and highest wind direction angles is less than 0.1 degree (adjustable) during the one minute period.

d. Every minute, the BAS shall calculate a rolling average of the last five one-minute wind speed and direction readings. In other words, it shall calculate a rolling five-minute average of the one-minute averages previously computed. Any one-minute periods reporting "null signal" shall be ignored. This rolling average shall be used to set EFStackMin.

e. If "null signal" is recorded for 5 consecutive one-minute periods, EFStackMin shall be set to the maximum value from the table above and a Level 2 alarm shall be generated.

C. Exhaust Fan Staging

1. The lead exhaust fan shall always be enabled.

2. Calculate the current stage total stack airflow, EFAirCurrent, as the sum of stack airflow measurements from enabled fans.

3. Calculate the current sum of airflows from all lab exhaust valves, LabEAFlow.

4. Each stage shall have a 5-minute minimum runtime during which staging shall be inhibited.

5. Stage up if any of the following sets of conditions is satisfied:

a. StageUp1**:** For 10 minutes, all of the following are true:

1) LabEAFlow > 80% of design lab exhaust flow for the current stage.

2) EFAirCurrent / Number of fans operating in next higher stage > EFStackMin*1.2.

3) Lab exhaust plenum bypass damper is 0% open.

b. StageUp2: For 10 minutes, LabEAFlow > 100% of design lab exhaust flow for the current stage.

c. StageUp3**:** For 1 minute, both of the following are true:

1) Exhaust fan speed is >= 99%.

2) Exhaust static pressure is 0.1” above setpoint.

6. Stage down if any of the following sets of conditions is satisfied:

a. StageDown1: If the plant staged up on StageUp1 or StageUp2 and for 10 minutes LabEAFlow < 80% of design lab exhaust flow for the next lower stage.

b. StageDown2: If the plant staged up on StageUp1 or StageUp2 and for 10 minutes both:

1) LabEAFlow < 100% of design lab exhaust flow for the next lower stage

2) Any lab exhaust plenum bypass damper > 10% open.

c. StageDown3: If the plant staged up on StageUp3 and for 10 minutes exhaust fan speed < 50%.

D. Exhaust Plenum Pressure Control

1. Static pressure setpoint: The plenum pressure setpoint is a negative value. Setpoint shall be reset using Trim & Respond logic per Guideline 36 with the following parameters:

Variable	Value
Device	Either EF
SP0	-1.0 inches
SPmax	-0.1 inches
SPmin	EFDPdes
Td	10 minutes
T	2 minutes
I	0
R	Zone Exhaust Static Pressure Reset Requests and Stack Pressure Reset Requests
SPtrim	+0.05 inches
SPres	-0.06 inches

SPres-max	-0.26 inches

a. Design plenum pressure setpoint, EFDPdes, shall be determined under Section 230593 Testing, Adjusting and Balancing. This shall be a negative value.

2. A PID loop shall maintain the exhaust static DP sensor at setpoint, the output of which shall be mapped to fan speed. Control point shall be the higher (less negative) of the two redundant static pressure sensor readings.

E. Stack Minimum Airflow Bypass Dampers

1. Bypass dampers are lead/lag alternated per Paragraph 3.1P.

2. A reverse acting PID loop shall maintain the lowest stack airflow of all enabled fans equal to EFStackMin. Loop output shall be mapped to bypass damper position as follows.

a. From 0% to 50% loop output, open lead bypass damper from fully closed to fully open.

b. From 50% to 100% loop output, open lag bypass damper from fully closed to fully open.

F. Alarms

1. Maintenance interval alarm when fan has operated for more than 2000 hours: Level 4. Reset interval counter when alarm is acknowledged.

2. Fan alarm is indicated by the status input being different from the output command for 15 seconds.

a. Commanded on, status off: Level 2. Do not evaluate alarm until the device has been commanded on for 15 seconds.

b. Commanded off, status on: Level 4. Do not evaluate the alarm until the device has been commanded off for 60 seconds.

3. High static pressure (>0.2” above setpoint) when fan control loop is active for longer than 5 minutes. Level 2.

4. Low stack airflow (10% below setpoint) when stack airflow control loop is active for longer than 5 minutes. Level 2.

5. Wind Station Internal Failure if either the wind sensor’s wind status register indicates the devices is in alarm or the wind sensor’s communication status is in fault. Level 2.

6. Wind Station Wind Speed Measurement Failure – If [wind speed is greater than 0.0 meters per second AND the difference between minimum and maximum wind speed is less than 0.05 meters per second during 5 consecutive one minute periods] OR [wind speed registers 0.0 meters per second for greater than 1 hour continuously]. Level 2.

7. Wind Station Wind Direction Measurement Failure – If the difference between lowest and highest wind direction angles is less than 0.1 degree during 5 consecutive one minute periods. Level 2.

8. Bypass Damper Failure if the bypass dampers are commanded shut but stack airflows are different than the sum of lab exhaust air valves by 20% for 30 minutes continuously. Level 2.

9. Airflow Measurement Station Failure if more than one fan is proven on and the airflow of any fan differs from the average of all fans by 30% for 30 minutes continuously. Level 2.

10. Exhaust Static Pressure Calibration Error if the two sensors disagree by more than 0.3" for more than 30 minutes continuously. Level 3.

G. System Requests

1. Stack Pressure Reset Requests

a. If the measured airflow out of any stack is less than 90% of EFStackMin and the lag bypass damper position is greater than 95% for 1 minute, send 3 Requests,

b. Else, if the measured airflow out of any stack is less than 95% of setpoint while the lag damper position is greater than 95% for 1 minute, send 2 Requests,

c. Else, if the lag bypass damper position is greater than 95%, send 1 Request until the damper position is less than 85%,

d. Else, if the lag bypass damper position is less than 95%, send 0 Requests.

3.35 METERING SUMMARIES

A. Provide metering summary separately for the following metering systems:

1. Electrical power

2. Potable water

3. Recycled water

B. Include all submeters including those mapped from equipment (e.g. VFDs, water treatment system, etc.)

C. Include "virtual meters" where loads are based on subtraction from or addition of other loads including:

1. Electricity

a. All HVAC equipment. Sum of all HVAC equipment meters (including those in VFDs)

b. Lighting loads

1) Each floor B2, L1, L2, L6, and two each on L6 to L18: Subtract plug load submeter from total floor power meter.

2) Sum of all interior lighting loads

3) Sum of all lighting including all exterior and garage lighting

c. Plug loads: Sum of all plug loads

d. UPS: Sum of all meters for UPS equipment.

e. Parking. Sum of all meters for electric vehicle charging.

f. Kitchens. Sum of all meters for kitchens (N1, N7, N8, N18).

2. Water

a. Kitchen. Sum of all water meters for kitchens N1, N7, N8, N18 and sum of all meters for kitchen dishwashers.

b. Irrigation: Sum of all irrigation meters

D. For each metering system:

1. Provide the system 1-line riser diagram on a summary graphic with links to subsections of the system by floor and major system.

2. On each subsection, indicate meter and virtual meter location with a title indicating end-use.

3. Through a hyperlink, show a screen summarizing meter data including:

a. Details of what is being metered

b. Pie chart or other graphical format

c. Summary of power on the following basis:

1) Current

2) Past day

3) Past month

4) Past year and year-to-date

E. Summary dashboards:

1. For both electricity and water

2. Pie chart or other graphical format showing total whole building consumption with a breakdown of the consumption by end-use, including the percentage of the total.

3.36 EQUIPMENT NOT CONTROLLED OR MONITORED BY BAS SYSTEM

A. Equipment Room Transfer Fans

1. Set setpoint to energize fan when space temperature rises above 85°F with 2°F differential.

B. Elevator Shaft Vent

1. Set setpoint to open vent damper when space temperature rises above 90°F with 2°F differential.

C. Elevator Room AC units

1. Set cooling setpoint to energize cooling when space temperature rises above 85°F with 2°F differential.

2. Set heating setpoint to energize heater when space temperature falls below 50°F with 2°F differential.

D. Chiller Room Exhaust Fan

1. Fan is enabled by emergency wall switch, wind-up timer switch or refrigerant monitor.

3.37 MISCELLANEOUS ALARMS

A. High water level or oil in sumps: Level 2

B. Points in Hand (Operator Override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output: Level 4

C. Fire alarm (via contact from Division 26 fire alarm system): Level 1

D. Fire alarm trouble (via contact from Division 26 fire alarm system): Level 2

E. Equipment alarm (for equipment with alarm contacts such as VFDs, AC units): Level 2

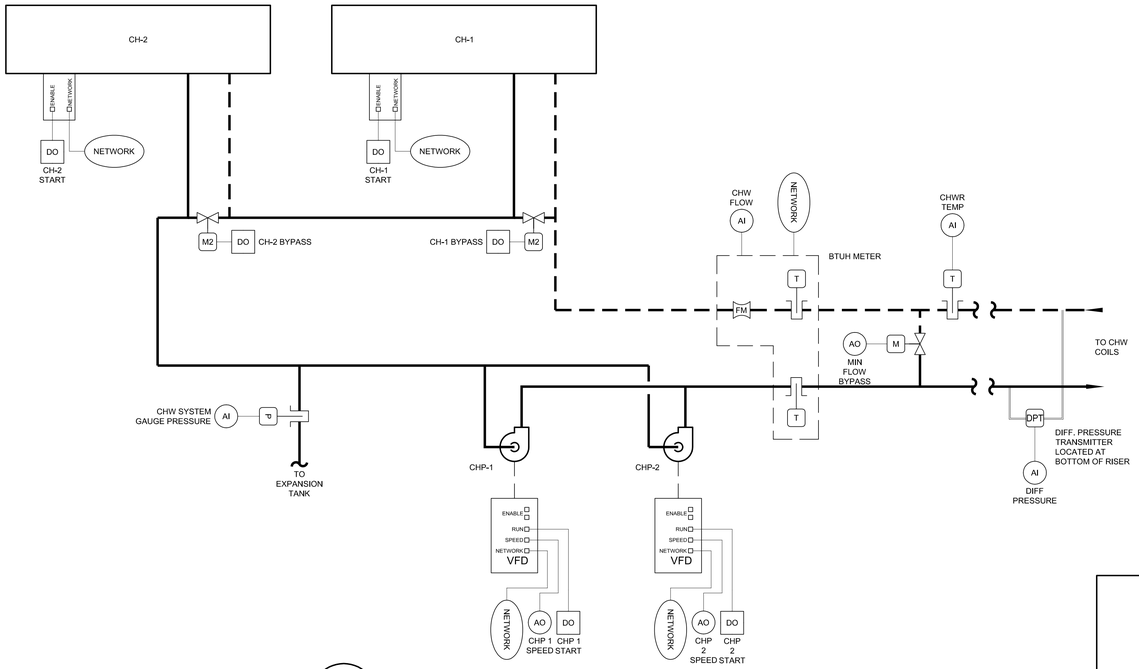
F. Failure or disconnection of a sensor as indicated by signal widely out of range: Level 2.

G. Panel or LAN failure: Level 2

H. Loss of communication with any device via Gateway (e.g. VFD) for more than 30 seconds: Level 2 (alarm shall indicate which specific device is not responding).

I. Electrical switchgear alarm (from Electrical Power System gateway): Level 2

END OF SECTION 259000



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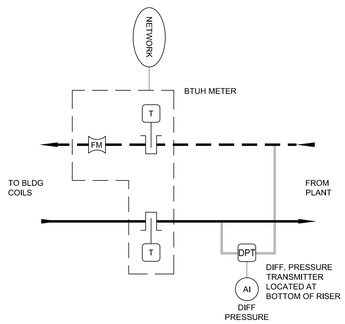
SERIES AIR-COOLED CHW SYSTEM SCHEMATIC

NO SCALE



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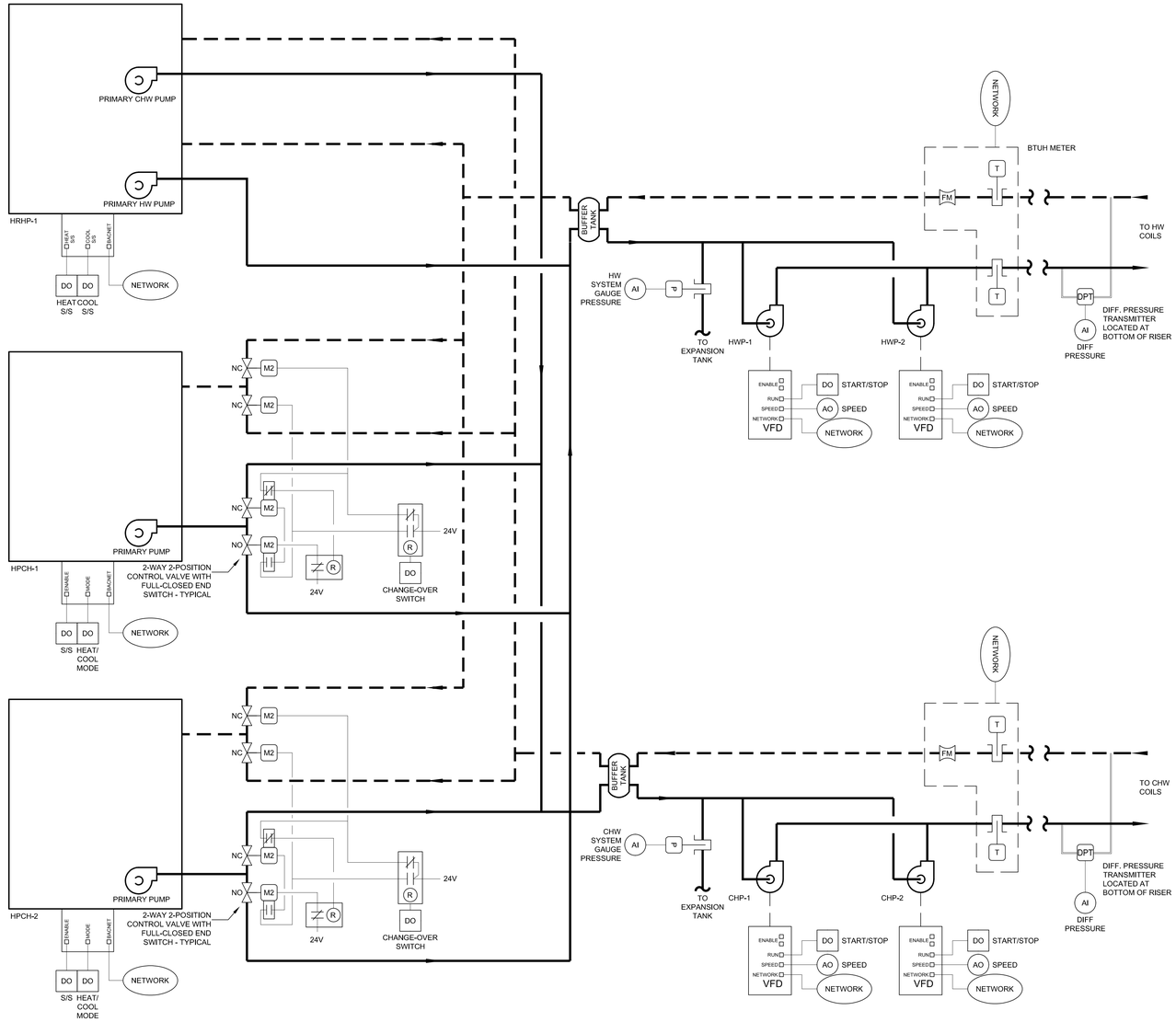
BLDG CENTRAL PLANT CONNECTION

NO SCALE



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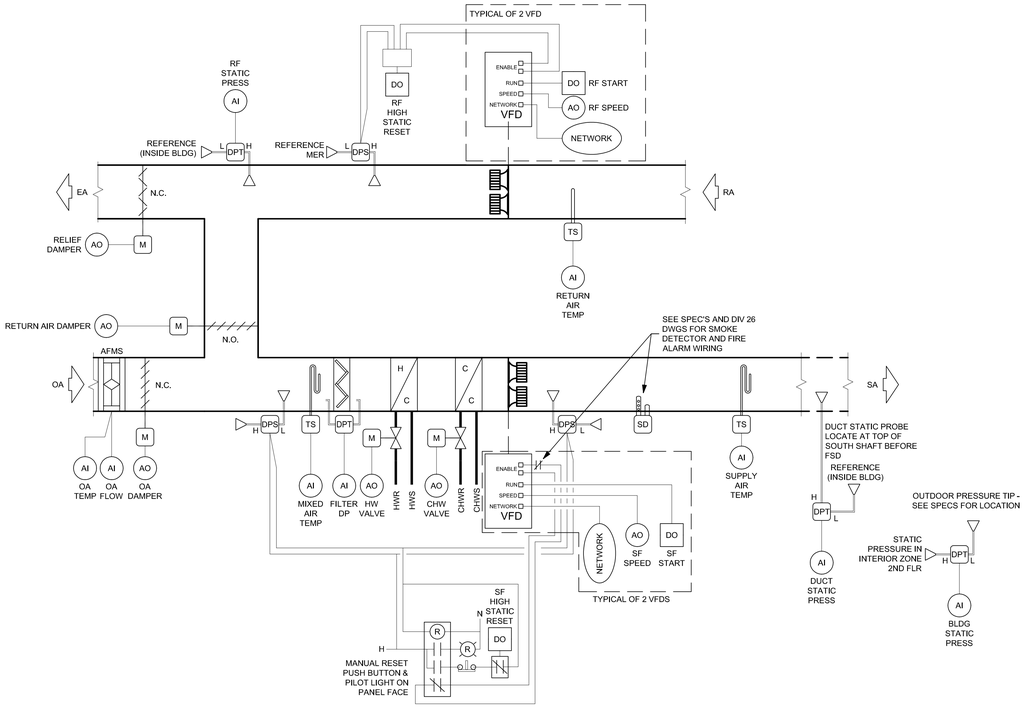
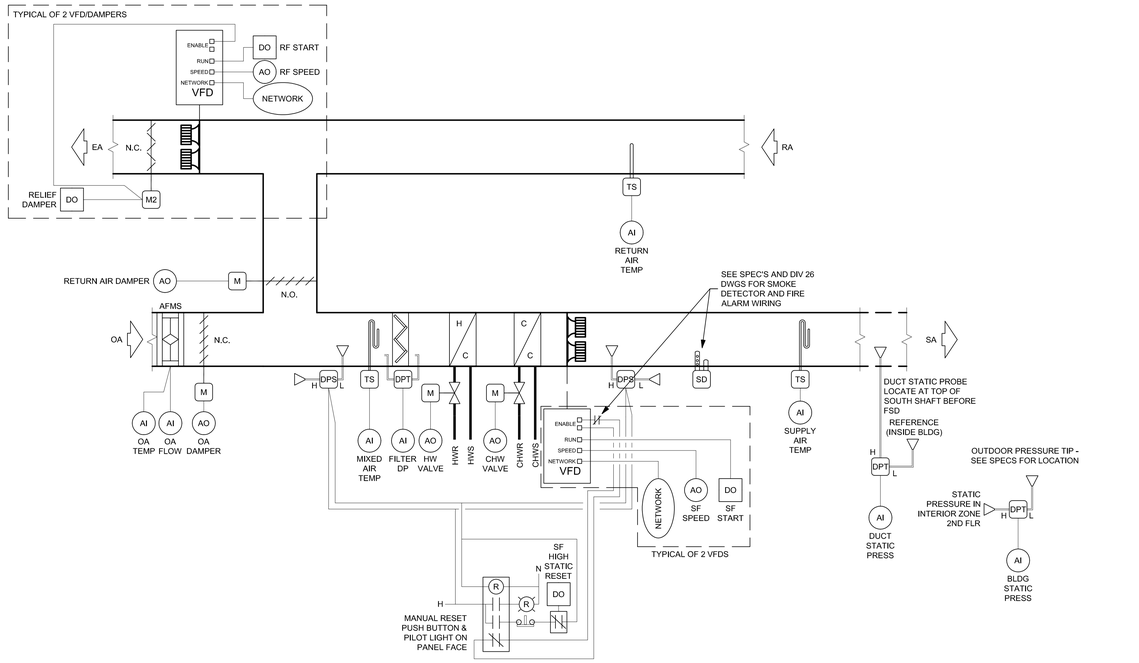
2-PIPE AND 4-PIPE AIR-SOURCE HEAT PUMP/CHW SYSTEM SCHEMATIC

NO SCALE



X / - VAV AIR HANDLER WITH RETURN FAN

NO SCALE



X / - VAV AIR HANDLER WITH RELIEF FAN

NO SCALE

X / - SPLIT AC UNIT OR HEAT PUMP W/BACNET

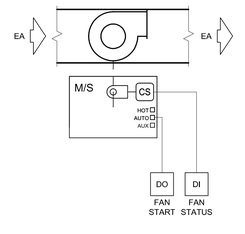
NO SCALE

X / - PACKAGED AC UNIT OR HEAT PUMP CONTROL DIAGRAM

NO SCALE

X / - PACKAGED VAV UNIT WITH BACNET

NO SCALE



X / - EXHAUST FAN CONTROL DIAGRAM

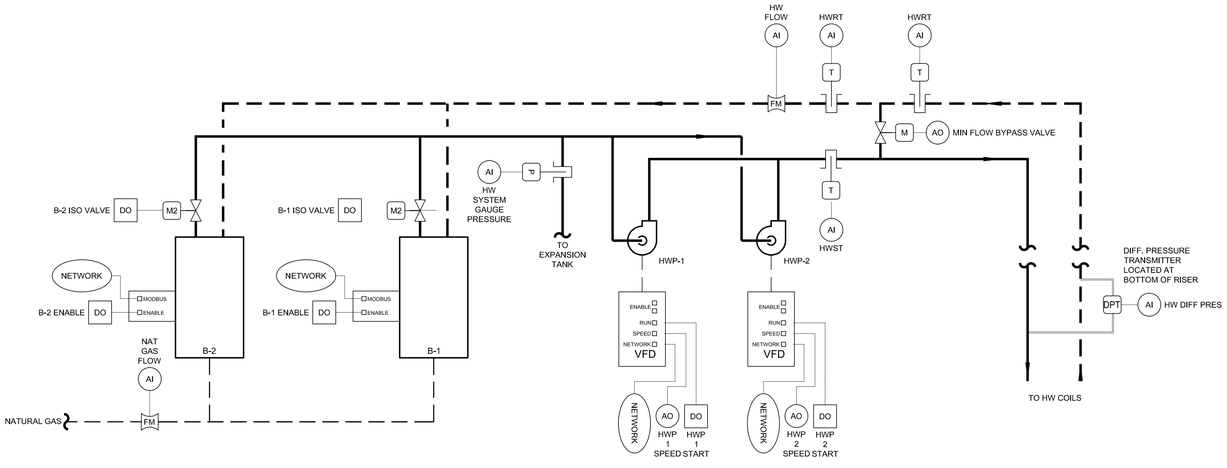
NO SCALE

X / - DEDICATED OA VAV AIR HANDLER

NO SCALE

X / - VAV SINGLE ZONE AIR HANDLER

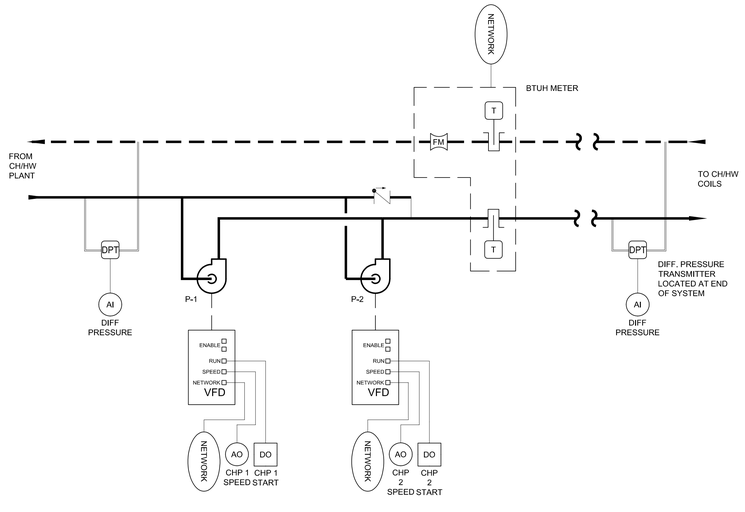
NO SCALE



X
-

HW SYSTEM SCHEMATIC

NO SCALE



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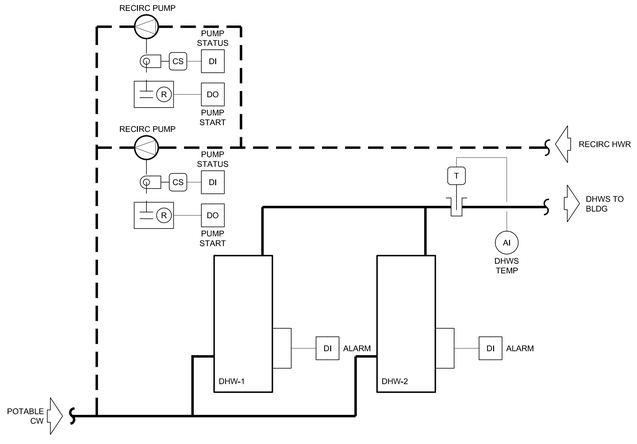
CENTRAL PLANT BLDG CONNECTION CONTROL DIAGRAM

NO SCALE



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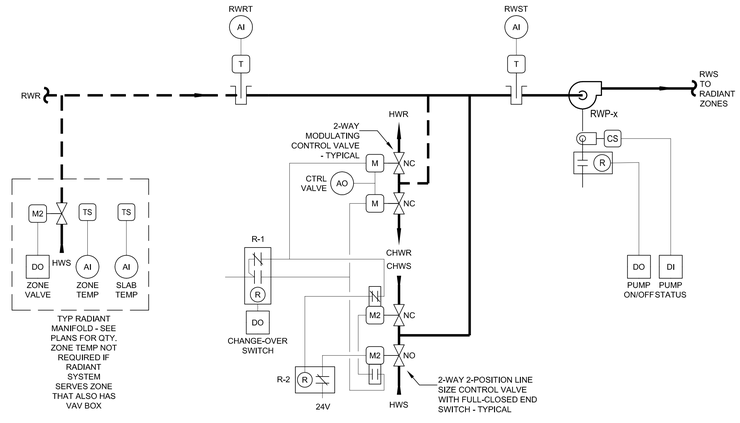
DHW SYSTEM SCHEMATIC

NO SCALE



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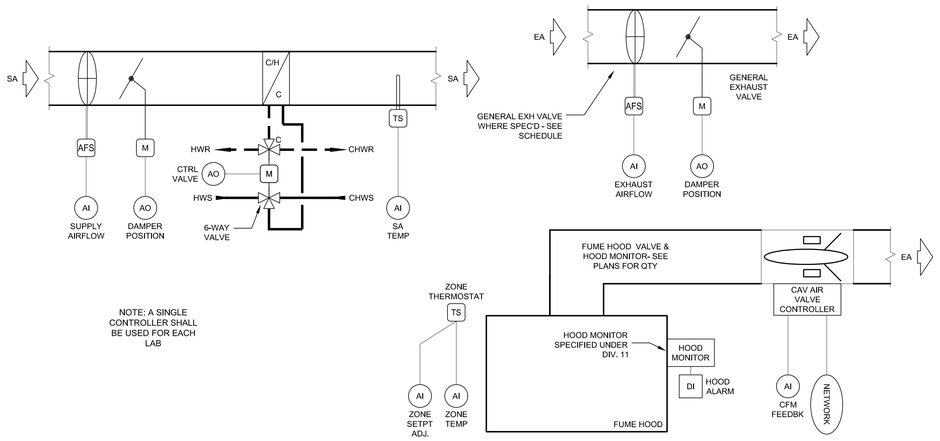
RADIANT HEAT/COOL SYSTEM

NO SCALE



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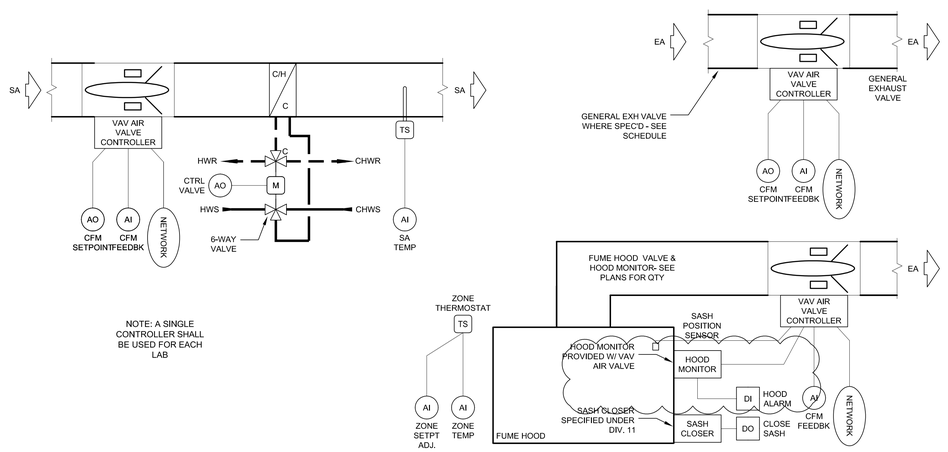
"SLOW" LAB ZONE CONTROL DIAGRAM

NO SCALE



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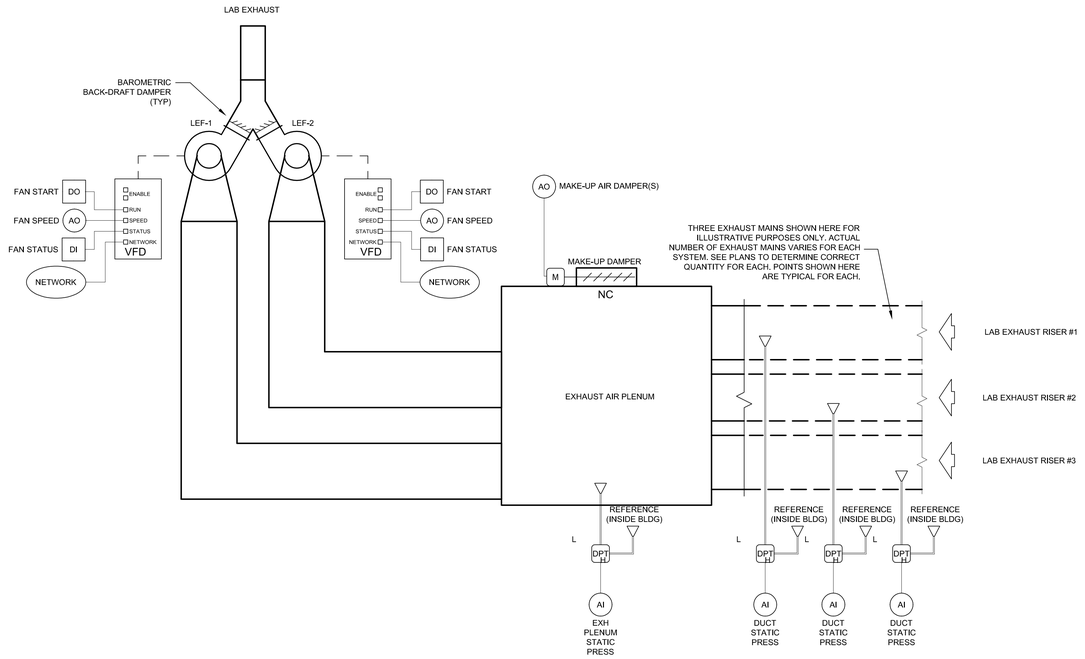
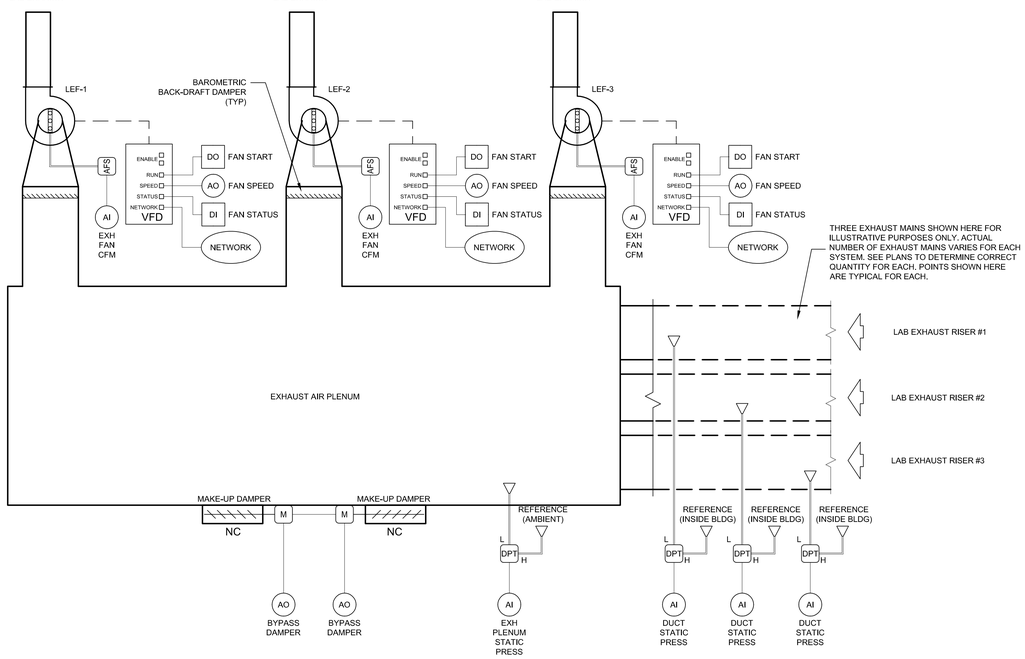
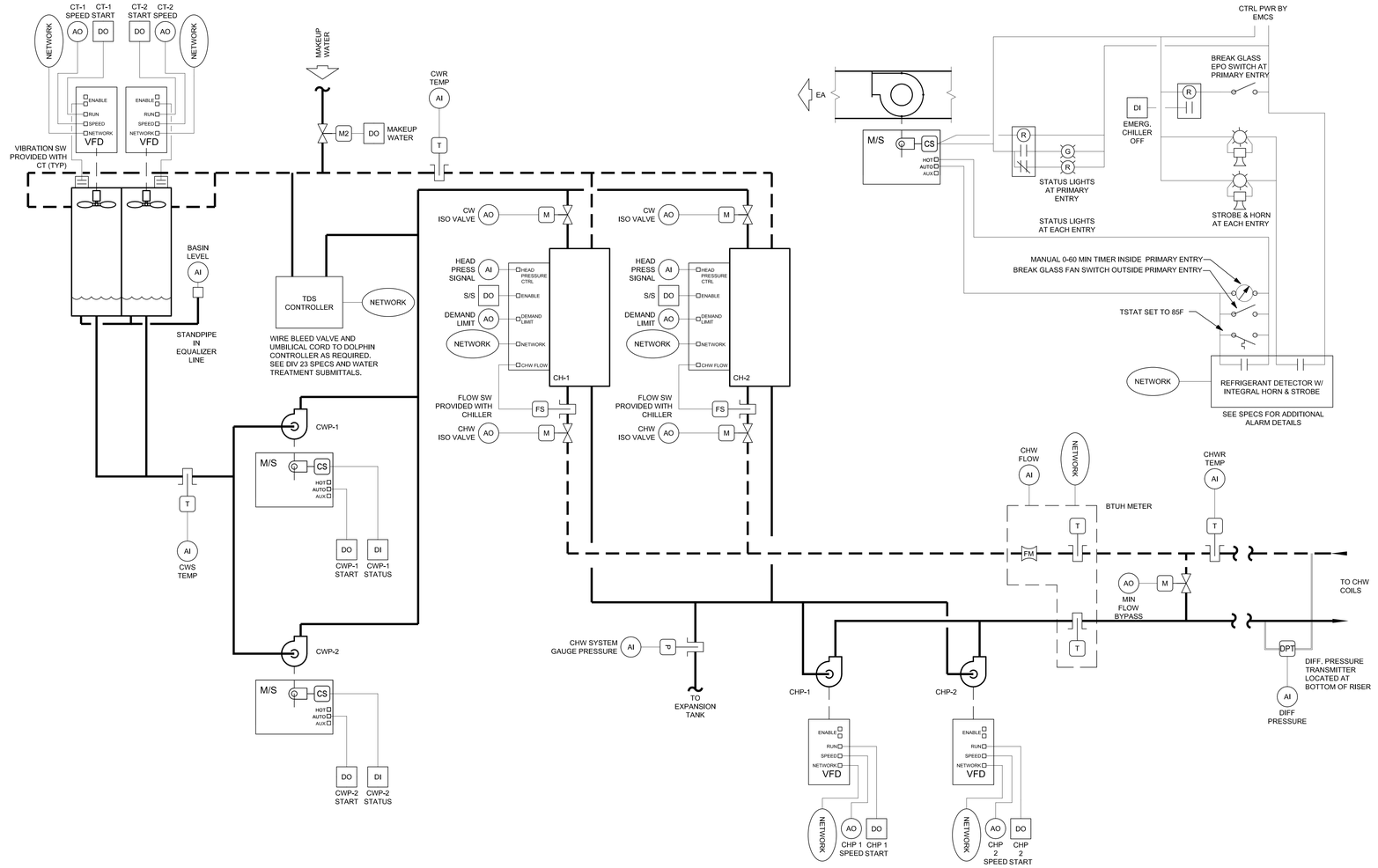
"FAST" LAB ZONE CONTROL DIAGRAM

NO SCALE







X
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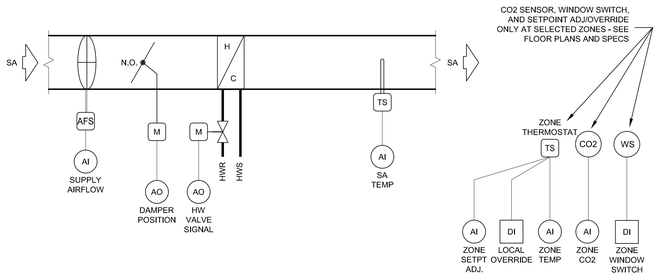
WATER-COOLED CHW SYSTEM SCHEMATIC

NO SCALE



X
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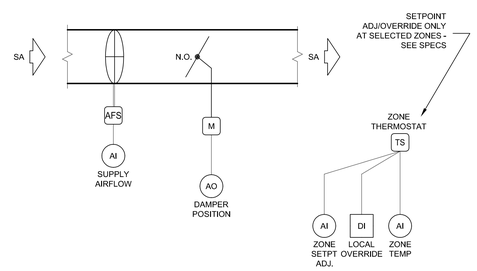
VAV RH ZONE CONTROL DIAGRAM

NO SCALE



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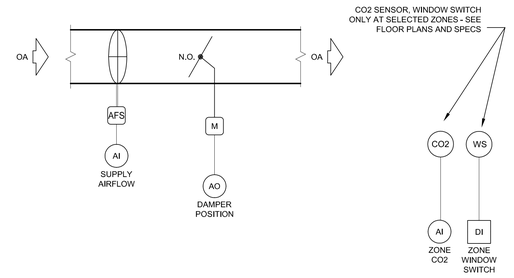
-

VAV COOLING ONLY ZONE CONTROL DIAGRAM

NO SCALE



X
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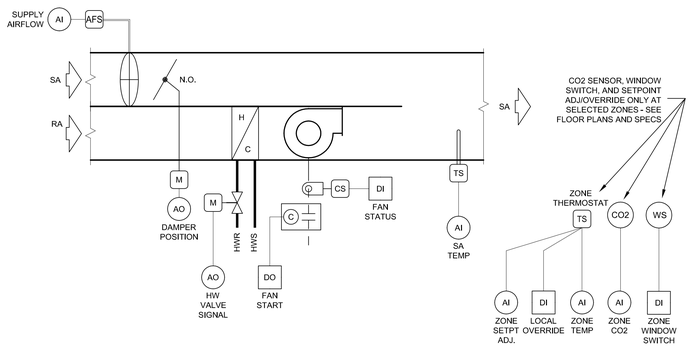
VENTILATION ZONE CONTROL DIAGRAM

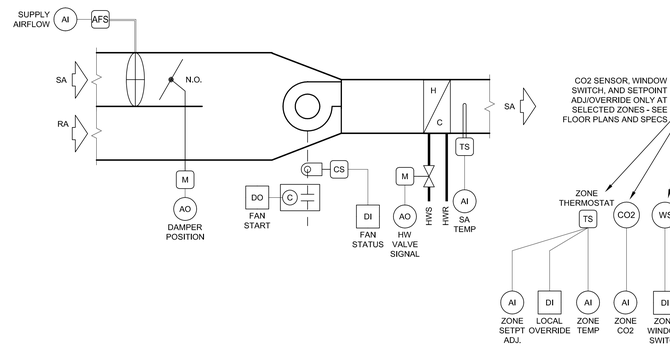
NO SCALE



X
-

VAV PARALLEL FAN POWERED ZONE CONTROL DIAGRAM

NO SCALE



X
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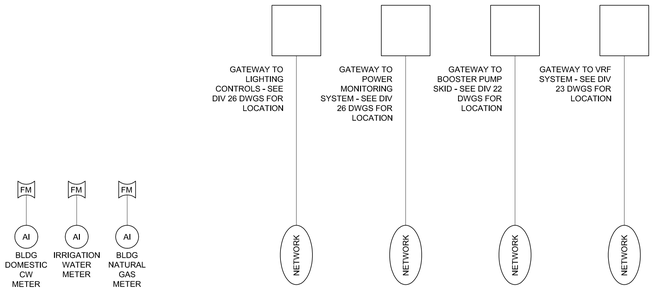
VAV SERIES FAN POWERED ZONE CONTROL DIAGRAM

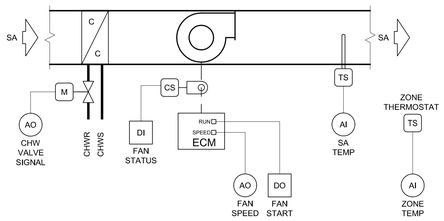
NO SCALE



X
-

MISCELLANEOUS POINTS

NO SCALE



X
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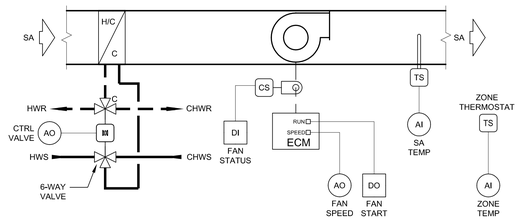
2-PIPE VARIABLE SPEED FAN COIL

NO SCALE



X
-

4-PIPE VARIABLE SPEED FAN COIL

NO SCALE

4CD Standard Graphic Screens

Notes:
The blue text is displayed but not editable.
The cyan text is editable (with the right security).
The underlined blue text are hyperlinks.

The graphic screens are meant to indicate the information required and a general layout. Modifications, such as color changes, and using 3D images of components are acceptable provided all requested information is shown

xx.x °F
xx %RH

Zone Group

Mode Occupied

VR x-xx

Serves Rooms xxxx, xxxx, xxxx

Control Sequences
O&M Manuals

Notes

Supply Air

AHU-x-x

SAT xx.x °F
DSP xx.x in.wg
Mode Occupied

Airflow

Actual xxx CFM
Setpoint xxx CFM
% of Max xxx %
Cool Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

Damper

Position xxx %open
SP Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

RH Coil

Position xxx %
HW Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

Discharge Temp

Actual xx.x °F
Setpoint xx.x °F

Boiler Plant

HWST xxx °F
Status ON

Zone

Zone State Cooling
Temp Loop Output xxx %
Cooling Setpoint xx.x °F
Heating Setpoint xx.x °F
Local setpoint adjust +x.x °F
Local override Off
CO2 xxx ppm
CO2 Setpoint xxx ppm
CO2 Loop Output xxx %
Occupancy Status Occupied
Window switch Closed

Setpoints

	Design	Operator Adjusted	
Max Cooling Airflow	xxx	xxx	CFM
Max Heating Airflow	xxx	xxx	CFM
Minimum Airflow	Auto	Auto	
Ventilation Area Airflow	xxx	xxx	CFM
Ventilation Occupant Airflow	xxx	xxx	CFM
Max Disch Temp	95.0	xx.x	°F
Occupied Cooling	75.0	xx.x	°F
Unoccupied Cooling	90.0	xx.x	°F
Occupied Heating	70.0	xx.x	°F
Unoccupied Heating	60.0	xx.x	°F
Cool Demand Limit 1	1.0	xx.x	°F
Cool Demand Limit 2	2.0	xx.x	°F
Cool Demand Limit 3	4.0	xx.x	°F
Heat Demand Limit 1	1.0	xx.x	°F
Heat Demand Limit 2	2.0	xx.x	°F
Heat Demand Limit 3	4.0	xx.x	°F
CO2	1000	xxx	ppm

Ventilation

	Current	
Unoccupied Minimum OA	xxx	CFM
Occupied Minimum OA	xxx	CFM
Active Minimum Airflow	xxx	CFM
Controllable Minimum Airflow	xxx	CFM
Time Averaged Ventilation	Active	
Ventilation Cycle Time	xx	Minutes
Open Period	xx	Minutes
Closed Period	xx	Minutes

24 Hr Trend Room Temp

Alarms

	Level
High Temp	Off
Low Temp	3
Low Airflow	Off
Low Disch Air Temp	3
Airflow Calibration	Off
Leaking Damper	Off
Leaking Valve	Off
High CO2	Off
CO2 Calibration	Off

xx.x °F
xx %RH

Zone Group

Mode Occupied

VC x-xx

Serves Rooms xxxx, xxxx, xxxx

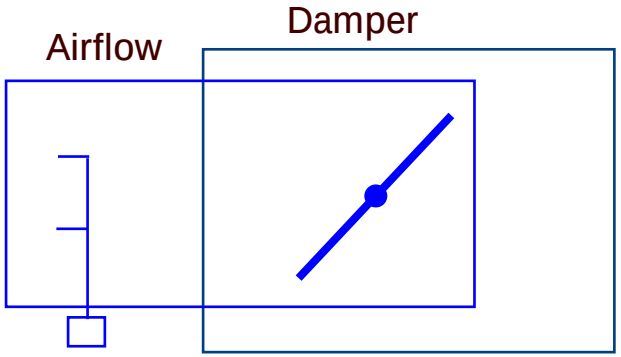
Control Sequences
O&M Manuals

Notes

Supply Air

AHU-x-x

SAT xx.x °F
DSP xx.x in.wg
Mode Occupied



Actual	xxx CFM	Position	xxx %open
Setpoint	xxx CFM	SP Reset Requests	x
% of Max	xxx %	%Request-hrs	xxx %
Cool Reset Requests	x	Importance Multiplier	x
%Request-hrs	xxx %		
Importance Multiplier	x		

Zone

Zone State	Cooling
Temp Loop Output	xxx %
Cooling Setpoint	xx.x °F
Heating Setpoint	xx.x °F
Local setpoint adjust	+x.x °F
Local override	Off
CO2	xxx ppm
CO2 Setpoint	xxx ppm
CO2 Loop Output	xxx %
Occupancy Status	Occupied
Window switch	Closed

Setpoints

	Design	Operator Adjusted	
Max Cooling Airflow	xxx	xxx	CFM
Minimum Airflow	Auto	Auto	
Ventilation Area Airflow	xxx	xxx	CFM
Ventilation Occupant Airflow	xxx	xx.x	CFM
Occupied Cooling	75.0	xx.x	°F
Unoccupied Cooling	90.0	xx.x	°F
Occupied Heating	70.0	xx.x	°F
Unoccupied Heating	60.0	xx.x	°F
Cool Demand Limit 1	1.0	xx.x	°F
Cool Demand Limit 2	2.0	xx.x	°F
Cool Demand Limit 3	4.0	xx.x	°F
Heat Demand Limit 1	1.0	xx.x	°F
Heat Demand Limit 2	2.0	xx.x	°F
Heat Demand Limit 3	4.0	xx.x	°F
CO2	1000	xxx	ppm

Ventilation

	Current	
Unoccupied Minimum OA	xxx	CFM
Occupied Minimum OA	xxx	CFM
Active Minimum Airflow	xxx	CFM
Controllable Minimum Airflow	xxx	CFM
Time Averaged Ventilation	Active	
Ventilation Cycle Time	xx	Minutes
Open Period	xx	Minutes
Closed Period	xx	Minutes

Alarms

	Level
Low Airflow	Off
Airflow Calibration	Off
Leaking Damper	Off
High CO2	Off
CO2 Calibration	Off

24 Hr Trend Room Temp

xx.x °F
xx %RH

VAV Zone Summary

Zone Group

Mode Occupied

AHU-x-x

SAT xx.x °F
DSP xx.x in.wg
Mode Occupied

Boiler Plant

HWST xxx °F
Status ON

Chiller Plant

CHWST xxx °F
Status ON

Zone		Zone Temperature			Airflow			Discharge Air			CO2			Cool Reset Requests			Static Pressure Reset Requests			HWST Reset Requests		
Tag	State	Actual °F	Heat Setpoint °F	Cool Setpoint °F	Actual CFM	Setpoint CFM	Damper %open	Temp °F	Setpoint °F	HW Valve %open	Actual PPM	Setpoint PPM	Loop Output %	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier
VR-2012	Heating	70	70	75	200	220	15	93	95	90	500	1000	0	0	21	1	0	14	1	1	30	1
VC-2013	Cooling	75	70	75	200	220	15							0	21	1	0	14	1			

4CD Standard Graphic Screens

Notes:
The blue text is displayed but not editable.
The cyan text is editable (with the right security).
The underlined blue text are hyperlinks.

The graphic screens are meant to indicate the information required and a general layout. Modifications, such as color changes, and using 3D images of components are acceptable provided all requested information is shown

xx.x °F
xx %RH

Zone Group

Mode Occupied

VR x-xx

Serves Rooms xxxx, xxxx, xxxx

Control Sequences
O&M Manuals

Notes

Supply Air

AHU-x-x

SAT xx.x °F
DSP xx.x in.wg
Mode Occupied

Airflow

Actual xxx CFM
Setpoint xxx CFM
% of Max xxx %
Cool Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

Damper

Position xxx %open
SP Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

RH Coil

Position xxx %
HW Reset Requests x
%Request-hrs xxx %
Importance Multiplier x

Discharge Temp

Actual xx.x °F
Setpoint xx.x °F

Boiler Plant

HWST xxx °F
Status ON

Zone

Zone State Cooling
Temp Loop Output xxx %
Cooling Setpoint xx.x °F
Heating Setpoint xx.x °F
Local setpoint adjust +x.x °F
Local override Off
CO2 xxx ppm
CO2 Setpoint xxx ppm
CO2 Loop Output xxx %
Occupancy Status Occupied
Window switch Closed

Setpoints

	Design	Operator Adjusted	
Max Cooling Airflow	xxx	xxx	CFM
Max Heating Airflow	xxx	xxx	CFM
Minimum Airflow	Auto	Auto	
Ventilation Area Airflow	xxx	xxx	CFM
Ventilation Occupant Airflow	xxx	xxx	CFM
Max Disch Temp	95.0	xx.x	°F
Occupied Cooling	75.0	xx.x	°F
Unoccupied Cooling	90.0	xx.x	°F
Occupied Heating	70.0	xx.x	°F
Unoccupied Heating	60.0	xx.x	°F
Cool Demand Limit 1	1.0	xx.x	°F
Cool Demand Limit 2	2.0	xx.x	°F
Cool Demand Limit 3	4.0	xx.x	°F
Heat Demand Limit 1	1.0	xx.x	°F
Heat Demand Limit 2	2.0	xx.x	°F
Heat Demand Limit 3	4.0	xx.x	°F
CO2	1000	xxx	ppm

Ventilation

	Current	
Unoccupied Minimum OA	xxx	CFM
Occupied Minimum OA	xxx	CFM
Active Minimum Airflow	xxx	CFM
Controllable Minimum Airflow	xxx	CFM
Time Averaged Ventilation	Active	
Ventilation Cycle Time	xx	Minutes
Open Period	xx	Minutes
Closed Period	xx	Minutes

24 Hr Trend Room Temp

Alarms

	Level
High Temp	Off
Low Temp	3
Low Airflow	Off
Low Disch Air Temp	3
Airflow Calibration	Off
Leaking Damper	Off
Leaking Valve	Off
High CO2	Off
CO2 Calibration	Off

xx.x °F
xx %RH

Zone Group

Mode Occupied

VC x-xx

Serves Rooms xxxx, xxxx, xxxx

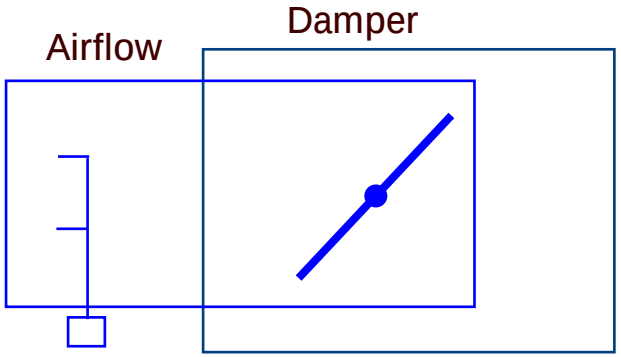
Control Sequences
O&M Manuals

Notes

Supply Air

AHU-x-x

SAT xx.x °F
DSP xx.x in.wg
Mode Occupied



Actual	xxx CFM	Position	xxx %open
Setpoint	xxx CFM	SP Reset Requests	x
% of Max	xxx %	%Request-hrs	xxx %
Cool Reset Requests	x	Importance Multiplier	x
%Request-hrs	xxx %		
Importance Multiplier	x		

Zone

Zone State	Cooling
Temp Loop Output	xxx %
Cooling Setpoint	xx.x °F
Heating Setpoint	xx.x °F
Local setpoint adjust	+x.x °F
Local override	Off
CO2	xxx ppm
CO2 Setpoint	xxx ppm
CO2 Loop Output	xxx %
Occupancy Status	Occupied
Window switch	Closed

Setpoints

	Design	Operator Adjusted	
Max Cooling Airflow	xxx	xxx	CFM
Minimum Airflow	Auto	Auto	
Ventilation Area Airflow	xxx	xxx	CFM
Ventilation Occupant Airflow	xxx	xx.x	CFM
Occupied Cooling	75.0	xx.x	°F
Unoccupied Cooling	90.0	xx.x	°F
Occupied Heating	70.0	xx.x	°F
Unoccupied Heating	60.0	xx.x	°F
Cool Demand Limit 1	1.0	xx.x	°F
Cool Demand Limit 2	2.0	xx.x	°F
Cool Demand Limit 3	4.0	xx.x	°F
Heat Demand Limit 1	1.0	xx.x	°F
Heat Demand Limit 2	2.0	xx.x	°F
Heat Demand Limit 3	4.0	xx.x	°F
CO2	1000	xxx	ppm

Ventilation

	Current	
Unoccupied Minimum OA	xxx	CFM
Occupied Minimum OA	xxx	CFM
Active Minimum Airflow	xxx	CFM
Controllable Minimum Airflow	xxx	CFM
Time Averaged Ventilation	Active	
Ventilation Cycle Time	xx	Minutes
Open Period	xx	Minutes
Closed Period	xx	Minutes

Alarms

	Level
Low Airflow	Off
Airflow Calibration	Off
Leaking Damper	Off
High CO2	Off
CO2 Calibration	Off

24 Hr Trend Room Temp

xx.x °F
xx %RH

Schedule

Zone Group Summary

Zone Group Name 1st Floor
Mode Occupied

AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied
Alarm OK

Heating Plant
HWST xxx °F
Status ON
Alarm OK

Chiller Plant
CHWST xxx °F
Status ON
Alarm OK

Mode Requests

Occupied xxx
Warmup xxx
Cooldown xxx
Setback xxx
Freeze Setback xxx

System/Plant Requests

Cooling SAT Reset xxx
Duct SP Reset xxx
HW Plant xxx
HWST Reset xxx
Min OA CFM xxx
Max CO2 DCV xxx

Total Airflow

Airflow Setpoints xxx cfm
Actual Airflow xxx cfm
Occupant OA xxx cfm
Area OA xxx cfm

Zone Alarms

High Temp xxx
Low Temp xxx
High CO2 xxx
CO2 Calibration xxx
Low Airflow xxx
Airflow Calibration xxx
Leaking Damper xxx
Rogue Cooling xxx
Rogue DSP xxx
Rogue HWST xxx

Zone		Zone Temperature			Airflow			Discharge Air			CO2			Cool Reset Requests			Static Pressure Reset Requests			HWST Reset Requests		
Tag	State	Actual °F	Heat Setpoint °F	Cool Setpoint °F	Actual CFM	Setpoint CFM	Damper %open	Temp °F	Setpoint °F	HW Valve %open	Actual PPM	Setpoint PPM	Loop Output %	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier
VR-2012	Heating	70	70	75	200	220	15	93	95	90	500	1000	0	0	21	1	0	14	1	1	30	1
VC-2013	Cooling	75	70	75	200	220	15							0	21	1	0	14	1			

xx.x °F
xx %RH

Schedule

Zone Group Summary

Zone Group Name 1st Floor
Mode Occupied

AHU-x-x
SAT xx.x °F
DSP xx.x in.wg
Mode Occupied
Alarm OK

Heating Plant
HWST xxx °F
Status ON
Alarm OK

Chiller Plant
CHWST xxx °F
Status ON
Alarm OK

Mode Requests

Occupied xxx
Warmup xxx
Cooldown xxx
Setback xxx
Freeze Setback xxx

System/Plant Requests

Cooling SAT Reset xxx
Duct SP Reset xxx
HW Plant xxx
HWST Reset xxx
Min OA CFM xxx
Max CO2 DCV xxx

Total Airflow

Airflow Setpoints xxx cfm
Actual Airflow xxx cfm
Occupant OA xxx cfm
Area OA xxx cfm

Zone Alarms

High Temp xxx
Low Temp xxx
High CO2 xxx
CO2 Calibration xxx
Low Airflow xxx
Airflow Calibration xxx
Leaking Damper xxx
Rogue Cooling xxx
Rogue DSP xxx
Rogue HWST xxx

Zone		Zone Temperature			Airflow			Discharge Air			CO2			Cool Reset Requests			Static Pressure Reset Requests			HWST Reset Requests		
Tag	State	Actual °F	Heat Setpoint °F	Cool Setpoint °F	Actual CFM	Setpoint CFM	Damper %open	Temp °F	Setpoint °F	HW Valve %open	Actual PPM	Setpoint PPM	Loop Output %	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier	Requests	%-Req-hrs	Importance Multiplier
VR-2012	Heating	70	70	75	200	220	15	93	95	90	500	1000	0	0	21	1	0	14	1	1	30	1
VC-2013	Cooling	75	70	75	200	220	15							0	21	1	0	14	1			

Draft by WCD for 4CD in December 2021
Finalized by 4CD 2023
Revision # 3.0

ARCHITECTURAL DESIGN GUIDE

FOR INFORMATION TECHNOLOGY INFRASTRUCTURE

This document's objective is to provide Architects and other designers with a design-requirements and guidelines document that will help them plan the information technology infrastructure for new building and renovation projects. The scope of this design guide includes the information technology infrastructure that will support the data network, wireless network, voice, classroom notification, coaxial TVs, cameras, and building automation services.

This design guide is produced by the Contra Costa Community College District (4CD) Information Technology Team (Hereafter called District IT) and reflects the District IT requirements and guidelines. This guide is not to be regarded as a project specifications document. It does not address the specific detail that telecommunication infrastructure design requires for any given building or type of building. It defines the design issues that must be addressed when planning telecommunication infrastructure for any building project and articulates the basic requirements/guidelines that should be adhered to.

The coordination of the requirements of this document with the specifications and drawing sets of the Telecommunications, Electronic Safety and Security, Architectural, Electrical, Mechanical, and Civil Engineering design disciplines at the Schematic Design phase of project development is vital for control of change orders and greatly facilitates smooth, cooperative interaction in Design Development and Construction Document phases of the project. Examples:

- Telecommunication room wall cover and floor finish (plywood, painting, sealing, tile placement) requirement information. This could be in Architectural or Division 27 - Communications document set. It is usually located in Architectural.

- Telecommunications Grounding and Bonding System requirements. This must be part of Division 26 - Electrical document set.

- Inside plant cable pathway requirements. This is often split between Division 26 - Electrical, Division 27 - Communications, and Division 28 - Electronic Safety and Security document sets. Splitting the design is OK but needs to be clearly defined as early as possible in the project planning phase.

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Acronyms and glossary used in this document:

AHJ	= Authority Having Jurisdiction
BDF	= Building Distribution Frame TR where the outside plant enters the building
BMS	= Building Management System
Drop	= A wall plate with data cables terminated in it (District IT average is 3 cables per drop)
ISP	= Inside Plant
IDF	= Intermediate Distribution Frame, a TR within a building connected to the BDF
Jack	= The individual outlet connector where a data, voice, or coaxial cable is terminated
MH	= Maintenance Hole in the outside plant conduit system
MPOE/MDF	= Minimum Point of Entry or Main Distribution Frame, the campus core TR that houses the main campus core systems
MTGB	= Main Telecommunications Grounding Busbar
OSP	= Outside Plant
TGB	= Telecommunications Grounding Busbar
TR	= Telecommunication Room, and MPOE/MDF, BDF, or IDF that houses networking equipment
WA	= Work Area

1. 4CD Contact

1.1. As the engineering and design progresses, there may be questions regarding specific or unique infrastructure applications. No deviation from the guidelines listed in this document are allowed unless such deviation is approved by District IT and documented.

1.1.1. Contact the District It Network Technology Manager at 925-229-6899 to determine who has been assigned to your project.

1.2. The term “4CD” is intended to include all facilities owned, rented or leased that comprise the Contra Costa Community College District, its District Office (DO), Main campuses (Contra Costa College, Diablo Valley College, and Los Medanos College), Satellite campuses (Brentwood and San Ramon), and their environs.

2. Codes, Definitions, and Uses.

2.1. California Administrative Code. Determine and conform to the Code of Record as applies to the Project, including but not limited to the applicable portions of the California Administrative Code, Title 24 documents.

2.2. Cal-OSHA. Designs to provide workspaces for District staff, students and service contractors that conform with the applicable requirements of the State of California Department of Industrial Relations, Division of Occupational Safety and Health (DOSH), also known as Cal/OSHA and Federal OSHA.

2.3. Standards. The following standards must be incorporated into the engineering, design, and installation of all District infrastructure systems.

2.3.1. ANSI (American National Standards Institute)
2.3.2. ANSI/EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310-D).
2.3.3. ANSI/TIA-568-C.1, C.2 and C.3 Commercial Building Telecommunications Cabling Standard, 2009.
2.3.4. ANSI/TIA-569-D (2015) Telecommunications Pathways and Spaces.
2.3.5. ANSI/TIA-606-B-2012, Administration Standard Telecommunications Infrastructure.
2.3.6. ANSI-J-STD-607-C, (2015) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
2.3.7. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.

2.4. ASTM (American Society for Testing and Materials)

2.5. BICSI Telecommunications Distribution Methods Manual – Latest edition.

2.6. BICSI - Outside Plant Design Reference Manual (OSPDRM) – Latest edition.

2.7. BICSI - Wireless Design Reference Manual (WDRM) - 3rd edition.

2.8. ICEA (Insulated Cable Engineers Association)

2.9. IEEE (Institute of Electrical and Electronic Engineers)

2.10. IEEE 100: The Authoritative Dictionary of IEEE Standards.

2.11. ISO: ISO/IEC 11801 Information Technology — Generic Cabling for Customer Premises.

2.12. National Electrical Manufacturers Association (NEMA)

3. Telecommunications Outside Plant Pathway

Campus Outside Plant (OSP) Environments: Construction involving a new or existing building structure shall have an assessment of the OSP pathway connectivity infrastructure, (i.e., connections between buildings) which should be accomplished very early in the project cycle. This assessment is of particular importance if demolition of any structure is required as part of the overall project, and/or the new project may impact an existing OSP connectivity infrastructure.

3.1. OSP from MPOE/MDF campus core systems to the building BDF

3.1.1. A minimum of three (3) four-inch (4”) entrance conduits shall be installed into the BDF of the building from the nearest existing telecommunications OSP connectivity access point, usually a telecommunications maintenance hole (MH).

3.1.2. Entrance conduit must not include more than two 90-degree bends without a pull box, hand-hole, or maintenance hole. Bends must be sweeping bends with a radius not less than 10 times the inside diameter of the 4-inch conduit.

3.1.3. If the required OSP access point is non-existent or the use of the nearest OSP access point is impractical, the required OSP access point must be designed and built. Any new maintenance hole number assignment shall be coordinated through Facilities Department manager for that location.

3.1.4. New maintenance holes shall be 5’x6’x4’ deep with round lids with a diameter of 32-1/2 inches. Hand holes (small maintenance holes) are not acceptable unless approved by District IT. No square lids are permitted. Lids should have pull-slots for easy removal, traffic rated, and labeled “TELECOMMUNICATIONS” or “TELEPHONE”. Recommend Jenson precast AT&T intercept enclosure with traffice rated hinged cover. Grounding rods should be included in the design of all maintenance holes. The distance between maintenance holes shall be no more than 300 feet if a direct path is possible and no 90-degree bends are used.

3.1.5. Dual OSP entrances from different OSP access points are very desirable where possible and should be considered especially for buildings that house emergency services, data core systems, disaster recovery systems, or those buildings designated as an essential service building on campus.

3.1.6. Fiber Optic Outside Plant cable will be used for data networking and shall consist of the following minimums based on building size. This fiber is only to be used for wired and WiFi data networking. If there are fiber optic needs for other building services, those needs must be discussed and approved by District IT.

3.1.6.1. For small buildings with only one TR a minimum of six multimode (50/125um) and a minimum of six Single-mode (8.3/125nm) optic fibers from the MPOE/MDF core data network on campus to the building BDF.

3.1.6.2. For buildings with more than one TR a minimum of eighteen multimode (50/125um) and a minimum of eighteen Single-mode (8.3/125nm) optic fibers from the MPOE/MDF core data network on campus to the building BDF.

3.1.7. Copper Outside Plant cable will be used for analog voice services within the building from the core data network on campus to the building BDF. Plan on a design of 25 copper pairs for buildings with a single TR or 100 copper pairs for larger buildings to be installed to the BDF and discuss the final design needs with District IT.

4. Telecommunication Room (TR)

The term TR refers to space allocated within a building to provide a secure operating environment for telecommunication infrastructure, cabling, termination facilities, and/or network equipment.

There are two types of TRs defined by District IT.

4.1. Building Distribution Frame (BDF).

Following are the characteristics of a BDF:

4.1.1. Each building has one BDF, even if that is the only TR in the building.

4.1.2. A BDF is the first connecting point within a building from the outside world.

4.1.3. The BDF houses infrastructure and equipment used to connect directly back to the MPOE/MDF campus distribution or core building.

4.1.4. A BDF houses infrastructure and equipment used to connect to other TRs throughout the building.

4.1.5. A BDF also houses access layer equipment used to serve the network drops within its serving area of the building.

4.2. Intermediate Distribution Frame (IDF).

Following are the characteristics of IDF(s):

4.2.1. IDFs are added to the building when there are multiple floors in the building or when the building is so large that network drops fed from the BDF would be more than 279 feet (85 meters) in cable distance from the BDF to the drop location.

4.2.2. There should be at least one IDF per floor of the building in addition to the BDF. There would need to be more than one IDF on each floor when the building is so large that network drops fed from the IDF on a floor would be more than 279 feet in cable distance from the IDF to the drop location.

4.2.3. IDFs house infrastructure and equipment used to connect 4CD networks back to the BDF and on to end user locations throughout the building.

4.3. TR use restrictions.

4.3.1. No TR shall be used as passageways to other equipment rooms, power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the voice, data, TV, or wireless equipment and cabling.

4.3.2. Every TR shall be dedicated to the building's telecommunications functions and related support facilities.

4.3.3. TRs shall not be shared with electrical equipment, building services, or other equipment. Specifically, a TR should not contain systems, such as, but not limited to, audio-visual (A/V) equipment or fire alarm panels.

4.3.4. No other building systems shall be housed within a TR without the prior written approval of District IT.

4.4. Locating TR Facilities Within a Building

4.4.1. In locating a BDF, consider that once unrated outside plant cable enters a building that cable shall not be exposed for a cable length of more than 50 feet (50'). So, the best place for a BDF would be a low floor or basement of the building within 50 feet of where the outside plant conduit will enter the building.

4.4.2. There are several factors that need to be considered when placing TRs within new or remodeled facilities. Site selection factors for the various rooms are

addressed below. Of these factors, the two most important are “stacking” of the spaces and providing a location that would allow the spaces to be expanded, if required, in the future.

4.4.3. Avoid locations that limit expansion such as structural steel, stairwells, elevator shafts, outside walls, or other fixed building walls.

4.4.4. TRs and the cabling they support shall be separated as much as possible from sources of electromagnetic interference (EMI), such as induction devices, transformers, ballasts, power supplies, elevator equipment, generators, motors, X-rays, photo copiers, microwave ovens, and similar equipment or be located near sources of mechanical vibration.

4.4.5. The location of TRs, particularly the IDF spaces, should allow easy access to horizontal cable distribution pathways.

4.4.6. TRs shall not be located below water level unless preventive measures against water infiltration are employed nor located in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions. No building plumbing or mechanical should run through any TR unless to provide service to that space.

4.4.7. TRs should be easily accessible and accessed directly from public hallways. Access should not be through offices, classrooms, other utility spaces, or building janitorial spaces.

4.4.8. A TR must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the amount of square footage available in the room.

4.4.9. IDF horizontal location: Whenever possible, IDFs shall be centrally located within the floor area it serves in order to maximize the number of drops it can service as well as minimizes the cable length from the IDF to the drop locations.

4.4.10. IDF vertical location: In multi-story buildings, requiring multiple IDF rooms (at least one for each floor), the IDF rooms shall be in vertical stack alignment. Offsetting an IDF on one floor from the IDF above it and below it is not allowed.

4.4.11. IDFs are not to service drops on more than one floor.

4.4.12. IDF’s shall have access managed thru the Districtwide Access Control System.

5. BDF/IDF Racks, Patch Panels, Fiber Panels & Cable Management

5.1. Racks are typically installed in TRs for the termination of horizontal data cabling, fiber optic cabling, and network switching equipment.

5.2. TR racks are to be 7 foot tall (at least 43 rack units) and provide vertical rails with threaded holes to support installation of 19-inch equipment and patch panels.

5.3. Racks are to have a load rating of at least 1000 pounds.

5.4. A mixture of 19”x 7’-tall four post and two post racks shall be used.

5.4.1. 4-Port Racks: A BDF or IDF will always have one 4 post rack mounted flush to the wall where the line of racks begin. Four post racks are reserved exclusively for items such as servers or UPS systems.

5.4.2. 2-Post Racks: The BDF or IDF will have 1 or more 2-post racks depending on the number of horizontal cables served from the TR. Patch panels, copper termination, or fiber termination panels should only be installed in two post racks.

5.5. Between each rack and at the end of each row of racks provide vertical wire managers at least 6 inch wide and 19 inches deep, with hinged cover doors that swings in either direction and with continuous fingers permitting cabling to enter the sidewalls of the manager. One rack unit horizontal wire management will be mounted on the front of the rack between patch panels and below each network switch.

5.6. Racks shall be placed side by side with no spaces between and no racks standing alone.

5.7. No more than (6) 48-port CAT 6A cable patch panels shall be placed in a two-post rack.

6. TR Room Sizing Guidelines and Typical TR Room Layouts

6.1. The size of the TR is dependent upon the size of the area that the room will serve, the number of drops served by the TR, and the variety of equipment installed within the room.

6.2. The TR shall provide enough space for all planned termination and electronic equipment and cables that will be installed within the TR including any environmental control equipment, power distribution/conditioners and uninterrupted power supply systems.

6.3. BDF sizing and sample drawings.

6.3.1. Each building will have one BDF that serves as the connection between everything outside the building and all TRs and drops within the building. This is true for all buildings, even unique buildings that are either very small or have some feature in them (such as a pool or gymnasium) that causes unique space concerns.

6.3.2. The BDF will contain a four-post cabinet as well as at least one 19 inch two post relay rack with cable management systems.

6.4. Provide the following clearances for equipment and cross-connect fields in TRs.

6.4.1. Allow a minimum of 42 inches (42") of working space in front and 42 inches (42") at rear of equipment racks measured from the front and rear of the rack to the wall. This 42” of space will allow for 36” of working area as well as 6” mounting space for wall mounted hardware.

6.4.2. Use the following parameters to determine the room size based on the area of coverage or number of cable drops served within the building by the BDF:

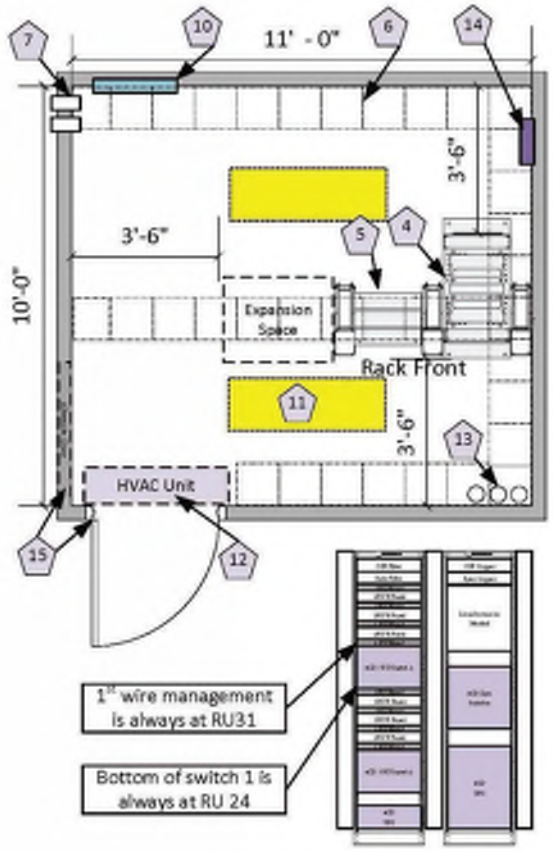
8,000 usable sq.ft. coverage area or 96 drops = 10 ft. x 11 ft. BDF = (2) Rack BDF
16,000 usable sq.ft. coverage area or 192 drops = 10 ft. x 13 ft. BDF = (3) Rack BDF
24,000 usable sq.ft. coverage area or 288 drops = 10 ft. x 15 ft. BDF = (4) Rack BDF
32,000 usable sq.ft. coverage area or 384 drops = 10 ft. x 17 ft. BDF = (5) Rack BDF

6.4.3. The following exhibits are shown as examples of approved BDF designs for 2, 3, 4, and 5 rack BDF rooms.

Exhibit I
2 Rack BDF

(2) Rack BDF

Room Highlights:
1) Maximum space served = 8,000 Gross Sq. Ft.
2) Maximum drops served = 96 drops with a average of 3 cables per drop or a total of 288 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

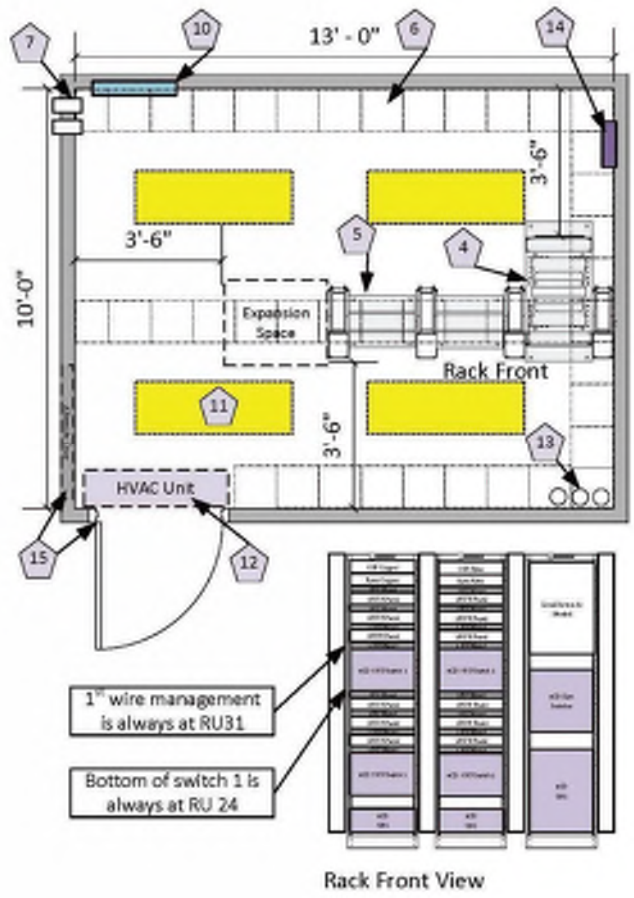


Rack Front View

Exhibit II
3 Rack BDF

(3) Rack BDF

Room Highlights:
1) Maximum space served = 16,000 Gross Sq. Ft.
2) Maximum drops served = 192 drops with a average of 3 cables per drop or a total of 576 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

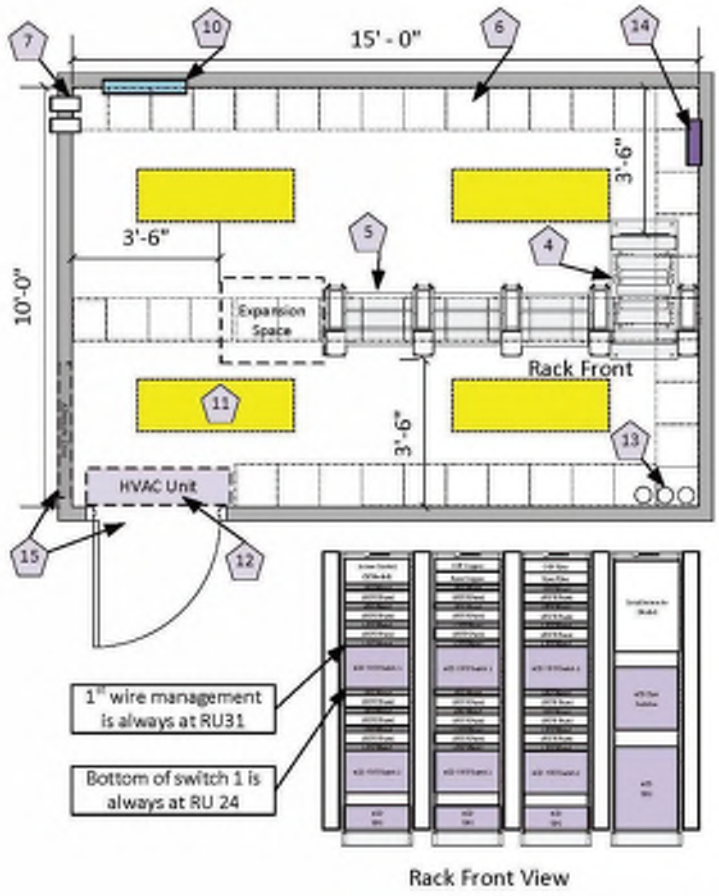


Rack Front View

Exhibit III
4 Rack BDF

(4) Rack BDF

Room Highlights:
1) Maximum space served = 24,000 Gross Sq. Ft.
2) Maximum drops served = 288 drops with a average of 3 cables per drop or a total of 864 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

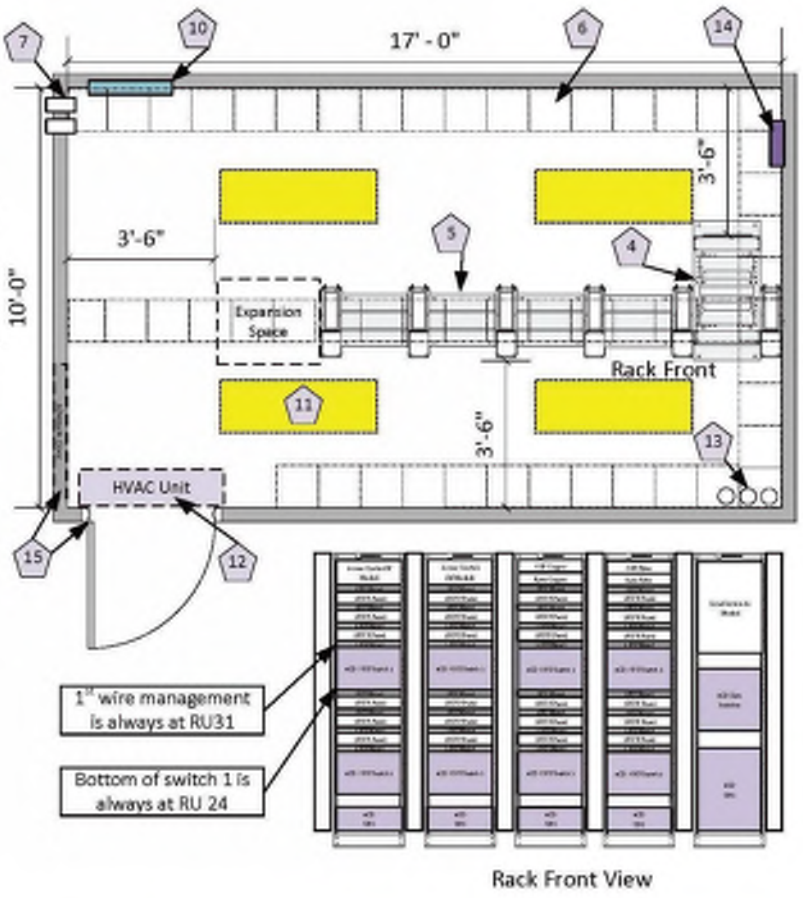


Rack Front View

Exhibit IV
5 Rack BDF

(5) Rack BDF

Room Highlights:
1) Maximum space served = 32,000 Gross Sq. Ft.
2) Maximum drops served = 384 drops with a average of 3 cables per drop or a total of 1,152 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



Rack Front View

6.5. IDF sizing and sample drawings.

6.5.1. Each floor (other than the floor with the BDF) will have an IDF that serves as the connection between the BDF and the cable drops.

6.5.2. Design more IDFs into the building if there are more floors. Example: A building with three floors will have at least 1 BDF and two IDFs.

6.5.3. It could be necessary for a floor in a building to require more than one IDF. This occurs when the distance from a TR to the cable drop traveling through the appropriate cable path is more than 279 feet.

6.6. Provide the following clearances for equipment and cross-connect fields in TRs.

6.6.1. Allow a minimum of 42 inches (42") of working space in front and 42 inches (42") at rear of equipment racks measured from the front and rear of the rack to the wall. This 42” of space will allow for 36” of working area as well as 6” mounting space for wall mounted hardware.

6.6.2. In many cases, equipment and termination hardware may extend beyond racks and backboard mounting surfaces. Clearance is measured from the outermost surface of these devices, rather than from the mounting surface of the rack or backboard.

6.6.3. Use the following parameters to determine the room size based on the area of coverage or number of cable drops served within the building by the IDF:

8,000 usable sq.ft. coverage area or 96 drops = 10 ft. x 11 ft. BDF = (2) Rack IDF
16,000 usable sq.ft. coverage area or 192 drops = 10 ft. x 13 ft. BDF = (3) Rack IDF
24,000 usable sq.ft. coverage area or 288 drops = 10 ft. x 15 ft. BDF = (4) Rack IDF
32,000 usable sq.ft. coverage area or 384 drops = 10 ft. x 17 ft. BDF = (5) Rack IDF

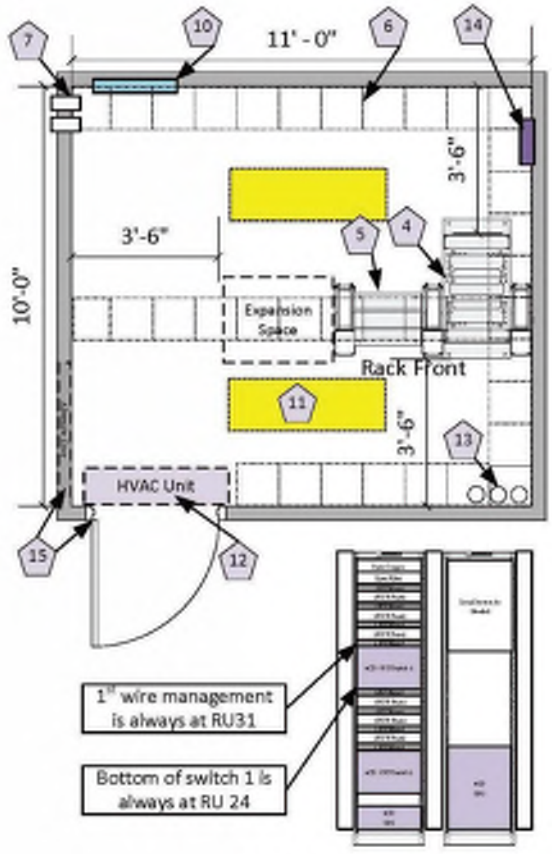
6.6.4. The following exhibits are shown as examples of approved IDF designs for 2, 3, 4, and 5 rack IDF rooms.

Exhibit V
2 Rack IDF

(2) Rack IDF

Room Highlights:

1) Maximum space served = 8,000 Gross Sq. Ft.
2) Maximum drops served = 96 drops with a average of 3 cables per drop or a total of 288 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



Rack Front View

Exhibit VI
3 Rack IDF

(3) Rack IDF

Room Highlights:
1) Maximum space served = 16,000 Gross Sq. Ft.
2) Maximum drops served = 192 drops with a average of 3 cables per drop or a total of 576 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
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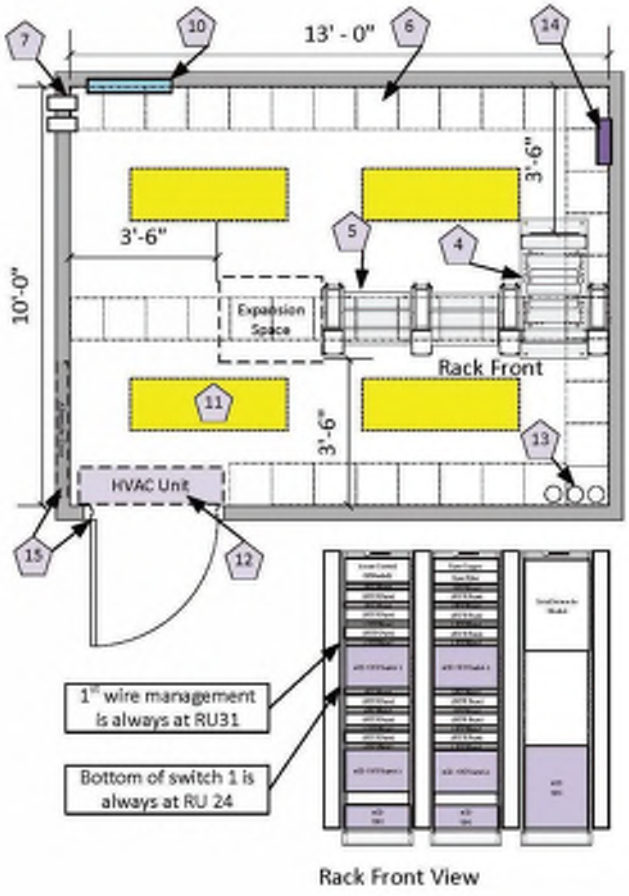

Rack Front View

Exhibit VII
4 Rack IDF

(4) Rack IDF

Room Highlights:
1) Maximum space served = 24,000 Gross Sq. Ft.
2) Maximum drops served = 288 drops with a average of 3 cables per drop or a total of 864 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
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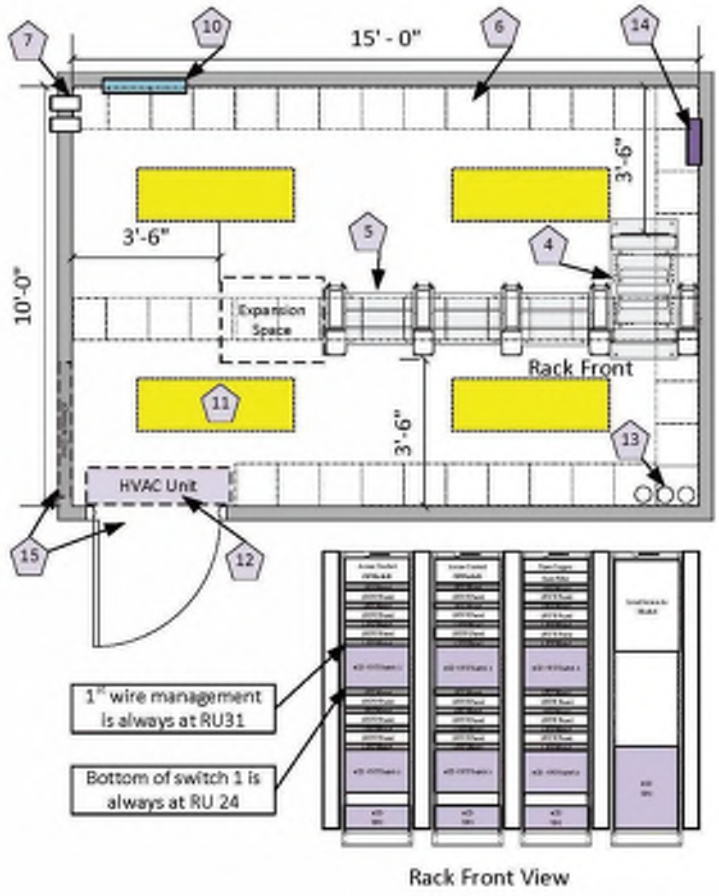
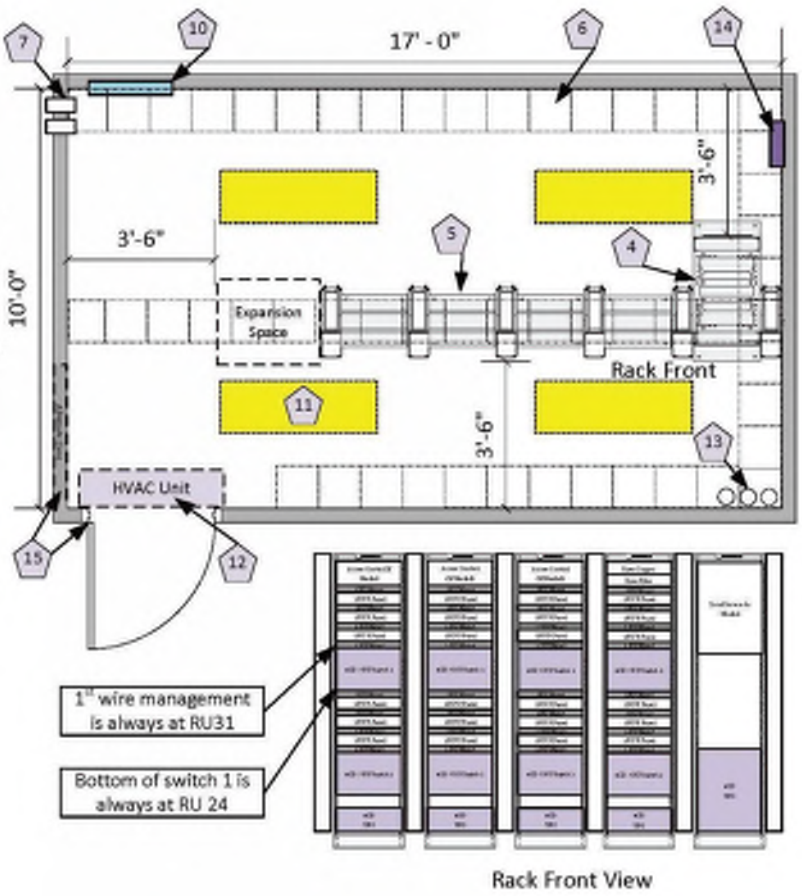


Exhibit VIII
5 Rack IDF

(5) Rack IDF

Room Highlights:
1) Maximum space served = 32,000 Gross Sq. Ft.
2) Maximum drops served = 384 drops with a average of 3 cables per drop or a total of 1,152 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



7. TR Room Construction Guidelines

7.1. Enclosing walls.

7.1.1. TR walls shall extend to the structural ceiling or floor slab above.

7.1.2. Fire rating of TR walls shall meet all requirements of the AHJ.

7.1.3. All penetrations of fire-rated TR walls or floors by any construction discipline shall be fire stopped.

7.2. Ceiling.

7.2.1. A suspended, false, lay-in, or hard lid ceiling shall not be installed over any TR.

7.2.2. Minimum clear ceiling height shall be 10 feet (10').

7.3. Floor.

7.3.1. TRs shall not be designed with raised floor systems no matter what set of functions they perform. TR floors should be floor slab, no raised or false floor.

7.3.2. Floor finish shall be smooth, dust-free, and not susceptible to static electricity build-up. Acceptable finishes would be low static composition tile, static dissipating tile (SDT), or sealed concrete.

7.4. Door.

7.4.1. The door shall be 3 ft. 0 in. wide X 7 ft. 0 in. high, opening outward, not into the TR, with a card reader lock that also supports brass key access for emergency use.

7.4.2. Door shall be labeled “Room #.”

7.4.3. The TR door shall be properly sealed to avoid dust and pests from entering the room.

7.5. Windows: TRs shall not have windows.

7.6. Roof Access: TRs shall not have roof access openings or ladders.

7.7. Water Infiltration: Measures must be taken to prevent water intrusion. Water, sewer, chemical, or drain piping of any kind shall not be routed through/within a TR.

7.8. Sprinkler systems.

7.8.1. If codes require fire protection sprinkler system heads within a TR, the sprinkler heads shall be the high heat type and shall be protected with a wire cage to prevent accidental discharge.

7.8.2. Sprinklers shall not be installed directly above the equipment racks.

7.9. Wall plywood sheeting.

7.9.1. Provide enough 4 ft. X 8 ft., ¾ in. thick Grade A-C, certified/ stamped as fire retardant and painted with two coats of white fire-retardant paint plywood sheets, to cover all four TR walls.

7.9.2. Fire retardant stamps shall be visible after painting.

7.9.3. Sheets shall be mounted securely to walls with 8-foot length vertical, 4 foot or less width horizontal. Bottom of sheet shall be at six inches (6") A.F.F.

8. TR Environmental Requirements

8.1. HVAC.

8.1.1. Each TR in a building should have its own dedicated HVAC not connected to or controlled by other building HVAC systems. A TR's HVAC system must be designed for 24 hours per day, 365 days per year operation and be monitored by campus BMS system. It should have its own thermostat located within the TR it serves. If the building is supported by a standby power system, consider connecting it to the HVAC system(s) that serve each TR.

8.1.2. HVAC systems shall not use the same electrical panel that is used to support the outlets servicing the electronics housed within a TR. See TR room electrical below.

8.1.3. The ambient temperature in a TR shall be maintained in the range of 70^0F to 80^0F.

8.1.4. The humidity range should be maintained at 30% to 55% relative humidity.

8.1.5. A TR shall ventilate at the rate of one air change per hour.

8.1.6. For HVAC sizing at program planning budget level do the following:

- For a TR performing the IDF function only, assume 2 tons of HVAC will be required (7,032 watts, 24,000 Btu).
- For a TR performing the BDF function assume 2.5 tons of HVAC will be required (12,000 watts, 42,000 Btu).

8.1.7. The filters in the HVAC system should have an ASHRAE dust spot rating of 85% or better.

8.2. Lighting

8.2.1. Lighting in the TR shall provide a minimum light level of 80 fc at desktop level on all sides of the rack equipment.

8.2.2. Lighting shall not be installed over the telecommunication racks in a TR.

8.2.3. If the building is equipped with a standby power system, TR lighting should be connected to it, or the TR should be provided with its own emergency lighting in case of power failure.

8.3. Electrical Sub-Panels

8.3.1. Sub-panels shall be provided for dedicated electrical service for all TRs. The estimated electrical load for the telecommunications space shall not exceed 80% of the panel capacity. No power outlets outside the TR shall be serviced by this panel. For initial planning, provide a 100-amp, 120/208 volt, 3-phase panel. Review the sub-panel calculations and design with District IT.

8.3.2. Individual branch circuits: All power circuits that supply outlets supporting electronics shall be individual branch circuits from their breaker in the TR sub-panel to the outlet receptacle supplying the electronics.

8.3.3. Sub-panels should be located inside the TR and near the TR entrance door, whenever possible and should be connected to a standby power source if available to the building.

8.3.4. Sub-panels shall be lockable.

8.4. Convenience Wall Outlets

8.4.1. Convenience wall outlets should be mounted in each room at +18 inches A.F.F. and horizontally spaced not to exceed 6 feet around the perimeter of the room.

8.4.2. Convenience outlets shall be non-switched, 120VAC 20 Amp, duplex and divided equally on branch circuits, (i.e., all receptacles in the same room shall not all be on the same circuit). Minimum of two (2) circuits shall be provided per room alternating duplexes around room with no more than four (4) receptacles on the same circuit.

8.4.3. Dedicated power circuits from shared panel boards within the power panel should be provided with both transient voltage surge suppression and electrical high frequency noise filtering.

9. Estimating Electronics Power Circuit Count for Equipment Racks

9.1. For each 4-post rack in a TR:

9.1.1. Provide one dedicated 120 VAC, 20-amp (non-switched) quad receptacle box and dedicated circuit above each rack.

9.1.2. Provide a minimum of two 220 VAC, 30-amp twist lock receptacles and dedicated circuits at the top of each rack. The 220 receptacles shall be coordinated with District IT for receptacle type at time of installation. These receptacles should be mounted above rear of the racks.

9.2. For each 2-post rack in a TR:

9.2.1. Provide one dedicated 120 VAC, 20-amp (non-switched) quad receptacle box and dedicated circuit above each rack.

9.2.2. Provide a minimum of one 220 VAC, 30-amp twist lock receptacles and dedicated circuits at the top of each rack in each TR. The 220 receptacles shall be coordinated with District IT for receptacle type at time of installation. These receptacles should be mounted above rear of the racks.

9.3. If the building is provided with an emergency generator system the electrical power, HVAC and lights in the TR shall be supplied from that power source.

9.4. The placement of the device box and its conduit shall not block or interfere with the rack's equipment mounting area (rails) on either side of rack.

10. Telecommunications Grounding and Bonding System

10.1. In addition to the normal electrical ground system, a Telecommunications Grounding and Bonding System shall be installed to support the telecommunications infrastructure. The requirements for this system are specified in ANSI-J-STD-607-A: The Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

10.2. The main components of this system are as follows.

10.2.1. Main Telecommunication Grounding Busbar (MTGB):

- A MTGB shall be installed in the BDF of the building.
- The MTGB is bonded to the nearest approved building grounding electrode (e.g., structural steel or ground rod) and the electrical entrance facility panel board’s equipment grounding busbar.

10.2.2. Telecommunications Grounding Busbar (TGB):

- A TGB shall be installed in each IDF of the building.

- The TGB shall be bonded to the electrical sub-panel serving the TR where the TGB is installed, bonded to building steel, bonded in series to each other TGB if there is more than one (1) TR and finally in series to the TMGB.

11. Telecommunication Inside Plant Pathway

11.1. Pathway design coordination.

11.1.1. The District has selected Category 6A as its cable standard for new construction and where complete building remodels make it possible to scale up the conduit and ladder rack systems. Where Category 5 or 5E is being replaced, Category 6A should be utilized with the existing conduits and ladder racking. If ladder racking and/or conduits are missing those should be addressed and changed per the 4CD standards.

11.1.2. Clarify as early in the design planning phases as possible what pathway is required and which construction discipline will draw, specify, and construct each portion of the required pathway.

11.1.3. There is often confusion on this issue that can cause delays and excessive change orders since telecommunication pathways detail design and build out usually requires very close coordination between the electrical/mechanical and telecommunications drawings and specification documents so that build out supply and construction responsibilities are clearly defined from the start of the Design Development phase of a project.

11.2. Interior TR pathway.

11.2.1. Cable Tray should be used within TRs to provide cable run management. All cable trays shall be a minimum 12” wide.

11.2.2. Cable tray shall meet Zone 4 or higher seismic bracing standards.

11.2.3. All trays must be bonded and grounded to the Telecom Grounding and Bonding System.

11.2.4. Cable tray layout design shall be reviewed and approved by District IT.

11.3. Riser pathway (from the BDF to IDFs in the building).

11.3.1. When more than one TR will be needed in a building, two (2), four-inch (4”) conduits will be installed from the BDF to each of the other IDFs in the building.

11.3.2. TRs in multi-story buildings shall be vertically stacked. When the TRs are stacked, risers can be easily accomplished using conduit stub-up floor/ceiling penetrations from one TR to the next.

11.3.3. Riser conduits or sleeves entering through the floor shall extend 3 inches above finished floor at the wall. Riser conduits or sleeves extending down from the ceiling shall extend to 9 feet above finished floor.

11.3.4. Sleeves should not be placed in the middle of the TR floor but placed next to the wall that has plywood attached, preferably starting in the opposite corner as seen when entering the door (see sample drawings).

11.3.5. Fiber Optic Riser cable used for data networking shall consist of a minimum of twelve multimode (50/125um) and minimum twelve Single-mode (8.3/125nm) optic fibers from the BDF to each TR in the building. This fiber is only to be use for wired and WiFi data networking. If there are fiber optic needs for other building services, those needs must be discussed and approved by District IT.

11.4. Primary horizontal cabling pathways.

11.4.1. Primary horizontal cabling pathways are major pathways that transport drop cables from the TR to secondary horizontal cabling pathway. They are usually constructed using cable tray; however, conduits can be used when it is necessary for the pathway to cross over a hard-lid ceiling.

11.4.2. At a minimum, primary horizontal pathways will always require pathway fire-wall penetration fire-stop technology through the TR walls into the occupied space of the floor the TR serves. Other wall penetrations may be required depending on the wall/ceiling layout of the TR's drop service area.

11.4.3. These primary horizontal cabling pathways should be routed following building lines and major floor access routes such as corridors and hallways. They should not cross over floor space designated as end user work area such as offices, work cubical areas, or classrooms.

11.4.4. Access for cabling personnel and technicians that is sufficient for easy cable placement yet causes minimal disruption to floor occupants is a critical design consideration when laying out the routing of primary horizontal cabling pathway.

11.4.5. Concealed cable tray systems may be used but are not recommended due to the potential for long term maintenance issues, increased costs of plenum rated materials, increased installation labor costs, wire damage and fire code violations. If cable trays are located in a ceiling that is a return air plenum, the wire and cable used shall be specified as plenum wiring, listed for use in an environmental air space by its manufacturer.

11.4.6. Supports shall be installed no more than 5 feet apart and within 2 feet of any fitting.

11.4.7. Cable tray shall be installed with 4-inch cable fence on both sides of the tray placed in main corridors throughout the floor allowing the shortest cabling distance from the tray to the drop conduit. Basket type cable tray is an acceptable option.

11.4.8. Cable tray shall be readily accessible and placed in ceilings that utilize removable tile. If transition over solid or inaccessible ceiling is required, access hatches of a minimum of 24" x 24" should be installed every 15 feet or continuous 4-inch conduits should be used to span the inaccessible ceiling area.

11.5. Secondary horizontal cabling pathways: from primary pathway to each drop location (conduits to drop backboxes).

11.5.1. Conduits or J-hook pathway will be installed from within 3' of a cable tray to a location above each drop wall backbox. Sub-up conduits will be installed from the conduit or J-hook pathway down the wall to each drop location.

11.5.2. Stub-up conduits to each drop will be sized depending on the number of cables at the drop, but unless otherwise noted, most drop conduits will be 1-1/4" conduits.

11.5.3. Junction boxes are mounted in the wall and connected to the stub-up conduit. They are used to mount the drop faceplate that houses the cable termination jacks. Generally double-gang 5S deep boxes with single-gang mud rings are used.

11.5.4. There are two special cases of secondary pathway that must be accounted for in most projects. These special cases require an understanding of the furniture layouts and wall construction before they can be sized and specified in any detail.

- Modular furniture raceway access.
- Wall mount access - stand alone or raceway.

11.5.5. All cable to each drop will be homerun through the pathway systems described. The drop cable will travel through the secondary pathway (conduit or J-hooks), then the primary pathway (cable tray and possibly conduits), then to the area-serving TR.

11.5.6. Drop faceplates should be single gang with four jack openings (holes). Usually electrical white color.

11.6. Cabling to drop

11.6.1. Cabling shall be provided to support a minimum of those described in Table I below. The horizontal cable extends from the station outlet (jack) to the

horizontal patch panel in the TR and is part of a structured cabling system that must be warranted by the manufacturers.

11.6.2. Jacks are to be color coded for easier identification and administration based on the following color list:

- Voice - white jacks (offices and conference rooms)
- Data in Administrative Areas and Offices - blue jacks (blue is default)
- Data in Instructional Areas - yellow jacks
- Classroom Notification System – orange jacks
- Wireless Access Points - green jacks
- Security – black jacks

11.6.3. Table I shows the count for drops, jacks, and jack colors needed depending on the usage for each room.

Table I
Drop Cable Counts

Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Standard Lecture Classrooms				
Teaching oriented wall	1	3	Yellow	Coordinate with multimedia plan
Non-teaching wall	1	3	Yellow	
Projector	1	2	Blue	
Instructor's podium	1	3	Yellow	Coordinate with multimedia plan
Classroom Notification speaker	1	2	Orange	See classroom notification section below for details.
Instructional Lab				Typically sized for 40 student computers plus 1 instructor computer and several printers/scanners
Instructor	1	3	Yellow	
Students	1	1	Yellow	Plus 1 spare drop per grouping of student workstations
Printer/Scanner	1	2	Blue	
Classroom Notification speaker	1	2	Orange	See classroom notification section below for details.
Self-Study Lab				
Students	1	1	Yellow	Power must be provided at each location
Printer/Scanner	1	2	Blue	
Student Carrels				
Students	1	1	Yellow	Power must be provided at each location.
Printer/Scanner	1	2	Blue	
Single Person Office				

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Single Person Office with Meeting Space	3	3	Blue	On opposing, non-door walls. Also a drop shall be installed, normally at 18"AFF, for meeting table.
Single Person Office	2	3	Blue	On opposing, non-door walls.
Single Person Modular Furniture	1	3	Blue	
Two Person Office				
Modular Furniture	1	3	Blue	
Network Multi-Function Printer	1	2	Blue	For office/cubicle areas determine where a networked, centralized, multifunction printer/scanner will be placed. Ensure WAO and appropriate power for placement.
Conference Rooms				
Presentation Wall	1	3	Blue	Coordinate with multimedia plan for the room.
Projector	1	2	Blue	
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate media connections with multimedia plan for the room.
Under Table	1	3	Blue	One floor mounted communication outlet box as well as an electrical outlet to allow access under the conference table per 6 ft of table.
Walls	1 per 10 feet	3	Blue	
Work Rooms				
Throughout the Workroom			Blue	Along counter tops where devices and printers shall be placed, communications outlets, with appropriate electrical outlets, will be distributed every six feet. Depending upon the size and configuration of the room, District IT will define the number of wired connections required. These will be placed at +6" above counter height. For self-standing copier machines, a communication outlet will be provided with appropriate dedicated electrical outlets.
Large Indoor Gathering Spaces				
Classroom Notification Speaker	1	2	Orange	See classroom notification section below for details.
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
				media connections with multimedia plan.
Moderator / Podium	1	3	Blue	To be coordinated with multimedia plan.
Other Data Locations				
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate media connections with multimedia plan.
Wireless Access Point	1	2	Green	Shall be installed 12” below the ceiling but not to exceed 12' above the finished floor. This shall take the form of a flush-mount outlet. This outlet can be located above a false ceiling. Variance needs to be requested below 8’ on a wall. For the longevity and safety of the WiFi system, access points must be mounted further than 12” from any metal or wire mesh surface. The location of the access point will be discreetly marked on the ceiling to enable technicians to find the access point without lifting tiles. Placement of Access Points is entirely dictated by the Wireless heatmap based Design.
Security Camera	1	2	Black	Pathway and routing to these security devices will be designed on an individual basis. Cables shall be terminated in suitable biscuit boxes.
Access Control to Individual Doors	1	2	Black	Pathway and routing to these security devices will be designed on an individual basis. Cables shall be terminated in suitable biscuit boxes.
Open Corridor or Lobby Workspace	1	3	Blue	
Building Maintenance Areas				Electrical rooms, security rooms, mechanical rooms, control rooms, boiler rooms, and garages.
Building Management Systems	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Mechanical Room	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Electrical Room	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Security Systems	1	2	Black	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Fire Alarm Systems	1	2	Black	A dedicated 1” homerun conduit shall be run from each fire alarm panel to the TR horizontal cross connect.
Intrusion Alarm Systems	1	2	Black	A dedicated 1” homerun conduit shall be run from each intrusion alarm panel to the TR horizontal cross connect.
Elevators	1	2	White	A dedicated 1” homerun conduit shall be run from the TR to the elevator equipment room and connected to a 2”W x 3”H x 2-1/2”D single gang box adjacent to the elevator equipment. Elevator voice instruments are normally provided by District IT. The design professional should consult with District IT concerning the district instrument of choice.
Storage Spaces	1	3	Blue	If storage space is large enough to be repurposed as office, it needs to be designed with Office standards above.

11.7. Classroom Notification System (CNS)

11.7.1. The CNS Push-To-Talk buttons will be installed in all large classrooms, meeting rooms, team rooms, or other large areas where people gather.

11.7.2. Hold a coordination meeting with District IT and Public Safety to confirm CNS locations.

11.7.3. At time of installation the contractor shall provide a spreadsheet detailing the room number, mac-address and jack used to patch each speaker. The system can not be configured for use without this information

11.7.4. The push to talk button must be located within 15 feet of the speaker and must be ADA accessible.

11.7.5. Push to talk buttons shall not be placed next to a doorway unless other criteria force that location.

11.7.6. Speaker shall be installed 12” below the ceiling and viewable from all locations in the room with the following connections:

- 2 Network drops will be terminated with orange jacks in a wall box attached inside the speaker enclosure. These drops will be labeled with the room number on both ends.

- Install a 20AWG wire from the speaker to the location of the button, this 20 AWG wire must be securely routed to the speaker through conduit. The wire shall be connected to the speaker as well as the button as directed in the manufacturer installation directions.

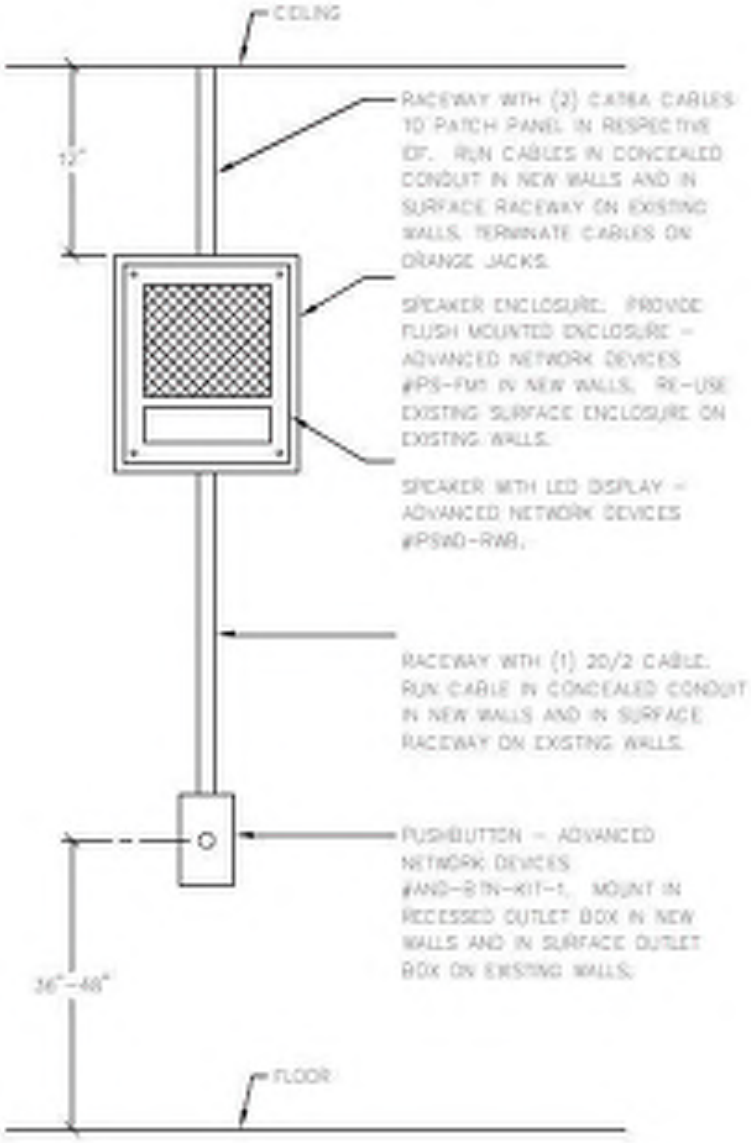
- All Buttons must be installed at ADA height (between 36” and 48” off the floor).

- All buttons must be within 15 feet of the speaker.

- Contractor to provide wall box for the button installed inside the wall.

- The following exhibit shows the layout of the CNS system in a classroom.

Exhibit IX
Classroom Notification System
(Drawing Detail Example) Orange



NOTES:
1. REFER TO MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR DEVICE WIRING REQUIREMENTS.
2. TERMINATE CAT6A CABLES IN A DUPLEX CAT6A JACK IN SPEAKER ENCLOSURE.
3. PROVIDE (2) CAT6A PATCH CORDS (ORANGE). SPEAKER END SHALL HAVE A 3 FOOT PATCH CORD. IDF END SHALL HAVE THE APPROPRIATE LENGTH PATCH CORD APPROPRIATELY ROUTED IN RACK AND ABLE TO BE PLUGGED INTO THE NETWORK SWITCH.

5 E-511 **EMERGENCY INTERCOM DETAIL**
NONE

11.7.7. Where the CNS system is installed in a remodeling location and the wall will not allow for in-wall installation, the speaker shall be installed 12” below the ceiling and viewable from all locations in the room with the following connections:

- 2 Network drops will be terminated with orange jacks in a wall box attached inside the speaker enclosure. These drops will be labeled with the room number on both ends.
- Install a 20AWG wire from the speaker to the location of the button, this 20 AWG wire must be securely routed to the speaker through Panduit securely mounted to the walls with screws (use of double-sided tape is not acceptable). The wire shall be connected to the speaker as well as the button as directed in the manufacturer installation directions.
- All Buttons must be installed at ADA height (between 36” and 48” off the floor).
- All buttons must be within 15 feet of the speaker.
- Contractor to provide surface mounted wall box for the button.
- The following exhibit shows the layout of the CNS system in a classroom where surface mounted raceway was used. In new buildings the wiring would be inside the wall.

Exhibit X
Classroom Notification System
(Example in a classroom surface mounted location)

11.8. Special use considerations

Special use considerations - Some specific types of areas and uses differ from “office/conference room” type space. Therefore, these areas should be addressed in the list below:

11.8.1. Classrooms

- The design professional should consult with District IT on a case-by-case basis to assure that any special needs are met.
- Do not design computer classrooms with only WiFi data connectivity. Computer classrooms need to have wired drops for each student.

11.8.2. Modular Office/Open Areas - These areas are unique and at times may require special modular telecommunications hardware. Special conduit and termination boxes may also be required. Therefore, the design professional should consult with District IT on a case-by-case basis to assure that needs are met.

11.8.3. Floor Outlets - Floor outlets shall be multi service recessed floor boxes. Any box shall be approved in advance by District IT.

11.8.4. ADA Requirements Outlets in public locations that will require access by the handicapped (i.e., payphones, public phones, etc.) have special height and reach requirements for their installation in terms of the “Highest Operable Mechanism.”

11.8.5. Emergency Notification Speakers with Push-To-Talk buttons. 4CD has identified these as Classroom Notification System (CNS). See the CNS section above for details.

11.8.6. Rooftops - Control equipment that is located on building rooftops frequently requires special provisioning of communications connectivity. This equipment can include HVAC monitors, cellular/wireless antennas, broadcasting equipment, telescopes, communication relays, photovoltaics, etc. Some of these systems shall be added after the building is built. It is more important to provide a clear pathway through which connections can be added later. Any control systems that require network connectivity need to be located within 275 feet of a IDF or BDF.

11.8.7. Specialty Locations - The campus will have specialty locations that will require custom configuration at the time of building design. These locations include but are not limited to theatres, lecture halls (seating capacity > 200), auditoriums, athletic broadcasting venues and control rooms, scoreboards, electronic advertising boards, and others that cannot be envisioned at this time. At the time of design, the requirements for each of these locations will be individually determined in design meetings with District IT.

11.8.8. Access Control, Cameras, Building Management Systems – Access Control and Building Management Systems have many cabling requirements. Any network jack providing services for these must be labeled with the system, room number and jack number on both ends.

12. Special Architectural Considerations

12.1. WiFi design

12.1.1. Design to provide for ubiquitous IEEE 802.11 AC networking throughout new and renovated spaces and at selected areas of the exterior designated by District IT.

12.1.2. Contractor's design must utilize a three-dimensional enterprise wireless prediction methodology equivalent to the planning manager in Ekahau Enterprise Site Survey to locate access points (AP's).

12.1.3. Contractor's WiFi design shall be prepared by an individual trained and holding current certification equivalent to that of an Ekahau Certified Survey Engineer (ECSE) for the planning tool used by the Contractor. Contractor's design to incorporate AP characteristics of the type identified as design basis. AP's will be 4CD furnished and Contractor installed.

12.1.4. 4CD has standardized on Ruckus Wireless AP's and controllers.

12.1.5. Design for occupied areas of the building interior will be based on the Ruckus Best Design Practices as presented in Ekahau design standards.

12.1.6. For the longevity and safety of the WiFi system, access points must be mounted further than 12" from any metal or wire mesh surface.

12.1.7. Design basis is 802.11AC devices operating at 5 GHz. Design for 2.4 GHz to assume network will push capable devices to 5 GHz.

12.1.8. Design capacity analysis should provide density as required to achieve 10 MBps minimum per device simultaneously.

12.1.9. The Design Professional must present complete planning report of the completed analysis to District IT for review and approval.

12.1.10. WAP's will have 2 drops terminated with green jacks and shall be labeled with the room number and jack number on both ends.

12.1.11. At time of installation the contractor shall provide a spreadsheet detailing the room number, mac-address and jack used to patch each wireless access point. The system cannot be configured for use without this information.

12.2. Emergency Responders Radio Coverage (ERRC)

12.2.1. Emergency Responders Radio Coverage systems are required by the California Fire Code to extend public safety radio into new and altered building space.

12.2.2. Designs of new ERRC are ordinarily provided as part of the Fire Alarm System design. Design for new District facilities to provide an Emergency Responders Radio Coverage system in the building where required by and constructed in conformance with the requirements of Code, the District's requirements as a provider of Public Safety services, and the Authority Having Jurisdiction.

12.2.3. Where ERRC systems route through Information Technology spaces, coordinate the design to maintain clearances and minimum pathway requirements of Information Technology Systems, and NFPA 72 as interpreted by the AHJ for required fire protection of the pathways and Telecommunications Rooms used for this function.

12.3. Two-way Communications

12.3.1. Two-way Communications Systems are required by the California Building Code for multi-story new and altered building space where elevators are used to reach the level of discharge.

12.3.2. Provide design of new two-way communications systems for new and altered District facilities where required by and constructed in conformance with the requirements of Code, 4CD, and the Authority Having Jurisdiction. Review the answering point options available with District IT to meet the Code requirements. District standards for supported two-way communications systems manufacturers are under review – design teams to request clarification at the 50% CD stage to ensure the Project incorporates current standards.

12.3.3. Where two-way communications systems route through Information Technology spaces, coordinate the design to maintain clearances and minimum pathway requirements of Information Technology Systems as defined elsewhere in this standard, and NFPA 72 as interpreted by the AHJ for required fire protection of the pathways and Telecommunications Rooms used for this function.

Finalized in 2023

Revision # 3.0

Revision Notes:

Revision 3.0 Reviewed with District IT team

SECTION 27 00 00 - COMMUNICATIONS

PART 1 - GENERAL

GENERAL

1.01 SUMMARY

A. This project requires the Contractor to furnish, label, test, document, and warrant a Structured Cabling System (SCS) in conformance with this specification for the facilities of the Contra Costa Community College District (4CD) referenced as ### (the Project Number, Project Name).

B. Construction drawings and all provisions of other Contract Divisions, if issued in conjunction with this specification, shall apply to this Division 27 specification. Coordination of work and resolution of conflicts between project documents issued by others such as Architects, Civil Engineers, Electrical/Mechanical Engineers, Plumbing Engineers, Civil Engineers, etc. and this Division 27 specification with its conjoined construction drawings shall be the responsibility of the Contractor.

C. The list of Division 27 section specifications that may be included as part of this Division 27 specification set includes, but is not limited to, the following:

1. Section 27 05 26 - Grounding and Bonding for Communications Systems
2. Section 27 05 29 - Hangers and Supports for Communications Systems
3. Section 27 05 33 - Conduits and Backboxes for Communications Systems
4. Section 27 05 36 - Cable Trays for Communication Systems
5. Section 27 05 41 - Fire Stopping for Communications Systems
6. Section 27 06 00 – 4CD Low Voltage Materials
7. Section 27 11 00 - Communications Equipment Room Fittings
8. Section 27 11 13 - Communications Entrance Protection
9. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
10. Section 27 11 19 - Communications Termination Blocks and Patch Panels
11. Section 27 15 13 - Communications Copper Horizontal Cabling
12. Section 27 15 43 - Communications Faceplates and Connectors
13. Section 27 15 53 - Communications Cable Plant Testing

Note: If a specific Division 27 specification section listed above is not included in the Division 27 specification set issued for this project, the work of that section is not required for this project.

D. 4CD developed an Architectural Design Guide that is intended to guide Architects and engineers as they develop the specific drawings and technical specifications for any project

within 4CD. That design guide is included in Attachment I of this specification for your reference.

E. 4CD Information Technology Team: The 4CD Information Technology Team assigned a project manager for all aspects of this project and that project manager shall be referenced here-in-after as the 4CD Information Technology Project Coordinator (ITPC). At all phases of this project, address all requests for information (RFI), all correspondence, and all required submittals to the assigned ITPC. If there is a change in the assignment of the ITPC or the ITPC determines a temporary designate, those changes will be given to the contractor in writing.

F. Progress Review Meetings: During the execution phase of this project the selected Contractor shall be prepared to attend weekly progress review meetings with the assigned ITPC or his/her designate.

1.02 QUALITY CONTROL

A. The Contractor shall have a current State of California C-7 license.

B. All work shall be performed in a neat and workmanlike manner (also see Division 01).

C. Product, materials, and equipment provided by the Contractor shall be of the quality specified.

D. All materials furnished under this contract shall be new and of a regularly manufactured line, currently in production at the time of installation.

E. Codes: (Most recent editions with addenda/TSB, etc.) All materials, installation, and workmanship shall comply with the applicable requirements and codes addressed within the following references:

1. National Electrical Manufacturers Association (NEMA).
2. NFPA 70, National Electrical Code (NEC).
3. ANSI/IEEE C2, National Electrical Safety Code (NESC).
4. FCC Rules and Regulations.
5. Local, county, state, and federal regulations and codes in effect as of the bid submission date.

F. Standards: (Most recent editions with addenda/TSB, etc.) All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/TIA-568.1-D, Commercial Building Telecommunications Infrastructure Standard
2. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
3. ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard
4. ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard

5. ANSI/TIA-569-D, Telecommunications Pathways and Spaces

6. ANSI/TIA-570-C, Residential Telecommunications Infrastructure Standard

7. ANSI/TIA-606-B, Administration Standard for Telecommunications Infrastructure

8. ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

9. ANSI/TIA-758-B, Customer Owned Outside Plant Telecommunications Infrastructure Standard

10. ANSI/TIA-4966, Telecommunications Infrastructure Standard for Educational Facilities

11. BICSI - Telecommunications Distribution Methods Manual (TDMM)

12. BICSI - Outside Plant Design Reference Manual (OSPDRM)

13. BICSI - Wireless Design Reference Manual (WDRM)

14. All products shall be Underwriters Laboratories (UL) listed, or other nationally recognized testing laboratory acceptable to 4CD listed for the application intended.

G. Where conflicts exist from one code or standard to another, the code or standard to adhere to will be decided by the ITPC or his/her designate.

1.03 WARRANTIES

A. The Contractor shall provide a one (1) year material and labor warranty on all the work the Contractor has performed.

B. The Contractor shall provide the SCS system manufacturer's 25-year materials and link performance certification warranty for all new cable installed by the Contractor in his execution of the work of this specification.

1.04 MATERIAL SUBSTITUTIONS

A. All requests for substitutions of products shall be made and approved or disallowed during the stated bid period for this project - see Division 01.

B. Three (3) hard copies and a URL reference of all proposed product substitution documentation are required. Proposed product substitution documentation shall contain, at a minimum, the following:

1. The product manufacturer's performance specifications cut sheet(s).

2. If existing, the manufacturer's installation instructions and/or installation recommendations for that product.

C. Acceptance of proposed substitutions is at the discretion of the ITPC. Allow 10 working days for review and final decision.

D. Substitutions must comply with the warranty requirements specified above.

1.05 SUBMITTALS

A. Required submittals upon award of contract.

1. A complete network drop numbering plan set in 4CD drop numbering format in printed and electronic format (PDF or AutoCAD is preferred).

2. Mock-ups of each type of network drop faceplate to be furnished for this project. Each drop mock-up shall contain the following:

   a. Full load of required connectors with eighteen inches (18") of connector type appropriate specified cable terminated on each connector.

   b. Required drop faceplate labeling to include faceplate icons as required by these Division 27 Specifications and the accompanying construction drawing set.

3. Manufacturers' cut sheets for all products to be supplied by the Contractor in response to these Division 27 specification sections.

4. Listed fire stop system documentation - reference Section 27 05 41 - Fire Stopping for Communication Systems.

5. A copy of the Contractor's C-7 license.

6. A copy of testing personnel certification(s) that show they are properly trained in the use of the testing equipment that will be employed by the contractor - reference Section 27 15 53 - Cable Plant Testing.

7. Testing device(s) calibration documentation.

8. Copies of Contractor's Structured Cabling System (SCS) manufacturer's authorized vendor/installer Certification document(s).

B. Required submittals prior to final acceptance.

1. Two (2) sets of Thumb drives or CDs of the as-built drawings (PDF, AutoCAD, or AutoCAD Lite Rev 2014 or later) - reference Section 27 15 53 - Cable Plant Testing.

2. Two (2) sets of Thumb drives or CDs of cable plant testing documentation - reference Section 27 15 53 - Cable Plant Testing.

3. Two (2) sets of Thumb drives or CDs of all fire stop pictures reference Section 27 05 41 - Fire Stopping for Communication Systems.

4. Two (2) copies of required warranties.

PART 2 - PRODUCTS

2.01 SECTION 27 06 00 - 4CD LOW VOLTAGE MATERIALS

A. It is recommended that the reader examine Section 27 06 00 - 4CD Low Voltage Materials before continuing.

B. Section 27 06 00 - 4CD Low Voltage Materials presents the 4CD's pre-approved Product/Material Listing by Division 27 Section number. In this specification set

product/material shall be specified by reference to the Product/Materials Schedule contained in Section 27 06 00.

C. The Contractor shall supply a complete and functioning system; if a product/material required for this project is not listed in 27 06 00 - 4CD Low Voltage Materials, Products and Materials Schedule, it shall be furnished by Contractor with submittal approval by the ITPC or his/her designate.

D. The Product and Materials Schedule allows for "or equal" substitutions. When "or equal" product/material is substituted, the "or equal" product/material submitted shall be equivalent in every way to the product/material listed in 27 06 00 - 4CD Low Voltage Materials, the Products and Materials Schedule - see Material Substitutions above. All products that the Contractor would like to submit as an “or equal” product must be submitted and approved by the ITPC or his/her designate.

2.02 QUANTITIES

Determining quantity of any given required item or product shall be the Contractor's responsibility using this specification and accompanying drawing set.

2.03 DEFINITION

In this Division 27 specification, the term "Furnish" shall mean "provide and install."

PART 3 - EXECUTION

3.01 COORDINATION

A. The Contractor shall coordinate the work specified in this Division 27 specification with the work of the other trades involved in this project.

B. The Contractor shall coordinate with Division 26 - Electrical concerning provision and installation of the following:

1. Conduit and cable tray pathway for communications.

2. Wall penetrations and floor coring for communications.

3. Backboxes for communications.

4. Telecommunications Space Power placement of communications.

5. Grounding and bonding for communications.

C. All questions and issues regarding coordination and construction element phasing shall be directed to the ITPC or his/her designate.

D. The Contractor shall coordinate their work so there shall be no disruption to any occupants of the 4CD campus unless coordinated and approved by the ITPC or his/her designate. Any necessary disruption shall be scheduled a minimum of 4 weeks in advance of its occurrence and affected parties shall be notified in writing of date, time, and planned duration of the disruption.

E. The Contractor shall follow all rules, regulations, and instructions stipulated by this specification, general provisions of the Contract, including General and Supplementary Conditions, and Division 01 specification sections, if issued in conjunction with these Division 27 specifications regarding the following:

1. Delivery hours.
2. Delivery locations.
3. Storage.
4. Hazardous Material.
5. Security.
6. Hours of work.
7. Safety.
8. Logistics.

3.02 INTENT OF DRAWINGS AND SPECIFICATIONS

A. Contractor shall keep on the Project site a copy of the Specifications and Drawings, and the same shall be available at all reasonable times for inspection and use by the ITPC or his/her designate and by any other person authorized by the ITPC or his/her designate. Any Drawings listed in the detail Specifications shall be regarded as a part thereof and of the Contract. Anything mentioned in these Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in these Specifications, shall be of like effect as though shown or mentioned in both.

B. It shall be the duty of Contractor to see that the provisions of these Specifications are complied with in detail irrespective of the inspection given the work during its progress by the ITPC or his/her designate. Any failure on the part of Contractor to observe the Specifications will be sufficient cause for the rejection of the work at any time before its acceptance.

C. The ITPC or his/her designate will furnish from time to time, such detail drawings, drawings, profiles, and information as the ITPC or his/her designate may consider necessary for Contractor's guidance to insure the proper and adequate execution of the Contract. Contractor shall comply with such detail drawings, drawings, profiles and information.

D. DO NOT USE drawing scale to determine exact dimensions or exact location. Scaled drawings are still to be considered diagrammatic and scale should be used for estimates only. If exact lengths or location placement dimensions are required, the drawings will specifically show those dimensions or placement coordinates.

3.03 INSTALLATION

Furnish all required materials, equipment, and tools necessary to properly complete the work of these specifications including, but not limited to, tools for pulling and terminating the cables, mounting hardware, ladders, lift equipment, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, technician communication devices, cable testing equipment, stands for cable reels, cable wenches, etc.

3.04 EXAMINATION

A. The Contractor is responsible for examining existing conditions and comparing them with drawings and specifications and notifying the ITPC or his/her designate of any discrepancies.

B. The Contractor is responsible for coordinating with the ITPC or his/her designate to address, adjust, and resolve any discrepancies found before commencing work.

C. If a discrepancy between existing conditions and these drawings and specifications is found after commencing work, stop any work that in the Contractor's opinion is affected by the found discrepancy. It shall then be the Contractor's responsibility to resolve all issues caused by the found discrepancy before commencing work in work areas affected by the discrepancy.

3.05 VERIFICATION

A. It is incumbent upon the Contractor to verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.

B. After installation, test, certify, and provide required warranties for the Structured Cabling System installed per the requirements of this specification.

3.06 ADJUSTMENTS

The Contractor is responsible for coordinating and documenting with the ITPC or his/her designate the change order process. Coordinate specific needed forms and procedures for change orders with the ITPC or his/her designate.

3.07 LABELING

The Contractor is responsible for labeling and documenting all aspects of the installed infrastructure. The Contractor will not receive acceptance or final payments until the ITPC agrees that labeling and documentation is completed for the project.

4CD has multiple college campuses and many individual buildings throughout the District. A labeling standard is required to develop a consistent database of infrastructure and networking documents. Since there are “Administration Buildings” and “Campus Center” buildings on multiple campuses, it is important to develop unique labeling scheme that identifies individual buildings, Telecommunication Rooms (TRs), and cable drops identified for each unique college and campus. Please consult with the ITPC to confirm codes and alphas for the particular college, campus, and buildings that you are working with. The following labeling standard has been developed and the Contractor will follow the labeling standard in all aspects of the work.

A. Fiber Labeling elements:

Labeling Element	Digits	Symbol
Building (3 digit alpha code for the building)	3-4	BBBB
MDF or IDF (1st digit = floor, 2nd digit = a,b,c,etc)	2	##
Patch panel (1st digit = P, 2nd digit = patch panel #)	2	P@
PP jack (the jack number 01-48 on the patch panel)	2	$$

B. Labeling examples:

Using two existing buildings on the Contra Costa College campus as an example, we will demonstrate how the labeling elements would be used to uniquely identify and label infrastructure. The alpha designation for the Administration building is “ADN”. The alpha designation for the Campus Center is “CCR”.

C. The label affixed to both ends of an outside plant fiber optic cable that feeds from the Administration building (TR 1a) to the Campus Center (TR 1a) would look like the following: ADN-1a-CCR-1a. Then the contractor would affix details of the cable such as copper count, fiber count, cable type, etc.

D. The label affixed to both ends of a riser cable that feeds from the Campus Center (TR 1a) to the Campus Center (TR 2a) would look like the following: CCR-1a-CCR-2a. Then the contractor would affix details of the cable such as copper count, fiber count, cable type, etc.

E. Horizontal Cable Labeling elements:

Labeling Element	Digits	Symbol
MDF or IDF	3	###
Room where the jack is located	3	@@@
Station location	2	$$
Type of Jack	1	X
Jack number	2	**

F. Jacks should be labeled in clockwise order when standing in the doorway looking into the room.

G. TR Room number (where cable terminates), Room number of the work area, Station Number, Jack Number (Prefixed with type “V” for voice, “D” for data) (Example: 109 122-1-V1 109 is the TR, 122 is the room where the jack is located, 1 is the station location, V1 is the 1st voice jack in that particular wall plate). For the purposes of saving space on the patch panel, the TR room number can be eliminated on the TR end of the cables.

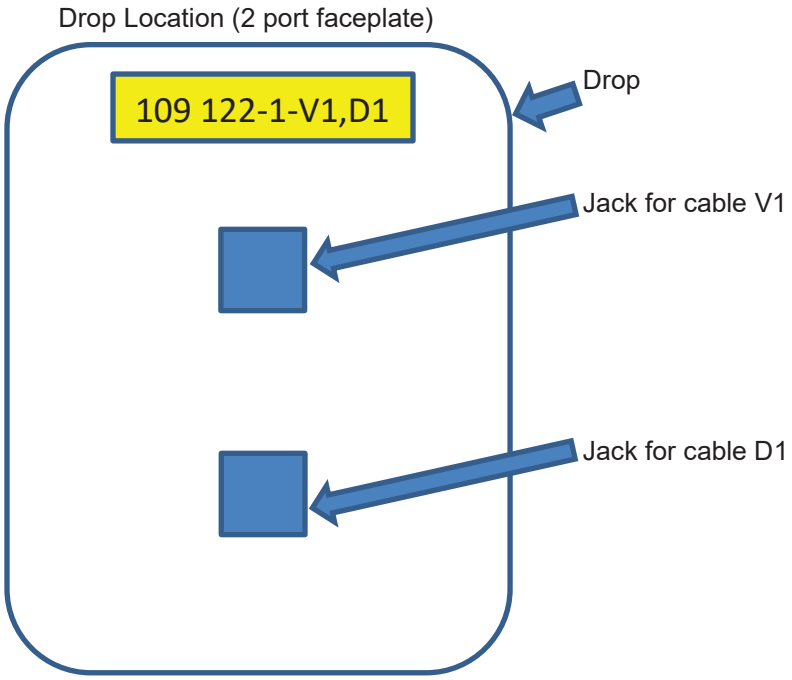
H. Cables for CNS, Cameras, WAPs, BMS devices, Access Control or other non-standard uses must be labeled with TR Room number (where cable terminates), Room number of the install area, Jack Number. For the purposes of saving space on the patch panel, the TR room number can be eliminated on the TR end of the cables. For example, a POE door in room 206 would have the following label on the door end of the cable, 205-206-AC-01 for the first door in room 206 which is served by TR 205. The TR patch panel label would be 206-AC-01. It is understood that cameras are not usually installed within rooms but the nearest room

I. Label Categories for non-standard jacks:

Access Control (such as door controllers or POE doors)	AC
Internal Cameras	CAI
External Cameras	CAE
Meters	ME
CNS Speakers	SP
Internal WAPS	WAI
External WAPS	WAE
Building Management System	BMS
Lighting Controls	LI

If a device type does not have a label described above, confirm with District IT.

J. An as-built floor plan of the coverage area of the TR will be mounted inside each TR by the Contractor. The floor plan will show the rooms and drop locations fed by the TR. The physical drop faceplate and the drop location on the as-built floor plan will be labeled with the TR identification, patch panel, and jack number for each cable fed by the TR. An example of a typical 2 port drop location with two cables connected to ports 10 and 11 on patch panel 2 in TR 2a is shown below:



3.08 LIST OF REQUIRED AS-BUILT DRAWINGS

A. As stated under "Submittals" above, as-built drawing files shall be “PDF”, "AutoCAD", or "AutoCAD Lite" 2014 or later release.

B. The list of required as-built drawings is as follows:

1. All cabling drop faceplate locations with identification for each jack at that drop.

2. Two-inch (2”) and larger conduit pathways to include conduit size label.

3. Pull box locations.

4. Two-inch (2”) and four-inch (4”) J hook runs indicated by a line series of “x”s.

5. MDF/IDF layout labeled per current construction drawing field mark-ups. Rack elevation layouts MUST be reviewed and approved by District IT before implementation.

6. Rack elevation labeled per current construction drawing field mark-ups.

7. Backbone copper and fiber schematic drawings with labeling information.

8. Updated outside plant drawings showing pathway, manholes, and pullboxes.

C After review of as-built drawings by the ITPC or his/her designate be prepared to make any required corrections for final submittal.

3.09 ACCEPTANCE

The project specified by this specification shall be considered completed and signed off as completed by the ITPC contingent upon the following:

1. All punch lists have been completed and signed as complete by the ITPC or his/her designate.

2. Required cable plant testing has been executed and required test result documentation has been submitted and approved by the ITPC or his/her designate - Refer to Section 27 15 53 - Communications Cable Plant Testing.

3. Any required adjustments to as-built drawings have been completed, submitted, and approved as complete by the ITPC or his/her designate.

4. Required warranty documentation has been submitted and approved as complete by the ITPC or his/her designate.

END OF SECTION

ATTACHMENT I

ARCHITECTURAL DESIGN GUIDE

FOR INFORMATION TECHNOLOGY INFRASTRUCTURE

This document's objective is to provide Architects and other designers with a design-requirements and guidelines document that will help them plan the information technology infrastructure for new building and renovation projects. The scope of this design guide includes the information technology infrastructure that will support the data network, wireless network, voice, classroom notification, coaxial TVs, cameras, and building automation services.

This design guide is produced by the Contra Costa Community College District (4CD) Information Technology Team (Hereafter called District IT) and reflects the District IT requirements and guidelines. This guide is not to be regarded as a project specifications document. It does not address the specific detail that telecommunication infrastructure design requires for any given building or type of building. It defines the design issues that must be addressed when planning telecommunication infrastructure for any building project and articulates the basic requirements/guidelines that should be adhered to.

The coordination of the requirements of this document with the specifications and drawing sets of the Telecommunications, Electronic Safety and Security, Architectural, Electrical, Mechanical, and Civil Engineering design disciplines at the Schematic Design phase of project development is vital for control of change orders and greatly facilitates smooth, cooperative interaction in Design Development and Construction Document phases of the project. Examples:

- Telecommunication room wall cover and floor finish (plywood, painting, sealing, tile placement) requirement information. This could be in Architectural or Division 27 - Communications document set. It is usually located in Architectural.

- Telecommunications Grounding and Bonding System requirements. This must be part of Division 26 - Electrical document set.

- Inside plant cable pathway requirements. This is often split between Division 26 - Electrical, Division 27 - Communications, and Division 28 - Electronic Safety and Security document sets. Splitting the design is OK but needs to be clearly defined as early as possible in the project planning phase.

Table of Contents

Acronyms and glossary used in this document:

AHJ	= Authority Having Jurisdiction
BDF	= Building Distribution Frame TR where the outside plant enters the building
BMS	= Building Management System
Drop	= A wall plate with data cables terminated in it (District IT average is 3 cables per drop)
ISP	= Inside Plant
IDF	= Intermediate Distribution Frame, a TR within a building connected to the BDF
Jack	= The individual outlet connector where a data, voice, or coaxial cable is terminated
MH	= Maintenance Hole in the outside plant conduit system
MPOE/MDF	= Minimum Point of Entry or Main Distribution Frame, the campus core TR that houses the main campus core systems
MTGB	= Main Telecommunications Grounding Busbar
OSP	= Outside Plant
TGB	= Telecommunications Grounding Busbar
TR	= Telecommunication Room, and MPOE/MDF, BDF, or IDF that houses networking equipment
WA	= Work Area

1. 4CD Contact

1.1. As the engineering and design progresses, there may be questions regarding specific or unique infrastructure applications. No deviation from the guidelines listed in this document are allowed unless such deviation approval is documented by the District IT contact.

1.1.1. Contact the District IT Network Technology Manager at 925-229-6899 to determine who has been assigned to your project.

1.2. The term “4CD” is intended to include all facilities owned, rented or leased that comprise the Contra Costa Community College District, its District Office (DO), Main campuses (Contra Costa College, Diablo Valley College, and Los Medanos College), Satellite campuses (Brentwood and San Ramon), and their environs.

2. Codes, Definitions, and Uses.

2.1. California Administrative Code. Determine and conform to the Code of Record as applies to the Project, including but not limited to the applicable portions of the California Administrative Code, Title 24 documents.

2.2. Cal-OSHA. Designs to provide workspaces for District staff, students and service contractors that conform with the applicable requirements of the State of California Department of Industrial Relations, Division of Occupational Safety and Health (DOSH), also known as Cal/OSHA and Federal OSHA.

2.3. Standards. The following standards must be incorporated into the engineering, design, and installation of all District infrastructure systems.

2.3.1. ANSI (American National Standards Institute)
2.3.2. ANSI/EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310-D).
2.3.3. ANSI/TIA-568-C.1, C.2 and C.3 Commercial Building Telecommunications Cabling Standard, 2009.
2.3.4. ANSI/TIA-569-D (2015) Telecommunications Pathways and Spaces.
2.3.5. ANSI/TIA-606-B-2012, Administration Standard Telecommunications Infrastructure.
2.3.6. ANSI-J-STD-607-C, (2015) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
2.3.7. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.

2.4. ASTM (American Society for Testing and Materials)

2.5. BICSI Telecommunications Distribution Methods Manual – Latest edition.

2.6. BICSI - Outside Plant Design Reference Manual (OSPDRM) – Latest edition.

2.7. BICSI - Wireless Design Reference Manual (WDRM) - 3rd edition.

2.8. ICEA (Insulated Cable Engineers Association)

2.9. IEEE (Institute of Electrical and Electronic Engineers)

2.10. IEEE 100: The Authoritative Dictionary of IEEE Standards.

2.11. ISO: ISO/IEC 11801 Information Technology — Generic Cabling for Customer Premises.

2.12. National Electrical Manufacturers Association (NEMA)

3. Telecommunications Outside Plant Pathway

Campus Outside Plant (OSP) Environments: Construction involving a new or existing building structure shall have an assessment of the OSP pathway connectivity infrastructure, (i.e., connections between buildings) which should be accomplished very early in the project cycle. This assessment is of particular importance if demolition of any structure is required as part of the overall project, and/or the new project may impact an existing OSP connectivity infrastructure.

3.1. OSP from MPOE/MDF campus core systems to the building BDF

3.1.1. A minimum of three (3) four-inch (4”) entrance conduits shall be installed into the BDF of the building from the nearest existing telecommunications OSP connectivity access point, usually a telecommunications maintenance hole (MH).

3.1.2. Entrance conduit must not include more than two 90-degree bends without a pull box, hand-hole, or maintenance hole. Bends must be sweeping bends with a radius not less than 10 times the inside diameter of the 4-inch conduit.

3.1.3. If the required OSP access point is non-existent or the use of the nearest OSP access point is impractical, the required OSP access point must be designed and built. Any new maintenance hole number assignment shall be coordinated through Facilities Department manager for that location.

3.1.4. New maintenance holes shall be 5’x6’x4’ deep with round lids with a diameter of 32-1/2 inches. Hand holes (small maintenance holes) are not acceptable unless approved by District IT. No square lids are permitted. Lids should have pull-slots for easy removal, traffic rated, and labeled “TELECOMMUNICATIONS” or “TELEPHONE”. Grounding rods should be included in the design of all maintenance holes. The distance between maintenance holes shall be no more than 300 feet if a direct path is possible and no 90-degree bends are used.

3.1.5. Dual OSP entrances from different OSP access points are very desirable where possible and should be considered especially for buildings that house emergency services, data core systems, disaster recovery systems, or those buildings designated as an essential service building on campus.

3.1.6. Fiber Optic Outside Plant cable will be used for data networking and shall consist of the following minimums based on building size. This fiber is only to be used for wired and WiFi data networking. If there are fiber optic needs for other building services, those needs must be discussed and approved by District IT.

3.1.6.1. For small buildings with only one TR a minimum of six multimode (50/125um) and a minimum of six Single-mode (8.3/125nm) optic fibers from the MPOE/MDF core data network on campus to the building BDF.

3.1.6.2. For buildings with more than one TR a minimum of eighteen multimode (50/125um) and a minimum of eighteen Single-mode (8.3/125nm) optic fibers from the MPOE/MDF core data network on campus to the building BDF.

3.1.7. Copper Outside Plant cable will be used for analog voice services within the building from the core data network on campus to the building BDF. Plan on a design of 25 copper pairs for buildings with a single TR or 100 copper pairs for larger buildings to be installed to the BDF and discuss the final design needs with District IT.

4. Telecommunication Room (TR)

The term TR refers to space allocated within a building to provide a secure operating environment for telecommunication infrastructure, cabling, termination facilities, and/or network equipment.

There are two types of TRs defined by District IT.

4.1. Building Distribution Frame (BDF).

Following are the characteristics of a BDF:

4.1.1. Each building has one BDF, even if that is the only TR in the building.

4.1.2. A BDF is the first connecting point within a building from the outside world.

4.1.3. The BDF houses infrastructure and equipment used to connect directly back to the MPOE/MDF campus distribution or core building.

4.1.4. A BDF houses infrastructure and equipment used to connect to other TRs throughout the building.

4.1.5. A BDF also houses access layer equipment used to serve the network drops within its serving area of the building.

4.2. Intermediate Distribution Frame (IDF).

Following are the characteristics of IDF(s):

4.2.1. IDFs are added to the building when there are multiple floors in the building or when the building is so large that network drops fed from the BDF would be more than 279 feet (85 meters) in cable distance from the BDF to the drop location.

4.2.2. There should be at least one IDF per floor of the building in addition to the BDF. There would need to be more than one IDF on each floor when the building is so large that network drops fed from the IDF on a floor would be more than 279 feet in cable distance from the IDF to the drop location.

4.2.3. IDFs house infrastructure and equipment used to connect 4CD networks back to the BDF and on to end user locations throughout the building.

4.3. TR use restrictions.

4.3.1. No TR shall be used as passageways to other equipment rooms, power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the voice, data, TV, or wireless equipment and cabling.

4.3.2. Every TR shall be dedicated to the building's telecommunications functions and related support facilities.

4.3.3. TRs shall not be shared with electrical equipment, building services, or other equipment. Specifically, a TR should not contain systems, such as, but not limited to, audio-visual (A/V) equipment or fire alarm panels.

4.3.4. No other building systems shall be housed within a TR without the prior written approval of District IT.

4.4. Locating TR Facilities Within a Building

4.4.1. In locating a BDF, consider that once unrated outside plant cable enters a building that cable shall not be exposed for a cable length of more than 50 feet (50'). So, the best place for a BDF would be a low floor or basement of the building within 50 feet of where the outside plant conduit will enter the building.

4.4.2. There are several factors that need to be considered when placing TRs within new or remodeled facilities. Site selection factors for the various rooms are addressed below. Of these factors, the two most important are “stacking” of the spaces and providing a location that would allow the spaces to be expanded, if required, in the future.

4.4.3. Avoid locations that limit expansion such as structural steel, stairwells, elevator shafts, outside walls, or other fixed building walls.

4.4.4. TRs and the cabling they support shall be separated as much as possible from sources of electromagnetic interference (EMI), such as induction devices, transformers, ballasts, power supplies, elevator equipment, generators, motors, X-rays, photo copiers, microwave ovens, and similar equipment or be located near sources of mechanical vibration.

4.4.5. The location of TRs, particularly the IDF spaces, should allow easy access to horizontal cable distribution pathways.

4.4.6. TRs shall not be located below water level unless preventive measures against water infiltration are employed nor located in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions.

4.4.7. TRs should be easily accessible and accessed directly from public hallways. Access should not be through offices, classrooms, other utility spaces, or building janitorial spaces.

4.4.8. A TR must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the amount of square footage available in the room.

4.4.9. IDF horizontal location: Whenever possible, IDFs shall be centrally located within the floor area it serves in order to maximize the number of drops it can service as well as minimizes the cable length from the IDF to the drop locations.

4.4.10. IDF vertical location: In multi-story buildings, requiring multiple IDF rooms (at least one for each floor), the IDF rooms shall be in vertical stack alignment. Offsetting an IDF on one floor from the IDF above it and below it is not allowed.

4.4.11. IDFs are not to service drops on more than one floor.

5. BDF/IDF Racks, Patch Panels, Fiber Panels & Cable Management

5.1. Racks are typically installed in TRs for the termination of horizontal data cabling, fiber optic cabling, and network switching equipment.

5.2. TR racks are to be 7 foot tall (at least 43 rack units) and provide vertical rails with threaded holes to support installation of 19-inch equipment and patch panels.

5.3. Racks are to have a load rating of at least 1000 pounds.

5.4. A mixture of 19”x 7’-tall four post and two post racks shall be used.

5.4.1. 4-Port Racks: A BDF or IDF will always have one 4 post rack mounted flush to the wall where the line of racks begin. Four post racks are reserved exclusively for items such as servers or UPS systems.

5.4.2. 2-Post Racks: The BDF or IDF will have 1 or more 2-post racks depending on the number of horizontal cables served from the TR. Patch panels, copper termination, or fiber termination panels should only be installed in two post racks.

5.5. Between each rack and at the end of each row of racks provide vertical wire managers at least 6 inch wide and 19 inches deep, with hinged cover doors that swings in either direction and with continuous fingers permitting cabling to enter the sidewalls of the manager. One rack unit horizontal wire management will be mounted on the front of the rack between patch panels and below each network switch.

5.6. Racks shall be placed side by side with no spaces between and no racks standing alone.

5.7. No more than (6) 48-port CAT 6A cable patch panels shall be placed in a two-post rack.

6. TR Room Sizing Guidelines and Typical TR Room Layouts

6.1. The size of the TR is dependent upon the size of the area that the room will serve, the number of drops served by the TR, and the variety of equipment installed within the room.

6.2. The TR shall provide enough space for all planned termination and electronic equipment and cables that will be installed within the TR including any environmental control equipment, power distribution/conditioners and uninterrupted power supply systems.

6.3. BDF sizing and sample drawings.

6.3.1. Each building will have one BDF that serves as the connection between everything outside the building and all TRs and drops within the building. This is true for all buildings, even unique buildings that are either very small or have some feature in them (such as a pool or gymnasium) that causes unique space concerns.

6.3.2. The BDF will contain a four-post cabinet as well as at least one 19 inch two post relay rack with cable management systems.

6.4. Provide the following clearances for equipment and cross-connect fields in TRs.

6.4.1. Allow a minimum of 42 inches (42") of working space in front and 42 inches (42") at rear of equipment racks measured from the front and rear of the rack to the wall. This 42” of space will allow for 36” of working area as well as 6” mounting space for wall mounted hardware.

6.4.2. Use the following parameters to determine the room size based on the area of coverage or number of cable drops served within the building by the BDF:

8,000 usable sq.ft. coverage area or 96 drops = 10 ft. x 11 ft. BDF = (2) Rack BDF
16,000 usable sq.ft. coverage area or 192 drops = 10 ft. x 13 ft. BDF = (3) Rack BDF
24,000 usable sq.ft. coverage area or 288 drops = 10 ft. x 15 ft. BDF = (4) Rack BDF
32,000 usable sq.ft. coverage area or 384 drops = 10 ft. x 17 ft. BDF = (5) Rack BDF

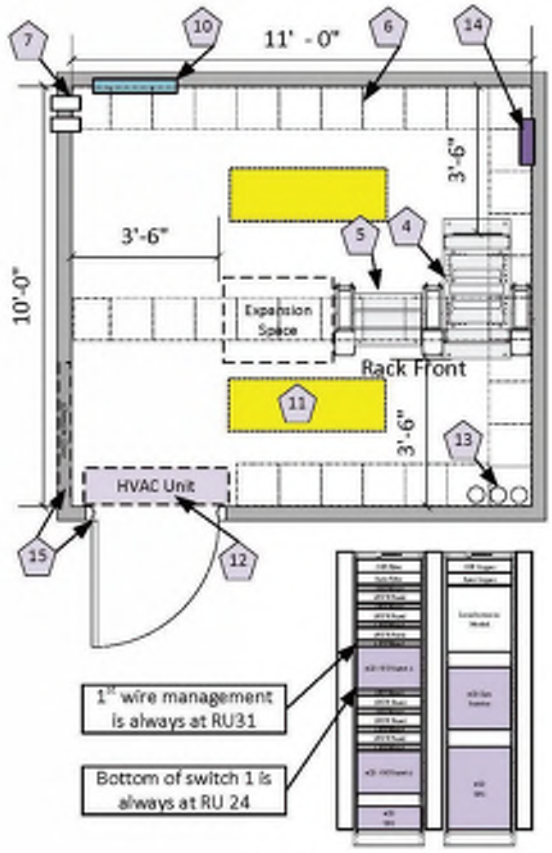
6.4.3. The following exhibits are shown as examples of approved BDF designs for 2, 3, 4, and 5 rack BDF rooms.

Exhibit I
2 Rack BDF

(2) Rack BDF

Room Highlights:

1) Maximum space served = 8,000 Gross Sq. Ft.
2) Maximum drops served = 96 drops with a average of 3 cables per drop or a total of 288 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



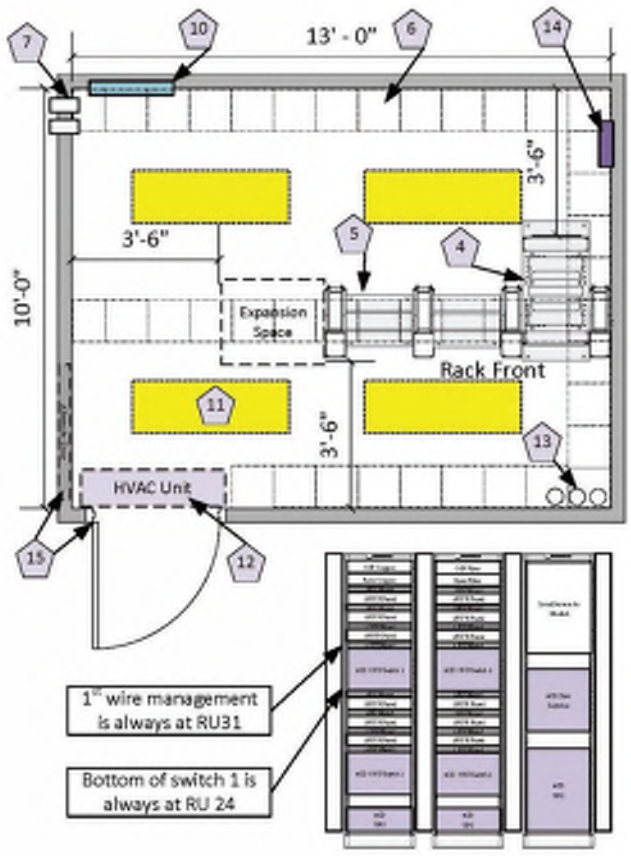
Rack Front View

Exhibit II
3 Rack BDF

(3) Rack BDF

Room Highlights:

1) Maximum space served = 16,000 Gross Sq. Ft.
2) Maximum drops served = 192 drops with a average of 3 cables per drop or a total of 576 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

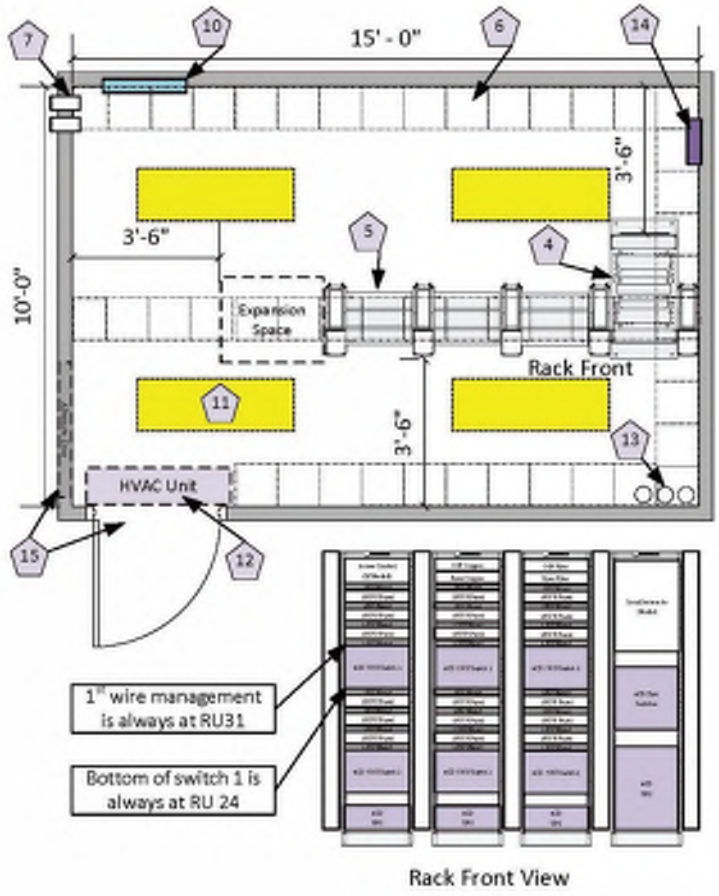


Rack Front View

Exhibit III
4 Rack BDF

(4) Rack BDF

Room Highlights:
1) Maximum space served = 24,000 Gross Sq. Ft.
2) Maximum drops served = 288 drops with a average of 3 cables per drop or a total of 864 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

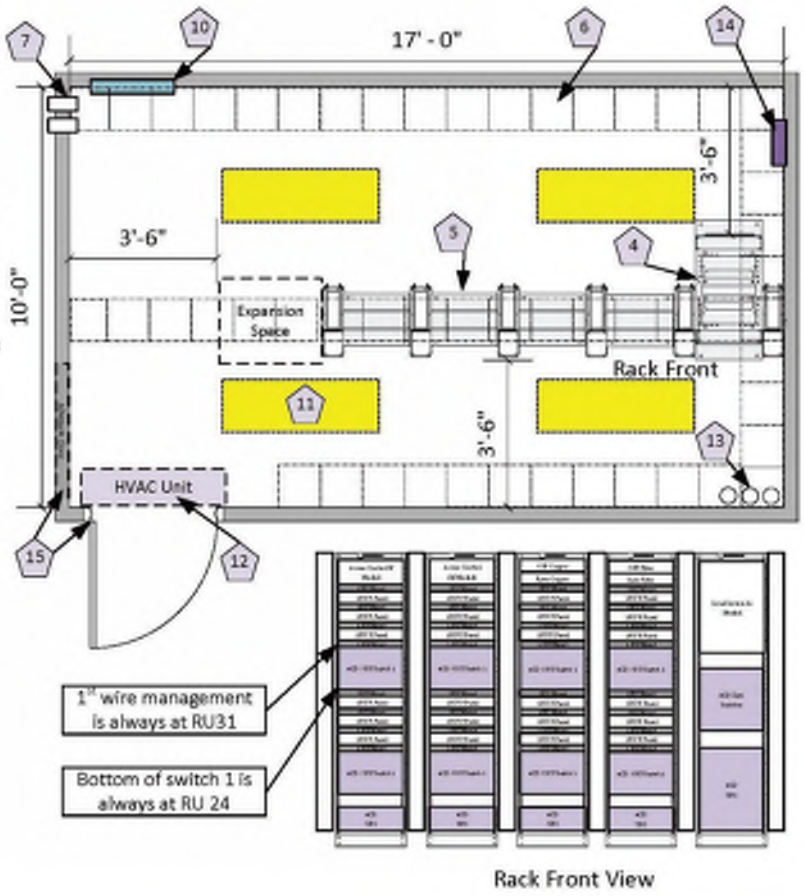


Rack Front View

Exhibit IV
5 Rack BDF

(5) Rack BDF

Room Highlights:
1) Maximum space served = 32,000 Gross Sq. Ft.
2) Maximum drops served = 384 drops with a average of 3 cables per drop or a total of 1,152 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



6.5. IDF sizing and sample drawings.

6.5.1. Each floor (other than the floor with the BDF) will have an IDF that serves as the connection between the BDF and the cable drops.

6.5.2. Design more IDFs into the building if there are more floors. Example: A building with three floors will have at least 1 BDF and two IDFs.

6.5.3. It could be necessary for a floor in a building to require more than one IDF. This occurs when the distance from a TR to the cable drop traveling through the appropriate cable path is more than 279 feet.

6.6. Provide the following clearances for equipment and cross-connect fields in TRs.

6.6.1. Allow a minimum of 42 inches (42") of working space in front and 42 inches (42") at rear of equipment racks measured from the front and rear of the rack to the wall. This 42” of space will allow for 36” of working area as well as 6” mounting space for wall mounted hardware.

6.6.2. In many cases, equipment and termination hardware may extend beyond racks and backboard mounting surfaces. Clearance is measured from the outermost surface of these devices, rather than from the mounting surface of the rack or backboard.

6.6.3. Use the following parameters to determine the room size based on the area of coverage or number of cable drops served within the building by the IDF:

8,000 usable sq.ft. coverage area or 96 drops = 10 ft. x 11 ft. BDF = (2) Rack IDF
16,000 usable sq.ft. coverage area or 192 drops = 10 ft. x 13 ft. BDF = (3) Rack IDF
24,000 usable sq.ft. coverage area or 288 drops = 10 ft. x 15 ft. BDF = (4) Rack IDF
32,000 usable sq.ft. coverage area or 384 drops = 10 ft. x 17 ft. BDF = (5) Rack IDF

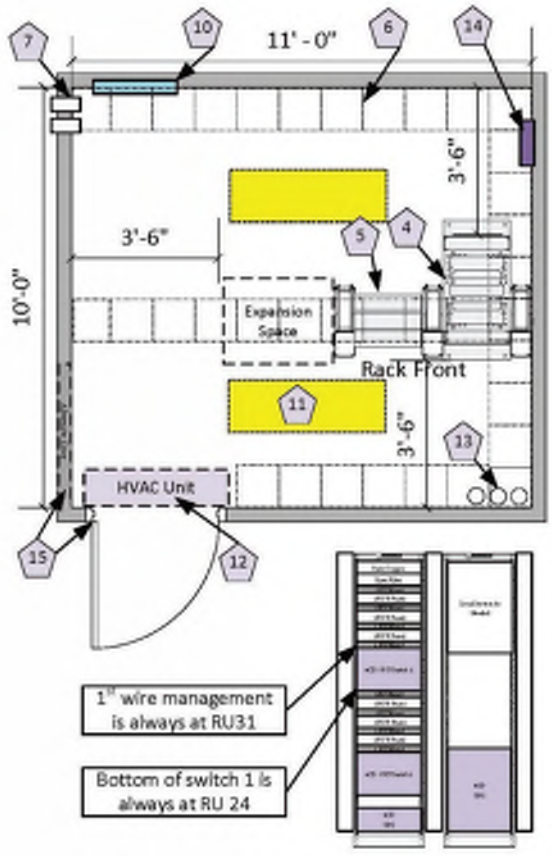
6.6.4. The following exhibits are shown as examples of approved IDF designs for 2, 3, 4, and 5 rack IDF rooms.

Exhibit V
2 Rack IDF

(2) Rack IDF

Room Highlights:

1) Maximum space served = 8,000 Gross Sq. Ft.
2) Maximum drops served = 96 drops with a average of 3 cables per drop or a total of 288 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



Rack Front View

Exhibit VI
3 Rack IDF

(3) Rack IDF

Room Highlights:

1) Maximum space served = 16,000 Gross Sq. Ft.
2) Maximum drops served = 192 drops with a average of 3 cables per drop or a total of 576 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
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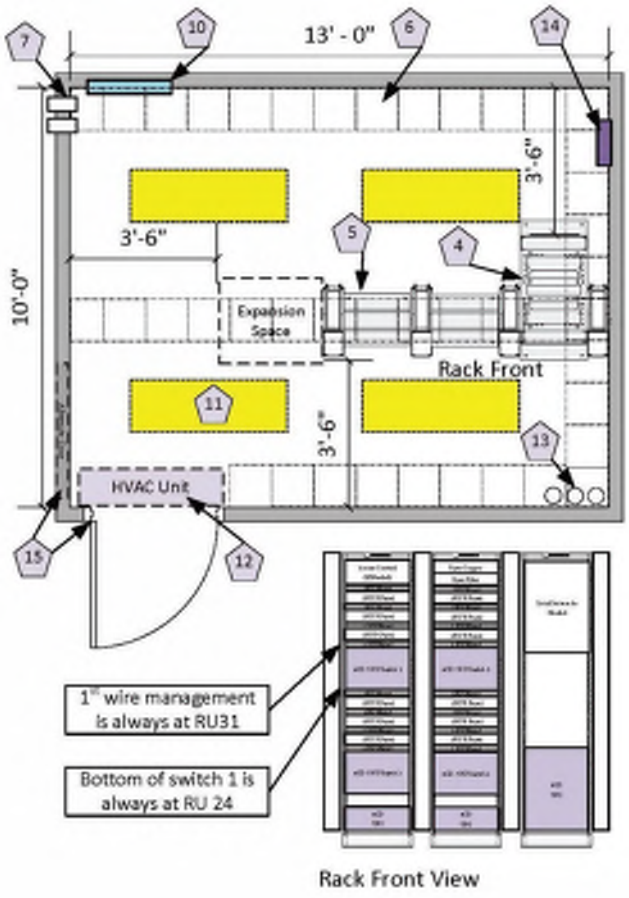
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.

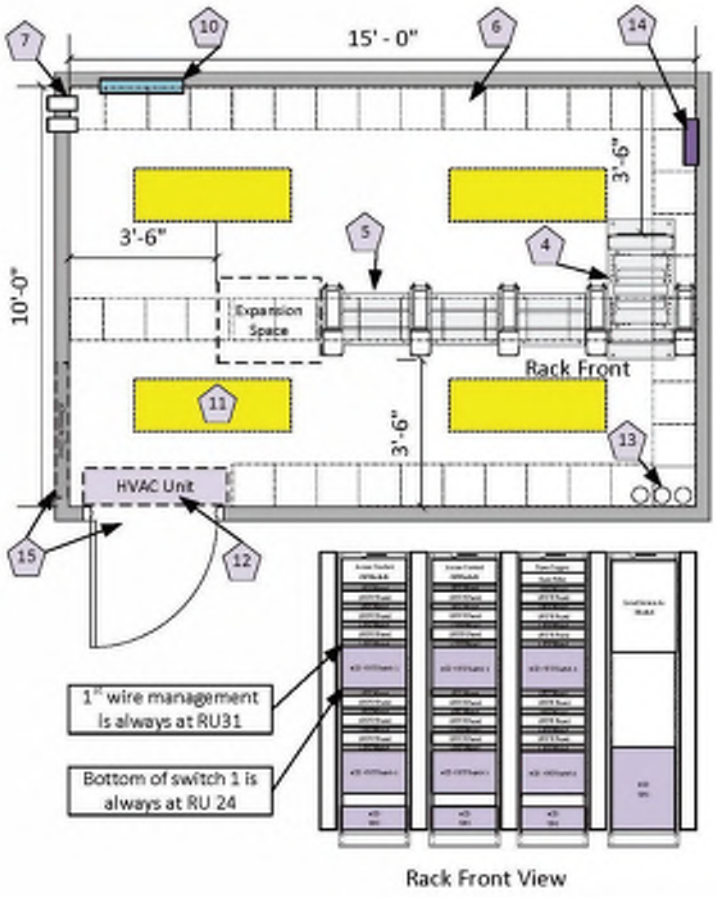


Rack Front View

Exhibit VII
4 Rack IDF

(4) Rack IDF

Room Highlights:
1) Maximum space served = 24,000 Gross Sq. Ft.
2) Maximum drops served = 288 drops with a average of 3 cables per drop or a total of 864 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
13) Entrance conduits
14) Telecommunications grounding busbar mounted at 6'0" AFF.
15) 3' wide door - sealed to stop dust and pests and alternate door location if needed.



Rack Front View

Exhibit VIII
5 Rack IDF

(5) Rack IDF

Room Highlights:
1) Maximum space served = 32,000 Gross Sq. Ft.
2) Maximum drops served = 384 drops with a average of 3 cables per drop or a total of 1,152 data cables.
3) Duplex convenience receptacles every 6'
4) Seismic 4-post open frame rack with one 120VAC 20 AMP dedicated quad box and two 220VAC 30 AMP twist lock receptacles mounted above the rack.
5) Seismic braced 2-post open rack with one 120VAC 20 AMP dedicated quad box and one 220VAC 30 AMP twist lock receptacles mounted above the rack.
6) Seismic rated ladder rack, 12" wide at 7'6" AFF
7) Sleeves entering room at 8'0" AFF
8) Walls lined with ¾" fire treated plywood
9) A minimum of 3'6" clearance shall be maintained at one end of the rack row and 3'6" clearance in front and rear of racks
10) Electrical panel with emergency power (if available)
11) Overhead lights on emergency power (if available)
12) 24x7 HVAC unit dedicated to the room
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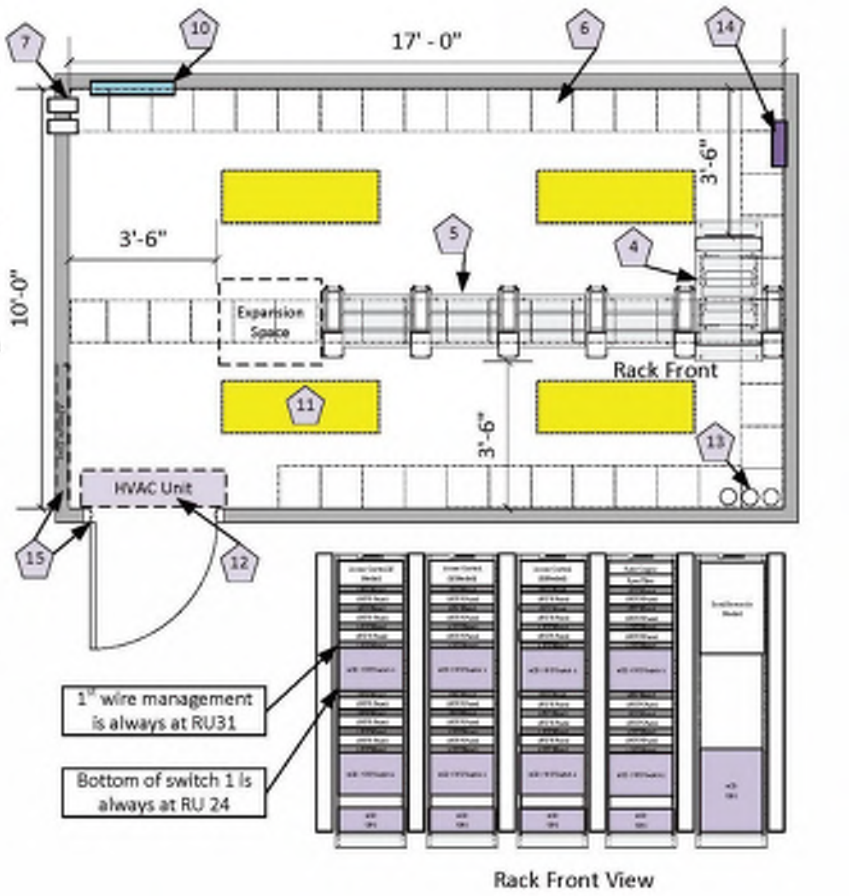


7. TR Room Construction Guidelines

7.1. Enclosing walls.

7.1.1. TR walls shall extend to the structural ceiling or floor slab above.

7.1.2. Fire rating of TR walls shall meet all requirements of the AHJ.

7.1.3. All penetrations of fire-rated TR walls or floors by any construction discipline shall be fire stopped.

7.2. Ceiling.

7.2.1. A suspended, false, lay-in, or hard lid ceiling shall not be installed over any TR.

7.2.2. Minimum clear ceiling height shall be 10 feet (10').

7.3. Floor.

7.3.1. TRs shall not be designed with raised floor systems no matter what set of functions they perform. TR floors should be floor slab, no raised or false floor.

7.3.2. Floor finish shall be smooth, dust-free, and not susceptible to static electricity build-up. Acceptable finishes would be low static composition tile, static dissipating tile (SDT), or sealed concrete.

7.4. Door.

7.4.1. The door shall be 3 ft. 0 in. wide X 7 ft. 0 in. high, opening outward, not into the TR, with a card reader lock that also supports brass key access for emergency use.

7.4.2. Door shall be labeled “Room #.”

7.4.3. The TR door shall be properly sealed to avoid dust and pests from entering the room.

7.5. Windows: TRs shall not have windows.

7.6. Roof Access: TRs shall not have roof access openings or ladders.

7.7. Water Infiltration: Measures must be taken to prevent water intrusion. Water, sewer, chemical, or drain piping of any kind shall not be routed through/within a TR.

7.8. Sprinkler systems.

7.8.1. If codes require fire protection sprinkler system heads within a TR, the sprinkler heads shall be the high heat type and shall be protected with a wire cage to prevent accidental discharge.

7.8.2. Sprinklers shall not be installed directly above the equipment racks.

7.9. Wall plywood sheeting.

7.9.1. Provide enough 4 ft. X 8 ft., ¾ in. thick Grade A-C, certified/ stamped as fire retardant and painted with two coats of white fire-retardant paint plywood sheets, to cover all four TR walls.

7.9.2. Fire retardant stamps shall be visible after painting.

7.9.3. Sheets shall be mounted securely to walls with 8-foot length vertical, 4 foot or less width horizontal. Bottom of sheet shall be at six inches (6") A.F.F.

8. TR Environmental Requirements

8.1. HVAC.

8.1.1. Each TR in a building should have its own dedicated HVAC not connected to or controlled by other building HVAC systems. A TR's HVAC system must be designed for 24 hours per day, 365 days per year operation and be monitored by campus BMS system. It should have its own thermostat located within the TR it serves. If the building is supported by a standby power system, consider connecting it to the HVAC system(s) that serve each TR.

8.1.2. HVAC systems shall not use the same electrical panel that is used to support the outlets servicing the electronics housed within a TR. See TR room electrical below.

8.1.3. The ambient temperature in a TR shall be maintained in the range of 70^0F to 80^0F.

8.1.4. The humidity range should be maintained at 30% to 55% relative humidity.

8.1.5. A TR shall ventilate at the rate of one air change per hour.

8.1.6. For HVAC sizing at program planning budget level do the following:

- For a TR performing the IDF function only, assume 2 tons of HVAC will be required (7,032 watts, 24,000 Btu).
- For a TR performing the BDF function assume 2.5 tons of HVAC will be required (12,000 watts, 42,000 Btu).

8.1.7. The filters in the HVAC system should have an ASHRAE dust spot rating of 85% or better.

8.2. Lighting

8.2.1. Lighting in the TR shall provide a minimum light level of 80 fc at desktop level on all sides of the rack equipment.

8.2.2. Lighting shall not be installed over the telecommunication racks in a TR.

8.2.3. If the building is equipped with a standby power system, TR lighting should be connected to it, or the TR should be provided with its own emergency lighting in case of power failure.

8.3. Electrical Sub-Panels

8.3.1. Sub-panels shall be provided for dedicated electrical service for all TRs. The estimated electrical load for the telecommunications space shall not exceed 80% of the panel capacity. No power outlets outside the TR shall be serviced by this panel. For initial planning, provide a 100-amp, 120/208 volt, 3-phase panel. Review the sub-panel calculations and design with District IT.

8.3.2. Individual branch circuits: All power circuits that supply outlets supporting electronics shall be individual branch circuits from their breaker in the TR sub-panel to the outlet receptacle supplying the electronics.

8.3.3. Sub-panels should be located inside the TR and near the TR entrance door, whenever possible and should be connected to a standby power source if available to the building.

8.3.4. Sub-panels shall be lockable.

8.4. Convenience Wall Outlets

8.4.1. Convenience wall outlets should be mounted in each room at +18 inches A.F.F. and horizontally spaced not to exceed 6 feet around the perimeter of the room.

8.4.2. Convenience outlets shall be non-switched, 120VAC 20 Amp, duplex and divided equally on branch circuits, (i.e., all receptacles in the same room shall not all be on the same circuit). Minimum of two (2) circuits shall be provided per room alternating duplexes around room with no more than four (4) receptacles on the same circuit.

8.4.3. Dedicated power circuits from shared panel boards within the power panel should be provided with both transient voltage surge suppression and electrical high frequency noise filtering.

9. Estimating Electronics Power Circuit Count for Equipment Racks

9.1. For each 4-post rack in a TR:

9.1.1. Provide one dedicated 120 VAC, 20-amp (non-switched) quad receptacle box and dedicated circuit above each rack.

9.1.2. Provide a minimum of two 220 VAC, 30-amp twist lock receptacles and dedicated circuits at the top of each rack. The 220 receptacles shall be coordinated with District IT for receptacle type at time of installation. These receptacles should be mounted above rear of the racks.

9.2. For each 2-post rack in a TR:

9.2.1. Provide one dedicated 120 VAC, 20-amp (non-switched) quad receptacle box and dedicated circuit above each rack.

9.2.2. Provide a minimum of one 220 VAC, 30-amp twist lock receptacles and dedicated circuits at the top of each rack in each TR. The 220 receptacles shall be coordinated with District IT for receptacle type at time of installation. These receptacles should be mounted above rear of the racks.

9.3. If the building is provided with an emergency generator system the electrical power, HVAC and lights in the TR shall be supplied from that power source.

9.4. The placement of the device box and its conduit shall not block or interfere with the rack's equipment mounting area (rails) on either side of rack.

10. Telecommunications Grounding and Bonding System

10.1. In addition to the normal electrical ground system, a Telecommunications Grounding and Bonding System shall be installed to support the telecommunications infrastructure. The requirements for this system are specified in ANSI-J-STD-607-A: The Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

10.2. The main components of this system are as follows.

10.2.1. Main Telecommunication Grounding Busbar (MTGB):

- A MTGB shall be installed in the BDF of the building.
- The MTGB is bonded to the nearest approved building grounding electrode (e.g., structural steel or ground rod) and the electrical entrance facility panel board’s equipment grounding busbar.

10.2.2. Telecommunications Grounding Busbar (TGB):

- A TGB shall be installed in each IDF of the building.
- The TGB shall be bonded to the electrical sub-panel serving the TR where the TGB is installed, bonded to building steel, bonded in series to each other TGB if there is more than one (1) TR and finally in series to the TMGB.

11. Telecommunication Inside Plant Pathway

11.1. Pathway design coordination.

11.1.1. The District has selected Category 6A as its cable standard for new construction and where complete building remodels make it possible to scale up the conduit and ladder rack systems. Where Category 5 or 5E is being replaced, Category 6A should be utilized with the existing conduits and ladder racking. If ladder racking and/or conduits are missing those should be addressed and changed per the 4CD standards.

11.1.2. Clarify as early in the design planning phases as possible what pathway is required and which construction discipline will draw, specify, and construct each portion of the required pathway.

11.1.3. There is often confusion on this issue that can cause delays and excessive change orders since telecommunication pathways detail design and build out usually requires very close coordination between the electrical/mechanical and telecommunications drawings and specification documents so that build out supply and construction responsibilities are clearly defined from the start of the Design Development phase of a project.

11.2. Interior TR pathway.

11.2.1. Cable Tray should be used within TRs to provide cable run management. All cable trays shall be a minimum 12” wide.

11.2.2. Cable tray shall meet Zone 4 or higher seismic bracing standards.

11.2.3. All trays must be bonded and grounded to the Telecom Grounding and Bonding System.

11.2.4. Cable tray layout design shall be reviewed and approved by District IT.

11.3. Riser pathway (from the BDF to IDFs in the building).

11.3.1. When more than one TR will be needed in a building, two (2), four-inch (4”) conduits will be installed from the BDF to each of the other IDFs in the building.

11.3.2. TRs in multi-story buildings shall be vertically stacked. When the TRs are stacked, risers can be easily accomplished using conduit stub-up floor/ceiling penetrations from one TR to the next.

11.3.3. Riser conduits or sleeves entering through the floor shall extend 3 inches above finished floor at the wall. Riser conduits or sleeves extending down from the ceiling shall extend to 9 feet above finished floor.

11.3.4. Sleeves should not be placed in the middle of the TR floor but placed next to the wall that has plywood attached, preferably starting in the opposite corner as seen when entering the door (see sample drawings).

11.3.5. Fiber Optic Riser cable used for data networking shall consist of a minimum of twelve multimode (50/125um) and minimum twelve Single-mode (8.3/125nm) optic fibers from the BDF to each TR in the building. This fiber is only to be use for wired and WiFi data networking. If there are fiber optic needs for other building services, those needs must be discussed and approved by District IT.

11.4. Primary horizontal cabling pathways.

11.4.1. Primary horizontal cabling pathways are major pathways that transport drop cables from the TR to secondary horizontal cabling pathway. They are usually constructed using cable tray; however, conduits can be used when it is necessary for the pathway to cross over a hard-lid ceiling.

11.4.2. At a minimum, primary horizontal pathways will always require pathway fire-wall penetration fire-stop technology through the TR walls into the occupied space of the floor the TR serves. Other wall penetrations may be required depending on the wall/ceiling layout of the TR's drop service area.

11.4.3. These primary horizontal cabling pathways should be routed following building lines and major floor access routes such as corridors and hallways. They should not cross over floor space designated as end user work area such as offices, work cubical areas, or classrooms.

11.4.4. Access for cabling personnel and technicians that is sufficient for easy cable placement yet causes minimal disruption to floor occupants is a critical design consideration when laying out the routing of primary horizontal cabling pathway.

11.4.5. Concealed cable tray systems may be used but are not recommended due to the potential for long term maintenance issues, increased costs of plenum rated materials, increased installation labor costs, wire damage and fire code violations. If cable trays are located in a ceiling that is a return air plenum, the wire and cable used shall be specified as plenum wiring, listed for use in an environmental air space by its manufacturer.

11.4.6. Supports shall be installed no more than 5 feet apart and within 2 feet of any fitting.

11.4.7. Cable tray shall be installed with 4-inch cable fence on both sides of the tray placed in main corridors throughout the floor allowing the shortest cabling distance from the tray to the drop conduit. Basket type cable tray is an acceptable option.

11.4.8. Cable tray shall be readily accessible and placed in ceilings that utilize removable tile. If transition over solid or inaccessible ceiling is required, access hatches of a minimum of 24” x 24” should be installed every 15 feet or continuous 4-inch conduits should be used to span the inaccessible ceiling area.

11.5. Secondary horizontal cabling pathways: from primary pathway to each drop location (conduits to drop backboxes).

11.5.1. Conduits or J-hook pathway will be installed from within 3’ of a cable tray to a location above each drop wall backbox. Sub-up conduits will be installed from the conduit or J-hook pathway down the wall to each drop location.

11.5.2. Stub-up conduits to each drop will be sized depending on the number of cables at the drop, but unless otherwise noted, most drop conduits will be 1-1/4” conduits.

11.5.3. Junction boxes are mounted in the wall and connected to the stub-up conduit. They are used to mount the drop faceplate that houses the cable termination jacks. Generally double-gang 5S deep boxes with single-gang mud rings are used.

11.5.4. There are two special cases of secondary pathway that must be accounted for in most projects. These special cases require an understanding of the furniture layouts and wall construction before they can be sized and specified in any detail.

- Modular furniture raceway access.

- Wall mount access - stand alone or raceway.

11.5.5. All cable to each drop will be homerun through the pathway systems described. The drop cable will travel through the secondary pathway (conduit or J-hooks), then the primary pathway (cable tray and possibly conduits), then to the area-serving TR.

11.5.6. Drop faceplates should be single gang with four jack openings (holes). Usually electrical white color.

11.6. Cabling to drop

11.6.1. Cabling shall be provided to support a minimum of those described in Table I below. The horizontal cable extends from the station outlet (jack) to the horizontal patch panel in the TR and is part of a structured cabling system that must be warranted by the manufacturers.

11.6.2. Jacks are to be color coded for easier identification and administration based on the following color list:

- Voice - white jacks (offices and conference rooms)
- Data in Administrative Areas and Offices - blue jacks (blue is default)
- Data in Instructional Areas - yellow jacks
- Classroom Notification System – orange jacks
- Wireless Access Points - green jacks
- Security – black jacks

11.6.3. Table I shows the count for drops, jacks, and jack colors needed depending on the usage for each room.

Table I
Drop Cable Counts

Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Standard Lecture Classrooms				
Teaching oriented wall	1	3	Yellow	Coordinate with multimedia plan
Non-teaching wall	1	3	Yellow	
Projector	1	2	Blue	
Instructor's podium	1	3	Yellow	Coordinate with multimedia plan
Classroom Notification speaker	1	2	Orange	See classroom notification section below for details.
Instructional Lab				Typically sized for 40 student computers plus 1 instructor computer and several printers/scanners
Instructor	1	3	Yellow	
Students	1	1	Yellow	Plus 1 spare drop per grouping of student workstations
Printer/Scanner	1	2	Blue	
Classroom Notification speaker	1	2	Orange	See classroom notification section below for details.
Self-Study Lab				
Students	1	1	Yellow	Power must be provided at each location
Printer/Scanner	1	2	Blue	
Student Carrels				
Students	1	1	Yellow	Power must be provided at each location.

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Printer/Scanner	1	2	Blue	
Single Person Office				
Single Person Office with Meeting Space	3	3	Blue	On opposing, non-door walls. Also a drop shall be installed, normally at 18”AFF, for meeting table.
Single Person Office	2	3	Blue	On opposing, non-door walls.
Single Person Modular Furniture	1	3	Blue	
Two Person Office				
Modular Furniture	1	3	Blue	
Network Multi-Function Printer	1	2	Blue	For office/cubicle areas determine where a networked, centralized, multifunction printer/scanner will be placed. Ensure WAO and appropriate power for placement.
Conference Rooms				
Presentation Wall	1	3	Blue	Coordinate with multimedia plan for the room.
Projector	1	2	Blue	
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate media connections with multimedia plan for the room.
Under Table	1	3	Blue	One floor mounted communication outlet box as well as an electrical outlet to allow access under the conference table per 6 ft of table.
Walls	1 per 10 feet	3	Blue	
Work Rooms				
Throughout the Workroom			Blue	Along counter tops where devices and printers shall be placed, communications outlets, with appropriate electrical outlets, will be distributed every six feet. Depending upon the size and configuration of the room, District IT will define the number of wired connections required. These will be placed at +6” above counter height. For self-standing copier machines, a communication outlet will be provided with appropriate dedicated electrical outlets.
Large Indoor Gathering Spaces				

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Classroom Notification Speaker	1	2	Orange	See classroom notification section below for details.
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate media connections with multimedia plan.
Moderator / Podium	1	3	Blue	To be coordinated with multimedia plan.
Other Data Locations				
Mounted TV/Display	1	2	Blue	Flush mounted biscuit and appropriate power. Coordinate media connections with multimedia plan.
Wireless Access Point	1	2	Green	Shall be installed 12” below the ceiling but not to exceed 12' above the finished floor. This shall take the form of a flush-mount outlet. This outlet can be located above a false ceiling. Variance needs to be requested below 8’ on a wall. For the longevity and safety of the WiFi system, access points must be mounted further than 12” from any metal or wire mesh surface. The location of the access point will be discreetly marked on the ceiling to enable technicians to find the access point without lifting tiles. Placement of Access Points is entirely dictated by the Wireless heatmap based Design.
Security Camera	1	2	Black	Pathway and routing to these security devices will be designed on an individual basis. Cables shall be terminated in suitable biscuit boxes.
Access Control to Individual Doors	1	2	Black	Pathway and routing to these security devices will be designed on an individual basis. Cables shall be terminated in suitable biscuit boxes.
Open Corridor or Lobby Workspace	1	3	Blue	
Building Maintenance Areas				Electrical rooms, security rooms, mechanical rooms, control rooms, boiler rooms, and garages.
Building Management Systems	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.

Table I Drop Cable Counts				
Room Usage	Minimum drop(s)	# of Jacks per Drop	Jack Color	Notes
Mechanical Room	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Electrical Room	1	2	Blue	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Security Systems	1	2	Black	This shall take the form of a flush-mount outlet coordinated with layout of equipment on wall.
Fire Alarm Systems	1	2	Black	A dedicated 1” homerun conduit shall be run from each fire alarm panel to the TR horizontal cross connect.
Intrusion Alarm Systems	1	2	Black	A dedicated 1” homerun conduit shall be run from each intrusion alarm panel to the TR horizontal cross connect.
Elevators	1	2	White	A dedicated 1” homerun conduit shall be run from the TR to the elevator equipment room and connected to a 2”W x 3”H x 2-1/2”D single gang box adjacent to the elevator equipment. Elevator voice instruments are normally provided by District IT. The design professional should consult with District IT concerning the district instrument of choice.
Storage Spaces	1	3	Blue	If storage space is large enough to be repurposed as office, it needs to be designed with Office standards above.

11.7. Classroom Notification System (CNS)

11.7.1. The CNS Push-To-Talk buttons will be installed in all large classrooms, meeting rooms, team rooms, or other large areas where people gather.

11.7.2. Hold a coordination meeting with District IT and Public Safety to confirm CNS locations.

11.7.3. At time of installation the contractor shall provide a spreadsheet detailing the room number, mac-address and jack used to patch each speaker. The system can not be configured for use without this information.

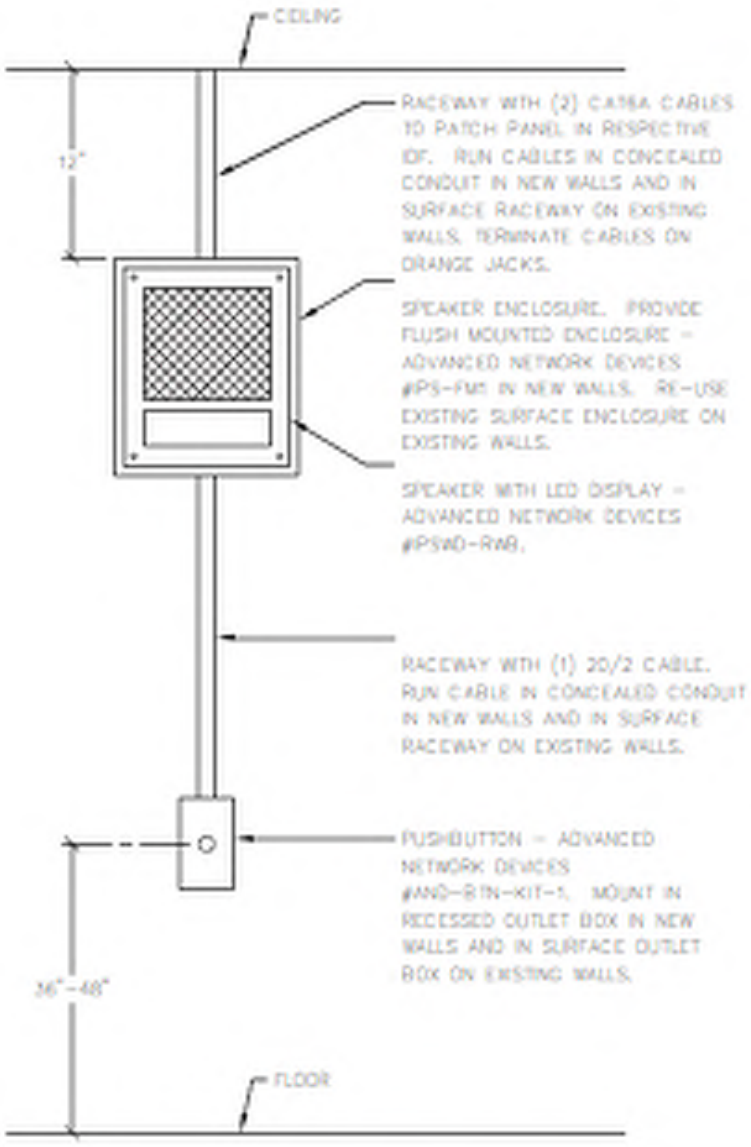
11.7.4. The push to talk button must be located within 15 feet of the speaker and must be ADA accessible.

11.7.5. Push to talk buttons shall not be placed next to a doorway unless other criteria force that location.

11.7.6. Speaker shall be installed 12” below the ceiling and viewable from all locations in the room with the following connections:

- 2 Network drops will be terminated with orange jacks in a wall box attached inside the speaker enclosure. These drops will be labeled with the room number on both ends.
- Install a 20AWG wire from the speaker to the location of the button, this 20 AWG wire must be securely routed to the speaker through conduit. The wire shall be connected to the speaker as well as the button as directed in the manufacturer installation directions.
- All Buttons must be installed at ADA height (between 36” and 48” off the floor).
- All buttons must be within 15 feet of the speaker.
- Contractor to provide wall box for the button installed inside the wall.
- The following exhibit shows the layout of the CNS system in a classroom.

Exhibit IX
Classroom Notification System
(Drawing Detail Example) Orange



NOTES:
1. REFER TO MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR DEVICE WIRING REQUIREMENTS.
2. TERMINATE CAT6A CABLES IN A DUPLEX CAT6A JACK IN SPEAKER ENCLOSURE.
3. PROVIDE (2) CAT6A PATCH CORDS (ORANGE). SPEAKER END SHALL HAVE A 3 FOOT PATCH CORD. IDF END SHALL HAVE THE APPROPRIATE LENGTH PATCH CORD APPROPRIATELY ROUTED IN RACK AND ABLE TO BE PLUGGED INTO THE NETWORK SWITCH.

5 / E-511 **EMERGENCY INTERCOM DETAIL**
NONE

11.7.7. Where the CNS system is installed in a remodeling location and the wall will not allow for in-wall installation, the speaker shall be installed 12” below the ceiling and viewable from all locations in the room with the following connections:

- 2 Network drops will be terminated with orange jacks in a wall box attached inside the speaker enclosure. These drops will be labeled with the room number on both ends.

- Install a 20AWG wire from the speaker to the location of the button, this 20 AWG wire must be securely routed to the speaker through Panduit securely mounted to the walls with screws (use of double-sided tape is not acceptable). The wire shall be connected to the speaker as well as the button as directed in the manufacturer installation directions.

- All Buttons must be installed at ADA height (between 36” and 48” off the floor).

- All buttons must be within 15 feet of the speaker.

- Contractor to provide surface mounted wall box for the button.

- The following exhibit shows the layout of the CNS system in a classroom where surface mounted raceway was used. In new buildings the wiring would be inside the wall.

Exhibit X
Classroom Notification System
(Example in a classroom surface mounted location)

11.8. Special use considerations

Special use considerations - Some specific types of areas and uses differ from “office/conference room” type space. Therefore, these areas should be addressed in the list below:

11.8.1. Classrooms

- The design professional should consult with District IT on a case-by-case basis to assure that any special needs are met.
- Do not design computer classrooms with only WiFi data connectivity. Computer classrooms need to have wired drops for each student.

11.8.2. Modular Office/Open Areas - These areas are unique and at times may require special modular telecommunications hardware. Special conduit and termination boxes may also be required. Therefore, the design professional should consult with District IT on a case-by-case basis to assure that needs are met.

11.8.3. Floor Outlets - Floor outlets shall be multi service recessed floor boxes. Any box shall be approved in advance by District IT.

11.8.4. ADA Requirements Outlets in public locations that will require access by the handicapped (i.e., payphones, public phones, etc.) have special height and reach requirements for their installation in terms of the “Highest Operable Mechanism.”

11.8.5. Emergency Notification Speakers with Push-To-Talk buttons. 4CD has identified these as Classroom Notification System (CNS). See the CNS section below for details.

11.8.6. Rooftops - Control equipment that is located on building rooftops frequently requires special provisioning of communications connectivity. This equipment can include HVAC monitors, cellular/wireless antennas, broadcasting equipment, telescopes, communication relays, photovoltaics, etc. Some of these systems shall be added after the building is built. It is more important to provide a clear pathway through which connections can be added later. Any control systems that require network connectivity need to be located within 275 feet of a IDF or BDF.

11.8.7. Specialty Locations - The campus will have specialty locations that will require custom configuration at the time of building design. These locations include but are not limited to theatres, lecture halls (seating capacity > 200), auditoriums, athletic broadcasting venues and control rooms, scoreboards, electronic advertising boards, and others that cannot be envisioned at this time. At the time of design, the requirements for each of these locations will be individually determined in design meetings with District IT.

12. Special Architectural Considerations

12.1. WiFi design

12.1.1. Design to provide for ubiquitous IEEE 802.11 AC networking throughout new and renovated spaces and at selected areas of the exterior designated by District IT.

12.1.2. Contractor's design must utilize a three-dimensional enterprise wireless prediction methodology equivalent to the planning manager in Ekahau Enterprise Site Survey to locate access points (AP's).

12.1.3. Contractor's WiFi design shall be prepared by an individual trained and holding current certification equivalent to that of an Ekahau Certified Survey Engineer (ECSE) for the planning tool used by the Contractor. Contractor's design to incorporate AP characteristics of the type identified as design basis. AP's will be 4CD furnished and Contractor installed.

12.1.4. 4CD has standardized on Ruckus Wireless AP's and controllers.

12.1.5. Design for occupied areas of the building interior will be based on the Ruckus Best Design Practices as presented in Ekahau design standards.

12.1.6. For the longevity and safety of the WiFi system, access points must be mounted further than 12" from any metal or wire mesh surface.

12.1.7. Design basis is 802.11AC devices operating at 5 GHz. Design for 2.4 GHz to assume network will push capable devices to 5 GHz.

12.1.8. Design capacity analysis should provide density as required to achieve 10 MBps minimum per device simultaneously.

12.1.9. The Design Professional must present complete planning report of the completed analysis to District IT for review and approval.

12.1.10. WAP's will have 2 drops terminated with green jacks and shall be labeled with the room number and jack number on both ends.

12.1.11. At time of installation the contractor shall provide a spreadsheet detailing the room number, mac-address and jack used to patch each wireless access point. The system cannot be configured for use without this information.

12.2. Emergency Responders Radio Coverage (ERRC)

12.2.1. Emergency Responders Radio Coverage systems are required by the California Fire Code to extend public safety radio into new and altered building space.

12.2.2. Designs of new ERRC are ordinarily provided as part of the Fire Alarm System design. Design for new District facilities to provide an Emergency Responders Radio Coverage system in the building where required by and constructed in conformance with the requirements of Code, the District's requirements as a provider of Public Safety services, and the Authority Having Jurisdiction.

12.2.3. Where ERRC systems route through Information Technology spaces, coordinate the design to maintain clearances and minimum pathway requirements of Information Technology Systems, and NFPA 72 as interpreted by the AHJ for required fire protection of the pathways and Telecommunications Rooms used for this function.

12.3. Two-way Communications

12.3.1. Two-way Communications Systems are required by the California Building Code for multi-story new and altered building space where elevators are used to reach the level of discharge.

12.3.2. Provide design of new two-way communications systems for new and altered District facilities where required by and constructed in conformance with the requirements of Code, 4CD, and the Authority Having Jurisdiction. Review the answering point options available with District IT to meet the Code requirements. District standards for supported two-way communications systems manufacturers are under review – design teams to request clarification at the 50% CD stage to ensure the Project incorporates current standards.

12.3.3. Where two-way communications systems route through Information Technology spaces, coordinate the design to maintain clearances and minimum pathway requirements of Information Technology Systems as defined elsewhere in this standard, and NFPA 72 as interpreted by the AHJ for required fire protection of the pathways and Telecommunications Rooms used for this function.

Revision Notes:

Revision 3.0 Reviewed with District IT team

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of communication bonding required by these specifications and related construction drawings.

B. Division 26 - Electrical specifications and accompanying drawings are particularly applicable to this section of this Division 27 specification.

C. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 11 00 - Communications Equipment Room Fittings
4. Section 27 11 13 - Communications Entrance Protection
5. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
6. Section 27 11 19 - Communications Termination Blocks and Patch Panels.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 BUSBARS

Furnish all required telecommunications grounding system busbars - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Bonding."

2.03 BONDING CONDUCTORS

Furnish all required 6 AWG green thermoplastic insulated stranded copper wire - see Section 27 06 00 - Schedules for Communications, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Bonding."

2.04 BONDING CONDUCTOR TERMINATIONS

A. Furnish all required two-hole compression lugs: Color coded to appropriate cable, high conductivity wrought copper, electro tin plated - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Bonding."

B. All bonding compression lugs and other bonding hardware shall be Underwriters Laboratories (UL), or other nationally recognized testing laboratory acceptable to ###, listed for the application intended.

PART 3 - EXECUTION

3.01 GENERAL

The contractor shall comply with all requirements as listed in ANSI/TIA/EIA-STD-607-A “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications” whether shown on the drawings or not.

3.02 INSTALLATION

A. Install busbars per manufactures instructions and at locations shown on the accompanying drawings. If locations are unclear, clarify location with ITPC before installing.

B. Provide all bonding as specified by these Division 27 specifications and the conjoined construction drawings. In particular make sure, when present in a Telecommunication Room (TR), that the following elements are bonded:

1. Metallic equipment racks.

2. Cable shields.

3. All metal raceways and cable trays.

C. Bonding conductors shall be continuous and routed in as direct a route as possible to the point of termination while adhering to the following: No bonding conductor shall vertically traverse a wall except at wall corners.

D. Clean ground bars prior to terminating bonding conductors.

3.03 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.04 LABELING

A. Reference construction drawings accompanying this Division 27 specification.

B. Comply with Section 27.00 00 – Communications.

C. Label all telecommunications bonding conductors as close as possible to the termination points with an ANSI/TIA/EIA 606 compliant label for bonding.

3.05 AS-BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

Comply with Section 27 00 00 – Communications.

END OF SECTION

SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of equipment supports, cable supports, and fastening hardware as called for in these specifications and conjoined construction drawings.

B. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 05 41 - Fire Stopping
4. Section 27 11 00 - Communications Equipment Room Fittings

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 J-HOOKS

A. Furnish all required four-inch (4"), two-inch (2") and one-inch (1") J-Hooks - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Pathway."

B. Comply with drawings for approved installation methods.

2.03 SURFACE MOUNT RACEWAY

Furnish all required surface mount cable raceway - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material

Category, "Pathway." Surface mounted raceway must be secured with fasteners, adhesive is not sufficient.

2.04 PIECE PARTS AND ACCESSORIES

Furnish all other piece parts, accessories, hanger rods, clamps, required to properly install per this specification section and the conjoined construction drawings required J-Hooks, and surface mount raceway.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall comply with requirements as listed in ANSI/TIA-569-B “Commercial Building Standard for Telecommunications Pathways and Spaces” whether shown on the drawings or not.

B. The Contractor shall make field adjustments and resolve conflicts between construction drawings, specifications, and field conditions before beginning any J-Hook and/or surface mount raceway installation.

3.02 INSTALLATION

A. Install all J-Hooks, surface mount raceway and associated components per manufacturer’s specifications, instructions, and recommendations. Do not exceed 80% of manufacturer’s fill and load factors.

B. Fasten hanger rods, conduit clamps, and other applicable supporting hardware to the building structure using expansion anchors, beam clamps, or powder actuated fastening systems. Do not use spring clips.

C. Do not fasten supports to piping, ductwork, mechanical equipment, lay-in ceiling support wires and grid, or conduits.

D. Do not drill into structural steel and concrete members without written authorization a structural engineer or the ITPC.

E. In areas where cable tray or conduit is not provided, support the cable with cable hangers. Cable hanger to cable hanger center-to-center separation shall be a maximum of five (5) feet. Cable bundles shall be at all times at least six (6) inches above any lay-in ceiling tiles. Cable support hangers shall be placed in as straight a line as possible.

3.03 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.04 LABELING

A. Reference construction drawings accompanying this Division 27 specification.

B. Comply with Section 27.00 00 – Communications.

3.05 AS BUILT DRAWINGS

Comply with Section 27 15 53 - Cable Plant Testing.

3.06 VERIFICATION

Comply with Section 27.00 00 – Communications.

3.07 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 05 33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. All provisions of Division 00, Division 01, Division 26 (or 1995 CSI Master Format Edition Division 16) - Electrical apply to work specified in Division 27 and this Section of Division 27.

B. With the exception of the work listed in item 1.01, C of this section, the work of this 27 05 33 section is to be furnished by others. Resolve any conflicts with the ITPC or his/her designate.

C. Refer to the drawing symbol list for reference to specific locations that shall require the installation of a 4-11/16 x 4-11/16 backbox, chase nipple, bushing, and a single gang mud ring.

PART 2 - PRODUCTS

Furnish all required 4-11/16 x 4-11/16 backboxes, chase nipples, bushings, and a single gang mud rings.

PART 3 - EXECUTION

A. The contractor shall comply with requirements as listed in ANSI/TIA-569-B “Commercial Building Standard for Telecommunications Pathways and Spaces” whether shown on the drawings or not.

B. The contractor shall make field adjustments and resolve conflicts between construction drawings, specifications, and field conditions before beginning any installation.

END OF SECTION

SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of equipment room fittings as called for in these specifications and accompanying drawings.

B. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 11 13 - Communications Entrance Protection
5. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
6. Section 27 11 19 - Communications Termination Blocks and Patch Panels.
7. Section 27 15 13 - Communications Copper Horizontal Cabling

C. Division 16 - Electrical also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

D. Division 28 - Electronic Safety and Security also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 CABLE TRAY

A. Furnish all required cable tray - see Section 27 06 00 - 4CD Low Voltage Materials, Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, “Telecom Room."

B. Furnish all required of the following:

1. Butt Splices;
2. Triangle Wall Brackets;
3. Junction Splices;
4. Wall Angle Support Kits;
5. Cable Tray Elevation Kits;
6. Single Earthquake Brackets;
7. Waterfall upper trays;
8. Horizontal Cable Managers;
9. Upper Tray Cable Managers;
10. ANSI/TIA/EIA STD-607-A Compliant Bonding Tags.

C. See Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

2.03 CABLE TRAY PIECE PARTS AND ACCESSORIES

Furnish all other piece parts and accessories to complete the accompanying construction drawing set communications room layouts. Use only manufacturer-supplied and/or manufacturer-provided hardware.

PART 3 - EXECUTION

3.01 GENERAL

The Contractor shall make field adjustments and resolve conflicts between accompanying construction drawings, specifications, and field conditions before beginning cable tray and/or vertical cable manager installation.

3.02 INSTALLATION

A. Install all cable tray and associated components per manufacturer’s instructions as required for a seismic zone four (4) location.

B. Cable tray shall be supported at intervals of no greater than every four (4) feet.

C. Follow cable tray elevations and layout patterns that are specified in the accompanying construction drawings as closely as field conditions will permit. Any proposed deviations, including those caused by field conditions, must be approved by the ITPC or his/her designate.

3.03 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.04 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

3.05 AS BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.06 ACCEPTANCE

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 05 41 - FIRE STOPPING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of fire stopping for communications systems as called for in these specifications and conjoined construction drawings.

B. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to, the following:

1. Section 27 00 00 - Communications

2. Section 27 06 00 - 4CD Low Voltage Materials

3. Section 27 11 13 - Communications Entrance Protection

4. Section 27 15 13 - Communications Copper Horizontal Cabling

5. Section 27 15 23 - Communications Optical Fiber Horizontal Cabling

C. A through-penetration is created when a cable tray, cable, conduit, or sleeve passes through an opening in a fire-rated wall or floor. The opening offers a path for fire and smoke to spread. A fire stop is a special sealing system designed and tested to restore the fire integrity of the barrier.

D. The Structured Cabling System (SCS) Contractor shall provide fire stops for any cable tray system or riser system utilized by the SCS and the CATV distribution system cabling as required by the latest National Electrical Code (NEC).

E. Fire stopping of openings or penetrations between floors, through rated fire and smoke walls, existing or created by the Contractor for SCS and CATV distribution system cable pass-through shall be the responsibility of the Contractor.

F. Fire stopping system material and its application shall be accomplished in a manner that is acceptable to ITPC or his/her designate as well as local fire and building Inspector of Record (IOR) over this work.

1.02 QUALITY CONTROL

A. Comply with Section 27 00 00 - Communications.

B. Fire stop system installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

A. Comply with Section 27 00 00 - Communications.

B. In addition to compiling with Section 27 00 00 - Communications, the Contractor shall make the following submittals:

1. Submit material safety data sheets provided with product when it is delivered to the job-site;

2. Provide certification from the fire stopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants;

3. Submit Underwriters Laboratories (UL) listed (or other nationally recognized testing laboratory acceptable to 4CD listed) system documentation for each type of application.

1.06 COORDINATION

A. Comply with Section 27 00 00 - Communications.

B. Deliver fire stopping products to the project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying project and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to the project; curing time; and mixing instructions for multi-component materials.

C. Coordinate delivery of materials with the scheduled installation date to allow minimum storage time at the job site.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 FIRE STOP PUTTY AND MINERAL WOOL

A. Furnish all required fire stop putty - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Fire Stop."

B. Furnish all required fire stop mineral wool - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Fire Stop."

2.02 FIRE STOP READY SLEEVES

Furnish all required fire stop; one-inch (1"), two-inch (2"), and four-inch (4") fire stop Ready Sleeves - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Fire Stop."

PART 3 - EXECUTION

3.01 GENERAL

A. Verify that openings are ready to receive the work of this section. Sequence work to permit fire stopping materials to be installed after adjacent and surrounding work is complete.

B. The Contractor shall make field adjustments and resolve conflicts between construction drawings, specifications, and field conditions before beginning fire stop system technology installation(s).

C. If a proposed fire stop system technology requires even minor modification(s) to the certified system to accommodate some particular through-penetration field condition, do not make or install modified fire stop system before submitting to ITPC or his/her designate an illustration drawing of the modifications approved by the IOR.

3.02 INSTALLATION

A. The Contractor shall be responsible for fire stopping all penetrations that support SCS cable and CATV distribution system cable.

B. As part of the work of this section, it shall be the responsibility of the Contractor to fire stop any penetrations created by or for the SCS and left unused.

C. Environmental requirements

1. Do not install fire stopping when ambient or substrate temperatures are outside limits permitted by fire stopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

2. Ventilate fire stopping per the fire stopping manufacturer's instructions by natural means or where there is inadequate means, forced air circulation.

3. During installation, provide masking and drop cloths to prevent fire stopping materials from contaminating any adjacent surfaces.

4. Do not use materials that contain flammable solvents.

D. Preparation

1. Clean out openings and joints immediately prior to installing fire stopping to comply with specifications, recommendations, and instructions of the fire stopping manufacturer.

2. Remove all foreign materials from surfaces of openings and joint substrates and from penetrating items that could interfere with adhesion of fire stopping.

3. Clean openings and joint substrates and penetrating items to produce clean, sound surfaces capable of developing the optimum bond with fire stopping. Remove loose particles remaining from the cleaning operation.

E. Labeling

When the fire stop system has been installed, place a manufacturers label next to the system. The label shall contain at a minimum the following items:

1. UL rating (or other nationally recognized testing laboratory acceptable to 4CD rating) and any other pertinent certification information.

2. The date the fire stop system was installed.

3. Name of Contractor who installed the fire stop system.

4. Comply with Section 27.00 00 - Communications.

F. Protection

1. Protect fire stopping during and after the curing period from contact with contaminating substances or form damage resulting from construction operations or other causes so that they are without deterioration or damage at the time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated fire stopping immediately and install new materials to produce fire stopping complying with specified requirements.

2. The Contractor shall take pictures of all fire stopping installations. The picture shall include the fire stop, label, and indicate the location for each penetration.

3. Keep areas of work accessible until inspection and sign off by the IOR.

3.03 EXAMINATION

Comply with Section 27.00 00 - Communications.

3.04 AS BUILT DRAWINGS

Comply with Section 27 15 53 - Cable Plant Testing.

3.05 VERIFICATION

Comply with Section 27.00 00 - Communications.

3.06 ADJUSTMENTS

Comply with Section 27.00 00 - Communications.

END OF SECTION

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of equipment room fittings as called for in these specifications and accompanying drawings.

B. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 11 13 - Communications Entrance Protection
5. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
6. Section 27 11 19 - Communications Termination Blocks and Patch Panels.
7. Section 27 15 13 - Communications Copper Horizontal Cabling

C. Division 16 - Electrical also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

D. Division 28 - Electronic Safety and Security also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 CABLE TRAY

A. Furnish all required cable tray - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, “Telecom Room." Hook and Loop fasteners only, no zip ties are allowed to secure cabling.

B. Furnish all required of the following:

1. Butt Splices;
2. Triangle Wall Brackets;
3. Junction Splices;
4. Wall Angle Support Kits;
5. Cable Tray Elevation Kits;
6. Single Earthquake Brackets;
7. Waterfall upper trays;
8. Horizontal Cable Managers;
9. Upper Tray Cable Managers;
10. ANSI/TIA/EIA STD-607-A Compliant Bonding Tags.

C. See Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

2.03 EQUIPMENT RACK VERTICAL CABLE MANAGERS

Furnish all required vertical cable managers; see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

2.04 EQUIPMENT RACK HORIZONTAL CABLE MANAGERS

Furnish all required horizontal cable managers; see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

2.05 CABLE TRAY & CABLE MANAGER PIECE PARTS AND ACCESSORIES

Furnish all other piece parts and accessories to complete the accompanying construction drawing set communications room layouts. Use only manufacturer-supplied and/or manufacturer-provided hardware.

PART 3 - EXECUTION

3.01 GENERAL

The Contractor shall make field adjustments and resolve conflicts between accompanying construction drawings, specifications, and field conditions before beginning cable tray and/or vertical cable manager installation.

3.02 INSTALLATION

A. Install all cable tray, vertical cable managers, horizontal cable managers, and associated components per manufacturer's instructions as required for a seismic zone four (4) location.

B. Cable tray shall be supported at intervals of no greater than every four (4) feet.

C. Follow cable tray, vertical cable manager, and horizontal cable manager elevations and layout patterns that are specified in the accompanying construction drawings as closely as field conditions will permit. Any proposed deviations, including those caused by field conditions, must be approved by the ITPC or his/her designate.

3.03 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.04 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

3.05 AS BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.06 ACCEPTANCE

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 11 13 – ENTRANCE PROTECTION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of outside plant cable (OSP) Building Entrance Terminal (BET) protection and termination for copper cabling as called for in these specifications and related drawings.

B. Coordinate location of entrance protection with 4CD Information Technology Project Coordinator (ITPC).

C. Division 26 - Electrical specifications and accompanying drawings are particularly applicable to this section of this Division 27 specification.

D. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 11 00 - Communications Equipment Room Fittings
4. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
5. Section 27 11 19 - Communications Termination Blocks and Patch Panels.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 MANUFACTURES

There is no preferred manufacturer.

2.03 MATERIALS AND FABRICATION

A. BET technology to include fusible link.

B. Protector technology: 5-Pin, 300V, 350 mA.

C. Miscellaneous parts and material required to complete a successful installation of the BET technology, such as splice case and associated hardware

PART 3 - EXECUTION

3.01 GENERAL

Comply with Section 27 00 00 - Communications.

3.02 INSTALLATION

A. Copper outside plant cabling

1. Install a Building Entrance Terminal protector unit for every 100 pairs of OSP entrance cable or entrance tie cable as specified in the drawings.

2. Mount the protector units in columns of not more than three units, with the top surface of the upper-most unit 6 feet A.F.F. Use mounting hardware recommended by the manufacturer.

3. Bond all protectors in each BET together using 1/0 AWG (6 AWG allowed) ground wire, in daisy chain style. Connect a segment of ground wire from the top unit to the Telecommunication Grounding Buss Bar in the telecommunications room. Install 100 5-pin protector units for each protector terminal.

4. Splice entrance cable or entrance tie cable to 26 AWG protector terminal fuse cable pigtails. Secure the splice case vertically on the TR wall as shown on the contract drawings.

5. The Contractor shall bond the shield of each OSP cable to the Telecommunication Grounding Buss Bar (TGBB) provided at the entrance facilities using 1/0 AWG copper wire.

6. At the termination end of multi-pair OSP cables, the Contractor shall provide six feet of managed service slack.

7. Label Building Entrance Terminals according standards listed in section 270000.

B. Test all terminated pairs of each copper backbone cable segment from the BET output field through the installed protector for the following:

1. Continuity to remote end.

2. Shorts between any two or more conductors.

3. Transposed pairs.

4. Reversed pairs.

5. Split pairs.

6. Grounded conductor.

7. Shield continuity.

3.03 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.04 LABELING

A. Reference construction drawings accompanying this Division 27 specification.

B. Label all OSP and telecommunications bonding conductors as close as possible to the termination points with an ANSI/TIA/EIA 606 compliant label for bonding.

C. Comply with Section 27 00 00 – Communications.

3.05 AS-BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

Comply with Section 27 00 00 – Communications.

END OF SECTION

SECTION 27 11 16 - COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of communication cabinets, racks, frames and enclosures as called for in this Section of the Division 27 specifications and accompanying construction drawings.

B. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 11 00 - Communications Equipment Room Fittings
5. Section 27 11 13 - Communications Entrance Protection
6. Section 27 11 19 - Communications Termination Blocks and Patch Panels.
7. Section 27 15 13 - Communications Copper Horizontal Cabling
8. Section 27 15 53 - Cable Plant Testing

C. Division 16 - Electrical also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

D. Division 28 - Electronic Safety and Security also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 CABINETS

A. Furnish all required cabinets - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

B. Furnish all required piece parts and hardware to construct and outfit the cabinets as shown on the construction drawing set accompanying this specification.

2.03 RACKS

A. Furnish all required 4-post equipment racks - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

B. Furnish all required piece parts and hardware to construct and outfit the equipment racks as shown on the construction drawing set accompanying this specification.

PART 3 - EXECUTION

3.01 GENERAL

A. Before anchoring cabinets, racks, or frames to floor, wall, or overhead runway/cable tray in any telecom room, review their in place layout with the ITPC, or his/her designate. When they give approval of in place layout, proceed with anchoring.

B. The Contractor shall comply with all SCS bonding requirements as listed in ANSI/TIA/EIA-STD-607-A “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications” whether shown on the accompanying drawings or not.

3.02 INSTALLATION

A. Install all cabinets, racks, frames, and enclosures per manufacturers’ installation specification, instructions, and recommendations as required for a seismic zone four (4) location.

B. Bond all cabinets, racks, frames, and enclosures to the Telecommunication Grounding Buss Bar (TGBB) using 6 AWG Green thermoplastic insulated stranded copper wire.

3.03 LABELING

A. Comply with Section 27 00 00 - Communications.

B. Before labeling any equipment rack or cabinet confer with the ITPC and his/her designate to determine label content and placement.

3.04 AS BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

END OF SECTION

SECTION 27 11 19 - COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of communication blocks and patch panels as called for in this section of the Division 27 specifications and conjoined construction drawings.

B. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 11 13 - Communications Entrance Protection
4. Section 27 15 13 - Communications Copper Horizontal Cabling
5. Section 27 15 53 - Cable Plant Testing

C. Division 28 - Electronic Safety and Security also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 COPPER TERMINATION BLOCKS

A. Furnish all 110 (or approved equal) termination block fields required to terminate the copper backbone (riser) cabling and the voice cross-connect system cabling - Reference Section 27 15 13 - Communications Horizontal Cabling.

B. Furnish all required 110 system (or approved equal) C4 and C5 termination blocks.

C. Furnish all required pair grouping 110 (or approved equal) termination block label strips.

D. See Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Room."

2.03 COPPER PATCH PANELS

A. Furnish all patch panels required to support the TR terminations of the horizontal cabling.

B. Furnish all patch panels required to support the voice cross-connect system - Reference Section 27 15 13 - Communications Horizontal Cabling.

C. See Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Telecom Rm."

2.04 BACKBONE FIBER PATCH PANELS

A. Furnish all required wall mount fiber patch panels - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product Material Category "Fiber."

B. Furnish all required rack mount fiber patch panels - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product Material Category, "Fiber."

C. Furnish all fiber patch panel piece parts required for the termination of Single Mode Fiber (SMF) and Multi Mode Fiber (MMF) optical fiber backbone cables and complete build-out of associated fiber patch panels including blank fill plates - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product Material Category, "Fiber."

D. SMF fiber connectors: Furnish all required SMF connector "Pigtails" - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product Material Category, "Fiber."

E. MMF fiber connectors: Furnish all required MMF connector "Pigtails" - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product Material Category, "Fiber."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Copper backbone termination.

1. Mount 110 (or approved equal) termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.

2. Backbone cables are to be routed neatly on overhead cable runway to block termination locations. For cable management from cable runway to block termination and the dressing of cable at the blocks, follow manufacturer’s specifications, instructions, and recommendations and standard industry practices.

3. Terminate all riser backbone cables per manufacturer’s specifications, instructions, and recommendations.

4. At the termination end of multi-pair riser cables, the Contractor shall provide 15 feet (15') of managed service slack.

5. If removal of the cable jacket is required to facilitate routing of ARMM or plenum backbone cable into the blocks, the exposed cable pairs shall be fully covered with black or gray plastic tape, neatly lapped to prevent gaps.

6. Install five (5) pair and four (4) pair 110 I.D. strips for backbone cabling as required per the construction drawing set accompanying this Division 27 specification.

B. Cable drop horizontal cable termination.

1. Install one (1) 48-port patch panel for every 48 horizontal UTP data cables.

2. Mount patch panels per the construction drawing set accompanying this Division 27 specification. Note: See Section 27 11 00 - Communications Equipment Room Fittings.

3. Each patch panel shall have a 2RU horizontal manager placed both above and below the panel.

4. Horizontal cables are to be routed neatly on overhead cable runway to equipment racks; exit cable runway into equipment rack vertical cable management and proceed to the patch panels. Hook and Loop fasteners only, no zip ties are allowed to secure cabling.

5. Cable termination.

a. Cables on the left side of the patch panel shall enter from the left side vertical cable manager. Cables on the right side of the patch panel shall enter from the right side vertical cable manager. Cables shall not cross the center line of the patch panel.

b. Terminate cables using the 8-pin jack, T568-B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.

C. Voice cross-connect system termination.

1. 110 or approved equal cable end termination.

a. Mount 110 (or approved equal) termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.

b. 110 or approved equal C4 blocks shall be used for all but the last position on each twenty-five (25) pair row of a 110 one hundred (100) pair field and C5 blocks for the last five (5) pair positions in each twenty-five (25) pair row.

2 Patch panel end terminations.

a. Install one (1) 48-port patch panel for every 48 UTP data cables terminated at the voice cross-connect systems 110 blocks.

b. Mount patch panels per the construction drawing set accompanying this Division 27 specification. Note: See Section 27 11 00 - Communications Equipment Room Fittings. Each patch panel shall have a 2RU horizontal manager placed both above and below the panel.

c. Terminate cables using the 8-pin jack, T568-B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.

D. Fiber backbone cable termination.

1. Install at the locations indicated on the construction drawing set and per manufacturer's specifications, instructions, and recommendations the wall mount and rack mount optical fiber patch panels.

2. Fiber backbone cables are to be routed neatly on overhead cable runway to patch panel termination locations. For cable management from cable runway to patch panel termination and the dressing of cable at the patch panel termination, follow manufacturer's specifications, instructions, recommendations, and standard industry practices.

3. Before terminating fiber backbone cable neatly install twenty-five feet (25') of service loop slack on Telecommunication Room wall near location where backbone cable is to be terminated. Diameter of service loops shall be eighteen inches (18"). Hook and Loop fasteners only, no zip ties are allowed to secure cabling.

4. Terminate fiber backbone cable by fusion splicing the appropriate connector "Pigtail" to the backbone cable. Comply with manufactures specifications, instructions, and recommendations.

5. Fiber connector "Pigtail" splicing: Use only fusion splicing to splice fiber connector pigtails to fiber backbone cable. No other splicing methodology shall be allowed.

3.02 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.03 ISP/OSP BACKBONE COPPER 110 TERMINATION BLOCK LABELING

A. Comply with Section 27.00 00 – Communications.

B. 110 block cable ID label shall be as follows:

1. Label shall be 4CD generated cable number - from Telecommunications Room (TR) number - cable pair count per 25 pairs (1-25, 26-50, etc.).

2. 'From' 4CD building Telecommunications Room (TR) number for ISP riser or 'From' 4CD building number for OSP cable.

3. Cable pair count per 25 pairs (1-25, 26-50, etc.)

C. See ITPC or his/her designate to obtain 4CD generated cable number.

D. Pair call-out labeling: Pair call-out labeling shall designate every fifth (5th) pair consecutively through total pair count of the cable terminated on the block but not including the first (1st) and twenty-fifth (25th) pairs of each twenty-five (25) pair field bundle: Example for fifty (50) pair cable -- 5, 10, 15, 20, 30, 35, 40, 45.

E. All labels shall be machine/printer created labels. Hand labeling is not acceptable unless approved in writing as acceptable by the ITPC or his/her designate.

3.04 HORIZONTAL COPPER PATCH PANEL LABELING

A. Comply with Section 27.00 00 – Communications.

B. Label placement.

1. Label each patch panel with a patch panel number. P1 for patch panel 1, P2 for patch panel 2, etc.

2. Modular jack assignment number and TR patch panel port number shall be the same number.

C. All labels shall be machine/printer created labels. Hand labeling is not acceptable unless approved in writing as acceptable by the ITPC or his/her designate.

3.05 BACKBONE FIBER PATCH PANEL LABELING

A. Comply with Section 27.00 00 – Communications.

B. Each backbone fiber patch panel shall have a header label.

C. Header Label format and content shall be as follows:

1. 4CD generated cable number. See ITPC or his/her designate to obtain 4CD generated cable number.

2. 'From' 4CD building Telecommunication Room (TR) number for ISP riser or 'From' 4CD building number- TR number for OSP cable.

3. Fiber strand type designation and strand count. SM (single mode) XX; MM (multi-mode) XX where XX = strand count. If cable is a hybrid make sure both strand type counts are accounted for in header label.

D. Fiber Patch Panel Port Labeling: Label each fiber patch panel port with the strand count terminated on the port.

E. All labels shall be printed labels. Hand labeling is not acceptable unless approved in writing as acceptable by the ITPC or his/her designate.

3.06 VOICE CROSS-CONNECT SYSTEM LABELING

A. The 110-Blocks shall be labeled “Voice Cross-Connect to Rack #_ Panel #__”. Each cable shall be numbered from 01-48 on the 110-block Designation Strips.

B. The patch panels on the racks shall be labeled “Voice Cross-Connect Rack #_ Panel #__”. Each modular jack shall be numbered from 01-48 on each panel.

3.07 TESTING

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.08 AS-BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.09 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

3.10 ACCEPTANCE

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation and termination of new horizontal cabling as specified in this section of the specifications.

B. The horizontal link portion of the cabling system specified in this section extends from the modular jack termination of the cable at the drop faceplate to its patch panel modular jack termination in its assigned telecommunication room (TR). It also applies to the voice cross-connect system described below.

C. All specifications and conjoined construction drawings issued as part of the construction documentation for this project are applicable to this Division 27 and this section. Those specifications that are particularly applicable to this section include, but are not limited to, the following:

1. Division 26 (or 1995 CSI Master Format Edition Division 16) – Electrical
2. Division 15 Mechanical
3. Section 27 00 00 - Communications
4. Section 27 06 00 - 4CD Low Voltage Materials
5. Section 27 05 29 - Hangers and Supports for Communications Systems
6. Section 27 05 41 - Fire Stopping for Communications Systems
7. Section 27 11 00 - Communications Equipment Room Fittings
8. Section 27 11 19 - Communications Termination Blocks and Patch Panels
9. Section 27 15 43 - Communications Faceplates and Connectors
10. Section 27 15 53 - Communications Cable Plant Testing

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCT

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 HORIZONTAL CABLE

Furnish all required horizontal cable - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Horizontal Cable."

2.03 VOICE CROSS-CONNECT CABLING

Furnish all horizontal cable required to support the voice services cross-connect system - Reference: 271119-Blocks & Patch Panels.

PART 3 – EXECUTION

3.01 GENERAL

A. All cable runs shall be installed per manufacturer's installation instructions.

B. Cable installation is “home-run” between the modular jack termination of the cable at the faceplate drop to the patch panel modular jack termination in its assigned TR.

   1. Each cable shall be installed without any splices.

   2. Each cable shall be installed without intermediate termination points unless approved by 4CD or his/her designate in writing.

C. The total length of any horizontal station cable from the modular jack termination of the cable at the drop faceplate to the patch panel modular jack termination in its assigned TR shall not exceed ninety meters (85m) - two hundred seventy nine feet (295’) - unless approved by the ITPC or his/her designate in writing.

3.02 CEILING TILE

A. Ceiling tile shall be removed as necessary for the cable installation and put back in place without damaging or soiling any of the tiles or supporting framework.

B. Ceiling tile shall be handled so no fingerprints or marks are left on the tiles, and the tiles are not damaged in any way.

C. The Contractor is responsible for the cost of repair or replacement of any tile or ceiling tile support/framework hardware that is damaged or soiled by the Contractor.

3.03 HORIZONTAL CABLE PLACEMENT

A. No cable shall run unsupported by conduit, cable tray, hangers, or other specified support for distances greater than five feet (5’).

B. No cable shall be attached to the suspended ceiling structure or laid directly on the ceiling tiles or hard lid as a means of support, and the bottom of a cable or cable bundle shall be minimum of six inches (6") above the ceiling tile grid.

C. No cable or cable bundle shall be supported by or attached by any means to fire sprinkler heads, delivery system hardware, environmental sensor system hardware, or the exterior of any conduit, ladder rack, or cable tray. Cable shall be supported by systems specifically installed for cable support.

D. Where cable being installed is not enclosed in conduit or cable tray, cross all electrical power circuit transport at right angles.

E. Where discontinuity of cable trays or conduit pathway occurs that causes cable or cable bundle to sag vertically three inches (3") or more, support the cable or cable bundle over the discontinuity using hangers, brackets, hooks, rings, and other applicable supporting devices specified in Section 27 05 29 - Hangers and Supports for Communications Systems.

F. During placement of cable runs, do not exceed manufacturer's maximum pulling tension or minimum bend radius limits.

G. Do not bundle cables in cable trays.

H. Do bundle two (2) or more cables with plenum-rated Velcro ties that are snug but which do not deform the cable geometry as follows:

1. Whenever cables in cable trays leave the cable tray and enter/exit distribution conduit.

2. Wherever cables enter a TR. Maintain bundling with the TR.

I. Manage slack to avoid excess cable or kinking.

J Pull new pulling string through all conduits while placing new horizontal cable. Leave a pulling string in the utilized conduits for future use.

K. Do not roll or store cable reels without an appropriate underlay.

L. Cables with jackets that are chaffed, burned, have exposed internal conductor insulation, or have any bare copper (shiners) shall be replaced.

M. Maintain the following clearances from EMI sources:

1. Unshielded power lines or equipment less than or equal to 5 kVA near cable in open or non-metal pathway: twelve inches (12").

2. Unshielded power lines or equipment greater than 5 kVA near cable in open or non-metal pathway: twenty-four inches (24").

3. Unshielded power lines or equipment less than or equal to 5 kVA near cable in grounded metal pathway: six inches (6").

4. Unshielded power lines or equipment greater than 5 kVA near cable in grounded metal pathway: twelve inches (12").

5. Power lines enclosed in grounded metal conduit less than or equal to 5 kVA near cable in grounded metal pathway: three inches (3").

6. Power lines enclosed in grounded metal conduit greater than 5 kVA near cable in grounded metal pathway: six inches (6").

7. Fluorescent fixtures near cable in open or non-metal pathway: twelve inches (12").

8. Fluorescent fixtures near cable in grounded metal conduit: six inches (6").

9. Motors or transformers near cable in non-metal pathway: forty-eight inches (48").

10. Motors or transformers near cable in grounded metal pathway: thirty-six inches (36").

11. Radiating coaxial cabling: six inches (6”).

N. After cable installation is complete, tested, and, if necessary, repairs made, install all required fire stopping. The ITPC or his/her designate will not accept the installation as completed until all required fire stopping has been installed and accepted as complete. See Section 27 05 41 – Fire Stopping.

3.04 VOICE CROSS-CONNECT CABLE PLACEMENT

A. This cabling system connects 48-port patch panel(s) in each rack to 110 blocks installed adjacent to the voice backbone or riser cable 110 terminations in each TR.

B. One cable shall be used for each modular jack in the patch panels. Modular jack counts are based on copper backbone/riser pair counts. Example: A 100-pair copper riser cable would require two (2) 48-port patch panels, a total of ninety-six (96) modular jack positions, and four (4) one hundred (100) pair 110 blocks - Reference: 271119-Blocks & Patch Panels.

C. Bundle voice cross-connect cables separately from horizontal data cables. Do not mix with horizontal data cables.

D. Test cable as for station cabling - Reference Testing below.

3.05 TERMINATION

Comply with Section 27 11 19 - Communications Termination Blocks & Patch Panels and Section 27 15 43 - Communications Faceplates and Connectors.

3.06 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.07 LABELING

A. Comply with Section 27.00 00 – Communications.

B. Label placement: Attach a label to both ends of each cable six inches (6") from the cables termination at the drop and TR patch panel port.

C. All labels shall be machine created labels. Hand labeling is not acceptable.

3.08 TESTING

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.09 AS-BUILT DRAWINGS

Comply with Section 27.00 00 – Communications.

3.10 VERIFICATION

Comply with Section 27.00 00 – Communications.

3.11 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

3.12 ACCEPTANCE

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 15 43 - COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of new faceplates and proper termination of new connectors specified in this section of the Division 27 specifications and accompanying construction drawings.

B. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to, the following:

1. Section 27 00 00 - Communications
2. Section 27 06 00 - 4CD Low Voltage Materials
3. Section 27 05 33 - Conduits and Backboxes for Communications Systems
3. Section 27 11 19 - Communications Termination Blocks and Patch Panels
4. Section 27 15 13 - Communications Copper Horizontal Cabling
5. Section 27 15 53 - Cable Plant Testing

1.02 QUALITY CONTROL

Comply with Section 27 00 00 - Communications.

1.03 WARRANTIES

Comply with Section 27 00 00 - Communications.

1.04 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.05 SUBMITTALS

Comply with Section 27 00 00 - Communications.

1.06 COORDINATION

Comply with Section 27 00 00 - Communications.

PART 2 - PRODUCTS

2.01 QUANTITY DETERMINATION

Comply with Section 27 00 00 - Communications.

2.02 FACEPLATES

Furnish all required faceplates - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Faceplates."

2.03 CONNECTORS

Furnish all required UTP data modular jacks - see Section 27 06 00 - 4CD Low Voltage Materials, 4CD Master Pre-Approved Product/Material/Manufacturer List Index, Product/Material Category, "Modular Jacks."

PART 3 - EXECUTION

3.01 GENERAL

For all cable types, connector installation execution shall comply with connector manufacturer's installation specifications, instructions, and recommendations.

3.02 EXAMINATION

Comply with Section 27.00 00 – Communications.

3.03 FACEPLATE LABELING

A. Comply with Section 27.00 00 – Communications.

B. Modular Jack Labels and Placements: Each drop faceplate modular jack position shall be labeled with its complete modular jack number which includes the Telecommunication Room (TR), room number, station number, jack type, and the jack number.

C. All labels shall be machine created labels, clearly legible, black letters on white background.

3.04 TESTING

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.05 AS-BUILT DRAWINGS

Comply with Section 27 15 53 - Communications Cable Plant Testing.

3.06 VERIFICATION

Comply with Section 27.00 00 – Communications.

3.07 ADJUSTMENTS

Comply with Section 27.00 00 – Communications.

3.07 ACCEPTANCE

Comply with Section 27.00 00 – Communications.

END OF SECTION

SECTION 27 15 53 - COMMUNICATIONS CABLE PLANT TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In order to conform to the overall project event schedule, the cabling contractor shall survey the work areas and coordinate cabling testing with other applicable trades.

C. In addition to the tests detailed in this document, the contractor shall notify the ITPC or his/her designate of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge.

D. All specifications and conjoined construction drawings issued as part of the construction documentation for this project are applicable to this Division 27 and this section. Those specifications that are particularly applicable to this section include, but are not limited to, the following:

1. Division 26 (or 1995 CSI Master Format Edition Division 16) – Electrical
2. Section 27 00 00 - Communications
3. Section 27 06 00 - 4CD Low Voltage Materials
4. Section 27 05 29 - Hangers and Supports for Communications Systems
5. Section 27 05 41 - Fire Stopping for Communications Systems
6. Section 27 11 00 - Communications Equipment Room Fittings
7. Section 27 11 19 - Communications Termination Blocks and Patch Panels
8. Section 27 15 43 - Communications Faceplates and Connectors

1.2 SCOPE

A. This Section includes the minimum requirements for the test certification, identification and administration of backbone and horizontal optical fiber cabling.

B. This Section includes minimum requirements for:

1. Fiber optic test instruments
2. Fiber optic testing
3. Identification
    a) Labels and labeling
4. Administration
    a) Test results documentation
    b) As-built drawings

C. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with a certifying optical loss test set

(OLTS) and the testing of fiber splices, except for pigtail splicing, with an optical time domain reflectometer (OTDR).

D. Testing shall be performed on each cabling link (connector to connector).

E. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and OTDR traces and event tables for multimode and singlemode links.

1. Documentation shall include optical length measurements.

1.3 QUALITY CONTROL

A. Comply with section 27 00 00.

B. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

1. Manufacturer of the fiber optic cable and/or the fiber optic connectors.

2. Manufacturer of the test equipment used for the field certification.

C. The ITPC or his/her designate shall be invited to witness and/or review field-testing.

1. The ITPC or his/her designate shall be notified of the start date of the testing phase five (5) business days before testing commences.

2. The ITPC or his/her designate will select a random sample of 5% of the installed links. The ITPC or his/her designate shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor shall repeat 100% testing at no cost to 4CD.

D. Comply with Section 27 00 00 - Communications.

1.4 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

1.5 SUBMITTALS

A. Manufacturers catalog sheets and specifications for fiber optic field-test instruments including Certifying optical loss test sets (OLTS; power meter and source) and optical time domain reflectometer (OTDR).

B. A schedule (list) of all optical fibers to be tested.

C. Sample test reports

D. Comply with Section 27 00 00 - Communications

1.6 ACCEPTANCE OF TEST RESULTS

A. Comply with section 27 00 00.

B. Each cabling link shall be in compliance with the following test limits:

1. Optical loss testing

a) Multimode and Singlemode links

1) The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.

(i) Link Attenuation (dB) = Cable_Attn (dB) + Connector_Attn (dB) + Splice_Attn (dB)

(ii) Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)

(iii) Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)

(iv) Maximum allowable connector_loss = 0.4 dB

(v) Splice_Attn (dB) = number_of_splices * splice_loss (dB)

(vi) Maximum allowable splice_loss = 0.05 dB

(vii) The values for the Attenuation_Coefficient (dB/km) are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5	1300	1.5
Multimode 50/125 µm	850	3.5	1300	1.5
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

2. OTDR testing not required if fiber passes required optical loss testing.
   a) Reflective events (connections) shall not exceed 0.4 dB.
   b) Non-reflective events (splices) shall not exceed 0.05 dB.

C. All installed cabling links shall be field-tested and pass the test requirements and analysis as described in Part 3. Any link that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link meets performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Part 3.

D. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of 4CD.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE TESTERS

A. The field-test instrument shall be within the calibration period recommended by the manufacturer.

B. Certifying Optical loss test set (OLTS)

1. Multimode optical fiber light source
   a) Provide dual LED light sources with central wavelengths of 850 nm (±30 nm) and 1300 nm (±20 nm)
   b) Output power of –20 dBm minimum.
   c) The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test

equipment or by use of an external mandrel wrap (as described in clause E.7 of ANSI/TIA-568-C.0) with a Category 1 light source.

d) Acceptable manufacturers

1) Fluke Networks DTX-1800 or Equal.

2. Singlemode optical fiber light source

a) Provide dual laser light sources with central wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).

b) Output power of –10 dBm minimum.

c) Acceptable manufacturers

1) Fluke Networks DTX-1800 or equal

3. Power Meter

a) Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.

b) Power measurement uncertainty of ± 0.25 dB.

c) Store reference power measurement.

d) Save at least 100 results in internal memory.

e) PC interface (serial or USB).

f) Acceptable manufacturers

1) Fluke Networks (Fluke DTX-1800 or equal).

4. Optional length measurement

a) An OLTS that is capable of measuring the optical length of the fiber shall be used.

C. Optical Time Domain Reflectometer (OTDR)

1. Multimode OTDR

a) Wavelengths of 850 nm (± 20 nm) and 1300 nm (± 20 nm).

b) Event dead zones of 3.7 m maximum at 850 nm and 1300 nm.

c) Attenuation dead zones of 10 m maximum at 850 nm and 13 m maximum at 1300 nm.

d) Distance range not less than 2000 m.

e) Dynamic range at least 10 dB at 850 nm and 1300 nm

2. Singlemode OTDR

a) Wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).

b) Event dead zones of 3.5 m maximum at 1310 nm and 1550 nm.

c) Attenuation dead zones of 10 m maximum at 1310 nm and 12 m maximum at 1550 nm.

d) Distance range not less than 10000 m.

e) Dynamic range at least 10 dB at 1310 nm and 1550 nm

3. Acceptable manufacturers

a) Fluke Networks or equal

2.2 ADMINISTRATION

A. Administration of the documentation shall include test results of each fiber link.

B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.

C. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

PART 3 – EXECUTION

3.1 GENERAL

A. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.

B. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

3.2 OPTICAL FIBER CABLE TESTING

A. Field-test instruments shall have the latest software and firmware installed.

B. Link test results from the OLTS shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

C. Testing shall be performed on each cabling segment (connector to connector).

D. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length.

E. Optical loss testing

1. Backbone link

a) Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.

b) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.

c) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

d) Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

e) Each fiber link shall be tested in both directions.

F. Polarity Testing

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA-568-C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.3 TEST RESULTS DOCUMENTATION

A. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”. The file format, CSV (comma *separated value), does not provide adequate protection of these records and shall* not be used. PDFs shall not be used

B. The test results documentation shall be available for inspection by the ITPC during the installation period and shall be passed to the ITPC within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.

C. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered on Thumb drive or CD-ROM prior to the ITPC acceptance of the building. This Thumb drive or CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.

D. Circuit IDs reported by the test instrument should match the specified label ID.

E. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information

1. The identification of the customer site as specified by the end-user
2. The name of the test limit selected to execute the stored test results
3. The name of the personnel performing the test
4. The date and time the test results were saved in the memory of the tester
5. The manufacturer, model and serial number of the field-test instrument
6. The version of the test software and the version of the test limit database held within the test instrument
7. The fiber identification number
8. The length for each optical fiber
    a) The index of refraction used for length calculation when using a length capable OLTS
9. Test results to include OLTS attenuation link measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
10. The overall Pass/Fail evaluation of the link-under-test for OLTS measurements

END OF SECTION

4CD LOW VOLTAGE MATERIALS LISTING

Table Notes:

1. Any material listed with an "or equal" product must contain the product manufacturer's performance specifications cut sheet for that product.
2. Items not showing manufacturer and part # shall be furnished by the Contractor using material that best fits the installation location and project needs.
3. Not all items listed are necessarily required for the current project and should be reviewed on a project by project basis.

Line #	Outline Section	Structured Cabling Material	Approved Manufacturer	Part #	As Specified, Or Equal	Description
1	General	Two-hole compression lugs	Cooper B-Line	SB47902	Or Equal	
2	General	6 AWG, green insulation, bonding wire			Or Equal	
3	General	J-STD-607-A Compliant Bonding Tag	Panduit	LTYK	Or Equal	
4	General	Grounding Strap	Cooper B-Line	SB6693/4X101/2	Or Equal	
5	General	Grounding busbar for BDF	Chatsworth	40153-020	Or Equal	
6	General	Grounding busbar for IDF	Chatsworth	40153-012	Or Equal	
7	General	Fire stop putty	3M	MP+	Or Equal	
8	General	Mineral wool			Or Equal	
9	General	Firestop, 1" Ready Sleeve	Specified Technology, Inc.	FS100	Or Equal	
10	General	Firestop, 2" Ready Sleeve	Specified Technology, Inc.	FS200	Or Equal	
11	General	Firestop, 4" Ready Sleeve	Specified Technology, Inc.	FS400	Or Equal	
12	General	Firestop, 2" Intumescent Plug	Specified Technology, Inc.	FP200	Or Equal	
13	General	Firestop, 4" Intumescent Plug	Specified Technology, Inc.	FP400	Or Equal	
14	General	Through wall penetration system	EZ-Path	EZDP44S	Or Equal	
15	Outside Plant	18 Singlemode / 18 Multimode (50 micron) fiber optic cable	Corning		Or Equal	
16	Outside Plant	CAT3, OSP rated, 24 gauge UTP copper cable			Or Equal	Submit products you propose to use
17	Outside Plant	4” three cell innerduct	Maxcell	MXD4003BK2650	Or Equal	
18	Outside Plant				Or Equal	
19	Inside Plant	6 Singlemode / 6 Multimode (50 micron) cable	Corning		Or Equal	
20	Inside Plant	Riser Rated Plenum (CMP) Category 3 UTP, 24 AWG.			Or Equal	Submit products you propose to use
21	Inside Plant				Or Equal	

Table Notes:

1. Any material listed with an "or equal" product must contain the product manufacturer's performance specifications cut sheet for that product.
2. Items not showing manufacturer and part # shall be furnished by the Contractor using material that best fits the installation location and project needs.
3. Not all items listed are necessarily required for the current project and should be reviewed on a project by project basis.

Line #	Outline Section	Structured Cabling Material	Approved Manufacturer	Part #	As Specified, Or Equal	Description
22	Inside Plant	48 port angled CAT6A patch panels.	CommScope Systimax		Or Equal	
23	Inside Plant	CAT6A plenum cable, blue color	Belkin		Or Equal	
24	Inside Plant				Or Equal	
25	Inside Plant	2 port Drop Faceplates, electrical white	CommScope Systimax		Or Equal	
26	Inside Plant	4 port Drop Faceplates, electrical white	CommScope Systimax		Or Equal	
27	Inside Plant	6 port Drop Faceplates, electrical white	CommScope Systimax		Or Equal	
28	Inside Plant	CAT 6A data jacks	CommScope Systimax		Or Equal	Color must match function
29	Inside Plant					
30	Inside Plant	4" J-Hook	Cooper B-Line	BCHR64	Or Equal	
31	Inside Plant	2" J-Hook	Cooper B-Line	BCHR32	Or Equal	
32	Inside Plant	1" J-Hook	Cooper B-Line	BCHR21	Or Equal	
33	Inside Plant	Surface Mount raceway	Panduit	LD-3	Or Equal	
34	Inside Plant	Surface Mount raceway	Panduit	LD-5	Or Equal	
35	Inside Plant	Surface Mount raceway	Panduit	LD-10	Or Equal	
36	Inside Plant	Surface Mount raceway	Panduit	T-70	Or Equal	
37	Inside Plant	5S Deep Back Box		5s	Or Equal	
38	Telecommunication Rooms	4 post 19" wide rack	Chatsworth		Or Equal	
39	Telecommunication Rooms	2 post 19" wide rack	Chatsworth		Or Equal	
40	Telecommunication Rooms	CAT 6A 48 port patch panels	CommScope Systimax		Or Equal	
41	Telecommunication Rooms	CAT 6 48 port patch panels	CommScope Systimax		Or Equal	
42	Telecommunication Rooms	Singlemode Fiber optic patch panels with SC connectors	CommScope Systimax		Or Equal	
43	Telecommunication Rooms	Multimode Fiber optic patch panels with SC connectors	CommScope Systimax		Or Equal	
44	Telecommunication Rooms	12" Cable Runway	Chatsworth		Or Equal	

Table Notes:

1. Any material listed with an "or equal" product must contain the product manufacturer's performance specifications cut sheet for that product.
2. Items not showing manufacturer and part # shall be furnished by the Contractor using material that best fits the installation location and project needs.
3. Not all items listed are necessarily required for the current project and should be reviewed on a project by project basis.

Line #	Outline Section	Structured Cabling Material	Approved Manufacturer	Part #	As Specified, Or Equal	Description
45	Telecommunication Rooms	Heavy Duty Butt Splice	Chatsworth		Or Equal	
46	Telecommunication Rooms	Triangular Runway Wall Support Kit	Chatsworth		Or Equal	
47	Telecommunication Rooms	Runway 90 degree junction Splice Clamp and Kit	Chatsworth		Or Equal	
48	Telecommunication Rooms	Runway Wall Angle Support Kit	Chatsworth		Or Equal	
49	Telecommunication Rooms	Runway Stand-Off Kit	Chatsworth		Or Equal	
50	Telecommunication Rooms	Runway Center Support hanger Kit	Chatsworth		Or Equal	
51	Telecommunication Rooms	Waterfall upper tray	Chatsworth	15275-01	Or Equal	
52	Telecommunication Rooms	2 U Horizontal Cable manager	Chatsworth	35441-702	Or Equal	
53	Telecommunication Rooms	2U Upper Tray Cable Manager	Chatsworth	13183-719	Or Equal	
54	Telecommunication Rooms	8' 6" Vertical Cable Manager	Chatsworth	15215-715	Or Equal	
55	Telecommunication Rooms	8' 10" Vertical Cable Manager	Chatsworth	40099-715	Or Equal	
56	Telecommunication Rooms	7' 6" Vertical Cable Manager	Chatsworth	40098-703	Or Equal	
57	Telecommunication Rooms	7' 10" Vertical Cable Manager	Chatsworth	40099-703	Or Equal	
58	Telecommunication Rooms	Seismic Bracing Kits	Chatsworth	12407-719	Or Equal	
59	Telecommunication Rooms	One-hundred (100) pair BET technology			Or Equal	Submit products you propose to use
60	Telecommunication Rooms	5 pin, 300V, 350mA, solid-state technology protectors			Or Equal	Submit products you propose to use
61	Classroom Notification System	IP Speaker with Display and Flashers	Advanced Network Devices	IPSWD-RWB		

Table Notes:

1. Any material listed with an "or equal" product must contain the product manufacturer's performance specifications cut sheet for that product.
2. Items not showing manufacturer and part # shall be furnished by the Contractor using material that best fits the installation location and project needs.
3. Not all items listed are necessarily required for the current project and should be reviewed on a project by project basis.

Line #	Outline Section	Structured Cabling Material	Approved Manufacturer	Part #	As Specified, Or Equal	Description
62	Classroom Notification System	20 gauge wire to button				
63	Classroom Notification System	Push to talk button kit	Advanced Network Devices	AND-BTN-KIT-1		required with every speaker
64	Classroom Notification System	Flush Mount	Advanced Network Devices	IPS-FM1		Prefered for new construction
65	Classroom Notification System	Surface Mount	Advanced Network Devices	IPS-SM1		To be used when a flush mount is not workable
66						

Design Guide is being examined by "reviewer" team, should have comments back by November 10th
Now we are working on Div 27 specifications
Review general section with header and footer
Review specific information here
Review material list and how to specify "or equal" or "approved equal"

	Team's Answers
110 punch blocks?	Yes
Blue cable	Yes, think about other colors for special devices like cameras
CAT 6 cable or CAT 6a?	Cat 6, consider Cat6a for WIFI and security cameras
All SYSTIMAX?	SYSTIMAX
2 U Wire Management?	SYSTIMAX
APC NETSHELTER SX 48U or 4 post open racks?	APC Netshelter, or Dell
Southwest data products wall cabinets?	
APC UPS systems, does the contractor supply those?	KCCD provides APC
Fiber optic panels: AT&T/Lucent “Lightguide” or equivalent fiber optic terminals	SYSTIMAX
LC Fiber connectors	Yes
The multimode LC connector shall be beige in color and the single mode LC connector shall be blue in color.	

SYSTIMAX for all Patch Panels, Fiber Panels, Work Station inserts and face plates.

All MDF and IDF will have the appropriate sized APC UPS (rack mountable). APC 5000 (3-U) UPS for MDFs with a 30 AMP twist lock receptor (LG-30) and APC 1500 (3-U) UPS for IDFs or APC 3000 (if a Cisco 4000 or greater switch is in the IDF rack). If an APC 5000 is needed a 30AMP twist lock receptor (LG-30) will need to be installed by the contractor as well.

Data COMM		
Part#:	**Description:**	**Manufacturer:**
2071E BL 4/23 Wl000	CAT-6 DATA CABLE - PVC	SYSTIMAX
MGS400-318	CAT 6 RJ-45 -BLUE	SYSTIMAX
MlXL-246	FACEPLATE	SYSTIMAX SYSTIMAX
360-IPR-1100-E-GS3-	CAT-6 PATCH PANEL-24 PORT	SYSTIMAX lU-24
360-IPR-l 100-E-GS3-2U-48	CAT-6 PATCH PANEL-48 PORT	SYSTIMAX
HTK-19-SS-2U	2-U WIRE MANAGEMENT PANEL	SYSTIMAX

FIBER MATERIAL:		
Part#:	**Description:**	**Manufacturer:**
R-006-LN-5L- F06BK/25D	6 STRAND M/M IN/OUT FIBER CABLE	SYSTIMAX
MFC-SCR-16-BG 360DP-6SC-LS	SIC MULTIMODE ANAEROBIC CONN.	SYSTIMAX
360G2-1U-MOD-FX	Distribution Panel 6 SC LazrSPEED® Aqua 360G2 1U Fixed Modular Cassette Shelf	SYSTIMAX
IDF		
360G2-2U-MOD-FX SYSTIMAX 360G2 2U Fixed Modular Cassette **MDF**	360G2 2U Fixed Modular Cassette Shelf	SYSTIMAX

DATA CABINETS:		
Part#:	**Description**	**Manufacturer:**
SWE-4000-12UD	24HX24WX24D	SOUTHWEST DATA
SWE-4000-18UD	36HX24WX24D	SWDP
SWE-4000-26UD	48HX24WX24D	SWDP
CH-415	Front & REAR LOCK KIT (key-415)	SWDP

DATA CABINETS:		
Part#:	**Description**	**Mfg.**
AR3307	APC NETSHELTER SX 48U	APC
AP9567	14 outlet PDU (1 for each rack)	APC
AR8112BLK	Seismic Kit (1 for each rack)	APC
AR7600	Baying kit (to bond multiple racks 1 per 2 racks)	APC

Data Station Jack Specification:	
Rating:	Category 6
Jack Type:	RJ-45
Pinning Config:	EIA/TIA 568B
Jack Color:	Blue

Faceplate Specifications:	
Size:	Single Gang USO Bezel
Ports:	Two (2) four (4) or six (6)
Color:	Almond/Electric Ivory
Insert Color:	Blue