SECTION 00 91 04

ADDENDUM #4

1.   PROJECT INFORMATION

    A.   Project Name: 7th Floor Fit-Out

    B.   Owner: Administrative Offices of the Courts

    C.   Civil Engineer: N/A

    D.   Architect: Tevebaugh Architecture

    E.   Structural Engineer: MacIntosh Engineering

    F.   MPE Engineer: DEDC, LLC

    G.   Architect Project Number: #17042

    H.   Date of Addendum: May 2, 2019

2.   NOTICE TO BIDDERS

    A.   This Addendum is issued to all registered plan holders pursuant to the Conditions of the Contract. This Addendum serves to clarify, revise, and supersede information in the Project Manual, Drawings, and previously issued Addenda. Portions of the Addendum affecting the Contract Documents shall be incorporated into the Contract by enumeration of the Addendum in the Owner/Contractor Agreement.

    B.   The Bidder shall acknowledge receipt of this Addendum to the Architect / Owner.

    C.   The date for receipt of bids is not changed by this Addendum, at the same time and location.

3.   ATTACHMENTS

    A.   This addendum includes the following attached Documents and Specification Sections:

        1.   Specification Section 00 41 13 – Bid Form
        2.   Specification Section 00 73 46 – Wage Determination Schedule – Page 2
        3.   Specification Section 01 10 00 – Summary of Work
        4.   Specification Section 01 21 00 – Allowances
        5.   Specification Section 01 22 00 – Unit Prices
        6.   Specification Section 27 10 00 – BSD – Structured Cabling
        7.   Specification Section 27 40 00 – Audio and Video Communication

8. Drawing Sheet A404 – Enlarged Plans & Reflected Ceiling Plans – Courtroom 7A and 7F
9. Drawing Sheet A408 – Enlarged Elevations – Courtroom 7A and 7F
10. Drawing Sheet A501 – Millwork Plans & Elevations – Courtrooms 7A
11. Drawing Sheet A502 – Millwork Plans & Elevations – Courtrooms 7B & 7C, 7D
12. Drawing Sheet A503 – Millwork Plans & Elevations – Courtrooms 7E
13. Drawing Sheet A504 – Millwork Plans & Elevations – Courtrooms 7F
14. Drawing Sheet A511 – Millwork Details - Courtrooms
15. Drawing Sheet A521 – Ceiling Details
16. Drawing Sheet M100a – Mechanical – 7th Floor Ductwork Area A
17. Drawing Sheet M100b – mechanical – 7th Floor Ductwork Area B
18. Drawing Sheet M110 – Mechanical – 7th Floor Reflected Ceiling Plan
19. Drawing Sheet E100 – Electrical New Work 7th Floor Power Plan
20. Drawing Sheet E200 – Electrical New Work 7th Floor Lighting Plan
21. Drawing Sheet E400 – Electrical – Courtroom 7A & 7F Lighting Plans
22. Drawing Sheet E401 – Electrical – Courtroom 7E Lighting Plan
23. Drawing Sheet SAD000 – General Notes, Legends, & Abbreviations
24. Drawing Sheet SAD100 – Security – New Work – 7th Floor – Diagram
25. Drawing Sheet SAD110 – Security – New Work – 7th Floor – Overall
26. Drawing Sheet SAD200 – AV Flow Diagram – New Work – 7th Floor (1 of 4)
27. Drawing Sheet SAD201 – AV Flow Diagram – New Work – 7th Floor (2 of 4)
28. Drawing Sheet SAD202 – AV Flow Diagram – New Work - 7th Floor (3 of 4)
29. Drawing Sheet SAD203 – AV Flow Diagram – new Work – 7th Floor (4 of 4)
30. Drawing Sheet SAD210 – AV – New Work – 7th Floor
31. Drawing Sheet SAD211 – AV – New Work – 7th Floor – Courts 7A, 7B, 7C, & 7D
32. Drawing Sheet SAD212 – AV – New Work – 7th Floor – Court 7E
33. Drawing Sheet SAD213 – AV – New Work – 7th Floor – Court 7F
34. Drawing Sheet SAD310 – Data – New Work – 7th Floor

4. REVISIONS TO PREVIOUS ADDENDA

    A. **REVISE** specification section 00 91 03 "Addendum #3" footer from 00 91 02 to 00 91 03.

5. REVISIONS TO DIVISIONS 00 and 33 OF THE SPECIFICATIONS

    A. Specification section 00 41 13 – Bid Form

        1. **REPLACE** specification section 00 41 13 "Bid Form" in its entirety with the attached specification section 00 41 13 "Bid Form."

B.   Specification Section 00 73 46 – Wage Determination Schedule

     1.   **REPLACE PAGE 2** of specification section 00 73 46 "Wage Determination Schedule" with the attached Page 2 (Prevailing Wage Schedule).

C.   Specification Section 01 10 00 – Summary of Work

     1.   **REVISE** specification section 01 10 00 "Summary of Work" in accordance with attached specification section 01 10 00 "Summary of Work". Removed wording has been struck through. Added working has been bolded.

D.   Specification section 01 21 00 - Allowances

     1.   **REVISE** specification section 01 21 00 "Allowances" in accordance with attached specification section 01 21 00 "Allowances". Removed wording has been struck through. Added working has been bolded.

E.   Specification section 01 22 00 - Unit Prices

     1.   **REVISE** specification section 01 22 00 "Unit Prices" in accordance with attached specification section 01 22 00 "Unit Prices". Removed wording has been struck through. Added working has been bolded

F.   Specification Section 27 10 00 – BSD – Structured Cabling

     1.   **REPLACE** specification section 27 10 00 "BSD – Structured Cabling" in its entirety.

G.   Specification Section 27 40 00 – Audio and Video Communication

     1.   **REPLACE** specification section 27 40 00 "Audio and Video Communication" in its entirety.

6.   <u>REVISIONS TO DRAWING SHEETS</u>

A.   Drawing Sheet A404 – Enlarged Plans & Reflected Ceiling Plans – Courtroom 7A and 7F

     1.   **REVISE** sheet A404 in accordance with attached sheet A404. All changes have been clouded.

B.   Drawing Sheet A408 – Enlarged Elevations – Courtroom 7A and 7F

     1.   **REVISE** sheet A408 in accordance with attached sheet A408. All changes have been clouded.

C.   Drawing Sheet A501 – Millwork Plans & Elevations – Courtrooms 7A

     1.   **REVISE** sheet A501 in accordance with attached sheet A501. All changes have been clouded.

D.   Drawing Sheet A502 – Millwork Plans & Elevations – Courtrooms 7B & 7C, 7D

     1.   **REVISE** sheet A502 in accordance with attached sheet A502. All changes have been clouded.

E.   Drawing Sheet A503 – Millwork Plans & Elevations – Courtrooms 7E

     1.   **REVISE** sheet A503 in accordance with attached sheet A503. All changes have been clouded.

F.   Drawing Sheet A504 – Millwork Plans & Elevations – Courtrooms 7F

     1.   **REVISE** sheet A504 in accordance with attached sheet A504. All changes have been clouded.

G.   Drawing Sheet A511 – Millwork Details - Courtrooms

     1.   **REVISE** sheet A511 in accordance with attached sheet A511. All changes have been clouded.

H.   Drawing Sheet A521 – Ceiling Details

     1.   **REVISE** sheet A521 in accordance with attached sheet A521. All changes have been clouded.

I.   Drawing Sheet M100a – Mechanical – 7th Floor Ductwork Area A

     1.   **REVISE** sheet M100a in accordance with attached sheet M100a. All changes have been clouded.

J.   Drawing Sheet M100b – mechanical – 7th Floor Ductwork Area B

     1.   **REVISE** sheet M100b in accordance with attached sheet M100b. All changes have been clouded.

K.   Drawing Sheet M110 – Mechanical – 7th Floor Reflected Ceiling Plan

     1.   **REVISE** sheet M110 in accordance with attached sheet M110. All changes have been clouded.

L.   Drawing Sheet E100 – Electrical New Work 7th Floor Power Plan

1.   **REVISE** sheet E100 in accordance with attached sheet E100. All changes have been clouded.

M.   Drawing Sheet E200 – Electrical New Work 7th Floor Lighting Plan

1.   **REVISE** sheet E200 in accordance with attached sheet E200. All changes have been clouded.

N.   Drawing Sheet E400 – Electrical – Courtroom 7A & 7F Lighting Plans

1.   **REVISE** sheet E400 in accordance with attached sheet E400. All changes have been clouded.

O.   Drawing Sheet E401 – Electrical – Courtroom 7E Lighting Plan

1.   **REVISE** sheet E401 in accordance with attached sheet E401. All changes have been clouded.

P.   Drawing Sheet SAD000 – General Notes, Legends, & Abbreviations

1.   **REVISE** sheet SAD000 in accordance with attached sheet SAD000. All changes have been clouded.

Q.   Drawing Sheet SAD100 – Security – New Work – 7th Floor – Diagram

1.   **REVISE** sheet SAD100 in accordance with attached sheet SAD100. All changes have been clouded.

R.   Drawing Sheet SAD110 – Security – New Work – 7th Floor – Overall

1.   **REVISE** sheet SAD110 in accordance with attached sheet SAD110. All changes have been clouded.

S.   Drawing Sheet SAD200 – AV Flow Diagram – New Work – 7th Floor (1 of 4)

1.   **REVISE** sheet SAD200 in accordance with attached sheet SAD200. All changes have been clouded.

T.   Drawing Sheet SAD201 – AV Flow Diagram – New Work – 7th Floor (2 of 4)

1.   **REVISE** sheet SAD201 in accordance with attached sheet SAD201. All changes have been clouded.

U.   Drawing Sheet SAD202 – AV Flow Diagram – New Work - 7th Floor (3 of 4)

    1.   **REVISE** sheet SAD202 in accordance with attached sheet SAD202. All changes have been clouded.

V.   Drawing Sheet SAD203 – AV Flow Diagram – new Work – 7th Floor (4 of 4)

    1.   **REVISE** sheet SAD203 in accordance with attached sheet SAD203. All changes have been clouded.

W.   Drawing Sheet SAD210 – AV – New Work – 7th Floor

    1.   **REVISE** sheet SAD210 in accordance with attached sheet SAD210. All changes have been clouded.

X.   Drawing Sheet SAD211 – AV – New Work – 7th Floor – Courts 7A, 7B, 7C, & 7D

    1.   **REVISE** sheet SAD211 in accordance with attached sheet SAD211. All changes have been clouded.

Y.   Drawing Sheet SAD212 – AV – New Work – 7th Floor – Court 7E

    1.   **REVISE** sheet SAD212 in accordance with attached sheet SAD212. All changes have been clouded.

Z.   Drawing Sheet SAD213 – AV – New Work – 7th Floor – Court 7F

    1.   **REVISE** sheet SAD213 in accordance with attached sheet SAD213. All changes have been clouded.

AA.   Drawing Sheet SAD310 – Data – New Work – 7th Floor

    1.   **REVISE** sheet SAD310 in accordance with attached sheet SAD310. All changes have been clouded.

7.   BIDDER'S QUESTIONS received through April 26th, 2019 at 8am.

Q1. I noticed in the presentation today that a schedule of values is required to be submitted with our bid form. This is normally submitted post bid and we are very rushed on bid day trying to get the paperwork in order. Can this requirement be changed to post bid like the drug forms and other documents?

    A1:   The Schedule of Values will be due within 18 days of award of bid along with the Drug Testing Forms (Specification Section 00 81 14) and the Affidavit of Employee Drug Testing Program (Specification Section 00 41 13).
    Previously answered in Addendum #1.

Q2. I noticed today that the recessed concrete slab areas are very rough and uneven. Will any grinding, levelling, or patching be required at these floor areas?

A2:   The recessed floor areas will receive a raised floor. The surface of the recessed slab shall meet the raised floor manufacture's requirements for installation. Edges of the upper slab around the recessed slab shall be patched as required to properly install the flooring in those areas per the flooring manufacturer's requirements for installation.
Previously answered in Addendum #2.

Q3. *I was wondering if the State could provide the name of the company that does maintenance of the glass curtainwall so that we could contact them about removing and replacing pieces to accommodate the construction elevator?*

A3:   The company that the facility has had success with in the past is:

Patrick McIntyre
Synergy Glass & Door Service
1116 MacDade Blvd. Unit G
Collingdale, PA 19023
Phone: (484) 540-3117
Fax: (484) 540-3124
pat@synergyglassanddoor.com
www.synergyglassanddoor.com
Previously answered in Addendum #1.

Q4. ModernControls is requesting that Johnson Controls FX by ModernControls be added as a Pre-Approved State of Delaware Building Automation System Product / Manufacture.

A4:   Per specification section 23 09 50-2.01-C, please see section 01 25 00 – Substitution Procedures.
Previously answered in Addendum #2.

Q5. At the pre-bid meeting there was mention that the project is to be done between the hours of 4:30pm to 7:00am. Please confirm.

A5:   The hours set forth in specification section 01 14 00-1.2-B-1, issued with this addendum, are to be considered typical owner occupancy hours. All other hours are to be considered to be the typical available working hours. The site superintendent will need to coordinate with Capitol Police weekly and daily to find out about any other special proceedings or special owner occupancy hours. When extended occupancy hours occur, the superintendent can choose to schedule the contractors differently or start with only work that adheres to the general guidelines for restrictions of work during owner occupied hours, as set forth in specification section 01 14 00-1.4-A.
Previously answered in Addendum #2.

Q6. Please identify the project start and finish dates.

    A6:   The start date shall be addressed once the successful bidder has received their Purchase Order from the State and the Pre-Construction meeting has been scheduled. Bidders are to include a schedule with their bids.
    Previously answered in Addendum #2.

Q7. Per the walk thru there was discussion in regards to the items that are being stored in the space.

    A7:   Per General Note H. on drawing sheets AD101a, AD101b, AD102a, and AD102b, all items left are to be removed and disposed of. Bidders shall assume that everything present in the space during bidding will be remaining at the time of construction start.
    Previously answered in Addendum #2.

Q8. 3-D Fabrication is requesting that the AWI Certification "Stamp on Submittals" be waived. Although 3-D Fabrication meets all standards that the AWI Certification requires, we are not officially certified.

    A8:   The AWI Certification requirement will **not** be waived for this project.
    Previously answered in Addendum #2.

Q9. The tile carpeting spec is listed in the TOC but is not in the spec book.

    A9:   The Tile Carpeting specification has been added to the bidding documents via this addendum.
    Previously answered in Addendum #2.

Q10. The spec section 087100 under hardware sets says to match the existing key system. Can you tell us what this is?

    A10:   The existing cores are 7 pin interchangeable (Coremax), from Best Access Systems. The keying system is patented and the cores and keys will have to be purchased through and authorized dealer and coordinated with the state. The state currently uses General Supply Company in Bethlehem, PA.
    Previously answered in Addendum #3.

Q11. *Regarding the construction elevator; if the design team worked with any particular company, can you provide the contact information to us?*

    A11:   The team worked with Delaware Elevator during design. Our contact was:

        PJ Laviola
        Residential & Special Applications General Manager
        22100 Allen Drive, Salisbury, MD 21801
        Email: PJLaviola@delawareelevator.com
        Phone: 410-749-3489 Ext. 1061
        Previously answered in Addendum #2.

Q12. *According to the finish schedule A801, RS-2 motorized double shades are to go in the north courtroom. The only windows in the north courtroom are the clerestory windows along the north elevation. I do not see any mounting details for these shades. Should these be recessed in a pocket in the ACT ceiling?*

    A12.   These shades shall be mounted similarly to E2/A102a.
        Previously answered in Addendum #3.

Q13. *The finish schedule does not have any location listed for RS-1 manual single shades. Detail E2/A102a shows a manual single shade and is called out along the east elevation. This appears typical for the entire elevation. There is no indication of RS-1 on any other exterior windows in the area of work. Please confirm that the east elevation is the only RS-1 location.*

    A13.   See drawing sheet A801, issued with this Addendum.
        Previously answered in Addendum #2.

Q14. *Will you be issuing a list of what contractors tour through the space?*

    A14.   We will not be issuing a list of contractors that have toured the space.
        Previously answered in Addendum #2.

Q15. *After reviewing Addendum # 2 with specifications of working hours. Is this project intended to be ONLY 2nd shift work or is it allowed 1st shift work and any disruptive work would have to be done on 2nd shift? Please clarify.*

    A15.   Please see specification section 01 14 00 "Work Restrictions," issued in this Addendum.
        Previously answered in Addendum #3.

Q16. *The Summary of Work says "Separate contracts shall be awarded for furniture, audio visual, information technology, and security work." Does this include everything to do with these trades including structured and other cabling, back boxes, terminations, etc.?*

    A16.   Please see specification section 01 10 00 "Summary of Work", issued with this addendum.

Q17. *In addendum 2, answer 6, you now want a schedule with the bid and not just a duration as per the bid form?*

    A17. A Schedule of Performance (project schedule) is required to be submitted with this bid.
        Previously answered in Addendum #3.

Q18. *Is all wood: baseboard, chair rail and general wood millwork to be used to come in factory finished?*

    A18. All wood shall be shop finished.
        Previously answered in Addendum #3.

Q19. *Is WB-3, listed in the Finish Schedule on sheet A801, used in this project?*

    A19. WB-3 is not utilized in this project.
        Previously answered in Addendum #3.

Q20. *Is exterior work (i.e. construction elevator, etc.) limited to the same working hours and restrictions as interior work?*

    A20. Exterior work is guided by the same restrictions as interior work for this project.
        Previously answered in Addendum #3.

Q21. *Is the carpet to be full spread / direct glued over top of the access flooring?*

    A21. Carpet shall be direct glued over top of the access floor.
        Previously answered in Addendum #3.

Q22. *Kitchenette 7611 shows VCT going over the access flooring. This is not recommended as any movement of the access floor can / will crack the VCT. Can you please verify that VCT is to go into this space?*

    A22. In lieu of VCT-1 in Kitchenette 7611, please provide access flooring with integrated, factory-applied finish; B.O.D. Tarkett homogenous vinyl tile with matte finish and iQ PUR surface treatment negating the need for waxing or other finish coating. Finish color and pattern to be selected from manufacturer's full range of homogenous vinyl tile patterns and colors.

Q23. *Should the elevator in vestibule 7E202 have a card reader? The elevator in vestibule 7A202 currently has a card reader.*

    A23. The elevator in vestibule 7E202 is to receive a card reader. Please also see updated SAD series drawings attached to this addendum.

Q24. *Should both doors in vestibule 7E202 (door numbers 7E201 and 7F201) and the door to sound lock vestibule 7E201 (door number 7EB) have magnetic locks?*

    A24.   Doors number 7E201 and 7F201 are to receive card readers; door 7EB shall only have card reader access on the institutional side with request to exit on the courtroom side. Please also see updated SAD series drawings attached to this addendum.

Q25. *Should the door entering JP Courtroom from vestibule 7A202 (door number 7A201) have a card reader? This door currently has one when exiting JP Courtroom to vestibule 7A202.*

    A25.   Door 7A201 is not to receive card readers. Please also see updated SAD series drawings attached to this addendum.

Q26.   Is the wage rate sheet correct, as the spec book is dated April?

    A26.   Please see up-to-date prevailing wage rates, dated 03/19/2019, issued in this Addendum. These are the wage rates that have been posted to My Marketplace.

Q27.   Is there glycol in the existing chilled water or hot water systems?

    A27.   There is no glycol in the existing chilled water or hot water systems.

Q28.   Can "General Polymers" be added under manufacturers and "Fastop 12 SL Self-Leveling Urethane Slurry System" be added under products for specification section 09 67 23 "Resinous Flooring"?

    A28.   This substitution has been declined.

Q29.   Can product "Johnson Controls – Model TSS" be added under products for specification section 23 36 00 "Air Terminal Units"?

    A29.   This substitution has been declined.

END OF SECTION

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7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

For Bids Due: _____(DATE)_____   **To:** _____(OWNER)_____

_____

_____

_____

_____

Name of Bidder: _____

Delaware Business License No.: _____**Taxpayer ID No.:** _____

(A copy of Bidder's Delaware Business License must be attached to this form.)

(Other License Nos.): _____

Phone No.: (**)** _____ **-** _____   **Fax No.: (**   **)** _____ **-** _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$ _____

($ _____)

ALLOWANCES

ADD

ALLOWANCE No. 1: <u>UNFORESEEN CONDITIONS</u> $<u>75,000 (SEVENTY-FIVE THOUSAND DOLLARS)</u>

ALLOWANCE No. 2: <u>STORED ITEMS REMOVAL</u> $ <u>5,000 (FIVE-THOUSAND DOLLARS)</u>

ALTERNATES

ADD

ALTERNATE No. 1: <u>Public corridor separation alternate with laminated glass.</u> $_____

ALTERNATE No. 2: <u>Public corridor separation alternate with ballistic resistant glazing.</u> $_____

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		ADD	**DEDUCT**
UNIT PRICE No. 1:	Price per square foot of additional gypsum board ceiling demolition.	$ _____	$ _____
UNIT PRICE No. 2:	Price per square foot of additional security plaster ceiling demolition.	$ _____	$ _____
UNIT PRICE No. 3:	Price per square foot of additional grouted, reinforced, CMU wall demolition.	$ _____	$ _____
UNIT PRICE No. 4:	Price per square foot of additional gypsum board ceiling reinstallation.	$ _____	$ _____
UNIT PRICE No. 5:	Price per square foot of additional security plaster ceiling reinstallation.	$ _____	$ _____
UNIT PRICE No. 6:	Price per square foot of additional grouted, reinforced, CMU wall reinstallation.	$ _____	$ _____
UNIT PRICE No. 7:	Price per cubic yard of additional soil removal.	$ _____	$ _____
UNIT PRICE No. 8:	Price per square foot of brick sidewalk replacement.	$ _____	$ _____
UNIT PRICE No. 9:	Price per linear foot of sidewalk curb replacement.	$ _____	$ _____
UNIT PRICE No. 10:	Price per square foot of additional terrazzo patching.	$ _____	$ _____
UNIT PRICE No. 11:	Price per additional power outlet.	$ _____	$ _____

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		ADD	DEDUCT
UNIT PRICE No. 12:	Price per additional voice and data outlet.	$ _____	$ _____
UNIT PRICE No. 13:	Price per additional foot of plumbing piping supply and installation.	$ _____	$ _____
UNIT PRICE No. 14:	Price per 30 yard dumpster for removal of items left on 7th floor by owner.	$_____	$_____

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
     (Individual's / General Partner's / Corporate Name)

    _____
    (State of Corporation)

Business Address:_____

                 _____

                 _____

                 _____

Witness: _____   **By:** _____
                                           (Authorized Signature)

  (SEAL)   _____
                                           (Title)
                            Date: _____

<u>ATTACHMENTS</u>
        Sub-Contractor List
        Non-Collusion Statement
        Bid Security
        Schedule of Performance
        (Others as Required by Project Manuals)

<u>DUE WITHIN 18 DAYS OF AWARD OF BID</u>
        Drug Testing Forms
        Affidavit of Employee Drug Testing Program
        Schedule of Values

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7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b <u>Delaware Code,</u> the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the *Owner*, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.** This form must be filled out completely with no additions or deletions.

Subcontractor Category	**Subcontractor**	**Address (City & State)**	**Subcontractors tax payer ID # or Delaware Business license #**
1. Sitework			
2. Concrete			
3. Structural Steel			
4. Glass & Glazing			
5. Carpentry Systems			
6. Millwork (Supply & Install)			
7. Doors, Frames, HW (Supply)			
8. Flooring			
9. Detention Hardware (Supply)			

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b <u>Delaware Code,</u> the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the *Owner*, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.** This form must be filled out completely with no additions or deletions.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
10. Sprinkler			
11. Plumbing Systems			
12. HVAC			
13. Electrical			
14. Structured Cabling			
15. Controls			
16. Fire Alarm			
17. AV			
18. Security			

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Office of Management and Budget, Division of Facilities Management.

All the terms and conditions of the Leonard L. Williams Justice Center 7th Floor Fit-Out Project have been thoroughly examined and are understood.

NAME OF BIDDER: _____

**AUTHORIZED REPRESENTATIVE
(TYPED):**   _____

**AUTHORIZED REPRESENTATIVE
(SIGNATURE):**   _____

TITLE: _____

ADDRESS OF BIDDER: _____

    _____

    _____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

7TH FLOOR FITOUT
LEONARD L. WILLIAMS JUSTICE CENTER
#MJ0217000001

BID FORM

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors that complies with this regulation:

Contractor/Subcontractor Name:

Contractor/Subcontractor Address:

Authorized Representative (typed or printed):

Authorized Representative (signature):

Title:

Sworn to and Subscribed before me this _____ day of _____ 20_____.
My Commission expires _____.   NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

END OF SECTION

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 761-8200

Mailing Address:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

Located at:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 15, 2019

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.92	29.46	42.87
BOILERMAKERS	71.61	36.33	53.41
BRICKLAYERS	55.89	55.89	55.89
CARPENTERS	55.63	55.63	44.22
CEMENT FINISHERS	75.54	52.62	23.19
ELECTRICAL LINE WORKERS	47.57	40.79	31.10
ELECTRICIANS	70.49	70.49	70.49
ELEVATOR CONSTRUCTORS	96.27	67.47	33.42
GLAZIERS	75.65	75.65	59.28
INSULATORS	57.88	57.88	57.88
IRON WORKERS	65.57	65.57	65.57
LABORERS	47.70	47.70	47.70
MILLWRIGHTS	74.23	74.23	59.84
PAINTERS	52.47	52.47	52.47
PILEDRIVERS	78.02	41.17	33.30
PLASTERERS	31.22	31.22	23.14
PLUMBERS/PIPEFITTERS/STEAMFITTERS	70.05	55.29	60.31
POWER EQUIPMENT OPERATORS	71.29	71.29	71.29
ROOFERS-COMPOSITION	25.12	24.79	22.64
ROOFERS-SHINGLE/SLATE/TILE	19.24	22.88	17.99
SHEET METAL WORKERS	72.53	72.53	72.53
SOFT FLOOR LAYERS	53.39	53.39	53.39
SPRINKLER FITTERS	60.04	60.04	60.04
TERRAZZO/MARBLE/TILE FNRS	64.45	64.45	64.45
TERRAZZO/MARBLE/TILE STRS	71.27	71.27	71.27
TRUCK DRIVERS	32.19	28.70	21.91

CERTIFIED: 03/19/2019   BY: _____ on behalf of Julie Petroff
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE
REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR
ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR
CLASSIFICATIONS, PHONE 302-761-8200

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

**PROJECT: MJ0217000001 7th floor fitout at leonard L Williams Justice Center, New
Castle County**

SECTION 01 10 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

    A.   Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2   WORK COVERED BY CONTRACT DOCUMENTS

    A.   The Project consists of fit-out of a portion of the existing Leonard L. Williams Justice Center. With the exception of work required to accommodate the exterior construction elevator, the renovation is interior.

        1.   Project Location: 500 North King Street, Wilmington, DE 19801
        2.   Owner State of Delaware, Department of Administrative Services, Division of Facilities Management: Carvel State Office Building, 820 North French Street, Wilmington, DE 19801

    B.   Contract Documents, dated April 2, 2019 were prepared for the Project by Tevebaugh Architecture: Two Mill Road, Suite #210, Wilmington, DE 19806

    C.   The Work consists of demolition and removal of selective areas and systems as delineated in the demolition drawings, and new work constructing new administrative space, courtrooms, and courtroom support spaces.

    D.   The Work will be constructed under a single prime contract.

1.3   WORK UNDER OTHER CONTRACTS

    A.   Separate Contract: The Owner shall employ specialty contractors for certain areas of work relating to this fit-out. Those operations will be conducted simultaneously with work under this Contract. That Contract includes the following:

        1.   Contract:
            a. Separate contracts shall be awarded for Furniture~~, Audio Visual~~, ~~Information Technology, and Security~~ work~~.~~**, apart from installation of the Jury Seats.**
            b. **Security programming shall be by building security vendor, but contracted through this contract. See SAD series drawings and security specifications for further information.**
            c. **Queueing system shall be by specified vendor, but contracted through this contract. See SAD series drawings for further information.**
            d. **Information technology equipment not specified in SAD series drawings or specifications, such as telephone equipment, printers, and**

personal employee workstations, shall be by owner. All equipment specified in SAD series drawings and specifications are part of the contract.

B.   Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.4   WORK SEQUENCE

A.   The Work will be conducted in one phase.

1.5   CONTRACTOR USE OF PREMISES

A.   General: During the construction period the Contractor shall have use of designated areas of the premises for construction operations, including use of designated areas of the site.

B.   Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1.   Owner Occupancy: Building will be occupied during construction.
2.   Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
3.   A construction elevator shall be provided and installed as part of this contract on the south façade of the building as depicted on the ASP and S series drawings. Contractors are not to utilize interior stairs or elevators.

C.   Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

1.6   OWNER-FURNISHED PRODUCTS

A.   The Owner will furnish furniture and equipment through other contracts as shown on floor plans. The Work includes providing support systems to receive Owner's equipment, and mechanical and electrical connections.

1.7   MISCELLANEOUS PROVISIONS

1.   Grass areas are off limits to truck traffic.
2.   Start and stop times each day for construction to be as specified by the Owner in specification Section 01 14 00 "Work Restrictions".

3. Contractor to protect areas noted on drawings including all areas noted as Existing to Remain or Not In Contract that they must pass through.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

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SECTION 01 21 00

ALLOWANCES

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

A.   Drawings and general provisions of the Contract, including General and Supplementary
       Conditions and other Division 01 Specification Sections, apply to this Section.

1.2   SUMMARY

A.   Section includes administrative and procedural requirements for allowances.

1.3   DEFINITIONS

A.   Allowance: An amount set aside in a construction contract for work that is not fully
       defined.

       1.   Allowances described in this Section are part of the Work only if an "Allowance
              Authorization Form" is submitted and approved.

1.4   PROCEDURES

A.   Coordination: Revise or adjust affected adjacent work as necessary to completely
       integrate work of the allowance into Project.

B.   Notification: When an allowance is needed to be used in accordance with the schedule
       following, the "Allowance Authorization Form" must be filled out by the Contractor and
       submitted to the Owner and the Architect. If the usage of the allowance is approved, the
       Owner and Architect shall sign-off on the form and return a copy to the Contractor.

C.   Execute accepted allowance work under the same conditions as other work of the
       Contract.

D.   Schedule: A schedule of allowances is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

 A. Allowance No. 1: Unforeseen Conditions

   1. This allowance is for additional unforeseen work that may be required to complete the work in the contract documents but is not known at the time of the completion of the contract documents due to concealed existing conditions. The value of this allowance, seventy-five thousand dollars ($75,000.00), is included in the bid form as part of the contract amount.

 B. **Allowance No. 2: Stored Items Removal**

   1. **This allowance is for the manpower to remove items that have been left on the 7th floor by the owner, as described in General Note H on drawing sheets AD101a, AD101b, AD102a, and AD102b. This allowance does not include the dumpster, which is listed under unit prices. Please see 01 22 00 "Unit Prices" for more information about the dumpster. The value of this allowance, five-thousand dollars ($5,000.00), is included in the bid form as part of the contract amount.**

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

   A.   Drawings and general provisions of the Contract, including General and Supplementary
        Conditions and other Division 1 Specification Sections, apply to this Section.

1.2   SUMMARY

   A.   This Section includes administrative and procedural requirements for unit prices.

1.3   DEFINITIONS

   A.   Unit Price: An amount proposed by bidders and stated on the Bid Form for a given unit
        of work defined in the Bidding Requirements that may be added to or deducted from the
        Contract amount based on actual quantities installed. Changes can be to either add
        additional work or delete work.

   B.   The cost or credit for each unit price is the net price to be added to or deducted from the
        Contract Sum to adjust for the actual quantity installed and includes all overhead, profit,
        supervision and miscellaneous costs. No other adjustments are made to the Contract
        Sum.

1.4   PROCEDURES

   A.   Coordination: Modify or adjust affected adjacent work as necessary to completely
        integrate work of the unit price into Project.

        1. Include as part of each unit price, miscellaneous devices, accessory objects, and
            similar items incidental to or required for a complete installation whether or not
            indicated as part of unit price.

   B.   Execute unit prices under the same conditions as other work of the Contract.

   C.   Schedule: A Schedule of Unit Prices and Allowances is included at the end of this
        Section. Specification Sections referenced in schedule contain requirements for
        materials necessary to achieve the work described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1   SCHEDULE OF UNIT PRICES

A.   **Unit Price No 1**: Additional Gypsum Board Ceiling Demolition: Provide unit price per square foot for demolition of additional existing gypsum board ceiling assembly of construction similar to the new work gypsum board ceilings detailed and specified in the Bid Documents.

B.   **Unit Price No 2**: Additional Security Plaster Ceiling Demolition: Provide unit price per square foot for the demolition of additional existing security plaster ceiling.

C.   **Unit Price No 3**: Additional Grouted, Reinforced, CMU Partition Demolition: Provide unit price per square foot for additional demolition of portions of existing reinforced CMU partitions similar to partition type P6S, but with 8" thick CMU in lieu of 6" CMU.

D.   **Unit Price No 4:** Additional Gypsum Board Ceiling Reinstallation: Provide unit price per square foot for reinstallation of additional existing gypsum board ceiling assembly of construction similar to the new work gypsum board ceilings detailed and specified in the Bid Documents.

E.   **Unit Price No 5:** Additional Security Plaster Ceiling Reinstallation: Provide unit price per square foot for the reinstallation of additional existing security plaster ceiling to match existing.

F.   **Unit Price No 6:** Additional Grouted, Reinforced, CMU Partition Replacement: Provide unit price per square foot for additional reinstallation of portions of existing reinforced CMU partitions similar to partition type P6S, but with 8" thick CMU in lieu of 6" CMU.

G.   **Unit Price No 7:** Additional Removal of Soil: Provide unit price per cubic yard for removal of soil.

H.   **Unit Price No 8:** Replacement of Existing Brick Sidewalk: Provide unit price per square foot to replace existing brick sidewalk at south of building to match existing.

I.   **Unit Price No 9:** Replacement of Sidewalk Curb: Provide unit price per linear foot to replace sidewalk curb in kind.

J.   **Unit Price No 10:** Patch Terrazzo Finish Flooring: Provide unit price per square foot to patch existing terrazzo finish flooring to match existing terrazzo flooring in public corridor.

K.   **Unit Price No 11:** Additional Power Outlet and Associated Wiring: Provide unit price for additional data outlet and wiring as delineated in Bid Document.

L.   **Unit Price No 12:** Additional Data Outlet and Associated Wiring: Provide unit price for additional data outlet and wiring as delineated in Bid Documents.

M.   **Unit Price No 13:** Additional Plumbing Piping: Provide unit price per linear foot for supply and installation of additional plumbing piping.

N. **Unit Price No 14: Price per 30 yard dumpster for removal of items left on the 7th floor by owner: Provide a unit price for the deliver, use, and tipping of a 30 yard dumpster. This is for use only for owner-left items on the 7th floor; not for general demolition or construction waste. Manpower for removal of owner-let items on the 7th floor is covered under allowances. See specification 01 21 00 "Allowances."**

END OF SECTION

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SECTION 27 10 00

STRUCTURED CABLING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A.   Section 07 84 13 - Penetration Firestopping.

1.02 REFERENCE STANDARDS

A.   Delaware Sate-Wide Information Techanology and Architecture Standards (NE-Cabling-002)

B.   Delaware Sate-Wide Information Techanology and Architecture Standards (AC-Wireless-001)

C.   NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D.   TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2015c, with Addendum (2017).

E.   ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications; Rev A, 2002.

1.03 SUBMITTALS

A.   See Section 01 31 00 - Project Management and Coordination, for submittal procedures.

B.   Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
1.   Storage and handling requirements and recommendations.
2.   Installation methods.

C.   Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

D.   Manufacturer Qualifications.

E.   Evidence of qualifications for installer.

F.   Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
1.   Record actual locations of outlet boxes and distribution frames.
2.   Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
3.   Identify distribution frames and equipment rooms by room number on drawings.

G.   Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.04 QUALITY ASSURANCE

A.   Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.

B.   Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
1.   Employing a BICSI Registered Communications Distribution Designer (RCDD).
2.   Supervisors and installers factory certified by manufacturers of products to be installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A.   Store products in manufacturer's unopened packaging until ready for installation.

B.   Keep stored products clean and dry.

1.06 WARRANTY

    A.   See Section 01 78 23 - Operation and Maintenance Data, for additional warranty requirements.

    B.   Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 NETWORK CABLING AND EQUIPMENT

    A.   The contractor shall refer to Delaware Sate-Wide Information Techanology and Architecture Standards (NE-Cabling-002) for product requirements for cabling and equipment.

    B.   Network switches shall be CISCO Catatlyst 3850 series.

2.02 WIRELESS ACCESS POINT

    A.   The contractor shall refer to Delaware Sate-Wide Information Techanology and Architecture Standards (AC-Wireless-001) for product requirements for installaiton of wireless access points.

    B.   Wireless access points shall be Aerohive AP250 or Cisco Aironet 1852i as indicated in AC-Wireless-001.

Standard ID:	**NE-Cabling-002**
Title:	**Structured Cabling System Standards and Specifications for State-Managed Facilities**
Domain:	**Network and Storage**
Discipline:	**Cabling**
Revision Date: Revision no.: Original date:	**1/8/2016** **6** **7/21/2008**

A. <u>**Authority:**</u> Title 29, Chapter 90C provides broad statutory authority to the Department of Technology and Information to implement statewide and interagency technology solutions, policy, standards and guidelines for the State of Delaware's technology infrastructure. "Technology" means computing and telecommunications systems, their supporting infrastructure and interconnectivity used to acquire, transport, process, analyze, store and disseminate information or data electronically. The term "technology" includes systems and equipment associated with e-government and Internet initiatives.

B. <u>**Applicability:**</u> Applies to all State of Delaware communications and computing resources. DTI is an Executive Branch Agency and has no authority over the customers in Legislative and Judicial Branches, as well as School Districts, and other Federal and Local Government entities that use these resources. However, all users, including these entities, must agree to abide by all policies, standards promulgated by DTI as a condition of funding, access and continued use of these resources.

C. <u>**Purpose:**</u> Cable configuration and installation is critical to providing connectivity in State buildings. This standard provides guidance for the design and installation of cabling. This standard provides guidance and requirements for data, voice, and CATV structured cabling systems and support infrastructure in all State owned and leased facilities and buildings.

Table of Contents

PART 1   SCOPE

A. **Areas Covered:** This standard covers the best practices and installation requirements for Voice, Data, CATV cabling and support structures including conduits and raceways, Voice and Data rooms and closets.

B. **Environments:** This standard applies to all State owned and leased building and office spaces. It is concerned with all Data, Voice and CATV cabling projects, whether they are for new construction or revisions additions and upgrades to existing systems.

PART 2   PROCESS

A. **Adoption:** These standards have been adopted by the Department of Technology and Information (DTI) through the Technology and Architecture Standards Committee (TASC) and are applicable to all Information Technology use throughout the State of Delaware.

B. **Revision:** Technology is constantly evolving; therefore, the standards will need to be regularly reviewed. It is the intent of the TASC to review each standard annually. The TASC is open to suggestions and comments from knowledgeable individuals within the State, although we ask that they be channeled through your Information Resource Manager (IRM).

C. **Contractors:** Contractors or other third parties are required to comply with these standards when proposing technology solutions to DTI or other State entities. Failure to do so could result in rejection by the Delaware Technology Investment Council. For further guidance, or to seek review of a component that is not rated below, contact the TASC at dti_tasc@state.de.us.

D. **Implementation responsibility:** DTI and/or the organization's technical staff will implement these best practices during the course of normal business activities, including business case review, architectural review, project execution and the design, development, or support of systems.

E. **Enforcement:** DTI will enforce these best practices during the course of normal business activities, including business case and architectural review of proposed projects and during the design, development, or support of systems. These best practices may also be enforced by others during the course of their normal business activities, including audits and design reviews.

F. **Contact us:** Any questions or comments should be directed to dti_tasc@state.de.us.

PART 3   EXECUTIVE SUMMARY

Because of ever-advancing Industry Standards and new Alliances between Cable and Hardware Manufactures and Vendors, this document seeks to enhance and clarify the State of Delaware's wiring and cabling standards and specifications for Structured Cabling Systems. Approved Contractors under State of Delaware Contract # 05-441-TL are required to adhere to these specifications and standards.

The structured cabling system will support Voice, Data, and imaging applications within State-owned and -leased office facilities. This document describes the Structured Cabling System requirements to be met in the proposals for Communications cabling by Vendors and Contractors. These requirements encompass all materials, design, engineering, installation, supervision, and training services for a Structured Cabling System.

These standards are adopted by the Department of Technology and Information (DTI), through the Technology and Architecture Standards Committee (TASC), and are applicable to all Information Technology use throughout the State of Delaware. Any questions or comments should be directed to dti_tasc@state.de.us.

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The following are examples of the Structured Cabling Systems that can be bid for new construction and whole building renovations, in which case all building structured cabling wiring is replaced. The choice of a Structured Cabling System is not limited to the Vendors or Manufactures listed below. The Channel Solutions shall be bid when possible. If a Link solution is bid the State Contact, PM, or DTI (Department of Technology and Information) must authorize the installation.

In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise. Where building renovations and additions do not require the removal of the existing structured cabling system, the existing cabling in conjunction with new cabling should maintain the system warranties. If the existing structured cabling system is not Category 5e or better, it must be upgraded to CAT6 or better with a matching patch panel.

- Hubbell Premise Wiring
- Ortronics
- Panduit
- Systimax
- Leviton

A. Terms and Conditions of Bids/quotes

1. An approved Contractors bid submittal should be based on the materials, systems, equipment, and Standards described in this document and in the bid response format of the attached example. Refer to Appendix G. All bids must be submitted in accordance with the specifications and information contained herein, as well as with any addenda, if required.
2. The bid package shall be accompanied by a presale warranty commitment, binding the Installation Contractor and Manufacturer to the customer-selected extended warranty package as described in State Contract # 05-441-TL page 21 section 3) paragraph b).
3. At any point in time, should you require clarification or have any questions pertaining to the content of this document, please call The State of Delaware Department of Technology and Information (DTI). 302-739-9500

PART 4   OBJECTIVE

This document has been developed as a source of information to assist in the design, implementation and maintenance of Voice, Data and Broad Band communications systems. It contains standards and specifications which guide users through structured cabling system design, planning, and installation.

To maximize the usefulness of this document, access to the various TIA/EIA (Telecommunications Industry Association/Electronic Industries Alliance), IEEE (Institute of Electrical and Electronics Engineers), BISCI, (Building Industry Consulting Service International), NEC (National Electrical Code), NFPA (National Fire Protection Association) Communications Standards, and implementation and installation Manuals for further reference is required. This document assumes that users have communications knowledge and training in all aspects of design, implementation, installation, and testing of a Voice/Data communications system.

This document does not address safety issues associated with use. It is the individual's responsibility to use established and appropriate safety and health practices and to determine the applicability of all regulations.

PART 5   CREDITS

Communications Cabling Construction
Developed by:
State of Delaware Department of Technology & Information
801 Silver Lake Blvd. Dover, DE
19904

The content of this document is drawn from experience, as well as other documents
and manuals, including the following:

- NEC 2011/2013 Code book
- NFPA-70 Publications
- TIA/EIA Communications Building Wiring Standards
- IEEE Publications & Standards
- BICSI Communications Distribution Design and Installation Publications
- MOTOROLA R56 Standards and Guideline for Communications
- Various Manufactures Publications and Requirements

PART 6   INTRODUCTION

Any Structured Universal Cabling System installed for the Agencies of the State of Delaware is designed to meet known and anticipated technology needs within the State. An advanced building cabling system provides for more than communication services; it provides an infrastructure for an institution's entire communications network. Instead of being a basic utility, it is as important as the high-tech systems that transmit signals over it and is an integral component of the State's overall information network.

These designs provide a universal and flexible cabling system for workstations, conference rooms, and laboratories. Today's cabling system must be multi- functional and provide service for telephones, computers, fax machines, LANs, WANs, broad band fiber optic and coaxial systems (CATV, SATV, CCTV.), Data Centers, computer-aided design workstations, Audio Video systems (AV), and other technologies. For a cabling system to be capable of meeting today's technology and institutional demands, it must have high bandwidth capacity and transmission speed while being extremely flexible.

This wiring architecture incorporates the applicable ANSI/EIA/TIA standards, BICSI guidelines and the latest technologies. This cabling distribution plan can integrate all types of systems from a variety of vendors. The design uses a subsystem approach, which allows for changes in the system without affecting other parts of the system. The Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Room equipment racks are designed to allow for growth, and the cable routing is accomplished through the provision of cable trays, conduits, sleeves, raceways, and cable hangers where required. Ease of administration and recordkeeping for moves and changes is readily apparent, as is the flexibility that a structured cabling system provides.

The wiring medium for the Communications Cable Network consists of Category 6 – 6a 24AWG Unshielded Twisted Pair (UTP) for station cabling and multi pair twisted copper for backbone cabling to support low-speed voice or Data, Category 6 or 6a for high speed LAN technologies, and 50/125 micron multi-mode fiber optic cable and 50/125 micron multi-mode for even higher bandwidth requirements. The unshielded twisted pair (UTP) Category 6 or 6a LAN cables can support Data transmission rates of 100, 250 and 500 Mb/Sec

respectively according to EIA/TIA Standards and manufacturers' specifications. These leading edge components, combined with the open wiring architecture, provide the technology, flexibility, and modularity that allow the system to grow and change to meet changing needs.

The central distribution location of the system is the Fiber Optic, coaxial and Copper Main Distribution Frame (MDF) located within the centrally located MDF/IDF Room of each building. Various fiber optic, coaxial and copper riser cables terminate on the MDF and extend to the Communications Rooms/Closets (IDFs) located throughout the buildings. Each building typically has one MDF/IDF Room and a varying number of IDF rooms/closets dictated by the horizontal station cabling limitation of 100 meters for high performance cable. The distance from the information outlet to the termination within the IDF is limited to 90 meters (the permanent link). The IDF room/closet houses the Intermediate Distribution Frame (IDF), Copper and Fiber Optic IDF Patch Panels, Local Area Network (LAN) equipment, and other electronics. Both the riser cables and the horizontal station cables feeding the floor's workstations information outlets terminate in the IDF on Data patch panels, Voice 110 hardware, and Fiber Optic Patch Panels. These termination points act as the cross-connect point between the MDF and the floor that is being served. Large floors are divided into zones, via an imaginary line, with each zone being served by its respective IDF room/closet. (See figure 1)

Each work area and workstation is served by an information outlet, which provides the jacks for plugging in telephones, computers, broad band coaxial systems, fax machines, modems, and other devices at the desktop. The information outlets are served by varying sets of cables consisting of fiber optic and copper technologies, which originate in the IDF Room. IDF outlets are typically displayed as varying types of triangles (shaded, half-shaded, etc.) on blueprints. (See figure 2)

A subsystem architectural approach, using the latest technologies, provides a comfortable level of assurance that the system will support new applications and industry standards as they emerge.

These standards are adopted by the Department of Technology and Information (DTI), through the Technology and Architecture Standards Committee (TASC), and are applicable to all Information Technology use throughout the State of Delaware. Any questions or comments should be directed to dti_tasc@state.de.us.

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Drawing Redacted

Drawing Redacted

PART 7	PROCEDURES

Designing a cable system for an institution involves various organizations and individuals and requires a great deal of coordination. Once an institution is designated for wiring, AutoCAD drawings of the floor plans need to be acquired. AutoCAD is a type of computer aided drafting (CAD) format. These files are plotted and converted to blueprints that serve as the working drawings for site surveys and engineering purposes. Based on interviews with the agency's staff and Technical Coordinator will draw triangles on the drawing displaying the locations that information outlets are to be located. Also, tentative locations for the Communications/Data rooms/closets will be marked on the drawings. This information will be approved by the institution's officials and sent to the engineering team.

The engineers will survey the building—floor plans for new construction—and evaluate the communications rooms/closets, plan cable routing, and review the information outlet locations. The necessary adjustments will be made during the site survey, and the engineer will leave the site with the proper approvals from the agency's management if there are major changes such as room relocations.

The engineering team will then design the cable system for the building. The end product will be submitted to the agency's Technical Coordinator for comment and/or revision. If no adjustments are necessary, the blueprints are issued to the contractor for construction.

PART 8	HORIZONTAL DISTRIBUTION SYSTEM

The horizontal structured cable plant is the portion of the communications wiring system that extends from the information outlet to the Communications/Data room/closet.

A. Horizontal Distribution System General
1. The horizontal distribution system includes the:
   - Information outlet at the workstation
   - Cables connecting the workstation to the Communications/Data room/closet
   - Intermediate routing and distribution systems

2. The horizontal distribution system should be configured in a star topology. All communications outlets within a work area should be connected to a single Communications/Data room/closet, as defined by the zone concept.

3. This infrastructure must serve all of the Communications requirements of the agency or owner.

4. Communications applications served by the horizontal system can include:

   - Voice (e.g., telephones)
   - Data (e.g., terminal connectivity, modems, etc.)
   - Local area networks (e.g. Ethernet)
   - Audio & Video (e.g., CATV, video conferencing and security monitoring)
   - Graphics & Imaging

5. When designing a horizontal distribution system, include capacity to satisfy long- term requirements as well as initial plans. Ensure that the distribution system has the flexibility to accommodate necessary moves, additions, changes, and system growth.

6. After construction, the horizontal distribution system is typically difficult to access. Therefore the time, effort, coordination, and skills required for changes can be extremely costly. In addition, access to the horizontal distribution system frequently causes disruption to the user community.

7. All Horizontal Workstation Communications and broad band coaxial system cabling will be "home-run" from the information outlet location to the termination point within the corresponding IDF or MDF/IDF room.

8. Horizontal cable paths will be in a "streets and avenues" manner, typically following main walkways.

9. Horizontal cables are to be fastened onto hangers five feet apart with all cables bundled with tie wraps, and are to have a small amount of slack visible.

10. Cables must not rest on any structures or the hung ceiling. Cables are not to be fastened to ducts, pipes, conduits, or any other existing structures. Cable bundles should be secured to the slab overhead to avoid any conflict with or EMI from flexible electrical conduits, transformers, motors, etc.

11. Some cabling shall run to workstation and other outlets through cavities in the dry wall and openings in sheet metal or wooden studs within the dry wall construction. The sheet metal studs will not have gaskets for this purpose, so it is the Contractor's responsibility to exercise extreme care in snaking cable through these areas, so as to avoid damage to the cable jacketing.

12. The building's horizontal wiring plan is to be installed on all floors from the information outlet to the termination point within the associated IDF Room.

13. Horizontal cable will be installed onto "J" hooks or equivalent in the ceiling or tops of walls near ceiling. Cables are to be fastened to "J" hooks or equivalent every 5 feet. The cable contractor is to provide and furnish the "J" hooks.

14. All station cable (horizontal) and tie cables that run from relay racks to the wall- mounted frames are to be plenum-rated.

B.   Horizontal Communications Cable Specification

1. For each type of information outlet indicated on the attached drawings, the contractor shall furnish all of the following equipment, install it in the correct configuration, and test it.

2. All cabling, outlets, and termination patch panels used for the Category 6 / ISO Class E data system may be provided by a single manufacturer and shall be certified as part of the 25 year minimum warranty- Where the installer chooses to use one (1) manufacturer for cabling and a different manufacturer for the outlets and termination patch panels for the Category 6 / ISO Class E data system, the two (2) manufacturers must prove to have compliant interconnecting hardware and shall be certified as part of the 25 year minimum warranty.

3. All Category 6 and 6a UTP & Fiber cabling is to be handled and terminated in accordance with the Manufacturer's Premises Communications Application and Installation Guide.

4. In addition to the above manufacturer's standards, all applicable EIA/TIA Category 6 and Fiber Optic Cable standards are to be strictly adhered to.

5. The fiber optic cable is to be terminated on both ends with an SC type connector on the patch panels.

6. The contractor is to use Plenum cable for all station 4-pair copper, coaxial, and 2-strand fiber cabling.

7. Plan routes to ensure that the proposed route on the plans falls within the EIA/TIA distance limitations (90 meters after termination) for horizontal cabling.

8. Cables serving information outlets that cannot be routed down wall cavities will be enclosed in latching surface-mount raceways, anchored (not with adhesives) to walls. Contractor will provide all raceway fittings to allow for level and plumb routes from ceiling to information outlet. Proper fill ratios must be observed. Contractor may reference the manufacturer's catalogs or specifications for correct fittings and fill ratios. Contractor must use all accessory fittings required in order to build a neat and functional installation. This same method will apply to routing horizontal cables to workstation outlets where ceilings are not accessible**.**

9. The RG-6U Plenum Cable and the RG11U Plenum Cable are to be terminated with F type connector or connectors. The RG6U Coaxial Station cabling will be terminated onto a rack or wall-mounted "F" Connector Patch Panel located in the IDF Room.

10. The IDF Room side of the Voice four-pair cables serving a standard outlet will be punched down

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on the corresponding IDF Room's wall-mounted frame on 110 Cat 6 field-terminated cross-connect terminal blocks.

11. The IDF Room side of the Category 6 – 6a four-pair cables serving a standard outlet will be punched down on individual 110 (Category 6–6a) modular patch panels, 568B wired. The patch panels will be mounted in the relay racks within the IDF rooms.

12. The contractor is to install a wire management panel between all patch panels and above the first panel as well as one below the last panel.

13. In locations that have wall-mounted racks, the contractor is to use the Cat 6 hinged down patch panels with associated cable management. In cases where the hinged down series is required, the contractor is to take care to dress the cables neatly and allow for future access to the rear of the panel.

14. Contractor is to label both the front and the rear of the patch panels. The terminations are to follow this sequence: Workstation 001A, 001B, 002A, 002B. It is acceptable to change numbering for floor or closet designation.

C. Zones

1. A zone is a contiguous area in which all horizontal wiring is homed to a single communications closet.

2. To maintain an orderly, understandable wiring system, it is imperative that the horizontal distribution system be structured in zones.

3. Within a zone, all communications wiring is run to a single communications closet.

4. Other zones use different Communications/Data rooms/closets. Cross-zone horizontal wiring is prohibited. Connections between zones are provided via the vertical distribution system.

PART 9   COMMUNICATIONS/DATA ROOMS/CLOSETS (GENERAL)

The Communications/Data room/closet is a concentration point for communications and LAN services. In this room, premise wiring and cabling are terminated and cross-connected. In addition, active networking devices such as switches are placed here. Communications/Data rooms/closets provide a safe area for housing distribution cabling, premise equipment, and termination fields. These rooms/closets are a focal point for communications services.

In addition to supporting in-house connectivity, the MDF Communications/Data room/closet often provides a termination point for the local telephone company. The entrance facility, or demarcation point (de-mark), is the location where outside communications services, such as copper telephone lines, fiber optic Data circuits, and CATV, are delivered to the building. Typically, distribution of communications services within the building originates at this point and is the responsibility of the owner.

Special considerations must be given when providing the building entrance pathways for the copper, fiber optic, and coaxial cables that service providers will install in to the building de-mark. It is the owner's responsibility to provide this pathway into the building. Contact DTI for standards and specifications for building entrances.

The following section details the basic requirements for a Communications/Data room/closet. It may be used to assist in:

- Designing new Communications/Data rooms/closets
- Assessing and refining existing Communications/Data rooms/closets to support evolving communications requirements.

A. Design Guidelines

The suggested building practices put forth in this section are recommendations and are subject to field conditions and budget constraints. Local building and electrical codes, practices and requirements may supersede the guidelines presented in this section.

1. Sizing of Communications/Data rooms/closets
   - The Communications/Data room/closet must have enough space to support required communications systems, including projected growth.
   - The existing system is likely to be replaced in the future
   - A new system may, require more (or less) space
   - The existing system and a new system may need to coexist during a cut-over

2. Location of Communications/Data rooms/closets
   - Communications/Data rooms/closets should be situated so as to minimize the length and the quantity of cable runs needed for the distribution systems.
   - The maximum horizontal distribution cable distance must be less than 90 meters (295 ft.), independent of media type. This distance represents the cable length from the mechanical termination of the media in the Communications/Data room/closet to the outlet in the work area. This is known as the permanent link.
   - Vertical (backbone) distribution system distance limitations vary and are dependent upon media, topology, and facility issues.

3. Unacceptable locations for Communications/Data rooms/closets:
   - Anywhere water vapor exists, such as boiler rooms, washrooms, or janitor's closets.
   - Spaces with corrosives, explosives, and combustibles, including acid, ammonia, chlorine, oxygen, and petroleum vapors.
   - Spaces containing steam pipes, drains, or clean-outs.
   - Areas with high traffic volumes (for security reasons, as well as to minimize the risk of inadvertent damage) unless separately enclosed.
   - Areas of high electromagnetic interference (EMI) or radio frequency interference (RFI). Both adversely affect system performance and reliability.

B. General Room Requirements

1. Electrical
   - All active Communications, Data and Video systems have specific electrical power requirements. Plan electrical service to ensure smooth installation, reliable service, and compliance with manufacturers' warranties. Be sure to consider equipment manufacturer's specifications, National Electric Code (NEC) requirements, State and local codes, ordinances, and requirements.

   - Electrical devices capable of causing line transients, such as fans, pencil sharpeners, radios, calculators, and lights, must be separated electrically from the Communications equipment. To

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accomplish this, all Communications and Data equipment requires separate electrically isolated ground circuits and/or building grounding. The outlets on these circuits should be labeled and/or color coded. Frequently, orange-colored wall outlets are used to identify power sources used for computing and communications equipment. Utility outlets are also needed in the Communications/Data room/closet for tools, test sets, and other equipment.

- Each Communications/Data room/closet shall have one 110V, 15 Amp electrical convenience outlet and one 110V, 20 Amp dedicated-circuit isolated-ground electrical outlet for the electronic equipment. This is a minimum requirement based on the typical current draw of the networking equipment to be placed. The ground for the equipment outlet should be an isolated ground where possible to avoid line transients. The 110V 20 Amp dedicated circuit isolated ground electrical outlet(s) should be mounted in convenient location to facilitate the use of the shortest equipment power cords. The recommended location is at the top of the rack or on the ladder tray.

- All electrical isolated ground outlets serving Communications and Data equipment must be attached to non-switched circuits to prevent inadvertent equipment shutdown. It is also recommended that they be on a UPS and/or generator if available.

2. **Grounding**
   - Most Communications and Data equipment requires bounding and grounding of equipment cabinets. Do not use plumbing or conduit (EMT) fixtures as a ground source. Grounding shall meet the NEC and EIA/TIA requirements and practices except where other authorities or codes impose more stringent requirements or practices. (Refer to NEC Chapter 2 article 250 and Chapter 8 Communications Systems, TIA/EIA Standard J-STD-607-A and Motorola R56 Standards and Guideline for Communication site).

   - In addition to protecting personnel and equipment from hazardous voltages, the grounding system may reduce the effect of electromagnetic interference (EMI) throughout the structured cable plant. Improper grounding can result in induced currents that disrupt Communications circuits.

   - Ensure that the installation conforms with applicable regulations and practices

   - Ensure that each Communications/Data room/closet has an appropriate ground buss bar

   - Ensure that grounding is available for cross-connect frames, patch panel racks, Telephone and Data equipment, as well as testing and maintenance equipment

3. **Space**
   - A distance of three feet is the preferred clearance from the front, back, and side of a relay rack.

   - If there are space constraints, it is acceptable to provide a minimum of two feet of clearance on one rack side for access and a minimum of two feet of front and back clearance for cross-connect fields, patch panels, etc. If possible, locate sleeves, cores, slots, and/or conduits together in one area to maximize usable wall space.

4. **Rooms/Closets Sizing**

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- Determine the number of relay racks required for the termination of patch panels and electronic equipment. Assume that free-standing relay racks will be installed and provide three feet of space on all sides of each.

- Determine the amount of wall space that will be required for the installation of termination equipment. A minimum of four feet should be used as a criterion.

- Determine if the plywood backboard will be furred-out. This equals approximately 4" of space taken from the room.

- Take into account the door swing if the door opens into the room. Ideally the door should open out from the room.

- Determine how much space any sleeves, conduits, or other equipment require.

- Determine the size of the room by constructing a diagram, to scale, of all of these components, taking into account all the walkways and door swings.

- If a very small number of information outlets are being installed, the minimum size a closet can be is 4' wide and 3' deep. This assumes a 4' X 8'X 3/4" plywood backboard, one wall-mounted relay rack that has a fiber optic patch panel, 110 blocks, copper patch panels, coax patch panel, LAN hubs and ground buss bar. It is recommended to install plywood on all walls, from the floor to the ceiling.

5. **Structural Walls**
   - Extend from the floor to the deck above (fire wall)

   - Be securely fastened to the floor and the deck above

   - Conform to national and local construction guidelines

6. **Wall Linings**
   - Each Communications/Data room/closet will contain a minimum of one furred-out or flush sheet of plywood (4' X 8') mounted on the wall.

   - It is recommended to install plywood floor to ceiling on all walls.

   - Securely fasten the plywood to wall framing members to ensure that it can support any attached equipment.

   - The plywood is to be 3/4", A/C grade, and fire-retardant.

   - All plywood backboards are to be mounted smooth side out and painted white at time of installation, prior to installation of equipment onto the plywood.

7. **Floor Finish**
   - Keep dust to a minimum in Communications/Data rooms/closets.

   - Anti-static Asphalt Tile, Linoleum Tile, or Sealed Concrete is acceptable floor finishes.

8. **Ceilings and Doors**
   - Dropped ceiling height should be at least nine feet from the finished floor to provide adequate space for equipment cabinets and suspended cable trays. Some equipment may require additional height, depending on the manufacturer's specifications. Avoid installing false ceilings in small closets.

   - Overhead ceiling vents should be centrally located to maximize air distribution and maintenance access. Avoid placing overhead ceiling vents directly over suspended racks and equipment cabinets.

   - All ceiling vents should have diffusers (vent manifolds) securely installed.

   - Design doorways with minimum measurements of 36 inches wide. Hinge the doors to open outward.

   - All Communications/Data rooms/closets should have door locks and a minimum number of windows, if any. Closets should be kept locked. Provide keys to select personnel who are on-site continuously.

9. **Lighting**
   - Within ceilings, position light fixtures at least eight feet above the finished floor.

   - Indirect (reflected) lighting is not recommended.

   - If possible, minimize heat and glare by using fluorescent light fixtures with protective covers instead of incandescent fixtures.

   - Do not place light fixtures where the light may be blocked or filtered.

   - Typically, light fixtures should not be directly above or within 12 inches of cabling, equipment cabinets, termination frames or other free-standing equipment.

   - Install light fixtures on power circuits separate from those used for communications equipment.

10. **Communication/Data Room/Closet Environment**
    - Manufacturers of most hardware recommend a room environment consisting of a temperature between 72–75° Fahrenheit and a 45–50% humidity level.

    - It is recommended that temperature swings do not exceed 10° and humidity remain within a ±5% range.

C. **MDF Requirements**

An MDF Room is a specialized communications closet that may house major communications systems, such as a PBX (private branch exchange), communications processor, and routing equipment. The MDF Room is generally considered to be distinct from an IDF Room because of the complexity of the equipment it contains.
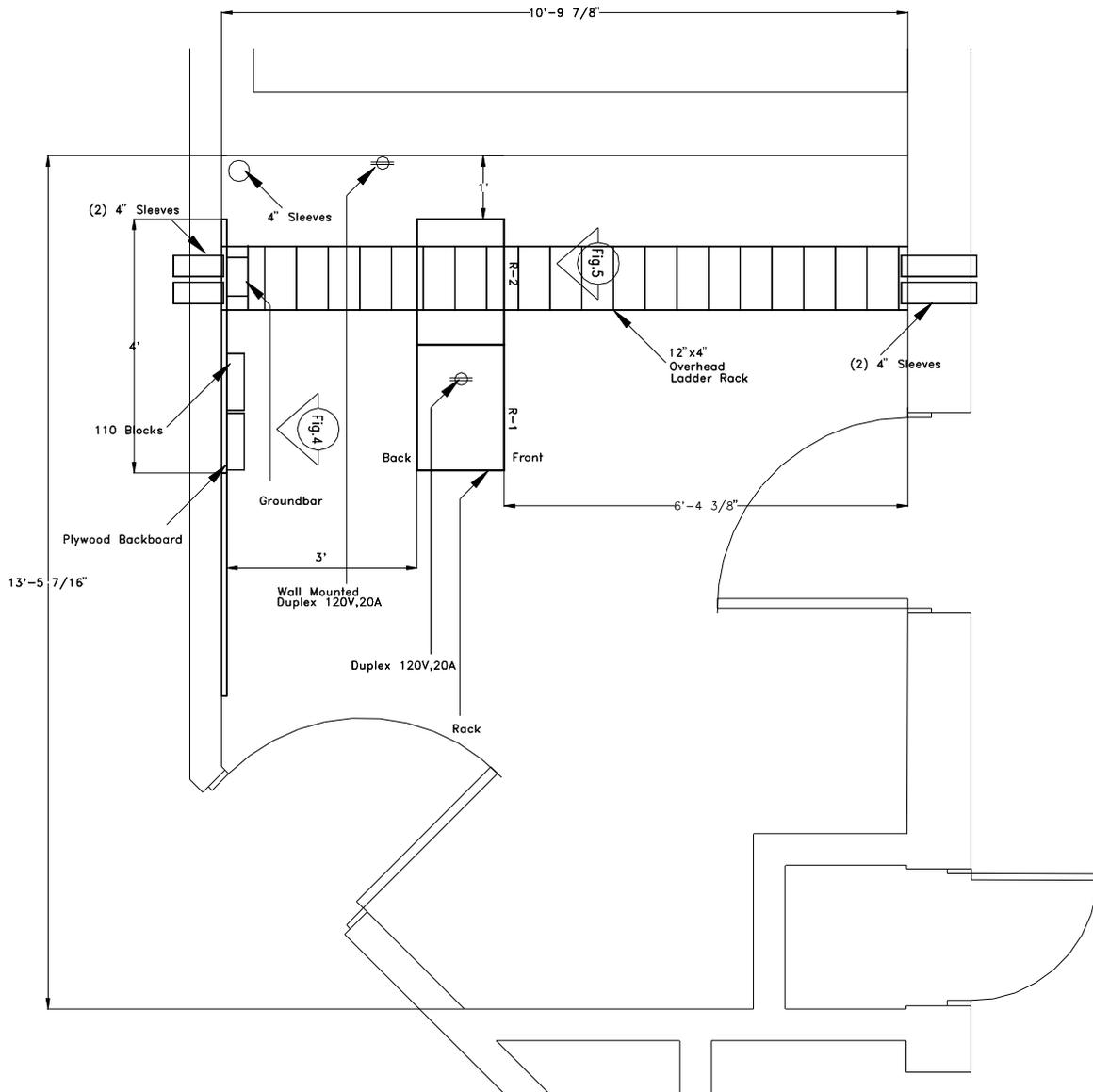
A typical Main Distribution Frame (MDF) Room is composed of a wall-mounted plywood backboard and relay racks designed for mounting termination equipment and electronics (see Figure 3). Most

MDFs within the building cabling system also serve as an IDF. This is accomplished by providing separate relay racks for each and delineating the wall-mounted frame's 110 blocks for Station cabling (see Figure 4 and Figure 5).

FIGURE 3

Main Distribution Frame Room Layout
NOT TO SCALE

FIGURE 4

PLYWOOD USED FOR FIRRED-OUT PLYWOOD BACKBOARD WILL BE 3/4" A/C GRADE, FIRE (3 1/2" CAVITY) RETARDANT PLYWOOD IN 4' WIDE X 8' HIGH SHEETS. PLYWOOD SHEETS ARE TO BE MOUNTED VERTICALLY ON 4" STUDS. ALL PLYWOOD BACKBOARDS ARE TO BE MOUNTED SMOOTH SIDE OUT AND BE PAINTED WHITE AT TIME OF INSTALLATION.

110 Blocks Schedule		
	A	B
1	(3) 100pr Riser	Distribution Cables
2	(3) 100pr Riser	Distribution Cables
3	(1) 100pr Riser	
	(1) 100pr Spare	
	(2) 25-Pr Tie to Rk	

Main Distribution Frame Voice Elevation
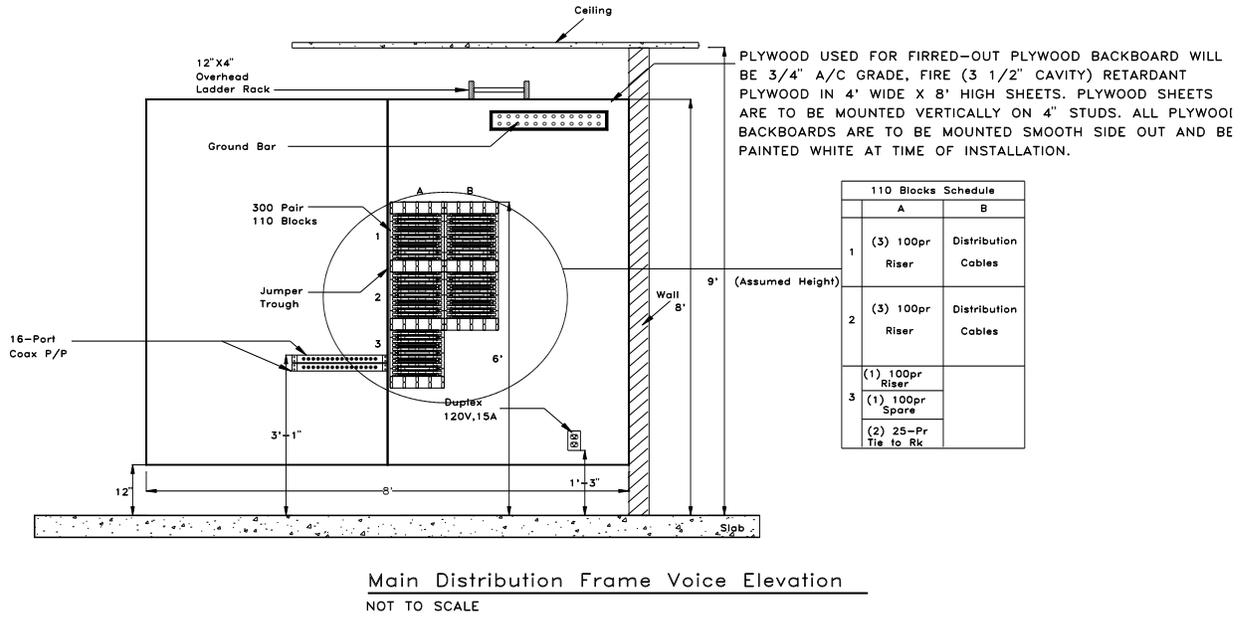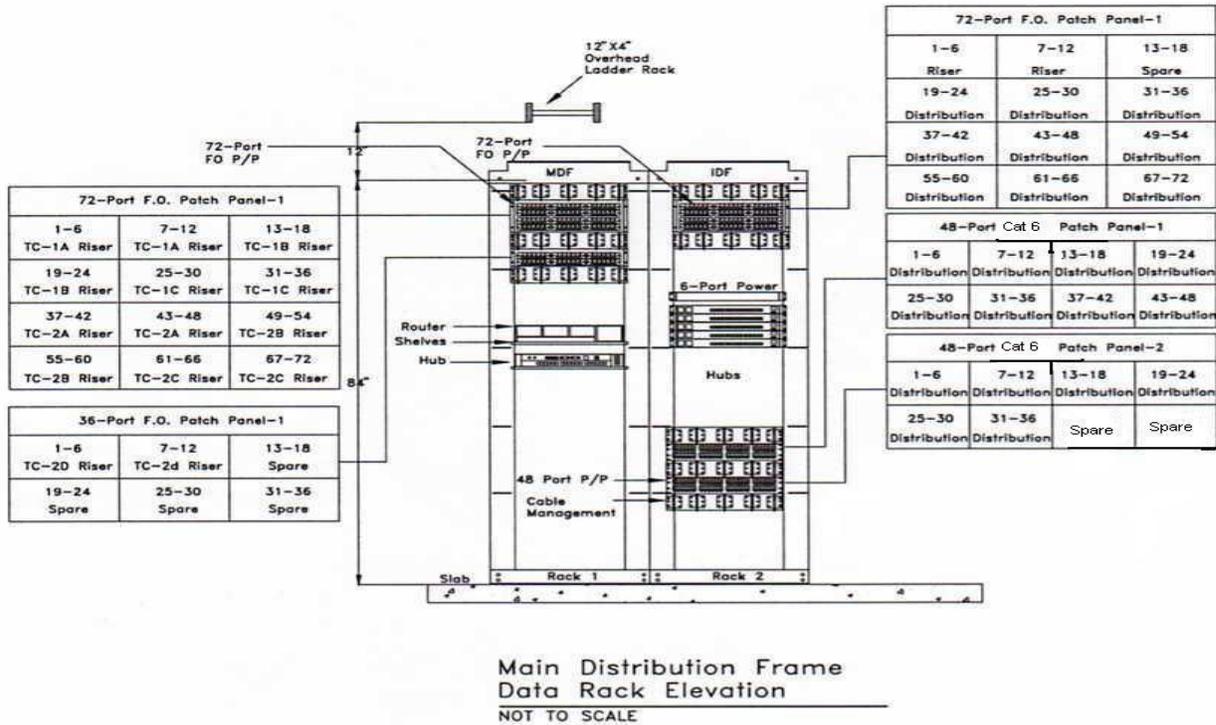NOT TO SCALE

FIGURE 5

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72-Port F.O. Patch Panel-1		
1-6	7-12	13-18
Riser	Riser	Spare
19-24	25-30	31-36
Distribution	Distribution	Distribution
37-42	43-48	49-54
Distribution	Distribution	Distribution
55-60	61-66	67-72
Distribution	Distribution	Distribution

48-Port Cat 6 Patch Panel-1			
1-6	7-12	13-18	19-24
Distribution	Distribution	Distribution	Distribution
25-30	31-36	37-42	43-48
Distribution	Distribution	Distribution	Distribution

48-Port Cat 6 Patch Panel-2			
1-6	7-12	13-18	19-24
Distribution	Distribution	Distribution	Distribution
25-30	31-36	Spare	Spare
Distribution	Distribution		

72-Port F.O. Patch Panel-1		
1-6	7-12	13-18
TC-1A Riser	TC-1A Riser	TC-1B Riser
19-24	25-30	31-36
TC-1B Riser	TC-1C Riser	TC-1C Riser
37-42	43-48	49-54
TC-2A Riser	TC-2A Riser	TC-2B Riser
55-60	61-66	67-72
TC-2B Riser	TC-2C Riser	TC-2C Riser

36-Port F.O. Patch Panel-1		
1-6	7-12	13-18
TC-2D Riser	TC-2d Riser	Spare
19-24	25-30	31-36
Spare	Spare	Spare

Main Distribution Frame
Data Rack Elevation
NOT TO SCALE

1. **MDF/IDF Room Equipment Enclosures**
   • Any MDF/IDF Rooms located in rooms that are shared with space used for any other purpose should have wire mesh cages or sheetrock walls around the Communications equipment, or the equipment should be installed in a lockable cabinet.

2. **Environment**
   • Environmental control equipment must function properly at all times. If the building system cannot ensure continuous operation on weekends and holidays, provision of stand-alone control units for the MDF/room and IDF room/closet is necessary.

   • Within the MDF room and IDF room/closet, temperature should not vary by more than 5°F, and humidity must not vary by more than 10%. Measure temperature and humidity five feet above the finished floor in the center of the communications room/closet.

3. **Local Exchange Carrier (LEC)**
   • Placement of Communications equipment may be influenced by vendors and service providers. For instance, the LEC (local phone company) may decide to terminate the Central Office (CO) service directly into the equipment space provided or request termination space other than that offered by the customer. If they request termination at a point other than that requested by the customer, the LEC should provide reasonable explanation.

   • The LEC, CATV, and most service providers will require a conduit entrance in to the building to provide their service. The minimum requirements are two (2) four- inch conduits for the LEC and one (1) four-inch conduit for each other service provider, unless they specify otherwise in writing.

- It is critical that the high speed Data line, TLS – Canoga Perkins and Fiber Optics be located in the MDF room. This will ensure security and simplify troubleshooting.

- The LEC may also need space for distribution systems terminations (either horizontal or vertical) and patch cable terminations.

4. **Other Equipment Vendors**
   - As with the local phone company (LEC), it is vital to consult with all Communications equipment manufacturers for their specific space and operational requirements, such as the telephone system and Data LAN/WAN equipment provider.

5. **Relay Racks**
   - Each MDF will contain a minimum of one 19"W X 7'H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.

   - The relay racks should have a minimum of 42 rack units of mounting space on standard 19" wide rails.

   - In some cases the relay racks are wall-mounted and in others they are free-standing two- or four-post racks. It must be determined which type of rack is required, based on field conditions, equipment manufacturer's requirements, and space allocated.

   - All racks are to be grounded and bolted to each other as well as to the slab or wall.

   - The rack should have vertical and horizontal cable management to accommodate routing of patch cords.

   - There should be a minimum distance of 48" to be maintained from three sides of the rack.

   - The relay rack specifications and associated components should meet the requirements of the equipment that will be installed in it.

   - It should be at a minimum 84" tall with 6" rails, with 19" equipment mounting space and vertical and horizontal wire management.

6. **Wall-mounted Relay Racks**
   - The rack is to be securely fastened to the wall behind it and attached to the ladder rack above.

   - The rack should be sized to accommodate the equipment to be installed in it, with vertical and horizontal jumper management.

7. **Communications Cabinets**
   - All communications cabinets are to be grounded to the grounding and bounding system and bolted to each other and to the slab.

   - Each communications cabinet is to be installed with its side to an adjacent wall. Three feet of clearance around the cabinet is recommended and the cabinets must have front and rear access.

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8. **Data Equipment Cabinets**
   • Data equipment cabinets should conform to the State Data Center Standard as follows:

Cabinet size	23.54"Wx44.30'Dx79.'H
Rack units	42 rack units for equipment mounting
Mounting rails	two pair 19" adjustable depth universal mounting
Mesh steel doors	single front and split rear with locking handles
Vertical cable management	trough, rings or Velcro tie downs or combination of, mountable left or right side
PDU mounting	space to mount two horizontal PDU closest to equipment mountable top or bottom, together or separate
PDU Metering	Metered PDU's to display Amperage, Voltage
Side panels	removable, solid, both sides
Top	solid with cabling access opening capabilities
Bottom if required	solid with cabling access opening capabilities

   • Cabinet should have grounding, bounding and anti-tip capabilities that can be added when required.
   • Approved cabinet Manufacturer: HP Model # BW903A or approved equal

9. **Cable Trays**
   • Between the relay rack and the wall-mounted frame, a 12" cable tray (center-rail systems are not permitted), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.

   • Do not attach any cable tray to a suspended ceiling grid.

   • An open wire basket cable tray system is acceptable for cable support.

   • Approved manufacturer: Cooper B-Line part # FT4X12X10 or approved equal

10. **MDF Room Electrical Requirements**
    • Each room shall have a minimum of one duplex dedicated 20 Amp isolated ground circuit and one shared 20 Amp circuit.

   • Larger equipment loads may require additional circuits.

D. **IDF Room Requirements**
   Each IDF Rooms within a building supports all connections in single, contiguous area (zones). Cross-zone wiring is not to be installed from user workstations. Connections between zones are made through backbone wiring systems, which link the IDF Rooms to the MDF. A typical Intermediate Distribution Frame (IDF) Room is composed of a wall-mounted plywood backboard and relay racks designed for mounting termination equipment and electronics.
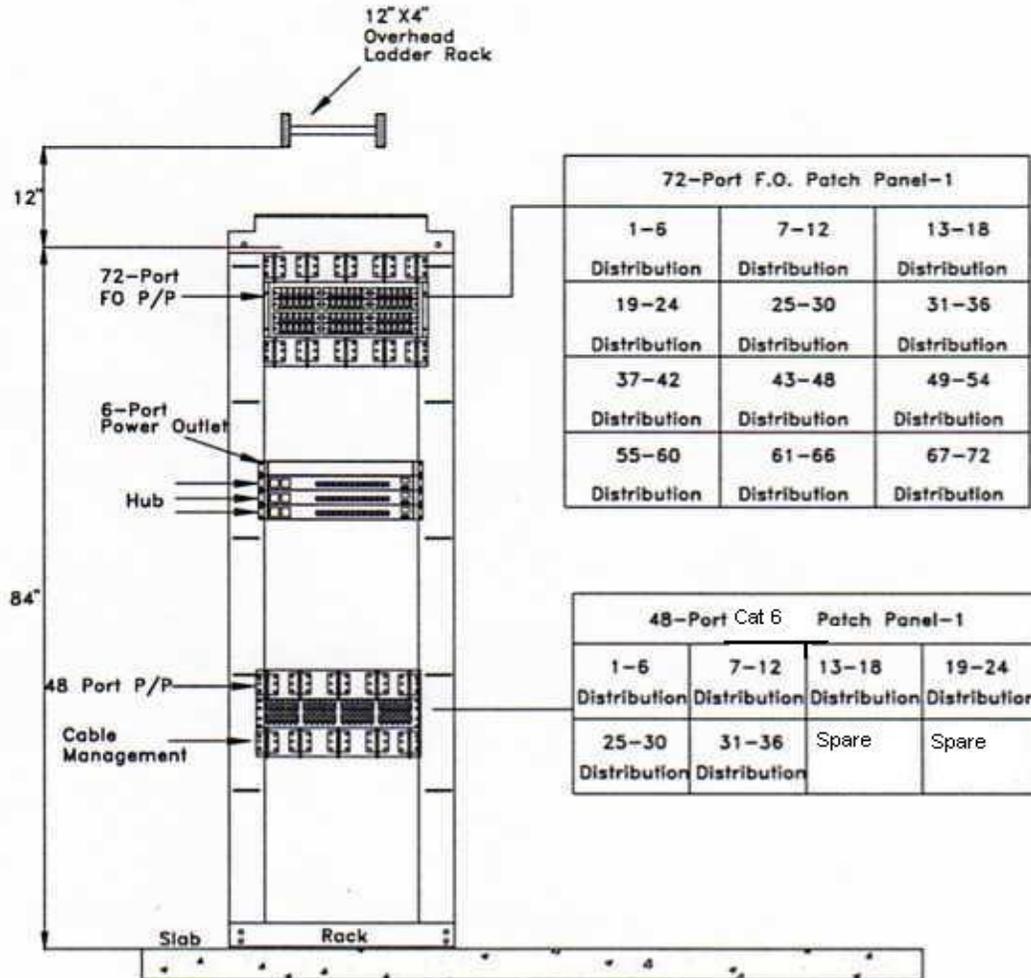
Drawing Redacted

FIGURE 7
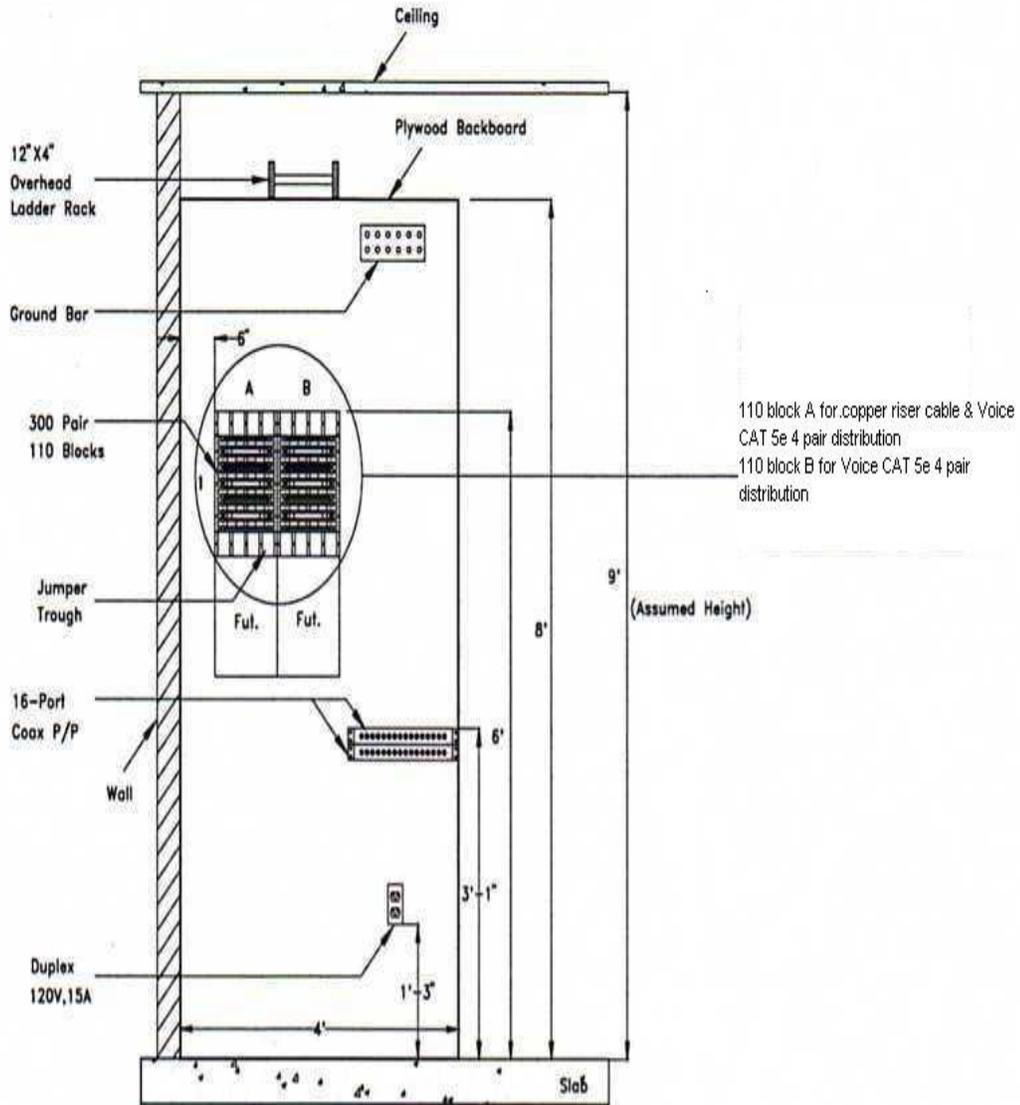
Sample IDF – Telecommunications Closet Elevation
NOT TO SCALE

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FIGURE 8

72-Port F.O. Patch Panel-1

1-6	7-12	13-18
Distribution	Distribution	Distribution
19-24	25-30	31-36
Distribution	Distribution	Distribution
37-42	43-48	49-54
Distribution	Distribution	Distribution
55-60	61-66	67-72
Distribution	Distribution	Distribution

48-Port Cat 6 Patch Panel-1

1-6	7-12	13-18	19-24
Distribution	Distribution	Distribution	Distribution
25-30	31-36	Spare	Spare
Distribution	Distribution		

Sample IDF —Telecommunications Closet Data Rack Elevation

NOT TO SCALE

1. **Number of IDF Communications/Data rooms/closets within a building**
   - Each floor should have at least one IDF Communications/Data room/closet.

   - Wiring workstations to IDF Communications/Data rooms/closets on different floors is not a preferred practice but can be done if no alternative exists.

   - If possible, IDF Telecommunication Closets should be positioned toward the center of the

building (usually the core area) and stacked vertically, when possible, in multi-story buildings.

2. **Plywood Backboard**
   - Each IDF Room will contain a minimum of one 4' X 8' sheet of plywood flush- mounted on the wall.

   - Securely fasten the plywood to wall-framing members to ensure that it can support attached equipment.

   - The plywood is to be 3/4", A/C grade and fire retardant.

   - All plywood backboards are to be mounted smooth side out and painted with white fire retardant paint at time of installation and prior to installation of equipment onto the plywood.

3. **IDF Room Equipment Enclosures**
   - Any IDF Rooms located in rooms that are share space used for any other purpose should have wire mesh cages or sheetrock walls around the Communications equipment.

4. **Relay Racks**
   - Each MDF will contain a minimum of one 19"W X 7'H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.

   - The relay racks should have a minimum of 42 rack units of mounting space on standard 19" wide rails.

   - In some cases the relay racks are wall-mounted and in others they are free-standing two- or four-post racks. It must be determined which type of rack is required, based on field conditions, equipment manufacturer's requirements, and space allocated.

   - All racks are to be grounded and bolted to each other as well as to the slab or wall.

   - The rack should have vertical and horizontal cable management to accommodate routing of patch cords.

   - The relay rack specifications and associated components should meet the requirements of the equipment that will be installed in it.

   - It should be at a minimum 84" tall with 6" rails, with 19" equipment mounting space and vertical and horizontal wire management.

5. **Wall-Mounted Relay Racks**
   - The rack is to be securely fastened to the wall behind the rack and attached to the ladder rack above.

   - The rack should be sized to accommodate the equipment to be installed in it, with vertical and horizontal jumper management.

6. **Communications Cabinets**

- All communications cabinets are to be grounded to the grounding and bounding system, bolted to each other and to the slab.

- Each communications cabinet is to be installed with its side to an adjacent wall.

- Three feet of clearance around the cabinet is recommended, and the cabinets must have front and rear access.

7. Cable Trays
- Between the relay rack and the wall-mounted frame, a 12" cable tray (no center rail systems), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.

- Do not attach cable trays to the suspended ceiling grid.

- An open wire basket cable tray system is acceptable for cable support.

8. IDF Room Electrical Requirements
- Each Communications/Data room/closet shall have one 110V, 15 Amp electrical convenience outlet and one 110V, 20 Amp dedicated–circuit, isolated-ground electrical outlet for the electronic equipment.

- This is a minimum requirement based on the typical current draw of the networking equipment to be placed.

- The ground for the equipment outlet should be isolated where possible to avoid line transients.

- The 110V 20 Amp dedicated-circuit, isolated-ground electrical outlets should be mounted in convenient location to facilitate the use of the shortest equipment power cords.

- The recommended location is at the top of the rack or on the ladder tray.

- All electrical isolated ground outlets serving Communications and Data equipment must be attached to non-switched circuits to prevent inadvertent equipment shutdown.

- It is also recommended that they be on a UPS and/or generator if available.

PART 10   MDF & IDF PRODUCT SPECIFICATIONS

A. Category 6 Patch Panels
In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Category 6 Patch Panel Requirements
- Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, in 48-port configurations.

- Panel frames shall be 14-gage steel with rolled edges top and bottom for proper stiffness.

- Panel design shall incorporate plastic push-fasteners to permit hands-free positioning onto standard EIA-310-D 19" mounting rails.

- Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75 in.).

- Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.

- Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050 in.

- Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.

- Panels shall have individual port identification numbers on the front and rear of the panel.

- Panel adapter modules shall be 110-style termination with tin lead solder plated IDC contacts.

- Printed circuit boards shall be fully enclosed front and rear for physical protection.

- Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.

- Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.

- Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.

- Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact termination tool.

- Panels shall be compatible with a 4-pair multi-punch impact termination tool designed specifically for the purpose. Bending or other damage to the panel using a multi-pair punch tool shall not occur.

- IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.

- IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.

- Panels shall not require special cords or special installation requirements.

- Panel ports shall accept optional hinged dust covers and port identification icon buttons.

- Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-A.

- Category 6 panels shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.

- Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.

2. **Category 6 Patch Panel Performance Requirements**
   - All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.

   - Category 6 panels shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.

   - The manufacturer shall provide Category 6 component compliance certificates from third party testing organizations upon request.

   - Panels shall be UL LISTED 1863 and CSA certified.

   - Panels shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

   - Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.

   - Panels shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.

   - Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3an and TSB-155, for a maximum 55-meter channel length. Conditions of requirement No. 10 above apply.

3. **Acceptable Manufacturers:**

   - Hubbell Premise Wiring.
     The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
P6E48U	NEXTSPEED® Category 6 Patch Panel, 48-Ports
PCBLMGT	Rear Cable Management Bar

   - Or approved equal of: Ortronics, Panduit, Systimax, Leviton

4. **Category 6 Patch Panel Installation Requirements**
   - Horizontal and backbone cabling of the proper category shall be fully deployed into the TR, TE, or ER according to applicable codes and standards.

   - Cable slack, service loops, bend radii, and pathway fill ratio shall comply with applicable codes and standards.

   - Racks, cabinets, enclosures, and metallic cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.

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- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

- Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.

- Terminate cables into the patch panel according to manufacturer's instructions.

- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.

- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).

- Horizontal or backbone cables extending from the panel terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.

- Cable terminations shall have no tensile or bending strain on panel IDC contacts in each installed location.

- Panels shall be properly labeled on front and back with the cable number and port connections for each port.

B.   Fiber Enclosures, Adapter Plates, Connectors

1.   Fiber Adapter Enclosure Requirements

- Enclosure design shall be a modular, rack-mounted, powder coated formed cold rolled steel enclosure with a removable front cover, rear panel, top panel, and slide-out inner tray.

- Each basic unit delivered shall consist of: (1) enclosure assembly, (2) mounting brackets, (6) cable ties, (5) snap-in cable clips (4) #12-24 mounting screws, (1) adhesive grid label, (4) adhesive cable clips, (2) Velcro cable ties, (3) label holders, and (1) splice tray stud, wing nut, and spacer.

- Material shall be as follows:

   a.   Enclosure, panels and tray: 16 gage cold rolled steel (CRS)

   b.   Mounting brackets: 14 gage CRS

   c.   Front cover: Acrylic (Plexiglas)

- Basic dimensions of the enclosures shall be approximately 17" wide by 12" deep.

- Enclosures shall be available in heights of 3.5" (2 RMU), 5.25" (3 RMU), and 7" (4 RMU) versions.

- Finish shall be black durable powder coat on all surfaces.

- Front door shall be Lexan plastic, hinged at the bottom, with a cap-plugged hole to accept an optional lock. Front door shall also be removable in the fully open position by sliding left off the mounting pins.

- Front door shall be secured in the closed position with lever-action quick-release latches.

- Top cover shall be removable in the forward direction, without fasteners, to provide access to the connector field. Top panel shall also have knockouts for backbone cable entry.

- Rear panel shall be removable without fasteners.

- Enclosure shall be equipped with panel-mounting brackets assembled for 19" rack mounting, compliant to ANSI/EIA-310-D.

- Panel mounting brackets shall be configurable to either 19" or 23" racks.

- Enclosure chassis shall have two mounting bracket locations for either flush mount or center mount on the rack.

- Rear of enclosure shall have two knockouts, top and bottom, for backbone cable entry and internal routing.

- Front of enclosure chassis shall have side cutouts for patch cord entry into, and exit from the enclosure.

- Inner tray shall slide out in the forward direction by releasing the lever-action quick-release latches. Tabs in the chassis shall engage with slots in the inner tray in the outward position to prevent tray from falling out.

- Inner tray shall have rear-located knockouts to match rear chassis knockouts.

- Inner tray panel mounting posts shall accept modular adapter panels, in high- or low-density versions. Adapter panels shall be available in ST multimode/singlemode.

- Splice tray mounting boss shall also accept a stud for mounting blown fiber adapter brackets.

- Inner tray shall have clips for cable ties, and holes to accept snap-in cable clips, front and rear, for complete cable management of patch cords and distribution cable strands.

- Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering the enclosure.

2. **Fiber Adapter Panels Requirements**
   - Fiber adapter panels shall be a modular, quick-fastening steel plate, powder coated to match the enclosure finish.

   - Fiber adapter panels shall have pre-installed SC fiber adapters, available in low- or high-density multi-mode or single-mode applications.

   - Each individually bagged unit delivered shall consist of: (1) fully assembled adapter panel, with push-pull fasteners pre-installed.

   - Adapter panels shall be constructed of 16 gage cold rolled steel.

   - Finish shall be black durable powder coat on all surfaces.

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- Basic dimensions of the FSP panels shall be 5.10" length by 1.10" wide.

- Panels shall have two pre-installed, push-pull type quick-release fasteners for quick snap-in installation. Push-pull fasteners shall have an industry standard center distance of 4.65".

- Panels shall be suitable for mounting either vertically or horizontally.

- Panels shall be available in with SC adapters with precision ceramic alignment sleeves.

- All fiber adapters installed in FSP panels shall have dust caps installed.

- Panels shall be available in low-density and high-density adapter patterns.

3. **Fiber Connector Requirements**
   - Please note OM4 minimum standard

     i. Internal Building Installation

        1. Installation distances LESS than 1640ft/500m should use OM4-Multimode Fiber.

        2. Installation distances GREATER than 1640ft/500m require use of single Mode fiber exclusively.

     ii. External Building/Campus Installation

        1. Buildings less than 1640ft/500m may use OM4-Multimode Fiber, but use of mixed strand OM4/Single Mode fiber is highly recommended.

        2. Installation distances GREATER than 1640ft/500m require use of Single Mode fiber exclusively.

- Connector basic design shall be a factory pre-polished SC optical fiber connector with a zirconium ceramic ferrule. Integral with the connector body is a wedge-activated fiber clamping mechanism to secure the inserted fiber into a mechanical splice with the factory installed cleaved fiber stub. Index-matching gel is supplied factory-injected into the cleaved fiber stub splice to optimize transmission performance. Connector attachment is achieved without tools, by inserting a field-cleaved optical fiber and then extracting the disposable clamp wedges from the connector body.

- Each basic connector unit delivered shall consist of: (1) connector body with disposable clamp wedge, (1) strain relief boot, and (1) plastic dust cap.

- SC multimode factory pre-polished connectors shall be 50 micron laser optimized pre-installed fiber.

- Connector termination method shall utilize an industry standard multi-layer strip tool and bare fiber cleave tool as the only field tools required.

- SC connectors shall have features to enable field verification using a Visual Fault Locator (VFL) during termination.

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- Connector materials shall be designed with thermal stability to comply with environmental requirements of ANSI/TIA/EIA-568-B.3 and Telcordia GR-1081-CORE.

- Multimode OM4 and singlemode pre-polished fiber connector materials shall be as follows:

    a. Ferrule: zirconium ceramic

    b. SC inner body: thermally stable injection molded thermoplastic

    c. Dust Cap: nylon or PVC

    d. Strain relief boot: UL94-V0 molded PVC

- Pre-polished SC connectors shall require no field polishing.

- Pre-polished Multimode-OM4 SC connector body shall be industry standard aqua for 50 micron multimode, laser optimized.

- colors for specific applications, as designated below:

- Pre-polished OM4 SC connectors shall require no adhesives for termination.

- SC connector internal fiber clamping mechanism shall firmly secure both the inserted glass fiber and the 900 micron buffer layer of the inserted fiber for maximum strain relief.

- All standard mating and interface dimensions for SC connectors shall comply with ANSI/TIA/EIA-604-10 (FOCIS 10).

- Ferrule outside diameter for SC multimode connectors shall be 1.2467mm to 1.2497mm.

- Ferrule outside diameter for SC singlemode connectors shall be 1.2483mm to 1.2497mm.

- SC ferrule tip shall have a PC spherical radius of approximately 7.0 mm radius for multimode and singlemode versions.

- Delivered connectors shall be individually bagged with the dust cap installed to protect from contamination.

- Delivered connectors shall have the disposable clamp activation wedge element pre-installed onto the connector body.

- Connector design and termination technique shall be independent of cable type or manufacturer, and shall be compatible for either 900 micron buffer or 250 micron buffer distribution cables.

- SC connector strain relief boot shall be a Telcordia style slotted design for maximum flexural strain relief.

- Strain relief boot shall be black for multimode, and yellow for singlemode.

- SC connectors shall be available individually bagged in packs of 12.

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- Pre-polished SC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.

- Pre-polished SC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3, Annex 'A'.

- Pre-polished SC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of Telcordia GR-1081-CORE.

- Qualification test data shall be available from the manufacturer upon request.

4. **Acceptable Manufacturers:**

- Hubbell Premise Wiring.
  The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
FCR350SP36R	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 6 Adapter Panels
FCR350SP54R	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 9 Adapter Panels
FCR525SPR	Fiber Enclosure - 3U Rack Mount Fiber Enclosure, Accepts 12 Adapter Panels
FCR700SP	Fiber Enclosure - 4U Rack Mount Fiber Enclosure, Accepts 15 Adapter Panels
FSPLCDM6AQ	Fiber Adapter Panel - 6 LC Duplex, Aqua for MM – Phosphor Bronze Sleeves
FSPLCQM6AQ	Fiber Adapter Panel - 6 LC Quad, Aqua for Multimode – Phosphor Bronze Sleeves
FSPLCDS6	Fiber Adapter Panel - 6 LC Duplex, Blue for SM – Zirconia Ceramic Sleeves
FSPLCQS3	Fiber Adapter Panel - 6 LC Quad Blue for SM – Zirconia Ceramic Sleeves
	Fiber Connector - LC, MM, 50/125um, OM4 – Aqua, Box of 12
FCLC900K50GM12	Fiber Connector - LC, SM, 9/125 UPC – Blue Box of 12

- Or approved equal of: Ortronics, Panduit, Systimax, Leviton

5. **Fiber Installation Requirements**
- For FCR-series enclosures, remove top and rear covers, and front door.

- Punch out the desired knockouts for cable entry.

- Using proper method, pull cables into cabinet through the desired knockout entry location.

- Strip the outer sheath and sub sheaths of the fiber cable to provide at least (2) meters service loop of the individual buffered fiber strands.

- Anchor the outer cable sheath into the rear channel of the inner tray using the cable ties provided. Note: in FCR-series enclosures, leave enough slack in the main cable to allow free motion of the inner tray fully outward. Remove cable entry knockouts as required.

- Installed copper and fiber cabling shall be properly strain relieved. Cable service coil, bend radius, and pathway fill ratio shall comply with applicable codes and standards.

- Use the plastic adhesive-backed clips provided to form the fiber strands into a large service coil on the surface of the inner tray. For FCR-series enclosures, be sure the inner tray has full mobility in and out, with no cable kinks or snags.

- Close inner tray and front cover, and lock the quick-release fasteners.

- Install SC fiber adapter panels by firmly using push fasteners to lock in place.

- Leave dust caps installed in the fiber adapter plates until connector termination is performed.

- Follow manufacturer's termination instructions for pre-polished connectors as specified

- Uncoil the 900-micron buffered strands of cable from the service loop and set-up for termination.

- Un-package the connector, and leave dust cap installed. Firmly press downward on the connector wedge tab to fully seat clamp wedges.

- Slide the strain relief boot onto the fiber strand before stripping.

- Using a fiber strip tool, strip buffered fiber completely to approx. 1.0" of exposed glass fiber.

- CAUTION: Do not nick or scrape the glass fiber with the strip tool.

- Wipe the glass fiber firmly with an alcohol wipe. Always use 99.9% pure reagent grade alcohol for fiber cleaning.

- Mark the 900 micron buffer layer from the strip-off point per instructions.

- Insert the fiber into the cleave tool and cleave the fiber to the specified length from the end of the 900 micron buffer layer. Always keep the cleave tool clean.

- CAUTION: Always dispose of glass fiber waste in an approved container.

- Gently insert the cleaved fiber into the connector body. Rotate connector slightly during insertion to fully seat the fiber into the internal splice.

- Hold the seated fiber in place using slight force to form a bow in the fiber.

- Y CAUTION: Do not allow the installed fiber to slip backward.

- While holding the fiber seated, squeeze the wedge holder device to activate the clamp, and

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then slip the wedge holder off the connector body. Dispose the wedge holder.

- Remove the connector dust cap and inspect the ferrule tip. A 400X microscope is recommended. View of the polished fiber should be a smooth round circle with no scratches, pits, cracks or chips. Use a lint-free wipe to clean off any contamination.

- Y CAUTION: Do not view ends of live fibers, with or without a microscope.

- Plug the connector into the proper adapter panel and proceed with the next connector. Leave dust cap installed if the connector is not mated.

C. Racks, Horizontal & Vertical Managers

1. Equipment Racks Requirements
- Racks shall be a structural aluminum construction, having two 6-inch deep rails.

- Racks shall feature universal side mounting hole pattern for vertical cable managers.

- Racks shall feature a weight load capacity of 1,000 lbs when properly secured to the floor.

- Each basic rack delivered shall consist of: (2) vertical rails, (2) base angles, (1) assembly hardware kit, (2) top angles, and (20) #12-24 dog point machine screws for panel mounting.

- Racks shall be available in either for 19-inch standard rack configurations.

- Tapped holes in the front and rear vertical rails for mounting of panels shall be #12-24 thread size. Powder coat shall not interfere with thread fit.

- Standard rack heights of 8 ft (96 in)

- Racks with heights of 8 ft shall have a capacity of 51 rack mount units

- Rack base angles shall be pre-drilled for floor mounting, and for assembly to vertical rails.

2. Horizontal Managers Requirements
- Horizontal Managers shall be 19"W, 3.5"H

- Horizontal managers shall be 16ga. Cold rolled steel construction with (6) pass thru holes, and (7) Front mounted 3.5" steel rod D-Rings.

- Horizontal managers shall have hinged Aluminum front cover to conceal patch cords.

3. Vertical Managers Requirements
- Vertical cable managers shall be 14"D, 10"W

- Vertical cable managers shall feature a steel rod construction for increased air flow.

- Vertical cable managers shall feature a solid aluminum door that is designed to open left or right and swing out of way for cable management.

- Vertical cable managers shall feature power strip mounting brackets on rear of manager.

- Vertical cable manager shall accept and include (16) 3" black cable management spools.

4. Acceptable Manufacturers:

- Hubbell Premise Wiring.
  The Hubbell products listed in the table below comply with all requirements specified in this document
- Cooper B-Line.
  The Cooper B-Line products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HPW84RR19D	84"H, 6"D Equipment Rack
HC219CE3N	2U Horizontal Manager w/ 3.5" Front rings and cover
XS1010	Vertical Cable Manager, 14"D, 10"W, with door & cable spools

B-Line CATALOG NUMBER	Description
SB55608419U6	84"H, 6"D Equipment Rack
SB87019S2FB	2U Horizontal Manager w/ 3.5" Front rings and cover
SB860810S084	Vertical Cable Manager, 14"D, 10"W, with door & cable spools

- Or approved equal of: Ortronics, Systimax, Leviton

D. Category 5e-110 Termination Blocks

1. 110 Termination Block Requirements

- Category 5e-110 wiring blocks shall be available in 50-pair, 100-pair and 300-pair capacities, with or without detachable standoff legs.

- Wiring blocks shall be available as kits that include wiring blocks, label strips, and the appropriate quantity of connecting blocks for termination to full capacity.

- Connecting blocks shall accommodate a 5-pair punch-down tool designed specifically for the purpose of Category 5e termination.

- Wiring blocks and connecting blocks shall be constructed of UL94-V0 rated high-impact flame-retardant polycarbonate blend thermoplastic.

- Wiring blocks shall accept 26-22 AWG solid or stranded conductors

- Wiring blocks shall accept conductor insulation diameters of .050 in to .070 in maximum.

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- Wiring blocks and connecting blocks shall have a temperature rating of 14 °F to 140°F with up to 95% non-condensing humidity.

- Wiring blocks shall have through-openings to permit rear cable entry and direct routing to each point of termination.

- Connecting blocks shall connect to the wiring block with a locking force of 35 Lb minimum.

- Connecting blocks shall withstand a minimum of 200 re-terminations without degradation to electrical or mechanical performance.

- IDC contact termination towers on the connecting blocks shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist. IDC towers shall also have high-definition color-coding.

2. **110 Termination Block Performance Requirements**
   - A UL or ETL third party testing organization shall independently verify all Category 5e transmission performance parameters.

   - Category 5e-110 termination blocks shall meet or exceed Category 5e transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2.

   - The manufacturer shall provide Category 5e component compliance certificates from third party testing organization upon request.

   - 5e-110 termination blocks shall be UL LISTED 1863.

   - 5e-110 termination blocks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

   - 5e-110 termination blocks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.

   - 5e-110 termination blocks shall meet or exceed the 4-connector channel performance requirements of Category 5e, per the ANSI/TIA/EIA-568-B.2.

3. **Acceptable Manufacturers:**

   - Hubbell Premise Wiring.
     The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
110BLK50FTK5	110 Field Termination Kit, 5e-110/50-pair with 5-Pair Conn. Blocks
110BLK100FTK5	110 Field Termination Kit, 5e-110/100-pair with 5-Pair Conn. Blocks
110BLK300FTK5	110 Field Termination Kit, 5e-110/300-pair with 5-Pair Conn. Blocks

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- Or approved equal of: Ortronics, Panduit, Systimax, Leviton

4. **110 Installation Requirements**
   - Follow manufacturer's instructions.

   - Mount 5e-110 wiring blocks in the desired location.

   - Route cables through the openings in the wiring block base.

   - Terminate UTP cables to the 5e-110 block according to manufacturer's instructions, using the connecting blocks and proper termination tool.

   - To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.

   - The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).

   - Cables extending from the block terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.

   - Cable terminations shall have no tensile or bending strain on IDC contacts after termination. Note: Use the appropriate cable management hardware to relieve cable strain and control bend radius.

PART 11   INFORMATION OUTLETS – DATA & VOICE

A work area has at least one standard Information Outlet consisting of two Data RJ45 jacks. All of the RJ45 jacks shall be Category 6 unless otherwise specified are wired according to the **568B** standard.

- DATA & VOICE Cabling Requirement Scenarios
  - DATA PC & VOIP Telephony INFORMATION OUTLET
    - 2x DATA RJ45 CAT 6 Jacks per Information Outlet
    - No Traditional Voice Wiring Required
  - DATA PC & TDM/Digital or Analog Phones/PBX
    - 2x DATA RJ45 CAT 6 Jacks per Information Outlet
    - 1x Voice CAT 5e Jack per Information Outlet

A. **Information Outlet Locations**
   1. The location of the information outlets is dependent on the environment in which the outlets will be installed. An office environment certainly is different than a laboratory, training room, or manufacturing area. If the outlets are to be wall- mounted, the bottom of the outlet is to be located 15" above of the finished floor under normal conditions. However, there are many exceptions to this rule. If there is existing equipment that does not allow for this, such as a credenza or countertop, the outlet must be placed at a height appropriate to the situation.

   2. Locate the outlet where it is closest to the equipment and people it will serve. Keep in mind that the cord from the outlet to the device can be a trip hazard or may span across doors. In an office

environment, each desk or workstation should have an information outlet. If a particular area has a series of fax machines or modems, then additional outlets should be installed. The number of jacks in an outlet is standard, so to maintain the standard, additional information outlets of the same configuration should be installed; do not install non-standard outlets.

3. Computer laboratories or training rooms require a large amount of connectivity in odd locations. Power poles are one solution as is the use of surface-mounted raceway or floor-mounted boxes. Each situation is different and must be considered individually. Again, standards are to be maintained in outlet configurations.

4. When locating an outlet, consideration should be given to the route the cable must take to the information outlet. If the outlet is to be installed on a masonry wall and surface-mount raceway is used for cable routing, the location of the outlet may be more dependent on the path available down or across the wall than where the equipment is located. Each location must be looked at individually to determine if the route to the desired outlet location is possible.

5. Wall-mounted outlets should not be located on heating units, equipment or ductwork. They are always to be located on either a gypsum, sheetrock, or masonry wall.

6. A description of the information outlet configurations follows:

   - Standard Office Information Outlets consist of: as detailed on the drawings attached to the contract, the contractor will install and terminate (3) four-pair, one UTP Category 6 or 6a for Data cables onto individual RJ45 female jacks.

   - Computer Laboratory or Training Room Information Outlets: as indicated on the attached drawings, the contractor will install and terminate the designated series of four-pair UTP Category 6 or 6a cables onto individual RJ45 jacks. The number of cables and jacks vary from two to eight, depending upon the furniture configuration and number of PCs to be served.

B. Category 6 Jacks
In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Category 6 Jack Requirements
   - Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.

   - Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.

   - Each jack shall be single unit construction, with snap – fit to industry standard keystone opening (.760" x .580").

   - Jack housings shall fully encase and protect printed circuit boards and IDC fields.

   - Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.

   - Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability.

   - Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.

   - Jack termination method shall follow the industry standard 110 IDC punch-down

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- Jacks shall be compatible with a 4-pair single punch impact tool designed specifically for the purpose.

- IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.

- Jacks shall terminate 26-22 AWG solid or stranded conductors.

- Jacks shall terminate insulated conductors with outside diameters up to .050".

- Jacks shall not require special cords, specialty tools or special installation requirements.

- Jacks shall include a translucent stuffer cap for wire retention and to permit visual inspection.

- Stuffer cap shall have retention snaps to assure conductor strain relief.

- Jacks shall accept FCC compliant 6 position plugs.

- Jacks shall accept optional hinged dust covers.

- Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.

- Jacks shall accept snap-on icons for specific identification.

- Jacks shall be available in various colors to meet specific customer applications.

- Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.

- Category 6 jacks shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.

2. **Category 6 Jack Performance Requirements**
   - All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.

   - Category 6 jacks shall exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.

   - Category 6 jacks shall exceed 10 Gb/s transmission requirements for connecting hardware, under the constraints of ANSI/TIA-TSB-155 (current draft).

   - The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.

   - Jacks shall be UL LISTED 1863 and CSA certified.

   - Jacks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

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- Jacks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.

- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.

- Jacks shall exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.

- Jacks shall exceed the 4-connector Category channel performance requirements for 10 Gb/s transmission over Category 6, according to TIA/TSB-155 (current draft).

- The 4-connector channel test configuration shall utilize Category 6 patch panels and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.

3. **Acceptable Manufacturers:**

- Hubbell Premise Wiring.
  The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HXJ6xx	NEXTSPEED® Category 6 Jack

  xx = Jack color. Replace xx with "W" for White, "BK" for Black, "B" for Blue, "GY" for Gray, "GN" for Green, "OW" for Office White, "OR" for Orange, "R" for Red, "Y" for Yellow. Refer to project drawing for color applications.
- Or approved equal of: Ortronics, Panduit, Systimax, Leviton

4. **Category 6 Jack Installation**
- Horizontal cabling of the proper category shall be fully deployed from the TR or TE to each wall plate location according to applicable codes and standards.

- Cable slack, service coil, bend radii, and pathway fill ratio shall comply with applicable codes and standards.

- Metallic horizontal cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.

- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

- Terminate jacks according to manufacturer's instructions.

- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.

- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).

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- Jacks shall be properly mounted in plates, frames, or housings with stuffer cap fully installed over IDC contacts.

- Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times the cable diameter.

- Cable terminations shall have no tensile or bending strain on IDC contacts after assembly of faceplate or housing to the wall outlet.

- Jacks shall be tested as part of the installed horizontal cabling system, with faceplates assembled complete and properly mounted.

- Each link or channel in the horizontal cabling system shall be identified and tested individually, using an industry standard level III tester with correct settings.

- Each jack shall be tested as part of the horizontal channel or link for the parameters listed below.

C. Face Plates

1. Face Plate Requirements
- Faceplates shall be constructed of high impact, UL94 V-0 rated thermoplastic.

- Faceplates shall be 2.75" W x 4.5" H (69.8 mm x 114.3 mm) for single gang and 4.5" X 4.5" (114.3 X 114.3 mm) for double gang.

- Port size in each faceplate shall be industry standard vertical keystone opening size (.760" x .580").

- Faceplates shall accept Hubbell XJ-series UTP jacks and Snap-Fit fiber optic, audio, and video modules for multimedia applications.

- Faceplates shall provide for ANSI/TIA/EIA-606-A compliant workstation outlet labeling.

- Faceplates shall be provided with clear plastic and color-matched label field covers.

- Color-matched blank Snap-Fit modules shall be available separately to fill unused ports and openings as required.

- Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.

- Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.

- Jacks and Snap-Fit modules shall snap firmly into rear of faceplate and position flush to outer plate surface.

- Faceplates shall be compatible with standard NEMA openings and boxes.

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- Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, flush mount boxes and drywall rings.

2. **Acceptable Manufacturers:**

- Hubbell Premise Wiring.
  The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
IFP11xx	1-Gang, 1-Port IFP Face Plate
IFP12xx	1-Gang, 2-Port IFP Face Plate
IFP13xx	1-Gang, 3-Port IFP Face Plate
IFP14xx	1-Gang, 4-Port IFP Face Plate
IFP16xx	1-Gang, 6-Port IFP Face Plate
IFP26xx	2-Gang, 6-Port IFP Face Plate
IFP29xx	2-Gang, 9-Port IFP Face Plate
IFP212xx	2-Gang, 12-Port IFP Face Plate

xx = Face Plate color. Replace xx with "W" for White, "BK" for Black, "GY" for Gray, "OW" for Office White, to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax, Leviton

PART 12   CABLE ROUTING SYSTEMS

Each cable routing system has advantages and disadvantages. Particular systems are favored for a variety of reasons, including architectural considerations, appearances, cost, local ordinances, and material concerns.

Various means of distributing cable from Communications/Data rooms/closets to the user work areas are identified in the following:

A.   Ceiling Distribution System

A distribution system within an accessible area above a false ceiling. This could either be a plenum area (where there is no enclosed system for cable routing) or an overhead conduit system (which has defined areas of access and routes).

B.   "J" Hooks

Where not installed in conduits, cable trays, or other supporting devices, the horizontal wiring plan is to be installed onto "J" hooks or an acceptable equivalent from the information outlet to the termination point within the IDF or MDF/IDF room. The "J" hooks are to be installed a maximum of five feet apart and fastened to the ceiling or the top of the walls near the ceiling. The cables are to be tie-wrapped to the "J" hooks, without crimping the sheath. The cable contractor is to furnish and install the "J" hooks. Cooper B-Line BCM 21, 32, and 64 are acceptable.

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C. Sleeves and Conduits

1. The use of conduits and sleeves within a building is common for the transport of communications cable. Conduits and sleeves are to be sized and routes are to be planned within and between buildings in order to route the cable plant from the MDF to IDF and IDF to Information Outlet, and to accommodate any additional cabling required. The sizing of the conduits and sleeves is to be based on the number of cables, the location and environment surrounding the sleeve or conduit, and acceptable conduit fill levels, which are typically 40%. All conduits are to be installed with the appropriate sweep to maintain the required bend radius for copper and fiber optic cable. All sleeves and conduits are to be installed with bushings and suspended according to building industry standards.

2. The following are guidelines to use in determining where sleeves and conduits are to be installed but does not limit nor identify all areas or situations where sleeves and conduits will be required.

   - All masonry walls that have cables passing through them are to have sleeves installed.
   - Gymnasiums and athletic areas are to have conduits installed to house cables passing through the area.
   - Each MDF and IDF Room is to have sleeves installed to contain the large number of cables exiting the room. Conduits are to be installed in areas where cables extend from one building to another via covered or enclosed bridges and corridors.

3. Cable routing is to follow a "streets and avenues" path in corridors where possible. However, there are a number of reasons for exceptions. In some cases, the corridors do not allow cables to be run because of architectural constraints or inaccessible ceilings. Also, in order to maintain the 90-meter standard for Category 6 cabling, some cables need to be run separately and diagonally to isolated information outlets. Throughout all runs, the contractor is to maintain EIA/TIA standards regarding the proximity of communications cabling to high voltage cabling, motors, transformers, fluorescent lighting, ballasts, etc.

PART 13   CABLING-GENERAL

A. All cable shall meet the requirements of the NEC, except where other authorities or codes impose a more stringent requirement or practice. Codes, such as the NEC, do not normally include transmission performance requirements. This section specifies the essential media transmission characteristics. It is advisable to consult standards associated with the planned service or equipment to determine any specific media limitations.

B. Contractor is to take all necessary precautions to assure that the maximum tensile load and minimum bend radius of all cables (fiber and copper) are not exceeded. When terminating Category 5e & 6 cable, care should be taken to maintain pair twists up to the termination point and not more than 0.5" of the cable pairs shall be untwisted. It is preferred that the cable sheath is also not removed more than 0.5" from the termination point. Tie wraps are to be hand-tightened on cables and are not to crimp the sheath. Contractor is responsible for protecting all connectorized cables from damage by other contractors at the information outlet before and after installation of the outlet faceplates.

C. All riser and station cable installed is to be plenum-rated cable. The fluoropolymer resin that insulates Category 5e & 6 plenum cables is engineered as a fire safety innovation. The NEC requires that all cable installed in plenum spaces and not encased in conduit must have certain fire resistance and low smoke producing characteristics. Not only are such cables highly resistant to fire but they also produce very little smoke.

D. For all new Voice cabling installed, "110" blocks shall be used for termination. The Copper Data cabling will be terminated onto Category 6 RJ45 Patch Panels. The fiber optic cabling will be terminated onto fiber distribution panels with SC connectors.

E. Cables shall be terminated on the appropriate unassigned (vacant) portions of the wall-mounted Main and Intermediate Distribution Frames or Patch Panels and run as uninterrupted conductor sections to the Information Outlets. All cable terminations shall be made uniformly in sequence, commencing with termination of the first cable pair on the first connection points in the upper left-hand corner of each block.

F. Minimum separation distances between pathways and power wiring of 480 V or less are shown in Table 1, below.

Table 1 Separation of Communications Pathways from <= 480V Power Lines

Condition	Minimum Separation Distances		
	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	127 mm (5 in)	305 mm (12 in)	610 mm (24 in)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	64 mm (2.5 in)	152 mm (6 in)	305 mm (12 in)
Power lines enclosed in a grounded metal conduit (or equivalent- shielding) in proximity to a grounded metal conduit pathway.	76 mm (3 in)	152 mm (6 in)	

All cabling shall be at least:

- 12" from high voltage lighting and fluorescent fixtures
- 72" from transformers and motors

PART 14   HORIZONTAL CABLING - CATEGORY 6 UTP DATA

All riser and station cable installed is to be plenum-rated cable.

A. Category 6 100 OHM balanced UTP Cable Requirements
In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.
2. Conductor diameters shall be 0.0224" $\pm$ .0003" solid copper.
3. Conductor insulation diameter shall be 0.039" $\pm$ .0005" fluoro copolymer.
4. Outer jacket diameter shall be 0.235" $\pm$ .008" low smoke PVC, with a nominal wall thickness of 0.015".
5. Ripcord shall be directly underneath the outer jacket.
6. Cable shall be marked every 2 ft including
   - Cable Manufacturer
   - Cable Description

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- Month and Year of manufacture.
- Job number.

7. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
8. Color coding of the pairs shall be as follows:
   - Pair 1: White/Blue; Blue
   - Pair 2: White/Orange; Orange
   - Pair 3: White/Green; Green
   - Pair 4: White/Brown; Brown
9. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.

B. Category 6 100 OHM balanced UTP Cable Performance Requirements

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-B.2-1, and shall be tested through 550 MHz.
3. Worst-case cable performance shall be +8.0 dB headroom over current TIA/EIA and ISO standards limits for NEXT and PSNEXT loss, and ELFEXT and PSELFEXT loss.
4. Insertion loss shall be 3.0% lower than standard Hubbell Category 6 plenum and riser cables described in Section 27 15 13.
5. Worst case electrical performance characteristics shall be as follows:
   - Characteristic Impedance: 100 + 15 (1.0-100 MHz) 100 + 20 (101-250 MHz)
   - Maximum Conductor Resistance: 9.38 /100 Meters @ 20°C
   - Maximum Resistance Unbalance: 3%
   - Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
   - Maximum Capacitance Unbalance: 330 pF/100 Meters
   - Maximum Delay Skew: 25 ns/100 Meters
6. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
7. Cable shall be UL and C(UL) listed.
8. Cable shall exceed IEEE 802.3af DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
9. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3ab.
10. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 55 Meters Channel Length.
11. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.
12. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.

C. Acceptable Manufacturers:

1. Hubbell Premise Wiring and Hitachi Cable Manchester (HCM)
   The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description

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C6SPxx	NEXTSPEED Category 6 550 MHz – Plenum Spool
C6RPxx	NEXTSPEED Category 6 550 MHz – Plenum REELEX

xx = Cable color. Replace xx with "W" for White, "GY" for Gray, "B" for Blue, "Y" for Yellow. Refer to project drawing for color applications.

HITACHI CATALOG NUMBER	Description
30025-8xx	Category 6 – Plenum Spool
30024-8xx	Category 6 550 MHz – Riser Spool

xx = Cable color. Replace xx with "WH" for White, "GY" for Gray, "BL" for Blue, "Y" for Yellow. Refer to project drawing for color applications.

2. Or approved equal of: Belden, Berk-Tek, Systemax

D. Category 6 100 OHM balanced UTP Cable Installation Requirements
1. Pull cable into conduits, or place into raceway or cable tray as specified. Do not exceed 25 Lb pull force per cable. Use appropriate lubricants as required to reduce pulling friction.
2. All exposed wiring shall be installed in surface raceway.
3. All wiring above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.
4. Cable slack and service loops shall be stored properly above the ceiling or under the access floor. A "figure-eight" service loop is recommended for Category 6 cabling to reduce EMI coupling.
5. Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.
6. Installed cable bend radius shall be greater than 4X cable diameter. Avoid kinking or twisting the cable during installation.
7. Do not over-tighten cable ties, and do not use staples or clamps to anchor cables. Velcro straps are recommended.
8. Recommended spacing of cable supports above the ceiling shall be 48".
9. Maintain the following clearances from EMI sources:
   - Power cable: 6 in.
   - Florescent lights: 12 in.
   - Transformers and electrical service enclosures: 36 in.
10. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle, and shall not make physical contact.
11. Length of each horizontal cable run from the TR to the wall outlet shall not exceed 90 meters.
12. Leave sufficient slack for 90 degree sweeps at all vertical drops.
13. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.
14. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.
15. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper 'shiners". The installer is responsible to replace damaged cables.
16. Horizontal cables extending from mounted jacks or panels shall maintain a minimum bend radius of at least 4 times the cable diameter.
17. Firestop all cable penetrations through fire-rated barriers per local codes.

PART 15   VERTICAL DISTRIBUTION SYSTEMS

A.   **Riser Connectivity and Cable General**

1.   The cabling system shall use a fiber/copper riser cable system between the IDF rooms and the MDF within the building.

2.   Copper Voice/Data Riser shall be 25-pair Category 3 plenum Copper Riser Cables Installed between each IDF and the MDF as indicated in the attached riser drawings. These cables are to be terminated onto the 110 termination blocks on the wall-mounted or rack-mounted frames in the IDF Rooms and MDF Room.

3.   Fiber Riser shall be 12-strand OM4-Multimode fiber optic cable is to be installed between each IDF and the MDF Room as indicated in the drawings. These cables are to be terminated onto fiber optic patch panels located in the relay racks in each of the IDF rooms and the MDF Room. The 12-strand OM4-Multimode fiber cable is to be connectorized with SC connectors on both ends.

4.   A plenum coaxial cable is to be installed from the MDF Head-End Room to the various IDF Rooms within the building. The cable is to be fastened to the wall- mounted plywood backboard in each floor's IDF and MDF Room with 15 feet of slack neatly coiled, tie wrapped, and left dead-ended.
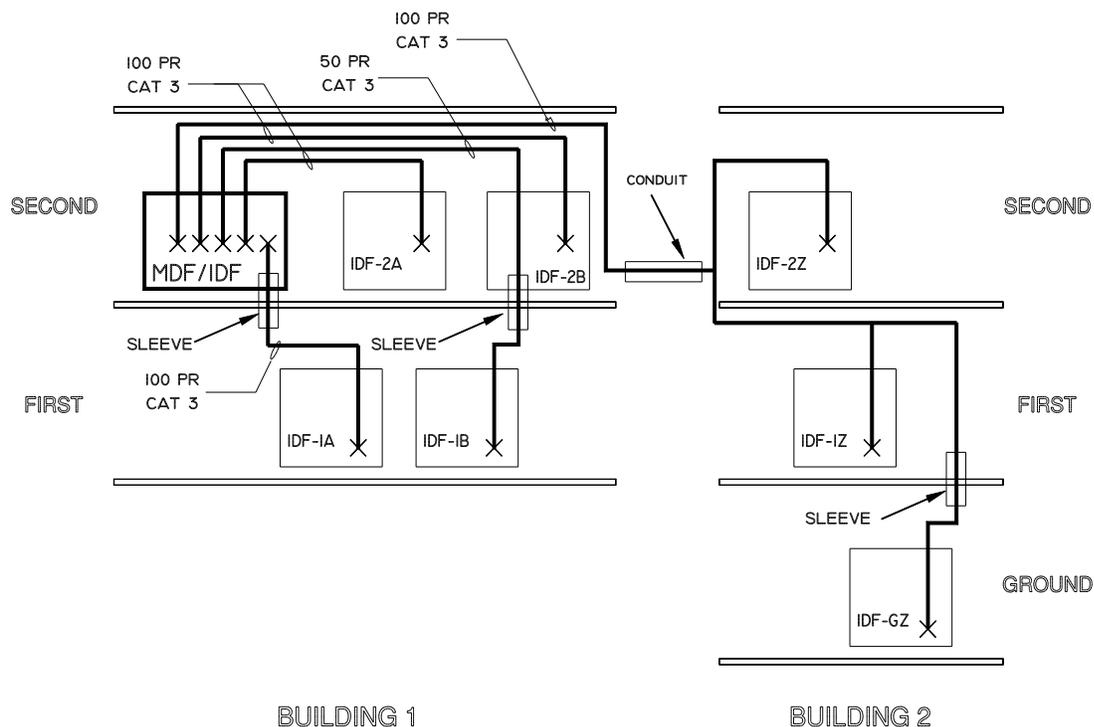
SAMPLE RISER—VOICE CABLING
SCALE: NONE

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B. Fiber Backbone Distribution cable: indoor, non-armored

1. Fiber Backbone Distribution cable Requirements
- Optical Fiber Indoor Distribution Cable shall be constructed with 12 optical fibers, each coated with a 900 micron color-coded PVC tight buffer, surrounded by an aramid yarn strength member, and a single outer jacket with the appropriate flame rating.
- Fiber cables shall be a non-metallic construction, OFNP (Plenum FT-6) flame rating.
- Cable markings shall repeat every meter, and shall have at minimum the following information:
  a. Sequential length indicator marking (meters)
  b. Manufacturer's name and catalog number
  c. Lot number, traceable back to the fiber draw lot
  d. Date of Manufacture
  e. Fiber type: (OM4 or Singlemode)
  f. Cable rating (OFNR, OFNP, etc.)
  g. Applicable Telcordia, TIA, IEC, and ICEA standard references and appropriate UL/CSA agency listings
- Cable jacket color shall be Aqua for Laser optimized 50 micron OM4 multimode.
- Buffer position color codes shall conform to standard ICEA and TIA-598 conventions as follows:1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White, 7-Red, 9-Yellow, 10-Voilet, 12-Aqua.
- Optical fiber in any cable construction shall be enhanced performance, bend-insensitive type.
- Multimode cables shall perform at minimum to the attenuation, bandwidth, and distance application parameters in the table below.
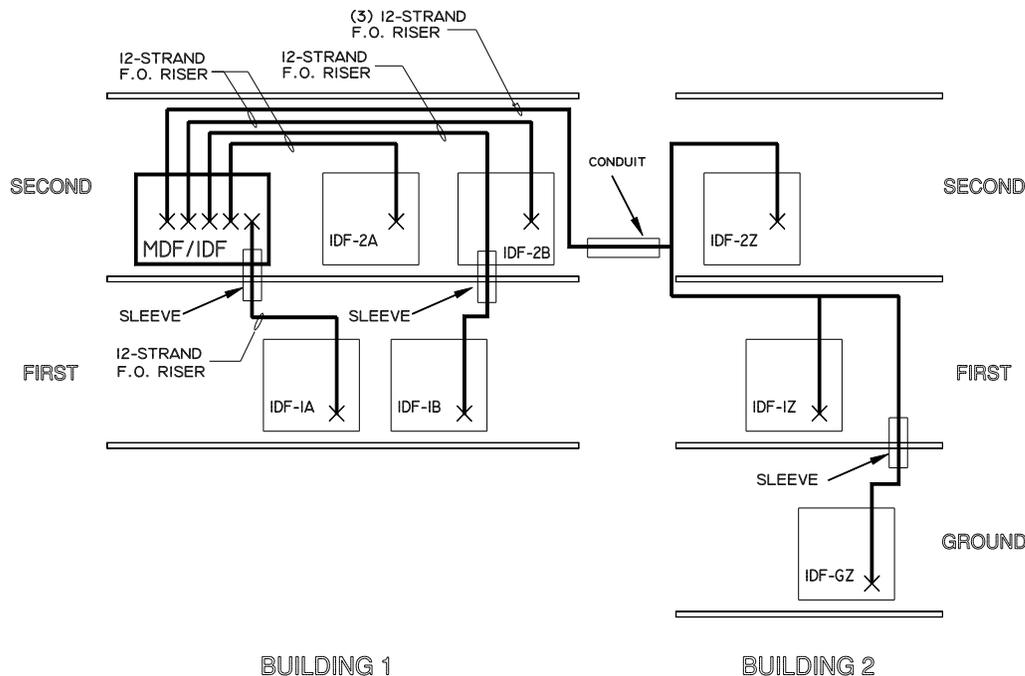
SAMPLE RISER-FIBER OPTIC CABLING
SCALE: NONE

Multimode Fiber Gigabit and 10 Gigabit Ethernet Application Chart					
Fiber Type	Wavelength (nm)	Max Attenuation (dB/km)	Bandwidth (MHz•Km)	1 GbE Distance (m) @ 850/1300nm	10 GbE Distance (m) @ 1300nm
MM 50 µm (OM4)	850 / 1300	3.0 / 1.0	4700 /	1100 / 550	550

- Optical fiber cables as supplied shall meet or exceed the applicable IEC 60793-1 qualification test requirements for optical, geometry, mechanical, and environmental parameters as specified, and tested in accordance with TIA/EIA-455.

2. PERFORMANCE REQUIREMENTS
- For installed fiber cables, all fiber strands shall pass insertion loss and return loss in accordance with test methods ANSI/TIA/EIA-526-14 for multimode cables.
- Installed fiber cables shall exceed all currently ratified bandwidth-distance- application performance parameters for IEEE 802.3ae (10 GbE) and for IEEE 802.3ba (40/100 GbE)
- Plenum cables shall be rated UL NFPA-262/UL910/CSA FT-6

3. Acceptable Manufacturers:

- Hubbell Premise Wiring or HCM.
  The Hubbell and HCM products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HFC1012P4	Fiber Optic Cable – 12-Strand MM 50 µm (OM4), Plenum, Aqua

HITACHI CATALOG NUMBER	Description
61868-12	Fiber Optic Cable – 12-Strand MM 50 µm (OM4), Plenum, Aqua

- Or approved equal of: Corning, Berk-Tek

4. Fiber Backbone Distribution cable: indoor, non-armored Installation Requirements
- Prior to cable deployment, backbone pathways (conduit, tray, raceway, wire basket, etc.) for cable routing shall be permanently installed in compliance with contract documents, and applicable codes and standards.
- Racks, cabinets or enclosures into which cables are to be routed shall be permanently installed in compliance with contract documents, and applicable codes and standards.
- Optical fiber cables shall be deployed using the proper pulling grip or apparatus attached to the exposed cable strength member. Contact the cable manufacturer regarding permissible methods for cable pulling. Never pull directly on the fiber strands of an optical fiber cable.
- Cables shall not exceed minimum bend radius limits or maximum pulling loads during or after installation. Avoid crushing or abrasion of the cable jacket during installation.
- Installed cables shall be fully supported and strain relieved from pulling on terminated connections. Apply wire ties loosely and avoid crushing or clamping cables with excessive

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force.

- All non-armored fiber optic riser cables are to be installed in plenum inner-duct. Fibers in inner-duct or armored plenum riser fiber serving as riser cables are to be installed according to the attached riser drawing. Contractor to size the inner-duct for each cable run. Multiple fiber optic cables can occupy an individual inner-duct when non-armored fiber is not used.

PART 16	CAMPUS CABLING

A. Outside Plant Cabling

1. The contractor is to follow the drawings regarding the installation of outside plant (OSP) cabling to buildings remote from the main building, such as portable rooms, trailers, other small buildings, etc. Many remote buildings can be served by conduits underneath or within ceilings of protected overhangs and bridges.

2. The contractor is to furnish and install outside plant cables and associated protector blocks, splice cases, and grounding where applicable in an approved manner.

3. The contractor will be responsible for obtaining all required right-of-way easements and permits before any excavation on the property begins.

4. All existing facilities in the area of excavation will be located and marked with paint, stakes, or flags before any excavation.

5. Outside plant optical fiber cable shall be 50/125 laser-optimized multimode or Singlemode strands loose-buffer tube water- blocking for outside plant application.

6. Outside plant copper cable will be solid insulated conductors 24 AWG with gel-filled core in 25-, 50-, or 100-pair increments.

7. RG-11 coaxial cable rated for OSP use will be used between buildings. Outside plant cables are to be routed aerially, underground, or buried by designed. Contractor may provide recommendations as to cable routing for approval.

8. Where noted, the contractor is to use aerial plant cabling between buildings. In cases where cables are attached to poles or buildings, aerial spans are not to exceed 100 ft from the last pole to the building, using slack span construction (no guying at either end). EIA/TIA guidelines and NEC code are to be strictly adhered to for separation and clearances from power lines and traffic.

9. Underground Cable is to be enclosed in conduit buried at least 24 inches below ground surface. In situations where fiber optic cables will be used, inner-ducts will be placed inside conduits to ensure physical protection for the cable. Proper fill ratios must be observed as well as proper bend radius. Metal sleeves through the foundation will be used to prevent conduit shearing. Sleeves must extend from inside the foundation wall to a minimum of 12". The end of the conduit within the building must be securely fastened to withstand the placing of cable. Sleeves are to be sealed with plugs or sealant. Conduit must be bounded and grounded in compliance with EIA/TIA and NEC requirements.

10. Minimum depth of trench should allow for 24 inches of cover from top of cable to final grade. Upon refilling the trench, the soil must be tamped to prevent sunken trench appearance. Conduit sleeves will be used for penetrations through foundation walls, using the same guidelines as for underground cable. OSHA regulations concerning shoring requirements must be followed during all phases of buried cable installation. Contractor must install buried cable so as to meet minimum separation distances from adjacent structures (power, gas, water, etc.) To minimize the chance of accidental dig-up, contractor will install detectable warning tape a minimum 18 inches above cable.

11. Multi-pair protector blocks shall be installed to provide protection from voltage surges and sneak current. The protector panel shall be equipped with 110 wiring block and solid state protector units type 4C, and others depending on the situation. Project Manager will coordinate with contractor. Protector panels shall be installed within 50 feet of each outside plant cable building entry point. Protector panels must be grounded and bounded to the building grounding system.

12. Splice cases shall be provided and installed at both ends of outside plant cables. Splice cases shall be used for cable transition from to inside plant cables.
    - Fiber optic splice cases shall be designed to seal, bind, anchor, and protect cable splices and transition points from outside plant to inside plant cables. The case shall be fully equipped with a suitable splice kit for the fiber quantities specified.
    - Copper splice case shall be designed for use with non-pressurized cable. The case shall be of a durable fire-retardant material, single piece with a hinged cover. The case shall be equipped with a cable entrance end plates assembly of adequate size to accommodate entering and exiting cables, ground straps, and all necessary termination, mounting hardware.

13. Pedestal/Cabinet shall have a heavy gauge galvanized steel housing or equivalent and be weather-resistant for the termination of copper and fiber optic cables. It shall be equipped with ground bar, protector blocks, and adequate space for splice cases to accommodate transition of cables into or out of the cabinet. Pedestal/Cabinet size dependent upon each situation.

14. All OSP cables will be grounded according to EIA/TIA and NEC standards and codes.

15. Contractor is to install a RG-11U Plenum Coaxial cable between the existing CATV Head-End Location and the MDF Room when indicated in the attached drawings. Not all buildings have a CATV Head-End, but if it exists, it will be noted on the attached drawings. These cables are not to be terminated, but must be neatly coiled and tie-wrapped with 40 feet of slack cable remaining at each end.

PART 17   PATCH CABLES

A. Patch cables should meet the minimum performance requirements specified for each system. This requirement specifically prohibits the use of flat, non-twisted (also known as "silver satin") cords for Data or local area network applications. However, "silver satin" patch cables are acceptable for use in telephone systems.

B. The contractor shall provide two Category 6 Patch Cords for each end of each standard outlet for horizontal LAN connectivity. The cords are to be of varying lengths based on the patch panel, electronics equipment, and work area configurations. The quantity and lengths are to be documented and agreed upon, and the owner or Project Manager is to sign for them upon acceptance. These cords are to be stored in the MDF or IDF room for which they are designated.

C. The contractor is to provide dual SC to LC Patch Cords for connectivity for ports or equipment served

by the fiber patch panel. The cords are to be of varying lengths based on the patch panel and electronics equipment configurations. These cords are to be stored in the MDF or IDF room for which they are designated.

D. Fiber Patch Cords

1. Fiber Patch Cord Requirements
- Provide factory-made, dual SC to LC fiber cables in 1-Meter lengths for every fiber cable installed.
- SC Optical fiber patch cords shall be constructed with aramid-reinforced PVC loose-jacket duplex cable, with optical fibers having a 900-micron PVC buffer coating diameter. Optical fiber used in 10 GbE patch cords shall be laser optimized 50 micron OM4-multimode, per ANSI/TIA/EIA-492AAAC, with no substitutes.
- Multimode 50 micron core optical fiber within the patch cord cable shall be graded index type in accordance with ANSI/TIA/EIA-492AAAC, with the following specifications:
  a. Core diameter: 50 +/-3.0 microns
  b. Cladding diameter: 125 +/- 2.0 microns
  c. Core/cladding concentricity: less than 3.0 microns
  d. Core non-circularity: 6% maximum
  e. Proof test: 100 kpsi
  f. Effective modal bandwidth: 5700 MHz•km
  g. Coating diameter: 245 +/-15 microns
  h. Buffer diameter: 900 microns nominal
- Connector terminations on each end of the fiber patch cord shall be heat-cured epoxy type with a machine polish, inspected 100% for polish quality and mated-pair insertion loss.
- Epoxy volume within each connector shall be sufficient to properly surround and strain relieve the fiber and buffer layer at the buffer/fiber transition inside the connector body.
- Optical fiber patch cords shall be supplied in a sealed plastic bag with dust caps installed on each end, with insertion loss test results included.
- Optical fiber patch cords shall be available in standard lengths of 1, 2, 3, and 5 meters.
- Optical fiber patch cords shall be manufactured with industry standard SC or LC connector terminations on each end.
- Factory mounted connectors on each end of the patch cords shall comply with the applicable ANSI/TIA/EIA-604 Intermateability standard.
- Buffered fiber strands within the cable jacket shall be surrounded by aramid (Kevlar) material serving as a strength member.
- The aramid (Kevlar) strength member shall be mechanically secured at each connector to provide tensile strain relief of the optical fiber.
- Additional strain relief of the buffered fiber shall result from crimping the rear of the connector during termination.
- Duplex fiber patch cords shall be a zip-cord cable construction with jacket cross-section dimensions of 3.0 mm X 6.0 mm for SC style.
- Duplex fiber patch cords shall have reverse-pair polarity according to ANSI/TIA/EIA-568-B.3 and TIA/EIA-TSB-125.
- Cable jacket shall be marked with the cable manufacturer, UL Optical Fiber Non-Metallic Riser rating (Type OFNR) designation, lot number, and fiber core/cladding diameter designation.

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- Fiber A-B polarity shall be clearly marked on each end of duplex patch cords.
- Optical fiber patch cord jacket color shall be aqua blue, specifically for 50 micron laser optimized multimode fiber cables.
- Fiber patch cord connector materials shall be as follows:
  a. SC Ferrules: zirconium ceramic
  b. SC housings: injection molded thermoplastic
  c. Dust Cap: nylon or PVC
  d. Strain relief boot: UL94-V0 molded PVC
  e. Strain relief boot on all connectors shall be beige.
  f. SC connector outer housing shall be beige.

2. **Fiber Patch Cord Performance Requirements**
   - Multimode 50 micron laser optimized patch cords shall have a maximum mated-pair insertion loss of 0.60 dB per end, with a minimum return loss of –20 dB.
   - Fiber patch cords shall exceed 10 Gigabit Ethernet performance requirements of IEEE 802.3 standard.
   - Fiber patch cords shall exceed the mechanical reliability requirements for tensile, flex, twist and impact as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.
   - Fiber patch cords shall exceed the environmental reliability requirements for high/low temperature and humidity as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.

3. **Acceptable Manufacturers:**

   - Hubbell Premise Wiring.
     The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
DFPCLCSCFyyMM (yy=length-1,2,3,5m)	LC-SC Optical Fiber Patch cords, OM4-MM, Aqua

   x = Length. Replace x with standard lengths of 1, 2, 3, 5 meters

   - Or approved equal of: Ortronics, Panduit, Systimax, Leviton

E. **Category 6 Patch Cords**
   In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

1. **Category 6 Patch Cord Requirements**
   - The contractor shall provide two Category 6 Patch Cords for each end of each standard outlet for horizontal LAN connectivity. The cords are to be of varying lengths based on the patch panel, electronics equipment, and work area configurations. The quantity and lengths are to be documented and agreed upon, and the owner or Project Manager is to sign for them upon acceptance. These cords are to be stored in the MDF or IDF room for which they are designated.
   - Category 6 patch cords shall be constructed with a clear polycarbonate plug and boot having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.
   - Plug dimensions and function shall comply with FCC 47, Part 68.5.

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- Patch cords shall have a snag-less feature, integral to the strain relief boot on each end.
- Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
- Patch cords shall be manufactured using a T568B wiring format, and shall function suitably for either T568A or T568B wiring schemes.
- Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
- Standard patch cord lengths shall range from1 ft. to 20 ft.
- Category 6 patch cords shall be backward compatible with existing Category 5 and 5e cabling systems for fit, form, and function.

2. **Category 6 Patch Cords**
- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 patch cords shall be channel performance balanced with Hubbell category 6 jacks, patch panels, and punch-down blocks.
- Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1 standard.
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
- Patch cords shall be cUL and UL LISTED 1863.
- Patch cords shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- Patch cords shall be third party verified, error-free Gigabit Ethernet performance to IEEE 802.3 standard.
- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
- Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-B.2-1 standard.
- The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks,

3. **Acceptable Manufacturers:**

- Hubbell Premise Wiring.
  The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HC6xx01	Category 6 Patch Cord, 1FT
HC6xx03	Category 6 Patch Cord, 3FT
HC6xx05	Category 6 Patch Cord, 5FT
HC6xx07	Category 6 Patch Cord, 7FT
HC6xx010	Category 6 Patch Cord, 10FT
HC6xx15	Category 6 Patch Cord, 15FT

| HC6xx20 | Category 6 Patch Cord, 20FT |
| HC6xx25 | Category 6 Patch Cord, 25FT |

xx = Cable Color. Replace xx with "W" for White, "BK" for Black, "B" for Blue, "GY" for Gray, "GN" for Green, "P" for Purple, "OR" for Orange, "R" for Red, "Y" for Yellow. Refer to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax, Leviton

PART 18   FIRE STOP - PENETRATION SEALANT

A. Provide fire-resistant silicone foam fill to restore fire ratings to all wall, floor, or ceiling penetrations. Foam must be UL classified and meet NEC and local code.

B. All penetrations through fire-rated floors and walls shall be sealed to prevent the passage of smoke, fire, toxic gas, or water. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

C. No flammable material may be used to line the chase of the hole in which the fire stop material is to be installed.

D. When damming materials are to be left in place after the seal is complete, then all such materials shall be non-flammable.

E. The sealant shall be poured into the hole after each cable has been spread to allow a minimum of ½" of foam to flow between them. No cables may be touching each other, because contact between cables could allow voids to form in the fire stop.

F. If plastic cartridges are used for smaller installations, the chemical components of the foam shall be pre-measured within the cartridges to ensure the proper ratios.

G. The sealant shall remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself perfectly to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion, and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling, and spalling.

H. When sealant is injected into a penetration, the foam shall expand to surround all the items within the penetration at that time and be fire resistant, maintaining the pass-minute rating.. No heat shall be required to further expand the foam to block the passage of fire and smoke or water.

I. The foam sealant material shall have been subjected to fire exposure testing in accordance with standard time-temperature curve in the Standard, UL, ASTM E

J. 119, and NJPA 251. The foam fire-stop material shall also have been subjected to the hose stream test in accordance with UL 10B.

PART 19   TESTING

A. General Test Procedures

1. Before an application for final acceptance of the work will be considered, all tests stated within this section shall be satisfactorily completed. The communications work shall include miscellaneous tasks, (e.g., removal of panel trims, junction, and pull box covers) deemed necessary to demonstrate compliance with the requirements of the Communications specifications, as well as cable and equipment manufacturers' recommended installation procedures.

2. Upon completion of testing and problem resolution, all connections must be 100% error free: "Error

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free" is defined to mean the item meets all the manufacturers' specifications and recommendations as published in their latest manufacturing manuals for proper installation and testing. In addition, each item must conform with all other related industrial practices and standards, Building Trades, and Electrical and Communications Industry Standards and Practices.

3. Upon successful completion of each item of testing, the Contractor shall issue in writing a certificate of compliance, along with the test results, to the Project Manager. All failed CAT-5e & 6 – 6a cables and/or Fiber strands shall be clearly labeled and identified as defective, with the type of defect (i.e. open ring side, grounded tip, short, excessive loss, etc.) identified.

4. The Contractor will attempt to remedy any defective copper cable pair or Fiber cable strand and specify in the documentation the location of the problem as identified during the testing procedures. The Fiber trouble location and identification must be completed with an OTDR.

B.   Copper Cable Test Procedures

1. Contractor must complete cable system performance verifications on all copper and fiber cable as specified below and provide the test results to the owner or project manager. Category 5e & 6 – 6a cable must meet or exceed all manufacturer's and EIA/TIA standards for performance and installation. Fiber cable must also meet or exceed all manufacturer's and EIA/TIA standards for performance and installation.

2. All copper and fiber optic testing documentation is to be submitted on a CD, as well as 8.5" x 11" hard copies.

3. At a minimum, in addition to any other required testing, the Contractor shall conduct and report on the following tests of copper cabling after the installation is complete:

   • MDF-to-IDF tests of all new riser pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.
   • IDF (110 frame or patch panels)–to-information outlet tests of all new cable pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.
   • The coaxial cable is to be tested from the MDF Room to the IDF Room and from the IDF Room to the coax outlet. Contractor is to test for continuity, shorts, and grounds.
   • The horizontal Category 5e & 6 – 6a cabling, installed from the IDF Room to the Information Outlet at the workstation, is to be manufacturer certified and warranted for Category 5e or 6 – 6a compliance. All manufacturers' performance certificates and extended warranties are to be provided to the owner or project manager upon completion of the testing and manufacturer certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR for the selected cabling system and therefore, qualified to install a certified cable plant.
   • All category 5e & 6 – 6a cabling is to be tested end–to-end and documented for Category 5e & 6 – 6a compliance at all frequencies up to and including 100MHz for 5e and 500 for 6 – 6a. Such testing is to comply with the procedures and standards outlined by the cable manufacturer and EIA/TIA TSB - 67 concerning testing of Category 5e & 6 – 6a cable plant.
   • A certified Cat 5e & 6 –6a testing system is to be used for such testing to insure that cable pairs are defect free. "Defect free" for the copper cable is defined as a copper pair not having any pair reversals, split pairs, shorts or opens. Test results shall be provided to the Owner or Project Manager within 2 days after testing or 5 days prior to the Owner connecting electronic equipment onto the cable network, whichever is sooner. The contractor must also provide

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testing summary reports of all category 5e & 6 – 6a cables including run numbers, and pass/fail results with respect to length, impedance, DC resistance, mutual capacitance, attenuation, NEXT loss, and active ACR. The contractor must also provide spreadsheet analysis of the linearly dependent parameters of length, DC resistance, mutual capacitance, and attenuation; the field measured values shall be compared to the specifications values on one spreadsheet.

- In the event that a CAT-5e or 6 – 6a cable fails to perform to the manufacturer's specifications, the Contractor will, at the owner's request, remove the cable and replace it with a new cable, replacing the defective cable at no additional expense to the owner.
- End-to-end testing is required for every RJ-45 connection. An owner's representative may accompany the Contractor's staff to witness the end-to-end testing. End-to-end testing is defined herein as testing all cabling links to the very last termination point. The Contractor is required to supply sufficient quantities of two-way radios and test equipment to ensure that the tests are completed accurately and expeditiously.
- The Owner, DTI, or Project manager may conduct performance tests of transport electronics connected to the cabling system. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.
- The Contractor shall provide to the Owner or Project Manager with copies of all copper-cable test results.

C. Fiber Optic Cable Test Procedures
1. All fiber optic cable and associated equipment lateral, and vertical riser cabling must be thoroughly tested. The fiber cable will be accepted only after each strand is tested in accordance with the specifications defined herein. All strands are to be tested and found to be 100% acceptable.

2. The Contractor shall test all cables, connectors, associated equipment, and hardware furnished by the Contractor upon receipt of same as defined herein.

3. As a minimum, the Contractor shall test, as described below, all optical fiber cable strands installed within the scope of this proposal:

   - Fully test complete links only. Piecemeal testing is not acceptable.
   - Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 850nm and 1300nm wavelengths. Conduct tests in accordance with EIA/TIA-526-14, Method B and with test instrument manufacturer's published instructions.
     a. Demonstrate that measured link loss does not exceed the expected value based on the number of mated connector pairs, the connector's published loss per mated pair, and the cable's published loss based on distance.
     b. Strands whose measured attenuation falls outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to: determine the true loss for each connector pair and the exact length of the fiber, and to identify the presence of any core damage.
     c. Riser end-to-end testing of individual optical fibers is considered to be from the MDF Room to the IDF Rooms distribution panels on each floor.
     d. Horizontal end-to-end testing of individual optical fibers is considered to be from each floor's IDF Room's Fiber Distribution Panels to the Information Outlet.
   - Faults related to connectors shall be corrected and the fiber re-tested as stated above until acceptable attenuation measurements are received.

- Where defects are found to be inherent in the fiber itself, notify the Project Manager in writing. Upon obtaining approval by the Project Manager, replace any cable having fewer than the manufacturer's guaranteed number of serviceable fibers.
- Remove all newly installed defective cables from pathways. Do not abandon cables in place.
- All test results and corrective procedures are to be documented and submitted as a spreadsheet to State/DTI within five (5) working days of test completion.
- Considering that the fiber cable plant is to be certified, each test report form shall provide at least the following information:
  a. Project name
  b. Contractor's name
  c. Date(s) of preparation and of testing
  d. Fiber type, strand count, connectors and patches
  e. Designated cable number (regardless of whether only one cable of each type is present) and individual fiber numbers
  f. Make, model, serial number, and date of last calibration of test equipment used
  g. Name of test crew foreman
  h. Test results: Calculated maximum link loss, length of run, OTDR, and also
  i. Power Meter-measured link loss for each fiber, pass/fail result, and comments.
- In addition to the tests specified above, the Contractor shall be present while the Owner or Project Manager conducts performance tests of the transport electronics connected to the cabling system; the contractor shall conduct on- the-spot cable tests and effect cable plant repairs as necessary. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.

- Recommended test equipment:
  a. Optical fiber power meter and Light Source: Siecor CPM-850/1300 meter and OS-100D Light Source, or equivalent.
  b. TDR: Tektronix TFP2 FiberMaster, Laser Precision TD-2000 or equivalent with 850nm and 1300nm emitter modules and hard copy printout, or equivalent.
  c. Optical fiber inspection scope: Cambridge Instruments 10x fiber scope, or equivalent.

- The Contractor shall provide copies of all fiber and copper cable test results to the Owner or Project Manager.

- All fiber optic cabling (workstation and riser) is to be installed in a manner that complies with and allows Owner to receive the manufacturer's extended warranty. The contractor is to be certified and authorized to provide the extended warranty. A manufacturer's extended warranty is to be provided, through the contractor, upon completion of the testing and manufacturer's certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR and therefore, qualified to certify and install the cable plant.

- The Owner and Project Manager reserves the right to observe any or all portions of the testing. Notification of testing is at least three days prior to start of testing.

D. Replacement

Any fiber strand, connector, block, or module installed by the Contractor that fails to meet the loss budget, or that tests below the manufacturer's standards, shall be replaced at no additional cost to the owners or State/DTI. The replacement cable, connector, or part shall be tested after repairs have been made to verify compliance. Only equipment that meets

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the installation requirements stated herein shall meet the system's acceptance requirements.

E. Source Manufacturing/Quality Control

Cables that are supplied by the Contractor, and test outside of the factory test data by a margin of 10 percent on loss, may be deemed non-usable and returned to the manufacturer for replacement.

F. Physical Inspection

Prior to conducting any transmission testing, the following visual inspections will be performed:

1. Verify that all cable has been installed in full compliance with the proposal specifications.

2. Check for physical damage to the Fiber Distribution Panels and termination hardware.

3. Check that all cabling is properly jacketed, installation properly labeled at both ends of the cable, inner-duct and termination hardware is completed in all IDFs and the MDF Room.

4. Verify that all cable bends are within the manufacturer's specified bend radius.

5. Verify that all cabinets and racks (which require grounding) are properly grounded and comply with the National and Local Electrical Codes and State Standards for grounding.

6. Verify that the cables are properly approved and structurally supported for termination.

7. Verify that all Delaware Fire Code requirements have been met and satisfied.

G. DOCUMENTATION

Proper labeling and documentation will allow a technician to quickly trace a particular cable link and will significantly reduce the time and costs of moves, additions, changes, and troubleshooting. Both labeling and documentation depend on the use of a system-wide coding scheme that will identify and locate each component of the wiring system and allow all components to be linked in a logical fashion.

There are three components of wiring system documentation:

1. Labeling Communications/Data room/closet termination areas aids in identifying the source and function of a circuit.
2. A labeling scheme simplifies the documentation process.
3. "As built" documents provide a permanent record of the communications infrastructure. These documents are a critical management resource. As a result, it is imperative that "as built" documentation be prepared as part of the communications infrastructure project. In addition, these documents must be kept current throughout the system's life cycle.

H. Termination Blocks

Labels on the connecting hardware should be coded based on the function of the terminated wiring. Colored designation strips are typically provided with a termination block.

I. Cable and Information Outlet Identification

The Contractor shall furnish and install cable tags labeled with identifying cable numbers mutually agreed upon with contractor and the Owner or Project Manager.

1. The Contractor shall clearly and consistently mark the appropriate designation strip labels on all termination hardware mutually agreed upon with the Owner or Project Manager. Contractor will submit a sample of all designation labels for approval before installation.
2. The Contractor shall affix outlet identification labels, machine printed or typed, with identifying cable numbers as shown on the attached drawings.
3. Subsequent to pulling and terminating cables, the Contractor shall place the appropriate cable tags within six (6) inches of each end of each copper cable and eighteen (18) inches of each optical fiber cable end.
4. If the cable tape becomes illegible or is removed at any time during the job, the
5. Contractor shall immediately replace it with a duplicate preprinted cable tag.
6. The Contractor shall provide the Owner or Project Manager with a listing of all cable identification numbers, keyed to cable types.
7. Contractor will label each information outlet with the following labeling scheme: If the 1st floor IDF closet "A" is the origination point of the cable feeding workstation "007" the following is the configuration of the label to be installed:
   Floor- IDF Closet - Information Outlet Number
   Example: 1A-007
8. Contractor will submit for approval a sample of all information outlet designation labels.

J.   "As-Built" Documentation

Maintaining records and documents is the most important portion of the administration of a communications infrastructure. Maintenance and moves, additions, and changes can become very difficult if a current set of records and documents is not maintained. In fact, isolation and resolution of problems are often delayed because configuration information is either unavailable or outdated.

Subsequent to the installation and prior to acceptance, the Contractor shall prepare and issue As-Built drawings, in an AutoCAD format, that shall reflect the lengths of cables installed and the actual manner and conditions of installation, including all deletions from, additions to, or departures from the contract documents. These documents are to include the information outlet station numbers and cable routing where they vary from the original plan. A copy of these documents will be stored in the MDF, with a master copy located at the Owner or Project Manager.

K.   Cable Management System

Wiring and equipment relationships must be maintained in a database or spreadsheet (depending on their complexity). The best approach is to use a third- party vendor's application for tracking cable management. These records contain comprehensive information about the users' communications configuration. The information will be very valuable in the support of long-term user-community communications requirements.

PART 20   APPENDIX A – COMMUNICATIONS PLANNING CHECKLIST

A.   Space allocation for Communications/Data room/closets

1. **Based on a number of factors, including the:**

   - Type of equipment to be installed
   - Size of the phone and data termination backboards
   - Access to floor cores and conduits
   - Cable tray requirements
   - Location, size, and swing of the Communications/Data room/closet door(s)

2. Square footage is not as important as the actual floor dimensions and the placement of the equipment. It is possible to design around some obstacles and still have a functional facility. For instance, an oblong room is not as desirable as a square room having the same square footage.

3. The criteria for establishing the size of a Communications/Data room/closet and determining whether or not it is functionally acceptable are complex. Answering the following questions is the first step in determining the long-term feasibility of a communications room or closet:

   - What will be the closet's primary function: phone, data, or combined services?
   - Where is it located in proximity to serviced workstations, network rooms, and other Communications/Data rooms/closets?
   - What type of equipment is going to be in the room/closet?
   - Is it wall- and/or rack-mounted?
   - How much equipment will be put in the room/closet? What are the dimensions of those devices?
   - What are their environment requirements?
   - Based on the type(s) of equipment going into the room/closet, what is the installation, maintenance, and operator work space required around the equipment?
   - Can the equipment be attached securely to the structure?
   - What cable types are being used? What are the cable separation requirements? Where are the cables terminated within the closet?
   - Does equipment mounted in the closet require an open space? Is there any other device needing clear space?
   - Is the room/closet securable? Do other entities need access to the space? What are their space requirements?
   - What size is the door? Does it swing in or out? Can the door be modified?
   - Is power available? Can it support the room/closet electrical requirements? Can it be modified?
   - Does the room need air conditioning? Does it ventilate well? Can it be modified?
   - Where are the floor cores and the ceiling access points for conduits?
   - Are there expansion requirements? Can the expansion requirements be accommodated by the room/closet size? Can the closed be enlarged at a later date?

PART 21   APPENDIX B - CABLE INSTALLATION CHECKLIST

A. Check Local Building Codes

The requirements stipulated by Section 800 of the National Electrical Code for Communications cable installations produce an orderly installation. However, it is important to consult your building inspector to determine whether there are special local requirements. Strapping requirements depend upon the building's design, State and Local Standards, and codes. Terminations can be made in standard junction boxes.

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B. Coordinate with Other Contractors

Plan to install the cabling system in new buildings after the power wiring, air- handling ducts, and ceiling supports have been installed, but before the ceiling tiles are in place. This will prevent damage to the cable system during construction.

C. Plan the Job

On a blueprint, mark all terminations and desired routings, if known, to accommodate future building modifications.

D. Label the Cables

Label each cable reel and its free end according to the termination locations marked on your blueprint.

E. Pull Cable into Place

Deliver the cable from the bottom of each reel, making sure not to kink, crush, or pinch the cable. Pull groups of cables to a logical point and then fan out to the individual termination points. Arrange the cables neatly so they are easily identifiable for relocation. Separate the Communications cables from other cables by at least six inches and avoid sharp edges, tight bends, and locations that would subject the cable to abrasion, corrosion, or moisture. According to the National Electrical Code, low-voltage cables cannot share a tray with power cables. Running signal cables close to power cables may also cause hum pickup. If in doubt about cable locations, consult the standards or the Owner.

F. Remove Slack

Remove slack in lines by pulling the cables back to the wiring room and by adjusting their ceiling location as needed.

G. Label and Cut

Label each cable and then cut it off, making sure to leave enough cable to reach the termination panel.

H. Tie Cables Together

Use cable ties to bundle and secure parallel runs together. Place the ties at intervals sufficient to prevent sagging and to maintain neatness. Distances between ties may vary from six inches to four feet, depending on the size of the cables.

I. Strap the Cable

Use straps to fasten the tied cable bundles to hangers at 4-foot or other appropriate intervals. The distance between hangers will vary from 3 to 20 feet, depending upon the strapping surface, the type and number of cables in each bundle, State and Local Standards, and codes. Make sure to support the cables with hangers rather than pipes, conduit, or other structures in the building plenum. If space permits, use existing hangers; otherwise, install new ones. Do not use straps that are too small for the cable diameter because they can cut or pinch the cable insulation.

J. Inspect the Job

Be sure that the cables are not resting on false ceilings or near electrical fixtures or sagging more than three inches from the point of the tie wrap.

PART 22   APPENDIX C - QUALITY ASSURANCE

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A. All materials used shall bear the Underwriters' Laboratory, Inc. label, provided a standard has been established for the material in question.

B. All products and materials shall be new and unused, clean, and free of defects, damage, and corrosion.

PART 23   APPENDIX D - CODES, REGULATIONS AND STANDARDS

A. All installations and equipment shall be in compliance with, equal to or exceed the minimum requirements of OSHA, NEC, NEMA, IEEE, SAME, ANSI, UL, EIA, TIA recommendations and the rules, regulations and requirements of the Federal Communications Commission.

B. The installation shall comply fully with all applicable Local, County and State of

C. Delaware laws and ordinances, regulations, and codes.

D. Local electrical and building codes in Delaware may be more restrictive than national codes, recommendations or practice. Follow the most restrictive code or recommendations.

E. Should any change in plans or Specifications be required to comply with governmental regulations, the Contractor shall notify the Owner or Project Manager at the time of submitting the construction schedule.

PART 24   APPENDIX E - WARRANTY

Besides the manufacturer's extended warranty the Contractor shall submit a single Guarantee stating that all portions of the work are in accordance with Contract requirements and guaranteeing all work against faulty and improper material and workmanship, including work and materials of all subcontractors, manufacturers, suppliers, and sub trade specialists, for a period of one (1) year from date of final acceptance by the project manager, State/DTI, and Owner. Where guarantees or warranties for longer terms are provided, such longer terms shall apply. Within 24 hours after notification, the Contractor shall correct any deficiencies that occur during the guarantee period at no additional cost to Owner, all to the satisfaction of the Project Manager and or Owner.

When installed by a Certified Installer and used in a Structured Cable System, the manufacturer's extended warranty shall cover the installation for a period of 5 years against defects in material and workmanship. It shall also guarantee that it will support any current and future applications designed for Data transmission over the 100/500MHz link/channel, as defined in TIA/EIA 568A Communications Standard.

All move, add and change (MAC) activity shall be covered by the warranty provided it is performed by a Certified Installer.

PART 25   APPENDIX F - BID/QUOTE RESPONSE FORMAT

A. Proposal identification number or control number. This number will be used as a reference for this individual proposal and will facilitate coordinating multiple bids or quotes for the same location or job site.

B. Requesting State Agency and Contact name, phone number and address. This should be the name of the State agency requesting the quote or bid and that agency's contact person's phone number(s) and address.

C. Building or office location address. This address should be the actual location of the job site. This address should include the floor numbers, if more than one story, and building numbers or names, if more than one building is involved.

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D. Total Cost of Bid/Proposal. This dollar amount should include the total material and labor cost. The material and labor cost should be stated separately and then totaled. Also state whether or not labor costs are based on prevailing wage standards or not.

Example:

Material	$3,500.00
Labor Prevailing	$2,750.00
Total	**$6,250.00**

E. Scope of Work. This section should be a written description of the work to be performed. It should be function-specific.

Example:

- Install, terminate both ends, test, and label XX work area locations consisting of one Voice and two Data CAT5e cables and CAT5e 568-B RJ45 jacks.
- Install one Voice cable from the Communications Closet to the Fir/Security Alarm Panel location.
- Using new conduit placed by others, provide and install a 100-pair Category 3 outside plant cable and a 12-strand Multimode Fiber Optic cable in inner-duct from the building communications closet to the boiler room of the main building.
- Provide and install lighting protection at each end of the 100-pair outside plant cable.
- Provide and install a 100-pair plenum-rated riser cable from the boiler room to the main communications closet and terminate on 110 type wall mount hardware.
- Terminate the six-strand Multimode Fiber Optic cable in SC type connectors.
- Provide and install 7' relay racks and CAT5e patch panels.

F. Material

The material should be and itemized list with manufacturer's name and part numbers, including all piece parts and quantity of each. Total man hours to complete the job should be included as an item in the list.

Hitachi Cable	Blue	30025-8BL	2,800 ft
Hitachi Cable	White	30025-8WH	2,000 ft
Hubbell Jack Single		609501108	14 ea
Hubbell Jack Double		60950096	14 ea
Hubbell 110 block		30200007	1 ea
Hubbell Panel P6E48U		951044344	1 ea
CIRCA protector panel		1880ECAS1-100G	2 ea
1 pair fuse CIRCA		4B1E	200 ea
etc.			
etc.			
etc.			
Labor Man Hours			72 hr

G. Warranty

This should include the name of the manufacturer from which the State will receive the warranty and the type and length of the warranty or warranties provided with the cabling solution that is proposed

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PART 26   APPENDIX G – OUTSIDE PLANT – DELDOT SPECIFIC REQUIREMENTS – TRAFFIC CONSTRUCTION

A. DELDOT FIBER INSTALLATION OVERVIEW
- Varied Distances
  - 200 ft -65km
- Locations
  - Highways/Roadway
  - Buried conduit
  - Pole Line
- Typical installation methodology & work to include
  - Backhoe work
  - Trenching/directional boring
  - conduit
  - hand holes
  - Vaults
- DelDot Mandated Safety standards
  - OSHA – Occupational Safety & Health Administration
  - All Delaware road work safety requirements shall be in accordance with the DelDOT Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways – Part 6 Temporary Traffic Control.
- DelDot Project Initiation Timeframes
  - Safety is priority one for all DelDOT projects – no road work will not be authorized without following the proper safety precautions and DelDOT safety approval. It some situations, DelDOT requires 2 week notice prior allowing road work to begin.

B. Deldot Singlemode Fiber Specifications & Purchasing requirements

- All fiber and splicing work must meet/exceed specification of Standards Bodies:
  - ANSI -American National Standard Institute
  - EIA/TIA -Electronic Industries Associations/Telecommunications Industry Association
    - Structured cabling systems for commercial buildings
  - NECA - National Electrical Contractors Association
  - BICSI – Building Industry Consulting Services Internation
  - State of Delaware and Local standards & code
  - ANSI TIA/EIA 758 (latest reference) Outside Plant Customer Owned Telecommunications Standard

- Fiber Cable Certification
  - Vendors must provide documentation, on a per job basis, written certification that all cables and services supplied as a result of this solicitation meet all current applicable ANSI EIA/TIA specifications and BICSI Guidelines
  - Testing methodology per section "Deldot Fiber Testing Requirements"
  - In order to adhere to warranty specifications and to standardize on cable specifications, the Delaware Department of Transportation has standardized on Corning fiber optic cable, which requires installation by a Corning EWP (Extended Warranty Program) Partnering Company.

C. DelDot Fiber Testing Procedure and Minimum Accepted results
- Single Mode Fiber
  - Maximum Bend Radius
    - Conductive cable - 15 times the cable's outside diameter when being pulled
    - Nonconductive cable – 10 times the cable's outside diameter when under no

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load and 20 times the outside diameter when being pulled
- o Fiber Connector Type
    - ▪ SC connectors – DOT standard is SC only
- o OTDR Testing & Results
    - ▪ Anritsu –CMA 5000 or equivalent
    - ▪ Power meter – Corning OTS 600 Series Power Meter & Light Source or Equivalent
    - ▪ Maximum Loss
        - • Optical fiber attenuation factor   1.5 dB/km standard limit, (e.g., TIA-568-C.3)
        - • Connector Coupling loss .75 dB/pair standard limit, (e.g., TIA-568-C.3)
        - • Fiber splice insertion loss .03 dB standard limit (e.g., TIA-568-C.3)
    - ▪ Utilize an optical fiber link transmission performance calculation worksheet to determine acceptable loss within specified run
- o Splicing Requirements
    - ▪ Fusion splice according to the manufacturer's instructions.
    - ▪ Secured by a splice closure containing splice trays in groups of 12 or 24 fiber
    - ▪ DelDOT has standardized on the 3M Brand splice cases.

- o Termination
    - ▪ Rack mounted enclosures are primary in the fiber hub and facilities and mounted on 19 Inch Racks
    - ▪ Pre-terminated Zuse Panel from Corning or equivalent are used for device termination
    - ▪ Wall mounted enclosures with Rack mounted patch panels are used only when specified by the Fiber Committee.
    - ▪ DelDOT has standardized on Corning components for patch panels, enclosures and all related equipment
    - ▪ Factory terminated duplex jumpers comply with optical fiber performance specifications of applicable standards (i.e., ANSI/TIA-568-C.3)
- o Administration
    - ▪ Adherence to the Outside Plant Fiber Optic Naming Convention provided by DelDOT Document available upon request.
    - ▪ Deliverables – this document is attached, please reference ####.

D. Outside Plant Pathway

- Construction Of Outside Plant Pathway
    - o Shall be in accordance with ANSI TIA/EIA 758 (latest reference) and BICSI Outside Plant-Customer Owned Manual and Telecommunication Distribution Methods Manual.
    - o Maintenance Hole (Manhole) access – OSHA trained Confined space training
    - o The department requirements contact to One Call before any digging.

- Inner duct
    - o Qty 4 – 1" corrugated inner duct is required within 4" PVC or HDPE conduit with a pull cords and 12 gauge solid tracer wire
    - o All inner ducts will be sealed with rubber inner duct plugs

- Conduits
    - o All Conduit installed unless otherwise designated is 4 inch
    - o Inside buildings, cabinets, Hubs, Telephone pole, Signal Poles or Maintenance holes and   hand holes, end of conduits are to be sealed with rubber conduit plugs, water plug or duct sealer.

E. Product Substitution

- All items or services delivered during the life of the contract shall be of the same type and manufacture as specified or accepted as part of the states contract.
- The Dept. of Transportation can change specification or vendors of equipment as a benefit to the state.
- Vendors are encouraged to offer any like substitute product (s), either generic or brand name for evaluation especially if an opportunity for cost savings to the state exists. The state requires the submissions in writing with specifications and/or product samples for evaluation prior to any approvals being granted.

F. Highway Safety

- Safety is priority one for all DelDOT projects – no road work will not be authorized without following the proper safety precautions and DelDOT safety approval. It some situations, DelDOT require 2 week notice prior allowing road work to begin.

Deliverables and long term administration of the Fiber Optic Program for Delaware Department of Transportation

The department of Transportation uses federal funds to provide most of the fiber requirements throughout the state of Delaware. Because the FHWA has more stringent requirements about the use of federal funds, the Department of Transportation Fiber Committee has put together a tasking and processing method that covers the requirements of federal reporting, Federal Audits as well as state audits. These additional deliverables are added to the cost of implementation and are covered as a line item in the proposals.

Fiber Tasks for the Department of Transportation

- The process for fiber implementation starts with the design phase and can take years to implement or even get funded. Starting at the design level, the department's fiber committee helps to insure that all the designs cover the fiber requirements as they pertain to the department's overall strategic plan. It also considers ease of repair, ease of redirection and cost.

- The fiber contractor is responsible for providing quotes for specific requirements as determined by the department's fiber committee and the engineering department. The requests come in a formal packet that has a logical design, the footages and parts to be used for the implementation. The fiber contractor produces a quote in the format dictated by the department which includes a narrative of the request and a spreadsheet break out of the components to be used - to include all parts being used and the labor it will take to produce this final product. Examples may be requested if necessary.

- Once the Quote is received it is processed with the department's final design and then awaits funding. In some instances this may be weeks. In some instances this funding may never occur.

Fiber Contractors Role

- The contract as stated above will provide the department with quotes for specific tasks. When given a Notice to Proceed from the Departments Fiber Committee the task is deemed funded and the work will be schedule as described in the sections above.

- There are several different scenarios that drive the department's fiber program and requires flexibility on the Fiber contractors part. Some of these issues are discussed below in more detail. The use of sub-contracts, the need for minor underground construction, tasks that encompass a fair amount of safety requirements due to the location of the sites that are being worked. I.E. I95, SR1 and bridge

work. As a rule most conduits and underground will be in place when the task is requested. There are times when that is not the case and underground construction will be required. Most of the time we are working outside but occasionally we will need to terminate and facilitate indoor facilities throughout the state.

Emergency Requirement

- Daytime call out is a common emergency where the fiber optic in the state has been impacted or severed by construction from the department or from a third party. There are times when it is considered an emergency when the fiber that was close to a project is not impacted, but discovered that it needs to be pulled out of the way and then re-instated. These types of call-outs are less frequent but not uncommon.

- Night Time and weekend call outs usually happen for some of the same reason, and can include weather events that cut the fiber or a tree falling, etc.. There are a few scenarios where this type of call-out is necessary.

- The fiber contractor must be able to be in contact with the representative from the state within a two hour time frame, 24 hours a day, seven days a week. The department also expects the contractor to be on site with their equipment, in four hours.

Deliverables

Logical Drawing vs. As Built. As a deliverable of a finalized task, the department requires what we call a logical. These are in Visio format and are incorporated into the master documentation of the departments overall fiber documentation. These are not to scale, but do require more detail from a fiber perspective than an as-built. As-builts, we consider to be markups of the original designs with field notes that show any deviation from the original task/ proposal. We do not require a formal as-built but we are not always able to inspect every aspect of the task. If the fiber contractor discovers that the field work deviates from the design, this should be reflected in the field notes, and if easier to explain, in a drawing or a markup of the logical or the as-built .
Note: Incorporation of Logical Drawings – The department's fiber committee will review the logical, provide the quality control function, ask for more detail or clarification if needed, and incorporate the final product into the corridor of the state road information system.
- GPS information – is required from the fiber vendor. This information should be provided to the department in an .mdb format, and include all information as it pertains to the conduit, the fiber, the compass direction, the wells, and intelligent devices. The department will provide the data dictionary for the collection of this information.

The department uses Trimble handhelds for the collection of the data in conjunction with Pathfinder and TerraSync software by Tremble. Both the GPS unit and the software necessary to use it, including the pathfinder licenses and TerraSync licenses, are the responsibility of the contractor.

- ODTR information is provided to the state in the deliverable package and will be reviewed during the quality control process. Failures of fiber strands, for any reason, in the field are unacceptable unless otherwise directed by the fiber committee.

- Power Meter Data is provided to the state in the deliverable package and will be reviewed during the quality control process. Failures of fiber strands, for any reason, in the field are unacceptable unless otherwise directed by the fiber committee.

- Packing Slips – all equipment bought for a specific task will have packing slips. The department is required to collect and store copies of these slips for the purpose of audit. Any deliverables packages that do not contain all of the deliverable elements will be rejected.

- Warranty Information – all warranty information as it pertains to the purchases of equipment for a specific task will be provided to the state in this deliverable package. This is to include the Corning

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Cabling System, 25 Year guarantee for all projects.

- Field Notes and Drawings will be digitized/ scanned and provided in the deliverable package.

- Final inspection – although this is not a physical deliverable, no deliverable package will be considered for payment or quality review until a final walk through has taken place.

Deliverable Review

- Fiber Committee Review – all deliverables go through the fiber committee for final review and quality control.

- If there are any omissions or information needs to be clarified or re-surveyed, the committee will provide the vendor with the request and the payment/ invoice will be put on hold until the requested information is re-submitted.

- Once the new information has been received the fiber committee will review the information and process payment if all deliverables meet the department's requirements.

Final Documentation Submission

Media
- o Directory Structure – all deliverables will be provided to the state in a directory structure provided by the department's Fiber Committee.
- o The information can be provided on a CD/DVD or Jump drive, which will be filed with the invoice information and not be returned.

- Invoice
  - o Submission – Invoice submission should be to the chair of the department's fiber committee
  - o Payment – payments are processed when all deliverables are met unless otherwise designated by the department's fiber committee
  - o Re-submission – in some cases there is a need to request a re-submission due to cost changes or scope changes. All changes in invoicing should have a valid change request describing the need for the change in scope or cost. These forms are generated by the department's fiber committee and signed by the fiber contractor.

Invoicing
- Once the department's fiber committee has processed the deliverables and the invoice has been checked for accuracy, the invoice is submitted for payment by the department's fiber committee chair.
- All information is filed and stored for review both physically and electronically.

PART 27	**APPENDIX H - CERTIFIED CONTRACTOR LIST**

Certified Contractor List

DELAWARE STATE-WIDE INFORMATION TECHNOLOGY AND ARCHITECTURE STANDARDS

Standard ID:	**AC-Wireless-001**
Title:	**Wireless Standard**
Domain:	**Architecture**
Discipline:	**Network**
Revision Date: Revision no.: Original date:	**11/2/2017** **8** **7/1/2001**

I.   Authority, Applicability and Purpose

A. <u>Authority:</u> Title 29, Chapter 90C provides broad statutory authority to the Department of Technology and Information (DTI) to implement statewide and inter-organization technology solutions, policies, standards, and guidelines for the State of Delaware's technology infrastructure. "Technology" means computing and telecommunications systems, their supporting infrastructure and interconnectivity used to acquire, transport, process, analyze, store, and disseminate information or data electronically. Technology includes systems and equipment associated with e-government and Internet initiatives.

B. <u>Applicability:</u> This applies to all State of Delaware communications and computing resources. DTI is an Executive Branch Organization and has no authority over the customers in Legislative and Judicial Branches, School Districts, and other Federal and Local Government entities that use these resources. However, all users must agree to abide by all policies and standards promulgated by DTI as a condition of funding and continued use of these resources.

C. <u>Purpose:</u> The purpose of this standard is to ensure that all access points are secure before attaching to the existing network. The main considerations should be classification of use, intended user, and network security.

II.   Scope

A. <u>Audience:</u> State IT personnel are the only intended users of this document.

B. <u>Applicability:</u> This standard will cover all wireless network access to State resources.

III.   Process

A. **Adoption:** DTI adopted these standards through the Technology and Architecture Standards Committee (TASC). They are applicable to all Information Technology use throughout the State of Delaware.

B. **Revision:** Technology is constantly changing. It is the intent of TASC to review each standard yearly. Your Information Resource Manager (IRM) will channel your suggestions and comments to TASC.

C. **Contractors:** DTI requires all contractors or other third parties to comply with these standards when proposing technology solutions to other State entities. Failure to do so could result in rejection by the Delaware Technology Investment Council. For further guidance, or to seek review of a non-rated component, contact TASC at dti_tasc@state.de.us.

D. **Implementation responsibility:** DTI and/or the organization's technical staff will implement this standard during the course of normal business activities, including business case review, architectural review, project execution and the design, development, or support of systems.

E. **Enforcement:** DTI will enforce this standard during the course of normal business activities, including business case and architectural review of proposed projects and during the design, development, or support of systems. This standard may also be enforced by others during the course of their normal business activities, including audits and design reviews.

F. **Contact us:** Please direct any questions or comments to dti_tasc@state.de.us.

IV.   Definitions/Declarations

A. Declarations

- Where authentication is warranted, time-stamped logging of access is required. When user based authentication is used, the logs should map usernames to IP addresses. When device based authentication is used device to IP address mapping must be retained. These logs should be retained for a minimum of three months.

- Proper placement of Access Point (AP) and power levels must be such that it will mitigate, as much as possible, the wireless signal extending into public spaces that are not State owned.

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V. Definition of Ratings

COMPONENT RATING	USAGE NOTES
STANDARD – DTI offers internal support and/or has arranged for external vendor support as well (where applicable). DTI believes the component is robust and DTI believes the component is robust and solidly positioned in its product life cycle.	These components can be used without explicit DTI approval for both **new projects** and **enhancement** of existing systems.
DECLINING – Deprecated - DTI considers the component to be a likely candidate to have support discontinued in the near future. A deprecated element is one becoming invalid or obsolete.	Via the State's waiver process, these components must be explicitly approved by DTI for **all projects**. They must not be used for **minor enhancement** and **system maintenance** without explicit DTI approval via the State's waiver process.
DISALLOWED – DTI declares the component to be unacceptable for use and will actively intervene to disallow its use when discovered.	No waiver requests for new solutions with this component rating will be considered.

A. **Missing Components:** No conclusions should be inferred if a specific component is not listed. Instead, contact TASC to obtain further information.

VI.   Component Assessments

A. **Scope:** The below assessments are to be utilized when the State's wireless services are not available and a specific wireless deployment is being designed.

Access Point	Rating	Comments
Aerohive AP250	Standard	This model current as of July 2017. Please consult with DTI before acquiring.
Cisco Aironet 1852i	Standard	This model current as of July 2017. Please consult with DTI before acquiring.

Protocol	Rating	Comments
802.11n	Standard	Adds MIMO, Uses 2.4 Ghz or 5Ghz. 600Mb/s
802.11ac	Standard	Wave 1: 80MHZ channel width , 1.3Gbps, single user MIMO Wave 2: 160Mhz channel width, 2.6Gps, multi-user MIMO
802.11g	Declining	Uses 2.4Ghz. Maximum of 54Mb/s
802.11a	Declining	Uses 5Ghz. Maximum of 54Mb/s
802.11b	Disallow	Does not support AES; therefore is no longer allowed.

Encryption Algorithms	Rating	Comments
WPA2 AES-CCMP	Standard	Wireless security standard v2 using AES
WEP	Disallow	Wireless security standard using TKIP
WPA	Disallow	Wireless security algorithm using RC4

Authentication	Rating	Comments
802.1X	Standard	Port-based access control method
PEAP/MS-CHAPv2	Standard	Authentication process using username/password
PEAP-EAP-TTLS	Standard	Authentication process using username/password
PEAP-EAP-TLS	Standard	Client certificate authentication

Pre-shared key	Standard	Depends on the situation.
No authentication	Standard	Depends on the situation.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

    A.   Comply with Delaware Sate-Wide Information Techanology and Architecture Standards (NE-Cabling-002)

    B.   Comply with Communication Service Provider requirements.

    C.   Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

    D.   Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 13.

3.02 INSTALLATION OF PATHWAYS

    A.   Install pathways with the following minimum clearances:
        1.   48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
        2.   12 inches from power conduits and cables and panelboards.
        3.   5 inches from fluorescent and high frequency lighting fixtures.
        4.   6 inches from flues, hot water pipes, and steam pipes.

    B.   Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

    C.   Firestopping: Seal openings around pathway penetrations through fire-rated walls, partitions, floors, and ceilings in accordance with Section 07 84 00.

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END OF SECTION

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SECTION 27 40 00
AUDIO AND VIDEO COMMUNICATION

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A.   Section 07 84 13 - Penetration Firestopping.

1.02 REFERENCE STANDARDS

A.   NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B.   TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2015c, with Addendum (2017).

C.   ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications; Rev A, 2002.

1.03 SUBMITTALS

A.   See Section 01 31 00 - Project Management and Coordination, for submittal procedures.

B.   Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
     1.   Storage and handling requirements and recommendations.
     2.   Installation methods.

C.   Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding.

D.   Evidence of qualifications for installer.

E.   Project Record Documents:
     1.   Record actual locations of outlet boxes and distribution frames.
     2.   Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
     3.   Identify distribution frames and equipment rooms by room number on drawings.

F.   Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.04 QUALITY ASSURANCE

A.   Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.

B.   Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
     1.   1. Supervisors and installers factory certified by manufacturers of products to be installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A.   Store products in manufacturer's unopened packaging until ready for installation.

B.   Keep stored products clean and dry.

1.06 WARRANTY

A.   See Section 01 78 23 - Operation and Maintenance Data, for additional warranty requirements.

B.   Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 AUDIO VIDEO COMMUNICATIONS EQUIPMENT

A.   The Audio Video communication system basis of design is as follows:
     1.   Audio: ClearOne, Extron, JBL, Williams Sound, and Shure.

      2.   Controls: Crestron

      3.   Video: Planar, Vaddio, Barco, Extron, and Kramer

  B.   The basis of design product cut sheets have been included in this specification for clarity and reference.

2.02 AUDIO VIDEO COMMUNICATIONS WIRING

  A.   The audio video communictions wireing utilized between devices that are to be run in ceiling spaces shall be shielded and plenum rated.

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AUDIO

TAG	MANUFACTURER	MODEL	NO. OF PAGES
DSP-1	ClearOne	Converge Pro 2 – 128T	3
DSP-2	ClearOne	Converge Pro 2 – 128	3
DSP-3	ClearOne	Converge Pro 2 – 120	3
AMP-1	Extron	XPA 1002-70V	4
AMP-2	Extron	XPA 2001-70V	3
SP-2	JBL	Control 2P	2
SP-1	JBL	Pro Control 26CT	4
ALS Receivers	Williams Sound	WIR SYS 3	8
IR	Williams Sound	WIR SYS 3	8
LS-1	Williams Sound	WIR SYS 3	8
M	Shure	MX418S/C	3
MM	Shure	MX418D/C	2
BM	Shure	MX393	5
WGN	RDL	ST-NG1	2
MOTU	MOTU	8pre	

CONTROLS

TAG	MANUFACTURER	MODEL	NO. OF PAGES
IRP	Crestron	IRP2	1
PoEI	Crestron	PWE-4803RU	1
WG	Crestron	CEN-GWEXER	4
PoE-1	Crestron	CEN-SW-POE-5	2
PoE-2	Packedge	SE-8P	22
CP-1	Crestron	PRO3	5
PCC	Crestron	TST-902	4
TP-1	Crestron	TSW-760	8
TP-2	Crestron	TSW-1060	8

SWITCHING

TAG	MANUFACTURER	MODEL	NO. OF PAGES
DG-1	C2G	53880-TruLink Dongle	2
DG-2	C2G	53880-TruLink Dongle	2
A-1	Extron	Annotator 300	3
IC-1	Extron	DTP T USW 233	3
IC-2	Extron	IN1604	4
IC-3	Extron	DTP T UWP 4K 232 D	3
IC-4	Extron	DTP T HWP 4K 231 D	3
IR-1	Extron	DTP HDMI 230 4K Tx/Rx	4
IR-2	Extron	DTP HDMI 330 4K Tx/Rx	4
MS-1	Extron	DXP 168 HD 4K	4
S-1	Extron	SW2/4 HD 4K	2
S-2	Extron	SW HD 4K Plus Series	3
OR-1	Kramer	TP-573	2
OR-2	Kramer	VM-1H4C	2
OR-3	Kramer	VM-1H4C	2
OR-4	Extron	DA2 HD 4K	2

OC-1	Kramer	TP-574	2

VIDEO

TAG	MANUFACTURER	MODEL	NO. OF PAGES
DC	Qomo	QD3900H1	2
M-1	NEC	AS224WMi	2
D-1	NEC	C651Q	4
D-2	NEC	C861Q	4
D-3	NEC	C751Q	4
D-4	SMART Board	6275	4
QM-1	NEC	E326	2
QM-2	NEC	P484	4
TM	Planar	PCT2265	2
C-1	Vaddio	RoboSHOT 30 HDBT	2
WP	wePresent	WiCS-2100	3

MISCELLANEOUS

TAG	MANUFACTURER	MODEL	NO. OF PAGES
Various	Legrand	Wiremold Floor Source Raised Floor Box – AF3	8

ClearOne®

DSP-1: 128T
DSP-2: 128
DSP-3: 120

CONVERGE® Pro 2
Professional Audio DSP Platform

CONVERGE Pro 2 is the industry's most advanced professional audio DSP platform for conferencing and sound reinforcement applications. It out-performs in any size room, any audio environment, any application.

CONVERGE Pro 2 is optimized to work with the new Beamforming Mic Array 2 and DIALOG® 20 2-Channel Wireless Microphone System through its native connection.

Powerful Architecture

+ 12 Mic/Line inputs with AEC
+ Built-in VoIP: 2 lines +3 lines (license)
+ Built-in Telco with ClearEffect™ processing
+ Built-in USB for PC-based conferencing
+ Built-in Dante™ for networked audio
+ Reduced footprint and power consumption

Audio Signal Processing

+ Next-gen Acoustic Echo Cancellation processing
+ Distributed Echo Cancellation® on every mic input
+ Noise Cancellation with Adaptive-Ambience
+ Acoustic Intelligence with faster convergence
+ DARE™ feedback elimination
+ Advanced microphone gating

Scalable Connectivity

+ Standalone and daisy-chained system
+ Stack units for up to 144 Mic/Line inputs
+ Expansion bus "C-Link" with 64 channels
+ "P-Link" bus to connect peripheral devices

Any Application

+ VoIP/POTS conferencing
+ PC-based conferencing & Unified Communications
+ Sound Reinforcement applications
+ Dante™ for audio networking

Configuration & Management

+ New CONSOLE® software
+ Auto-discovery of devices
+ MatrixView™ for entire system
+ FlowView™ for visualized audio signal paths
+ System monitoring and troubleshooting

Flexible Control Options

+ Dialer app for Windows, Mac, iOS, and Android
+ Touch Panel Controller with tabletop and wall mount options
+ 3rd-party control modules

APPLICATIONS

Boardrooms

Conference Rooms

Huddle Rooms

Training Rooms

Lecture Halls

Courtrooms

Auditoriums

Telemedicine Facilities

CONVERGE Pro 2 128TD Front Panel

CONVERGE Pro 2 128TD Back Panel

CONVERGE Pro 2	Conferencing										Sound Reinforcement	
	128	128D	128T	128TD	128V	128VD	48T	48V	120	012	128SR	128SRD
System												
Mic/Line inputs	12	12	12	12	12	12	4	4	12	X	12	12
Mic/Line outputs	8	8	8	8	8	8	8	8	X	12	8	8
AEC	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
C-link expansion bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P-link peripheral bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
USB audio interface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethernet, RS-232, GPIO interface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Applications												
Built-in USB for PC-based conferencing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X
Built-in Telco for teleconferencing	X	X	✓	✓	X	X	✓	X	X	X	X	X
Built-in VoIP for VoIP conferencing	X	X	X	X	✓	✓	X	X	X	X	X	X
Sound Reinforcement applications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Built-in Dante for audio networking	X	✓	X	✓	X	✓	X	X	X	X	X	✓
Peripheral Devices												
Beamforming Mic Array 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
DIALOG® 20 - Wireless Mic System	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GPIO Expander	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
USB Expander	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Configuration, Management & Control												
New CONSOLE® software	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dialer app - Win, Mac, iOS, Android	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Touch Panel Controller	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Third-party control modules	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PRODUCT SPECIFICATIONS

Unless otherwise specified, all measurements are performed with a 20Hz to 22kHz BW (no-weighting). Specifications are applicable based on the SKU types.

Mic/Line Inputs & Outputs

Inputs: Balanced audio inputs, 3.81mm Orange color Phoenix/Euroblock type male header, Push-on mini-terminal block

Outputs: Balanced audio outputs, 3.81mm Black color Phoenix/Euroblock type male header, Push-on mini-terminal block

Frequency Response:
20Hz – 22kHz @ +4dBu, +/- 0.5dBu

EIN (Equivalent Input Noise):
20kHz BW, max gain, Rs = 150Ω, -126dBu

THD + N (Total Harmonic Distortion + Noise):
20Hz – 22kHz @ +4dBu, line level, 0.006%
20Hz – 22kHz @ -56dBu, mic level, <0.04%

Dynamic Range:
20Hz – 20kHz @ 0dB, >105dB

Crosstalk (Mic/Line):
Channel to Channel, stimulus at 20dBu to receptor at -56dBu, 1kHz, < -98dB

Input Impedance:
Balanced (line to ground), 2.2kΩ, 1%

Nominal Input Level:
Adjustable -56dB to 0dB, 7dB step coarse gain

Maximum Input Level: -65dBu to 20dBu

Phantom Power: 48V, Impedance 6.81kΩ

Output Impedance:
Balanced (line to ground), 95Ω, 1%

Output Level:
0dBu (Nominal), 20dBu (Max), -40dBu (Selectable)

USB Audio

Port Type: USB-B connector

Audio: Digital Audio, 2 x 2 bidirectional channels

Sample Rate: 48kHz

Sample Bit Depth: 24-Bit

Compatible:
USB 2.0
USB 3.0

Telephone

Port Type: RJ11

Frequency Response:
Mic/Line Input to Telephone Out:
250Hz – 3.4kHz , +/- 2dB, 4dBu
Telephone In to Mic/Line Out:
250Hz – 3.4kHz, +/- 2dB, -15dBu

THD + N:
Mic/Line Input to Telephone Out: <0.1% @ 4dBu
Telephone In to Mic/Line Out: <0.3% @ -15dBu

Dynamic Range:
Mic/Line Input to Telephone Out: >67dBu
Telephone In to Mic/Line Out: >87dBu

REN: Ringer Equivalent Number 0.2

Transhybrid Balance:
30dB (1kHz, all AC terminations)

VoIP

Port Type:
RJ-45, 10/100Mbps Ethernet Network, Auto Negotiation

Audio:
5 Lines (2 default + 3 lines through License), each line supporting 1+5 calls

Codec:
G.711 uLaw
G.711 ALaw
G.722

Ethernet

Port Type:
RJ-45, 10/100Mbps Ethernet Network, Auto Negotiation

IP address:
IPv4 (IPv6 upgradeable through future s/w, f/w upgrade)

Dante™ Audio

Port Type: RJ-45 Gigabit Ethernet connectors for Primary and Secondary Ports

Audio: Digital Audio, 16 x 16 bidirectional channels

Sample Rate: 48kHz / 96kHz

Sample Bit Depth: 24-Bit

Amplifier Output (Applicable to 48T SKU)

Speaker Output Port: Dual binding posts

Audio: 2 Channels

Output Power: 10W Max, 8Ω load

Frequency Response:
20Hz – 22kHz @ +10dBu, +/- 0.5dBu

THD + N: 20Hz – 22kHz @ +10dBu, 1W, <0.3%

Dynamic Range:
20Hz – 22kHz @ 20dB, >102dB, with 20kHz digital low pass filter

Crosstalk:
Channel to Channel, stimulus at 20dBu, 10W output to receptor 8Ω load, 20Hz – 22kHz, < -70dB

C-Link Expansion Bus

Ports Type: RJ-45 (Cat5e or Cat6)

C-Link In & Out: Proprietary Expansion Bus

Audio: 64 Expansion channels

Cable: Solid core, factory terminated Cat 5e or 6 cable

Distance: Up to 150 Ft (45M)

P-Link Peripheral Bus

Ports Type: RJ-45 (Cat5e or Cat6)

P-Link In & Out: Proprietary Peripheral Bus

PoE In:
P-Link In Port
PoE IEEE802.3AF

Audio:
Up to 3 Beamforming Microphone Array 2 units + up to 3 DIALOG 20 Wireless Receiver units

Cable: Solid core, factory terminated Cat 5e or 6 cable

Distance: Up to 200 Ft (60M)

RS232

Port Type: DB9 Female

Settings:
9600/19200/38400/57600/115200 Baud; Serial Echo; Flow Control

Support: Serial commands

GPIO

Port Type:
5.08mm Green color Phoenix/Euroblock type male header

Support: Control, Status, Variable Voltage Control

Power Pin: 5V DC @ 350mA Power Source

Pin 1 to 4:
Open Collector Outputs: 40VDC @ 250mA
Active Outputs (Source/Sink): 5VDC @25mA
Logic Inputs: 40.2kΩ pull up
Variable Voltage Control Inputs: 5VDC max

Ground Pin: GND

USB Control

Port Type: USB-B connector

Location: Front Panel

Compatible:
USB 2.0
USB 3.0

PRODUCT SPECIFICATIONS

Unless otherwise specified, all measurements are performed with a 20Hz to 22kHz BW (no-weighting).
Specifications are applicable based on the SKU types.

LEDs
Location: Front Panel

Status LED:
Off: Unit still initializing
Blue - Fast Blinking: Stack Syncing in progress
Blue - Slow Blinking: Unit not configured
Blue - Solid: Configured unit
Red - Fast Blinking: Stack Sync error

Locate LED:
Blue - Blinking: Unit "Locate" command received

Power LED:
Blue - Solid: Unit is powered on

Touch Sensor
Sensor Type: Capacitive Touch Button

Location: Front Panel

Power & Thermal
Port Type: AC Inlet

Mains Voltage: 100-240V AC, 50/60Hz

Power Consumption: 50 Watts Typical

Thermal: 170 BTU/Hr Typical

Operating Temperature:
14°F/-10°C to 104°F/40°C Ambient Temperature

Dimension & Weight
RU size: 1 RU

Width x Depth x Height:
1. Without rack-ears:
   17 x 10.73 x 1.72in or 43.2 x 27.3 x 4.4cm
2. With rack-ears:
   19 x 10.73 x 1.72" or 48.3 x 27.3 x 4.4cm

Unit Weight: 9.3 lbs (Approximately)

Shipping Weight: 13.8 lbs (Approximately)

Package (as applicable based on SKUs)
Power Cord: 6 Ft (1.8M), Grounded, Qty 1

Input Connectors:
Terminal Block Connector, 3 Position (Orange), Qty 12

Output Connectors:
Terminal Block Connector, 3 Position (Black), Qty 8

GPIO Connector:
Terminal Block Connector, 6 Position (Green), Qty 1

C-Link Cable:
RJ-45 To RJ-45 Cable, 18 Inches (0.45M), Qty 1

Telephone cable: 12 Ft (3.6M), Qty 1

VoIP Cable: RJ-45 To RJ-45, 7 Ft (2M), Qty 1

USB Cable: USB Type A to Type B, 6 Ft (1.8M), Qty 1
Rack Ears: Pre-installed, Qty 2

Screw/Washer Kit: Rack Decor, Qty 4

Part Numbers

Part Number	Product
910-3200-001	CONVERGE Pro 2 128
910-3200-001-D	CONVERGE Pro 2 128D
910-3200-002	CONVERGE Pro 2 128T
910-3200-002-D	CONVERGE Pro 2 128TD
910-3200-003	CONVERGE Pro 2 128V
910-3200-003-D	CONVERGE Pro 2 128VD
910-3200-005	CONVERGE Pro 2 48T
910-3200-006	CONVERGE Pro 2 48V
910-3200-004	CONVERGE Pro 2 120
910-3200-007	CONVERGE Pro 2 012
910-3200-101	CONVERGE Pro 2 128SR
910-3200-101-D	CONVERGE Pro 2 128SRD

Specifications

XPA 1002 Series

Audio (XPA 1002, XPA 1002 Plus)

Voltage gain

    XPA 1002 .... 16x (24 dB)

    XPA 1002 Plus......................... 23x (27dB)

Stereo channel separation............. >75 dB @ 1 kHz

CMRR.. 75 dB @ 1 kHz (typical)

Audio input (XPA 1002, XPA 1002 Plus)

Number/signal type........................ 1 stereo or 2 mono, balanced/unbalanced

Connectors................................... (1) 3.5 mm captive screw connector, 5 pole

Impedance.................................... >10k ohms unbalanced/balanced, DC coupled

Nominal level................................. +4 dBu (1.23 Vrms), balanced

Maximum level .... +20 dBu (7.75 Vrms), balanced

Input sensitivity

    XPA 1002 .... +4 dBu (1.23 Vrms)

    XPA 1002 Plus

        8 ohm or higher speaker

        load .... +4 dBu (1.23 Vrms)

        4 ohm speaker load........... +1 dBu (0.87 Vrms)

Input signal detection threshold...... -40 dBu ±3 dB, balanced

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output (XPA 1002, XPA 1002 Plus)

Number/signal type........................ 1 stereo, 4 or 8 ohm direct

Connectors................................... (1) 5 mm screw lock captive screw connector, 4 pole

> **NOTE:** These connectors accept wires of 22 AWG to 12 AWG.

Load impedance............................ 4 ohms minimum

Amplifier type .... Class D

Output power

    XPA 1002 .... 60 watts rms per channel, 8 ohms, 1 kHz, <0.05% THD

                              100 watts rms per channel, 4 ohms, 1 kHz, <0.05% THD

    XPA 1002 Plus......................... 100 watts rms per channel, 8 ohms, 1 kHz, <0.05% THD

                              100 watts rms per channel, 4 ohms, 1 kHz, <0.05% THD

Frequency response .... 20 Hz to 20 kHz, ±1 dB

THD + Noise .... 0.05% @ 20 Hz - 20 kHz, 8 ohms, at 3 dB below clipping

S/N .... 105 dB, 20 Hz - 20 kHz, unweighted

Damping factor .... >100 @ 8 ohms

Control/remote — amplifier (XPA 1002, XPA 1002 Plus)

Control port .... (1) 3.5 mm captive screw connector, 5 pole

Pin configurations

    DC volume control (analog)...... Pin 1 = +10 VDC, 50 mA (max.), pin 2 = volume/mute (variable voltage), pin 3 = GND

    Volume control voltage range... 0 V (mute) to 10 V (maximum volume)

    Standby power control
    (contact closure)..................... Pin 4 = GND, pin 5 = standby

General (XPA 1002, XPA 1002 Plus)

Power supply................................ Internal
Input: 100-240 VAC, 50-60 Hz, 0.5 A

Power consumption and thermal dissipation

    XPA 1002 ....

		115 VAC, 60Hz			230 VAC, 50Hz		
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	8Ω	0.3	29.9	14.9	51	0.2	29.9	14.9	51
	4Ω	0.4	41.1	16.1	55	0.2	41.1	16.1	55
Quiescent (idle)		0.1	10.1	10.1	34	0.1	9.8	9.8	33
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

    XPA 1002 Plus.........................

		115 VAC, 60Hz			230 VAC, 50Hz		
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	8Ω	0.4	45.1	20.1	69	0.5	44.4	19.4	66
	4Ω	0.4	47.4	22.4	76	0.5	45.2	20.2	69
Quiescent (idle)		0.1	12.3	12.3	42	0.2	12.4	12.4	42
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, no vents, with internal heat sinks

Protection .... Clip limiting, thermal, short circuit, DC output

Indication .... Limiter/Protect LED indicates the onset of clip limiting, thermal cycling, short circuit

Mounting

    Rack mount............................. Yes, with optional 1U rack shelf

Enclosure type .... Metal

Enclosure dimensions .... 1.7" H x 8.7" W x 9.5" D (1U high, half rack wide)
(4.3 cm H x 22.1 cm W x 24.1 cm D)

Product weight .... 2.5 lbs (1.1 kg)

Shipping weight .... 5 lbs (3 kg)

Vibration .... ISTA 1A in carton (International Safe Transit Association)

Regulatory compliance

    Safety..................................... BSMI, CCC, CE, c-UL, GS, KC Mark, PSE, S Mark, UL
UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release; meets UL 60065, IEC 60065, and BSEN 60065 for AV equipment.

    EMI/EMC................................ CE, CISPR 22 Class B, C-tick, FCC Class B, ICES, KCC, VCCI Class B

Environmental.......................... Complies with the appropriate requirements of ENERGY STAR® (ENERGY STAR qualified amplifier), EU code of conduct, RoHS, WEEE

Warranty .... 3 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

Audio (XPA 1002-70V, XPA 1002-100V)

Voltage gain
    XPA 1002-70V......................... 57x (35 dB)
    XPA 1002-100V....................... 81x (38 dB)
CMRR.. 75 dB @ 1kHz (typical)

Audio input (XPA 1002-70V, XPA 1002-100V)

Number/signal type....................... 2 balanced/unbalanced
Connectors................................... (1) 3.5 mm captive screw connector, 5 pole
Impedance.................................... >10k ohms unbalanced/balanced, DC coupled
Nominal level................................ +4 dBu (1.23 Vrms), balanced
Maximum level .... +20 dBu (7.75 Vrms), balanced
Input sensitivity .... +4 dBu (1.23 Vrms)
Input signal detection threshold...... -40 dBu ±3 dB, balanced

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output (XPA 1002-70V, XPA 1002-100V)

Number/signal type
    XPA 1002-70V......................... 2 mono, 70 V line
    XPA 1002-100V....................... 2 mono, 100 V line
Connectors................................... (1) 5 mm screw lock captive screw connector, 4 pole

> **NOTE:** These connectors accept wires of 22 AWG to 12 AWG.

Load impedance
    XPA 1002-70V......................... 50 ohms minimum
    XPA 1002-100V....................... 100 ohms minimum
Amplifier type .... Class D
Output power
    XPA 1002-70V......................... 100 watts rms per channel, 70 V, 1 kHz, <0.1% THD
    XPA 1002-100V....................... 100 watts rms per channel, 100 V, 1 kHz, <0.1% THD
Frequency response .... 20 Hz to 20 kHz, ±1 dB
THD + Noise .... <0.1% @ 1 kHz at 3 dB below clipping
S/N.. 100 dB, 20 Hz - 20 kHz, unweighted
Damping factor
    XPA 1002-70V......................... >100 @ 50 ohms
    XPA 1002-100V....................... >100 @ 100 ohms
High pass filter .... 80 Hz, 12 dB per octave rolloff (switch selectable)

Communications — amplifier (XPA 1002-70V, XPA 1002-100V)

Control port .... (1) 3.5 mm captive screw connector, 2 pole
Pin configuration
    Standby power control
    (contact closure)...................... Pin 1 = GND, Pin 2 = standby

General (XPA 1002-70V, XPA 1002-100V)

Power supply .... Internal
Input: 100-240 VAC, 50-60 Hz

Power consumption and thermal dissipation

XPA 1002-70V ....

Condition		115 VAC, 60Hz				230 VAC, 50Hz			
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	70 V	0.4	43.3	18.3	62	0.2	43.2	18.2	62
Quiescent (idle)		0.1	10.2	10.2	35	0.1	9.9	9.9	34
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

XPA 1002-100V ....

Condition		115 VAC, 60Hz				230 VAC, 50Hz			
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	100 V	0.4	42.1	17.1	58	0.3	42.7	17.7	60
Quiescent (idle)		0.1	9.7	9.7	33	0.1	9.0	9.0	31
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling .... Convection, no vents, with internal heat sinks
Protection .... Clip limiting, thermal, short circuit, DC output
Indication .... Limiter/Protect LED indicates the onset of clip limiting, thermal cycling, or short circuit
Mounting
  Rack mount............................. Yes, with optional 1U rack shelf
Enclosure type .... Metal (Aluminum)
Enclosure dimensions .... 1.7" H x 8.7" W x 9.5" D (1U high, half rack wide)
(4.3 cm H x 22.1 cm W x 24.1 cm D)
Product weight .... 2.5 lbs (1.1 kg)
Vibration .... ISTA 1A in carton (International Safe Transit Association)
Regulatory compliance
  Safety..................................... BSMI, CE, c-UL, UL
UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release; meets UL 60065, IEC 60065, and BSEN 60065 for AV equipment.
  EMI/EMC................................. CE, CISPR 22 Class B, C-tick, FCC Class B, ICES, KCC, VCCI Class B
  Environmental......................... Complies with the appropriate requirements of ENERGY STAR® (ENERGY STAR qualified amplifier), EU code of conduct, RoHS, WEEE
Warranty .... 3 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

NOTE: Shipping weights and dimensions are available at **www.extron.com**.

081617-D4

Specifications

XPA 2001 Series

Audio

Voltage gain

     XPA 2001-70V......................... 57x (35 dB)

     XPA 2001-100V....................... 81x (38 dB)

Stereo channel separation.............. >75 dB @ 1 kHz

CMRR.. 75 dB @ 1 kHz (typical)

Audio input

Number/signal type........................ 1 stereo or 2 mono, balanced/unbalanced

Connectors................................... (1) 3.5 mm captive screw connector, 5 pole

Impedance.................................... >10k ohms unbalanced/balanced, DC coupled

Nominal level................................. +4 dBu (1.23 Vrms), balanced

Maximum level.............................. +20 dBu (7.75 Vrms), balanced

Input sensitivity .... +4 dBu (1.23 Vrms) if driven by one input
                                         -2 dBu (0.615 Vrms) if both inputs are summed

Input signal detection threshold...... -40 dBu ±3 dB, balanced

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type

     XPA 2001-70V......................... 1 mono, 70 V line

     XPA 2001-100V....................... 1 mono, 100 V line

Connectors................................... (1) 5 mm screw lock captive screw connector, 2 pole

> **NOTE:** These connectors accept wires of 22 AWG to 12 AWG.

Load impedance

     XPA 2001-70V......................... 25 ohms minimum

     XPA 2001-100V....................... 50 ohms minimum

Amplifier type .... Class D

Output power

     XPA 2001-70V......................... 200 watts rms, 70 V, 1 kHz, <0.1% THD

     XPA 2001-100V....................... 200 watts rms, 100 V, 1 kHz, <0.1% THD

Frequency response .... 20 Hz to 20 kHz, ±1 dB

THD + Noise .... <0.1% @ 1 kHz at 3 dB below clipping

S/N.. 100 dB, 20 Hz - 20 kHz, unweighted

Damping factor

     XPA 2001-70V......................... >100 @ 25 ohms

     XPA 2001-100V....................... >100 @ 50 ohms

High pass filter .... 80 Hz, 12 dB per octave rolloff (switch selectable)

Control/remote — amplifier

Control port .... (1) 3.5 mm captive screw connector, 5 pole

Pin configurations

    DC volume control (analog)...... Pin 1 = +10 VDC, 50 mA (max.), pin 2 = volume/mute (variable voltage), pin 3 = GND

    Volume control voltage range... 0 V (mute) to 10 V (maximum volume)

    Standby power control (contact closure)   Pin 4 = GND, pin 5 = standby

General

Power supply................................. Internal
Input: 100-240 VAC, 50-60 Hz

Power consumption and thermal dissipation

    XPA 2001-70V..........................

		115 VAC, 60Hz				230 VAC, 50Hz			
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	70 V	0.4	42.2	17.2	59	0.3	43.3	18.3	62
Quiescent (idle)		0.2	9.5	9.5	32	0.1	10.2	10.2	35
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

    XPA 2001-100V......................

		115 VAC, 60Hz				230 VAC, 50Hz			
		AC Line Current	AC Power Consumed	Thermal Dissipation		AC Line Current	AC Power Consumed	Thermal Dissipation	
Condition		A	W	W	BTU/hr	A	W	W	BTU/hr
Active (1/8 power), all channels driven	100 V	0.4	43.7	18.7	64	0.4	44.8	19.8	68
Quiescent (idle)		0.1	11.9	11.9	41	0.1	11.9	11.9	40
Standby		<0.1	<1	<1	<3	<0.1	<1	<1	<3

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, no vents, with internal heat sinks

Protection .... Clip limiting, thermal, short circuit, DC output

Indication .... Limiter/Protect LED indicates the onset of clip limiting, thermal cycling, or a short circuit

Mounting

    Rack mount............................. Yes, with optional 1U rack shelf

Enclosure type .... Metal

Enclosure dimensions .... 1.7" H x 8.7" W x 9.5" D (1U high, half rack wide)
(4.3 cm H x 22.1 cm W x 24.1 cm D)

Product weight .... 2.5 lbs (1.1 kg)

Vibration .... ISTA 1A in carton (International Safe Transit Association)

Regulatory compliance

    Safety...................................... BSMI, CCC, CE, c-UL, GS, KC Mark, PSE, S Mark, UL
UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release; meets UL 60065, IEC 60065, and BSEN 60065 for AV equipment.

    EMI/EMC................................ CE, CISPR 22 Class B, C-tick, FCC Class B, ICES, KCC, VCCI Class B

    Environmental......................... Complies with the appropriate requirements of ENERGY STAR® (ENERGY STAR qualified amplifier), EU code of conduct, RoHS, WEEE

Warranty .... 3 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

NOTE: Shipping weights and dimensions are available at **www.extron.com**.

081617-D24

CONTROL® 2P

COMPACT POWERED REFERENCE MONITOR

S-2

JBL
PROFESSIONAL

CONTROL® 2P
COMPACT POWERED REFERENCE MONITOR

Perfect for all
APPLICATIONS

Digital Editing

Entertainment Installations

AV Presentations

Electronic Musical Instruments

FEATURES

STUDIO QUALITY TRANSDUCERS FOR ACCURACY, AND RICH BASS RESPONSE: 80 HZ - 20 KHZ

35 WATT PER-CHANNEL POWER AMPLIFIER AND HIGH SENSITIVITY DRIVERS PRODUCE EXCEPTIONAL OUTPUT: 115 DB MAX SPL PER PAIR.

BALANCED XLR, AND UNBALANCED RCA INPUTS ALLOW CONNECTION TO A RANGE OF SIGNAL SOURCES.

STEREO HEADPHONE JACK ALLOWS MONITORING USING HEADPHONES.

ERGONOMIC, SIDE-MOUNTED VOLUME CONTROL - SIMULTANEOUSLY CONTROLS LEFT AND RIGHT SPEAKERS.

HIGH FREQUENCY ADJUST CONTROL - ALLOWS THE USER TO CONTOUR HF RESPONSE TO APPLICATION REQUIREMENTS.

MAGNETICALLY-SHIELDED TRANSDUCERS FOR USE NEAR CRT MONITORS AND MAGNETICALLY SENSITIVE EQUIPMENT.

INTERNAL PEAK LIMITER AND OVERLOAD PROTECTION CIRCUIT - PROTECTS THE SYSTEM FROM DAMAGE CAUSED BY CONTINUOUS OVER-DRIVING.

WALL-MOUNT CAPABLE USING OPTIONAL MTC-2P MOUNTING KIT.

INCLUDED SNAP-ON PEDESTALS OPTIMIZE LISTENING ANGLE FOR DESK TOP APPLICATIONS.

SPECIFICATION

Frequency Range:	80 Hz - 20 kHz
Maximum SPL Per Pair:	115 dB
Maximum SPL Master Only:	111 dB
LF Transducer:	135 mm (5.25 in) low frequency loudspeaker
HF Transducer:	19 mm (.75 in) polycarbonate dome tweeter
Crossover Frequency:	4.2 kHz
Input Sensitivity:	+4 dBu XLR 1/4"; 0 dBu RCA
Signal Input Connectors (x2):	Balanced Neutrik®* Combo XLR 1/4" TRS; Unbalanced RCA
Amplifier Power:	35 Watts continuous per-channel
Power Requirements:	19 V DC / 3.42 A - use only supplied power supply
Headphone Jack:	3.5 mm (1/8")
Dimensions:	235 x 159 x 143 mm (9.3 x 6.3 x 5.6 in)
Net Weight Master Speaker:	2.6 kg (5.5 lb)
Net Weight Extension Speaker:	2.2 kg (4.5 lb)

* Neutrik and the names of Neutrik products referenced herein are either trademarks and/or service marks of Neutrik.

JBL

Control® 26C/CT

Background/ Foreground Ceiling Speakers

Professional Series

Key Features:

▶ Coaxially mounted 165 mm (6.5 in) woofer with butyl rubber surround and 19 mm (¾ in) titanium coated diffraction-loaded tweeter

▶ High power, wide frequency response and low distortion for high sound level capability

▶ Wide coverage allows fewer speakers, reducing the cost of the installed sound system without sacrificing performance

▶ JBL's exclusive SonicGuard™ overload protection allows higher operational levels and improved system reliability (26C only)

▶ Packaged with grille, backcan and tile rails for fast installation and easy dealer stocking

The Control 26C is a compact ceiling speaker providing premium performance in background, foreground music sound systems. The Control 26C is perfectly suited for a wide variety of applications from casinos and hotels to upscale restaurants and themed locations. High power handling, wide frequency response and low distortion make the Control 26C ideal for sound systems requiring a higher fidelity sound from ceiling loudspeakers. The premium performance capability ensures excellent sound character, providing pleasant, enveloping sound throughout the listening area.

The Control 26C's 16 ohm impedance allows use of multiple speakers in parallel without having to use a more expensive constant voltage distributed system. The optional Control 26CT version includes a multitap transformer for 70V/100V systems.

JBL's exclusive SonicGuard overload protection is a non-invasive loudspeaker protection system that is inaudible to the listener, ensuring reliability while providing full fidelity sound. The computer-optimized ported enclosure delivers warm, smooth bass response. Low frequency output can be further augmented with the addition of one of the Control Contractor subwoofer models.

The 165 mm (6.5 in) woofer features a polyurethane-coated cone and pure butyl-rubber surround for long life, even in high humidity environments. An aluminum voice coil former provides extra cooling for greater long-term power handling.

The coaxially mounted 19 mm (¾ in) titanium coated tweeter provides crisp, clear highs. Diffraction-loading of the tweeter provides wide, even coverage of the listening area. The extremely broad 110° coverage pattern allows for fewer speakers to be used, making for a simpler and less expensive installation.

Specifications:

System:

Freq. Range (-10 dB)[1]:	75 Hz - 20 kHz
Power Capacity[2]:	150 Watts Continuous Program Power
	75 Watts Continuous Pink Noise
Nominal Sensitivity[3]:	89 dB SPL, 1W @ 1 m (3.3 ft)
Nominal Coverage Angle[4]:	110° conical coverage
Directivity Factor (Q):	5.9 averaged 500 Hz to 4 kHz
Directivity Index (DI):	4.6 averaged 500 Hz to 4 kHz
Rated Maximum SPL:	107 dB @ 1 m (3.3 ft)
Nominal Impedance (26C):	16 ohms (Min Z 16.5 Ω @ 290 Hz)
Transformer Taps (26CT):	70V: 60W, 30W, 15W & 7.5W taps
	100V: 60W, 30W, & 15W taps

Transducers:

Low-Frequency:	165 mm (6.5 in) Polypropelene-coated, 1" coil on aluminum former
High-Frequency:	19 mm (¾ in) Titanium coated polyester

Physical:

Enclosure:	Backcan: Formed steel
	Baffle/Rim: Medium impact polystyrene, fire rated UL94V-0
Overload Protection:	Full-range power limiting to protect network and transducers. (On Control 26C, not on Control 26CT)
Termination:	Removable locking connector with screw-down terminals. 2 input terminals and 2 loop-thru output terminals. Max. wire 12 AWG (2.5 mm²)
Safety Agency Rating:	Suitable for use in air handling spaces per UL1480, UL2043, NFPA90 & NFPA 70. S7232/UL Listed, Signaling Speaker. Transformer UL registered per UL1876. In accordance with IEC60849/EN60849.
Outside Dimensions (H x Dia):	210 x 252 mm (8.3 x 9.9 in) 190 mm (7.5 in) front of ceiling tile to back of backcan
Cutout Size:	220 mm (8.75 in)
Net Weight (ea):	3.4 kg (7.5 lb) CT: 4.2 kg (10 lb)
Shipping Weight (pair):	8.1 kg (18.0 lb) CT: 9.7 kg (21 lb)
Included Accessories:	C-shaped support backing plate
	2 tile support rails (fits both 2 x 4 ft or 600 x 1200 mm tiles)
	Cutout template
	Paint shield
	Removable locking wiring connector

[1]Half-space (flush mounted in ceiling)
[2]Continuous Pink Noise rating is IEC-shaped pink noise with a 6 dB crest factor for 100 hours continuously. Continuous Program power is a conservative expression of the system's ability to handle normal speech and music program material and is defined as 3 dB above the Continuous Pink Noise Rating.
[3]Half-space (in ceiling), average 100 Hz to 10 kHz
[4]500 Hz to 4 kHz

JBL continually engages in research related to product improvement. Changes introduced into existing products without notice are an expression of that philosophy.

► Control® 26C/CT Background/Foreground Ceiling Speakers

Input connection is conveniently provided on a removable locking connector (included), providing secure connection via screwdown terminals and allowing a system to be prewired before installing the speaker for fast snap-on convenience. Separate connector terminals are available for the input and for the loop-through wires, making it easy to jumper the speaker signal to additional speakers. The input terminal plate provides strain relief for either bare wire, plenum cable or ½ inch conduit (12 mm I.D.). The terminal box is securely enclosed to meet safety codes.

The speaker trim and grille are paintable to match any decor. A paint shield is provided for covering the drivers while painting the rim.

Installation of the Control 26C is quick and easy. The loudspeaker is packaged complete with the backcan, grille, support backing bracket and tile rails.

The entire installation can be accomplished without requiring access above the ceiling. A template is provided for marking the cutout. An innovative C-shaped support backing plate can be installed from below through the cutout to reinforce the top of the ceiling material. Tile bridge rails are included which can be screwed onto the C-plate to extend support to the T-channel grid in suspended ceiling installations. After the speaker is fitted through the cutout, it is held securely in place via three mounting tabs which tighten onto the C-plate, if used, or directly onto the ceiling material.

The Control 26C backcan is made of formed steel and the speaker is suitable for use in air handling spaces, per U.L.-2043. An attachment loop is provided on the backcan for cabling to the building structure as a secondary support in seismic areas or where required by code.

The model Control 26CT includes a 60W multitap transformer for use in either 70.7V or 100V distributed-line systems. The transformer effectively limits the power to the speaker, so SonicGuard is not included in the Control 26CT. Taps are selected with a rotary switch conveniently located on the front panel, but protected under the grille, so that the speaker does not have to be removed to adjust tap settings.

All JBL Control Contractor loudspeakers - both ceiling speakers and surface-mount models - are designed with a similar sonic signature, allowing for mixing and matching of the various models within an application, providing a similar tonal character throughout the entire listening area.

Frequency response is measured on-axis with at a distance referenced to 1 meter at 1-watt. Shown as a half-space (2π) environment.
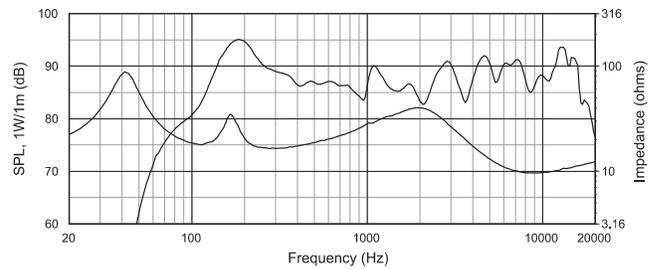
Off Axis Frequency Response (1/3 Oct Avg)
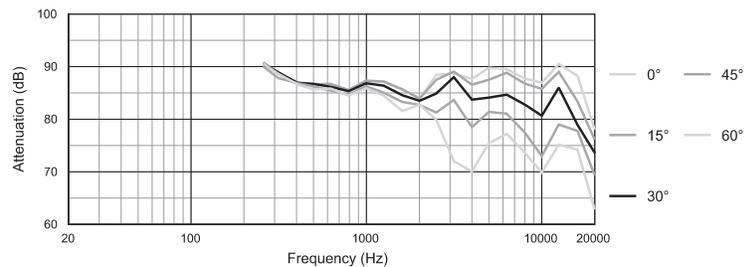
1/3 Octave Polars
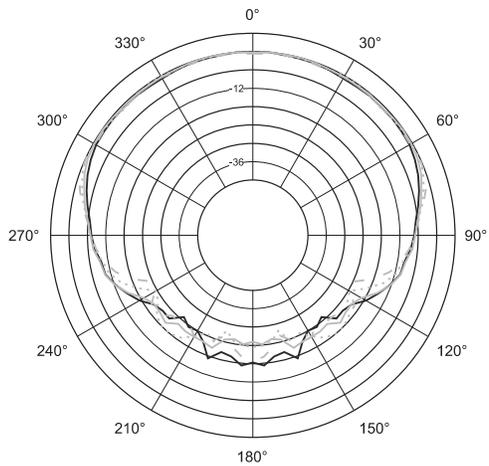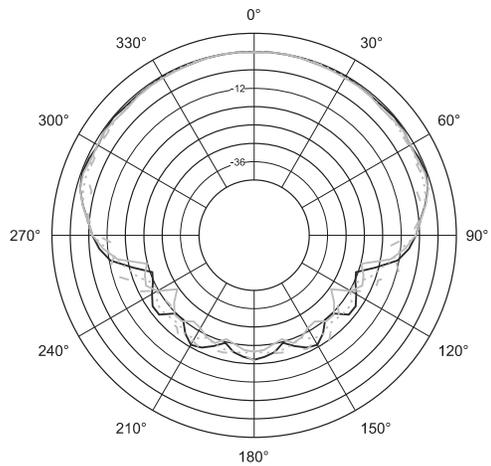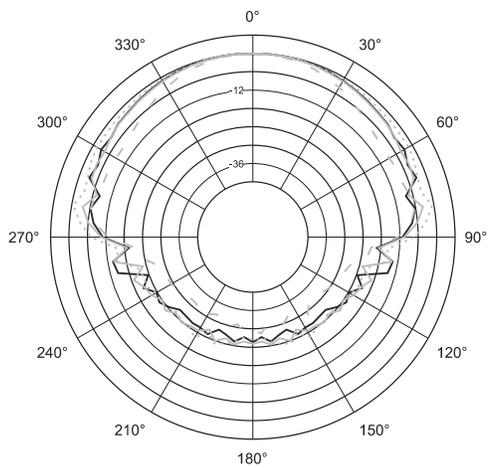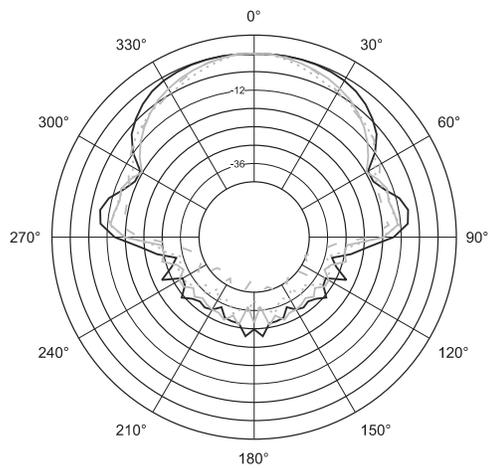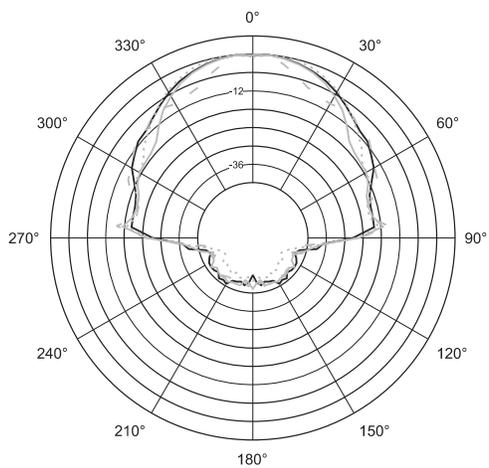
▶ Control® 26C/CT Background/Foreground Ceiling Speakers

Architectural Specifications:

The loudspeaker shall be of in-ceiling design, consisting of a 165 mm (6.5 in) low frequency transducer, a coaxially-mounted 19 mm (¾ in) high frequency transducer, and frequency dividing network installed in a ported enclosure. The low frequency voice coil shall be 25 mm (1 in) in diameter and the coil former shall be of aluminum for maximum heat dissipation.

Performance specifications of a typical production unit shall be as follows: Measured sensitivity (SPL at 1m [3.3 ft] with 4V input, averaged from 100 Hz to 10 kHz) shall be at least 89 dB-SPL. Usable frequency response shall extend from 75 Hz to 20 kHz (10 dB below rated sensitivity in half-space) with no external equalization. Rated power shall be at least 75 watts continuous pink noise power, defined as conforming to international standard IEC268-5 (shaped pink noise with peak-to-average ratio of 6 dB) for a period of 100 continuous hours.

The system shall be protected against damage from occasional overpowering via full range series lamps that limit the power to the network and transducers (Control 26C, not Control 26CT). The high frequency transducer shall be horn-loaded to more evenly cover a minimum 110° polar conical coverage area.

The backcan shall be constructed of formed steel and the baffle of UL94V-0 fire rated medium impact polystyrene. An enclosed terminal box shall be included proving strain relief for use with either plenum-rated wire, ½ in (13 mm inside diameter) conduit, or flexible conduit up to 22 mm (⅞ in) outside diameter. The external wiring shall be accomplished via a removable lockable wiring connector with screw-down terminals to provide both secure wire termination and prewiring capability before loudspeaker installation. An attachment loop shall be provided on the back panel for cabling to building structure as a secondary support point.

The system shall include a support backing plate to reinforce the ceiling material and tile support rails for use on either 2 x 4 ft or 600 x 1200 mm suspended ceiling tiles and which can all be installed from beneath the ceiling tile.

Overall front face diameter shall not exceed 252 mm (9.9 in), overall depth from the bottom of the ceiling shall not exceed 190 mm (7.5 in), and shall weigh no more than 3.4 kg (7.5 lb).

Control 26C: Nominal impedance shall be 16 ohms.

Control 26CT: The loudspeaker shall be equipped with transformer for use in either 70.7 or 100V distributed-line speaker systems, with taps selectable by rotary switch located on the front panel so that the speaker does not have to be removed to adjust tap settings. Taps shall be nominally 60W @ 70V, 30W @ 70V (60W @ 100V), 15W@ 70V (30W @ 100V), and 7.5W @70V (15W @ 100V).

The loudspeaker shall be the JBL Model Control 26C (Control 26CT).
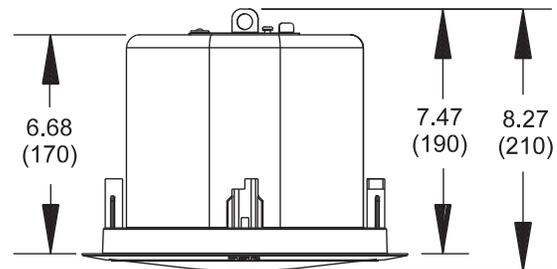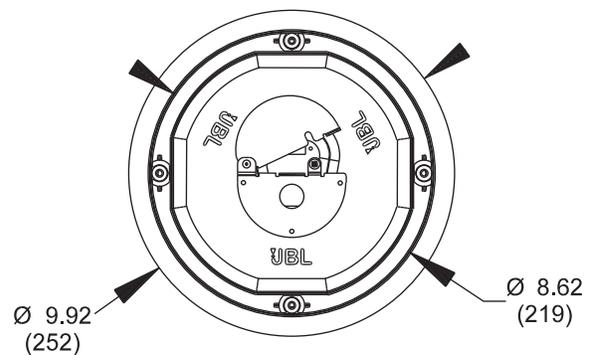
Ø 8.62 (219)

Ø 9.92 (252)

6.68 (170)

7.47 (190)

8.27 (210)

Dimensions in inches (mm)

WILLIAMS SOUND ®

WIR SYS 3

SoundPlus® Value Courtroom System
ADA Courtroom Assistive Listening System

The Value Courtroom System, model WIR SYS 3, is the ideal hearing assistance package for courtrooms with limited budget resources. Participants wear headset style receivers to listen to the courtroom proceeding at the volume of their comfort level anywhere up to 28,000 sq. ft. For the severely hard of hearing, the RX22-4 receiver can be used with a neckloop (included) to amplify the participant's telecoil equipped hearing aid. SoundPlus infrared technology ensures privacy and security: the message of the proceeding will not travel outside the walls of the courtroom.

Each WIR SYS 3 package includes: one (1) TX9 emitter, one (1) MOD 232 modulator, three (3) underchin RX18 receivers, one (1) RX22-4 receiver, one (1) EAR 022, one (1) CHG 518 charger, one (1) NKL 001 neckloop and one (1) RPK 005 rack panel kit. The WIR SYS 3 meets and exceeds government ADA regulations for public hearing assistance, and is backed by a five-year warranty.*

SoundPlus® Value Courtroom System

MOD 232 Modulator

Size, Weight:	8.5" W x 8.2" D x 1.7" H (21.5 cm x 20.8 cm x 4.4 cm), 3.1 lbs (1.5 kg)
Color:	Black epoxy paint with white legends (optional white enclosure available)
Rack Mount:	1/2 rack space wide, 1 rack space high, one or two modulators may be mounted in a single IEC rack space with RPK 005 (single) or RPK 006 (double) Rack Mount Kits
Power Supply:	Wall Transformer, 24VAC, 50-60 Hz, 15VA North America: TFP 016, UL/CSA Europe: TFP 027-01, 2-pin Schuko plug, CE UK: TFP 027-02, 3-pin UK plug, CE
Modulation:	FM Wideband, +50kHz deviation, 50uS pre-emphasis
Carrier Frequency:	Channel A: Selectable, 2.3/2.8/3.3/3.8 MHz, Channel B: Selectable, 2.3/2.8/3.3/3.8 MHz
Signal-to-Noise Ratio:	More than 60dB
Frequency Response:	30 to 16,000 Hz, +1 dB, -3 dB, electrical response
Total Harmonic Distortion:	Less than 2%, electrical response
Audio Processing:	Compression (slope) adjustable from 1:1 or 2:1 Switchable compression gain: Moderate: 16 dB. Max: 33 dB
Auto Carrier Shut-Off:	15-minute timer shuts off carrier when no audio is present (can be disabled)

MOD 232 Front Panel
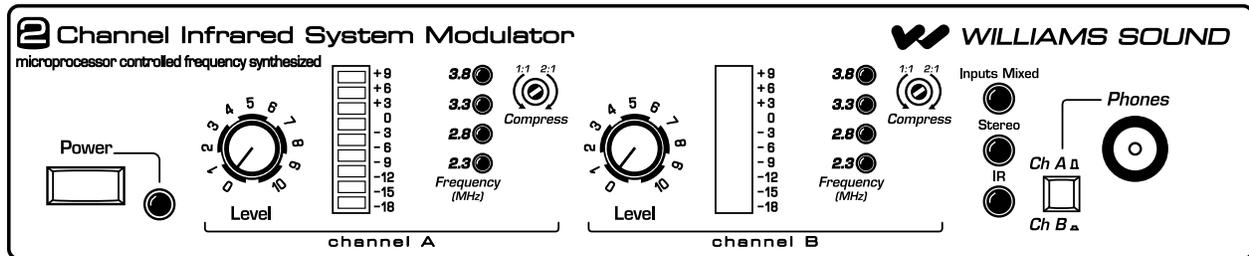
A133

Power Switch:	Two-position push button, ON/OFF
Power Indicator:	Green LED
Audio Level Controls:	CHA and CHB Input Level, rotary knobs
Audio Indicators:	CHA and CHB Audio Level, 10-segment LED's
Carrier LEDs:	4 green LED carrier "on" indicators per channel (indicates frequency, malfunctions)
Compress Control:	1:1 or 2:1
Input Mix LED:	Indicates inputs A and B audio are mixed and transmitted by CHA, CHB off
Stereo LED:	Indicates stereo mode
Phones Switch:	Selects CH1 or CH2 for phones when not in stereo mode
Phones Output:	1/4" TRS headphone jack. Accepts stereo, mono, and any impedance phones.
Infrared Test LED:	IR LED for receiver testing, monitoring, and audio signal testing.

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE!

*90 days on accessories

SoundPlus® Value Courtroom System

MOD 232 Rear Panel
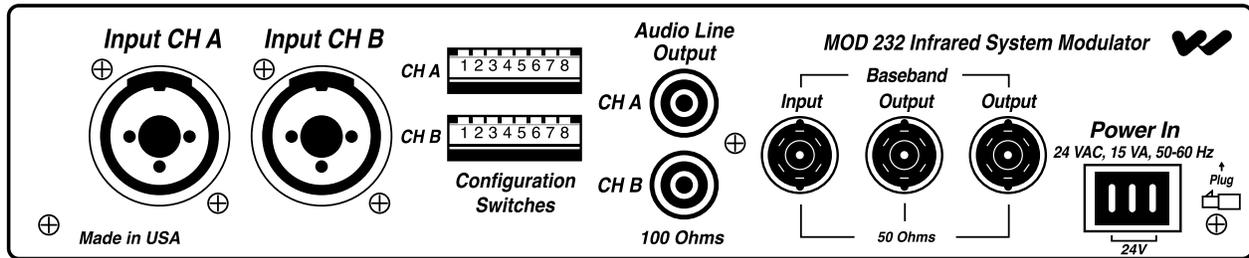
A134

Power Input:	3-Pin Molex, 24 VAC, 50-60 Hz, 15 VA
Audio Input Jack:	CHA and CHB combination XLR/TRS jack
Mic Level:	Balanced, Lo-Z, 100 µV min. to 90 mV max., 1mV nominal, 3 kΩ input impedance, supplies switchable simplex power per DIN 45596 for condenser mics
Line Level:	Balanced or unbalanced, 21 mV min. to 10 V max., 212 mV nominal, 100 kΩ
Audio Line Output Jacks:	RCA Jack, CHA and CHB, 500 mV, unbalanced, 100 Ω source impedance, load impedance must be greater than 1kΩ
Configuration Switches:	CHA and CHB 8-position DIP switch, selects Mic/Line input, compressor gain, simplex power, discrete or mixed inputs, carrier frequency, channel disable, auto shut-off timer
Baseband Input Jack:	BNC, allows mixing with additional MOD 232 Modulator (4CH operation), 100mV, 50Ω input impedance, use with MOD 232, BNC, RG-58 Cable
Baseband Output Jack:	Two BNC jacks carry baseband signal, 100 mV/channel, 50 Ω source impedance, for use with WIR TX9 or MOD 232 only
Approvals:	CE, FCC, RoHS, WEEE
Operating Requirements:	0-50º C ambient temperature, non-condensing, non-corrosive atmosphere
Warranty:	5 years on modulator, 90 days on accessories

WIR TX9 Emitter:

Dimensions, Weight:	11.25" W x 6.25" H x 2.125" D (28.6 cm x 15.9 cm x 5.4 cm), 1.9 lbs (0.9 kg)
Color:	Black with white legends, red acrylic lens (optional white enclosure available)
Power Supply:	Wall Transformer, 24 VAC, 50-60 Hz, 35 VA, 3-pin MOLEX Connector North America: TFP 010, UL/CSA Europe: TFP 027-01, 2-pin Schuko plug, CE UK: TFP 027-02, 3-pin UK plug, CE Note: Each WIR TX9 requires its own power supply
Power Cable:	NEC Class 2 wiring, two-conductor, 18 ga, 200' (61 m) max. length
Indicators:	Green LED power indicator, red LED baseband indicator
Carrier Frequency:	50 kHz to 8 MHz
Emitter IR Power:	3.5 watts
Coverage Area:	Up to 28,000 sq.ft. (2,600 m2) in single-channel mode when using the RX22-4 Receiver Up to 18,000 sq.ft. (1,700 m2) in two-channel mode when using the RX22-4 Receiver Up to 3,063 sq.ft. (285 m2) in single-channel mode when using the RX18 Receiver (See coverage area diagrams)
Baseband Input:	BNC, 100 mV per carrier, 50 Ω, for use with WIR TX9 or MOD 232 only
Baseband Output:	BNC, 50 Ω, for use with TX9 only
Baseband Cable:	RG 58 Coax, BNC connectors, maximum 1000' (300 m) length
Operating Requirements:	0-50º C ambient temperature, non-condensing, non-corrosive atmosphere
Mounting Kits:	Wall or Ceiling Mount: BKT 024 Omnidirectional mount, Mic Stand Kit: SS-11 or SS-6
Warranty:	5 years on Emitter, 90 days on accessories
Approvals:	CE, FCC, RoHS, WEEE
Compatible Receivers:	WIR RX22-4 Four-Channel Receiver, RX18 two-Channel Receiver

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE!

SoundPlus® Value Courtroom System

WIR TX9 Rear Panel

Multi-Channel Infrared Transmitter

CE

Class 1
LED Product

CAUTION
RISK OF ELECTRIC SHOCK
DO NOT OPEN

**WARNING: TO REDUCE THE RISK OF FIRE OR
ELECTRIC SHOCK DO NOT EXPOSE THIS
EQUIPMENT TO RAIN OR MOISTURE.**

RoHS

Note: It is normal for this unit to feel warm while it is in operation.

Power Supply Wiring:
    Use NEC, Class 2 Wiring, 18 ga. minimum,
    200 ft. (70m) maximum length (18 ga.)

Baseband Signal Wiring:
    Use RG58 Coax,1000 ft. (350m) max. length

Williams Sound, Minneapolis, Minnesota, USA
Patent Pending

Made in U.S.A.

Mounting
Bracket

WILLIAMS SOUND ®
HELPING PEOPLE HEAR

www.williamssound.com

Baseband Signal Wiring:
    Use 50 Ohm Coaxial Cable (RG58)

Baseband
(Modulation)

NC   24 VAC

Power In:
24VAC~
50-60Hz
35VA

Plug

↓ Power On

Baseband On ↓

Out   Out   In

50 Ohms

A135

Receiver Coverage Area with TX9 Emitter in Single Channel Mode

FEET
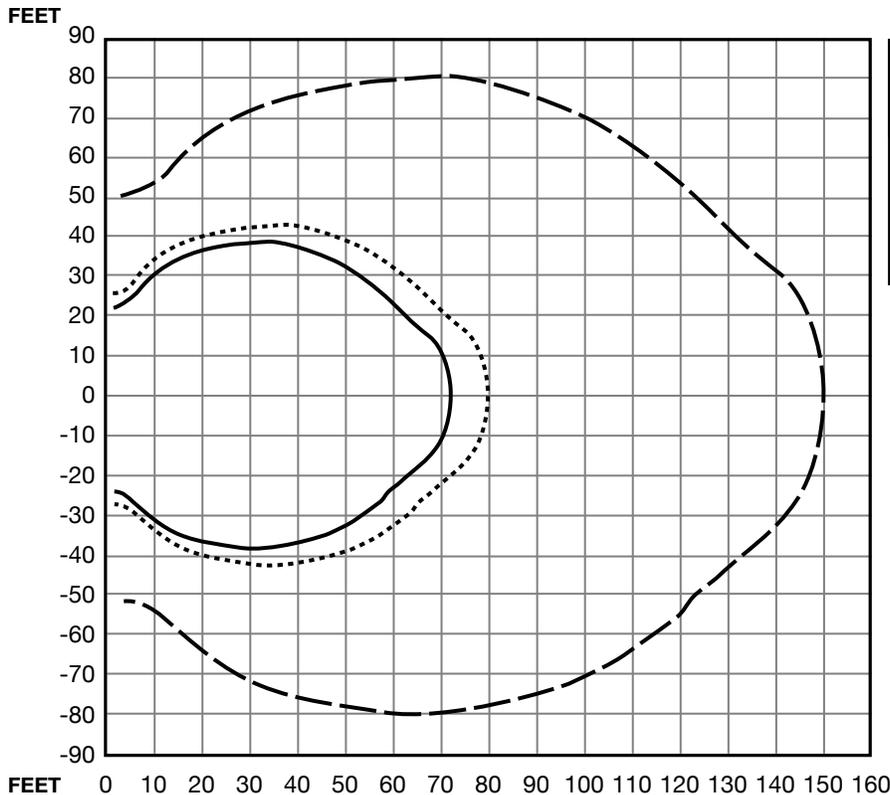
**RECEIVER COVERAGE AREA WITH
TX9 OR TX90 TRANSMITTER IN
SINGLE CHANNEL MODE**

— — — RX22-4 RECEIVER

· · · · · · · RX15-2 RECEIVER

——— RX18 RECEIVER

FEET 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160

A136

The coverage area for the TX9 will vary depending on the receiver being used. The diagram above demonstrates the receiver coverage when operating a single TX9 emitter in single channel mode. Patterns are direct radiation patterns.

Note: Reflections of the infrared light from walls, ceilings and floors may change these patterns.

SoundPlus® Value Courtroom System

WIR RX22-4 Receiver

RX22-4 TOP

EARPHONE JACK

CHANNEL SELECTOR

"ON" INDICATOR

ON/OFF VOLUME SWITCH

RX22-4 FRONT

SOUNDPLUS™
IR
TECHNOLOGY

WILLIAMS SOUND

A137
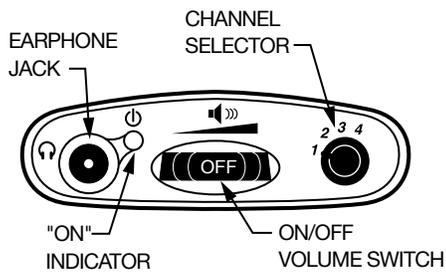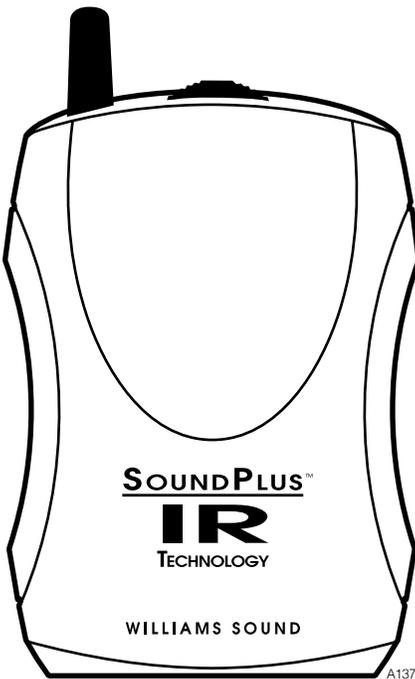
Receiver Style:	Body-Pack, dual-lens detector, lanyard
Size:	4.5" L x 2.85" W x 1.2" H (114.3 mm x 72.4 mm x 30.4 mm)
Weight:	4.6 oz (130 g) with batteries
Color and Material:	Black
Lanyard:	3 ft (.91 m), allows receiver to be worn around the neck
Operating Temperature:	-10° C to +50° C
Battery Type:	2 x AA, alkaline (BAT 001) or NiMH (BAT 026)
Battery Life:	Alkaline: 60 hours, NiMH: 30 hours/charge
Battery Drain:	25 mA, nominal
Charging Contacts:	For use only with CHG 3512
Carrier Frequency:	Channel 1: 2.3 MHz, Channel 2: 2.8 MHz
	Channel 3: 3.3 MHz, Channel 4: 3.8 MHz
De-Emphasis:	50 uS
FM Deviation:	±50 kHz
Signal-to-Noise Ratio:	60dB min.
Squelch:	Receiver squelches (mutes) at 40 dB S/N ratio
Frequency Response:	25 Hz to 16 KHz, +1 dB, -3 dB, electrical response
Total Harmonic Distortion:	Less than 1%, electrical response
Controls:	ON/OFF/VOLUME: combination thumbwheel knob
	Channel Selector: four-position rotary switch
Indicators:	Red LED "ON" indicator, flashes to indicate Low battery
Audio Output Jacks:	3.5 mm stereo mini phone jack Accepts 3.5 mm mono or stereo phone plug
Audio Output Power:	15 mW max at 32 Ω
Acoustic Output:	110 dB SSPL90 w/ EAR 013
Sensitivity:	Better than 1 nW/cm2 for 40 dB signal-to-noise ratio
Approvals:	CE, FCC, RoHS, WEEE
Warranty:	5 years on receiver, 90 days on accessories
Compatible Headphones/ Earphones:	Mono or stereo, 8-32 ohms, 3.5 mm mini phone plug, HED 021, HED 026, EAR 013, EAR 014, EAR 022, NKL 001

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE!

SoundPlus® Value Courtroom System

WIR RX18 Receiver

Weight:	2.0 oz (56 g) with battery
Material and Color:	ABS plastic, Black and Grey
Battery Type, Life:	BAT AP07D NiMH Battery Pack, 7 hours
Operating Range:	3,063 sq ft (285 m²) when used with the TX9 emitter or TX90 transmitter in single-channel mode
Modulation Frequency:	2.3 MHz or 2.8 MHz or stereo
Frequency Response:	200 Hz to 8 kHz, ± 5 dB
Signal to Noise Ratio:	60 dB at 10 m
Controls:	Volume control thumbwheel
	3-position selection switch (2.3 MHz, 2.8 MHz, stereo)
Acoustic Output:	120 dB MAX SSPL90 with 2 cc coupler
Compatibility:	Compatible with 2.3 MHz and 2.8 MHz IR transmitters,
	WIR TX900 and WIR TX925 systems
Battery Charger:	CHG 518
Power Switch:	Built into receiver "arms"
Ear pads:	Uses EAR 240 silicon eartips
Approvals:	CE, RoHS
Warranty:	5 years (90 days on battery)

FREQUENCY SELECTION SWITCH
2.3 MHz, STEREO, 2.8 MHz

2.3 ◎ 2.8

L
BAL
R

BALANCE
CONTROL

VOLUME
CONTROL

BATTERY
(BAT AP07D)

A163
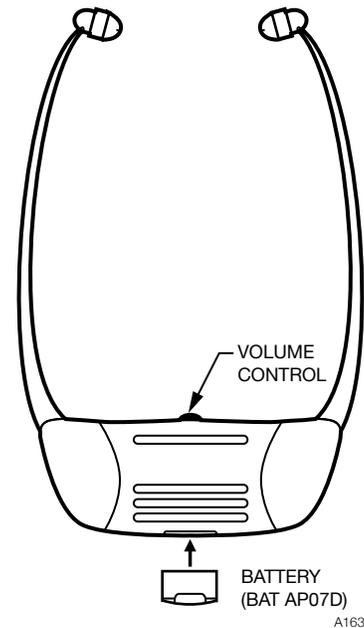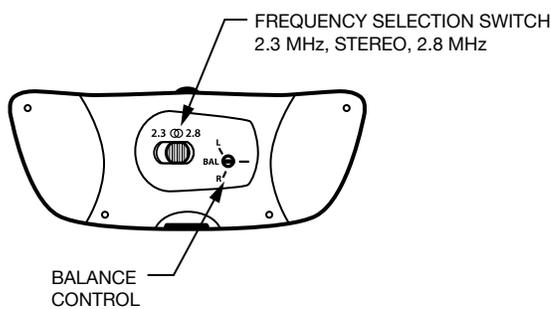
NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE!

SoundPlus® Value Courtroom System

Two-Channel System Diagram

WIR TX9 EMITTER (REAR)

TO ADDITIONAL EMITTERS
(IF NECESSARY)

**RX22-4 RECEIVERS
(WIRELESS)**

MOD 232 MODULATOR (REAR)

CHA
AUDIO IN

CHB
AUDIO IN

BASEBAND SIGNAL ➡
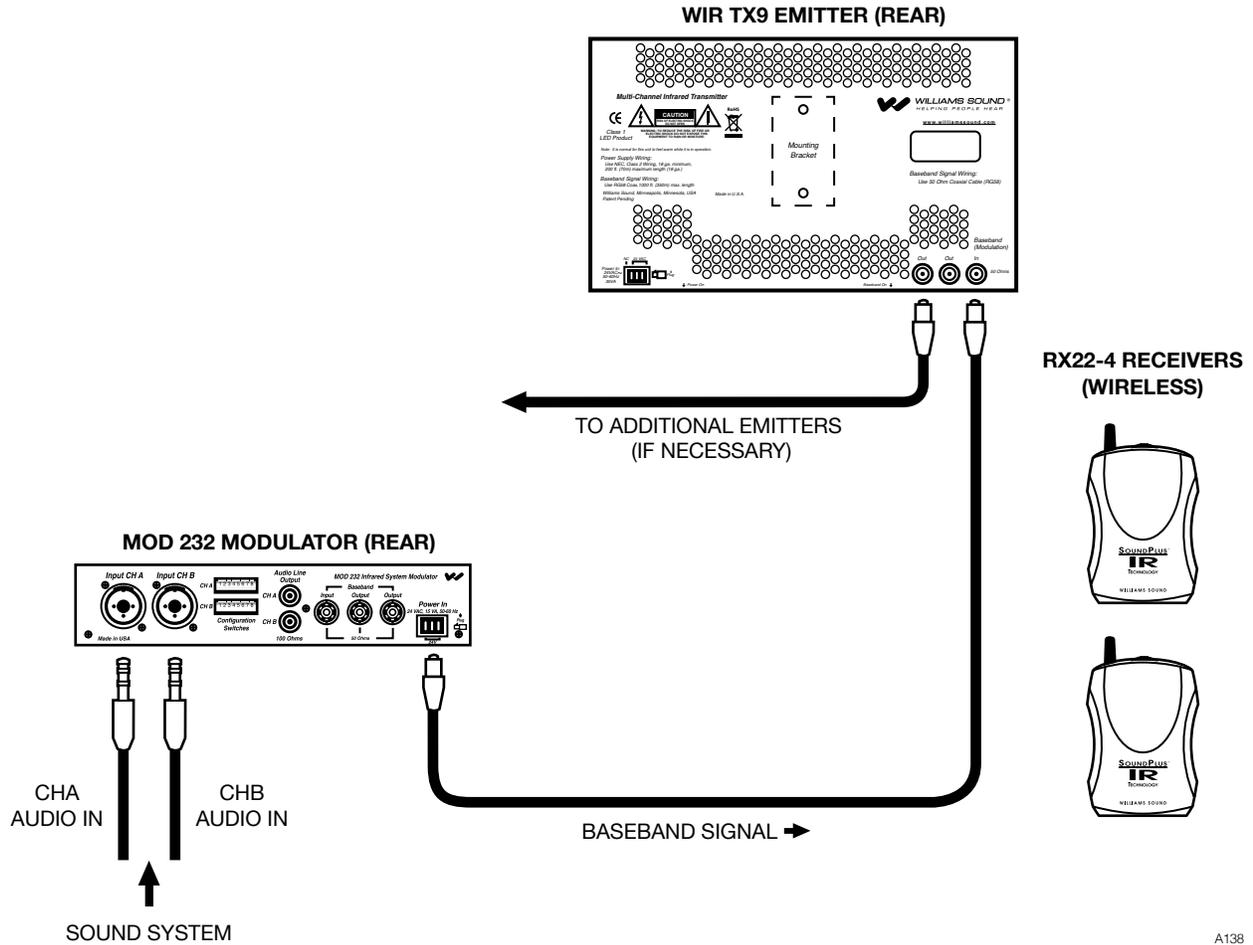
SOUND SYSTEM

A138

SoundPlus® Value Courtroom System

Bid Specs

Modulator, Model MOD 232

The infrared system shall consist of separate modulator and emitter units, with portable receivers. The modulator unit shall be a half-rack style, metal enclosure. A rack panel shall be available to mount one or two modulator units within a single EIA rack space. An adjustable floor stand and mounting bracket shall be available to mount the modulator and emitter together for portable operation.

The modulator shall provide two channels of selectable FM carrier signals; 2.3/2.8/3.3/3.8 MHz, so that a single modulator can be used to simultaneously transmit up to two channels, and two modulators can be ganged together to transmit up to four channels simultaneously. The carrier signals shall use 50 kHz deviation and 50 µS pre-emphasis. The carrier signals (baseband) shall be transmitted to one or more emitters by 50 ohm RG58 coaxial cable with BNC-type connectors. A BNC–type baseband input jack and baseband output jack shall be provided on the modulator.

The modulator shall be powered by an external 24 VAC, 10 VA, 50-60 Hz power supply, connected via a three-pin Molex power connector. It shall have a rocker-type power switch, power LED indicator, four carrier indicator LEDs and two bar graph-type LED audio indicators. The modulator shall have a modulated IR LED on the front panel for testing purposes, and a headphone jack that accommodates mono and stereo 1/4" headphones, and channel monitoring switch. The modulator shall have two rotary audio input level controls, and a screwdriver adjustable control for varying the input compression from 1:1 or 2:1 . The modulator shall have two timers that automatically shut off the carriers when there is no audio signal present for 15 minutes. The modulator shall have two combination input jacks that accept 3-pin XLR plugs for balanced microphone input or 1/4" TRS plugs for balanced or unbalanced line-level inputs. The XLR inputs shall be low impedance, accept signal levels from 100 µV to 90 mV and supply 15 V simplex power per DIN45596. The TRS jacks shall accept balanced or unbalanced audio signal levels from 21 mV to 10 V. The modulator shall have CE, FCC, RoHS, and WEEE approval and carry a five-year parts and labor warranty.

The modulator shall be the Williams Sound model MOD 232.

Emitter, Model TX9

The emitter shall be contained in a metal enclosure with a shatter-resistant lens. The emitter shall include an omni-directional mounting bracket for permanent installation and a bracket shall be available for mounting on a floor stand for portable installations. Each emitter shall be powered by a 24 VAC, 50 VA, 50-60 Hz power supply. The power connector shall be a 3-pin Molex-type. The emitter shall have a BNC-type 50 ohm baseband input and a BNC-type baseband 50 ohm output jack. The emitter shall have a repeater circuit to allow multiple numbers of emitters to operate from the baseband signal. The emitter shall have a visible LED indicator for power and for baseband signal. Carrier frequency is 50KHz to 8 MHz. The emitter shall shut off when the baseband signal is not present. The emitter shall provide an effective coverage area of up to 28,000 sq ft (2,600 sq m) in single channel mode and up to 18,000 sq ft (1,700 sq m) in two channel mode when using the RX22-4 receiver. The emitter shall be convection-cooled, without fans. The emitter shall have CE, FCC, RoHS, and WEEE approval and carry a five-year warranty on parts and labor.

The emitter shall be Williams Sound model WIR TX9.

Receiver, Model WIR RX18

The receiver shall be an under-chin stetho style with an IR detector lens in the face of the unit. The receiver shall have a rotary type volume control and the power switch shall be built into the arms of the unit so it will automatically shut off when not in use. The receiver shall operate for seven hours per charge with the BAT AP07D NiMH battery pack. The receiver shall be housed in a black and grey plastic case. The receiver shall have a three position selector switch for 2.3 MHz, stereo or 2.8 MHz modulated IR signals. The receiver shall provide 120dB SSPL90 output. The system electrical frequency response shall be 200Hz to 8kHz and the S/N ratio shall be 60dB at 10m. The receiver shall have CE, RoHS and WEEE approval and be covered by a five-year parts and labor warranty (90 days on battery pack).

The receiver shall be the Williams Sound model WIR RX18.

Four-Channel Receiver, Model RX22-4

The receiver shall be a body-pack type with IR detector lens behind face of the unit. The unit shall have a lanyard for hands-free operation. The receiver shall have a rotary-type volume control. The receiver shall operate for 60 hours with two AA alkaline batteries and for 30 hours per charge with NiMH AA batteries. The receiver shall be charged without battery removal via charger contacts in the case. A drop-in charger accessory shall recharge the batteries in 8 hours when used with CHG 3512 charger.

The receiver shall be the Williams Sound model WIR RX22-4

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WILLIAMS SOUND ®
HELPING PEOPLE HEAR

800.843.3544 / info@williamssound.com / www.williamssound.com

Model MX400 Series Microphones
Specification Sheet

MODEL MX400 SERIES MICROPHONES

OVERVIEW

Shure Microflex® MX400 Series microphones are miniature gooseneck-mounted electret condenser microphones designed primarily for speech and vocal pickup. They can be mounted on lecterns, pulpits, or conference tables. All models include a preamplifier and are available with interchangeable cardioid, supercardioid, or omnidirectional cartridges.

FEATURES

- Wide dynamic range and frequency response for accurate sound reproduction across the audio spectrum
- Interchangeable cartridges provide the right polar pattern for every application
- Balanced, transformerless output for increased immunity to noise over long cable runs
- Shock mount that provides over 20 dB isolation from surface vibration noise
- Locking flange mount for permanently securing microphone to lecterns, pulpits, or conference tables
- Snap-fit foam windscreen

MODEL VARIATIONS

- **MX412**: 305 mm (12 in.) gooseneck microphone.
- **MX418:** 457 mm (18 in.) gooseneck microphone.
- **MX412S**: 305 mm (12 in) gooseneck microphone; includes a mute switch and an LED.

- **MX418S**: 457 mm (18 in) gooseneck microphone; includes a mute switch and an LED.

SPECIFICATIONS

Frequency Response (Figure 1)
  50 to 17,000 Hz
Polar Pattern (Figure 2)
Output Impedance (at 1000 Hz)
  Rated at 150 Ω (180 Ω actual)
Open Circuit Sensitivity (at 1 kHz, ref. 1 V/Pascal*)
  Cardioid: −35.0 dB (17.8 mV)
  Supercardioid: −33.5 dB (21.1 mV)
  Omnidirectional: −27.5 dB (42.2 mV)
    All settings −12 dB at 0 gain
    *1 Pascal = 94 dB SPL
Maximum SPL (1 kHz at 1% THD, 1 kΩ load)
  Cardioid: 124.2 dB
  Supercardioid: 122.7 dB
  Omnidirectional: 116.7 dB
    All settings +6 dB at 0 gain
Equivalent Output Noise (A-weighted)
  Cardioid: 28.0 dB SPL
  Supercardioid: 26.5 dB SPL
  Omnidirectional: 20.5 dB SPL
Signal to Noise Ratio (referenced at 94 dB SPL)
  Cardioid: 66.0 dB
  Supercardioid: 67.5 dB
  Omnidirectional: 73.5 dB

Dynamic Range at 1 kΩ Load
  96.2 dB
    100 dB at 0 gain
Common Mode Rejection
  45.0 dB minimum
Mute Switch Attenuation (switched models only)
  50.0 dB minimum
Preamplifier Output Clipping Level (1% THD)
  −6.0 dBV (0.5 V)
    −12 dB at 0 gain
Polarity
  Positive sound pressure on diaphragm produces positive voltage on pin 2 relative to pin 3 of output connector.
Power Requirements
  11 to 52 Vdc phantom, 2.0 mA
Environmental Requirements
  Operating Temperature Range: −18° C to 57° C (0° F to 135° F)
  Relative Humidity: 0 to 95%
Dimensions (Figure 3)

Certification
Eligible to bear CE Marking. Conforms to European EMC Directive 89/336/EEC. Meets applicable tests and performance criteria in European Standard EN55103 (1996) parts 1 and 2, for residential (E1) and light industrial (E2) environments.

REPLACEMENT PARTS

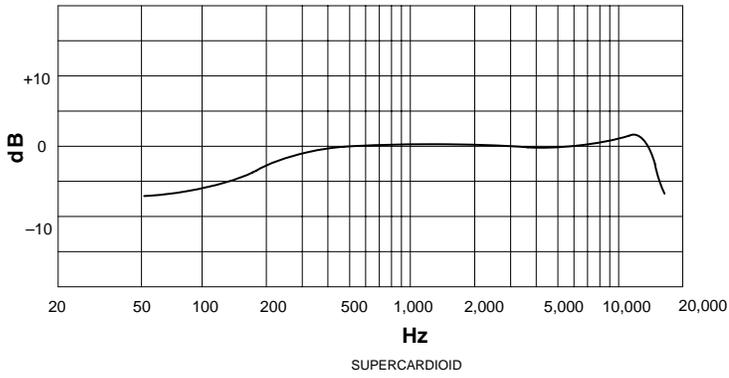|	
Foam Ball Windscreen	A99WS
Locking Metal Windscreen	A412MWS

Portable Desktop Base	A412B
Stand Adapter	A57E
Omnidirectional Cartridge	R183B
Supercardioid Cartridge	R184B
Cardioid Cartridge	R185B
Snap-fit Foam Windscreen (4)	RK412WS
Shock Mount	A400SM
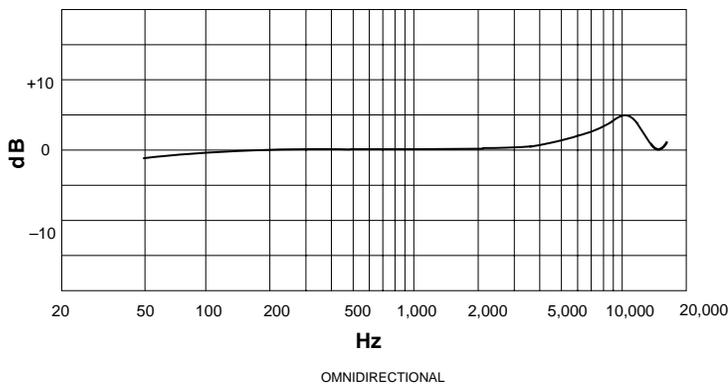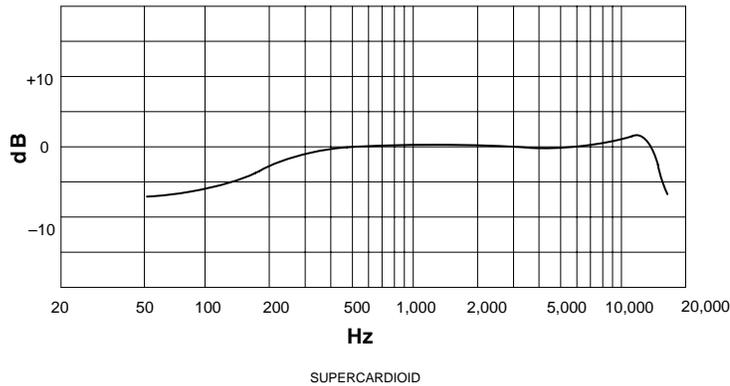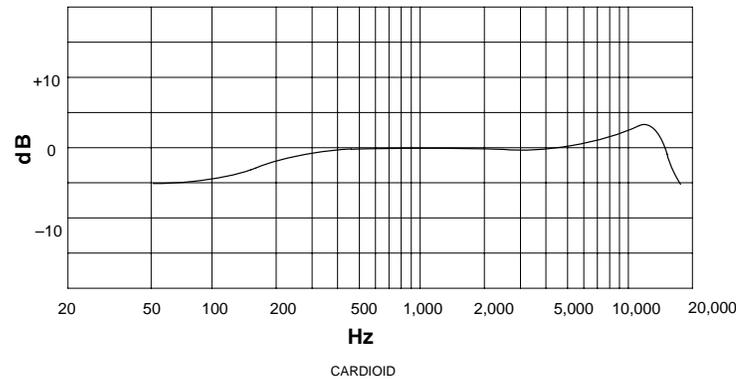
TYPICAL FREQUENCY RESPONSE
Figure 1

TYPICAL POLAR PATTERNS
Figure 2

2

428.74 mm
(16.88 in.)

330.70 mm
(13.02 in.)

98.04 mm
(3.86 in.)

MX412

11.68 mm
(0.46 in.)

20.07 mm
(0.79 in.)

571.44 mm
(22.50 in.)

473.40 mm
(18.64 in.)

98.04 mm
(3.86 in.)

MX418

11.68 mm
(0.46 in.)

20.07 mm
(0.79 in.)

468.11 mm
(18.43 in.)

333.87 mm
(13.14 in)

134.24 mm
(5.28 in.)

MX412S

11.68 mm
(0.46 in.)

20.07 mm
(0.79 in.)

607.64 mm
(23.92 in.)

473.40 mm
(18.64 in)

134.24 mm
(5.28 in.)

11.68 mm
(0.46 in.)

20.07 mm
(0.79 in.)

MX418S

50.80 mm
(2.00 in.)

66.70 mm
(2.62 in.)

14.40 mm
(0.56 in.)

14.40 mm
(0.56 in.)

38 mm
(1.5 in.)

43.18 mm
(1.70 in.)

SHOCK MOUNT ASSEMBLY

SHURE

(Actual Size)

DIMENSIONS

Figure 3

MOUNTING FLANGE

MODEL MX400D SERIES MICROPHONES

OVERVIEW

Shure Microflex® MX400D Series microphones are miniature electret condenser gooseneck microphones with a desktop base and attached 3 m (approximate)/10 ft cable. The desktop base allows these microphones to be used in multi-purpose rooms where quick set-up is required, or where permanent installation is impractical.

FEATURES

• Wide dynamic range and frequency response for accurate sound reproduction across the audio spectrum
• Interchangeable cartridges provide the right polar pattern for any application
• Balanced, transformerless output for increased immunity to noise over long cable runs
• Programmable on/off switch and LED on/off indicator
• New brighter LED improves visibility under strong ambient lighting
• Logic input and output terminals for remote control or use with automatic microphone mixers
• Snap-fit foam windscreen

MODEL VARIATIONS

• **MX412D**: 304.8 mm (12 in.) desktop mini-condenser, gooseneck-mounted microphone.

• **MX418D**: 457.2 mm (18 in.) desktop mini-condenser, gooseneck-mounted microphone.

SPECIFICATIONS

Frequency Response (Figure 1)
  50 to 17,000 Hz
Polar Pattern (Figure 2)
Output Impedance (at 1,000 Hz)
  Rated at 150 Ω (180 Ω actual)
Open Circuit Sensitivity
  At 1 kHz, ref. 1 V per Pascal*
  Cardioid: –33.5 dBV (21.1 mV)
  Supercardioid: –32.5 dBV (23.7 mV)
  Omnidirectional: –28.0 dBV (39.8 mV)
    * 1 Pascal=94 dB SPL
Maximum SPL (1kHz at 1% THD, 1 kΩ load)
  Cardioid: 123.0 dB
  Supercardioid: 122.0 dB
  Omnidirectional: 117.5 dB
Equivalent Output Noise (A-weighted)
  Cardioid: 29.0 dB SPL
  Supercardioid: 28.0 dB SPL
  Omnidirectional: 70.5 dB SPL
Signal to Noise Ratio (referenced at 94 dB SPL)
  Cardioid: 65.0 dB
  Supercardioid: 66.0 dB
  Omnidirectional: 70.5 dB
Dynamic Range with 1 kΩ load
  94.0 dB
Common Mode Rejection
  45.0 dB minimum
Mute Switch Attenuation
  50.0 dB minimum
Preamplifier Output Clipping Level (1% THD)
  –6.0 dBV (0.5 V)
Polarity
  Positive sound pressure on diaphram produces positive voltage on pin 2 relative to pin 3 of XLR output connector.

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Power Requirements
  11 to 52 Vdc phantom, 2.0 mA
Environmental Requirements
  Operating Temperature Range: –18° to 57° C (0° to 135° F)
  Relative Humidity: 0 to 95%
Dimensions (Figure 3)
Weight
  MX412D: 0.81 kg (1.80 lbs.) net, 1.63 kg (3.62 lbs.) packaged
  MX418D: 0.82 kg (1.82 lbs.) net, 1.64 kg (3.64 lbs.) packaged
Cable Type (figure 7)
  The attached custom cable contains a shielded audio pair and three unshielded conductors for logic control.
  Overall diameter=0.6 mm (0.165 in.)
Certification
  Eligible to bear CE Marking. Conforms to European EMC Directive 89/336/EEC. Meets applicable tests and performance criteria in European Standard EN55103 (1996) parts 1 and 2, for residential (E1) and light industrial (E2) environments.

REPLACEMENT PARTS

Snap-Fit Foam Windscreen (4 per pkg.)	RK412WS
Foam Ball Windscreen	A99WS
Locking Metal Windscreen	A412MWS
Replacement 3 m (10 ft) XLR Cable	C120
Custom Logic Cable (specify length)	15A523/1
Omnidirectional Cartridge	R183B
Supercardioid Cartridge	R184B
Cardioid Cartridge	R185B
Base Plate Bumpers	80A8053A
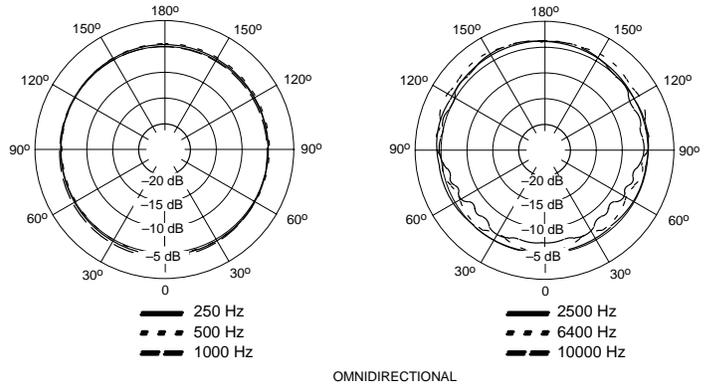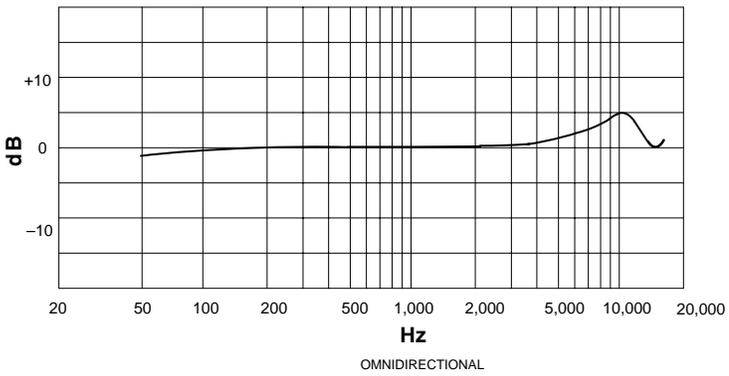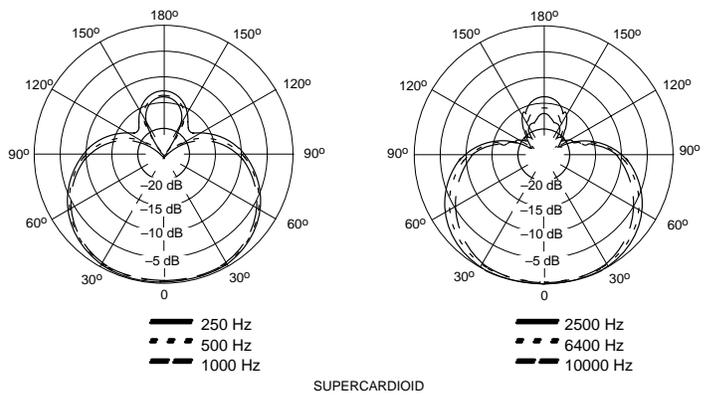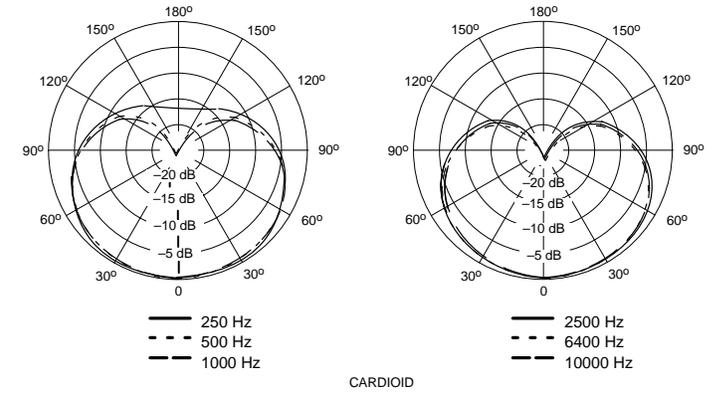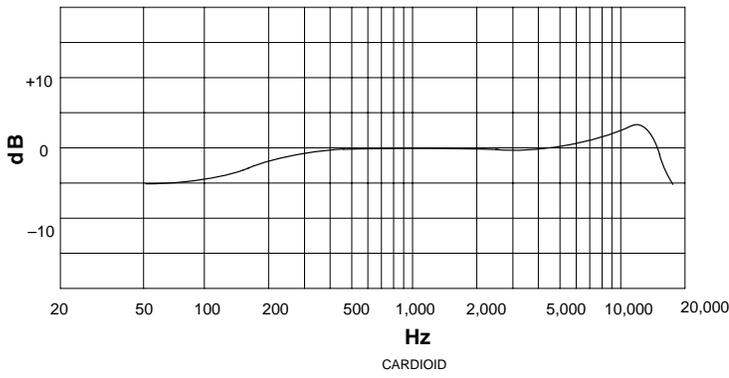
CARDIOID

SUPERCARDIOID

OMNIDIRECTIONAL

TYPICAL FREQUENCY RESPONSE

Figure 1

250 Hz
500 Hz
1000 Hz

CARDIOID

2500 Hz
6400 Hz
10000 Hz

250 Hz
500 Hz
1000 Hz

SUPERCARDIOID

2500 Hz
6400 Hz
10000 Hz

250 Hz
500 Hz
1000 Hz

OMNIDIRECTIONAL

2500 Hz
6400 Hz
10000 Hz

TYPICAL POLAR PATTERNS

Figure 2

approximately 3 m
(10 ft)

102.1 mm
(4 9/16 in.)

MX412D: 355.4 mm (14 in.)
MX418D: 501.7 mm (19 3/4 in.)

50.8 mm
(2 1/32 in.)

161.9 mm
(6 3/8 in.)

Figure 3

2
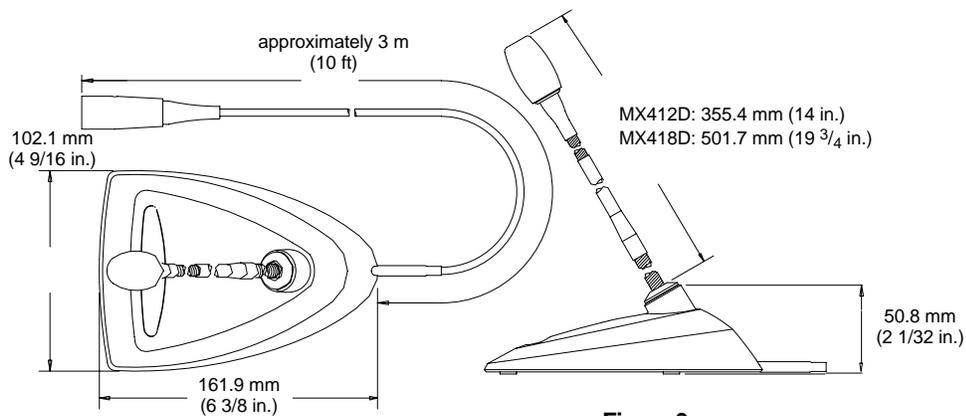
MX392-MX392BE-MX393
Boundary Microphones

Shure Microflex® MX300 Series microphones are surface-mounted electret condenser microphones designed primarily for mounting on conference tables, stage floors, and lecterns. Their high sensitivity and wide frequency range make them especially suitable for picking up speech and vocals in sound reinforcement and recording applications. Interchangeable cartridges provide the installer with greater flexibility and make it possible to easily reconfigure microphone coverage as the need arises. The MX392 and MX393 models include an internal preamplifier.

MX300 Series microphones take advantage of the principle that, at a barrier or boundary, the sound pressure level doubles. When placed near a sufficiently large boundary surface, the microphone has 6 dB higher sensitivity and approximately 3 dB greater direct-to-reverberant sound ratio.

Features

The MX392, MX392BE, and MX393 feature programmable logic input and output. Additionally they provide following benefits:

- Flat frequency response across the vocal range for uncolored sound
- Interchangeable cartridges that provide a choice of polar pattern for each application
- Sleek, low-profile design for surface mounting
- Programmable mute button
- LED indicator
- Logic input/output for remote control or use with automatic mixers
- RF filtering

Model Variations

MX392: Attached, unterminated cable.
MX392BE: Attached, unterminated cable configured at the factory for bottom exit.
MX393: Detachable cable with XLR output connector.
The polar pattern of the included cartridge is indicated by a model number suffix:

/**C** Cardioid
/**S** Supercardioid
/**O** Omnidirectional
/**N** Cartridge not included

Interchangeable Cartridges

Remove Grille

Cartridge

Remove Bracket
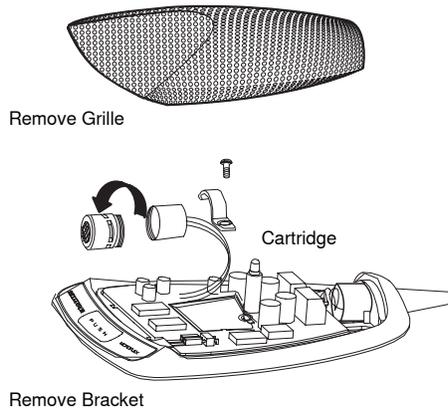
Microflex microphones use interchangeable cartridges that allow you to choose the polar pattern for different installations.

360˚
R183
Omnidirectional

115˚
R184
Supercardioid

130˚
R185
Cardioid

Cartridge Polar Patterns
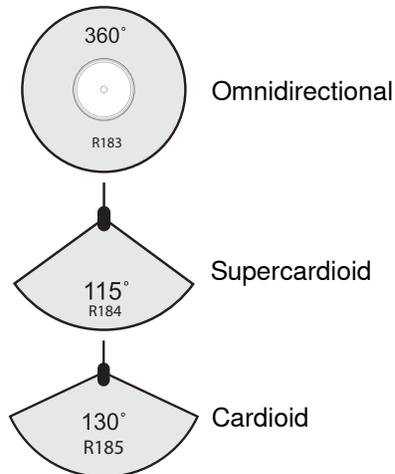
Permanent Installation

MX392 and MX393

1. Remove grille to access mounting key holes.
2. Cut slots into pads.
3. Slide microphone forward to engage screws in slots.

Note: If using rear side-exit cable option, only drill two outer holes.
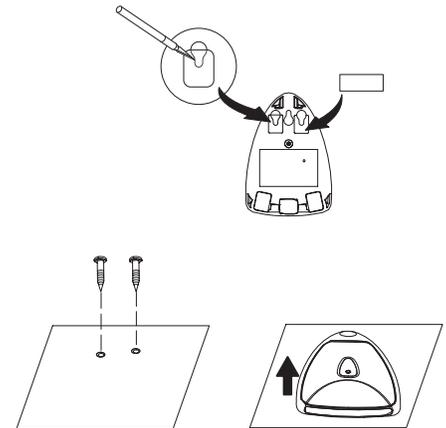
Microphone Placement

For best low-frequency response and rejection of background noise, place the microphone on a large, flat surface, such as a floor, table, or lectern.

To reduce reverberance, avoid reflective surfaces above or to the side of the microphone, such as beveled sides of pulpits or overhanging shelves.

60 cm (2 ft.)   60 cm (2 ft.)

115°

115°   115°
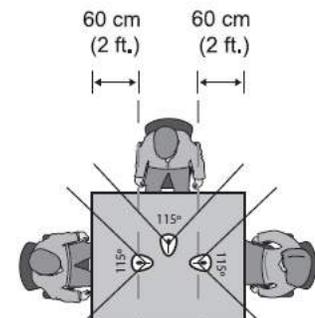
MX392BE

Once placement has been determined, the microphones can be permanently installed. First, drill the hole in the selected area to allow the bottom entry cable to be conveniently routed out of sight. Then use the pressure sensitive adhesive to keep the microphone firmly in place.
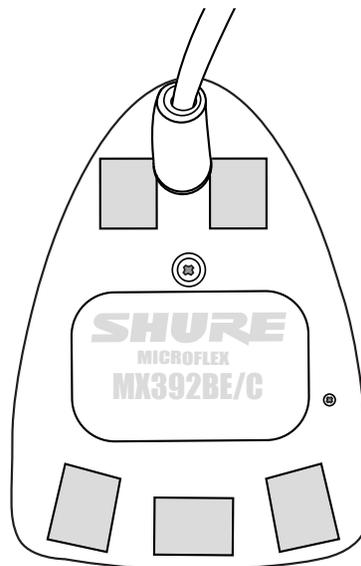
Drilling the hole:

1. Determine the cutting area for the bottom exit cable and drill a 1/2" (12.7 mm) circular hole. Remove all debris from the mounting surface.
2. Route the cable through the drilled hole.
3. Connect the integrated XLR cable to a mixer or P.A. system.

Re-Routing Cable for Bottom Exit (If your MX392 is not BE configured)

1. Remove the grille.
2. Disconnect wires from screw terminals.
3. Grasp rubber boot within 1/2" of housing, using gas pliers. Rotate boot and cable ccw to remove connector from threaded "L" bracket.
4. Remove cable from microphone housing.
5. Insert cable through access hole in microphone base.
6. Insert cable connector through hole and thread it into "L" bracket.
7. If desired, rubber strain relief can be reattached to cable end or removed from cable before fastening it to bracket.
8. Re-connect wires to proper screw terminals on circuit board.
9. Insert supplied round rubber plug into unused side cable exit.
10. Reinstall grille and foam screen.
11. Insert cable through hole in mounting surface. Secure microphone to mounting surface.

Pressure Sensitive Adhesive

1. Thoroughly clean the application area with the included alcohol wipe. Removing the dust will allow the microphone to adhere well.
2. Remove the adhesive backing and gently set the microphone into position.
3. Once the microphone is in position, firmly apply pressure to the microphone.
Note: The pressure sensitive adhesive will be extremely difficult to move once pressure has been applied.

Bottom view of MX392BE/C with adhesive pads

Configuration

DIP Switches

Use the DIP switches to configure logic settings and mute button behavior.

The DIP switches are covered with a piece of clear tape at the factory. Remove tape to modify the switch settings.

Note: Bottom cover must be closed for microphone to function.
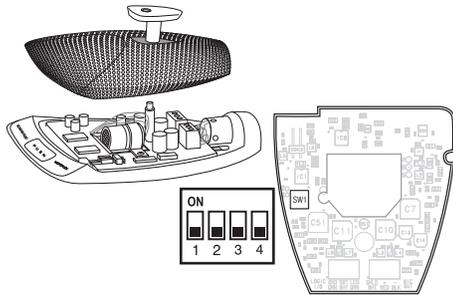
	OFF (factory default)	ON
1	Momentary	Toggle
2	Push-to-mute	Push-to-talk
3	Mute button enabled, LED illuminates when mic is active	Disable mute button (microphone always on), logic controls LED
4	--	--

Wiring Diagram

NOTE: Audio and logic ground are connected at microphone base.

Audio – (Black)
Audio + (Red)
LED IN (Orange)
SWITCH OUT (White)
Ground (Green)
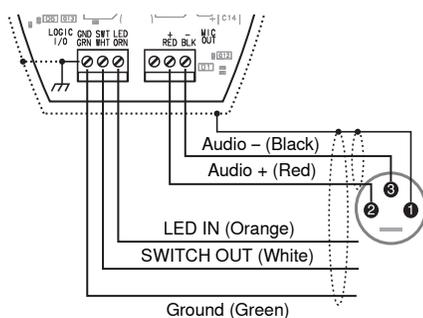
Mute Button Configuration

Use DIP switches 1 and 2 to configure the mute button, as follows.

Be sure to set DIP switch 3 **off** (factory default) so that the mute button controls audio from the microphone.

Switch Function	DIP Switch Setting
Momentary: push-to-mute (as shipped).	
Momentary: push-to-talk	
Toggle: (Push On/Push Off): Mic is active when powered on	
Toggle: (Push On/Push Off): Mic is mute when powered on	

Connecting to an Automatic Mixer

Use these settings if connecting the microphone to an automatic mixer or other device that mutes audio and controls the LED.

1. Connect logic leads to the automatic mixer. Connect the LED IN to the gate output to illuminate the LED when that channel is gated on.
2. Set DIP switch 3 on. This disbles the mute button (the microphone passes audio regardless of whether the button is pressed or not).
3. Set DIP switch 1 to configure how the mute button sends SWITCH OUT logic:
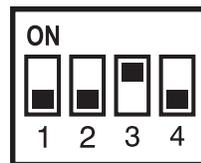
Momentary: push = 0 Vdc, release = 5 Vdc
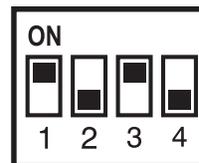
Toggle: initial = 5 Vdc, push = 0 Vdc

Logic Wiring
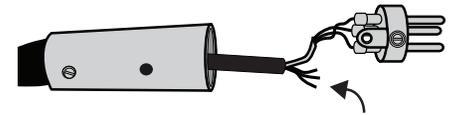
Green (LOGIC GROUND): Connects to the logic ground of an automatic mixer, switcher, or other equipment.

Orange (LED IN): Set DIP switch 3 on to use LED IN. When shorted to LOGIC GROUND, the LED turns on.

White (SWITCH OUT): Provides TTL logic (0 Vdc or 5 Vdc) in response to the mute button. Set DIP switch 1 for momentary or toggle. When phantom power is applied, logic initializes high (5 Vdc). DIP switch 2 has no effect on SWITCH OUT.

Changing SWITCH OUT to Always Momentary

Use the following modification in situations where your logic interface requires momentary closure of the SWITCH OUT, but you want the mute button to toggle the microphone (DIP switch 1 ON, 3 OFF):

1. Access the circuit board inside the microphone base.
2. Remove the resistor at R45 and reinstall it at location R46.
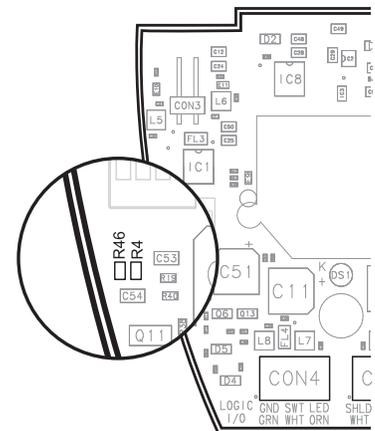
Painting

A supplied plastic paint shield
B retainer
C grille
D foam screen
E supplied adhesive masking strip
F supplied rubber plug
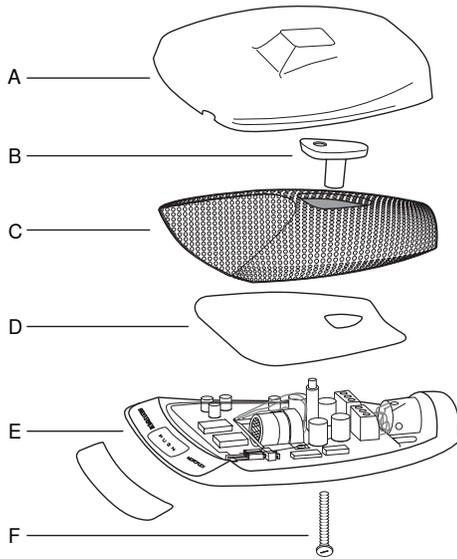
1. Remove foam screen from grille before painting
2. Clean surfaces to be painted with denatured alcohol or naphtha.
3. To avoid filling grille holes, apply paint in thin layers.
4. **Important:** Use fine sandpaper to remove paint from the bottom edges of the grille. This ensures electrical continuity for proper shielding.

Specifications

All measurements taken with microphone mounted on a wooden surface (76 x 76 cm)

Cartridge Type

Electret Condenser

Frequency Response

50–17000 Hz

Polar Pattern

MX392/C, MX392BE/C, MX393/C	Cardioid
MX392/S, MX392BE/S, MX393/S	Supercardioid
MX392/O, MX392BE/O, MX393/O	Omnidirectional

Output Impedance

180 Ω

Output Configuration

Active Balanced

Sensitivity
@ 1 kHz, open circuit voltage

Cardioid	–30 dBV/Pa
Supercardioid	–28 dBV/Pa
Omnidirectional	–22 dBV/Pa

1 Pa=94 dB SPL

Maximum SPL
1 kHz at 1% THD, 1 kΩ load

Cardioid	119 dB
Supercardioid	118 dB
Omnidirectional	111 dB

Equivalent Output Noise
A-weighted

Cardioid	23 dB SPL
Supercardioid	21 dB SPL
Omnidirectional	15 dB SPL

Signal-to-Noise Ratio
Ref. 94 dB SPL at 1 kHz

Cardioid	71 dB
Supercardioid	73 dB
Omnidirectional	80 dB

Dynamic Range
1 kΩ load, @ 1 kHz

96 dB

Common Mode Rejection
10 Hz to 100 kHz

45 dB, minimum

Preamplifier Output Clipping Level
at 1% THD

–6 dBV (0.5 V)

Polarity

Positive sound pressure on diaphragm produces positive voltage on pin 2 relative to pin 3 of output XLR connector

Mute Switch
50–20000 Hz

–50 dBminimum

Logic Connections

LED IN	Active low (≤1.0V), TTL compatible. Absolute maximum voltage: -0.7V to 50V.
LOGIC-OUT	Active low (≤0.5V), sinks up to 20mA, TTL compatible. Absolute maximum voltage: -0.7V to 24V (up to 50V through 3kΩ).

Cable

MX392	3½ m (12 ft) attached cable with shielded audio pair and three conductors for logic control, unterminated
MX392BE	3½ m (12 ft) attached cable with shielded audio pair and three conductors for logic control, unterminated, bottom exit
MX393	3½ m (12 ft) detachable cable with 3-pin audio connector

Net Weight

172 g (0.38 lbs)

Environmental Conditions

Operating Temperature	–18–57°C (0–135°F)
Storage Temperature	–29–74°C (–20–165°F)
Relative Humidity	0–95%

Power Requirements

11–52 V DC, 2.0 mA

Accessories

Furnished Accessories

Paint Mask	80C514
Switch Paint Mask	80A541
Set of 5 rubber pads with adhesive (MX392BE)	RPM470

Replacement Parts

Black or White Omnidirectional Cartridge for all MX-(Microflex®) Models and WL183	R183B
Black or White Cardioid Cartridge for WL185 and all MX-(Microflex®) Models	R185B
12' Cable, 3-Pin Mini Connector (TA3F) to Male XLR, Used with MX393	C129
Custom Logic Cable (specify length)	95B2509
12' Cable (5-Conductor, 2 Shielded) with threaded adapter on microphone end to bare end for MX392	C130

Certifications

Meets essential requirements of all applicable European Directives.

Eligible for CE marking.

The CE Declaration of Conformity can be obtained from Shure Incorporated or any of its European representatives. For contact information please visit www.shure.com

The CE Declaration of Conformity can be obtained from: www.shure.com/europe/compliance

Authorized European representative:
Shure Europe GmbH
Headquarters Europe, Middle East & Africa
Department: EMEA Approval
Jakob-Dieffenbacher-Str. 12
75031 Eppingen, Germany
Phone: 49-7262-92 49 0
Fax: 49-7262-92 49 11 4
Email: info@shure.de

RDL®
Radio Design Labs

SPECIALISTS IN PRACTICAL PRECISION ENGINEERING™

STICK-ON® SERIES
Model ST-NG1
Random Noise Generator

- True *Random* Noise Source
- Masking Noise Sources
- Pink Noise
- White Noise
- Mic and/or Line Level Noise Signals

The ST-NG1 is part of the group of versatile STICK-ON products from Radio Design Labs. STICK-ONs feature the advanced circuitry for which RDL products are known, combined with unequalled versatility in mounting possibilities. The durable adhesives provided with the ST-NG1 permit permanent or removable mounting. Numerous available mounting accessories, brackets and rack-mount chassis are optionally available to facilitate any system design. STICK-ONs are designed, built and rated for continuous duty in professional A/V systems.

APPLICATION: The ST-NG1 is the ideal choice where random white or pink noise is needed. It is suitable either as a reference noise source for audio measurements; or as a masking noise source in engineered sound or counter-intelligence applications, particularly where true *random noise* is required.

Amplitude limiting circuitry in the ST-NG1 controls extreme peak excursions while preserving random variations of at least 20 dB. The noise generating circuitry in the ST-NG1 is truly random analog noise occupying the full bandwidth from 20 Hz to 20 kHz. This makes the ST-NG1 ideal in masking environments where secure, random noise is required. Unlike the typical digitally-generated pseudo-random noise generators, which can be decoded and removed by effective intelligence equipment, the ST-NG1 produces no repetitive frequency or amplitude pattern.

Four outputs are available on the ST-NG1. Both a mic-level and line-level output are provided from each noise source. A 25-turn gain-trimming potentiometer is provided for the white noise. A separate 25-turn gain-trimming potentiometer is provided to set the pink-noise level, independent of the white-noise setting. The gain trim for each noise source adjusts both the line and mic output for that source. Each output is balanced low-impedance, and may be wired either balanced or unbalanced. All outputs may be used simultaneously.

Wherever white or pink noise signals are needed, the ST-NG1 is the ideal choice. Use the ST-NG1 individually, or combine it with other RDL products as part of a complete audio/video system.
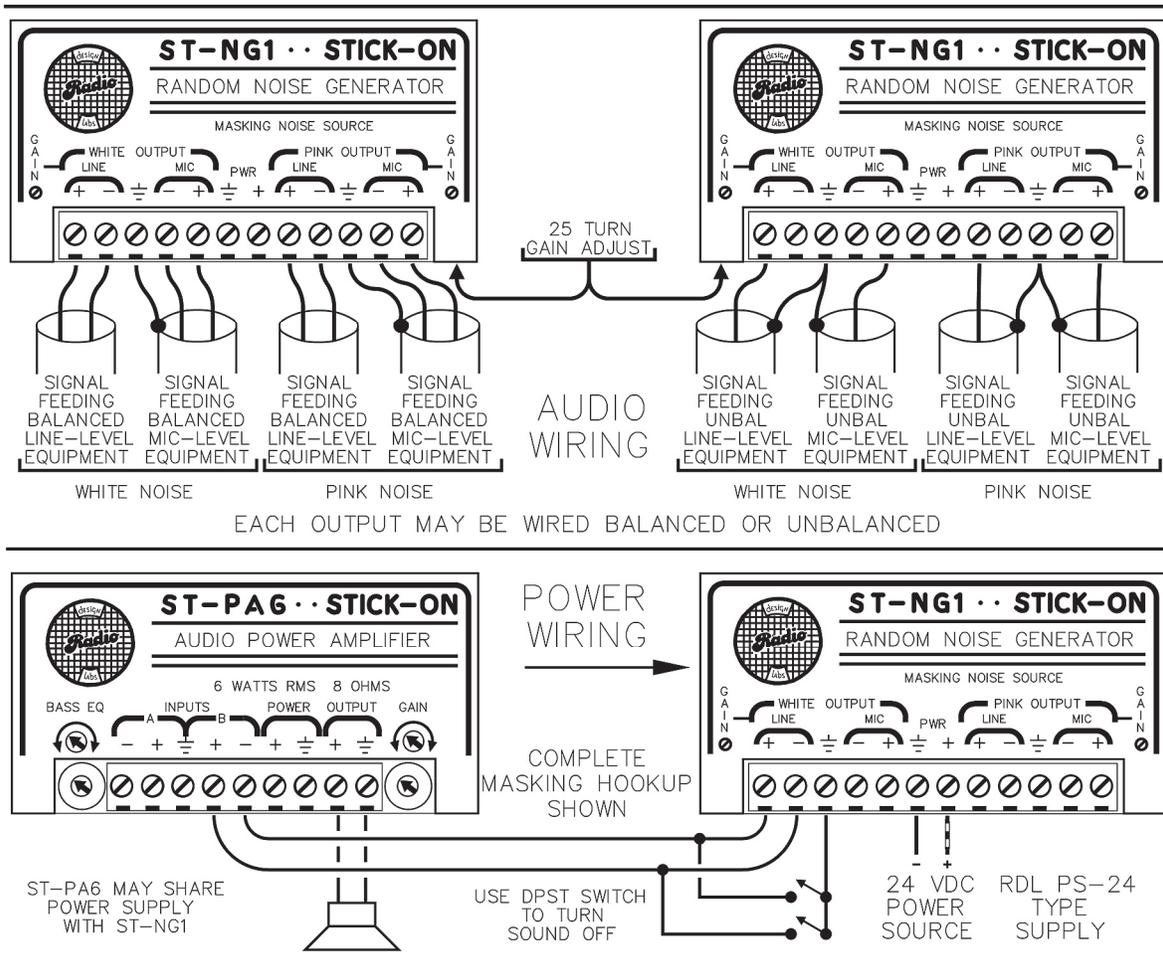
STICK-ON® SERIES
Model ST-NG1
Random Noise Generator

Installation/Operation

CE

**Declaration of Conformity available from rdlnet.com.
Sole EMC specifications provided on product package.
Specifications are subject to change without notice.**

TYPICAL PERFORMANCE

Outputs (each source):	+4 dBu balanced line-level	Noise Band:	20 Hz to 20 kHz	
	-45 dBu balanced mic level	Ambient Operating Environment:	0° C to 55° C	
Output Level:	OFF to +8 dBu	Power Requirement:	GROUND-REFERENCED	
	(line-level output adjustable)		24 Vdc @ 30 mA	
	Off to -40 dBu	Dimensions:	Height: 1.55 in.	3.94 cm
	(mic-level output)		Width: 3.00 in.	7.62 cm
Spectral Distribution:	White and Pink Simultaneously		Depth: 0.65 in.	1.65 cm

8pre USB™
User's Guide for Windows

MOTU

SAFETY PRECAUTIONS AND ELECTRICAL REQUIREMENTS

⚠ **CAUTION! READ THIS SAFETY GUIDE BEFORE YOU BEGIN INSTALLATION OR OPERATION. FAILURE TO COMPLY WITH SAFETY INSTRUCTIONS COULD RESULT IN BODILY INJURY OR EQUIPMENT DAMAGE.**

⚡ **HAZARDOUS VOLAGES: CONTACT MAY CAUSE ELECTRIC SHOCK OR BURN. TURN OFF UNIT BEFORE SERVICING.**

WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR OTHER MOISTURE.

CAUTION: TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

WARNING: DO NOT PERMIT FINGERS TO TOUCH THE TERMINALS OF PLUGS WHEN INSTALLING OR REMOVING THE PLUG TO OR FROM THE OUTLET.

WARNING: IF NOT PROPERLY GROUNDED THE MOTU 8pre USB COULD CAUSE AN ELECTRICAL SHOCK.

The MOTU 8pre USB is equipped with a three-conductor cord and grounding type plug which has a grounding prong, approved by Underwriters' Laboratories and the Canadian Standards Association. This plug requires a mating three-conductor grounded type outlet as shown in Figure A below. If the outlet you are planning to use for the MOTU 8pre USB is of the two prong type, DO NOT REMOVE OR ALTER THE GROUNDING PRONG IN ANY MANNER. Use an adapter as shown below and always connect the grounding lug to a known ground. It is recommended that you have a qualified electrician replace the TWO prong outlet with a properly grounded THREE prong outlet. An adapter as illustrated below in Figure B is available for connecting plugs to two-prong receptacles.
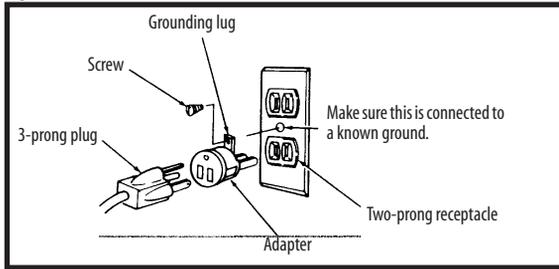
Figure A

- 3-prong plug
- Grounding prong
- Properly grounded 3-prong outlet

Figure B

- Grounding lug
- Screw
- 3-prong plug
- Make sure this is connected to a known ground.
- Two-prong receptacle
- Adapter
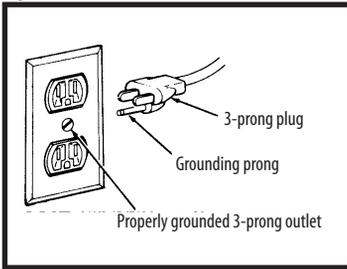
WARNING: THE GREEN GROUNDING LUG EXTENDING FROM THE ADAPTER MUST BE CONNECTED TO A PERMANENT GROUND SUCH AS TO A PROPERLY GROUNDED OUTLET BOX. NOT ALL OUTLET BOXES ARE PROPERLY GROUNDED.

If you are not sure that your outlet box is properly grounded, have it checked by a qualified electrician. NOTE: The adapter illustrated is for use only if you already have a properly grounded two-prong receptacle. Adapter is not allowed in Canada by the Canadian Electrical Code. Use only three wire extension cords which have three-prong grounding type plugs and three-prong receptacles which will accept the MOTU 8pre USB plug.

IMPORTANT SAFEGUARDS

1. Read these instructions. All the safety and operating instructions should be read before operating the 8pre USB.
2. Keep these instructions. These safety instructions and the 8pre USB owner's manual should be retained for future reference.
3. Heed all warnings. All warnings on the 8pre USB and in the owner's manual should be adhered to.
4. Follow all Instructions. All operating and use instructions should be followed.
5. Do not use the 8pre USB near water.
6. Cleaning - Unplug the 8pre USB from the computer and clean only with a dry cloth. Do not use liquid or aerosol cleaners.
7. Ventilation - Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Heat - Do not install the 8pre USB near any heat sources such as radiators, heat registers, stoves, or another apparatus (including an amplifier) that produces heat.
9. Overloading - Do not overload wall outlets and extension cords as this can result in a risk of fire or electrical shock.
10. Grounding - Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult and electrician for replacement of the obsolete outlet.
11. Power cord - Protect the 8pre USB power cord from being walked on or pinched by items placed upon or against them. Pay particular attention to cords and plugs, convenience receptacles, and the point where they exit from the 8pre USB.
12. Power switch - Install the 8pre USB so that the power switch can be accessed and operated at all times.
13. Disconnect - The main plug is considered to be the disconnect device for the 8pre USB and shall remain readily operable.
14. Accessories - Only use attachments/accessories specified by the manufacturer.
15. Placement - Use only with the cart, stand, tripod, bracket or table specified by the manufacturer, or sold with the 8pre USB. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
16. Surge protection - Unplug the 8pre USB during lightning storms or when unused for long periods of time.
17. Servicing - Refer all servicing to qualified service personnel. Servicing is required when the 8pre USB has been damaged in any way, such as when a power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the 8pre USB, the 8pre USB has been exposed to rain or moisture, does not operate normally, or has been dropped.
18. Power Sources - Refer to the manufacturer's operating instructions for power requirements. Be advised that different operating voltages may require the use of a different line cord and/or attachment plug.
19. Installation - Do not install the 8pre USB in an unventilated rack, or directly above heat-producing equipment such as power amplifiers. Observe the maximum ambient operating temperature listed below.
20. Power amplifiers- Never attach audio power amplifier outputs directly to any of the unit's connectors.
21. Replacement Parts - When replacement parts are required, be sure the service technician has used replacement parts specified by the manufacturer or have the same characteristics as the original part. Unauthorized substitutions may result in fire, electric shock or other hazards.
22. Safety Check - Upon completion of any service or repairs to this MOTU 8pre USB, ask the service technician to perform safety checks to determine that the product is in safe operating conditions.

ENVIRONMENT

Operating Temperature: 10°C to 40°C (50°F to 104°)

TO REDUCE THE RISK OF ELECTRICAL SHOCK OR FIRE

⚠ **CAUTION** RISK OF ELECTRIC SHOCK DO NOT OPEN ⚡

Do not handle the power cord with wet hands. Do not pull on the power cord when disconnecting it from an AC wall outlet. Grasp it by the plug. Do not expose this apparatus to rain or moisture. Do not place objects containing liquids on it.

AC INPUT

100 - 240VAC ~ • 50 / 60Hz • 7 Watts.

Contents

Part 1
Getting Started

Quick Reference: 8pre USB USB Front Panel

1. Each analog input has individual front panel controls, including a preamp gain knob, 48 volt phantom power on/off switch and -20 dB pad switch. There is 48 dB of preamp gain for the mic input and 39 dB for the quarter-inch instrument input.

2. The VOLUME knob is a rotary encoder that can be pushed as well as turned:

   ▪ Turn it to adjust headphone volume. In the LED section to the right, the row of amber LEDs, second from the top, provides general feedback regarding the headphone level as you turn the knob.

   ▪ Push in the knob twice (so that it clicks two times) and then turn it to adjust the volume of the main outs on the rear panel. In the LED section to the right, the middle row of green LEDs, third from the bottom, provides general feedback regarding the headphone level as you turn the knob.

   ▪ Push in and hold the knob for 3 seconds to enter a mode where you can change the clock source. In this mode, the CLOCK LED flashes, turn the knob to change the clock mode. Push it again to exit clock mode.

   ▪ Push and hold the knob for 5 seconds to enter a mode where you can change 2x optical input and output (88.2 or 96kHz) to Type I (for 2x optical connection to SMUX-compatible products) or Type II (for 2x optical connection to MOTU products). The bottom LED in the "1" or "2" column flashes. Turn the volume knob to switch between Type I and II, respectively.

3. These eight 5-segment meters show input signal level for the mic/instrument XLR/combo inputs on the rear panel. When you turn the volume knob, which is a digital rotary encoder, the row of amber LEDs, second from the top, provides general feedback regarding the headphone level as you turn the knob. The scale goes from left to right, where all LEDs are illuminated at full headphone

volume. The middle row of green LEDs (third from the bottom) performs a similar role for the main out volume adjustment.

4. When the 8pre USB is connected to a computer with USB, and the computer is turned on, the 8pre USB functions as an audio interface. When the computer is off or not connected, the 8pre USB functions as an analog-to-digital converter. The *Interface* and *Converter* LEDs indicate which mode the 8pre USB is in.

5. The CLOCK LEDs indicate the current clock source and sample rate. Choose 44.1, 48, 88.2 or 96kHz to operate the 8pre USB under its own internal clock at the chosen sample rate. To resolve the 8pre USB to another digital audio device via connection to its optical input, choose either *optical in 1x* (for 44.1 or 48 kHz) or *optical in 2x* (for 88.2 or 96 kHz). If you are resolving to optical at 2x, choose Type II for MOTU products or Type I for third-party products, as described earlier in item number 2.

6. This is a standard quarter-inch stereo headphone jack. From the factory, its output matches the main outs on the rear panel. But it can be programmed to mirror any other (optical) output pair. It can even be programmed to serve as its own independent output. Use the volume knob above to control its level.

7. These eight preamp gain knobs provide 48 dB of preamp gain for the mic input and 39 dB for the quarter-inch hi-Z TRS guitar/instrument input. Both inputs have preamps, so you can plug just about anything into them: a microphone, a guitar, a synth. Use the trim knob and the analog input level meters over in the metering section to calibrate the input signal level. The meters cover both the TRS and XLR input.

8. The 48V phantom power switches provide phantom power for condenser microphones.

9. Engage the PAD switch to apply a -20 dB reduction in level.

Quick Reference: 8pre USB USB Rear Panel

1. The two ADAT optical ("lightpipe") ports in the top row provide eight channels of digital input and output at 44.1 and 48 kHz. At the 2x sample rates (88.2 or 96 kHz), the top row provides channels 1-4 (in and out) and the bottom row provides channels 5-8 (in and out). When operating the optical ports at a 2x sample rate, be sure to choose either Type I or Type II operation, as explained in item 2. on the previous page.

   When the 8pre USB is connected to a computer, these optical ports provide digital input and output to and from the computer.

   When the 8pre USB is not connected directly to a computer (with USB), the optical input is disabled and the eight optical output channels mirror any incoming signal on the 8pre USB's eight XLR/TRS combo jack analog inputs. By connecting the 8pre USB to another device, such as another ADAT-optical equipped interface or a digital mixer, you add an additional eight mic inputs to your system.

   When the 8pre USB is slaving to its optical input, it resolves to the input in the top row, even when operating at the 2x sample rates (88.2 or 96 kHz).

   When the 8pre USB is operating at the 1x sample rates (44.1 or 48 kHz), the optical output in the bottom row mirrors the 8-channel optical output in the top row, allowing you to send the 8pre USB optical output to two different destinations in your studio, if needed.

2. Connect a MIDI device here using standard MIDI cables. Connect the 8pre USB's MIDI OUT port to the MIDI IN port on the other device. Conversely, connect the 8pre USB's MIDI IN port to the MIDI OUT port on the other device. You can connect different devices to each port, such as a controller device to the IN port and a sound module to the OUT port. You can also daisy-chain MIDI devices, but be sure to manage their MIDI channels (so that they don't receive or transmit on the same channel).

3. Connect the 8pre USB to the computer here using the standard USB cable provided with your unit. If you need to connect other USB devices, use a USB 2 hub.

4. These two balanced, quarter-inch jacks serve as the 8pre USB's main outputs. You can connect them to a set of powered studio monitors and then control the volume from the front panel volume knob. To hear disk tracks in your audio software on these main outs, assign the disk tracks (and master fader) to these main outs (Main Out 1-2). You can also use CueMix DSP to monitor live 8pre USB inputs here as well.

5. These eight XLR/TRS combo jack accepts either a mic cable or a cable with a quarter-inch plug. The preamp for each input delivers 48 dB of preamp gain for the mic input and 39 dB for the quarter-inch hi-Z TRS guitar/instrument input. Each XLR (mic) input can be supplied with 48V phantom power or -20 dB pad via its corresponding front-panel switches.

Quick Reference: MOTU Audio Console

Choose the global sample rate for the system here.

Determines the clock source for your 8pre. If you're just using the analog ins and outs, set this to 'Internal'. The other settings are for digital transfers (via optical) or external synchronization to other systems.

Uncheck this option if the Windows audio software you are using with the 8pre USB does not support Windows WaveRT drivers and instead only supports WDM drivers.

Click the tabs to access general MOTU interface settings or settings specific to the 8pre (or other connected interface.)

When operating the 8pre as an interface, choosing a smaller setting here reduces the delay you may hear when listening to live input that you are running through effects plug-ins in your software. But lower settings also increase the strain on your computer. For details, see "Samples Per Buffer" on page 28.

This option should always be left on (checked). There are only a few rare cases in which you would want to turn it off.

This menu lets you choose what you will hear from the headphone jack. To mirror the main outs, choose *Main Out 1-2*. Or you can mirror any other output pair. To hear the phones as their own independent output, choose *Phones 1-2*.

Click the 8pre tab to access these settings.

Lets you enable or disable the optical input and/or output to conserve USB bus bandwidth. For details, see "Optical input/output" on page 30.

MOTU Audio Console in Cubase

How to access these settings

There are several ways to access these settings:
- From the Windows Start menu, choose Programs>MOTU>MOTU Audio Console.
- From within Cubase, go to the Device Setup window, click the MOTU Audio ASIO list item and and click the *Control Panel* button.
- From within other applications, refer to their documentation.
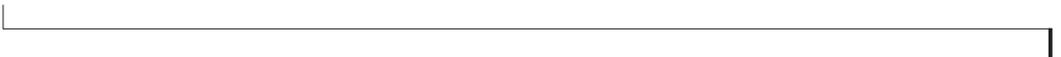
About the 8pre USB

OVERVIEW

The 8pre USB is and audio interface that can operate in two general modes: as a USB audio interface or as an analog-to-digital converter.

With a standard 19-inch, single-space, rack-mountable I/O form factor, the 8pre USB connects directly to a computer with a standard USB cable or to another interface with an ADAT optical cable.

As a USB audio interface, the 8pre USB is a complete computer-based hard disk recording system for Mac OS X and Windows that offers eight high-quality mic inputs and at any standard sample rate up to 96kHz, plus one bank of ADAT optical digital I/O that provides 8 channels of digital I/O at any sample rate up to 96 kHz. At 88.2 or 96 kHz, a second bank of dedicated ADAT optical jacks provide input and output on channels 5-8.

When the 8pre USB is not connected to a computer, it operates as an analog-to-digital converter. By connecting the 8pre USB's optical ports to another audio interface, digital mixer or other digital audio system that supports 8-channel ADAT optical I/O, the 8pre USB becomes an 8-channel analog-to-optical expansion interface that adds eight high-quality mic inputs to the system.

The 8pre USB offers the following features:

■ Eight 24-bit analog combo XLR/TRS mic/instrument inputs with preamps

■ Digitally controlled preamp gain, -20 dB pad switch, and 48V phantom power for each mic input, adjustable from the front panel and from the computer

■ Two 24-bit analog TRS main outputs

■ Eight-channel ADAT optical digital I/O at sample rates up to 96 kHz

■ MIDI I/O

■ On-board SMPTE synchronization

■ Headphone jack

■ Main volume knob (for headphone + main outs)

■ Front-panel 5-segment input meters

■ Front-panel mode and clock status LEDs

■ No-latency analog to digital conversion from the eight analog inputs to the eight ADAT optical digital outputs

With its XLR/TRS combo jack inputs, mic preamps, no-latency monitoring of live input and synchronization capabilities, the 8pre USB is a complete, portable "studio in a box" when used with a Mac or Windows computer.

THE 8PRE USB I/O REAR PANEL

The 8pre USB rear panel has the following connectors:

■ Two gold-plated, balanced +4dB quarter-inch (TRS) analog outputs (with 24-bit 96kHz converters)

■ Eight 24-bit analog combo XLR/TRS mic/instrument inputs with preamps, each equipped with individually switchable 20 dB pad, 48V phantom power and 24-bit 96kHz converters

■ Two sets of ADAT optical 'light pipe' connectors (8 channels of ADAT optical I/O at all supported sample rates)

■ MIDI IN and MIDI OUT

■ One USB jack

16 inputs and 12 outputs

When operating as a USB audio interface, all 8pre USB inputs and outputs can be used simultaneously, for a total of 16 inputs and 12 outputs:

Connection	Input	Output
Mic preamps 24-bit 96kHz on XLR/TRS combo	8	-
Main outputs 24-bit 96kHz on bal/unbal TRS	-	stereo
Headphone output	-	stereo
ADAT optical digital (from 44.1 up to 96 kHz)	8	8
Total	**16**	**12**

All inputs and outputs are discrete. In other words, using a mic input does not "steal" an input from the ADAT optical I/O bank. The same is true for the headphone outs and the main outs.

The two banks of ADAT optical ports provide eight channels of input and output at 88.2 or 96 kHz. The upper bank provides channels 1-4 and the lower bank provides channels 5-8.

The headphone output can operate as an independent output pair, or it can mirror any other 8pre USB output pair, such as the main outs.

Mic inputs with 48V phantom power

Eight rear-panel combo (XLR/TRS) jacks with preamps, phantom power and 20 dB pad let you to connect a microphone, guitar or any quarter-inch input. The XLR jack serves as a mic input, and the TRS jack serves as a high-impedance guitar/instrument or line-level input. Dedicated front-panel gain knobs allow you to adjust each input independently. Defeatable 48V phantom power and 20dB pad are supplied by convenient front panel switches.

Converters

All eight analog inputs are equipped with 24-bit 96kHz, 64x oversampling A/D converters. The main outs have 24-bit 128x oversampling D/A converters. All audio is carried to the computer in a 24-bit data stream.

Main Outs

The main outs are equipped with 24-bit 128x oversampling D/A converters and serve as independent outputs for the computer. The main outputs are on balanced TRS +4dB quarter-inch jacks. Both of these jacks can also accept unbalanced plugs.

Optical

The 8pre USB provides two banks of optical "lightpipe" jacks that support the ADAT optical digital I/O format. At 44.1 or 48 kHz, the upper bank provides eight channels of 24-bit digital audio, and the lower bank simply mirrors all 8 channels of the upper bank.

At 88.2 or 96 kHz, the upper bank handles channels 1-4 and the lower bank handles channels 5-8 via the industry Standard S/MUX ("Type I") protocol for third-party product or MOTU's own "Type II" protocol for connecting the 8pre USB optically to any MOTU audio interface. For details, see "Setting the 2x optical mode" on page 31.

MIDI I/O

The 8pre USB's standard MIDI IN and MIDI OUT jacks supply 16 channels of MIDI I/O to and from the computer via the 8pre's USB connection.

Hi-speed USB 2.0

The 8pre USB connects to any Mac or PC equipped with a Hi-speed USB 2.0, which provides enough bus bandwidth to easily handle all simultaneous inputs and outputs.

On-board SMPTE synchronization

The 8pre USB can resolve directly to SMPTE time code via any analog input, without a separate synchronizer. The 8pre USB can also generate SMPTE time code via any analog output. The 8pre USB provides a DSP-driven phase-lock engine with sophisticated filtering that provides fast lockup times and sub-frame accuracy.

The included MOTU SMPTE Console™ software provides a complete set of tools to generate SMPTE for striping, regenerating or slaving other devices to the computer. Like CueMix DSP, the synchronization features are cross-platform.

THE 8PRE USB FRONT PANEL

Preamp gain, 48V phantom power and pad

The 8pre USB front panel provides convenient, individual gain control, 48-volt phantom power switch and 20 dB pad switch for each analog input.

Headphone output and main volume control

The 8pre USB front panel includes a quarter-inch stereo headphone output jack and volume knob. The volume knob also controls the rear-panel main outs. Push the knob to toggle between them.

Metering section

The front panel of the 8pre USB displays input metering. The five-segment input meters provide dedicated multi-segment metering for their respective analog inputs.

The *Mode* lights indicate whether the interface is currently operating as a USB audio interface or an analog-to-optical converter.

The *Clock* lights indicate the global sample rate and clock source.

16-BIT AND 24-BIT RECORDING

The 8pre USB system handles all data with a 24-bit signal path, regardless of the I/O format. You can record and play back 16-bit or 24-bit audio files at any supported sample rate via any of the 8pre USB's analog or digital inputs and outputs. 24-bit audio files can be recorded with any compatible host application that supports 24-bit recording.

INCLUDED SOFTWARE

The 8pre USB software installer provides the following including cross-platform software applications for Mac and Windows.

MOTU Audio Console

MOTU Audio Console provides access to basic hardware settings, such as sample rate, optical I/O format selection, headphone output channel selection, foot switch input programming, and other settings.

MOTU SMPTE Console

MOTU SMPTE Console provides access to the 8pre USB system's SMPTE time code synchronization features, including locking to time code, generating time code, displaying a time code readout, and so on.

CueMix FX

CueMix FX gives you complete control over the 8pre USB's CueMix DSP on-board mixer, which provides no-latency monitoring and mixing of live inputs through your 8pre USB.

CueMix FX provides attractive graphic mixing for quick access to all mixing features, digitally controlled gain, and other settings in your MOTU audio interface.

CueMix FX provides many advanced features, such as an accurate instrument tuner and an extensive arsenal of audio analysis tools, including a real-time FFT, spectrogram "waterfall" display, oscilloscope, and phase analysis tools.

HOST AUDIO SOFTWARE

The 8pre USB system ships with Windows drivers that allows you to record, edit, play back and mix your 8pre USB projects using your favorite Windows audio software.

CHAPTER 2 Packing List and System Requirements

PACKING LIST

The 8pre USB ships with the items listed below. If any of these items are not present in your 8pre USB box when you first open it, please immediately contact your dealer or MOTU.

- One 8pre USB I/O rack unit

- One set of removable rack brackets

- One USB cable

- Power cord

- One 8pre Mac/Windows manual

- One cross-platform installer disc

- Product registration card

WINDOWS SYSTEM REQUIREMENTS

The 8pre USB system requires the following Windows system:

- A 1 GHz Pentium-based PC compatible or faster equipped with at least one USB2 port

- 1 GB RAM; 2 GB or more recommended

- Windows 8, 7 or Vista, 32- or 64-bit; Vista SP 2 or later required

- Available Hi-speed USB 2.0 port

- A large hard drive (preferably at least 250 GB)

PLEASE REGISTER TODAY!

Please register your 8pre USB today. There are two ways to register.

- Visit www.motu.com/register

OR

- Fill out and mail the included product registration card

As a registered user, you will be eligible to receive technical support and announcements about product enhancements as soon as they become available. Only registered users receive these special update notices, so please register today.

Thank you for taking the time to register your new MOTU products!

CHAPTER 3 Installing the 8pre USB Software

OVERVIEW

INSTALLATION

Before you connect the 8pre USB to your computer and power it on, run the 8pre USB software installer. This ensures that all the 8pre USB components are properly installed in your system.

☛ If you've already connected the 8pre USB to your computer and powered it on, Windows may issue an alert notifying you that the 8pre USB requires drivers, followed by another window asking you to locate the drivers. If this happens:

1 Cancel the driver search.

2 Power off and disconnect the 8pre USB.

3 Run the MOTU Audio Installer as instructed in the next section.

Run the MOTU Audio installer

Install the 8pre USB software as follows:

1 Insert the MOTU Audio Installer disc; or, if you have downloaded the MOTU Audio installer, locate the folder containing the download.

2 Read the *Read Me* file for installation assistance and other important information.

3 Open the *Setup Audio* application.

4 Follow the directions that the installer gives you.

Drivers are installed, along with MOTU Audio Console, CueMix FX, and other components, summarized in the table below.

Software component	Purpose	For more information
MOTU Audio and MIDI drivers	Provides multi-channel audio input and output for MOTU FireWire and USB Audio devices with host audio software.	"MOTU Audio drivers" on page 18
MOTU Audio Console	Provides access to all of the settings in the 8pre USB and other MOTU interfaces. Required for 8pre USB operation.	chapter 5, "MOTU Audio Console" (page 27)
CueMix FX	Gives you complete control over the 8pre USB's CueMix DSP on-board mixer, which provides no-latency monitoring and mixing of live inputs through your 8pre USB.	chapter 9, "CueMix FX" (page 47)
MOTU SMPTE Console	Provides access to the 8pre USB system's SMPTE time code sync features.	chapter 10, "MOTU SMPTE Console" (page 73)

MOTU AUDIO DRIVERS

ASIO

ASIO is an acronym for *Audio Streaming Input and Output*. The MOTU Audio ASIO driver provides multi-channel audio input and output for applications that support ASIO audio drivers, such as Ableton Live, Avid Pro Tools, Cakewalk SONAR, Cockos Reaper, Propellerhead Reason and Record, Steinberg Cubase and Nuendo, and others.

For details about using the 8pre USB with ASIO, see chapter 7, "Configuring Host Audio Software" (page 33).

WDM

WDM is an acronym for *Windows Driver Model*. The MOTU Audio WDM driver provides multi-channel audio input and output for applications that support WDM audio drivers.

For details about using the 8pre USB with WDM, see chapter 7, "Configuring Host Audio Software" (page 33).

WaveRT

Uncheck this option (Figure 5-1 on page 28) if the Windows audio software you are using with your MOTU audio interface does not support Windows WaveRT drivers and instead only supports WDM drivers.

MOTU AUDIO CONSOLE

MOTU Audio Console (available in the Start menu) gives you access to all of the settings in the 8pre USB, such as the clock source and sample rate. For complete details, see chapter 5, "MOTU Audio Console" (page 27).

MOTU MIDI DRIVER

This driver allows you to access the 8pre USB's MIDI input and output ports. The ports are published in Windows and are available to all MIDI software.

CUEMIX FX

CueMix FX (available in the Start menu) provides control over the 8pre USB's no-latency CueMix FX on-board mixing, an instrument tuner, a full-featured oscilloscope, and other audio analysis tools. For details, see chapter 9, "CueMix FX" (page 47).

MOTU SMPTE CONSOLE

MOTU SMPTE Console (available in the Start menu) software provides a complete set of tools to resolve the 8pre USB to SMPTE time code, and to generate SMPTE for striping, regenerating or slaving other devices to the computer. For details, see chapter 10, "MOTU SMPTE Console" (page 73).

CHAPTER 4   Installing the 8pre USB Hardware

OVERVIEW
Here's an overview for installing the 8pre USB:

CONNECT THE 8PRE USB TO YOUR COMPUTER
1 Plug one end of the 8pre USB cable (included) into a USB socket on the computer.

2 Plug the other end of the USB cable into the 8pre USB I/O.

CONNECT AUDIO INPUTS AND OUTPUTS
The 8pre USB audio interface has the following audio input and output connectors:

■ 8 combo XLR/quarter-inch analog mic/instrument/line inputs

■ 2 balanced, +4 dB quarter-inch TRS main outs

■ 2 pair of ADAT optical ("Lightpipe") in/out

Here are a few things you should keep in mind as you are making these connections to other devices.

Mic/instrument/line inputs
Connect a microphone, line-level signal, guitar or other similar instrument to any XLR/quarter-inch combo jack input on the rear panel. If your microphone requires phantom power, engage the 48V phantom power switch on the front panel. Use the gain knobs on the front panel to adjust the preamp gain as needed for each input. The gain knob provides approximately 48 dB of gain for the XLR mic input and 39 dB for the guitar input. Use the input level meters on the front panel (labeled *Analog In*) to calibrate the level. These meters register for both the XLR and TRS input.

If a line level signal is still too hot with the trim turned all the way down, engage the -20dB pad switch on the front panel.

Main outs

The main outputs serve as independent outputs. The main out volume is controlled by the volume knob on the front panel. Push the knob to toggle between phone and main out volume control. In a standard studio configuration, the main outs are intended for a pair of studio monitors, but they can also be used as additional outputs for any purpose.

Optical

The 8pre USB provides 8-channel digital input and output at 44.1, 48, 88.2 and 96 kHz. The 8pre USB rear panel provides two sets of ADAT optical ("lightpipe") connectors: a top row and a bottom row.

Reminder: optical goes OUT to IN and IN to OUT. Input and output are independent. For example, you could connect ADAT optical input from your digital mixer and connect the output to an audio interface connected to your computer.

Optical operation at 44.1 or 48 kHz

When connected to an ADAT "lightpipe" compatible device, the two optical connectors in the top row provide eight channels of digital input and output at 44.1 and 48 kHz.

In addition, when operating the 8pre USB at a 1x sample rate (either 44.1 or 48 kHz), optical output is duplicated on the second (lower) optical output. This lets you send the 8pre USB's 8-channel ADAT optical output to two separate destinations in your studio, if needed.

Optical operation at 88.2 or 96 kHz

When operating the 8pre USB at the 2x sample rates (88.2 or 96 kHz), the top row of optical connectors provides channels 1-4 (in and out) and the bottom row provides channels 5-8 (in and out) when connected to another optical device that supports 88.2/96 kHz optical sample rates.

When operating the optical ports at a 2x sample rate, be sure to choose either Type I or Type II operation, as explained in "Setting the 2x optical mode" on page 31.

Using optical I/O when operating the 8pre USB as an audio interface

When the 8pre USB is connected to a computer (Figure 4-3 on page 22), these optical ports provide digital input and output to and from the computer.

Using optical I/O to operate the 8pre USB as an 8-channel expander

When the 8pre USB is not connected directly to a computer via USB, the optical input is disabled and the eight optical output channels mirror any incoming signal on the 8pre USB's eight XLR/TRS combo jack analog inputs. By connecting the 8pre USB optical output to another device, such as another ADAT-optical equipped interface or a digital mixer, you add an additional eight mic inputs to your system, as demonstrated in Figure 4-4 on page 23. This can be done at any sample rate up to 96 kHz.

To set the sample rate (or clock mode) when operating as an 8-channel optical expander, see "Setting the clock source in converter mode" on page 31.

CONNECT MIDI GEAR

Connect your MIDI device's MIDI IN jack to the 8pre USB's MIDI OUT jack (Connection A below). Conversely, connect the MIDI device's MIDI OUT jack to the 8pre USB's MIDI IN jack (Connection B).
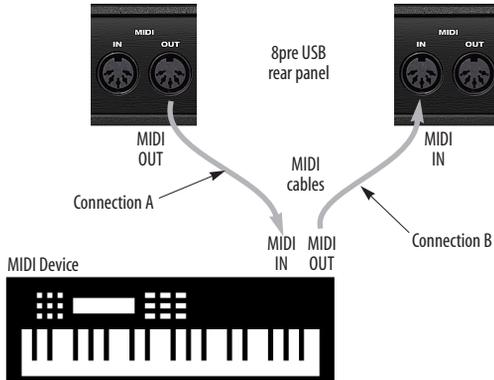
Figure 4-1: Connecting a MIDI device to the 8pre USB.

One-way MIDI connections

MIDI devices that do not receive MIDI data, such as a dedicated keyboard controller, guitar controller, or drum pad, only need Connection B shown in Figure 4-1. Similarly, devices that never send data, such as a sound module, only need Connection A. Make both connections for any device that needs to both send and receive MIDI data.

Connecting additional gear with MIDI THRUs

If you need to connect several pieces of MIDI gear, run a MIDI cable from the MIDI THRU of a device already connected to the 8pre USB to the MIDI IN on the additional device as shown below in Figure 4-2. The two devices then share the 8pre USB's MIDI OUT port. This means that they share the same set of 16 MIDI channels, too, so try to do this with devices that listen to only one MIDI channel (such as effects modules), which makes it easier to avoid MIDI channel conflicts.
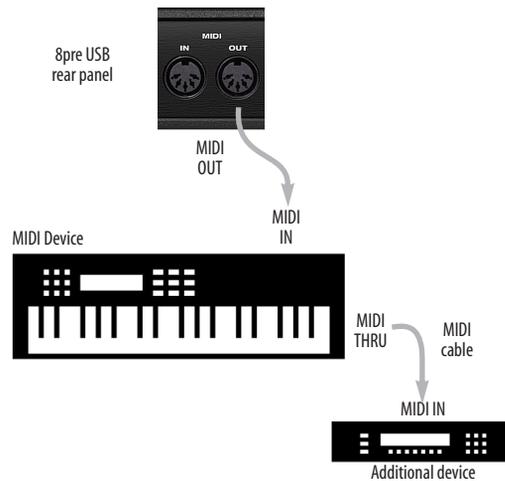
Figure 4-2: Connecting additional devices with MIDI THRU ports.

OPERATING THE 8PRE USB AS AN INTERFACE

Here is a typical studio setup for using the 8pre USB as an audio interface. All mixing and processing can be done in the computer with audio software. During recording, you can use the 8pre USB's CueMix™ DSP no-latency monitoring to listen to what you are recording via the main outs, headphone outs, or any other output pair. You can control monitoring from the included MOTU CueMix FX software.
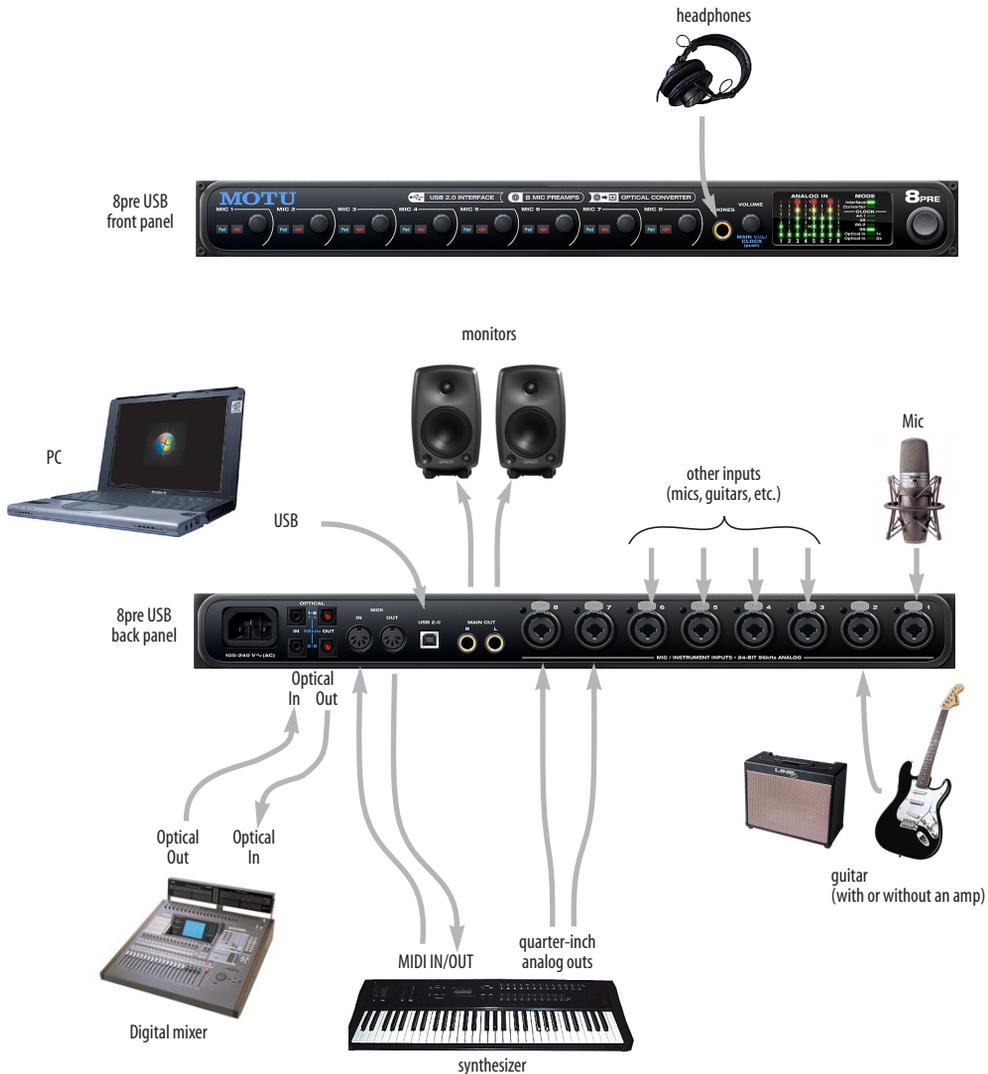
Figure 4-3: A typical 8pre USB studio setup.

OPERATING THE 8PRE USB AS A CONVERTER

As explained earlier in "Using optical I/O to operate the 8pre USB as an 8-channel expander" on page 20, the 8pre USB can serve as an 8-channel analog-to-digital converter when disconnected from the computer and instead connected to another device equipped with an ADAT optical input. For example, you could connect the 8pre USB optical output to the optical input on a MOTU audio interface, such as the 828, Traveler, or 896. The 8pre USB then serves as an 8-channel expander that adds an additional eight mic inputs

to the interface. The benefit of connecting the 8pre USB in this manner (instead of as another USB interface) is that you can seamlessly integrate the 8pre USB's inputs into the on-board no-latency CueMix monitor mixing in the interface, since the 8pre USB's inputs are fed into CueMix via the interface's optical inputs.

If the device to which you are connecting the 8pre USB supports 2x optical sample rates (88.2 or 96 kHz), you'll need to use both banks of connectors as discussed in "Optical operation at 88.2 or 96 kHz" on page 20.
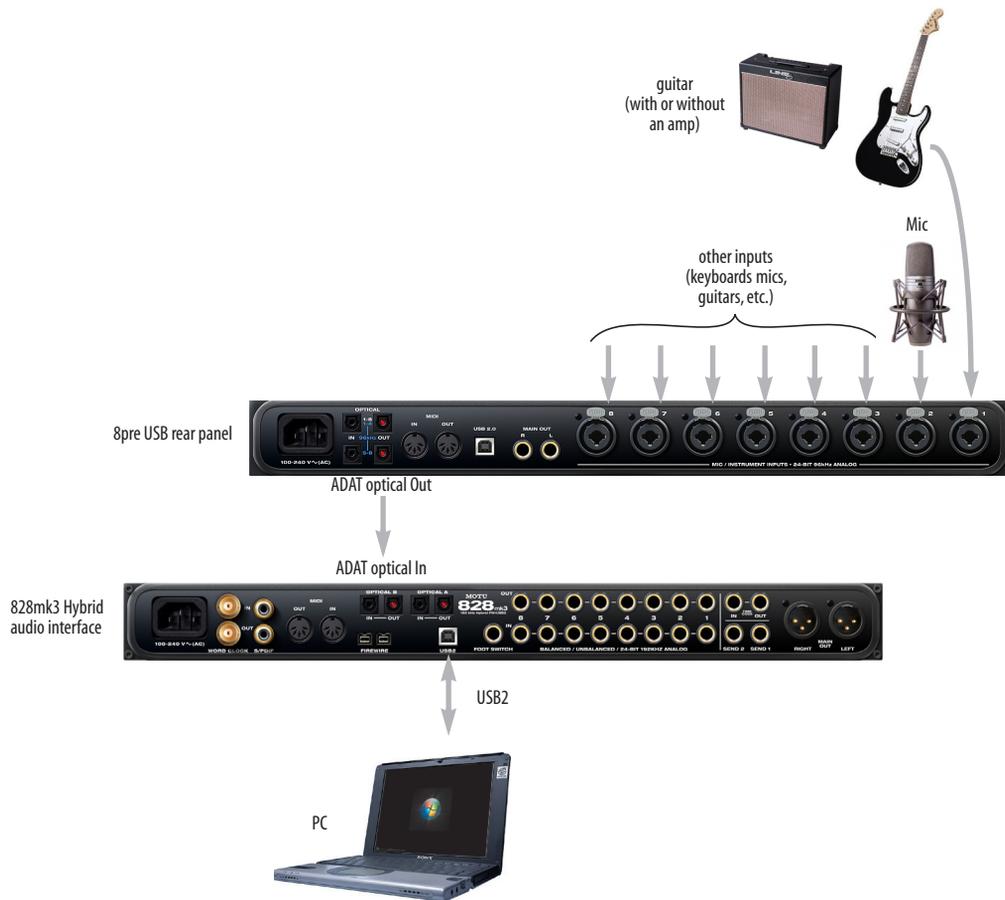
Figure 4-4: Using the 8pre USB as an optical converter.

SYNCING OPTICAL DEVICES

The word *optical* is our short-hand way of referring to any device that connects to the 8pre USB via an optical cable. An example is an audio interface with optical connectors on it. There are many other devices that fall into this category, including digital mixers, digital effects processors, synthesizers and many more.

When connecting *optical* devices, make sure that their digital audio clock is phase-locked (in sync with) the 8pre USB. There are two ways to do this:

- Slave the optical device to the 8pre USB

- Slave the 8pre USB to the optical device

Two banks of optical

The 8pre USB has two banks of optical connectors: a top row and a bottom row:

Figure 4-6: Two optical banks.

When you are operating at the 1x sample rates (44.1 or 48 kHz), use the top two connectors.

When you are operating at the 2x sample rates, (88.2 or 96 kHz), use both sets of connectors. The top row provides channels 1-4 and the bottom row provides channels 5-8, as indicated by the blue labeling on the rear panel (Figure 4-6).

Setting the clock source

In *ADAT optical* clock mode (as demonstrated in the right-hand diagram below), the 8pre USB always resolves to the optical input in the *top row*, even during 88.2 or 96 kHz operation. So be sure to connect the device that is the ADAT optical clock master to the 8pre USB's optical input in the top row.

Optical bank mirroring

When the 8pre USB is operating at the 1x sample rates (44.1 or 48 kHz), the optical output in the bottom row mirrors the 8-channel optical output in the top row.

8pre USB Clock Source setting = *Internal*, or any clock source setting except *Optical*. The optical device slaves to the 8pre USB (via its optical cable connection).

8pre USB

ADAT Optical OUT

ADAT Optical IN

Audio interface or other optical device

With this setup, in MOTU Audio Setup, choose the *Optical* clock source setting. The 8pre USB slaves to the optical device via their optical cable connection.

Audio interface or other optical device

ADAT Optical OUT

ADAT Optical IN

8pre USB

8pre USB Clock Source setting = optical

Figure 4-5: Two setups for synchronizing an optical device with the 8pre

Part 2
Using the 8pre USB

CHAPTER 5   MOTU Audio Console

OVERVIEW

MOTU Audio Console gives you access to basic 8pre USB hardware settings, such as sample rate, clock source, optical format and more.

ACCESSING THE 8PRE USB SETTINGS

There are several ways to access 8pre USB settings:

■ Open MOTU Audio Console from the Windows Start menu > Programs > MOTU.

■ From within your host audio software's audio driver preferences. For example, in Cubase or Nuendo, open the Device Setup window, click *VST Audio System* and choose *MOTU Audio ASIO* from the *ASIO Driver* menu. Then click the *MOTU Audio ASIO* item in the list and click the *Control Panel* button.

☛ Most applications provide access only to basic settings such as sample rate and clock source. For access to all settings, open MOTU Audio Console using one of the techniques above.

General tab settings

The General tab (Figure 5-1) provides settings that apply to all connected MOTU FireWire and USB audio interfaces.

8pre USB tab settings

The 8pre USB tab (Figure 5-1) provides settings that apply to a specific 8pre USB interface. If you have several 8pre USB (or other MOTU) interfaces connected, you'll see a separate tab for each one.

'GENERAL' TAB SETTINGS

Sample Rate

Choose the desired *Sample Rate* for recording and playback. The 8pre USB can operate at 44.1 (the standard rate for compact disc audio), 48, 88.2 or 96KHz. Make absolutely sure that all of the devices connected digitally to the 8pre USB optical connectors match the 8pre USB's sample rate.

☛ Mismatched sample rates cause distortion and crackling. If you hear this sort of thing, check the sample rate settings in your hardware and here in MOTU Audio Console.

Samples Per Buffer

The *Samples Per Buffer* setting lets you reduce the delay you hear when patching live audio through your audio software. For example, you might have a live guitar input that you would like to run through an amp simulation plug-in that you are running in your host audio software. When doing so, you may hear or feel some "sponginess" (delay) between the source and the processed signal. If so, don't worry. This effect only affects what you hear: it is not present in what is actually recorded.

You can use *Samples Per Buffer* setting to reduce this monitoring delay—and even make it completely inaudible.

☛ If you don't need to process an incoming live signal with software plug-ins, you can monitor the signal with no delay at all using CueMix FX, which routes the signal directly to your speakers via hardware. For details, see chapter 9, "CueMix FX" (page 47).

Adjusting the *Samples Per Buffer* setting impacts the following things:

▪ The strain on your computer's CPU
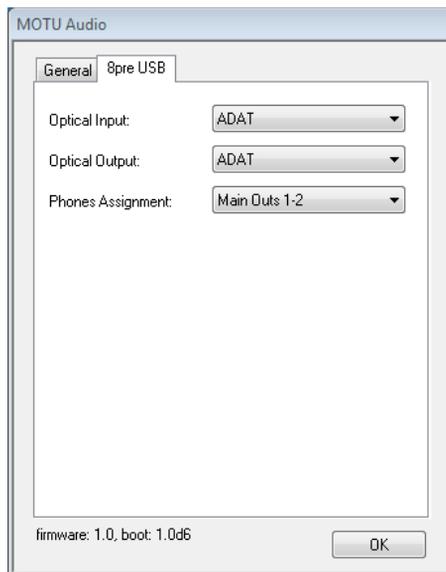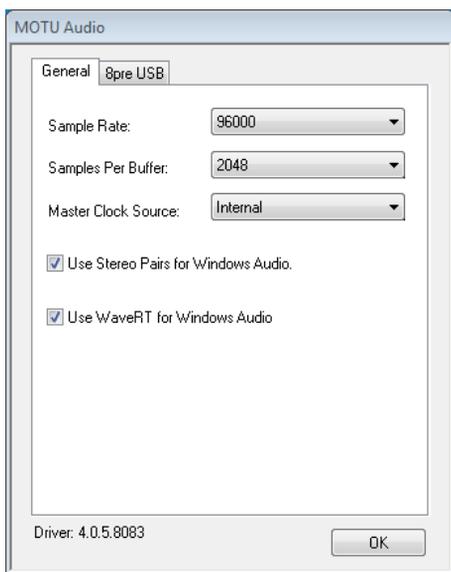
Figure 5-1: MOTU Audio Console gives you access to all of the settings in the 8pre USB hardware.

■ The delay you hear when routing a live signal through your host audio software plug-ins

■ How responsive the transport controls are in your software

This setting presents you with a trade-off between the processing power of your computer and the delay of live audio as it is being processed by plug-ins. If you reduce the *Samples Per Buffer*, you reduce patch thru latency, but significantly increase the overall processing load on your computer, leaving less CPU bandwidth for things like real-time effects processing. On the other hand, if you increase the *Samples Per Buffer*, you reduce the load on your computer, freeing up bandwidth for effects, mixing and other real-time operations. But don't set the *Samples Per Buffer* too low, or it may cause distortion in your audio.

If you don't process live inputs with software plug-ins, leave this setting at its default value of 1024 samples. If you do, try settings of 256 samples or less, if your computer seems to be able to handle them. If your host audio software has a processor meter, check it. If it starts getting maxed out, or if the computer seems sluggish, raise the *Samples Per Buffer* until performance returns to normal.

If you are at a point in your recording project where you are not currently working with live, patched-thru material (e.g. you're not recording vocals), or if you have a way of externally monitoring input, choose a higher *Samples Per Buffer* setting. Depending on your computer's CPU speed, you might find that settings in the middle work best.

The *Samples Per Buffer* setting also impacts how quickly your audio software will respond when you begin playback, although not by amounts that are very noticeable. Lowering the *Samples Per Buffer* will make your software respond faster; raising the *Samples Per Buffer* will make it a little bit slower, but barely enough to notice.

Master Clock Source

The *Master Clock Source* determines the digital audio clock that the 8pre USB will use as its time base. The following sections briefly discuss each clock source setting.

Internal

Use the *Internal* setting when you want the 8pre USB to operate under its own digital audio clock. For example, you may be in a situation where all you are doing is playing tracks off hard disk in your digital audio software on the computer. In a situation like this, you most often don't need to reference an external clock of any kind.

ADAT optical

The *ADAT optical* clock source setting refers to the clock provided by the 8pre USB's optical input, when it is connected to another optical device. This setting only appears in the Master Clock Source menu when the optical input bank is enabled and set to the *ADAT Optical* format, as explained in "Optical input/output" on page 30.

This setting can be used to resolve the 8pre USB directly to the optical input connection, allowing you to resolve the 8pre USB to the other device.

This setting is useful if you just need to make a simple, click-free digital transfer between the 8pre USB and another device.

☛ The 8pre USB has two banks of optical connectors: a top row (for 8-channel operation at 44.1 or 48 kHz) and a bottom row (for channels 5-8 at 88.2 or 96 kHz). In ADAT optical clock mode, the 8pre USB always resolves to the optical input in the *top row*, even during 88.2 or 96 kHz operation. So be sure to connect the ADAT optical clock master to the optical input in the top row.

If the *ADAT Optical* setting does not appear in the menu, it means that the 8pre USB's optical input is currently turned off. Choose the *ADAT optical* format from the Optical input menu (Figure 5-1 on page 28).

For further details about this setting, see "Syncing optical devices" on page 24.

SMPTE
Choose this setting to resolve the 8pre USB directly to SMPTE time code (LTC) being received via one of the 8pre USB's audio inputs. For details, see "Setup for SMPTE time code sync" on page 76 and chapter 10, "MOTU SMPTE Console" (page 73).

Use stereo pairs for Windows audio
Some legacy Windows audio applications require audio channels to be grouped in stereo pairs. If you are using old Windows audio software, and you are having issues accessing Audio Express channels from within the software, try enabling the *Use Stereo Pairs for Windows Audio* option.

Use WaveRT for Windows audio
If your host software supports WaveRT, enable this option. Consult your host application documentation for details.

8PRE USB TAB SETTINGS

Optical input/output
The *Optical input* and *Optical output* settings let you enable the 8pre USB's 8-channel ADAT optical ('lightpipe') input and output. If you are not using the optical connections, it is recommended that you turn them off (by choosing *Disabled* from the menu) to reduce bandwidth and processing overhead.

Phones Assignment
The *Phones Assignment* setting lets you choose what you will hear from the headphone jack. Choose *Main Out 1-2* if you'd like the headphone output to match the main outs. Choose *Phones 1-2* if you would like the headphones to serve as their own independent output, which you can access as an independent output destination in your host audio software and as an output destination for the four on-board CueMix FX mix busses.

CHAPTER 6   Front Panel Settings

OVERVIEW

The VOLUME knob is a rotary encoder that can be pushed as well as turned. By pushing it repeatedly, or by pushing and holding it in for varying amounts of time, you can adjust several 8pre USB settings as described in the following sections.
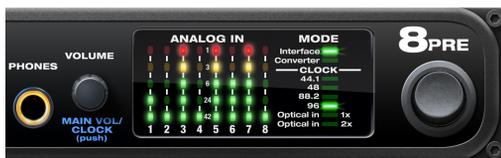
Figure 6-1: The VOLUME knob is a push-button rotary encoder.

Except where noted, all of the features described in this chapter are available when the 8pre USB is operating as either an audio interface or an optical converter.

ADJUSTING HEADPHONE VOLUME

Turn the VOLUME knob to adjust headphone volume. In the *Analog In* LED section to the right, the row of amber LEDs, second from the top, provides general feedback regarding the headphone level as you turn the knob.
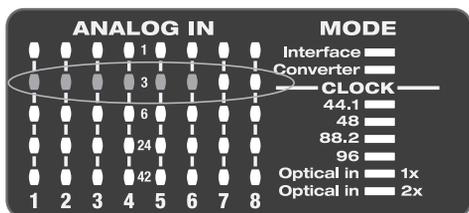
Figure 6-2: When you adjust headphone volume, the amber row of LEDs (second from the top) provides feedback as you turn the rotary encoder.

ADJUSTING MAIN OUT VOLUME

Push in the knob twice (so that it clicks two times) and then turn it to adjust the volume of the main outs on the rear panel. In the LED section to the

right, the middle row of green LEDs, third from the bottom, provides general feedback regarding the headphone level as you turn the knob.
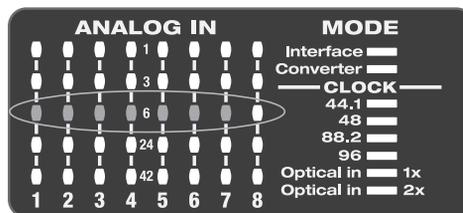
Figure 6-3: When you adjust main out volume, the top-most green row of LEDs, third from the bottom, provides feedback as you turn the rotary encoder.

SETTING THE 2X OPTICAL MODE

Push and hold the knob for 5 seconds to enter a mode where you can change 2x optical input and output (88.2 or 96kHz) to Type I (for 2x optical connection to SMUX-compatible products) or Type II (for 2x optical connection to MOTU products). The bottom LED in the "1" or "2" column flashes. Turn the volume knob to switch between Type I and II, respectively.
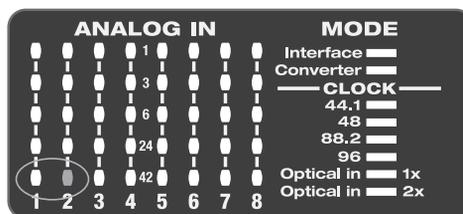
Figure 6-4: Setting the optical mode.

SETTING THE CLOCK SOURCE IN CONVERTER MODE

When the 8pre USB is operating as an optical converter (when it is not connected to a computer via USB), push in and hold the VOLUME knob for 3 seconds to enter a mode where you can change the clock source. In this mode, the CLOCK LED

flashes, turn the knob to change the clock mode.
Push it again to confirm the current clock setting
exit clock mode.

CHAPTER 7   Configuring Host Audio Software

OVERVIEW

The 8pre USB provides multi-channel audio input and output for ASIO- and WDM-compatible audio applications, including Ableton Live, Avid Pro Tools, Cockos Reaper, Propellerhead Reason and Record, Steinberg Cubase and Nuendo, Cakewalk SONAR, and others.

Additionally, sample-accurate synchronization is possible with applications that support ASIO 2 or 3's sample-accurate positioning protocol.

PREPARATION

To make sure that everything is ready for your host audio software, install your host audio software first (if you haven't already done so), and then see these chapters before proceeding:

■ chapter 3, "Installing the 8pre USB Software" (page 17)

chapter 4, "Installing the 8pre USB Hardware" (page 19).

RUN MOTU AUDIO CONSOLE

Before you run your host audio software, launch MOTU Audio Console to configure your 8pre USB hardware.

MOTU Audio Console provides settings to configure your audio interface and enable the desired inputs and outputs. Only enabled inputs and outputs will be available to your software, so this is an important step. For complete details see chapter 5, "MOTU Audio Console" (page 27).
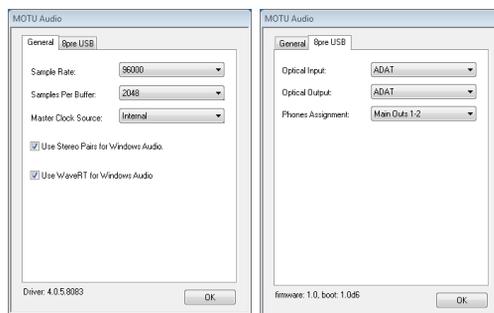
Figure 7-1: MOTU Audio Console.

For complete details about the 8pre USB settings, see chapter 5, "MOTU Audio Console" (page 27). The following sections provide a brief explanation of each 8pre USB setting.

Sample rate

Choose the desired overall sample rate for the 8pre USB system and your host audio software. Newly recorded audio will have this sample rate.

Master Clock Source

This setting is very important because it determines which audio clock the 8pre USB will follow.

If you do not have any digital audio connections to your 8pre USB (you are using the analog inputs and outputs only), and you will not be slaving your host software to external SMPTE time code, choose *Internal*.

If you have devices connected to the 8pre USB optical ports, see "Syncing optical devices" on page 24.

If you are slaving the 8pre USB and your host software to SMPTE time code, follow the directions in chapter 10, "MOTU SMPTE Console" (page 73).

☛ In order to use the 8pre USB's direct SMPTE sync (and sample-accurate sync) feature, the host audio software must support the ASIO 2.0 sample-accurate positioning protocol. Cubase and Nuendo support this protocol; for other software, check with its documentation.

Samples Per Buffer

The *Samples Per Buffer* setting can be used to reduce the delay — or *monitoring latency* — that you hear when live audio is patched through your 8pre USB hardware and host audio software. For example, you might have MIDI instruments, samplers, microphones, and so on connected to the analog inputs of the 8pre USB. If so, you will often be mixing their live input with audio material recorded in your audio software. See chapter 8, "Reducing Monitoring Latency" (page 41) for complete details.

Phones Assign

This 8pre USB setting lets you choose what you'll hear from the headphone jack. For example, if you choose *Main Out 1-2*, the headphones will duplicate the main outs. Or you can choose any other output pair. If you choose *Phones 1-2*, this setting makes the headphone jack serve as its own independent output pair. As a result, you'll see *Phones 1-2* as an additional audio destination in your host's audio output menus.

Optical input and output

To make an 8pre USB optical input or output available in your host software, choose *ADAT optical* from the optical input and/or output menu. If you won't be using the optical connectors, turn them off.

Main Outs Assign

Use the Main Outs Assign setting to determine what audio you will hear on the main outs of the 8pre USB. If you would like to treat them as their own separate output pair, choose *Main Out 1-2*.

CHOOSING THE MOTU AUDIO DRIVER

Once you've made the preparations described so far in this chapter, you're ready to run your audio software and enable the MOTU Audio driver. Check the audio system or audio hardware configuration window in your software. There will be a menu there that lets you choose among various drivers that may be in your system. Choose the desired MOTU Audio driver from this menu. Several driver options are available. For a summary, see "MOTU Audio drivers" on page 18.

Pro Tools

In Avid Pro Tools, go to the Setup menu and choose *Playback Engine* as shown in Figure 7-2. Choose the *MOTU Audio ASIO* from the Current Engine menu. For information about the *H/W Buffer Size* setting, see "Adjusting the audio I/O buffer" on page 43.

☛ Pro Tools 9 or later is required for operation with the 8pre USB.
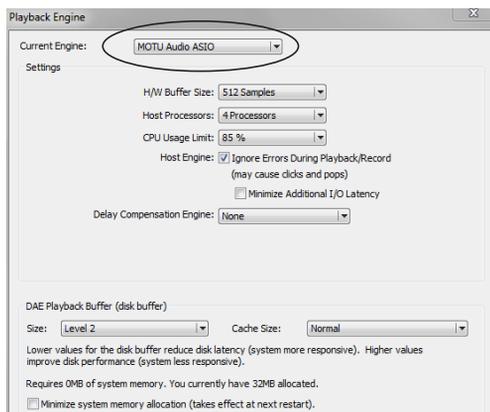
Figure 7-2: Enabling the MOTU Audio ASIO driver in Pro Tools

Cubase and Nuendo

In Cubase or Nuendo, go to the *Device Setup* window. Click the *VST Audio System* item in the Devices list and choose *MOTU Audio ASIO* from the *ASIO Driver* menu as shown below in Figure 7-3. Activate the inputs and outputs within Cubase or Nuendo as usual.
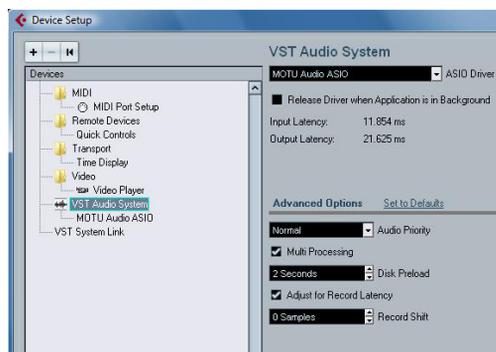
Figure 7-3: Enabling the MOTU Audio ASIO driver in Cubase

CONFIGURING HOST AUDIO SOFTWARE

Live

In Ableton Live, access the preferences window and click the *Audio* tab. Choose *ASIO* from the *Driver Type* menu. Choose the *MOTU Audio ASIO* from the *Input Audio Device* and *Output Audio Device* menus as shown below in Figure 7-4. To enable or disable input or output channels, click the *Input Config* or *Output Config* buttons.
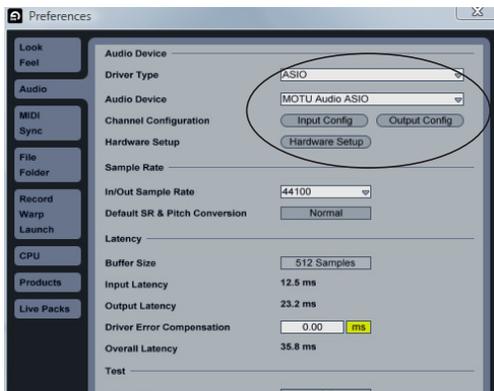
Figure 7-4: Enabling the MOTU Audio ASIO driver in Live

Reason and Record

In Propellerhead Reason or Record, go to the Preferences window, choose *Audio* preferences from the menu and choose *MOTU Audio ASIO* from the *Audio Card Driver* menu as shown below in Figure 7-5.
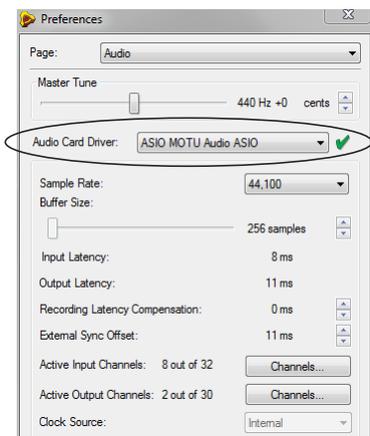
Figure 7-5: Enabling the MOTU Audio ASIO driver in Reason

Reaper

In Cockos Reaper, access the Preferences and click *Devices* under the *Audio* preferences. Choose *ASIO* for the audio system and choose *MOTU Audio ASIO* from the ASIO driver menu as shown below in Figure 7-6.
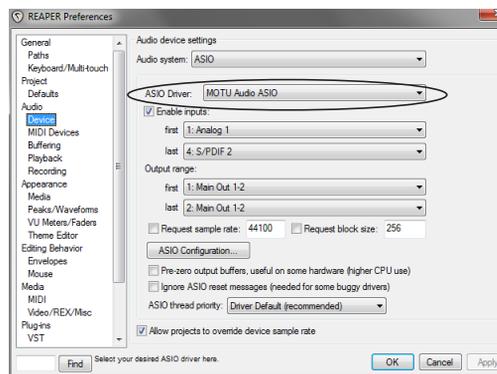
Figure 7-6: Enabling the MOTU Audio ASIO driver in Reaper

SONAR

In Cakewalk SONAR, you can use the MOTU ASIO driver or the MOTU WDM driver. Note that when using ASIO, only one audio interface may be selected for use in SONAR.

Using the MOTU ASIO driver

1 Go to SONAR's Preferences.

2 In the Audio preferences section, choose *Playback and Recording*.

3 Choose ASIO as the Driver Mode, as shown below.
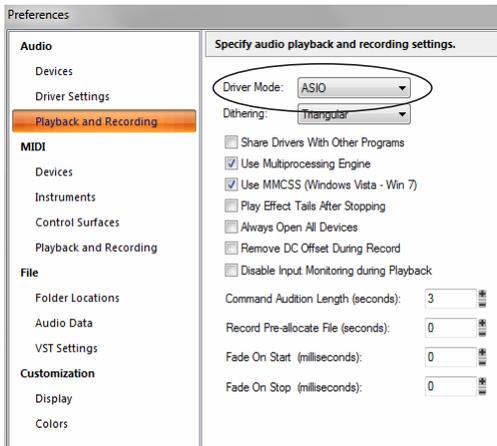
Figure 7-7: Enabling the MOTU Audio ASIO driver in SONAR.

4 Next, in the Audio preferences section, choose *Devices*.

5 Check the 8pre USB inputs and outputs that you wish to use and uncheck the ones you don't.

Using the MOTU WDM driver
1 Go to SONAR's Preferences.

2 In the Audio preferences section, choose *Playback and Recording*.

3 Choose *WDM/KS* as the Driver Mode, as shown below.
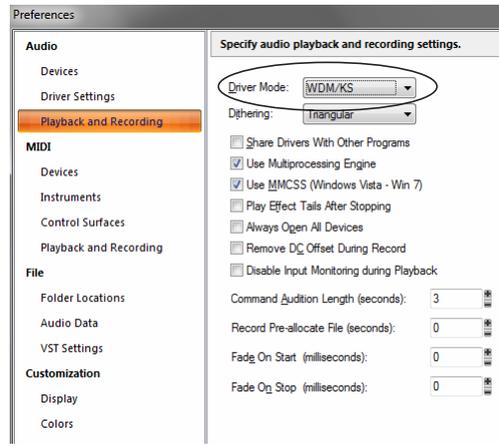
Figure 7-8: Enabling the MOTU WDM driver in SONAR.

4 Next, in the Audio preferences section, choose *Devices*.

5 Check the 8pre USB inputs and outputs that you wish to use and uncheck the ones you don't, as shown in Figure 7-7 on page 37.

Other audio settings in SONAR
There are a few other settings in SONAR that impact 8pre USB operation:

1 In the Audio preferences section, choose *Driver Settings*.

2 Choose an 8pre USB input and output for recording and playback timing as shown below in Figure 7-9. It doesn't matter which input or output you choose.
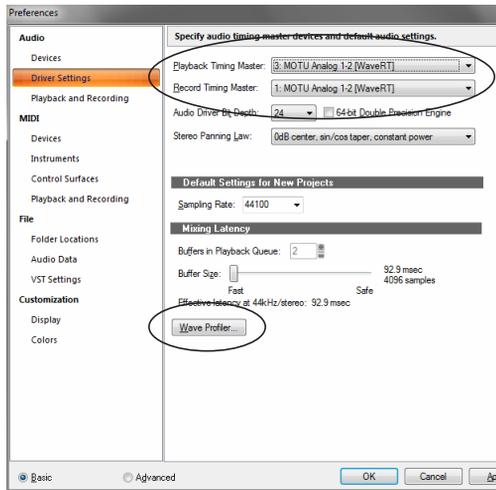
Figure 7-9: Make sure you have chosen a 8pre USB input and output for the playback and recording timing master settings.

3 Additionally, if you are using the MOTU WDM driver, click the *Wave Profiler* button and run the Wave Profiler. This process chooses the optimum settings for the 8pre USB hardware.
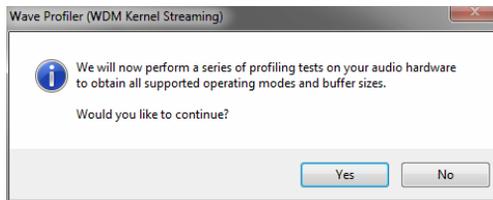
Figure 7-10: Running the Wave Profiler in Cakewalk's SONAR.

Sound Forge
In Sony Sound Forge, go to the Preferences window, click the *Audio* tab, and then choose *MOTU Audio* from the *Audio device type* menu.

Other audio software
For other audio applications, the procedure is similar to that shown above. Consult your owner's manual for further information.

REDUCING LATENCY
On Windows, audio I/O buffer size is handled by the audio driver rather than the host audio application.

In the MOTU Audio Console, *Samples Per Buffer* provides an adjustable audio buffer setting that lets you control the amount of delay you'll hear when monitoring live inputs through your host audio software or processing them with software plug-ins.

For information, see the "Adjusting the audio I/O buffer" section of chapter 8, "Reducing Monitoring Latency" (page 41).

WORKING WITH 8PRE USB INPUTS AND OUTPUTS
Once you've enabled the 8pre USB's driver, 8pre USB audio inputs and outputs will appear in your host software wherever audio inputs and outputs are listed. If you don't see the optical inputs and/or outputs, check MOTU Audio Console to make sure they are enabled. If you don't plan to use either optical bank, turn it off to conserve computer bandwidth.

Remember that the headphone output can be configured in MOTU Audio Console to mirror other outputs. In addition, the 8pre USB optical banks can be disabled. This will affect how they appear (and if they appear at all) in your host software's audio input lists. See "Optical input/output" on page 30 and "Phones Assignment" on page 30.

Number of channels
If your host audio software requires that you specify the number of audio voices or channels you will be using, be sure to choose enough channels to cover the 16 inputs and 12 outputs provided by your 8pre USB.

Mix1 1-2 return bus
In your host audio software audio input menus, you'll see an 8pre USB input called *Mix1 Return 1-2*. This is a stereo feed from the 8pre USB that

matches its main outs. This can be used, for example, to record a final stereo mix for reference and archiving purposes.

☛ Warning: the Mix1 Return 1-2 return inputs can cause feedback loops! DO NOT assign this input to a track assigned to the 8pre USB main outs.

For Mix1 Return 1-2, you can choose whether or not to include audio being sent to the main outs from the computer. See "Mix1 Return Includes Computer Output" on page 52.

The "Phones 1-2" output
Host audio tracks assigned to the *Phones 1-2* output pair will be heard on the headphone jack only. If the Phones are set to mirror another output (such as the main outs), the mirrored audio stream is mixed with the phones audio output. For further explanation, see "Phones Assignment" on page 30.

Audio Input and output names
The 8pre USB audio driver supplies text string labels for its inputs and outputs to clearly identify each one, but some applications do not display these labels.

PROCESSING LIVE INPUTS WITH HOST PLUG-INS
If you patch a live input (such as a MIDI synthesizer) through a plug-in effect in your host software, you might hear a slight delay. There are several ways to reduce this delay. For details, see chapter 8, "Reducing Monitoring Latency" (page 41).

WORKING WITH CUEMIX FX MIXING
The 8pre USB provides external mixing, which you can operate hand-in-hand with your host's mixing environment. For example, the 8pre USB can serve as a monitor mixer routing channels to musicians, or it can serve as an integrated extension of your host's mixing environment. If you program an 8pre USB mixing configuration that goes hand in hand

with your host project, be sure to use the file save features in CueMix FX to save the 8pre USB settings as a file in your host project folder for instant recall of all settings. See chapter 9, "CueMix FX" (page 47) for complete details.

SYNCHRONIZATION
You may encounter situations in which you need to synchronize your audio software and the 8pre USB to the other components of your system.

Synchronizing digital audio connections
If you have devices connected to the 8pre USB digital optical ports, you need to be concerned with the synchronization of the 8pre USB's digital audio clock with other devices connected to it digitally (if any). For example, if you have a digital mixer connected to the 8pre USB via an ADAT optical light pipe cable, you need to make sure that their audio clocks are phase-locked. For details, see "Syncing optical devices" on page 24. If you don't have any digital audio devices connected to the 8pre USB, digital audio phase-lock does not apply to you.

Resolving directly to time code (with no synchronizer)
If your host audio software supports ASIO2 or 3's sample-accurate positioning protocol, then it can resolve to the 8pre USB's built-in time code synchronization feature. To resolve your 8pre USB directly to SMPTE time code with no additional synchronization devices, use the setup shown in "Setup for SMPTE time code sync" on page 76.

CHAPTER 8 Reducing Monitoring Latency

OVERVIEW

When operating the 8pre USB as an audio interface, *monitoring latency* is that slight delay you hear when you run an input signal through your host audio software. For example, you might hear it when you drive a live mic input signal through a reverb plug-in running in your audio sequencer.

This delay is caused by the amount of time it takes for audio to make the entire round trip through your computer, from when it first enters an 8pre USB input, passes through the 8pre USB hardware into the computer, through your host audio software, and then back out to an 8pre USB output.

If you don't need to process a live input with plug-ins, the easiest way to avoid monitoring latency is to use the 8pre USB's CueMix DSP feature to patch the input directly to your monitor outs via the 8pre USB audio hardware. This is just like bussing inputs to outputs in a digital mixer. For details, see "CueMix DSP hardware monitoring" on page 44.

If you *do* need to process a live input with plug-ins, or if you are playing virtual instruments live through your 8pre USB audio hardware, you can significantly reduce latency — and even make it completely inaudible, regardless of what host audio application software you use. This chapter explains how.

It is important to note that monitoring delay has no effect on when audio data is recorded to disk or played back from disk. Actual recording and playback is extremely precise.

☛ Monitoring latency does not occur when operating the 8pre USB as an optical expander (in converter mode).

MONITORING LIVE INPUT

There are two ways to monitor live audio input with an 8pre USB: 1) through the computer or 2) via CueMix™ DSP hardware monitoring. Figure 8-1 below shows method 1, which allows you to add effects processing such as reverb and guitar amp effects via plug-ins in your audio software. See the next section, "Adjusting the audio I/O buffer" for details about how to reduce — and possibly eliminate — the audible monitoring delay that the computer introduces.

Figure 8-2 on page 43 shows how to use CueMix™ DSP hardware-based monitoring, which lets you hear what you are recording with no monitoring delay and no computer-based effects processing. (You can add effects later, after you've recorded the live input as a disk track.) See "CueMix DSP hardware monitoring" later in this chapter for details on how to use CueMix DSP with your audio software, or with the included MOTU CueMix FX software.

If the material you are recording is suitable, there is a third way to monitor live input: use both methods (Figure 8-1 and Figure 8-2) at the same time. For example, you could route vocals to both the computer (for a bit of reverb) and mix that processed signal on the main outs with dry vocals from CueMix DSP.

4. Mic signal (with plug-in processing, if any) is routed to the main outs (or other outputs that you've specified in the software).

1. Live input (from mic, guitar, etc.) enters the MOTU interface.

2. Mic signal goes immediately to the computer (dry, with no effects processing).

3. Mic signal is 'patched thru' back to the audio interface with reverb or other plug-in effects, if any.

PC

Figure 8-1: There are two ways to monitor live audio inputs with an 8pre USB: 1) through the computer or 2) via CueMix™ DSP hardware monitoring. This diagram shows method 1 (through the computer). When using this method, use MOTU Audio Console's buffer setting (Figure 8-3 on page 43) to reduce the slight delay you hear when monitoring the live input, but don't lower it too much, or your computer might get sluggish.

ADJUSTING THE AUDIO I/O BUFFER

A *buffer* is a small amount of computer memory used to hold data. For audio interfaces like the 8pre USB, buffers are used for the process of transferring audio data in and out of the computer. The size of the buffers determines how much delay you hear when monitoring live inputs through your audio software: larger buffers produce more delay; smaller buffers produce less.

Buffer size adjustment is made in MOTU Audio Console, as shown in Figure 8-3 via the *Samples Per Buffer* setting.
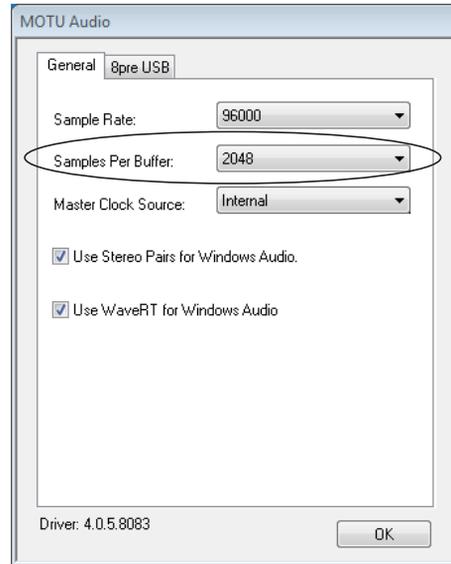
Figure 8-3: Lowering the 'Samples Per Buffer' setting in MOTU Audio Console reduces patch thru latency. But doing so increases the processing load on your computer, so keep an eye on the Performance Monitor in your host audio software.

1. Live input (from mic, guitar, etc.) enters the MOTU interface.

3. Mic signal is mixed with the main outs, and you can control the volume (relative to the rest of the mix) with the mic's fader in CueMix.

2. CueMix™ DSP immediately patches the live mic signal directly to the main outs (or other output), completely bypassing the computer (dry, with no effects processing).

Figure 8-2: This diagram shows the signal flow when using CueMix™ DSP no-latency monitoring. Notice that this method does not allow you to process the live input with plug-ins in your audio software while it is being monitored. You can, however, add effects later — after recording the live input as a disk track. CueMix™ DSP lets you hear what you are recording with no delay and no computer-based effects.

Lower latency versus higher CPU overhead

The buffer setting has a large impact on the following things:

- Patch thru latency

- The load on your computer's CPU

- Possible distortion at the smallest settings

- How responsive the transport controls are in your audio software

The buffer setting presents you with a trade-off between the processing power of your computer and the delay of live audio as it is being patched through your software. If you reduce the size, you reduce patch thru latency, but significantly increase the overall processing load on your computer, leaving less CPU bandwidth for things like real-time effects processing. On the other hand, if you increase the buffer size, you reduce the load on your computer, freeing up bandwidth for effects, mixing and other real-time operations.

If you are at a point in your recording project where you are not currently working with live, patched-thru material (e.g. you're not recording vocals), or if you have a way of externally processing inputs, choose a higher buffer size. Depending on your computer's CPU speed, you might find that settings in the middle work best (256 to 1024).

Transport responsiveness

Buffer size also impacts how quickly your audio software will respond when you begin playback, although not by amounts that are very noticeable. Lowering the buffer size will make your software respond faster; raising the buffer size will make it a little bit slower, but barely enough to notice.

Effects processing and automated mixing

Reducing latency with the buffer size setting has another benefit: it lets you route live inputs through the real-time effects processing and mix automation of your audio software.

CUEMIX DSP HARDWARE MONITORING

The 8pre USB has a more direct method of patching audio through the system: *CueMix DSP*. CueMix DSP is a digital mixer in the 8pre USB hardware itself. CueMix DSP has two important benefits:

- First, it completely eliminates the patch thru delay (reducing it to a small number of samples — about the same amount as any digital mixer).

- Secondly, CueMix DSP imposes no strain on the computer.

The trade-off, however, is that CueMix DSP bypasses your host audio software. Instead, live audio inputs are patched directly through to outputs in the 8pre USB itself and are mixed with disk tracks playing back from your audio software. This means that you cannot apply host-based plug-ins, mix automation, or other real-time effects that your audio software provides. But for inputs that don't need these types of features, CueMix DSP is the way to go.

On the other hand, if you really need to use the mixing and processing provided by your audio software, you should not use CueMix DSP. Instead, reduce latency with the buffer setting (as explained earlier in this chapter).

TWO METHODS FOR CONTROLLING CUEMIX DSP

There are two ways to control CueMix DSP:

- With the 8pre's CueMix FX software

- From within your host audio software (if it supports direct hardware monitoring)

You can even use both methods simultaneously.

Using the CueMix FX app

If your host audio software does not support direct hardware monitoring, you can run the CueMix FX software side-by-side with your audio software and manage your monitor mix in CueMix FX.

CueMix FX allows you to create up to six separate 8pre USB monitor mixes, or any other desired routing configurations. These routings are independent of your host audio software. For complete details, see chapter 9, "CueMix FX" (page 47).

Controlling CueMix DSP from your audio software

Some ASIO-compatible audio applications, such as Cubase and Nuendo, allow you to control CueMix DSP monitoring from within the application (without the need to use CueMix FX). In most cases, this support consists of patching an 8pre USB input directly to an output when you record-arm a track. Exactly how this is handled depends on the application.

CueMix DSP routings that are made via host applications are made "under the hood", which means that you won't see them in CueMix FX. However, CueMix DSP connections made inside your host audio software dovetail with any other mixes you've set up in CueMix FX. For example, if your host application routes audio to an output pair that is already being used in CueMix FX for an entirely separate mix bus, both audio streams will simply be merged to the output.

Follow the directions below in the section that applies to you.

Controlling CueMix DSP from within Cubase or Nuendo

To turn on CueMix in Cubase SX or Nuendo, enable the Direct Monitoring check box in the Device Setup window.
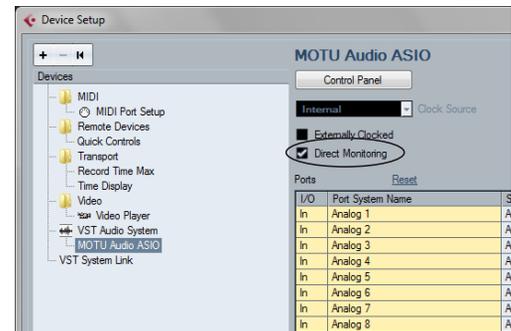
Figure 8-4: Activating the Direct Monitoring option in Cubase or Nuendo.

Other ASIO 2.0-compatible host software

If your ASIO-compatible host audio software supports ASIO's direct monitoring feature, consult your software documentation to learn how to enable this feature. Once enabled, it should work similarly as described for Cubase (as explained in the previous section).

Using CueMix DSP with WDM- or Wave-compatible software

Run CueMix Console (chapter 9, "CueMix FX" (page 47)) and use it to route live inputs directly to outputs, control their volume and panning, etc. If necessary, you can save your CueMix Console setup with your project file.

CueMix FX

OVERVIEW

When operating the 8pre as an audio interface, the 8pre's CueMix FX software provides access to the flexible on-board mixing features of the 8pre. CueMix lets you route any combination of inputs to any stereo output pair. These mixes can be set up entirely independently of your host audio software. CueMix FX allows you to set up four completely independent mix configurations with the 8pre. You can also save and load mix configurations.

CueMix FX can be used independently of host audio software, or together with it. CueMix mixing dovetails with the direct monitoring (hardware patch thru) features of your host audio software, allowing you to seamlessly mix in both environments.

CueMix FX also provides many advanced audio analysis tools, including a tuner and oscilloscope.

ADVANTAGES OF CUEMIX MONITORING

CueMix FX provides several major advantages over monitoring live inputs through your host audio software:

- CueMix has no buffer latency. Thanks to the 8pre's DSP chip, CueMix provides the same throughput performance as a digital mixer.

- CueMix imposes absolutely no processor drain on the computer's CPU.

- CueMix routing can be maintained independently of individual software applications or projects.

CueMix FX does not provide effects processing. For information about using your audio software's native plug-ins together with CueMix, see chapter 8, "Reducing Monitoring Latency" (page 41).

CUEMIX FX INSTALLATION

CueMix FX is installed as a standard application by the 8pre setup software.

CUEMIX FX BASIC OPERATION

The CueMix FX is simple to operate, once you understand these basic concepts.

Four mixes

CueMix provides four separate mixes: Mix1, Mix2, Mix3 and Mix4. Each mix can have any number of inputs mixed down to any 8pre output pair that you choose. For example, Mix1 could go to the headphones, Mix2 could go to the main outs, Mix3 could go to a piece of outboard gear connected to optical outputs 7-8, etc.

Many inputs to one output pair

It might be useful to think of each mix as some number of inputs all mixed down to a stereo output pair. CueMix FX lets you choose which inputs to include in the mix, and it lets you specify the level and pan for each input being fed into the mix.

Viewing one mix at a time

CueMix FX displays one mix at a time. To select which mix you are viewing, choose it from the Mix menu, as shown in Figure 9-1. Double-click the name to change it.

Each mix is independent

Each mix has its own volume, pan, mute and solo settings. Settings in one mix will not affect another. For example, if an input is used in one mix, it will still be available in other mixes. In addition, inputs can have a different volume, pan, mute and solo setting in each mix.

Widening the CueMix FX window

To view more input faders at once, drag the right-hand edge of the window to the right.

WORKING WITH A MIX

Each mix has the following components:

- A stereo output with master fader

- Name

- Master mute (to enable/disable the entire mix)

- Any number of mono or stereo inputs

- Pan, volume, mute and solo for each input

Viewing a mix

To view a mix, choose it from the Mix menu, as shown in Figure 9-1. The menu shows all mixes by name, followed by the audio interface's output pair that it corresponds to.

Naming a mix

Click the mix name to edit its text.
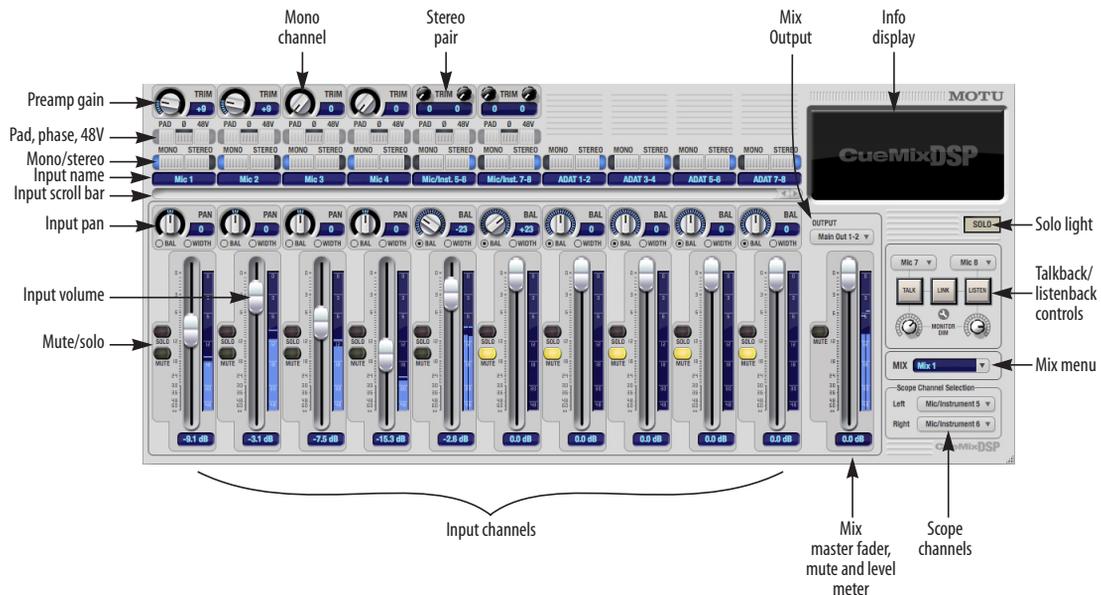
Figure 9-1: MOTU CueMix FX is a virtual mixer that gives you control over the 8pre USB's on-board mixing features.

Mix master fader

The master fader (Figure 9-1) controls the overall level of the mix (its volume on its stereo output). Use the individual input faders to the left to control individual input levels.

Mix mute

The master mute button (next to the master fader) (Figure 9-1) temporarily disables (silences) the currently displayed mix.

Mix level meter

The level meters (next to the master fader) show you the output for the mix's physical output, which may include audio from your host audio software. The clip indicators clear themselves after a few seconds.

Input channels

The channel strips to the left of the master fader represent each input in your 8pre. Use the input scroll bar to view additional inputs. Double-click an input name to rename it.

Preamp gain

All 8pre USB analog inputs provide individual, digitally controlled preamp gain (trim). There is 48 dB of preamp gain for the mic input and 39 dB for the quarter-inch instrument input.

Once you adjust the trim levels, you can save them as a file on disk for future instant recall. See "Saving and loading hardware presets" on page 52 and "Configurations menu" on page 69.

Pad and 48V phantom power

The -20 dB Pad and 48V phantom power settings are the same as the controls on the front panel. If you change the setting in the software, the front panel reflects the change as well, and vice versa. There are separate settings for each mic input.

Invert phase (ø)

Click the *Phase* button (Figure 9-1) to invert the phase of the input signal. For stereo pairs, you can invert the phase for the left and right channels independently: click the phase button (ø) repeatedly to cycle among two states for mono channels (on or off) and four states for stereo grouped channels (no inversion, left only, both, or right only).

Mono/stereo pairing

Click the *Mono* button (Figure 9-1) if you would like an input to be treated as a mono channel. If you would like to work with it as one channel of a linked stereo pair, click the *Stereo* button. Inputs are grouped in odd/even pairs (mic 1-2, Analog 1-2, 3-4, etc.) Stereo pairs appear as a single channel strip in the CueMix FX mixer.

Input name

The input name appears just below the mono/stereo buttons. This name also appears in host audio software on the computer (if the software supports channel names).

Input scroll bar

Use the input scroll bar to view additional inputs when the window is too narrow to display them all at once.

Mix-specific settings

All input settings below the input scroll bar (input volume, pan, mute and solo) are bound to the currently displayed mix (chosen from the Mix menu). Each input can have different volume, pan, mute and solo settings in the four different mixes.

Input pan

The input pan knob (Figure 9-1) pans the input across the bus stereo outputs. All input pan settings belong to the mix currently being viewed.

If the input itself is grouped as a stereo pair), two forms of panning control are provided:

Balance

Balance works like the balance knob on some radios: turn it left and the right channel dims, turn it right and left channel dims. But the left channel always stays left and the right channel stays right.

Width

Width spreads the left and right channels across the stereo image, depending on the knob position. Maximum value (turning the pan knob all the way up) maintains the original stereo image: the left channel goes entirely left and right goes entirely right, without attenuation. The minimum value (turning the knob all the way down) creates a mono effect: equal amounts of left and right are combined and sent to both outputs. In between, the left out is a mixture of the left input and some of the right input (and vice-versa) with the effect of narrowing the field.

Input fader

Use the input fader (Figure 9-1) to adjust the input volume in the mix. Note that an input can have different level, pan, mute and solo settings for each mix. Input channel level meters are post-fader.

Input mute/solo

To add an input to a mix, or remove it, click its MUTE button. To solo it, use its SOLO button. The Solo light (Figure 9-1) illuminates when any input is soloed (including inputs that may currently be scrolled off-screen).

SHORTCUTS

Hold down the following modifier keys as shortcuts:

Shortcut	Result
Shift key	Applies your action to all inputs in the mix.
Control key	Applies your action to the stereo input pair
Space bar	Applies your action to all busses
Double-click	Returns the control to its default value (pan center, unity gain, etc.)

INFO DISPLAY

The info display shows fly-over help for items in the CueMix FX window.

TALKBACK AND LISTENBACK

CueMix FX provides *Talkback* and *Listenback* buttons. Talkback allows an engineer in the control room to temporarily dim all audio and talk to musicians in the live room. Conversely, Listenback allows musicians to talk to the control room.

Hardware setup

Figure 9-2 below shows a typical hardware setup for Talkback and Listenback. For Talkback, set up a dedicated mic in your control room and connect it to a mic input on your MOTU audio interface. For Listenback, set up a dedicated listenback mic in the live room for the musicians and connect it to another mic input. For talkback output, set up a headphone distribution amp or set of speakers in the live room, and connect it to the 8pre's headphone out, as demonstrated below in Figure 9-2.
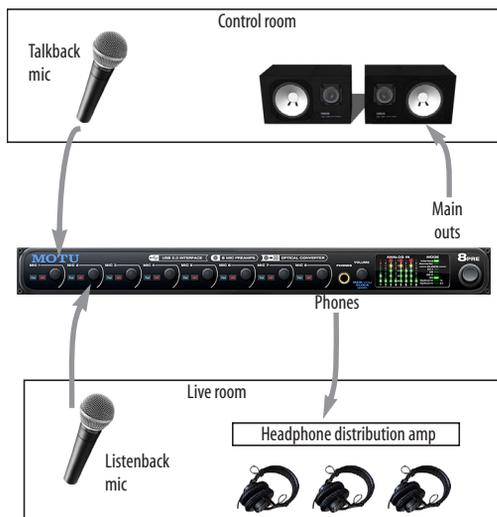
Figure 9-2: Typical hardware setup for Talkback and Listenback.

Talkback / Listenback mic input

Choose the audio input to which your Talkback and/or Listenback mic is connected, as shown below:
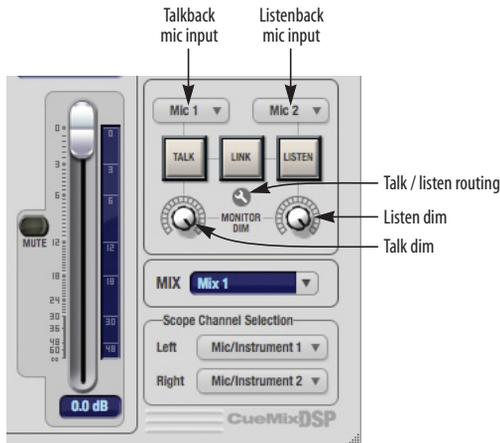
Figure 9-3: Specifying the talkback and listenback mic inputs. Use the input fader for the chosen input to control the mic volume.

Talkback / Listenback monitor dim

Use the knobs next to the Talk and Listen buttons (Figure 9-3) to determine the amount of attenuation you would like to apply to all other audio signals (besides the talkback/listenback signal) when Talkback and/or Listenback is engaged. To completely silence all other CueMix audio, turn them all the way down. Attenuation only occurs when talkback or listenback is engaged. Audio playing back from disk (your host software) is not affected.

Talk / Listen signal routing

Click the *Talk/Listen routing* button (Figure 9-3) to open the routing dialog (Figure 9-4). Check the boxes next to the outputs on which you'd like to hear the Talkback mic and/or Listenback mic. For example, as demonstrated in the diagram in Figure 9-2, to hear the Talkback mic on the headphones in the live room, check the *Phones L-R* check box in the *Talk* column as demonstrated in

Figure 9-4. To hear the Listenback mic on the main monitors in the control room, check the *Main Out 1-2* check box in the *Listen* column.
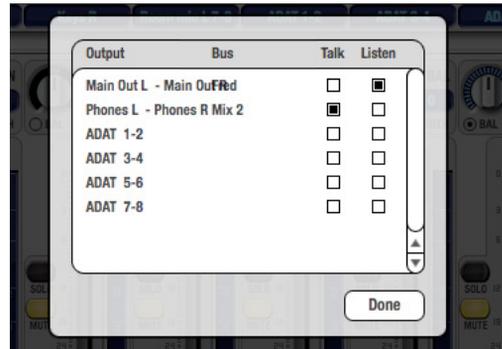
Figure 9-4: Routing the Talkback and Listenback mics to outputs.

Engaging/disengaging Talkback and Listenback

To engage Talkback or Listenback, press on the Talk or Listen buttons (Figure 9-3) and then release to disengage. Alt-click to make the buttons "sticky" (stay engaged until you click them again — so you don't have to hold down the mouse). Or use the Talkback menu items.

If you would like to engage both Talkback and Listenback at the same time, enable the *Link* button (Figure 9-3).

Controlling Talkback and Listenback volume

To control the volume of the Talkback and/or Listenback mics, adjust their input fader in CueMix FX. This fader controls the volume of the input, regardless of which bus mix is being displayed in the CueMix FX window. In other words, once an input has been designated as a Talkback or Listenback input, its fader becomes global for all CueMix buses.

SCOPE CHANNEL SELECTION

The *Scope channel selection* menus (Figure 9-1 on page 48) let you choose what input channels will be fed to the CueMix FX audio analysis (scoping) features. See "Devices menu" on page 52.

FILE MENU

Saving and loading hardware presets

The 8pre USB can store up to 16 presets in its on-board memory. A preset includes all CueMix FX settings for all mix busses, but it excludes global settings like clock source and sample rate.

The Load Hardware Preset and Save Hardware Preset commands in the CueMix FX file menu let you name, save and load presets in the 8pre USB.

Peak/hold time

In CueMix FX, a peak indicator is a line (representing a virtual LED) displayed in a level meter that indicates the maximum signal level registered by the meter. The *Peak/hold time* setting (File menu) determines how long this indicator remains visible before it disappears (or begins to drop). To disable peak/hold indicators altogether, choose Off from this sub-menu.

Mix1 Return Includes Computer Output

When checked (enabled), the *Mix1 return includes computer Output* File menu item causes audio being sent to the main outs (Mix 1) from host software on the computer to be included in the Mix1 1-2 return bus. This feature can be used to apply the audio analysis tools, such as the FFT display and oscilloscope, to computer audio output. See "Scoping host software audio output" on page 53.

☞ Warning! When this option is enabled, it can cause feedback loops! In your host software, make sure that the stereo return bus is not routed back to the main outs!

For more information on the Mix 1 Return feature, see "Mix1 1-2 return bus" on page 38.

Hardware follows console stereo settings

This File menu item applies to other MOTU interfaces products and has no effect on the 8pre USB.

EDIT MENU

Undo/Redo

CueMix FX supports multiple undo/redo. This allows you to step backwards and forwards through your actions in the software.

Copying & pasting (duplicating) entire mixes

To copy and paste the settings from one mix to another:

1 Select the source mix (Figure 9-1) and choose Copy from the Edit menu (or press control-C).

2 Choose the destination mix and choose Paste from the Edit menu (or press control-V).

Clear Peaks

Choose *Clear Peaks* from the Edit menu to clear all peak indicators in all CueMix FX meters.

DEVICES MENU

If you are working with more than one MOTU audio interface product, this menu displays all interfaces that are currently on line. Choose any device from the menu to edit its settings using the CueMix FX software.

Below each device are five signal analysis tools: FFT Analysis, Oscilloscope, X-Y Plot, Phase Analysis, and the Tuner. Choose one to open its window. For details on these features, see the following sections.

Figure 9-5: **Opening the signal analysis windows.**

Scope channels

The *Scope channel selection* menus (Figure 9-1 on page 48) let you choose what input channels will be fed to the CueMix FX audio analysis (scoping) features described in the following sections.

Scoping the main outs

If you wish to scope audio output, send it to the Mix 1 output and choose one or both of the Mix 1 returns from the Scope Channel Selection menus.

Scoping host software audio output

If you want to scope audio output from your host software, send your host's output to the Mix 1 outputs, enable the *Mix1 Return Includes Computer Output* option (File menu), and choose one or both of the Mix1 returns from the Scope Channel Selection menus.

FFT ANALYSIS / SPECTROGRAM

Choose *FFT Analysis* from the Devices menu (Figure 9-5) to open a new window that displays a real-time Fast Fourier Transform (FFT) frequency measurement curve, as shown in Figure 9-6. Each MOTU audio interface has its own FFT/spectrogram window.

Choosing a channel to display

The FFT window follows the currently chosen *Scope channels* (Figure 9-1 on page 48).

View controls

You can show and hide the FFT display and spectrogram as desired using the *View* controls (Figure 9-7).
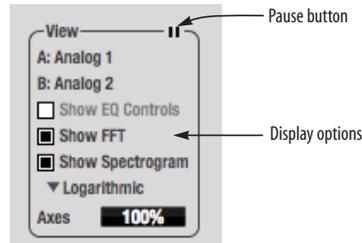
Figure 9-7: View controls

☛ The *Show EQ controls* item is for other MOTU audio interfaces and is grayed out for the 8pre USB.
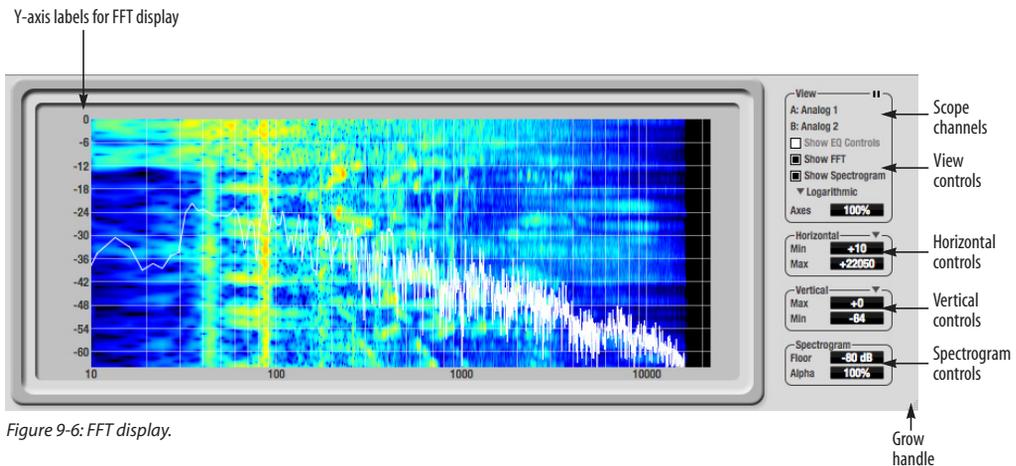
Figure 9-6: FFT display.

Spectrogram

Click the *Show Spectrogram* option (Figure 9-7) to superimpose a real-time spectrogram "waterfall" display in the background of the FFT display, as demonstrated in Figure 9-6.

The spectrogram scrolls from top to bottom, where the top edge of the display represents what you are hearing "now". Color represents amplitude along the left/right frequency spectrum. The amplitude color scale runs from black (silence) to red (full scale) as follows:

Figure 9-8: Spectrogram color-to-amplitude spectrum.

Also see "Spectrogram controls" on page 55.

Logarithmic or Linear X-Axis Scale

The x-axis defaults to a logarithmic scale, but can be changed to a linear scale if desired. In the View controls (Figure 9-7), click *Logarithmic* to access the x-axis scale options menu. With a linear scale selected, frequency is constant, but the width of each octave along the x-axis is different. With a logarithmic scale selected, octaves are displayed with a constant width, but frequency is displayed logarithmically within each octave.

Axes display

The *Axes* control (Figure 9-7) sets the opacity of the grid displayed in the graph, from 100% (fully visible) down to 0% (fully hidden).

Pausing the display

The Pause button in the upper right corner of the View section (Figure 9-7) allows you to freeze the display at any time. To resume, click the button again.

Horizontal controls (frequency axis)

The *Horizontal* controls (Figure 9-7) configure the value range of the x-axis (frequency). Click and drag the values up or down to set them, or double-click to return to the default value.

There are two modes for the controls: *Zoom/Offset* and *Min/Max*. To change the mode, use the Horizontal control menu (Figure 9-9).
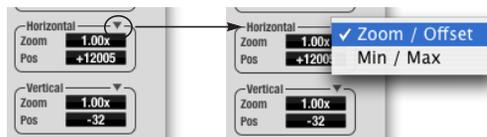
Figure 9-9: Horizontal control menu

In *Zoom/Offset* mode, *Zoom* sets the display zoom from 1x to 100x, where the number represents the zoom factor relative to the entire frequency range. For example, when the horizontal zoom value is 1x, the entire frequency range from 10 to 24000 Hertz is displayed; when the horizontal zoom value is 2x, one half of the entire frequency range is displayed. *Pos* determines which frequency is displayed at the center of the graph.

In *Min/Max* mode, *Min* and *Max* set the lowest and highest displayed frequencies (in Hertz).

Vertical controls (amplitude axis)

The *Vertical* controls (Figure 9-7) operate similarly to the Horizontal controls, except that they configure the y-axis (amplitude).

In *Zoom/Offset* mode, *Zoom* sets the display zoom from 1x to 100x, and *Pos* sets the center amplitude of the graph.

In *Min/Max* mode, *Min* and *Max* set the smallest and largest displayed amplitude.

Spectrogram controls

The *Floor* control (Figure 9-6) sets the amplitude threshold for the spectrogram display, from -144 dB up to 1 dB.

The *Alpha* control (Figure 9-6) sets the opacity of the spectrogram information displayed in the graph, from 100% (fully visible) down to 0% (fully hidden).

OSCILLOSCOPE

The Oscilloscope (Figure 9-10) graphs the amplitude of an audio signal over time.

Amplitude is displayed on the y-axis and time is displayed on the x-axis. A thick white vertical line marks where time equals zero; a thick white horizontal line marks where amplitude equals zero (Figure 9-10, below).

Level meters are displayed to the right of the graph. One or two meters are shown, depending on the current view mode (see "View controls").

Opening the oscilloscope

Each MOTU audio interface has its own oscilloscope. To open an oscilloscope, choose the *Oscilloscope* item from the Devices menu under the desired interface (Figure 9-5).

Choosing a channel to display

The oscilloscope follows the currently chosen *Scope channels* (Figure 9-1 on page 48).

View controls

The View controls (Figure 9-11) provide several options for the oscilloscope display.
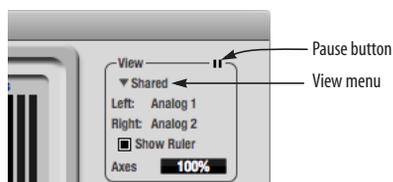
Figure 9-11: View controls
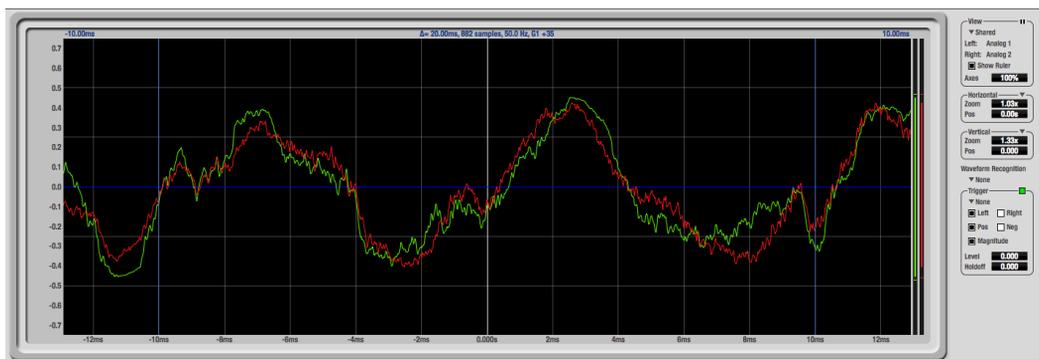
Figure 9-10: Oscilloscope

View menu

The View menu (Figure 9-11) lets you choose how you wish to display the audio channel(s) being displayed.

View menu setting	What it displays
Left	Left channel only
Right	Right channel only
Split screen	Left channel on top; right channel on the bottom
Shared	Left and right on top of each other; left is green, right is red
Add	Left and right channels' amplitudes are added together
Subtract L-R	The right channel's amplitude is subtracted from the left channel's amplitude

Display options

The *Axes* control (Figure 9-11) sets the opacity of the grid displayed in the graph, from 100% (fully visible) down to 0% (fully hidden). The *Show Ruler* option toggles the measurement items (see "Measurement information" on page 58).

Pausing the display

The Pause button in the upper right corner of the View section (Figure 9-11) allows you to freeze the display at any time. To resume, click the button again. The level meters will remain active while the display is paused.

Horizontal controls (time axis)

The *Horizontal* controls (Figure 9-12) configure the value range of the x-axis (time). Click and drag the values up or down to set them, or double-click to return to the default value.

There are two modes for the controls: *Zoom/Offset* and *Min/Max*. To change the mode, use the Horizontal control menu (Figure 9-12).
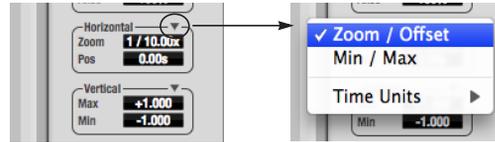
Figure 9-12: Horizontal control menu

In *Zoom/Offset* mode, *Zoom* sets the display zoom from 1/1000x to 10x, where the number represents the number of pixels per sample. For example, when the horizontal zoom value is 10x, 10 samples are displayed in 100 pixels; when the horizontal zoom value is 1/10x, 100 samples are displayed in 10 pixels. *Pos* moves the line marking time equals zero left or right.

In *Min/Max* mode, *Min* and *Max* set the earliest and most recent displayed time.

Time Units

The *Time Units* sub-menu (Figure 9-12) provides the option to view the X axis in Seconds or Samples.

Vertical controls (amplitude axis)

The *Vertical* controls (Figure 9-12) operate similarly to the Horizontal controls, except that they configure the y-axis (amplitude).

In *Zoom/Offset* mode, *Zoom* sets the display zoom from 1/2 to 200x, and *Pos* moves the line marking amplitude equals zero line up or down.

In *Min/Max* mode, *Min* and *Max* set the smallest and largest displayed amplitude.

Waveform Recognition

The Waveform Recognition option searches through new audio data looking for a waveform which most resembles that which was previously displayed. The region where this takes place is a small window around the line marking time equals zero, denoted by the extra vertical graph lines surrounding it. There are two kinds of waveform recognition available: Type I and Type II.
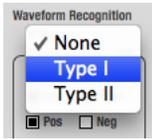
Figure 9-13: Waveform Recognition menu

Type I recognition provides the most stable display of the waveform. It is the most resistant to change. Louder transients, such as those produced by a snare drum, are not displayed inside of the waveform window. Type I is best for observing the shape of a signal produced by a synthesizer or observing the tone of a guitar through a chain of pedals.

Type II recognition is less resistant to change. It will include loud transients within the waveform recognition window. Type II is better for observing percussive music where the beat itself is to be centered within the waveform window.

Trigger

When the *Trigger* (Figure 9-14) is not enabled (the Trigger menu is set to *None*), the graph updates based on time: after every *n* samples of the monitored audio signal, the most recent samples are displayed. When the Trigger is enabled (set to any mode other than *None*), the graph updates in response to specific conditions in the signal. The Trigger section defines that criteria and how the graph will display the events that match.
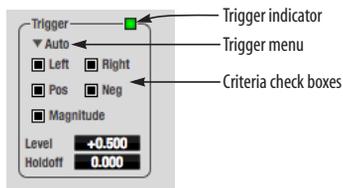
Figure 9-14: Trigger settings

Criteria

The criteria check boxes (Figure 9-14) determine the conditions that the trigger is looking for and where it will look for them.

The *Left* check box causes the condition to be looked for in the left channel of the signal; likewise, the *Right* check box looks for the condition in the right channel. One or both of these can be enabled simultaneously. If neither is enabled, the criteria will not be found because the trigger is not looking at any audio signal.

The *Pos* and *Neg* check boxes determine the slope of the event. When the *Pos* check box is enabled, the trigger will look for an event where amplitude is increasing; likewise, enabling the *Neg* check box tells the trigger to look for an event where amplitude is decreasing. One or both of these can be enabled simultaneously. If neither is enabled, the criteria will not be found because the trigger is not looking for any particular kind of event.

The *Level* setting defines the amplitude threshold that the trigger is looking for. The Level is indicated on the graph by a blue horizontal line (or two blue horizontal lines, if *Magnitude* is enabled). Events which cross this threshold using the enabled slope(s) in the enabled channel(s) will activate the trigger. The response of the trigger is set by the Trigger mode (see "Trigger modes", below).

Enabling the *Magnitude* check box tells the trigger to look for both positive and negative Level values, regardless of whether the Level value is positive or negative. For example, if Level is set to +0.500 and *Magnitude* is enabled, the trigger will look for both +0.500 and -0.500. You will see a second blue line appear in the display when *Magnitude* is enabled to denote the second value.

Holdoff

Holdoff defines a time interval during which the oscilloscope does not trigger. The most recent trace will be displayed during that period. When the period is over, the trigger is "re-armed", i.e. it will begin looking for the criteria again.

Click and drag this value up or down to set it, or double-click to return to the default value.

Trigger modes

The Trigger menu (Figure 9-14 on page 57) provides four modes:

Trigger mode	What it does
None	The Trigger is not active; this is the default mode. The incoming audio signal will be displayed continuously as audio is received.
Auto	The display is always updating, but when the condition is met, the trigger event will be displayed centered around the line marking time equals zero.
Normal	The display updates only when the condition is met; the last trace will be displayed until the next matching event is found.
Single Sweep	Similar to Normal mode, but the last trace will be displayed until you manually arm the trigger by clicking the Trigger indicator (Figure 9-14 on page 57) or by pressing the spacebar.

Trigger indicator

The Trigger indicator (Figure 9-14 on page 57) displays the state of the trigger, and also provides a way to manually interact with it. The Trigger indicator always displays one of three colors:

Color	Status
Green	When the current Trigger criteria has been met (including when the Trigger mode is *None*).
Yellow	When the Trigger is armed, but has not yet found an event which matches its criteria. Yellow can also indicate that the graph has been manually paused using the Pause button in the View section (see "Pausing the display" on page 56).
Red	When the Trigger is being held off, either because the Trigger mode is set to Single Sweep or the Holdoff time is not set to zero.

You can also click on the Trigger indicator to force certain actions, depending on the Trigger mode. In Auto and Normal modes, clicking on the Trigger indicator causes the display to run freely; you may click & hold to force this to occur for as long as you'd like. In Single Sweep mode, clicking on the Trigger indicator re-arms the trigger. When the Trigger mode is *None,* clicking on the Trigger indicator has no effect.

Measurement information

You can view detailed information about a particular time range by using the measurement bars.
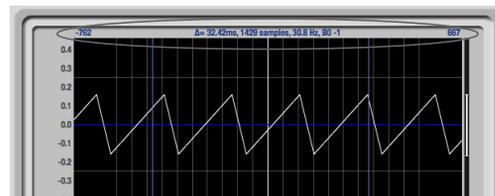
Figure 9-15: Measurement information

To adjust the left and right edges of the measurement area, click and drag the blue bars in the graph, or click and drag the blue numbers in the upper left or right corners. To reset them to the default value, double-click the numbers.

Information about the measured area is displayed at the center of the top ruler: the duration (in seconds and samples), the approximate frequency, and the scientific note name. If the measured area is long enough, the approximate beats per minute (bpm) is displayed.

Ideas for using the Oscilloscope
The Oscilloscope can be used in many useful ways during the routine operation of your recording studio. Here are just a few examples.

Analyzing and comparing harmonic content
The oscilloscope lets you "see" the nature of the harmonic profile in any audio material. You can also view two signals side by side (in stereo mode) to compare their profiles and, if necessary, make adjustments to the source of each signal and view your changes in real time.

Viewing transients such as drum hits
If you loop a snare hit or other similar transient audio clip and feed it through the oscilloscope, you can more or less "freeze" the transient waveform in the oscilloscope frame. This can be useful, for example, for viewing the results of real-time compression that you are applying with an effects plug-in, as demonstrated in Figure 9-16. In this example, a snare hit is being compressed by Digital Performer's Dynamics plug-in. As you make adjustments to the compression plug-in's settings, you can see the transient waveform change the next time the Oscilloscope triggers. For compression, this can be particularly useful for balancing the effect of the attack on the transient, relative to the decay portion of the waveform. Conversely, you can see the effect of the threshold setting directly on the decay portion, relative to the attack. In effect, you can see as well as hear the results of your compression adjustments.

To view a transient waveform in the Oscilloscope display, turn off Waveform Recognition and use the *Normal* Trigger mode. Adjust the level high enough to encompass the vertical amplitude of most of the transient. If the transient pulse sweeps across the
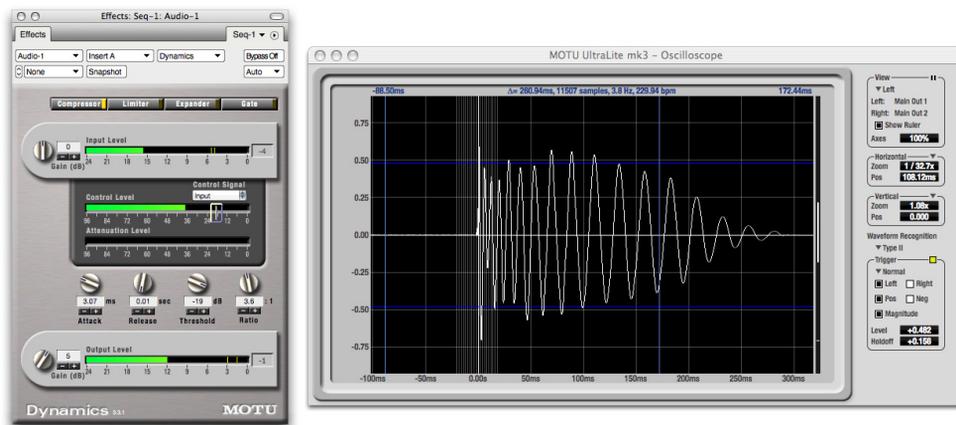
Figure 9-16: Viewing transients in the Oscilloscope

screen, try raising the Holdoff level. Once the transient is settled in the display and fairly stable, you may need to adjust the horizontal position to center it in the display. These settings are depicted in the example in Figure 9-16.

You can also pause the display at any time and adjust the horizontal bounds to locate a transient.

Clip detection

You can use the Oscilloscope to detect clipping in a digital audio signal. To do so, enable all criteria (Figure 9-14 on page 57), choose *Single Sweep* from the trigger menu (Figure 9-14), set the level to 0.999 and click the trigger indicator (Figure 9-14) to arm it (yellow). As soon as the signal clips, the trigger indicator will turn red, and the display will show the offending clip at the line marking time equals zero.

Viewing timing pulses

If you have two audio signals with recognizable, timed pulses in them, and you wish to compare their timing with respect to each other, you can use Split Screen or Shared view to visually compare the timing of the two signals. You can zoom in to the sample level for sample accurate viewing.

Building synthesizer patches

If you are building a synth patch on a synthesizer (or forming similar highly periodic audio material), you can run the audio signal through the Oscilloscope as you adjust its sound to check in real time for undesirable (and possibly inaudible) characteristics, which are easily seen in the Oscilloscope display. A good example is DC offset. If a signal develops DC offset, the apparent vertical center of its overall waveform will drift above or below the line marking amplitude equals zero. Try setting Waveform Recognition to *Type I* and setting Trigger to *None*.

Another example is waveform polarity. If you are combining several raw waveforms, polarity is a critical, yet not always obvious, factor in determining the resulting sound. You can use the Oscilloscope to easily view and compare polarities to see if they are inverted from one another or not. The *Add* and *Subtract L - R* View menu settings are particularly useful here.

You can also use the Oscilloscope to help you apply waveform modulation and keep it "in bounds". For example, you could easily see if pulse width modulation is collapsing in on itself to choke the sound, an effect that is readily seen in the Oscilloscope display but not necessarily easy to determine by ear when using multiple modulation sources.

Guitarists can also visually observe the effects of their pedals and processing, while playing. With the Trigger mode set to *None* and Waveform Recognition set to *Type I*, the waveform will be tracked automatically.

When applying filters and filter resonance, the visual effect on the waveform can be invaluable in reinforcing what you are hearing as you make adjustments.

Monitoring control voltage output from Volta

MOTU's Volta instrument plug-in for Mac OS X turns your audio interface into a control voltage interface, giving you precise digital control from your favorite audio workstation software of any hardware device with a control voltage (CV) input. The CV signals output from Volta can be monitored in the Oscilloscope, giving you visual feedback on LFOs, envelopes, ramps, step sequencers, and more.

For more information on Volta, see www.motu.com.

X-Y PLOT

The *X-Y Plot* window (Figure 9-17) graphs the amplitude of a stereo audio signal on a two-dimensional grid.

For each unit of time (i.e. each sample), the amplitude of the left channel is displayed on the x-axis and the amplitude of the right channel is displayed on the y-axis. A thick white vertical line marks where left channel amplitude equals zero; a thick white horizontal line marks where right channel amplitude equals zero (Figure 9-17, below). There are also thick white diagonal lines for y = x and y = -x.

Metering

Level meters are displayed above and to the right of the graph for the left (green) and right (red) channels, respectively. An additional *Correlation meter* (blue) is displayed on the right. This meter displays the correlation between the two channels.

The higher the meter, the higher the correlation between the two channels. Below are a few examples:

Situation	Meter level	X-Y Plot graph	Mathematical relationship
Perfect correlation	+1	Diagonal line going from lower left to upper right:	y = x
Zero correlation	0	No discernible pattern	None
Perfectly out of phase	-1	Diagonal line going from upper left to lower right:	y = -x

Opening the X-Y Plot

Each MOTU audio interface has its own X-Y Plot window. Choose the *X-Y Plot* item from the Devices menu under the desired interface (Figure 9-5 on page 53).

Figure 9-17: X-Y Plot

Choosing a channel to display

The X-Y Plot follows the currently chosen *Scope channels* (Figure 9-1 on page 48).

View controls

The View controls (Figure 9-18) provide several options for the X-Y Plot display.
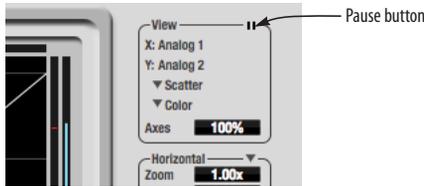
Figure 9-18: View controls

Pausing the display

The Pause button in the upper right corner of the View section (Figure 9-18) allows you to freeze the display at any time. To resume, click the button again. The level meters will remain active while the display is paused.

Line/Scatter

Choose either *Line* or *Scatter* from the menu in the View section (Figure 9-18) to plot each point (sample) as either a single pixel or as a continuous line that connects each plot point to the next, as shown below in Figure 9-19.
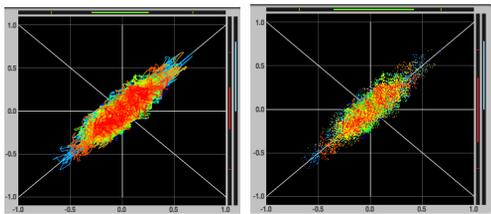
Figure 9-19: The same X-Y Plot displayed in Line versus Scatter mode.

☛ Line mode is significantly more CPU intensive than Scatter. You can reduce Line mode CPU overhead on the X-Y Plot by reducing the Length parameter (described below).

Color/Grayscale

In *Color* mode (Figure 9-18) the most recently displayed audio data is shown in red, which fades to yellow, green and then finally blue, before disappearing. In Grayscale mode, data is first shown in white and then fades to gray. To adjust the scale of this color/brightness change, see "Decay" on page 63.

Axes

The *Axes* control (Figure 9-18) sets the opacity of the grid displayed in the graph, from 100% (fully visible) down to 0% (fully hidden).

Horizontal and vertical controls

The *Horizontal* and *Vertical* controls (Figure 9-20) configure the value range of the x-axis (left channel amplitude), and y-axis (right channel amplitude), respectively. Click and drag the values up or down to set them, or double-click to return to the default value.

There are two modes for the controls: *Zoom/Offset* and *Min/Max*. To change the mode, use the menu shown in Figure 9-20.
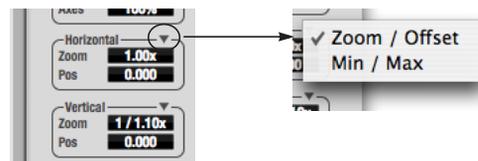
Figure 9-20: Setting the Horizontal or Vertical control modes.

In *Zoom/Offset* mode, *Zoom* scales the axis. *Pos* moves the lines marking x = 0 left and right, or y = 0 up and down.

In *Min/Max* mode, *Min* and *Max* let you scale the grid by moving the -1.0 and +1.0 points along the axis. Min/Max mode lets you control the graph boundaries directly.

Persistence

The *Persistence* controls (Figure 9-21) affect the appearance of data from when it is first displayed until it disappears from the grid.
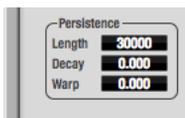
Figure 9-21: The Persistence controls.

Length

Length (Figure 9-21) sets the number of recent samples to show on the plot. For example, when Length is set to 10,000, the 10,000 most recent samples are shown.

Decay

The brightness (in Grayscale mode) or hue (in Color mode) of each sample on the plot is determined by a linear scale, with the most recent sample displayed at the maximum value and the oldest sample displayed at the minimum value. *Decay* (Figure 9-21 on page 63) determines the brightness or hue of the minimum value. When Decay is zero, the oldest sample is black. When Decay is +1.000, the oldest sample is fully opaque (in Grayscale mode) or red (in Color mode).

Warp

Warp (Figure 9-21) determines the position of data points after they are first drawn. When warp is zero, data points remain in the same position. When warp is positive, they contract towards the origin (center of the grid). When warp is negative, they expand away from the origin. The further the warp value is from zero, the greater the effect.

Using the X-Y Plot

The X-Y Plot helps you "see" the width of the stereo field of a mix. It also helps you determine if a mix has issues with polarity, as follows:

Activity on the X-Y Plot	What it indicates
Signal activity occurs mostly along the x = y axis (lower left to upper right) and the Correlation meter reading is high	Left and right channels are predominantly in polarity (the stereo field is relatively narrow)
Signal activity occurs mostly along the y = -x axis (upper left to lower right) and the Correlation meter reading is low (near -1)	Left and right channels are predominantly out of polarity (not in phase)
Signal activity occurs in a seemingly random fashion throughout the grid	No phase relationship exists (i.e. it is probably a wide stereo field)

If a stereo signal is out of phase, it is not mono compatible because it can cancel itself out, either partially or nearly completely, when collapsed to mono.
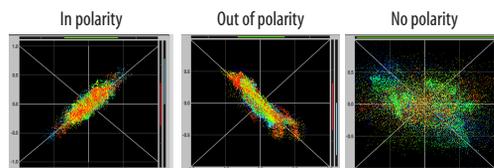
Figure 9-22: Checking polarity in a stereo signal with the X-Y Plot.

PHASE ANALYSIS

The *Phase Analysis* window (Figure 9-23 on page 64) graphs frequency versus phase difference versus amplitude of a stereo signal on either rectangular or polar coordinates.

In rectangular coordinates, the vertical axis represents frequency, and the horizontal axis represents the phase of the left channel minus the phase of the right channel (measured in radians).

In polar coordinates, the radius represents frequency and the angle (theta) from the +y vertical axis represents the phase difference of left channel minus the right channel.

Correlation Meter

The blue *Correlation Meter* to the right of the display shows the correlation between the two channels. The higher the meter, the higher the correlation between the two channels.

Opening the Phase Analysis

Each MOTU audio interface has its own Phase Analysis window. Choose the *Phase Analysis* item from the Devices menu under the desired interface (Figure 9-5 on page 53).

Choosing a channel to display

The Phase Analysis window follows the currently chosen *Scope channels* (Figure 9-1 on page 48).

View controls

The View controls (Figure 9-24) provide several options for the Phase Analysis display.
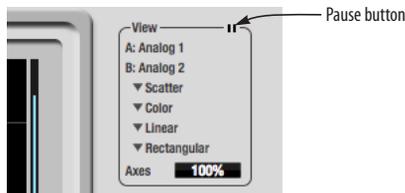
Figure 9-24: View controls

Pausing the display

The Pause button in the upper right corner of the View section (Figure 9-24) allows you to freeze the display at any time. To resume, click the button again. The correlation meter will remain active while the display is paused.

A/B (stereo audio channels)

The *View* section (Figure 9-24) displays the pair of input or output audio channels you are viewing. See "Choosing a channel to display" above.

Figure 9-23: Phase Analysis

Line/Scatter

Choose either *Line* or *Scatter* from the menu in the View section (Figure 9-24) to plot each data point as either a single pixel or as a continuous line that connects each frequency data point to the next, as shown below in Figure 9-19.
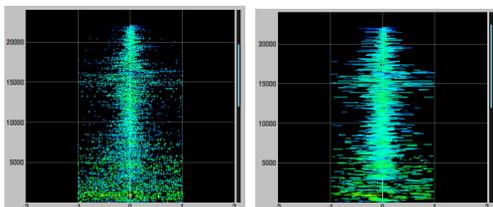
Figure 9-25: The same Phase Analysis displayed in Line versus Scatter mode.

☛ Line mode is significantly more CPU intensive than Scatter. You can reduce Line mode CPU overhead for the Phase Analysis display by increasing the Floor filter and reducing the Max Delta Theta filters (see "Filters" on page 66).

Color/Grayscale

In *Color* mode (Figure 9-24) signal amplitude is indicated by color as follows: red is loud and blue is soft. In grayscale mode, white is loud and gray is soft.

Linear/Logarithmic

Choose either *Linear* or *Logarithmic* from the menu in the View section (Figure 9-24) to change the scale of the frequency axis. In rectangular coordinates, the vertical axis represents frequency, and in polar coordinates, the radius from the center is frequency. With a linear scale, frequencies are spaced evenly; in a logarithmic scale, each octave is spaced evenly (frequencies are scaled logarithmically within each octave).

Linear is better for viewing high frequencies; logarithmic is better for viewing low frequencies.

Rectangular/Polar

Choose either *Rectangular* or *Polar* from the menu in the View section (Figure 9-24) to control how audio is plotted on the Phase Analysis grid. *Rectangular* plots the audio on an X-Y grid, with frequency along the vertical axis and phase difference on the horizontal axis. *Polar* plots the data on a polar grid with zero Hertz at its center. The length of the radius (distance from the center) represents frequency, and the angle (theta) measured from the +y (vertical) axis represents the phase difference in degrees.
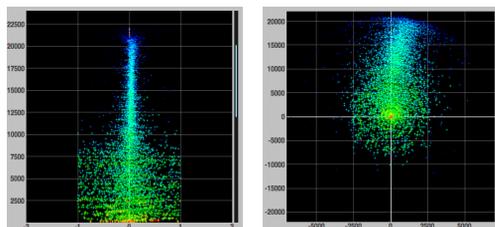
Figure 9-26: Rectangular versus Polar display (with a linear plot).

Above, Figure 9-26 shows Rectangular versus Polar display with a Linear plot. Below, Figure 9-27 shows the same displays (and the same data) with a Logarithmic plot:
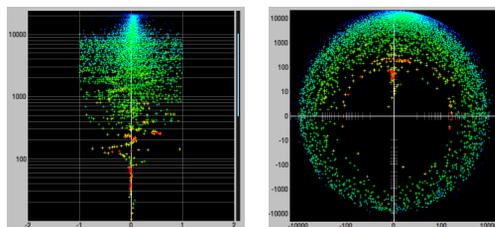
Figure 9-27: Rectangular versus Polar display with a logarithmic plot.

Axes

The *Axes* control (Figure 9-24) sets the opacity of the grid displayed in the graph, from 100% (fully visible) down to 0% (fully hidden).

Horizontal and vertical controls

The *Horizontal* and *Vertical* controls (Figure 9-28) let you scale each axis of the grid and offset its zero point. Click and drag the values up or down to set them, or double-click to return to the default value.

There are two modes for the controls: *Zoom/Offset* and *Min/Max*. To change the mode, use the menu shown in Figure 9-28.
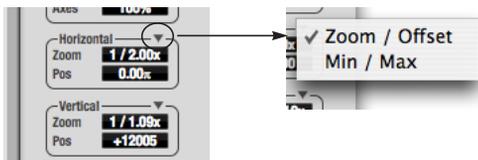
Figure 9-28: Setting the Horizontal or Vertical control modes.

In *Zoom/Offset* mode, *Zoom* scales the axis. *Pos* moves the zero line.

In *Min/Max* mode, *Min* and *Max* let you scale the grid by moving the end points along the axis. Min/Max mode lets you set the boundaries of the graph directly.

Filters

The *Filters* section (Figure 9-29) lets you control the density of the Phase Analysis display.
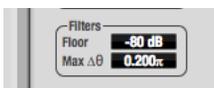
Figure 9-29: Filters

Floor

Floor (Figure 9-29) determines the amplitude threshold for the display. When the amplitude of both channels drops below this threshold, the signal is not shown.

Max delta theta

Max delta theta (Figure 9-29) only affects Line view (see "Line/Scatter" on page 65) and sets the maximum difference in frequency between plot points in the line plot. For two adjacent

frequencies, if the distance (phase difference) between the two frequencies is greater than the Max delta theta, then the line is not drawn.

Using the Phase Analysis

In the polar display (top row of Figure 9-30 on page 67), stereo material that is predominantly phase-aligned (correlated) appears along the vertical axis, as demonstrated in the first column (*Perfectly in phase*) in Figure 9-30. If the vertical line tilts left or right, this indicates general differences in phase; the more the tilt (delta theta), the more the phase difference. If the vertical line points downwards in the polar display, this indicates that the stereo image is predominantly out of polarity, as demonstrated by the fourth column (*Inverted*) in Figure 9-30. Delays appear as spirals in the polar display.

The rectangular display (bottom row of Figure 9-30) also shows a predominantly phase-aligned stereo image along the vertical axis, and tilt (or left-right offset) from the center vertical axis represents differences in phase. If a signal is predominantly out of polarity, it appears along the theta = -1.0 or theta = +1.0 lines in the rectangular display, as demonstrated in the fourth column (*Inverted*) in Figure 9-30 on page 67.

Using Phase Analysis for multiple mic placement

The polar display can be very useful when recording drums or another instrument with multiple microphones. The slight delays caused by the differences in distance to the source can often create a comb filtering (delay) effect between two mic signals, due to phase cancellation. These comb filter effects appear as spirals in the polar display. If you arrange the mics so that the null points (where the spiral pattern meets the negative y axis) are

outside the critical frequency range of the instrument being recorded, you can avoid phase problems among the mic signals.

Tuning PA systems
The Phase Analysis window can also be used to troubleshoot and tune PAs and sound reinforcement systems by placing microphones in strategic locations, comparing the two signals in the Phase Analysis grid and looking for phase issues at various locations.

Summing to mono
The Phase Analysis window is ideal for checking stereo audio that needs to be summed to mono. The Phase Analysis lets you see what frequencies will be canceled out when summed.

In the rectangular view, any lines in the signal that touch the +1.0 or -1.0 vertical lines in the grid will be canceled out at the frequency where they touch, when the signal is summed to mono.

In the polar view, any signal that falls on the negative y axis (below zero) will be canceled out when the signal is summed to mono.

Checking for phase issues in stereo tracks
You can use the Phase Analysis window to check the overall polarity of a stereo mix. Figure 9-31 is an example of a full stereo mix that has phase issues, as indicated by the majority of the signal's energy, which is predominantly skewed to the left side of the rectangular view (left) and spread along the -y axis in the polar view (right).
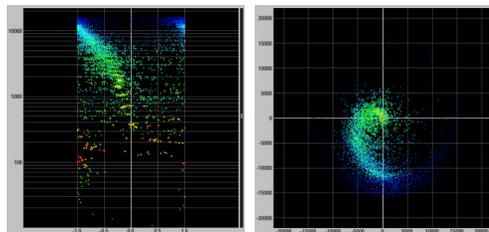
Figure 9-31: A stereo mix with phase issues.
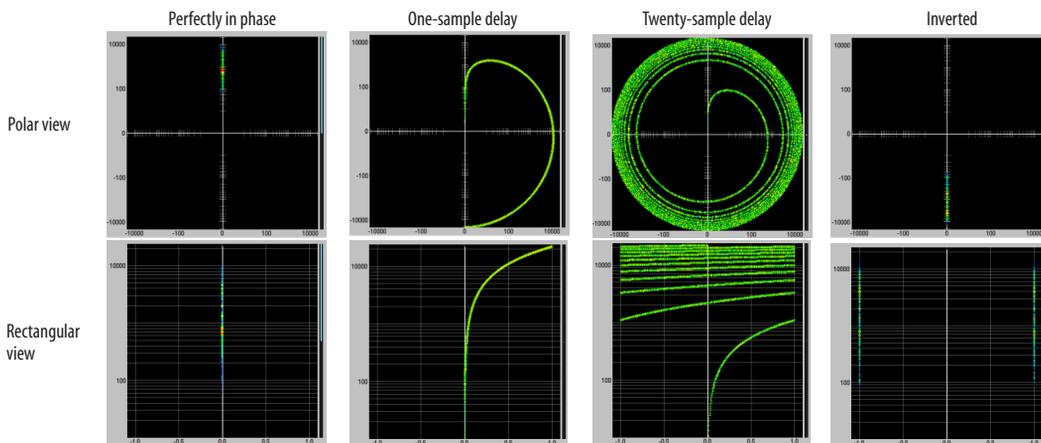
Figure 9-30: Two identical audio streams in the Phase Analysis.

TUNER

Detected frequency · Meter · Meter value

1000.05 Hz   +21.4 cents

-25   +25

-50   +50

Analog 1 Out
Analog 2 Out

440.00

MOTU

Detected note · Arrow · Reference frequency
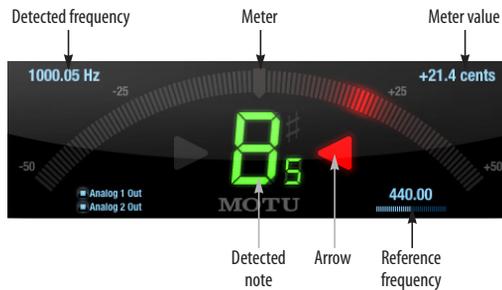
The *Tuner* window is an accurate and easy to use tuner.

Opening the Tuner

Each MOTU audio interface has its own Tuner window. Choose the *Tuner* item from the Devices menu under the desired interface (Figure 9-5 on page 53).
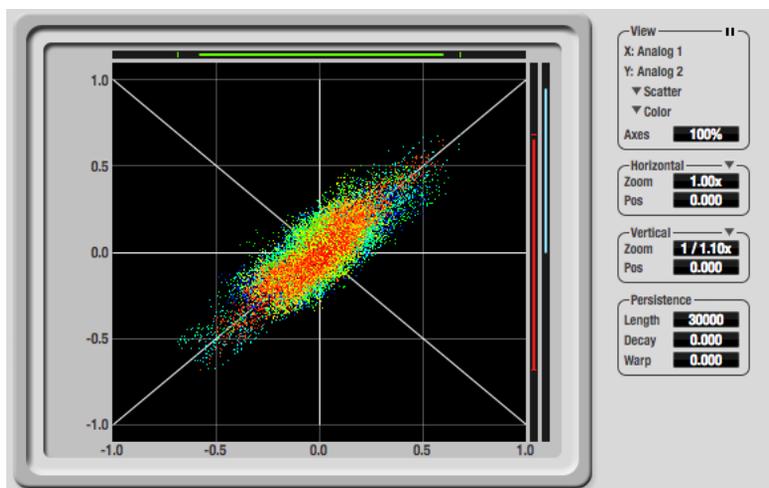
Choosing a channel to tune

The Tuner follows the currently chosen *Scope channels* (Figure 9-1 on page 48).

In the Tuner window, the displayed channel pair is shown in the lower left corner. Each channel has a checkbox to enable or disable its input to the tuner.

Tuner controls

Detected frequency: fundamental frequency of the incoming signal, in Hertz (Hz).

Detected note: note name and octave that correspond to the detected fundamental frequency.

Meter: representation of the pitch difference between the detected note and the detected fundamental frequency. The horizontal position of the illuminated segments indicates how far the detected frequency is from the detected note. The number of illuminated segments indicates uncertainty or inharmonicity in the signal; a greater number of illuminated segments represents greater uncertainty. The color of the segments changes gradually from green (in tune) to yellow, orange, and red (progressively further out of tune).

Meter value: difference between the detected note and the detected frequency, in cents.

Arrows: the direction in which the detected frequency needs to move to match the frequency of the detected note. The color of the arrows changes progressively in the same manner as the meter segments. When the detected fundamental frequency matches the detected note within three cents, both arrows will be illuminated.

Reference frequency: sets the frequency reference for the pitch A4, between 400 and 480 Hz. The default frequency is 440 Hz. The reference frequency can be adjusted by dragging on the bar below the number, or by clicking the number and typing a value. To reset the tuner to the default frequency, double-click the slider, or click the number, press the Delete key, and press Enter.

Tuning stereo signals

When tuning a stereo signal, the tuner analyzes the sum of the two channels. If the channels are not phase coherent, the tuner may not be able to measure the frequency of the signal. To tune only one channel of the channel pair, disable one of the channels as described in "Choosing a channel to tune".

CONFIGURATIONS MENU

A configuration is just like a hardware preset (a "snapshot" of all settings in CueMix FX and therefore the 8pre USB hardware itself), except that it can be created and managed using the CueMix FX software on your computer, completely independently of the 8pre USB hardware. The commands in the Configurations menu let you create, save, load, import, export and otherwise manage as many configurations as you wish.

Here is a summary of Configurations menu operations:

Configurations Menu item	What it does
Create New	Lets you name and save a new configuration, which appears at the bottom of the Configurations menu.
Save	Overwrites the current configuration (checked in the list at the bottom of the menu) with the current settings in CueMix FX.
Save To	Same as Save above, except that it lets you first choose the configuration you wish to save to (instead of the current one).
Delete	Lets you choose a configuration to permanently remove from the menu.
Import	Loads all configurations from a configuration file on disk.
Export	Saves all current configurations as a file on disk.
Configuration list	Choose any configuration to load it. The current (last loaded or saved) configuration has a check mark next to it.

Modifying a configuration

The name of the current configuration is displayed in the CueMix FX window title bar. If you make any changes to the settings in CueMix FX, an asterisk appears in front of the name to remind you that the current state of CueMix FX doesn't match the saved configuration. If you wish to update the saved configuration with the new changes, use the Save command. To save the current state of CueMix FX to another configuration, use Save To. To save as a new, separate configuration, use Create New.

Saving a CueMix FX configuration as a hardware preset

To save a CueMix FX configuration as a hardware preset:

1 Choose the configuration from the Configurations menu to make it the current active configuration.

2 Choose *File menu> Save Hardware Preset*.

3 Type in a name, choose a preset slot and click OK.

Saving a hardware preset as a CueMix FX configuration

To save a hardware preset as a CueMix FX configuration:

1 Choose *File menu> Load Hardware Preset* to make it the current active preset.

2 Choose *Configuration menu> Create New* (or *Save To*) to save it as a configuration.

TALKBACK MENU

Choose the commands in the Talkback menu to engage or disengage Talkback or Listenback. See "Talkback and listenback" on page 50.

PHONES MENU

The Phones menu allows you to choose what you will hear on the headphone output, just like the Phones setting in MOTU Audio Console. However, this menu provides one extra option that is exclusive to CueMix FX: *Follow Active Mix*. This menu item, when checked, causes the headphone output to mirror the output of the current mix being viewed in CueMix FX. For example, if you are currently viewing mix bus 3, the headphones will mirror the mix bus 3 output (whatever it is assigned to).

CONTROL SURFACES MENU

CueMix FX can be controlled from an automated control surface such as the Mackie Control™. Use the commands in the *Control Surfaces* menu to enable and configure this feature.

Application follows control surface

When checked, the *Application follows control surface* menu command makes the CueMix FX window scroll to the channel you are currently adjusting with the control surface, if the channel is not visible when you begin adjusting it. The same is true for the bus tabs: if you adjust a control in a bus that is not currently being displayed, CueMix FX will jump to the appropriate tab to display the control you are adjusting.

Share surfaces with other applications

When the *Share surfaces with other applications* menu command is checked, CueMix FX releases the control surface when you switch to another application. This allows you to control your other software with the control surface. Here's a simple way to understand this mode: the control surface will always control the front-most application. Just bring the desired application to the front (make it the active application), and your control surface will control it. When you'd like to make changes to CueMix FX from the control surface, just bring CueMix FX to the front (make it the active application).

When this menu item is unchecked, your control surface will affect CueMix FX all the time, even when CueMix FX is not the front-most application. In addition, you will not be able to control other host audio software with the control surface at any time (because CueMix FX retains control over it at all times). This mode is useful when you do not need to use the control surface with any other software.

CueMix Control Surfaces

CueMix FX includes support for the following control surface products:

- Mackie Control™

- Mackie HUI™

- Mackie Baby HUI™

Use the sub-menu commands in the *CueMix Control Surfaces* menu item to turn on and configure control surface support, as described briefly below.

Enabled

Check this menu item to turn on control surface operation of CueMix FX. Uncheck it to turn off control surface support.

Configure…

Choose this menu item to configure your control surface product. Launch the on-line help for specific, detailed instructions on configuring CueMix FX for operation with your control surface product.
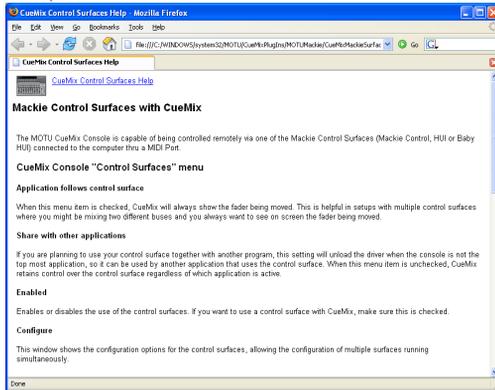
Figure 9-32: Refer to the extensive on-line help for details about configuring CueMix FX for operation with your control surface product.

CUEMIX IN OPTICAL EXPANDER MODE

When the 8pre operates as an optical expander (as discussed in "Operating the 8pre USB as a converter" on page 23), CueMix is hard-wired to route each analog input to its corresponding optical output channel (analog in 1 to optical out 1, analog in 2 to optical out 2, and so on).

In addition, when operating the 8pre at a 1x sample rate (either 44.1 or 48 kHz), the analog input signals are duplicated and sent to both optical output banks. This lets you send the analog input signals to two separate optical destinations, if desired.

When operating the 8pre at a 2x sample rate (88.2 or 96 kHz), the two optical output banks work in concert to provide channels 1-4 and 5-8, respectively, for a total of 8 channels of high-resolution.

MOTU SMPTE Console

OVERVIEW

The 8pre USB can resolve directly to SMPTE time code via any analog input, without a separate synchronizer. The 8pre USB can also generate time code via any analog output. The 8pre USB provides a DSP-driven phase-lock engine with sophisticated filtering that provides fast lockup times and sub-frame accuracy. Direct time code synchronization is supported by Cubase, Nuendo and other audio sequencer software that supports the ASIO 2 or 3 sample-accurate sync protocol.

MOTU SMPTE CONSOLE

The included MOTU SMPTE Console™ software provides a complete set of tools to generate SMPTE for striping, regenerating or slaving other devices to the computer.

CLOCK/ADDRESS

The *Clock/Address* menu (Figure 10-1) provides the same global *Master Clock Source* setting as in MOTU Audio Console ("Master Clock Source" on page 29), but it includes additional information: each setting shows both the clock and the address (time code or sample location), separated by a forward slash (/). To resolve the 8pre USB to SMPTE time code, choose the *SMPTE / SMPTE* setting in the Clock/Address menu. This means that the system will use SMPTE as the clock (time base) and SMPTE as the address.

FRAME RATE

This setting should be made to match the SMPTE time code frame rate of the time code that the system will be receiving. The 8pre USB can auto-

The Reader section provides settings for resolving to video and/or SMPTE time code.

The Generator section provides settings for striping SMPTE time code.
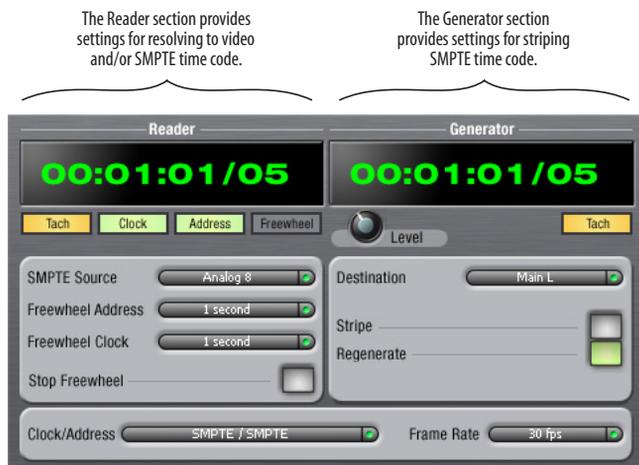
Figure 10-1: SMPTE Console gives you access to your 8pre USB's on-board SMPTE time code synchronization features.

detect and switch to the incoming frame rate, except that it cannot distinguish between 30 fps and 29.97 fps time code, or 23.976 and 24 fps time code. So if you are working with either of these rates, make sure you choose the correct rate from this menu.

READER SECTION

The Reader section (on the left-hand side of the window in Figure 10-1) provides settings for synchronizing the 8pre USB to SMPTE time code.

Status lights

The four status lights (Tach, Clock, Address and Freewheel) give you feedback as follows:

Tach

The Tach light blinks once per second when the 8pre USB has successfully achieved lockup to SMPTE time code and SMPTE frame locations are being read.

Clock

The Clock light glows continuously when the 8pre USB has successfully achieved lockup to an external time base, such as SMPTE time code or the S/PDIF input.

Address

The Address light glows continuously when the 8pre USB has successfully achieved lockup to SMPTE time code.

Freewheel

The Freewheel light illuminates when the 8pre USB is freewheeling address (time code), clock or both. For details about Freewheeling, see "Freewheel Address" and "Freewheel clock" below.

SMPTE source

Choose the analog input that is connected to the time code source. This is the input that the 8pre USB "listens" to for time code.

Freewheel Address

Freewheeling occurs when there is a glitch or drop-out in the incoming time code for some reason. The 8pre USB can freewheel past the drop-out and then resume lockup again as soon as it receives readable time code. Choose the amount of time you would like the 8pre USB to freewheel before it gives up and stops altogether.

The 8pre USB cannot freewheel address without clock. Therefore, the *Freewheel Address* setting will always be lower than or equal to the *Freewheel Clock* setting, and both menus will update as needed, depending on what you choose.

Keep in mind that freewheeling causes the system to keep going for as long as the duration you choose from this menu, even when you stop time code intentionally. Therefore, if you are starting and stopping time code frequently (such as from the transports of a video deck), shorter freewheel times are better. On the other hand, if you are doing a one-pass transfer from tape that has bad time code, longer freewheel times will help you get past the problems in the time code.

The 'Infinite' freewheel setting

The *Infinite* freewheel setting in the *Freewheel Address* menu causes the 8pre USB to freewheel indefinitely, until it receives readable time code again. To make it stop, click the *Stop Freewheeling* button.

Freewheel clock

Freewheeling occurs when there is a glitch or drop-out in the incoming SMPTE time code for some reason. The 8pre USB can freewheel past the drop-out and then resume lockup again as soon as it receives a stable, readable clock signal.

The 8pre USB cannot freewheel address without clock. Therefore, the *Freewheel Address* setting will always be lower than or equal to the *Freewheel Clock* setting, and both menus will update as needed, depending on what you choose.

The 'Infinite' freewheel setting

The *Infinite* freewheel setting in the *Freewheel Clock* menu causes the 8pre USB to freewheel indefinitely, until it receives readable time code again. To make it stop, click the *Stop Freewheeling* button.

Stop Freewheeling

The Stop Freewheeling button stops the system if it is currently freewheeling.

GENERATOR SECTION

The Generator section (on the right-hand side of the window in Figure 10-1) provides settings for generating SMPTE time code.

Level

Turn the level knob to adjust the volume of the SMPTE time code being generated by the 8pre USB. The level knob disappears when the Destination is set to *None*.

Tach light

The Tach light blinks once per second when the 8pre USB is generating SMPTE time code.

Destination

In the *Destination* menu, choose either *SMPTE* (to generate time code) or *None* (to turn it off).

Stripe

Click this button to start or stop time code. To set the start time, click directly on the SMPTE time code display in the Generator section and type in the desired start time. Or drag vertically on the numbers.

Click here to edit the start time, or drag vertically on the numbers.
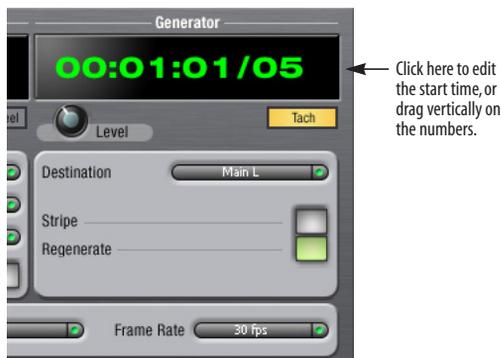
Figure 10-2: Setting the time code start time.

Regenerate

This option, when enabled, causes the generator to generate time code whenever the 8pre USB is receiving SMPTE time code.

RESOLVING CUBASE OR NUENDO TO TIME CODE

To resolve your 8pre USB and Cubase or Nuendo directly to SMPTE time code with no additional synchronization devices, use the setup shown in "Setup for SMPTE time code sync" on page 76. Make sure the Master *Clock Source* setting in the MOTU Audio Console window is set to *SMPTE*. Also, make sure that you've connected an LTC input signal to a 8pre USB analog input, and that you've specified that input in the *SMPTE Source* menu in SMPTE Console.

SETUP FOR SMPTE TIME CODE SYNC

The 8pre USB system can resolve directly to SMPTE time code. It can also generate time code, under its own clock or while slaving to time code. Therefore, the 8pre USB can act both as an audio interface and as a SMPTE time code synchronizer to which you can slave other devices. You can use the 8pre USB to slave your audio software to SMPTE as well, via sample-accurate sync (if your host software supports it).

Use this setup if you have:

✓ A SMPTE time code source, such as a multitrack tape deck.

✓ An 8pre USB by itself, OR with another slaved device (such as a digital mixer).

✓ Host software that supports sample-accurate sync.

This setup provides:

✓ Continuous sync to SMPTE time code.

✓ Sub-frame timing accuracy.

✓ Transport control from the SMPTE time code source.

SMPTE time code source

audio cable bearing LTC (Longitudinal Time Code)

Analog (line) input

8pre USB interface

USB cable

Windows computer running Cubase or other sample-accurate ASIO software
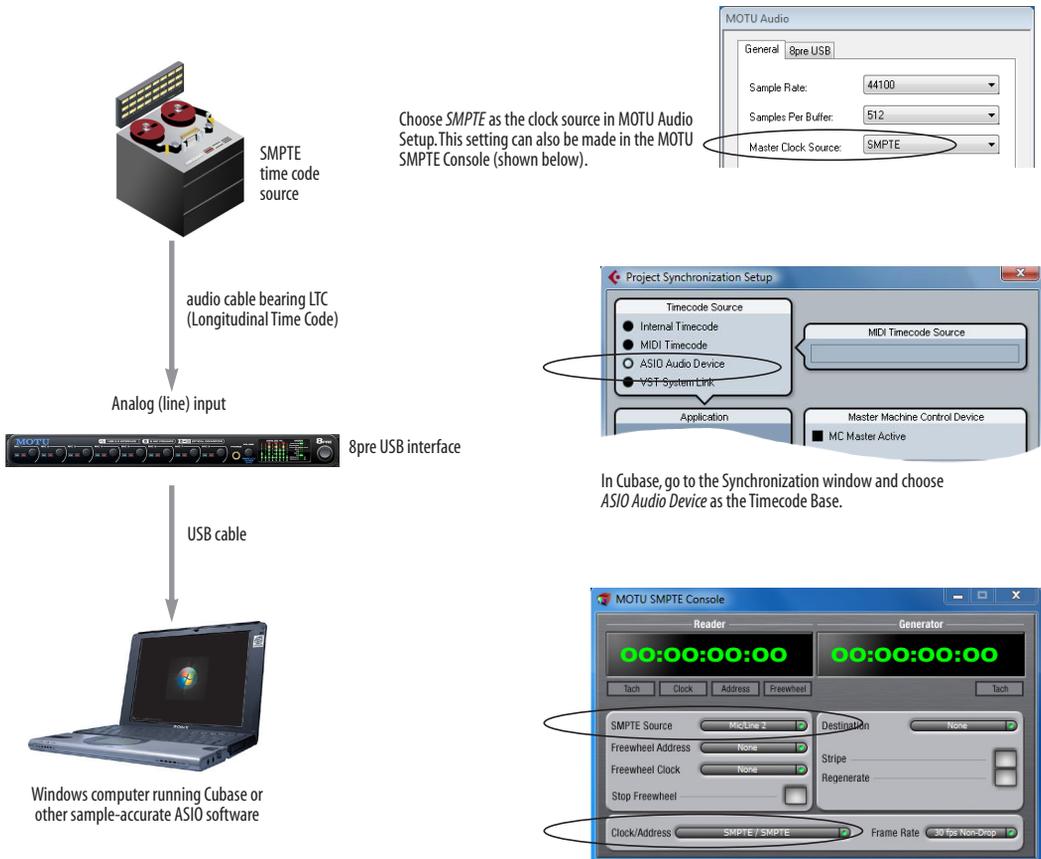
Figure 10-3: Connections for synchronizing the 8pre USB directly to SMPTE time code.

Choose *SMPTE* as the clock source in MOTU Audio Setup. This setting can also be made in the MOTU SMPTE Console (shown below).

In Cubase, go to the Synchronization window and choose *ASIO Audio Device* as the Timecode Base.

Launch the MOTU SMPTE Console and specify the *SMPTE Source*, which is the interface receiving the SMPTE time code. Also, confirm that the *Clock Source/Address* is *SMPTE/SMPTE*.

CHAPTER 11   Troubleshooting

Why does the start sound not play through the 8pre USB?
The 8pre USB will only playback audio at a sampling rate of 44.1, 48, 88.2 or 96 kHz.

The computer freezes when it starts up
If the computer is unable to boot up, it may be a conflict with the WDM Driver. As soon as the computer boots up, Windows will try and initialize the WDM Driver. If this fails, your computer will hang. To determine if the WDM Driver is the problem, boot up in Safe Mode or remove the MOTU Audio software with the Add/Remove Programs Control Panel then restart. If that fixes the problem, visit motu.com to download the very latest drivers and then install them.

'New hardware detected' window
If you connect your 8pre USB before running the MOTU Audio installer, Windows will prompt you that new hardware has been detected. Cancel this, and run the 8pre USB Software Installer, rather than allowing Windows to locate the drivers.

Clicks and pops under word clock sync
Many problems result from incorrect word clocking. It is essential that all digital devices in the system be word locked. Consult "Choosing a clock source for optical connections" on page 27 for detailed information on how to sync with other gear that is connected optically. Whenever there is any weird noise or distortion, suspect incorrect digital clocking.

Clicks and pops due to hard drive problems
If you have checked your clock settings and you are still getting clicks and pops in your audio, you may have a drive related problem. Set your Master Clock Source to *Internal* and try recording just using the analog inputs and outputs of the 8pre

USB. If you encounter the same artifacts you may want try using another drive in your computer. Clicks and pops can also occur when the drive is severely fragmented or there are other drive-related issues. If you are using a USB drive on the same bus as the 8pre USB, it could be that the USB bus is overloaded (too many devices on the same bus). Try removing all devices except the 8pre USB.

Connecting or powering gear during operation
It is not recommended that you connect/disconnect, or power on/off devices connected to the 8pre USB while recording or playing back audio. Doing so may cause a brief glitch in the audio.

8pre USB inputs and outputs are not available in host audio software
Make sure that the inputs and outputs are enabled. See "Working with Track16 inputs and outputs" on page 53.

No optical inputs or outputs are available in host audio application
Check to make sure you have the desired optical inputs and/or outputs enabled in the MOTU Audio Console.

Monitoring - How to monitor inputs?
Please refer to the documentation for the audio application that you are using. If your application does not support input monitoring, you will need to use the 8pre USB's hardware-based CueMix DSP monitoring feature. Please see chapter 8, "Reducing Monitoring Latency" (page 41).

Controlling monitoring latency
See chapter 8, "Reducing Monitoring Latency" (page 41).

CUSTOMER SUPPORT

We are happy to provide customer support to our registered users. If you haven't already done so, please take a moment to register on line at motu.com, or fill out and mail the registration card included with your 8pre USB. Doing so entitles you to technical support and notices about new products and software updates.

REPLACING DISKS

If your installer disc becomes damaged, our Customer Support Department will be glad to replace it. You can request a replacement disc by calling our business office at (617) 576-2760 and asking for the customer service department. In the meantime, you can download the latest drivers from www.motu.com.

TECHNICAL SUPPORT

If you are unable, with your dealer's help, to solve problems you encounter with the 8pre USB system, you may contact our technical support department in one of the following ways:

■ Tech support hotline: (617) 576-3066 (Monday through Friday, 9 a.m. to 6 p.m. EST)

■ Online support: www.motu.com/support

Please provide the following information to help us solve your problem as quickly as possible:

■ The serial number of the 8pre USB system. This is printed on a label placed on the bottom of the 8pre USB rack unit. You must be able to supply this number to receive technical support.

■ A brief explanation of the problem, including the exact sequence of actions which cause it, and the contents of any error messages which appear on the screen.

■ The pages in the manual which refer to the parts of the 8pre USB or AudioDesk with which you are having trouble.

■ The version of your computer's operating system.

We're not able to solve every problem immediately, but a quick call to us may yield a suggestion for a problem which you might otherwise spend hours trying to track down.

If you have features or ideas you would like to see implemented, we'd like to hear from you. Please write to the 8pre USB Development Team, MOTU Inc., 1280 Massachusetts Avenue, Cambridge, MA 02138 or send an email to: customerservice@motu.com.

IRP2

IR Emitter Probe w/Terminal Block Connector

The IRP2 is an IR (infrared) emitter probe designed to adhere directly
over the IR sensor window of a television, DVD player, or any other IR
controllable device. The IRP2 connects to any Crestron control system with
a 2-pin terminal block type Crestron IR port, providing a 1-way IR
control interface to the device. The IRP2 is composed of an infrared LED
housed in a miniature shell. Its integral 7 foot cable may be extended up
to 1000 feet using ordinary twisted pair cable. Includes IR mask and
two-sided tape for mounting.

SPECIFICATIONS

Connectors

(1) 2-pin 3.5mm detachable terminal block for connection to a Crestron
IR port

Enclosure

Black injection molded plastic with integral lightweight cable

Dimensions

Height: 0.25 in (0.64 cm)
Width: 0.31 in (0.79 cm)
Depth: 0.56 in (1.43 cm)

Cable Length

Mini-wire Lead: 3 ft (0.91 m) long
Cable: 7 ft (2.13 m) long

CRESTRON

PoE Injector

The PWE-4803RU is an 802.3af compliant Power over Ethernet (PoE) power

source designed to support PoE powered devices such as the Crestron®

CEN-WAP-ABG-1G Wireless Access Point. Standards-based Power over

Ethernet affords a one-wire solution for connecting Ethernet devices,

delivering power and data over a single CAT5/6 network cable. Using the

PWE-4803RU, there is no need to install a separate power supply at the

device location. The PWE-4803RU can simply be mounted at any convenient

location up to 100 meters (328 feet) from the device.

SPECIFICATIONS

Output Rating

350 mA maximum @ 48 Volts DC nominal;

Power Requirements

100-250 Volts AC, 50/60 Hz

Connectors

LAN: (1) 8-wire RJ45, female;

10BaseT/100BaseTX Ethernet port;

LAN PoE: (1) 8-wire RJ45, female;

Main Power Input: (1) IEC 320 C14 socket;

LED Indicators

POWER: (1) Tri-color LED;

Amber indicates power is available but no device is connected;

Green indicates a PoE device is connected and drawing power;

Environmental

Temperature: 32° to 104°F (0° to 40°C)

Humidity: 10% to 90% RH (non-condensing)

Heat Dissipation: 28 BTU/Hr

Dimensions

Height: 1.35 in (3.43 cm)

Width: 2.40 in (6.10 cm)

Depth: 3.98 in (10.11 cm)

Weight

6.0 oz (169 g)

infiNET EX® & ER Wireless Gateway

> Multipurpose 2-way RF wireless gateway

> Simultaneously supports infiNET EX® and Crestron "ER" wireless devices [2]

> Ultra dependable infiNET EX mesh network technology

> "Extended Range" RF technology optimized for wireless touch screen remotes

> Dynamic discovery for fast, easy setup

> "Wi-Fi® friendly" channel selection for trouble-free operation

> Built-in RF network diagnostics

> Up to 150 feet (46 meters) infiNET EX range indoors, 250 feet (76 m) outdoors [1]

> 100 to 200 feet (33 to 66 meters) ER range indoors, 1000 feet outdoors

> Supports infiNET EX expanders and ER roaming for extended coverage [1,3]

> Extendable antenna using optional ANT-EXT [5]

> Compact, stackable "IFE small" form factor

> Surface or DIN rail mountable using bracket provided

> Available rack mount and pole mount options [5]

> High-speed Ethernet control system interface

> 24VDC or PoE network powered

> Models available with PoE injector included

> Optional 24VDC power pack sold separately

The CEN-GWEXER is a 2-way RF wireless transceiver designed for use with Crestron® infiNET EX® and "ER" (Extended Range RF) wireless devices. A single CEN-GWEXER gateway enables an entire wireless network of Crestron remotes, keypads, lighting dimmers, motorized shades, thermostats, door locks, and other devices to communicate with a Crestron control system.

infiNET EX® Technology

Ultra-reliable infiNET EX wireless technology provides steadfast 2-way RF communications throughout a residential or commercial structure without the need for physical control wiring. Employing a 2.4 GHz mesh network topology, nearly every infiNET EX device on the network acts as an "expander," relaying wireless commands between the gateway and all the other "EX" devices on the network to ensure that every command reaches its intended destination without disruption. Each infiNET EX device that is added to the network effectively increases the range and stability of the entire network by providing multiple redundant signal paths. The wireless range between any two EX devices is typically up to 150 ft (46 m) indoors.[1]

"ER" Extended Range RF Technology

Crestron Extended Range (ER) wireless technology enables compatibility with certain Crestron wireless touch screens and handheld remotes including the TSR-302, TST-600, TST-602, and TST-902.[2] Crestron "ER" operates in the same 2.4 GHZ spectrum as infiNET EX, and is specifically optimized for use with wireless touch screen devices to ensure robust and dependable bidirectional RF communications. The CEN-GWEXER continuously monitors each ER device on the network, diligently keeping

track when a device goes to sleep, shuts down, or wanders out of range, and restores communications seamlessly when the device reappears on the network. The typical wireless range for ER devices is 100 to 200 feet indoors, or up to 1000 feet outdoors. For even greater coverage, ER supports roaming amongst up to eight gateways.[3]

Easy Setup

The CEN-GWEXER can manage both infiNET EX and ER wireless devices simultaneously, eliminating the need for separate gateways, antennas, and LAN connections. Setting up a network of infiNET EX and/or ER devices is simple, utilizing dynamic discovery to locate and acquire each wireless device automatically. If no ER devices are acquired, the CEN-GWEXER can support up to 100 infiNET EX devices (inclusive of up to six Crestron MLX-3 handheld remotes [2]). Each ER device that is added to the network negates ten EX devices, with a maximum of ten ER devices allowed. For a more detailed breakdown, please refer to "Supported Devices" in the specifications section of this spec sheet.[4]

Single-Wire Hookup

The CEN-GWEXER gateway communicates with a control system over Ethernet and gets its operating power over the same Ethernet connection using PoE technology. PoE (Power over Ethernet) simply requires the presence of an 802.3af or 802.3at PoE power source.

• Crestron offers the PWE-4803RU PoE Injector, which connects inline with the Ethernet cable, allowing for installation at any convenient location between the gateway and the network switch. The PWE-4803RU is capable of powering a single gateway, and is available separately or packaged with the gateway as model CEN-GWEXER-PWE or CENI-GWEXER-PWE.

CEN-GWEXER   infiNET EX® & ER Wireless Gateway

Rear & Front Views

- Crestron also offers Ethernet switches with built-in PoE (models CEN-SW-POE-5 and CEN-SWPOE-16 [5]), affording a complete high-performance networking solution capable of providing PoE for multiple gateways and other PoE devices. Using an Ethernet switch with built-in PoE eliminates the need for individual PoE Injectors.

As an alternative to PoE, the CEN-GWEXER can be powered using an optional 24VDC power pack, model PW-2407WU.[5]

Integrator Friendly Enclosure
The CEN-GWEXER features the Crestron IFE form factor, a compact "Integrator Friendly Enclosure" design that fits almost anywhere and enables a variety of installation options. Its shape allows multiple gateways and other IFE compliant devices to be stacked together. Using the included mounting bracket, it can be fastened to any flat surface or snapped onto a standard DIN rail. Rack mount and pole mount kits are also available.[5]

SPECIFICATIONS

Supported Devices

infiNET EX® Devices: Supports all Crestron and third-party infiNET EX devices including HR-100, HR-150, and MLX-3 handheld remotes [2]
infiNET EX Expanders: Supports Crestron infiNET EX expander models CLW-EXPEX and GLA-EXPEX
ER "Extended Range" Devices: Supports Crestron wireless touch screen models TSR-302, TST-600, TST-602, & TST-902 [2]

Maximum Devices Allowed [4]:

infiNET EX Devices*	infiNET EX Expanders	ER "Extended Range" Devices
100	5	0
90	5	1
80	5	2
70	5	3
60	5	4
50	5	5
40	5	6
30	5	7
20	5	8
10	5	9
0	5	10

Inclusive of a maximum of six MLX-3 remotes

Wireless Communications

RF Transceiver: infiNET EX & ER 2-way RF, 2.4 GHz ISM Channels 11-26 (2400 to 2483.5 MHz), default channel 15; IEEE 802.15.4 compliant
infiNET EX Range (typical): 150 ft (46 m) indoor, 250 ft (76 m) outdoor, to nearest mesh network device(s); subject to site-specific conditions and individual device capabilities [1]
ER Range (typical): 100 to 200 ft (33 to 66 m) maximum indoor, 1000 ft (305 m) outdoor, subject to site-specific conditions
ER Roaming: Supports roaming amongst up to 8 gateways [3]

Wired Communications

Ethernet: 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP, IEEE 802.3at Type 1 compliant

Controls & Indicators

PWR: (1) Green LED, indicates operating power supplied via PoE or 24VDC
ACT: (1) Green LED, indicates wireless RX and TX data activity
ACQUIRE: (1) Recessed pushbutton with red LED, used to set up connections with wireless devices
SETUP: (1) Recessed pushbutton with red LED, used to set up connection with the control system via Ethernet
RESET: (1) Recessed pushbutton, for hardware reset
LAN PoE: (1) Green and (1) Amber LEDs, green indicates Ethernet link status, amber indicates Ethernet activity

Connectors

ANTENNA: (1) Connection for supplied antenna
COMPUTER: (1) Micro-B USB female; Computer console port, for installer use only; 6 ft (2.83 m) Micro-B to A USB cable included
G: (1) 4-40 screw, chassis ground lug

5.04 in
128 mm

6.15 in
157 mm

5.20 in
133 mm

1.35 in
35 mm

CEN-SW-POE-5

5-Port PoE Switch

> 5-port unmanaged Ethernet switch
> All ports support 1000Base-T Gigabit Ethernet
> Provides PoE (802.3af) on 4 ports
> Auto-negotiating and auto MDI/MDIX
> Rugged metal enclosure
> Surface or rack-rail mountable

The CEN-SW-POE-5 is a 5-port unmanaged Gigabit Ethernet switch that provides Power over Ethernet (PoE) from four of its ports. Power over Ethernet affords a one-wire solution for connecting Crestron touch screens, gateways, and other devices, delivering power and data over a single CAT5/6 network cable. All 5 ports are Gigabit capable to ensure maximum bandwidth for multimedia and critical control data.

Using the CEN-SW-POE-5, there is no need to install a separate power supply at each networked device location. The CEN-SW-POE-5 can simply be mounted at a convenient location on a wall or in an equipment rack, providing a single power source for four separate 802.3af compliant PoE powered devices. Non-PoE devices may also be connected to any port on the CEN-SW-POE-5 without risk of damage to either component.

SPECIFICATIONS

Ethernet

Ports: (5) 10Base-T/100Base-TX/1000Base-T Ethernet
Network Standards: IEEE 802.3, 802.3u, 802.3ab, 802.3x, & 802.3af
Transmission Method: Store-and-Forward

Indicators

PoE 1 – 4: (4) green LEDs, indicate a PoE powered device is connected to each corresponding Ethernet port

Uplink: (1) green LED and (1) amber LED; indicate Ethernet link status, speed, and activity at the Uplink port

1 – 4: (1) green LED and (1) amber LED per each of (4) Ethernet ports; indicate Ethernet link status, speed, and activity at each corresponding port

Power: (1) yellow LED, indicates operating power supplied via external power pack

Connectors

Uplink: (1) 8-wire RJ45, female; 10Base-T/100Base-TX/1000Base-T Ethernet port

1 – 4: (4) 8-wire RJ45, female; 10Base-T/100Base-TX/1000Base-T Ethernet ports and PoE Power Sourcing Equipment (PSE) outputs

G: (1) 6-32 screw, chassis ground lug

48VDC: (1) 4-pin (2x2) rectangular connector; 48 Volt DC power input (power pack included)

Power Requirements

Power Pack: 1.25 Amps @ 48 Volts DC; 100-240 Volts AC 50/60 Hz power pack included

Environmental

Temperature: 32° to 104°F (0° to 40°C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 10 BTU/hour

Enclosure

Chassis: Metal, black finish, with (2) integral mounting flanges, vented top and bottom
Mounting: Freestanding, surface mount, or attach to a single rack rail

Dimensions

Height: 5.06 in (129 mm)
Width: 4.66 in (119 mm)
Depth: 1.17 in (30 mm)

Weight

13.5 oz (381 g)

CRESTRON

MODELS & ACCESSORIES

Available Models

CEN-SW-POE-5: 5-Port PoE Switch

Notes:

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.

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Specifications subject to change without notice. Revised 10/03/14
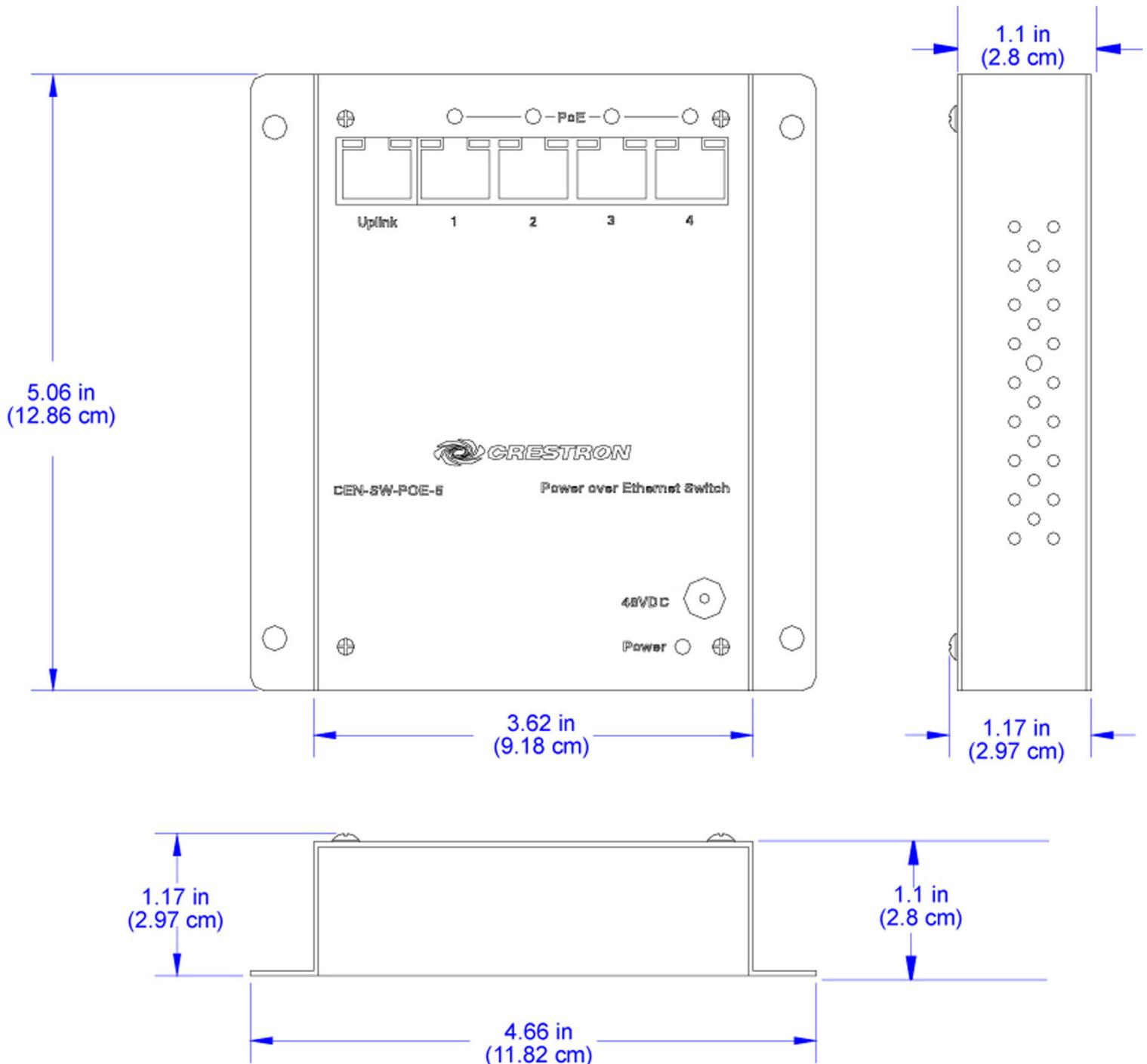
Pakedge Switches

Pakedge switches are designed to meet the most demanding needs of high bandwidth, low latency applications found in high performance commercial and residential A/V networks. Built with enterprise grade components and encased in solid, industrial quality housing, Pakedge switches provide seamless, scalable, and reliable network connectivity. No matter what your network needs are, there is a Pakedge switch for you.

Enterprise Performance

Designed for A/V Applications

Enhanced Security

Advanced Traffic Management

Intuitive GUI

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Switch Families

SE-Series

Unmanaged Switch

SK-Series
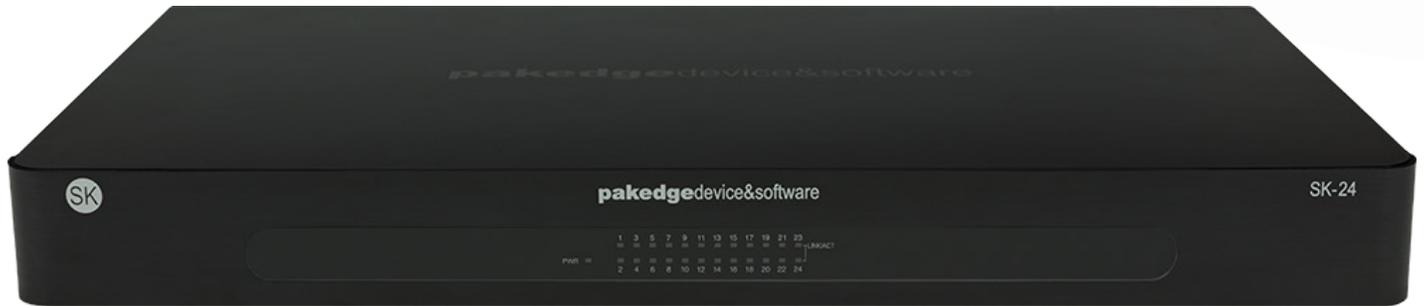
Managed Switch

SX-Series

Managed Switch

pakedgedevice&software inc

SE-Series

Pakedge SE-Series unmanaged switches are a staple in networks of all sizes, offered in various port counts, port orientations and PoE models. The SE-Series combine plug and play ports with gigabit switching performance, Pakedge reliability, and sleek AV style aesthetics.

They are ideal for use in smaller and simple networks that don't require advanced traffic management features, such as traffic segmentation, priority or Pakedge Zones™. SE-Series switches can also be used as an "edge" device downstream of a managed switch. This allows the managed switch to segment traffic while the unmanaged switch provides extra plug and play ports directly at the point of use.

Rack Mountable

Industry Alloy Housing

Blue LEDs

Sleek Black AV style housing

Gigabit Ethernet Plug and Play Ports

Auto Detect PoE/ PoE+ Ports (Select Models)

Special Port Features (Select Models)

Black Stealth Ports™	Fiber Ports
Powered by PoE	PoE/PoE+ Ports
PoE Passthrough	

pakedgedevice&software inc

When to use an SE-Series Switch

- Small networks with few devices that don't require advanced bandwidth management

- Devices that require Power over Ethernet without the need for advanced management

- At the edge or point of use - networked devices and a managed switch further upstream.

Auto Detect PoE/PoE+ devices

Auto Detect Port Speeds

Plug and Play Ports

Fanless thermal design

High throughput gigabit plug and play ports designed for AV streaming.

Non shared Fiber ports on select switches

Front and rear port orientation models.

Compare Models

	Ethernet Ports	PoE Ports	PoE+ Ports	Powered by PoE	PoE Passthrough	Fiber Ports	Port Orientation	Rack Mountable
SE Series								
SE-5-EP	5	-	-	✓	-	-	Rear Ports	-
SE-5P2-EP-A	5	2	-	✓	✓	-	Rear Ports	-
SE-8-EP	8	-	-	✓	-	-	Rear Ports	-
SE-8P2-EP-A	8	2/4*	-	✓	✓	-	Rear Ports	-
SE-18	16	-	-	-	-	2	Rear Ports	✓
SE-26	24	-	-	-	-	2	Rear Ports	✓
S20fe	16	-	-	-	-	4	Front Ports	✓
S28fe	24	-	-	-	-	4	Front Ports	✓
SE-8P4	8	4	2	-	-	-	Rear Ports	✓
SE-8P	8	8	4	-	-	-	Rear Ports	✓
S8P4fe	8	4	2	-	-	-	Front Ports	✓
SE-USB1-EP	2	1	-	✓	✓	-	In-Wall	-

* 4 PoE ports with AC adapter only

SK-Series

Pakedge SK-Series value line managed switches provide advanced traffic management capabilities for high bandwidth, low latency AV networks. Incorporating Pakedge technologies such as TruStream™ for traffic prioritization and quality assurance and Pakedge Zones™ for segmentation of diverse multimedia traffic, these switches are an integral part of the Pakedge Connect+ Platform and are ideal for high performance networks small and large.

The SK-Series is designed to provide the features & functionality of an enterprise grade switch for budget-conscious installations. It incorporates a high performance enterprise grade chipset, an efficient fanless thermal design, and intuitive setup menus.
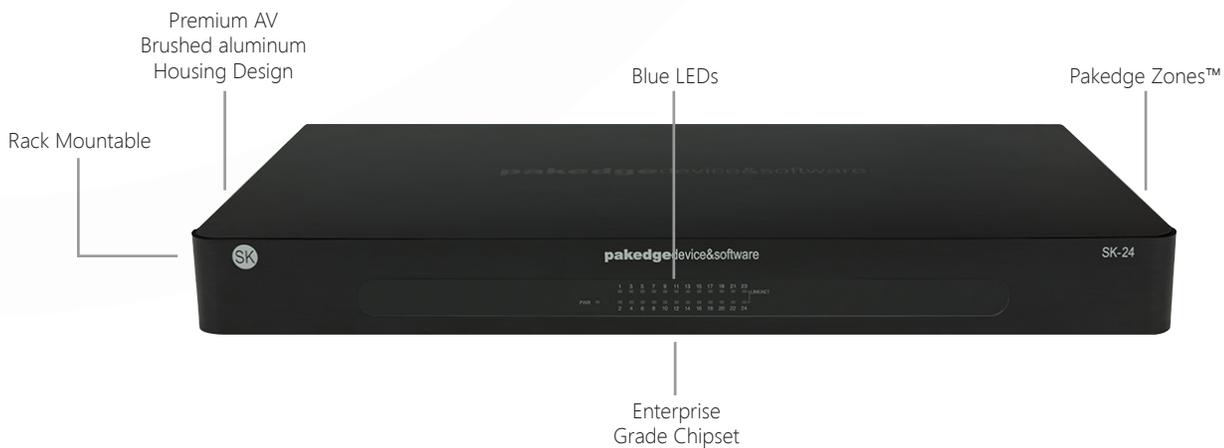
Premium AV Brushed aluminum Housing Design

Blue LEDs

Pakedge Zones™

Rack Mountable

pakedge device&software

SK-24

Enterprise Grade Chipset

Fully Configurable Switch

High throughput gigabit plug and play ports designed for AV streaming.

Fanless thermal design

Front and rear port orientation models.

Pakedge Zones for high quality A/V traffic management.

Connect+ Certified

SX-Series

SX-Series switches provide uncompromising top of the line performance with state of the art features. Designed specifically for demanding network systems, SX-Series switches incorporate high performance enterprise grade switch on a chip (SoC) cores, Pakedge Zone Wizard and Zone Template setup tools, and a high efficiency thermal management system incorporating dual chambers and ultra-quiet variable speed fans. Ideal for installations in demanding, noise sensitive environments like home theaters or conference rooms.
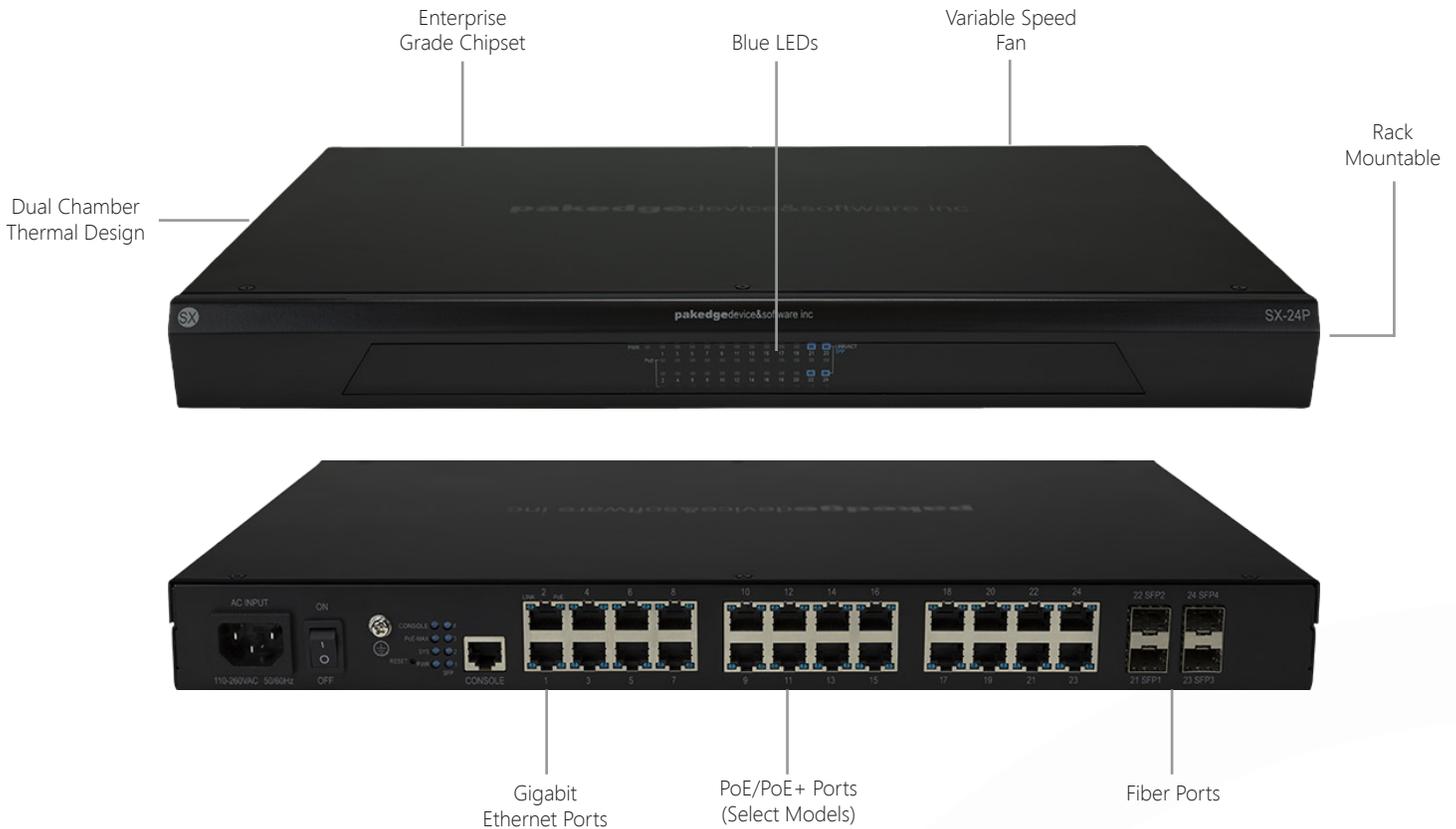
Enterprise Grade Chipset

Blue LEDs

Variable Speed Fan

Rack Mountable

Dual Chamber Thermal Design

Gigabit Ethernet Ports

PoE/PoE+ Ports (Select Models)

Fiber Ports

Fully Configurable Switch

High throughput gigabit plug and play ports designed for AV streaming.

Pakedge Zones for high quality A/V traffic management.

Auto Detect Port Speeds

Auto Detect devices PoE/PoE+

Non shared Fiber ports on select switches

Zone Wizard

Connect+ Certified

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When to use an SK-Series Switch

- Small to medium networks with high bandwidth, low latency devices and applications (streaming video, VOIP, high resolution audio, multi-zone audio)

- Networks requiring traffic segmentation for performance (Networks that require QoS or Pakedge Zones™ to segment network traffic.)

- Network security requirements that necessitate the isolation of application specific traffic (automation systems, IOT, BYOD wireless)

- Budget constrained projects

When to use an SX-Series Switch

- Medium to large networks with large numbers of high bandwidth, low latency applications (streaming video, VOIP, high resolution audio, multi-zone audio)

- Networks requiring the highest levels of performance and reliability

- Networks requiring traffic segmentation for performance (Networks that require QoS or Pakedge Zones™ to segment network traffic.)

- Network security requirements that necessitate the isolation of application specific traffic (automation systems, IOT, BYOD wireless, IP security cameras)

- Network devices requiring PoE as a power source (touch panels, VOIP devices, access points, etc.)

- Large network projects that require use of advanced setup tools for rapid deployment

Compare Models

	Ethernet Ports	PoE Ports	PoE+ Ports	Powered by PoE	Fiber Ports	Port Orientation
SK Series						
SK-8-EP	8	-	-	✓	1	Rear Ports
SK-24	24	-	-	-	2	Rear Ports
SK-24F	24	-	-	-	2	Front Ports
SX Series						
SX-24P8	24	8	4	-	4 Combo	Rear Ports
SX-24P16	24	16	12	-	4 Combo	Rear Ports
SX-24P	24	24	12	-	4 Combo	Rear Ports
SX-24	24	-	-	-	4 Combo	Rear Ports
S24F	24	-	-	-	2 Combo	Front Ports
S24Hf	24	24	12	-	4 Combo	Front Ports

Summary

	Ethernet Ports	PoE Innovations				Ports		VLANs			Thermal Management			TruStream™	Rack Mountable
		PoE Ports	PoE+ Ports	Powered by PoE	PoE Passthrough	Fiber Ports	Port Orientation	VLANs	Pakedge Zones™	Zone Wizard	Quiet Fan	Variable Fan	Fanless		
SE Series															
SE-5-EP	5	-	-	✓	-	-	Rear Ports	-	-	-	-	-	✓	-	-
SE-5P2-EP-A	5	2	-	✓	✓	-	Rear Ports	-	-	-	-	-	✓	-	-
SE-8-EP	8	-	-	✓	-	-	Rear Ports	-	-	-	-	-	✓	-	-
SE-8P2-EP-A	8	2/4*	-	✓	✓	-	Rear Ports	-	-	-	-	-	✓	-	-
SE-18	16	-	-	-	-	2	Rear Ports	-	-	-	-	-	✓	-	✓
SE-26	24	-	-	-	-	2	Rear Ports	-	-	-	-	-	✓	-	✓
S20fe	16	-	-	-	-	4	Front Ports	-	-	-	-	-	✓	-	✓
S28fe	24	-	-	-	-	4	Front Ports	-	-	-	-	-	✓	-	✓
SE-8P4	8	4	2	-	-	-	Rear Ports	-	-	-	-	-	✓	-	✓
SE-8P	8	8	4	-	-	-	Rear Ports	-	-	-	-	-	✓	-	✓
S8P4fe	8	4	2	-	-	-	Front Ports	-	-	-	-	-	✓	-	✓
SE-USB1-EP	3	1	-	✓	✓	-	In-Wall	-	-	-	-	-	✓	-	-
SK Series															
SK-8-EP	8	-	-	✓	-	1	Rear Ports	✓	✓	-	-	-	-	✓	✓
SK-24	24	-	-	-	-	2	Rear Ports	✓	✓	-	-	-	✓	✓	✓
SK-24F	24	-	-	-	-	2	Front Ports	✓	✓	-	-	-	✓	✓	✓
SX Series															
SX-24P8	24	8	4	-	-	4 Combo	Rear Ports	✓	✓	✓	-	-	✓	✓+	✓
SX-24P16	24	16	12	-	-	4 Combo	Rear Ports	✓	✓	✓	-	✓	-	✓+	✓
SX-24P	24	24	12	-	-	4 Combo	Rear Ports	✓	✓	✓	-	✓	-	✓+	✓
SX-24	24	-	-	-	-	4 Combo	Rear Ports	✓	✓	✓	-	-	✓	✓	✓
S24F	24	-	-	-	-	2 Combo	Front Ports	✓	-	-	-	-	✓	✓	✓
S24Hf	24	24	12	-	-	4 Combo	Front Ports	✓	-	-	✓	-	-	✓	✓

Notes

✓+ – This switch has IGMP Query in addition to IGMP snooping.

Combo Ports – These fiber ports are shared combo ports, meaning that when used, they take the place of one of the RJ-45 ports on the switch.

* 4 PoE ports with AC adapter only

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SE-Series Specifications

Product Name	SE-5-EP	SE-5-P2-EP-A	SE-8P2-EP-A	SE-8-EP	SE-18	SE-26	S20fe	S28fe	SE-8P4	SE-8P	S8P4fe	SE-USB1-EP
Powered By PoE	✓	✓	-	✓	-	-	-	-	-	-	-	✓
Port Orientation	Rear Facing	Rear Facing	Rear Facing	Rear Facing	Rear Facing	Rear Facing	Front Facing	Front Facing	Rear Facing	Rear Facing	Front Facing	In-Wall
Port Density												
Total Ports	5	5	8	8	16	24	20	28	8	8	8	3
PD Powered Port	Port 1 - af	Port 1 - at	Port 1 - at	Port 1 - af	-	-	-	-	-	-	-	Rear Port - at
PoE	-	2	2/4*	-	-	-	-	-	4	8	4	1
PoE+	-	-	-	-	-	-	-	-	2	4	2	-
SFP Ports	-	-	-	-	2	2	4	4	-	-	-	-
Performance												
PoE Budget	-	12.95W by PoE+	12.95W by PoE+	-	-	-	-	-	63W	136W	63W	12.95W
Fan	-	-	-	-	-	-	-	-	-	-	-	-
Switch Power Consumption	2.9W	6.7W	6.7W	4.5W	11W	15.5W	-	-	12W	14W	12W	2W
Switching Capacity	10Gbps	10Gbps	16Gbps	16Gbps	36Gbps	52Gbps	-	-	16Gbps	16Gbps	16Gbps	6Gbps
Packet Buffer	832Kbits	832Kbits	832Kbits	832Kbits	3.5Mbits	3.5Mbits	3.5Mbit	3.5Mbit	128Kbits	128Kbits	128Kbits	128Kbits
Throughput	7.4Mpps	7.4Mpps	11.9Mpps	11.9Mpps	26.7Mpps	38.6Mpps			11.9Mpps	11.9Mpps		4.4Mpps
MAC Table	1K	1K	1K	1K	16K	16K	16K	16K	8K	8K	8K	2K
Jumbo Frame	9K											
Link Agg Max	-											
Max Multicast	-											
QoS Queues	-											
Power												
Input Voltage	100-240V AC, 50/60Hz											
Physical Specifications												
Dimensions	5.86 x 3.30 x 1.02	5.86 x 3.30 x 1.02	7.59 x 3.30 x 1.02	7.59 x 3.30 x 1.02	12.68 x 7.30 x 1.73	12.68 x 7.30 x 1.73	2 x 17 x 5	2 x 17 x 5	12.68 x 7.30 x 1.73	12.68 x 7.30 x 1.73	10.46 x 7.26 x 1.70	4.25 x 1.9 x 2.4
Weight	1.2lbs	1.2lbs	1.5lbs	1.5lbs	4.3lbs	4.3lbs	2lbs	2.3lbs	4.3lbs	4.3lbs	3.3lbs	1 lb
Operating temperature	0~40°C (32°~104°F)											
Storage temperature	-40 ~ 70° (-40°~158°F)											
Operating Humidity	10% - 90% non-condensing											
Certifications	FCC/CE, RoHS											
Standards	IEEE802.3 10BASE-T, IEEE802.3u, 100BASE-TX, IEEE802.3x full-duplex flow control, IEEE802.3ab, 1000BASE-T											

SK-Series Specifications

Product Name	SK-8-EP	SK-24	SK-24F
Powered By PoE	✓	-	-
Port Orientation	Rear Facing	Rear Facing	Front Facing
Port Density			
Total Ports	8	24	24
PD Powered Port	Port 1 - af	-	-
PoE	-	-	-
PoE+	-	-	-
SFP Ports	1	2	2
Performance			
PoE Budget	-	-	-
Fan	-	-	-
Switch Power Consumption	7W	20W	20W
Switching Capacity	18Gbps	52Gbps	52Gbps
Packet Buffer	4Mbits	64Kbits	64Kbits
Throughput	13.3Mpps	38.6Mpps	38.6Mpps
MAC Table	8K	16K	16K
Jumbo Frame	10K	10K	10K
Link Agg Max	8	6	
Max Multicast	256		
QoS Queues	8	4	
Power			
Input Voltage	100-240V AC, 50/60Hz		
Physical Specifications			
Dimensions	9 x 5 x 1.25	17.36 x 9.99 x 1.73	17.36 x 8.66 x 1.73
Weight	5 lbs	6.7lbs	9.6lbs
Operating temperature	0~40°C (32°~104°F)		
Storage temperature	-40 ~ 70° (-40°~158°F)		
Operating Humidity	10% - 90% non-condensing		
Certifications	FCC/CE, RoHS		
Standards	IEEE802.3 10BASE-T, IEEE802.3u, 100BASE-TX, IEEE802.3x full-duplex flow control, IEEE802.3ab, 1000BASE-T		

SX-Series Specifications

Product Name	SX-24	S24F	S24Hf	SX-24P8	SX-24P16	SX-24P
Powered By PoE	-	-	-	-	-	-
Port Orientation	Rear Facing	Front Facing	Front Facing	Rear Facing	Rear Facing	Rear Facing
Port Density						
Total Ports	24	24	24	24	24	24
PoE	-	-	24	8	16	24
PoE+	-	-	12	4	12	12
SFP Ports	4	2	4	4	4	4
Performance						
PoE Budget	-	-	400W	123W	370W	370W
Fan	-	-	✓	-	Variable Speed Quiet	Variable Speed Quiet
Switch Power Consumption	30W	30W	450W*	141W	388W	388W
Switching Capacity	64Gbps	64Gbps	64Gbps	56Gbps	56Gbps	56Gbps
Packet Buffer	4Mbits	4Mbits	4Mbits	4Mbits	4Mbits	4Mbits
Throughput	35.7Mpps	35.7Mpps	35.7Mpps	35.7Mpps	35.7Mpps	35.7Mpps
MAC Table	8K					
Jumbo Frame	16K	16K	16K	9K	9K	9K
Link Agg Max	8	8	8	6	6	6
Max Multicast	256					
QoS Queues	4					
Power						
Input Voltage	100-240V AC, 50/60Hz					
Physical Specifications						
Dimensions	17.12 x 12.21 x 1.73	17.125 x 8.12 x 1.74	12.75 x 7.5 x 1.75	17.12 x 12.21 x 1.73	17.12 x 12.21 x 1.73	17.12 x 12.21 x 1.73
Weight	7.9lbs	6.7lbs	11.5lbs	13lbs	13lbs	13lbs
Operating Temperature	-	-	0~40°C (32°~104°F)	0~40°C (32°~104°F)	0° ~ 40°C (32° ~ 104°F)	0° ~ 40°C (32° ~ 104°F)
Storage Temperature	-40 ~ 70° (-40°~158°F)					
Operating Humidity	10% - 90% non-condensing					
Certifications	FCC/CE, RoHS					
Standards	IEEE802.3 10BASE-T, IEEE802.3u, 100BASE-TX, IEEE802.3x full-duplex flow control, IEEE802.3ab, 1000BASE-T					

Warranty

Pakedge Device & Software offers a 3-year limited warranty. Pakedge Device & Software will repair or replace products that do not perform as specified within 3 years of the date of purchase due to a defect in materials, workmanship, or functionality.

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Switch Types

Pakedge switches are available in two types - Unmanaged & Managed

Pakedge unmanaged SE-Series switches are "plug and play" switches that require no configuration setup. They auto-discover connected devices, auto-detect network speeds and communication modes, and integrate into the network in seconds. Unmanaged switches are ideal for use in small networks with a limited number of devices that don't require a lot of bandwidth management, in a segment of a network downstream of a managed switch, or at the "edge" near the point of use of the device. Key benefits of unmanaged switches include ease of installation, and simple network expansion.

Pakedge managed SK and SX-Series switches are fully configurable to meet the unique needs of a specific network for maximum performance. These settings include bandwidth management settings, port settings, and security settings. Managed switches are ideal for networks, large or small, that have high bandwidth, low latency devices that compete against each other and require active bandwidth management for best performance. Key benefits include optimized performance tailored specifically to your network and the ability to scale and meet your network needs today and tomorrow.

Key Switch Features

Enterprise Chipset   (SE)   (SK)   (SX)

High performance switches start with the core. The engines powering Pakedge switches are enterprise grade high performance processors using switch on a chip (SoC) technology. Network processors are optimized to process AV network traffic flows at high speeds. They reduce the load on other system components by taking on many of the packet-based communications maintenance tasks such as general TCP processing, network address translation and some encryption/decryption tasks. AV Traffic management is a key function of the switch and the chipset is the heart of that functionality. A high performance chipset is critical to fast and accurate switching capabilities.

Pakedge Zones™

SK   SX

ZONE ID **1**	ZONE ID **2**	ZONE ID **3**	ZONE ID **4**	ZONE ID **5**	ZONE ID **6**
Management	Voice	Audio/Video	Automation	Data	Guest
High Priority	High Priority	Medium Priority	Medium Priority	Low Priority	Low Priority
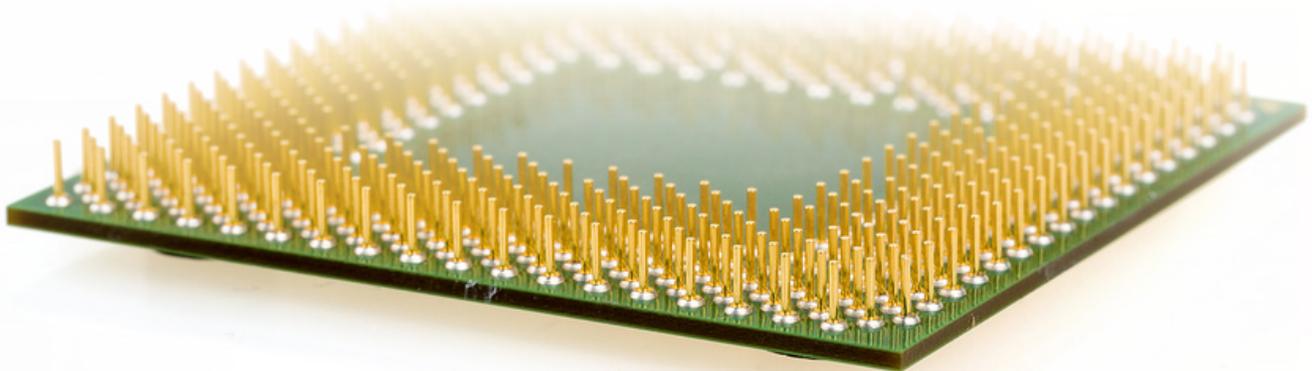
While VLANs can segment a network into multiple smaller networks and prioritize them, the configuration process can be difficult. Enterprise networks can support hundreds of VLANs, and managing them all can be a daunting task.

Pakedge Zones simplify VLANs for A/V networks by breaking them into six subnetworks: management, voice, audio/video, automation, data and guest. Network ports on routers and switches under these subnetworks are color-coded for easy identification.

Wi-Fi Network
Multi-SSID Access Points Serve Multiple VLANs
192.168.1.X

Switch

Wireless Access Point

Wireless Access Point

Management Zone
ZONE 1

Router Kit

Voice Zone

ZONE 2
High Priority
VOIP Data
192.168.2.X

Gateway

IP Cameras

Audio/Video Zone

ZONE 3
Medium Priority
Media
192.168.3.X

Smart HDTV

Gaming System

Streaming Device

Automation Zone

ZONE 4
Medium Priority
Home Controls & Automation
192.168.4.X

Switch

Control Panel

Automation System

iPod Dock

Media Server

Data Zone

ZONE 5
Low Priority
Home Network
192.168.5.X

Laptop

Network Attached Storage

Smartphone

Computer

Guest Zone

ZONE 6
Lowest Priority
Guest Network
192.168.6.X

Printer

Laptop

Traffic Segmentation

Pakedge Zones™ make traffic segmentation easy - allowing multiple traffic types and even broadcast traffic from devices like IP security cameras to exist on the network without interference. Pakedge Zones prevent traffic from flooding your network so that latency sensitive traffic like VoIP can maintain optimal performance.

Assignment

Pakedge Zones can be assigned to fixed ports, or devices can be assigned to a specific Pakedge Zone, thus enabling ports to be used for multiple Pakedge Zones™.

Security

Pakedge Zones™ can be used to provide enhanced network security by allowing users and devices to be separated onto different zones from sensitive network equipment or private information.
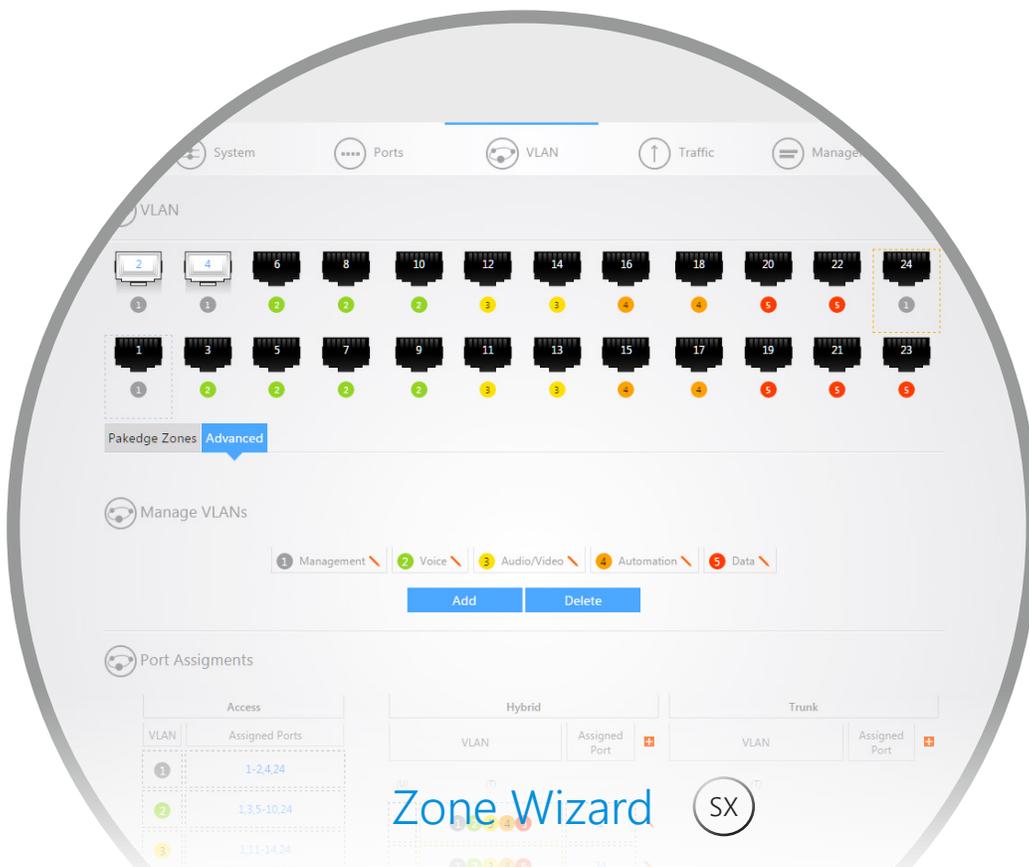
Zone Wizard

The New Pakedge Zone Wizard is a revolutionary way to configure a network. Pakedge Zones can be applied through a simple drag-and-drop process, allowing for network segmentation and prioritization through an easy, color-coded, drag-and-drop process. With the Zone Wizard, formerly complicated configurations can be completed in mere minutes.

Zone Templates

Pakedge Zone Templates are preconfigured Pakedge Zone configurations based on common network setups. Zone Templates reduce set-up time while minimizing configuration errors by allowing users to simply select the Pakedge Zone configuration most applicable to their network needs.

Available Templates

Audio/Video - Automation - Data

Voice - Audio/Video - Automation

Voice - Guest

Data - Guest

All Management (Default)

Key

- Management (VID 1) + Zone Link
- Voice (VID 2)
- Audio/Video (VID 3)
- Automation (VID 4)
- Data (VID 5)
- Guest (VID 6)

(isolated)

PoE Innovations

Pakedge switches incorporate a number of innovations around Power over Ethernet (PoE), "Powered by PoE" and "PoE Passthrough". "Powered by PoE" switches utilize a PoE source to supply power to operate the switch. The PoE source can be a power injector or an upstream PoE switch. "Powered by PoE" switches are ideal for use in locations where there is no nearby electrical power source, or in retrofit projects where the cost of running an electrical line is cost prohibitive. These locations include access tunnels, attics and other unwired spaces.

"PoE Passthrough" switches offer the convenience of "Powered by PoE" switches with the additional benefit of passing through enough power to drive additional devices - like touch panels, IP security cameras, and wireless access points. They are ideal for use in areas like attics and basements without easy access to traditional wall outlets, or to extend a PoE cable run from a PoE+ switch farther away than 100m.
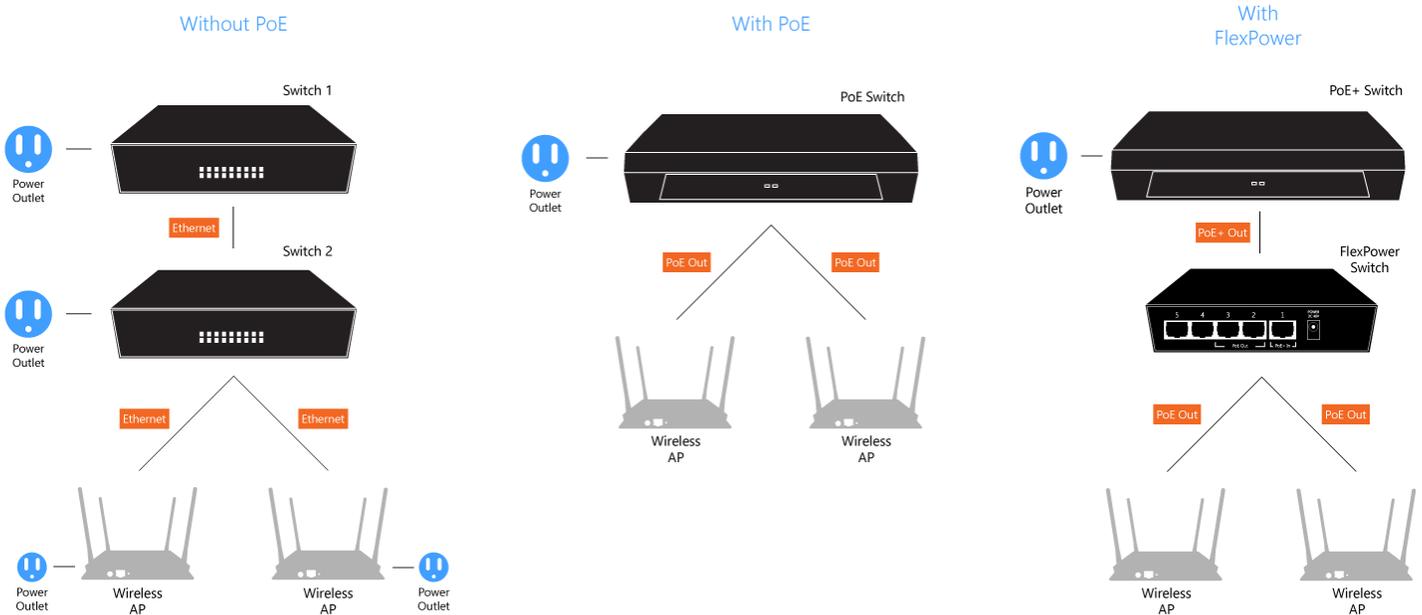
	Ethernet Ports	PoE Ports	PoE+ Ports	Management	Application
PoE Switches					
SE-8P4	8	4	2	Unmanaged	Use PoE switches to provide PoE or PoE+ power to devices throughout the network like touch panels, security cameras, wireless access points and PoE Powered or PoE Passthrough switches while providing a data connection.
SE-8P	24	8	4	Unmanaged	
SE-8P4fe	24	4	2	Unmanaged	
SX-24P8	24	8	4	Managed	
SX-24P16	24	16	12	Managed	
SX-24P	24	24	12	Managed	
S24HF	24	24	12	Managed	
S3-24P	24	24	12		
PoE Powered Switches					
SK-8-EP	8	-	-	Managed	Powered by PoE switches are ideal at the point of use of other devices - like in an entertainment center - or as a way to expand your network without needing additional AC power, perfect for areas like attics or basements.
SE-5-EP	5	-	-	Unmanaged	
SE-8-EP	8	-	-	Unmanaged	
PoE Pass Through					
SE-5P2-EP-A	5	2	-	Unmanaged	All of the benefits of a PoE powered switch but with the additional ability to power up to 2 PoE devices without running multiple cables from a PoE+ switch.
SE-8P2-EP-A	8	2*	-	Unmanaged	
SE-USB1-EP	3	1	-	Unmanaged	

pakedgedevice&software inc   *4 Ports PoE when powered with AC Adapter.

PoE Switch Variations

PoE Switches (SE) (SX)

AC Power In

PoE Power Out
AC power from the switch creates Poe lines to provide data and power to PoE supported devices

PoE Powered Switches (SE)

PoE Power In
Power the entire switch using a single PoE line

PoE Passthrough Switches (SE)

(2) PoE Out
(1) PoE+ In creates (2) PoE Out lines

PoE+ In
By utilizing a PoE+ In line, you can power the switch and create (2) PoE Out lines at the same time

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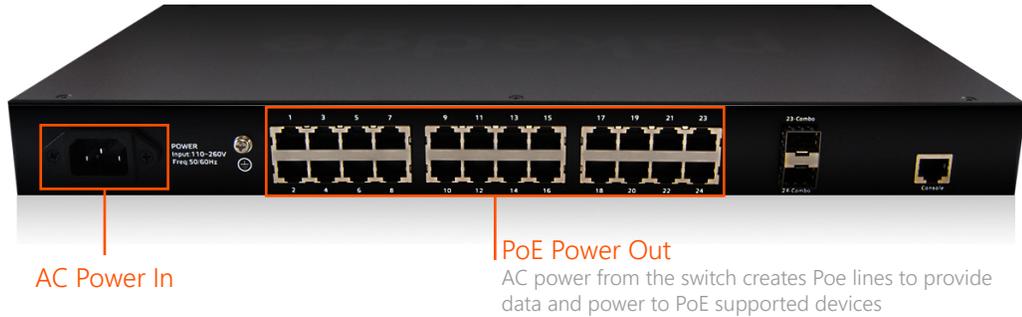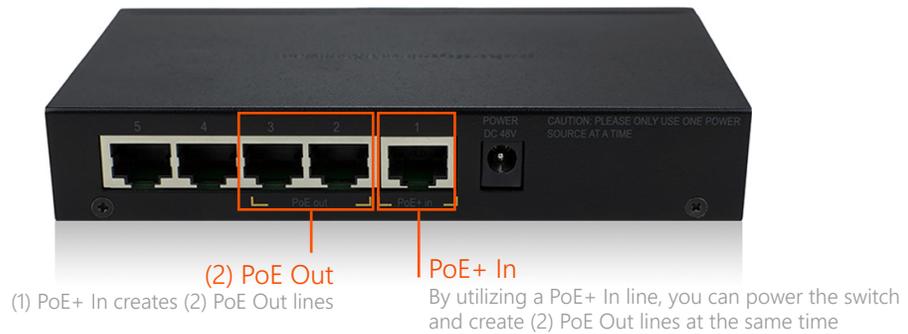
TruStream™ (SK) (SX)

Pakedge managed switches incorporate TruStream™ technologies designed for seamless and efficient processing of multimedia traffic.

Traffic Prioritization

A series of traffic management algorithms ensure that traffic is prioritized and delivered by device, port, or media type based on user configurable specification. Latency sensitive devices and traffic types like streaming video and VoIP phones can be prioritized ahead of traffic from less sensitive devices resulting in overall improved networking.

Link Aggregation

Link Aggregation allows the switch to combine multiple network connections in parallel to create a trunk capable of increasing bandwidth and carrying more traffic than a single connection. This is ideal for connections between switches.

Multicast/Broadcast Traffic Management

Pakedge switches incorporate IGMP protocols to prevent multi-cast traffic storms from overwhelming the network and slowing the system to a crawl. Multicast and broadcast traffic is commonly generated by media streaming applications from audio and video broadcast servers, such as Sonos™ and other devices. IGMP snooping enables Pakedge managed switches to identify multicast traffic throughout the network and only pass it to the nodes that need it. IGMP query (available in SX switches) only enables nodes in the network to be identified as those that want to receive multicast traffic.

Bandwidth Management

TruStream™ enables flow control between our managed switches and computers/devices on a network, allowing data to be handled at the most efficient pace for all devices, reducing data overflow and ensuring that data isn't lost. Network performance and scalability is optimized through a suite of bandwidth management techniques such as Flow Control and User Specified rate limits to increase throughput, ensure smooth operation for bandwidth heavy applications, and prevent individual ports from sending more traffic than downstream ports can process.

Enhanced Security (SK) (SX)

Pakedge managed switches employ a variety of features to protect the security of your network.
These features, when integrated with other Pakedge devices, provide an advanced multi-layer level of
network security.

Access Control Lists

- Allow or block individual devices based on MAC and IP addresses to ensure only authorized devices connect.

ARP Spoofing Prevention

- Prevents an attack that tricks network equipment into believing that an unauthorized device is "trusted"

MAC Filtering

- Block or allow devices based on MAC address or port number

Worm Attack Defense

- Prevents viruses from spreading to vulnerable devices throughout a network

Denial of Service (DoS) Defense

- Prevents external attacks that overload networks, shutting them down.

Mac Attack Defense

- Prevents a type of attack that exposes all devices within the network to external access

Port Based Network Access Control

- Works with corporate authentication servers to allow large numbers of devices.

IP Filtering

- Allow specific devices to pair to specific ports based on IP address, MAC address, or port number.

Thermal Management (SE) (SK) (SX)

Pakedge switches employ a variety of thermal management designs to dissipate heat. Most switches are based on a passive thermal design, allowing the heat to dissipate through vents in the switch casing to the surrounding environment.

Switches with a high number of PoE ports (typically greater than 8) utilize active thermal management through a cooling fan. These fans are located inside the unit and exhaust hot air through vents in the casing. Fans may be quiet fans that operate continuously or quiet variable speed fans that throttle up or down depending on heat generation.

Pakedge SX series switches employ a unique air chamber design, which works in conjunction with the variable speed fan for maximum cooling efficiency and low noise. The chamber isolates the heat generating components from the other parts of the electronic architecture to maximize fan effectiveness, allowing for quieter operation than standard switches.

Optical Fiber Ready (SE) (SK) (SX)

Pakedge switches with SFP ports can utilize fiber cable for connections - enabling faster speeds and more reliable data transmission over greater distances than Ethernet, with Ethernet range is limited to 100m. Fiber is an ideal way to connect switches together for uninterrupted throughput. Fiber is not susceptible to EMI and is capable of higher data rates than any other types of networking media.

welcome to your...

SK-24
Switch

System

Ports

VLAN

Traffic

Management

1   3   5   7   9   11   13   15   17   19   21   23   25
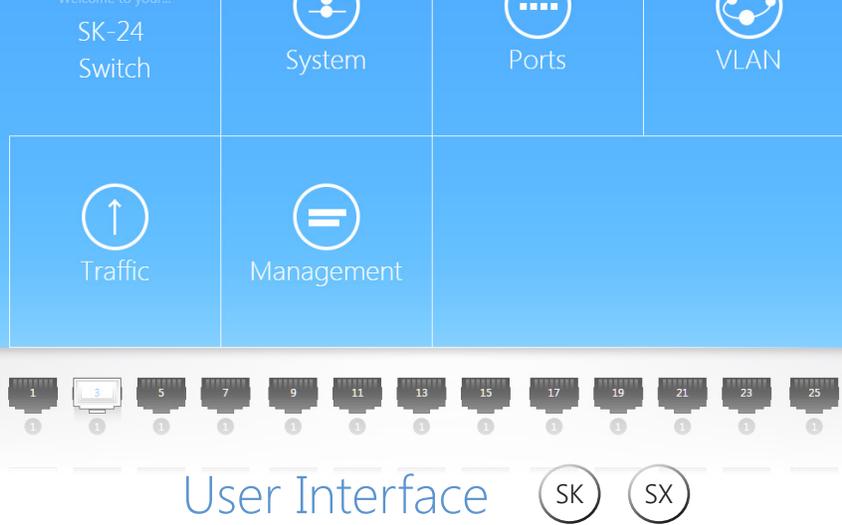
User Interface   SK   SX

Pakedge switch management menus are designed with an emphasis on user experience/use interface (UX/UI) principles. The result is a simple, intuitive, easy to use menu that is simple in look and feel across the entire Pakedge product line. The unified design language makes it easy to use any Pakedge product – with previously difficult features like Pakedge Zones simplified into an easy drag-and-drop format. designed to prioritize simplicity without sacrificing functionality. The most important and commonly used AV features are brought to the forefront – ensuring faster setup, easier configuration, and simple maintenance.

Port Orientations   SE   SK   SX

Rear Port Switch

Designed with a premium AV look to blend into rack with other rear cabled devices like AV receivers for a sleek, clean AV look.

Front Port Switch

Allows for rapid cable changes, with an industrial look and sporting Black Stealth Ports™ making it easy to blend into any server rack.

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Switch Accessories

SFP

Fiber
Modules

The Fiber Modules plug into SFP or SFP+ ports on select Pakedge switches and routers, allowing the insertion of fiber-optic cables for the interconnecting of routers and switches.

Fiber Cables

FC-LC-LC-SM

Pakedge single mode fiber cables can transmit signals long distances without data loss or emitting interference. Constructed with extra durable cable jackets and a transparent glass cores, fiber cables are ideal for connecting switches to other switches without deterioration in quality. Available in lengths of 1, 2, 3, 4, 5, 10, 25, 75, 100, 200, 300, and 400 meters.
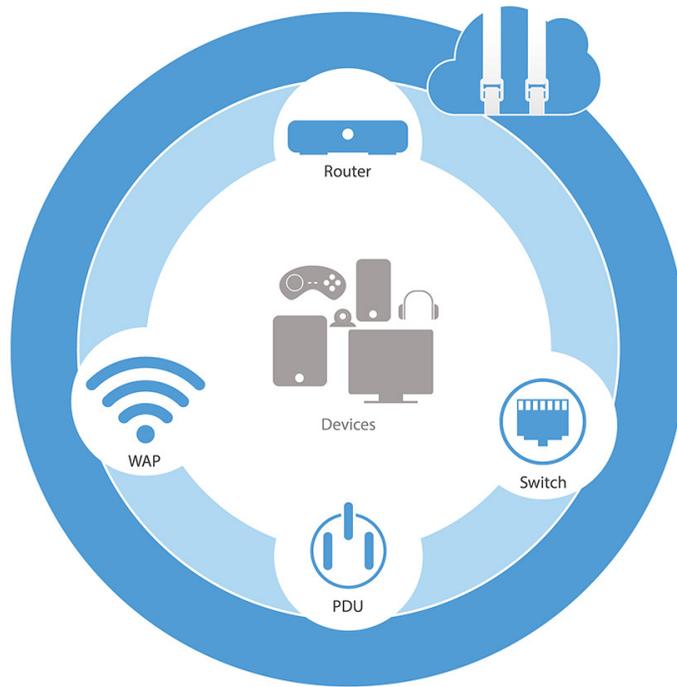
Connect+ Certified

The Pakedge Connect+ Platform is a carefully integrated system of switches, routers, wireless, power management and software technologies, designed specifically to work with each other to deliver seamless, scalable, and reliable multimedia networking performance. When unified with the BakPak Cloud Management System, the functionality of the Pakedge Connect+ Platform is extended with cloud-enabled services such as monitoring and management of all connected devices anywhere, any time, and from any device.

Why Pakedge?

- Purpose-built for A/V networking applications
- Enterprise-level performance
- Seamless, scalable, and reliable
- End-to-end network system solutions
- Free lifetime technical support
- Free lifetime firmware updates and functionality support

Warranty

Pakedge Device & Software offers a 3-year limited warranty. Pakedge Device & Software will repair or replace products that do not perform as specified within 3 years of the date of purchase due to a defect in materials, workmanship, or functionality.

About Pakedge Device & Software

Pakedge is an industry leading manufacturer of high performance end-to-end networking platforms for residential and commercial A/V applications. Recognized by industry peers and winner of the prestigious CEPro Brand Leader award for Networking in 2013 and 2014, Pakedge specializes in integrating high performance engineering innovations, operational simplicity, and systems engineering to develop technology that enables customers to unleash the power of their network.

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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 1GB 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

> Two RS-232/422/485 COM ports with hardware and software handshaking

> Four RS-232 COM ports with software handshaking only

> Eight IR/serial, eight relay, and eight Versiport I/O ports

> Three built-in 3-Series control card expansion slots

> Programmable event scheduling with astronomical time clock

> Native BACnet™/IP support [2]

> IEC 61000-4-5 Installation Class 4 surge immunity on COM, Versiport, and network connections [3]

> Installer setup via front panel, 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 color LCD display for setup and diagnostics

> Front panel USB computer console port

> 2-space rack-mountable

The flagship Crestron® PRO3 is an enterprise-class control system with an enhanced feature set including a front panel color LCD display, built-in control card expansion slots, and a dedicated Control Subnet port. Featuring the 3-Series® control engine, the PRO3 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 PRO3 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 PRO3 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 PRO3 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.

PRO3 – Rear View

Dedicated Control Subnet

The Crestron Control Subnet is a Gigabit Ethernet network dedicated to Crestron devices. Via the PRO3'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 PRO3, discovering each device and assigning IP addresses without any extra effort from the installer.

A separate LAN port on the PRO3 provides a single-point connection to the primary 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 hidden from the primary 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 PRO3 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 PRO3 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 PRO3 includes six 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.

Control Card Expansion Slots

Additional control ports can be added to the PRO3 using 3-Series Control Cards [1]. The PRO3 provides three control card expansion slots on its rear panel, affording great expansion capability without requiring any additional rack space.

Front Panel Color LCD Display

The PRO3's front panel includes a color LCD display to enable extensive setup and diagnostics without having to connect a computer.

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: 1 GB
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 support RS-232 up to 115.2k baud with software handshaking, two ports also support 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

S1 – S3: (3) 3-Series control card expansion slots

COM 1 – 2: (2) 5-pin 3.5 mm detachable terminal blocks;
Bidirectional RS-232/422/485 ports [3];
Up to 115.2k baud; hardware and software handshaking support

COM 3 – 6: (4) 3-pin 3.5 mm detachable terminal blocks;
Bidirectional RS-232 ports [3];
Up to 115.2k baud; software handshaking support

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

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

LAN: (1) 8-pin RJ45 jack;
10Base-T/100Base-TX/1000Base-T Ethernet port [3];
Connects to the customer's LAN

CONTROL SUBNET: (1) 8-pin RJ45 jack;
10Base-T/100Base-TX/1000Base-T Ethernet port [3];
Provides a dedicated local network for Crestron devices

USB: (1) USB Type A female;
USB 2.0 port for storage devices

MEMORY: (1) SD memory card slot;
Accepts one SD or SDHC card up to 32 GB for memory expansion

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) [3];
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

NET: (1) 4-pin 3.5 mm detachable terminal block;
Cresnet master port, outputs power to Cresnet devices [3];
See "Power" section for additional specifications

100-240V~2.4A 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 2.0 computer console port (6 ft cable included);
For setup only

LCD Display

Display Type: TFT active matrix color LCD
Size: 2.8 inch (72 mm) diagonal
Resolution: 320 x 240 pixels
Functions: Displays configuration menus, control port activity, and other system information

Controls & Indicators

PWR: (1) Green LED, indicates operating power supplied from AC line
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
CNPS FAULT: (1) Red LED and (1) pushbutton, LED indicates an excessive Cresnet load detected at the NET port, pushbutton resets the fault indication
SLOT 1 – 3: (3) Green LEDs, indicate control cards are inserted in the corresponding slots
Nav Pad: (1) 5-way navigation pad for menu navigation and parameter adjustment
HOME: (1) Pushbutton, returns to the home menu

BACK: (1) Pushbutton, steps menu back one level

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

Main Power: 2.4 Amps @ 100-240 Volts AC, 50/60 Hz
Available Cresnet Power: 75 Watts (3.125 Amps @ 24 Volts DC)

Environmental

Temperature: 41° to 113° F (5° to 45° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 45 BTU/hr with no Cresnet devices, no control cards;
                       71 BTU/hr with full Cresnet load, no control cards;

See individual control card spec sheets for additional specifications

Enclosure

Chassis: Metal, black finish, vented top and sides
Faceplate: Extruded metal, black finish, polycarbonate label overlay
Mounting: Freestanding or 2 RU 19-inch rack-mountable (adhesive feet and rack ears included)

Dimensions

Height: 3.47 in (89 mm) without feet
Width: 17.28 in (439 mm), 19.00 in (483 mm) with rack ears
Depth: 10.13 in (258 mm)

Weight

5.0 lb (2.3 kg)

MODELS & ACCESSORIES

Available Models

PRO3: 3-Series Control System®

Available Accessories

C3COM-3: 3-Series® Control Card - 3 COM Ports
C3IO-16: 3-Series® Control Card - 16 Versiport I/O Ports
C3IR-8: 3-Series® Control Card - 8 IR Ports
C3RY-8: 3-Series® Control Card - 8 Relay Ports
C3RY-16: 3-Series® Control Card - 16 Relay Ports
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 PRO3 supports a maximum of 2000 BACnet objects when dedicated for BACnet use only. Actual capabilities are contingent upon the overall program size and complexity.
3. The following connections comply with IEC 61000-4-5 Installation Class 4 surge immunity levels: COM 1 - 6, I/O 1 - 8, NET, LAN, and CONTROL SUBNET.

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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TOP VIEW

17.16 in
436 mm

17.28 in
439 mm

19.00 in
483 mm

3.47 in
89 mm

10.13 in
258 mm

8.7" Wireless Touch Screen

> *Advanced wireless touch screen controller*

> *Thin, stylish tablet design*

> *Non-slip rear surface*

> *8.7" LED backlit color LCD display*

> *Capacitive touch screen technology*

> *Multi-touch capable*

> *Smart Graphics™ support*

> *Voice recognition capability [2,3]*

> *High-performance H.264 streaming video [3]*

> *Customizable audio feedback*

> *Built-in Web browsing [2,3]*

> *On-screen multi-language keyboard*

> *Customizable screensaver*

> *Built-in microphone and speakers*

> *Dual-mode RF wireless performance — Extended Range 2.4 GHz RF plus Wi-Fi® [7]*

> *Instant-Waking® behavior — like an IR remote with all the benefits of 2-way RF!*

> *Supports roaming for extended wireless coverage [6]*

> *Large-capacity, user-replaceable Li-Ion battery pack*

> *Rechargeable using power pack or table dock (both included) [1]*

> *Doubles as a stationary tabletop touch screen while docked*

> *Wall dock option available separately*

The Crestron® TST-902 Wireless Touch Screen is an advanced wireless controller, engineered to deliver ultimate performance, reliability, and customizability for controlling a wide range of technologies in a corporate, government, classroom, or high-end home environment. Its thin, tablet-style design is easy to hold and moves effortlessly between portable and stationary tabletop or in-wall use.[1] Its large-capacity rechargeable battery affords several hours or days of operation between charges. Dual-mode wireless performance with roaming capability assures dependable connectivity throughout a commercial facility or luxury residence.

Featuring a high-contrast 8.7" capacitive touch screen with Smart Graphics™, the TST-902 allows completely customizable control over media presentation and teleconferencing systems, lighting and shades, HVAC and BMS, home theater, and a host of other technologies. Additional advanced features include the abilities to control any function using voice commands, view full-motion streaming video from cameras and other sources, and browse the Internet.[2,3]

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[2]

- A power-saving screensaver, allowing display of time, temperature, and other text content at a reduced brightness level

- 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

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 TST-902 provides the ability to use spoken commands to control virtually anything. Voice recognition can be used to quickly turn devices on or off, choose a lighting scene, select and play a specific media title or playlist, initiate a conference call, or enter a password. Simply press the Voice Recognition button on the touch screen and say a command and Crestron does the rest.[2,3]

CRESTRON®

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 TST-902 to display live streaming video from an IP camera, a streaming encoder (Crestron CEN-NVS200, DM-TXRX-100-STR, or similar[4]), or a DigitalMedia™ switcher.[3]

Web Browsing

Using its built-in Web browser, the TST-902 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 TST-902. Of course, the Web browser may also be used to simply browse the Internet, watch online videos, and check up on social media.[2,3]

Multi-Touch Support

The TST-902's capacitive touch screen affords enhanced capabilities for browsing Web pages using multi-touch gestures.

On-Screen Keyboard

An on-screen multi-language keyboard allows for quick entry of passwords, URLs, and text searches.

Audio Feedback

Customized audio files can be loaded on the TST-902 to add another dimension to the touch screen graphics using personalized sounds, button feedback, and voice prompts.

Dual-Mode Wireless

To deliver the ultimate in wireless touch screen performance and functionality, the TST-902 employs a combination of Crestron Extended Range 2.4 GHz RF (ER) and Wi-Fi® wireless technologies.

- **Extended Range RF (Required) —** Primary functionality is supported via Crestron ER (Extended Range) wireless communications, providing seamless touch screen control with true feedback. A single ER gateway [4] enables ultra dependable wireless performance at a range of up to 200 feet (60 m) indoors.[5] Roaming capability allows for even greater coverage using up to eight ER gateways.
- **Wi-Fi (Optional) —** While the TST-902 can be operated using only ER wireless, advanced wireless capabilities such as streaming video, voice recognition, Web browsing, and dynamic graphics can only be supported using both ER and Wi-Fi together (dual-mode). Crestron enhanced Wi-Fi wireless performance achieves a remarkable 50 feet (15 m) omnidirectional coverage indoors.[5] For Wi-Fi networks with multiple access points, the TST-902 supports the ability to hand off communication from one access point to another if the active connection is lost.[6] The choice of 802.11 b, g, and n protocols affords reliable, high-speed wireless performance in virtually any RF environment. For optimal Wi-Fi performance, Crestron offers the CEN-WAP-1500 High Power Dual-Band Wireless Access Point [4].

IMPORTANT: EVERY INSTALLATION OF THE TST-902 REQUIRES A CRESTRON ER WIRELESS GATEWAY TO ENABLE ESSENTIAL WIRELESS CAPABILITY. THE TST-902 WILL NOT WORK WITH WI-FI ALONE.[7]

Instant-Waking®

To ensure the most transparent user experience possible, the TST-902 has been engineered to wake instantly upon touching the touch screen. Commands are sent immediately — just like an IR remote but with none of IR's limitations. So spontaneous actions like muting the audio, pausing the video, or changing the channel can be executed on-the-fly without any waiting.

Extended Battery Life

The TST-902 features a large-capacity, user-replaceable Li-Ion battery pack to enable up to 9 hours of continuous operation and several days of typical use between charges. Intelligent power management and Lithium Ion battery technology afford a perfect balance of long battery life, light weight, and compact size.

Table Dock Charger

The TST-902 includes a stylish table dock for charging its internal battery while simultaneously allowing it to be used as a stationary tabletop touch screen. The table dock holds the TST-902 firmly at a fixed upright angle while docked, and allows it to be simply lifted off at any time for portable use. Its sleek appearance achieves a look befitting the most contemporary boardroom or luxury living room.[1]

Wall Dock Option

Available separately, the TST-902-DSW provides a flush mount, in-wall docking solution, allowing the TST-902 to be used as a stationary wall mount touch screen with the ability to go wireless at any time.

SPECIFICATIONS

Note: See also TST-902-DS for additional specifications.[1]

Touch Screen Display

Display Type: TFT Active matrix color LCD
Size: 8.74 inch (222 mm) diagonal
Resolution: 1008 x 588 pixels
Brightness: 300 nits (cd/m²)
Contrast: 700:1
Color Depth: 24-bit, 16.7M colors
Illumination: LED Backlit
Viewing Angle: ±88° horizontal, ±88° vertical
Touch Screen: Projected Capacitive, multi-touch capable

Buttons & Indicators

Battery LED: (1) White LED, indicates battery condition and charging status when docked
Reset: (1) Pinhole recessed button on rear for hardware reset and setup initiation

Memory

LPDDR2 RAM: 1 GB
Flash: 4 GB
Maximum Project Size: 512 MB

Graphics Engine

Crestron® Smart Graphics™, multi-language Web browser [2,3], multi-language on-screen keyboard, screensaver

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

Wireless Communication (Primary) – Extended Range RF [7]

RF Transceiver: 2-way RF, 2.4 GHz ISM Channels 11-26 (2400 to 2483.5 MHz), IEEE 802.15.4 compliant
Transmitting Power: 75 mW (Ch.11), 100 mW (Ch.12-23), 15 mW (Ch.24), 3.5 mW (Ch.25), 1 mW (Ch.26) @ High Setting; 1 mW (Ch.11-25), 0.5 mW (Ch.26) @ Low Setting
Range (typical): 100 to 200 feet (30 to 60 m) maximum indoor, 1000 feet (300 m) outdoor, subject to site-specific conditions
Gateway: Requires a Crestron Extended Range (ER) Wireless Gateway [4]
Roaming: Supports roaming between a maximum of eight gateways

Wireless Communication (Secondary) – Wi-Fi® [7]

Transceiver: IEEE 802.11b/g/n Wi-Fi (2.4 GHz 2-way RF), static IP or dynamic IP via DHCP
Security: 64 & 128-bit WEP, WPA™ & WPA2™-PSK with TKIP & AES
Range: Up to 50 feet (15 m), subject to site-specific conditions

Gateway: Requires a CEN-WAP-1500 or similar 802.11b/g/n wireless access point and Ethernet-enabled Crestron control system
Handoff: Supports handoff between a maximum of four Wi-Fi wireless access points [6]

Wired Communications

USB: USB client for console only (installer setup and firmware update)

Video

Streaming Formats: H.264 (MPEG-4 part 10 AVC) or MJPEG, up to 1280x720 @ 30 fps [3]

Audio

Features: Built-in microphone and speakers, multi-language voice recognition [2,3]
Audio Feedback Formats: MP3

Connectors

Power: (1) 1.7 x 4.0 mm DC power connector; 24 Volt DC power input (power pack included)

Docking Connector: (3) contacts; Mates with the docking port on the charging dock (included)

Headphones: (1) 3.5 mm TRS mini phone jack; Stereo headphone output

USB: (1) Mini-B USB console port behind battery compartment cover, for installer use only

Battery

Rechargeable Battery: Li-Ion, 7.4 Volt, 9100 mAh, model TST-902-BTP, user replaceable
Usage per Charge: 300 hours typical under normal use (10% active duty cycle with standby/power down enabled); 9 hours continuous using default settings
Charging Time: Up to 6 hours (typical)

Power Requirements

Power Pack: 0.75 Amps @ 24 Volts DC; 100-240 Volts AC, 50/60 Hz power pack, model PW-2407WURA included

Note: Power connection can be via the charging dock or onboard DC power connector

Power Consumption: 7 Watts

Environmental

Temperature: 32° to 112° F (0° to 45° C); 50° to 104° F (10° to 40° C) while charging
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 20.5 BTU/hr

Construction

Plastic, non-slip rear surface, integral docking port

Dimensions

Height: 6.44 in (164 mm)
Width: 10.37 in (264 mm)
Depth: 0.74 in (19 mm)

Weight

28.5 oz (808 g)

MODELS & ACCESSORIES

Available Models

TST-902: 8.7" Wireless Touch Screen

Included Accessories

TST-902-DS: Table Dock for TST-902 (Qty. 1 included)
TST-902-BTP: Battery Pack for TST-902 (Qty. 1 included)
PW-2407WURA: Wall Mount Power Pack, 24VDC, 0.75A, 1.7mm, Universal (Qty. 1 included)

Available Accessories

TST-902-DSW: Wall Dock for TST-902
CEN-RFGW-EX: infiNET EX® & ER Wireless Gateway
CEN-GWEXER: infiNET EX® & ER Wireless Gateway
MC3: 3-Series Control System® w/infiNET EX® & ER Wireless Gateway
DIN-AP3MEX: DIN Rail 3-Series® Automation Processor w/infiNET EX® & ER Wireless Gateway
CEN-WAP-1500: High Power Dual-Band Wireless Access Point
CEN-NVS200: Network Video Streamer
DM-TXRX-100-STR: HD Streaming Transmitter/Receiver

Notes:

1. The TST-902 ships with (1) TST-902-DS Table Dock included. Additional table docks, or the TST-902-DSW wall dock, may be ordered separately. Refer to the TST-902-DS and TST-902-DSW spec sheets for additional information.
2. Voice recognition, Web browsing, weather information, and certain other functions require an Internet connection via Wi-Fi.
3. Voice recognition, streaming video, Web browsing, and dynamic graphics capabilities require dual-mode wireless (ER + Wi-Fi).
4. Item(s) sold separately.
5. Wireless range subject to site-specific conditions.
6. True roaming is supported for ER wireless communication only, affording uninterrupted wireless performance for primary touch screen functions. Wi-Fi "handoff" capability enables automatic handoff amongst up to four pre-designated Wi-Fi wireless access points, wherein the last successful Wi-Fi connection is maintained indefinitely until that connection is lost, at which point communication is handed off to the next nearest access point. A very brief interruption to wireless Ethernet communication may occur during the handoff. Primary ER wireless communication is unaffected by the Wi-Fi handoff process.
7. ER (Extended Range) RF wireless communication supports basic wireless touch screen functionality, and is required for all applications. For advanced functionality including streaming video, voice recognition, Web browsing, and dynamic graphics, Wi-Fi wireless communication is also required (dual-mode). The TST-902 will not work with Wi-Fi alone.

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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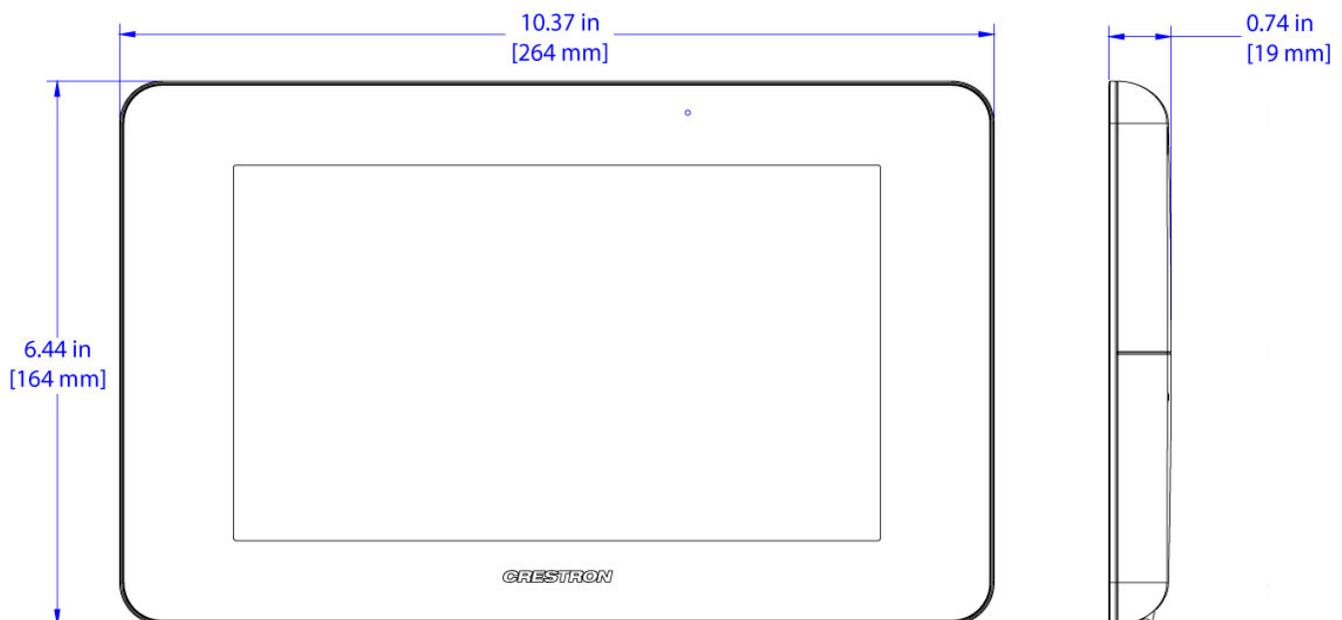
7 in. Touch Screen

> Ultra clean, modern appearance

> Thin profile and compact footprint

> Affordable and easy to install

> 7 in. (178 mm) 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 [2,3]

> H.264 or MJPEG streaming video display

> Built-in 5 MP H.264 IP camera [3]

> Built-in microphone and speakers [3]

> Rava® SIP intercom and phone technology [3]

> Native Sonos® app [2]

> Zoom Rooms™ conferencing control mode [9]

> Integrates directly with Crestron Fusion®, Microsoft®, Google®, Robin®, Teem®, Appspace®, Zoom™, and EMS Software™ room scheduling services [1,6]

> Supports IBM® Notes® and CollegeNET® 25Live® through Crestron Fusion (on-premises server only)

> Available light bar and hallway sign options [8]

> Built-in PinPoint™ beacon [3,10]

> Customizable audio feedback

> Control for Crestron Pyng® OS 2 system

> Integration with supported 2N® door stations [11]

> Built-in web browsing [2]

> Multi-language support

> On-screen keyboard

> Customizable screensaver

> Single-wire Ethernet connectivity

> PoE or PoE+ network powered (refer to specifications)

> Enterprise grade security

> Web based configuration

> Cloud-based provisioning and management

> SNMP monitoring support

> US, UK, or European electrical wall box mounting

> Lectern mount over a rectangular cutout

> Retrofit and masonry mounting options available [12]

> Multi-surface and ADA compliance mounting options available [4]

> Tabletop and swivel mount options available [4]

> 3 RU rack mount option available [4]

> 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 series 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 series 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® technology 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, and browse the Internet. Native applications are included to enable use as a room scheduling panel, control a Zoom Rooms™ conferencing system, and enjoy full access to a Sonos® Home Sound System. [2]

For dedicated room scheduling applications, see also the TSS-7 Series 7 in. Room Scheduling Touch Screen.

TSW-760-W-S – Shown in White

TSW-760-B-S with TSW-760-TTK-B-S Tabletop Kit

Smart Graphics® Technology

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 [2]
- A power-saving screensaver that allows display of time, temperature, and other text content at a reduced brightness level
- Customizable themes allowing a completely different look and feel for every user, event, or season
- Fully-developed SmartObjects® technology that enables 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, lower the windows shades, lock the doors, arm the security system, or enter a password. Simply say a command and Crestron does the rest. [2,3]

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 [4]), 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. [3]

Shown in Crestron Room Scheduling mode with optional Light Bar and Multi-Surface Mount Kit

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 [4]) or a third-party video monitoring system. [3]

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 Apps

The TSW-760 comes with apps for all the most popular enterprise scheduling services.

- **Crestron Scheduling App –** Supports direct integration with Crestron Fusion® software, Microsoft® Exchange software (for users of Outlook® software and Office 365® software), and Google Calendar™ calendaring app (including G Suite™ software). [5]
- **Third-Party Apps –** Includes support for Teem®, Robin®, Appspace® [1], Zoom™ and EMS Software™ applications [6]. Other providers may be added in the future.
- **Additional Options –** Supports IBM® Notes® software and CollegeNET® 25Live® software through Crestron Fusion (on-premises server only).

Whatever provider you choose, the setup is as simple as connecting each touch screen to the network and choosing your app from the web-based setup menu. The selected app downloads from the cloud and installs on the touch screen automatically. There is no programming or control system required. [6]

See also the TSS-7 Series 7 in. Room Scheduling Touch Screen for an alternate solution.

Crestron room scheduling touch screens help organizations to maximize productivity and realize the most usable time out of every meeting space. They install at the entrance to each room to provide indication of the room's availability and a view of its schedule for the day. If the room is reserved, its touch screen displays details about the current meeting, accented in red, so attendees can immediately confirm they're in the right place before entering the room. If the room is available, the screen states so in green and shows the time remaining until the next scheduled meeting. If desired, the room can be reserved on the spot for an ad hoc meeting.

If you wish to reserve a room for later in the day, just step up to any touch screen, swipe through the room's timeline for the day, and reserve the room for any available time slot. If that room isn't available when you want it, the touch screen can find you another available room nearby. Additional optional functions include the abilities to check into a scheduled meeting, extend a meeting, end a meeting early, toggle between two languages, or limit access to various functions using PIN code authorization.

Crestron room scheduling also offers three levels of customization depending on your needs. For basic customization and branding, custom background images or videos and custom logos may be selected to personalize the standard user interface from Crestron. For editing the user interface elements further, such as changing colors, adjusting positioning, or removing elements, a custom CSS stylesheet may be created. Finally, to add entirely new user interface elements, the HTML5 coding used to create the scheduling user interface may be modified. [7]

Status Indicator Options

Adding the optional light bar accessory (TSW-760-LB Series) to a TSW-760 produces a ring of light around the perimeter of the touch screen, which can be seen with just a glance down the hallway. For room scheduling applications, the light bar provides 180° visual indication of a room's availability status, glowing green if the room is available and red when reserved. Other custom functionality is available through integration with a control system, allowing illumination of the light bar in any color. [8]

As an alternative to the light bar, Crestron offers a selection of hallway signs and indicators that mount on the wall or ceiling above each touch screen. The SSW and SSC series hallway signs both feature a two-sided acrylic sign face that can be custom engraved with the room name or number. The SIW-100 offers a lower profile wall mount status indicator. [8]

Zoom Rooms™ App

The Zoom Rooms application enables the TSW-760 to be used as a touch screen control panel for a Zoom Rooms software-based conferencing and collaboration solution. The TSW-760 offers a superior alternative to a consumer tablet device, providing a more reliable and secure platform with versatile, streamlined options for tabletop, wall mount, and lectern mount installations. Its 7 in. color touch screen delivers the same user-friendly

Zoom Rooms experience as a typical tablet, but without the risk of misplacing the device. Instead of Wi-Fi® communications, the TSW-760 uses a wired Ethernet connection to ensure reliable connectivity. [9]

The TSW-760 may be configured to run the Zoom Rooms app exclusively, or to allow toggling between the Zoom Rooms app and regular Smart Graphics touch screen control mode. The latter allows for integrating Zoom Rooms conferencing into a larger AV system while providing control for both through one touch screen device.

Note: Zoom Ultrasonic is supported up to an average of 3 feet (1 m) from the TSW-760 touch screen to an end user device. The range will vary based on environmental noise, the sensitivity of the end user device, and the orientation to the touch screen.

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. [3,10]

Web Browsing

Using its built-in web browser, the TSW-760 provides 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. The web browser may also be used to simply browse the Internet, check traffic conditions, or look up a recipe. [2]

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 network cable. PoE (Power over Ethernet) eliminates the need for a local power supply or any dedicated power wiring. Crestron PoE switches (CEN-SW-POE-5 or CEN-SWPOE-16 [4]) offer a total networking solution with built-in PoE for multiple touch screens. A PoE Injector (PWE-4803RU [4]) is also available to support a single touch screen.

Note: Refer to the "Power" specifications for additional details.

Enterprise Grade Security

Crestron touch screens employ enterprise-grade networking with robust security features such as 802.1X authentication, TLS encryption, HTTPS connectivity, and Active Directory® software integration. These features are imperative to protect your network against service interruptions and malicious intrusions, and to ensure compliance with your organization's stringent network policies. Cloud-based provisioning and management streamlines the process of configuring and monitoring every touch screen on the network and keeping them updated. Additional support for SNMP allows every touch screen to be monitored by your IT administrator alongside every other device on the network.

Crestron XiO Cloud™ Service

Crestron XiO Cloud is Crestron's unifying cloud-based platform for remotely provisioning, monitoring, and managing Crestron devices across an enterprise or an entire client base. Crestron XiO Cloud enables installers and IT managers to deploy and manage thousands of devices in the amount of time it would ordinarily take to manage just one. It provides a zero-touch solution that allows complete configuration of device settings without any hardware in hand, then simply connect each device on site and let Crestron XiO Cloud push out the settings, licenses, drivers, and firmware updates – automatically and securely – for a quick and painless, ready-to-use deployment.

Ongoing Crestron XiO Cloud services facilitate daily management and monitoring of every device through a single dashboard with comprehensive reporting and logging, live status viewing and alerts, performance metrics and analytics, scheduled actions and updates, and more. As requirements grow and evolve, new features and functionality can be added easily to one or many devices at any time without ever going on site. Crestron XiO Cloud is a subscription-based service offering an adaptable SaaS (Software as a Service) solution with graduated levels of functionality and unlimited scalability. For more information about Crestron XiO Cloud, please visit https://www.crestron.com/xiocloud.

Crestron Pyng® OS 2 Control

The TSW-760 may be used to control a Crestron Pyng® OS 2 whole home solution. After a TSW-760 is added to a room in Crestron Pyng, a home control project is loaded directly to the touch screen. From there, the TSW-760 allows for control over lighting, shades, climate, media, security, and cameras, including the ability to create and recall scenes that create a desired ambiance within certain rooms or for the entire home. A TSW-760 may be installed in each room in the home to provide easy access to the room's environmental and media subsystems.

2N® Door Station Integration

The TSW-760 may be integrated with a supported 2N® door station [11] via the touch screen's built-in Rava® SIP intercom to provide a door station solution for Crestron Pyng. When a call is initiated on the 2N door station, the video and audio feed is displayed on the TSW-760. Controls are provided on the touch screen to answer or decline the call, and Crestron Pyng quick actions (such as "Open Gate") may be performed while the call is in progress. A "do not disturb" option is also provided in Crestron Pyng to prevent calls from appearing on the TSW-760.

Wall or Lectern Mounting Options

Using the bracket provided, the TSW-760 is easily installed over a 2-gang or 3-gang US 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, TSW-760, TSW-1060, TSS-7, and TSS-10 series touch screens, making it easy to swap out devices at any time. [12]

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 [4]). 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.

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 [4]), which facilitate replacement without having to tear out the old mounting hardware or patch the wall.

Tabletop Option

Using the optional Tabletop Kit (TSW-760-TTK [4]), 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 [4]).

Rack Mount Option

The TSW-760 can be mounted in a 19 in. EIA equipment rack using the optional Rack Mount Kit (TSW-560/760-RMK-1 [4]). When rack mounted, the touch screen occupies three rack spaces.

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 [2], multi-language on-screen keyboard, screensaver, single scalable streaming video window, native Sonos app [2], native room scheduling applications [6], native Zoom Rooms app, setup and diagnostics via web browser or onscreen UI

Room Scheduling Support

Crestron Scheduling App: Crestron Fusion, Microsoft Exchange & Office 365, Google Calendar & G Suite (IBM Notes and CollegeNET 25Live are also supported through Crestron Fusion On-premises only) [5]
Third-Party Apps: Teem, Robin, Appspace [1], Zoom, EMS Software [6]

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: 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, Active Directory authentication, HTTPS web browser setup, Crestron XiO Cloud client, IEEE 802.3at compliant
USB: USB 2.0 host for room availability light bar or hallway sign [8]
Bluetooth: Crestron PinPoint proximity detection beacon [3,10]

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 [3]

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 [2,3]
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 light bar or hallway sign [8]

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;
- 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

Construction

Housing: 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 in. H x 3-3/4 in. W (56 mm H x 96 mm W) cutout; 1-3/8 in. (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 or add-on accessories

Weight

14.1 oz (400 g)

Compliance

UL Listed for US & Canada, IC, CE, FCC Part 15 Class B digital device

Notes:

1. Appspace functionality is currently limited to their Room Management feature (aka, room cards or meeting cards) only.
2. Voice recognition, web browsing, weather information, Sonos app, and certain other functions require an Internet connection.
3. The camera, microphone, and Bluetooth transceiver may 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.
4. Item(s) sold separately. Refer to each product's spec sheet for complete information.
5. Room Scheduling Mode requires the TSW-760 to be designated exclusively for room scheduling use, which precludes use of certain features and functions described in this spec sheet. For design assistance, contact the Crestron True Blue support team at https://www.crestron.com/support.

6. Additional subscriptions and/or licenses may be required. Refer to each provider's website for details about the capabilities and requirements of its scheduling application and services. Third-party apps typically run on the TSW-760 as they do on a tablet device. The TSW-760 runs only one app, which is selected at setup. Only the apps approved and delivered by Crestron can run on the TSW-760.
7. For more information on custom programming for the Crestron room scheduling app, refer to the Crestron Room Scheduling Panels Programming Guide (Doc. 8213) at www.crestron.com/manuals.
8. The light bar and hallway sign accessories are sold separately. Only one light bar or hallway sign may be connected to the TSW-760. Use of either accessory precludes use of the other without the addition of a custom-programmed control system and Cresnet wiring for the hallway sign. Refer to the Accessories section for a list of all available options. Refer to each accessory's spec sheet for further information.
9. A complete Zoom Rooms solution requires a mini PC or Mac computer running Zoom software, a Zoom Rooms subscription, plus additional peripherals and cables. Visit https://zoom.us/zoomrooms for more information about Zoom Rooms capabilities, hardware requirements, and subscription plans. For design assistance, contact the Crestron True Blue support team at https://www.crestron.com/support.
10. Onboard PinPoint beacon functionality is not currently supported and will be enabled through a future update. When enabled, the TSW-760 will provide an integrated, equivalent alternative to the standalone PP-100-W beacon. For more details, refer to the PP-100-W 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 them.
11. Supported 2N door stations include the 2N IP Audio Kit, 2N IP Audio Kit Lite, 2N IP Base, 2N IP Force, 2N IP Safety, 2N IP Solo, 2N IP Uni, 2N IP Vario, 2N IP Verso, and 2N IP Video Kit. For pairing instructions, refer to the Crestron Pyng OS 2 for CP3-R Product Manual (Doc. 8356) and the TSW-560/TSW-760/TSW-1060 Supplemental Guide (Doc. 7927) at www.crestron.com/manuals.
12. 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 a TSW-UMB-PMK or TSW-550-BBI, without modification to the wall. If replacing another older Crestron device, use the appropriate TSW-60-RMB series 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 https://www.crestron.com/How-To-Buy/Find-a-Representative or by calling 855-263-8754.

The specific patents that cover this and other Crestron products are listed online at https://www.crestron.com/legal/patents.

Certain Crestron products contain open source software. For specific information, visit https://www.crestron.com/opensource.

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MODELS & ACCESSORIES

Available Models

TSW-760-B-S: 7" Touch Screen, Black Smooth
TSW-760-W-S: 7" Touch Screen, White Smooth

Available Accessories

TSW-760-TTK Series: Tabletop Kit
TSW-560/760/1060-SMK: Swivel Mount Kit for TSW-760-TTK Series
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
TSW-760/1060-RMB-2: Retrofit Mounting Bracket – Converts TPS-4L to TSW-760
TSW-760/1060-MSMK Series: Multi-Surface Mount Kit
TSW-560/760-RMK-1: Rack Mount Kit
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
SW-XIOC-S Series: Crestron XiO Cloud™ Standard Provisioning and Management Service for one device
SW-XIOC-P Series: Crestron XiO Cloud™ Premium Provisioning and Management Service for one device
SW-FUSION-C-3: Crestron Fusion® Cloud; 250 rooms; 3-year service, support, and updates
SW-FUSION-P-L: Crestron Fusion® On-premises; Unlimited rooms; lifetime service, support, and updates
SW-HS-x-C Series: Crestron Fusion® Cloud Room Scheduling for one touch screen
SW-HS-x-P Series: Crestron Fusion® On-premises Room Scheduling for one touch screen
TSW-760-LB Series: Room Availability Light Bar
SSC Series: Room Availability Hallway Sign, Ceiling Mount
SSW Series: Room Availability Hallway Sign, Wall Mount
SIW-100: Room Availability Status Indicator, Wall Mount

3.57 in
91 mm

1.11 in
28 mm

3.71 in
95 mm

5.76 in
147 mm

1.96 in
50 mm

0.05 in
1.2 mm

**Wall mounting bracket
(included)**

1.52 in
39 mm

4.79 in
122 mm

7.61 in
194 mm

0.48 in
13 mm
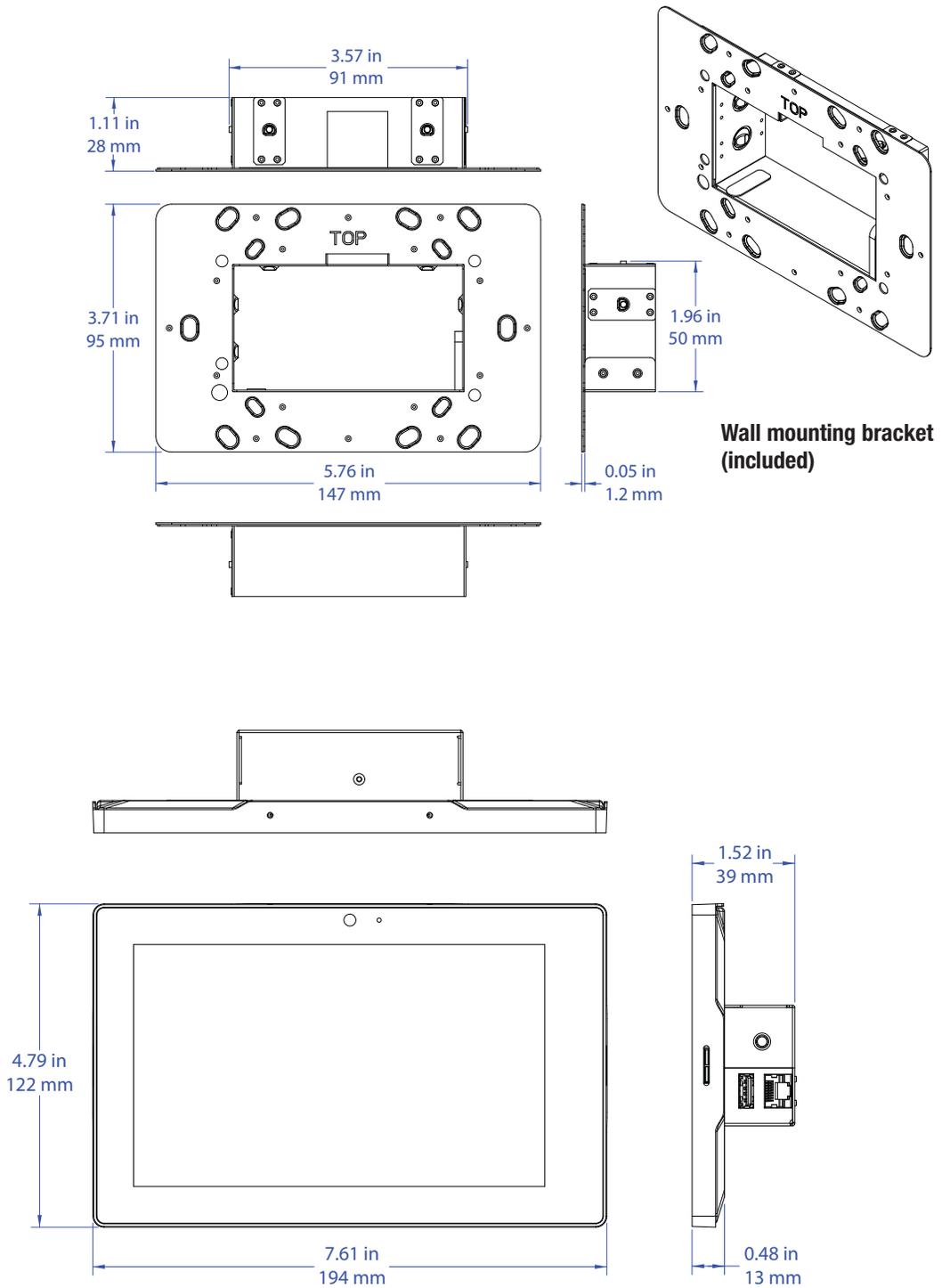
10.1 in. Touch Screen

> Ultra clean, modern appearance

> Thin profile and compact footprint

> Affordable and easy to install

> 10.1 in. (257 mm) widescreen active-matrix color display

> 1280 x 800 WXGA 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 [2,3]

> H.264 or MJPEG streaming video display

> Built-in 5 MP H.264 IP camera [3]

> Built-in microphone and speakers [3]

> Rava® SIP intercom and phone technology [3]

> Native Sonos® app [2]

> Zoom Rooms™ conferencing control [9]

> Microsoft Teams™ online meeting solution

> Integrates directly with Crestron Fusion®, Microsoft®, Google®, Robin®, Teem®, Appspace®, Zoom™, and EMS Software™ room scheduling services [1,6]

> Supports IBM® Notes® and CollegeNET® 25Live® through Crestron Fusion (on-premises server only)

> Available light bar and hallway sign options [8]

> Built-in PinPoint™ beacon [3,10]

> Customizable audio feedback

> Control for Crestron Pyng® OS 2 system

> Integration with supported 2N® door stations [11]

> Built-in web browsing [2]

> Multi-language support

> On-screen keyboard

> Customizable screensaver

> Single-wire Ethernet connectivity

> PoE or PoE+ network powered (refer to specifications)

> Enterprise grade security

> Web based configuration

> Cloud-based provisioning and management

> SNMP monitoring support

> US, UK, or European electrical wall box mounting

> Lectern mount over a rectangular cutout

> Retrofit and masonry mounting options available [12]

> Multi-surface and ADA compliance mounting options available [4]

> Tabletop and swivel mount options available [4]

> 4 RU rack mount option available [4]

> 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 HD color graphics, the Crestron TSW-1060 series 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-1060 series delivers the ultimate touch screen experience in an unobtrusive, space-saving design. It features a brilliant, high-definition 10.1 inch capacitive touch screen display with Smart Graphics® technology 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, and browse the Internet. Native applications are included to enable use as a room scheduling panel, to control a Zoom Rooms™ conferencing system or Microsoft Teams™ online meeting solution, and to enjoy full access to a Sonos® Home Sound System. [2]

For dedicated room scheduling applications, see also the TSS-10 Series 10.1 in. Room Scheduling Touch Screen.

TSW-1060-W-S – Shown in White

TSW-1060-B-S with TSW-1060-TTK-B-S Tabletop Kit

Smart Graphics® Technology

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 [2]
- A power-saving screensaver that allows display of time, temperature, and other text content at a reduced brightness level
- Customizable themes allowing a completely different look and feel for every user, event, or season
- Fully-developed SmartObjects® technology that enables 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-1060 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-1060 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-1060 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, lower the windows shades, lock the doors, arm the security system, or enter a password. Simply say a command and Crestron does the rest. [2,3]

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-1060 to display live streaming video from an IP camera, a streaming encoder (Crestron CEN-NVS200, DM-TXRX-100-STR, or similar [4]), 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-1060's integrated microphone and speakers. [3]

CRESTRON®

Shown in Crestron Room Scheduling mode with optional Light Bar and Multi-Surface Mount Kit

Built-in Camera

A 5 megapixel camera is built into the TSW-1060 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 [4]) or a third-party video monitoring system. [3]

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-1060, enabling enhanced control of Sonos products as part of a complete Crestron system. The app checks for updates nightly so it's always current. [2]

Room Scheduling Apps

The TSW-1060 comes with apps for all the most popular enterprise scheduling services.

- **Crestron Scheduling App –** Supports direct integration with Crestron Fusion® software, Microsoft® Exchange software (for users of Outlook® software and Office 365® software), and Google Calendar™ calendaring app (including G Suite™ software). [5]

- **Third-Party Apps –** Includes support for Teem®, Robin®, Appspace® [1], Zoom™ and EMS Software™ applications [6]. Other providers may be added in the future.

- **Additional Options –** Supports IBM® Notes® software and CollegeNET® 25Live® software through Crestron Fusion (on-premises server only).

Whatever provider you choose, the setup is as simple as connecting each touch screen to the network and choosing your app from the web-based setup menu. The selected app downloads from the cloud and installs on the touch screen automatically. There is no programming or control system required. [6]

See also the TSS-10 Series 10.1 in. Room Scheduling Touch Screen for an alternate solution.

Crestron room scheduling touch screens help organizations to maximize productivity and realize the most usable time out of every meeting space. They install at the entrance to each room to provide indication of the room's availability and a view of its schedule for the day. If the room is reserved, its touch screen displays details about the current meeting, accented in red, so attendees can immediately confirm they're in the right place before entering the room. If the room is available, the screen states so in green and shows the time remaining until the next scheduled meeting. If desired, the room can be reserved on the spot for an ad hoc meeting.

If you wish to reserve a room for later in the day, just step up to any touch screen, swipe through the room's timeline for the day, and reserve the room for any available time slot. If that room isn't available when you want it, the touch screen can find you another available room nearby. Additional optional functions include the abilities to check into a scheduled meeting, extend a meeting, end a meeting early, toggle between two languages, or limit access to various functions using PIN code authorization.

Crestron room scheduling also offers three levels of customization depending on your needs. For basic customization and branding, custom background images or videos and custom logos may be selected to personalize the standard user interface from Crestron. For editing the user interface elements further, such as changing colors, adjusting positioning, or removing elements, a custom CSS stylesheet may be created. Finally, to add entirely new user interface elements, the HTML5 coding used to create the scheduling user interface may be modified. [7]

Status Indicator Options

Adding the optional light bar accessory (TSW-1060-LB Series) to a TSW-1060 produces a ring of light around the perimeter of the touch screen, which can be seen with just a glance down the hallway. For room scheduling applications, the light bar provides 180° visual indication of a room's availability status, glowing green if the room is available and red when reserved. Other custom functionality is available through integration with a control system, allowing illumination of the light bar in any color. [8]

As an alternative to the light bar, Crestron offers a selection of hallway signs and indicators that mount on the wall or ceiling above each touch screen. The SSW and SSC series hallway signs both feature a two-sided acrylic sign face that can be custom engraved with the room name or number. The SIW-100 offers a lower profile wall mount status indicator. [8]

Zoom Rooms™ App

The Zoom Rooms application enables the TSW-1060 to be used as a touch screen control panel for a Zoom Rooms software-based conferencing and collaboration solution. The TSW-1060 offers a superior alternative to a consumer tablet device, providing a more reliable and secure platform with versatile, streamlined options for tabletop, wall mount, and lectern mount installations. Its 10.1 in. color touch screen delivers the same user-friendly

Zoom Rooms experience as a typical tablet, but without the risk of misplacing the device. Instead of Wi-Fi® communications, the TSW-1060 uses a wired Ethernet connection to ensure reliable connectivity. [9]

The TSW-1060 may be configured to run the Zoom Rooms app exclusively, or to allow toggling between the Zoom Rooms app and regular Smart Graphics touch screen control mode. The latter allows for integrating Zoom Rooms conferencing into a larger AV system while providing control for both through one touch screen device.

Note: Zoom Ultrasonic is supported up to an average of 3 feet (1 m) from the TSW-1060 touch screen to an end user device. The range will vary based on environmental noise, the sensitivity of the end user device, and the orientation to the touch screen.

Microsoft Teams™ App
Microsoft Teams is the hub for teamwork in Office 365® software, engaging people and bringing them together through messaging, voice over IP, online meetings, conferencing, content sharing, and collaboration. The Microsoft Teams application on the TSW-1060 enables presentation, calling, conferencing, and collaboration — all through a single touch screen console, with exceptional full-duplex wideband audio and HD video. A consistent user experience in every meeting space is provided via the familiar and intuitive Microsoft Teams UI, affording simple operation, built-in calendaring, and one-touch meeting joins.

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. [3,10]

Web Browsing
Using its built-in web browser, the TSW-1060 provides 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. The web browser may also be used to simply browse the Internet, check traffic conditions, or look up a recipe. [2]

On-Screen Keyboard
Typing in passwords, URLs, and text searches is facilitated using the on-screen multi-language keyboard.

Multi-Touch Support
The TSW-1060'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-1060, containing all control, video, intercom, and power signals within a single wire.

Power over Ethernet
Using PoE technology, the TSW-1060 gets its operating power right through the network cable. PoE (Power over Ethernet) eliminates the need for a local power supply or any dedicated power wiring. Crestron PoE switches (CEN-SW-POE-5 or CEN-SWPOE-16 [4]) offer a total networking solution with built-in PoE for multiple touch screens. A PoE Injector (PWE-4803RU [4]) is also available to support a single touch screen.

Note: PoE+ is required when connecting a light bar or hallways sign via USB. Refer to the "Power" specifications for additional details.

Enterprise Grade Security
Crestron touch screens employ enterprise-grade networking with robust security features such as 802.1X authentication, TLS encryption, HTTPS connectivity, and Active Directory® software integration. These features are imperative to protect your network against service interruptions and malicious intrusions, and to ensure compliance with your organization's stringent network policies. Cloud-based provisioning and management streamlines the process of configuring and monitoring every touch screen on the network and keeping them updated. Additional support for SNMP allows every touch screen to be monitored by your IT administrator alongside every other device on the network.

Crestron XiO Cloud™ Service
Crestron XiO Cloud is Crestron's unifying cloud-based platform for remotely provisioning, monitoring, and managing Crestron devices across an enterprise or an entire client base. Crestron XiO Cloud enables installers and IT managers to deploy and manage thousands of devices in the amount of time it would ordinarily take to manage just one. It provides a zero-touch solution that allows complete configuration of device settings without any hardware in hand, then simply connect each device on site and let Crestron XiO Cloud push out the settings, licenses, drivers, and firmware updates – automatically and securely – for a quick and painless, ready-to-use deployment.

Ongoing Crestron XiO Cloud services facilitate daily management and monitoring of every device through a single dashboard with comprehensive reporting and logging, live status viewing and alerts, performance metrics and analytics, scheduled actions and updates, and more. As requirements grow and evolve, new features and functionality can be added easily to one or many devices at any time without ever going on site. Crestron XiO Cloud is a subscription-based service offering an adaptable SaaS (Software as a Service) solution with graduated levels of functionality and unlimited scalability. For more information about Crestron XiO Cloud, please visit https://www.crestron.com/xiocloud.

Crestron Pyng® OS 2 Control
The TSW-1060 may be used to control a Crestron Pyng® OS 2 whole home solution. After a TSW-1060 is added to a room in Crestron Pyng, a home control project is loaded directly to the touch screen. From there, the TSW-1060 allows for control over lighting, shades, climate, media, security,

and cameras, including the ability to create and recall scenes that create a desired ambiance within certain rooms or for the entire home. A TSW-1060 may be installed in each room in the home to provide easy access to the room's environmental and media subsystems.

2N® Door Station Integration

The TSW-1060 may be integrated with a supported 2N® door station [11] via the touch screen's built-in Rava® SIP intercom to provide a door station solution for Crestron Pyng. When a call is initiated on the 2N door station, the video and audio feed is displayed on the TSW-1060. Controls are provided on the touch screen to answer or decline the call, and Crestron Pyng quick actions (such as "Open Gate") may be performed while the call is in progress. A "do not disturb" option is also provided in Crestron Pyng to prevent calls from appearing on the TSW-1060.

Wall or Lectern Mounting Options

Using the bracket provided, the TSW-1060 is easily installed over a 2-gang or 3-gang US 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-1060 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, TSW-760, TSW-1060, TSS-7, and TSS-10 series touch screens, making it easy to swap out devices at any time. [12]

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 [4]). 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.

When installing the TSW-1060 in place of an older Crestron touch screen (APAD, CT-1000, LC-1000, TPS-4L, TPS-6L, TPS-2000L, or TPS-3100L), Crestron offers Retrofit Mounting Brackets (TSW-60-RMB series [4]), which facilitate replacement without having to tear out the old mounting hardware or patch the wall.

Tabletop Option

Using the optional Tabletop Kit (TSW-1060-TTK [4]), the TSW-1060 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 [4]).

Rack Mount Option

The TSW-1060 can be mounted in a 19 in. EIA equipment rack using the optional Rack Mount Kit (TSW-1060-RMK-2 [4]). When rack mounted, the touch screen occupies four rack spaces.

SPECIFICATIONS

Touch Screen Display

Display Type: TFT active matrix color LCD
Size: 10.1 inch (257 mm) diagonal
Aspect Ratio: 16:10 WXGA
Resolution: 1280 x 800 pixels
Brightness: 400 nits (cd/m²)
Contrast: 950:1
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 [2], multi-language on-screen keyboard, screensaver, single scalable streaming video window, native Sonos app [2], native room scheduling applications [6], native Zoom Rooms app, native Microsoft Teams app, setup and diagnostics via web browser or onscreen UI

Room Scheduling Support

Crestron Scheduling App: Crestron Fusion, Microsoft Exchange & Office 365, Google Calendar & G Suite (IBM Notes and CollegeNET 25Live are also supported through Crestron Fusion On-premises only) [5]
Third-Party Apps: Teem, Robin, Appspace [1], Zoom, EMS Software [6]

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: 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, Active Directory authentication, HTTPS web browser setup, Crestron XiO Cloud client, IEEE 802.3at compliant
USB: USB 2.0 host for room availability light bar or hallway sign [8]
Bluetooth: Crestron PinPoint proximity detection beacon [3,10]

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 [3]

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 [2,3]
Audio Feedback Formats: MP3

Connectors

LAN PoE: (1) 8-pin RJ45 connector, female, with 2 LED indicators; 10Base-T/100Base-TX Ethernet port and 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 light bar or hallway sign [8]

Power

Power over Ethernet:
   IEEE 802.3at Type 2 compliant PoE+ PD (Powered Device);
   - Normally requests 15 Watts from an 802.3at Type 2 PSE with LLDP advanced power management;
   - With room scheduling and USB enabled, requests 18 Watts from an 802.3at Type 2 PSE with LLDP;
   - Requests 30 Watts (PoE+ Class 4) from an 802.3at Type 2 PSE without LLDP;
   - Requests 15.4 Watts (PoE Class 0) from an 802.3af (or 802.3at Type 1) PSE
   Note: Enabling the USB port requires use of an 802.3at Type 2 PoE+ PSE.

Environmental

Temperature: 32° to 112° F (0° to 45° C)
Humidity: 10% to 90% RH (non-condensing)
Heat Dissipation: 44 BTU/hr

Construction

Housing: 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 in. H x 3-3/4 in. W (56 mm H x 96 mm W) cutout;
      1-3/8 in. (35 mm) minimum mounting depth;
      Additional wall mount, surface mount, rack mount, and tabletop options available separately

Dimensions

Height: 6.59 in. (168 mm)
Width: 10.23 in. (260 mm)
Depth: 1.52 in. (39 mm)
Dimensions do not include the mounting bracket or add-on accessories

Weight

23.9 oz (675 g)

Compliance

UL Listed for US & Canada, IC, CE, FCC Part 15 Class B digital device

Notes:

1. Appspace functionality is currently limited to their Room Management feature (aka, room cards or meeting cards) only.
2. Voice recognition, web browsing, weather information, Sonos app, and certain other functions require an Internet connection.

3. The camera, microphone, and Bluetooth transceiver may each be defeated programmatically at any time. For applications demanding an extra measure of privacy, Crestron offers models TSW-1060-NC-B-S and TSW-1060-NC-W-S, which have no physical camera, microphone, or Bluetooth transceiver installed.

4. Item(s) sold separately. Refer to each product's spec sheet for complete information.

5. Room Scheduling Mode requires the TSW-1060 to be designated exclusively for room scheduling use, which precludes use of certain features and functions described in this spec sheet. For design assistance, contact the Crestron True Blue support team at https://www.crestron.com/support.

6. Additional subscriptions and/or licenses may be required. Refer to each provider's website for details about the capabilities and requirements of its scheduling application and services. Third-party apps typically run on the TSW-1060 as they do on a tablet device. The TSW-1060 runs only one app, which is selected at setup. Only the apps approved and delivered by Crestron can run on the TSW-1060.

7. For more information on custom programming for the Crestron room scheduling app, refer to the Crestron Room Scheduling Panels Programming Guide (Doc. 8213) at www.crestron.com/manuals.

8. The light bar and hallway sign accessories are sold separately. The TSW-1060 must be powered by a PoE+ power source when a light bar or hallway sign is connected. Only one light bar or hallway sign may be connected to the TSW-1060. Use of either accessory precludes use of the other without the addition of a custom-programmed control system and Cresnet wiring for the hallway sign. Refer to the Accessories section for a list of all available options. Refer to each accessory's spec sheet for further information.

9. A complete Zoom Rooms solution requires a mini PC or Mac computer running Zoom software, a Zoom Rooms subscription, plus additional peripherals and cables. Visit https://zoom.us/zoomrooms for more information about Zoom Rooms capabilities, hardware requirements, and subscription plans. For design assistance, contact the Crestron True Blue support team at https://www.crestron.com/support.

10. Onboard PinPoint beacon functionality is not currently supported and will be enabled through a future update. When enabled, the TSW-1060 will provide an integrated, equivalent alternative to the standalone PP-100-W beacon. For more details, refer to the PP-100-W 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 them.

11. Supported 2N door stations include the 2N IP Audio Kit, 2N IP Audio Kit Lite, 2N IP Base, 2N IP Force, 2N IP Safety, 2N IP Solo, 2N IP Uni, 2N IP Vario, 2N IP Verso, and 2N IP Video Kit. For pairing instructions, refer to the Crestron Pyng OS 2 for CP3-R Product Manual (Doc. 8356) and the TSW-560/TSW-760/TSW-1060 Supplemental Guide (Doc. 7927) at www.crestron.com/manuals.

12. 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-1060 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 a TSW-UMB-PMK or TSW-550-BBI, without modification to the wall. If replacing another older Crestron 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 https://www.crestron.com/How-To-Buy/Find-a-Representative or by calling 855-263-8754.

The specific patents that cover this and other Crestron products are listed online at https://www.crestron.com/legal/patents.

Certain Crestron products contain open source software. For specific information, visit https://www.crestron.com/opensource.

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MODELS & ACCESSORIES

Available Models

TSW-1060-B-S: 10.1 in. Touch Screen, Black Smooth
TSW-1060-W-S: 10.1 in. Touch Screen, White Smooth

Available Accessories

TSW-1060-TTK Series: Tabletop Kit
TSW-560/760/1060-SMK: Swivel Mount Kit for TSW-1060-TTK Series
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-1060
TSW-760/1060-RMB-2: Retrofit Mounting Bracket – Converts TPS-4L to TSW-1060
TSW-1060-RMB-3: Retrofit Mounting Bracket – Converts TPS-6L to TSW-1060
TSW-1060-RMB-4: Retrofit Mounting Bracket – Converts TPS-3100L to TSW-1060
TSW-760/1060-MSMK Series: Multi-Surface Mount Kit
TSW-560/760-RMK-2: Rack Mount Kit
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
SW-XIOC-S Series: Crestron XiO Cloud™ Standard Provisioning and Management Service for one device
SW-XIOC-P Series: Crestron XiO Cloud™ Premium Provisioning and Management Service for one device
SW-FUSION-C-3: Crestron Fusion® Cloud; 250 rooms; 3-year service, support, and updates
SW-FUSION-P-L: Crestron Fusion® On-premises; Unlimited rooms; lifetime service, support, and updates
SW-HS-x-C Series: Crestron Fusion® Cloud Room Scheduling for one touch screen
SW-HS-x-P Series: Crestron Fusion® On-premises Room Scheduling for one touch screen
TSW-1060-LB Series: Room Availability Light Bar
SSC Series: Room Availability Hallway Sign, Ceiling Mount
SSW Series: Room Availability Hallway Sign, Wall Mount
SIW-100: Room Availability Status Indicator, Wall Mount

3.57 in
91 mm

1.11 in
28 mm

3.71 in
95 mm

TOP

5.76 in
147 mm

1.96 in
50 mm

0.05 in
1.2 mm

TOP

Wall mounting bracket (included)

6.59 in
168 mm

10.23 in
260 mm

1.52 in
39 mm

0.48 in
13 mm

SPECIFICATION SHEET

C2G
GET CONNECTED
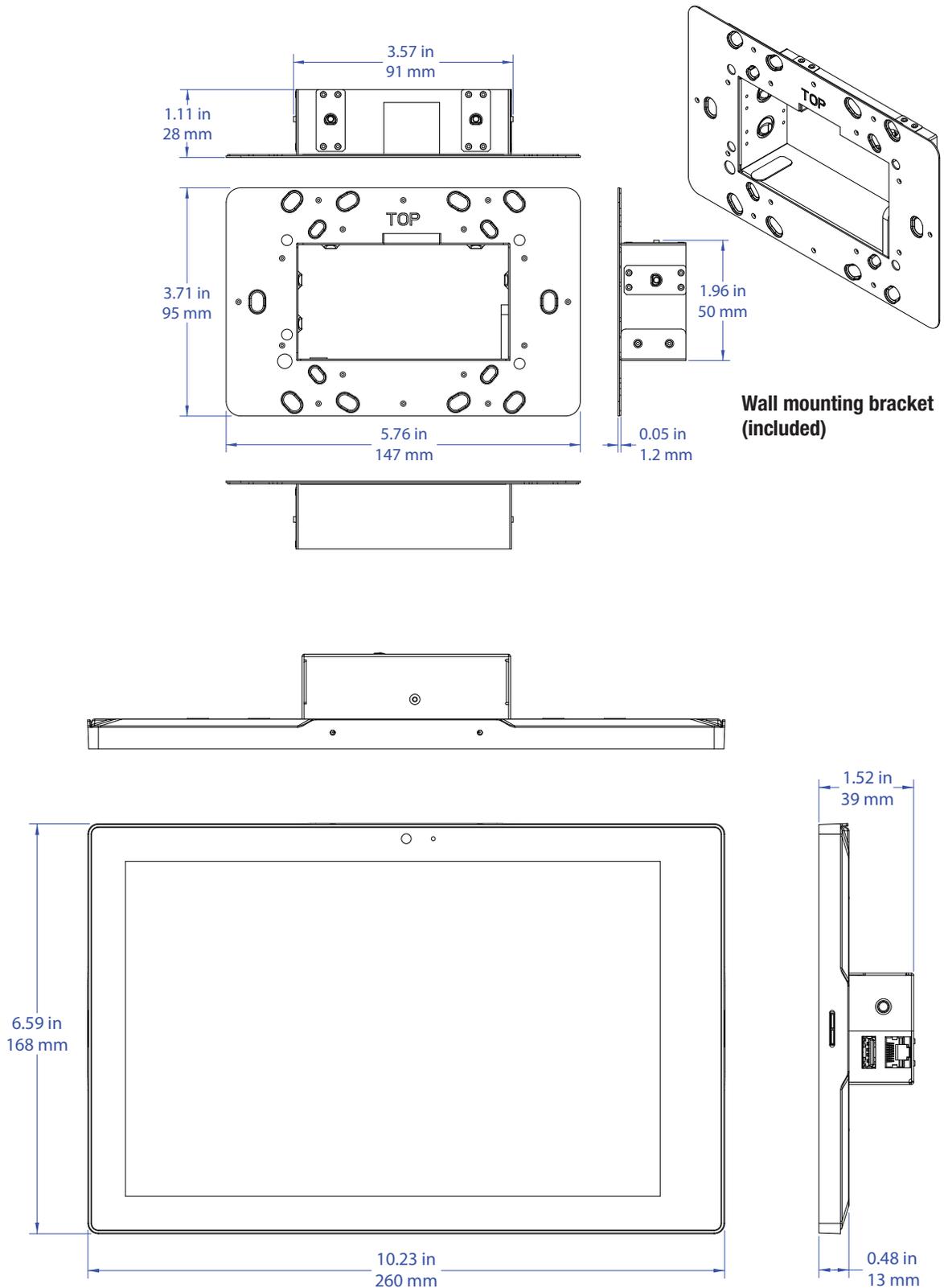
TruLink® USB 2.0 Superbooster

– Supports USB 2.0 speeds up to 480Mbps
– Supports cable lengths of up to 100m (328ft)
– Receiver provides a full 500mA to the connected USB device
– Power injector feature allows the power adapter to be placed at the transmitter or the receiver
– Wall plates are designed to fit a standard Decora® cutout
– Dongles and Wall Plates are completely interchangeable. Use the combination that best suits each application

Note: Decora® is a registered trademark of the Leviton Manufacturing Company. This product is not manufactured or endorsed by the Leviton Manufacturing Company, Inc.

Specifications: TruLink® USB 2.0 Superbooster

General Specifications:

USB Specification:	USB 2.0
USB Data Bandwidth:	Up to 480Mbps
Maximum Cable Distance:	100m (328ft)

Power Specifications:

Power Adapter Input:	100 - 240V~50/60Hz
Power Adapter Output:	24.0VDC, 1000mA
Power Adapter Pin Diameter:	5.5mm
Power Adapter Center Pin Polarity:	Positive
Power Adapter Cable Length:	12ft
USB Power Output:	5V, 500mA

Physical Characteristics:

Transmitter Connectors:	(1) USB B Female
	(1) DC Power Female*
	(1) RJ45 Female
Receiver Connectors:	(1) USB A Female
	(1) DC Power Female*
	(1) RJ45 Female
Wall Plate Insert Dimensions:	66.5 x 30.0mm
Wall Plate Dimensions:	103.6 x 40 x 44mm
Dongle Dimensions:	86 x 57 x 30mm

*The female DC power port on the wall plate transmitter and receiver is a screw terminal designed to accept bare wire.

Item Number	Description	Weight (lb)
53877	USB 2.0 Superbooster Wall Plate Kit (T & R)	0.80
53878	USB 2.0 Superbooster Wall Plate (T) & Dongle (R) Kit	0.80
53879	USB 2.0 Superbooster Dongle (T) & Wall Plate (R) Kit	0.80
53880	USB 2.0 Superbooster Dongle Kit (T & R)	0.80

(T) - Transmitter
(R) - Receiver
(T & R) - Transmitter and Receiver

C2G
GET CONNECTED

Specifications

Annotator 300

Video input

Number/signal type .... 1 RGB, RGBcvS, component (interlaced, progressive, HD), S-video, composite video
1 HDMI (HDCP compliant)
1 DisplayPort (HDCP compliant)

Connectors .... 1 female 15-pin HD
1 female HDMI
1 female DisplayPort

Nominal level .... 1 Vp-p for Y of component video and S-video, and for composite video
0.7 Vp-p for RGB and for R-Y and B-Y of component video
0.3 Vp-p for C of S-video

Minimum/maximum levels.............. Analog: 0.0 V to 1.0 Vp-p with no offset at unity gain

Impedance .... 75 ohms

Horizontal frequency .... 15 kHz to 100 kHz

Vertical frequency.......................... 24 Hz to 75 Hz

Resolution range

    VGA and HDMI........................ 640x480 to 1600x1200 and 1920x1200*
NTSC, PAL, SECAM, 480i, 480p, 576i, 576p, 720p, 1080i, 1080p, and 2k

    DisplayPort .... 640x480 to 1600x1200 and 2560x1600*
480p, 576p, 720p, 1080i, 1080p, and 2k
*reduced blanking

Return loss .... <-30 dB @ 5 MHz

DC offset (max. allowable) .... 0.5 V

Standards..................................... DVI 1.0, HDMI, DisplayPort 1.1a, HDCP

Video processing

Decoder .... 12 bit digital (3D-adaptive comb filter)

Analog sampling .... 12 bits per color; 13.5 MHz standard (video), 170 MHz standard (RGB)

HDMI pixel data bit depth .... 8, 10, or 12 bits per channel; 165 MHz pixel clock

Display Port pixel data bit depth ..... 8, 10, or 12 bits per channel; 270 MHz pixel clock

Colors .... 1 billion, (10 bit processing)

Video output

Number/signal type .... 2 HDMI (HDCP compliant)
1 DTP (HDCP compliant)

Connectors .... 2 female HDMI
1 female RJ-45 connector

Digital bit depth .... 8 or 10 bit, automatic

Vertical frequency.......................... 23.98 Hz, 24 Hz, 25 Hz, 29.97 Hz, 30 Hz, 50 Hz, 59.94 Hz, 60 Hz

Scaled resolution .... $640x480^8$, $800x600^8$, $1024x768^8$, $1280x768^8$, $1280x800^8$, $1280x1024^8$, $1360x768^8$, $1366x768^8$, $1440x900^8$, $1400x1050^8$, $1600x900^{8,}$, $1600x1200^8$, $1680x1050^8$, $1920x1200^8$
HDTV: $480p^{7,8}$, $576p^6$, $720p^{3,4,5,6,7,8}$, $1080i^{6,7,8}$, $1080p^{1,2,3,4,5,6,7,8}$, $2048x1080^{1,2,3,4,5,6,7,8}$
^{1} = 23.98 Hz, ^{2} = 24 Hz, ^{3} = 25 Hz, ^{4} = 29.97 Hz, ^{5} = 30 Hz, ^{6} = 50 Hz, ^{7} = 59.94 Hz, ^{8} = 60 Hz

Interconnection between Annotator 300 and DTP/HDBT receiver

Termination standard......................... TIA/EIA T568B

Signal transmission distance

    1080p @ 60 Hz......................... Up to 330' (100 m) using shielded twisted pair cable or XTP DTP 24 STP cable

Cable requirements .... Solid conductor, 24 AWG or better

Cable recommendations................. 400 MHz bandwidth, STP (shielded twisted pair)

> **NOTE:**   Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance

Audio input

Number/signal type .... 1 embedded digital audio from HDMI
    1 embedded digital audio from DisplayPort

Connectors .... 1 female HDMI
    1 female DisplayPort

Audio output

Number/signal type .... 2 embedded digital audio on HDMI
    1 DTP 330 (embedded digital and remote balanced/unbalanced analog)
    or HDBaseT (embedded digital)

Connectors .... 2 female HDMI
    1 RJ-45

Sync

Input type .... RGBHV, RGBS, RGsB, RGBcvS, bi-level or tri-level component video

Input standards .... NTSC 3.58, NTSC 4.43, PAL, SECAM

Input level .... 2.75 V to 5.0 Vp-p for RGBHV or RGBS
    0.6 Vp-p for component video tri-level sync
    0.3 Vp-p for component video bi-level sync or RGsB

Input impedance .... Horizontal: 75 ohms
    Vertical: 510 ohms

Communication — signal processor

Serial control port........................... 1 bidirectional RS-232, 3-pin captive screw connector

Baud rate and protocol................... 9600, 8 data bits, 1 stop bit, no parity (default)

Serial control pin configuration....... 1 = Tx, 2 = Rx, 3 = Gnd

Contact closure .... 1 rear panel 3.5 mm captive screw connector, 3 pole

Contact closure pin configurations . Pin 1 = input 1, 2 = input 2, 3 = input 3

USB control port............................. 1 female mini USB on front panel

USB standards .... USB 2.0, high speed

Ethernet control port...................... 1 RJ-45 female connector

Ethernet data rate .... 10/100Base-T, half/full duplex with autodetect

Ethernet protocol .... ARP, ICMP (ping), IP, TCP, UDP, DHCP, HTTP, SMTP, Telnet

Ethernet default settings .... Link speed and duplex level = autodetected
    IP address = 192.168.254.254
    Subnet mask = 255.255.0.0
    Gateway = 0.0.0.0
    DHCP = off

Web server.................................... Up to 200 simultaneous sessions
    40 MB nonvolatile user memory

Program control .... Extron control/configuration program for Windows®
    Extron Simple Instruction Set (SIS™)

Communications — external device (pass-through, unidirectional or bidirectional) (RS-232/IR over DTP)

> **NOTE:** Protocol is mirrored between the connected DTP 330 endpoint and the "Over DTP" port on Annotator 300. Signals from a control device pass into the Annotator 300 "Over DTP" port, is embedded with the DTP signal, and sent to individual DTP 330 Rx endpoint for control of a remote sink device.
> The "Over DTP" port is simply a pass-through connection to a DTP endpoint. There is no RS-232 or IR insertion from any Annotator 300 control port to the "Over DTP" port.

Serial control pass-through ports
    Annotator 300 output/DTP Rx.. RS-232 via (1) 3.5 mm, 5 pole captive screw connector (shared with IR port)
Baud rates...................................... 300 to 38400
Protocol .... 8 or 7 data bits
    1 or 2 stop bits
    no parity (default)
    even or odd parity
Serial control pin configuration....... 1 = Tx, 2 = Rx, 3 = Gnd
IR pass-through control ports .... TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz
    Annotator 300 output/DTP Rx.. (1) 3.5 mm captive screw connector, 5 pole (shared with RS-232 port)
IR control pin configuration .... 3 = Gnd 4 = IR Tx, 5 = IR Rx

Communication — annotation

Number/signal type .... 32 USB devices (via hubs)
Connectors .... 3 USB type A connectors (2 on rear and 1 on front)
USB standards .... USB 2.0, USB 1.1, USB 1.0 compatible
USB data rates................................ Low speed (1.5 Mbps), full speed (12 Mbps)

General

Power supply.................................. Internal
    Input: 100-240 VAC, 50-60 Hz
Power consumption .... 37 watts
Auxiliary power output
    USB .... 5 VDC, 500 mA on each USB connector
    DTP output .... Supports one endpoint (one DTP Rx)
Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
    Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling.. Fan, air flows from right to left (as viewed from the front panel)
Thermal dissipation .... 81.4 BTU/hr
Mounting
    Rack mount .... Yes, with pre-installed brackets.
    Furniture mount .... Yes, with optional under-desk or through-desk mounting kit
Enclosure type................................ Metal
Enclosure dimensions .... 1.75" H x 17.5" W x 9.5" D (1U high, full rack wide)
    (4.4 cm H x 44.5 cm W x 24.1 cm D)
    (Depth excludes connectors and knobs.)
Product weight................................ 5.4 lbs (2.4 kg)
Shipping weight.............................. 7 lbs (4 kg)
DIM weight..................................... 8 lbs (4 kg)
Vibration .... ISTA 1A in carton (International Safe Transit Association)
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, WEEE.
Warranty.. 3 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

Specifications

DTP T USW 233

Video

VGA

Gain	Unity
Bandwidth..............................	170 MHz (-3 dB)
Crosstalk	-50 dB @ 10 MHz, -30 dB @ 100 MHz
Switching speed.....................	<5 ms. (max)

HDMI

Maximum data rate	6.75 Gbps (2.25 Gbps per color)
Maximum pixel clock	165 MHz
Resolution range	Up to 1920x1200 or 1080p @ 60 Hz; 2k
Formats..................................	RGB and YCbCr digital video
Standards...............................	DVI 1.0, HDMI, HDCP 1.1, CEA-861E

Video input — HDMI

Number/signal type.......................	2 HDMI inputs (or single link DVI-D with the appropriate DVI-HDMI adapters)
Connectors...................................	2 female HDMI type A

Video input — VGA

Number/signal type.......................	1 VGA-QXGA; RGBHV
Connectors...................................	1 female 15-pin HD
Nominal level................................	0.7 Vp-p
Min./max. level.............................	Analog, 0.3 V to 1.5 Vp-p with no offset
Impedance....................................	75 ohms
Horizontal frequency	15 kHz to 145 kHz
Vertical frequency..........................	30 Hz to 170 Hz
Return loss	<-40 dB @ 5 MHz

> **NOTE:** The VGA input is digitized and output as DTP. The VGA signal is not scaled.

Sync — VGA

Input type	RGBHV, bi-level and tri-level sync
Input level	1.9 V to 5.0 Vp-p
S/N...	>90 dB at maximum input (unweighted)
Max. input voltage.........................	5.0 Vp-p

Interconnection between transmitter and receiver

Number/signal type.......................	1 DTP 230 output
Connector.....................................	1 female RJ-45
Termination standard......................	TIA/EIA T568B
Transmission distance...................	Up to 230' (70 m) using shielded twisted pair cable or XTP DTP 24 STP cable
Cable requirements	Solid conductor, 24 AWG or better
Cable recommendations..........	400 MHz bandwidth, STP (shielded twisted pair)

> **NOTE:** Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

> **NOTE:** Input and output mode signaling:
> **DTP:** HDMI with embedded audio, analog audio, RS-232 and IR, and remote power
> **HDBT:** HDMI with embedded audio plus RS-232 and IR

Audio

Gain .... Unbalanced output: 0 dB; balanced output +6 dB

Frequency response .... 20 Hz to 20 kHz, ±0.5 dB

THD + Noise .... 0.01% @ 1 kHz at nominal level

S/N .... >90 dB, at maximum input (unweighted)

Crosstalk .... <-45 dB @ 20 kHz, or -72 dB @ 1 kHz or below

Stereo channel separation.............. >80 dB @ 1 kHz to 20 kHz

Audio input

Number/signal type........................ 1 analog stereo, unbalanced or
2-digital audio, embedded in the HDMI

Connectors.................................... 1 female 3.5 mm mini stereo jack
2 female HDMI Type A (shared with video input)

Source formats

HDMI...................................... LPCM up to 7.1/24-bit/192 kHz, Dolby TrueHD, Dolby Digital Plus, Dolby Digital EX, Dolby Digital 5.1, Dolby Digital 2/0 Surround, Dolby Digital 2/0, DTS-HD Master Audio, DTS-HD, DTS-ES Discrete 6.1, DTS-ES Matrix 6.1, DTS Digital Surround 5.1, DTS 2 Channel

Analog.................................... Analog stereo audio

Impedance.................................... 10k ohms, DC coupled

Nominal level................................. -10 dBV

Maximum level .... +6dBV, unbalanced

CMRR... >60 dB typ @ 1 kHz

Input gain adjustment.................... -18 dB to +24 dB, 1 dB steps, adjustable per input

> **NOTE:**   0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type........................ 1 analog audio over DTP signal, or
1 embedded digital audio over DTP signal

Connectors.................................... 1 RJ-45 jack

Communications — switcher

Serial control port.......................... RS-232 via (1) 3.5 mm, 3 pole captive screw connector

Serial control pin configuration .... Pin 1 = Tx, pin 2 = Rx, pin 3 = Gnd

Baud rate and protocol (RS-232) ... 9600 baud, 8 data bits, 1 stop bit, no parity

Tally port .... (1) 3.5 mm, 4 pole captive screw connector

Tally port pin configuration............. Pin 1 = input 1 tally, pin 2 = input 2 tally, pin 3 = input 3 tally, pin 4 = +5 VDC

Contact closure remote control ...... (1) 3.5 mm, 4 pole captive screw connector

Contact closure pin configuration... Pin 1 = input 1, pin 2 = input 2, pin 3 = input 3, pin 4 = Gnd

USB control port .... 1 front panel female mini USB, type B

USB standards .... USB 2.0, high speed

Program control .... Extron Simple Instruction Set (SIS™)

Communications — RS-232/IR over DTP

> **NOTE:** Protocol is mirrored between the connected DTP 230 Rx and the Over DTP output port. Signals from a control device pass into the Over DTP port, are embedded with the DTP signal, and sent to the DTP 230 Rx endpoint for control of remote sink and source devices.
>
> The Over DTP port is a pass-through connection to the DTP endpoint. There is no RS-232 or IR insertion from the DTP T USW 233 control port to the Over DTP port.

Serial control pass-through port ..... 1 RS-232 and IR via (1) 3.5 mm, 5-pole captive screw connector
Serial control pin configuration .... Pin 1 = Tx, pin 2 = Rx, pin 3 = Gnd
Baud rates .... 300 to 115200 baud
Protocol .... 8 or 7 data bits
1 or 2 stop bits
no parity (default)
even or odd parity
IR pass-through control port .... TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz
IR control pin configuration .... 3 = Gnd, 4 = IR Tx, 5 = IR Rx

General

Power supply .... External
Input: 100-240 VAC, 50-60 Hz
Output: 12 VDC, 1.8 A, 18 watts
Power consumption
Device .... 5.5 watts
Device and power supply .... 7.2 watts

> **NOTE:** The DTP T USW 233 can be powered either locally by the external power supply or remotely by a receiver on the other end of the twisted pair cable.

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling .... Convection, vents on top and sides
Thermal dissipation
Device .... 15.4 BTU/hour
Device and power supply .... 21.0 BTU/hour
Mounting
Rack mount............................. Yes, with optional 1U high rack shelf
Furniture mount .... Yes, with optional under-desk mounting kit
Enclosure type .... Metal
Enclosure dimensions .... 1.0" H x 8.75" W x 6.0" D (half rack wide)
(2.5 cm H x 22.2 cm W x 15.2 cm D)
(Depth excludes connectors.)
Product weight .... 0.6 lbs (0.3 kg)
Regulatory compliance................... CE, c-UL UL, CE**, C-tick, FCC Class A**, ICES, VCCI,
Complies with the appropriate requirements of RoHS, WEEE

> **NOTE:** **CE and FCC testing is conducted with STP (shielded twisted pair) I/O cable.

Warranty .... 3 years parts and labor
Everlast power supply warranty ..... 7 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** Shipping weights and dimensions are available at **www.extron.com**.

4346-090818-D12

Specifications

IN1604 Series

IC-2

Video input

Number/signal type........................	1 analog RGBHV, component video (YUVi, YUVp, and YUV-HD), S-video, or composite video
	3 HDMI/DVI (HDCP compliant)
Connectors...................................	1 female 15-pin HD
	3 female HDMI type A
Equalization	Automatic
Input cable length	Up to 75' (22.9 m) for all supported input rates
Nominal level.................................	1 Vp-p for Y of component video and S-video, and for composite video
	0.7 Vp-p for RGB and for R-Y and B-Y of component video
	0.3 Vp-p for C of S-video
Minimum/maximum levels..............	Analog: 0.0 V to 1.0 V with no offset at unity gain
Impedance....................................	75 ohms
Horizontal frequency	15 kHz to 100 kHz
Vertical frequency..........................	24 Hz to 75 Hz
Resolution range...........................	640x480 to 1920x1200* sampled pixel for pixel, NTSC, PAL, SECAM, 480i, 480p, 576i, 576p, 720p, 1080i, 1080p, and 2K
	*reduced blanking
Return loss	>30 dB @ 5 MHz
DC offset (max. allowable)..............	0.5 V
Standards.....................................	DVI 1.0, HDMI, HDCP

Video processing

Decoder..	12 bit digital (3D-adaptive comb filter)
Analog sampling	12 bits per color; 13.5 MHz standard (video) 170 MHz standard (RGB)
Digital pixel data bit depth..............	8, 10, or 12 bits per channel; 165 MHz pixel clock (HDMI)
Colors..	1 billion (10 bit processing)

Video output

Number/signal type	
IN1604 DTP	1 DTP or HDBaseT, configurable (HDCP compliant)
IN1604 HD	1 HDMI digital video (HDCP compliant)
Connectors	
IN1604 DTP	1 female RJ-45
IN1604 HD	1 female HDMI
HDMI peripheral device power	200 mA
Digital bit depth.............................	8 or 10 bit, automatic
Scaled resolution	640x480[8], 800x600[8], 1024x768[8], 1280x720[8],1280x768[8], 1280x800[8], 1280x1024[8], 1360x768[8], 1366x768[8], 1400x1050[8], 1440x900[8], 1600x900[8], 1600x1200[8], 1680x1050[8], 1920x1200[8]
	HDTV 480p[7,8], 576p[6], 720p[3,4,5,6,7,8], 1080i[6,7,8], 1080p[1,2,3,4,5,6,7,8], 2K (2048x1080)[1,2,3,4,5,6,7,8]
	[1] = at 23.98 Hz, [2] = at 24 Hz, [3] = at 25 Hz,[4] = at 29.97 Hz, [5] = at 30 Hz, [6] = at 50 Hz, [7] = at 59.94 Hz, [8] = at 60 Hz

Sync

Input type .... RGBHV, RGBS, RGsB, bi-level or tri-level component video

Input standards............................. NTSC 3.58, NTSC 4.43, PAL, SECAM, TMDS

Input level .... 2.75 V to 5.0 Vp-p for RGBHV or RGBS
0.6 Vp-p for component video tri-level sync
0.3 Vp-p for component video bi-level sync, RGsB, or composite video

Input impedance............................ Horizontal and vertical: 510 ohms

Max. input voltage.......................... 5.0 Vp-p

Interconnection between IN1604 DTP and DTP/HDBaseT receiver (IN1604 DTP only)

Connectors..................................... 1 female RJ-45

Termination standard...................... TIA/EIA-T568B

Signal transmission distance

    DTP 330................................. Up to 330' (100 m) using shielded twisted pair cable or XTP DTP 24 STP cable

    DTP 230................................. Up to 230' (70 m) using shielded twisted pair cable or XTP DTP 24 STP cable

Cable requirements........................ Solid conductor, 24 AWG or better

Cable recommendations .... 400 MHz bandwidth, STP (shielded twisted pair)

> **NOTE:** Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

> **NOTE:** Output signals:
> **DTP:** HDMI with embedded audio, analog audio, RS-232 and IR, and remote power
> **HDBaseT:** HDMI with embedded audio, RS-232 and IR

Audio

Gain...

		Input	Output	System Gain
Unbalanced	Analog input 1 (TRS)		Analog output	0 dB
			TP output	-6 dB
	Analog input 2 (captive screw)		Analog output	-6 dB
			TP output	-12 dB
Balanced	Analog input 2 (captive screw)		Analog output	0 dB
			TP output	-6 dB

Frequency response .... 20 Hz to 20 kHz, ±0.5 dB

THD + Noise .... < 0.1% @ 1 kHz, 20 Hz to 20 kHz bandwidth (at nominal level)

S/N.. >90 dB, at maximum output (unweighted)

Crosstalk .... ≤ -80 dB @ 1 kHz, fully loaded

Stereo channel separation.............. >80 dB @ 1 kHz

Audio input

Number/signal type........................ 1 analog stereo, unbalanced
1 analog stereo, balanced/unbalanced
3 digital stereo, de-embedded from HDMI (PCM only)

Connectors..................................... (1) 3.5 mm stereo jack; tip (L), ring (R), sleeve (ground)
(1) 3.5 mm captive screw connector, 5 pole
3 female HDMI type A

Impedance...................................... Analog inputs: >10k ohms unbalanced, >20k ohms balanced

Nominal level.................................. 3.5 mm stereo jack: +4 dBu (1.23 Vrms)
Captive screw connector: +4 dBu (1.23 Vrms) or -10 dBV (316 mVrms), adjustable

Maximum level .... Analog inputs: +15 dBu unbalanced, +21 dBu balanced

CMRR.. 70 dB @ 1 kHz

Input gain adjustment..................... -18 dB to +24 dB, adjustable per input, in 1 dB steps, analog inputs only

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type

    IN1604 DTP .... 1 analog stereo or mono, balanced/unbalanced
                                               1 DTP (embedded digital audio and remote balanced/unbalanced analog audio) or HDBaseT (embedded digital)

> **NOTE:** Remote analog audio output is not available in HDBaseT mode.

    IN1604 HD .... 1 analog stereo or mono, balanced/unbalanced
                                               1 HDMI embedded

Connectors

    IN1604 DTP .... (1) 3.5 mm captive screw connector, 5 pole
                                               1 female RJ-45
    IN1604 HD .... (1) 3.5 mm captive screw connector, 5 pole
                                               1 female HDMI

Impedance..................................... 50 ohms unbalanced, 100 ohms balanced

Gain error...................................... ±0.5 dB channel to channel

Maximum level (Hi-Z)..................... >+15 dBu, unbalanced, >+21 dBu, balanced at 1% THD+N

Output volume range .... 0 to -100 dB in 1 dB steps

> **NOTE:** System gain for the analog DTP receiver output is rated at -12 dB (unbalanced) and -6 dB (balanced).

Communications — scaling presentation switcher

Serial control port

    IN1604 DTP .... 1 bidirectional RS-232, 3.5 mm captive screw connector, 5 pole (rear panel, uses 3 poles)
    IN1604 HD .... 1 bidirectional RS-232, 3.5 mm captive screw connector, 3 pole (rear panel)

Baud rate and protocol .... 9600, 8 data bits, 1 stop bit, no parity

Serial control pin configuration

    IN1604 DTP .... 1, 2 = unused, 3 = Tx, 4 = Rx, 5 = Gnd
    IN1604 HD .... 1 = Tx, 2 = Rx, 3 = Gnd

Contact closure .... 4 contact closure inputs on (1) 3.5 mm captive screw connector, 5 pole

Tally output .... 4 tally outputs on (1) 3.5 mm captive screw connector, 5 pole

Tally output power.......................... +5 VDC, 0.2 A

USB control port .... 1 front panel female mini USB B

USB standards .... USB 2.0, high speed

Program control .... Extron PCS configuration software for Windows®
                                                Extron Simple Instruction Set (SIS™)

Communications — external device (pass-through, unidirectional or bidirectional) (RS-232/IR over TP for the IN1604 DTP only)

> **NOTE:** Protocol is mirrored between the connected DTP endpoint and the "Over TP" port on the IN1604 DTP. Signals from a control device pass into the "Over TP" port, are embedded with the TP signal, and sent to an individual DTP Rx or HDBaseT endpoint for control of remote sink devices.
>
> The "Over TP" port is simply a pass-through connection to endpoints. There is no RS-232 or IR insertion from any IN1604 DTP control port to the "Over TP" port.

Serial control pass-through port

    "Over TP" output .... RS-232 via (1) 3.5 mm captive screw connector, 5 pole (shared with IR port)

Baud rates .... Up to 115200 baud

Protocol .... 6 - 8 data bits
                                          1 or 2 stop bits
                                          no parity (default)
                                          even or odd parity
                                          flow control = XON, XOFF, none

Serial control pin configuration .... 1 = Tx, 2 = Rx, 3 = Gnd
IR pass-through control port .... TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz
　　"Over TP" output .... (1) 3.5 mm captive screw connector, 5 pole (shared with RS-232 port)
IR control pin configuration .... 3 = Gnd, 4 = IR Tx, 5 = IR Rx

General

Power supply .... Internal
　　　　　　　　　　　　　　　　　　　Input: 100-240 VAC, 50-60 Hz
Power consumption
　　Full power
　　　　IN1604 DTP....................... 25.0 watts
　　　　IN1604 HD .... 15.1 watts
　　Power save mode
　　　　IN1604 DTP....................... 9.0 watts
　　　　IN1604 HD .... 6.6 watts
Remote power capability................ IN1604 DTP only: supports one DTP Rx endpoint device

> **NOTE:**　Remote power is not available in HDBaseT mode.

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
　　　　　　　　　　　　　　　　　　　Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling .... Fan, air flows front to rear, vents on front and rear
Thermal dissipation
　　Full power
　　　　IN1604 DTP....................... 67.0 BTU/hr
　　　　IN1604 HD .... 50.2 BTU/hr
　　Power save mode
　　　　IN1604 DTP....................... 28.0 BTU/hr
　　　　IN1604 HD .... 22.3 BTU/hr
Mounting
　　Rack mount............................. Yes, with optional rack shelf
　　Furniture mount .... Yes, with optional under-desk or through-desk mounting kit
Enclosure type .... Metal
Enclosure dimensions .... 1.75 H x 8.75" W x 8.5" D (1U high, half rack wide)
　　　　　　　　　　　　　　　　　　　(4.4 cm H x 22.2 cm W x 21.6 cm D)
　　　　　　　　　　　　　　　　　　　(Depth excludes connectors.)
Product weight
　　IN1604 DTP .... 2.1 lbs (1.0 kg)
　　IN1604 HD .... 2.1 lbs (1.0 kg)
Shipping weight
　　IN1604 DTP .... 4 lbs (2 kg)
　　IN1604 HD .... 4 lbs (2 kg)
Vibration .... ISTA 1A in carton (International Safe Transit Association)
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, WEEE.
Warranty .... 3 years parts and labor

> **NOTE:**　All nominal levels are at ±10%.

> **NOTE:**　Specifications are subject to change without notice.

8.1-011515-D5

Specifications

DTP T UWP 4K 232 D

TRUE 4K specifications

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096x2160 at 30 Hz	4:4:4	8 bit
3840x2160 at 30 Hz		

Frame rate[1] .... 24, 25, or 30 fps
Chroma sampling[1] 4:4:4, 4:2:2
Color bit depth[1] .... 8 bits per color
Signal type .... DVI 1.0, HDMI 1.4, HDCP 1.4
Maximum video data rate .... 10.2 Gbps (3.4 Gbps per color)

> **NOTE:** [1]Subject to the maximum data rate limit. Use our calculator (**http://www.extron.com/product/ videotools.aspx**) to determine video parameters supported by this data rate.

Video

> **NOTE:** *Appropriate DVI-D to HDMI cables or adapters are required for DVI signal input/output.

Maximum data rate
    HDMI .... 10.2 Gbps (3.4 Gbps per color)
    VGA .... 6.75 Gbps (2.25 Gbps per color)
Maximum pixel clock
    HDMI .... 300 MHz
    VGA .... 165 MHz
Resolution range .... Up to 1920x1200 or 1080p @ 60 Hz; 8 bit color depth
    2048x1080 (2K) @ 60 Hz
    4K (4096x2160) @ 30 Hz or 4K UHD (3840 x 2160) @ 30 Hz; 8-bit color
Formats .... RGB digital video
Standards .... DVI 1.0, HDMI, HDCP 1.2, EDID 1.3, CEA-861E

Video input — HDMI

Number/signal type .... 1 single link HDMI (or DVI-D*) input
Connectors .... 1 female HDMI type A

Video input — VGA

Number/signal type .... 1 analog RGBHV
Connectors .... 1 female 15-pin HD (RGB)
Nominal level .... 0.7 Vp-p for RGB
Minimum/maximum levels .... 0.3 V to 1.45 Vp-p
Impedance .... 75 ohms
Horizontal frequency .... 15 kHz to 130 kHz
Vertical frequency .... 30 Hz to 150 Hz
Return loss .... <-30 dB @ 5 MHz
DC offset (max. allowable) .... 250 mV

Interconnection between transmitter and receiver

Signal type	1 DTP 230 output
Connectors	1 female RJ-45
Termination standards	TIA/EIA T568B

Signal transmission distance

1080p @ 60 Hz	Up to 230' (70 m) using shielded twisted pair (STP) cable or XTP DTP 24 cable
2048x1080p @ 60 Hz	Up to 130' (40 m) using STP cable or XTP DTP 24 cable
4K/UHD @ 30 Hz	Up to 130' (40 m) using STP cable or XTP DTP 24 cable
Cable requirements	Solid conductor, 24 AWG or better
Cable recommendations	400 MHz bandwidth STP cable

> **NOTE:** Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

Audio

Gain	Unbalanced output: 0 dB; balanced output +6 dB
Frequency response	20 Hz to 20 kHz, ±0.5 dB
THD + Noise	0.03% @ 20 Hz to 20 kHz at maximum output
S/N	>90 dB at maximum output (15 dBu), balanced (unweighted)
Stereo channel separation	>80 dB @ 1 kHz to 20 kHz

Audio input

Number/signal type

Analog audio (over DTP)	2 stereo, unbalanced
Digital audio	1 embedded digital audio on DTP
Embedded digital audio source formats	2-ch PCM, PCM, Dolby Digital 2/0, Dolby Digital 2/0 Surround, Dolby Digital 5.1, Dolby Digital EX, DTS Digital Surround 5.1, DTS-ES Matrix 6.1, DTS-ES Discrete 6.1
Connectors	(2) 3.5 mm stereo jack, 2 channel; tip (L), ring (R), sleeve (ground)
Impedance	>10k ohms, DC coupled
Nominal level	-10 dBV (316 mVrms)
Maximum level	+7 dBu, unbalanced

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type

Analog audio (over DTP)	1 stereo, unbalanced
Digital audio	1 embedded digital audio on DTP
Embedded digital audio source formats	2-ch PCM, PCM, Dolby Digital 2/0, Dolby Digital 2/0 Surround, Dolby Digital 5.1, Dolby Digital EX, DTS Digital Surround 5.1, DTS-ES Matrix 6.1, DTS-ES Discrete 6.1
Connectors	1 female RJ-45 jack

Communications — transmitter

Serial control port	RS-232 via (1) 3.5 mm, 5-pole captive screw connector for RS-232 control (±5 V) and contact closure input switching
Baud rate and protocol	9600 baud rate, 8 data bits, 1 stop bit, no parity
Contact closure remote control	(1) 3.5 mm, 5-pole captive screw connector (connector is shared with RS-232 control port)
USB control port	1 front panel female mini USB type B
USB standards	USB 2.0, high speed
Program control	Extron Simple Instruction Set (SIS™)

Communications — external device (pass-through)

Serial control pass-through port ..... Bidirectional RS-232

Connector

    DTP output............................. (1) 3.5 mm captive screw connector, 5-pole

Baud rate and protocol .... 300 to 115200 baud, 8 or 7 data bits, 1 or 2 stop bits, non-parity (default), even or odd parity

> **NOTE:** Protocol is mirrored between the connected DTP 230 or DTP 330 endpoints and the "Over DTP" ports on the DTP T UWP 4K 232 D. Signals from a control device pass into each "Over DTP" port, are embedded with the DTP signal, and sent to the individual endpoints for control of remote sink or source devices.

General

Power supply................................. External
    Input: 100-240 VAC, 50-60 Hz
    Output: 12 VDC, 1.5 A, 18 watts

Power consumption

    Device .... 4.8 watts, 12 VDC

    Device and power supply .... 6.3 watts, 100-240 VAC, 50-60 Hz

> **NOTE:** Each transmitter or receiver can be powered either locally by an external power supply or remotely by receiver or transmitter on the other end of the twisted pair cable.

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
    Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, vented

Thermal dissipation

    Transmitter

        Device .... 15.3 BTU/hr

        Device and power supply... 20.1 BTU/hr

Mounting

    Rack mount............................. Yes, with included rack ears

Enclosure type .... Metal

Enclosure dimensions

    Faceplate .... Two 2.60" H* x 1.30" W x 0.20" D
    (66 mm H x 33 mm W x 6 mm D)
    (Fits the opening in a 2-gang decorator wallplate.)

    Device .... Two 2.70" H x 3.50" W x 1.90" D
    (69 mm H x 89 mm W x 48 mm D)

> **NOTE:** *Height is 4.2" (10.4 cm) including mounting tabs.

Product weight .... 0.4 lbs (0.2 kg)

Regulatory compliance................... AS/NZS, c-UL, C-tick, CE**, FCC Class A**, ICES, UL, VCCI
    Complies with the appropriate requirements of RoHS, WEEE

> **NOTE:** **CE and FCC testing is conducted with STP cable.

Warranty .... 3 years parts and labor

Everlast power supply warranty...... 7 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** Shipping dimensions and weights are available at **www.extron.com**.

4420-D3

Specifications

DTP T HWP 4K 231 D

TRUE 4K specifications

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:4:4	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1] .... 8 bits per color
Signal type[1] .... HDMI 1.4, HDCP 2.2
Maximum video data rate[1] .... 10.2 Gbps (3.4 Gbps per color)

> **NOTE:** [1]Subject to the maximum data rate limit. Use our calculator at **www.extron.com/4Kdatarate** to determine video parameters supported by this data rate.

Video

Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock .... 300 MHz
Resolution range .... Up to 2560x1600* @ 60 Hz or 4K (4096x2160) @ 30 Hz,
UHD (3840x2160) @ 30 Hz, 4K/UHD @ 60 Hz with 4:2:0 chroma subsampling
(*Reduced blanking)
Color bit depth .... 8, 10, or 12 bits — subject to the maximum data rate limit
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 1.4, HDCP 2.2, CEA-861E

Video input

Number/signal type .... 1 single link HDMI (or DVI-D*) input
Connectors .... 1 female HDMI type A

> **NOTE:** *Appropriate HDMI to DVI-D cables or adapters are required for DVI signal input/output.

Interconnection between transmitter and receiver

Connectors.................................... 1 female RJ-45 per unit for 1 cable connecting the transmitter and receiver

Termination standards..................... TIA/EIA T568B

DTP signal

    Signal transmission distance

        1080p @ 60 Hz.................. Up to 230' (70 m) using shielded twisted pair (STP) cable or XTP DTP 24 cable

        2560x1600 @ 60 Hz.......... Up to 130' (40 m) using STP cable or XTP DTP 24 cable

        4K/UHD @ 30 and 60 Hz... Up to 130' (40 m) using STP cable or XTP DTP 24 cable

    Cable requirements .... Solid conductor, 24 AWG or better

    Cable recommendations.......... 400 MHz bandwidth STP cable

> **NOTE:** Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

> **NOTE:** Output mode signaling:
> **DTP:** HDMI with embedded audio, analog audio, RS-232 and IR, and remote power
> **HDBaseT:** HDMI with embedded audio plus RS-232 and IR

Audio

Gain... Unbalanced output: 0 dB; balanced output: +6 dB

Frequency response .... 20 Hz to 20 kHz, ±0.5 dB

THD + Noise .... 0.03% @ 20 Hz to 20 kHz at maximum output

S/N... >90 dB at maximum output (15 dBu), balanced (unweighted)

Stereo channel separation.............. >80 dB @ 1 kHz to 20 kHz

Audio input

Number/signal type........................ 1 stereo (2 channel), unbalanced

> **NOTE:** Analog audio is not embedded onto the digital video signal. Analog audio and digital embedded audio are transmitted simultaneously and output on the receiver on two different connectors.

Connectors.................................... (1) 3.5 mm stereo jack, 2 channel; tip (L), ring (R), sleeve (ground)

Impedance..................................... >10k ohms, DC coupled

Nominal level................................. -10 dBV (316 mVrms)

Maximum level .... +7 dBV, unbalanced

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Communications — external device (RS-232/IR over TP)

Serial control port........................... RS-232 via (1) 3.5 mm, 5 pole captive screw connector
(connector is shared with IR control port)

> **NOTE:** Protocol is mirrored between the connected DTP 230 or DTP 330 endpoints and the "Over TP" ports on the DTP T HWP 4K 231 D. Signals from a control device pass into each "Over TP" port, are embedded with the DTP signal, and sent to the individual DTP 230 Tx or Rx endpoints for control of remote sink or source devices. The "Over TP" ports are simply pass-through connections to DTP endpoints.

Baud rate and protocol .... 300 to 115200 baud, 8 or 7 data bits, 1 or 2 stop bits, non-parity (default), even or odd parity

Serial control pin configurations...... Captive screw connectors: 1 = Tx, 2 = Rx, 3 = Gnd

IR control port............................... (1) 3.5 mm, captive screw connector, 5 pole (connector is shared with RS-232 control port)
TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz

IR control pin configuration .... 3 = Gnd, 4 = IR Tx, 5 = IR Rx

General

Power supply	External Input: 100-240 VAC, 50-60 Hz Output: 12 VDC, 1.5 A, 18 watts
Power consumption	
Device	4.6 watts, 12 VDC
Device and power supply	6.1 watts, 100-240 VAC, 50-60 Hz

> **NOTE:** Each transmitter or receiver can be powered either locally by an external power supply or remotely by receiver or transmitter on the other end of the twisted pair cable.

Temperature/humidity	Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling	Convection, no vents
Thermal dissipation	
Device	14.3 BTU/hr
Device and power supply	19.7 BTU/hr
Mounting	
Furniture or wall mount	Yes, with a 1-gang wall box or mud ring
Enclosure type	Metal
Enclosure dimensions	
Faceplate	2.6" H x 1.3" W x 0.3" D (6.6 cm H x 3.3 cm W x 0.6 cm D)
Device	2.8" H x 1.7" W x 1.9" D (7.1 cm H x 4.3 cm W x 4.8 cm D)

> **NOTES:**
> - Overall height is 4.2" (10.7 cm), including mounting tabs. Mounting holes are 3.2" (8.2 cm) apart on center.
> - Depth excludes connectors. Fits the opening in a 1 gang decorator wallplate)

Product weight	0.2 lbs (0.1 kg)
Regulatory compliance	AS/NZS, C-tick, c-UL, CE**, FCC Class A**, ICES, UL

> **NOTE:** **CE and FCC testing is conducted with STP cable.

Warranty	3 years parts and labor
Everlast power supply warranty	7 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** Shipping dimensions and weights are available at **www.extron.com**.

4455-D7

Specifications
DTP HDMI 230 4K Tx/Rx

TRUE 4K specification

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1] .... 8 bits per color
Signal type .... HDMI 1.4, HDCP 2.2
Max. video data rate .... 10.2 Gbps (3.4 Gbps per color)

NOTE: [1]Subject to the maximum data rate limit. Use our calculator (**http://www.extron.com/product/videotools.aspx**) to determine video parameters supported by this data rate.

NOTE: This product consists of a transmitter (DTP HDMI 4K 230 Tx) and a receiver (DTP HDMI 4K 230 Rx), sold separately, with twisted pair cables linking the transmitter and receiver.

NOTE: *Appropriate HDMI to DVI-D cables or adapters are required for DVI signal input/output.

Video
Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock...................... 300 MHz
Resolution range .... Up to 2560x1600* @ 60 Hz or
4K (4096x2160) @ 30 Hz, UHD (3840x2160) @ 30 Hz,
4K/UHD @ 60 Hz with 4:2:0 chroma subsampling
(* reduced blanking)
Color bit depth.............................. 8, 10, or 12 bits — subject to the maximum data rate limit
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 1.4, HDCP 2.2, CEA-861E

Video input — transmitter
Number/signal type....................... 1 single link HDMI (or DVI-D*)
Connectors................................... 1 female HDMI type A

Interconnection between transmitter and receiver
Connectors................................... 1 female RJ-45 per unit
Termination standard..................... TIA/EIA T568B

Signal transmission distance

    1080p @ 60 Hz .... Up to 230' (70 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable

    2560x1600 @ 60 Hz................ Up to 130' (40 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable

    4K/UHD @ 30Hz and 60 Hz .... Up to 130' (40 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable

Cable requirements........................ Solid conductor, 24 AWG or better

Cable recommendations .... 400 MHz bandwidth, STP (shielded twisted pair)

> **NOTE:** Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

Video output — receiver

Number/signal type........................ 1 single link HDMI (or DVI-D*)

Connectors.................................... 1 female HDMI type A

Audio

Gain... Unbalanced output: 0 dB; balanced output +6 dB

Frequency response .... 20 Hz to 20 kHz, ±0.5 dB

THD + Noise .... 0.03% @ 20 Hz to 20 kHz at maximum output

S/N.. >90 dB, at maximum output (15 dBu), balanced (unweighted)

Stereo channel separation.............. >80 dB @ 1 kHz to 20 kHz

Audio input

Number/signal type........................ 1 PC level stereo, unbalanced

> **NOTE:** Analog audio is not embedded onto the digital video signal. Embedded digital audio is not de-embedded from the digital video signal.

Connectors.................................... (1) 3.5 mm stereo jack, 2 channel; tip (L), ring (R), sleeve (ground)

Impedance..................................... >10k ohms, DC coupled

Nominal level................................. -10 dBV (316 mVrms)

Maximum level .... +7 dBV (unbalanced)

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type........................ 1 stereo (2 channel), balanced/unbalanced

Connectors.................................... (1) 3.5 mm captive screw connector, 5 pole

Impedance..................................... 50 ohms unbalanced, 100 ohms balanced

Gain error...................................... ±0.1 dB channel to channel

Maximum level (600 ohm) .... >+11 dBu, balanced

Control/remote — external device (pass-through, unidirectional or bidirectional)

Serial control port input/output

    Transmitter .... RS-232 via (1) 3.5 mm, 5 pole captive screw connector for RS-232 control (±5 V) (connector is shared with IR control port)

    Receiver .... 1 set of proprietary signals on a female RJ-45 jack

Serial control port output/input

    Transmitter .... 1 set of proprietary signals on a female RJ-45 jack

    Receiver .... RS-232 via a 3.5 mm, 3 pole captive screw connector

Baud rate and protocol .... 300 to 115200 baud, 8 or 7 data bits, 1 or 2 stop bits, non-parity (default), even or odd parity

Serial control pin configuration .... 1 = Tx, 2 = Rx, 3 = Gnd

IR control port .... (1) 3.5 mm, captive screw connector, 5 pole (connector is shared with RS-232 control port)
TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz

IR control pin configuration .... 3 = Gnd, 4 = IR Tx, 5 = IR Rx

General

Power supply .... External
Input: 100-240 VAC, 50-60 Hz
Output: 12 VDC, 1.5 A, 18 watts

Power consumption

    Transmitter

        Device .... 2.5 watts, 12 VDC

        Device and power supply... 3.4 watts, 100-240 VAC, 50-60 Hz

    Receiver

        Device .... 4.2 watts, 12 VDC

        Device and power supply... 5.8 watts, 100-240 VAC, 50-60 Hz

> **NOTE:** Each transmitter or receiver can be powered either locally by an external power supply or remotely by receiver or transmitter on the other end of the twisted pair cable.

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, no vents

Thermal dissipation

    Transmitter

        Device .... 7.4 BTU/hr

        Device and power supply... 10.4 BTU/hr

    Receiver

        Device .... 13.0 BTU/hr

        Device and power supply... 18.7 BTU/hr

Mounting

    Rack mount............................. Yes, with optional 1U high rack shelf

    Furniture mount....................... Yes, with optional under-desk mounting kit

Enclosure type .... Metal

Enclosure dimensions

    Transmitter .... 1.0" H x 4.3" W x 3.0" D (quarter rack wide)
(2.5 cm H x 10.9 cm W x 7.6 cm D)
(Depth excludes connectors.)

    Receiver .... 1.0" H x 4.3" W x 6.0" D (quarter rack wide)
(2.5 cm H x 10.9 cm W x 15.2 cm D)
(Depth excludes connectors.)

Product weight

    Transmitter .... 0.5 lbs (0.3 kg)

    Receiver .... 1.0 lb (0.5 kg)

Regulatory compliance................... CE, c-UL UL, CE**, C-tick, FCC Class A**, ICES, VCCI,
Complies with the appropriate requirements of RoHS, WEEE
UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release,
excluding the power supply.

NOTE: **CE and FCC testing is conducted with STP (shielded twisted pair) I/O cable.

Product warranty   3 years parts and labor

Everlast power supply warranty...... 7 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

NOTE: Shipping weights and dimensions are available at **www.extron.com**.

4482-101618-D18

Extron

Specifications

DTP HDMI 330 4K Tx/Rx

TRUE 4K specification

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1] .... 8 bits per color
Signal type .... HDMI 1.4, HDCP 2.2
Max. video data rate .... 10.2 Gbps (3.4 Gbps per color)

NOTE: [1]Subject to the maximum data rate limit. Use our calculator (**http://www.extron.com/product/videotools.aspx**) to determine video parameters supported by this data rate.

NOTE: This product consists of a transmitter (DTP HDMI 4K 330 Tx) and a receiver (DTP HDMI 4K 330 Rx), sold separately, with twisted pair cables linking the transmitter and receiver.

NOTE: *Appropriate HDMI to DVI-D cables or adapters are required for DVI signal input/output.

Video

Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock...................... 300 MHz
Resolution range .... Up to 2560x1600* @ 60 Hz or
4K (4096x2160) @ 30 Hz, UHD (3840x2160) @ 30 Hz,
4K/UHD @ 60 Hz with 4:2:0 chroma subsampling
(* reduced blanking)
Color bit depth .... 8, 10, or 12 bits — subject to the maximum data rate limit
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 1.4, HDCP 2.2, CEA-861E

Video input — transmitter

Number/signal type....................... 1 single link HDMI (or DVI-D*)
Connectors .... 1 female HDMI type A

Interconnection between transmitter and receiver

Connectors .... 1 female RJ-45 per unit
Termination standard..................... TIA/EIA T568B

Signal transmission distance

1080p @ 60 Hz	Up to 330' (100 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable
2560x1600 @ 60 Hz	Up to 330' (100 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable
4K/UHD @ 30Hz and 60 Hz	Up to 330' (100 m) using shielded twisted pair (STP) cable or XTP DTP 24 STP cable
Cable requirements	Solid conductor, 24 AWG or better
Cable recommendations	400 MHz bandwidth, STP (shielded twisted pair)

NOTE: Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance.

Video output — receiver

Number/signal type	1 single link HDMI (or DVI-D*)
Connectors	1 female HDMI type A

Audio

Gain	Unbalanced output: 0 dB; balanced output +6 dB
Frequency response	20 Hz to 20 kHz, ±0.5 dB
THD + Noise	0.03% @ 20 Hz to 20 kHz at maximum output
S/N	>90 dB, at maximum output (15 dBu), balanced (unweighted)
Stereo channel separation	>80 dB @ 1 kHz to 20 kHz

Audio input

Number/signal type	1 PC level stereo, unbalanced

NOTE: Analog audio is not embedded onto the digital video signal. Embedded digital audio is not de-embedded from the digital video signal.

Connectors	(1) 3.5 mm stereo jack, 2 channel; tip (L), ring (R), sleeve (ground)
Impedance	>10k ohms, DC coupled
Nominal level	-10 dBV (316 mVrms)
Maximum level	+6 dBV (unbalanced)

NOTE: 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type	1 stereo (2 channel), balanced/unbalanced
Connectors	(1) 3.5 mm captive screw connector, 5 pole
Impedance	50 ohms unbalanced, 100 ohms balanced
Gain error	±0.1 dB channel to channel
Maximum level (600 ohm)	>+11 dBu, balanced

Communications — external device (pass-through, unidirectional or bidirectional)

Serial control port input/output

    Transmitter .... RS-232 via (1) 3.5 mm, 5 pole captive screw connector for RS-232 control (±5 V) (connector is shared with IR control port)

    Receiver .... 1 set of proprietary signals on a female RJ-45 jack

Serial control port output/input

    Transmitter .... 1 set of proprietary signals on a female RJ-45 jack

    Receiver .... RS-232 via a 3.5 mm, 3 pole captive screw connector

Baud rate and protocol .... 300 to 115200 baud, 8 or 7 data bits, 1 or 2 stop bits, non-parity (default), even or odd parity

Serial control pin configuration .... 1 = Tx, 2 = Rx, 3 = Gnd

IR control port .... (1) 3.5 mm, captive screw connector, 5 pole (connector is shared with RS-232 control port)
TTL level (0 to 5 V) modulated infrared control from 30 kHz up to 60 kHz

IR control pin configuration .... 3 = Gnd, 4 = IR Tx, 5 = IR Rx

General

Power supply .... External
Input: 100-240 VAC, 50-60 Hz
Output: 12 VDC, 1.5 A, 18 watts

Power consumption

    Transmitter

        Device .... 2.5 watts, 12 VDC

        Device and power supply... 3.4 watts, 100-240 VAC, 50-60 Hz

    Receiver

        Device .... 4.2 watts, 12 VDC

        Device and power supply... 5.8 watts, 100-240 VAC, 50-60 Hz

> **NOTE:** Each transmitter or receiver can be powered either locally by an external power supply or remotely by receiver or transmitter on the other end of the twisted pair cable.

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, no vents

Thermal dissipation

    Transmitter

        Device .... 7.4 BTU/hr

        Device and power supply... 10.4 BTU/hr

    Receiver

        Device .... 13.0 BTU/hr

        Device and power supply... 18.7 BTU/hr

Mounting

    Rack mount .... Yes, with optional 1U high rack shelf

    Furniture mount .... Yes, with optional under-desk mounting kit

Enclosure type .... Metal

Enclosure dimensions

    Transmitter .... 1.0" H x 4.3" W x 3.0" D (quarter rack wide)
(2.5 cm H x 10.9 cm W x 7.6 cm D)
(Depth excludes connectors.)

    Receiver .... 1.0" H x 4.3" W x 6.0" D (quarter rack wide)
(2.5 cm H x 10.9 cm W x 15.2 cm D)
(Depth excludes connectors.)

Product weight

    Transmitter .... 0.5 lbs (0.3 kg)

    Receiver .... 1.0 lb (0.5 kg)

Regulatory compliance................... CE, c-UL UL, CE**, C-tick, FCC Class A**, ICES, VCCI,
Complies with the appropriate requirements of RoHS, WEEE
UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release, excluding the power supply.

NOTE: **CE and FCC testing is conducted with STP (shielded twisted pair) I/O cable.

Product warranty .... 3 years parts and labor
Everlast power supply warranty...... 7 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

NOTE: Shipping weights and dimensions are available at **www.extron.com**.

4483-101618-D17

Specifications

DXP HD 4K Series

TRUE 4K specifications

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1]............................. 8, 10, or 12 bits per color
Signal type..................................... HDMI 1.4, HDCP 1.4
Max. video data rate .... 10.2 Gbps (3.4 Gbps per color)

NOTE: [1]Subject to the maximum data rate limit. Use our calculator (**http://www.extron.com/product/ videotools.aspx**) to determine video parameters supported by this data rate.

Video
Routing
    DXP 88 HD 4K Series.............. 4 x 4 matrix
                                         8 x 4 matrix
                                         8 x 8 matrix
    DXP 1616 HD 4K Series.......... 16 x 8 matrix
                                         16 x 16 matrix
Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock...................... 300 MHz
Resolution range............................ Up to 2560x1600* @ 60 Hz or 4K (4096x2160) @ 30 Hz,
                                         UHD (3840x2160) @ 30 Hz
                                         (*2560x1600 with reduced blanking)
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 1.4, HDCP 1.4, CEA-861E

Video input
Number/signal type
    DXP 88 HD 4K Series.............. 4 or 8 HDMI digital video (HDCP compliant)
    DXP 1616 HD 4K Series.......... 16 HDMI digital video (HDCP compliant)
Connectors
    DXP 88 HD 4K Series.............. 4 or 8 female HDMI type A
    DXP 1616 HD 4K Series.......... 16 female HDMI type A

Video output

Number/signal type

    DXP 88 HD 4K Series.............. 4 or 8 HDMI digital video (HDCP compliant)

    DXP 1616 HD 4K Series.......... 8 or 16 HDMI digital video (HDCP compliant)

Connectors

    DXP 88 HD 4K Series.............. 4 or 8 female HDMI type A

    DXP 1616 HD 4K Series.......... 8 or 16 female HDMI type A

Audio

Supported formats — Pass through

    HDMI connectors .... LPCM up to 7.1/24-bit/192 kHz, Dolby Atmos, Dolby TrueHD, Dolby Digital Plus, Dolby Digital EX, Dolby Digital 5.1, Dolby Digital 2/0 Surround, Dolby Digital 2/0, DTS-HD Master Audio, DTS-HD, DTS ES Discrete 6.1, DTS ES Matrix 6.1, DTS Digital Surround 5.1, DTS 2 Channel

Supported formats — S/PDIF .... 2-channel PCM audio or encoded bitstream audio for Dolby® or DTS® multi-channel surround sound

Audio — individual audio groups (HDMI)

Gain.. Unbalanced output, -6 dB; balanced output, 0 dB

Frequency response .... 20 Hz to 20 kHz, ± 0.2 dB

THD + Noise

    DXP 88 HD 4K Series.............. 0.03% @ 1 kHz at nominal level

    DXP 1616 HD 4K Series.......... 0.01% @ 1 kHz at nominal level

S/N

    DXP 88 HD 4K Series.............. >90 dB at maximum output (unweighted)

    DXP 1616 HD 4K Series.......... >105 dB at maximum balanced output (unweighted)

Crosstalk

    DXP 88 HD 4K Series.............. <-80 dB @ 20 Hz to 20 kHz, fully loaded

    DXP 1616 HD 4K Series.......... <-90 dB @ 20 Hz to 20 kHz, fully loaded

Stereo channel separation............. >80dB @ 20 Hz to 20 kHz

> **NOTE:** 0 dBu = 0.775 Vrms, 0 dBV = 1 Vrms, 0 dBV ≈ 2 dBu

Audio output

Number/signal type

    DXP 88 HD 4K Series.............. 4 or 8 HDMI, embedded
        2 stereo, balanced or unbalanced
        2 S/PDIF

    DXP 1616 HD 4K Series.......... 8 or 16 HDMI, embedded
        4 stereo, balanced or unbalanced
        4 S/PDIF

Connectors

    DXP 88 HD 4K Series.............. 4 or 8 female HDMI
        (2) 3.5 mm captive screw, 5 pole, for stereo
        2 female RCA, for SPDIF

    DXP 1616 HD 4K Series.......... 8 or 16 female HDMI
        (4) 3.5 mm captive screw, 5 pole, for stereo
        4 female RCA for S/PDIF

Impedance

    Stereo audio........................... 50 ohms unbalanced, 100 ohms balanced

    S/PDIF.................................... 75 ohms

Gain error...................................... ±0.1 dB channel to channel

D/A conversion .... 24-bit, 192 kHz

Maximum level (Hi-Z)..................... >+21 dBu, balanced, or +15 dBu, unbalanced

Output volume range .... 0 to -100 dB in 1 dB steps

Communications

Serial control port........................... 1 bidirectional RS-232

Serial control connector .... (1) 3.5 mm captive screw, 3 pole (rear panel)

Baud rate and protocol .... 300 to 115200 baud; 7 or 8 data bits; 1 or 2 stop bits; no parity, even, odd, mark, or space parity
Defaults: 9600 baud, 8 data bits, 1 stop bit, no parity

Serial control pin configuration .... 1 = Tx, 2 = Rx, 3 = Gnd

USB control port........................... 1 front panel female USB mini-B

USB standards .... USB 2.0, low speed

Ethernet control port..................... 1 female RJ-45 connector

Ethernet data rate .... 10/100Base-T, half/full duplex with autodetect

Ethernet protocol .... DHCP, DNS, HTTP, HTTPS, ICMP, NTP, SFTP, SMTP, SNMP, SSH, TCP/IP, UDP/IP, ARP, Telnet

Ethernet default settings .... Link speed and duplex level: autodetected
IP address: 192.168.254.254
Subnet mask: 255.255.0.0
Gateway: 0.0.0.0
DHCP: Off

Web server .... Up to 200 simultaneous sessions
40.0 MB nonvolatile user memory

Program control .... Extron control/configuration program for Windows®
Extron Simple Instruction Set (SIS™)
Microsoft® Internet Explorer®, Telnet

General

Power supply................................. Internal
Input: 100-240 VAC, 50-60 Hz

Power consumption (full load)

DXP 88 HD 4K Series.............. 41 watts

DXP 1616 HD 4K Series.......... 85 watts

Power consumption (power save)

DXP 88 HD 4K Series.............. 25.5 watts

DXP 1616 HD 4K Series.......... 63.5 watts

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Fans, air flows from left to right (as viewed from front panel)

Thermal dissipation, full load

DXP 88 HD 4K Series

115 VAC, 60 Hz................. 130 BTU/hr

240 VAC, 50 Hz................. 128 BTU/hr

DXP 1616 HD 4K Series

115 VAC, 60 Hz................. 266 BTU/hr

240 VAC, 50 Hz................. 273 BTU/hr

Mounting

Rack mount............................. Yes, with included brackets

Enclosure type .... Metal

Enclosure dimensions

DXP 88 HD 4K Series.............. 1.75" H x 17.4" W x 9.5" D (1U high, full rack wide)
(4.4 cm H x 43.2 cm W x 24.1 cm D)

DXP 1616 HD 4K Series.......... 3.5" H x 17.4" W x 9.5 D (2U high, full rack wide)
(8.9 cm H x 43.2 cm W x 24.1 cm D)
(Depth excludes connectors and knobs. Width excludes rack ears.)

Product weight

DXP 88 HD 4K Series.............. 5.2 lbs (2.4 kg)

DXP 1616 HD 4K Series.......... 8.1 lbs (3.6 kg)

Vibration .... ISTA 1A in carton (International Safe Transit Association)
Regulatory compliance
    Safety...................................... CE, c-UL, UL
    Compliances .... CE, C-Tick, FCC Class A, ICES, VCCI
    Environmental......................... Complies with the appropriate requirements of RoHS, WEEE.
Warranty .... 3 years parts and labor

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Shipping weights and dimensions are available at **www.extron.com**.

CMS-090617-D7

Specifications
SW 2/4 HD 4K

TRUE 4K specification

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1]............................. 8 bits per color
Signal type.................................... HDMI 1.4, HDCP 1.4
Max. video data rate .... 10.2 Gbps (3.4 Gbps per color)

NOTE: [1]Subject to the maximum data rate limit. Use our calculator at **www.extron.com/4Kdatarate** to determine video parameters supported by this data rate.

Video

Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock...................... 300 MHz (600 MHz for 4K rates with 4:2:0 chroma subsampling)
Resolution...................................... Up to 1920 x 1200 or 1080p @ 60 Hz, 12-bit color
4K (4096x2160) @ 30 Hz, UHD (3840x2160) @ 30 Hz
4K/UHD @ 60 Hz with 4:2:0 chroma subsampling
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 1.4, HDCP 1.4

NOTE: The SW HD 4K Series switchers support TMDS data rates up to 10.2 Gbps, Deep Color up to 12-bit, 3D**, HD lossless audio, and other HDMI specification features.

**Extron strongly recommends compatibility testing while designing and before installing any 3D system. There are several unique 3D formats in use by source devices and display manufacturers. The level of 3D product support is governed by pixel clock, signal format, and communication between source and sink devices. Please contact an Extron Application Engineer for more information.

Video input

Number/signal type........................ 2 or 4 (depending on model) single link HDMI (or DVI-D*)
Connectors.................................... 2 or 4 female HDMI

Video output

Number/signal type........................ 1 single link HDMI (or DVI-D*)
Connectors.................................... 1 female HDMI

NOTE: *Appropriate HDMI to DVI-D cables or adapters are required for DVI signal input/output.

Communication — Switcher

Serial control port	1 RS-232, 3.5 mm, 3 pole captive screw connector
Pin configuration	1 = Tx, 2 = Rx, 3 = GND
Baud rate and protocol	9600 baud, 8 data bits, 1 stop bit, no parity
Auto-input switching	(1) 3.5 mm, 2 pole captive screw connector
Pin configuration	Pins 1 and 2 of captive screw connector shorted together enable auto-input switching
Contact closure	
SW2 HD 4K	(2) 3.5 mm captive screw, 3 pole (shared with Tally output)
SW4 HD 4K	(4) 3.5 mm captive screw, 3 pole (shared with Tally output)
Tally output	
SW2 HD 4K	(2) 3.5 mm captive screw, 3 pole (shared with Contact closure)
SW4 HD 4K	(4) 3.5 mm captive screw, 3 pole (shared with Contact closure)
Tally output power	(1) 3.5 mm captive screw, 3 pole for +5 VDC, 0.2 A
IR controller module	IR 102 remote control (optional) 30' maximum, 40 degrees off axis
Program control	Extron Simple Instruction Set™ (SIS™)

General

Power supply	External Input: 100-240 VAC, 50-60 Hz Output: 12 VDC, 1.5 A, 18 watts
Power consumption	
Device	6 watts, 12 VDC
Device and power supply	8 watts, 12 VDC
Temperature/humidity	Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Cooling	Convection, no vents
Thermal dissipation	
Device	19.8 BTU/hr
Device and power supply	24.4 BTU/hr
Mounting	
Rack mount	Yes, with optional 1U rack shelf
Furniture mount	Yes, with optional under-desk mounting kit or through-desk mounting kit
Enclosure type	Metal
Enclosure dimensions	1.75" H x 8.75" W x 3.0" D (1U high, half rack wide) (4.4 cm H x 22.2 cm W x 7.6 cm D) (Depth excludes connectors.)
Product weight	0.5 lb (0.3 kg)
Regulatory compliance	CE, c-UL KC-mark, UL, CE**, C-tick, FCC Class A**, ICES, VCCI, Complies with the appropriate requirements of RoHS, WEEE
Product warranty	3 years parts and labor
Everlast power supply warranty	7 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** Shipping weights and dimensions are available at **www.extron.com**.

4389-091218-D4

Specifications
SW HD 4K PLUS Series

TRUE 4K specification — HDMI SW variant

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 60 Hz	4:4:4	8 bit
3840 x 2160 at 60 Hz		
4096 x 2160 at 30 Hz		12 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1] .... 8, 10, or 12 bits per color
Signal type .... HDMI 2.0b, HDCP 2.2
Max. video data rate .... 18 Gbps (6 Gbps per color)

> **NOTE:** [1]Subject to the maximum data rate limit. Use our calculator at **www.extron.com/4Kdatarate** to determine video parameters supported by this data rate.

Video

Maximum data rate .... 18 Gbps (6 Gbps per color)
Maximum pixel clock .... 600 MHz
Resolution .... Up to 1920 x 1200 or 1080p @ 60Hz, 12-bit color
4K (4096x2160) @ 60 Hz (4:4:4 color space, 8 bit color) (Max for HDMI variant only)
UHD (3840 x 2160) @ 60Hz with 4:4:4 color space, 8-bit color (Max for DTP variant only)
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0, HDMI 2.0b, HDMI 1.4, HDCP 1.4, HDCP 2.2, CEA-861E

> **NOTE:** The SW HD 4K PLUS Series switchers support TMDS data rates up to 18 Gbps, HDR, up to 12-bit deep color, 3D**, HD lossless audio, and other HDMI specification features.
>
> **Extron strongly recommends compatibility testing while designing and before installing any 3D system. There are several unique 3D formats in use by source devices and display manufacturers. The 3D support in this product is limited to signals operating within 164 MHz pixel clock and requires format and EDID compatibility between source and sink devices. Please contact an Extron Application Engineer for more information.

Video input

Number/signal type .... 2, 4, 6, or 8 (depending on model) single link HDMI (or DVI-D*)
Connectors .... 2, 4, 6, or 8 female HDMI type A

Video output

Number/signal type......................... 1 single link HDMI (or DVI-D*)

Connectors.................................... 1 female HDMI type A

> **NOTE:** *Appropriate HDMI to DVI-D cables or adapters are required for DVI signal input/output.

Communication

Serial control port........................... 1 RS-232, 3.5 mm, 3 pole captive screw connector

    Pin configuration..................... 1 = Tx, 2 = Rx, 3 = GND

    Baud rate and protocol............ 9600 baud, 8 data bits, 1 stop bit, no parity

USB control port............................ 1 female mini USB B on front panel

USB standards .... USB 2.0, low speed

Ethernet data rate .... 10/100Base-T, half/full duplex, with auto detect

Ethernet protocol .... ARP, ICMP (ping), IP, TCP, DHCP, HTTP, SMTP, Telnet

Program control............................. Extron control/configuration program for Windows®
Extron Simple Instruction Set™ (SIS™)
Microsoft® Internet Explorer®
Telnet

Contact closure/tally output

    SW2 HD 4K PLUS................... (1) 3.5 mm captive screw, 5 pole (C,T,C,T,+V)

    SW4 HD 4K PLUS................... (1) 3.5 mm captive screw, 5 pole (C,T,C,T,+V)
(1) 3.5 mm captive screw, 4 pole (C,T,C,T)

    SW6 HD 4K PLUS................... (6) 3.5 mm captive screw, 3 pole (C,G,T)
(1) 3.5 mm captive screw, 3 pole (+V)

    SW8 HD 4K PLUS................... (8) 3.5 mm captive screw, 3 pole (C,G,T)
(1) 3.5 mm captive screw, 3 pole (+V)

    C = contact, G = ground, T = tally, +V = +5 V

General

Power supply

    SW2 and SW4 HD 4K PLUS ... External
Input: 100-240 VAC, 50-60 Hz
Output: 12 VDC, 1.5 A, 18 watts

    SW6 and SW8 HD 4K PLUS ... Internal
Input: 100-240 VAC, 50-60 Hz

Power consumption

    SW2 and SW4 HD 4K PLUS

        Device .... 3.9 watts, 12 VDC

        Device and power supply... 5.5 watts, 12 VDC

    SW6 and SW8 HD 4K PLUS ... 12.1 watts

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, no vents

Thermal dissipation

    SW2 and SW4 HD 4K PLUS

        Device .... 12.2 BTU/hr

        Device and power supply... 17.8 BTU/hr

    SW6 and SW8 HD 4K PLUS ... 40.4 BTU/hr

Mounting

    SW2 and SW4 HD 4K PLUS

        Rack mount....................... Yes, with optional 1U rack shelf

        Furniture mount .... Yes, with optional under-desk mounting kit or through-desk mounting kit

    SW6 and SW8 HD 4K PLUS

        Rack mount....................... Yes, with supplied mounting brackets

Enclosure type .... Metal

Enclosure dimensions

    SW2 and SW4 HD 4K PLUS ... 1.75" H x 8.75" W x 6.0" D (1U high, half rack wide)
                                          (4.4 cm H x 22.2 cm W x 15.2 cm D)
                                          (Depth excludes connectors.)

    SW6 and SW8 HD 4K PLUS ... 1.75" H x 17.5" W x 8.5" D (1U high, full rack wide)
                                          (4.4 cm H x 44.4 cm W x 21.6 cm D)
                                          (Depth excludes connectors.)

Product weight

    SW2 and SW4 HD 4K PLUS ... 1.2 lbs (0.5 kg)
    SW6 and SW8 HD 4K PLUS ... 2.5 lbs (1.1 kg)

Regulatory compliance.................. CE, c-UL, UL, PSE, RoHs, and WEEE

Product warranty .... 3 years parts and labor

Everlast power supply warranty...... 7 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

NOTE: Shipping weights and dimensions are available at **www.extron.com**.

3888-D1

TP-573

HDMI HDCP 2.2 Transmitter with RS-232 & IR over PoC Long-Reach DGKat

| HDMI | HDCP Compliant | DGKat | Kramer Core | HDCP 2.2 Compatible

The TP-573 is a DGKat™ twisted pair transmitter for HDMI, bidirectional RS-232 and infrared signals. The TP-573 converts the input signals to a twisted pair signal and the TP-574 converts it back to HDMI, RS-232 and infrared signals

FEATURES

Max. Data Rate - 4.95Gbps (1.65Gbps per graphic channel)

HDTV Compatible

HDCP Compliant

DGKat™ Signal Integration - Kramer's unique technology for converting TMDS as well as control and communication to signals that run over twisted pair cables

HDMI Support - x.v.Color™, Lip Sync, HDMI Uncompressed Audio Channels, Dolby TrueHD, DTS-HD

3D Pass-Through

EDID PassThru - Passes EDID signals between the source and display

Bidirectional RS-232 & IR Interface - 38400 max baud rate

System Range - Up to 90m (295ft) at 1080i @60hz or up to 70m (230ft) at 1080p @ 60hz when using Kramer DGKat cables. Note: Transmission range depends on the signal resolution, graphics card and display used. If using third-party shielded CAT cables, both ends of the shield must be soldered to the connectors for the products to function properly

Power Connect System™ - A single connection to the transmitter powers both units

**Compact DigiTOOLS®** - 3 units can be rack mounted side-by-side in a 1U rack space with the recommended rack adapter

TECHNICAL SPECIFICATIONS

INPUTS:	1 HDMI connector, 1 bidirectional IR port on a 3.5mm mini jack, 1 bidirectional RS−232 port on a 9−pin D−sub connector
OUTPUTS:	1 CAT 5 OUT on an RJ−45 connector
BANDWIDTH:	4.95Gbps (1.65Gbps per graphic channel)
COMPLIANCE WITH HDMI STANDARD:	Supports HDMI and HDCP
POWER CONSUMPTION:	12V DC, 510mA
INCLUDED ACCESSORIES:	12V DC power supply
PRODUCT DIMENSION:	12.00cm x 7.15cm x 2.44cm (4.72" x 2.81" x 0.96") W, D, H
PRODUCT WEIGHT:	0.2kg (0.4lbs) approx
SHIPPING DIMENSION:	15.70cm x 12.00cm x 8.70cm (6.18" x 4.72" x 3.43") W, D, H
SHIPPING WEIGHT:	0.5kg (1.1lbs) approx
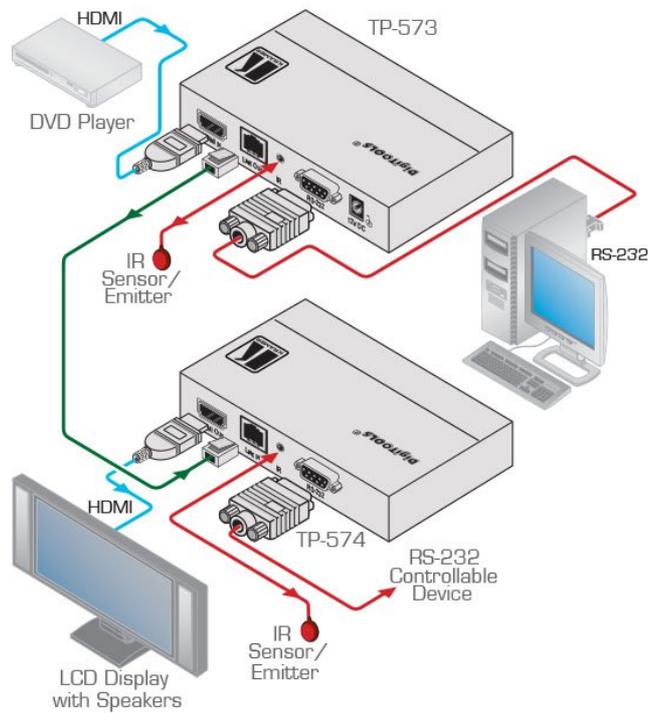
VM-1H4C
1:4 HDMI with RS-232 & IR to PoC
Long-reach DGKat DA

| HDMI | HDCP Compliant | DGKat

The VM-1H4C is a high-quality 1:4 twisted pair distribution amplifier for HDMI signal to PoC Long-reach DGKat signals. The unit receives serial commands and IR signals transparently via the RS-232 port and the TP link. It reclocks and equalizes the input signal and distributes it to four DGKat TP outputs

FEATURES

Max. Data Rate - 4.95Gbps (1.65Gbps per graphic channel)

HDTV Compatible

HDCP Compliant

DGKat™ Signal Integration - Kramer's unique technology for converting TMDS as well as control and communication to signals that run over twisted pair cables

EDID Pass–through - Pass–through algorithm ensures Plug and Play operation for HDMI source and display systems

HDMI Support - x.v.Color™ and uncompressed audio channels, Dolby TrueHD, DTS-HD

3D Pass-Through

Kramer Equalization & re-Klocking™ Technology - Rebuilds the digital signal to travel longer distances

System Range - Up to 90m (295ft) at 1080i @60hz or up to 70m (230ft) at 1080p @ 60hz when using Kramer DGKat cables. Note: Transmission range depends on the signal resolution, graphics card and display used. If using third–party shielded CAT cables, both ends of the shield must be soldered to the connectors for the products to function properly

Power Connect - The VM-1H4C provides power to the twisted pair receivers when they are within 270ft (90m) of the transmitter

Active Input & Output LED Indicators

**Serial Command Handling** - Receives serial commands transparently via the RS-232 port and the TP link

Desktop Size - Compact size. 2 units can be rack mounted side-by-side in a 1U rack space with the recommended rack adapter

TECHNICAL SPECIFICATIONS

INPUTS:	1 HDMI connector, 1 IR on a 3.5mm mini jack, 1 RS-232 on a 9-pin D-sub connector
OUTPUTS:	4 twisted pair on RJ-45 connectors
MAX. DATA RATE:	Supports up to 4.95Gbps (1.65Gbps per graphic channel)
COMPLIANCE WITH HDMI STANDARD:	Supports HDMI and HDCP
INDICATOR LEDs:	Power, INPUT, OUTPUT 1, 2, 3 and 4
POWER CONSUMPTION:	12V DC, 2A
OPERATING TEMPERATURE:	0° to +40°C (32° to 104°F)
STORAGE TEMPERATURE:	−40° to +70°C (−40° to 158°F)
HUMIDITY:	10% to 90%, RHL non-condensing
INCLUDED ACCESSORIES:	Power supply
PRODUCT DIMENSION:	21.46cm x 16.30cm x 4.36cm (8.45" x 6.42" x 1.72") W, D, H
PRODUCT WEIGHT:	0.0kg (0.0lbs) approx
SHIPPING DIMENSION:	35.10cm x 21.20cm x 7.20cm (13.82" x 8.35" x 2.83") W, D, H
SHIPPING WEIGHT:	1.9kg (4.2lbs) approx
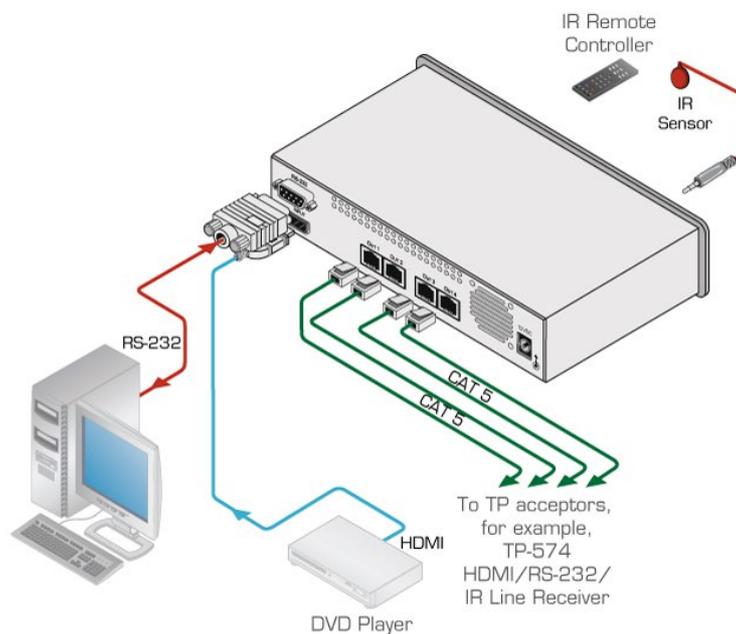
VM-114H2C

2x1:2+2 HDMI & DGKat with RS-232 & IR to HDMI & PoC Long-reach DGKat switchable DA

| HDMI | HDCP Compliant | DGKat | Kramer Core

The VM-114H2C is a high-performance PoC switcher and distribution amplifier for HDMI and DGKat™ twisted pair signals. It reclocks and equalizes one of two selectable input signals (HDMI or DGKat twisted pair) and distributes it to two DGKat twisted pair and two HDMI outputs

FEATURES

Max. Data Rate - 6.75Gbps (2.25Gbps per graphic channel) (HDMI), 4.95Gbps (1.65Gbps per graphic channel) (DGKat)

HDTV Compatible

HDCP Compliant

DGKat™ Signal Integration - Kramer's unique technology for converting TMDS as well as control and communication to signals that run over twisted pair cables

EDID Pass–through - Pass–through algorithm ensures Plug and Play operation for HDMI source and display systems

HDMI Support - x.v.Color™, HDMI Uncompressed Audio Channels, Dolby TrueHD, DTS-HD (only on the TP inputs and outputs)

3D Pass-Through

Kramer Equalization & re-Klocking™ Technology - Rebuilds the digital signal to travel longer distances

System Range - Up to 90m (295ft) at 1080i @60hz or up to 70m (230ft) at 1080p @ 60hz when using Kramer DGKat cables. Note: Transmission range depends on the signal resolution, graphics card and display used. If using third–party shielded CAT cables, both ends of the shield must be soldered to the connectors for the products to function properly

Active Input & Output LED Indicators

Compatible Transmitters/Receivers - Transmitters: PT-571, TP-573, TP-577; Receivers: PT-572, TP-575, TP-576, TP-577

Power Connect™ System - A single connection to the transmitter or the receiver powers both units when the devices are within 90m (270ft) of each other

Flexible Control Options - Front panel buttons, RS-232, infrared control sensor, remote included

Desktop Size - Compact size. 2 units can be rack mounted side-by-side in a 1U rack space with the recommended rack adapter

TECHNICAL SPECIFICATIONS

INPUTS:	1 HDMI connector, 1 DGKat twisted pair on an RJ−45 connector
OUTPUTS:	2 HDMI connectors, 2 DGKat twisted pairs on RJ−45 connectors
MAX. DATA RATE::	6.75Gbps (2.25Gbps per graphic channel) (HDMI), 4.95Gbps (1.65Gbps per graphic channel) (DGKat)
COMPLIANCE WITH HDMI STANDARD:	Supports HDMI and HDCP
CONTROLS:	Input select button, EDID select button, panel lock button, RS−232, local and remote IR controls
INDICATOR LEDs:	IR communication, power, IN 1(HDMI), IN 2 (CAT 5), OUTPUT 1, 2, 3 and 4
POWER CONSUMPTION:	12V DC, 910mA
INCLUDED ACCESSORIES:	Power supply, bracket installation kit, RC−IR3 infrared remote control transmitter
PRODUCT DIMENSION:	21.46cm x 16.30cm x 4.36cm (8.45" x 6.42" x 1.72") W, D, H
PRODUCT WEIGHT:	0.9kg (2.0lbs) approx
SHIPPING DIMENSION:	35.10cm x 21.20cm x 7.20cm (13.82" x 8.35" x 2.83") W, D, H
SHIPPING WEIGHT:	1.9kg (4.2lbs) approx
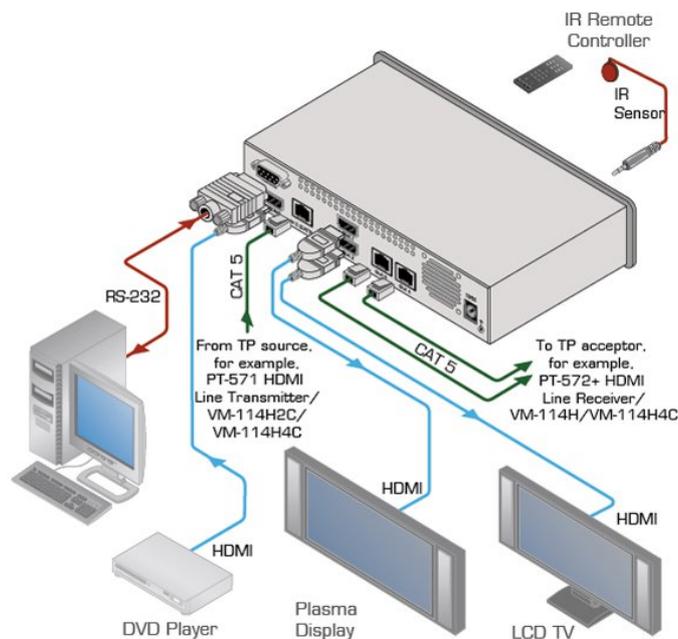
Specifications
DA HD 4K Series

TRUE 4K specification

Max. 4K Capabilities		
Resolution and Refresh Rate	**Chroma Sampling**	**Max. Bit Depth per Color**
4096 x 2160 at 30 Hz	4:4:4	8 bit
3840 x 2160 at 30 Hz		
4096 x 2160 at 60 Hz	4:2:0	
3840 x 2160 at 60 Hz		

Frame rate[1] .... 24, 25, 30, 50, or 60 fps
Chroma sampling[1] .... 4:4:4, 4:2:2, or 4:2:0
Color bit depth[1]............................. 8 bits per color
Signal type..................................... HDMI 1.4, HDCP 1.4
Max. video data rate .... 10.2 Gbps (3.4 Gbps per color)

> **NOTE:** [1]Subject to the maximum data rate limit. Use our calculator (**http://www.extron.com/4Kdatarate**) to determine video parameters supported by this data rate.

Video

Maximum data rate .... 10.2 Gbps (3.4 Gbps per color)
Maximum pixel clock...................... 300 MHz
Resolution range............................ Up to 1920x1200 or 1080p @ 60 Hz, 12-bit color,
4K (4096x2160) @ 30 Hz, UHD (3840x2160) @ 30 Hz
Formats .... RGB and YCbCr digital video
Standards .... DVI 1.0*, HDMI 1.4, HDCP 1.4

> **NOTE:** Extron strongly recommends compatibility testing while designing, and before installing any 3D system. There are several unique 3D formats in use by source devices and display manufacturers. The level of 3D product support is governed by pixel clock, signal format, and communication between source and sink devices. Please contact an Extron Application Engineer for more information.

> **NOTE:** *Appropriate DVI-D to HDMI cables or adapters are required for DVI signal input/output.

Video input

Number/signal type......................... 1 single link HDMI (or DVI-D*)
Connectors.................................... 1 female 19-pin HDMI type A

Video output

Number/signal type
    DA2 HD 4K .... 2 single link HDMI (or DVI-D*)
    DA4 HD 4K .... 4 single link HDMI (or DVI-D*)
    DA6 HD 4K .... 6 single link HDMI (or DVI-D*)
Connectors
    DA2 HD 4K .... 2 female 19-pin HDMI type A
    DA4 HD 4K .... 4 female 19-pin HDMI type A
    DA6 HD 4K .... 6 female 19-pin HDMI type A

Control/communications

Serial control port............................	RS-232, 3.5 mm, 3-pole captive screw connector
Baud rate and protocol	9600 baud, 8 data bits, 1 stop bit, non-parity
Serial control pin configuration	1 = Tx, 2 = Rx, 3 = GND
USB control port	1 front panel, female, mini USB B
USB standards	USB 2.0, low speed
Program control	Extron Simple Instruction Set (SIS™)

General

Power
> DA2 HD 4K .... External
> Input: 100-240 VAC, 50-60 Hz
> Output: 12 VDC, 0.5 A 6 watts
>
> DA4 HD 4K and DA6 HD 4K ... Internal
> Input: 100-240 VAC, 50-60 Hz

Power consumption
> DA2 HD 4K
>> Device .... 3.3 watts
>> Device and power supply... 4.3 watts
>
> DA4 HD 4K .... 8 watts
> DA6 HD 4K .... 10 watts

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Cooling .... Convection, vents on top

Thermal dissipation
> DA2 HD 4K
>> Device .... 8.9 BTU/hr
>> Device and power supply... 12.4 BTU/hr
>
> DA4 HD 4K .... 23.5 BTU/hr
> DA6 HD 4K .... 28.2 BTU/hr

Mounting
> Rack mount............................ Yes, with optional rack shelf kit

Enclosure type .... Metal

Enclosure dimensions
> DA2 HD 4K .... 1.0" H x 4.3" W x 3.0" D (one quarter rack wide)
> 2.5 cm H x 10.9 cm W x 7.6 cm D (depth excludes connectors)
>
> DA4 HD 4K and DA6 HD 4K ... 1.75" H x 8.75" W x 6.0" D (1U high, half rack wide)
> 4.4 cm H x 22.2 cm W x 15.2 cm D (Depth excludes connectors)

Product weight
> DA2 HD 4K .... 0.35 lbs (0.2 kg)
> DA4 HD 4K and DA6 HD 4K ... 1.6 lbs (0.7 kg)

Regulatory compliance................... CE, c-UL, UL, C-Tick, FCC Class A, ICES, VCCI, AS/NZS, RoHS, WEEE
Product warranty .... 3 years parts and labor
Everlast power supply warranty...... 7 years parts and labor

> **NOTE:** All nominal levels are at ±10%.

> **NOTE:** Specifications are subject to change without notice.

> **NOTE:** Shipping weights and dimensions are available at www.extron.com.

4430-D5

KRAMER

TP-574

HDMI HDCP 2.2 Receiver with RS-232 & IR over PoC Long-Reach DGKat

| HDMI | HDCP Compliant | DGKat | Kramer Core | HDCP 2.2 Compatible

The TP-574 is a DGKat™ twisted pair receiver for HDMI, bidirectional RS-232 and infrared signals. The TP-573 converts the input signals to a twisted pair signal and the TP-574 converts it back to HDMI, RS-232 and infrared signals

FEATURES

Max. Data Rate - 4.95Gbps (1.65Gbps per graphic channel)

HDTV Compatible

HDCP Compliant

HDMI Support - x.v.Color™, Lip Sync, HDMI Uncompressed Audio Channels, Dolby TrueHD, DTS-HD

3D Pass-Through

EDID PassThru - Passes EDID signals between the source and display

Bidirectional RS-232 & IR Interface - 38400 max baud rate

System Range - Up to 90m (295ft) at 1080i @60hz or up to 70m (230ft) at 1080p @ 60hz when using Kramer DGKat cables. Note: Transmission range depends on the signal resolution, graphics card and display used. If using third-party shielded CAT cables, both ends of the shield must be soldered to the connectors for the products to function properly

DGKat™ Signal Integration - Kramer's unique technology for converting TMDS as well as control and communication to signals that run over twisted pair cables

Power Connect System™ - A single connection to the transmitter powers both units

Compact DigiTOOLS® - 3 units can be rack mounted side-by-side in a 1U rack space with the recommended rack adapter

TECHNICAL SPECIFICATIONS

INPUTS:	1 CAT 5 IN on an RJ−45 connector
OUTPUTS:	1 HDMI connector, 1 bidirectional IR port on a 3.5mm mini jack, 1 bidirectional RS−232 port on a 9−pin D−sub connector
BANDWIDTH:	4.95Gbps (1.65Gbps per graphic channel)
COMPLIANCE WITH HDMI STANDARD:	Supports HDMI and HDCP
POWER CONSUMPTION:	12V DC from TP−573
PRODUCT DIMENSION:	12.00cm x 7.15cm x 2.44cm (4.72" x 2.81" x 0.96") W, D, H
PRODUCT WEIGHT:	0.2kg (0.4lbs) approx
SHIPPING DIMENSION:	15.70cm x 12.00cm x 8.70cm (6.18" x 4.72" x 3.43") W, D, H
SHIPPING WEIGHT:	0.4kg (0.8lbs) approx
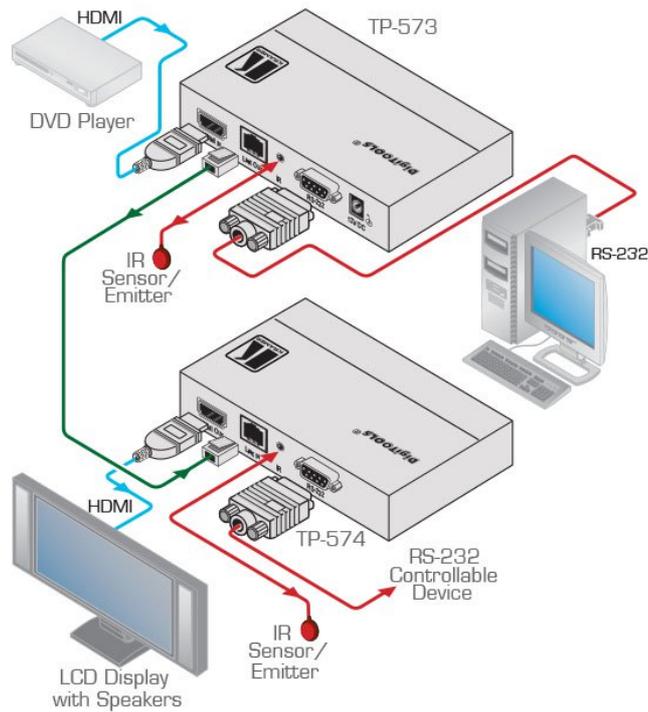
Document Camera

Capture

QPC80H2

Science Cam

The QPC80 H2 is a high definition camera with HDMI pass-through, SD image capture, RS232, and microscope adapter. Bring the finest details to life and play-back recordings instantly to save time and resources during your presentation.

QD3900H1

Voted #1 Doc Cam

The QD3900 H1 is a powerful flatbed document camera with an A4 backlit stage and two evenly distributed LED lamps. Experience easy presenter control with RS232 compatibility and presentation tools. The QD3900 H1 also has new built-in annotation without the use of software!

QPC35

Caterpillar Cam

QOMO's classic QPC35 USB camera features a long wide-reaching neck and a sturdy clamp-on base. Plug-and-Play and simple to use one-click capture function makes the QPC35 the choice camera for a hands on classroom.

Model	QPC35	QPC80H2	QD3900H1
Image Sensor	1/4" CMOS	Omnivision 1/3" CMOS	1/4" CMOS
Sensor (MP)	5	5	5
Autofocus	✔	✔	✔
Auto White Balance	✔	✔	✔
Image Split	✔	✔	✔
Image Title	✔	✔	✔
Image Freeze	✔	✔	✔
Digital Rotate	90°, 180°, 270°	90°, 180°, 270°	90°, 180°, 270°
Optical zoom	Dynamic	6x	10x
Digital zoom	Dynamic	10x	12x
Resolution	XGA：640*480 SXGA：800*600 WXGA: 1024*768 1080P：1920*1080 720P：2048*1536 1944*2592	XGA：1024*768 SXGA：1280*1024 WXGA：1366*768 1080P：1920*1080 720P：1280*720	XGA：1024*768 SXGA：1280*1024 WXGA：1366*768 1080P：1920*1080 720P：1280*720
Shooting Area	16.53" x 11.69"	16.53" x 11.69"	14.96" x 11.22"
Frame Rate	1080P@30fps	1080P@30fps	1920x1080@30fps
Video and Audio Record	✔	✔	✔
Microphone	✔	✔	✔
RS232	✗	✔	✔
Lighting	Built-in Ultra Bright LEDs	Built-in Ultra Bright LEDs	Arm and Backlight LEDs
Operating System	Windows 7/8.1/10	Windows 7/8.1/10	Windows 7/8.1/10
AV Inputs	✗	HDMI, VGA, 3.5MM	HDMI, VGA(2), 3.5MM(2),
AV Outputs	USB	HDMI, VGA, 3.5MM Composite	HDMI, VGA, 3.5MM, VGA
Memory	N/A	SD/Internal	SD/Internal
Power	DC 5V	DC 12V	DC 12V
Power Consumption	1.5W	10W	12W
Warranty	2 years	2 years	2 years
Net Weight	4.6 lbs	3.7 lbs	11.02 lbs
Dimensions Folded (L x W x H)	21.06" x 2.25" x 15.5"	7.87" x 6.25" x 13"	20.07" x 16.14" x 4.72"
Remote Control	✗	✔	✔
Built in Annotation	✗	✗	✔

NEC AccuSync™ Series

M-1

17"-24" LCD monitors ideal for value-conscious users

High-quality LCD monitors don't necessarily have to be associated with high-end price tags.

NEC AccuSync Series monitors have set a new standard in value for the flat-panel monitor category, offering you a perfect opportunity to take advantage of the many benefits offered by the latest display technology without having to break your budget. The 17" NEC AccuSync **AS172**, 19" **AS193i** and widescreen 20" **AS203WMi**, 22" **AS224WMi** and 24" **AS242W** deliver eco-friendly, value-driven and cost-conscious display solutions to small-to-medium-sized businesses and home office users. The widescreen models increase productivity by expanding your working area to simultaneously view multiple application windows.

It's easy to be green.

The AccuSync Series is loaded with features that promote environmental consciousness. Eco-friendly benefits include ECO Mode™ and an off timer for further energy savings, a resettable carbon footprint meter for tracking the conservation of green gas emissions, and a significant reduction in packaging materials. The AccuSync Series sets the bar for "green" technology by using LED backlighting, which is more energy-efficient. Compared to their predecessors, these model consume up to 33% less power overall, weigh up to 20% less, radiate less heat, use less packaging, utilize recycled plastics in their production and are free of hazardous materials such as mercury, lead and arsenic.

Highlights

- LED backlight technology provides for industry-leading low power consumption and less hazardous materials
- Ambix® dual-input technology allows for digital/analog compatibility
- Tilt adjustable stand helps you reach a more comfortable view
- Integrated multimedia speakers provide an option for business conferencing (AS203WMi & AS224WMi)
- IPS LCD for outstanding color and wide-angle viewing (AS193i and AS203WMi)
- Touch integration-enabling design increases application options (AS224WMi)
- NaViSet™ software (available via download) offers an expanded and intuitive interface, allowing you to more easily adjust display settings via mouse and keyboard
- ECO Mode (default setting) sets the brightness variable from 0-80%, saving more power and reducing your energy costs
- Carbon footprint meter helps track and calculate the reduction of green gas emissions
- Rapid Response™ technology delivers virtually uninterrupted, undistorted viewing of high-speed, full-motion video
- ENERGY STAR® and TCO qualifications reduce electrical costs and lower total cost of ownership

MODEL		AS172	AS193i	AS203WMi	AS224WMi	AS242W
DISPLAY	Panel Technology	TN	IPS		TN	
	Viewable Image Size	17"	19"	20"	21.5"	23.6"
	Aspect Ratio	5:4		16:9		
	Native Resolution	1280 x 1024		1600 x 900	1920 x 1080	
	Pixel Pitch	0.26mm	0.29 mm	0.271mm	0.25mm	0.272mm
	Pixels Per Inch	96 @ native resolution	86 @ native resolution	97 @ native resolution	102 @ native resolution	94 @ native resolution
	Backlight Type	W-LED				
	Brightness (typical)	250 cd/m²				
	Contrast Ratio (typical)	1000:1				
	Viewing Angle (typical)	170° Vert., 170° Hor. (85U/85D/85L/85R) @ CR>5	178° Vert., 178° Hor. (89U/89D/89L/89R) @ CR>10			170° Vert., 170° Hor. (85U/85D/88L/88R) @ CR>5
	Response Time (typical)	5ms	14ms		5ms	
	Displayable Colors	More than 16.7 million				
	Synchronization Range					
	Horizontal (Analog/Digital)	31.5-81.1 kHz				
	Vertical	56-76 Hz			56-75 Hz	56-76 Hz
	Input Signal					
	Video	Analog RGB 0.7 Vp-p/75 Ohms				
	Sync	Separate Sync: TTL Level (Positive/Negative); Composite Sync: TTL Level (Positive/Negative); Composite Sync on Green: (0.3Vp-p negative 0.7Vp-p positive)			Separate Sync: TTL Level (Positive/Negative)	Separate Sync: TTL Level (Positive/Negative); Composite Sync: TTL Level (Positive/Negative); Composite Sync on Green: (0.3Vp-p negative 0.7Vp-p positive)
	Input Connectors	DVI-D, VGA 15-pin D-sub				
POWER CONSUMPTION	On (typical)	11W	18W	14W	18W	19W
	Power Savings Mode (typical)	0.15W		0.4W	0.25W	0.45W
PHYSICAL SPECIFICATIONS	Dimensions (WxHxD)					
	Net (with stand)	14.7 x 14.7 x 8.1 in. / 373.1 x 373.1 x 205.1mm	16.2 x 15.9 x 8.1 in. / 412.5 x 403.1 x 205.1mm	18.3 x 13.2 x 8.1 in. / 466.0 x 335.1 x 205.1mm	20.0 x 14.4 x 8.1 in. / 507.4 x 364.7 x 205.1mm	22.5 x 15.8 x 8.3 in. / 571.4 x 400.9 x 211.2mm
	Net (without stand)	14.7 x 12.2 x 2.7 in. / 373.2 x 310.2 x 69mm	16.2 x 13.4 x 2.7 in. / 412.5 x 341.2 x 69mm	18.3 x 11.0 x 2.1 in. / 466.0 x 278.2 x 53.3mm	20.0 x 11.9 x 2.4 in. / 507.4 x 301.1 x 60.0mm	22.5 x 13.8 x 2 in. / 571.4 x 350.8 x 50.4mm
	Weight					
	Net (with stand)	7.3 lbs. / 3.3 kg	8.6 lbs. / 3.9 kg	7.5 lbs. / 3.4 kg	9 lbs. / 4.1 kg	8.8 lbs. / 4.0 kg
	Net (without stand)	6.4 lbs. / 2.9 kg	7.7 lbs. / 3.5 kg	6.4 lbs. / 2.9 kg	8.2 lbs. / 3.7 kg	7.9 lbs. / 3.6 kg
	VESA Hole Configuration	100 x 100mm				
ENVIRONMENTAL CONDITIONS	Operating Temperature	41-95°F / 5-35°C				
	Operating Humidity	20 - 80%				
	Operating Altitude	6562 ft. / 2000m				
	Storage Temperature	14-140°F / -10-60°C				
	Storage Humidity	10-85%				
	Storage Altitude	40,000 ft. / 12,192m				
ENVIRONMENTAL COMPLIANCE	Energy Star				7.0	
	TCO	6.0				
	RoHS	Yes				
LIMITED WARRANTY		3 years parts and labor, including backlight*				
ADDITIONAL FEATURES		ECO Mode; Carbon footprint meter; Thin frame; Tilt; Rapid Response; Ambix; XtraView; OSD user controls; NaViSet software; Cable management; VESA mount; HDCP; DDC/CI; No Touch Auto Adjust; Plug and Play (VESA DDC 2B); VESA DPMS power management; AccuColor color control; Digital smoothing; Digital controls; ISO 9241-307 Class l		ECO Mode; Carbon footprint meter; Thin frame; Tilt; Integrated speakers; Rapid Response; Ambix; XtraView; OSD user controls; NaViSet software; Cable management; Touch-integratable (AS222WM); VESA mount; HDCP; DDC/CI; No Touch Auto Adjust; Plug and Play (VESA DDC 2B); VESA DPMS power management; AccuColor color control; Digital smoothing; Digital controls; ISO 9241-307 Class l		ECO Mode; Carbon footprint meter; Thin frame; Tilt; Rapid Response; Ambix; XtraView; NaViSet software; VESA mount; HDCP; DDC/CI; No Touch Auto Adjust; Plug and Play (VESA DDC 2B); VESA DPMS power management; AccuColor color control; Digital smoothing; Digital controls; ISO 9241-307 Class l
SHIPS WITH		Setup sheet; User manual; Power cord; 15-pin D-sub cable	Setup sheet; User manual; Power cord; Video cable; Remote if applicable	Setup sheet; User manual; Power cord; 15-pin D-sub cable; Audio cable		Setup sheet; User manual; Power cord; 15-pin D-sub cable

* Warranty restrictions apply. Contact your representative for details.
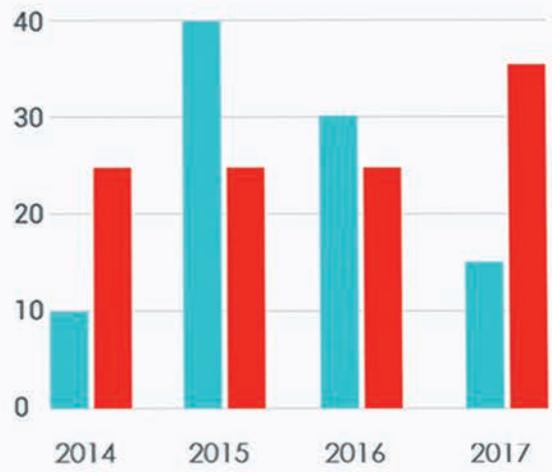
\Orchestrating a brighter world **NEC**

D-1: C651Q
D-2 : C861Q
D-3 : C751Q

NEC Ultra High Definition Large Format Displays

65", 75", 86" and 98" Commercial Displays Ideal for Digital Signage Applications

Brand new UHD displays in an aesthetically-focused design allows for seamless integration into any digital signage environment while maintaining the commercial ruggedness necessary for the retail, educational and corporate environments

Beyond Standard Signage

With industry leading experience in superior design and customer focus, the NEC large C series allow for clear, detailed imagery for unobtrusive digital messaging. New contemporary and slim mechanical design with focused aesthetics allows for the smooth and stylistic integration into any type of environment. Their full metal chassis coupled with real-time temperature sensors and integrated cooling fans maintain the professional quality necessary for commercial environments. With an anti-glare screen and ultra high definition panel, customers can enjoy the perfect image in any circumstance. These displays come equipped with a wide range of the latest connectivity interfaces including three separate HDMI 2.0 interfaces, two separate DisplayPort interfaces and a DisplayPort Out connection to complement the native Ultra High Definition at 60Hz panel. These displays also include expandability options such as the Open Pluggable Specification (OPS) and Raspberry Pi Compute Module slots for source integration directly into the display. The NEC C series boasts 350 - 400 cd/m^2 brightness that allows for efficient readability in higher ambient light situations and is ideal for 24/7 signage in airports, quick-serve restaurants, and retail.

Scalable Computing Power

Integrated computing options allow for cable free signage for any type of situation. The on-board multimedia player can be utilized for simple signage applications by allowing auto-play off of USB or SD card and content transfer via LAN. For more advanced signage systems, these displays contain an industry first ability to integrate a Raspberry Pi Compute module for near limitless potential and application. Finally, each display adheres to the Open Pluggable Specification that gives the ability to seamlessly integrate a full PC, HDBaseT receiver or other options directly into the unit.

Advanced Heat Management

Monitoring and managing the temperature of each display is crucial to secure reliability and longevity. An industrial-strength, premium-grade panel with additional thermal protection, internal temperature sensors with self-diagnostics, and fan-based technology allows for 24/7 operation, and protects your display investment. Without thermal management, displays can be prone to damaging heat over time. This damaging heat will lower the picture quality and life expectancy of the product. Integrated cooling fans automatically turn on and stay on when high internal temperatures are detected. These will stay on until the heat is properly dissipated and the display remains under proper temperature thresholds.

Location of Thermal Management Cooling Fans

2

Anti-Glare Panel

Each of the new large C series commercial displays come equipped with a high haze panel that scatters ambient lighting rather than reflecting it like most other displays. This allows for content to always be viewable and onlookers to have perfect screen readability in any situation.

| With Anti-Glare | Without Anti-Glare |

Blue ON LED and Ambient Light Sensor

New mechanical structure allows for sleeker LED and ambient light sensor design. Auto dimming of the LED backlights can be utilized through the ambient light sensor allowing for the brightness to change depending on the external lux in the room of installation.

SpectraView Engine

Enhanced imaging performance through advanced settings of all relevant parameters allow full control of brightness, color, gamma and uniformity via integrated color-critical chipset.

Key Guide

New Key Guide function allows for easier access to buttons when manually controlling the unit via the buttons on the back of the display by adding a graphic on the screen that directs the customer to the correct button layout in both landscape and portrait modes.

(EXIT)   (▼)   (▲)   (—)   (+)   (SET)   (MUTE)   (∣)
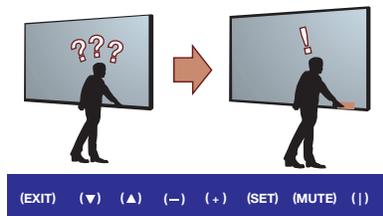
Aesthetically Focused Design

Brand new mechanical design focuses on smooth, sleek curves, thinner bezels, reduced depth and reduced overall weight while maintaining the quality and reliability for efficient 24/7 runtime capabilities.

NaViSet Administrator 2

This software is an all-in-one remote support solution that runs from a central location and provides monitoring, asset management and control functionality of the majority of NEC display devices and Windows computers. It is ideal for multi-device installations over larger infrastructures.

NaViSet
Administrator 2

L-Shaped Connectivity

Connectivity is located on both the bottom and side of the display to allow for easy access regardless of orientation.
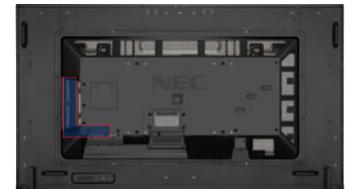
Cisco Compatible Partner:

Full compatibility with Cisco WebEx Kit products. The Cisco WebEx Kit is a professional video conferencing tool that has everything integrated into a single soundbar including microphone(s), camera(s), the speaker and the Video Conferencing Codec. This, combined with the large format NEC displays provide the ultimate conferencing solution.

Removable Logo

When mounting from Landscape to Portrait orientation, there is now the ability to change the orientation of the logo or remove it all together

MODEL		C651Q	C751Q	C861Q	C981Q
LCD MODULE	Panel Technology	D-LED, VA	E-LED, S-IPS		D-LED, S-IPS
	Viewable Image Size	65"	75"	86"	98"
	Native Resolution	3840 x 2160	3840 x 2160		
	Brightness (Typical/Maximum)	320/400 cd/m²	245 cd/m² /350 cd/m²		
	Contrast Ratio (Typical)	4000:1	1200:1 native, not including localized dimming		1300:1 native, not including localized dimming
	Viewing Angle	178° Vert., 178° Hor. (89U/89D/89L/89R) @ CR>10			
	Aspect Ratio	16:9			
	Displayable Colors	Over 1.07 Billion			
	Orientation	Landscape, Portrait, Face Up, Face Down			
	Panel Haze (%)	44	28		
CONNECTIVITY	Input Terminals				
	Digital	HDMI 2.0 x3 (with HDCP), DisplayPort 1.2 x2 (with HDCP)			
	Analog	None			
	Audio	3.5mm Mini Jack , HDMI Audio x3, DisplayPort Audio x2			
	External Control	LAN (100Mbit), 3.5 Mini Jack IR Remote, RS232C			
	Data	microSD (Media Player), USB 2.0 (Media Player), USB 2.0 (Service), USB Type-B (Upstream), USB 2.0 x2 (Compute Module, USB CM1 is Powered 5V/2A)			
	Output Terminals				
	Digital	DisplayPort (Outputs DisplayPort1 and OPS (1CH DisplayPort Only))			
	Analog	None			
	Audio	3.5mm Audio Mini Jack, External Speaker x2			
	External Control	LAN (100Mb)			
POWER CONSUMPTION	On (Typ/Max Brightness/Overall Max)	200W/255W/365W	195W/250W/375W	230W/300W/425W	240W/380W/525W
	Network Standby	2W			
	Normal Standby	0.5W			
	Current Rating	4.3A @ 100V, 1.8A @ 240W	4.4A @ 100V, 1.9A @ 240V	5.0A @ 100V, 2.1A @ 240V	6.1A @ 100V, 2.6A @ 240V
	Speaker Rating	Integrated 10W x 2, Optional 15W x 2			
PHYSICAL SPECIFICATIONS	Bezel Width (L/R, T/B)	12.9mm/12.9mm, 13.1mm/13.1mm	14.8mm/14.8mm/ 14.8mm/14.8mm	15.3mm/15.3mm/ 15.3mm/15.3mm	15.9mm/15.9mm/ 15.9mm/15.9mm
	Net Dimensions (Without stand; W x H x D)	57.34 x 32.7 x 3.1in. 1457.0 x 831.6 x 79.4mm	66.2 x 37.8 x 2.8in. 1681.2 x 959.6 x 71.1mm	75.9 x 43.3 x 2.9in. 1928.2 x 1099.2 x 74.3mm	86.4 x 49.2 x 3.7in. 2193.8 x 1248.8 x 93.0mm
	Net Weight (Without Stand)	89.9lbs / 40.8kg	115.7lbs. / 52.6kg	127.2 lbs. / 57.8kg	198.6 lbs. / 90.0kg
	VESA Hole Configuration	8x M8 x 16mm (600 x 400, 400 x 400)			
SENSORS	Ambient Light Sensor	Integrated and programmable			
	Human Sensor	Optional through KT-RC2 Accessory			
	Temperature Sensor	Integrated and programmable; linked to cooling fans			
	NFC Sensor	Integrated; works in conjunction with free NEC Intelligent Wireless Data Application			
ENVIRONMENTAL CONDITIONS	Operating Temperature	0 to 40C			
	Operating Humidity	20-80%			
	Operating Altitude	3000m (9843ft)			
LIMITED WARRANTY		3 years Advanced Replacement			
ADDITIONAL FEATURES		HDR Gamma Support (HLG nand PQ), Localized Dimming, Ambient Light Sensor, AMX Support, Auto ID/Auto TileMatrix, Automated Email Alert Function, CEC Support through HDMI, Crestron Roomview Support, DICOM Simulation, Display Browser Control, Display Wall Calibrator Compatible, High Haze Panel, Image Flip, Intelligent Wireless Data (NFC), Key Guide, Media Player through Browser Control/SD Card/USB, Multi Picture Mode, NaViSet Administrator 2 Compatible, OSD Rotation for Portrait Orientation, OPS Compatible, PJ Link Support, Point Zoom Function, Power USB Port (5V/2A), Programmable LUT x3, Raspberry Pi Compute Module Compatible, Removable Logo Ornament, Real Time Clock, SpectraView Engine Support, SNMP Support, 24-Hour Scheduler Function, Cisco Compatible			
SHIPS WITH		3m AC Power Cord, 1.8m HDMI cable, 1.8m DisplayPort Cable, IR Remote Control, Batteries, CD-ROM (User Manual)			
OPTIONAL ACCESSORIES		Table Top Stand (ST-801), Optional Speakers (SP-TF1), All OPS Option Cards, Raspberry Pi Compute Module 1 and 3 with optional NEC Interface Board, Large Wall Mount (WMK-6598), Regular Wall Mount (WMK-3257 for C651Q, C751Q, and C861Q only) Slim Wall Mount (WMK-3255S for C651Q), Human Sensor (KT-RC2)			

Dimensions

2193.8 (C981Q)
1928.2 (C861Q)
1681.2 (C751Q)
1457.0 (C651Q)

1248.8 (C981Q)
1099.2 (C861Q)
959.6 (C751Q)
831.6 (C651Q)

Options

OPS PC's

OPS-PCAEQ-PS2
OPS-APIS-PS
OPS-TCIS-PS

SDI

HD-SDI   **SB-01HC**

3G-SDI   **SB-04HC**

HDBaseT   **SB-07BC**

Compute Module

Compute Module Interface Board   **DS1-IF10CE**

NEC Raspberry Pi Compute Module   **RP3CM16GB**

Tabletop Stand   **ST-801**

Speaker   **SP-TF1**

Input Panels

1.	HDMI IN2	12.	USB CM1 (2A)
2.	HDMI IN3	13.	USB CM2
3.	DisplayPort IN2	14.	LAN1
4.	DisplayPort IN1	15.	LAN2
5.	DisplayPort OUT	16.	USB MP
6.	Audio IN	17.	microSD
7.	External Speaker Terminal	18.	REMOTE IN
8.	Internal/External Speaker Switch	19.	RS-232C
9.	Audio OUT	20.	HDMI IN1
10.	USB1		
11.	USB2		

Bottom Panel

Side Panel

www.necdisplay.com

SMART®

SMART Board® **6000 series**

Our most popular interactive display with iQ embedded computing and collaboration features for walk up and use simplicity.

65" | 75"

Walk in and it turns on
A proximity sensor automatically powers up the SMART Board 6000 when you walk in the room saving time and energy costs.

Pick up a pen and start writing
The intelligent pen tray automatically selects the black or red pen tool, so you don't have to choose it from a menu before writing.

As easy as writing on paper
SMART invented DViT® (Digital Vision Touch) technology to ensures a smooth writing experience that looks and feels natural.

1-YEAR

⊙ **SMART Learning Suite** subscription included

4K ULTRA HD RESOLUTION

energy ENERGY STAR

Unparalleled Collaborative Experience

With 30 years of experience in education technology, SMART interactive displays are designed to support teaching approaches that affect learning outcomes.

Multiple students, tools and colors at the same time

Simultaneous Tool Differentiation frees multiple students to write, erase and move notes at the same time. **Pen ID**™ recognition and **Object awareness**™ detection automatically make pens write in different colors, fingers move and palms erase.

Write and save notes directly into applications

SMART Ink® software lets teachers write over videos and into **PDFs, Microsoft Office**® **files** and websites, then save notes in almost any file type. Automatically convert notes to text and access tools, such as spotlight, magnifier and screen shade.

Built to use. Built to last.

Durable and commercial-grade, SMART Board displays have received many safety, regulatory and environmental certifications, giving you peace of mind that they adhere to government or other regulatory requirements.

- **4K** 4K Ultra HD resolution
- Accelerated Life Testing
- LED rated for 50,000 hours
- Fully heat-tempered, anti-glare glass
- Silktouch™ frictionless surface

- ENERGY STAR® certification
- Conflict-free materials and sourcing
- Regulatory and environmental certifications*
- 3-year standard warranty** (1-year on pens)

SMART Remote Management lets you efficiently maintain, secure and support all your devices — including SMART Board displays with iQ.

*See specification chart for detailed certifications.
**1- or 2-year extended options available. 5-year standard in UK.

Engage students. Empower teachers.

Together with ◉ **SMART Learning Suite** software and **iQ embedded computing** options, SMART Board displays give teachers endless ways to quickly and easily create and deliver dynamic lessons.

SMART Learning Suite transforms static content into interactive lessons including collaborative workspaces, game-based activities and formative assessments – all in one ultimate education suite.

Desktop experience

Teachers can connect their Windows or Mac® computer and deliver interactive SMART Notebook® lessons at the display. Time-saving activity and assessment templates are easy to customize for all grades and subjects.

Online experience

Teachers can add game-based and collaborative activities to SMART Notebook, PDF and PowerPoint files, and send lessons to student devices to complete individual handouts or work together in collaborative workspaces.

iQ embedded computing puts everything teachers need to seamlessly transition lessons in one place at the touch of a finger – without extra hardware or apps.

Android™ experience

iQ provides teachers one-touch access to SMART Notebook lessons and collaboration tools including a whiteboard, web browser, apps library and native, wireless screen sharing.

Windows® experience

Give teachers access to Microsoft Office files and applications on a full Windows 10 Pro computer right at the display by adding an Intel® Compute Card to iQ.

Get the most out of your SMART solution

Your purchase is just the beginning. Our implementation services, professional development and technical support resources help educators learn to use their SMART solutions, hone their technology skills and improve student learning outcomes.

Education Consulting
SMART has a team of former educators dedicated to supporting implementation, as well as publications and research demonstrating improved outcomes.

Professional Development
SMART provides complimentary professional development plans, and online courses and webinars that cover both functional and pedagogical topics.

Technical Support
So much more than downloads and guides, SMART support has tons of training resources to get you started and a thriving community of educators to tap into.

Authorized reseller:

SMART Technologies
smarttech.com/contact

SMART.®

	6265	6365	6275	6375
SMART Learning Suite	1-year subscription	1-year subscription	1-year subscription	1-year subscription
iQ apps and features	SMART Notebook Player Customizable home screen Digital whiteboard Web browser Native screen sharing File and app libraries	SMART Notebook Player Customizable home screen Digital whiteboard Web browser Native screen sharing File and app libraries	SMART Notebook Player Customizable home screen Digital whiteboard Web browser Native screen sharing File and app libraries	SMART Notebook Player Customizable home screen Digital whiteboard Web browser Native screen sharing File and app libraries
Intel Compute Card with Windows 10 Pro	Upgrade option available	Included. Options available. See **smarttech.com/iQ** for details.	Upgrade option available	Included. Options available. See **smarttech.com/iQ** for details.
SMART Remote Management	Optional	Optional	Optional	Optional
DISPLAY				
Screen size (diagonal)	65"	65"	75"	75"
Resolution	4K Ultra HD (3840 × 2160)	4K Ultra HD (3840 × 2160)	4K Ultra HD (3840 × 2160)	4K Ultra HD (3840 × 2160)
Refresh rate	60 Hz	60 Hz	60 Hz	60 Hz
Aspect ratio	16:9	16:9	16:9	16:9
Back lighting	e-LED	e-LED	e-LED	e-LED
LED lifespan	Commercial-grade – 50,000 hours	Commercial-grade – 50,000 hours	Commercial-grade – 50,000 hours	Commercial-grade – 50,000 hours
LCD quality	Grade A	Grade A	Grade A	Grade A
Contrast ratio	4000:1	4000:1	5000:1	5000:1
Brightness	360 cd/m^2	360 cd/m^2	360 cd/m^2	360 cd/m^2
Response time	8 ms	8 ms	8 ms	8 ms
Glass	Fully heat-tempered, anti-glare	Fully heat-tempered, anti-glare	Fully heat-tempered, anti-glare	Fully heat-tempered, anti-glare
TOUCH AND DIGITAL INK				
Touch technology	DViT	DViT	DViT	DViT
Simultaneous tool differentiation	✓	✓	✓	✓
Object awareness	✓	✓	✓	✓
Pen ID	✓	✓	✓	✓
SMART Ink	✓	✓	✓	✓
Silktouch	✓	✓	✓	✓
Simultaneous touch points	8 (Windows and Mac)	8 (Windows and Mac)	8 (Windows and Mac)	8 (Windows and Mac)
Tools included	2 pens (black, red)	2 pens (black, red)	2 pens (black, red)	2 pens (black, red)
IQ APPLIANCE				
Model	AM40	AM50	AM40	AM50
Operating system	Android 7.1 Nougat	Android 7.1 Nougat	Android 7.1 Nougat	Android 7.1 Nougat
Processor	RK3399, Dual-core A72 + Quad-core A53, 64 bits, 2GHz	RK3399, Dual-core A72 + Quad-core A53, 64 bits, 2GHz	RK3399, Dual-core A72 + Quad-core A53, 64 bits, 2GHz	RK3399, Dual-core A72 + Quad-core A53, 64 bits, 2GHz
Memory	4 GB	4 GB	4 GB	4 GB
Storage	32 GB	32 GB	32 GB	32 GB
Wireless technology	Bluetooth 4.1 802.11A/B/G/N/Ac	Bluetooth 4.1 802.11A/B/G/N/Ac	Bluetooth 4.1 802.11A/B/G/N/Ac	Bluetooth 4.1 802.11A/B/G/N/Ac
Connectors	HDMI 1.4 out USB 3.0 Type-A (×2) RJ45 Gigabit Ethernet	HDMI 1.4 out USB 3.0 Type-A (×2) RJ45 Gigabit Ethernet	HDMI 1.4 out USB 3.0 Type-A (×2) RJ45 Gigabit Ethernet	HDMI 1.4 out USB 3.0 Type-A (×2) RJ45 Gigabit Ethernet
CONNECTIVITY				
Wired	RJ45	RJ45	RJ45	RJ45
Wi-Fi	IEEE 802.11A/B/G/N/Ac with 2 × 2 MIMO (both 2.4 and 5 GHz bands)	IEEE 802.11A/B/G/N/Ac with 2 × 2 MIMO (both 2.4 and 5 GHz bands)	IEEE 802.11A/B/G/N/Ac with 2 × 2 MIMO (both 2.4 and 5 GHz bands)	IEEE 802.11A/B/G/N/Ac with 2 × 2 MIMO (both 2.4 and 5 GHz bands)
Bluetooth	4.0 dual mode (backwards compatible with Bluetooth 2.1 + EDR)	4.0 dual mode (backwards compatible with Bluetooth 2.1 + EDR)	4.0 dual mode (backwards compatible with Bluetooth 2.1 + EDR)	4.0 dual mode (backwards compatible with Bluetooth 2.1 + EDR)
INPUTS/OUTPUTS				
Front control panel	Standby, input select, mute/freeze frame, volume, onscreen display menu navigation	Standby, input select, mute/freeze frame, volume, onscreen display menu navigation	Standby, input select, mute/freeze frame, volume	Standby, input select, mute/freeze frame, volume
Video	HDMI 1.4 (×2), Display Port	HDMI 1.4 (×2), Display Port	HDMI 1.4 (×2), Display Port	HDMI 1.4 (×2), Display Port
Audio	Stereo 3.5 mm out	Stereo 3.5 mm out	Stereo 3.5 mm out	Stereo 3.5 mm out
USB	Type-A, Type-B (touch) (×3)	Type-A, Type-B (touch) (×3)	Type-A, Type-B (touch) (×3)	Type-A, Type-B (touch) (×3)
Other	OPS slot, RS-232 in	OPS slot, RS-232 in	OPS slot, RS-232 in	OPS slot, RS-232 in
Speakers	10 W integrated speakers (×2)	10 W integrated speakers (×2)	10 W integrated speakers (×2)	10 W integrated speakers (×2)
POWER				
Power consumption (display only)	1.7 W standby, 83 W normal	1.7 W standby, 83 W normal	1.7 W standby, 130 W normal	1.7 W standby, 130 W normal
ENERGY STAR certified	✓	✓	✓	✓
Presence detection	One sensor	One sensor	One sensor	One sensor
INSTALLATION				
Dimensions	59 3/8" × 36 3/8" × 5 1/8" (150.8 cm × 98.3 cm × 12.9 cm)	59 3/8" × 36 3/8" × 5 1/8" (150.8 cm × 98.3 cm × 12.9 cm)	68 1/8" × 43 3/8" × 4 3/4" (173.1 cm × 110.2 cm × 12 cm)	68 1/8" × 43 3/8" × 4 3/4" (173.1 cm × 110.2 cm × 12 cm)
Weight	153 lb. (69.3 kg)	153 lb. (69.3 kg)	185 lb. (84 kg)	185 lb. (84 kg)
VESA mounting points	300 mm × 400 mm	300 mm × 400 mm	600 mm × 400 mm	600 mm × 400 mm
CERTIFICATION AND COMPLIANCE				
Regulatory certifications	UL (U.S./Canada), FCC, IC, CE, RCM, CITC, TRA	UL (U.S./Canada), FCC, IC, CE, RCM, CITC, TRA	UL (U.S./Canada), FCC, IC, EMC, LV, VCCI, PSE	UL (U.S./Canada), FCC, IC, EMC, LV, VCCI, PSE
Environmental compliance	EU: REACH, RoHS, WEEE and Packaging; U.S.: Packaging and Conflict Minerals	EU: REACH, RoHS, WEEE and Packaging; U.S.: Packaging and Conflict Minerals	EU: REACH, RoHS, WEEE and Packaging; U.S.: Packaging and Conflict Minerals	EU: REACH, RoHS, WEEE and Packaging; U.S.: Packaging and Conflict Minerals
Full HDMI and USB compliance	✓	✓	✓	✓
Accelerated life testing	✓	✓	✓	✓
Conflict-free minerals and sourcing	✓	✓	✓	✓

\Orchestrating a brighter world

NEC

Essential performance. Enticingly priced.

NEC E Series

Large Screen LED-backlit LCD   32" | 43" | 50" | 55" | 65"

LED-Backlit, Commercial-Grade LCD Displays
Ideal for Education, Corporate and Digital Signage Applications

The Essentials

With a brilliant panel and simplified controls, the NEC E Series delivers everything you need for captivating digital signage

- Integrated USB Media Player allows for playback of video, audio and picture files
- High-definition and high contrast ratio displays provide stunning images
- Built-in tuner allows for high-definition broadcast capabilities
- Additional energy options include a Power Savings Mode to further reduce energy consumption
- 3-year warranty protects your investment

The Extras

Delivering more than just the basics, the NEC E Series has integrated features that will leave no head unturned

- LED backlighting enables eco-friendly digital signage
- Simple 24-hour scheduler feature allows for programmable on/off times
- Reduced bezel width creates seamless digital signage
- Multiple HDMI ports enhance best-in-class connectivity
- Internal, 5W - 10W down-firing stereo speakers enhance the experience with superior sound
- Ability to wake the display simply by plugging HDMI or VGA into the unit

FULL HD 1080p   LED LED Backlit LCD

MODEL		E326	E436	E506	E556	E656
LCD MODULE	Panel Technology	IPS		VA	IPS	VA
	Viewable Image Size	31.5"	42.5"	49.5"	54.64"	64.5"
	Native Resolution	1920 x 1080				
	Brightness (Typical/Minimum)	350 cd/m² / 300 cd/m²				
	Contrast Ratio (Typical)	1400:1	1200:1	3000:1	1200:1	4000:1
	Viewing Angle	176° Vert., 176° Hor. (88U/88D/88L/88R) @ CR>20				
	Aspect Ratio	16:9				
	Displayable Colors	Over 16.7 Million				
	Orientation	Landscape				
CONNECTIVITY	Input Terminals					
	Digital	HDMI x3				
	Analog	VGA 15-pin D-SUB, RCA Composite/Component				
	Audio	RCA Audio				
	External Control	RS232C (Unidirectional)				
	Tuner	ATSC (8-VSB, Clear-QAM) / NTSC Coaxial Tuner				
	USB	USB Media Player (Video, Audio, Image)				
	Output Terminals					
	Audio	SPDIF				
POWER CONSUMPTION	On (Max)	59W	80W	107W	109W	156W
	Standby	<0.5W				
	Current Rating	0.9A @ 120V	0.8A @ 120V	1.0A @ 120V		1.4A @ 120V
	Speaker Rating	5W x 5W	10W x 10W			
PHYSICAL SPECIFICATIONS	Bezel Width (L/R, T/B)	11.9mm/11.9mm/ 11.9mm/16.1mm	10.4mm/10.4mm/ 10.4mm/13.4mm	11.9mm/11.9mm/ 11.9mm/14.4mm	12.9mm/12.9mm/ 12.9mm/14.7mm	13.9mm/13.9mm/ 13.9mm/14.9mm
	Net Dimensions (Without stand; W x H x D)	28.6 x 16.7 x 3.0 in. 726.7 x 424.3 x 76.8mm	38.1 x 22.0 x 3.0 in. 968.2 x 559.4 x 76.8mm	44.2 x 25.5 x 3.0 in. 1123.6 x 646.7 x 77.0mm	48.8 x 28.0 x 3.1 in. 1239.2 x 711.6 x 79.2mm	57.4 x 32.9 x 3.5 in. 1457.9 x 834.5 x 89.5mm
	Net Weight (Without Stand)	10.6lbs / 4.8kg	18.9lbs / 8.6kg	28.4lbs / 12.9kg	34.4lbs / 15.6kg	51.8lbs / 23.5kg
	VESA Hole Configuration	4x M4 x 12mm (100 x 100)	4 x M6 x 16mm (200 x 200)	4 x M6 x 15mm (200 x 200)	4 x M6 x 15mm (400 x 200)	4 x M6 x 17.5mm (400 x 400)
ENVIRONMENTAL CONDITIONS	Operating Temperature	0 to 40C				
	Operating Humidity	10-80%				
	Operating Altitude	2000m (6562ft)				
LIMITED WARRANTY		3 years Advanced Replacement				
ADDITIONAL FEATURES		Built-In ATSC/NTSC Tuner, Wake on Video Signal, On/Off Scheduler Function, Built-In Closed-Captioning (TTS), V-Chip Functionality, USB Media Player, Integrated Speakers (5W x 2 for E326, 10W x 2 for all others)				
SHIPS WITH		3m AC Power Cord, 1.8m VGA Cable, Remote Control, Batteries, User Manual				
OPTIONAL ACCESSORIES		Table Top Stand (ST-32E), All OPS PC's when coupled with the OPS-DOCK	Table Top Stand (ST-43E), All OPS PC's when coupled with the OPS-DOCK	Table Top Stand (ST-50E), All OPS PC's when coupled with the OPS-DOCK	Table Top Stand (ST-50E), All OPS PC's when coupled with the OPS-DOCK	Table Top Stand (ST-65E2),All OPS PC's when coupled with the OPS-DOCK

* RS-232C communication is only unilateral. The displays will not send feedback commands.
** Warranty restrictions apply. Contact your representative for details.

① DIGITAL AUDIO OUT (SPDIF)

② RCA COMPOSITE/ COMPONENT

③ DIGITAL ANALOG TUNER

④ VGA D-SUB IN

⑤ AUDIO MINI JACK IN

⑥ USB (Video, Audio, Picture)

⑦ HDMI IN

⑧ RS-232 IN

For times when the remote is not available, full display controls are conveniently situated on the side of the bezel, allowing you to change channels, adjust the volume and access the on-screen display manager.

E326

E436

E506

E556

E656

www.necdisplay.com

QM-2
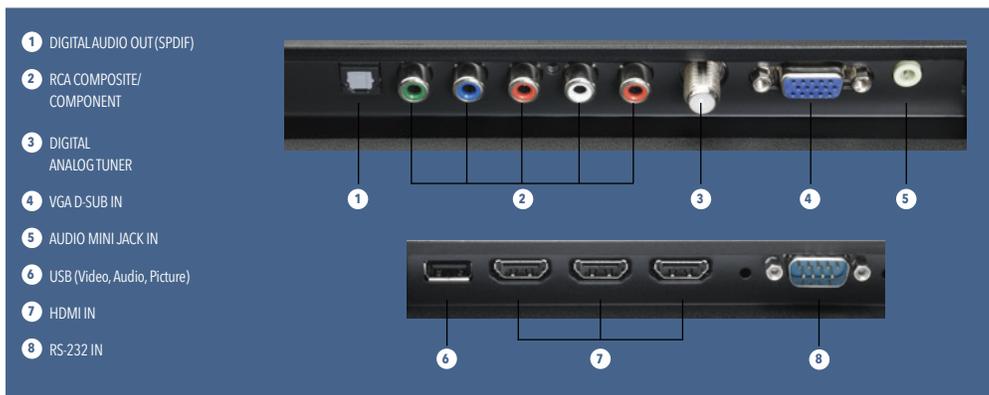
NEC

40", 48" and 55" Professional Displays Ideal for Digital Signage Applications

NEC Professional Large Format Displays

Brand new aesthetically-focused design allows for seamless integration into any digital signage environment while maintaining the professional ruggedness necessary for the transportation, restaurant and financial industries.

Beyond Standard Signage

Create maximum visual impact through seamless simplicity with the new professional NEC P series products. New contemporary and slim mechanical design with focused aesthetics allows for the smooth and stylistic integration into any type of environment. Their full metal chassis coupled with real-time temperature sensors and integrated cooling fans maintain the professional quality necessary for commercial environments. With a wide range of the latest connectivity interfaces including resolution support up to Ultra High Definition at 60Hz, these displays offer the future-proofing necessary for the investment. These displays also include expandability options such as the Open Pluggable Specification (OPS) and Raspberry Pi Compute Module slots for source integration directly into the display. The NEC P series boasts 700 cd/m^2 brightness along with a new anti-glare surface that allows for efficient readability in higher ambient light situations and is ideal for 24/7 signage in airports, quick-serve restaurants, financial institutions and command and control.

Scalable Computing Power

Integrated computing options allow for cable free signage for any type of situation. The on-board multimedia player can be utilized for simple signage applications by allowing auto-play off of USB or SD card and content transfer via LAN. For more advanced signage systems, these displays contain an industry first ability to integrate a Raspberry Pi Compute module for near limitless potential and application. Finally, each display adheres to the Open Pluggable Specification that gives the ability to seamlessly integrate a full PC, HDBaseT receiver or other options directly into the unit.

Advanced Heat Management

Monitoring and managing the temperature of each display is crucial to secure reliability and longevity. An industrial-strength, premium-grade panel with additional thermal protection, internal temperature sensors with self-diagnostics, and fan-based technology allows for 24/7 operation, and protects your display investment. Without thermal management, displays can be prone to damaging heat over time. This damaging heat will lower the picture quality and life expectancy of the product. Integrated cooling fans automatically turn on and stay on when high internal temperatures are detected. These will stay on until the heat is properly dissipated and the display remains under proper temperature thresholds.

L-Shaped Connectivity

Connectivity is located on both the bottom and side of the display to allow for easy access regardless of orientation
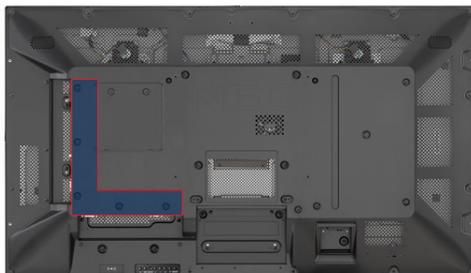
Blue ON LED and Ambient Light Sensor

New mechanical structure allows for sleeker LED and ambient light sensor design. Auto dimming of the LED backlights can be utilized through the ambient light sensor allowing for the brightness to change depending on the external lux in the room of installation.

Proof of Play

This function provides accurate proof that displays are working as established when checking from an external location. Information regarding video source, time on, audio source and more can be pulled through the display when coupled with NaViSet Administrator 2.

SpectraView Engine

Enhanced imaging performance through advanced settings of all relevant parameters allow full control of brightness, color, gamma and uniformity via integrated color-critical chipset.

Auto TileMatrix, Auto ID and Auto IP Address Technologies

Auto IP Address simplifies control setup by setting the static IP address on the first display then initiating the feature so that the IP Addresses of consecutive displays follow the LAN daisy chain. These displays also have Auto TileMatrix and Auto ID that can, in the case of a video wall, automatically scale up to a UHD signal across the entirety of the wall through DisplayPort 1.2 while individually IDing each screen, saving time and overall cost of installation.

Key Guide

New Key Guide function allows for easier access to buttons when manually controlling the unit via the buttons on the back of the display by adding a graphic on the screen that directs the customer to the correct button layout in both landscape and portrait modes.

(EXIT) (▼) (▲) (—) (+) (SET) (MUTE) (|)

NaViSet Administrator 2
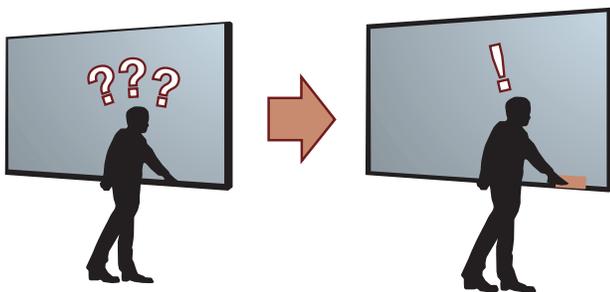
This software is an all-in-one remote support solution that runs from a central location and provides monitoring, asset management and control functionality of the majority of NEC display devices and Windows computers. It is ideal for multi-device installations over larger infrastructures.

NaViSet
Administrator 2

Dedicated Color Calibration Software

As the brightness and color temperature of the LCD change with time, colors may not match across multiple screens. The NEC Display Wall Calibrator software ensures color uniformity and fidelity across multiple screens, creating a perfectly matched image in tiled environments.

NEC
Display Wall Calibrator

Intelligent Wireless Data Function

The built-in near field communication (NFC) chip allows data to be read and written via a mobile phone or tablet PC. Users can significantly reduce installation costs as displays can be easily configured and serviced using the NEC NFC Android app. This is extremely useful for larger rollouts as it can be utilized even when the display is powered off.

Removable Logo

When mounting from Landscape to Portrait orientation, there is now the ability to change the orientation of the logo or remove it all together

3

		P404	P484	P554
LCD MODULE				
Panel Technology		SPVA	SPVA	S-IPS
Viewable Image Size		40"	48"	55"
Native Resolution		1920 x 1080		
Brightness (Typical/Minimum)		550 cd/m² / 700 cd/m²		
Contrast Ratio (Typical)		4000:1		1300:1
Viewing Angle		178° Vert., 178° Hor. (89U/89D/89L/89R) @ CR>10		
Aspect Ratio		16:9		
Displayable Colors		Over 1.07 Billion		
Orientation		Landscape, Portrait, Face Up, Face Down		
Panel Haze (%)		25		44
CONNECTIVITY				
Input Terminals	Digital	HDMI 2.0 x2 (with HDCP), DVI-D (with HDCP), DisplayPort x2 (with HDCP)		
	Analog	VGA 15-pin D-SUB, RCA Composite		
	Audio	3.5mm Audio Mini Jack x2, DisplayPort Audio x2, HDMI Audio x3		
	External Control	LAN (100Mbit), 3.5 Mini Jack IR Remote, RS232C		
	Data	microSD (Media Player), USB 2.0 (Media Player), USB 2.0 (Service), USB Type-B (Upstream), USB 2.0 x2 (Compute Module, Powered 5V/2A)		
Output Terminals	Digital	DisplayPort (Outputs DisplayPort)		
	Audio	3.5mm Audio Mini Jack		
	External Control	LAN (100Mb)		
POWER CONSUMPTION				
On (Typ/Max)		92W/115W	115W/140W	125W/175W
Network Standby		3W		
Normal Standby		<0.5W		
Current Rating		2.9A - 1.2A @ 100V - 240V	3.1A - 1.2A @ 100V - 240V	3.6A - 1.5A @ 100V - 240V
Speaker Rating		Integrated 10W x 10W, Optional 15W x 3		
PHYSICAL SPECIFICATIONS				
Bezel Width (L/R, T/B)		13.2mm/13.2mm/ 13.2mm/13.2mm	13.2mm/13.2mm/ 13.2mm/13.2mm	14.2mm/14.2mm/ 14.2mm/14.2mm
Net Dimensions (Without stand; W x H x D)		36.1 x 20.9 x 2.2 in. 918.0 x 530.6 x 54.7mm	42.8 x 24.6 x 2.2 in. 1086.5 x 625.3 x 54.7mm	49.0 x 28.1 x 2.5 in. 1244.0 x 714.8 x 62.9mm
Net Weight (Without Stand)		31.5lbs / 14.3kg	38.8lbs / 17.6kg	54.2lbs / 24.6kg
VESA Hole Configuration		4x M6 x 12mm (300 x 300)		
SENSORS				
Ambient Light Sensor		Integrated and programmable		
Human Sensor		Optional through KT-RC2 Accessory		
Temperature Sensor		Integrated and programmable; linked to cooling fans		
NFC Sensor		Integrated; works in conjunction with free NEC Intelligent Wireless Data Application		
ENVIRONMENTAL CONDITIONS				
Operating Temperature		0 to 40C		
Operating Humidity		20-80%		
Operating Altitude		3000m (9843ft)		
LIMITED WARRANTY		5 years Advanced Replacement		
ADDITIONAL FEATURES		Ambient Light Sensor, AMX Support, Auto ID/Auto TileMatrix, Automated Email Alert Function, CEC Support through HDMI, Crestron Roomview Support, DICOM Simulation, Display Browser Control, Display Wall Calibrator Compatible, Factory Uniformity Correction, High Haze Panel, Image Flip, Intelligent Wireless Data (NFC), Key Guide, Media Player through Browser Control/SD Card/USB, Multi Picture Mode, NaViSet Administrator 2 Compatible, OSD Rotation for Portrait Orientation, OPS Compatible, PJ Link Support, Point Zoom Function, Power USB Port (5V/2A), Programmable LUT x3, Raspberry Pi Compute Module Compatible, Removeable Logo Ornament, Real Time Clock, SpectraView Engine Support, SNMP Support (with Uniformity Control), 24-Hour Scheduler Function, UHD Support through HDMI/DisplayPort		
SHIPS WITH		3m AC Power Cord, 1.8m DVI Cable, IR Remote Control, Batteries, CD-ROM (User Manual)		
OPTIONAL ACCESSORIES		Table Top Stand (ST-401), Optional Speakers (SP-TF1), All OPS Option Cards, NEC Raspberry Pi Compute Module (RP3CM16GB) with optional Compute Module Interface Board (DS1-IF10CE), Wall Mount (WMK-3257), Slim Wall Mount (WMK-3255S), Human Sensor (KT-RC2)		

Dimensions

1244.0 (P554)
1086.5 (P484)
918.0 (P404)

62.9 (P554)
54.7 (P484)
54.7 (P404)

714.8 (P554)
625.3 (P484)
530.6 (P404)

Options

OPS PC's

OPS-APIC-PS	OPS-PCAEQ-PS
OPS-PCIB-PS	OPS-APIS-PS
OPS-TCIS-PS	

SDI

HD-SDI	**SB-01HC**
3G-SDI	**SB-04HC**

HDBaseT SB-07BC

Compute Module

Compute Module Interface Board	**DS1-IF10CE**
NEC Raspberry Pi Compute Module	**RP3CM16GB**

Tabletop Stand	**ST-401**
Speaker	**SP-TF1**
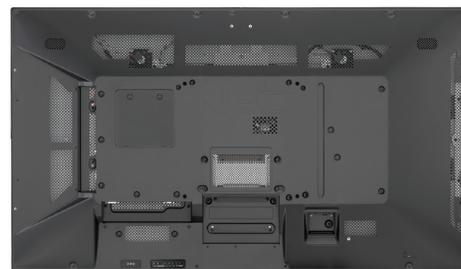
Input Panels

1.	DVI-D	13.	USB2
2.	HDMI IN2	14.	USB CM1 (2A)
3.	DisplayPort IN2	15.	USB CM2
4.	DisplayPort IN1	16.	LAN1
5.	DisplayPort OUT	17.	LAN2
6.	VGA (RGB, YPbPr)	18.	VIDEO IN
7.	Audio IN1	19.	USB MP
8.	Audio IN2	20.	microSD
9.	External Speaker Terminal	21.	REMOTE IN
10.	Internal/External Speaker Switch	22.	RS-232C
11.	Audio OUT	23.	HDMI IN1
12.	USB1		

Bottom Panel — 1 2 3 4 5 6 7 8

Side Panel — 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

www.necdisplay.com

Cat.No. 25.NEC.80.GL.UN.288 08.8.2017

PCT2265 - Multi-Touch
22" Touch Screen Monitor

TM

The Planar® Helium™ PCT2265 is a 22" full HD touch screen LCD monitor optimized with multi-touch interactivity. With its integrated USB 3.0 hub and dual-hinge desk stand, the Planar Helium Series PCT2265 provides the ultimate touch on the desktop experience.

SPECIFICATION	DETAIL
Product Name	PCT2265
Planar Part Number	997-7251-00
Viewable Size	21.5" diagonal (18.77" horizontal x 10.56" vertical)
Touchscreen Type	Projected Capacitive
Number of Touch Points	10
Touchscreen Interface	USB
Contrast Ratio (typ)	3000:1
Viewing Angle (typ)	178° H,V
Response Time (typ)	18 ms
Brightness (w/touchscreen)	225 cd/m²
Brightness (w/o touchscreen)	250 cd/m²
Display Type	Edge-Lit LED LCD
Display Resolution	1920 x 1080
Aspect Ratio	16:9
Tilt Range	-5° to +90°
Palette	16.7 million colors
Pixel Pitch	0.2482
Refresh Rate	50-76 Hz
Panel Depth	2.49" (63.2 mm)

Dimensions (W x H x D)	20.57" x 15.16" x 9.39" (522.4 mm x 385.0 mm x 238.5 mm)
Dimensions without Stand	20.57" x 12.54" x 2.49" (522.4 mm x 318.4 mm x 63.2 mm)
Display Weight	14.6 lb (6.64 kg)
Display Weight (w/o stand)	9.5 lb (4.31 kg)
Shipping weight	18.5 lb (8.4 kg)
Video Inputs	Analog, HDMI, DVI-D (w/HDCP)
HDCP	Yes
Audio Output	2 speakers, 2W/ch
Compatibility	Windows® 7, 8, 10 - HID Compliant - no drivers needed for basic touchscreen operation
External Connections	VGA D-Sub 15-pin, DVI 24-pin, HDMI 19-pin, USB - Type A to B, 3.5 mm audio in, AC Power In, USB 3.0 Hub (1 up, 4 down)
Power Supply	Internal
Power Requirements	100 to 240 VAC, 50/60Hz
Power Consumption (max)	28W (.5W standby and off)
Operating Temperature	0° to +40° C
Humidity	10 - 85% RH (non-condensing)
VESA Compatible/Location	Built-in 100 mm VESA, back
Recommended Usage	Up to 16 hours per day
Service and Support	3-Year Customer First™ Warranty featuring FREE 2-Day Advance Replacement (US only). Please see warranty document for more details and for replacement procedures outside the US.
Options / Features	Dual-hinge stand, built-in USB Hub -USB 3.0 (1 up, 4 down), Kensington® Security Slot
Product Approvals	cTUVus, CE, FCC-B, RoHS II
CI-Black-PN	997-7251-00
In the Box	PCT2265 22" Wide Multi-Touch Monitor, Power Cord, VGA Cable, DVI-D cable, HDMI Cable, USB Cable (A to B), Audio-in Cable, User's Guide
UPC	8 10689 00001 3

For more information, please visit www.planar.com

Specifications are subject to change without notice.

Specification Report Date: 3/15/2019

Tech Spec

RoboSHOT 12 HDBT and RoboSHOT 30 HDBT

High-Performance PTZ Cameras

RoboSHOT™ 12 HDBT: 999-9960-000 (North America), 999-9960-001 (Europe/UK), 999-9960-009 (Australia/New Zealand)

RoboSHOT 30 HDBT, black: 999-9963-000 (North America), 999-9963-001 (Europe/UK), 999-9963-009 (Australia/New Zealand)

RoboSHOT 30 HDBT, white: 999-9963-000W (North America), 999-9963-001W (Europe/UK), 999-9963-009W (Australia/New Zealand)

Camera Features

- RoboSHOT 12 HDBT: Exmor® 1/2.8 type, high-speed, low-noise image sensor; 12X optical zoom; 73° horizontal field of view in wide mode – perfect for small to medium rooms
- RoboSHOT 30 HDBT: Exmor R™ back-lit 1/2.8 type, high-speed, low-noise image sensor; 30X optical zoom; 65° horizontal field of view for medium to large venues – houses of worship, lecture theaters, IMAG systems
- 2.38 megapixels total, full HD (native 1080p/60)
- Improved color mapping for true, vivid color
- IP H.264 streaming – view real-time video from the camera using any standards-based media viewer
- Tri-Synchronous Motion™ simultaneous 3-axis pan/tilt/zoom movement between presets
- Smooth, silent direct-drive motors – ultra-accurate positioning, from 120° per second down to 0.35° per second
- Designed for use with the Vaddio OneLINK™ HDMI extension module for HDBaseT Cameras
- Web interface for remote administration and operation, integration-ready Telnet or RS-232 control, presenter-friendly IR remote control

Back of the Camera

Rear panel connections are identical for both models.
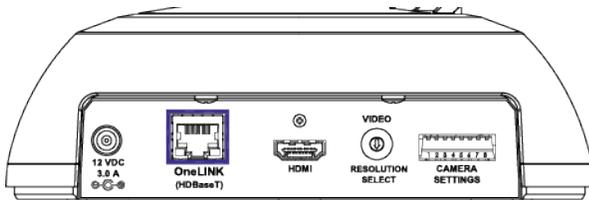
From left to right:

- **Power connector:** If not using a OneLINK HDMI extension module, use the 12 VDC, 3.0 A power supply shipped with the camera.
- **OneLINK HDBaseT/Network RJ-45 connector:** If not using a OneLINK HDMI extension module, connect to the network.
- **HDMI connector:** HDMI video output; connect to a display if not using a OneLINK HDMI extension module.
- **Video Resolution Select switch:** Select the video output resolution.
- **Camera Settings DIP switches:** Settings for IR remote frequency, baud rate and image flip.

What's Included

Each RoboSHOT HDBT camera is shipped with these items:

- Vaddio IR Remote Commander
- Thin profile wall mount with mounting hardware
- 12 VDC, 3.0 amp switching power supply and AC cord set(s)
- Quick-Start Guide

Basic Connection Diagram
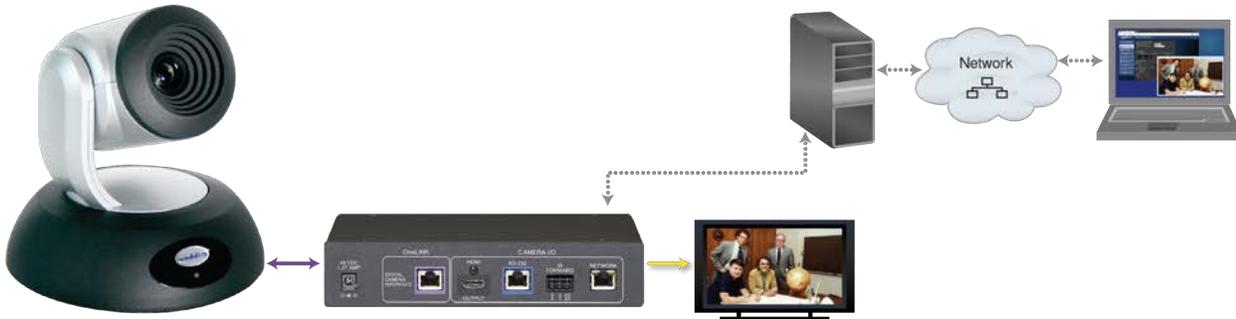
The OneLINK™ HDMI extension module is not required; the camera can be connected directly to the network.

Specifications

Camera and image

Image device	RoboSHOT 12 HDBT: 1/2.8-Type Exmor® CMOS sensor		
	RoboSHOT 30 HDBT: 1/2.8-Type Exmor R™ backlit CMOS sensor		
Pixels	2.14 million (effective), 2.38 million (total)		
Pan and tilt	Pan ± 160°, tilt +90° -30°; pan and tilt speed 0.35°/sec to 120°/sec		
Lens and horizontal FOV	RoboSHOT 12 HDBT		
	Normal (default): 10X optical zoom, 67.3° (wide) to 7.6° (tele), f=3.8mm to 38.0mm, F1.8 to F3.4		
	Super Wide: 12X optical zoom, 73.0° (wide) to 6.6° (tele), f=3.91mm to 47.0mm, F1.8 to F3.4		
	RoboSHOT 30 HDBT		
	30X optical zoom, 65° (wide) to 2.3° (tele), F1.6 to F4.7		
Min. working distance	RoboSHOT 12 HDBT: 10mm (wide), 0.8m (tele)		
	RoboSHOT 30 HDBT: 10mm (wide), 1.2m (tele)		
Min. illumination	Recommended: 100+ lux	**Gain**	Auto / Manual (28 steps)
Backlight compensation	On/off	**Aperture/detail**	16 steps
Focusing system	Auto Focus / Manual Focus Mode / One Push Trigger Mode / Infinity Mode / Near Limit Mode		
White balance	Auto, ATW, Indoor, Outdoor, One-push, Manual		
Sync system	Internal	**S/N ratio**	More than 50 dB
Noise reduction	On/Off, 6 Steps	**Power**	12 VDC, 3.0 A or PoE+
Remote management	IR Remote Commander, web interface, Telnet and RS-232 command APIs		

Physical and Environmental

Height	6.9 in. (176 mm)	**Weight**	4.85 lbs.(2.2 kg)
Width	7.1 in. (179 mm)	**Operating/storage temperature**	0°C to +40°C (32°F to 104°F)
Depth	6.8 in. (172 mm)	**Operating/storage humidity**	20% to 80% RH, non-condensing

Specifications are subject to change without notice.

wePresent WiCS-2100

Inspiring collaboration with wireless presentations

- **Share audio and video content from a Chromebook or Android device, using Google's native Chromecast protocol**

- **Integration of audio/ video content from an iOS device, using Apple's native AirPlay protocol**

- **On screen user preview displays thumbnails of all connected devices for immediate preview**

- **Dynamic screen layout that allows multiple presenter's content to configure automatically to optimize display.**

- **Eco standby mode that utilizes discreet power to maintain functionality**

wePresent's WiCS-2100 is a simple to use wireless presentation collaboration solution that allows presentation, interaction and collaboration between users with any kind of device. WiCS-2100 is the first wePresent unit to offer eco standby mode which allows for reduced power consumption without compromising any performance or reliability. Eco standby mode utilizes discreet power to maintain functionality while conserving energy use.

Features for effective collaboration

Expanding upon wePresent's wireless, cross platform presentation gateway technology, the WiCS-2100 provides businesses and educators with new features specifically designed for more efficient and effective collaboration. WiCS-2100 offers the interactive features found in WiPG-1600W with additional upgrades designed to make meeting and learning experiences more collaborative.

Student Monitor

Teachers (or moderators) can preview a thumbnail of a student's (or other user's) device on their own computer or device. This feature in the wePresent Education Pack helps monitor a student's activity or presentation before it is sent to the main display. Teachers can focus even more on coaching and keeping their students on the right track.

Google and Apple AirPlay support

WiCS-2100 offers integration with Chromecast and AirPlay devices, including audio and video support. This allows users of both mirroring solutions to collaborate simultaneously and take advantage of the full range of on-board interaction and collaboration tools available such as on screen annotation and interactive whiteboard capabilities.

BARCO

Improved multi user Layout & conference controls

02

With dynamic screen layout, on screen collaboration becomes quicker and more flexible.   WiCS-2100 adapts to multiple presenters by automatically configuring the presentation content to optimize display.

For environments where moderator control is crucial, WiCS-2100 offers the conference controller an on screen user preview for up to 32 logged in users as well as the ability to lock down the presentation from others.

WiCS-2100 brings effective wireless collaboration to boardrooms, classrooms and anywhere people work together.

PRODUCT SPECIFICATIONS	WEPRESENT WICS-2100
Operating system	Windows 7, 8, 10 and above macOS X, 10.9 and above Android 4.1 and above iOS 9 and above
Native industry standard support	Apple AirPlay Google Cast
Video Output	1 x HDMI
Frame rate	up to 30 fps
Output resolution	up to 1080p
Connected users	up to 32 via Wi-Fi or 64 via LAN
Sources	up to 4 simultaneously with dynamic screen layout
Audio Outputs	HDMI analog via audio jack 3.5mm
Authentication protocol	WPA / WPA2 PSK Station mode 802.1x EAP
Wireless transmission protocol	2.4G(b/g/n) / 5G(a/n/ac) switchable
Interfaces	1 x Ethernet LAN 1 x (back) + 1 x (front) USB
Power consumption	11.79W（full load power consumption） under test conditions: · Power source : DC 12V · SW version : RC217 · HW version : ER · USB port : 0.5A load (each port) · WiFi : 5G/11ac (project four 1080p video stream) · Ethernet port : Transfer iperf packet · HDMI : Output four picture · Phone Jack : Connect to earphone
Heat dissipation	19 BTU/hr
Weight	1000±5%g（with package） 344±5%g（without package）
Dimensions	169.87 x 129.19 x 45.52mm（without package） 215 x 218 x 103mm（with package）
Environmental temperature	Operation temperature: 0°C -+40°C Storage : -20°C -+70°C
Environmental humidity	Operational : ＜85% Storage : ＜90%RH

ENABLING BRIGHT OUTCOMES

BARCO

A Raised Floor Box for Every Application

Wiremold® FloorSource™ Series Raised Floor Boxes offers a large selection of raised floor boxes to meet most user's needs. FloorSource Raised Floor Boxes provide functionality, flexibility, accessibility, and capacity when it comes to raised floor and shop floor box applications. They have many applications, some of which are PBX rooms, MIS processing rooms, university computer labs, financial institutions and houses of worship. Wiremold provides four unique styles of boxes which allow users a wide variety of power and communication configurations. FloorSource Raised Floor Boxes and Stage Floor Boxes are also compatible with the Walkerflex® Manufactured Wiring System.

AF Series™ Raised Floor Boxes offer flexibility, accessibility, and capacity.

FEATURES & BENEFITS

■ **Locking tabs.** Helps to secure box to floor panel and makes installation quick and easy.

■ **Available prewired.** Units can be prewired for power reducing labor costs for field installation.

■ **Large multi-compartment boxes.** Provides adequate wiring capacity and easily isolates power and communication services.

■ **Multiple depth profiles.** Boxes are available in multiple depth profiles allowing users to meet different raised floor depth requirements.

■ **Triple service capacity.** Accommodates power, communication and/or audio/video devices. Eliminates the need for multiple boxes

■ **Ease of installation.** FloorSource Raised Floor Boxes are designed to be installed after floor coverings have been installed.

■ **Flexible box designs.** Users can configure services where they want and need them.

■ **Listed by Underwriters Laboratories Inc. to U.S. and Canadian safety standards.**

■ **Meets NEC Section 300-22(C).** AC, AF, SAF, and CRFB Series Floor Boxes are suitable for use in air handling spaces and raised floor plenums.

■ **Datacom connectivity options.** Accepts industry standard and proprietary devices from a wide range of manufacturers to provide a seamless and aesthetically pleasing interface for voice, data, audio, and video applications at the point-of-use.

FloorSource™ Rectangular Raised Floor Boxes.

TOP GUARD™ — Protection from water, dirt, and debris.

AF1

The AF1 Raised Floor and Stage Floor Box provides three separate compartments that accommodate a combination of power, communication and audio/video devices. This combination is accomplished with the built-in service dividers. These dividers are arranged in a single-double, single-gang configuration. Die-cast aluminum housing provides added strength and reliability. Polycarbonate hinged lid and trim flange are available for carpet or tile applications, as well as color choice of black, brown, or gray.

DESCRIPTION	DIMENSIONS
Overall Trim Ring	8 3/4" x 6 3/4" [222mm x 171mm]
Module Depth Overall	5" [127mm]
Panel Opening	8" x 6" [203mm x 152mm]
Cover Size	7 1/2" x 5" [191mm x 127mm]
Activation Chamber Volume	130 cu in. [2130ml]
User Volume	78.6 cu in. [1288ml]
Total Volume	208.6 cu in. [3418ml]
Knockout Sizes	Seven (7) 1/2" & Two (2) 3/4" Trade Size KOs (Power Side only)
Service	Triple
Maximum Floor Thickness	1 1/2" [38mm] (includes floor covering)

Devices shown in photo are sold separately.

AF3

The AF3 Raised Floor and Stage Floor Box provides four separate compartments that accommodate up to eight gangs of communication, power and/or audio/ video devices. The top panel has a unique built-in service divider that accommodates a combination power, communication and audio/video devices. These dividers are arranged in a single-double, single-gang configuration. The lower panel provides single-gang activation points in a single service configuration. Die-cast aluminum housing provides added strength and reliability. Polycarbonate hinged lid and trim flange are available for carpet or tile applications, as well as a color choice of black, brown, or gray.

DESCRIPTION	DIMENSIONS
Overall Trim Ring	9 1/8" x 11" [232mm x 279mm]
Module Depth Overall	5" [127mm]
Panel Opening	8" x 10" [203mm x 254mm]
Cover Size	7 1/2" x 9 1/2" [191mm x 242mm]
Activation Chamber Volume	220 cu in. [3604ml]
User Volume	180 cu in. [2948ml]
Total Volume	300 cu in. [4915ml]
	Knockout Sizes Seven (7) 1/2" & Two (2) 3/4" Trade Size KOs (Power Side only)
	Service Triple
	Maximum Floor Thickness 1 1/2" (includes floor covering)
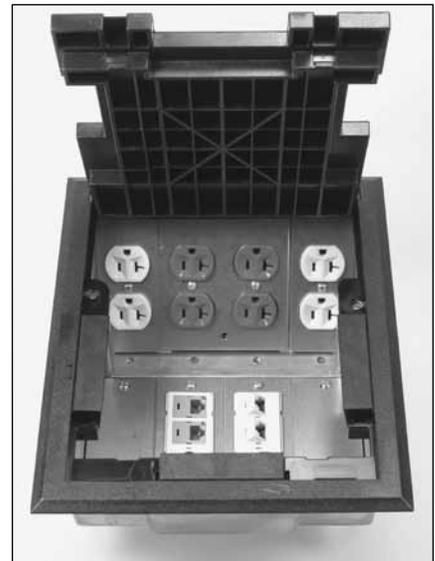
Devices shown in photo are sold separately.

Catalog No./Item	Description/Specifications
AF1-KC Black Carpet Cover **AF1-KT** Black Tile Cover **AF1-NC** Brown Carpet Cover **AF1-NT** Brown Tile Cover **AF1-YC** Gray Carpet Cover **AF1-YT** Gray Tile Cover	**AF1 Series Raised Floor Box** – Provides three compartments for power, communication and audio/video devices. Select device plates on page 3.

Top

Devices sold separately.

Catalog No./Item	Description/Specifications
AF3-KC Black Carpet Cover **AF3-KT** Black Tile Cover **AF3-NC** Brown Carpet Cover **AF3-NT** Brown Tile Cover **AF3-YC** Gray Carpet Cover **AF3-YT** Gray Tile Cover	**AF3 Series Raised Floor Box** – Provides four compartments for power, communication and audio/video devices. Select device plates on page 3.

Top

Devices sold separately.

Bottom

Upper (Top) Panel Device Plates for AF1 and AF3 Boxes

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
SGT-B	**Single-Gang Plate** – Blank.	**DGT-B**	**Double-Gang Plate** – Blank plate. Use in center compartment only.
SGT-DP	**Single-Gang Plate** – One duplex opening.	**DGT-2DP**	**Double-Gang Plate** – Two duplex openings. Use in center compartment only.
SGT-H	**Single-Gang Plate** – For Heyco bushing opening or single receptacle 1.046" [35.7mm]. Use in outer, side compartments only.	**DGT-DP/B**	**Double-Gang Plate** – One duplex opening and blank. Use in center compartment only.
SGT-1KO	**Single-Gang Plate** – 1" [25mm] knockout.	**DGT-AAP**	**Internal Audio/Video Plate** – Accepts three (3) Extron® Electronics AAP Series Devices (Sold separately).
SGT-ACT	**Single-Gang Plate** – Accepts three (3) 2A Pass & Seymour® Activate inserts.	**DGT-ACT**	**Double-Gang Plate** – Use in center compartment only. Includes one Activate adapter.
SGT-3S2	**Single-Gang Plate** – Accepts three 93) Ortronics® Series II inserts.	**DGT-MAAP**	**Internal Audio/Video Plate** – Accepts Five (5) Extron® Electronics MAAP Series Devices (Sold separately).
SGT-MAAP	**Internal Audio/Video Plate** – Accepts three (3) Extron® Electronics MAAP Series Devices (Sold separately).	**DGT-RT**	**Double-Gang Plate** – Use in center compartment only. Includes one (1) Ortronics® Series II adapter and one (1) TracJack adapter.
		SGT-3TJ	**Single-Gang Plate** – Accepts three (3) Ortronics® TracJack inserts.
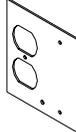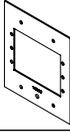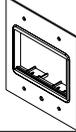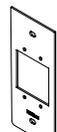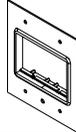
Lower (Bottom) Panel Device Plates for AF3 Boxes Only

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
SGB-B	**Single-Gang Plate** – Blank.	**SGB-ACT**	**Single-Gang Plate** – Accepts three Pass & Seymour® 2A Activate inserts.
SGB-DP	**Single-Gang Plate** – One duplex opening.	**SGB-3S2**	**Single-Gang Plate** – Accepts three (3) Ortronics® Series II inserts.
SGB-MAAP	**Internal Audio/Video Plate** – Accepts two (2) Extron® Electronics MAAP Series Devices (Sold separately).	**SGB-3TJ**	**Single-Gang Plate** – Accepts three (3) Ortronics® TracJack inserts.
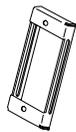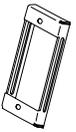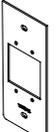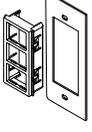
NOTE: Lower panel accommodates four single-gang plates.

AC8850 and AC8105

The AC8850 and AC8105 are boxes with a 5" [127mm] depth design, with the AC8105 providing an extra 2" [51mm] of width for additional wiring capacity. These boxes can accommodate four duplex power receptacles on one side. Power plate with duplex knockouts included with box. The communication plate will accept at least three communication adapters for up to 18 ports of activation. Lids rotate 180° for easy orientation. Gray lids are die-cast zinc construction.
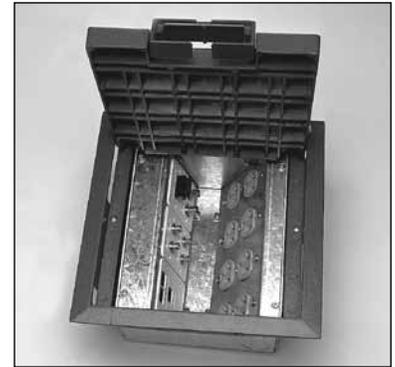
Devices shown in photo are not supplied.

DESCRIPTION	AC8850 DIMENSIONS	AC8105 DIMENSIONS
Box Dimensions	8" x 8" x 5" [203mm x 203mm x 127mm]	8" x 10" x 5" [203mm x 254mm x 127mm]
Overall Trim Ring	9 1/4" x 9 1/4" [235mm x 235mm]	9 1/4" x 11 1/4" [235mm x 286mm]
Module Depth Overall	5" [127mm]	5" [127mm]
Panel Opening	8" x 8" [203mm x 203mm]	8" x 10" [203mm x 254mm]
Cover Size	7 11/16" x 7 11/16" [195mm x 195mm]	7 11/16" x 9 11/16" [195mm x 246mm]
Activation Chamber Volume	97.22 cu in. [1593ml]	111.08 cu in. [1820ml]
User Volume	102.22 cu in. [1674ml]	151.97 cu in. [2490ml]
Total Volume	199.22 cu in. [3264ml]	262.97 cu in. [4309ml]
Knockouts	**Power** – Four (4) 1/2"-3/4" Trade Size Concentric KOs **Communication** – Four (4) 1/2"-3/4" Trade Size Concentric KOs	
Service	Single	Triple
Maximum Floor Thickness	2" [51mm] (including floor covering)	2" [51mm] (including floor covering)

AC Series Power Plates

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
P8105-4DP	**Double-Gang Plate** – Four duplex KOs. One plate supplied with AC8105 box.	**P8850-4DP***	**Power Plate** – Four duplex KOs. One plate supplied with AC8850 box.
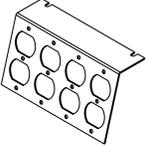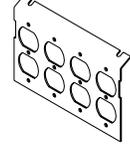
AC Series Communication Plates

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
C8005P-3DBP*	**Communication Plate** – Three duplex KOs for 106 communication style adapter. Fits both AC8850 and AC8105 Boxes.	**C8850P-RT*** **C8850P-2RT***	**Communication Plate** – For AC8850 Box. Includes one (1) or two (2) Ortronics® Series II and one (1) or two (2) TracJack adapters.
C8850P-ACT* **C8850P-2ACT***	**Communication Plate** – For AC8850 Box. Includes one (1) or two (2) Pass & Seymour® 6A Activate adpters.	**C8005P-3RT***	**Communication Plate** – For AC8850 and AC8105 Boxes. Includes three (3) Ortronics® Series II and three (3) TracJack adapters.
C8005P-3ACT*	**Communication Plate** – For AC8850 and AC8105 Boxes. Includes three (3) Pass & Seymour® 6A Activate adapters.	**C8005P-AAP-6A***	**Internal Audio/Video Plate** – Accepts six (6) Extron® Electronics AAP Series Devices (Sold separately) and one (1) CM communication adapter. **NOTE: For use in AC8105 Style box.**
C8005P-MAAP-6A*	**Internal Audio/Video Plate** – Accepts six (6) Extron® Electronics MAAP Series Devices (Sold separately) and one (1) CM communication adapter. **NOTE: For use in AC8105 Style box.**		
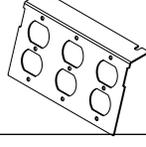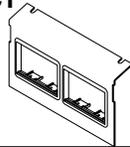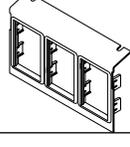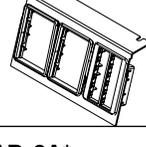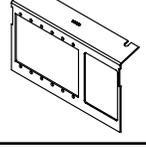
* AC8850 is a single-service box. Power plates cannot be used in conjunction with communication plates.
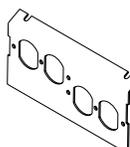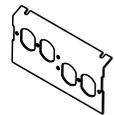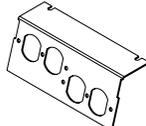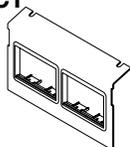
AC8840 and AC8104

The AC8840 and AC8104 are boxes with a 4" [102mm] depth design, with the AC8104 providing an extra 2" [51mm] of width for added wiring capacity. These boxes can accommodate two duplex power receptacles on one side. Power plate with duplex knockouts included with box. The communication plate will accept two communication adapters for up to 12 ports of activation. Lids can be rotated 180° for easy orientation. Gray lids are die-cast zinc construction.

Devices shown in photo are not supplied.

DESCRIPTION	AC8840 DIMENSIONS	AC8104 DIMENSIONS
Box Dimensions	8" x 8" x 4" [203mm x 203mm x 102mm]	8" x 10" x 4" [203mm x 254mm x 102mm]
Overall Trim Ring	9 1/4" x 9 1/4" [235mm x 235mm]	9 1/4" x 11 1/4" [235mm x 286mm]
Module Depth Overall	4" [102mm]	4" [102mm]
Panel Opening	8" x 8" [203mm x 203mm]	8" x 10" [203mm x 254mm]
Cover Size	7 11/16" x 7 11/16" [195mm x 195mm]	7 11/16" x 9 11/16" [195mm x 246mm]
Activation Chamber Volume	63.92 cu in. [1047ml]	76.87 cu in. [1260ml]
User Volume	84.34 cu in. [1382ml]	130.09 cu in. [2131ml]
Total Volume	152.34 cu in. [2496ml]	201.09 cu in. [3295ml]
Knockouts	**Power** – Four (4) 1/2"-3/4" Trade Size Concentric KOs **Communication** – Two (2) 1/2"-3/4" Trade Size Concentric KOs	
Service	Single	Dual
Maximum Floor Thickness	2" [51mm] (including floor covering)	2" [51mm] (including floor covering)

AC Series Power Plates

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
P8840-2DP	**Power Plate** – Two duplex KOs. One plate supplied with AC8840 box.	**C8004P-2DBP***	**Power Plate** – Two duplex KOs. For AC8840 and AC8104 Boxes.
P8104-2DP*	**Power Plate** – Two duplex KOs. One plate supplied with AC8104 box.		

* AC8840 is a single-service box. Power plates cannot be used in conjunction with communication plates.

AC Series Communication Plates

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
C8004P-2ACT*	**Communication Plate** – For AC8840 and AC8104 Boxes. Includes two (2) Pass & Seymour® 6A Activate adapters.	**C8004P-2RT***	**Communication Plate** – For AC8840 and AC8104 Boxes. Includes two (2) Ortronics® Series II adapters and two (2) TracJack adapters.

* AC8840 is a single-service box. Power plates cannot be used in conjunction with communication plates.
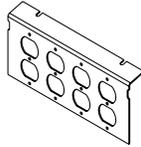
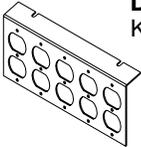# AC Series Raised Floor Boxes

AC10105-2

The AC10105-2 box with a 5" [127mm] depth is a square profile box that provides eight-gangs of power and/or communication device capacity. Power plate with duplex knockouts included with box. The AC10105-2 also provides increased plug-in volume which is ideal for the additional space needed when plugging in transformer type plugs. Lids can be rotated 180° for easy orientation. Gray lids are die-cast zinc construction.
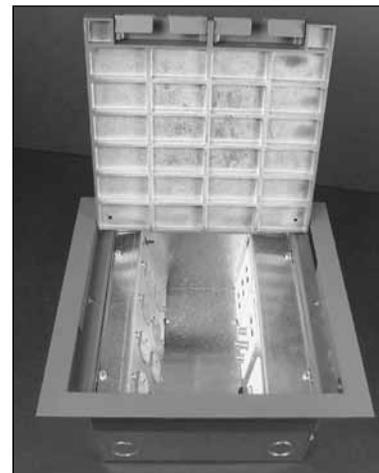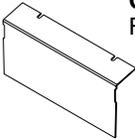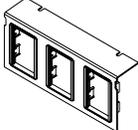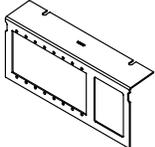

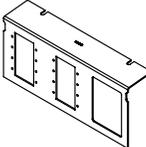| DESCRIPTION	DIMENSIONS
Box Dimensions	10" x 10" x 5" [254mm x 254mm x 127mm]
Overall Trim Ring	11 1/2" x 11 1/2" [292mm x 292mm]
Module Depth Overall	5" [127mm]
Panel Opening	10" x 10" [254mm x 254mm]
Cover Size	9 5/8" x 9 5/8" [245mm x 245mm]
Activation Chamber Volume	115 cu in. [1884ml]
User Volume	243 cu in. [3981ml]
Total Volume	358 cu in. [5865ml]
Knockouts	**Power** – Four (4) 1/2" Trade Size Concentric KOs **Communication** – Four (4) 1/2"-3/4" Trade Size Concentric KOs
Service	Triple
Maximum Floor Thickness	2" [51mm] (includes floor covering)

AC Series Power Plates

Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
P10105-4DP	**Double-Gang Plate** – Four duplex KOs. One plate supplied with AC10105 box.	**P10105-5DP**	**Double-Gang Plate** – Five duplex KOs.

AC Series Communication Plates

| Catalog No./Item	Description/Specifications	Catalog No./Item	Description/Specifications
C10105P-B	**Communication Plate** – Blank. For AC10105 Box.	**C10105P-3RT**	**Communication Plate** – For AC10105 Box. Includes three (3) Ortronics® Series II adapters and three (3) TracJack adapters.
C10105P-3ACT	**Communication Plate** – For AC10105 Box. Includes three 6A Activate adapters.	**C10105P-MAAP-6A**	**Internal Audio/Video Plate** – Accepts eight (8) Extron® Electronics MAAP Series Devices (Sold separately) and one (1) CM communication adapter.
C10105P-AAP-6A	**Internal Audio/Video Plate** – Accepts eight (8) Extron® Electronics AAP Series Devices (Sold separately) and one (1) CM communication adapter.		
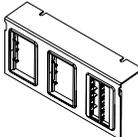
SAF21/2 Series Raised Floor Box

Catalog No./Item	Description/Specifications

SAF21/2-KC Black Carpet Lid and Flange
SAF21/2-KT Black Tile Lid and Flange
SAF21/2-NC Brown Carpet Lid and Flange
SAF21/2-NT Brown Tile Lid and Flange
SAF21/2-YC Gray Carpet Lid and Flange
SAF21/2-YT Gray Tile Lid and Flange

SAF Raised Floor Box – The SAF Shallow Raised Floor Box has been designed to fit into 2 1/2" floor depths and provides two compartments that accommodate a combination of power, communication and audio/video devices. The SAF21/2 can accommodate two duplex receptacles on one side and up to six communication devices on the other side. The power and communication compartments can only be used for designated services. Four 1/2" trade size KOs are in the sides of the box to feed the power devices. The hinged polycarbonate lid and trim flange for carpet or tile are available in black, brown, or gray. Two duplex receptacle power plates are supplied with each box. Receptacles not included. Three blank communication plates are included with each box. Box includes a communication compartment cover plate for use in air handling spaces. SAF21/2 Box will accept up to two SG2 Power Plates, and up to three SGC2 Communication Plates. Consult factory for custom plates.
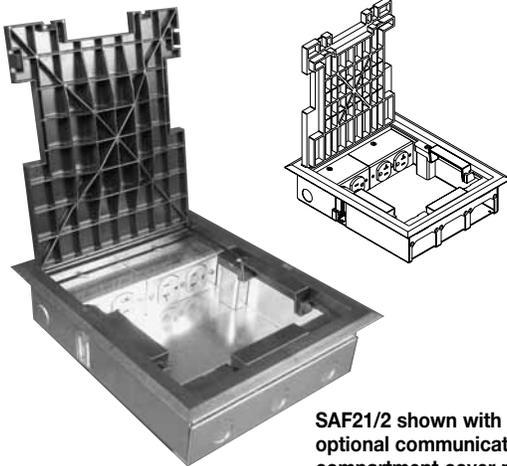
SAF21/2 shown with optional communication compartment cover plate (provided with box).
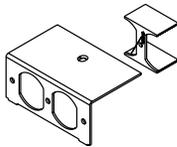
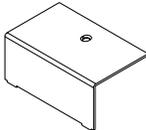| DESCRIPTION	DIMENSION
Overall Trim Ring	9 1/8" x 11" [232mm x 279mm]
Module Depth Overall	2.5" [64mm]
Panel Opening	8" x 10" [203mm x 254mm]
Cover Size	7 1/2" x 9 1/2" [191mm x 242mm]
Activation Volume	18.5 cu in. [303ml]
Power Volume	29 cu in. [475ml]
Max. Floor Panel Thickness with Floor Covering	1 3/16" [30mm]
Knockouts	**Power** – Four (4) 1/2" Trade Size Concentric KOs **Communication** – Three (3) 1/2" Trade Size Concentric KOs
Service	Triple
Maximum Floor Thickness	1 3/8" [35mm] (including floor covering)

SAF21/2 Series Plates
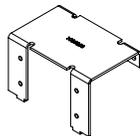
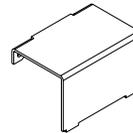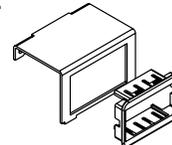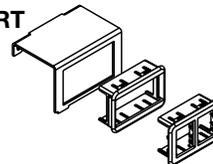| Catalog No./Item	Description/Specifications
SG2-DP	**Power Plate** – Single-gang duplex receptacle. Two plates supplied with SAF21/2 Box.
SG2-B	**Power Plate** – Single-gang blank plate.
SGC2-MAAP	**Communication Plate** – Accepts two (2) Extron® Electronics MAAP devices (Sold separately).

Catalog No./Item	Description/Specifications
SGC2-B	**Communication Plate** – Single-gang blank. Three plates supplied with each SAF21/2 Box.
SGC2-ACT	**Communication Plate** – Single-gang adapter. Includes one (1) Pass & Seymour® 2A Activate adapter.
SGC2-RT	**Communication Plate** – Includes one (1) Ortronics® Series II adapter and one (1) TracJack adapter.

Static Load Capacities for FloorSource Products

Product Series	Maximum Load in Pounds*
AF1 & AF2 Tile	833 lbs.
AF1 & AF2 Carpet	1066 lbs.
AF3 & AF4 Tile	820 lbs.
AF3 & AF4 Carpet	433 lbs.
SAF Tile	1400 lbs.
SAF Carpet	1067 lbs.
AC8840 & AC8850	1178 lbs.
AC8104 & AC8105	855 lbs.
AC10105-2	1666 lbs.

*Load applied through a 2" [51mm] mandrel in center of cover. Loads are static load ratings and do not apply to rolling loads.

861 Series Raised Floor Boxes

Walker offers a complete line of single service round raised floor boxes. The small profile boxes are available in over twenty cover options. See the current version of ED1260 (861 Series Raised Floor Boxes) for complete details.

ED670R15 – Updated May 2014 – For latest specs visit www.legrand.us/wiremold

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A.   Comply with Delaware Sate-Wide Information Techanology and Architecture Standards (NE-Cabling-002)

B.   Comply with Communication Service Provider requirements.

C.   Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

D.   Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 13.

3.02 INSTALLATION OF PATHWAYS

A.   Install pathways with the following minimum clearances:
   1.   48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
   2.   12 inches from power conduits and cables and panelboards.
   3.   5 inches from fluorescent and high frequency lighting fixtures.
   4.   6 inches from flues, hot water pipes, and steam pipes.

B.   Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

C.   Firestopping: Seal openings around pathway penetrations through fire-rated walls, partitions, floors, and ceilings in accordance with Section 07 84 00.

END OF SECTION

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DRAWINGS REDACTED