COMMSCOPE®

SYSTIMAX® GigaSPEED® X10D High Density Shielded Solution

Design and Installation Guidelines

April 2011

at work

CONTENTS

OVERVIEW

CommScope, through its SYSTIMAX brand, manufactures a modular, flexible telecommunications cabling distribution system with a complete line of products supporting:

- Analog and digital voice
- High-speed data systems and local area networks (LANs)
- Video and imaging (e.g., CCTV, CATV)
- Intelligent Building Infrastructure Buildings (IBIS) - (e.g., fire, security, heating, ventilation, and air conditioning [HVAC], etc.).

The purpose of this guide is to help customers to design and install a SYSTIMAX cabling system that complies with the SYSTIMAX GigaSPEED X10D guaranteed performance specifications and is capable of supporting 10GBASE-T (10 Gigabit Ethernet over twisted pair) LAN over the configurations specified up to a full 100 meter, 4-connection channel. The GigaSPEED X10D FTP solution meets or exceeds all the Category 6A/Class E_A requirements in ANSI/TIA-568-C.2, CENELEC EN 50173 series, and ISO/IEC 11801:2002 including its amendments 1 & 2.

Additional information for design purposes can be found in the following documents:

- SYSTIMAX Performance Specifications
- Telecommunications cabling and associated standards published by organizations such as the American National Standards Institute and Telecommunications Industry Association (e.g., TIA-569-B, TIA-942), International Standardization Organization/International Electrotechnical Commission (e.g., ISO/IEC 11801, ISO/IEC 24764), and Comitee European de Normalisation Electrotechnique (CENELEC; e.g., EN 50173 and EN 50174 series).
- National and local codes such as the National Electrical Code (NEC), or equivalent documents.
- BICSI Telecommunications Distribution Methods Manual

This set of guidelines supports copper cabling solutions that conform to existing architectures, as defined by telecommunications cabling standards. Registered SYSTIMAX installations that conform to this guide and the SYSTIMAX Performance Specifications are covered by the SYSTIMAX 20-year Extended Product Warranty and Application Assurance. These guidelines also include:

- The standards defined architecture for the horizontal channel and permanent link
- Design options for SYSTIMAX components used within the channel

This information as well as support software and Application guides for system- and vendor-specific practices (e.g., SYSTIMAX 1000BASE-T Application Guide) can be found by visiting the CommScope web site at **www.commscope.com**

CODE REQUIREMENTS AND POWER SEPARATION

Refer to the "SYSTIMAX PowerSum and GigaSPEED Cabling Design Guidelines" and "Power Separation Guidelines for SYSTIMAX installations" for power separation guidelines. ANSI/TIA-942-A has Data Center guidelines that should also be followed.

Always check with applicable codes and standards, and consult with authorities having jurisdiction before submitting final designs. Applicable local or national safety regulations take precedence whenever their required separation distances are larger or other requirements conflict with those specified in this document. For example:

- In the UK, BS 7671
- In the USA, NEC

BONDING AND GROUNDING

Always check with applicable codes and standards, and consult with authorities having jurisdiction before submitting final designs. Applicable local or national safety regulations take precedence whenever their requirements conflict with those specified in this document.

The proper bonding and grounding of the telecommunications cabling, pathways, equipment, and connecting hardware is critical to achieve optimal cabling performance, reduce electromagnetic interference (EMI), protect equipment, and maintain safety for building occupants and maintenance personnel. Refer to the ANSI-J-STD-607- A-2002, ISO/IEC 60364, EN 50174-2 and EN 50310 for accepted industry practices.

Before cabling installation, the building should be checked to verify that excess ground voltages do not exist. Typical causes might be high-powered specialized equipment or faulty electrical wiring. Standards require less than 1 Vac and less than 1 Vdc between grounds at any points where FTP cabling is installed. SYSTIMAX FTP cabling must be grounded at locations where panels are installed, typically in each Equipment Room and Telecommunications Room (each Distributor). Grounding is generally not required at the TO since the application must provide proper grounding.

The primary components of a standardized telecommunications grounding and bonding infrastructure include:

- Telecommunications Main Grounding Busbar (TMGB) – located at the telecommunications EF and connected to the electrical EF and building grounding electrode system. At this point, the telecommunications grounding and bonding infrastructure is connected to other building grounding systems (e.g., electrical, water piping, lightning protection) and is also bonded to the metal framework of the building.
- Telecommunications Bonding Backbone (TBB) – ties TMGB to TGBs (typically No. 6 AWG).
- Telecommunications Grounding Busbar (TGB) – located in the TRs and EFs. These are also connected to the metal framework of the building.
- Grounding Equalizers (GE)– tie multiple TBBs together.

Consult the CommScope guideline "Earthing, Grounding and Bonding Guidelines for SYSTIMAX GigaSPEED X10D FTP/ScTP Cabling System". Specific documented bonding and grounding instructions should be provided to the installers.

ADMINISTRATION AND LABELING

Cabling administration and labeling is an important cabling element that allows for easy maintenance and management of the telecommunications cabling system. Use the labeling inserts supplied with the SYSTIMAX connecting hardware and faceplates to properly label the cabling components. Product labeling Word templates for SYSTIMAX panels are available on mycommscope.com. An online label set creation tool can also aid in filling out label templates. This will allow automatic generation of labeling sequences for SYSTIMAX cables, connecting hardware, and faceplates. Label sheets for these products include 8-1/2 x 11 inch or A4 format. Color-coded labels for termination fields should be implemented as follows:

TABLE 1: COLOR CODING OF CONNECTING HARDWARE FIELDS

Cabling Element	Color Code
Backbone Riser	WHITE
Backbone Tie	GRAY
Backbone Campus	BROWN
Horizontal	BLUE
Equipment	PURPLE
Network Interface (Cust. Side)	GREEN
Network Interface (CO Side)	ORANGE
Auxilliary Circuits, Alarms	YELLOW
Key Telephone Systems	RED

Cable should also be identified at both ends with labels suitable for wrapping. The labels should be made of a durable material such as vinyl, use a white printing surface, and wrap around the cable so that a clear label end self-laminates the printed area. If a cabling element contains mixed categories of cabling, such as a horizontal mixed with category 5E, they can be identified using enhanced color-coding such as white stripes on the blue label to differentiate X10D FTP cabling. Refer to the ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings for proper administration and labeling practices.

GENERAL CABLING GUIDELINES

- Follow local regulations and applicable codes of the "authority having jurisdiction".
- Refer to the TIA-568-C series or CENELEC 50174 for planning and installation practices.
- All cables, connecting hardware, interconnecting cords, bonding and grounding, and support structures should be visually inspected for proper installation. Telecommunications cables should be installed with proper pathway support.

They must:

- Not be placed directly on fluorescent light fixtures.
- Not be supported by ceiling grid systems, electrical conduits, gas, or water pipes.

Also:

- The use of cable lubricant is not allowed.
- Avoid water and water splatter, high humidity, and chemical contaminants including lubricants, paint and cleaning solvents.
- Avoid cold temperature bending of cables.

- Operating temperature range for SYSTIMAX copper cable is –4°F to 140°F (-20°C to 60°C)
- Installation temperature for SYSTIMAX copper cables cable is 32°F to 140°F (0°C to 60°C) However, at the extreme temperatures care must be exercised to prevent excessive kinking or increases in pulling tension. If the cable has been stored below 32°F (0°C) for more than 8 hours, the cable must be conditioned at room temperature, 59°F to 86°F (15°C to 30°C) for at least 4 hours before installation. The recommended installation temperature range is listed in the following table:

TABLE 3: CABLE WEIGHTS PER 1000FT (305M)

Cable Type	1291B	2291B	3291B
Weight	15.9 kg	17.6 kg	18 kg
	(35 lb)	(39 lb)	(40 lb)

BUNDLING AND ALIEN CROSSTALK

A primary feature of the GigaSPEED X10D FTP Cabling is the Alien Crosstalk performance in support of the 10GBASE-T standard. This performance is achieved even under the worst case condition of all cables routed together in the most tightly packed form. This is usually referred to as a "combed and laced" cable bundle where all cables maintain their position within a bundle and the bundle is tie wrapped at regular intervals. The GigaSPEED X10D FTP supports:

- Tie wrapping up to 3 times per meter (once every foot). Tie wraps must not distort cable jacket.
- Cable Tray vertical depths up to 23 cm (9 inches) using hardware with suitable protection, sweeping edges and well controlled entry. Check with raceway manufacturer for tray support and design and limitations. Note that general guidelines and current standards call for 15 cm (6 inches) maximum.
- GS10FP Cords may also be bundled by combing to eliminate crossovers and securing with tie wraps. Bundling is typical for long equipment cords. Crossconnect cords and Work Area cords are usually randomly placed or routed separately but not typically combed and tied, but they may be as well.

FILL GUIDELINES

The GigaSPEED X10D 91 series FTP cable diameters are 0.296 in. (7.5 mm) for 1291 and 3291 and 0.276 in. (7 mm) for 2291. For the 7.5 mm diameter, the following fill guidelines may be used:

- 1.4 cables per cm^2 (9 cables per in^2) in trays or other open raceways if the layout is done as follows –
  - cables are layed in place without tying in smaller bundles
  - crossovers are not made in the raceway
  - crossovers are not made where cables enter or exit the raceway
  - entries and exits are wide enough to sweep cables out from the raceway
- 1.1 cables per cm^2 (7 cables per in^2) in trays or other open raceways if cables have crossovers in the raceway and where individual cables randomly enter or exit the raceway. Note that density will be lowered further if tied bundles have crossovers in the raceway and randomly enter or exit the raceway, or if entry or exit openings are constrictive.

Note that raceway manufacturer's guidelines on fill and weight may be more restrictive. Consult the Cabling and Pathways Estimator tool on mycommscope.com. Plan for 25% fill allowing space for later additions. Conduits generally have 40% fill limits. Table 4 is a quick reference for different conduit sizes. Note that this can be increased where conduit is used for short sleeves and when careful feed and pulling is exercised.

TABLE 4: CONDUIT FILL

Conduit Size	1291/3291	2291
3/4	2	2
1	4	4
1.25	8	9
2	19	20
3	51	53
4	85	89

Faceplates and Boxes

HGS620 is compatible with most CommScope faceplates and boxes using the HGS M-Series Adapter (HGS-A-MS). Check for adequate rear clearance; 5 cm (2 in) from the front mounting surface position to the rear wall is required.

Installation alongside other cabling

Ensure that other cable types are routed, bundled, and terminated in separate groups.

CABLE/CORD DISTANCE

Typical channel guidelines call for no more than 90 meters of 91 series FTP cable and 10 meters of G10FP cord/cordage length. However, specific site guidelines may alter this if the site guidelines are effectively documented and followed. Often, additional cordage length is called for, with a corresponding decrease in cable distance.

There are several motivations for such a tradeoff. Cordage to a consolidation point is a coordinated design replacement for cable. Additional length of work area cords for multi-user telecom outlet assemblies requires the same coordination. Data center cords might need additional cord length to span large Equipment Distribution Areas.

These changes are coordinated so that strict attenuation limits are preserved. The following formula and table, adopted from ANSI/TIA/EIA-568-C1 may be used to determine alternate maximum cordage lengths useable with reduced cable length. These may be applied to any of the configurations outlined within this document.

Total Cord Length ≤ (102-Horizontal)/1.2

Horizontal Length ≤ 102 – 1.2 (Total Cord Length)

TABLE 5: ALTERNATE MAXIMUM LENGTHS FOR CABLE AND CORDAGE

Length of horizontal cable H m (ft)	Maximum combined length of work area cord, patch cords, and equiped cord C m (ft)
90 (295)	10 (33)
85 (279)	14 (46)
80 (262)	18 (59)
75 (246)	22 (72)
70 (230)	27 (89)

CORD AND CABLE GUIDELINES

Table 6 provides the minimum length and configuration guidelines for the GigaSPEED X10D FTP Solutions that are applicable to the work area and data center channel models shown in Figures 1 to 8.

Channel Components	2-Connection Channel (Figure 1, 6)	3-Connection Channel (Figure 2, 7)	3-Connection Channel (Figure 3, 8)	4-Connection Channel (Figure 4, 9)	4-Connection Channel (Figure 10)
Equipment Cord	1m (3.3 ft)	2m (6.6 ft)	2m (6.6 ft)	2m (6.6 ft)	2m (6.6 ft)
Cross-Connect Cord	Not Applicable	1m (3.3 ft)	Not Applicable	1m (3.3 ft)	1m (3.3 ft)
Horizontal Cable	3m (9.7 ft)	5m (16.4 ft)	5m (16.4 ft)	5m (16.4 ft)	5m (16.4 ft)
CP Cord	Not Applicable	Not Applicable	5m (16.4 ft)	5m (16.4 ft)	Not Applicable
Remote Cross-Connect Cord	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1m (3.3 ft)
Remote Equip-ment Cord/ Work Area Cord	1m (3.3 ft)	1m (3.3 ft)	1m (3.3 ft)	1m (3.3 ft)	2m (6.6 ft)

TABLE 6B: ADDITIONAL SUPPORTED CHANNEL CONFIGURATION WITH MINIMUM LENGTHS

Channel Components	Central Cross-connect Configuration
Equipment Cord	1m (3.3 ft)
Horizontal Cable	5m (16.4 ft)
Cross-Connect Cord	1m (3.3 ft)
Horizontal Cable	5m (16.4 ft)
Remote Equipment Cord	1m (3.3 ft)

WORK AREA CHANNEL MODELS

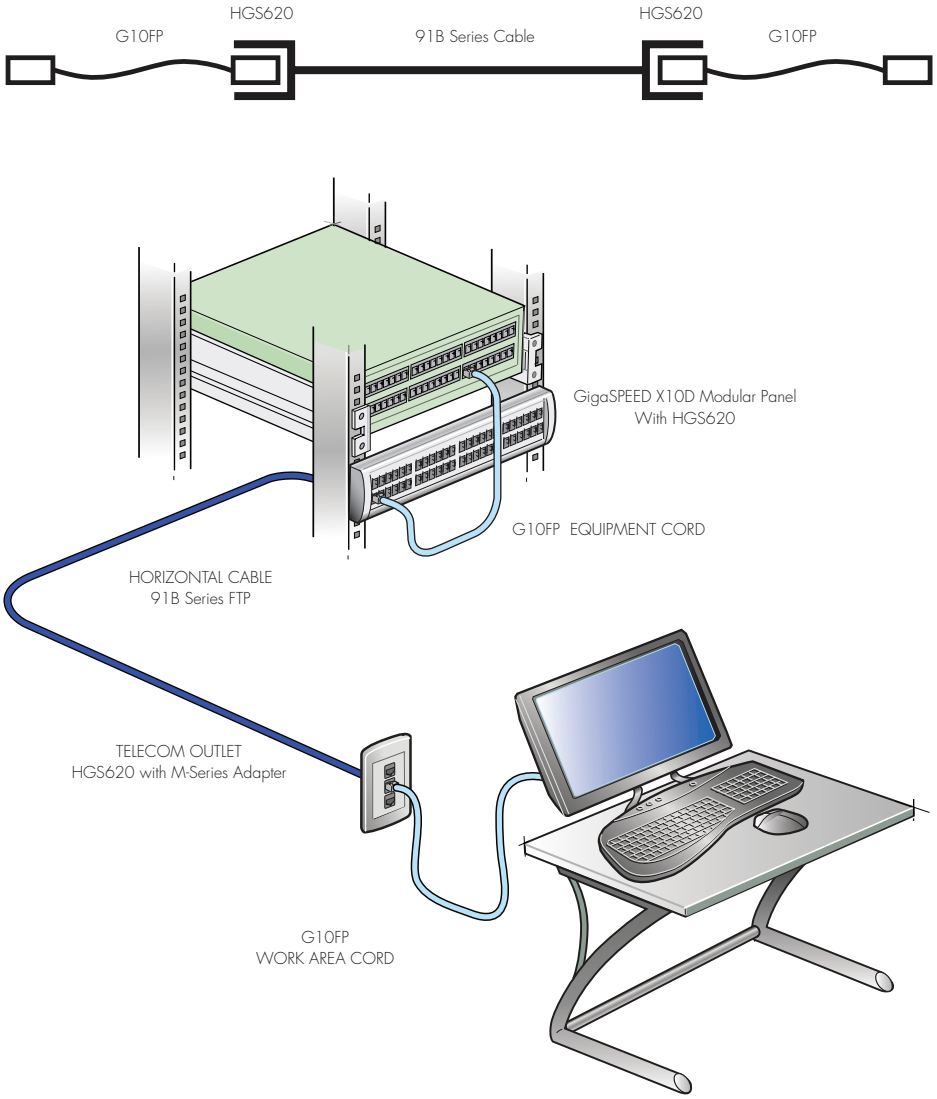
The following illustrations of the various channels identify connections from the central equipment (data switch, BAS controller, etc.) to the work area equipment (workstations, servers, etc.). They show the *TIA-568-C Commercial Building Telecommunications Cabling Standard and ISO/IEC IS 11801 Information Technology- Generic Cabling for Customer Premises* defined configurations containing up to four cabling connections. A connection is where two cabling segments come together.

These models are also commonly applied in backbone cabling subsystems, although the configurations like the Data Center channel models would also be used.

Two Connection Model

The most basic channel model has only 2 connections and is typically referred to and tested (without the cords) as a permanent link. The horizontal with the cords is tested as a channel.

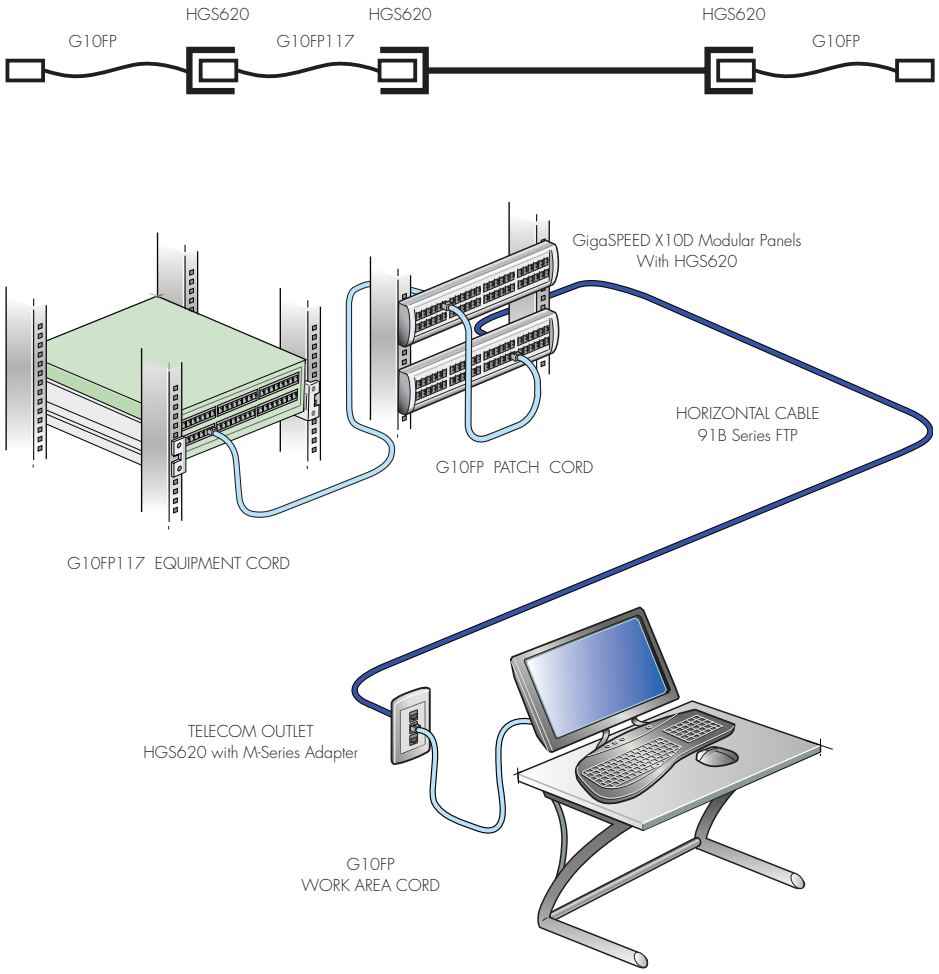
Figure 1. Two Connection Model, Interconnection to Telecommunications Outlet



Three Connection Models

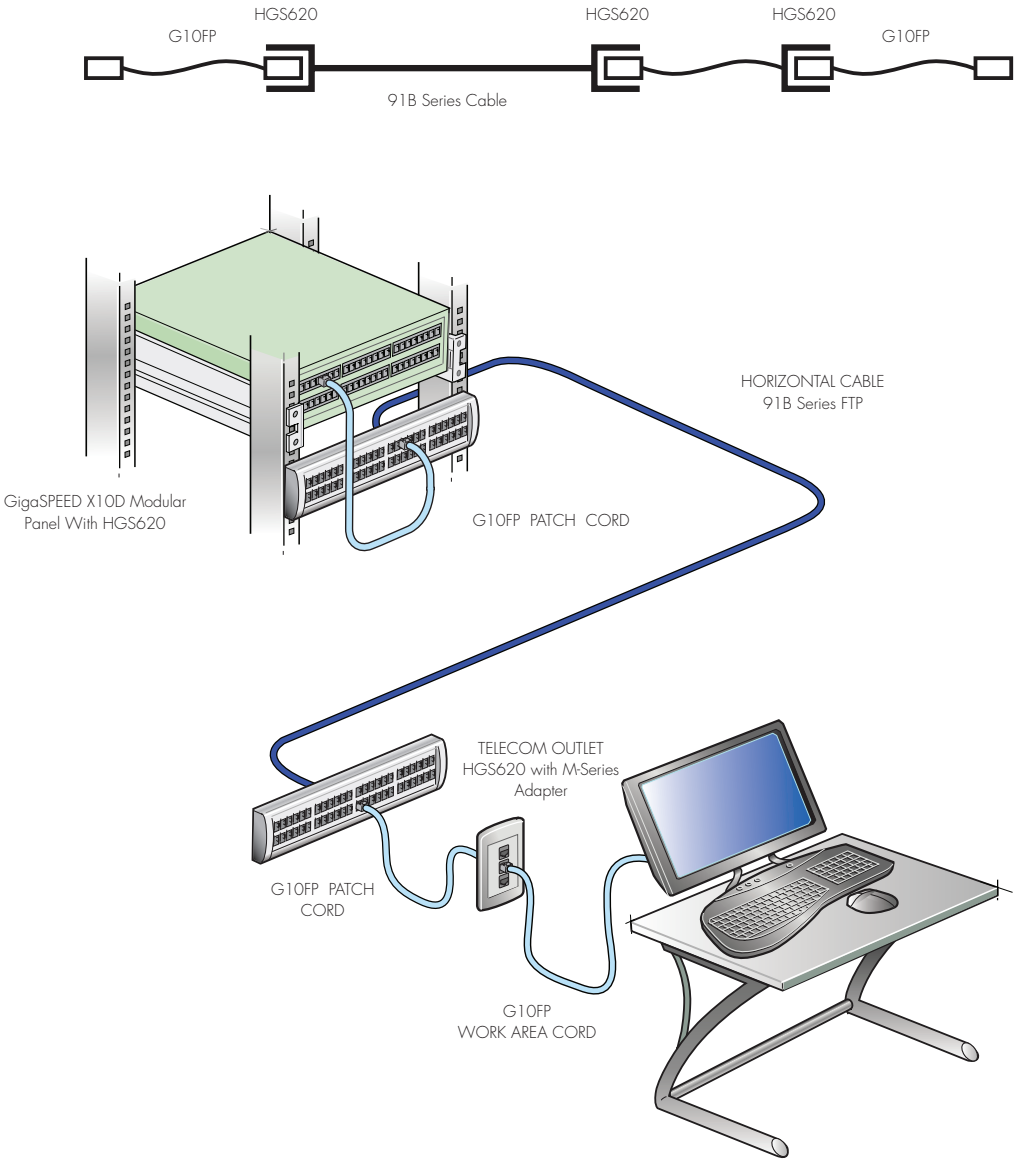
A third connection can support two different channel models, a cross-connection or a consolidation point. At large sites or sites with a high density of switching equipment or where space constraints might otherwise dictate, the Horizontal Distribution Area can be configured with a cross-connection. This configuration is typically referred to and tested (with the cords) as a channel. This configuration can also be applied to backbone cabling with a main cross-connect.

Figure 2. Three Connection Model: Cross-connection to Telecommunications Outlet



Where open office spaces may have a high turnover or where installation may be staged, the horizontal cable can be terminated at a consolidation point. This is often done for supporting modular office designs, allowing easy cabling changes from the consolidation point to the telecom outlet that follow changes made to the open office space. This configuration is typically called a permanent link. It may be tested without the cords as a permanent link, or with the cords as a channel.

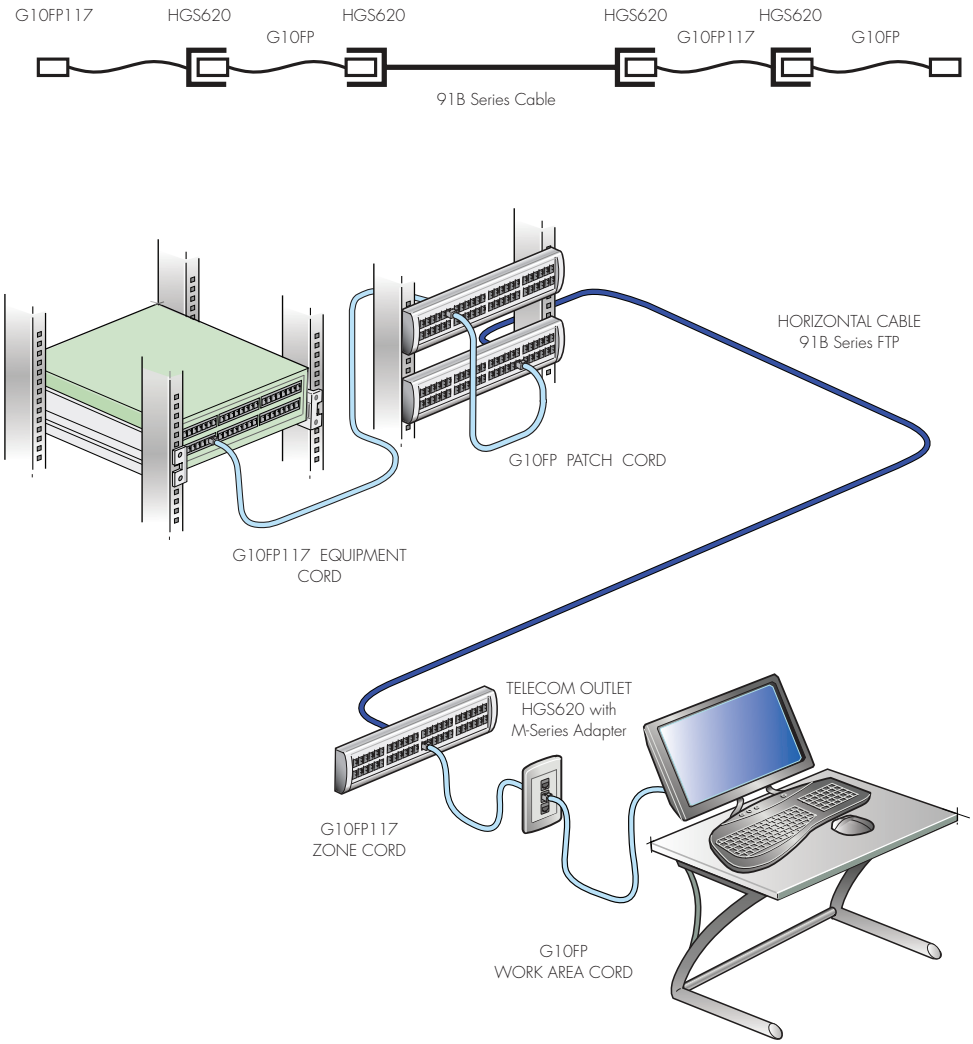
Figure 3. Three Connection Model: Interconnection to a consolidation point



Four Connection Model

At large open office sites where administration flexibility calls for it, four connections are often used in channels. This configuration offers flexibility and protection at both ends of the Horizontal cabling, providing the advantages of cross-connection in the telecommunications room and the flexibility of the consolidation point for modular office design. This configuration is typically referred to and tested (with the cords) as a channel.

Figure 4. Four Connection Model: Cross-connection with a consolidation point

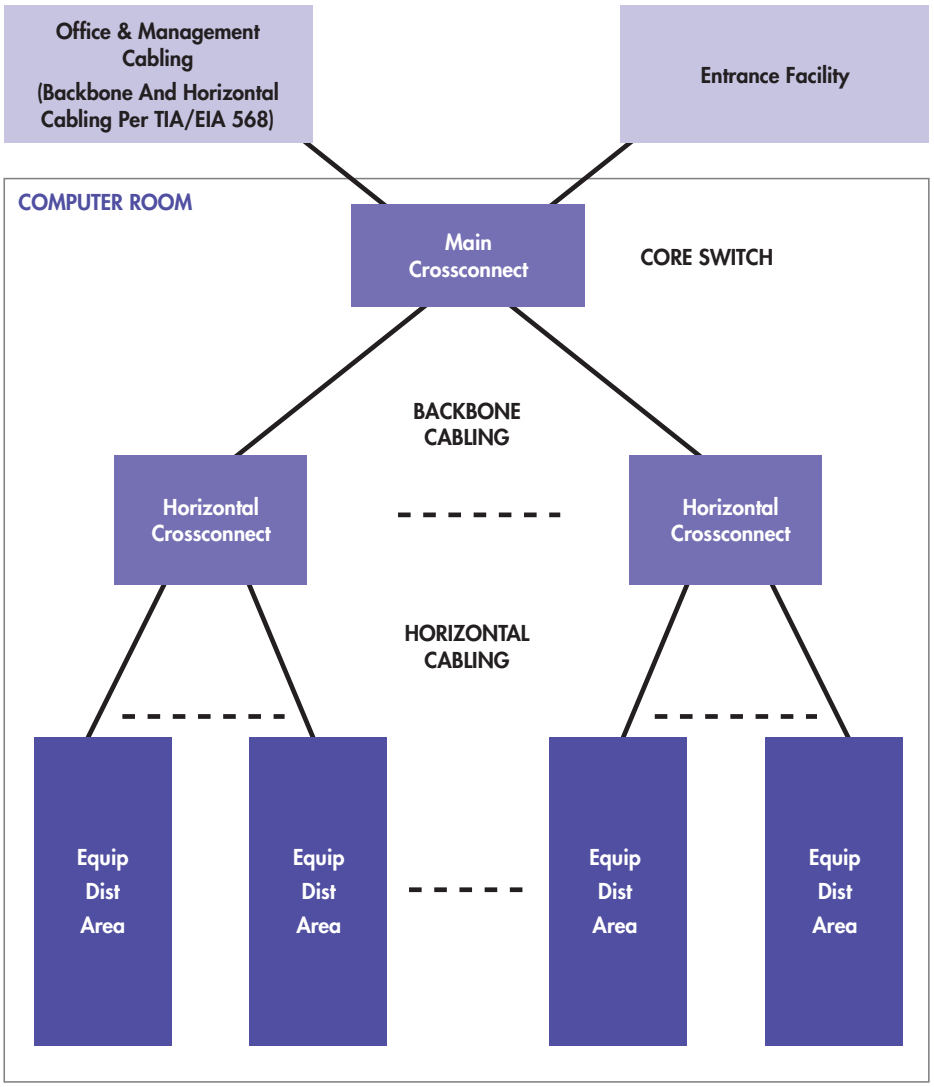


Data Center Computer Rooms

Data Center cabling is an excellent application for SYSTIMAX FTP, allowing data center cabling operations upgrades when 10GBASE-T equipment becomes available. The following pages show configurations for supporting ANSI/TIA-942-A Telecommunications Infrastructure Standard for Data Centers.

The standardized channel configurations were developed based on those in the TIA-568-C Series Commercial Building Telecommunications Cabling Standard because data centers utilize much of the same LAN equipment that was designed for these channels. However, data center equipment has become specialized and is typically deployed in high density. The cabling design must be tightly coordinated with other system designs, such as the electrical and HVAC. Security and operations also become significant design factors. Consult ANSI/TIA-942-A for additional information and details.

Figure 1. Two Connection Model, Interconnection to Telecommunications Outlet



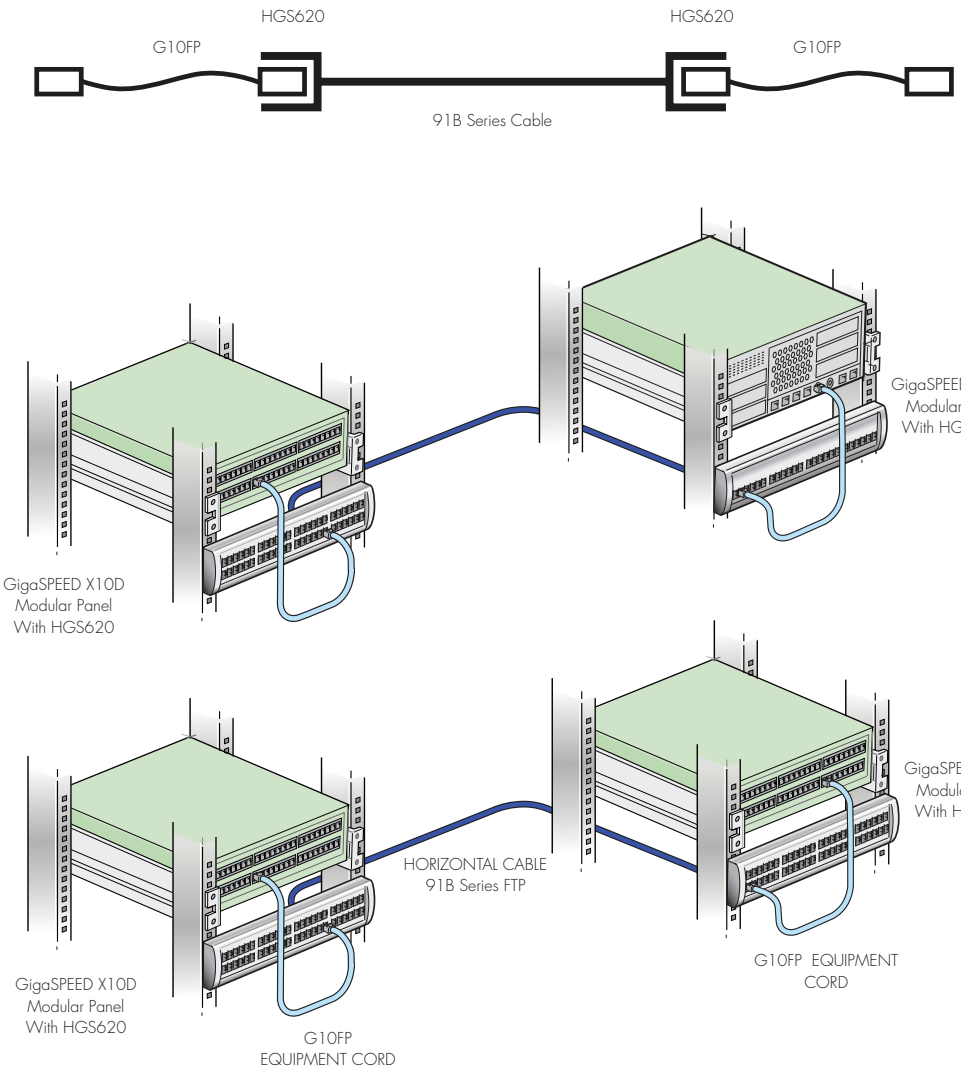
Data Center Channel Models

The following illustrations identify various channels between different areas within a data center's computer room. These configurations contain up to four connections. A connection is where two cabling segments come together, while the connections on the end equipment are not counted in the models.

Two Connection Model

The most basic channel model has only 2 connections and is typically referred to and tested (without the cords) as a permanent link. The Horizontal with the cords may also be tested as a channel.

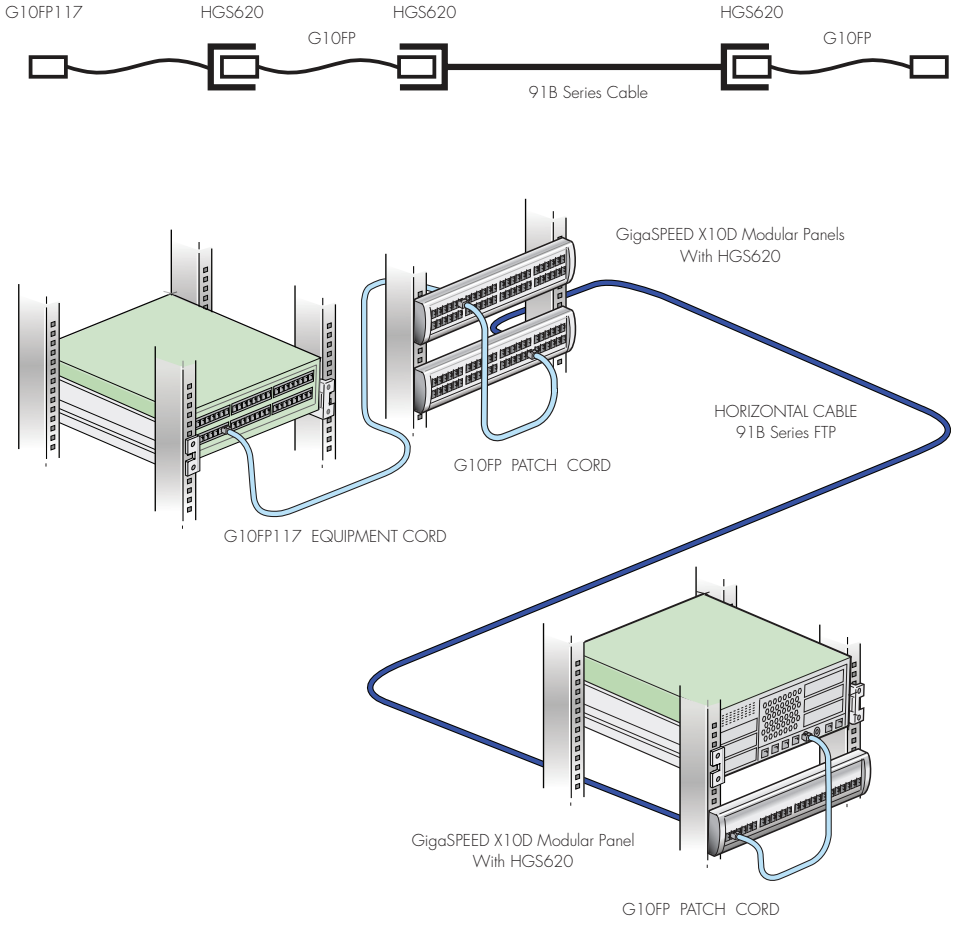
Figure 6. Two Connection Model, Interconnection to Interconnection



Three Connection Model

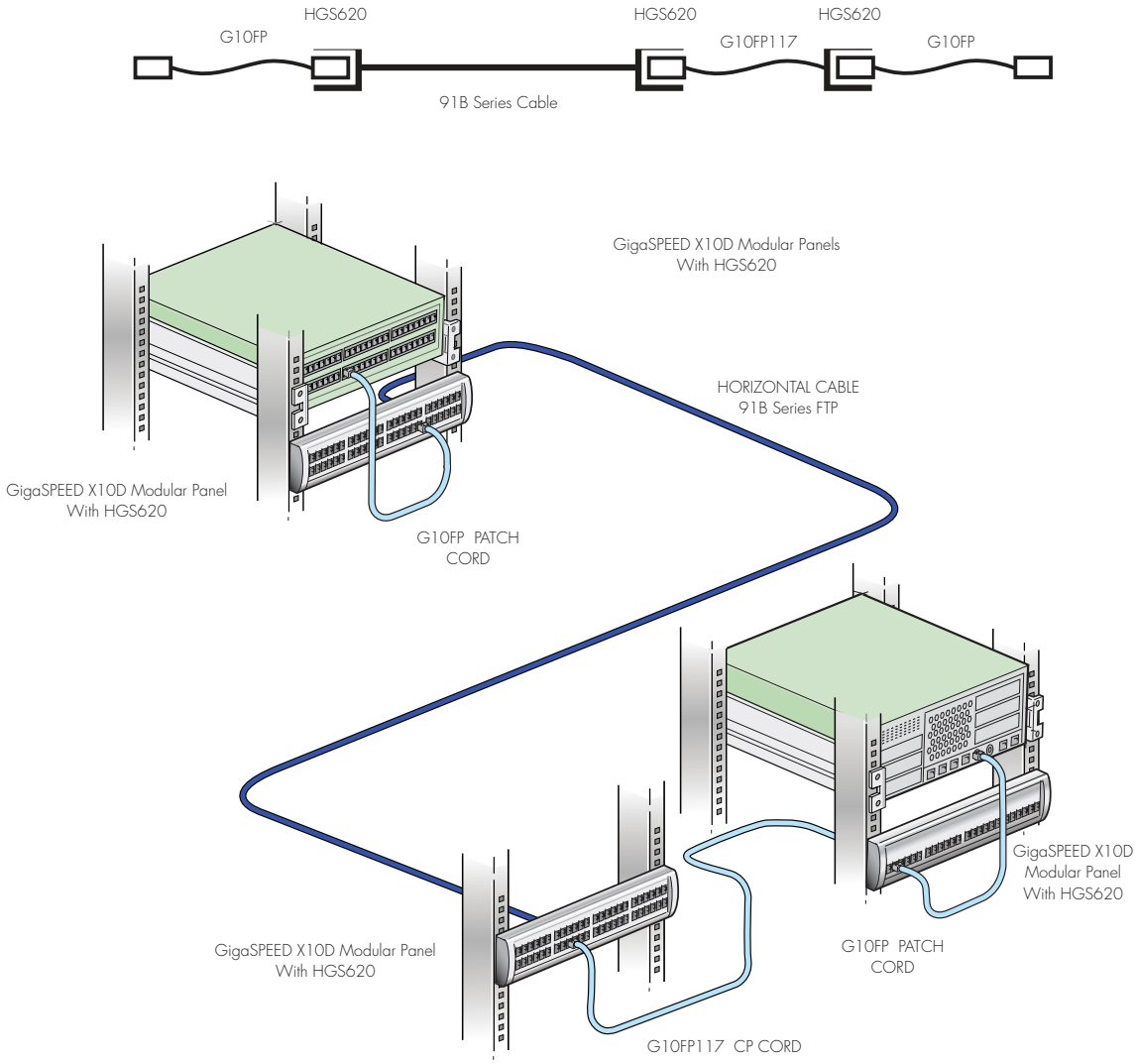
A third connection can support two different channel models, a cross-connection or a consolidation point. At large sites or sites with a high density of switching equipment or where space constraints might otherwise dictate, the horizontal distribution area can be configured with a cross-connection. This configuration is typically referred to and tested (with the cords) as a channel. This configuration can also be applied to backbone cabling with a main cross-connect.

Figure 7. Three Connection Model, Cross-connection to Interconnection



Where a site administrator may need flexibility or where installation may be staged, the horizontal cable can be terminated at a consolation point. It might be used for example to terminate a horizontal bundle at the middle of a row of equipment, and allow the site administrator to apportion horizontal cables between sections of the row as needed. This configuration is typically called a permanent link. It may be tested without the cords as a permanent link, or with the cords as a channel.

Figure 8. Three Connection Model, Interconnection with a consolidation point

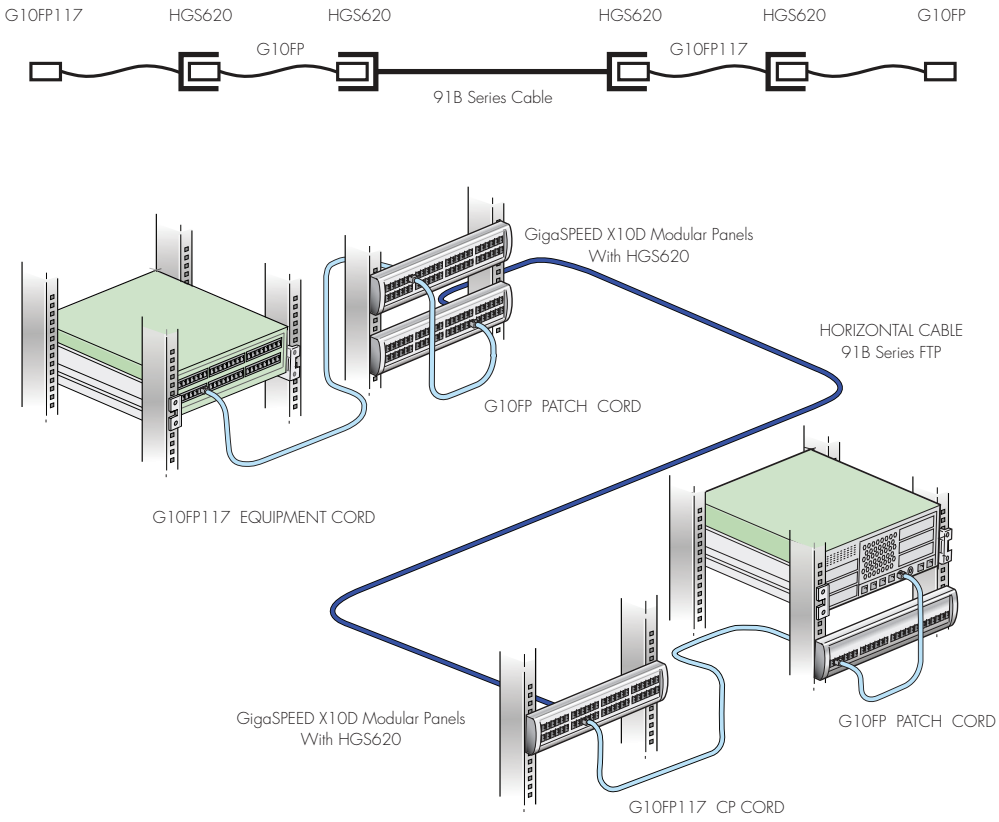


Four Connection Model

In large data centers the cabling administration is typically consolidated at cross-connects, and four connections would be used in channels. These configurations are typically referred to and tested (with the cords) as a channel. There are two configurations, a crossconnection with a consolidation point and a double cross-connect.

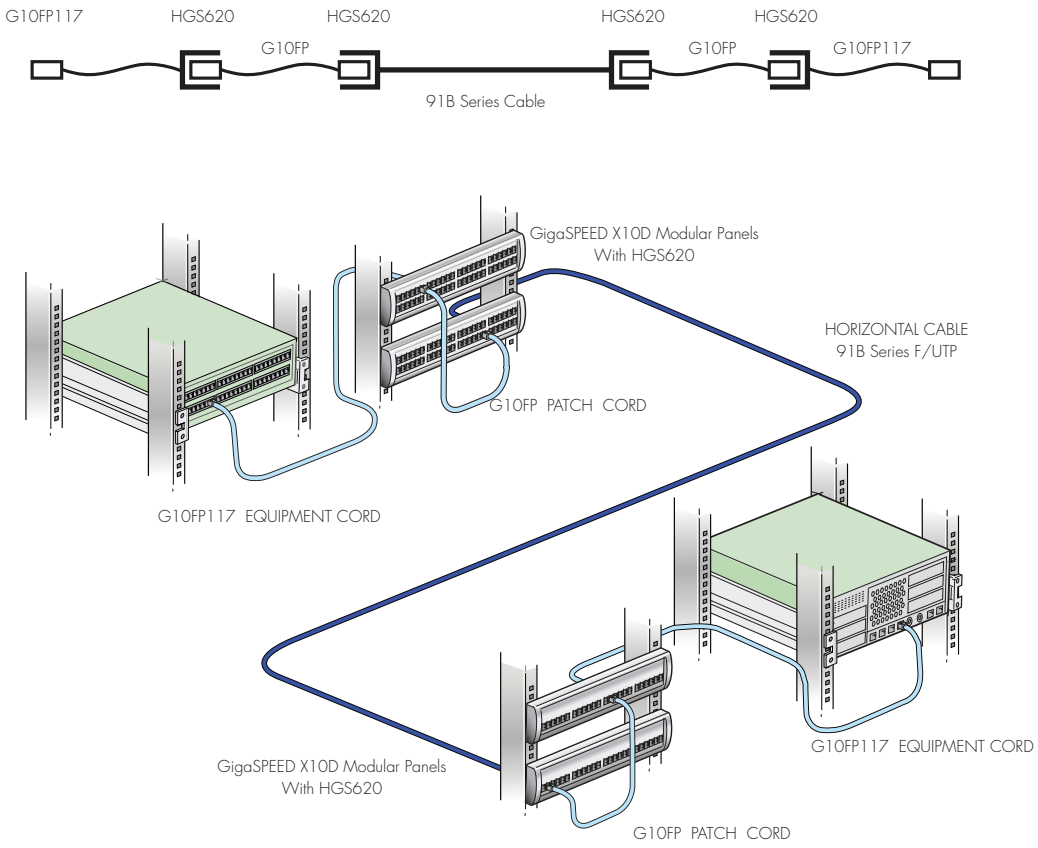
The consolidation point configuration (Figure 9) allows for two levels of administration to the server equipment as in Figure 8 on the previous page, but also provides a cross-connect for the switching equipment. The consolidation point may be useful for flexibility allocating horizontal capacity to many small customers that must be independently maintained.

Figure 9. Four Connection Model, Cross-Connection to consolidation point



The dual cross-connect configuration is a classic backbone configuration. It provides uniform administration and is suited for large corporate data centers. This configuration is also applicable to backbone cabling from the main distribution area.

Figure 10. Four Connection Model, Cross-Connect to Cross-Connect



Data center cabling can also be planned with a centralized cross-connection architecture. This is a useful extension of the two connection model of Figure 6, although the cable lengths must be carefully planned. For this, two cable segments are cross-connected into a single channel. The total cable length must stay within the maximum of Table 5 and the minimum lengths of Table 6B.

Figure 11. Two Cable Central Cross-connect Configuration

SYSTIMAX X10D FTP INSTALLATION

Cable Pathways

The following diagrams provide basic information concerning the primary pathway methods used for proper support, protection, and installation of the telecommunications cabling. Refer to the TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces and manufacturer's guidelines for more detailed information.

Using Hangers for the Cable Pathway

1. Avoid more than 144 cables in a single hanger pathway, including crossovers of cables along the pathway.
2. Maintain proper distance between hangers to avoid cable stress caused by tension in the suspended cable run.
3. The cable surface of the hanger should have rounded or flexible edges in order to avoid damaging or deforming the cable sheath.
4. When using cable ties to secure cables be sure to wrap ties loosely and use the appropriate plenum or non-plenum cable tie. Hook and Loop straps may be easier to use and adjust.
5. Do not place cables on lighting fixtures or hot pipes. Follow local and national codes for proper pathway support of cables, and note that telecommunications cabling standards require pathway support of cabling.

Using Conduit for the Cable Pathway

1. Make sure conduits are properly reamed and bushed.
2. Feed cables directly into the conduit end or use a suitable conduit shoe to avoid excessive pulling tension and prevent cable tearing.
3. See the NEC (Chapter 9, Table 4) for identifying different conduit types and sizes.
4. Cable lubricants should not be used because of excessive drying time.

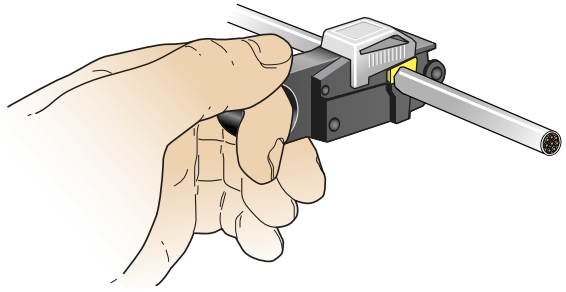
Using Raceways for the Cable Pathway

1. Follow design specifications for loading weight of cable tray or raceway.
2. Standards require a minimum of 300 mm (12 in) access headroom to be provided and maintained above a cable tray system or cable runway.
3. Follow manufacturers specifications for cable fill limits. Cabling must not exceed 23 cm (9 in) depth, or 15 cm (6 in) for standards compliance.
4. Cable routing should be planned to avoid crossovers and entanglement when branching off of the pathway. Plan all runs prior to installation.
5. When using cable ties to secure cables to tray, be sure to wrap ties loosely and use the appropriate plenum or non-plenum cable tie.
6. Telecommunications cabling must be partitioned from power or routed in a separate group when combined in the same tray or raceway (Check Power Separation design specifications).

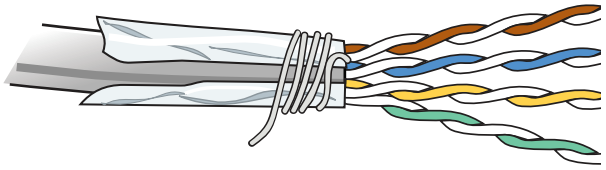
Cable Handling

- Check with design specifications and requirements.
- Cable ties should be applied loosely to cable bundles and allow sliding of the cable tie across the cable bundle. Tie wraps must not distort cable jacket.
- Cable installation should not significantly deform the cable jacket.
- Maximum pulling tension of each cable should be kept below 110 N (25 lb).
- Avoid slack loops. Pull back excess cable along "slack runs" for storage of excess cable. Where slack looping is unavoidable, ensure that cable is not twisted while creating loops (this can untwist the cable pairs). Disengage the outlet from the faceplate and form the slack loops without twisting the cable. Unwinding and using the slack must account for the same problems.
- Maintain bend radius and avoid kinks. Minimum bend radius is 4x the cable diameter for cables and 1x the cordage diameter for cords.
- Avoid untwisting and separation of cable pairs. Maintain twists to the point of termination and avoid pair wrapping.

Use a precision jacket scoring tool such as this Xcelite 2CSKY, which has fine adjustment settings. With this, a single blade can be used and it can be adjusted so that the foil is not damaged or cut.

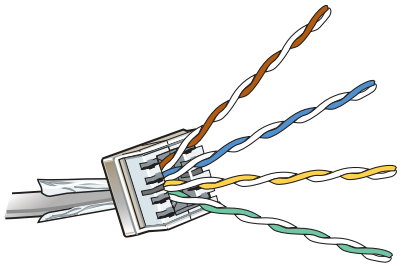


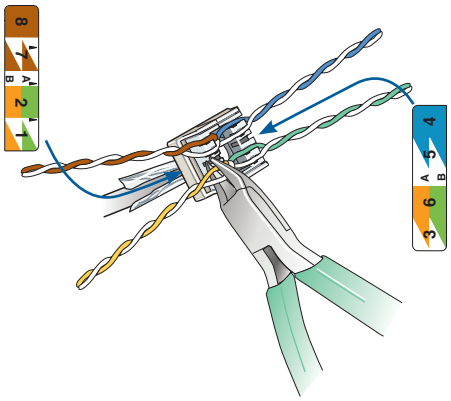
- Fold the foil and drain wire back
- Trim off the clear cellophane wrapping
- Separate the pairs, cut the flute flush with the end of the jacket and restore the pairs to their original positions
- Ensure that the foil is wrapped tight over the jacket and wrap the drain wire close to the end of the foil but not overlapping
- Arrange pairs directly in a flat arrangement:
  - Brown
  - Blue
  - Orange
  - Green



Insert end completely into the termination manager with pair colors oriented to the labels

Close the termination manager with the spring clip capturing the drain wire

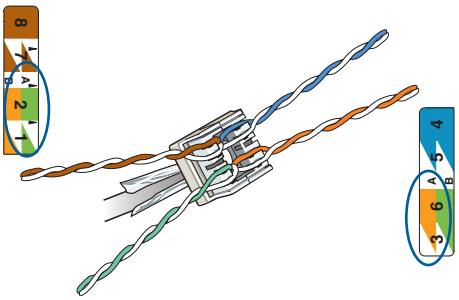


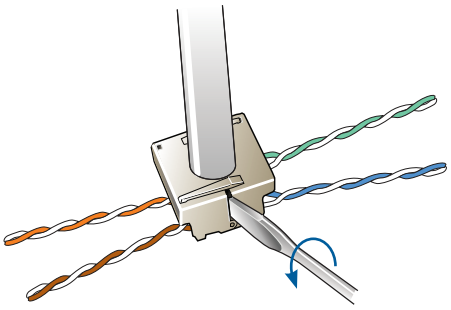


Follow the label colors (T568B shown)

Place conductors directly into the termination slots and trim flush

T568A wiring follows the alternate label colors

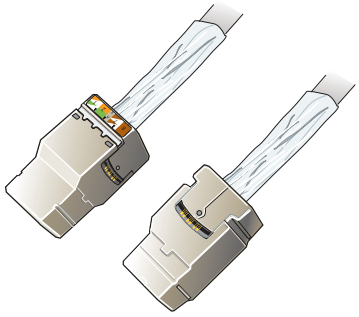


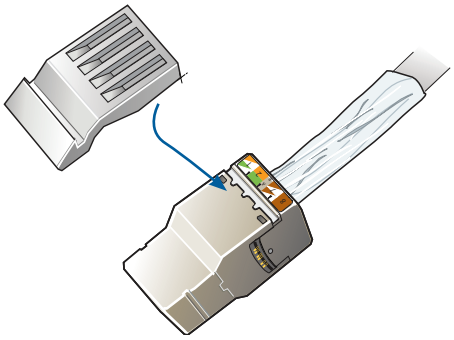


If pairs are not set correctly, the termination manager can be opened. Pry along the edge seam by twisting a small screwdriver.

Engage the termination manager squarely into the HGS620 housing. It must be properly aligned.

Note: the Brown label side faces the 3 notches

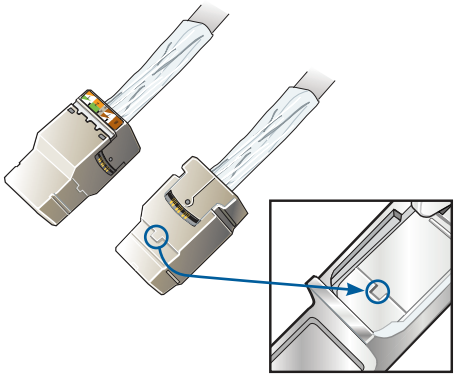


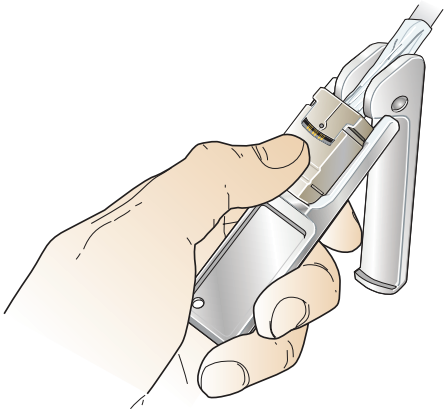


When mounting in a Keystone compatible opening, insert the Keystone clip before closing the HGS620.

The bottom of the clip has 3 knobs that are inserted into the 3 notches. Closing the HGS620 locks the Keystone clip in place.

The HGS620 side features fit into the matching wrench pocket features

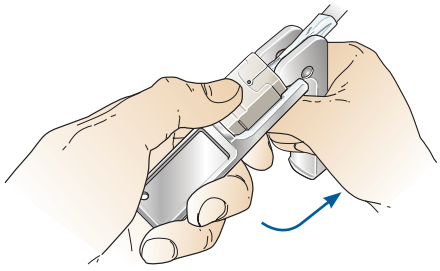




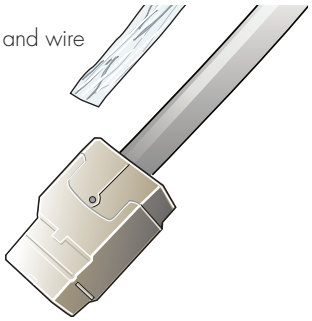
Hold the HGS620 in the wrench's pocket

Note: Avoid placing thumb over the HGS620 opening

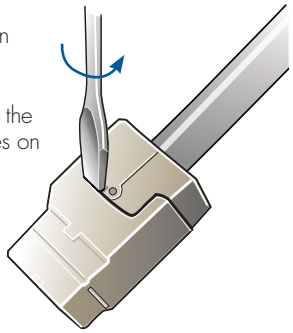
Pull the wrench handle out



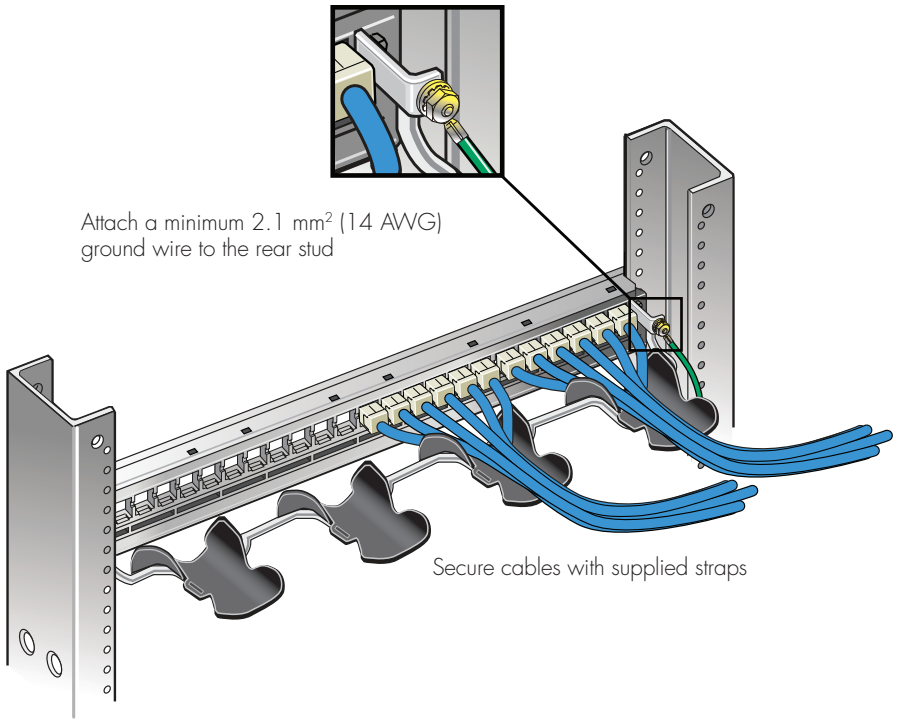
Trim excess foil and wire



The HGS620 can be opened for re-termination by alternately prying the side seam features on each side

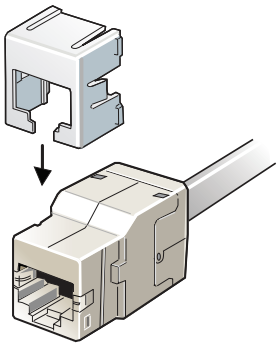


The HGS620 contacts a panel ground bar when inserted into the Evolve panel



Insert HGS620 in through the rear of the Evolve panel. HGS620 can be removed by releasing the locking tab alongside the front opening with a small screwdriver.

Attach the M-Series Adapter for use in faceplates and boxes with a modular mount opening.



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