Local Area Network (LAN)

Networking Cabling & Accessories
Horizontal Cabling, Work Area and Telecom Room
STANDARDS

LAN Overview

INFORMATION CONTAINED IN THIS WEST PENN WIRE TECHNICAL BULLETIN HAS BEEN PROVIDED BY THE FOLLOWING STANDARDS AND MANUALS.

• TIA/EIA 568-B-1 - Commercial Building Telecommunications Standard: Part 1: General Requirements
• TIA/EIA 568-B-2 - Commercial Building Telecommunications Standard: Part 2 Balanced Twisted Pair Cabling Components
• TIA/EIA 568-B-2.1 - Commercial Building Telecommunications Standard: Part 2.1 Transmission Performance 4 pair 100Ω Category 6 Cabling
• TIA/EIA 568-B-3 - Commercial Building Telecommunications Standard: Part 3 Optical Fiber Cabling Components
• TIA/EIA 568-B-3.1 - Commercial Building Telecommunications Standard: Part 3.1 50/125um Optical Fiber Specifications
• BICSI Design Reference Manual 5th Edition

BICSI

BICSI is a non-profit telecommunications association, founded in 1974 to serve and support telephone company building industry consultants responsible for the design and distribution of telecommunications wiring in commercial and multi-dwelling buildings.

www.bicsi.org

Global Engineering Documents

To acquire telecommunication standards:
1-800-854-7179
www.global.his.com

Changes in TIA/EIA 568 Standards

• Incorporation of the TSB’s, Addenda, and Interim Standards from the TIA/EIA 568-A.
• The TIA/EIA 568-A Standard has been reorganized into three technical Standards;
• Category 5 is no longer recognized, and has been replaced by Category 5E and Category 6.
• Performance specifications are provided for Category 5E and Category 6.
• Performance specifications are provided for 50/125um Optical Fibers
• Small Form Factor (SFF) optical fiber connector designs are allowed in addition to the 568SC.
• The term ‘Telecommunication closet’ has been replaced with ‘Telecommunications room’.
• The ‘permanent link’ has replaced the ‘basic link’ as the test configuration.
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LAN Overview
LAN Network Cabling
LAN's are used to interconnect two or more personal computers (PC's) and other network devices in a geographically limited area not exceeding a multibuilding campus

FUNDAMENTALS:
In its basic form, a LAN is a group of PC’s connected with cabling links to a centralized network access device (Called a Hub, or Switch). A special purpose PC (Called a Server) is also connected to the same hub or switch and is used to coordinate network activities and store shared data.
Horizontal Cabling

Horizontal cabling is used to describe cabling that links network devices in user work areas (WA’s) to network equipment located in the Telecommunications Room (TR). This cabling generally extends horizontally along floors, walls, and ceilings.

**Distance:** 90 m link - Link is the bulk cable run without assemblies or patch cables.

**100 m** channel - Channel is the entire run of cable including assemblies and patch cables.

**Topology:** Star Configuration: From Hub to Desktop

**Cabling Media Types:**

- 4 pair 100ohm Impedance UTP (Unshielded Twisted Pair) or F/UTP (Foil over UTP - Shielded).

- Category 5E: TIA/EIA-568.B.2
  - 4 Pair 24AWG
  - Voice or Data - Data: 10/100BaseT Ethernet
  - UTP or F/UTP Design

- Category 6: TIA/EIA-568-B.2-1
  - 4 Pair 24 or 23AWG
  - Data: 100/1000BaseT Ethernet
  - UTP or F/UTP Design

- Category 6A: TIA/EIA-568-B.2-10
  - Augmented Cat 6
  - 4 Pair 23AWG
  - Data: 100/1000/10000BaseT Ethernet
  - UTP or F/UTP Design

- Category 7 **(Not Available)**
  - 4 Pair 23 or 22AWG
  - Data: 10GBaseT Ethernet
  - S/FTP Design - Shielded over Shielded Pair

- Optical Fiber OM1, OM2, OM3, OM4 Design
  - OM1: 62.5/125µm Fiber Shorter Runs
  - OM2: 50/125µm
  - OM3: 50/125µm Laser Optimized 10G Network
  - OM4: 50/125µm 40G Network
Cables

A Network Cable is designed specifically to carry a certain amount of digital data from one point to another with low loss, low cross talk and other electrical parameters. One main design characteristic of all Network Cables is the Pair design. To keep crosstalk to a minimum all four of the pairs of the network cables are twisted at different rates.

**Category 5E:**
- 24AWG Solid Bare Copper
- 100Mhz Rated for 100BaseT Applications
- 4 Pairs twisted at different rates

**Category 6:**
- 24 or 23 AWG Solid Bare Copper
- 250Mhz Rated for 1GBaseT Applications
- 4 Pairs twisted at different rates
- Can support 10G up to 35m (114f)

**Category 6A:**
- 23 AWG Solid Bare Copper
- 500Mhz Rated for 10GBaseT Applications
- 4 Pairs twisted at different rates
- 10G Network up to 100m (328f)

Cat5E, 6 and 6A are offered in UTP (Unshielded Twisted Pair) and STP (F/UTP) Shielded designs.

The Shield's main purpose is to protect the internal signaling from outside electrical interference.
Cables

Network Cable Color Code:

1. White/Orange
2. Orange
3. White/Green
4. Blue
5. White/Blue
6. Green
7. White/Brown
8. Brown

Network Cables Installation

Cables Pull Tension
Pull tension is applied to not allow the conductors to be stretched during installation Category 5E:
- Category 5E: 25lbf
- Category 6: 25lbf
- Category 6A: 35lbf

Cables Bend Radius
The bend radius of Network cables is a simple calculation. Take the OD of the cable and Times it by 4.

Example:
- 4245 Category 5E UTP CMR
  -\.191” x 4 = .76”
- Standard is called out to be 1”

Do Not of Network Cables
Do not bend the cable more than at a 90 degree angle
Do not exceed the Minimum bend radius at 4X the cable OD
Do not forceably tug the cable while pulling
Do not tighten cable ties on cable bundles
Do not run over or step on cables laying on the ground
Electrical Characteristics

Network Cables are designed for Digital Data applications. In order to maintain a string of data through a network cable there are many electrical performances to adhere to.

Characteristic Impedance
Impedance is an important electrical parameter in network cabling. Impedance is measured in Ohms (Ω). The impedance of a network cable is 100Ω +/-5.

Capacitance
Capacitance is an important electrical parameter in network cabling and in any digital communications. Capacitance is the ability of a body to store an electrical charge. So the lower the number the better when related to communication cabling. Capacitance is measured by pico farads (pf) per foot or meter.

Capacitance of a network cable is Nominally between 13pf/f - 16pf/ft

Attenuation
Attenuation is simply a loss of signal due to conductor size, related dielectric materials and frequency. Attenuation is measured in decibles (dB) per foot or 100 meter.

NEXT - Near-end CrossTalk
Near-end crosstalk (NEXT) is an error condition that can occur when connectors are attached to twisted pair cabling. NEXT is usually caused by crossed or crushed wire pairs. NEXT is measured by decibles (dB).

PS-NEXT - Power Sum NEXT
PSNEXT is a NEXT measurement which includes the sum of crosstalk contributions of all adjacent pairs.[1] It is the algebraic sum of near-end crosstalk (NEXT) of three wire pairs as they affect the fourth pair in a four-pair cable.

FEXT - Far End CrossTalk
Interference between two pairs of a cable measured at the other end of the cable with respect to the interfering transmitter.

ELFEXT- Equal Level Far End CrossTalk
An FEXT measurement with attenuation compensation.

ACR Attenuation to Crosstalk Ration
Attenuation-to-crosstalk ratio (ACR) is a parameter that is measured when testing a communication link, which represents the overall performance of the cable. ACR is a mathematical formula that calculates the ratio of attenuation to near-end crosstalk for each combination of cable pairs.

PS-ACR Power Sum Attenuation to Crosstalk Ratio
Power Sum of the Attenuation to Crosstalk ratio.
West Penn Wire Bulk Cables

<table>
<thead>
<tr>
<th>Environment</th>
<th>Category 5E UTP</th>
<th>Category 5E F/UTP</th>
<th>Category 6 UTP</th>
<th>Category 6 F/UTP</th>
<th>Category 6A UTP</th>
<th>Category 6A F/UTP</th>
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<td>Non Plenum</td>
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<td>4245F</td>
<td>4246</td>
<td>4246F</td>
<td>4246A</td>
<td>4246AF</td>
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<td>Plenum</td>
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<td>254245F</td>
<td>254246</td>
<td>254246F</td>
<td>254246A</td>
<td>254246AF</td>
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<td>Indoor/Outdoor</td>
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<td>4246IO</td>
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<td>Outside Plant</td>
<td>4245OSP</td>
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<td>4246OSP</td>
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<td></td>
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<tr>
<td>Armored</td>
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</table>
Work Area

The Work Area (W A) employees Wall Plates, Cable Assemblies, and Connectors.

The Wall plate contains inserts such as RJ45 Jack to connect the Horizontal cabling to the IP devices through cable assemblies.

Horizontal Cabling
90m - 100m total
Cat5E: 10/100BaseT
Cat6: 1GBaseT
Cat6A: 10GBaseT
Wall Plates

The wall plates used are usually Keystone style. But Decora® and Modular Style can be used for the transition from Horizontal cabling to the Work Area.

**Keystone:**

<table>
<thead>
<tr>
<th>KEYSTONE Type</th>
<th>Keystone Style Plates</th>
<th>Keystone Style Plates w/Label</th>
<th>Keystone Style Plates Stainless</th>
<th>Keystone Adapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G, 1 Port</td>
<td>SKF-1</td>
<td>SKFL-1</td>
<td>SSKF-1</td>
<td>CMK-BA</td>
</tr>
<tr>
<td>1G, 2 Port</td>
<td>SKF-2</td>
<td>SKFL-2</td>
<td>SSKF-2</td>
<td>CMK-BL</td>
</tr>
<tr>
<td>1G, 3 Port</td>
<td>SKF-3</td>
<td>SKFL-3</td>
<td>SSKF-3</td>
<td>CMK-BNC75</td>
</tr>
<tr>
<td>1G, 4 Port</td>
<td>SKF-4</td>
<td>SKFL-4</td>
<td>SSKF-4</td>
<td>CMK-F3</td>
</tr>
<tr>
<td>1G, 6 Port</td>
<td>SKF-6</td>
<td>SKFL-6</td>
<td>SSKF-6</td>
<td>CMK-HDMI</td>
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<tr>
<td>2G, 6 Port</td>
<td>DKF-6</td>
<td>DKFL-6</td>
<td>CMK-1C</td>
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<tr>
<td>2G, 8 Port</td>
<td>DKF-8</td>
<td>DSKF-8</td>
<td>CMK-PCTRS</td>
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<td>2G, 12 Port</td>
<td>DKF-12</td>
<td>DKFL-12</td>
<td>CMK-SC</td>
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</table>

**Decora:**

<table>
<thead>
<tr>
<th>DECORA® Type</th>
<th>Keystone Adapter Plates</th>
<th>1G Decora Style</th>
<th>2G Decora Style</th>
</tr>
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<tbody>
<tr>
<td>1G, 1 Port</td>
<td>DA-1</td>
<td>SKFD-1</td>
<td>DKFD-2</td>
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<tr>
<td>1G, 2 Port</td>
<td>DA-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1G, 3 Port</td>
<td>DA-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1G, 4 Port</td>
<td>DA-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1G, 6 Port</td>
<td>DA-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2G, 6 Port</td>
<td>DKF-6</td>
<td></td>
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</tr>
<tr>
<td>2G, 8 Port</td>
<td>DKF-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2G, 12 Port</td>
<td>DKF-12</td>
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**Modular Style:**

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<th>MODULAR Type</th>
<th>Plates</th>
<th>Adapters</th>
<th>Adapters 2 Port</th>
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<td>1G Modular</td>
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<tr>
<td>2G Modular</td>
<td>SGF-12</td>
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<tr>
<td>BNC</td>
<td></td>
<td>SCM-1BNC</td>
<td>SCM-2BNC</td>
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<tr>
<td>“F” Type</td>
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<td>SCM-1F</td>
<td>SCM-2F</td>
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<tr>
<td>LC</td>
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<td>SCM-1LC</td>
<td>SCM-2LC</td>
</tr>
<tr>
<td>SC</td>
<td></td>
<td>SCM-2SC</td>
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<tr>
<td>CAT 5E</td>
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<td>SCM245-C5E</td>
<td>SCM245-C5E</td>
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<tr>
<td>CAT 6</td>
<td></td>
<td>SCM245-C6C</td>
<td>SCM245-C6C</td>
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<tr>
<td>HDMI</td>
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<td>SCM-1HDMI</td>
<td>SCM-2HDMI</td>
</tr>
<tr>
<td>USB</td>
<td></td>
<td>SCM-1USB</td>
<td>SCM-2USB</td>
</tr>
<tr>
<td>VGA</td>
<td></td>
<td>SCM-1GATB</td>
<td></td>
</tr>
</tbody>
</table>
Connectors

RJ45 Jacks

Registered Jacks (RJ)45 is a data connector with 8P8C. There are a variety of RJ style connectors. RJ11/RJ12 - Found in houses and offices for Telecommunication Voice. RJ45 - Found for Networking and Data applications. The RJ45 Jacks allow T568A or T568B Wiring.

RJ45 Jacks can be terminated by a single punchdown tool or a Multi-Termination Tool, such as our KJMT-8600.

RJ45 Jack Style

- Category 5E UTP or Shielded
- Category 6 UTP or Shielded
- Category 6A UTP or Shielded

UTP RJ45 Jacks are available in Multiple Colors: Black, Blue, Red, Yellow, Orange, Green

F/UTP RJ45 Jacks have to be shielded or Metal.

<table>
<thead>
<tr>
<th>Type</th>
<th>Category 5E UTP</th>
<th>Category 5E F/UTP</th>
<th>Category 6 UTP</th>
<th>Category 6 F/UTP</th>
<th>Category 6A UTP</th>
<th>Category 6A F/UTP</th>
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<tbody>
<tr>
<td>Tool Less</td>
<td>KJ5458TL-C5E</td>
<td>KJ5458TL-C6C</td>
<td>KJ5458TL-C6C</td>
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<tr>
<td>MT Tool</td>
<td>KJMT-8600</td>
<td>KJMT-8600</td>
<td>KJMT-8600</td>
<td>KJMT-8600</td>
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<tr>
<td>Pair Separation</td>
<td>TL-CATWIREST</td>
<td>TL-CATWIREST</td>
<td>TL-CATWIREST</td>
<td>TL-CATWIREST</td>
<td>TL-CATWIREST</td>
<td>TL-CATWIREST</td>
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</tbody>
</table>
Modular Plugs

Modular plugs are not normally part of the installation techniques in the Work Area. But there might be times where you may have to install and terminate a modular plug.

T568B cable color code while loading into a modular Plug.

Modular Plug Style

<table>
<thead>
<tr>
<th>Category 5E</th>
<th>Category 6</th>
<th>Category 6A</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTP or Shielded</td>
<td>UTP or Shielded</td>
<td>UTP or Shielded</td>
</tr>
</tbody>
</table>

West Penn Wire offers EZ Modular Connectors and Standard plugs for Category 5E and 6 UTP. For our Category 6 and 6A Shielded Cables, West Penn Wire offers modular complete kits. 90170-BI

<table>
<thead>
<tr>
<th>Type</th>
<th>Category 5E UTP</th>
<th>Category 5E F/ UTP</th>
<th>Category 6 UTP</th>
<th>Category 6 F/ UTP</th>
<th>Category 6A UTP</th>
<th>Category 6A F/ UTP</th>
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</thead>
<tbody>
<tr>
<td>EZ Plug</td>
<td>32-EZP</td>
<td>CN-EZP-STP</td>
<td>32-6EZP</td>
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<td>Loading Bar</td>
<td>32-2198UL</td>
<td>32-6198UL</td>
<td>106190</td>
<td>106190</td>
<td>106090</td>
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<td>Standard Plug</td>
<td>32-5998UL</td>
<td>32-2098UL</td>
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<td>CN-CAPFMUL-S1</td>
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<td>Kits</td>
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<td>90170-BI</td>
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<td>Crimp Tool</td>
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<td>Strip Tool</td>
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<td>Pair Separation</td>
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<td>Boats</td>
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<td>CN-B0051</td>
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</tbody>
</table>
Cable Assemblies Work Area

Cable assemblies are needed at the Work Area location to allow signals to be guided from the wall plate (RJ45 Jack) to the computer or IP device.

Network assemblies are available for Category 5E, Category 6, and Category 6A.

For the Network UTP Cables assemblies are available in multiple colors:
Black, Red, Yellow, Orange, Green, Pink

F/UTP Network assemblies are usually only available in a Gray Jacket, but other colors can be ordered.

Network assemblies are available in a variety of lengths:
3, 5, 7, 10, 15, 20 and 25 ft.

West Penn Wire also offers long length with Pulling Eye.

Cable Assemblies Telecommunication Closets and Equipment Room

Cable assemblies are needed at the TC or ER location to allow signals to be guided from the patch panel (RJ45 Jack) to the computer or Network Switching Devices.

<table>
<thead>
<tr>
<th>Type</th>
<th>Category 5E UTP</th>
<th>Category 5E F/UTP</th>
<th>Category 6 UTP</th>
<th>Category 6 F/UTP</th>
<th>Category 6A UTP</th>
<th>Category 6A F/UTP</th>
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<tbody>
<tr>
<td>Component Level</td>
<td>CSEC-114cc-xxFB</td>
<td>CSES-314GY-xxFB</td>
<td>C6C-114cc-xxFB</td>
<td>C6CS-314GY-xxFB</td>
<td>C6A-114cc-xxFB</td>
<td>C6AS-314cc-xxFB</td>
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<td>Channel Level No Boots</td>
<td>C5E-121cc-xxFB</td>
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<td>C6C-115cc-xxFB</td>
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<td>Channel Level with Boots</td>
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</tr>
</tbody>
</table>

**CC: Colors**
Black (BK), Blue (BU), Green (GN), Gray (GY), Orange (OR), Red (RD), White (WH), Yellow (YE)

**xx: Lengths**
3, 5, 7, 10, 15, 20, 25 feet.
Telcommunication Room (TR) / Equipment Room (ER) - TIA/EIA-569

In the TR and/or ER Networking passive equipment is needed. These parts are normally a patching system. If a Category 6 System or a 1G Network is implemented, a passive network patch panel of the same or better quality is needed.

Patch Panel Style

Category 5E UTP and Shielded
Category 6 UTP and Shielded
Category 6A UTP and Shielded

<table>
<thead>
<tr>
<th>Type</th>
<th>Category 5E UTP</th>
<th>Category 5E F/UTP</th>
<th>Category 6 UTP</th>
<th>Category 6 F/UTP</th>
<th>Category 6A UTP</th>
<th>Category 6A F/UTP</th>
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<tbody>
<tr>
<td>MD Series</td>
<td>12458MD-C5E</td>
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<td>12458MD-C6C</td>
<td>24458MD-C6C</td>
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<td>24458MD-C5E</td>
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<td>24458MD-C6C</td>
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<td>24458MD-C6AC</td>
<td>48458MD-C6AC</td>
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<td>48458MD-C6AC</td>
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<td>Angled</td>
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MD Series: 110 Connector Blocks
MT Series: Snap-in Keystone Jacks