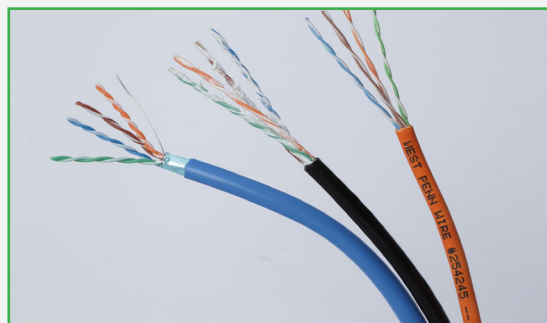# Local Area Network (LAN)
Networking Cabling & Accessories
Horizontal Cabling, Work Area and Telecom Room

LAN Overview

INFORMATION CONTAINED IN THIS WEST PENN WIRE TECHNICAL BULLETIN HAS BEEN PROVIDED BY THE FOL-
LOWING 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 Speci"cations • BICSI Design Reference
Manual 5th Edition • BICSI Telecommunication Cabling Installation Manual 3rd Edition.

BICSI

BICSI is a non-pro"t 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• Category 5 is no longer recognized, and has been replaced by Category 5E and Category 6.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 speci"cations are provided for Category 5E and Category 6.
• Performance speci"cations are provided for 50/125um Optical Fibers
• Small Form Factor (SFF) optical "ber 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 con"guration.
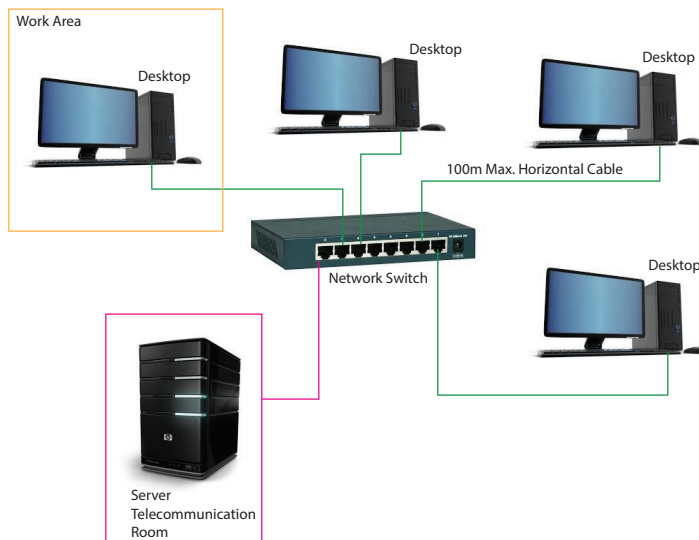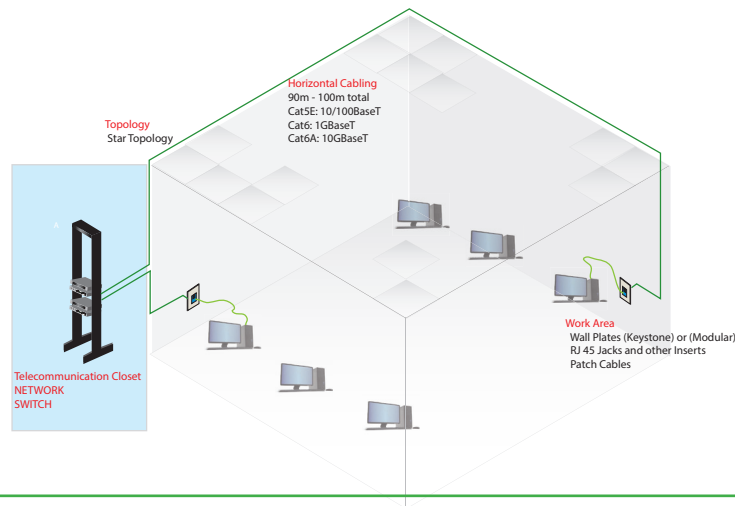
TABLE OF CONTENTS

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
90m - 100m total
Cat5E: 10/100BaseT
Cat6: 1GBaseT
Cat6A: 10GBaseT

Topology
Star Topology

Work Area
Wall Plates (Keystone) or (Modular)
RJ 45 Jacks and other Inserts
Patch Cables

Telecommunication Closet
NETWORK SWITCH

Work Area

Desktop

Desktop

Desktop

100m Max. Horizontal Cable

Network Switch

Desktop

Server
Telecommunication Room

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 Conguration: 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
  - • 4 Pair 23 or 22AWG
  - • Data: 10GBaseT Ethernet
  - • S/FTP Design- Shielded over Shielded Pair
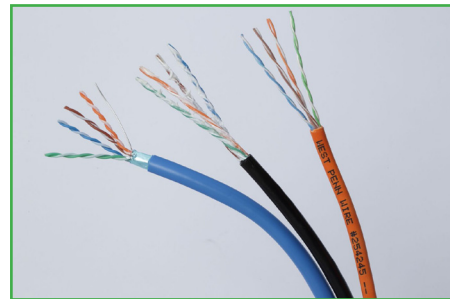
• Optical Fiber OM1, OM2, OM3, OM4 Design

- • 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 Coper
• 100Mhz Rated for 100BaseT Applications
• 4 Pairs twisted at different rates

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

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

Category 7:
• 23 AWG Solid Bare Copper
• 650MHZ Rated for 10GBaseT Application
• Digital Media Ultra 4K Applications
• 4 Pair twisted at different rates
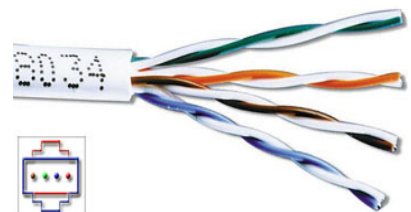• 10G Network up to 100m (328ft)
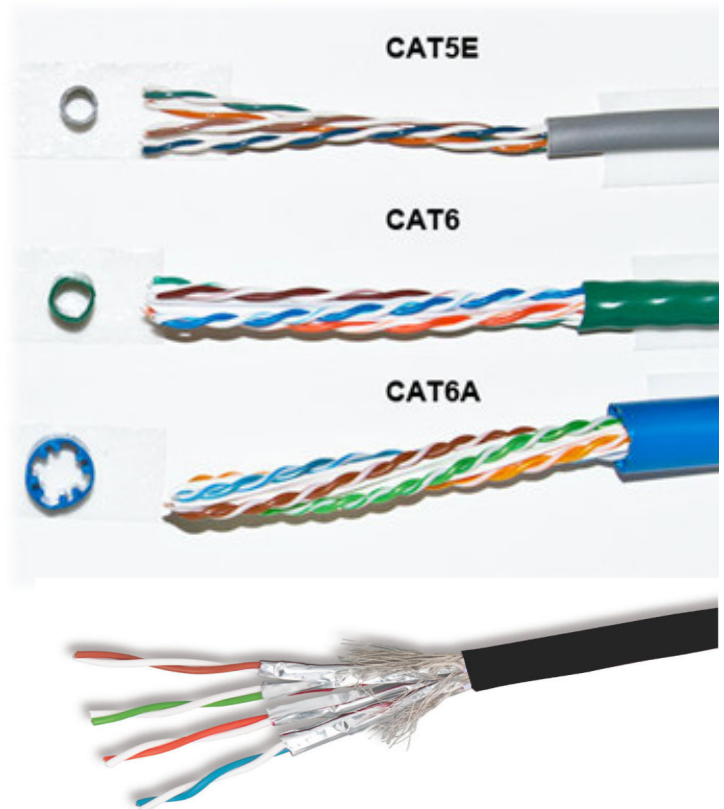
Cat5E, 6 and 6A are offered in
UTP (Unshielded Twisted Pair) and STP (F/UTP)
Shielded designs.

The Shields main purpose is to protect the internal signaling from outside electrical interference.
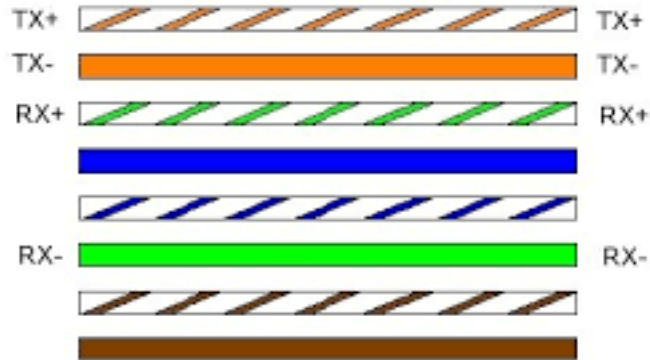
Cables

Network Cable Color Code:

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

TIA/EIA 568B
Ethernet Cable Wiring

archonmagnus.com

Network Cables Installation

Cables Pull Tension
Pull tension is applied to not allow the conductors to be stretched during installation
Category 5E: 25lbf - (pounds force)
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/ft - 16pf/tft

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 Attenutaion 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 Attenutaion to Crosstalk Ratio
Power Sum of the Attenutaion to Crosstalk ratio.
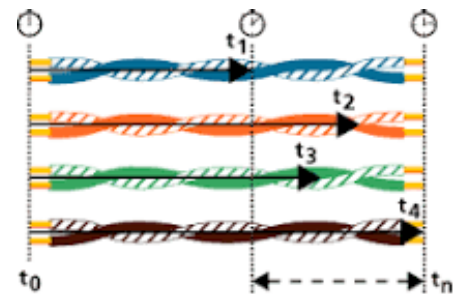
West Penn Wire Bulk Cables
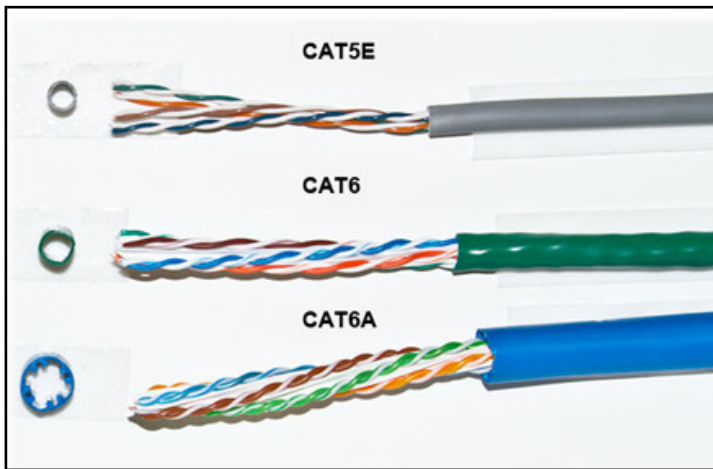
Environment	Category 5E UTP	Category 5E F/UTP	Category 6 UTP	Category 6 F/UTP	Category 6A UTP	Category 6A F/UTP	Category 7 F/STP
Non Plenum	4245	4245F	4246	4246F	4246A	4246AF	
Plenum	254245	254245F	254246	254246F	254246A	254246AF	254247F
Indoor/Outdoor	4245IO		4246IO	4246FIO	4246AFIO		
Outside Plant	4245OSP		4246OSP				
Armored	M57562						

Work Area

The Work Area (WA) employees Wall Plates, Cable Assemblies, and Connector.
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

Work Area
Wall Plates (Keystone) or (Modular)
RJ 45 Jacks and other Inserts
Patch Cables
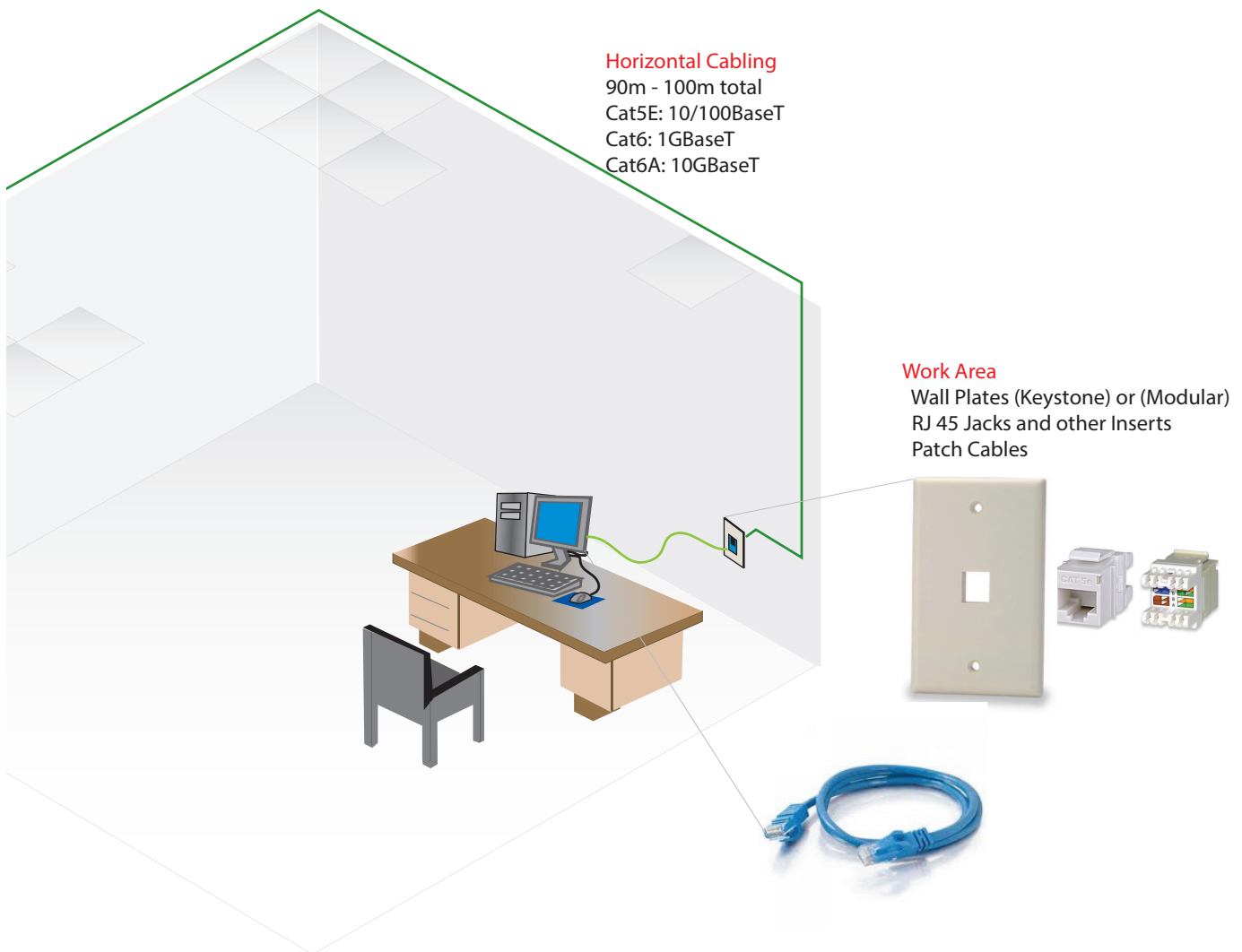
Wall Plates

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:

KEYSTONE Type	Keystone Style Plates West Penn	Keystone Style Plates	Keystone Style Plates w/Label	Keystone Style Plates Stainless	Keystone Adapters
1G, 1 Port	SGKF-1	SKF-1	SKFL-1	SSKF-1	CMK-BA
1G, 2 Port	SGKF-2	SKF-2	SKFL-2	SSKF-2	CMK-BL
1G, 3 Port	SGKF-3	SKF-3	SKFL-3	SSKF-3	CMK-BNC75
1G, 4 Port	SGKF-4	SKF-4	SKFL-4	SSKF-4	CMK-F3
1G, 6 Port		SKF-6	SKFL-6	SSKF-6	CMK-HDMI
2G, 6 Port		DKF-6	DKFL-6		CMK-LC
2G, 8 Port		DKF-8		DSKF-8	CMK-PCTRS
2G, 12 Port		DKF-12	DKFL-12	DSKF-12	CMK-SC
					CMK-USB

DECORA® Type	Keystone Adapter Plates		1G Decora Style	2G Decora Style
1G, 1 Port	DA-1		SKFD-1	DKFD-2
1G, 2 Port	DA-2			
1G, 3 Port	DA-3			
1G, 4 Port	DA-4			
1G, 6 Port	DA-6			
2G, 6 Port	DKF-6			
2G, 8 Port	DKF-8			
2G, 12 Port	DKF-12			

MODULAR Type	Plates	Adapters	Adapters 2 Port
1G Modular	SGF-06		
2G Modular	SGF-12		
BNC		SCM-1BNC	SCM-2BNC
"F" Type		SCM-1F	SCM-2F
LC		SCM-1LC	SCM-2LC
SC			SCM-2SC
CAT 5E			SCM245-C5E
CAT 6			SCM245-C6C
HDMI		SCM-1HDMI	SCM-2HDMI
USB		SCM-1USB	SCM-2USB
VGA		SCM-1VGATB	

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

Back View of Keystone Jack

SX-KJMT-8600
4-Pair Termination Tool

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
Categoy 6   UTP or Shielded
Category 6A   UTP or Shielded

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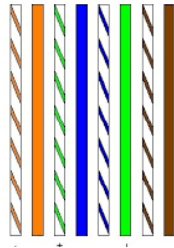Black, Blue, Red, Yellow, Orange, Green

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

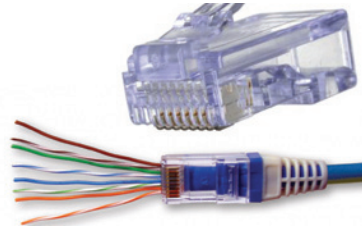| Type	Category 5E UTP	Category 5E F/UTP	Category 6 UTP	Category 6 F/UTP	Category 6A UTP	Category 6A F/UTP
West Penn Brand			KJ456C-C6C-xx			
MT Series	KJ458MT-C5E-xx	KJS458MT-C5E	KJ458MT-C6C-xx	KJS458MT-C6C	KJ458MT-C6AC-xx	KJS458MT-C6AC
Tool Less		KJS458TL-C5E		KJS458TL-C6C		KJS458TL-C6AC
MT Tool	KJMT-8600	KJMT-8600	KJMT-8600	KJMT-8600	KJMT-8600	KJMT-8600
Pair Separation	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST

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

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

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

Type	Category 5E UTP	Category 5E F/UTP	Category 6 UTP	Category 6 F/UTP	Category 6A UTP	Category 6A F/UTP
EZ Plug	32-EZP	CN-EZP-STP	32-6EZP			
Loading Bar	32-2198UL		32-6198UL	106190	106190	106090
Standard Plug	32-5998UL	32-2098UL			CN-CAPFMUL-S1	
Kits				90170-BI	90170-BI	90170-BI
Crimp Tool	TL-EZRJ45PROCT	TL-EZRJ45PROCT	TL-EZRJ45PROCT	12515C	12515C for 106190	12515C
Strip Tool	TL-15015	TL-15015	TL-15015	15010C	15010C	15010C
Pair Separation	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST	TL-CATWIREST
Boats	32-1900-xx	32-1900-xx	32-1900-xx	CN-B0051	CN-B0051	CN-B0051

Cable Assemblies Work Area

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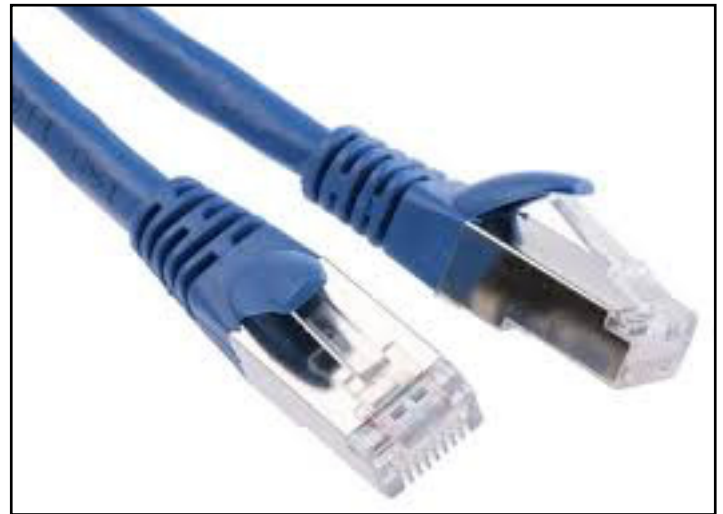(RJ45 Jack) to the computer or IP device.

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
avialable 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 allows signals to be guided from the patch panel
(RJ45 Jack) to the computer or Network Switching Devices.

Type	Category 5E UTP	Category 5E F/ UTP	Category 6 UTP	Category 6 F/ UTP	Category 6A UTP	Category 6A F/ UTP
West Penn Brand			C6-CA1-cc-xx			
Component Level	C5EC-114cc-xxFB	C5ES-314GY-xxFB	C6C-114cc-xxFB	C6CS-314GY-xxFB	C6A-114cc-xxFB	C6AS-314cc-xxFB
Channel Level No Boots	C5E-121cc-xxFB		C6C-115cc-xxFB			
Channel Level with Boots	C5E-114cc-xxFB					

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 quaility is needed.

Patch Panel Style

Category 5E UTP and Shielded
Category 6 UTP and Shielded
Category 6A UTP and Shielded
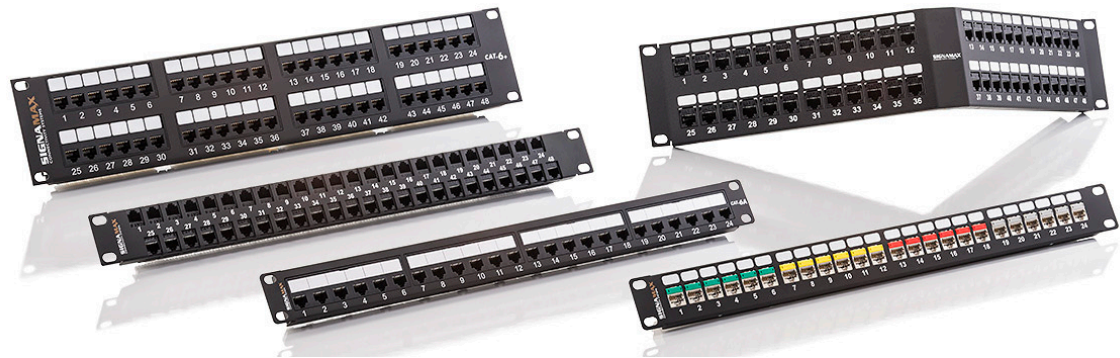
Type	Category 5E UTP	Category 5E F/UTP	Category 6 UTP	Category 6 F/UTP	Category 6A UTP	Category 6A F/UTP
West Penn Branded			24PP-C6C-L 48PP-C6C-L			
MD Series	12458MD-C5E 24458MD-C5E 48458MD-C5E		12458MD-C6C 24458MD-C6C 48458MD-C6C		24458MD-C6AC 48458MD-C6AC	
MT		24458S-C5E 48458S-C5E	24458-C6C 48458-C6C	24458S-C6C 48458S-C6C	24458-C6A 48458-C6A	24458S-C6A 48458S-C6A
High Density	48458HD-C5E		48458HD-C6C			
Angled	24458A-C5E 48458A-C5E	24458SA-C5E 48458SA-C5E	24458A-C6C 48458A-C6C	24458SA-C6C 48458SA-C6C	24458A-C6A 48458A-C6A	24458SA-C6A 48458SA-C6A

MD Series: 110 Connector Blocks
MT Series: Snap-in Keystone Jacks

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