Introduction to IT Physical Infrastructure (Layer 1)

Foundational Infrastructure

11/19/15

Agenda

- Wave 2/NBASE-T
- Physical Infrastructure Topology
- Access Point Installation
- Cable and Wiring
- Rack and Cabinet Mounting
- Design Requirements
- Labeling
- Power and Grounding
- Checklist
- Summary

Planning for Wave 2 WiFi: 2016

- 11ac clients consuming less airtime by speaking three times as fast
- MU-MIMO is a novel technology that might double or even quadruple WLAN user density by increasing the number of simultaneously supported clients.

	802.11n	802.11n IEEE Specification	802.11ac Wave 1 Today	802.11ac Wave2 WFA Certification Process Continues	802.11ac IEEE Specification
Band	2.4 GHz & 5 GHz	2.4 GHz & 5 GHz	5 GHz	**5 GHz**	5 GHz
MIMO	Single User (SU)	Single User (SU)	Single User (SU)	**Multi User (MU)**	Multi User (MU)
PHY Rate	450 Mbps	600 Mbps	1.3 Gbps	**2.34 Gbps - 3.47 Gbps**	6.9 Gbps
Channel Width	20 or 40 MHz	20 or 40 MHz	20, 40, 80 MHz	20, 40, 80, **80-80, 160** MHz	20, 40, 80, 80-80, 160 MHz
Modulation	64 QAM	64 QAM	256 QAM	256 QAM	256 QAM
Spatial Streams	3	4	3	3-**4**	8
MAC Throughout*	293 Mbps	390 Mbps	845 Mbps	1.52 Gbps- 2.26 Gbps	4.49 Gbps

* Assuming a 65% MAC efficiency with highest MCS

NBASE-T Ethernet

- New Ethernet standard to provide 1Gbps and greater network speeds (2.5 and 5 Gbps) over copper wires
  - 330 feet (100 meter) max.

References:

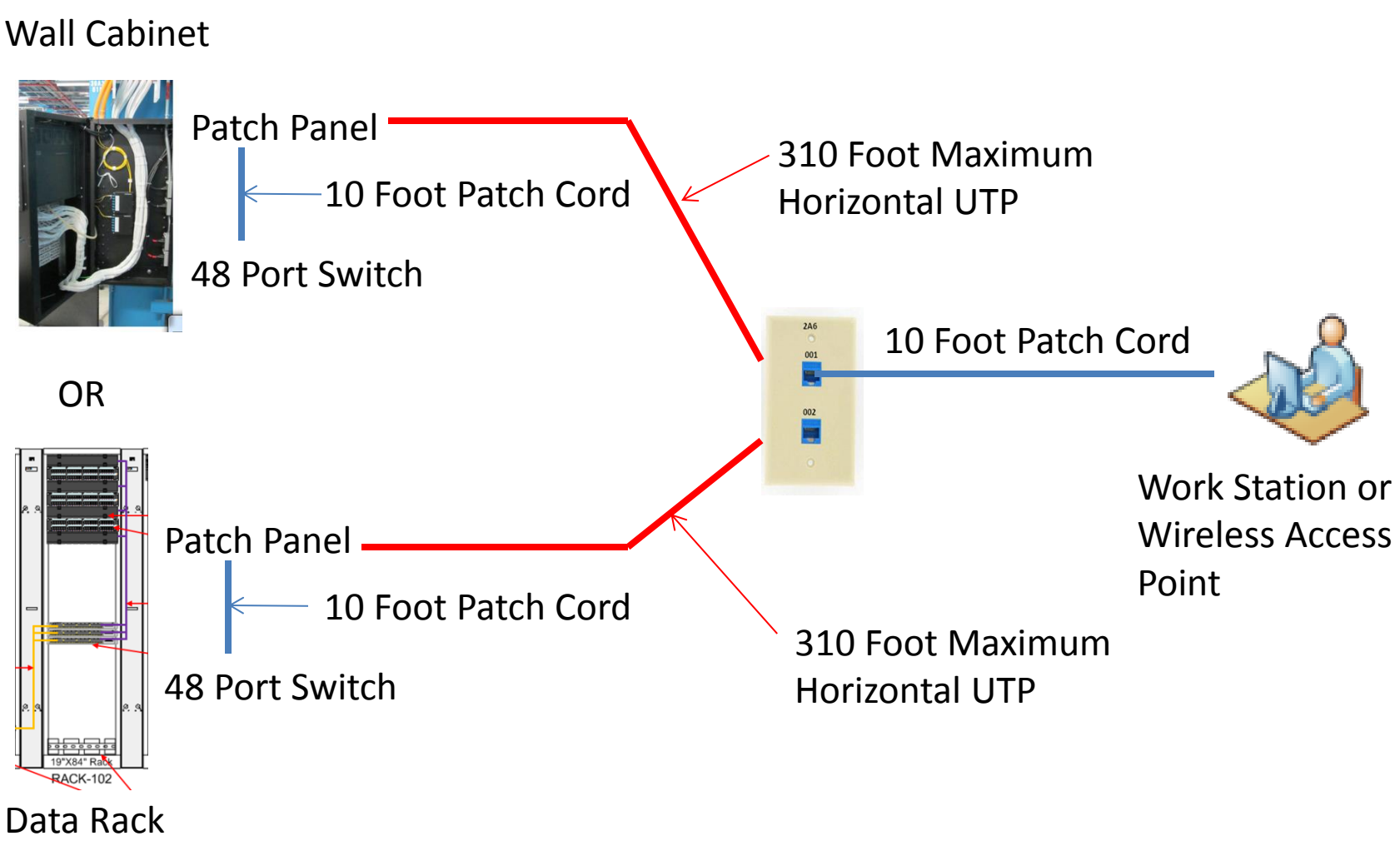
http://www.nbaset.org/technology/

http://blogs.cisco.com/enterprise/introducing-the-nbase-t-alliance-redefining-access-networks

Physical Infrastructure Topology

Permanent Link and Channel Connectivity

330 Foot Maximum (100 Meters) end to end Channel Connectivity

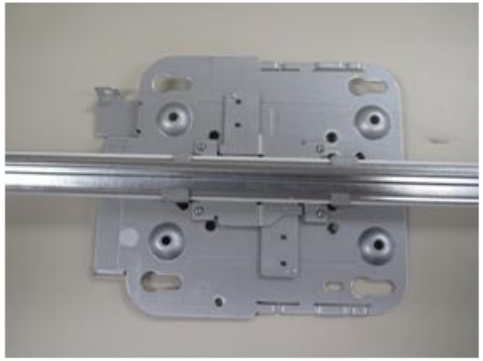


School Wireless Access Point

Access Point mounted on ceiling in middle of classroom and labelled with the room number.

Access Point Mounting Bracket Details

http://www.cisco.com/c/en/us/td/docs/wireless/access_point/mounting/guide/apmount.html#pgfId-23144



Station Wire Categories

Preparing for Wave 2 (Multigigabit) WiFi Access Points:

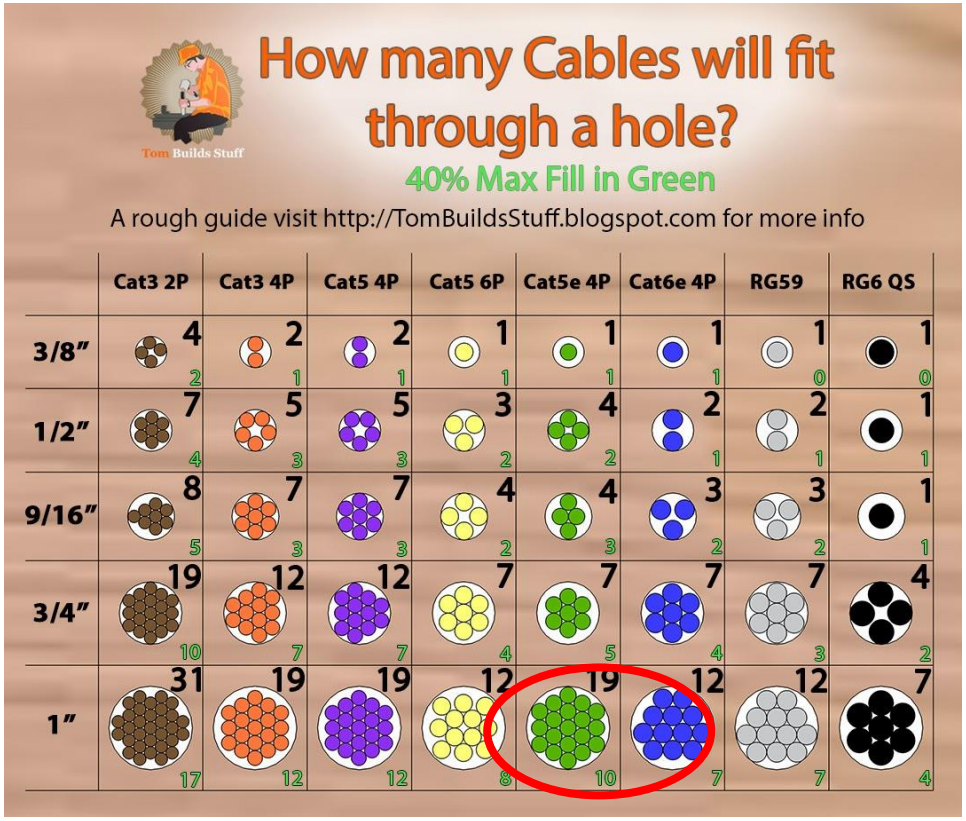
- Wiring that supports NBASE-T 1, 2.5, and 5Gbps connections and maximum length
- Cat-6/6a should be considered for 10G future proofing
- Cat-5e is the most cost effective and ease of use cable

Table 3. Cabling Options for Multigigabit Ethernet Ports

Cable Type	FE	1G	2.5G	5G	10G
Cat5e	l	l	l	l **100m**	
Cat6	l	l	l	l	l **55m**
Cat6a	l	l	l	l	l **100m**

FE – Fast Ethernet (100Mbps)

Relative Diameter of Cat 5e, 6 and 6A



Conduit Trade Size	Fill*	No. of CAT6A UTP Cables 9.0 mm (0.354") O.D.	No. of CAT6A F/UTP Cables 7.4 mm (.290") O.D.
53 mm (2")	40%	13	20
	60%	20	30
78 mm (3")	40%	30	45
	60%	45	66
103 mm (4")	40%	51	80
	60%	78	116

*40% is the fill ratio recommended for initial runs to allow for growth. 60% is the maximum fill ratio.

http://blog.blackbox.com/technology/2014/04/the-difference-between-cat6-and-cat6a-cable-diameters/

Station Wire Categories

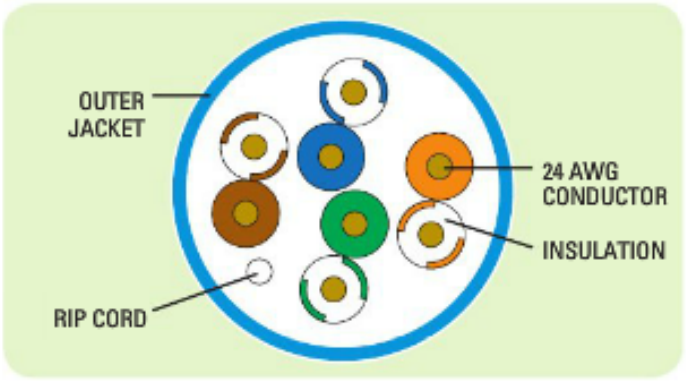
Cat 5e Cable Electrical Specifications

ELECTRICAL PERFORMANCE

Frequency MHz	PSACR* (min)	ACR* (min)	Insertion Loss (max)	PSNEXT (min)	NEXT (min)	PSACRF (min)	ACRF (min)	Return Loss (min)
1	63.3	64.3	2.0	65.3	66.3	61.0	64.0	20.0
4	52.3	53.3	4.0	56.3	57.3	49.0	52.0	23.0
10	43.9	44.9	6.4	50.3	51.3	41.0	44.0	25.0
16	39.1	40.1	8.1	47.2	48.2	36.9	39.9	25.0
20	36.6	37.6	9.2	45.8	46.8	35.0	38.0	25.0
25	34.0	35.0	10.3	44.3	45.3	33.0	36.0	24.3
31.25	31.3	32.3	11.6	42.9	43.9	31.1	34.1	23.6
62.5	21.6	22.6	16.8	38.4	39.4	25.1	28.1	21.5
100	13.6	14.6	21.7	35.3	36.3	21.0	24.0	20.1
155	4.7	5.7	27.7	32.4	33.4	17.2	20.2	—
200	—	—	32.0	30.8	31.8	15.0	18.0	—
250	—	—	36.4	29.3	30.3	13.0	16.0	—
300	—	—	40.5	28.1	29.1	11.5	14.5	—
350	—	—	44.3	27.1	28.1	10.1	13.1	—

Note: Values are expressed in dB per 100 m (328 ft.) length @ 20°C.
*PSACR & ACR not specified in ANSI/TIA 568-C.2

GenSPEED® 5350 ENHANCED CATEGORY 5e CROSS-SECTION



ELECTRICAL CHARACTERISTICS

DC Resistance (max) Ohms/100 m (328 ft) @ 20°C	8.9
DC Resistance Unbalance (max) Individual Pair %	3.0
Delay Skew (max) ns/100 m	45
Nom. Velocity of Propagation % Speed of Light	CMP: 72 CMR: 70
Characteristic Impedance Frequency (f): 1-350 MHz	Ohms 100 ± 15

Category 5e Station Wire

- There is no difference between cat5e and cat5E, it is marketing hype. The correct text is category 5e.

- Cat 5e must be tested at 100Mhz for near end/far end cross talk per IEEE 802.3 1000BASE-T (Gigabit Ethernet) standards

- The standard stops at 100 MHz, the only limit lines beyond 100 MHz are defined as category 6 (250 MHz) and augmented category 6 (500 MHz) In most cases, the vendor has characterized the cable to 350 MHz.

  The limit lines in the standards represent the minimum acceptable quality for an installation. Vendors like to show how they exceed the standard. Quoting 350 MHz is seen as a way of doing this, but a number of vendors have started guaranteeing headroom (amount better than the limit line) rather than extended frequency, which is far more meaningful.

- Category 5e vs Category 5E | Fluke Networks

Copper Station Wire

Design/Install Requirements

- Horizontal wiring installed in a ceiling or raised floor utilized as a return air plenum environments shall be plenum rated
- Wires should run in a straight line at 90-degree angles to the building structure and be formed properly. Wire clamps/rings shall be placed 4’ horizontally or 8’ vertically. Cable/wire tie wraps or Velcro straps will be every 6’ horizontally or 8’ vertically in columns. the installed cable must not be under tension greater than 25 pounds (II kg). This will be visually apparent by the sag of the cables.
- Cables shall not be laid directly on ceiling tiles, HVAC ducts or attach to sprinkler pipes, electrical conduit, ceiling tile hangers or any other structure not specifically intended for communications support.
- Splices, Bridge-Taps, or any method of repairing a damaged cable are not allowed. Damaged cables shall be replaced. *This does not preclude being able to re-terminate a cable that is damaged at either end.*
- It is recommended that a 30 foot service loop be provided in the horizontal permanent link to enable future drop location move requirements
- Installation test results are required. Additional transmission parameters for bi-directional multi-pair transmission used in 1000Base-T, 100 MHz. near end/ far end cross talk should all have passing results.

Copper Station Wire Distance Separations

EMI

Electromagnetic interference (EMI) is disturbance that affects an electrical circuit due to either electromagnetic induction or electromagnetic radiation emitted from an external source. The UTP cable should be installed some distance away from an EMI sources.

Minimum Separation Distances per ANSI/TIA/EIA-569 between power and Data Cables (possible sources of EMI)

	Minimum Separation Distance		
	< 2 kVA in (mm)	**2 - 5 kVA in (mm)**	**> 5 kVA in (mm)**
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	5 (127)	12 (305)	24 (610)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.	2.5 (64)	6 (152)	12 (305)
Power lines enclosed in a grounded metal conduit (or equivalent - shielding) in proximity to a Grounded metal conduit pathway.	3 (76)	6 (152)	
Electrical motors and transformers	48 (1,220)		
Florescent Lighting	12 (305)		

The distances referenced above are guidelines meant to protect the integrity of the data signal from induced noise. The following separations are **required** (NESC Section 320.B.2) for safety of personnel and for protection of equipment:

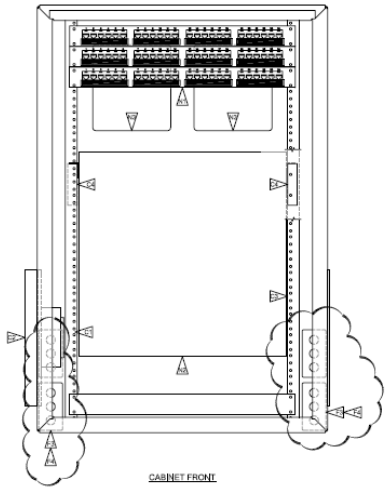
STRUCTURE	MINIMUM SEPARATION
Power or other foreign conduit	3 inch concrete
	4 inch masonry
	12 inch earth
Pipes (gas, oil, water, etc.)	6 inch when crossing
	12 inch when parallel

Small Size Equipment Cabinet

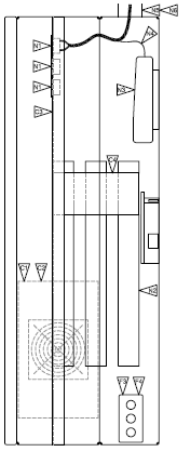
Hubbell RE4X
42” H x 24” W x 10” D

5 RU’s for Equipment
4 RU’s for Patch Panels

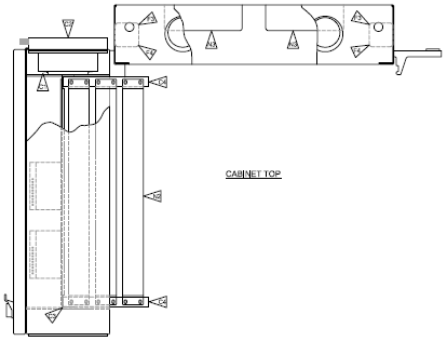
Small Size Equipment Cabinet



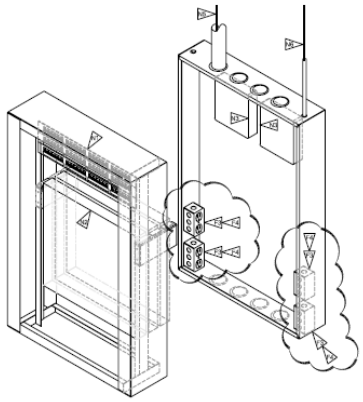
CABINET FRONT



CABINET SIDE



CABINET TOP



CHATSWORTH

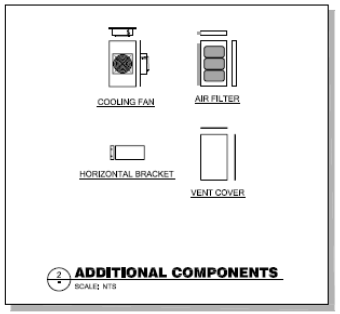
- INSTALL (1) FAN KIT ON LOWER LEFT VENT OPENING, INSIDE CABINET (FORCING AIR INTO ENCLOSURE).
- INSTALL (1) FAN FILTER ASSEMBLY OUTSIDE CABINET, AT LOWER LEFT VENT OPENING (ADJACENT TO FAN).
- INSTALL VERTICAL EQUIPMENT RAILS WITH EQUIPMENT MOUNTING FACE 3" FROM FRONT OF CENTER PARTITION.
- PROVIDE AND INSTALL CUSTOM HORIZONTAL MOUNTING BRACKET - TOP SCREW HOLE ON HORIZONTAL BRACKET SHALL BE SECURED TO THE 23RD SCREW HOLE FROM TOP OF ENCLOSURE.

SITE SERVICES

- NOT USED.
- PROVIDE AND INSTALL (1) 2" (MIN) CONDUIT TO CEILING OR TRAY FOR WORKSTATION CABLING AND (1) 3/4" CONDUIT TO CEILING OR NEAREST CABLE PATHWAY FOR SINGLEMODE FIBER.
- PROVIDE AND INSTALL (4) SINGLE-GANG OUTLET BOXES - (1) CIRCUIT AND (2) OUTLET BOXES ON EACH SIDE OF CABINET.
- PROVIDE (2) 120V\20A\Ø ELECTRICAL CIRCUITS TO SERVICE ENCLOSURE - EACH OUTLET BOX PAIR TO RECIEVE NEMA 5-20R DUPLEX RECEPTACLE AND SEPERATE CIRCUITS FOR REDUNDANCY.
- PROVIDE SUFFICIENT UNISTRUT AND MOUNTING HARDWARE TO INSTALL CABINET IN ACCORDANCE WITH SEISMIC, SAFETY AND ALL OTHER APPLICABLE BUILDING CODES TO LOCATIONS SPECIFIED BY PROJECT DOCUMENTATION.

NETWORK

- PROVIDE AND INSTALL 24-PORT PATCH PANELS AT TOP OF ENCLOSURE.
- PROVIDE AND INSTALL UP TO (3) CISCO SWITCHES AS NEEDED.
- PROVIDE AND INSTALL UP TO (2) WIRELESS CISCO ACCESS POINTS.
- ROUTE CAT-5E CABLING TO WIRELESS ACCESS POINTS WITHIN CABINET.
- ROUTE CAT-5E CABLING TO REMOTE ACCESS POINTS OR WORKSTATIONS THROUGH PATHWAYS PROVIDED BY OTHERS.
- PROVIDE AND INSTALL SINGLEMODE FIBER TO CABINET.



Small Size Equipment Cabinet

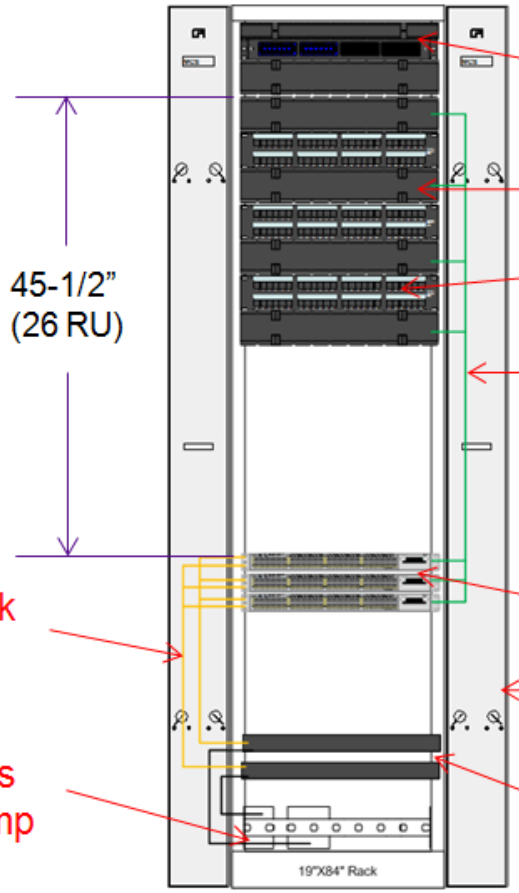
Front

Rear Inside Swing Gate

End

Front Inside

Typical Rack Design



1, 2,3 or 4U fiber patch panel with wire management as required

2U Horizontal wire managers

48 Port copper patch panels

Harness cables or patch cords

48 port switch stack

6 Inch vertical wire management

120 volt, 20 amp power strips with L5-20 cords and 5-20R receptacles

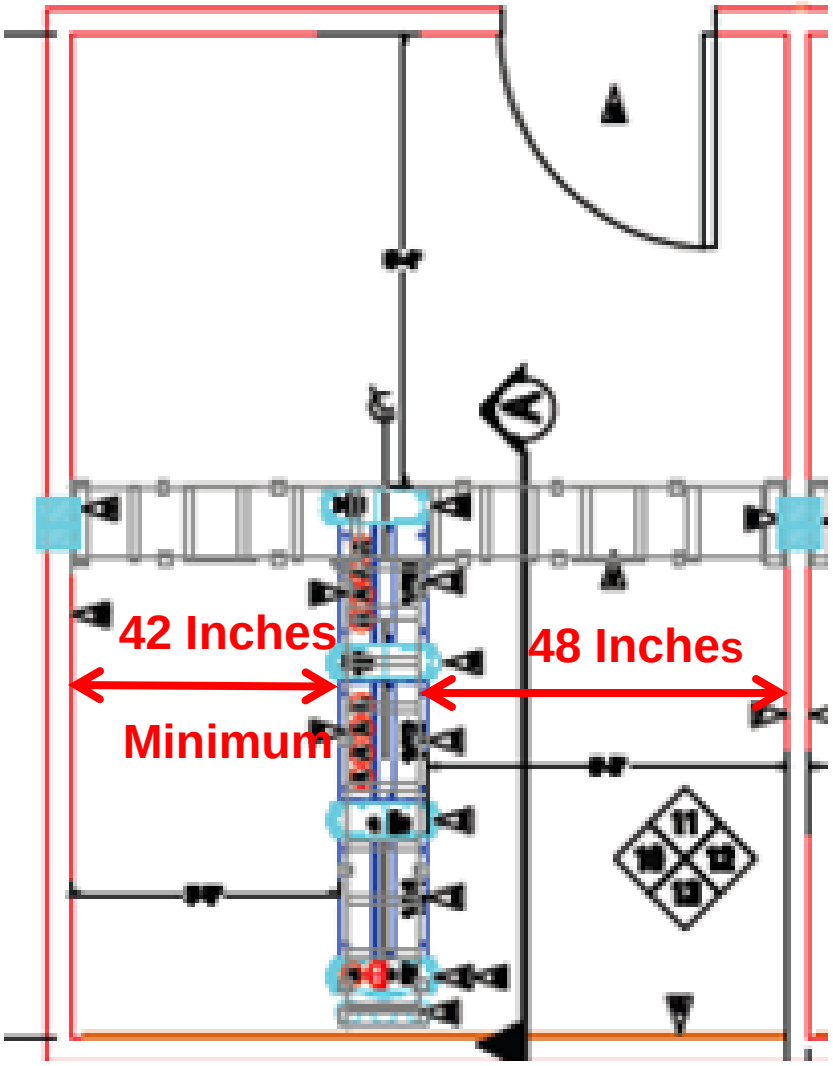
Power cords routed on back side of wire manager

(2) L5-20 power receptacles on separate 120 volt, 20 amp circuits

RACK-101

144 ports

Data Room Layout
with front/back rack clearance



Data Room Design Requirements

- Network Data Room Components
  - Free standing equipment racks
  - Ladder/cable trays for communications cabling pathway
  - Grounding and bonding
  - HVAC, Power
  - Conduits, sleeves for communications cabling pathways entering/exiting the room
  - Fire stopping conduits and sleeves
  - Fiber and copper patch panels
  - Vertical and horizontal cable managers for communications cabling pathway
  - Lockable door
  - Plywood on one wall for voice grade circuits

- Data Cabinet
  - Ladder/cable trays for communications cabling pathway distribution
  - Grounding and bonding
  - Power
  - Fiber and copper patch panels
  - Lockable door

Data Room/Cabinet Component Definitions

- **Ladder tray** systems are used to support low voltage COAX, Fiber , ARMM, F1 and F2 cables used for distribution and IT communication in a uniform fashion. System allows for end-user data cables to be ran from data room point of entry to vertical cable manager in an environmentally safe manner and meet building code requirements.

- **Vertical cable managers** securely route cables to keep them neat, organized and out of the way, allowing for easy identification during maintenance. Allows for end-user data cables to be routed from ladder tray to switch to provide connectivity.

- **Horizontal wire managers** help provide cable strain relief and maintain a clean, orderly and maintainable rack installation.

- **Free standing equipment racks** are utilized for installing network electronics. They also provide a structure for installing wire managers, power and grounding/bonding infrastructure.

- **Wall mounted equipment enclosures & free standing equipment cabinets** provide environmental and malicious activity protection to switch. Provides network capability to areas identified that are over 295ft from a data room.

Data Room/Cabinet Component Definitions

- **Conduit** is a tube used to protect and route end user data wiring in a building and requirement to reduce the risk of short-circuits, electrocution or fires. Provides distribution of end user data cables throughout building and provides environmental protection while meeting building code requirements.

- **Conduit sleeves** are a method of entry from building to data room. Provide environmental protection to end user data cables while meeting building code requirements. A requirement to reduce the risk of short-circuits, electrocution or fires, e.g. fire barriers and walls.

- **Grounding and Bonding** is a National Electric Code (NEC) and Building Industry Consultant Service International (BCSI) requirement which provides equipment and personnel protection.

Station Connectors

A dual 4 pair station wire will be terminated on an un-keyed 8 pin modular jack which shall conform to the appropriate performance specifications as set forth in EIA/TIA 568B.

All jacks shall be labeled with its appropriate assigned number.

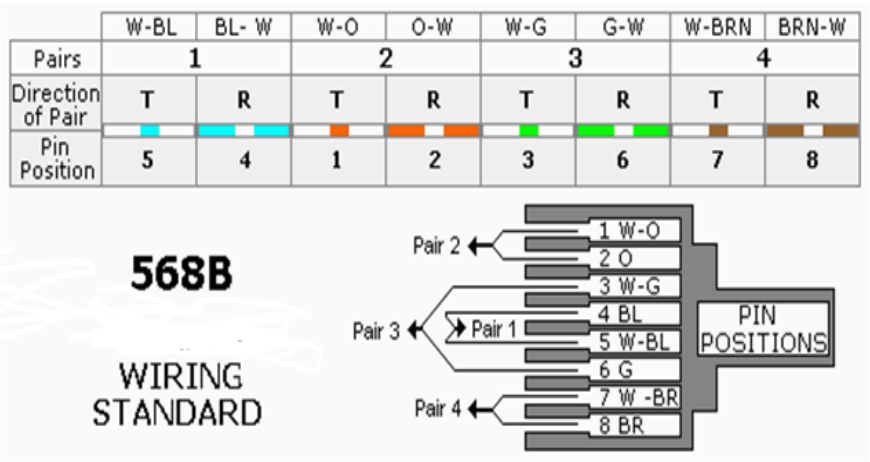


Figure 2.18 - RJ45 Terminations of 4 pair Cable

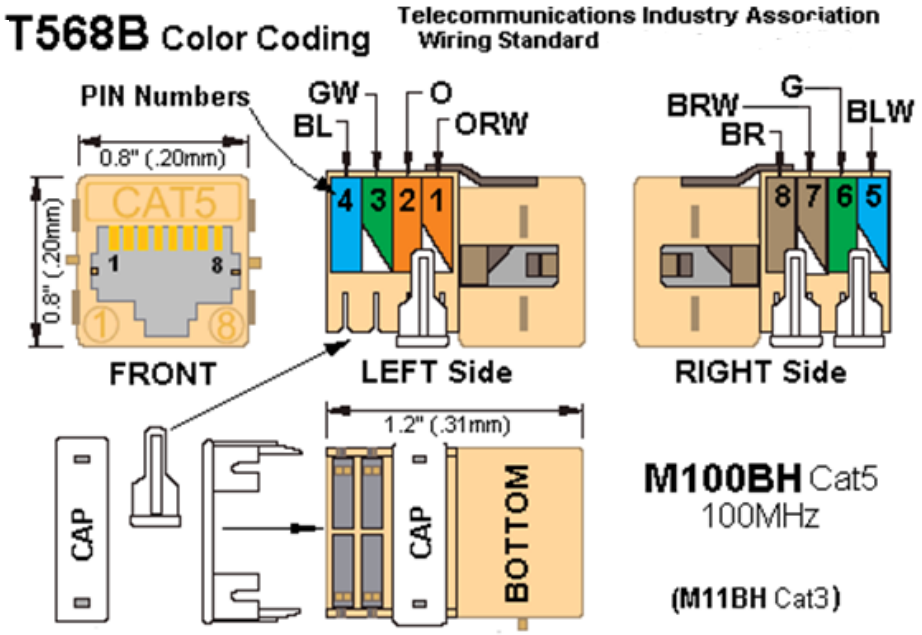
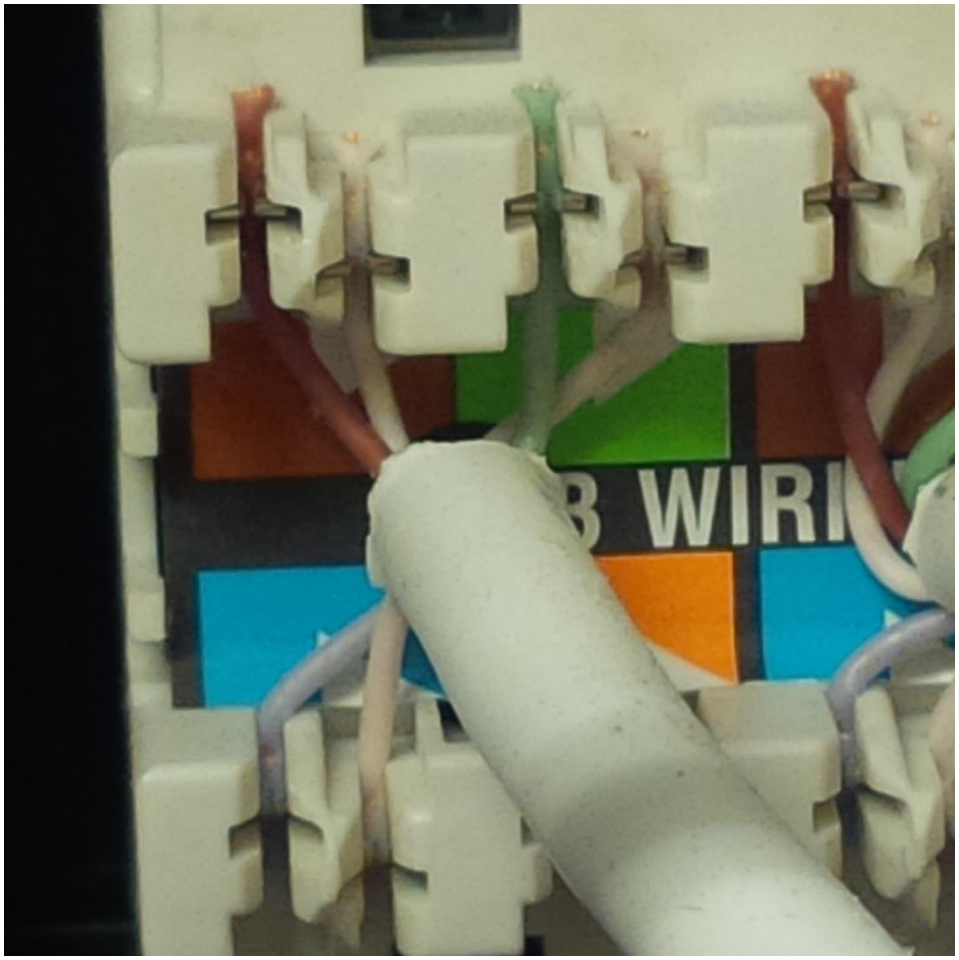


Figure 2.19 - RJ45 Termination requirements

Proper Wire Termination with EIA/TIA 568B

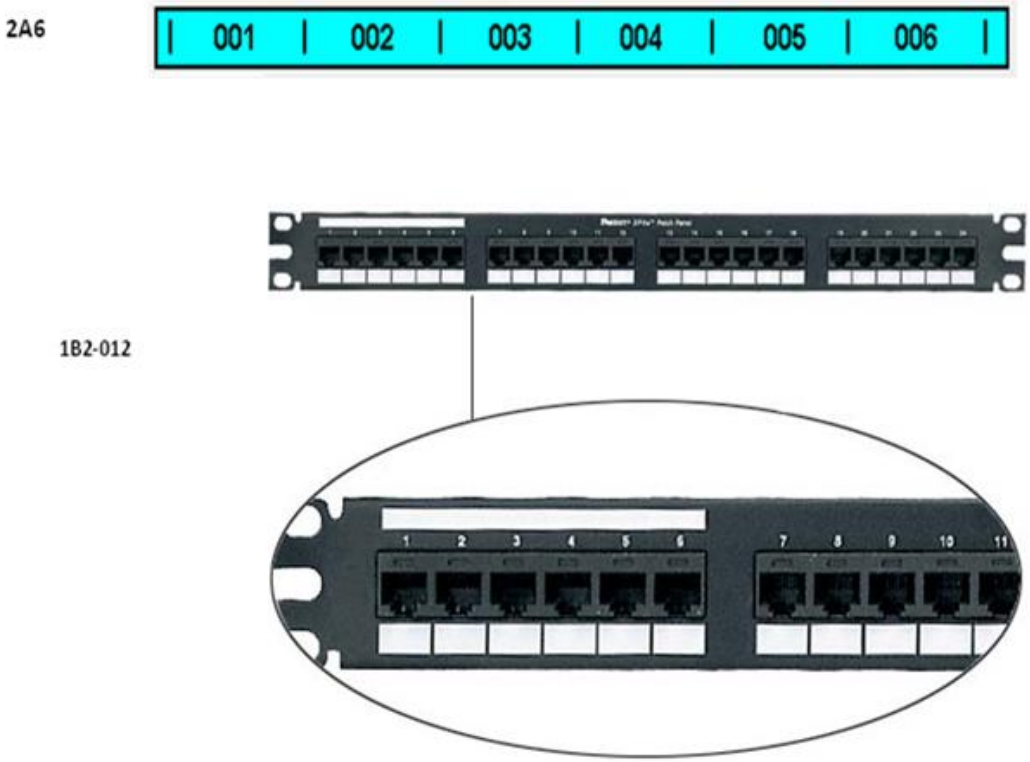


Proper attachment or punch down of the cable to the jack is critical to performance. The maximum amount of untwisting is 0.5”

Connection Hardware Labeling

- The numbering scheme will consist of two fields, separated by a dash, in order, by floor and room number of serving communications room (CR) and jack number.
- The actual jack number shall consist of a minimum of 3 and a maximum of 4 characters. The three characters shall be 001-999, preferably numbered in sequence by closest proximity to the CR where possible. When assigning jack numbers on floors with more than one CR, a logical geographical division of feed(s) shall be considered based on cabling distances and building environment.
- An example of this numbering scheme would be the following: 2A6-001, meaning; 2 = Floor, A6 = room number and 001 being the first jack number.
- When labeling the number on the patch panel, the serving wire closet or IDF number need appear only once on each labeling strip with the 3 character jack number at each jack position. The jack at the station end of the wire run will be labeled with both the CR. (or IDF.) number and jack number.
- Each school shall make a best effort to conform to this standard. However, during normal Move and Change (MAC) activities utilizing the existing number scheme should be continued for consistency. Migration to this standard shall be accomplished in a phased approach when 1 or more of the following applies:
    - New building
    - Major remodel
    - Where an entire communications/data room can be renumbered

Connection Hardware Labeling



Power Standard

Code Compliance

All power design and installation practices shall adhere to the most current version of the National Electric Code (NEC), which is published by the National Fire Protection Association. The NEC should be reviewed as each edition is released (every 3 years). All installations practices shall also adhere to applicable state or local codes.

Power Requirements

Adequate power outlets shall be provided for the number of cabinets and (or) racks to be powered. Power may be required from the ceiling or from the floor, depending on the type of equipment and physical environment. The type of power outlet must be identified for proper installation.

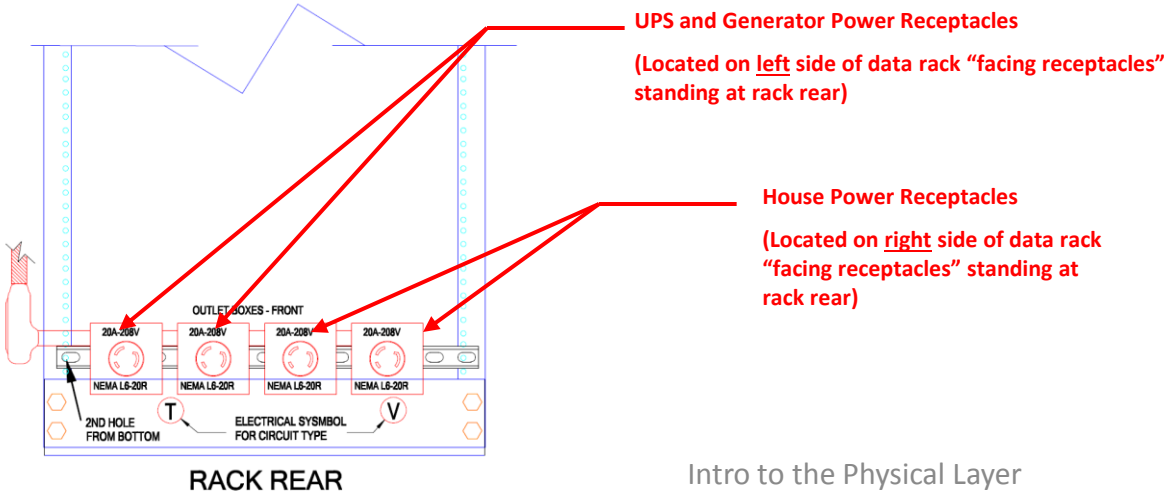
In addition to the power connections to telecommunications equipment, sufficient standard convenience outlets should be provided to power auxiliary equipment, power tools, test equipment, etc.

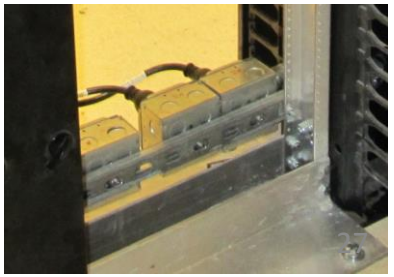
Power Standard Guidelines

- When the equipment in a particular rack or cabinet exceeds the capacity of the existing service outlets or associated 20-amp circuit breaker, installing additional service outlets dedicated to a second 20-amp circuit breaker is permissible.

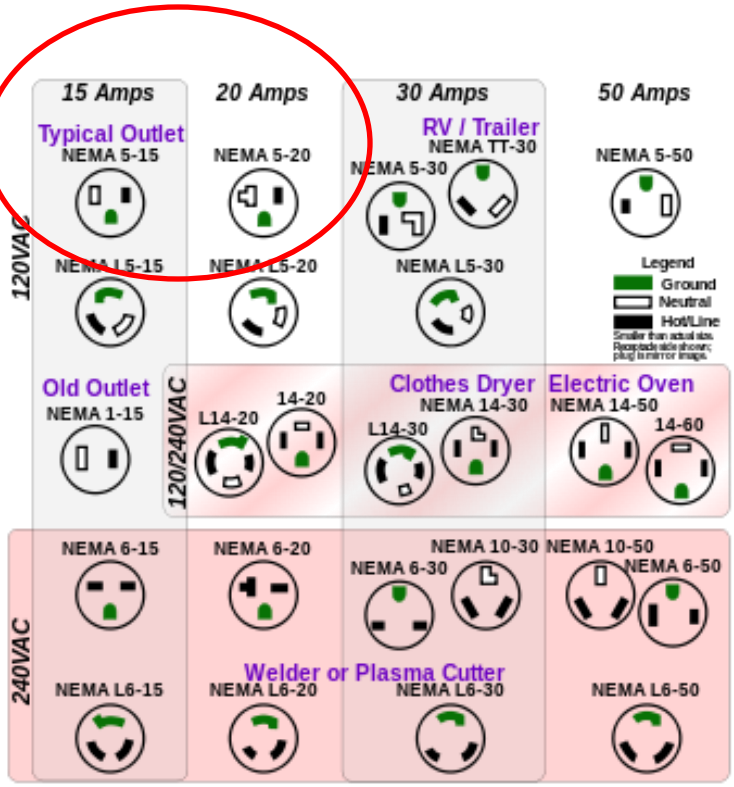
- Communication Rooms and shall have a dedicated sub-power panel if requirements are sufficient enough to justify the cost. Each outlet in the room must be clearly marked with panel and circuit designations. *An isolation transformer may be included in the room design where known contaminated power exists.* All power distribution to the telecommunications equipment in the room shall be provided from this dedicated panel, and the panel should be in view of and as close as possible to the telecommunications equipment.

- A minimum clearance will be maintained in front of electrical panels per NEC 110.16. *When considering clearance take into account the depth of the electronic chassis to be installed in the cabinet or rack.*

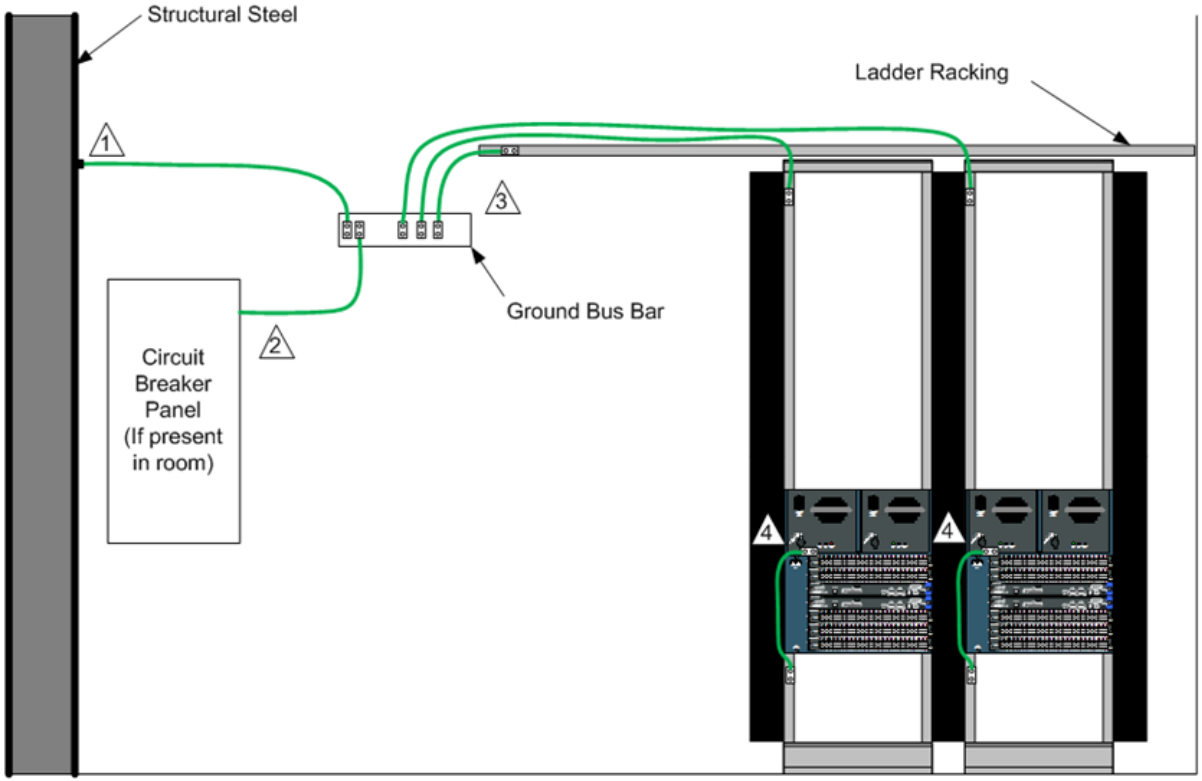




Power Receptacle Chart
120VAC 15/20Amps



Small Data Room Grounding Details (for 3 or less racks/cabinets)



1. Bonded connection to structural steel by means of exothermic weld, lug, pressure connector or clamp.
2. Make this connection only if the breaker panel is present within the Telecom room and is less than 30 feet of the bus bar. It must be installed by a qualified electrician.
3. Connections to the bus bar must be made with a 2 hole crimp connector. Use the same type of connector at the ladder and equipment racking.
4. Connect switch to the equipment rack by means of the pre-fabricated grounding strap from NetIG/WWT or make your own on site. Smaller switches do not need a separate ground wire.

Grounding Conductor (Green Wire) Sizing

Sizing of the Bonding Backbone	
Conductor length linear m (ft)	Conductor Size (AWG)
less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
greater than 20 (66)	3/0

Bonding and Grounding

General

The basic elements of the grounding and bonding infrastructure specified in this document shall be followed for all telecommunications installations regardless of the building structure.

This standard specifies the elements that comprise the grounding and bonding infrastructure. The following section provides the detailed requirements associated with each system component.

Grounding and bonding of building electrical services is outside the scope of this document. However, coordination between electrical and telecommunications grounding and bonding systems is essential for the proper application of this Standard.

In all cases the applicable electrical codes for grounding and bonding for telecommunications shall be met.

The grounding and bonding infrastructure originates at the service equipment (power) ground and extends throughout the building. It includes the following major components:

- Main Grounding Busbar;
- Bonding Conductor
- Bonding Backbone

Main Grounding Busbar (MGB)

The main grounding busbar (MGB) serves as the central attachment point for the telecommunications bonding backbone and equipment. Typically there should be one MGB per building as the dedicated extension of the building grounding electrode system. The MGB should be located in the building Main Distribution Facility (MDF) and placed to minimize the length of the bonding conductor required.

The MGB shall serve equipment located within the same room or space (MDF). Should the building design call for other telecommunications spaces (i.e., Intermediate Distribution Facility (IDF), Equipment cabinets) an extension of the MGB shall be installed to serve the equipment in those spaces.

Bonding and Grounding

Bonding Conductor

The bonding conductor shall bond the MGB to the service equipment (power) ground.

The bonding conductor for telecommunications shall be, as a minimum, the same size as the bonding backbone.

Bonding Backbone

The bonding backbone is a conductor that interconnects all grounding busbars in IDFs, equipment rooms and cabinets with the MGB.

The bonding backbone should be designed with consideration given to the type of building construction, building size, general telecommunications requirements, and the configuration of the pathways and spaces.

The interior water piping system of the building shall not be used as a bonding backbone.

The metallic cable shield shall not be used as a bonding backbone.

When two or more bonding backbones are used within a multistory building, they shall be bonded together with a grounding equalizer (GE) at the top floor and at a minimum of every third floor in between.

The bonding backbone and grounding equalizer shall be a copper conductor. The minimum conductor size shall be a No. 6 AWG. The conductor may be insulated and shall meet the fire ratings of its pathway. The sizing of the bonding backbone is not intended to account for the reduction or control of electromagnetic interference.

Product Manufacturers

- **UTP copper cables**
  - http://www.panduit.com/en/home
  - http://www.commscope.com/Product-Catalog/Enterprise/
  - http://www.belden.com/index.cfm
  - http://www.leviton.com/OA_HTML/SectionDisplay.jsp?section=37665&minisite=10251
  - http://www.hubbell-premise.com/catalog.aspx
  - http://www.generalcable.com/na/us-can/products-solutions

- **Fiber cables**
  - http://www.corning.com/worldwide/en.html
  - http://www.ofsoptics.com/index.html
  - http://www.panduit.com/en/home
  - http://www.commscope.com/Product-Catalog/Enterprise/
  - http://www.hubbell-premise.com/catalog.asp

- **Wire managers**
  - http://www.chatsworth.com/products/
  - http://www.panduit.com/en/home
  - http://www.commscope.com/Product-Catalog/Enterprise/
  - http://www.hubbell-premise.com/catalog.aspx

- **Cabinets**
  - http://www.chatsworth.com/products/
  - http://www.commscope.com/Product-Catalog/Enterprise/
  - https://www.google.com/?gws_rd=ssl#q=great+lakes+cabinets
  - http://www.newark.com/hoffman-enclosures
  - http://www.rittal.com/com-en/content/en/produkte/schaltschraenke/schaltschraenke.jsp
  - http://www.hubbell-premise.com/catalog.aspx

- **Racks**
  - http://www.chatsworth.com/products/
  - http://www.panduit.com/en/home
  - http://www.hubbell-premise.com/catalog.aspx

Post Installation Check List

Building:	
Data Room:	
Date:	
Evaluator:	

Close Out Checklist			
Activity	**Completed**	**Not Completed**	**Notes**
Design Drawing Requirements			
Cable Tray			
Cable Management			
Rack Placement			
Power			
Generator			
UPS			
Fiber			
UTP			
Labeling			
Fiber Patch Panel Installation			
Copper Patch Panel Installation			
Grounding/Bonding			
Wireless			
Enclosures			
Antennas			
Coax			
Mounting Bracket			

Note: By checking Yes in the following boxes it is being communicated that the above work has been completed and completed correctly. The Evaluator of this document is being held to the responses in this worksheet. If there are any questions or concerns in completing this spreadsheet please contact the Cable & Wire Designer assigned to this project.

List of Industry Standards Documents

- The telecommunications industry standards. Listed below are the updated revision/version of the industry standard documents that the design/ installation contractor will need to reference and follow as a condition under this contract.
- **ANSI/BICSI:**
- ANSI/BICSI 002-2014 - Data Center Design & Implementation Best Practices
- ANSI/BICSI 003-2014 - Building Information Modeling (BIM) Practices for Information Technology Systems
- **BICSI:**
- Information Technology Systems Installation Methods Manual - 6th Edition
- Outside Plant Design Reference Manual - 5th Edition
- Telecommunications Distribution Methods Manual - 13th Edition
- **TIA:**
- TIA-568-C.0 - Aug 14, 2012 - Generic Telecommunications Cabling for Customer Premises
- TIA-568-C.1 - May 3, 2012 - Commercial Building Telecommunications Cabling Standard
- TIA-568-C.2 - Nov 7, 2014 - Balanced Twisted-pair Telecommunications Cabling and Components Standards
- TIA-568-C.3 - Oct 13, 2011 - Optical Fiber Cabling Components Standard
- TIA-569 Rev B - Mar 12, 2015 - Telecommunications Pathways and Spaces
- TIA-606 Rev B - Jun 22, 2012 - Administration Standard for Telecommunications Infrastructure
- TIA-607 Rev B - Aug 21, 2013 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- TIA-758 Rev B - Mar 27, 2012 - Customer-owned Outside Plant Telecommunications Infrastructure Standard
- TIA-862 Rev A - Mar 30, 2011 - Building Automation Systems Cabling Standard
- TIA-942 Rev A - Mar 2014 - Telecommunications Infrastructure Standard for Data Centers
- TIA-1005 Rev A - Jan 7, 2015 - Telecommunications Standard for Industrial Premises
- TSB-162 Rev A - Nov 1, 2013 - Telecommunications Cabling Guidelines for Wireless Access Points
- **IEEE:**
- IEEE 802.3af-2003: Power over Ethernet. (PoE).
- IEEE 802.3at-2009: Power over Ethernet Plus (PoE Plus)
- IEEE 802.11-2012: Wireless Networking.
- IEEE 802.3an-2006: 10GBASE-T 10 Gbps (1250 Mbps) Ethernet over Unshielded Twisted Pair (UTP).
- **NFPA:**
- NFPA 70 - National Electrical Code - 2014 Edition
- NFPA 70E - Standard for Electrical Safety in the Workplace - 2015 Edition

Summary

- Plan wiring for Wave 2 Access Points
- Rack or cabinet mounting options
- Location and mounting of the AP is critical
- Contractor must follow the list of Industry Standards Documents
  - Cat 5E must be tested at 100Mhz for near end/far end cross talk per IEEE 802.3 1000BASE-T (Gigabit Ethernet) standards
  - Locating the data closet/cabinet: max wiring distance is 330 feet(100 meters)

Q and A

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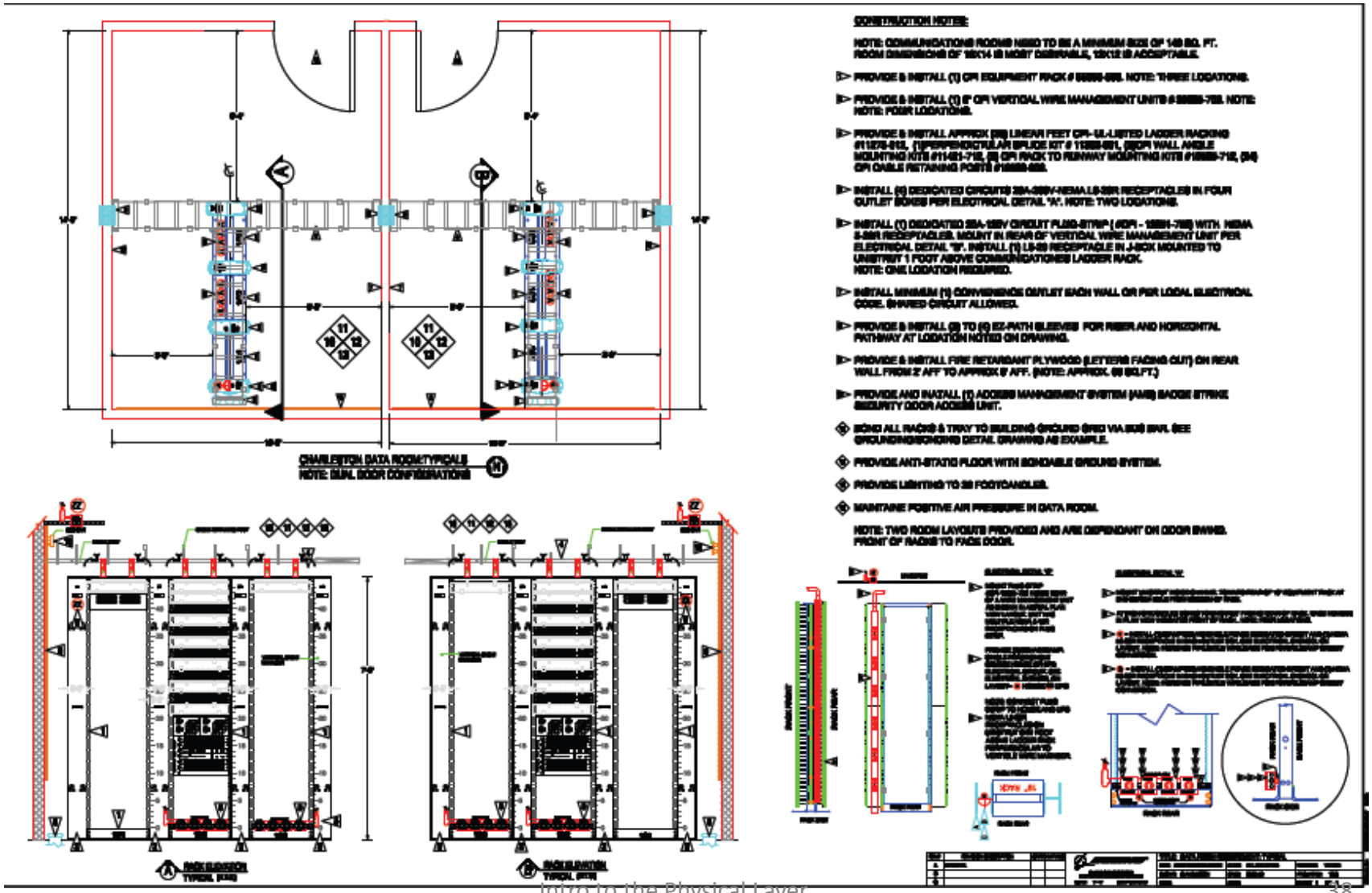
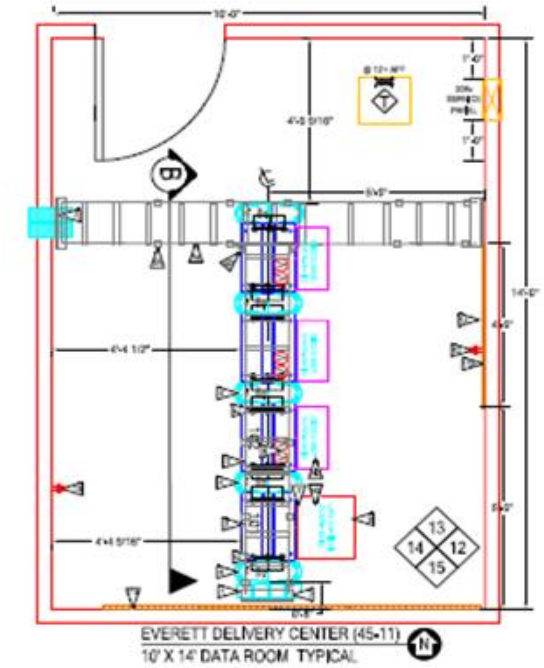
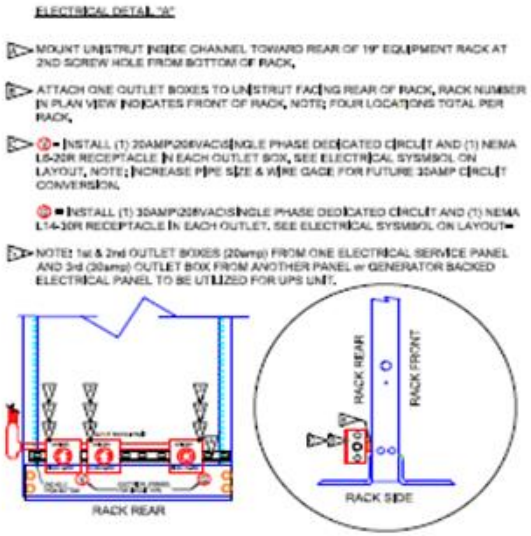
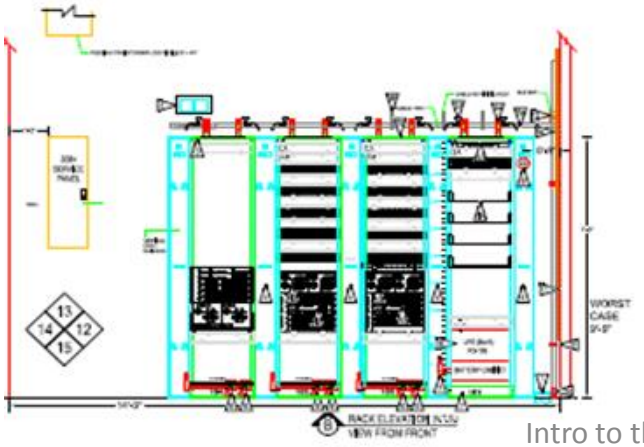
Data Room Design Requirements

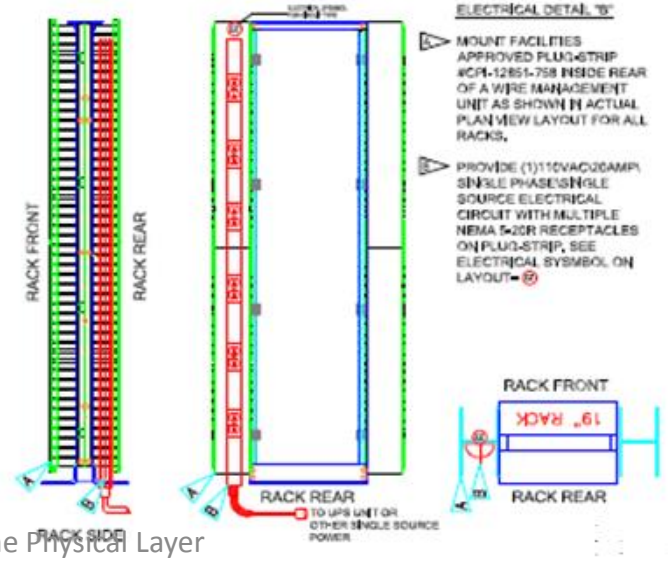


Data Closet build out Components









Station Connectors

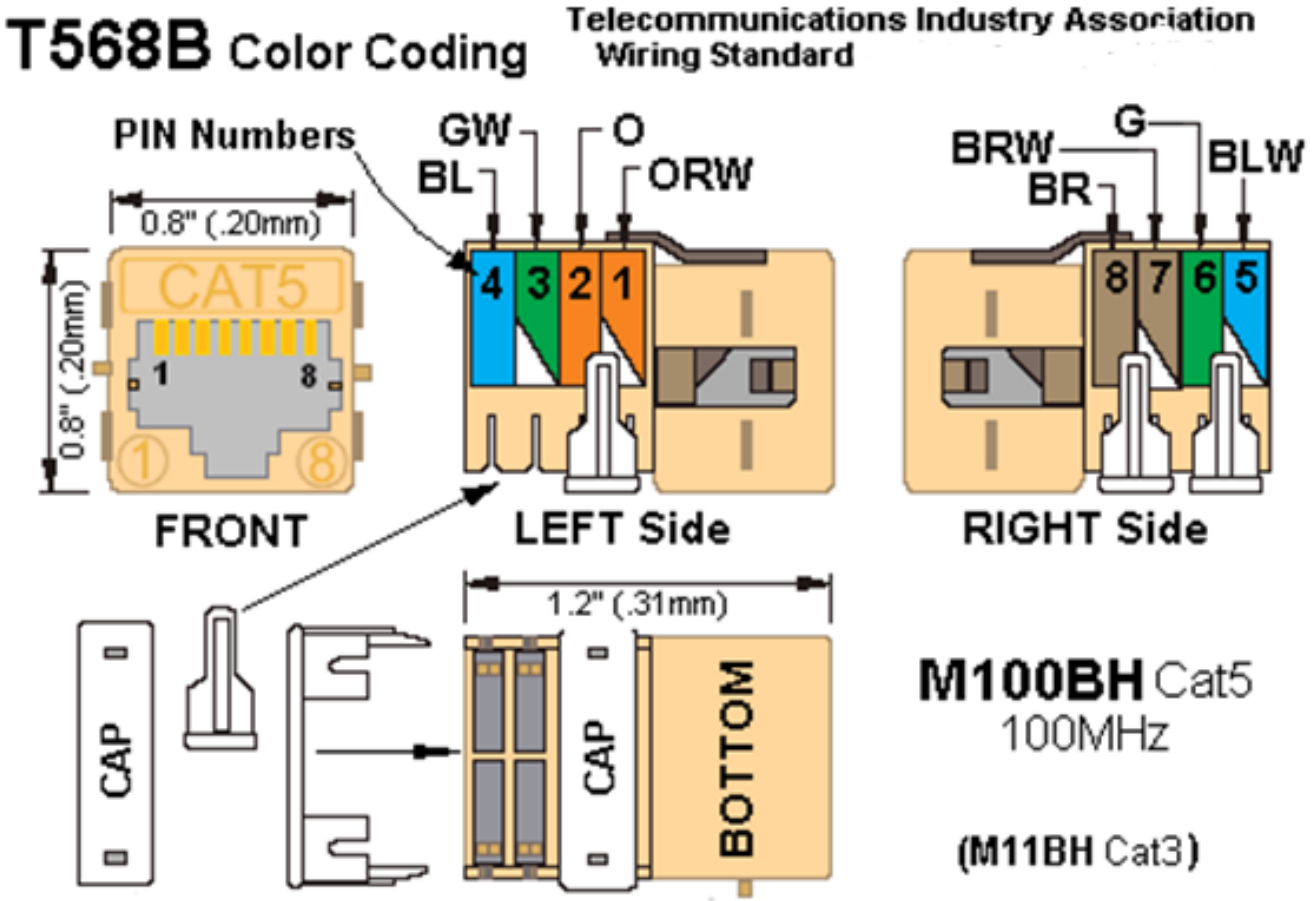
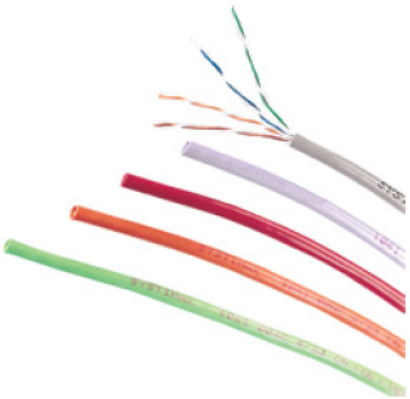


Figure 2.19 - RJ45 Termination requirements



SYSTIMAX® 61 Series 4-Pair PowerSUM Cable

100 ohm high performance cable with excellent NEXT levels

The High-Speed 100 ohm High Performance PowerSUM Cable The SYSTIMAX® 61 Series 4-Pair Cable is a high speed, 100 ohm high performance cable with excellent NEXT levels. SYSTIMAX 61 series cables provide excellent high-speed transmission and support applications such as 155 Mb/s ATM, 622 Mb/s ATM and the IEEE 802.3 1000BASE-T (Gigabit Ethernet) Standard, using parallel transmission scheme technology. The 1061 4-pair cable meets or exceeds Category 5e/Class D specifications in ISO/IEC 11801, CENELEC EN50173, and TIA/EIA 568B.2. Further, these cables are ETL verified as Category 5e.

The 2061F 4-pair cable is composed of 24 AWG solidcopper conductors. The core of twisted pairs is jacketed with a low-smoke PVC. 2061F cable is ETL rated.

- Variety of colors available
- Meets or exceeds the Category 5 and Category 5e requirements in ISO/IEC 11801 (2002), EN50173-1 (2002) and ANSI/TIA-568-C.2
- Supports an operating voltage of 72 Vdc between any conductors throughout the operating temperature range

http://www.commscope.com/catalog/enterprise/product_details.aspx?id=18299&tab=1