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Category 5 / 5E & Cat 6 Cabling Tutorial and FAQ's

Information on installing cat 5 / 5e cabling

The following information is considered to be "just the right mix" of technical vs. practical knowledge and information on category 5 / 5e cabling, for beginner to intermediate.

This article does not cover all of the details necessary to do a fully compliant 568A installation (to do that you will need to read the entire standard). It does, however, touch upon what I believe to be the most important things that you will need to know. To insure that you fully understand all of the information, I strongly suggest that you read through the entire article, from beginning to end, including the definitions. Even the intermediate level installer may find new useful facts that they were not aware of. This article is for general information only. Please always check with local code officials, and / or cabling consultants when planning an installation. Please be aware that the terms category 5 and cat 5 mean the same thing and are both used throughout this article. In addition, this article also applies to Category 5E (Cat 5 Enhanced) and Category 6 cables. Basically, when we refer to category 5 cable in this article, we are speaking in general but actually are referring to UTP data cable which encompasses all three types.
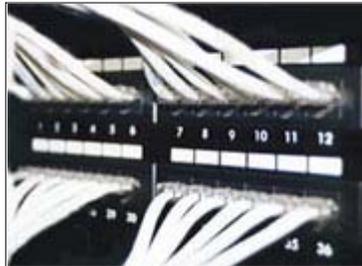
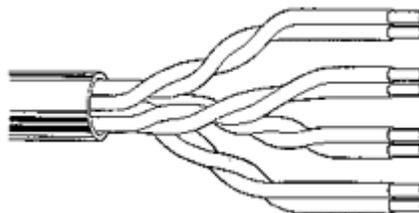**NEW!!! Check out the latest in our category 5E information series!**
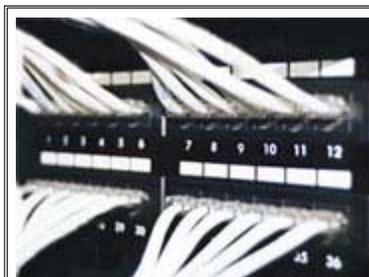
The photo above shows a typical category-5E patch panel with patch cables connecting each network segment to a port on the Hub.
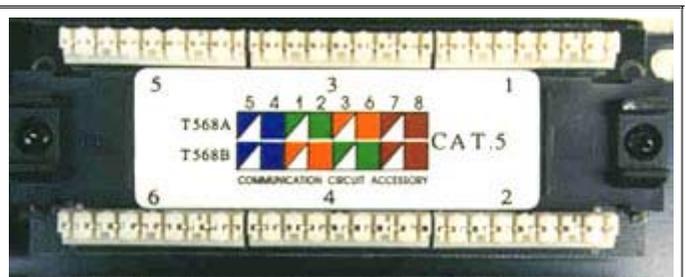
The photo above shows part of the back side of a typical category 5E patch panel. The method of connection is by insulation displacing '110' blocks. Note the connection diagram, showing connection for both 568A and 568B wiring schemes.

Basic Concept of a Twisted Pair Cable

Definitions + Information	
Category 5 Cable (UTP) (Unshielded Twisted Pair)	A multipair (usually 4 pair) high performance cable that consists of twisted pair conductors, used mainly for data transmission. Note: The twisting of the pairs gives the cable a certain amount of immunity from the infiltration of unwanted interference. category-5 UTP cabling systems are by far, the most common (compared to SCTP) in the United States. Basic cat 5 cable was designed for characteristics of up to 100 MHz. Category 5 cable is typically used for Ethernet networks running at 10 or 100 Mbps.
Category 5 E Cable (enhanced)	Same as Category 5, except that it is made to somewhat more stringent standards (see comparison chart below). The Category 5 E standard is now officially part of the 568A standard. Category 5 E is recommended for all new installations, and was designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet).

Category 6	Same as Category 5 E, except that it is made to a higher standard (see comparison chart below). The Category 6 standard is now officially part of the 568A standard.
Category 7	Same as Category 6, except that it is made to a higher standard (see comparison chart below). The Category 7 standard is still in the works (as of this writing) and is not yet part of the 568A standard. One major difference with category 7's construction (as compared with category 5, 5 E, and 6) is that all 4 pairs are individually shielded, and an overall shield enwraps all four pairs. Category 7 will use an entirely new connector (other than the familiar RJ-45).
Category 5 Cable (SCTP) (Screened Twisted Pair)	Same as above, except that the twisted pairs are given additional protection from unwanted interference by an overall shield. There is some controversy concerning which is the better system (UTP or SCTP). Category 5 SCTP cabling systems require all components to maintain the shield, and are used almost exclusively in European countries.
Category 5E, RJ45 jack (Work Area Outlet)	An 8 conductor, compact, modular, female jack that is used to terminate category-5E cable at the user (or other) location. The jack is specifically engineered to maintain the performance of cat 5E cabling.
Category 5E Patch Panel	A Category 5E Patch Panel is basically just a series of many category-5E jacks, condensed onto a single panel. Common panel configurations are 12, 24, 48, and 96 ports. Patch panels are typically used where all of the horizontal cable sections meet, and are used to connect the segments to the Network Hub.
Category 5E Patch Cable	A Category 5E Patch Cable consists a length of cat 5E cable with an RJ-45 male connector, crimped onto each end. The cable assembly is used to provide connectivity between any two category-5E female outlets (jacks). The two most common are from hub to patch panel, and work area outlet (jack) to the computer.
EIA/TIA 568A Standard	This standard was published in July of 1991. The purpose of EIA/TIA 568A, was to create a multiproduct, multivendor, standard for connectivity. Prior to the adoption of this standard, many "proprietary" cabling systems existed. This was very bad for the consumer. Among other things, the standard set the minimum requirements for category 5E cable and hardware. The 568 "standard" is not to be confused with 568A or 568B wiring schemes, which are themselves, part of the "568A standard".
568A and 568B Wiring Schemes	When we refer to a jack or a patch panel's wiring connection, we refer to either the 568A, or 568B wiring scheme, which dictates the pin assignments to the pairs of cat 5E cable. It is very important to note that there is no difference, whatsoever, between the two wiring schemes, in connectivity or performance when connected form one modular device to another (jack to Patch panel, RJ-45 to RJ-45, etc.), so long as they (the two devices) are wired for the same scheme (A or B). The only time when one scheme has an advantage over the other, is when one end of a segment is connected to a modular device, and the other end to a punch block. In which case, the 568A has the advantage of having a more natural progression of pairs at the punch block side. More on 568 A&B later on.
Four Pairs	Pair 1: White / **Blue** Pair 3: White / **Green** Pair 2: White / **Orange** Pair 4: White / **Brown**
Wiremap	This is the most basic test that can be performed on a category-5E segment. Wiremap tests for the basic continuity between the two devices. In 568A or B, all eight pins of each device should be wired straight through (1 to 1, 2 to 2, 3 to 3, etc.). A wiremap (continuity) test, should also test for **absence of** <u>shorts</u>, <u>grounding</u>, and <u>external voltage.</u>
Crosstalk	Crosstalk is the "bleeding" of signals carried by one pair, onto another pair through the electrical process of induction (wires need not make contact, signals transferred magnetically). This is an unwanted effect, that can cause slow transfer, or completely inhibit the transfer of data signals over the cable segment. The purpose of the wire twists, in category 5E cable is to significantly reduce the crosstalk, and it's effects. Two types are: NEXT (Near End Crosstalk), and FEXT (Far End Crosstalk). Fiber Optic cable is the only medium that is 100% immune to the effects of crosstalk.
Ambient Noise or Electromagnetic Interference (EMI)	Similar to crosstalk, in that it is an unwanted signal that is induced into the cable. The difference is that ambient noise (or EMI) is typically induced from a source that is external to the cable. This could be an electrical cable or device, or even an adjacent category 5E cable.
Attenuation	Attenuation is the loss of signal in a cable segment due to the resistance of the wire plus other electrical factors that cause additional resistance (Impedance and Capacitance for example). A longer cable length, poor connections, bad insulation, a high level of crosstalk, or ambient noise, will all increase the total level of attenuation. The 568A standard, specifies the maximum amount of attenuation that is acceptable in a category-5E cable segment.

Category 5E Installation. Do's and Don'ts.

Do	Run all cables in a "Star" configuration. That is to say that they all emanate from, and are "homerun" to, one central location, known as the wiring hub. Visualize a wagon wheel, all of the spokes, start from on central point, known as the hub of the wheel.
Do	Keep all cable runs to a maximum of 295 feet (for each run).
Do	Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted
Do Not	Skin off more than 1" of jacket when terminating
Do	Make gradual bends of the cable, where necessary. No sharper than a 1" radius. (about the roundness of a half-dollar)
Do Not	Allow the cable to be sharply bent, or kinked, at any time. This can cause **permanent damage** to the cables' interior.
Do	Dress the cables neatly with cable ties. Use low to moderate pressure.
Do Not	Over tighten cable ties. We recommend Hook and Loop (Velcro) Cable Ties for commercial installations.
Do	Cross-connect cables (where necessary), using cat 5E rated punch blocks and components.
Do Not	Splice or bridge category-5E cable at any point. There should never be multiple appearances of category 5E cable.
Do	Use low to moderate force when pulling cable.
Do Not	Use excessive force when pulling cable.
Do	Use cable pulling lubricant for cable runs that may otherwise require great force to install. (You will be amazed at what a difference the cable lubricant will make)
Do Not	Use oil, or any other lubricant, not specifically designed for cable pulling. Oil, or other lubricants, can infiltrate the cable, causing damage to the insulation.
Do	Keep cat 5E cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as possible.
Do Not	Tie cables to electrical conduits, or lay cables on electrical fixtures.
Do	Install proper cable supports, spaced no more than 5 feet apart.
Do Not	Install cable that is supported by the ceiling tiles (this is unsafe, and is a violation of the building codes).
Do	Always label every termination point. Use a unique number for each cable segment. The idea here, is to make moves, adds, changes, and troubleshooting as simple as possible.
Do	Always test every installed segment with a cable tester. "Toning" alone, is not an acceptable test.
Do	Always install jacks in such a way as to prevent dust and other contaminants from settling on the contacts. The contacts (pins) of the jack should face up on flush mounted plates, or left, right, or down (never up) on surface mount boxes.
Do	Always leave extra slack on the cables, neatly coiled up in the ceiling or nearest concealed place. It is recommended that you leave at least 5 feet at the work outlet side, and 10 feet at the patch panel (wiring hub) side.
Do Not	Never install cables "taught" in the ceiling, or elsewhere. A good installation should have the cables loose, but never sagging.

Do	Always use grommets to protect the cable where passing through metal studs or anything that can possibly cause damage to them.
Do	Choose either 568A or 568B wiring standard, before you begin your project. Wire all jacks and patch panels for the same wiring scheme (A or B).
Do Not	Mix 568A and 568B wiring on the same installation.
Do Not (1 exception)	Use staples on category-5E cable that crimp the cable tightly. The common T-18 and T-25 cable staples are not recommended for category 5E cable. The T-59 insulated staple gun is ideal for fastening cat5 & 6 and fiber optic cabling as it does not put any excess pressure on the cable.
Do	Always obey all local, and national, fire and building codes. Be sure to "firestop" all cables that penetrate a firewall. Use plenum rated cable where it is mandated.

LANshack.com sells all of
the very best tools, testers and toolkits for installing and troubleshooting UTP copper cabling.

We also carry
an impressive line of Fiber Optic Test Instruments.

Share one Network Cable for two Network Devices:
Network Splitter (Pair), Network Splitter Kit (Includes Cables)

or Run Voice & Data over one CAT5 Cable: Voice/Data Splitter