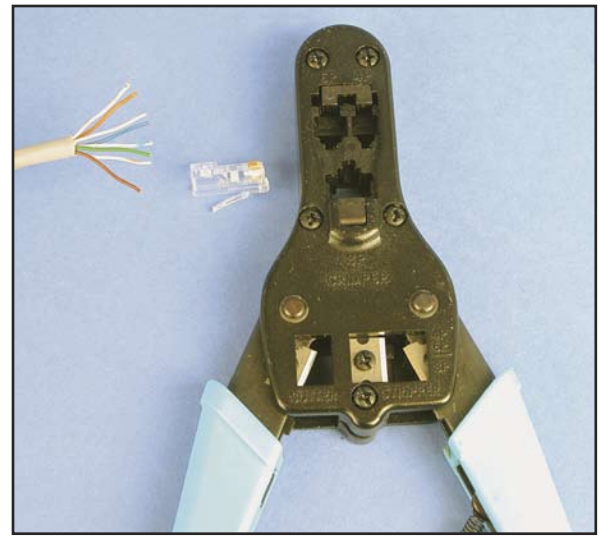
Allen T. Poland Jr, K8AXW

A CAT5 Cable and Connector Tester

How to deal with those "modular" connectors that are showing up everywhere.



As time goes on, ham radio and the use of computers are becoming more integrated. I think it is safe to assume that most hams own at least one computer and that at least half of those use the computer with ham radio. More and more the computer is being used for logging, especially for multi-operation on Field Day, contests, emergency operations and other situations that make networked computers convenient if not essential.

Sooner or later each of us will find the need to use *Category 5* (CAT5) Ethernet type cables for networking. These are the cables with the eight-pin telephone-style modular (RJ-45 type) connectors on each end. Although ready-made CAT5 cables of various lengths are readily available, it has been my experience that whatever I buy is either 6 inches too short or 6 feet too long. This just adds to the existing rat's nest of wires behind my desk. Also, there will come a time when your home network fails to work and something is needed to check the integrity of the cables and connectors.

Rolling Your Own

I found learning how to install the connectors on CAT5 cable a very interesting diversion. When I decided to wire part of my house with CAT5 cable it became a necessity. Probably the most interesting part happens after my large, arthritic fingers have wrestled with eight wires and a connector for several minutes and I wonder: "Is it going to work?" Fortunately, they do most of the time. Sooner or later one doesn't work, however, and then it can get very annoying. The first question is: "Okay, which end is bad?" Commercial testers are available but the cheapest one I was able to find was $17 plus shipping. The prices go from there up into the hundreds of dollars. This is for a piece of equipment that will be used only occasionally. I couldn't justify even the modest cost of a low-end unit.

I decided to make up a gizmo to check these connectors as they are installed. The name of the game was to do it as inexpensively as possible. For me it turned out to be free. If one has a nice junk box, this is possible. If you don't, this device still can be made up for just a few dollars.

CAT5 cables consist of four twisted wire pairs surrounded by a plastic jacket. It is necessary to remove a short piece of jacket from the end of the cable, fan out the wires and arrange the wires into the proper order. Then you insert them into an eight conductor connector and crimp to complete the assembly. The crimping action forces eight guillotine blades down to cut through the insulation and make contact with the connector pins. It's an easy and straightforward process but it is also very easy to cross wires inside the connector. The second possible problem is that one of the blades might fail to cut the insulation and make contact. To check for these errors I put together two circuits that will give a visual indication of almost any problem.

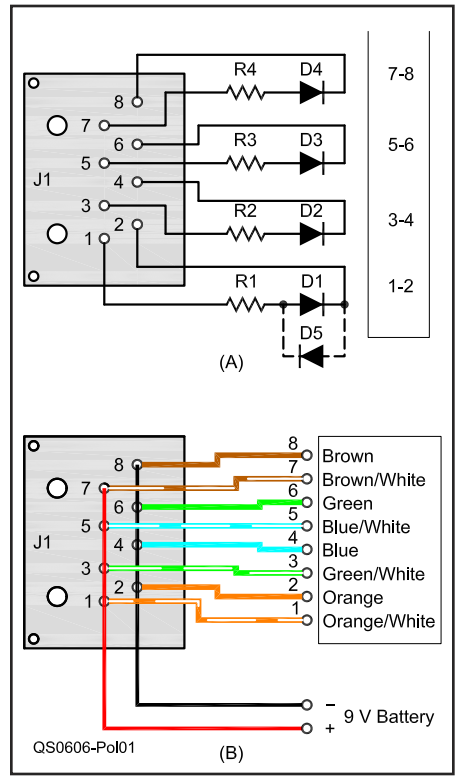


Figure 1 — Schematic of test system. The indicator board is at (A) and the power board is at (B).

D1-D4 — Green LED, four LED configuration, RadioShack 276-022.
D5-D8 — Red LED, four LED configuration. Optional, RadioShack 276-026 (see text).
J1-J4 — RJ-45 sockets. Removed from old equipment or Mouser #806-GDL-A-88.
R1-R4 — 1 kΩ, ¼ W resistors.
TS-1 — Eight position terminal strip. RadioShack 274-678, or equivalent.

Enter the Test Set

The circuit in Figure 1A is what I call the *indicator board*. It is a piece of perforated board (*perfboard*) on which I have mounted a female RJ-45 connector, four 1 kΩ resistors and four LEDs. Since this test setup is something to be used only occasionally, no attempt was made to build it as a showcase. Point to point wiring was used with whatever scrap wire was lying around.

The circuit in Figure 1B is what I call the *power board*. It is a piece of perfboard on which I mounted a female RJ-45 connector, an eight lug terminal strip and a connector for a 9 V battery.

I salvaged the 8-pin connectors from an old NIC (network interface card). They are somewhat difficult to remove because the 8 pins are soldered on both the top and bottom of the circuit board to plated through holes. With a "sucker" type soldering iron and a screwdriver they will come off. The second one is easier to get off because, after the first one, you know that they will indeed come off!

The terminal strip can be any kind of device you might have, just as long as it can make reliable connections to each of the eight

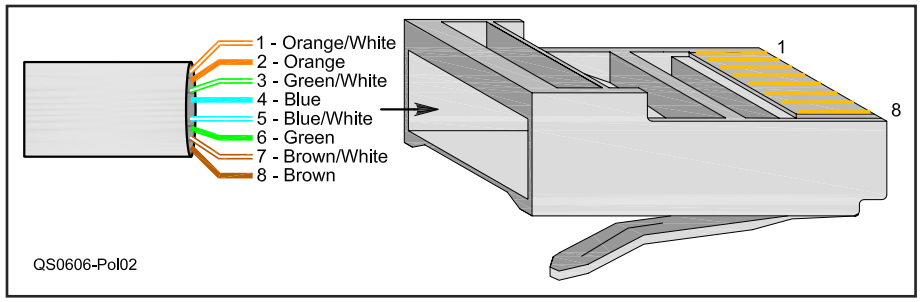


Figure 2 — The correct sequence of wiring in the connector. The connector is held with the tab facing down. Conductors must be fully inserted before crimping.

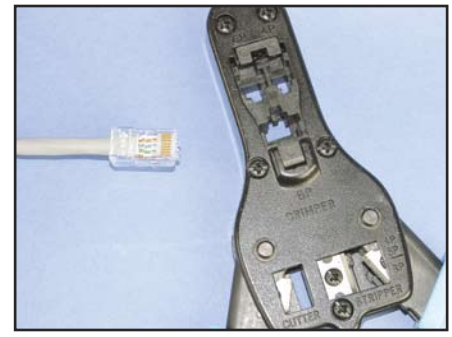


Figure 3 — Wires arranged and inserted in the RJ-45 connector ready to crimp.

small wires. I used a European barrier strip because it was what I had in the junk box.

The process of using this device is as follows. Install a connector on one end of the CAT5 cable and plug it into the Indicator Board. Strip the eight wires on the other end of the cable and insert them into the 8 connector strip on the power board, in the correct order. Plug a 9 V battery onto the battery connector.

If the eight wires are making contact in the connector and are installed correctly, all four LEDs will light up. If an LED is not illuminated, then that pair is either reversed or one of the wires isn't making contact inside the connector. Try re-crimping and if that doesn't correct the problem, then it will be necessary to cut the connector off and do it again.

Once it is determined that the first connector is okay, install the second connector. This time plug the second assembled connector into the power unit. If all eight LEDs illuminate, your cable is good to go. If any LEDs fail to illuminate then the second connector is bad. The main thing to note here is that a negative indication at this point means the second connector has a fault. There is no longer the question of "which end is bad?"

Putting the Test Set Together

Construction is fairly straightforward. It can be as fancy as you wish. In my case, I just made it easy on myself. I used two small pieces of perfboard. I built the power board first. The two mounting tabs on the CAT5 connector will go through the holes as spaced on the perfboard but none of the other pins will line up with the predrilled holes. I cut a rectangular hole in the perfboard for all of the connector pins to hang through, mounted the connector and bent the mounting tabs over. I then used hot glue on the sides of the connector to hold it in place.

The terminal strip is also anchored with hot glue as is a strip of Velcro that holds the 9V battery. Wiring is point to point, on either side of the perfboard.

The indicator board is built the same way. The eight pin RJ-45 connector is mounted exactly the same as it was on the power board. Eight voltage dropping resistors are mounted next and then the four LEDs. Again, point to point wiring is used. On the subject of wire, I found that telephone multi-conductor cable is full of very small color coded wire that is ideal for this type of wiring. If you have a chance to obtain a piece of this cable, grab it!

I used red LEDs because I had a handful of them lying around. If you wish to get a bit fancy here, you can use green LEDs and then use reversed biased red LEDs in parallel with them. Whenever a connector or cable is tested, all green LEDs will indicate that you're good to go. If you have a red LED illuminated then you know that you have a reversed pair. If no LED is illuminated in that particular circuit, then you have an open in the connector.

This might give you hope that a re-crimp will correct the problem. If not, then the outcome will be the same. Cut the connector off and do it again. There's one good thing about a simple circuit and primitive construction. You can always improve on it.

Figure 2 shows the correct sequence of wiring in the connector. It cannot be changed unless the same change is made in the opposite end connector. I'd like to point out that the conductors are wired "straight through." That is, pin 1 goes to pin 1, pin 8 goes to pin 8. Note that the wires are inserted into the connector with the connector latch lever down. Make sure all eight wires are completely in the connector. They can be seen through the clear plastic. Figure 3 shows the wires lined up in the connector ready to crimp. Figure 4 shows the completed and crimped connector. Note the clamped outer jacket on the left side, it provides the strain relief.

CAT5 connectors are available that let the wires go completely through. After checking for accuracy, the excess is trimmed off. Such connectors are great for checking the color code sequence, thus helping eliminate one of two problems with wiring these connectors. The only downside to them is they cost approximately twice as much as the standard connector.

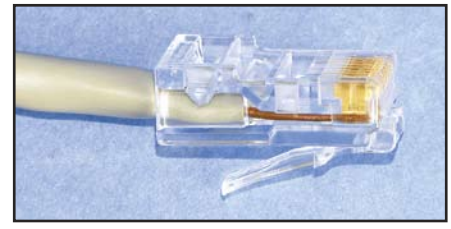


Figure 4 — RJ-45 connector crimped and ready to go. Note the jacket clamp on the left and the "guillotine" blades on the right.

Equipment manufacturers have been using more and more cables with these connectors for purposes other than data networking. First they showed up as microphone connectors and now are frequently used for remote mounting front panels. This makes having the capability to make and test such cables even more important. One additional item that will be needed will be a crimp tool. A source of an inexpensive crimp tool with two dozen connectors is **www.cyberguys.com**, #115-1321.

If you intend to add this tester to your kit of gear that you take to the field, you might want to dress it up to impress your friends. Otherwise, just hide it as I do!

Allen Poland, K8AXW, celebrates his 50th year in ham radio this month. He obtained his Conditional Class ticket and call K8AXW while stationed in Bad Aibling, Germany in 1956. His German call was DL4TPO and he also held the call K3FKA for several years while living in Maryland. He presently holds Amateur Extra class and First Class Radiotelephone licenses. His main interest in ham radio has been building, and for the past 15 years, building, upgrading and repairing computers. He is now retired from the Westvaco Corporation, Luke Mill, after working 40 years as a power plant operator. You can reach him at 1335 Ludwick St, Keyser, WV 26726 or at **k8axw@arrl.net**.