61700515E1-44.1C
March 2014

Troubleshooting Guide

Cable Diagnostics Troubleshooting Guide

This troubleshooting guide provides instructions for using cable diagnostics feature to obtain information about Ethernet cable states and lengths to help troubleshoot cabling problems, or to gather general cable information. The diagnostic tests reveal cable shorts, open connections, and distances to the faults, using the ADTRAN Operating System (AOS) product's web-based graphical user interface (GUI) and the command line interface (CLI).

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Cable Diagnostics Overview

Cable diagnostics is a method of testing Ethernet cables connected to 10/100 Ethernet or 10/100/1000 Gigabit-Ethernet physical interfaces. By using the GUI or the CLI, cable diagnostics can be run on switchports to determine if the cables stemming from the port(s) are functioning properly, have a short or an open connection, and either the total length of the cable or the length of the cable to the fault. By using cable diagnostics, network administrators can save time and money diagnosing cable problems and determining where on the cable the problems have occurred.

Ethernet Twisted Pair Technology Review

There are two commonly used standards of Ethernet over a twisted pair cable. The most common are 10/100Base-T (Fast Ethernet) and 1000Base-T (Gigabit Ethernet). Breaking these terms down, the number corresponds to the theoretical maximum transmission speed in megabits per second (Mbps), B signifies that they operate as a baseband (no frequency shifts), and T designates that they operate over a twisted pair cable.

Ethernet transmissions employ a technique called cancellation, which protects against electromagnetic noise created by the electrical circuit flowing through the wire. If the circuit creates a strong enough electromagnetic field, electrical interference can result and corrupt the transmitted data. This phenomenon is known as crosstalk.

To eliminate crosstalk, cancellation transmits the same data twice. It sends the first signal, and then sends a mirrored transmission (exactly the same as the first except with reversed polarity). The device receiving the transmission compares the two signals, making sure they are equal but mirrored, and identifies the difference between the signals as noise and discards it. Using this technique greatly reduces the amount of corrupted data transmitted, ensuring a higher quality transmission.

Ethernet Cable

Fast Ethernet and Gigabit Ethernet both require (at a minimum) a Category 5 (CAT 5) cable for connection. A CAT 5 cable is a copper twisted pair cable designed for high signal integrity.

CAT 5 cable is composed of four twisted pairs of wires in a single cable jacket. Using a CAT 5 cable balances the lines, helping to preserve high signal quality, lowering noise, and reducing crosstalk. CAT 5 cable is most often used with 100Base-T networks. Each twisted pair in the cable is made up of 24-gauge copper wire, twisted three times per inch.

In addition to a CAT 5 cable, Gigabit Ethernet can also use a CAT 5e cable. CAT 5e cable is an enhanced version of a CAT 5 cable, with greater ability to reduce far-end crosstalk on connections. Although Gigabit Ethernet was designed to operate on a standard CAT 5 cable, the higher specifications of CAT 5e cables and connectors make it a better choice for Gigabit Ethernet.

Ethernet Cable Connectors

Fast Ethernet and Gigabit Ethernet (as well as CAT 5 and CAT 5e cables) use the same connectors. Each connector has eight pins, with each pin functioning as a transmission point or a receiving point. The following illustration depicts the connector and its pins.

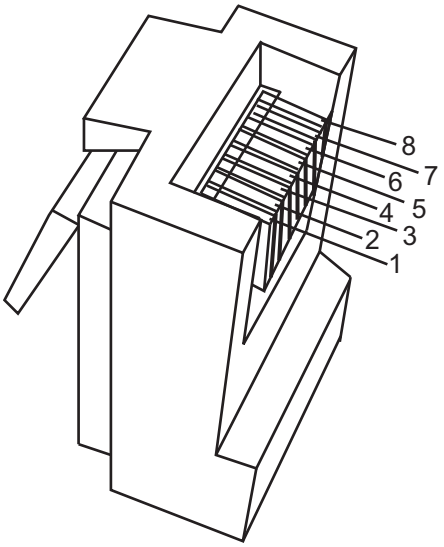


Figure 1. RJ-45 Connector

There are two types of connections associated with these 8-pin modular connectors (usually called RJ-45 connectors). They are straight-through connections and cross-over connections. A straight-through connection describes a connection in which pin 1 is matched with pin 1; pin 2 is matched with pin 2, etc. In other words, transmit is connected to transmit, receive to receive. A crossover connection describes a connection in which receive is connected to transmit (for example, pin 1 to pin 3).

Nodes that transmit on pins 1 and 2 and receive on 3 and 6, when connected with a network device (for example, PC to router), most often use straight-through connections. When nodes are connected directly with each other (for example, PC to PC or switch to switch), they most often require a crossover connection. The different connections are important to note as they may influence connectivity problems.

While Fast Ethernet and Gigabit Ethernet use the same connectors, they use the connectors differently. Fast Ethernet makes use of four of the pins or two pairs of wire, while Gigabit Ethernet uses all eight pins and four pairs of wire. The pin descriptions and functions for each Ethernet type are detailed in the following sections.

Fast Ethernet

As previously noted, Fast Ethernet operates at 100 Mbps and only requires two pairs (four pins) of the connector to operate. Fast Ethernet transmits data on pins 1 and 2, while it receives data on pins 3 and 6. Each transmission or reception of data is in one direction over one pair of wires.

Fast Ethernet transmits data by using a coding scheme called 4B/5B, because in each transmission every group of eight bits is coded into a 5-bit signal. In this case, each bit does not directly represent a signal on the wire as it does in 10Base-T Ethernet.

To understand Fast Ethernet pin usage, the following table describes each pin and how it is used. +TD translates as data transmission, +RD translates as receiving data, and -TD and -RD signify the mirrored version of the same signal being transmitted on +TD and +RD.

Table 1. Fast Ethernet Pin Out

Pin	Color	Function	Description
1	White with Green	+TD	Transmits data signal
2	Green	-TD	Transmits mirrored data signal
3	White with Orange	+RD	Receives data signal
4	Blue	Unused	Unused
5	White with Blue	Unused	Unused
6	Orange	-RD	Receives mirrored data signal
7	White with Brown	Unused	Unused
8	Brown	Unused	Unused

Gigabit Ethernet

Unlike Fast Ethernet, Gigabit Ethernet requires all four pairs of wire (eight pins) to operate. Gigabit uses these single pairs to communicate bidirectionally, thus transmitting at a much higher rate than Fast Ethernet. Fast Ethernet transmits on one pair and receives on one pair of wires, but Gigabit Ethernet uses the same pairs for both transmission and reception.

Like Fast Ethernet, Gigabit Ethernet also changes the method in which data is coded. However, instead of using one bit, Gigabit Ethernet codes two bits per signal. Each signal over the Ethernet cable represents two bits and not one.

To understand Gigabit Ethernet pin usage, the following table describes each pin and how it is used. Each pin bidirectionally transmits or receives data, described as Data A (DA), Data B (DB), Data C (DC), and Data D (DD).

Table 2. Gigabit Ethernet Pin Out

Pin	Color	Function	Description
1	White with Green	+DA	Bidirectionally receives data A
2	Green	-DA	Bidirectionally transmits data A
3	White with Orange	+DB	Bidirectionally receives data B
4	Blue	+DC	Bidirectionally receives data C
5	White with Blue	-DC	Bidirectionally transmits data C
6	Orange	-DB	Bidirectionally transmits data B
7	White with Brown	+DD	Bidirectionally receives data D
8	Brown	-DD	Bidirectionally transmits data D

General Terminology

An understanding of a few key terms aids in the interpretation of the cable diagnostic results.

- **Short** is an instance where two connectors of the same cable pair touch or are connected, thus impairing the normal operation of the circuit.
- **Open** is an instance where the circuit is not complete and, therefore, there is a gap in connection.
- **Terminated** is an instance where the cable is connected to an Ethernet device on both ends.
- **Unterminated** is an instance where the cable is not connected to an Ethernet device on one end.
- **Link** is a complete communication channel between two nodes in a subnetwork.
- **PHY** is the physical interface of a product that transmits information over the physical layer of the network.
- **Twisted Pair** is two insulated copper wires twisted around each other to reduce interference from one wire to the other.

Hardware and Software Requirements and Limitations

The features and abilities of cable diagnostics are limited by the hardware support of each Ethernet PHY. To confirm feature availability on your AOS platform, refer to the *Product Feature Matrix* available online at https://supportforums.adtran.com (article number 2272).

GUI support for the cable diagnostics feature was introduced in AOS 17.1. CLI support was added in AOS R10.7.0.

Cable diagnostics only applies to copper-based connections, and is not supported on fiber connections.

Cable diagnostics can only test CAT 5 and CAT 5e cables.

For best results, disconnect the cable from the far end device. For ports where the link is up, the diagnostic test may report inaccurate results.

Limitations

Although designed to test multiple ports at a time, running a cable diagnostic test will disrupt traffic on the port(s) being tested. For ports where the link is up, the diagnostic test will return a range (in meters).

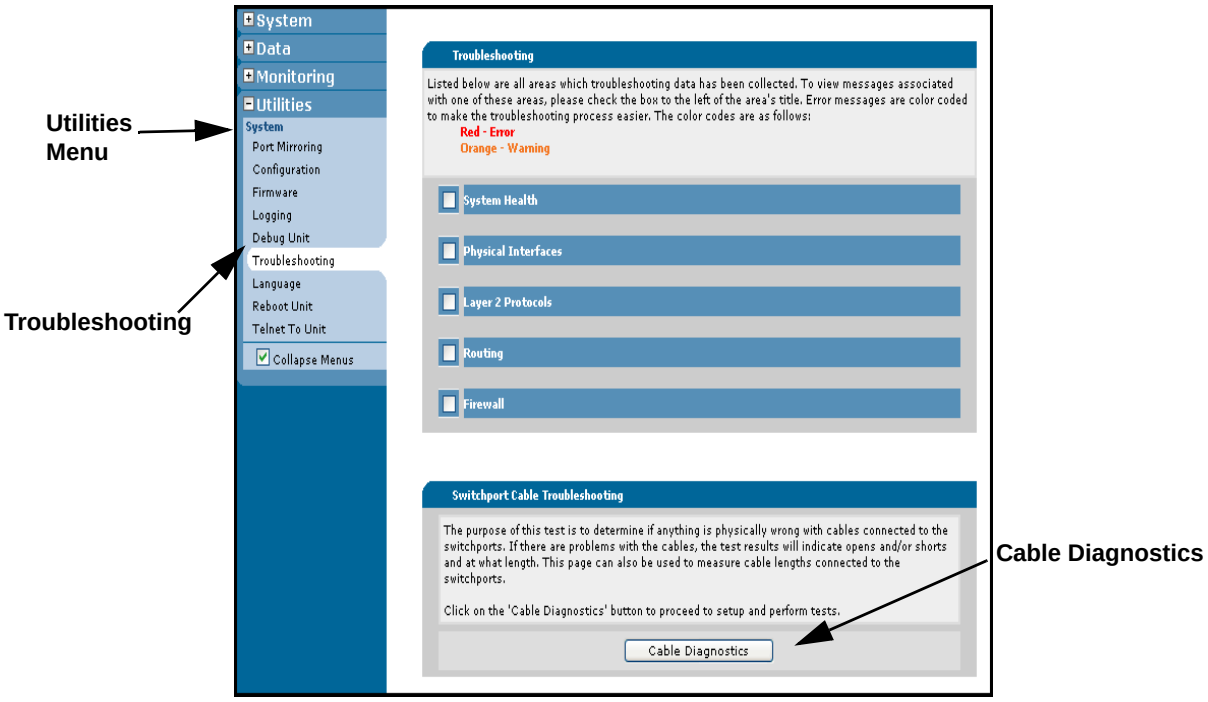
Using Cable Diagnostics in the GUI

To access the GUI and use cable diagnostics, follow these steps:

1. Open a new Web page in your Internet browser.
2. Type your AOS product's IP address in the Internet browser's address field in the following form:
   http://<ip address> for example:
   http://60.26.109.200
3. At the prompt, enter your user name and password and select **OK**.

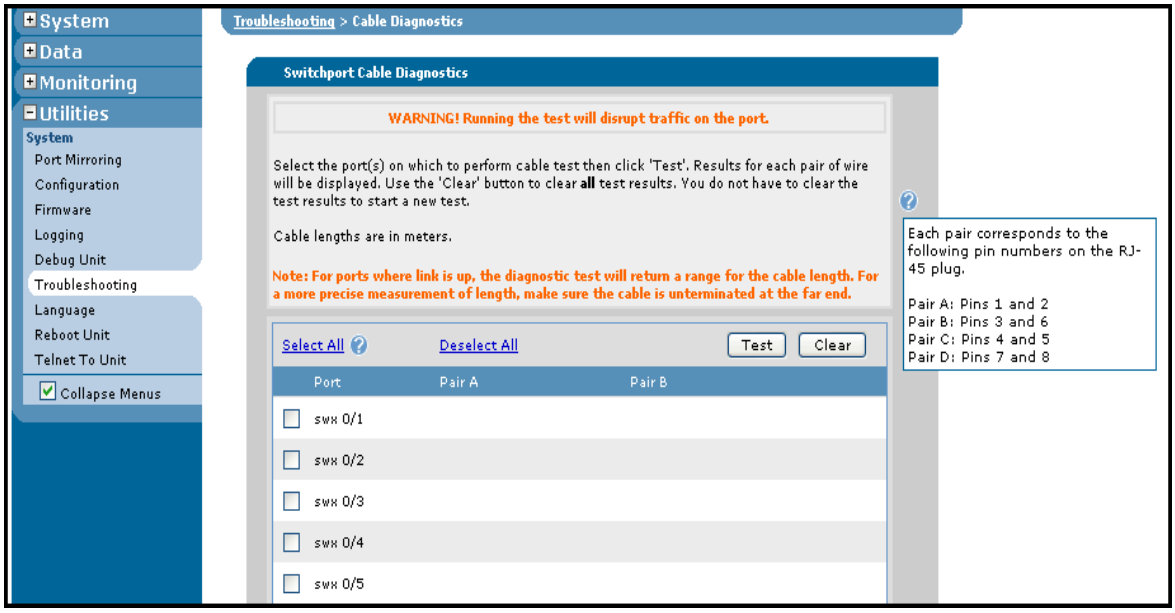
NOTE *The default user name is **admin** and the default password is **password**.*

4. Select **Troubleshooting** under the **Utilities** menu at the left.



5. Select the **Cable Diagnostics** button to open the cable diagnostics menu.

6. On the cable diagnostics menu, select the ports to be tested by checking the box next to the port. Tests can be run on single or multiple ports.



NOTE

*For Fast Ethernet switchport tests, Pair A and Pair B wires are tested. For gigabit switch port tests, Pairs A, B, C, and D are tested. Each pair corresponds to a set of pins. Pair A corresponds to pins 1 and 2; Pair B corresponds to pins 3 and 6; Pair C corresponds to pins 4 and 5; and **Pair D** corresponds to pins 7and 8.*

NOTE

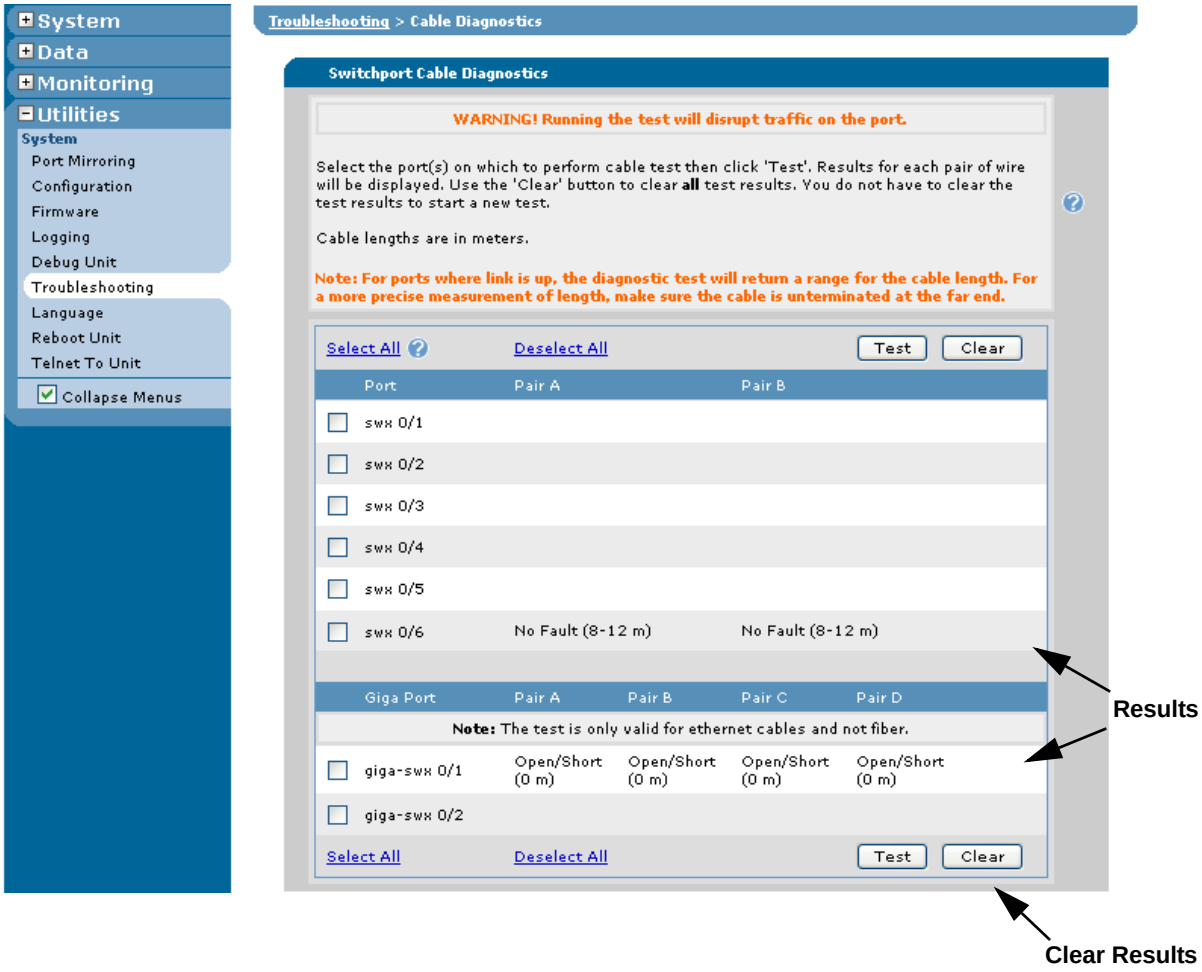
Cable diagnostics testing is not supported on fiber (SFP) ports.

CAUTION

Running a cable diagnostics test will disrupt traffic on the port(s) to be tested.

7. After selecting all ports to be tested, select the **Test** button.When the test is complete, you will see results

similar to the following illustration:



8. After testing, if you wish to save the test results, you need do nothing except exit the GUI. After testing, if you wish to discard the test results, select the **Clear** button at the bottom of the illustration, then exit the GUI.

Using Cable Diagnostics in the CLI

1. Telnet to the unit (telnet <*ip address*>). For example:

   telnet 10.10.10.1.

   If during the unit's setup process you have changed the default IP address (10.10.10.1), use the configured IP address.

2. Enter your user name and password at the prompt.

   *The AOS default user name is **admin** and the default password is **password**. If your product no longer has the default user name and password, contact your system administrator for the appropriate user name and password.*

3. Enable your unit by entering **enable** at the prompt as follows:

   >enable

4. If configured, enter your Enable mode password at the prompt.
5. Enter the **test cable-diagnostics** command along with the specified **interface** and **slot/port** as follows:

   #test cable-diagnostics interface switchport 0/1

   Unlike the GUI interface, the CLI interface only allows a single port to be tested at a time.

   The unit will then run the test and return the test results:

```
Port          Pair A     Pair B
-----------------------------------------
swx 0/1    No Fault   No Fault
             (128 m)    (128 m)
```


Reading Cable Diagnostic Results

There are four main results shown for cable diagnostics testing. The results indicate wherealong a cable a specific problem has been detected, allowing for the appropriate action to be taken to correct the problem with minimal interruption of the network. The following are the types of results you can expect to see using cable diagnostics:

1. **No Fault**. A **No Fault** result indicates that the cable is functioning properly. If a length range (in meters) is displayed, it indicates the cable is terminated and linked at the far end. To receive a more accurate cable length, remove the cable termination at the far end.
2. **Short**. A **Short** result indicates that some degradation has occurred on the wire, and wires are now short circuiting or touching each other within the cable. The distance listed (in meters) indicates the distance to the fault. Most common causes of shorts are due to damage to the cable or the connectors.
3. **Open**. An **Open** result indicates that the wire is not terminated. This does not mean conclusively that there is a fault on the wire. It is possible that the cable is simply not terminated at the far end. (This is the recommended method for determining cable length) However, if the test result reports vastly different numbers for pairs within the same cable, this is a clear indication of a problem.

Each of these results must be evaluated in the context of the specific network configuration and the physical location and layout of the cables within the network area. To apply the correct solution, understand which pins and pairs of the cable have been affected, the location of the fault, the actual fault result, and the other parameters specific to your network configuration.