ADTRAN Switch Engine (ASE)

Using VeriPHY in ASE

Configuration Guide

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To the Holder of this Document

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Revision History

Rev A	June 2021	Initial release

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1. VeriPHY Overview

The VeriPHY cable diagnostic is a method of testing Ethernet cables connected to 10/100 Ethernet or 10/100/1000 Gigabit-Ethernet physical interfaces. By using the Graphical User Interface (GUI) or the Command Line Interface (CLI), cable tests can be run on switch ports 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 the VeriPHY feature of ADTRAN Switch Engine (ASE) products, network administrators can save time and money diagnosing cable problems and determining where along the cable the problems have occurred.

2. 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), *Base* 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 simultaneously 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 however CAT5e is recommended.

A CAT 5 cable is copper twisted pair cable designed for high signal integrity and 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 and strongly recommended by ADTRAN as the minimum cable spec for use with the ASE series switches. 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.

The following table is provided for reference of CAT *N* cable specs and corresponding transmission speeds.

Table 1. Network Cable Category Specs

Category	Shielding	Max Transmission Speed	Max Bandwidth
CAT 3	Unshielded	10Mbps	16 MHz
CAT 5	Unshielded	10-100Mbps	100 MHz
CAT 5e	Unshielded	1,000Mbps – 1Gbps	100 MHz
CAT 6	Shielded or Unshielded	10Gbps up to 55 meters	250 MHz
CAT 6a	Shielded	10Gbps up to 55 meters	500 MHz
CAT 7	Shielded	100Gbps up to 15 meters	600 MHz
CAT 7a	Shielded	100Gbps up to 15 meters	1,000 MHz
CAT 8	Shielded	40Gbps up to 30 meters	2,000 MHz

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.

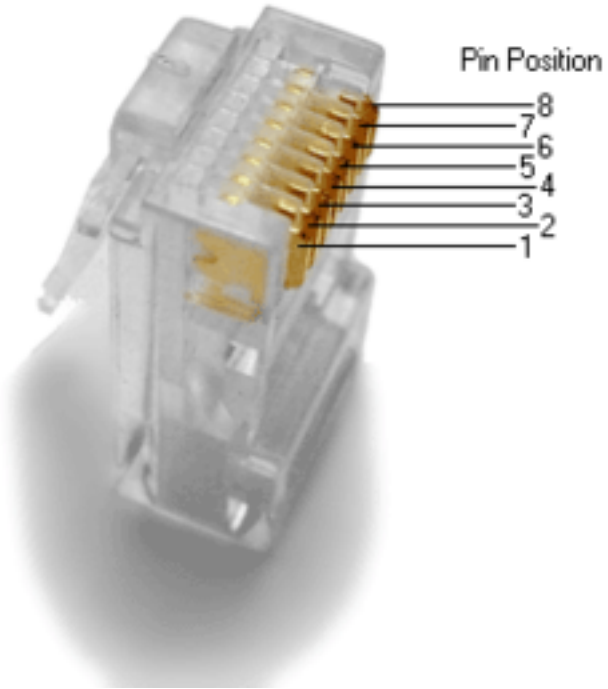


Figure 1. RJ-45 Connector

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.With the support of the MDI-X standard, cross-overs are no longer a concern, except with older equipment.

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 2. 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 3. 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 VeriPHY cable test results.

Table 4. General Terminology

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

3. Hardware and Software Requirements and Limitations

The features and abilities of VeriPHY are limited by the hardware support of each Ethernet PHY and applies to the following ASE models running firmware v4.4-42 or later.

Table 5. Supported Products

Product	P/N
NetVanta 1560-08-150W Switch	17108108PF2
NetVanta 1560-24-740W Switch	17108124PF2
NetVanta 1560-48-740W Switch	17108148PF2
NetVanta 1560-08-65W Switch	17101561PF2
NetVanta 1560-24-370W Switch	17101564PF2
NetVanta 1560-48-370W Switch	17101568PF2

The VeriPHY feature applies only to copper-based connections, and is not supported on fiber connections. The VeriPHY feature can only test CAT 5 or higher Ethernet cable standards using an RJ45 compatible connector.

Limitations

Although designed to test multiple ports at a time, running a cable diagnostic test will disrupt traffic on the port(s) being tested. If a link is established on any UTP port in 100BASE-TX or 10BASE-T, VeriPHY cable diagnostics will cause the link to drop while the diagnostics are running. Once the diagnostics are finished, the link will be reestablished. 1G Ports are unaffected.

For ports where the link is up, the diagnostic test will return a range (in meters).

VeriPHY is accurate for cables of length 7 - 140 meters and precise within +/- 1.5 meters.

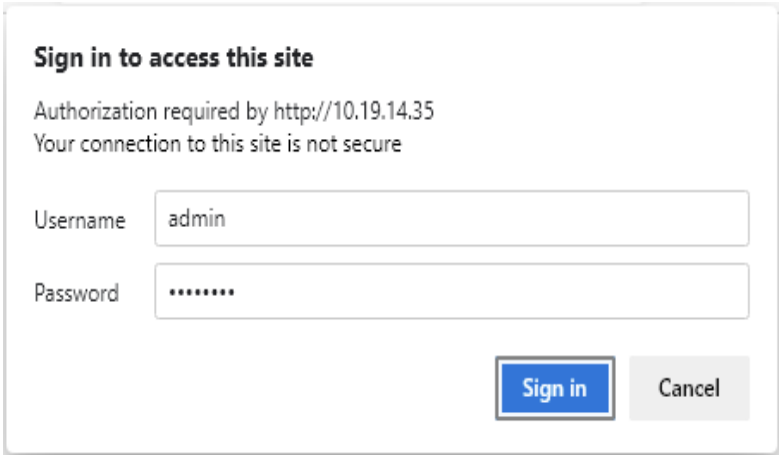
4. Using VeriPHY in the ASE GUI

To access the GUI and use the VeriPHY feature, follow these steps:

1. Open your Internet browser application.
2. Enter the IP address of the ASE switch 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.
4. Select the **Sign In** button.

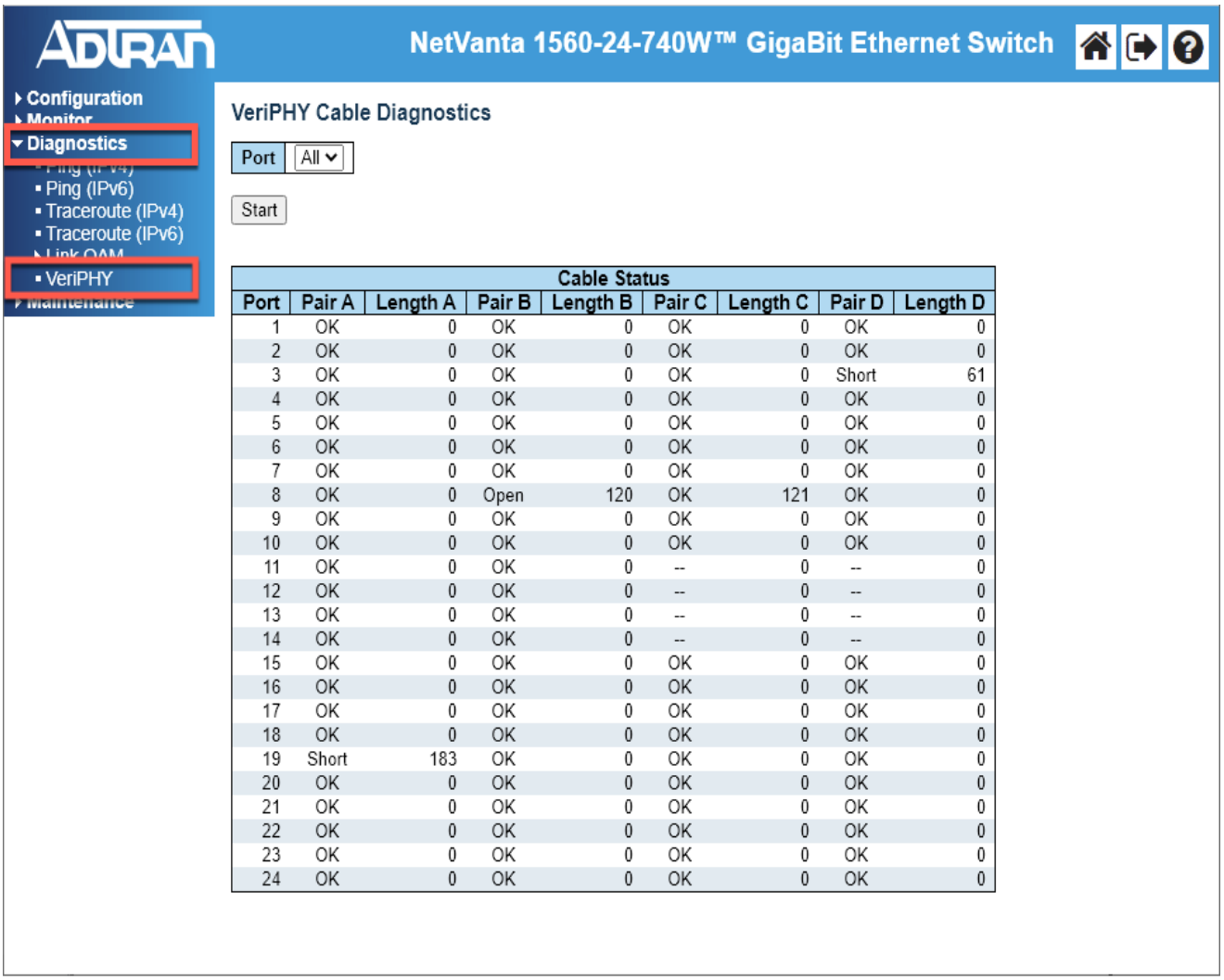
> **NOTE**
>
> *The default user name is* **`admin`** *and the default password is* **`password`**.*.*



CAUTION!

Running the VeriPHY cable test will disrupt traffic on 10 or 100 Mbps management port(s) being tested. Most test complete in around 5 seconds. If all ports are selected, the test can take approximately 15 seconds to complete. Once the diagnostics are finished, the link will be reestablished. 1G Ports are unaffected.

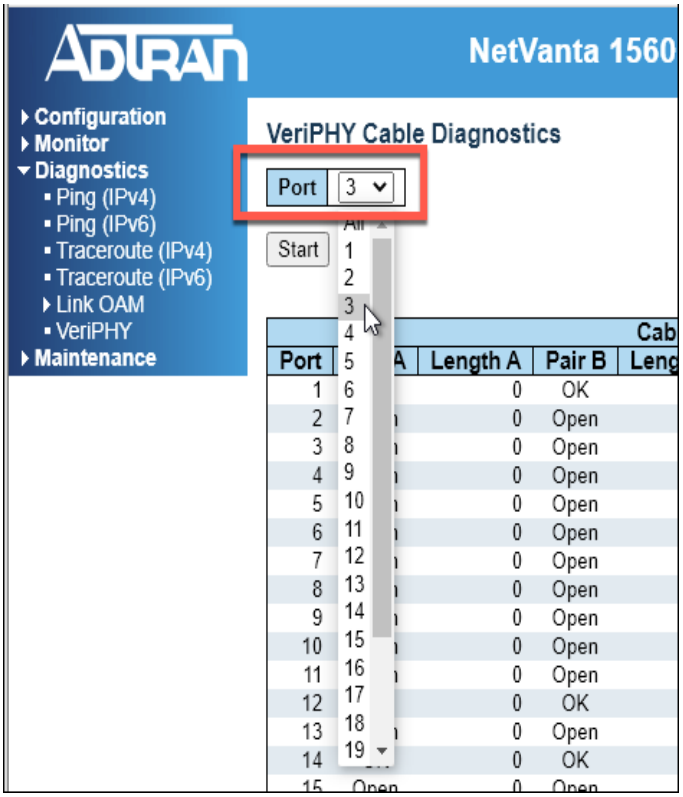
5. Select **Diagnostics** > **VeriPHY**.



Cable Status

Port	Pair A	Length A	Pair B	Length B	Pair C	Length C	Pair D	Length D
1	OK	0	OK	0	OK	0	OK	0
2	OK	0	OK	0	OK	0	OK	0
3	OK	0	OK	0	OK	0	Short	61
4	OK	0	OK	0	OK	0	OK	0
5	OK	0	OK	0	OK	0	OK	0
6	OK	0	OK	0	OK	0	OK	0
7	OK	0	OK	0	OK	0	OK	0
8	OK	0	Open	120	OK	121	OK	0
9	OK	0	OK	0	OK	0	OK	0
10	OK	0	OK	0	OK	0	OK	0
11	OK	0	OK	0	--	0	--	0
12	OK	0	OK	0	--	0	--	0
13	OK	0	OK	0	--	0	--	0
14	OK	0	OK	0	--	0	--	0
15	OK	0	OK	0	OK	0	OK	0
16	OK	0	OK	0	OK	0	OK	0
17	OK	0	OK	0	OK	0	OK	0
18	OK	0	OK	0	OK	0	OK	0
19	Short	183	OK	0	OK	0	OK	0
20	OK	0	OK	0	OK	0	OK	0
21	OK	0	OK	0	OK	0	OK	0
22	OK	0	OK	0	OK	0	OK	0
23	OK	0	OK	0	OK	0	OK	0
24	OK	0	OK	0	OK	0	OK	0

6. Test results from the previous use of VeriPHY are displayed. To re-run the test and update the display, select an individual port or choose **All** to test all ports, then select the **Start** button near the upper-left of the table.



NOTE

For Fast Ethernet switch port 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 on the RJ-45 connector. 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 7 and 8.

In the example test output on the previous page, ports 11-14 are configured for fast Ethernet as evidenced by the "--" notation indicating pairs C and D are unused.

5. Using VeriPHY in the ASE CLI

To access the VeriPHY feature using the CLI, follow these steps:

1. Telnet to the unit (**`telnet`** *<ip address>*). For example:
   `# Telnet 10.10.10.1`
2. Enter your user name and password at the prompt.
3. At the command prompt, enter the VeriPHY command
   `# veriphy`

A cable diagnostic for all ports is initiated.

```
Starting VeriPHY - Please wait
Interface               Pair A  Length  Pair B, Length  Pair C  Length  Pair D  Length
----------------------  ------  ------  ------ -------  ------  ------  ------  ------
GigabitEthernet 1/1     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/2     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/3     Open    0       Open    0       Open    0       Short   61
GigabitEthernet 1/4     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/5     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/6     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/7     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/8     OK      0       Open  120       Open  121       OK      0
GigabitEthernet 1/9     OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/10    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/11    OK      0       OK      0       N/A     0       N/A     0
GigabitEthernet 1/12    OK      0       OK      0       N/A     0       N/A     0
GigabitEthernet 1/13    OK      0       OK      0       N/A     0       N/A     0
GigabitEthernet 1/14    OK      0       OK      0       N/A     0       N/A     0
GigabitEthernet 1/15    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/16    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/17    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/18    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/19    SHORT 183       OK      0       OK      0       OK      0
GigabitEthernet 1/20    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/21    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/22    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/23    OK      0       OK      0       OK      0       OK      0
GigabitEthernet 1/24    OK      0       OK      0       OK      0       OK      0
10GigabitEthernet 1/1   No test results
10GigabitEthernet 1/2   No test results
```

NOTE

For Fast Ethernet switch port 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 on the RJ-45 connector. 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.

In the example above, ports 11-14 are configured for fast Ethernet as evidenced by the "N/A" notation indicating pairs C and D are unused.

CLI Variants for the VeriPHY Command

Below are optional command syntax variations that facilitate testing of a single port or a range of ports.

Single Port Test

To invoke a cable test for a single port on a specified interface, enter the **`veriphy interface`** *`<interface type> <slot/port>`* command as follows:

```
#veriphy interface GigabitEthernet 1/2
```

```
Starting VeriPHY - Please wait
Interface              Pair A  Length  Pair B, Length  Pair C  Length  Pair D  Length
---------------------  ------  ------  --------------  ------  ------  ------  -------
GigabitEthernet 1/2    Open    0       Open    0       Open    0       Open    0
```

Port Range x Through y Test

To invoke a cable test for a specified range of ports, enter the **veriphy interface** *<interface type> <slot/port-port>* command as follows:

```
#veriphy interface GigabitEthernet 1/2-5

Starting VeriPHY - Please wait
Interface              Pair A  Length  Pair B, Length  Pair C  Length  Pair D  Length
---------------------  ------  ------  --------------  ------  ------  ------  -------
GigabitEthernet 1/2    Open    0       Open    0       Open    0       Open    0
GigabitEthernet 1/3    Open    0       Open    0       Open    0       Open    0
GigabitEthernet 1/4    Open    0       Open    0       Open    0       Open    0
GigabitEthernet 1/5    OK      0       OK      0       OK      0       OK      0
```

6. Interpreting VeriPHY Results

There are four main results shown for VeriPHY diagnostics testing. The results indicate where along 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 the VeriPHY cable test:

Table 6. Interpreting VeriPHY Results

Result	Description
OK	This is a no fault result indicating the cable is functioning properly and terminated correctly
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.
Open	Indicates a break in the pair.
Short X	A cross-pair short. One or more wires in one pair are shorted with one or more wires in another pair. These do not happen in isolation. e.g. if a Short A occurs, there must be a short B,C,or D that it is shorted with.
Cross X	Abnormal cross-pair coupling with pair X which introduces a crosstalk condition. As with the short condition described above, these do not happen in isolation.
- -	This result indicates an un-used pair. Refer to definitions above for Gigabit Ethernet vs. Fast Ethernet.
N/A	(Same as above)

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.