Technical Note

4-Wire Testing on the Cirris 1000HX Cable Analyzer

Version 2.20

Minor Revision for manufacturing change
May, 1998

CIRRIS

An ISO 9001 Certified Company

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1991 Parkway Boulevard
Salt Lake City, Utah 84119-2026
United States of America

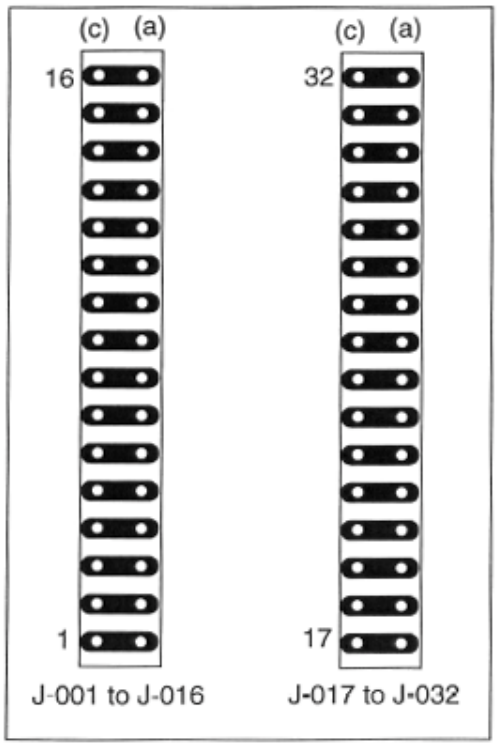
Four-Wire Testing

Capability and Tolerances

Your Cirris 1000HX Cable Analyzer can now perform four-wire testing. The analyzer can measure resistances from 0.010 ohms to 10 ohms with a tolerance of 4% or 5 milliohms (whichever is greater). The 1000HX can make **relative** measurements down to one milliohm (0.001).

Adapters

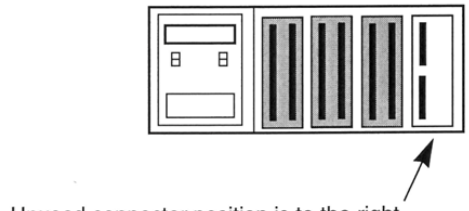
To do four-wire testing, you will need new adapters (Cirris adapter signature FBEA7D) as shown below.



Installing Four Wire Adapters

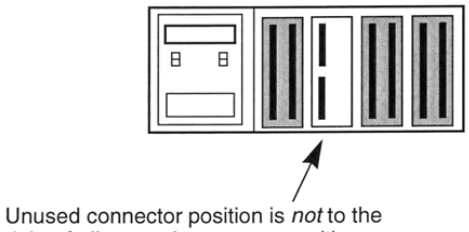
These are continuous-count adapters. You *must* install them in the analyzer starting at scanner position J1, so all empty scanner positions are to the right of the slots already in use.

Correct Installation



Unused connector position is to the right of all used connector positions

Wrong Installation



Unused connector position is *not* to the right of all unused connector positions

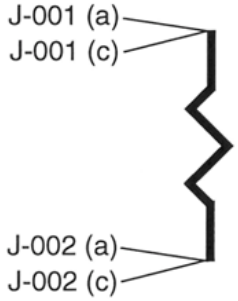
Things you must remember!

- Because these are four-wire type adapters, you must *not* use them in conjunction with other adapter types.
- All of the pins used for testing *must* be four-wire terminated. Any pins you do not use can be left un-terminated, but only if they come *after* all terminated pins. A good rule of thumb is: four-wire terminate all unused adapter pins. You will get "fixture open" errors if you do not follow this rule. **Note:** Four-wire termination is where the two adapter pins related to a single test point are wired together.

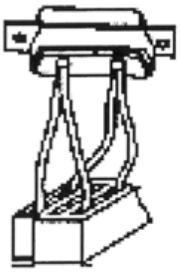
Tie adapter pins together correctly

Make sure both adapter pins, which relate to a single test point, are tied together at the point where you want to make your resistance measurements, as shown below.

Make your resistance measurement where points (a) and (c) tie together.



A practical example of how to connect fixturing for four-wire testing.



Remember these things:

- For four-wire testing to work, the total resistance from one test point to another (including the resistance of your fixturing, and the cable being tested) must not exceed 10 ohms! Typically, fixturing with wires less than two meters (about six feet) long has less than 0.5 ohms total resistance. If the fixturing and cable resistance is less than 10 ohms, four-wire testing will "null out" the fixturing resistance.

- Your resistance measurement begins at the point where the two fixture wires connect together. They must be connected as close to the actual test point as possible. For example, you might tie them together on your harness board right at the test connector.

Testing

With your fixturing set up correctly, and a Sample Cable (a cable you are certain is built correctly) installed on your analyzer:

1. Hold down the DISPLAY/PRINT switch, and turn on the analyzer.

2. Set the "Connection Resistance" and "Insulation Resistance" options to the values you wish to use. (Connection resistance will be displayed in numbers down to 1 milliohm whenever four-wire adapters are installed on the analyzer). For instructions on how to set the options, see your *1000HX User's Guide.*

3. Begin testing the cable. The analyzer will automatically learn the connection pattern in the cable and check your fixturing setup.

Remember these things:

- While the analyzer is in the test sequence, press the FUNCTION switch to perform the four-wire test. If the **Hipot** option is on, the analyzer will hipot test the cable immediately after the four-wire test has been successfully completed. If the **Auto-Hipot** function is turned on, the cable will automatically be four-wire tested, then hipot tested.

- Before and after a four-wire test, the cable is tested for proper continuity. A continuous low-current connection resistance test is performed to a level 100 milliohms above the four-wire connection threshold.

- The analyzer checks your fixturing continuously. Using the connections test, it constantly checks for the presence of intermittent short circuits, and fixture wires that should be connected together.

- Immediately prior to performing each high-current measurement, the resistance is measured using low current. High current is then applied based on that two-wire resistance measurement (if the two-wire resistance is less than 10 ohms). This prevents the analyzer from applying high current that could damage a contact while a cable is being connected.

The value of four-wire testing

Simply stated, a four-wire test is a test for wires and contact points. The advantage of four-wire testing over two-wire resistance testing is that four-wire testing "nulls out' the resistance of the test fixturing. Only the resistance of the wire and the contact itself is measured.

How four-wire testing works

In four-wire testing, a known amount of electrical current flows from point J-001 to point J-002. To "null out" the resistance of the test fixturing, *two* wires are connected to *each* test point. One of these wires provides a known amount of current flowing into ("sourced" into) point J-001.

A second wire is connected to point J-002. It provides a return ("sink") path for the current flowing into J-001

The other two wires (one to point J-001, the other point J-002) work much like the probes on a voltmeter used to measure a voltage. The voltage drop across the two test points (J-001 and J-002) is measured. The resistance is then automatically calculated from this voltage drop reading using Ohm's Law. This result is the four-wire resistance measurement.

Limitations of four-wire testing

The accuracy of the tester limits the effective range of four-wire testing. A tester is less accurate when it tests cables that have over 10 ohms of resistance, than if the fixturing resistance is "nulled out" using the four-wire testing technique.

Four-wire testing may satisfy a testing specification. It offers no advantage for quality assurance testing of cables which have more than 10 ohms of resistance.

Four-wire testing does not eliminate problems caused by the resistance of test connectors. Connectors wear a little bit with each insertion cycle. This wear creates resistance on the test connector, which four-wire testing does *not* "null out." To be certain that your tests remain accurate, you must maintain the analyzer's connectors carefully, or build special four-wire test connectors which use spring-loaded contacts. These contacts wear less with each insertion cycle than traditional connectors do.

Using Cirris Test Language (CTL) commands

You can use Cirris Test Language (CTL) during four-wire testing. Some of the details are listed below.

RESIS() RESIS() will perform a four-wire test, if necessary, to establish a resistance value and will check the validity of the only points being accessed.

CR_TEST() CR_TEST() may also perform a four-wire test if the low-current connection test indicates that this has to be done to determine an accurate resistance.

CR4TEST CR4TEST performs a continuity test followed by a four-wire test.

Specifications

These are the specifications for the 1000HX as they relate to four-wire testing.

Range 0.010 ohm to 10 ohms starting in 1 milliohm increments. Can make relative measurements down to 1 milliohm (0.001 ohm).

Accuracy 4% tolerance or 5 milliohms, whichever is greater.

Current used 1.00 amp for fixture and connection resistance less than 1.2 ohms, 0.250 amp for fixture and connection resistance less than 10 ohms.

Low-current test Less than 10 milliamps are used to perform a continuous test whenever a cable is attached to the 1000HX. The cable is tested using low-current four-wire techniques to a threshold of 100 milliohms above the high-current four-wire threshold to look for intermittent short circuits.

FOUR-WIRE TESTING