HST-3000

Copper Testing

User's Guide

JDSU

HST-3000

Copper Testing

User's Guide

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Federal Communications Commission (FCC) Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.
– Increase the separation between the equipment and receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced radio/TV technician for help.

In order to maintain compliance with the limits of a Class B digital device JDSU requires that quality interface cables be used when connecting to this equipment. Any changes or modifications not expressly approved by JDSU could void the user's authority to operate the equipment.

Industry Canada Requirements

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

EMC Directive Compliance

This product was tested and conforms to the EMC Directive, 89/336/EEC as amended by 92/31/EEC and 93/68/EEC for electromagnetic compatibility, class A.

Low Voltage Directive Compliance

This product was tested and conforms to the Low Voltage Directive, 73/23/EEC as amended by 93/68/EEC. Conformity with this directive is based upon compliance with the harmonized safety standards, EN60950 and EN 61010-1.

WEEE and Battery Directive Compliance

JDSU has established processes in compliance with the Waste Electrical and Electronic Equipment (WEEE) Directive, 2002/96/EC, and the Battery Directive, 2006/66/EC.

This product, and the batteries used to power the product, should not be disposed of as unsorted municipal waste and should be collected separately and disposed of according to your national regulations. In the European Union, all equipment and batteries purchased from JDSU after 2005-08-13 can be returned for disposal at the end of its useful life. JDSU will ensure that all waste equipment and batteries returned are reused, recycled, or disposed of in an environmentally friendly manner, and in compliance with all applicable national and international waste legislation.

It is the responsibility of the equipment owner to return equipment and batteries to JDSU for appropriate disposal. If the equipment or battery was imported by a reseller whose name or logo is marked on the equipment or battery, then the owner should return the equipment or battery directly to the reseller.

Instructions for returning waste equipment and batteries to JDSU can be found in the Environmental section of JDSU's web site at www.jdsu.com. If you have questions concerning disposal of your equipment or batteries, contact JDSU's WEEE Program Management team at WEEE.EMEA@jdsu.com.

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About This Guide

This chapter describes how to use this guide. Topics discussed in this chapter include the following:

– “Purpose and scope” on page xiv
– “Assumptions” on page xiv
– “Terminology” on page xiv
– “Application-oriented user guide” on page xv
– “HST-3000 Base Unit User’s Guide” on page xv
– “Safety and compliance information” on page xv
– “Technical assistance” on page xvi
– “Conventions” on page xvii

Purpose and scope

The purpose of this guide is to help you successfully use the features and capabilities of the Acterna HST-3000.

This guide includes task-based instructions that describe how to configure, use, and troubleshoot the HST-3000's copper testing option.

Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the HST-3000 effectively and efficiently. We are assuming that you have basic computer experience and are familiar with basic telecommunication concepts, terminology, and safety.

Terminology

The following terms have a specific meaning when they are used in this guide:

– **HST-3000** — The HST-3000 family of products or the combination of a base unit and a SIM.

– **SIM** — Service Interface Module. Referred to generically as the module.

For definitions of other terms used in this guide, see "Glossary" on page 203.

Application-oriented user guide

The *HST-3000 Copper Testing User's Guide* is an application-oriented user's guide containing information relating to the basic use of the device and includes detailed procedures for testing and troubleshooting copper services.

This user's guide should be used in conjunction with the *HST-3000 Base Unit User's Guide*.

HST-3000 Base Unit User's Guide

The *HST-3000 Base Unit User's Guide* contains overall information relating to device and general functions such as using the unit with a keyboard, peripheral support, battery charging, saving and printing results, and managing files. This guide also contains technical specifications for the base unit and a description of JDSU's warranty, services, and repair information, including terms and conditions of the licensing agreement.

Safety and compliance information

Safety and compliance information are contained in a separate guide and are provided in printed format with the product.

Technical assistance

If you need assistance or have questions related to the use of this product, use the information in Table 1 to contact JDSU's Technical Assistance Center (TAC) for customer support.

Before you contact JDSU for technical assistance, please have the serial numbers for the service interface module (SIM) and the base unit handy (see "Locating the serial number" in the *HST-3000 Base Unit User's Guide*).

Table 1 Technical assistance centers

Region	Phone Number	
Americas	1-855-ASK-JDSU 1-855-275-5378 301-353-1550	tac@jdsu.com
Europe, Africa, and Mid-East	+49 (0) 7121 86 1345 (JDSU Germany)	hotline.europe@jdsu.com
Asia and the Pacific	+852 2892 0990 (Hong Kong) +8610 6833 7477 (Beijing-China)	

During off-hours, you can request assistance by doing one of the following: leave a voice message at the TAC for your region; email the North American TAC (tac@jdsu.com); submit your question using our online Technical Assistance request form at www.jdsu.com.

Conventions

This guide uses conventions and symbols, as described in the following tables.

Table 2 Typographical conventions

Description	Example
User interface actions appear in this **typeface**.	On the Status bar, click **Start**.
Buttons or switches that you press on a unit appear in this **TYPEFACE**.	Press the **ON** switch.
Code and output messages appear in this `typeface`.	`All results okay`
Text you must type exactly as shown appears in this **`typeface`**.	Type: **`a:\set.exe`** in the dialog box.
Variables appear in this **typeface**.	Type the new **hostname**.
Book references appear in this *typeface*.	Refer to *Newton's Telecom Dictionary*
A vertical bar | means "or": only one option can appear in a single command.	`platform [a|b|e]`
Square brackets [ ] indicate an optional argument.	`login [platform name]`
Slanted brackets < > group required arguments.	`<password>`

Table 3 Keyboard and menu conventions

Description	Example
A plus sign + indicates simultaneous keystrokes.	Press **Ctrl+s**
A comma indicates consecutive key strokes.	Press **Alt+f,s**
A slanted bracket indicates choosing a submenu from menu.	On the menu bar, click **Start > Program Files**.

Table 4 Symbol conventions

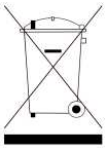
	This symbol represents a general hazard.
	This symbol represents a risk of electrical shock.
	This symbol represents a risk of explosion
	This symbol represents a Note indicating related information or tip.
	This symbol, located on the equipment or its packaging indicates that the equipment must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Table 5 Safety definitions

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Getting Started

1

This chapter provides a general description of the HST-3000's copper testing feature. Topics discussed in this chapter include the following:

– "About copper testing" on page 2
– "What's new in this release" on page 2
– "Options" on page 3
– "Quick tour" on page 5
– "Accessing the copper testing feature" on page 8

About copper testing

The HST-3000's copper testing features allow quick turn-up and troubleshooting of the services provided over copper.

This includes testing with DVOM, opens, power (Mains) influence (PI), noise, balance, time domain reflectometer (TDR), resistive fault locate (RFL), load coil detect, loss, wideband transmission impairment measurement set (WBTIMS), caller ID, and POTS dialer. The HST-3000 provides process customization through on-board auto tests and allows workflow improvements via connectivity to craft access terminals and back-office systems.

What's new in this release

The following features were added in this release.

– Additional FED commands. Commands have been added to the Actions menu. The commands available vary depending on where you access the Actions menu. For example, on the Resistance screen, "FED Open All" has been added, but on the Longitudinal Balance screen, the "FED Quiet Term" command has been added.

– FEXT and NEXT terminations. If using the UFEDIIB accessory, there are additional "Bonded FEXT" and "Bonded NEXT" commands available from the Manual FED Commands screen.

– UFED identification. If using the UFEDIIB accessory, you can give each FED its own address (similar to a MAC address) and then send a command to a specific UFEDIIB.

Features and capabilities

The copper testing features include the following:

- Measuring AC and DC voltage, current, and resistance
- Measuring to opens (length of cable)
- Measuring balance, noise, and power (Mains) influence (PI)
- Locating cable faults with the TDR or RFL
- Detecting load coils
- Measuring loop loss (voiceband) including receiving and sending tones; transmission impairment testing (noise, SNR, return loss)
- Voice service and caller ID (CLID) testing
- WBTIMS and WB2 TIMS testing including sending/receiving tones; measuring wideband, impulse, and spectral noise; and transmission impairment testing (noise, SNR, return loss, crosstalk)
- Automatic testing using scripts, including POTS close out, good pair check, and wideband auto tests.

Options

You can expand your testing capability by purchasing additional Copper Testing options. Table 6 lists the copper options.

NOTE:

For additional information about HST-3000 options, SIMs, and services, contact your local JDSU representative or contact JDSU through the company web site, www.jdsu.com.

Table 6 Copper options

Option	Description	Part Number
Time Domain Reflectometer (TDR)	Allows you to identify bridged taps, wet sections, load coils, shorts, opens, and splices on the span. Available for the HST-3000c only.	HST3000-TDR
Wideband (WB) Tones	Allows you to measuring wideband loss, noise, and impulse noise. Available for the HST-3000c only.	HST3000-WBTONES
Transmission Impairment Measurements	Allows you to detect noise, return loss, signal to noise ratio (SNR), crosstalk[a], and impulse noise[a] tests in the wide and narrow bands. Available for the HST-3000c only. **NOTE:** For crosstalk, SNR, and return loss measurements, you must have both the WB Transmission Impairment and WB Tones options.	HST3000-TxIMP
Resistive Fault Locator (RFL)	Allows you to determine the distance from the point of test to resistive faults, such as grounds, shorts, and battery crosses on the span. Available for the HST-3000c only.	HST3000-RFL
Spectral Analysis	Allows you to detect radio frequency interference from digital services or AM radios that can reduce the performance of a copper wire. Available for the HST-3000c only.	HST3000-SPE

a. Wideband only.

Quick tour

The following section describes the status indicators and connections applicable to copper testing.

Status LEDs

These six indicators report the status of the application. The function of each LED is descried in Table 7.

Table 7 Status LEDs

LED	Function
Sync	A two-color LED that reports the status of modem synchronization. – Flashing green indicates that the modems are training. – Solid green indicates that the modems have synchronized. – Solid red indicates a synchronization error has occurred.
Data	A two-color LED that reports the status of the data connection. – Flashing green indicates that the data connection is not yet established. – Solid green indicates that a data connection has been established with the network (so that the HST-3000 may send and receive data on the network). – Solid red indicates that a data connection error.
Error	A two-color LED that reports error conditions. Solid red indicates an error condition.
Alarm	A two-color LED that indicates alarm conditions. Solid red indicates an alarm condition.

Table 7 Status LEDs (Continued)

LED	Function
LpBk	A two-color LED that indicates a loopback condition. Solid amber indicates that a local loopback has been achieved.
Batt	Indicates battery status. For more information, see the *HST-3000 Base Unit User's Guide*.

Status icons

Off hook and on hook icons appear in the upper right corner of the menu bar indicating the state of the phone. Table 8 describes these status icons. For descriptions of other status icons, see the *HST-3000 Base Unit User's Guide*.

Table 8 Status icons

Icon	Function
	Indicates the phone is on hook.
	Indicates the phone is ringing.
	Indicates the phone is off hook.

Connectors

The connectors for copper testing are found on the SIM. Figure 1 shows the top panel, with a copper testing SIM attached.

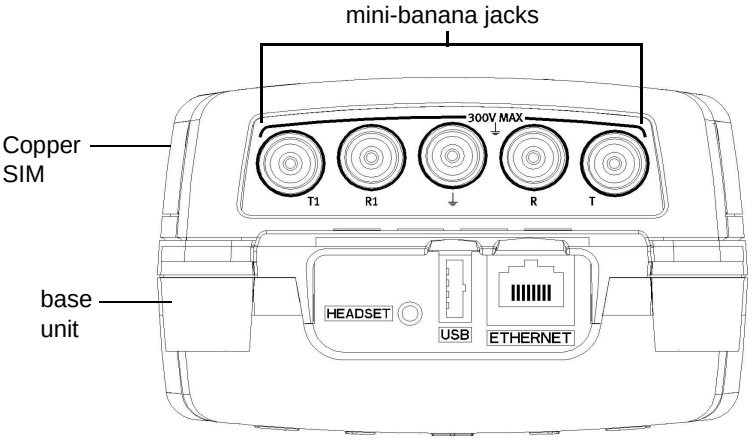


Figure 1 HST-3000 top panel

The five mini-banana jacks are used to connect to the tip and ring pairs (T, R, T1, R1 or A, B, A1, B1) and to ground (sleeve or Earth).

CAUTION: INSTRUMENT DAMAGE

Connecting to circuits with voltage higher than 300V, compared to ground, may damage the internal components. Connect only to circuits with less than 300V.

WARNING: ELECTRICAL SHOCK

Electrical shock may result in serious injury or death. Use care when connecting to telecommunications circuits, to be sure that you do not come in contact with exposed conductors or power mains. Connect TNV signals to TNV ports only.

Accessing the copper testing feature

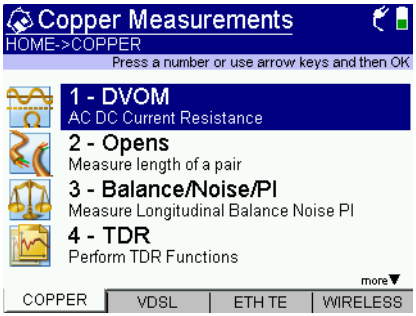
The following procedure describes how to access the copper testing feature.

To access the copper testing feature

1 Press the **Home** navigation key.

2 Press the **Copper** soft key.

The Copper Measurements menu appears.



The following sections describe these features and how to use them.

NOTE:

Some of the features listed above are optional. This manual assumes that all options are installed. Some of your menu selections may vary, depending on your installed options.

DVOM Testing

2

This chapter provides task-based instructions for using the DVOM features. Topics discussed in this chapter include the following:

– “About the DVOM” on page 10
– “Measuring voltage” on page 10
– “Measuring resistance” on page 12
– “Measuring insulation resistance” on page 15
– “Measuring the distance to a short” on page 16
– “Measuring current” on page 17

About the DVOM

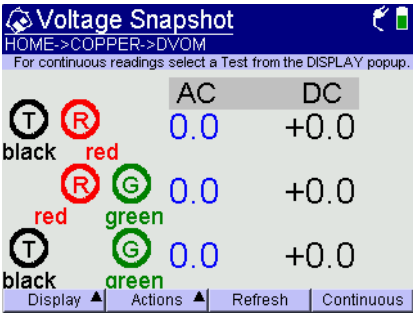
Using the Digital Volt/Ohm Meter (DVOM) feature, the HST-3000 measures AC and DC voltage, resistance, distance to a short, and current.

To access the DVOM feature

1 Access the Copper Measurements menu (see page 8).

2 Press the **1** key to access the DVOM.

The Voltage Snapshot menu appears.



3 Press the **Continuous** soft key to take continuous measurements.

The following sections describe how to use the DVOM.

Measuring voltage

Using the DVOM, you can measure AC and DC voltage.

To measure voltage

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Press the **Display** soft key, and then select **AC Volts**.

The AC Voltage menu appears.

3 To specify the connection, press the **Actions** soft key, and then select the one of the following:

- Tip to Ring (A to B)
- Ring to Gnd (Ground) (B to E)
- Tip to Gnd (A to E)

NOTE:

You can also press the left or right arrow key to move among the connections.

4 To open all leads, do the following:

a Verify you are testing with a FED.

b Press the **Actions** soft key and then select **FED Open All**.

c Specify a duration, in seconds. This is how long the leads will remain open.

The screen displays a duration timer during the test.

5 To specify the termination, press the **Actions** soft key, and then select the one of the following:

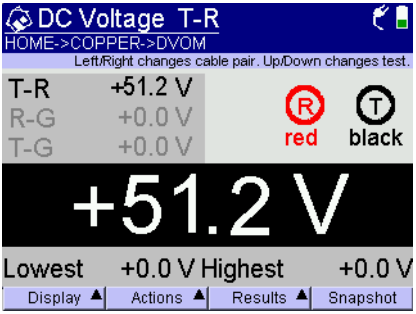
- 1MEG-ohm Term
- 100K-ohm Term

6 Press the **Display** soft key and then select **DC Volts**.

NOTE:

You can also press the up or down arrow key to move between AC volts and DC volts.

The DC Voltage menu appears.



Results appear on the screen.

7 To turn off the FED (return to Through mode), press the **Actions** soft key and then select **FED Off/Thru**.

8 To clear or save results, press the **Results** soft key and select the appropriate option.

9 To return to the Voltage Snapshot menu, press the **Snapshot** soft key.

10 To learn what your results mean, see "AC voltage" and "DC voltage" in Chapter 12 "Interpreting Test Results".

Measuring voltage is complete.

Measuring resistance

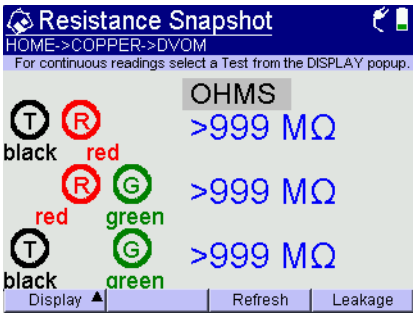
Using the DVOM, you can measure resistance to identify shorts, grounds, and resistive faults.

To measure resistance

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Press the **Display** soft key and then select **Resistance Snapshot** or **Resistance Continuous**.

Depending on your selection, either the Resistance Snapshot or Resistance T-G menu appears.



NOTE:

You can also press the up or down arrow key to select the resistance test.

3 For greatest accuracy, JDSU recommends that you compensate the ohms measurement to remove the effects of the test leads.

To compensate ohms measurements, complete the following steps:

a Press the **Configure** navigation key.

b Follow the instructions on the screen to connect the black, red, and green leads to perform test lead compensation.

c Press the **Compensate** soft key.

The compensation stops automatically when finished.

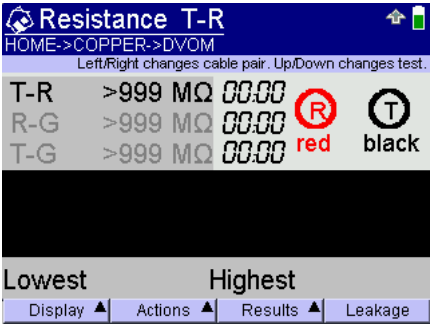
d Press the **Home** navigation key to return to the Resistance Snapshot or Resistance T-G menu.

e Press the **Refresh** soft key.

4 If you selected Resistance Continuous in step 2, you can specify the pair to measure by doing the following:

a Press the **Actions** soft key

b Select the connection: Tip to Ring (A to B), Ring to Gnd (Ground, or B to E), or Tip to Gnd (A to E)



NOTE:

You can also press the left or right arrow key to move among the connections.

Timers are available for each pair, allowing you to test each pair for a specified amount of time. These timers are included when you save the results.

5 To short the leads using a UFED, UFEDII, or UFEDIIB, do the following:

a Verify you are testing with a FED.

b Press the **Actions** soft key and then select **FED Tip-Ring-Gnd Short**.

c Specify a duration, in seconds. This is how long the leads will remain shorted.

The screen displays a duration timer during the test.

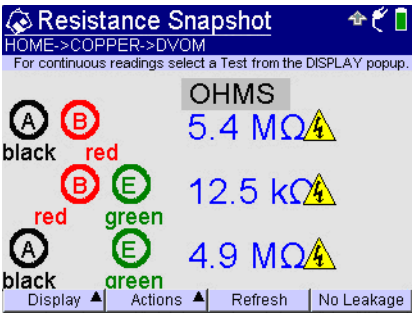
6 To open all the leads using the UFED, UFEDII, or UFEDIIB, do the following:

a Press the **Actions** soft key and then select **FED Open All**.

b Specify a duration, in seconds. This is how long the leads will remain open.

The screen displays a duration timer during the test.

7 Press the **Leakage** soft key to use the high-voltage ohmmeter.



NOTE: If you selected Australia as the country (on the international settings menu), an audible beep will sound and the LEDs will blink to warn of high voltages and the value will be in kilo-ohms if the result is less than 1 mega-ohm.

8 To learn what your results mean, see “Resistance” in Chapter 12 “Interpreting Test Results”.

Measuring resistance is complete.

Measuring insulation resistance

Insulation resistance is used in the United Kingdom when testing behind or with a Master Jack across the pair under test.

NOTE:

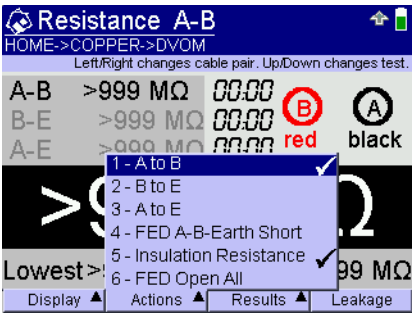
The Insulation Resistance measurement is only available when the **Country** is set to **UK** on the **System>Instrument>International Settings** menu.

To test insulation resistance

1 Select **DVOM** from the main Copper Measurements menu.

2 Press the **Display** soft key and then select **Resistance Continuous**.

3 Press the **Actions** soft key, and if not already selected, select **Insulation Resistance**.



The test restarts and displays results.

Measuring the distance to a short

The following procedure describes how to measure the distance to a short.

NOTE:

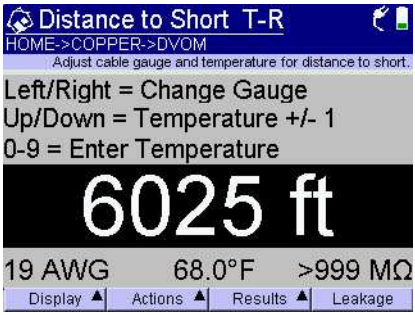
Use this feature only when the resistance is 4 kΩ or less (4 kΩ or less is almost always a hard short). If there is no hard short on Tip and Ring (A and B), the measurement will be inaccurate.

To measure distance

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Press the **Display** soft key and then select **Distance to Short**.

The Distance to Short menu appears.



3 Use the **Actions** soft key to select the connection, e.g., Tip to Ring (A to B), Ring to Ground (B to E), and so on.

4 Use the left and right arrows to change the wire gauge, if needed.

5 Use the up and down arrows to change the temperature by one degree or use the keypad to enter the temperature.

NOTE:

For the resistive distance to be accurate, it is critical that you enter the correct gauge and temperature.

6 To calculate a specific resistance in ohms to distance, press the **Actions** soft key, and then select **Distance to Short Calculator**.

7 Press the **Leakage** soft key to use the high-voltage ohmmeter.

Results appear on the screen.

Measuring current

Using the DVOM, you can test for continuity, and check for proper loop current for POTS lines.

To measure current

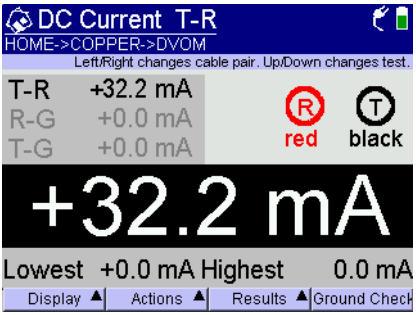
1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Press the **Display** soft key and then select Current.

NOTE:

This test is not accessible in the DVOM by using the up and down arrow keys.

The Current menu appears with results.



3 To perform a Ground resistance measurement, press the **Ground Check** soft key.

This test verifies the presence of adequate station ground at the customer premise. This test requires a connection to a working POTS line served from a grounded battery feed switch, where either A or B is connected to earth ground. If the switch floats the ground, this measurement will always give a result of “Bad Ground”.

This test looks at the ratio of the A/B current compared to the -48v (A or B) to Ground current. Based on this ratio the HST gives a result of “Good, Bad or Marginal”. The HST automatically looks at both A and B for the -48v to Ground current results, just in case A and B are reversed. It shows all results in the upper section of the screen, in addition to the “Good, Bad, Marginal” result.

The good, bad, and marginal results use thresholds that may not agree with all practices. The results of -48v/G current should be > or = 1.52 times the AB current for the ground (earth) to be “Good” and if it is < or = 1.49 times Loop current then it is a “Bad Ground” with everything in between being “Marginal”. This lines up well in establishing a site principle ground of 25 ohms or less.

4 To turn off the FED (return to Through mode), press the **Actions** soft key and then select **FED Off/Thru**.

5 To learn what your results mean, see “DC current” in Chapter 12 “Interpreting Test Results”.

Measuring opens

3

This chapter provides task-based instructions for measuring opens. Topics discussed in this chapter include the following:

–
– “About opens” on page 22
– “Compensating the measurement” on page 22
– “Connecting and specifying the cable” on page 23
– “Testing with a UFED” on page 25
– “Measuring ringers” on page 26

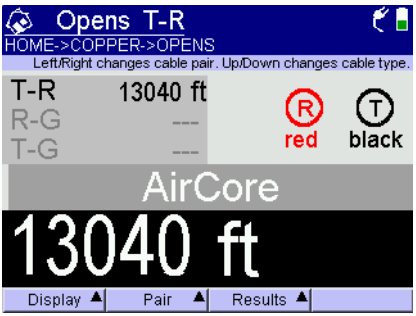
About opens

The HST-3000 measures the total electrical (capacitive) length of a pair using the opens feature.

To access the opens feature

– From the Copper Measurements menu (see page 8), press the **2** key.

The Opens menu appears.



Compensating the measurement

For greatest accuracy, JDSU recommends that you compensate the opens measurement to remove the effects of the test leads.

To compensate the opens measurements

1 Press the **Configure** navigation key.

2 Follow the instructions on the screen to connect the black, red, and green leads to perform test lead compensation.

3 Press the **Compensate** soft key.

The compensation stops automatically when finished.

4 Press the **Home** navigation key to return to the Opens menu.

Connecting and specifying the cable

For accurate measurements, you can specify the cable fill type and capacitance.

To specify the connected cable

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 To specify the connection, press the **Pair** soft key, and then select the one of the following:

- Tip to Ring (A to B)
- Ring to Gnd (Ground, or B to E)
- Tip to Gnd (A to E)

You can also press the left or right arrow key to move among the connections.

NOTE:

When measuring from Tip (A) or Ring (B) to Ground (E), you should connect the Ground (earth) lead to the shield (ground), and be sure to enter the fill type or the distance will not be accurate. If you connect to some other ground that is not parallel to your pair, and do not enter the appropriate fill type, this measurement will be inaccurate. When connecting T-R (A-B), you do not have to enter fill type.

3 To specify the fill type or change the capacitance based on a type of cable, do the following (otherwise proceed step 4):

a Press the up and down arrows, or press the **Display** soft key and select the appropriate type.

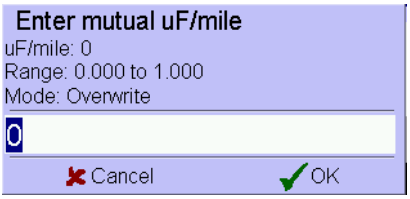
b Proceed to step .

4 If you want to specify a custom capacitance, do the following:

a Press the **Display** soft key.

b Select **Custom**, and then select **Mutual**.

A custom capacitance dialog box appears.



c Type a value for the mutual conversion factor in µF/mile (or other units depending on your configuration). The HST-3000 uses this value for Tip-to-Ring (or A-B) capacitance.

d Press the **OK** key.

5 If you want to specify a ground capacitance, do the following:

a Press the **Display** soft key.

b Select **Custom**, and then select **Gnd**.

The custom capacitance dialog box appears.

c Type a value for the ground capacitance between Tip (A) to Ground (E), and Ring (B) to Ground (E), in µF/mile (or other units depending on your configuration). The HST-3000 uses this value for Tip (A) or Ring (B) to Ground (E) capacitance.

d Press the **OK** key.

6 To use the Opens Custom Cable feature to learn the characteristics of a cable, do the following:

a Press the **Configure** navigation key.

b Press the right arrow (**>**) key.

The Opens Custom Cable screen appears.

This feature allows you to save the characteristics of certain cable pairs for future use to allow quicker setup time.

c Select **New**, and then press **1** to specify the distance, and then press **2** to specify the name.

d Press the **Calculate** soft key.

The HST calculates and saves the characteristics of the cable.

e Press the **Home** navigation key to return to the Opens menu.

The name you specified in step c appears as a selection under **Display>Cable Book**.

7 To display the results in units of capacitance, press the **Display** soft key, and then select **Capacitance**.

8 Press the **Results** soft key to clear or save the results.

9 To learn what your results mean, see "Opens" in Chapter 12 "Interpreting Test Results".

Testing with a UFED

If using a far end device (FED) accessory, such as a FED, UFEDII, or UFEDIIB, you can open all leads during the test.

To open all leads

1 Verify you are testing with a FED.

2 Press the **Actions** soft key and then select **FED Open All**.

3 Specify a duration, in seconds. This is how long the leads will remain open.

The screen displays a duration timer during the test.

Measuring ringers

The ringers test provides a count of the number of ringers on the line.

To measure ringers

1. Press the **Display** soft key, and then select **Ringers**.
2. Press the **Results** soft key to clear or save the results.
3. To learn what your results mean, see “Opens” in Chapter 12 “Interpreting Test Results”.

Measuring PI and Noise

4

This chapter provides task-based instructions for measuring power influence, noise, and balance. The HST-3000 performs longitudinal balance, power (mains) influence (PI) and noise measurements to calculate balance. Topics discussed in this chapter include the following:

– “Connecting to the line” on page 28
– “Measuring longitudinal balance” on page 28
– “Measuring PI and noise” on page 29

Connecting to the line

Before running the test, connect the test leads to the line under test.

– Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

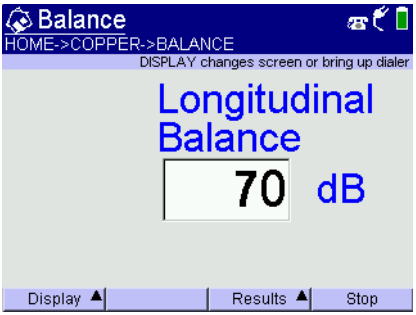
Measuring longitudinal balance

Balance is a number representing the quality of the telephone circuit and the degree to which the Tip (A) and Ring (B) conductors are electrically the same in their ability to cancel noise. The balance measurement is used to identify poor loop quality or cable bonding and grounding issues that allow excessive loop noise. Wideband background noise is covered in the WBTIMS section.

To measure longitudinal balance

1 From the Copper Measurements menu (see page 8), press the **3** key.

The Longitudinal Balance menu appears.



2 To place a quite termination or to short the leads using the UFED, UFEDII, or UFEDIIB, do the following:

   a Press the **Actions** soft key and then select one of the following:

   FED Quiet Term- 600Ω.

   FED Tip-Ring-Gnd Short

   b Specify a duration, in seconds. This is how long the leads will be terminated or shorted.

   The screen displays a duration timer during the test.

3 Press **Start** to begin the test.

4 Press the **Results** soft key to clear or save the results.

5 To learn what your results mean, see "PI/Noise/Balance" in Chapter 12 "Interpreting Test Results".

Measuring balance is complete.

Measuring PI and noise

Power influence (Tip to Ground [A to E] and Ring to Ground [B to E] noise) is the unwanted current inducted on the pair from power lines and other AC sources. Noise is the unwanted current that the pair has failed to cancel and which the customer hears as noise.

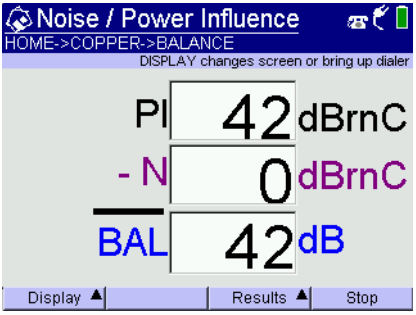
To measure PI and noise

1 Press the **Display** soft key, and then select **PI/Noise**.

NOTE:

This test excites the line and is sometimes referred to as a "stress test."

The Noise/Power Influence menu appears.



NOTE:

If the induced power influence is too low to calculate balance (normally 60 is required), the balance result will display asterisks, but the PI and noise measurement will still be valid.

2 To place a quite termination or to short the leads using the UFED, UFEDII, or UFEDIIB, do the following:

a Press the **Actions** soft key and then select one of the following:

FED Quiet Term- 600Ω.

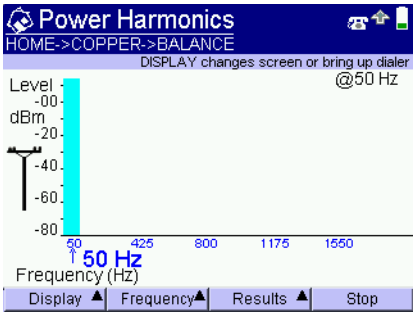
FED Tip-Ring-Gnd Short

b Specify a duration, in seconds. This is how long the leads will be terminated or shorted.

The screen displays a duration timer during the test.

3 Press the **Display** soft key, and then select **Power Harmonics**.

The Power Harmonics menu appears.



Press the **Start** soft key to begin the test. The test shows levels of commercial power line harmonics (both even and odd) that may be present on the line under test. This test runs from Tip to Ring with no filter applied. Use the Frequency soft key to select the fundamental (main) frequency (50Hz or 60Hz). The test shows harmonics of the fundamental frequency within the overall frequency range of 1-1500Hz.The power level of each harmonic is displayed. Use the left or right arrow to move through the power bands.

Normally the main or fundamental frequency (60Hz for North America) has the highest level with the odd harmonics (180, 300, 420, 540Hz, etc.) decreasing in level as the frequency increases. The pattern (or “signature”) of these harmonics can be a useful aid in identifying power company situations that can affect telephone company copper pair performance.

4 Press the **Results** soft key to clear or save the results.

5 To learn what your results mean, see “PI/Noise/Balance” in Chapter 12 “Interpreting Test Results”.

Measuring power influence and noise is complete.

Locating cable faults

5

This chapter provides task-based instructions for locating cable faults and detecting load coils. Topics discussed in this chapter include the following:

– “About locating cable faults” on page 34
– “Locating faults using the TDR” on page 34
– “Locating faults using crosstalk TDR” on page 40
– “Viewing a saved TDR trace” on page 41
– “Performing a dual TDR trace” on page 42
– “Performing a peak TDR trace” on page 43
– “Locating faults using RFL” on page 44
– “Detecting load coils” on page 50

About locating cable faults

There are two optional features on the HST-3000 that help locate cable faults.

– **TDR** — The Time Domain Reflectometer (TDR) identifies bridged taps, wet sections, load coils, shorts, opens, and splices on the span.
– **RFL** — The Resistive Fault Locator (RFL) provides the distance from the point of test to resistive faults, such as grounds, shorts, and battery crosses on the span.

Locating faults using the TDR

The following procedure describes how to locate cable faults using the TDR.

To locate cable faults using the TDR

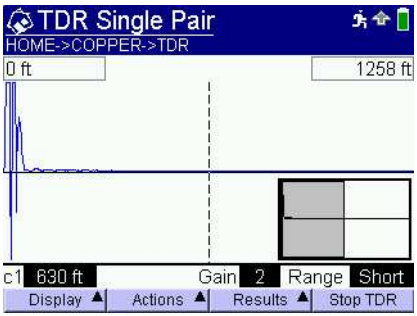
1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Copper Measurements menu (see page 8).

3 Press the **4** key.

4 Press the **Start TDR** soft key.

The TDR graph appears.



5 To add a DC pulse in order to see changes in the graph, press the **Actions** soft key, and then select **Stress Mode**. The spike or dip will shift when the pulse is applied.

NOTE:

The TDR must be running for Stress Mode to be available. It is greyed out when the TDR is stopped.

A warning appears during the stress pulse to indicate higher voltage is present.

6 *Optional.* To toggle worldview, do the following:

When worldview is enabled, a small box appears in the lower right that shows the entire viewable range, instead of just a piece of it. Worldview shows your current view versus the entire range.

a Press the **Configure** navigation key.

b Press the **1** key, and then press **1** to turn worldview on, or press **2** to turn worldview off.

c Press the **Home** navigation key to return to the TDR graph.

7 To move the cursor(s), do the following:

a Press the **Actions** soft key.

b Select **Move Cursor 1** or **Move Cursor 2**.

NOTE:

By default, cursor one is active and pressing the right and left arrow keys move it. To move the second cursor, press the **Actions** soft key then **2**.

c Use the left and right arrows to move the cursor to the beginning of the fault, or enter a distance directly on the keypad to move the cursor and display to a desired

distance. The display shows you the distance to the cursor position. This also gives you the approximate distance to the fault.

NOTE:

You can also move the graph higher and lower by pressing the second function and then the up or down arrow; press the second function then a left or right arrow to move the display the width of the screen.

8 To help identify small or distant faults, use the up or down arrow keys to gain the vertical axis and enhance the reflection of faults. Do not apply excessive gain. This makes a normal condition appear as a fault.

9 If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key, and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **3**.

10 If you want to configure the length of cable you are testing, do the following:

a Press the **Actions** key

b Select **Range**.

c Choose a range.

– Extra Short Range 0-300 ft

– Short Range 0-2000ft

– Medium Range 100-8kft

– Long Range 1k-16kft

– Extended Range 10k-25kft

– Auto Range enables the “automatic TDR” feature. This allows you to progress through all TDR settings by pushing one button (repeatedly).

If you selected **Auto Range**, press the up arrow key to move to the next among the Auto TDR selections.

The Auto TDR settings are listed in Table 9.

Table 9 Auto TDR settings

Auto TDR setting number	Gain	Pulse Width	Range	Zoom
8	64	4.1 µSec	Long	0 X
7	32	1 µSec	Long	1 X
6	16	256 nSec	Medium	2 X
5	16	65 nSec	Medium	3 X
4	8	n/a	Short	1 X
3	4	n/a	Short	2 X
2	2	n/a	Short	3 X
1	1	n/a	Short	4 X

– If you have the WB2 option, you have two additional Range options: SRHR and Step TDR.

  SRHR is Short Range, High Resolution. This is used on short spans (0 to 1000 ft.) and uses a very short duration pulse.

  Step TDR is also used on short spans (0 to 1000 ft.). Step TDR is different than traditional TDR because it uses a very long pulse. For a traditional pulse-based TDR, a pulse is sent into a pair to see any energy that is reflected back by a fault. For step TDR, you send a very long pulse (at least twice as long as it would take a signal to reach the end of the pair) to look at what happens to the leading edge of the pulse to see the effect of faults. Essentially, it is a different way of doing pulse-based TDR, but it can give better resolution on short lines. However, the signature of the faults is very different than the normal (traditional TDR) traces.

11 If you want to modify the velocity propagation (VP), do one of the following:

NOTE:

The default VP is appropriate for 24–26 AWG (4–5 mm) telco aerial cable.

a Press the **Actions** soft key, and then select **Change VP**.

b To select a propagation based on cable fill type, press the **1** key and then select a cable fill.

c To select a propagation based on the gauge of the cable, press the **2** key and then select a gauge.

d To define a specific velocity, press the **3** key, and then type a velocity in the dialog box.

12 To apply time varying gain, press the **Display** soft key, and then press the **9** key.

This allows you to provide a normalization factor to counteract line attenuation.

NOTE:

Time varying gain is not available when using the SRHR, Step TDR range, or Crosstalk TDR.

If the characteristics of cable under test don't match the initial settings of the HST, the end (or right-hand side) of the trace can slope up or down. To overcome this, press the up or down arrow until it is level.

13 If you are testing toward a FED, UFEDII, or UFEDIIB, use the Actions menu to select a command to send.

a Press the **Actions** soft key.

b Select **FED Command**.

c Specify a command to send to the FED.

– TDR Helper – continuously open and short the pair. On a TDR trace, you can then see the end of the copper pair by seeing the open trace (slope up) and the short trace (slope down) and these will flip flop for the amount of time you specify. This allows you to see where the FED is located.

– Open All – opens all test leads.

– Tip-Ring Short – applies a short across tip (A) and ring (B).

14 *Optional.* To run the TDR and have the HST automatically interpret the results, do the following.

a Press the **Actions** soft key.

b Select **Auto ID**.

c Press the **Start TDR** soft key to restart the test.

After the test is complete, the results appear on the screen.

The results can be viewed as a tabular results or a trace with descriptive text and pointers to the event(s). To change the result display, press the **Results** soft key and then select either **List** or **Graph**.

15 Press the **Results** soft key to save the graph, if desired.

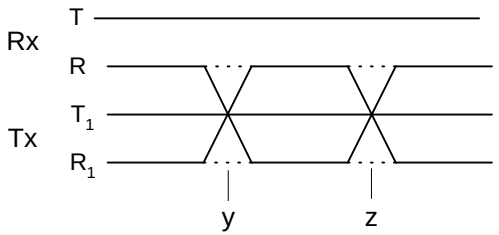
You can also view and compare current and saved TDR traces using the Results key. For information on saving your results in graphical form, see “Saving results” on page 167.

16 To learn what your results mean, see “TDR” in Chapter 12 “Interpreting Test Results”.

Locating cable faults with the TDR is complete.

Locating faults using crosstalk TDR

Transmission line problems occur when one of the conductors (Tip/A or Ring/B) is split. The split causes the line to have poor balance and makes the line susceptible to noise. Crosstalk TDR is the best mechanism for finding split lines. In the following illustration, the R and R_1 lines are crossed at points y and z.

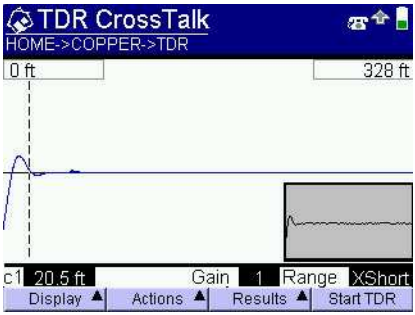


The crosstalk test transmits a signal on one pair of wires, and measures the received signal on the second pair. This test quickly locates splits along a circuit.

To locate splits using crosstalk TDR

1. Connect T, R, T1, and R1 (or A, B, A1, and B1) to the lines under test.
2. Access the Copper Measurements menu (see page 8).
3. Press the **4** key to select TDR.
4. Press the **Display** soft key, and then press the **7** key.

The TDR crosstalk graph appears.



5 Press the **Results** soft key to save the graph, if desired.

You can also view and compare current and saved TDR traces using the Results key. For information on saving your results in graphical form, see "Saving results" on page 167.

Locating cable faults with the TDR is complete.

Viewing a saved TDR trace

The following procedure describes how to view a saved trace.

To view a saved trace

1 Access the Copper Measurements menu (see page 8).

2 Press the **4** key.

3 Press the **Results** soft key.

4 Press **2** to view a saved trace.

5 Select the file name of the trace and then press the **OK** key.

The graph appears.

Performing a dual TDR trace

A dual trace displays two TDR traces simultaneously. You can view a dual trace by doing the following:

– Loading a reference trace while viewing the current live trace.
– Viewing two live traces simultaneously in dual mode.

NOTE:

Dual pair TDR is not available when using the SRHR or Step TDR range.

– Loading a saved graph and a reference trace.

The following procedure describes how to perform a dual trace.

To perform a dual trace

1 Access the Copper Measurements menu (see page 8).

2 Press the **4** key.

3 Connect T, R, T1, and R1 to the lines under test.

4 Press the **Display** soft key.

5 Press the **6** key to enable the dual trace feature.

6 *Optional.* Load a reference trace by doing the following:

a Press the **Stop TDR** soft key.

b Press the **Display** soft key, and then press **5**.

c Press the **Start TDR** soft key.

d Press the **Results** soft key, and then select **Load Reference Trace**.

The HST-3000 displays the reference trace simultaneously with the live trace.

7 *Optional.* You can view a reference trace and live trace several different ways by doing the following:

a Press the **Results** soft key

b Select one of the following:

To…	Press…
View a single trace	the **4** key
View both traces on top of each other	the **5** key
View the mathematical difference in the two traces	the **6** key
View both traces on the same screen but separated	the **7** key

8 For information on saving your results in graphical form, see “Saving results” on page 167.

Performing a dual trace is complete.

Performing a peak TDR trace

The HST-3000 can display minimum, maximum, and current TDR traces over a test period. This feature is useful for analyzing faults that occur intermittently.

To perform a peak TDR trace

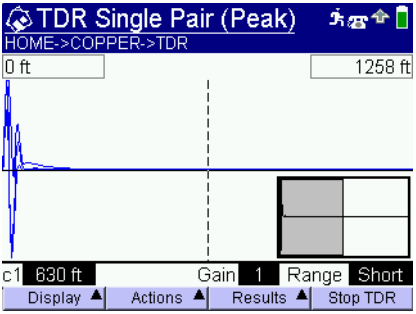
1 Access the Copper Measurements menu (see page 8).

2 Press the **4** key.

3 Press the **Start TDR** soft key to get a live trace.

4 Press the **Display** soft key.

5 Press the **8** key to initiate peak analysis.



The bold line represents the current measurement; the thin lines represent the minimum and maximum traces.

Performing a peak trace is complete.

Locating faults using RFL

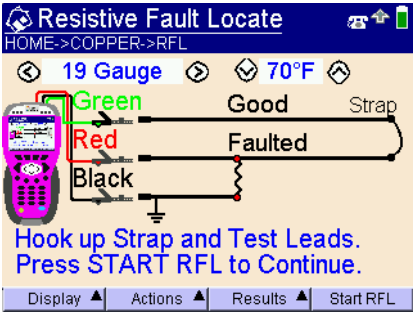
The following procedure describes how to locate cable faults using the RFL.

To locate a cable fault using RFL

1 Access the Copper Measurements menu (see page 8).

2 Press the **8** key to select Resistive Fault Locate.

The Resistive Fault Locate screen appears.



For greatest accuracy, JDSU recommends that you compensate RFL to offset the resistance of your leads.

3 To compensate the RFL, complete the following steps:

a Press the **Configure** navigation key.

b Follow the instructions on the screen to connect the black, red, and green leads to perform test lead compensation.

c Press the **Compensate** soft key.

The compensation stops automatically when finished.

d Press the **Home** navigation key to return to the RFL menu.

4 Select the cable makeup by performing the following steps.

a Press the **Actions** soft key.

b Select the type of makeup.

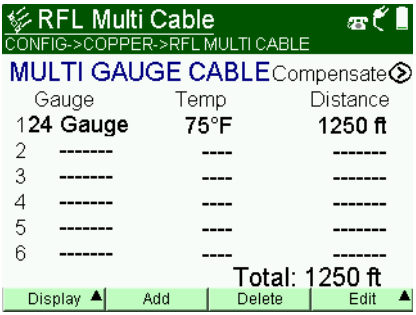
To use this type of makeup…	Press…
single gauge	the **1** key
multi gauge	the **2** key

5 If you selected multi gauge, select the gauge and temperature for each cable section by performing the following steps.

a Press the **Configure** navigation key.

b Press the right arrow (>) to move to the RFL Multigage screen.

The multi gauge configuration screen appears.



c Press the **Add** soft key.

d Select the gauge and then press **OK**.

e Enter the temperature and then press **OK**.

f Enter the distance and then press **OK**.

You can delete an entire line by pressing the **Delete** soft key.

g Repeat steps c through f for each gauge of cable.

h Press the **Home** navigation key to return to the RFL screen.

6 To change the Ground hookup, do the following:

a Press the **Display** soft key.

b Select **Change Ground Hookup**.

c Use the left or right arrow key to specify whether Green or Black is the Ground lead.

d Press the **OK** key.

NOTE:

The Ground hookup function is available only if you have a Copper Measurement board rev 510. To verify, go to the System>Tools>Options>Revisions screen and look for “Copper”. The Change Ground Hookup selection is not available in K-Test.

7 Connect the black, red, and green (and blue for separate pair) leads to the line under test as shown on the screen.

8 *Optional.* Toggle the units of the result (ohms or feet) by performing the following steps.

a Press the **Display** soft key.

b Select the units.

To display this unit…	Press…
Feet (or Meters, depending on your configuration)	the **1** key
Ohms	the **2** key

9 To change the type of test to run, do the following:

a Press the **Display** soft key, and then select one of the following:

– Press the **3** key to select **Single pair manual strap**

– Press the **4** key to select **Single pair w/FED**

– Press the **5** key to select **Separate pair manual strap**

– Press the **6** key to select **Separate pair w/FED**

– Press the **7** key to select **K-Test w/manual strap**

– Press the **8** key to select **K-Test w/FED**

NOTE:

The K-Test functions are available only if you have a Copper Measurement board rev 510. To verify, go to the System>Tools>Options>Revisions screen and look for “Copper”.

The K-Test is typically used to test for fault location when there is no “known good” (reference) pair.

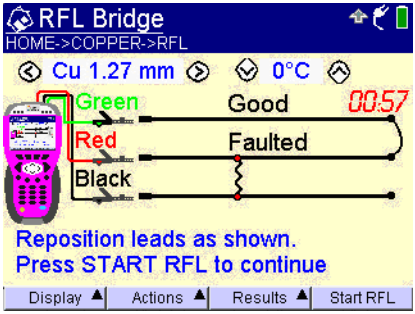
Use this test to find the approximate distance to faults on a single pair of wires when both wires have a fault on them and there is no known good spare pair or wire to use as a reference (when Single & Separate Pair RFL cannot be used).

In order to get the desired results make sure the following guidelines are met:

- The faults must occur at the same physical point on the pair to the same place or reference. For example both wires are faulted to the shield at the same location.
- The fault ratio is 2:1. The fault size on one wire vs. the fault on the other is twice as large. For example one wire has a 10K ohm fault and the other has a 20K ohm fault.
- The larger fault value should be at least 100 times greater than the loop ohms of the pair under test. For example if the loop ohms is 100 then the larger fault value should be > 10K ohms.

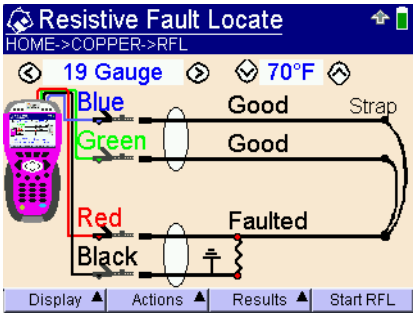
b The HST K-Test is a two step measurement that starts with the far end open and does a series of resistance measurements to determine the faults present and if it is possible to solve the resistance to fault. Then with the far end shorted, the measurement finishes and calculates the results. It can be run manually or use a FED to automatically provide the correct conditions for the test.If you selected a test with the FED, specify the FED strap duration by pressing the **Actions** soft key, selecting **Change FED Strap Duration**, and then enter the number of seconds, between 60 and 900. A counter appears indicating the duration of the strap

inside the FED. This counter changes colors when the duration is under a minute and the test has not been started.



10 Press the **Start RFL** soft key.

The test runs then displays the results.



The results for the specific fault appear.

The HST-3000 assumes that the fault is on the red lead. If the fault is not on the red lead, it will automatically flip Tip (A) and Ring (B) and run the test again. Thus, your screen may show swapped leads.

11 To learn what your results mean, see “RFL” in Chapter 12 “Interpreting Test Results”.

Locating a cable fault using the RFL is complete.

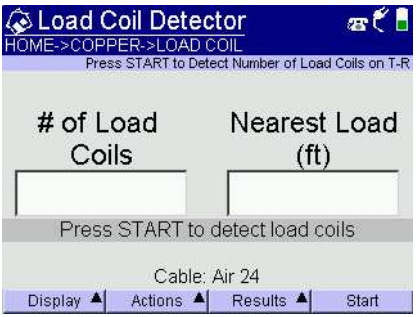
Detecting load coils

The HST-3000 can detect up to five load coils that may exist on the line, out to 27,000 (8,200 meters) feet. It will also report a short, open, or a high noise condition, if detected. For accurate load coil detection, test on a pair without voltage (supplied by a battery). Although the detector will work with voltage on a pair, accuracy will be compromised. In addition, the detector works best when the last coil is followed by 1200 feet (336 meters) of cable.

To detect load coils

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Copper Measurements menu (see page 8).
3. Press the **5** key.

   The Load Coil Detector menu appears.
4. To modify the velocity propagation, press the **Actions** soft key, then follow the instructions provided in step 11 on page 38.
5. Press the **Start** soft key.



The count appears in the box. If at least one load coil is detected, the distance to the first load appears.

NOTE:

The distance to first load measurement assumes no other impairments are present between the HST-3000 and the first load coil. If other impairments are present, accuracy is reduced.

If voltage greater than 50V peak is present, the test will abort.

If noise, a short, or an open is detected, it appears on this screen.

6 To learn what your results mean, see “Load coils” in Chapter 12 “Interpreting Test Results”.

Detecting load coils is complete.

Measuring loop loss

6

This chapter provides task-based instructions for measuring loop loss. Topics discussed in this chapter include the following:

– “About loop loss” on page 54
– “Receiving tones” on page 54
– “Transmitting tones” on page 55
– “Measuring transmission impairment in the voiceband” on page 57

About loop loss

The HST-3000 can send and receive voiceband tones to measure loop loss, perform a 3-tone slope test, dial the telephone switch to receive a milliwatt tone, and measure transmission impairment (noise, impulse noise, return loss). Transmission impairment measurement is an optional feature for the HST. For information about HST options, contact your JDSU representative or contact JDSU through the company web site, www.jdsu.com.

To access the Loss Measurement function

1. Access the Copper Measurements menu (see page 8).
2. Press the **6** key.

   The Loss Meter menu appears.
3. Press the **Actions** soft key.
4. Select **Termination**, in ohms, for termination of the loop.
5. Proceed to one of the tests described in this section:
   - "Receiving tones" on page 54
   - "Transmitting tones" on page 55
   - "Measuring transmission impairment in the voiceband" on page 57

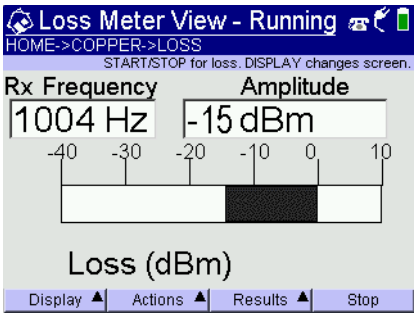
Receiving tones

The following procedure describes how to receive tones.

To receive tones

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Press the **Actions** soft key, then the **1** key.
3. Press the **Start** soft key.

You should hear audio of the tone. The HST-3000 begins measuring the frequency and level of each tone. The loss appears in the bar graph.



4 If testing toward a FED, press the **Actions** soft key and then select **FED Commands**. The Manual FED screen appears. See “Manually commanding the FED” on page 140.

5 Press the **Stop** soft key.

6 To learn what your results mean, see “Loss” in Chapter 12 “Interpreting Test Results”.

Receiving tones is complete.

Transmitting tones

The following procedure describes how to transmit tones.

To transmit tones

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Press the **Actions** soft key, and select one of the following options:

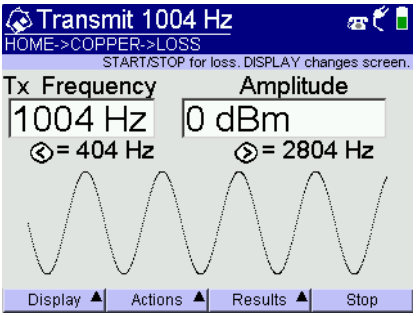
– To transmit custom tones, press **3**. A popup menu appears. Using the keypad, enter a frequency from 200 to 7000 Hz.

– To transmit other tones, press **2**, and then select one of the transmission options:

To…	Press…
Transmit a 404 Hz tone	the **1** key
Transmit a 1004 Hz tone	the **2** key
Transmit a 2804 Hz tone	the **3** key
Transmit 3 tone slope	the **4** key
Transmit a trace tone	the **5** key

3 Press the **Start** soft key.

You should hear audio of the tone. The tone graph appears.



NOTE:

Your display may look different, depending on your transmission selection.

4 *Optional*. To change the amplitude of the signal, press the **Actions** soft key, and then select **Change Amplitude**. Type the new amplitude in the dialog box. Press # to enter a negative sign (-). Press the **OK** key.

5 *Optional.* To change the frequency, press the left and right arrows.

NOTE:

The arrows are only available if transmitting a 404, 1004, or 2804 Hz tone and will move among only these frequencies.

6 Press the **Stop** soft key.

7 To learn what your results mean, see "Loss" in Chapter 12 "Interpreting Test Results".

Transmitting tones is complete.

Measuring transmission impairment in the voiceband

With the transmission impairment measurement option, you can use the HST-3000 to perform the following voiceband tests:

– Noise (O.41 method) — measures noise using the ITU-T O.41 method. Results include the minimum, maximum, and current noise levels displayed in decibels. You can also apply a filter.

– Noise with Tone (O.41 method) — Measures the current noise level in decibels in the presence of a holding tone (820 or 1020 Hz). You can also specify the termination, in ohms, and apply a filter.

– SNR (signal to noise ratio) — Measures the signal strength relative to background noise. You can specify the termination, in ohms, and apply a filter. The result is displayed in decibels.

– Impulsive Noise (O.71 method) — Measures impulse noise using the ITU-T O.71 method. You can specify the impulse noise threshold, test duration, dead time, notch filters, and other parameters. You can specify the termination, in ohms, and apply a filter. Results include a count of impulse noise events.
– Return Loss — Measures return loss caused by impedance mismatches for a specified frequency or a range of frequencies. You can specify the termination, in ohms, and apply a filter. Results are display in decibels.

To select a transmission impairment test

1 Access the Loss Measurement application. See "About loop loss" on page 54.

2 Press the **Display** soft key, and then select **Transmission Impairment**.

3 Press the number key for the measurement you want to perform:

Measurement	Press
Noise (O.41 method)	the **1** key
Noise with Tone (O.41 method)	the **2** key
SNR (signal to noise ratio)	the **3** key
Impulsive Noise (O.71 method)	the **4** key
Return Loss	the **5** key

4 To continue, see the appropriate section:
– "Noise testing (ITU-T O.41 method)" on page 59
– "Noise with tone testing (O.41 method)" on page 60
– "Signal to noise ratio testing" on page 62
– "Impulsive noise testing (ITU-T O.71 method)" on page 63

– "Return loss testing" on page 66
– "Return loss sweep testing" on page 67.

Noise testing (ITU-T O.41 method)

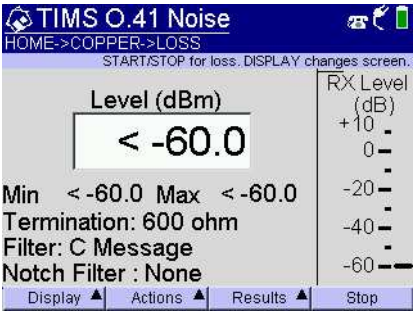
This test measures noise using the ITU-T O.41 method. Results include the minimum and maximum noise levels.

To measure noise

1 Connect the Tip (T or A) and Ring (R or B) leads to the line under test.

2 Select the **Noise (O.41 method)** test. See page 58.

The TIMS O.41 Noise screen appears.



3 Press the **Actions** soft key, and then choose one of the following options:

Options	Action
Enable or disable a filer	Select **Filter**, and then select the type of filter you want to apply or disable. For information about filters, see Table 18 on page 196.

Options	Action
Specify the termination (impedance)	Select **Termination**, and then select a value.
Specify the measurement in dB (decibels) or dBrn (decibels above the reference noise level)	Select **dB** or **dBrn**.

4 Press the **Start** soft key to begin the test.

You should hear audio of the tone. The noise level result appears on the TIMS O.41 Noise screen.

You have completed the test.

Noise with tone testing (O.41 method)

This test measures the noise level, in decibels, in the presence of a holding tone (820 Hz or 1020 Hz). You can perform this test using a single HST to generate the holding tone locally, or you can use the HST with another device generating the holding tone at the far end.

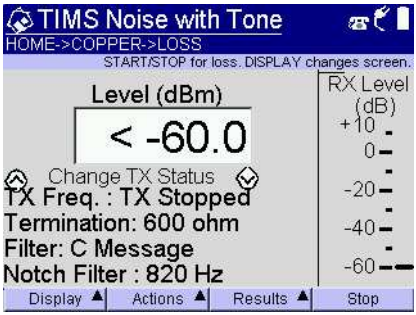
To perform a noise with tone test

1 Determine whether you will use an HST by itself or with another device at the far end, and then connect the HST to the line under test:

- Single HST: Connect both Tip and Ring (or A and B) pairs (T/R and T1/R1) to the lines under test. The HST will measure the signal to noise ratio on the T/R (A/B) pair and transmit a holding tone on the T1/R1 (A1/B1) pair.
- With a device at the far end: Connect only the Tip (A) and Ring (B) pair (T/R or A/B) to the line under test. The HST measures the signal to noise ration on the T/R pair. The far end device transmits the holding tone.

2 Select the **Noise with Tone (O.41 method)** test. See page 58.

The TIMS Noise with Tone screen appears.



3 Press the **Actions** soft key, and then choose one of the following options:

Options	Action
Specify the termination (impedance)	Select **Termination**, and then select a value in ohms.
Enable or disable a filer	Select **Filter**, and then select the type of filter you want to apply or disable. For information about filters, see Table 18 on page 196.
To specify a notch filter	Select **Notch Filter**, and then select either **820** Hz or **1020** Hz. For information about filters, see Table 18 on page 196.

4 If the HST will transmit the holding tone, use the up and down arrow keys to change the tone from 1020 Hz to 820 Hz or to stop transmitting.

5 Press the **Start** soft key to begin the test.

You should hear audio of the tone. Results appear in the TIMS Noise with Tone screen.

6 To change the result measurement from dB to dBrn, press the **Result** soft key, and then select either **dB** or **dBrn**.

You have completed the test.

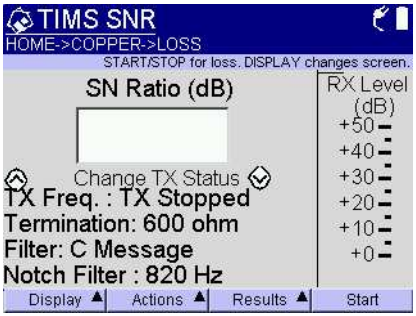
Signal to noise ratio testing

This test measures the signal strength relative to background noise. You can use the HST to perform this measurement using a single HST by itself or using the HST and another device at the far end. You can specify the termination and apply a filter. The result is displayed in decibels.

To measure the signal to noise ratio (SNR)

1. Determine whether you will use an HST by itself or with another device at the far end, and then connect the HST to the line under test:
   - Single HST: Connect both Tip and Ring (or A and B) pairs (T/R and T1/R1) to the lines under test. The HST will measure the signal to noise ratio on the T/R (A/B) pair and transmit a holding tone on the T1/R1 (A1/B1) pair.
   - With another device: Connect only the Tip (A) and Ring (B) pair (T/R or A/B) to the line under test. The HST measures the signal to noise ration on the T/R (A/B) pair. The far end device transmits the holding tone.
2. Select the **SNR** test. See page 58.

   The TIMS SNR screen appears.



3 Press the **Actions** soft key, and then choose one of the following options:

Options	Action
Enable or disable a filter	Select **Filter**, and then select the type of filter you want to apply or disable. For information about filters, see Table 18 on page 196.
Specify the termination (impedance)	Select **Termination**, and then select a value.

4 Press the **Start** soft key to begin the test.

You should hear audio of the tone. Results appear in decibels on the TIMS SNR screen.

You have completed the test.

Impulsive noise testing (ITU-T O.71 method)

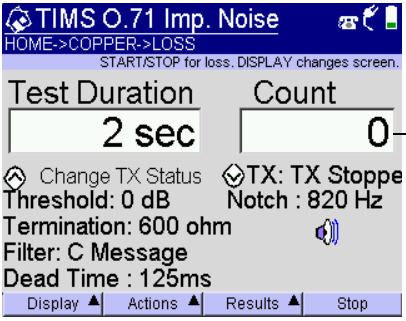
This test measures impulsive noise using the ITU-T O.71 method. When you select the impulsive noise test, you must configure test parameters.

To measure impulsive noise

1 Connect the Tip (A) and Ring (B) pair (T/R or A/B) to the line under test.

2 Select the **Impulsive Noise (O.71 method)** test. See page 58.

The TIMS O.71 Imp. Noise screen appears.



3 Press the **Actions** soft key, and then choose one of the following options:

Options	Action
Specify the termination (impedance)	Select **Termination**, and then select a value in ohms.
Enable or disable a filer	Select **Filter**, and then select the type of filter you want to apply or disable. For information about filters, see Table 18 on page 196.
To configure parameters for the test	Select **Impulse Items**. The test parameter options appear. See step 4.

4 Select a parameter, and then enter a value. The following table describes the parameters.

Impulse Noise Parameters	Description
Set Threshold	Enter a value, from **40** to **90** dBrn or **-50** to **0** dB, to indicate when the HST will detect impulse noise. When this value is exceeded, the HST will register an impulse noise event.
Test Duration	Select one of the following: – **Timed Test** — Enter a value, from **1** to **60** minutes, to indicate how long the test will run. – **Untimed Test**
Dead Time	Enter a value, from **25** to **1000** milliseconds (ms) to indicate how long the HST will wait before attempting to detect the next impulse event.
Notch Filter	Select one of the following: – **820** Hz – **1020** Hz – **None**
Test Tone Frequency	Select one of the following: – **820** Hz – **1020** Hz
Test Tone Amplitude	Select one of the following: – **3** dBrn – **0** dBrn – **-10** dBrn
Mute/Enable Sound Effects	When the sound is enabled, the HST will beep each time an impulse event is detected.

5 Press the **Start** soft key to begin the test.

A count of impulse noise events appears on the TIMS O.71 Imp. Noise screen.

You have completed the test.

Return loss testing

This test measures return loss caused by impedance mismatches for a user-specified frequency. Results are displayed in decibels.

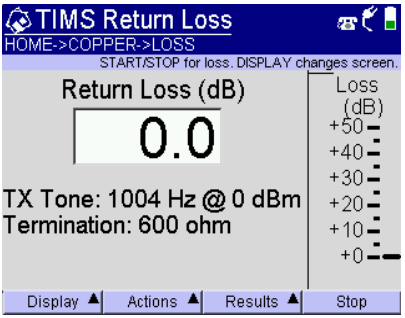
To measure return loss

1 Connect the Tip (A) and Ring (B) pair (T/R or A/B) to the line under test.

2 Select the **Return Loss** test. See page 58.

3 If the Return Loss Sweep screen appears, press the **Actions** soft key, and then select **Return Loss**.

The TIMS Return Loss screen appears.



4 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination (impedance)	Select **Termination**, and then select a value, in ohms, for the termination.
To specify the return loss frequency	Select **TX Tone**, and then enter a value, from **200** to **5000** Hz, for the frequency.

5 Press the **Start** soft key to begin the test.

Results appear in the TIMS Return Loss screen.

You have completed the test.

Return loss sweep testing

This test measures return loss over a range of frequencies, from 200 Hz to 5000 Hz. The HST displays the return loss in decibels.

To measure return loss over a range of frequencies

1 Connect the Tip (A) and Ring (B) pair (T/R or A/B) to the line under test.

2 Select the **Return Loss** measurement option. See page 58.

3 If the Return Loss screen appears, press the **Actions** soft key, and then select **Return Loss Sweep**.

The Return Loss screen appears.

4 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

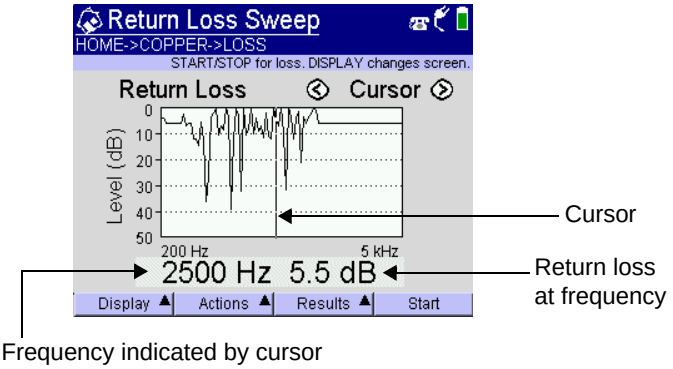
c Select a termination.

To select…	Press…
600 ohm	the **1** key
900 ohm	the **2** key

5 To begin the sweep, press the **Start** soft key.

The HST begins measuring return loss across the frequency range. The current frequency and decibel measurement appear at the bottom of the screen.

A vertical line cursor shows where the frequency lies within the range.



6 Use the left and right arrow keys to move the cursor and view return loss at different frequencies.

You have completed the test.

Testing voice service

7

This chapter provides task-based instructions for using the optional HST-3000 copper testing features. Topics discussed in this chapter include the following:

– “Testing voice service and Caller ID” on page 72

Testing voice service and Caller ID

The POTS dialer allows you to place and receive voice calls to verify that the service is working properly. You can also use the dialer for the following tasks:

– to drop battery for opens testing
– to establish a quiet termination for balance and noise tests
– to determine if loss at 1004 Hz is acceptable
– to test incoming caller ID number and name

The following procedure describes how to test voice service and caller ID.

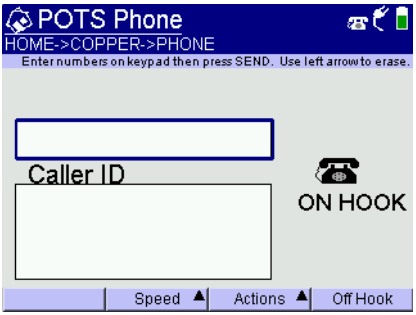
To test voice service and caller ID

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Copper Measurements menu (see page 8).

3 Press the **7** key.

The POTS Phone menu appears.



4 Place a call.

a Dial the number using the speed-dial (**Speed** soft key) or manually enter the phone number using the keypad.

To use pulse dialing, press the **Actions** soft key and then select **Pulse Dialing**.

b Press the **OK** key to initiate the call.

c Speak into the microphone located above the OK key.

d *Optional.* To mute the microphone, press the **Actions** soft key, and then select **Mute** (or Un Mute) **Microphone**.

The mute feature is only available when off hook.

e Press the **On Hook** soft key to end the call.

5 Receive a call.

a Request someone to call you.

b When the HST-3000 indicates an incoming call, press the **Off Hook** soft key.

For lines that have caller ID, the name and number information appears in the box.

NOTE:

For lines that support Caller ID Call Waiting, you can be on a call and the when the HST-3000 indicates an incoming call, the name and number information appears in the box.

c *Optional.* To mute the microphone, press the **Actions** soft key, and then select **Mute** (or Un Mute) **Microphone**.

The mute feature is only available when off hook.

d Press the **On Hook** soft key to end the call.

Testing voice service and caller ID is complete.

Wideband testing

8

This chapter provides task-based instructions for using the wideband testing features. Topics discussed in this chapter include the following:

– “Performing WBTIMS measurements” on page 76
– “Performing WB2 measurements” on page 110

Performing WBTIMS measurements

The wideband transmission impairment measurement set (WBTIMS) is an optional suite of tests designed to trouble-shoot copper problems associated with technologies that use frequencies above the voice range. These tests include the following:

– Wideband loss
– Wideband noise
– Impulse noise
– Transmission impairment measurements

For additional information about HST options, contact your JDSU representative or contact JDSU through the company web site, www.jdsu.com.

To access the WBTIMS feature

1 Access the Copper Measurements menu (see page 8).

2 Press the **9** key.

The WB Loss Meter menu appears.

The following procedures describe how to use the WBTIMS feature.

NOTE:

For best results, do not use the battery charger while performing WBTIMS measurements, especially when measuring very low amplitudes.

Measuring wideband loss

The HST-3000 can send and receive tones to measure wideband loss.

Receiving wideband tones

The following procedure describes how to receive wideband tones.

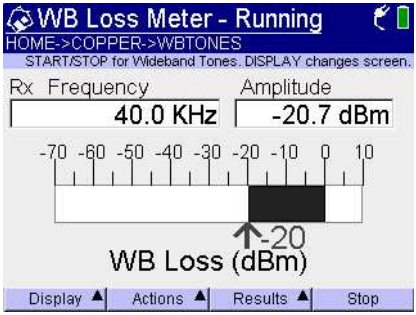
To receive wideband tones

1. Connect the Tip and Ring (A and B) leads to the line under test. Do not connect the Ground (Earth) lead.
2. Press the **Actions** soft key, then the **1** key.

   The Loss Meter menu appears.
3. Press the **Start** soft key.

   The HST-3000 begins measuring the frequency and level of each tone.

   The loss appears in the bar graph.



4. To change the frequency range, do the following:
   a. Press the **Display** soft key.
   b. Select **WideBand Tones** then select a range:

To select...	Press...
10 kHz - 1.6 MHz	the **1** key
20 kHz - 2.2 MHz	the **2** key
25 kHz - 30 MHz	the **3** key

5 *Optional.* To change the display view, do the following:

a Press the **Display** soft key, and then select the view.

– Frequency list

– Slope graph (not available in the 25 kHz - 30 MHz range)

– WB Graph View – graphs the tone as it is received. (In addition, if testing on an ADSL2 or VDSL circuit, the upstream and downstream areas/bands will be different colors.) For this test, a FED is required. This test performs similar to a sweep as it looks at multiple frequencies, however it does a snapshot at each frequency, rather than a continuous sweep.

– Frequency meter

6 If testing toward a FED, press the **Actions** soft key and then select **FED Commands**. The Manual FED screen appears. See "Manually commanding the FED" on page 140.

7 Press the **Stop** soft key.

8 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see "Saving results" on page 167.

Receiving tones is complete.

Transmitting wideband tones

The following procedure describes how to transmit wideband tones.

To transmit wideband tones

1 Connect the Tip and Ring (A and B) leads to the line under test.

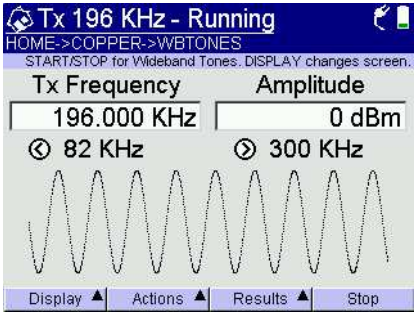
2 Press the **Actions** soft key.

3 Select the tone to transmit.

To transmit this type of tone…	Select…
standard tone	**Tx Tones**, and then select a frequency
custom tone	**Custom Tone**. A Tx Frequency field appears. Enter a value for the frequency (kHz), with up to three decimal places. Press the asterisk key (*) to enter a decimal point.

4 Press the **Start** soft key.

The tone graph appears.



NOTE:

Your display may look different, depending on your transmission selection.

5 *Optional*. To change the amplitude of the signal, do the following:

a Press the **Actions** soft key

b Select **Amplitude**.

c Type the new amplitude in the dialog box, and then press the **OK** key.

6 *Optional.* Change the frequency by using the left and right arrows.

NOTE:

The arrow keys are only available if transmitting a standard tone and will move among only those frequencies.

7 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key
75 ohm	the **3** key
120 ohm	the **4** key

8 Press the **Results** soft key to save or clear the results.

9 Press the **Stop** soft key.

Transmitting tones is complete.

Performing four-wire wideband measurements

Some provisioning situations involve four wires; one example is DDS, which requires a transmit pair and a receive pair. You can use the HST-3000 to test both pairs simultaneously.

To measure loss on both pairs

1 Connect the T, R, T1 and R1 to the pairs under test (a total of four connections for two lines).

2 Press the **Actions** soft key, and then select **Simultaneous Tx/Rx Tones**.

3 Select the tone you want to transmit.

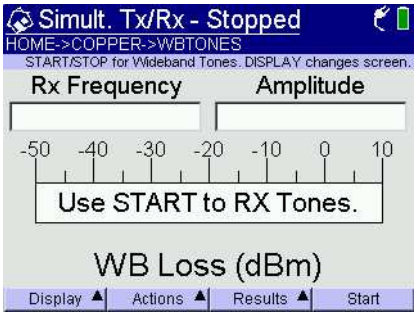
4 *Optional.* To send a specific tone, do the following:

a Press the **8** key. The Tx Frequency dialog box appears.

b Type a value for the transmitted frequency in kHz.

c Press the **OK** key.

The Loss Meter menu appears. The HST-3000 begins measuring the frequency and level of each tone. The loss appears in the bar graph.



5 *Optional.* To change the display view, do the following:

a Press the **Display** soft key, and then select the view.

– Frequency list

– Slope graph (not available in the 25 kHz - 30 MHz range)

– Frequency meter

6 Press the **Stop** soft key.

7 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see “Saving results” on page 167.

Measuring wideband loss is complete.

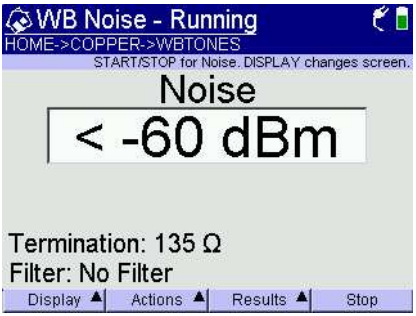
Measuring wideband noise

The wideband noise measurement is used to identify interferences that may interrupt signal transmission.

To measure wideband noise

1. Connect the Tip and Ring (A and B) leads to the line under test.
2. Press the **Display** soft key.
3. Select **Wideband Noise**.

   The Noise Power menu appears.



4. *Optional.* To apply a filter, do the following:
   a. Press the **Actions** soft key.
   b. Press the **1** key.
   c. Select a filter.

To select…	Press…
E (DDS, BRI)	the **1** key
F (HDSL, T1)	the **2** key
G (ADSL)	the **3** key
None	the **4** key

5. *Optional.* To change termination, do the following:
   a. Press the **Actions** soft key.
   b. Press the **2** key.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key
75 ohm	the **3** key
120 ohm	the **4** key

6 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see "Saving results" on page 167.

7 Press the **Stop** soft key.

Measuring wideband noise is complete.

Measuring impulse noise

Impulse noise is spurious voltage spikes that can disrupt digital transmissions.

The following procedure describes how to measure impulse noise.

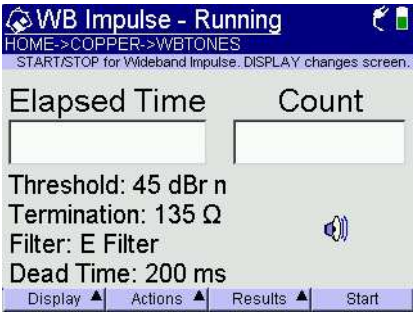
To measure impulse noise

1 Connect the Tip and Ring (A and B) leads to the line under test.

2 Press the **Display** soft key.

3 Select **Impulse Noise**.

The Impulse Noise menu appears.



4 Select the type of test by performing the following steps.

a Press the **Actions** soft key.

b Select the type of test.

To select…	Press…
Timed	the **1** key
Untimed	the **2** key

5 Set the noise threshold by performing the following steps.

a Press the **Actions** soft key.

b Press the **3** key.

c Type the noise threshold, and then press the **OK** key.

6 Select a filter by performing the following steps.

a Press the **Actions** soft key.

b Press the **4** key.

c Select a filter.

To select…	Press…
E (DDS, BRI)	the **1** key
F (HDSL, T1)	the **2** key
G (ADSL)	the **3** key

7 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Press the **5** key.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key
75 ohm	the **3** key
120 ohm	the **4** key

8 To begin the test, press the **Start** soft key.

A count of impulse noise events appears on the Impulse Noise screen.

9 To view the Impulse Noise Event Log, press the **Results** soft key, and then select **View Event Log**.

If an impulse noise "hit" occurs, a log file is generated that includes the date and time and the number of counts that occurred in that second. The log file also includes the termination, filter, threshold, and test start time.

10 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see "Saving results" on page 167.

11 Press the **Stop** soft key.

You have completed the test.

Measuring spectral noise

Radio frequency interference from digital services or AM radios can reduce the performance of a copper wire. With the spectral noise option, the HST-3000 can detect and measure the existence of such interference.

Using the spectral analyzer

The HST-3000 can display the noise on the line.

To measure spectral noise

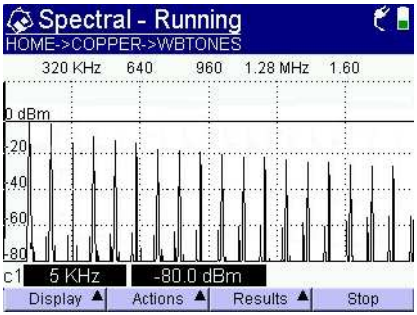
1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Press the **Display** soft key, and then press the **2** key.
3. Select the span.

To select...	Press...
0 Hz - 1.5 kHz	the **1** key
0 Hz - 6.0 kHz	the **2** key
2 kHz - 1.9 MHz (Wideband)	the **3** key
4 kHz - 3.8 MHz (Wideband)	the **4** key
20 kHz - 7.5 MHz (WB2[a])	the **5** key
20 kHz - 17.3 MHz (WB2[a])	the **6** key
17.6 MHz - 30 MHz (WB2[a])	the **7** key
20 kHz - 30 MHz (WB2[a])	the **8** key
20 kHz - 30 MHz, 10kHz (WB2[a])	the **9** key

a. available only with WB2 SIM.

4. Press the **Start** soft key to run the test.

The spectral noise graph appears.



5 If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **3**.

The X axis zoom level is persistently saved to allow consistent viewing (the last saved zoom level is restored each time the spectral measurement is launched).

NOTE:

You can also zoom using the shift + arrow keys:
Shift + left/right zooms on the X axis.
Shift + up/down zooms on the Y axis.

However, zoom level changes made in this manner are not saved.

6 To view by a specific technology, do the following:

a Press the **Actions** soft key.

b Press the **1** key.

c Press the key corresponding to the technology.

7 To view by a specific interference, do the following:

NOTE:

The view by interference selection is only available on spans 7.5 MHz and higher.

a Press the **Actions** soft key.

b Press the **2** key.

c Press the key corresponding to the interference.

8 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

c Select a termination.

Your termination selections vary depending on the span.

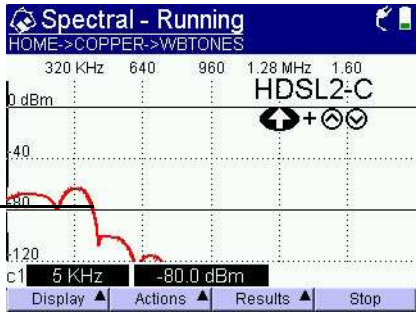
9 *Optional.* To superimpose a spectral mask for a specific technology, do the following:

a Press the **Display** soft key and then press **7**.

NOTE:

The Spectral Mask selection is only available on spans 1.9 MHz and higher.

b Select a technology.



Spectral mask

10 *Optional.* To change the scale of the y-axis, do the following:

a Press the **Actions** soft key.

b Select a scale: **Switch to dBm** or **Switch to dBm/Hz**.

11 Press the **Results** soft key to save the results, if desired.

For information about saving your results in graphical form, see “Saving results” on page 167.

12 Press the **Stop** soft key.

Spectral analysis is complete.

Viewing a saved spectral analysis trace

The following procedure describes how to view a saved trace.

To view a saved trace

1 Press the **Results** soft key.

2 Press **2** to **Load Reference Trace**.

3 Select the file name of the graph and then press the **OK** key.

The graph appears.

Comparing traces

After you have saved a spectral trace and loaded the trace, you can use it as a reference and compare it to a current trace.

To compare traces

1 Press the **Results** soft key.

2 Select one of the following:

To do this...	Press...
View a single trace (only the current/ active trace)	the 6 key
View both (typically are laid on top of each other)	the 7 key
View the difference (the delta between the two traces)	the 8 key
View the comparison of the two traces (both traces shown, but separated from each other)	the 9 key

3 Compare the traces.

This can be used to troubleshoot anomalies such as excessive impulse noise on the copper loop, large noise spikes on a spectral graph, and DSL errors impacting performance.

Another use for the comparison feature is to help identify the source of radio frequency interference (RFI) using the SDI-100.

Using the SDI-100

The SDI-100 (Spectral Detector and Identifier) is an optional accessory used to help identify the source of radio frequency interference (RFI). The SDI-100 can detect signals from 20 kHz to 30 MHz (supports ADSL and VDSL ranges).

The typical use for the SDI-100 is to troubleshoot anomalies such as excessive impulse noise on the copper loop, large noise spikes on a spectral graph, and DSL errors impacting performance.

Before running any tests, verify that you have HST software version 6.34.03 or higher (System>Tools>Options/Revs/Copyright).

Locating RFI

The following procedure describes how to use the SDI-100 to locate radio frequency interference.

To use the SDI-100 to identify the source of RFI

1 Select the **Spectral** test and then choose a span.

Service	Bandwidth/Span
ADSL	20kHz – 1.1MHz
ADSL2	20kHz – 7.5MHz
VDSL	20kHz – 17.3MHz
VDSL2	20kHz – 30MHz

2 Press the **Actions** soft key, and then set the termination to 100 ohms.

3 Press the **Configure** key, and then set the **Averages** setting to 1.

This is the number of measurements to use for calculating the average. If set to a low number, the spectral measurements may look slightly erratic, because one measurement may be slightly higher or lower than the next. So, if you set this to a higher number, the measurement

appears more stable. However, the higher number will add latency. Therefore, specifying this setting as “1” will enable quicker responsiveness and easier location of the interferer.

4 **Start** the test.

The spectral graph will look similar to Figure 2.

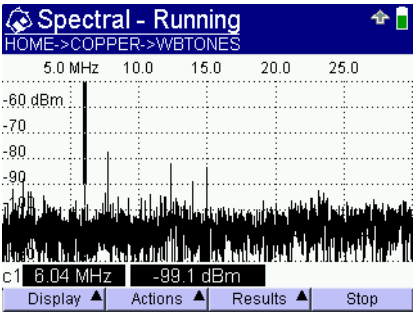


Figure 2 Spectral trace

5 Adjust the focus of the test by pressing the **Actions** soft key, and then selecting **View by Technology** and specifying the technology.

Service	Frequency range
HDSL	20kHz – 400kHz
T1	20kHz – 1.54MHz
ADSL	20kHz – 1.1MHz[a]
VDSL D1	1.1MHz – 3.75MHz
VDSL U1	3.75kHz – 5.2MHz
VDSL D2	5.2MHz – 8.5MHz
VDSL U2	8.5MHz – 12MHz
VDSL D3	12MHz – 17.6MHz
VDSL U3	17.6MHz – 30MHz

a. For ADSL2, focus on the range 20kHz – 2.2MHz

NOTE:

The selections vary depending on the selected span.

6 **Stop** the test but do not exit.

7 Save the spectral data. Select **Results>Save graph data**.

8 Connect the SDI-100 to the test tool's T, R, and Ground (A, B, earth) connectors.

9 Load and view the saved spectral trace. Select **Results>Load reference trace**.

NOTE:

The spectral trace was obtained from the copper loop under test in the spectral noise analysis mode. The SDI-100 is to be used to identify locations for noise spikes of interest. The stored trace becomes the reference data as you use the SDI-100 whose input will be dynamically displayed on the same screen as the stored trace.

10 View the difference of the saved and current trace by selecting **Results>View Compared**.

The spectral graph will look similar to Figure 3.

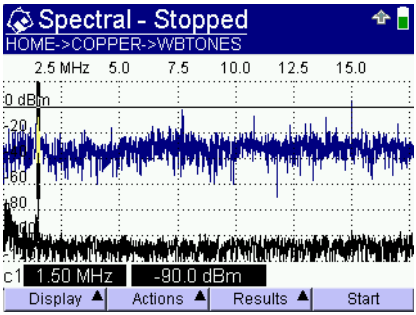


Figure 3 Saved spectral trace compared to current

11 Zoom in at the spike of interest.

The spectral graph will look similar to Figure 4.

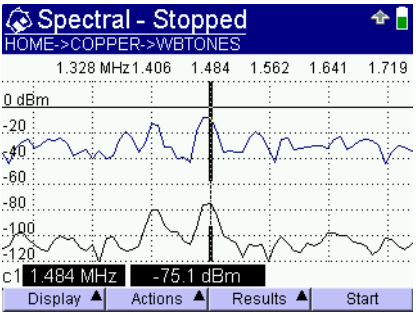


Figure 4 Zoom on saved trace compared to current

12 Hold the wand in your hand (grasping the handle), and point the narrow edge of the wand away from you.

13 Move around the home or along the copper loop looking for noise spikes and amplitude changes.

14 After you get a general idea of the direction of the signal, slightly rotate the wand, pointing the face (flat surface) of the wand toward the signal.

The point at which the signal drops will give you a bearing for the signal.

15 Move toward the signal. If it is increasing, you are going toward the disturbance. Modifying your bearing if the signal loses strength.

You have located the signal.

Troubleshooting The SDI-100 is directional in terms of the received signal strength. Looking down on the top of the antenna, the reception pattern is circular, as shown (in yellow) in Figure 5.

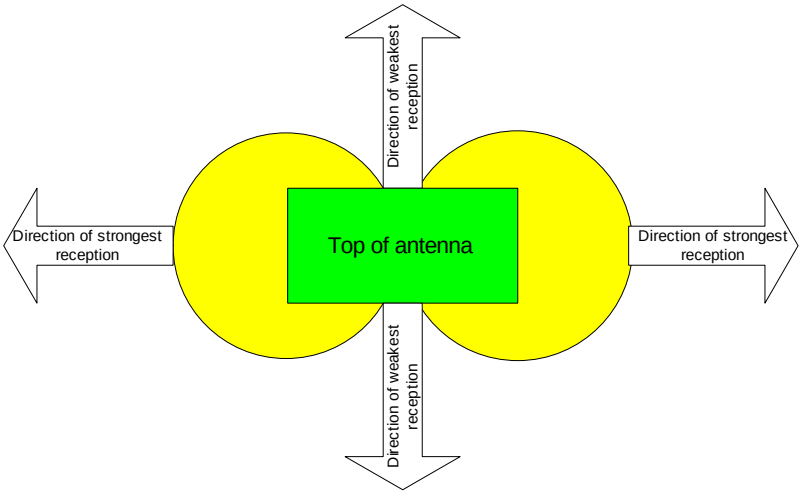


Figure 5 Copper Testing signal reception

When the broad flat surface of the antenna (the face) is pointed towards a radiating source, the received signal strength is at a minimum, or what is sometimes called a null. This null is very sensitive to the position of the antenna and a slight rotation in either direction will result in a rapidly increasing received signal.

When the narrow edge of the antenna is pointed towards a radiating source, the received signal strength is at a maximum, or what is sometimes called a peak. This peak is not very sensitive to the position of the antenna and a slight rotation in either direction will not result in a rapidly decreasing received signal.

For this reason it is recommended that the initial approximate location of the radiating interferer be done with end of the antenna, searching for a peak signal. After an approximate bearing is established, the flat face of the antenna should be

pointed towards the interferer to search for the null. This allows the quickest and most precise determination of the bearing of the interferer. As you approach the interferer, the received signal will increase and be strongest right next to it.

Measuring transmission impairment in the wideband

With the transmission impairment measurement option, you can use the HST-3000 to perform the following types of wideband tests:

- Wideband Noise — Measures noise in the wideband. You can specify the termination and apply a filter. Results displayed in decibels.
- SNR (signal to noise ratio) — Measures the signal strength relative to background noise. You can specify the termination and apply a filter. Result is displayed in decibels.
- Impulse Noise — Counts impulse noise events in the wideband. You can specify the impulse noise threshold, test duration, and dead time. You can also specify the termination and apply a filter.
- Return Loss — Measures return loss caused by impedance mismatches for a user-specified frequency or over a range of frequencies. Results are displayed in decibels.
- NEXT (Near End Crosstalk) — Detects coupling from one pair of wires to another at the near end. You can specify the termination and tone frequency.
- FEXT (Far End Crosstalk) — Detects coupling from one pair of wires to another at the far end. You can specify the termination and tone frequency.

To select a wideband transmission impairment test

1. Access the Wideband TIMS feature. See page 76.
2. Press the **Display** soft key, and then select **Transmission Impairment**.

3 Press the number key for the test you want to perform:

Measurement	Press
Noise	the **1** key
Signal to noise ratio (SNR)	the **2** key
Impulse Noise	the **3** key
Return Loss	the **4** key
NEXT	the **5** key
FEXT	the **6** key

4 To continue, see the appropriate section:

- “Wideband noise testing” on page 97
- “Signal to noise ratio testing” on page 99
- “Impulse noise testing” on page 100
- “Return loss testing” on page 102
- “Return loss sweep testing” on page 103
- “Near-end cross talk (NEXT) testing” on page 105
- “Near-end cross talk (NEXT) sweep testing” on page 106
- “Far-end crosstalk (FEXT) testing” on page 108

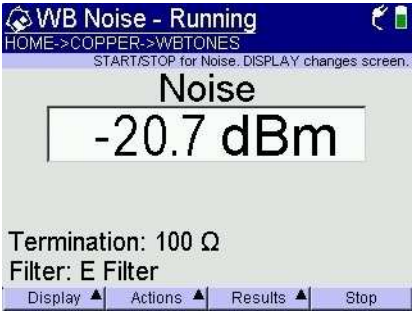
Wideband noise testing

To measure wideband noise

1 Connect the primary Tip (T), Ring (R), and Ground leads to the line under test.

2 Select the **Noise** test. See page 96.

The Wideband Noise screen appears.



3 To apply a filter or specify the termination (impedance), press the **Actions** soft key, and then do the following:

Option	Action
To apply a filter	– Select **Filter**, and then select the filter you want to apply. – For more information about filters, see Table 18 on page 196.
To specify the termination	– Select **Termination**, and then select a value, in ohms, for the termination.

4 To begin the test, press the **Start** soft key.

The noise result appears, in dBm, on the Wideband Noise screen.

5 To view results in dBrn, press the **Result** soft key, and then select **Display Results in dBrn**.

You have completed the measurement.

Signal to noise ratio testing

To measure the SNR

1 Connect the primary Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Select the **SNR** test. See page 96.

The SNR screen appears.

3 To apply a filter or specify the termination (impedance), press the **Actions** soft key, and then do the following:

Option	Action
To apply a filter	– Select **Filter**, and then select the filter you want to apply. – For more information about filters, see Table 18 on page 196.
To specify the termination	– Select **Termination**, and then select a value, in ohms, for the termination.

4 Press the **Start** soft key to begin the test.

Results appear in the SNR screen.

You have completed the test.

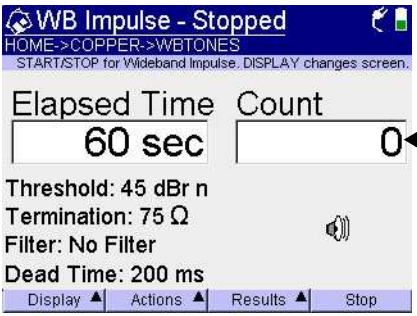
Impulse noise testing

To measure impulse noise

1 Connect the Tip (A), Ring (B), and Ground (E) leads to the line under test.

2 Select the **Impulse Noise** test. See page 96.

The Impulse Noise screen appears.



3 Select the type of test by performing the following steps.

a Press the **Actions** soft key.

b Select the type of test.

To select…	Press…
Timed	the **1** key
Untimed	the **2** key

4 Set the noise threshold by performing the following steps.

a Press the **Actions** soft key.

b Press the **3** key.

c Type the noise threshold, and press the **OK** key.

5 Select a filter by performing the following steps.

a Press the **Actions** soft key.

b Press the **5** key.

c Select a filter.

To select…	Press…
E (DDS, BRI)	the **1** key
F (HDSL, T1)	the **2** key
G (ADSL)	the **3** key

6 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Press the **6** key.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key
75 ohm	the **3** key
120 ohm	the **4** key

7 To begin the test, press the **Start** soft key.

A count of impulse noise events appears on the Impulse Noise screen.

8 To view the Impulse Noise Event Log, press the **Results** soft key, and then select **View Event Log**.

If an impulse noise “hit” occurs, a log file is generated that includes the date and time and the number of counts that occurred in that second. The log file also includes the termination, filter, threshold, and test start time.

9 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see "Saving results" on page 167.

10 Press the **Stop** soft key.

You have completed the test.

Return loss testing

This test measures return loss caused by impedance mismatches for a user-specified frequency. Results are displayed in decibels.

To measure return loss

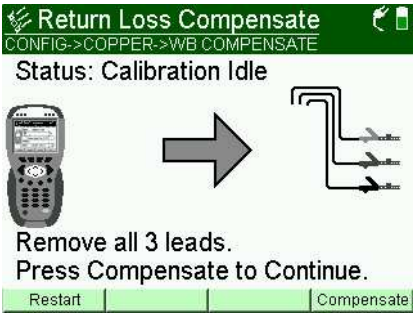
1 Before you begin the test, JDSU recommends running return loss compensation:

a Select the **Return Loss** test. See page 96.

b If the Return Loss Sweep screen appears, press the **Actions** soft key, and then select **Return Loss**.

c Press the **Configure** soft key.

The Return Loss Compensate screen appears.



d Follow the on-screen instructions.

e When compensation is complete, press the **Home** navigation key.

The Return Loss screen appears.

2 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination	Select **Termination**, and then select a value in ohms.
To specify the transmit tone frequency	Select **TX Tone**, and then enter a value, from **10** to **2000** kHz, for the frequency. Press **OK**.

3 Press the **Start** soft key to begin the test.

The result appears in decibels (dB) in the Return Loss screen.

You have completed the test.

Return loss sweep testing

This test measures return loss over a range of frequencies, from 10 kHz to 2 MHz. The HST displays return loss results in decibels.

To measure return loss over a range of frequencies

1 Before you begin the test, JDSU recommends calibrating the HST:

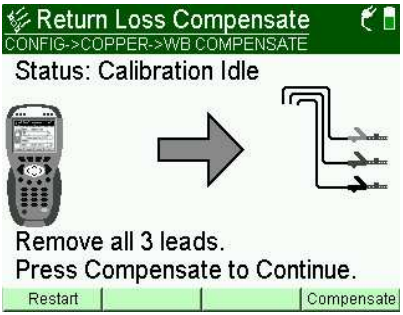
a Connect the Tip (A), Ring (B), and Ground (E) leads to the line under test.

b Select the **Return Loss Sweep** test. See page 96.

c If the Return Loss screen appears, press the **Actions** soft key, and then select **Return Loss Sweep**.

d Press the **Configure** soft key.

The Return Loss Compensate screen appears.



e Follow the on-screen instructions.

f When compensation is complete, press the **Home** navigation key.

The Return Loss Sweep screen appears.

2 To specify the termination (impedance), do the following.

a Press the **Actions** soft key, and then select **Termination**.

b Select a value, in ohms, for the termination.

3 To begin the test, press the **Start** soft key.

The HST begins measuring return loss across the frequency range. A graph appears in the Return Loss screen.

The current frequency and return loss measurement appear at the bottom of the screen. A vertical line cursor shows where the frequency lies within the range. You can view results for different frequencies by moving the cursor.

4 Use the left and right arrow keys to move the cursor and change to different frequencies within the range.

You have completed the test.

Near-end cross talk (NEXT) testing

This test detects coupling at the near end from one pair of wires to another. The HST transmits a tone on a pair of wires from the near end while noise is measured on another pair of wires at the near end. This allows coupling from one pair to another to be detected. You can specify the termination and tone frequency.

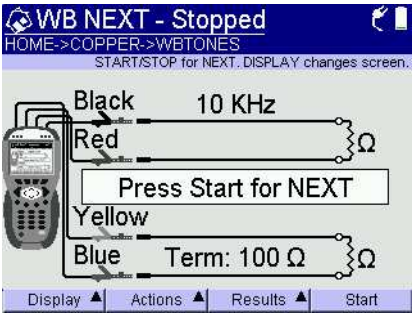
To measure near-end crosstalk

1 Connect both Tip (A) and Ring (B) pairs (T/R and T1/R1 or A/B and A1/B1) to the lines under test.

2 Select the **NEXT** test (see page 96).

3 If the NEXT Sweep screen appears, press the **Actions** key, and then select **NEXT Single**.

The NEXT screen appears.



4 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination (impedance)	– Select **Termination**, and then select a value in ohms.
To specify the transmit tone frequency	– Select **NEXT Frequency**, and then enter a value from **10** to **2000** kHz. – Press **OK**.

5 Press the **Start** soft key to begin the test.

The crosstalk measurement appears in decibels on the NEXT screen.

You have completed the test.

Near-end cross talk (NEXT) sweep testing

This test detects coupling from one pair of wires to another at the near end over a range of tone frequencies. The HST transmits a range of frequencies on a pair of wires (from the near end) and the crosstalk is measured on another pair of wires at the near. This allows coupling from one pair to another to be detected. You can specify the termination, and the start and end frequencies for the sweep.

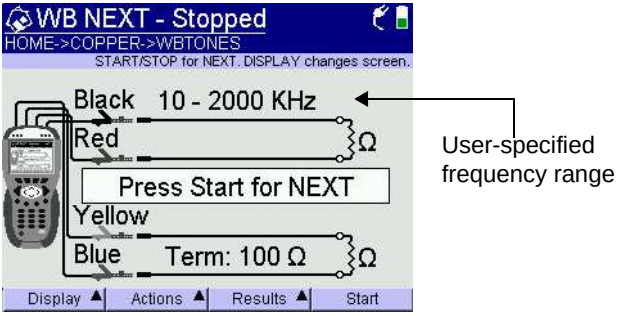
To measure near-end crosstalk over a range of frequencies

1 Connect both Tip (A) and Ring (B) pairs (T/R and T1/R1 or A/B and A1/B1) to the lines under test.

2 Select the **NEXT** test (see page 96).

3 If the NEXT screen appears, press the **Actions** key, and then select **NEXT Sweep**.

The NEXT Sweep screen appears.

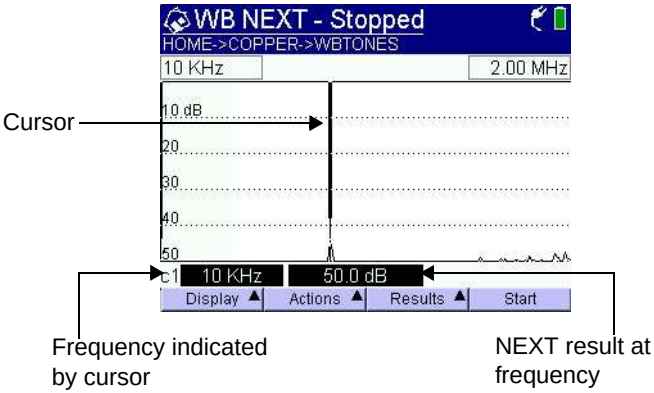


4 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination (impedance)	– Select **Termination**, and then select a value in ohms.
To specify the beginning of the frequency range you want to view	– Select **NEXT Start Frequency**, and then enter a value from **10** to **2000** kHz. – Press **OK**.
To specify the end of the frequency range you want to view	– Select **NEXT Stop Frequency**, and then enter a value from **10** to **2000** kHz. – Press **OK**.

5 Press the **Start** soft key to begin the test.

The HST begins the test. A graph appears in the NEXT Sweep screen.



The current frequency and NEXT measurement appear at the bottom of the screen. The lighter area on the graph indicates the user-specified frequency range. The shaded area is outside the range. A vertical line cursor shows the position of the current frequency. You can view noise results for different frequencies by moving the cursor.

6 Use the left and right arrow keys to move the cursor and change to different frequencies within the range.

You have completed the test.

Far-end crosstalk (FEXT) testing

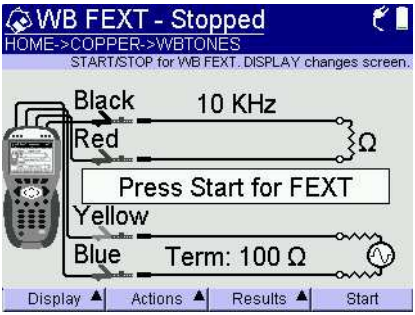
The test detects coupling at the far end from one pair of wires to another. A tone is transmitted by a device at the far end on one a pair of wires and the HST measures noise on another pair of wires at the near end. This allows coupling from one pair to another to be detected.

To measure far-end cross talk

1 Connect both Tip (A) and Ring (B) pairs (T/R and T1/R1 or A/B and A1/B1) to the lines under test.

2 Select the **FEXT** test (see page 96).

The FEXT screen appears.



3 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination (impedance)	– Select **Termination**, and then select a value in ohms.
To specify the transmit frequency	– Select **FEXT Frequency**, and then enter a value, from 10 to 2000 kHz.

4 Press the **Start** soft key to begin the test.

The noise measurement appears in decibels on the FEXT screen.

You have completed the test.

Performing WB2 measurements

The optional wideband2 (WB2) SIM includes a suite of tests designed to troubleshoot copper problems associated with technologies that use frequencies above the traditional wideband range (above 2.2 MHz).

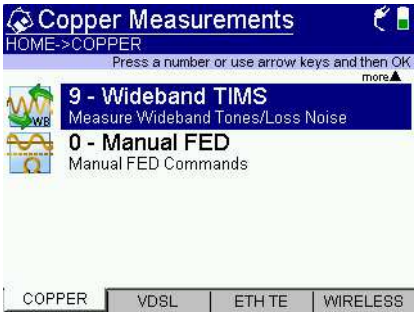
These tests include the following:

- Spectral Noise (See "Using the WB2 spectral analyzer" on page 114)
- Noise (See "Measuring wideband2 noise" on page 122)
- SNR (See "WB2 Signal to noise ratio testing" on page 124)
- Impulse noise (See "Measuring WB2 impulse noise" on page 125)
- Impulse Capture (See "Running a WB2 impulse capture" on page 127)
- Return Loss (See "WB2 Return loss testing" on page 130 and "WB2 Return loss sweep testing" on page 132)
- NEXT (See "WB2 Near-end cross talk (NEXT) testing" on page 133 and "WB2 Near-end cross talk (NEXT) sweep testing" on page 135)
- Balance (See "WB2 Balance testing" on page 137)

For additional information about HST options, contact your JDSU representative or contact JDSU through the company web site, www.jdsu.com.

To access the WB2 feature

1 From the Copper Measurements menu, press the **9** key.



NOTE:

Depending on the options you ordered, “Wideband TIMS” may be a different selection number.

You may get a “Updating SIM” message on the screen. This happens when the software on the base unit is different than the software on the SIM. The base unit automatically updates the software on the SIM. This screen disappears when the update is finished.

The following procedures describe how to use the WB2 TIMS feature.

Connecting to the line

When performing WB2 tests, connect to the line as described in the following procedure.

NOTE:

For best results, do not use the battery charger while performing WB2 TIMS measurements, especially when measuring very low amplitudes.

To connect to the line

1 Using the provided cable, connect the test leads to the HST as described, and outlined in Figure 6.

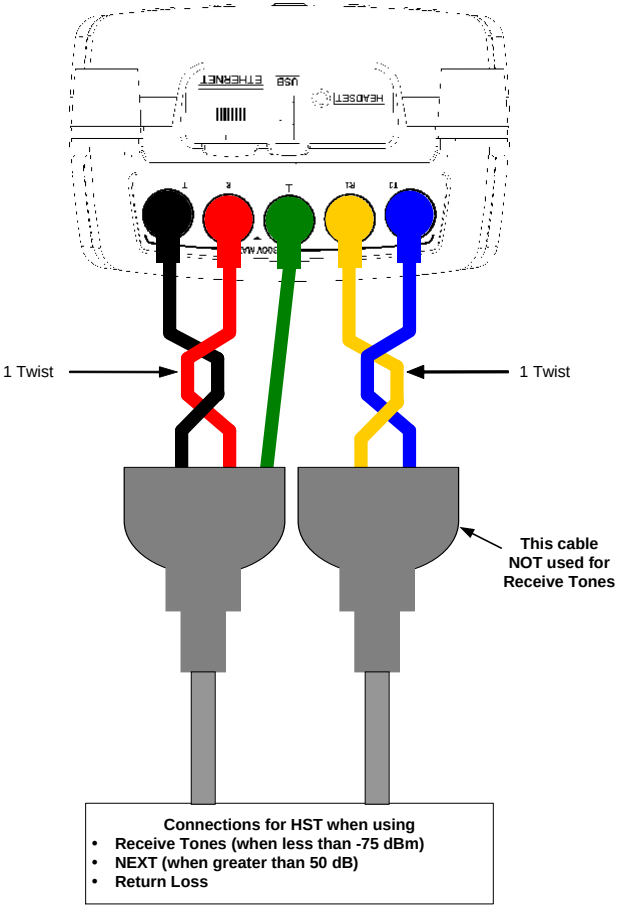


Figure 6 Connecting to the HST-3000

a Connect pair 1 using the black and red leads, placing 1 full twist in the cable.

– Connect the black lead to Tip (T, or “A”).

– Connect the red lead to Ring (R, or “B”).

b Connect the green lead to Ground.

c Connect pair 2 using the yellow and blue leads, placing 1 full twist in the cable.

– Connect the yellow lead to R1 (or “B1”).

– Connect the blue lead to T1 (or “A1”).

2 Connect the other end of the test leads to the line under test as described, and outlined in Figure 7.

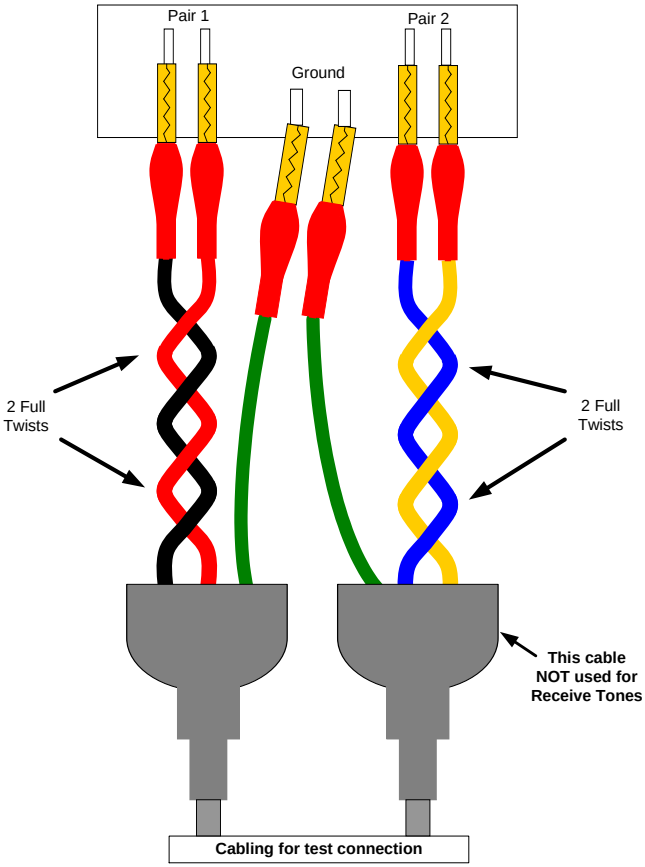


Figure 7 Connecting to the line

a Connect pair 1 using the black and red leads, placing 2 full twists in the cable.

b Connect the pair 1 green lead to Ground (Earth).

c Connect pair 2 using the yellow and blue leads, placing 2 full twists in the cable.

d Connect the pair 2 green lead to Ground (Earth).

NOTE:

Your physical connector may vary, depending on what you ordered.

The line is connected and you are ready to begin testing.

Using the WB2 spectral analyzer

With the spectral noise measurement, the HST-3000 can detect and measure the existence of interference such as AM radio. The HST-3000 can display the noise on the line.

To measure WB2 spectral noise

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113.

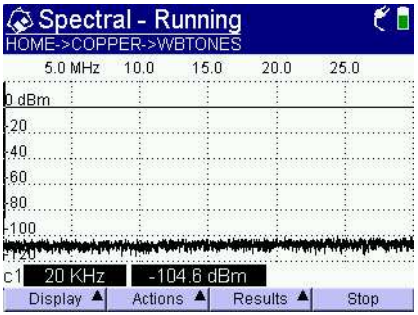
2 Press the **Display** soft key, and then press the **2** key.

3 Select the span:

- 20 kHz to 7.5 MHz
- 20 kHz to 17.3 MHz
- 17.6 MHz to 30 MHz
- 20 kHz to 30 MHz
- 20 kHz to 30 MHz, 10kHz

4 Press the **Start** soft key to run the test.

The spectral noise graph appears.



5 If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **2**.

The X axis zoom level is persistently saved to allow consistent viewing (the last saved zoom level is restored each time the Spectral measurement is launched).

NOTE:

You can also zoom using the shift + arrow keys:
Shift + left/right zooms on the X axis.
Shift + up/down zooms on the Y axis.

However, zoom level changes made in this manner are not saved.

6 *Optional.* To change the number of measurements to use for calculating the average, press the **Setup** key, and then specify the **Averages**.

If set to a low number, the spectral measurements may look slightly erratic, because one measurement may be slightly higher or lower than the next. So, if you set this to a higher number, the measurement appears more stable. However, the higher number will add latency.

7 To view an area of interest by a specific technology, do the following:

a Press the **Actions** soft key.

b Press the **1** key.

c Press the key corresponding to the technology.

8 To view an area of interest by a specific interference, do the following:

NOTE:

The view by interference selection is only available on spans 7.5 MHz and higher.

a Press the **Actions** soft key.

b Press the **2** key.

c Press the key corresponding to the interference.

9 To show the maximum signal peaks since starting the measurement, press the **Actions** soft key, and then select **Max Hold**.

To return to normal view, press the **Actions** soft key, and then select **Max Hold**

10 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

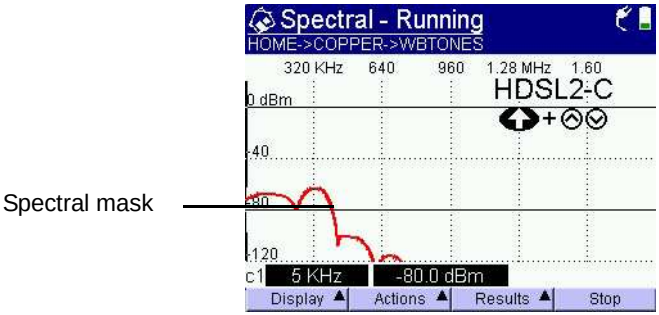
c Select a termination.

Your termination selections vary depending on the span.

11 *Optional.* To superimpose a spectral mask for a specific technology, do the following:

a Press the **Display** soft key and then press **7**.

b Select a technology.



12 *Optional.* To change the scale of the y-axis, do the following:

a Press the **Actions** soft key.

b Select a scale: **Switch to dBm** or **Switch to dBm/Hz**.

13 Press the **Results** soft key to save the results, if desired.

For information about saving your results in graphical form, see "Saving results" on page 167.

14 Press the **Stop** soft key.

Spectral analysis is complete.

Measuring wideband2 loss

The HST-3000 can send and receive tones to measure wideband loss.

Receiving wideband2 tones

The following procedure describes how to receive wideband2 tones.

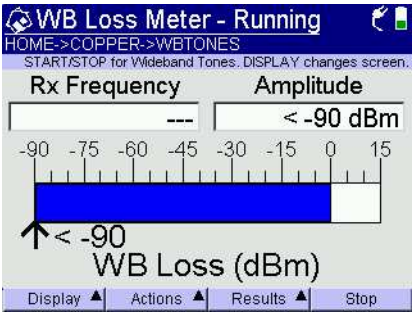
To receive wideband2 tones

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113

2 Press the **Display** soft key, then the **1** key.

3 Select the **25 kHz - 30 MHz** frequency range.

The Loss Meter menu appears.



4 Press the **Start** soft key.

The HST-3000 begins measuring the frequency and level of each tone.

The loss appears in the bar graph.

5 *Optional.* To change the display view, press the **Display** soft key, and then select **Frequency List View** or **Frequency Meter View**.

6 *Optional.* To change the termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

c Select a value in ohms.

7 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see “Saving results” on page 167.

Receiving tones is complete.

Transmitting wideband2 tones

The following procedure describes how to transmit wideband2 tones.

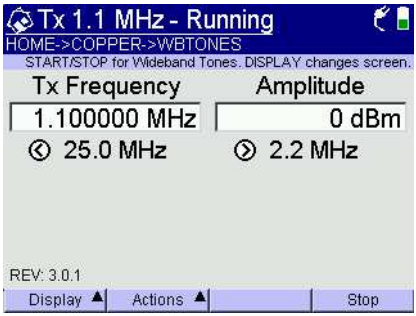
To transmit wideband2 tones

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113.
2. Press the **Actions** soft key.
3. Press the **2** key to transmit tones.
4. Select the tone to transmit.

To transmit …	Do this…
standard tone	Select a frequency
custom tone	Press the **8** key A Tx Frequency field appears. Enter a value for the frequency (kHz).

5. Press the **Start** soft key.

   The tone graph appears.



NOTE:

Your display may look different, depending on your transmission selection.

6 *Optional*. To change the amplitude of the signal, press the **Actions** soft key, and then select **Amplitude**. Type the new amplitude in the dialog box, and then press the **OK** key.

7 *Optional.* Change the frequency by using the left and right arrows.

NOTE:

The arrow keys are only available if transmitting a standard tone and will move among only those frequencies.

8 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Select **Termination**.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key

9 Press the **Results** soft key to save or clear the results.

10 Press the **Stop** soft key.

Transmitting tones is complete.

Performing two-pair wideband measurements

Some provisioning situations involve two pairs; one example is HDSL-4, which requires a two pairs. You can use the HST-3000 to test both pairs simultaneously.

To measure loss on both pairs

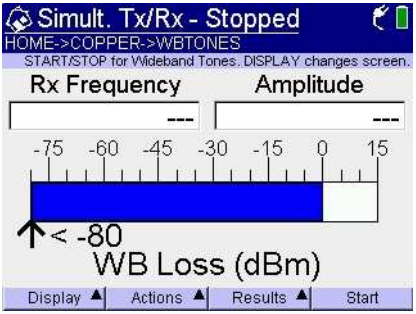
1 Connect the Tip (A), Ring (B), T1 (A1), R1 (B1), and Ground (E) leads to the line under test, as described in "Connecting to the line" on page 113 (a total of four connections for two lines).

2 Press the **Actions** soft key, and then select **Simultaneous Tx/Rx Tones**.

3 Select the tone to transmit.

To transmit …	Do this…
standard tone	Select a frequency
custom tone	Press the **8** key A Tx Frequency field appears. Enter a value for the frequency (kHz), and then press the **OK** key.

The Loss Meter menu appears. The HST-3000 begins measuring the frequency and level of each tone. The loss appears in the bar graph.



4 *Optional.* To change the display view, do the following:

a Press the **Display** soft key

b Select the view.

To select…	Press…
Frequency list	the **5** key

To select…	Press…
Frequency meter	the **6** key
TX status view	the **7** key

5 Press the **Results** soft key to save or clear the results. For information on saving your results, see "Saving results" on page 167.

Measuring wideband2 loss is complete.

Measuring wideband2 noise

The wideband noise measurement is used to identify interferences that may interrupt signal transmission.

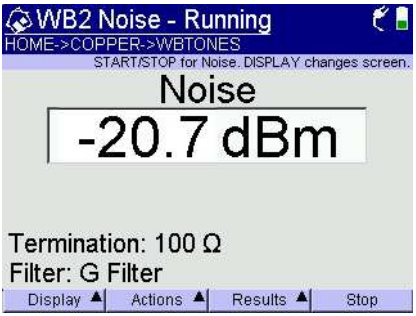
To measure wideband noise

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113.

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select **Noise**.

The Noise Power menu appears.



4 *Optional.* To apply a filter, do the following:

a Press the **Actions** soft key.

b Press the **1** key.

c Select a filter.

To select…	Press…
G Filter	the **1** key
G2 Filter	the **2** key
J-20K8	the **3** key
J-20K12	the **4** key
J-20K17	the **5** key
J-20K30	the **6** key
J-640K17	the **7** key
J-17M25	the **8** key
J-17M30	the **9** key
J-25M30	the **0** key

5 *Optional.* To change termination, do the following:

a Press the **Actions** soft key.

b Press the **2** key.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key

6 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see “Saving results” on page 167.

Measuring wideband2 noise is complete.

WB2 Signal to noise ratio testing

To measure the SNR

1 Connect the primary Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select the **SNR** test.

The SNR screen appears.

4 To apply a filter or specify the termination (impedance), press the **Actions** soft key, and then do the following:

Option	Action
To apply a filter	– Select **Filter**, and then select the filter you want to apply. – For more information about filters, see Table 18 on page 196.
To specify the termination	– Select **Termination**, and then select a value, in ohms, for the termination.

5 Press the **Start** soft key to begin the test.

Results appear in the SNR screen.

You have completed the test.

Measuring WB2 impulse noise

Impulse noise is spurious voltage spikes that can disrupt digital transmissions.

The following procedure describes how to measure WB2 impulse noise.

To measure impulse noise

1 Connect the Tip (A) and Ring (B) leads to the line under test, as described in "Connecting to the line" on page 113

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select **Impulse Noise**.

The Impulse Noise menu appears.

4 Select the type of test by performing the following steps.

a Press the **Actions** soft key.

b Select the type of test.

To select…	Press…
Timed	the **1** key
Untimed	the **2** key

5 Set the noise threshold by performing the following steps.

a Press the **Actions** soft key.

b Press the **4** key.

c Type the noise threshold, and press the **OK** key.

NOTE:

When the test is stopped, you can also change the threshold by pressing the up or down arrows.

6 *Optional.* To change the threshold units, do the following.

a Press the **Actions** soft key.

b Press the **3** key.

This toggles between dBm and dBr n.

7 Select a filter by performing the following steps.

a Press the **Actions** soft key.

b Press the **5** key.

c Select a filter.

To select…	Press…
G Filter	the **1** key
G2 Filter	the **2** key
J-20K8	the **3** key
J-640K17	the **4** key
J-17M25	the **5** key
J-17M30	the **6** key
J-25M30	the **7** key
No Filter	the **8** key

8 *Optional.* To change termination, do the following:

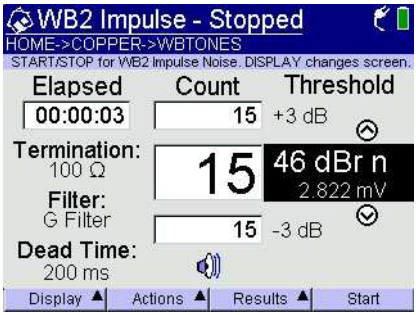
a Press the **Actions** soft key.

b Press the **6** key.

c Select a termination.

To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key

9 After the test is complete, view the results.



The Impulse Counter has three counters: the main (user programmable) threshold, 46 dBrn in this example, and two absolute counters, 3 dB above and below the main threshold. This three counter display helps to define the impulse event. For example, if all of the events happened between the main counter and -3 dB, the events tripped both the 43 and 46 dBr n threshold.

10 To view the Impulse Noise Event Log, press the **Results** soft key, and then select **View Event Log**.

If an impulse noise “hit” occurs, a log file is generated that includes the date and time and the number of counts that occurred in that second. The log file also includes the termination, filter, threshold, and test start time.

11 Press the **Results** soft key to save or clear the results. For information on saving your results, see “Saving results” on page 167.

Measuring impulse noise is complete.

Running a WB2 impulse capture

Impulse capture works like an oscilloscope. It provides a graphic display of the signal.

The following procedure describes how to run a WB2 impulse capture.

To run a WB2 impulse capture

1 Connect the Tip (A) and Ring (B) leads to the line under test, as described in "Connecting to the line" on page 113

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select **Impulse Capture**.

The Impulse Noise menu appears.

4 Set the noise threshold by performing the following steps.

a Press the **Actions** soft key.

b Select **Set Threshold**.

c Enter the noise threshold, and then press the **OK** key.

NOTE:

When the test is stopped, you can also change the threshold by pressing the up or down arrows.

5 *Optional.* To change the threshold units, do the following.

a Press the **Actions** soft key.

b Press the **1** key.

This toggles between dBm and dBr n.

6 Select a filter by performing the following steps.

a Press the **Actions** soft key.

b Press the **3** key.

c Select a filter.

To select…	Press…
G Filter	the **1** key
G2 Filter	the **2** key
J-20K8	the **3** key
J-640K17	the **4** key
J-17M25	the **5** key
J-17M30	the **6** key

To select…	Press…
J-25M30	the **7** key
No Filter	the **8** key

For explanations of the filters, see Table 21 on page 200.

7 *Optional.* To change termination, do the following:

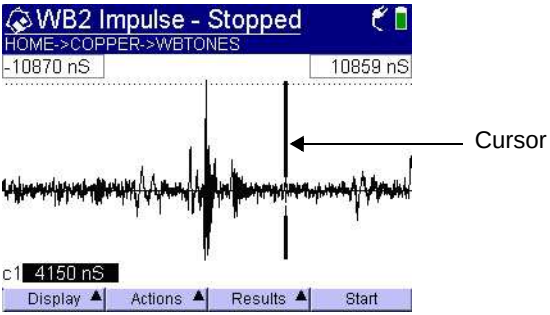
a Press the **Actions** soft key.

b Press the **4** key.

c Select a termination.

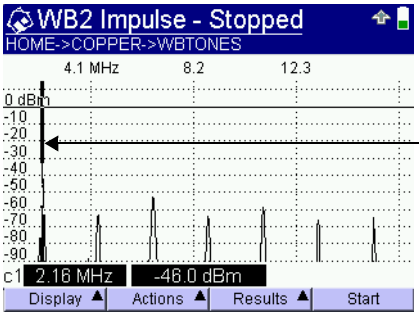
To select…	Press…
100 ohm	the **1** key
135 ohm	the **2** key

8 Press the **Start** soft key.



As soon as the signal crosses the selected threshold, a time-domain graph will be displayed showing ±10 µs of when the impulse occurred.

9 To view the results in the frequency domain instead of the time domain, press the **Results** soft key and then select Frequency Domain View.



The view selections are only active after data has been captured.

10 If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **3**.

NOTE:

You can also zoom using the shift + arrow keys:
Shift + left/right zooms on the X axis.
Shift + up/down zooms on the Y axis.

11 Press the **Results** soft key to save or clear the results. For information on saving your results in graphical form, see “Saving results” on page 167.

You have completed the procedure.

WB2 Return loss testing

This test measures return loss caused by impedance mismatches for a user-specified frequency. Results are displayed in decibels.

To measure return loss

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select the **Return Loss** test.

If the Return Loss Sweep screen appears, press the **Actions** soft key, and then select **Return Loss**.

4 Connect only the first pair, Tip (A) and Ring (B), to the line under test. (See steps 1 and 2 on page 113.)

5 Press the **Actions** soft key, and then select one of the following options:

To specify...	Select...
the Termination	**Termination**, and then select a value.
a single frequency	**TX Frequency**, and then enter a value, from **50** to **10000 kHz**, and then press **OK**.

6 Press the **Start** soft key to begin the test.

The result appears in decibels (dB) in the Return Loss screen.

You have completed the test.

WB2 Return loss sweep testing

This test measures return loss over a range of frequencies, from 100 kHz to 20 MHz, in 100 kHz steps. The HST displays return loss results in decibels.

To measure return loss over a range of frequencies

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test, as described in "Connecting to the line" on page 113
2. Select the **Return Loss Sweep** test. See page 96.

   If the Return Loss screen appears, press the **Actions** soft key, and then select **Return Loss Sweep**.

3. To specify the termination, press the **Actions** soft key, select **Termination**, and then select a value.
4. To begin the test, press the **Start** soft key.

The HST begins measuring return loss across the frequency range. A graph appears in the Return Loss screen.

The current frequency and return loss value appear at the bottom of the screen. A vertical line cursor shows where the frequency lies within the range. You can view results for different frequencies by moving the cursor.

If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **3**

NOTE:

You can also zoom using the shift + arrow keys:
Shift + left/right zooms on the X axis
Shift + up/down zooms on the Y axis.

5 Use the left and right arrow keys to move the cursor and change to different frequencies within the range.

You have completed the test.

WB2 Near-end cross talk (NEXT) testing

This test detects coupling at the near end from one pair of wires to another. The HST transmits a tone on a pair of wires from the near end while noise is measured on another pair of

wires at the near end. This allows coupling from one pair to another to be detected. You can specify the termination and tone frequency.

To measure near-end crosstalk

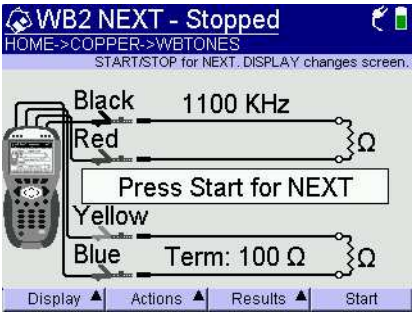
1 Connect both pairs (T/R and T1/R1) to the lines under test, as described in "Connecting to the line" on page 113.

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select the **NEXT** test.

If the NEXT Sweep screen appears, press the **Actions** key, and then select **NEXT Single**.

The NEXT screen appears.



4 Press the **Actions** soft key, and then select one of the following options:

Option	Action
To specify the termination (impedance)	– Select **Termination**, and then select a value in ohms.
To specify the transmit tone frequency	– Select **NEXT Frequency**, and then enter a value from **25** to **30000** kHz. – Press **OK**.

5 Press the **Start** soft key to begin the test.

The crosstalk measurement appears in decibels on the NEXT screen.

You have completed the test.

WB2 Near-end cross talk (NEXT) sweep testing

This test detects coupling from one pair of wires to another at the near end over a range of tone frequencies, from 100 kHz to 30 MHz, in 100 kHz steps. The HST transmits a range of frequencies on a pair of wires (from the near end) and the crosstalk is measured on another pair of wires at the near end. This allows coupling from one pair to another to be detected. You can specify the termination, and the start and end frequencies for the sweep.

To measure near-end crosstalk over a range of frequencies

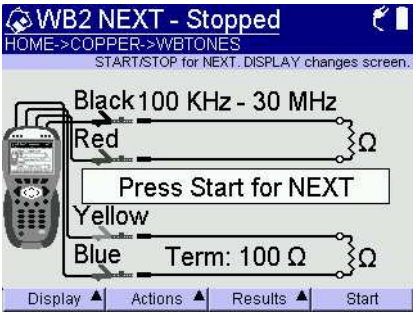
1 Connect both pairs (T/R and T1/R1) to the lines under test, as described in "Connecting to the line" on page 113.

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select the **NEXT** test.

If the NEXT screen appears, press the **Actions** key, and then select **NEXT Sweep**.

The NEXT Sweep screen appears.



4 To change the Termination, do the following.

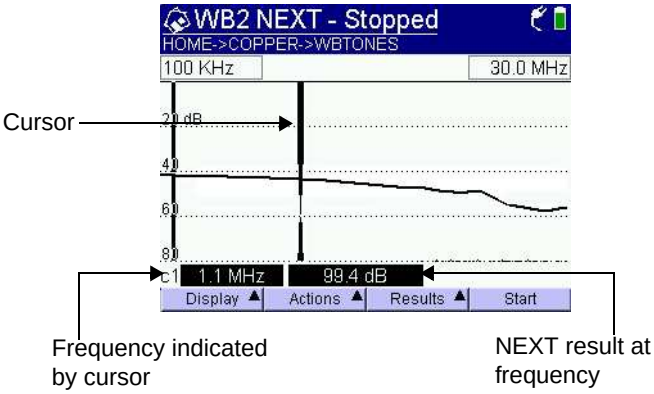
a Press the **Actions** soft key.

b Select **Termination**.

c Select a value in ohms.

5 Press the **Start** soft key to begin the test.

The HST begins the test. A graph appears in the NEXT Sweep screen.



The current frequency and NEXT value appear at the bottom of the screen. A vertical line cursor shows the position of the current frequency. You can view noise results for different frequencies by moving the cursor.

If you want to zoom in or out around the cursor on the x-axis or y-axis, press the **Display** soft key and then select the desired option. For example, to zoom in around the x-axis, press the **Display** soft key and then press **2**

NOTE:

You can also zoom using the shift + arrow keys:
Shift + left/right zooms on the X axis
Shift + up/down zooms on the Y axis.

6 Use the left and right arrow keys to move the cursor and change to different frequencies within the range.

You have completed the test.

WB2 Balance testing

The WB2 balance measurement is a two-step test. First, it measures the differential (across the pair) signal; then, the common mode signal. This test requires two pieces of equipment: a HST at each end, or an HST with a FED.

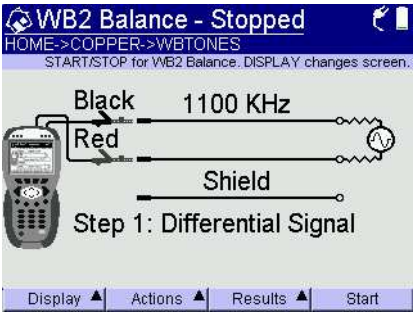
To measure WB2 balance

1 Connect the Tip (A), Ring (B), and Ground (E) leads to the line under test.

2 Press the **Display** soft key, then select **WB2 TIMS**.

3 Select the **Balance** test.

The WB2 Balance screen appears.



4 Connect the Tip (A) and Ring (B) leads on the far-end HST as shown on the screen.

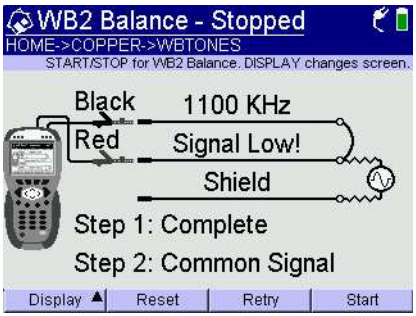
5 To specify the termination (impedance) or change the receive frequency, press the **Actions** soft key, and then do the following:

Option	Action
To specify the termination	– Select **Termination**, and then select a value, in ohms, for the termination.
To change the receive frequency	– Select **RX Frequency**, and then enter a frequency, in kHz.

6 If you are testing toward a FED, press the **Actions** soft key and then select **Balance with FED**.

7 Press the **Start** soft key to begin the first step of the test.

When the first step is complete, the screen changes to display the connections for the second step of the test.



8 Connect the Tip (A), Ring (B), and Ground (E) leads of the HST at the far end as shown on the screen.

9 Press the **Start** soft key to begin the second step of the test.

The results appear on the screen.

You have completed the test.

Testing with a FED

9

This chapter provides task-based instructions for using the optional far end device (FED) accessory for testing. Topics discussed in this chapter include the following:

– “About controlling a Far End Device” on page 140
– “Manually commanding the FED” on page 140

About controlling a Far End Device

The FED controls are implemented two ways:

– commands embedded into applications. For example, shorting the leads while measuring resistance (these are documented within the respective application).

– manual control using commands (see below).

Using the Manual FED application, you can control a far end device (FED) to allow two-ended pair testing with a single piece of test equipment.

After a technician has connected a FED (such as the JDSU UltraFED) to the far end of the pair under test and has connected the HST-3000 to the near end, the HST controls the FED using DTMF tones.

JDSU's newer Far End Devices (the UFEDIIB and newer) are uniquely addressable. Each addressable FED has a unique ID (similar to a MAC address), so you can select a specific FED to control.

Manually commanding the FED

The following procedure describes how to manually control a FED.

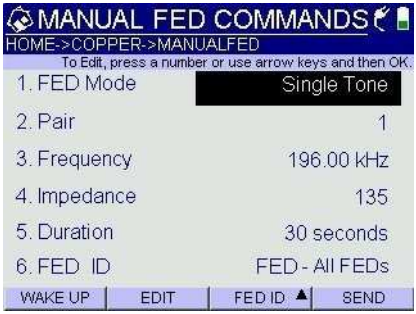
To control a far end device

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Copper Measurements menu (see page 8).

3 Select **Manual FED**.

The Manual FED Commands menu appears.



4 Configure the command to send by specifying the FED Mode, Pair, Frequency, Impedance, Duration, and FED ID.

a Use either the number key or use the up and down arrow keys to highlight a setting, and then press the EDIT soft key.

b Use the left and right arrow keys to change the selection, and then the OK key to accept.

Table 10 explains the FED Mode settings. Table 11 explains the other settings.

Table 10 FED Mode settings

Setting	Description
Single Tone	Connects a tone generator across tip (A) to ring (B). This is used to measure loss.
Trace Tone 1	Connects a tone generator across tip (A) to ring (B) and sends a 577 Hz tone.
Trace Tone 2	Connects a tone generator across tip (A) to ring (B) and sends a 1004 Hz tone.

Table 10 FED Mode settings (Continued)

Setting	Description
Balance Single Tone	Connects the complex tone from tip (A) to ring (B) to ground. This is used to asses the balance of the line in the xDSL frequency range.
Quiet Term.	Terminates the pair at the FED.
Open All	Tip (A), ring (B), and ground (sleeve) are disconnected from the cable pairs under test. This is used to isolate the pair under test.
Tip-Ring Short	Connects tip (A) to ring (B). Also called Strap mode. This is used with the loop resistance measurement or with the RFL measurements.
Tip-Ring-Gnd Short	Connects tip (A), ring (B), and ground (sleeve) to ground. This is used during the resistive balance measurement.
RFL 3-Way Strap	Connects tip (A) to T1 to ring (B). This is used primarily for RFL measurements on a known good pair.
TDR Helper	Continuously open and short the pair. On the TDR screen, the open trace [slope up] and the short trace [slope down] appear and will flip flop at the end of the line to indicate where the FED is located.
Off / Thru	Tip (A), ring (B) are connected to the CO tip (A) and ring (B) so that
Pr 1-Pr 2 Short	Connects tip (A) to T1 and ring (B) to R1. This is used primarily for RFL measurements on a known good pair.
Multi Tone	Connects the complex tone from tip (A) to ring (B). This is used for spectral tone tests when checking loss or crosstalk.

Table 10 FED Mode settings (Continued)

Setting	Description
Battery Level	Reports the battery state: good, low, very low.
FED ID	Reports the unique ID of the FED.
FED SW Ver.	Reports the software version of the FED.

Table 11 Other command settings

Setting	Description
Pair	Select the pair under test: – Pair 1 – Pair 2
Frequency	Specify a specific frequency to be sent, between 200 Hz and 30 MHz.
Impedance	Select 100, 135, or 600 ohm impedance, Bonded FEXT, or Bonded NEXT. Note: Bonded FEXT is only available on UFEDIIB and only if the FED Mode is Single Tone. Bonded NEXT is only available on UFEDIIB and if the FED Mode is Quiet Term.
Duration	Set the duration of the test.
FED ID	Allows you to define which FED to command. Go to step 5.

5 To define which FED to command, do one of the following:

– If you are using an older, non-addressable FED, or to communicate to all FEDs connected to the line, select All FEDs from the FED ID menu. Go to step 7.

– If you are using a newer UFEDIIB, you can select a specific FED to control, go to step 6.

6 Press the **FED ID** soft key, and then select the desired FED.

If no FED IDs are listed, use the Discover command.

a Press the **FED ID** soft key.

b Select **Discover**.

The FED will respond with its unique address and ask whether to add the ID to the address list (“the register”).

c Press the **OK** key to add the address.

Only one FED can be discovered at a time, but up to four FED IDs can be stored in the register.

If you wish to remove a FED address from the list, do the following:

a Select the **FED ID** soft key

b Select **Delete**.

c Choose which FED address to delete, and then press the **OK** key.

The address is deleted.

7 To send a wake up command to the FED, press the WAKE UP soft key.

This brings the FED out of sleep mode, to the active state.

NOTE: The wake up command also can cancel or stop a command. (For example, if you sent a command to short the leads, sending a wake up command will cancel the short.)

8 Press the SEND soft key.

The command that you specified in step 4 – step 6 is sent and the test runs for the specified duration.

You have completed the test.

Automated tests

10

This chapter provides task-based instructions for using the automated tests. Topics discussed in this chapter include the following:

– “About the automatic tests” on page 146
– “Good pair check” on page 147
– “POTS closeout” on page 150
– “Wideband autotest” on page 152
– “Copper Expert” on page 155
– “Associating test records with test results” on page 156
– “Copper DSL test” on page 157
– “Series fault test” on page 159
– “Bridged tap test” on page 160
– “True length test” on page 161
– “RFL pretest” on page 163
– “Kick test” on page 164
– “Shield test” on page 165
– “Customizing test scripts” on page 166

About the automatic tests

The Auto Test features of the HST-3000 allow automatic testing (scripts). Features include the following:

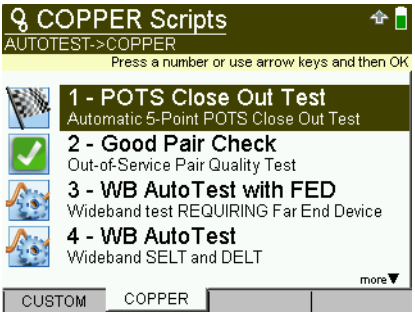
– Good Pair Check — Out-of-service pair quality check
– Closeout Test — A Bellcore (Telcordia) T.136 five-point test sequence
– Wide band auto test — Technology pair test with FED
– Copper Expert — Tests the pair and then provides advice on how to proceed.

To access the copper auto test scripts

1 Press the **Auto Test** navigation key.

2 Press the **Copper** soft key.

The Copper Scripts menu appears.



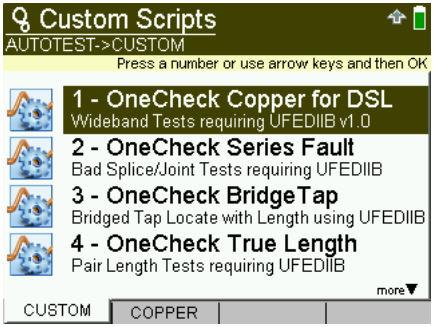
If you have purchased a UFEDIIB accessory, additional custom scripts are available.

To access the custom auto test scripts

1 Press the **Auto Test** navigation key.

2 Press the **Custom** soft key.

The Custom Scripts menu appears



Good pair check

The good pair check is an JDSU out-of-service pair quality test. The following procedure describes how to run a good pair check.

To run a good pair check

1. Connect the Tip (A), Ring (B), and Ground (E) leads to the line under test.
2. Access the Copper Scripts menu (see page 146).
3. Press the **2** key to select Good Pair Check.

   A list of configurations appears.

4 Select a configuration then do one of the following:

If you selected…	do this…
An existing configuration	– If you want to run the configuration as is, press the **1** key. Go to step 12. – If you want to edit the configuration, press the **2** key. – Select the item to change. – Press **1** to Accept Configs. Go to step 11.
New configuration	Go to step 6.

5 Select the technology type.

6 Select the cable type (AirCore, Jelly-Filled, and so on).

7 Select the cable gauge (22, 24, or 26).

8 Select the voltage termination (100K ohms or 1M ohms).

9 Edit the pass/fail threshold criteria for the tests.

Select **Continue** when finished.

10 Select the tests you want to include in the autotest.

With the test highlighted, press the **OK** key to toggle whether the test is included.

– Voltage (VDC, VAC T-G/R-G, and VAC T-R)

– Circuit Res (Resistance/Leakage)

– Soak

The “Soak” test is a Leakage resistance measurement that runs for a selected duration which compares the initial result with a final result. The purpose is to see if changes in the result are caused by the continuous testing of the circuit with the leakage mode ohm meter.

If changes occur, it is typically because of corrosion being broken down by the stress of the high voltage ohm meter.

- Opens
- Longitudinal Balance
- Power Influence
- Circuit Noise
- WB Impulse Noise
- WB Noise
- Load Coil
- Bridged Tap

When finished, press the **Accept** soft key.

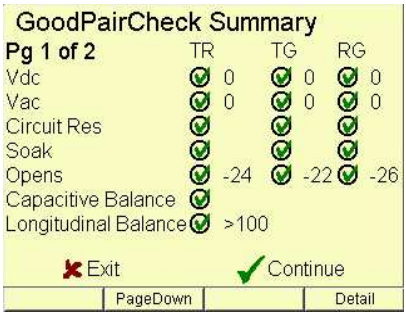
11 Do one of the following:

- Press the **1** key to save the configuration. Enter the file name for the configuration file then press the **OK** key.

  The HST-3000 saves the configuration and starts the test.

- Press **2** to run the test without saving the configuration.

As the test runs, the good pair check summary is displayed.



A check mark indicates pass; an “X” indicates fail, an exclamation point indicates a marginal result.

The test stops automatically when complete.

12 *Optional.* To view more detailed measurements, press the **Detail** soft key.

To learn what your results mean, see Chapter 12 “Interpreting Test Results”.

13 *Optional.* Press the **Save** soft key to save the results. (For information on associating saved test results with a test record, see “Associating test records with test results” on page 156.)

Performing a good pair check is complete.

POTS closeout

The POTS closeout test is a Bellcore (Telcordia) T.136 five-point test sequence. The following procedure describes how to run a closeout test.

To run a closeout test

1 Connect the Tip (A), Ring (B), and Ground (E) leads to the line under test.

2 Access the Copper Scripts menu (see page 146).

3 Press the **1** key to select POTS Close Out Test.

4 Select a configuration then do one of the following:

If you selected…	do this…
An existing configuration	– If you want to run the configuration as is, press the **1** key. Go to step 12. – If you want to edit the configuration, press the **2** key. – Select the item to change. – Press **1** to Accept Configs. Go to step 11.
New configuration	Go to step 5.

5 Enter the phone number for a tone test.

6 Enter the phone number for a quiet line.

7 Edit the threshold criteria for the following parameters:

- Current
- Narrowband loss
- Power influence
- Circuit noise
- Balance

Select **Continue** when finished.

8 Select the tests you want to include in the autotest, and then press the **Accept** soft key.

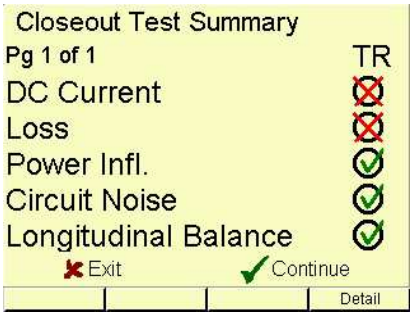
9 Perform one of the following:

- Press the **1** key to save the configuration. Enter the file name for the configuration file then press the **OK** key.

  The HST-3000 saves the configuration and starts the test.

- Press **2** to run the test without saving the configuration.

As the test runs, the status and results of the test are displayed.



A check mark indicates pass; an “X” indicates fail, an exclamation point indicates a marginal result.

The test stops automatically when complete.

10 *Optional.* To view more detailed measurements, press the **Detail** soft key.

11 To learn what your results mean, see Chapter 12 “Interpreting Test Results”. For information on saving your narrowband results in graphical form, see Chapter 11 “Saving results”.

12 *Optional.* Press the **Save** soft key to save the results. (For information on associating saved test results with a test record, see “Associating test records with test results” on page 156.)

Performing a closeout test is complete.

Wideband autotest

The wideband autotest is a technology pair test with a FED (or UFED or UFEDIIB). The following procedure describes how to run a wideband autotest.

To run a wideband autotest

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Copper Scripts menu (see page 146).

3 Press the **4** key to select Wideband AutoTest with FED.

4 Select a configuration then do one of the following:

If you selected…	do this…

An existing configuration	– If you want to run the configuration as is, press the **1** key. Go to step 12.
	– If you want to edit the configuration, press the **2** key.
	  – Select the item to change.
	  – Press **1** to Accept Configs. Go to step 11.

New configuration	Go to step 5.

5 Select the FED type (JDSU, Dynatel 3-wire).

6 Select the technology (ISDN, T1, ADSL, and so on).

7 Select the cable type (AirCore, Jelly-Filled, and so on).

8 Select the cable gauge.

9 Select a voltage termination (100K-ohms or 1M-ohm).

10 Edit the pass/fail threshold criteria for each test.

Select **Continue** when finished.

11 Select the tests you want to include in the autotest.

With the test highlighted, press the **OK** key to toggle whether the test is included.

- Voltage (VDC, VAC T-G/R-G, and VAC T-R)
- Circuit Res (Resistance/Leakage)
- Opens
- Longitudinal Balance
- Power Influence
- Circuit Noise
- WB Noise
- WB Impulse Noise
- Load Coil
- Bridged Tap
- Loop Resistance
- WB Loss

When finished, press the **Accept** soft key.

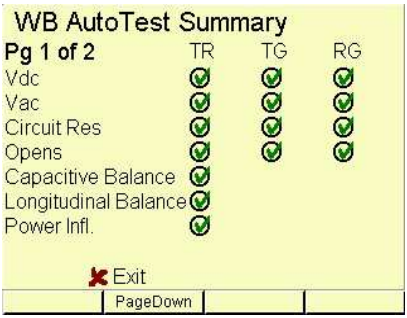
12 Do one of the following:

- Press the **1** key to save the configuration. Enter the file name for the configuration file then press the **OK** key.

  The HST-3000 saves the configuration and starts the test.

- Press **2** to run the test without saving the configuration.

As the test runs, the status and results of the test are displayed.



A check mark indicates pass; an “X” indicates fail, an exclamation point indicates a marginal result.

If the tests pass, dual ended tests start:

– TDR to open FED
– FED shorted to Ground/Earth
– TDR to shorted FED
– Resistive balance
– FED sends WB frequency sweep. The actual measured loss (AML) is compared to estimated measured loss (EML). The distance is calculated using the TDR open and TDR shorted tests. The result is reported as SL (swept loss)
– Wideband longitudinal balance (WBLB).

The test stops automatically when complete.

13 *Optional.* To view more detailed measurements, press the **Detail** soft key.

To learn what your results mean, see Chapter 12 “Interpreting Test Results”.

14 *Optional.* Press the **Save** soft key to save the results. (For information on associating saved test results with a test record, see “Associating test records with test results”.)

The wideband autotest is complete.

Copper Expert

The Copper Expert test is an optional autotest that runs a variety of measurements such as voltage, resistance, opens, and others to evaluate the pair and provide advice. For this test, it is recommended that you use a far end device (FED) at the far end of the circuit.

The following procedure describes how to run the Copper Expert test.

To run a wideband autotest

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Copper Scripts menu (see page 146).

3 Press the **5** key to select Copper Expert with FED.

4 Select a configuration:

If you want to…	do this…
run the configuration as is	press the **1** key
specify a different configuration	press the **2** key to specify the termination press the **3** key to specify the technology

5 Start the test by selecting **Run Test**.

As the test runs, the status and results of the test are displayed.

After running all tests, the status of the pair is displayed along with advice on how to proceed.

Associating test records with test results

A test record describes general information about a test. A test record can include work order number, technician name and ID, circuit ID, and location. You can associate a test record with up to two test result files.

For information about creating, modifying and deleting test records, see the *HST-3000 Base Unit User's Guide*.

To associate a test record with test results

1 After running the Auto Test, press the **OK** key to **Continue**.

2 Select **Associate w/Test Record**.

A list of available test records appears.

3 Select a record from the list.

The HST associates the test record with the selected result file.

Copper DSL test

This custom script is very similar to the Wideband Auto Test with FED but supports bonded DSL and requires the UFEDIIB accessory.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The WBTIMS option is required to run the WB Noise and WB Impulse tests.
- The BDCM-WB2 SIM is required to support VDSL.
- The TDR option is required for the Bridge Tap test.
- The TxIMP option is required for the WBSNR test.
- The far end device must be a UFEDIIB to support bonding.

Running the script

The following procedure describes how to run a Copper DSL test.

To run a Copper DSL test

1 Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.

2 Access the Custom Scripts menu.

3 Select **OneCheck Copper for DSL**.

4 Select a configuration:

If you want to…	do this…
specify a new configuration	press the **1** key go to step 5
use one of the default configurations	select a default and then select Run Test.

5 Select the FED type.

6 Select the technology.

7 Select the cable type.

8 Select the cable gauge.

9 Select a voltage termination.

10 Edit the pass/fail threshold criteria for each test.

After setting all of the thresholds, scroll down to **Continue** and then press OK.

11 Select the tests you want to include in the autotest.

With the test highlighted, press the **OK** key to toggle whether the test is included.

- Voltage (VDC, VAC T-G/R-G, and VAC T-R)
- Circuit Res (Resistance/Leakage)
- Opens
- Longitudinal Balance
- Power Influence
- Circuit Noise
- WB Noise
- WB NEXT
- WB Impulse Noise

- Load Coil
- Bridged Tap
- Loop Resistance
- WB Loss
- WB SNR
- WB Balance

When finished, press the **Accept** soft key.

12 Do one of the following:

- Press the **1** key to save the configuration. Enter the file name for the configuration file then press the **OK** key.

  The HST-3000 saves the configuration and starts the test.
- Press **2** to run the test without saving the configuration.

13 Select the UFEDIIB pair. The test begins.

As the test runs, the status and results of the test are displayed.

After running all tests, the status of the pair is displayed along with advice on how to proceed.

Series fault test

Series faults are bad splices and usually one side has a higher resistance than the other.Longitudinal balance, which runs to an open, won't clearly show there is an issue especially if the fault is far away.

The purpose of the Series Fault test is to:

- show the difference in the longitudinal balance when the UFED is under the strap state versus the short state
- show the resistive leg balance

These two results will clearly show if there is a series fault.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The copper measurement board (the “CAT” board) must be revision 510 or 912. These support the “green on ground” feature used with the RFL measurement to determine the leg balance. (To check the revision, press the System key, select Options/Revs/Copyright from the Tools menu, and then select the Revisions soft key.)
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a Series Fault test.

To run a Series Fault test

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck Series Fault**.
4. Select the UFEDIIB pair. The test begins.

As the test runs, the status and results of the test are displayed.

Bridged tap test

The Bridged Tap script runs a TDR test and then an Opens test toward a UFED to determine if the line under test has a bridged tap and the length of the tap.

This test uses the Copper Expert bridge tap detection sequence, where it sets the UFED into an open state, checks for a TR short and then runs an Auto TDR and uses the Auto Read results.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The TDR option is required.
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a Bridged Tap test.

To run a Bridged Tap test

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck Bridged Tap**.

   The test begins.

As the test runs, the status and results of the test are displayed.

True length test

The True Length test measures the actual, or “true” length of the pair using results from opens, TDR & loop resistance. Since any one of these measurements on its own may be misleading, the combination of the three gives a better result

for the length of the pair. Opens can be fooled by bridged taps, distance from loop resistance is highly affected by temperature & gauge. TDR is affected by propagation velocity.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The TDR option is required.
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a True Length test.

To run a True Length test

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck True Length**.
4. Select the UFEDIIB pair. The test begins.

As the test runs, the status and results of the test are displayed.

Confidence in length is based on the agreement of lengths from the three tests. If all three readings are close to each other, a high confidence factor is assigned; if there is a bigger spread, then a lower confidence factor is assigned.

In certain cases, the gauge of the tested pair can be determined. That result is displayed as a soft key. Possible results for gauge are ‘22’, ‘24’, ‘26’, ‘Mixed’ and blank. The TDR uses

Auto-gauge to determine the gauge, then displays it as a soft key. If you change the gauge, the Distance To Short result will be recalculated using this gauge.

The temperature defaults to the last used temperature, or 68.0 F. If you change the temperature, the Distance To Short will be recalculated, which may change the True Length and Confidence in length.

RFL pretest

The RFL PreTest script is a script designed to quickly identify if the line under test should be tested using a K-test or RFL test by evaluating the open circuit resistance and perhaps the closed loop resistance.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a RFL PreTest.

To run a RFL PreTest

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck RFL PreTest**.
4. Select the UFEDIIB pair. The test begins.

The test sets the UFED to open all leads, then measures leakage resistance across each pair. This determines whether there is a fault, and if so, attempts to determine the type of test to be performed.

If the leakage test isn't able to determine the type of test to recommend, the loop resistance test runs. It sets the UFED to strap all leads, then measure loop resistance.

As the test runs, the status and results of the test are displayed.

Kick test

The kick test measures voltage, circuit resistance, opens and longitudinal balance.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a Kick Test.

To run a Kick Test

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck Kick Test**.

   The test begins.

If the voltage test detects battery, a "open all" command is sent to the FED, and the test restarts.

Shield test

The Ground check test verifies whether the ground is good. Depending on the CAT version, this script will perform an RFL or a loop and leg resistive measurement. Both measurements shall require the UFED in order to strap the far end.

Constraints

In order to run this script as desired, the following items are required:

- The HST must be running software version 7.30.12 or higher.
- The copper measurement board (the “CAT” board) must be revision 510 or 912. These support the “green on ground” feature used with the RFL measurement to determine the leg balance. (To check the revision, press the System key, select Options/Revs/Copyright from the Tools menu, and then select the Revisions soft key.) If your unit has a different copper board, the test measures leakage resistance.
- The far end device must be a UFEDIIB.

Running the script

The following procedure describes how to run a Shield Test.

To run a Shield Test

1. Connect the Tip (A), Ring (B), and Ground (Earth) leads to the line under test.
2. Access the Custom Scripts menu.
3. Select **OneCheck Shield Test**.
4. Select the UFEDIIB pair. The test begins.

The test sets the FED to strap all leads, then runs either the RFL test, or leakage resistance.

Customizing test scripts

JDSU can customize test scripts for your particular solution, and provide training on the use of scripts. If you purchased custom scripts, you can access them by pressing the AutoTest navigation key.

NOTE:

For more information about purchasing customized test scripts, contact your JDSU sales representative.

Saving results

11

This chapter provides task-based instructions for saving results. Topics discussed in this chapter include the following:

– “About saving results” on page 168
– “Saving and clearing results” on page 168
– “Appending result files” on page 169
– “Saving graphs” on page 169
– “Saving screen captures” on page 170

About saving results

The HST allows you to save test results to a file, append a result file, and save results as graphics.

NOTE:

The save selections vary depending on the results category. For example, for Balance, you can Save or Save Append, but for Spectral, you can Save Graph or Save Screen Shot.

The following sections describe these features.

Saving and clearing results

The following procedures describe how to save results to a text file and clear test results on the HST display.

To save results to a file

1. From a result menu, press the **Results** soft key.
2. Select **Save Results**.
3. Enter a file name (up to 20 characters).
4. Press the **OK** key to save results to the file or press **Cancel** to exit.

   The test results are saved to the file. For information about managing files, see the *HST-3000 Base Unit User's Guide*.

To clear on-screen results

1. From any result menu, press the **Results** soft key.
2. Select **Clear Results**.

   The on-screen results are cleared.

Appending result files

The following procedure describes how to save result data to an existing file without overwriting the file.

To append a result file

1. From a result menu, press the **Results** soft key.
2. Select **Save Results Append**.
3. Enter a file name (up to 20 characters).

   You can enter the name of an existing file in which you want to save results, or you can enter a new file name.
4. Press the **OK** key to save results to the file.

   The results are saved to the file. For information about managing files, see the *HST-3000 Base Unit User's Guide*.

Saving graphs

If you want to save a graph or trace in text format, you can use the Save Graph feature. This is useful if you want to reload it to the screen (such as comparing traces) or to import the file into a spreadsheet.

To save graphs or traces

1. From a graph or trace result menu, press the **Results** soft key.
2. Select **Save Graph** or **Save Trace**.
3. Enter a file name (up to 20 characters).

   You can enter the name of an existing file in which you want to save results, or you can enter a new file name.
4. Press the **OK** key to save results to the file.

The results are saved to the file. For information about managing files, see the *HST-3000 Base Unit User's Guide*.

Saving screen captures

You can save results for the following tests in graphical form:

– Narrowband loss
– Wide band loss
– TDR
– Spectral noise
– Wideband crosstalk

To save test results in graphical form

1 Press the **Results** soft key.

2 Select **Save Screen Capture**. A dialog box appears for entering a file name.

3 Type the name of a file, or press the **OK** button to accept the default.

The HST-3000 saves the graphic in BMP format.

You can retrieve the files from the HST-3000 by connecting through a serial port. Table 12 lists the locations of the graphics.

Table 12 Location of graphics

Test type	Location
TDR	CUST\USER\RESULTS\COPPER\TDR\
Spectral analysis	CUST\USER\RESULTS\COPPER\
Narrowband loss	CUST\USER\RESULTS\COPPER\
Wide band loss	CUST\USER\RESULTS\COPPER\

For more information about managing files, see the *HST-3000 Base Unit User's Guide*.

Interpreting Test Results

12

The information in this chapter is intended to help you understand and interpret test results. Topics discussed in this chapter include the following:

– “AC voltage” on page 174
– “DC voltage” on page 174
– “DC current” on page 175
– “Resistance” on page 176
– “Opens” on page 177
– “PI/Noise/Balance” on page 178
– “TDR” on page 179
– “Loss” on page 182
– “Load coils” on page 182
– “POTS dialer” on page 183
– “WB TX/RX” on page 184
– “WB Noise” on page 184
– “Impulse Noise” on page 184
– “RFL” on page 185

AC voltage

The following section describes the AC voltage result.

Question Why do you measure AC volts?

Answer You measure AC volts to:

- detect the presence of hazardous voltage.
- measure induced AC current from power lines and other AC sources.
- measure ringer voltage level.

AC voltage results on Tip to Ring should be 0.0 volts. Tip to Ground and Ring to Ground should be equal to each other. Anything else indicates AC signal interference and/or an unbalanced line.

Example If you get an AC voltage reading from Tip to Ground of 5 volts and a reading from Ring to Ground of 15 volts, then either Tip is open or Ring is longer. This will also be indicated by noise on the loop.

Application Ring voltage level can be checked by having the CO ring back on the line. Results should be either 85 volts (older switches) or 105 volts (newer switches).

DC voltage

The following section describes the DC voltage result.

Question Why do you measure DC volts?

Answer You measure DC volts to:

– detect and measure CO/exchange battery current.

– detect crossed battery conditions.

To measure DC volts, remove the line battery and measure Tip and Ring to Ground. It should be < 3.0 volts; anything else indicates crossed battery that inhibits digital signals.

Example With the battery removed, you get a measurement on Tip to Ground of 15 volts. This indicates there may be an open in the insulation drawing current from another pair.

Application To check for span/battery voltage, measure Tip to Ring across several pairs. On good lines Tip to Ring will be 48–52 volts, Tip to Ground will be < 5 volts, and Ring to Ground will be -48–52 volts.

DC current

The following section describes the DC current result.

Question Why do you measure DC current?

Answer You measure DC current to verify if enough current is present to operate equipment including the phone or caller ID boxes.

DC current on Tip to Ring should be ≥ 23 mA at the NID. Anything less will not allow for differences in temperature and phone equipment will not operate during extremes.

Example In January you measure 21 mA from an aerial cable at the NID and there are no problems. In July, the customer complains, so you test the line and measure 17 mA. The heat has increased resistance and lowered the current.

Application The 23 mA threshold covers most temperature extremes.

Resistance

The following section describes the resistance result.

Question Why do you measure resistance?

Answer You measure resistance to find faults (resistive and ground faults).

Resistance should be measured with the battery disconnected, so that the resistance of the battery itself doesn't affect the measurements.

The typical resistance is > 3.5 MΩ. Lower values indicate a short or ground fault

Example If you get a measurement on Tip to Ring of 3.5 MΩ, 3.5 MΩ on Ring to Ground, 5 kΩ on Tip to Ground, there is a ground fault from Tip.

Application Loop resistance is measured with the pair short circuited (shorted) at one end, so a much lower resistance value is measured, as the current can readily flow down one lead and easily back up the other across the short. This “loop resis-

tance" measurement is often required to qualify HICAP (high-capacity) circuits such as ISDN, HDSL and T1 with values approximating 700 or 800 Ω.

Resistance is measured not only across Tip (A) to Ring (B), but also from Tip (A) to Ground (Earth) or Ring (B) to Ground (Earth). Resistance is also measured from one lead to Ground to check for shorts to the shield and other ground references, indicating a fault on one lead of the wire pair. Resistance measurements made to Ground are used to compare the resistance value of one lead to the other, to see how much difference exists in the resistance of one lead compared to the other. It is important for both leads to be nearly the same (resistive balance), and a difference of more than 3 percent is usually considered unacceptable.

Distance can be determined by shorting the pair at the far end, entering the cable gauge and temperature, pressing the **Display** soft key, and then selecting **Distance**.

Opens

The following section describes the opens result.

Question Why do you measure opens (capacitance)?

Answer You measure opens to:

– measure total electrical loop length (includes length of bridged taps).

– find wet sections, bridged taps or open faults.

Opens/Capacitance: < 3% difference between Tip and Ring values indicate an acceptably balanced loop. Anything greater indicates an unbalanced line or open fault, which inhibit digital signals.

You can also compare the distance from the Opens measurement to a resistive distance measurement, and determine the presence of a bridged tap by the difference in the distances.

Example Two loops in the same bundle display different loop lengths. Use a known good loop to determine capacitance, then run the opens again to determine the length of the bridge tap or location of the fault. Verify with the TDR.

Application Measure multiple vacant pairs by attaching one lead to Ground and using the other to the Tip of each vacant conductor. (Battery should be removed) Compare the distance for each for consistency.

PI/Noise/Balance

The following section describes the power influence/noise/balance result.

Question Why do you measure power influence, noise (also called metallic noise), and balance?

Answer You measure power influence, noise, and balance to:

– measure the quality of the pair: a measurement of the degree to which the Tip lead is electrically the same as the Ring lead.

  The more each lead is electrically identical (capacitance, inductance, impedance), the better the pair will resist induced noise. If they do not cancel induced noise equally, the difference is realized as unwanted current, or metallic or mutual noise. If the imbalance of the leads is too great, the customer would hear noise.

– look for grounds or crossed battery or other faults that make one lead electrically different than the other.

The balance result should be >60 dB. Anything less indicates electrical differences between Tip and Ring that can lead to noise and other signal problems.

Example If you get a balance of 50 dB, the pair quality is too low as it should mitigate 60 dB. This would indicate some imbalance in the quality of each lead and reduced noise immunity. Higher PI values (of 75 or more) would result in audible or interfering noise across the leads.

If power influence is 80 and noise is 20 (mutual, or metallic noise measured T-R), the pair is effectively cancelling out 60 dB of the 80 dB of the power influence

Application Balance is PI minus Noise. Noise should be < 20 dBrnC and PI should be < 80 dBrnC. When PI is too low (the loop is short, or doesn't parallel power lines), use longitudinal balance test to do measurements. The HST measures longitudinal balance by exciting the line with its own signal (when PI is too low).

TDR

The following section describes the TDR result.

Question Why do you use a TDR (Time Domain Reflectometer)?

Answer You use a TDR to identify and locate buried splices, shorts and low resistance faults, opens, bridge taps, load coils, and wet cables.

Velocity of Propagation (VoP) is the speed of the TDR signal travelling down the wire pair relative to the speed of light. The HST uses this value to convert reflections to distance. To ensure an accurate distance calculation at the cursor, the VoP should match the cable gage and fill. The default value is appropriate for 24–26 AWG (4–5 mm) telco aerial cable and provides sufficient accuracy in most situations.

Example Figure 8 shows a sample TDR graph.

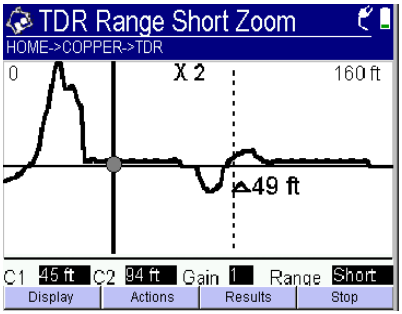


Figure 8 Sample TDR graph

Application A TDR transmits an electronic pulse that is reflected back to the test set and analyzed (think of it as Sonar on copper). The shape of the reflection is determined by the impairment on the line. In general, opens are indicated by an upward trace, and shorts by a downward trace. Any impairment that degrades and weakens the signal strength will create a downward bump in the trace. Any impairment which creates a strong signal reflection creates a upward bump in the trace (such as the open end of a loop). Basic DVOM and capacitance meters can also determine impairments, whereas the TDR is used to locate the faults.

Interpreting TDR performance

The performance of a TDR can vary due to many factors. These include:

– the variations of any given cable pair at the time of test
– the TDR settings used
– the individual interpretation of one user versus another

To illustrate, when using the HST's TDR to look for the open or shorted end of the pair under test on two different gauges of cable, the following performance is expected.

For AWG (American Wire Gauge) 26 which is approximately the same as 0.4mm European gauge, the expected performance is to be able to see the open or shorted end of the cable at 11,000 feet or 3,352 meters.

For AWG (American Wire Gauge) 22 which is approximately the same as 0.63mm European gauge, the expected performance is to be able to see the open or shorted end of the cable at 24,000 feet or 7,315 meters.

Thus, the wire size or gauge can impact the TDR performance. The larger the wire size, the less the TDR's signal, or pulse, is attenuated. Since the TDR's pulse is subject to the attenuation of the cable (both as it travels out, and the reflection from the end is subject to the attenuation of the cable as it travels back), the larger the wire diameter, the lower the reflection attenuation is for either direction.

The performance expectations above assume that the cable you are using is of a single gauge that has no faults, loads, or bridged taps and that you have selected the proper VP, Pulse Width, Gain, and Zoom.

The examples above were not performed in TVG (Time Varying Gain) mode.

Loss

The following section describes the loss result.

Question Why do you measure loss?

Answer You measure loss to determine the degree to which a signal loses strength as it travels down the pair. A weaker signal affects the quality of a call, and the customer complains about call quality.

A 1004 Hz signal should not exceed a loss of < -8.0 dBm.

Example If your current is good at 30 mA, but 1004 loss is -9 dBm, then there could be an improper load or too much cable on the circuit. A large amount of loss can result in dialing, caller ID, or fax problems, also high frequency voices may not be clear.

Application The POTS voice passband is 300 Hz to 3300 Hz. A tone at a 0 dBm and 1004 Hz is sent from the CO and measured at the premises (or other access point) to determine if loss is acceptable. Sometimes 404 Hz, 1004 Hz and 2804 Hz loss is measured to ensure attenuation is constant over the POTS frequency range.

Load coils

The following section describes the load coil result.

Question Why do you check for load coils?

Answer You check for load coils to ensure there are no load coils present on a digital line (such as ADSL or ISDN).

Example The POTS service test is fine but the ADSL signal cannot be detected at the NID. The test set indicates 2 load coils on a 15 kft loop. In a normal loading scheme, the first one will be 3 kft from the CO and the second will be 9 kft from the CO. The TDR can be used to verify the location of the loads. Loads are used to improve POTS over long loops, but inhibit digital signals.

Application Load coils are required on most loops 18 kft or longer to ensure voice quality. Load coils must be evenly spaced starting at 3 kft from the CO and placed at 6 kft intervals thereafter, with at least 2,000 feet between the last load coil and the customer premises. Load coils must be removed on digital circuits.

POTS dialer

The following section describes the POTS dialer.

Question What do you use the POTS dialer for?

Answer You use the POTS dialer to:

- place calls to drop battery for opens testing, or to establish a quiet termination for balance and noise tests.
- place POTS calls or check caller ID.

WB TX/RX

The following section describes wideband transmit and receive tones.

Question What do you use wideband tones for?

Answer You use wideband tones to check cable performance (attenuation) at higher frequencies used for digital services.

WB Noise

The following section describes wideband noise.

Question Why do you measure wideband noise?

Answer You measure wideband noise to determine the amount of noise in a frequency range used for digital services such as BRI or ADSL.

Impulse Noise

The following section describes impulse noise.

Question Why do you measure impulse noise?

Answer Impulse noise is used to check for the presence of noise spikes that disrupt digital services.

RFL

The following section describes the RFL.

Question Why do you use an RFL?

Answer You use an RFL to find resistive faults such as poor splices, water, shorts, and battery crosses by cable damage (caused by rodents, the weather, etc.).

Maintenance and Troubleshooting

13

This chapter describes how to maintain your unit and identify and correct problems related to copper testing. Topics discussed in this chapter include the following:

– “About troubleshooting” on page 187
– “General test problems” on page 188
– “Copper test problems” on page 188

About troubleshooting

If you are having trouble with the HST-3000, the following sections describe common problems and solutions. You should verify whether your problem is listed here before contacting technical assistance. There are two sections included:

– General
– Copper tests

General test problems

The following section addresses questions about testing in general.

Issue

Inconsistent test results.

Resolution

Verify that your test leads are good and are connected properly for the test you are performing.

Copper test problems

The following section addresses questions about Copper testing.

Issue

The Tip-Ring voltage is reading negative.

Resolution

The Tip and Ring test leads may be swapped. Check your test leads to verify that they are hooked up properly.

Issue

I am performing an Opens test. The mutual value looks good, but the Tip and Ring values are really short.

Resolution

Verify the ground. The module must be grounded to the same ground as the pair under test.

Specifications

A

This appendix contains specifications for the copper testing option. Topics discussed in this appendix include the following:

– “Copper measurement specifications” on page 190
– “Transmission impairment specifications” on page 192
– “RFL specifications” on page 194
– “K-Test specifications” on page 194
– “Spectral measurement specifications” on page 195
– “TIMS filter specifications” on page 196
– “WB2 specifications” on page 197

About the copper specifications

Some of the specifications vary, depending on the version of the copper measurement board. Those variances are noted in the following tables. To view the version of copper measurement board in your unit, go to: SYSTEM->OPTIONS/REVS/COPYRIGHT->REVISIONS.

Copper measurement specifications

Table 13 provides the specifications for the copper measurements.

Table 13 Copper measurement specifications

Result	Range	Res.	Accuracy
AC Voltage	0 to 99.9 VAC rms	0.1 VAC	1 % ± 0.5 VAC
	100 to 200 VAC rms	1.0 VAC	3 %
DC Voltage	(±) 0 to 99.9 VDC	0.1 VDC	1 % ± 0.5 VDC
	(±) 100 to 285 VDC	1.0 VDC	3 %
Resistance with CO Voltage	0 to 9999 Ω	1 Ω	1 % ± 5 Ω
	0 to 9999 Ω	100 Ω	1 % ± 50 Ω
	10 k to 99.9 k Ω	100 Ω	1 %
	100 k to 999.9 k Ω	100 Ω	3 %
	1 M to 9.9 M Ω	100 k Ω	5 %
	10 M to 99.9 M Ω	1 M Ω	15 %
	100 M to 999 M Ω[a]	1 M Ω	20 %
DC Current	(±) 0 to 90 mADC	0.1 mADC	1 % ± 0.5 mADC
Opens (Capacitance)	0 to 3 kft (0 to 45 nF)	1 ft	1 % ± 3 feet
	3 to 10 kft (45 to157 nF)	1 ft	3 %
	10 to 50 kft (157 to 786 nF)	1 ft	5 %
	50 to 100 kft (0.78 to 1.6 uF)	1 ft	10 %
Power Influence	40 to 120 dBnrc	1 dB	2 dB
Noise	0 to 50 dBnrc	1 dB	2 dB

Table 13 Copper measurement specifications (Continued)

Result	Range	Res.	Accuracy
Longitudinal Balance	28 to 75dB 76 to 95dB	1dB 1dB	2dB (not specified)
TDR @ Vp = 0.667[b]	10 to 2kft 100 to 10kft 400 to 20kft	2.6ft 10ft 21ft	0.5% of range 0.5% of range 0.5% of range
Short range TDR @ Vp = 0.66			
SRHR-pulse	10 to 1000ft	0.4ft	0.2% of range
SRHR-step	10 to 1000ft	0.4ft	0.2% of range
Load Coil	Up to 27,000ft	up to 5	± 1
RX Tones			
amplitude	-40 to +10dBm	0.1dB	± 0.5dB
frequency	200 to 7000Hz	1Hz	± 1Hz
impedance	600 wet, 600/900 dry, Bridged 600/900 Ω		
TX Tones			
amplitude	0 to -20dBm	1dB	± 0.5dB
frequency	200 to 5000Hz 5000 to 7000Hz	1Hz 1Hz	± 1Hz ±.75dB, ± 1Hz
impedance	600/900 Ω		
WB Noise			
no filter	10 to -60dBm	0.1dB	± 2dB
G filter	10 to -65dBm	0.1dB	± 2dB
F or E filter	10 to -70dBm	0.1dB	± 2dB
Impulse Noise			
G filter	45 to 100dBrn	1 count	± 2dB threshold
F filter	40 to 100dBrn	1 count	± 2dB threshold
E filter	35 to 100dBrn	1 count	± 2dB threshold
WB TX Tones			
amplitude	+5 to -10dBm -10 to -20dBm	1dB	± 0.5dB ± 1dB
frequency	10kHz to 2.2 MHz	1Hz	0.05%
impedance	100/135 Ω		

Table 13 Copper measurement specifications (Continued)

Result	Range	Res.	Accuracy
WB RX Tones			
amplitude	+10 to -70 dBm	0.1 dB	± 2 dB
frequency	10 kHz to 2.2 MHz	100 Hz	± 200 Hz to -40 dBm
impedance	100/135 Ω		

a. valid for HST-000-500, -450, and -233 boards; not specified for the HST-000-217 board.
b. TDR performance can vary depending on cable gauge. See "Interpreting TDR performance" on page 181.

Transmission impairment specifications

Table 14 provides specifications for the Transmission impairment (TIMS) measurements.

Table 14 Transmission impairment measurement specifications

Result	Range	Res.	Accuracy
Noise and Noise w/tone			
level	+10 to -60 dBm	0.1 dB	± 2 dB
frequency	100 to 4950 Hz per filter		
filters	C-message, Psophometric, Channel, or No filter		
holding tones	820 or 1020 Hz @ +3, 0, or -10 dBm		
notch filters	820 or 1020 Hz		
termination	900/600 Ω and Bridge		
SNR			
level	0 to 50 dB		± 2 dB
frequency	820 and 1020 Hz		
filter	C-message, Psophometric, Channel, or No filter		
termination	900/600		

Table 14 Transmission impairment measurement specifications (Continued)

Result	Range	Res.	Accuracy
WB SNR			
level	0 to 50 dB		± 2 dB
filter	E, F, G, and none		
termination	75/100/120/135 Ω, and Bridge		
Impulse noise and Impulse noise w/tone			
threshold level	-50 to 0 dBm	0.1 dB	± 2 dB
frequency	100 to 4950 Hz per filter		
filters	C-message, Psophometric, Flat, Optional, or No filter		
holding tones	820 or 1020 Hz @ +3, 0, or -10 dBm		
notch filters	820 or 1020 Hz		
termination	900/600 Ω and Bridge		
Return Loss			
level	0 to 50 dB	1 dB	± 2 dB
frequency	200 to 5000 Hz	12 Hz (50 Hz for sweep)	
impedance	900/600 Ω		
WB Return Loss			
level	0 to 50 dB	1 dB	± 2 dB
frequency	10 to 2000 kHz	1000 Hz (19 kHz for sweep)	
termination	100/135 Ω		
NEXT			
level	0 to 50 dB at 500 kHz		± 2 dB at 1 MHz and crosstalk of 40 dB
frequency	10 to 2000 kHz		
termination	100/135 Ω		
FEXT			
level	0 to 50 dB at 500 kHz		± 2 dB at 1 MHz and crosstalk of 40 dB
frequency	10 to 2000 kHz		
termination	100/135 Ω		

RFL specifications

Table 15 provides specifications for the RFL (Resistive Fault Locator) measurements. These specs apply to single and separate pair RFL.

Table 15 RFL measurement specifications

Result	Range	Accuracy
Fault Size	0 Ω to 10 MΩ [a] 0 Ω to 20 MΩ[b]	
Loop Resistance	0 Ω to 7000 Ω	
Resistance to fault at 25° C	RTS[c] 1 Ω to 99 Ω	0.1% of RTS ±0.1 Ω ±RF/10 MΩ ±0.1% of RTF[d]
	RTS 100 Ω to 999 Ω	0.20% of RTS ±0.1 Ω ±RF/3.50 MΩ

a. For Copper boards HST-000-217, -233, and -450.
b. For Copper board HST-000-500.
c. RTS. Resistance to strap.
d. RTF. Resistance to fault.

K-Test specifications

Table 16 provides the specifications for the K-Test measurement.

Table 16 K-Test measurement specifications

Distance	Fault Size	Accuracy
max 7,000Ω	max 20 MΩs	RTF (resistance to fault) accuracy is 3% or +/- 3 ohms whichever is greater

Spectral measurement specifications

Table 17 provides specifications for the spectral measurements.

Table 17 Spectral measurement specifications

Result	Range
Dynamic range	-80 dBm to +10 dBm
Span Ranges	Wideband: 2 kHz to 1920 kHz 4 kHz to 3840 kHz Narrowband: DC to 1500 Hz DC to 6144 Hz
Frequency resolution	Wideband: 2 kHz or 4 kHz Narrowband: 1.5 Hz or 6 Hz
Terminations	Wideband: 75 Ω, 100 Ω 120 Ω, 135 Ω, or Bridge Narrowband: 600 Ω, 900 Ω or Bridge

TIMS filter specifications

Table 18 provides information about filters you can apply when performing voice band (narrowband) or wideband transmission impairment measurement tests.

Table 18 Narrowband and wideband filter ranges

Filter	Range	Specification	Measurement
Narrowband			
C-message	690 Hz to 3000 Hz	IEEE Standard 743	Impulse Noise Noise, SNR, PI
Channel	275 Hz to 3450 Hz	ITU-T O.41	Noise SNR
Psophometric	530 Hz to 2000 Hz	ITU-T O.41	Impulse Noise Noise, SNR
No Filter	100 Hz to 4950 Hz		
Flat Filter	200 Hz to 3900 Hz	ITU-T O.71	Impulse Noise
Optional Flat Filter	600 Hz to 3000 Hz	ITU-T O.71	Impulse Noise
1020 Hz Notch	860 Hz to 1180 Hz	ITU-T O.132	Impulse Noise Noise, SNR
820 Hz Notch	690 Hz to 1000 Hz	ITU-T O.132	Impulse Noise Noise, SNR
Wideband			
No Filter	5 kHz to 2.5 MHz	N/A	SNR
No Filter	5 kHz to 4 MHz	N/A	Noise
E Filter	1 kHz to 50 kHz	IEEE Standard 743	Impulse Noise Noise SNR
F Filter	4.9 kHz to 245 kHz	IEEE Standard 743	
G Filter	20 kHz to 1.1 MHz	IEEE Standard 743	

Table 18 Narrowband and wideband filter ranges (Continued)

Filter	Range	Specification	Measurement
G2 Filter	20 kHz to 2.2 Mhz	N/A	Noise, SNR
G.1M	5 khz to 348 khz	N/A	
G.2M	5 khz to 690 khz	N/A	
E1	50 kHz to 3 MHz	N/A	
U0	25 kH to 138 kHz	N/A	
D1	138 kHz to 3.75 MHz	N/A	

WB2 specifications

This section provides specifications for the optional WB2 features.

WB2 measurements

Table 19 provides the specifications for the WB2 measurements.

Table 19 WB2 Measurement Specifications

Result	Range	Res.	Accuracy
RX Tones	25 kHz to 17.6 MHz	100 Hz	± 1000 Hz
	17.7 MHz to 30 MHz	100 Hz	± 1600 Hz
0 to -5 dBm	25 kHz to 50 kHz	1 dB	± 2 dB
0 to -69 dBm	51 kHz to 100 kHz	1 dB	± 1.5 dB
+15 to -69 dBm	100 kHz to 30 MHz	0.1 dB	± 1 dB
-70 to -90 dBm	25 kHz to 30 MHz	0.1 dB	± 2 dB
TX Tones	25 khz to 30 MHz	1000 Hz	± 0.01%
0 to -5 dBm	25 kHz to 50 kHz	1 dB	± 2 dB
0 to -40 dBm	51 kHz to 100 kHz	1 dB	±1.5 dB
+14 to -40 dBm	100 kHz to 9.99 MHz	1 dB	±1.0 dB
+14 to -40 dBm	10 MHz to 30 MHz	1 dB	±1.5 dB

Table 19 WB2 Measurement Specifications (Continued)

Result	Range	Res.	Accuracy
WB Noise			
with G filter	15 to -50 dBm	0.1 dB	± 1 dB
	-51 to -85 dBm	0.1 dB	± 2 dB
w/ other filters	15 to -50 dBm	0.1 dB	± 1 dB
	-51 to -75 dBm	0.1 dB	± 2 dB
Impulse Noise with any filter	32 to 105 dBrn (-58 to +15 dBm)	1 dB	± 2 dB threshold
Return Loss		0.1 dB	
Freq. Range	50 kHz to 10 MHz		± 1.5 dB for results between 0 and 10 dB ± 2.5 dB for results between 11and 25 dB
TX Range	0, 5, and 10 dB		
Termination	100/120/135 Ω		
NEXT			
Freq. Range	25 kHz to 30 MHz	1000 Hz	
Level	0 dB to 80 dB	0.1 dB	± 2 dB at crosstalk
Termination	100/135 Ω		0 to 50 dB
SNR			
Freq. Range	25 kHz to 30 MHz		
Level	0 dB to 50 dB	0.1 dB	± 2 dB for results between 5 dB and 40 dB
Termination	100/135 Ω		
Balance	0 dB to 60 dB	1 dB	± 2 dB

WB2 Spectral measurement specifications

Table 20 provides specifications for the WB2 spectral measurements.

Table 20 WB2 Spectral measurement specifications

Frequency Rage	Resolution	Level Range
20 kHz to 7.5 MHz	2.156 kHz	+15 to -90 dBm, -28 to -150 dBm/Hz
20 kHz to 17.3 MHz	4.3125 kHz	+15 to -90 dBm, -28 to -147 dBm/Hz
17.6 MHz to 30 MHz	4.3125 kHz	+15 to -90 dBm, -28 to -147 dBm/Hz
20 kHz to 30 MHz	8.625 kHz	+15 to -90 dBm, -29 to -144 dBm/Hz
Terminations		100 Ω, 135 Ω

WB2 TIMS filter specifications

Table 21 provides information about filters you can apply when performing wideband2 transmission impairment measurement tests.

Table 21 Wideband2 filter ranges

Filter	Lower 3dB	Upper dB	Measurement	Specification
No Filter	50 kHz	35 MHz	Impulse	None
G Filter (ADSL)	50 kHz	1.1 MHz	SNR Noise Impulse	IEEE Std 743-1995 Complies above 50 kHz
G2 Filter (ADSL2+)	20 kHz	2.2 MHz	SNR Noise Impulse	None
J-20K8 Filter (VDSL2-8)	25 kHz 25 kHz 25 kHz	8.5025 MHz 8.5025 MHz 8.5025 MHz	SNR Noise Impulse	None
J-20K12 Filter (VDSL /VDSL2-12)	25 kHz 25 kHz	12.0025 MHz 12.0025 MHz	SNR Noise	None
J-20K17 Filter (VDSL2-17)	25 kHz 25 kHz	17.0025 MHz 17.0025 MHz	SNR Noise	None
J-20K30 Filter (VDSL2-30)	25 kHz 25 kHz	30.0025 MHz 30.0025 MHz	SNR Noise	None
J-640K17 Filter	640 kHz 640 kHz 400 kHz	17.6 MHz 17.6 MHz 17.6 MHz	SNR Noise Impulse	None
J-17M25 Filter	17.6 MHz 17.6 MHz 17.6 MHz	25 MHz 25 MHz 25 MHz	SNR Noise Impulse	None
J-17M30 Filter	17.6 MHz 17.6 MHz 17.6 MHz	30 MHz 30 MHz 30 MHz	SNR Noise Impulse	None

Table 21 Wideband2 filter ranges (Continued)

Filter	Lower 3dB	Upper dB	Measurement	Specification
J-25M30	25 MHz	30 MHz	SNR	None
Filter	25 MHz	30 MHz	Noise	
	25 MHz	30 MHz	Impulse	

Glossary

C

CO — Central Office.

Crosstalk — The interference caused by signals on adjacent circuits in a network.

CPE — Customer Premise Equipment. Devices or equipment that the customer provides to interface with the telco.

D

Delay — A contributing measure of the carrying capacity of a link. Delay indicates how long it takes bits to find their way through a network.

Digital — Having only discrete values, such as 0 or 1.

DTMF — Dual Tone Multi-Frequency. A voice-band tone-based method of signaling.

DVOM — Digital Volt/Ohm Meter.

E

Echo — The reflecting of a signal back to its source due to a variety of reasons.

F

F — Far End Device. A test accessory used for pre-qualification and troubleshooting of VDSL and ADSL2+ networks.

G

Gnd — Ground.

J

Jelly — icky pik. Cable with a jelly-like substance used to repel water. Generally used in buried cable.

L

LAN — Local Area Network. A limited distance (typically under a few kilometers or a couple of miles) high-speed network (typically 4 to 100 Mbps) that supports many computers.

LED — Light Emitting Diode. The lights indicating status or activity on electronic equipment.

Load Coil — A device used on local loops (or access lines) in North America, particularly within the United States, to extend their reach. Outside of the US, loading coils are rare and extended distances are achieved by creative use of mixed wire gauges.

Loopback — A diagnostic test that returns the transmitted signal back to the sending device after is has passed through a network or across a particular link. The returned signal can then be compared to the transmitted one. The discrepancy between the two help to trace the fault.

M

Mutual — A reading across Tip and ring.

P

Physical Layer — Handles transmission of raw bits over a communication channel. The physical layer deals with mechanical, electrical, and procedural interfaces.

Physical Port — A physical or logical connection to a computer or test instrument through which data flows. An Ethernet port, for example, is where Ethernet network cabling plugs into a computer.

PIC — aircore PIC. Plastic coated cable used for aerial plant.

Pulp — woodpulp. Older cable type with woodpulp as insulation material. Used primarily in Alaska.

R

RFL — Resistive Fault Locator

RS-232 — An EIA standard which is the most common way of linking data devices together.

T

TDR — Time domain reflectometer.

W

WAN — Wide Area Network. A data communications network that spans any distance and is usually provided by a public carrier.

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