HST-3000

T1 Testing

User's Guide

JDSU

HST-3000

T1 Testing

User's Guide

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Ordering information This guide is a product of JDSU's Technical Information Development Department, issued as part of the HST-3000. The catalog number for a printed user's guide is ML-058501. The catalog number for a USB stick containing the manual in electronic form is ML-060301.

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.

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.

Contents

About This Guide

Topics discussed in this chapter include the following:

Purpose and scope

The purpose of this guide is to help you successfully use the features and capabilities of the HST-3000 with the T1 testing capability. This guide includes task-based instructions that describe how to configure, use, and troubleshoot the HST-3000 for T1 (DS1) physical transmission testing.

This guide also includes information about the following optional testing features:

– T1 DDS Testing
– VF (PCM) Analysis
– PCM Signaling Analysis
– ISDN PRI Testing

Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the HST-3000 T1 testing option efficiently and effectively. We assume that you have basic computer experience and are familiar with basic telecommunications safety, concepts, and terminology.

Screen shots are provided for reference only; depending on a number of variables they might not reflect what appears on your test instrument.

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 301.

HST-3000 T1 testing user's guide

This guide is an application-oriented user's guide containing information about using the HST-3000 T1 testing option to perform test operations on T1 and fractional T1 (FT1) lines. Also included is information about using the following optional test features: T1 DDS, VF (voice frequency), Signaling, and ISDN PRI. For information about purchasing an optional test feature, contact your JDSU sales representative.

This guide includes an overview of testing features, instructions for using the HST-3000 in monitor, terminate, and drop and insert test operations, and test result descriptions. This guide also contains specifications and contact information for JDSU's Technical Assistance Center (TAC). 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 240-404-2999 301-353-1550	(1-866-228-3762) 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

When applicable, this guide uses the conventions and symbols described in the following tables.

Table 2 Typographical conventions

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

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

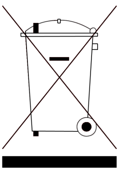
	This symbol represents a caution.
	This symbol represents a risk of electrical shock.
	This symbol represents a risk of explosion.
	This symbol represents a Note indicating related information or tip.
	This symbol, located on the equipment, battery, or packaging indicates that the equipment or battery 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 basic information about the HST-3000 T1 testing option. Topics discussed in this chapter include the following:

Overview and options

An HST-3000, with T1 testing capability, allows you to perform the test operations necessary to install, maintain, and troubleshoot T1 and Fractional T1 circuits. Test operations include in-service monitoring, bit error rate testing (BERT), loopback testing, and drop and insert testing.

You can expand your testing capability by purchasing additional T1 testing options. All test operations using the T1 options are performed from a T1 access point. The options available for purchase are as follows:

Table 6 T1 testing options

Option	Description	Order Number
T1 DDS Testing	This option allows you to perform monitor and BERT test operations on a DDS channel from a T1 access point. This option supports alternating and latching loop codes.	HST3000-T1DDS
Voice Frequency (PCM) Analysis	This option allows you to test voice-grade and data-grade VF circuits. On a specified DS0 channel, you can measure standard tone characteristics (frequency, tone level, and DC offset), test for spectral noise, and perform a three-tone sweep test. Additionally, you can configure signaling bits and listen to audible output from the HST's loudspeaker.	HST3000-PCMTIMS

Table 6 T1 testing options (Continued)

Option	Description	Order Number
PCM Signaling Analysis	With this option, you can monitor both directions of a user-specified DS0 channel on a T1 line for call activity. Additionally, you can use the HST to emulate the CPE (PBX) or CO sides of a network to originate or terminate a call over a user-specified DS0 channel on a duplex T1 circuit. The HST can display characteristics of each received DTMF, MF, DP digit (DP digits on Loop Start and Ground Start trunks only), and signaling event.	HST3000-PCMSIG
ISDN PRI Testing	With this option, you can install and maintain ISDN PRI services over T1 interfaces. You can place, receive, and analyze calls, test data services using BERT analysis, test voice services using a microphone/speaker audio headset, and monitor physical (layer 1), LAPD (layer 2), and Q.931 (layer 3) results.	HST3000-PRI
Pulse Shape Analysis	With this option, you can measure the peak voltage, width, rise time, fall time, overshoot, undershoot, and signal level of a T1 pulse. The HST displays the measurements and a graph of the pulse shape. You can also measure the pulse for conformance to the ANSI T1.102 (DSX) and ANSI T1.403 (Network Interface) pulse mask.	HST3000-PS
Frame Relay	Allows you to test frame relay services.	HST3000-FR

What's new

This release of the T1 SIM supports the following new features:

- Simplified user interface. The menu structure, tab structure, and setup screens have been simplified and streamlined to allow you to configure and run your tests quickly and efficiently. Before testing, we strongly recommend that you read "Configuring your test" on page 6 to become comfortable with the new interface.
- Single Monitor Mode. When running T1 BERT applications, single monitor mode allows you to monitor a T1 signal in a single direction.
- Dual Monitor Mode. When running T1 BERT applications, dual monitor mode allows you to monitor a T1 signal in both directions.
- Automatic rediscovery of BERT pattern. A new AUTO-R pattern is available. When you select this pattern, if your instrument loses pattern sync, it will automatically redetect the BERT pattern when sync is regained.

T1 connectors

A SIM with T1 testing capability contains the physical interfaces needed to perform T1 (DS1) testing. The Primary and Secondary T1 transmit (Tx) and receive (Rx) connectors are located on the side of the SIM (see Figure 1). Table 7 on page 6 describes the connectors on the T1 SIM.

Your SIM may have additional connectors depending on its testing features.

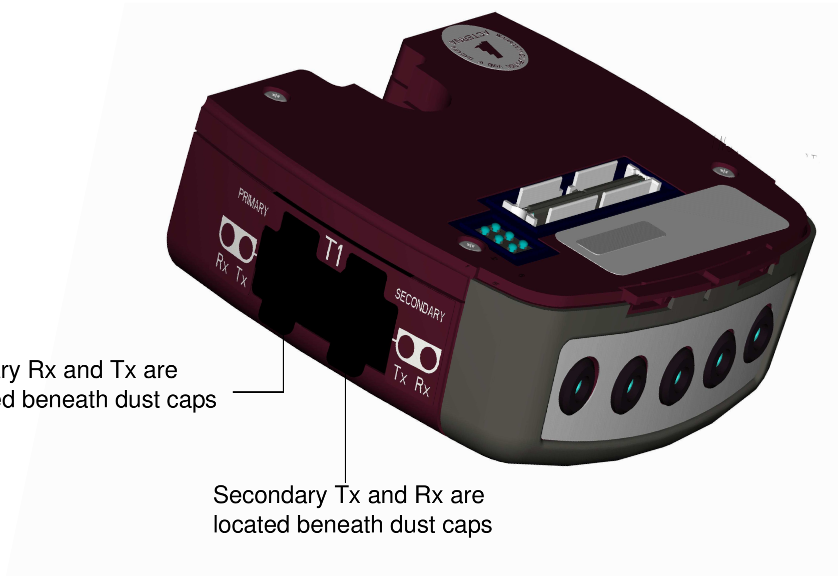


Figure 1 T1 interface connectors

NOTE:

The T1 interface connectors are protected by flexible dust caps. The dust caps are permanent fixtures and should not be removed.

Table 7 describes the connectors on the T1 SIM. For additional input and output specifications, see Appendix F.

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 only to TNV ports.

Table 7 T1 SIM connectors

Connector	Type	Description
Primary Rx	Bantam Jack	T1 connection to the primary receiver. Used in Monitor, Terminate, and Drop and Insert modes.
Primary Tx	Bantam Jack	T1 connection to the primary transmitter. Used in Terminate and Drop and Insert modes.
Secondary Rx	Bantam Jack	T1 connection to the secondary receiver. Used in Monitor and Drop and Insert modes.
Secondary Tx	Bantam Jack	T1 connection to the secondary transmitter. Used in Drop and Insert mode.

Configuring your test

Configuring your tests involves launching an application, selecting a test mode, and then specifying settings on the configuration menus.

Launching an application

Before you can launch a T1 application, you must have a SIM with T1 testing capability. Also, make sure the SIM is properly connected to the HST base unit before you power on the unit. For information about connecting a SIM and powering the HST, see the *HST-3000 Base Unit User's Guide*.

The following procedure describes how to launch an application.

To launch a T1 application

1 Power on the HST-3000.

2 Press the **T1** soft key.

The T1 Measurements menu appears. This menu lists the T1 test applications. Menu items vary depending on the options you purchased.

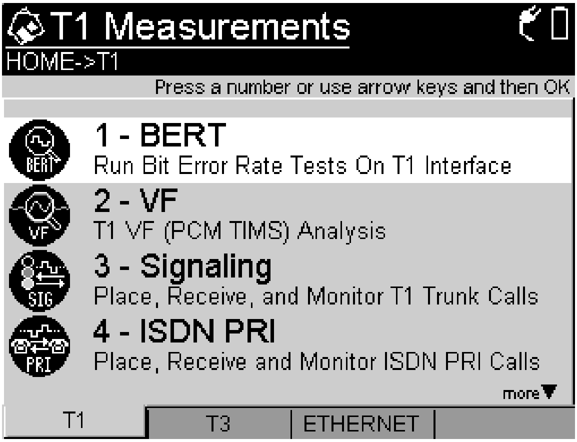


Figure 2 T1 Measurements menu

3 Select the application you want to launch.

You can press a number key that corresponds to the application you want to launch. For example, press the 1 key to launch the BERT application. You can also use the up and down arrow keys to highlight your selection, and the press the OK key. The following table lists all currently available T1 applications.

Application	Select...
T1 full rate and fractional rate (FT1) bit error rate analysis	**BERT**
Voice frequency (PCM TIMS) analysis	**VF**
Monitor, place, and receive T1 trunk calls	**Signaling**
Monitor, place, and receive ISDN PRI calls	**ISDN PRI**

Application	**Select...**
Frame relay testing	**Frame Relay**
T1 pulse shape analysis	**Pulse Shape**

A "*Please Wait ... Launching Test Application*" message appears briefly. The message disappears, the HST launches the application, and a menu listing each of the test modes for the application appears.

4 Select a test mode for the application.

A "*Please Wait ... Reconfiguring Test*" message appears briefly.

The message disappears, the HST configures the test, and the Summary Results screen appears.

5 To review or change the current test settings, press the **Configure** button.

The Summary Settings menu appears, listing each of the key settings required to run your test.

– If the settings meet your test requirements, and if you do not need to change any of the settings on the other configuration menus, press **Home** to return to the Results display, and then press the **Restart** soft key to clear statistical and historical results and restart the test.

– If you need to change the settings, proceed to "Specifying basic test settings" on page 9.

For information about purchasing options for the HST-3000, contact your JDSU representative or your local JDSU sales office. You can also contact JDSU through the company web site, www.jdsu.com.

For information about purchasing options for the HST-3000, contact your JDSU representative or your local JDSU sales office. You can also contact JDSU through the company web site, www.jdsu.com.

Specifying basic test settings

After you launch an application, you verify and specify test settings using the configuration menus. The following procedure describes how to access the test configuration menus and specify basic settings.

> **NOTE:**
>
> If you change settings while transmitting traffic, results will not reflect the true state of the circuit. Always stop traffic before changing settings.

To specify basic test settings

1 Launch an application and specify the test mode (see "Launching an application" on page 6).

The HST launches the application in the mode you specified, and the Summary Results screen appears.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

The settings and the values for the settings vary depending on the current application and test mode.

For example, if you launched a T1 BERT application in *Terminate* mode, the Pattern menu allows you to specify the transmitted BERT pattern. If you are running the VF application, no Pattern menu appears because it is not required for the VF test.

3 To change a setting, do the following:

a If the setting you need to change appears on the Summary Settings menu, proceed to step c.

b If the setting you need to change does not appear on the Summary Settings menu, use the left and right arrow keys on your keypad to scroll through the available configuration menus. For example, if you want to specify the type of alarm to transmit, scroll to the Error Settings configuration menu.

c Press the number corresponding to the setting you want to change, and then select or type the value for the setting as appropriate.

If you type the value for a setting (such as the Tx Clock Offset), **OK** stores the new value. **Cancel** returns you to the previous configuration menu without storing the new value.

Basic test settings are specified. For detailed instructions on configuring the remaining settings, refer to one of the following chapters:

– Chapter 2 "T1 and FT1 testing"
– Chapter 3 "T1 DDS testing"
– Chapter 4 "Voice Frequency (PCM) Analysis"
– Chapter 5 "PCM Signaling Analysis"
– Chapter 6 "ISDN PRI testing"
– Chapter 7 "Automated T1 Testing"

Saving test configurations

After you have finished configuring the HST-3000 for a particular test, you can store the test configuration for future use. The configurations are stored on power down.

To store a test configuration

1. Set up the HST-3000 for the test you are performing.
2. Press the **Configure** navigation key.
3. Press the **Storage** soft key.
4. Select **Save Config**.

5 Enter the file name.

6 Press the **OK** key.

The test configuration is stored.

Loading a configuration

After a configuration is saved, you can load it. This could save you some time in cases where the majority of settings are the same.

To load a test configuration

1 Press the **Configure** navigation key.

2 Press the **Storage** soft key.

3 Select **Load Config**.

4 Select the file to load.

5 Press the **OK** key.

The test configuration is loaded.

Overwriting a configuration

You can change a saved configuration then overwrite the old version.

To overwrite a configuration

1 Press the **Configure** navigation key.

2 Press the **Storage** soft key.

3 Press the **3** key.

4 Select the file to overwrite.

5 Press the **OK** key.

The test configuration is overwritten.

Deleting a configuration

If a configuration is no longer needed, you can delete it.

To delete a test configuration

1. Press the **Configure** navigation key.
2. Press the **Storage** soft key.
3. Select Delete **Config.**
4. Select the file to delete.
5. Press the **OK** key.

The test configuration is deleted.

Restarting tests

Pressing the **Restart** soft key (at the bottom of the Results display) clears statistical and historical results and restarts your test.

Viewing test results

After you start a test, the Summary category appears showing an overview of the test results. You can view other results by selecting a different test result category.

To view test results

1. Configure and run a test.
2. Press the **Display** soft key, and then do one of the following:
   – Use the arrow keys to highlight a result category, and then press **OK**.

– Press the number corresponding to the category.

  If a leading zero appears in front of a number, you must also enter the leading zero. For example, if you want to display the third category listed on a menu with more than ten categories, press “0”, and then “3”. If you want to display the eleventh category on the menu, press “1” twice.

  The test results for the category appear.

For descriptions of test results, see Appendix A through Appendix D.

Clearing history results

The following procedure describes how to clear history results in the LED and Summary categories.

To clear history results

1. Configure and run a test.
2. Press the **Home** button.
3. Press the **Results** soft key.
4. Select **Clear History**.

The HST-3000 clears any history results in the LED and Summary categories. Statistical results are not cleared and continue to accumulate.

Instrument settings and user preferences

For information about the following HST-3000 features, see the *HST-3000 Base Unit User’s Guide*:

– Powering the HST-3000

- Changing instrument and preference settings, such as date and time format, port settings, sound, and screen settings
- International settings
- Remote operation
- Web browser
- VT100 emulation
- Transferring files using FTP
- Managing files
- Printing

T1 and FT1 testing

2

This chapter provides information on performing turn-up and maintenance testing using the HST-3000 T1 testing feature. Topics discussed in this chapter include the following:

About testing

The HST-3000, with a T1-capable SIM, is intended to be used to commission and maintain T1 and fractional T1 (FT1) transmission circuits. Typically this involves out-of-service testing to ensure that the physical layer is clean and there are no problems with network equipment or improper provisioning.

You can use the HST-3000 in the following ways:

– To terminate a circuit, and then loop back to another HST 3000 unit or piece of network equipment (such as a CSU or repeater) to perform BER testing.

– To emulate a piece of network equipment (such as an NIU or CSU) and respond to loop backs from another HST-3000 at the far end.

– To perform BER analysis end-to-end between two HST-3000 units (typically requires two technicians) with analysis performed in both directions. This allows you to easily isolate faults on the circuit.

– To passively monitor one or two T1 circuits (in-service testing) by examining transmission layer metrics such as CRC and frame errors or timing slips.

– To perform drop-and-insert (D&I) BER testing on individual DS0 channels within a T1 circuit. This is typically conducted from a DSX patch panel.

HST-3000 T1 testing applications include the following features:

– Standard DS1 transmit (Tx) and receive (Rx) interfaces.

– Fractional T1 analysis for contiguous and non-contiguous timeslots in 56kbps or 64kbps format.

– Supported framing formats: DS1 Unframed, ESF (D4 Extended SuperFrame format), SF (D4 SuperFrame format), SLC-96, and auto framing.

– Insertion of BPV, bit errors, frame bit errors and CRC errors.

– Generation of the following loop codes: NIU, CSU, FT1 CSU (V.54), CSU, HDSL, MSS, user defined, and repeater.
– “OK” message is displayed if no errors or alarms have occurred during the test. This provides a quick and easy way of determining that the line is free from errors.
– Physical layer alarms, errors, and statistics are collected at all times.

Test modes

The HST-3000 with a T1-capable SIM can operate in the following test modes:

– **Terminate Mode**: This mode is for testing out-of-service lines using the Primary T1 transmitter (Tx) and the Primary T1 receiver (Rx). You can generate and send test patterns on the Tx and receive patterns on the Rx.
– **Dual Monitor Mode**: This mode measures signal parameters, monitors traffic from a resistor-isolated DS1 monitor point, or bridges onto the line. Both the primary and secondary T1 receivers are monitored simultaneously.
– **Single Monitor** Mode. This mode monitors the primary T1 receiver only.
– **Drop and Insert Mode (D&I)**: This mode allows you to perform bit error rate testing (BERT) on user-selected channels within a DS1 circuit. Non-selected channels remain in-service and pass through unchanged.

Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 8 describes how the LEDs operate.

Table 8 Status LEDs

LED	Description
Sync	A two-color LED that reports the signal status. – Solid green indicates a signal is present and there is frame synchronization on all active receivers. – Flashing green indicates auto-framing is running on at least one active receiver. – Solid red indicates that at least one of the active receivers does not have signal or frame synchronization. – If the Sync LED is not illuminated, no signal has been detected on any active receiver.
Data	A two-color LED that reports pattern synchronization status. – Solid green indicates pattern synchronization has been achieved on all active receivers. – Flashing green means auto pattern is running on at least one active receiver. – Solid red indicates that at least one of the active receivers does not have pattern synchronization. – If the Data LED is not illuminated, it means the selected traffic pattern is live, or no pattern synchronization has been detected on any active receiver.
Error	An LED that reports error conditions. – If the Error LED is not illuminated it means all Summary results are OK. – Solid red indicates an error.

Table 8 Status LEDs (Continued)

LED	Description
Alarm	An LED that reports alarm status. – If the Alarm LED is not illuminated, then no alarm was detected. – Solid red indicates an alarm was detected.
LpBk	This LED indicates the local loopback state of the HST unit. – Solid green indicates the HST has been placed in loopback by the remote end. – If the LpBk LED is not illuminated, there is no local loopback.
Batt	A three-color LED that indicates the battery status. – The LED is off when the battery has a useful charge. – Solid green indicates the AC adapter is plugged in. – Solid red indicates the battery has 8 percent battery life, or below. – Flashing red indicates about five minutes of use remain. When this happens, the battery should be charged or replaced immediately. – Solid amber or flashing amber indicates the battery capacity indicator (“gas gauge”) needs to be reset. **NOTE:** For information about charging the battery, changing batteries, and resetting the battery capacity indicator, see the *HST-3000 Base Unit User’s Guide*.

Monitoring a channel

The HST-3000 allows you to monitor the primary and secondary T1 receivers simultaneously (using Dual Monitor mode), or just the primary receiver (using Single Monitor mode). You can analyze full T1 and fractional T1 (DS0) channels and examine transmission layer results, such as CRC and frame errors, or BPVs for a single side of the traffic or in both directions.

The following procedure describes how to monitor a circuit.

> **NOTE:**
> The transmitters (Tx) are turned off in Monitor mode.

To monitor a channel

1 Launch the **BERT** application. See “Launching an application” on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Review the Summary Settings.

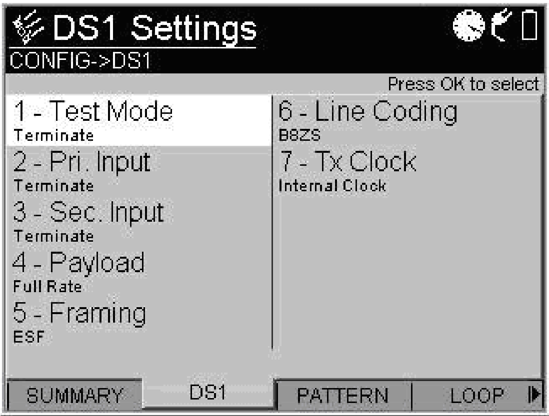
If the settings are appropriate for your test, press the **Home** key and proceed to step 8.

To change the settings, do one of the following:

- Go to the desired item by selecting the item number using the keypad
- Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step .

Go to the DS1 Settings menu.



4 Configure settings by pressing a number on the key pad that corresponds to the setting you want to configure. For example, press the 1 key to configure the test mode.

You can also use the arrow keys to highlight the setting you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

The following table describes the settings.

Setting	Parameters
Test Mode	Select **Single Monitor** or **Dual Monitor** mode.

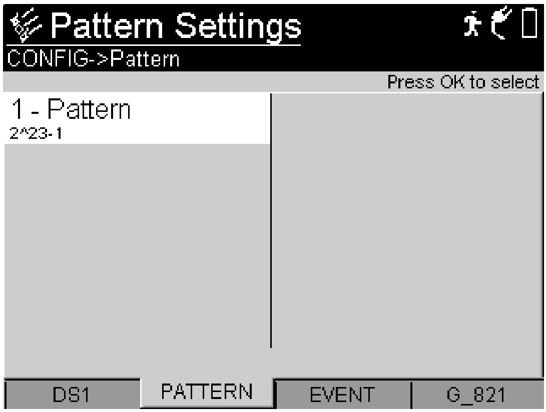
Setting	Parameters
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate**: Used to terminate a line with 100 Ω – **DSX Monitor** (default): Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input (Dual Monitor mode only)	Set the Secondary receiver (Rx) to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.
Payload	Select the type of channel you want to monitor: – **Full Rate**: DS1 channel – **Fractional Rate**: DS0 channel from a DS1 – **T1-DDS**: This option only appears if you purchased the T1 DDS option. For information about monitoring a T1 DDS channel, see “Monitoring a DDS channel” on page 69.

Setting	Parameters
Framing	Select the framing format for the signal: – **Auto** – **Unframed** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion **NOTE**: If you use the All Zeros BERT pattern, the line coding should be set to B8ZS. If you set the line coding to AMI (instead of B8ZS) and select the All Zeros BERT pattern, you will not be in compliance with the ANSI standard for ones density. If this occurs, the HST will not maintain the T1 signal or timing.
Bit Rate (Fractional Rate only)	Select one of the following: – **Nx56** – **Nx64**
DS0 Channels (Fractional Rate only)	Use the arrow keys to highlight any of the 24 channels (timeslots), then press the **OK** key to select the channel. You can select multiple channels. When you have finished selecting channels, press the **Commit** soft key. At least one timeslot must be selected. To select all channels, press the **Select All** soft key. To clear all channels, press the **Clear All** soft key.

Setting	Parameters
Tx Clock	Select one of the following: – **Internal Clock** – **Recovered from Primary** – **Recovered from Secondary**

5 To specify a BERT pattern, do the following:

Go to the Pattern Settings menu.



a Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

For a description of available patterns, see “BERT patterns” on page 282.

NOTE:

If you select the All Zeros BERT pattern, the line coding should be set to B8ZS. To change the line coding, press the **DS1** soft key, and then select **Line Coding**. See “Line Coding” on page 23.

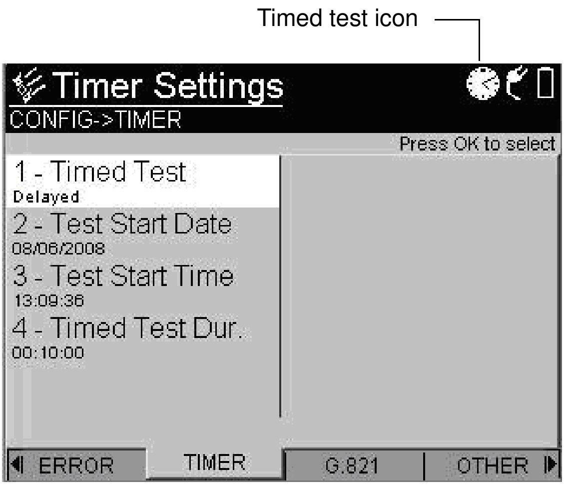
b Press the **OK** key to select the pattern.

If you select Multipat, User Bit Pattern, or User Byte Pattern, you must enter additional information. The following table describes the settings.

Setting	Parameter
User Bit Patt.	Enter a binary number from 3 to 32 bits long.
User Byte Patt.	Enter a hexadecimal number from 1 to 64 bytes long.
Multipat (Ones)	If you select Multipat as the pattern, select how long each pattern should be transmitted: – **15 sec** – **30 sec** – **45 sec** – **1 min** – **3 min** – **5 min** – **10 min** – **15 min** For a description of the Multipat pattern, see “MULTIPAT” on page 285.
Multipat (1:7)	Same as Multipat (Ones)
Multipat (2in8)	
Multipat (3in24)	
Multipat (QRSS)	

6 To perform a timed test, do the following:

Go to the Timer Settings menu.



a Select **Timed Test**, and then select one of the following.

– **Enabled** – turns on timed testing

– **Disabled** – turns off timed testing

– **Delayed** – sets timed testing to run at a specific date and time.

If enabled or delayed is selected, a clock icon appears in the upper right corner of the display.

If you selected Enabled, proceed to step d.

If you selected Delayed, proceed to step b.

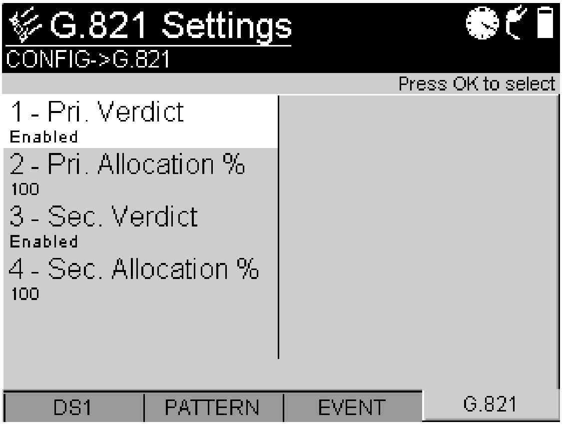
b Select **Test Start Date** and then enter the month, day, and year that you want to run the test.

c Select **Test Start Time** and then enter the hour, minute, and second at which you want to begin the test.

d Select **Timed Test Dur** and then enter the number of hours, minutes, and seconds you want the test to run.

7 To configure settings for G.821 performance analysis, do the following:

Go to the G.821 Settings menu.



a Select a setting, and then specify the parameter. The following table describes the settings.

Setting	Parameter
Pri. Allocation %	Enter a value, from 0.1% to 100%, to indicate the percentage of the end-to-end target values for ESR (Errored Seconds Ratio) and SESR (Severely Errored Seconds Ratio) that must be met for the primary test path to be acceptable. The end-to-end target values are based on the “Hypothetical Reference Configuration” (HRX) of length 27 500 km.

Setting	Parameter
Sec. Allocation % (Dual Monitor mode only)	Enter a value, from 0.1% to 100%, to indicate the percentage of the end-to-end target values for ESR (Errored Seconds Ratio) and SESR (Severely Errored Seconds Ratio) that must be met for the secondary test path to be acceptable. The end-to-end target values are based on the "Hypothetical Reference Configuration" (HRX) of length 27 500 km.

8 Connect the HST-3000 to the test access point (see Figure 3):

– Connect the HST T1 Primary Rx jack to the DSX-1 A-side MON jack

– If you are testing in Dual Monitor mode, connect the HST T1 Secondary Rx jack to the DSX-1 Z-Side MON jack

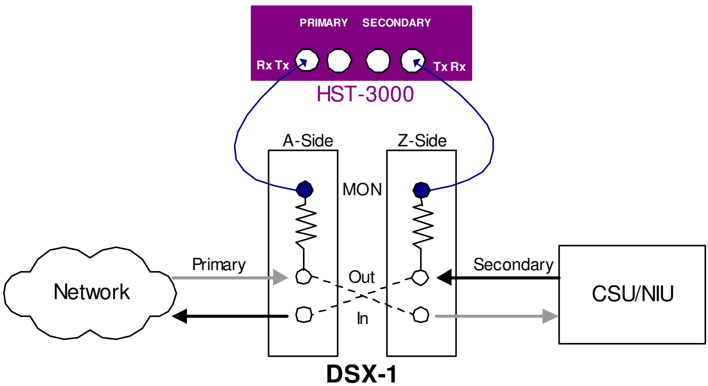


Figure 3 Monitor connections

9 Press the **Home** navigation key, and then press the **Restart** soft key to clear all alarms and begin the test.

Test results appear in the Summary category.

10 To view other results, see "Viewing test results" on page 61.

11 To stop a running test, press the **Cancel** key.

You have finished monitoring the circuit.

Measuring timing slips

The HST-3000 allows you to monitor the timing between two T1 signals for timing slips. For example, you can check customer premises equipment against a master clock at the central office, or you can compare two lines of network equipment. The HST-3000 measures the difference, in bits per second (bps), between the Primary Rx (receiver) and Secondary Rx.

The following procedure describes how to measure timing slips.

To measure timing slips

1 Launch the **BERT** application. See "Launching an application" on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Select **Test Mode**, and then select **Dual Mon**.

4 Select **Payload**, and then select one of the following:

To monitor a…	Select
DS1 channel	**Full Rate**
DS0 channel from a DS1	**Fractional Rate**

5 Review the remaining Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 7.

To change the settings, do one of the following:

– Go to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 6.

6 Configure the remaining settings for the test (see step 4 through step 6 beginning on page 21).

7 Connect the HST-3000 to a reference signal and to the test signal (see Figure 4):

– Connect a cable from the HST T1 Secondary Rx jack to a DS1 BITS clock or a known, good reference signal.

– Connect a cable from the HST primary Rx jack to the signal to be tested.

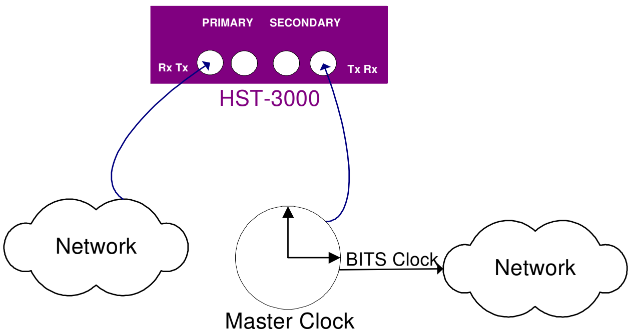


Figure 4 Timing slips connections

8 Press the **Home** navigation key.

9 Press the **Restart** soft key to clear all alarms and begin the test.

Test results appear in the Summary category.

10 Press the **Display** soft key, and then select **Signal**.

The Signal Results window appears.

11 Check the timing slips result.

For a description of the result, see “Timing Slips” on page 219.

12 To end the test, press the **Cancel** key and disconnect the cables.

You have finished measuring timing slips.

Terminate testing

In Terminate mode, you can use the HST-3000 to perform bit error rate testing (BERT or BER testing) on DS1 channels, and DS0 channels within a DS1. You can test for bit errors, BPVs, frame errors, and CRC errors (if applicable).

In Terminate mode, you can also use the HST to perform loopback testing. Loop back testing allows you to qualify T1 circuit error performance by testing for bit errors, BPVs, frame errors, and CRC errors (if applicable) on T1 and FT1 lines. The HST-3000 can generate a number of commonly used loop codes, including NIU, CSU, FT1 CSU, MSS, repeater, HDSL, and user-defined loop codes. This allows you to set up a loop at an NIU, CSU, or any repeater between the DSX-1 and the customer premises. For instructions on configuring user-defined loop codes, see “Configuring user-defined loop codes” on page 45.

The following procedure describes how to perform a BER test.

To perform a BER test

1 Launch the **BERT** application. See “Launching an application” on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Review the Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 11.

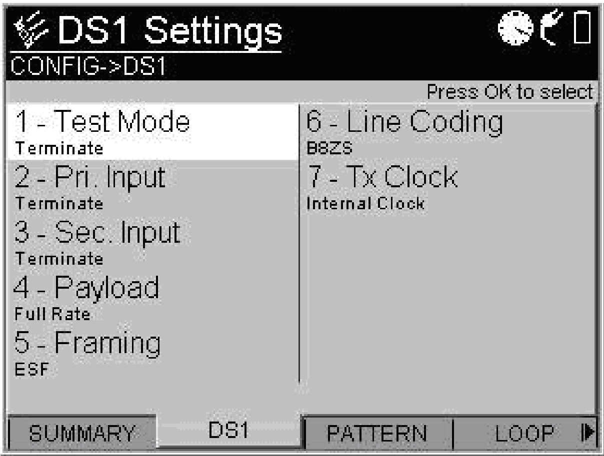
To change the settings, do one of the following:

– Go to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 4.

Go to the DS1 Settings menu.



4 Configure the settings by pressing a number on the key pad that corresponds to the setting you want to configure. For example, press the 1 key to configure the test mode.

You can also use the arrow keys to highlight the option you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

The following table describes the settings.

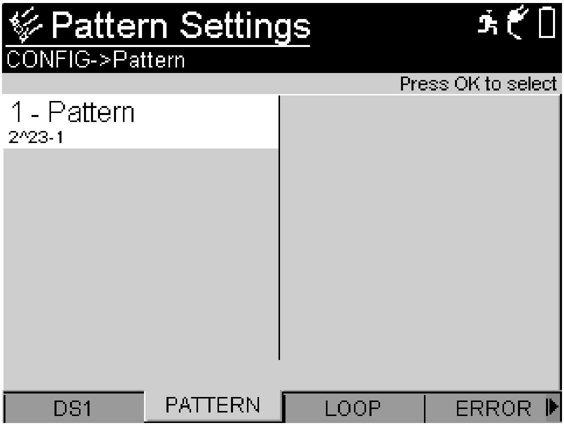
Setting	Parameter
Test Mode	Select **Terminate**.
Pri. Input	**NOTE:** The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary Rx input to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** (default): Used to terminate a line with 100 Ω – **DSX-Monitor**: Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary Rx input to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.
Payload	Select the type of channel you want to monitor: – **Full Rate**: DS1 channel – **Fractional Rate**: DS0 channel from a DS1 – **T1-DDS**: This option only appears if you purchased the T1 DDS option. For information about DDS terminate test operations, see "Terminate testing" on page 77.

Setting	Parameter
Framing	Select the framing format for the signal: – **Auto** – **Unframed** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**
Idle Byte (Fractional Rate only)	Enter an 8-bit binary value. This idle pattern will be transmitted in the channels that are not selected for test.
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion. **NOTE:** If you use the All Zeros BERT pattern, the line coding should be set to B8ZS. If you set the line coding to AMI (instead of B8ZS) and select the All Zeros BERT pattern, you will not be in compliance with the ANSI standard for ones density. If this occurs, the HST will not maintain the T1 signal or timing.
Bit Rate (Fractional Rate only)	Select one of the following: – **Nx56** – **Nx64**
DS0 Channels (Fractional Rate only)	Use the arrow keys to highlight a channel (timeslot), and then press **OK** to select the channel. When you have finished selecting channels, press the **Commit** soft key. To select all 24 channels, press the **Select All** soft key. To clear all channels, select **Clear All**.

Setting	Parameter
Tx Clock	Specify the signal timing source for the Primary Tx output: – **Internal** – **Recovered from Primary Rx** – **Recovered from Secondary Rx**

5 To specify a BERT pattern, do the following:

Go to the Pattern Settings menu.



a Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

For a description of available patterns, see “BERT patterns” on page 282.

NOTE:

If you select the All Zeros BERT pattern, the line coding should be set to B8ZS. To change the line coding, press the **DS1** soft key, and then select **Line Coding**. See “Line Coding” on page 34.

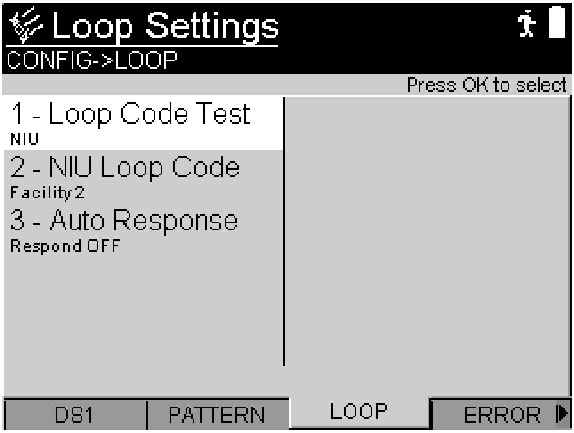
b Press the **OK** key to select the pattern.

If you selected Multipat, User Bit Pattern, or User Byte Pattern, you must enter additional information. The following table describes the settings.

<table>
<tr><th>Setting</th><th>Parameter</th></tr>
<tr><td>User Bit Patt.</td><td>Enter a binary number from 3 to 32 bits long.</td></tr>
<tr><td>User Byte Patt.</td><td>Enter a hexadecimal number from 1 to 64 bytes long.</td></tr>
<tr><td>Multipat (Ones)</td><td>If you select Multipat as the pattern, select how long each pattern should be transmitted:
– **15 sec**
– **30 sec**
– **45 sec**
– **1 min**
– **3 min**
– **5 min**
– **10 min**
– **15 min**
For a description of the Multipat pattern, see “MULTIPAT” on page 285.</td></tr>
<tr><td>Multipat (1:7)</td><td rowspan="4">Same as Multipat (Ones)</td></tr>
<tr><td>Multipat (2in8)</td></tr>
<tr><td>Multipat (3in24)</td></tr>
<tr><td>Multipat (QRSS)</td></tr>
</table>

6 To configure loop code parameters, do the following:

Go to the Loop Settings menu.



a Select **Loop Code Test**, and then select the type of loop code test:

– **NIU**

– **CSU**

– **FT1 CSU (V.54)**: Only available for fractional T1 testing.

– **HDSL**

– **Repeater**

– **MSS**

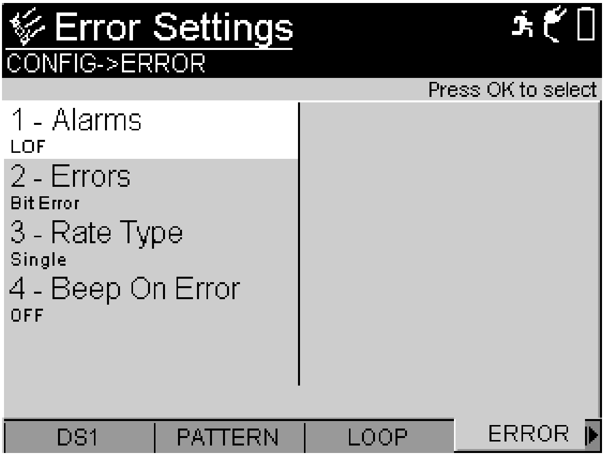
– **User-Defined**

If you specified the Payload as T1-DDS, the Loop Code Test option will not be available. For information about T1 DDS terminate testing, see “Terminate testing” on page 77.

b Configure the settings for the selected loop code. For a list of available loop codes and parameters, see “T1 and FT1 loop codes” on page 290.

7 To specify errors or alarms to insert, do the following:

Go to the Error Settings menu.



a Press the number key that corresponds to the setting you want to configure. For example, to configure an alarm, press the **1** key.

The following table shows the available settings.

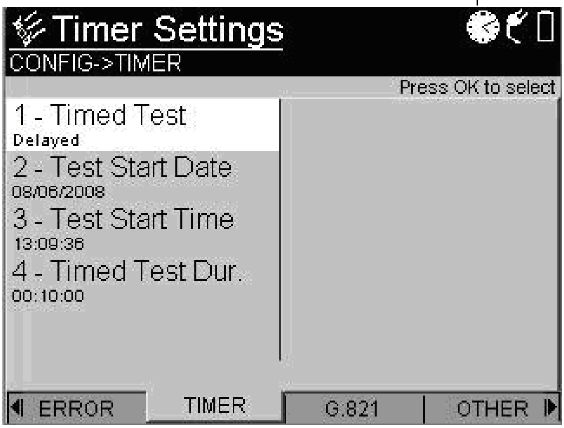
Setting	Parameter
Alarms	Select **Alarms**, and then specify the type of alarm to be inserted. For a list of available alarms, see “Alarms” on page 286.
Errors	Select **Errors**, and then specify the type of error to be inserted. For a list of available errors, see “Errors” on page 287.
Rate Type	This setting is only available if the error type is Bit Error. Select **Rate Type**, and then indicate how errors will be inserted: **Single** **Rate** **Multiple**

Setting	Parameter
Frame Errors	This setting is only available if the error type is Frame Errors. Select **Frame Errors**, and then indicate how many errors will be inserted on a single key press: 1 or 2.
Rate	This setting is only available if the rate type is Rate. Select **Rate**, and then indicate the insertion rate for logic errors.
Error Count	This setting is only available if the Rate Type is Multiple. Enter the number of errors to be inserted. The range is **1** though **50**.
Beep On Error	Select whether an audible beep will sound when an error is detected.

8 To perform a timed test, do the following:

Go to the Timer Settings menu.

Timed test icon



a Select **Timed Test**, and then select one of the following.

– **Enabled** – turns on timed testing

– **Disabled** – turns off timed testing

– **Delayed** – sets timed testing to run at a specific date and time.

If enabled or delayed is selected, a clock icon appears in the upper right corner of the display.

If you selected Enabled, proceed to step d.

If you selected Delayed, proceed to step b.

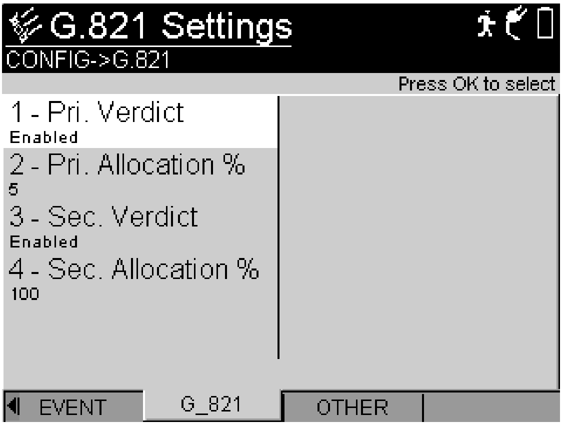
b Select **Test Start Date** and then enter the month, day, and year that you want to run the test.

c Select **Test Start Time** and then enter the hour, minute, and second at which you want to begin the test.

d Select **Timed Test Dur** and then enter the number of hours, minutes, and seconds you want the test to run.

9 To configure settings for G.821 performance analysis, do the following:

Go to the G.821 Settings menu.

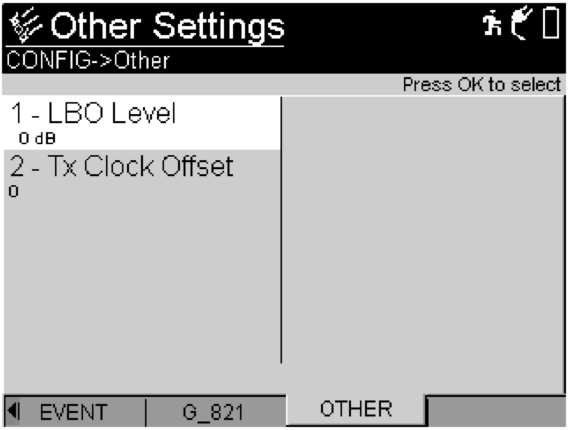


a Select a setting, and then specify the parameter. The following table describes the settings.

Setting	Parameter
Pri. Verdict	Indicates the primary channel will be analyzed for conformance to G.821 specifications. The HST will return either a “Pass” or “Fail” result. The only option for this setting is Enabled.
Pri. Allocation %	Enter a value, from 0.1% to 100%, to indicate the percentage of the end-to-end target values for ESR (Errored Seconds Ratio) and SESR (Severely Errored Seconds Ratio) that must be met for the primary test path to be acceptable. The end-to-end target values are based on the “Hypothetical Reference Configuration” (HRX) of length 27 500 km.
Sec. Verdict	Indicates the secondary channel will be analyzed for conformance to G.821 specifications. The HST will return either a “Pass” or “Fail” result. The only option for this setting is Enabled.
Sec. Allocation %	Enter a value, from 0.1% to 100%, to indicate the percentage of the end-to-end target values for ESR (Errored Seconds Ratio) and SESR (Severely Errored Seconds Ratio) that must be met for the secondary test path to be acceptable. The end-to-end target values are based on the “Hypothetical Reference Configuration” (HRX) of length 27 500 km.

10 To configure cable loss level or clock offset for the transmit signal, do the following:

Go to the Other Settings menu.



a Select the following settings, and specify the parameters:

Setting	Parameters
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock Offset	Enter a value, from **-50** through **50** ppm, to indicate the offset frequency generated by the 1544 kbps internal clock. To specify negative or positive numbers, press the **+/-** soft key. To clear the entire field, press the **Clear** key. To delete a single character, press the **Delete** soft key.

11 If you are performing and end-to-end test, skip to step 13. If you are configuring a loopback test, connect the HST to the test access point (see Figure 5):

- Connect the HST T1 Tx Primary jack to the DSX-1 TX (IN) jack.
- Connect the HST Rx Primary jack to the DSX-1 RX (OUT) jack.

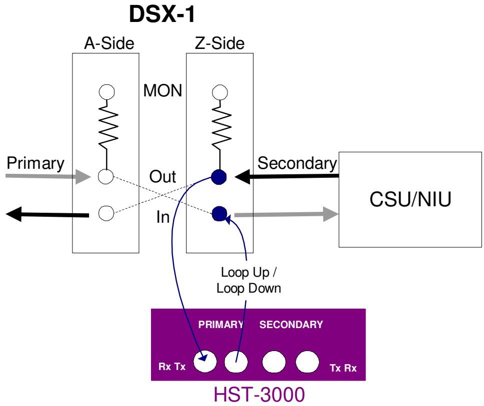


Figure 5 Loopback Connections

12 Proceed to step 15.

13 If you are performing an end-to-end test, connect the HST-3000 to the test access point (see Figure 6):

- Connect the HST T1 Primary Tx to the DSX-1 TX (In) jack.
- Connect the HST T1 Primary Rx to the DSX-1 RX (Out) jack.

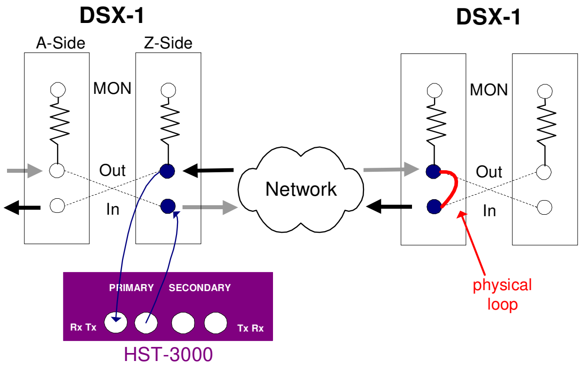


Figure 6 End-to-end connection

If you are performing a straightaway (end-to-end) test at the customer premises, you will likely be accessing the circuit at the 66 block, NIU, or DSX-1 patch panel.

14 For end-to-end testing, you can use two test sets or set up a physical loop at the far end DSX-1. If you are unsure of this process, contact your supervisor.

15 Press the **Home** navigation key.

16 Press the **Restart** soft key to clear all alarms and begin the test.

17 To insert errors, do one of the following:

- Press the **1** key.
- Press the **Action** soft key and then press the **1** key.

This inserts the number and type of error that you specified on the Error Settings menu.

The error is inserted into the Primary Tx (transmit) path.

18 To enable or disable alarms, do one of the following:

– Press the **3** key.

– Press the **Action** soft key and then press the **2** key.

This enables or disables the type of alarm that you specified on the Error Settings menu.

The alarm is inserted into the Primary Tx (transmit) path.

19 To send loop commands, press the **Actions** soft key, select **Loop Action**, and then select either **Loop Up** or **Loop Down**. The loop command is sent to the device you selected on the Loop Settings menu.

20 If the circuit is physically looped back, check to see that the inserted errors are received in the Summary test result category (For instructions on viewing results, see "Viewing test results" on page 61). If you are performing an end-to-end test, verify that the HST units at each end of the circuit received the inserted errors.

21 To stop a running test, press the **Cancel** key.

NOTE:

If you are performing a T1 loop/repeater test and you select, **Actions > Arm**, you may see the Sync and Data LEDs flashing and errors in the Summary results.

This can occur if the signal power level from the repeater is too high for the HST, more than +6dBdsx. To resolve this issue, on the HST, configure the signal input to DSX-MON and use the DSX monitor drop from the repeater.

BER testing is complete.

Configuring user-defined loop codes

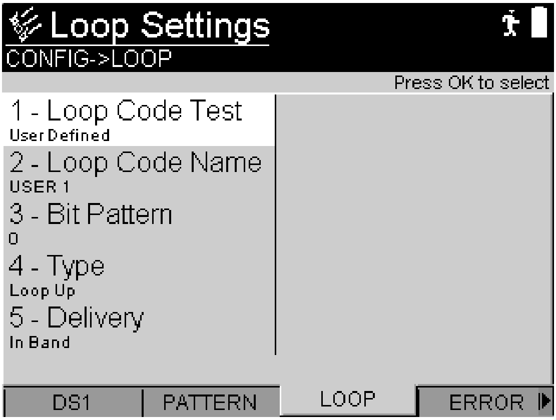
The HST-3000 allows you to define up to ten user-defined loop codes. These codes are available each time you configure a loopback test. The following procedure describes how to define a loop code.

To configure a user-defined loop code

1. Launch the **BERT** application. See "Launching an application" on page 6.
2. Press the **Configure** button.

   The Summary Settings menu appears, listing the key settings for the application you launched.
3. Select **Test Mode**, and then select **Terminate.**
4. Select **Payload**, and then select **Full Rate**.
5. Press the **LOOP** soft key.

   The Loop Settings menu appears.

6. Select **Loop Code Test**, and then select **User Defined**.

   The user-defined loop code settings appear.
7. Configure the settings for the loop code. Press the number key that corresponds to the setting you want to configure. For example, press the **2** key to enter a name for your loop code.

The following table describes the options.

Setting	Parameter
Loop Code Name	Default names appear as User1, User2, User3, and so on. To change a pattern name, use the arrow keys to highlight a name, then press the **Edit** soft key. Use the keypad to enter letters.
Bit Pattern	Enter a pattern. The pattern can be 1 to 16 bits long. Press the **OK** key to accept the change.
Type	Specify the type of loop code: – **Loop Up** – **Loop Down** – **Other**
Delivery	Select either **In Band** or **Out of Band**.

You have finished configuring a user-defined loop code.

Pulse shape analysis

With the Pulse Shape option, you can use the HST-3000 to measure the height, width, rise time, fall time, overshoot and undershoot, and signal level of a T1 pulse. The HST displays the measurements and a graph of the pulse shape. You can also measure the pulse for conformance to ANSI T1.102 (DSX) and ANSI T1.403 (Network Interface) specifications.

To perform pulse shape analysis

1 Launch the **Pulse Shape** application. See "Launching an application" on page 6.)

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Review the Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 8.

To change the settings, do one of the following:

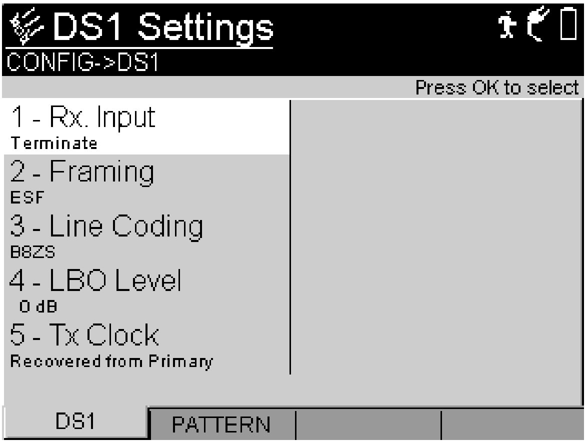
– Go to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 4.

4 Press the **DS1** soft key.

The DS1 Settings menu appears.



5 Configure the DS1 settings. The following table describes the available settings.

Setting	Parameter
Rx Input	**Terminate** is the only option.

Setting	Parameter
Framing	Select the framing format for the signal: – **Auto** – **Unframed** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion **NOTE**: If you use the All Zeros BERT pattern, the line coding should be set to B8ZS. If you set the line coding to AMI (instead of B8ZS) and select the All Zeros BERT pattern, you will not be in compliance with the ANSI standard for ones density. If this occurs, the HST will not maintain the T1 signal or timing.
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock	Specify the timing source for the Primary Tx output: – **Internal Clock** – **Recovered from Primary**

6 To specify a test pattern, do the following:

a Press the **PATTERN** soft key.

The Pattern Settings menu appears.

b Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

The Bridgetap and Multipat patterns are not available during pulse shape analysis. For a description of available patterns, see "BERT patterns" on page 282.

c Press the **OK** key to select the pattern.

If you selected User Bit Pattern, or User Byte Pattern, you must enter additional information:

Setting	Parameter
User Bit Patt.	Select **User Bit Patt.**, and then enter a binary number from **3** to **32** bits long.
User Byte Patt.	Select **User Bit Patt.**, and then enter a hexadecimal number from **1** to **64** bytes long.

7 After you have configured the settings, press the **Home** navigation key.

8 Connect the HST to the test access point. See Figure 5 on page 43 or Figure 6 on page 44.

9 To start the test, press the **Restart** soft key.

10 To initiate a pulse shape capture, press the **Action** soft key then select **Capture Pulse**.

11 To view pulse shape results, press the **Display** soft key, and then select **Pulse Shape**.

A graphical representation of the pulse appears. For information about pulse shape results, see "Pulse shape results" on page 224.

12 To measure conformance to ANSI T1.403 (network interface) or T1.102 (DSX) specifications, do the following:

a Press the **Action** soft key, and then select either **Enable Mask T1.403** or **Enable Mask T1.102**.

The HST applies the selected mask and displays the results as a graph.

b To disable a mask, press the **Action** soft key, and then select **Disable Mask**.

You have completed pulse shape analysis.

Drop and insert testing

Drop and insert (D&I) testing allows you to "drop" an individual DS0 channel (fractional bandwidth) from a T1 circuit to perform bit error rate testing (BERT) on the selected channel. The remaining channels are not affected and remain in-service. You can also monitor a channel in D&I mode by not inserting data into the transmission.

When a signal enters the HST-3000's Secondary Rx, the HST inserts a user-specified pattern into the selected DS0 channels, and then transmits those channels through the Primary Tx. Non-selected channels pass through the Primary Tx unchanged. When a signal enters the Primary Rx, the HST inserts the user-defined idle byte pattern into selected DS0 channels, and then transmits those channels through the Secondary Tx. Non-selected channels pass through the Secondary Tx unchanged. Figure 7 illustrates how the HST-3000 inserts patterns in D&I mode.

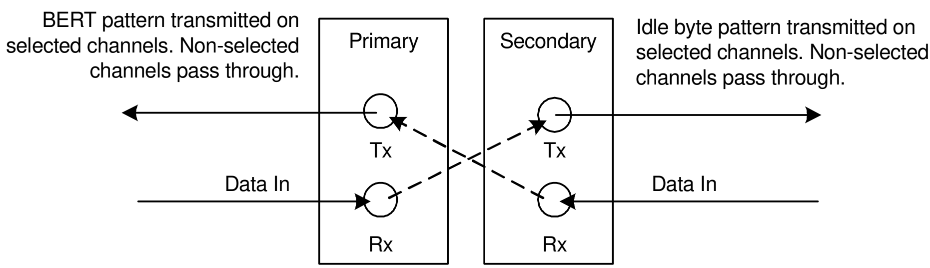


Figure 7 Drop and insert data flow

Before operating in D&I mode, JDSU recommends using the power adaptor to plug the HST into an outlet, and keeping the unit plugged in throughout D&I testing. This ensures that testing will not be interrupted due to loss of battery power.

> **NOTE:**
>
> If the HST-3000 loses power while connected to a live circuit in D&I mode, the circuit will go down.

The following procedure describes how to perform a drop and insert test.

To perform a drop and insert test

1 Launch the **BERT** application. See "Launching an application" on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Select **Test Mode**, and then select **Drop And Insert**.

4 Review the remaining Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 9.

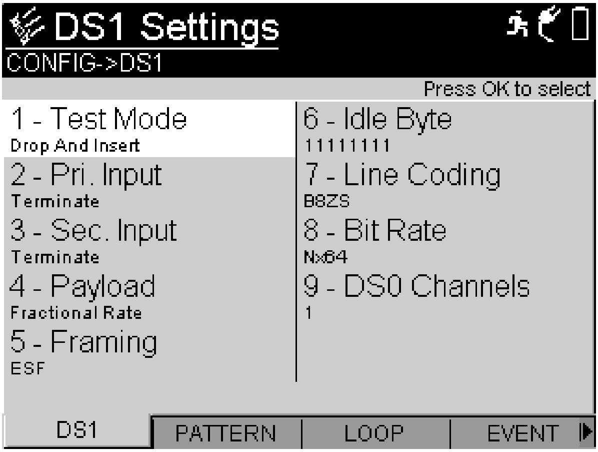
To change the settings, do one of the following:

– Go to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 3.

Go to the DS1 Settings menu.



5 Configure the settings by pressing a number on the key pad that corresponds to the setting you want to configure. For example, press the 1 key to configure the test mode.

You can also use the arrow keys to highlight the option you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

The following table describes the remaining options.

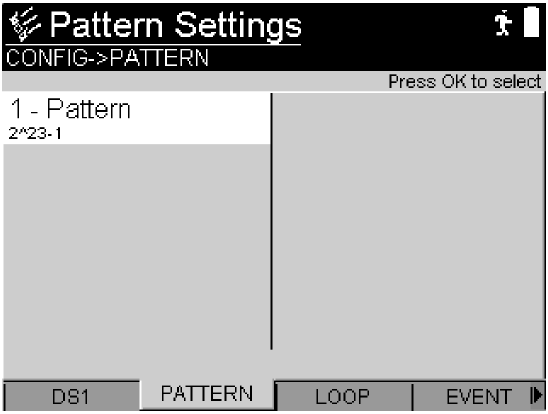
Setting	Parameters
Test Mode	Select **Drop and Insert**.

Setting	Parameters
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** (default): Used to terminate a line with 100 Ω – **DSX Monitor**: Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary receiver (Rx) to one of the following: – **Bridge** – **Terminate** – **DSX Monitor** For descriptions, see Pri. Input.
Payload	**Fractional Rate** is the only available parameter.
Framing	Select the framing format for the signal: – **Auto** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format
Idle Byte	Type an 8-bit binary value. This idle pattern will be transmitted in selected channels through the secondary Tx.

Setting	Parameters
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion
Bit Rate	Select one of the following: – **Nx56** – **Nx64**
DS0 Channel	Use the arrow keys to highlight a channel (timeslot), and then press **OK** to select the channel. When you have finished selecting channels, press the **Commit** soft key. To select all 24 channels, press the **Select All** soft key. To clear all channels, select **Clear All**.
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**

6 To specify a BERT pattern, do the following:

Go to the Pattern Settings menu.



a Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

For a description of available patterns, see “BERT patterns” on page 282.

b Press the **OK** key to select the pattern.

If you selected Multipat, User Bit Pattern, or User Byte Pattern, you must enter additional information. The following table describes the settings.

Setting	Parameter
User Bit Patt.	Enter a binary number from 3 to 32 bits long.
User Byte Patt.	Enter a hexadecimal number from 1 to 64 bytes long.

Setting	Parameter
Multipat (Ones)	If you select Multipat as the pattern, select how long each pattern should be transmitted: – **15 sec** – **30 sec** – **45 sec** – **1 min** – **3 min** – **5 min** – **10 min** – **15 min** For a description of the Multipat patter, see "MULTIPAT" on page 285.
Multipat (1:7)	Same as Multipat (Ones)
Multipat (2in8)	
Multipat (3in24)	
Multipat (QRSS)	

Go to the Loop Setting menu. The only available parameter is **FT1 CSU (V.54)**.

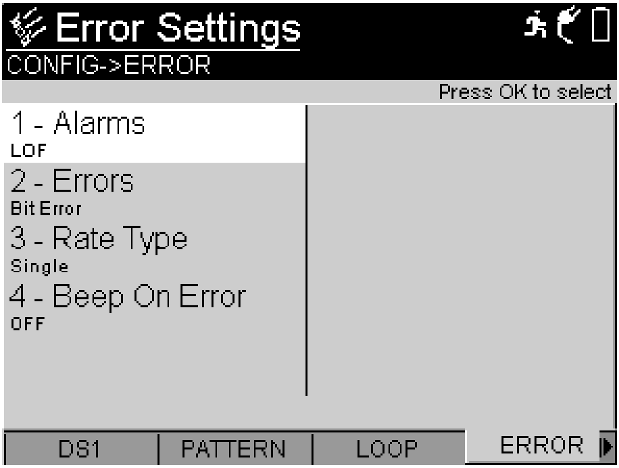
7 To enable bit errors, do the following:

a Press the **Home** navigation key.

b Press the **Action** soft key, and then select **Enable D&I**.

c Press the **Configure** soft key.

Go to the Error Settings menu.



d Configure the error settings. Press the number key that corresponds to the setting you want to configure. For example, to specify a bit error, press the **1** key.

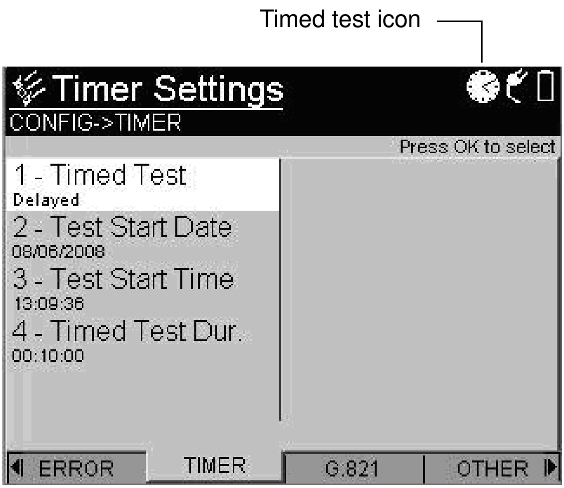
The following table shows the available settings.

Setting	Parameter
Errors	Select **Bit Error**.
Rate Type	Select **Rate Type**, and then indicate how errors will be inserted: **Single** **Rate** **Multiple** Rate Type is only visible if the error type is Bit Error.
Rate	Select **Rate**, and then indicate the insertion rate for logic errors. This option is only visible if the Rate Type is Rate.

Setting	Parameter
Error Count	Enter the number of errors to be inserted. The range is **1** though **50**. This option is only available if the Rate Type is Multiple.
Beep On Error	Select whether an audible beep will sound when an error is detected.

8 To perform a timed test, do the following:

Go to the Timer Settings menu.



a Select **Timed Test**, and then select one of the following.

– **Enabled** – turns on timed testing

– **Disabled** – turns off timed testing

– **Delayed** – sets timed testing to run at a specific date and time.

If enabled or delayed is selected, a clock icon appears in the upper right corner of the display.

If you selected Enabled, proceed to step d.

If you selected Delayed, proceed to step b.

b Select **Test Start Date** and then enter the month, day, and year that you want to run the test.

c Select **Test Start Time** and then enter the hour, minute, and second at which you want to begin the test.

d Select **Timed Test Dur** and then enter the number of hours, minutes, and seconds you want the test to run.

9 Connect the HST-3000 to the test access point (see Figure 8 on page 60):

– Connect the HST T1 Secondary Rx to the DSX-1 Z-Side MON jack.

– Connect the HST T1 Secondary Tx to the DSX-1 Z-Side Tx (In) jack.

– Connect the HST T1 Primary Rx to the DSX-1 A-Side MON jack.

– Connect the HST T1 Primary Tx to the DSX-1 A-Side Tx (In) jack.

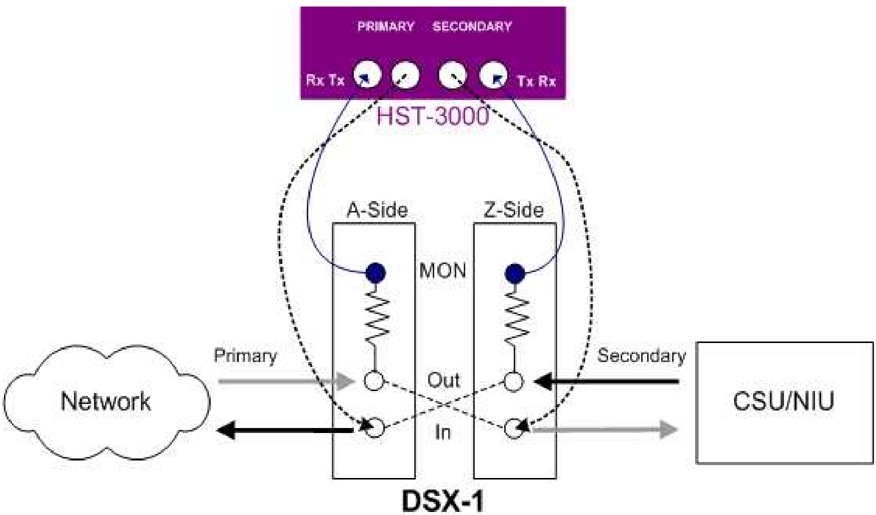


Figure 8 Drop and insert mode connection

10 Press the **Home** navigation key.

11 Press the **Restart** soft key to clear all alarms and begin the test.

12 To enable (or disable) drop and insert, press the **Actions** soft key, and then select **Enable D&I** (or **Disable D&I**).

13 To view results, see "Viewing test results" on page 61.

14 To stop a running test, press the **Cancel** key.

Drop and insert testing is complete.

Viewing test results

The following procedure describes how to view test results.

To view test results

1 Configure and run a test:
- See "Monitoring a channel" on page 19
- See "Terminate testing" on page 31
- See "Drop and insert testing" on page 51

2 Press the **Home** navigation key.

3 Press the **Display** soft key.

The test categories appear.

4 Select a category.

Test results for the selected category appear. For descriptions of test results, see Appendix A beginning on page 213.

Troubleshooting

Table 9 describes situations that you may encounter when using the HST-3000.

Table 9 Problems and resolutions

Issue	Description	Resolution
No signal present	This occurs when there is no valid input connected to the HST-3000.	Make sure the cables are connected to the receiver and that the signal consists of valid data.
Alarm Indication Signal (AIS) detected	This alarm is displayed when an unframed “all ones” pattern is received. This is usually generated by network equipment to indicate a fault or lack of data on the line.	Clear the fault and restart the test.
Pattern synchronization is not achieved	The error is displayed when an input signal is detected but the incoming data pattern is different to the test pattern selected in the BERT setup.	Check the test pattern. make sure the correct one is selected.
Frame synchronization is not achieved	The HST-3000 cannot recognize a frame within the received signal.	Check the framing type used on the line and change the DS1 setup accordingly.
Bipolar violations (BPVs) detected	This error occurs when the polarity of a received pulse does not match the rules of the line code. It is normally seen when AMI is expected but B8ZS is in use on the line.	Check that the line code parameter is set correctly.

Table 9 Problems and resolutions (Continued)

Issue	Description	Resolution
When performing a T1 loop/repeater test, The Sync and Data LEDs flash and Summary errors appear after the Arm option is selected.	This can occur when the signal power level from the repeater is too high for the HST to tolerate, more than +6dBdsx.	On the HST, access the DS1 Settings menu and configure the input to DSX monitor. Use the DSX-MON drop from the repeater.
In Monitor mode, the Sync and Data LEDs are red even though frame synchronization and pattern synchronization are present on the primary interface.	The HST monitors the primary and secondary interfaces simultaneously. The Sync and Data LEDs will be green only if both receivers have frame and pattern synchronization, respectively.	To monitor only one T1 interface, select Terminate mode, and then configure the primary input to DSX-Monitor. Make sure you do not connect the primary transmitter.

T1 DDS testing

3

This chapter contains information on using the T1 DDS testing option to perform tests on DDS channels from a T1 access point. Topics discussed in this chapter include the following:

About testing

The T1 DDS test option allows you to perform BERT, loop-back, and monitor test operations on a DDS channel within a user-specified DS0 channel from a T1. The T1 DDS option offers the following features:

– Supports analysis of either primary or secondary DDS channels on the same physical interface.
– Supports commonly used latching and alternating loop codes.
– Supports the following channel formats: DS0A2.4, DS0A4.8, DS0A9.6, DS0A19.2, DS0A56 Kbps, and Clear Channel (64 Kbps).
– Supports majority vote type error correction on received data at rates of DS0A2.4, DS0A4.8, and DS0A9.6 kbps. Error correction can be enabled or disabled.
– Supports subrate error correction for 19.2 Kbps. Error correction can be enabled or disabled.

Test modes

The HST-3000 with a T1 capable SIM can operate in the following test modes:

– **Terminate Mode**. This mode is for testing out-of-service lines using the Primary T1 transmitter (Tx) and the Primary T1 receiver (Rx). You can generate and send test patterns on the Tx and receive patterns on the Rx.
– **Dual Monitor Mode**: This mode measures signal parameters, monitors traffic from a resistor-isolated DS1 monitor point, or bridges onto the line. Both the primary and secondary receivers are monitored simultaneously.
– **Single Monitor** Mode. This mode monitors the primary T1 receiver only.

Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 10 describes how the LEDs operate.

Table 10 Status LEDs

LED	Description
Sync	A two-color LED that reports the signal status. – Solid green indicates a signal is present and there is frame synchronization on all active receivers. – Flashing green indicates auto-framing is running on at least one active receiver. – Solid red indicates that at least one of the active receivers or the DS0A19.2 channel does not have signal or frame synchronization. – If the Sync LED is not illuminated, no signal has been detected on any active receiver.
Data	A two-color LED that reports pattern synchronization status. – Solid green indicates pattern synchronization has been achieved on all active receivers. – Flashing green means auto pattern is running on at least one active receiver. – Solid red indicates that at least one of the active receivers does not have pattern synchronization. – If the Data LED is not illuminated, it means the selected traffic pattern is live, or no pattern synchronization has been detected on any active receiver.
Error	An LED that reports error conditions. – If the Error LED is not illuminated it means all Summary results are OK. – Solid red indicates an error.

Table 10 Status LEDs (Continued)

LED	Description
Alarm	An LED that reports alarm status. – If the Alarm LED is not illuminated, then no alarm was detected. – Solid red indicates an alarm was detected.
LpBk	This LED indicates the local loopback state of the HST unit. – Solid green indicates the HST has been placed in loopback by the remote end. – If the LpBk LED is not illuminated, there is no local loopback.
Batt	A three-color LED that indicates the battery status. – The LED is off when the battery has a useful charge. – Solid green indicates the AC adapter is plugged in. – Solid red indicates the battery has 8 percent battery life, or below. – Flashing red indicates about five minutes of use remain. When this happens, the battery should be charged or replaced immediately. – Solid amber or flashing amber indicates the battery capacity indicator (“gas gauge”) needs to be reset. **NOTE:** For information about charging the battery, changing batteries, and resetting the battery capacity indicator, see the *HST-3000 Base Unit User’s Guide*.

Monitoring a DDS channel

With the T1 DDS option, you can simultaneously monitor two DDS channels (using Dual Monitor mode), or just the primary channel (using Single Monitor mode) for transmission layer results, such as CRC and frame errors, or BPVs. The HST can be configured to monitor either the primary or secondary DDS channels.

The following procedure describes how to monitor a circuit.

> **NOTE:**
>
> The transmitters (Tx) are turned off in Monitor mode.

To monitor a DDS channel

1 Launch the **BERT** application. See "Launching an application" on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Select **Payload**, and then select **T1-DDS**.

4 Review the remaining Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 9.

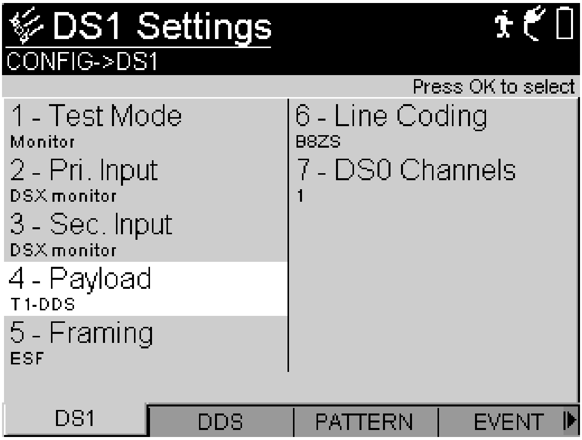
To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 5.

5 Go to the DS1 Settings menu.



Configure the settings by pressing a number on the key pad that corresponds to the setting you want to configure. For example, press the 2 key to configure the primary input (Rx).

You can also use the arrow keys to highlight the setting you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

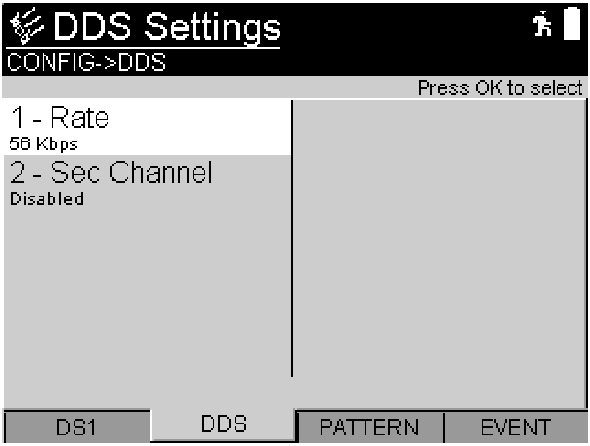
The following table describes all the available settings.

Setting	Parameter
Test Mode	Select **Single Monitor** or **Dual Monitor** mode.

Setting	Parameter
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge** — High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** — Used to terminate a line with 100 Ω – **DSX-Monitor** (default) — Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input (Dual Monitor mode only)	Set the Secondary receiver (Rx) to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.
Framing	Select the framing format for the signal: – **Auto** – **ESF** — D4 Extended SuperFrame format – **D4/SF** — D4 SuperFrame format
Line Coding	Select one of the following line coding options: – **B8ZS** — Bipolar 8 zeros substitution – **AMI** — Alternate mark inversion

Setting	Parameter
DS0 Channels	Use the arrow keys to highlight one of the 24 channels (timeslots), and then press the **OK** key to select the DDS channel where you will perform the test. Press the **Commit** soft key to select the channel.

Go to the DDS Settings menu.



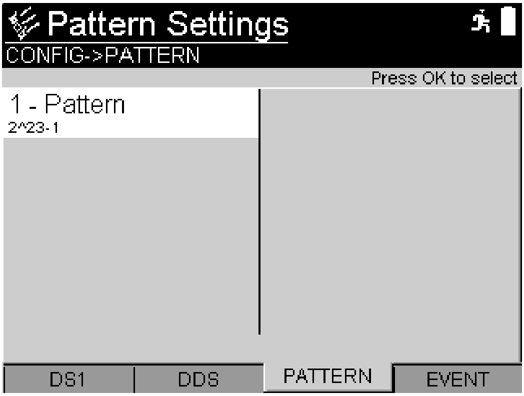
6 Press a number on the keypad that corresponds to the setting you want to configure. For example press the 1 key to specify the data rate.

The following table shows all the available options.

Setting	Parameter
Rate	Select one of the following data rates: – **2.4 Kbps** – **4.8 Kbps** – **9.6 Kbps** – **19.2 Kbps** – **56 Kbps** – **64 Kbps**
Sec Channel	This setting does not appear if the selected rate is 64 Kbps. Select one of the following options: – **Enable** – **Disable**
Analysis Channel	This setting only appears when the secondary channel is enabled. Select the channel where you will perform the test: – **Primary** – **Secondary**
Error Correction	This setting only appears if the specified rate is 19.2 Kbps or below. Specify one of the following options: – **Enable** – **Disable**

7 To specify a BERT pattern, do the following:

Go to the Pattern Settings menu.



a Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

For a description of available patterns, see "BERT patterns" on page 282.

b Press the **OK** key to select the pattern.

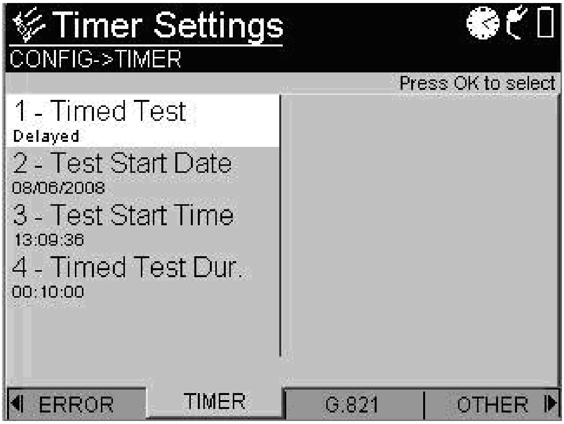
If you selected User Bit Pattern or User Byte Pattern, you must enter additional information. The following table describes the settings.

Setting	Parameter
User Bit Patt.	Enter a binary number from 3 to 32 bits long.
User Byte Patt.	Enter a hexadecimal number from 1 to 64 bytes long.

8 To perform a timed test, do the following:

Go to the Timer Settings menu.

Timed test icon



a Select **Timed Test**, and then select one of the following.

– **Enabled** – turns on timed testing

– **Disabled** – turns off timed testing

– **Delayed** – sets timed testing to run at a specific date and time.

If enabled or delayed is selected, a clock icon appears in the upper right corner of the display.

If you selected Enabled, proceed to step d.

If you selected Delayed, proceed to step b.

b Select **Test Start Date** and then enter the month, day, and year that you want to run the test.

c Select **Test Start Time** and then enter the hour, minute, and second at which you want to begin the test.

d Select **Timed Test Dur** and then enter the number of hours, minutes, and seconds you want the test to run.

9 Connect the HST-3000 to the test access point (see Figure 9):

- Connect the HST T1 Primary Rx jack to the DSX-1 A-side MON jack
- Connect the HST T1 Secondary Rx jack to the DSX-1 Z-Side MON jack

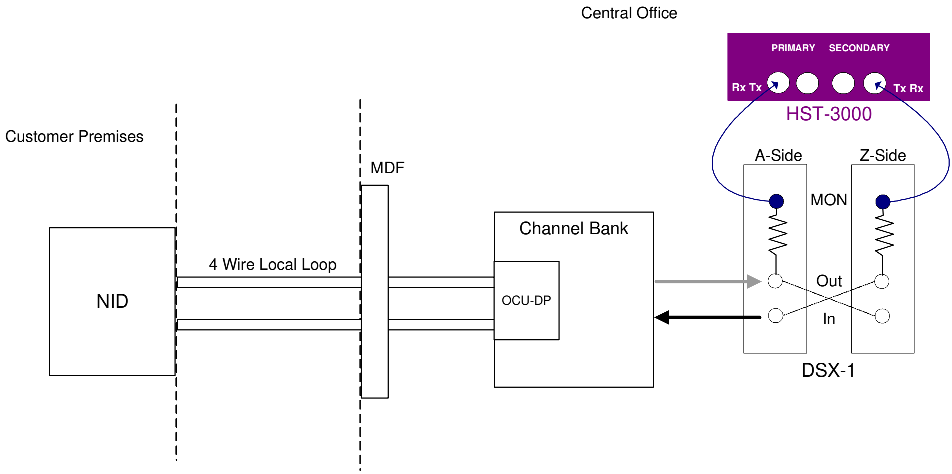


Figure 9 Monitor connections

10 Press the **Home** navigation key, and then press the **Restart** soft key to clear all alarms and errors and begin the test.

Test results appear in the Summary category.

11 To view other results, see "Viewing test results" on page 90.

12 To stop a running test, press the **Cancel** key.

You have finished monitoring a DDS channel.

Terminate testing

In Terminate mode, you can use the HST-3000, with the T1-DDS option, to perform bit error rate testing (BERT or BER testing) on a DDS channel from a T1 interface. You can insert errors, such as bit errors, CRC errors, and frame errors. You can also enable alarms, such as LOF, LOS, AIS, and yellow alarm.

The T1 DDS option also allows you to perform loopback testing on DDS circuits. The following alternating loop codes are supported: CSU, CSU 1st Repeater, CSU 2nd Repeater, DSU, HL96NY, OCU, OCU + HL96, 56Kbps 1st Repeater, and 56Kbps 2nd Repeater. The following latching loop codes are supported: CSU, DS0-DP, Data Port, DSU, LSI, NEI, OCU, V.54.

The following procedure describes how to perform a BER test on a DDS channel.

To perform a BER test on a DDS channel

1 Launch the **BERT** application. See “Launching an application” on page 6.

2 Press the **Configure** button.

   The Summary Settings menu appears, listing the key settings for the application you launched.

3 Select **Test Mode**, and then select **Terminate**.

4 Select **Payload**, and then select **T1-DDS**.

5 Review the remaining Summary Settings.

   If the settings are appropriate for your test, press the **Home** key and proceed to step 13.

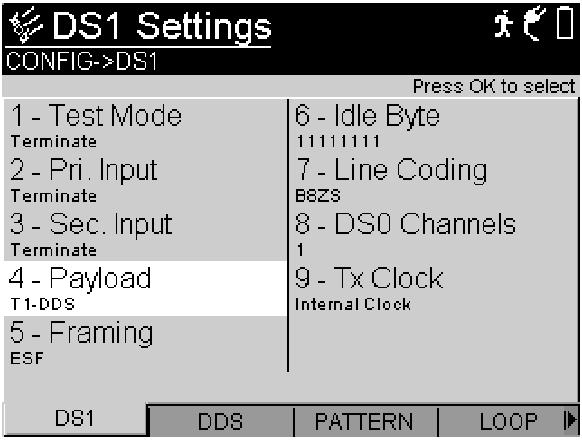
To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 6.

6 Go to the DS1 Settings menu.



a Select **Test Mode**, and then select **Terminate**.

b Select **Payload**, and then select **T1-DDS**.

c Configure the remaining parameters by pressing a number on the keypad that corresponds to the setting you want to configure. For example, press the **2** key to specify the primary input (Rx).

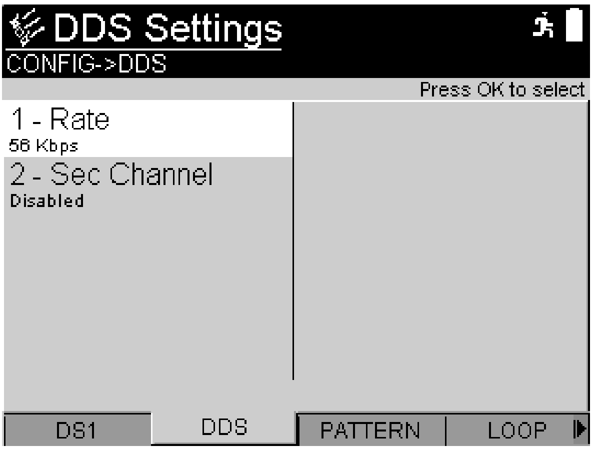
You can also use the arrow keys to highlight the option you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

The following table describes all the parameter options.

Setting	Parameters
Pri. Input	**NOTE:** The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary Rx input to one of the following: – **Bridge** — High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** (default) — Used to terminate a line with 100 Ω – **DSX-Monitor** — Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary Rx input to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.
Framing	Select the framing format for the signal: – **Auto** – **ESF** — D4 Extended SuperFrame format – **D4/SF** — D4 SuperFrame format
Idle Byte	Type a 8-bit binary value. This idle pattern will be transmitted in the channels that are not selected for test.

Setting	Parameters
Line Coding	Select one of the following line coding options: – **B8ZS** — Bipolar 8 zeros substitution – **AMI** — Alternate mark inversion
DS0 Channels	Use the arrow keys to highlight one of the 24 channels (timeslots), and then press the **OK** key to select the DDS channel where you will perform the test. Press the **Commit** soft key to select the channel.
Tx Clock	Specify the DS1 signal timing source for the Primary Tx output: – **Internal** – **Recovered from Primary Rx** – **Recovered from Secondary Rx**

7 Go to the DDS Settings menu.

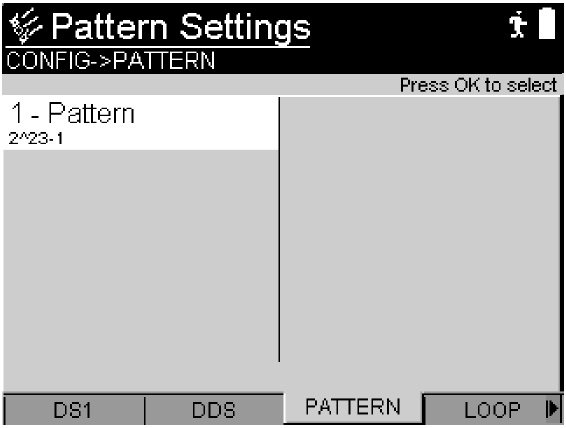


Press a number on the keypad that corresponds to the setting you want to configure. For example, press the **1** key to specify the rate.

Setting	Parameters
Rate	Select one of the following data rates: – **2.4 Kbps** – **4.8 Kbps** – **9.6 Kbps** – **19.2 Kbps** – **56 Kbps** – **64 Kbps**
Sec Channel	If the rate is set to 64 Kbps, the setting will not appear. Select one of the following options: – **Enable** – **Disable**
Analysis Channel	This setting only appears when the secondary channel is enabled. Select the channel where you will perform the test: – **Primary** – **Secondary** On the non-analyzed channel, an all ones idle byte signal will trans-mitted.
Error Correction	This setting only appears when the rate is set to 19.2 Kbps or lower. Specify one of the following options: – **Enable** – **Disable**

8 To specify a BERT pattern, do the following:

Go to the Pattern Settings menu.



a Select **Pattern**, and then use the arrow keys to highlight a BERT pattern from the list.

For a description of available patterns, see "BERT patterns" on page 282.

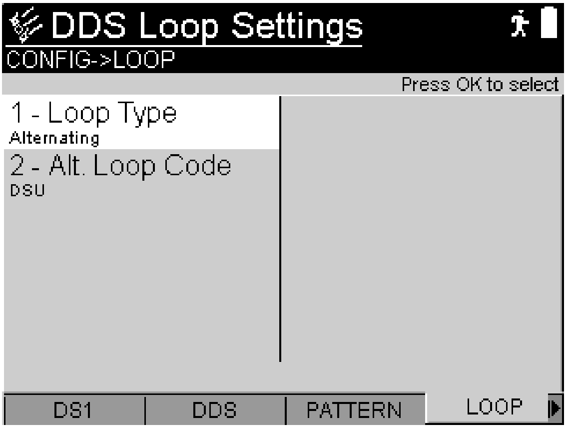
b Press the **OK** key to select the pattern.

If you selected User Bit Pattern or User Byte Pattern, you must enter additional information. The following table describes the settings.

Setting	Parameter
User Bit Patt.	Enter a binary number from 3 to 32 bits long.
User Byte Patt.	Enter a hexadecimal number from 1 to 64 bytes long.

9 To configure loop code settings, do the following:

Go to the DDS Loop Settings menu.



a Select **Loop Type**, and then select either **Alternating** or **Latching**. The menu settings change according to your selection.

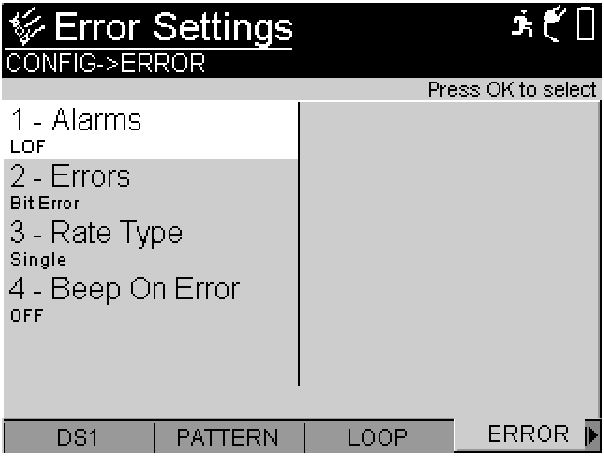
b Select either **Lat. Loop Code** or **Alt. Loop Code**.

A list of available loop codes appears.

c Select a loop code. For descriptions of available loop codes, see "T1 DDS loop codes" on page 288.

10 To select errors or alarms to insert, do the following:

Go to the Error Settings menu.



a Press the number key that corresponds to the setting you want to configure. For example, to configure an alarm, press the **1** key.

The following table shows the available settings.

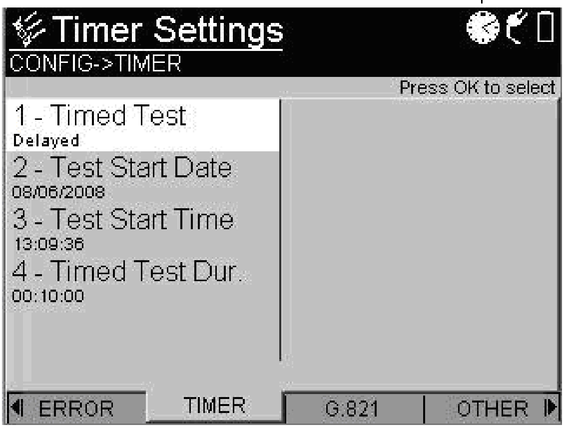
Setting	Parameter
Alarms	Select **Alarms**, and then specify the type of alarm to be inserted. For a list of available alarms, see "Alarms" on page 286.
Errors	Select **Errors**, and then specify the type of error to be inserted. For a list of available errors, see "Errors" on page 287.
Rate Type	Select **Rate Type**, and then indicate how errors will be inserted: – **Single** – **Rate** – **Multiple** Rate Type is only visible if the error type is Bit Error.

Setting	Parameter
Frame Errors	Select **Frame Errors**, and then indicate how many errors will be inserted on a single key press: 1 or 2. This is only visible if the error type is Frame Errors.
Rate	Select **Rate**, and then indicate the insertion rate for logic errors. This option is only visible if the rate type is Rate.
Error Count	Enter the number of errors to be inserted. The range is **1** though **50**. This option is only available if the Rate Type is Multiple.
Beep On Error	Select whether an audible beep will sound when an error is detected.

11 To perform a timed test, do the following:

Go to the Timer Settings menu.

Timed test icon



a Select **Timed Test**, and then select one of the following.

– **Enabled** – turns on timed testing

– **Disabled** – turns off timed testing

– **Delayed** – sets timed testing to run at a specific date and time.

If enabled or delayed is selected, a clock icon appears in the upper right corner of the display.

If you selected Enabled, proceed to step d.

If you selected Delayed, proceed to step b.

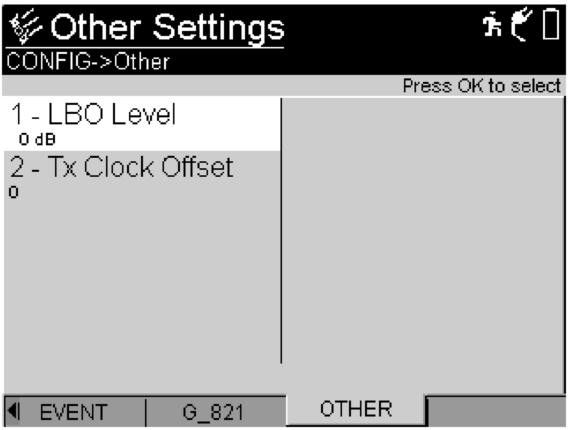
b Select **Test Start Date** and then enter the month, day, and year that you want to run the test.

c Select **Test Start Time** and then enter the hour, minute, and second at which you want to begin the test.

d Select **Timed Test Dur** and then enter the number of hours, minutes, and seconds you want the test to run.

12 To configure cable loss level or clock offset for the transmit signal, do the following:

Go to the Other Settings menu.



a Select the following settings, and specify the parameters:

Setting	Parameters
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock Offset	Enter the offset frequency generated by the 1544 kbps internal clock. You can specify a frequency within the following range: **-50** through **50** ppm. To specify negative or positive numbers, press the **+/-** soft key. To clear the entire field, press the **Clear** key. To delete a single character, press the **Delete** soft key.

13 If you are using two test sets, skip to step 15. If you are configuring a loopback test, connect the HST to the test access point (see Figure 10):

– Connect the HST T1 Tx Primary jack to the DSX-1 TX (In) jack.

– Connect the HST Rx Primary jack to the DSX-1 RX (Out) jack.

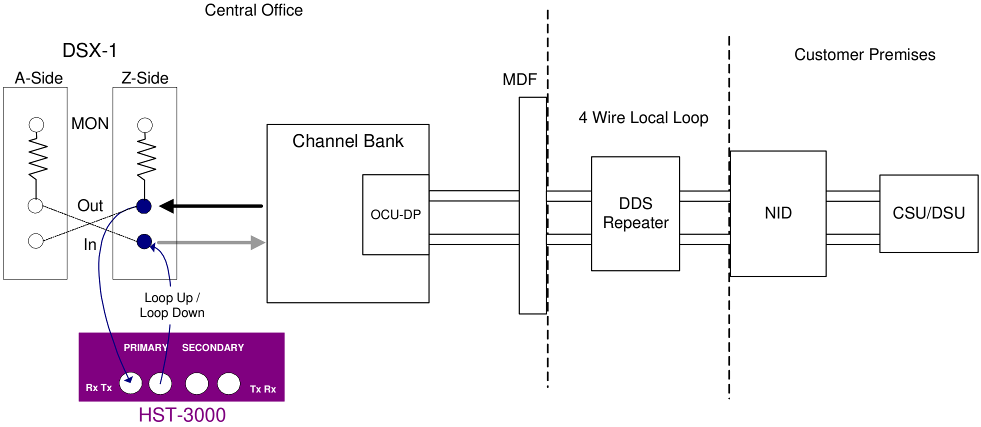


Figure 10 Loopback Connections

14 Proceed to step 16.

15 If you are using the HST and another test set, you will likely be accessing the circuit at the 66 block, network interface device (NID), or DSX-1 patch panel. The following instructions describe how to connect the HST to a DSX-1 patch panel (see Figure 11):

– Connect the HST T1 Primary Tx to the DSX-1 TX (In) jack.

– Connect the HST T1 Primary Rx to the DSX-1 RX (Out) jack.

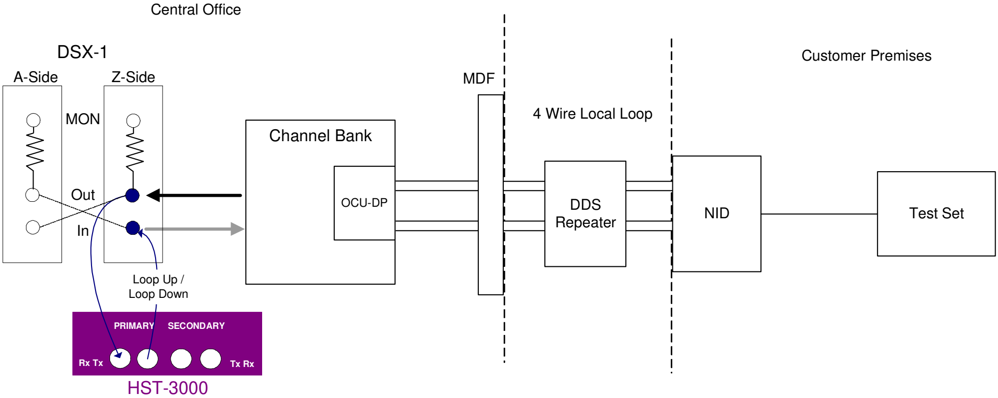


Figure 11 End-to-end connection

16 Press the **Home** navigation key.

17 Press the **Restart** soft key to clear all alarms and begin the test.

18 To insert errors, do one of the following:

– Press the **1** key.

– Press the **Action** soft key and then press the **1** key.

This inserts the number and type of error that you specified on the Error Settings menu.

The error is inserted into the Primary Tx (transmit) path.

19 To enable or disable alarms, do one of the following:

– Press the **3** key.

– Press the **Action** soft key and then press the **2** key.

This enables or disables the type of alarm that you specified on the Error Settings menu.

The alarm is inserted into the Primary Tx (transmit) path.

20 To send loop commands, press the **Actions** soft key, select **Loop Action**, and then select either **Loop Up** or **Loop Down**. The loop command is sent to the device you selected on the Loop Settings menu.

21 If the circuit is physically looped back, check to see that the inserted errors are received in the Summary test result category. If you are performing an end-to-end test, verify that the test sets at each end of the circuit received the inserted errors.

22 To view test results, see "Viewing test results" on page 90.

23 To stop a running test, press the **Cancel** key.

You have finished BER testing a DDS channel.

Viewing test results

The following procedure describes how to view test results.

To view test results

1 Configure and run a test.

2 Press the **Home** navigation key.

3 Press the **Display** soft key.

The test categories appear.

4 Select a category.

Test results for the selected category appear. For descriptions of test results, see "T1, FT1, DDS, and Pulse Shape Test Results" on page 213.

Troubleshooting

Table 11 describes situations that you may encounter when using the HST-3000.

Table 11 Problems and resolutions

Issue	Description	Resolution
The following results are not available: DDS Error Correction Count and DDS Error Correction Seconds	The error correction results do not appear in the Interface test result category.	The error correction results only appear when error correction is enabled. To enable error correction: – Press the **Configure** navigation key. – Press the **DDS** soft key. – Check the Rate setting. To enable error correction, the rate must be set to 19.2Kbps or lower. – Select **Error Correction**, and then select **Enable**.
The DDS Frame Synchronization result is not available.	This result does not appear in the Interface result category.	The DDS Frame Sync result is only available when the rate is set to 19.2 Kbps (with or without error correction enabled). To set the data rate: – Press the **Configure** navigation key. – Press the **DDS** soft key. – Select **Rate**, and then select **19.2Kpbs**.

Voice Frequency (PCM) Analysis

4

This chapter describes how to use the optional PCM TIMS feature to perform testing on voice frequency (VF) circuits. Topics discussed in this chapter include the following:

About VF analysis

The HST-3000 PCM TIMS option allows you to perform tests on voice-grade and data-grade VF circuits. Tests are performed on VF circuits from a T1 access point. With the PCM TIMS option, you can do the following:

– Standard Tone Measurement — Analyze a specified DS0 channel for standard VF characteristics such as tone frequency, tone level, and DC offset.

– Noise Measurement — Test a specified DS0 channel for spectral noise analysis by filtering the received signal using C-message, D-message, 3.4 kHz, and 1,010 Hz notched filters.

– Standard Tone Transmission — Insert a single voice frequency tone over a specified DS0 channel. Tone characteristics include pre-defined and user-defined frequencies and levels.

– Loopback Tone Transmission — Insert 2713 Hz loop up and loop down tones at -10.0 dBm on the test channel.

– Three-tone Step — Insert the repeated transmission of three tones (404, 1004, and 2804 Hz) over a specified DS0 channel at a user-specified level and duration.

– Frequency Sweep — Transmit a user-defined range of tones (from 500 Hz to 3500 Hz) over a specified DS0 channel. You can configure a block out range (notch); the frequency separation between tones; the level, tone duration, and sweep direction.

– Impulse Noise — Measure impulse noise on a specified DS0 channel according to a user-defined threshold. You can also apply C- or D-message and notched filters.

– Configure Signaling Bits — You can configure and transmit AB(CD) signaling bits with either 2-bit or 4-bit binary values, depending on the specified framing format.

– Audio Output — The audible output from the HST's loudspeaker allows you to verify path continuity and identify audible faults, such as low levels, noise, and echo.

Operating modes

You can operate the PCM TIMS option in the following modes:

- **Terminate** — In Terminate mode the HST separates both sides of a T1 path. The HST terminates the input signal at the receive side and generates an independent output signal.
- **Monitor** — In Monitor mode, the HST measures the parameters of the received pulse code modulation (PCM) data signal using one or two receivers.
- **Drop & Insert** — In Drop and insert (D&I) mode the HST can access user-specified DS0 channels from a T1 line. You can then perform testing on the selected channels leaving the other channels unaffected.

Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 12 describes how the LEDs operate.

Table 12 Status LEDs

LED	Description
Sync	A two-color LED that reports the signal status. – Solid green indicates a signal is present and there is frame synchronization on all active receivers. – Flashing green indicates auto-framing is running on at least one active receiver. – Solid red indicates that at least one of the active receivers does not have signal or frame synchronization. – If the Sync LED is not illuminated, no signal has been detected on any active receiver.
Data	The Data LED is not used in VF (PCM) analysis.

Table 12 Status LEDs (Continued)

LED	Description
Error	An LED that reports error conditions. – If the Error LED is not illuminated it means all results are OK. – Solid red indicates an error.
Alarm	An LED that reports alarm status (Yellow Alarm or AIS). – If the Alarm LED is not illuminated, then no alarm was detected. – Solid red indicates an alarm was detected.
LpBk	This LED is not used in VF testing.
Batt	A three-color LED that indicates the battery status. – The LED is off when the battery has a useful charge. – It is green when the AC adapter is plugged in. – Solid red indicates the battery has 8 percent battery life, or below. – It flashes red when approximately five minutes of use remains. When this happens, the battery should be charged or replaced immediately. – If the LED is solid amber or flashing amber, the battery capacity indicator ("gas gauge") needs to be reset (see the *HST-3000 Base Unit User's Guide*).

VF test options

The PCM TIMS option offers the following types of tests: Quiet Tone, Holding Tone, Three Tone, Single Tone, Frequency Sweep, and Impulse Noise. You can also specify values for AB(CD) signaling bits. The following sections provide an overview of each test type. For instructions on performing tests, see "Performing VF analysis" on page 98.

Quiet tone test

This test lets you measure noise on a PCM data circuit when no tones are present and one end of the circuit has been terminated. This test simulates this condition by inserting a code representing zero signal (0xFE) into the test channel.

Holding tone test

This test lets you transmit a tone, with a frequency of 1004 Hz and a transmit level of -16 dBm, on the test channel.

Three tone test

This test lets you measure the frequency response of the test channel when three tones (404, 1004, and 2804 Hz) are transmitted. These tones are transmitted automatically and repetitively as a step. You can specify the transmission duration for each tone, and you can specify the transmit level. All three tones are transmitted at the same level.

Single tone test

This test lets you transmit any one of five preset tone frequencies, or a user-defined frequency from 20 to 3904 Hz on the test channel. You can also specify any one of five preset tone levels, or specify a user-defined level from -40.0 to 3.0 dBm.

Frequency sweep test

This test lets you transmit a specified range of tones on the test channel. You can configure the upper and lower bounds of the range to be anywhere from 500 Hz to 3500 Hz. You can also set a blocked (notched) frequency range as well as the step size, the amount of frequency separation between tones.

Additionally, you can specify the point at which the HST begins transmitting the tones, either from higher to the lower frequency or from lower to higher. The range of tones is transmitted repeatedly at a user-specified level and duration.

Impulse noise test

This test lets you measure impulse noise on the test channel. You can specify the threshold for detecting instances of impulse noise (impulse noise hits). Additionally, you can apply C- or D-message and notched filters. When you start the test, the HST will clear any previous results and start new count of impulse noise hits.

User-defined signaling bits

Depending on the specified line framing format, you can assign 2- or 4-bit values to the AB(CD) signaling bits. If the framing format is set to D4/SF or SLC-96, you can configure a 2-bit value. If the framing format is set to ESF, you can configure a 4-bit value. This feature is only available in Terminate and D&I modes. Also, you cannot define signaling bits if you are accessing the VF settings from the PCM Signaling application (see "PCM Signaling Analysis" on page 109).

Performing VF analysis

The following procedure describes how to use the HST-3000 to perform VF analysis from a T1 line.

To perform VF analysis

1. Launch the **VF** (voice frequency) application. See "Launching an application" on page 6.
2. Press the **Configure** button.

   The Summary Settings menu appears, listing the key settings for the application you launched.
3. Review the Summary Settings.

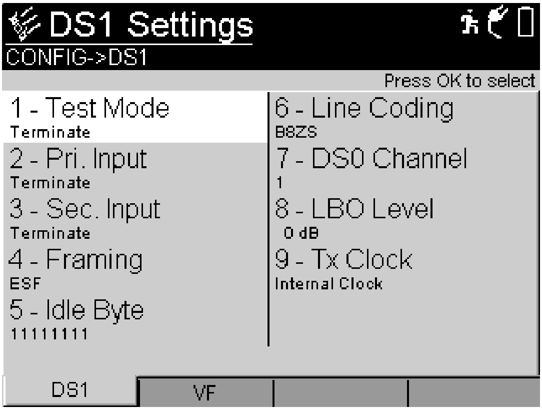
   If the settings are appropriate for your test, press the **Home** key and proceed to step 7.

To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad
– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 4.

4 Go to the DS1 Settings menu.



Configure the settings by pressing a number on the keypad that corresponds to the setting you want to configure. For example, press the **1** key to configure the operating mode.

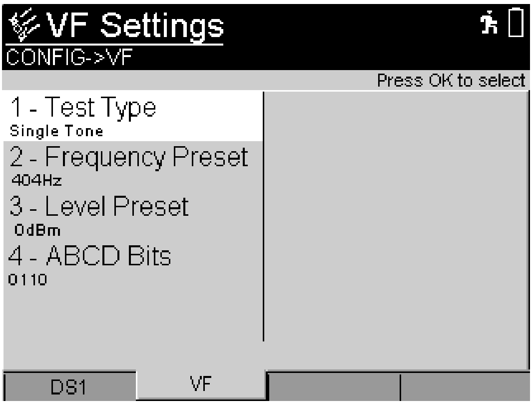
The following table describes the available options on the DS1 Settings menu.

Setting	Parameters
Test Mode	Select one of the following operating modes: – **Terminate** – **Monitor** – **Drop & Insert** For descriptions of each mode, see “Operating modes” on page 95.

Setting	Parameters
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate**: Used to terminate a line with 100 Ω – **DSX Monitor** (default): Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20 dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary receiver (Rx) to one of the following: **– Bridge** **– Terminate** **– DSX Monitor** For descriptions, see Pri. Input.
Framing	Select the framing format for the signal: – **Auto** – **Unframed** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**
Idle Byte	Type an 8-bit binary value. This idle pattern will be transmitted in the channels that are not selected for test.

Setting	Parameters
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion
DS0 Channel	Enter a number for the channel you want to test. The channel range is from **1** to **24**. Press the **OK** key.
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock	Specify the signal timing source for the Primary Tx output: – **Internal** – **Recovered from Primary Rx** – **Recovered from Secondary Rx**

Go to the VF Settings menu.



5 Select **Test Type**, and then select one of the following tests (For test descriptions, see “VF test options” on page 96):

- **Quiet Tone**. After you select this option, skip to step 6 on page 105.
- **Holding Tone**. After you select this option, skip to step 6 on page 105.
- **Three Tone**. Configure the settings for the test:

Settings	Parameters
Level Preset	Select the decibel level for the tones: – **3 dBm** – **0 dBm** – **-10 dBm** – **-13 dBm** – **-16 dBm** – **User Level**
User Level	This option appears when you select User Level as the Level Preset. Specify the level the at which the tones will be transmitted. You can enter a value from -40.0 dBm to 3.0 dBm.
404Hz Duration 1004Hz Duration 2804Hz Duration	Select one of the three tones, and then enter the number of seconds for the duration. The minimum is **2** seconds the maximum is **60** seconds. The default duration is 5 seconds.

– **Single Tone**. Configure the settings for the test:

Settings	Parameters
Frequency Preset	Select one of the following frequencies: – **404 Hz** – **1004 Hz** – **2713 Hz** – **2804 Hz** – **User Frequency**
Frequency	This setting appears when the Frequency Level is configured to User Frequency. Enter a frequency. The range is **20** to **3904** Hz.
Level Preset	Select the decibel level for the tones: – **3 dBm** – **0 dBm** – **-10 dBm** – **-13 dBm** – **-16 dBm** – **User Level**
User Level	This setting appears when the Level Preset is configured to User Level. Specify the level the at which the tone will be transmitted. You can enter a value from **-40.0** dBm to **3.0** dBm.

– **Frequency Sweep**. Configure the settings for the test:

Setting	Parameters
Level Preset	Select the decibel level for the tones: – **3 dBm** – **0 dBm** – **-10 dBm** – **-13 dBm** – **-16 dBm** – **User Level**
User Level	This setting appears when the Level Preset is configured to User Level. Enter a value, from **-40.0** dBm to **3.0** dBm, to specify the level the at which the tones will be transmitted.
Frequency Range	You can specify a range from **20** to **3904** Hz. Select **Lower Frequency**, and then enter a value for the lower boundary of the frequency range. Select **Upper Frequency**, and then enter a value for the upper boundary of the frequency range.
Tone Duration	Enter a value, from **2** to **10** seconds, to indicate how long each tone will be transmitted.
Step Size	Enter a value, from **10** to **1000** Hz, to indicate the amount of separation between tones.
Sweep Direction	Select **Up** to begin the sweep from the lower frequency boundary. Select **Down** to begin the sweep at the upper frequency boundary.

Setting	Parameters
Blocked Range	This setting indicates a frequency range that will not be transmitted as part of the sweep. The blocked range can be from **20** to **3904** Hz. The default range is 2450 to 2750 Hz. Select **Lower Frequency**, and then enter a value for the lower boundary of the blocked frequency range. Select **Upper Frequency** and then enter a value for the upper bounder of the blocked frequency range.

– **Impulse Noise**. Configure the settings for the test:

Setting	Parameters
Impulse Noise Threshold	Enter a value, from **60** to **93** dBrn, to indicate when the HST will detect impulse noise.
Filter Type	Apply one of the following filters: **No Filter** **C Message** **C Notched** **D Message** **D Notched**

6 Configure the signaling bits:

a Depending on the specified DS1 framing format, one of the following settings appears: **ABCD Bits** or **AB Bits**. Select the available setting.

b Enter values for each signaling bit. The values must be either one (1) or zero (0).

c Press the **OK** key.

7 Connect the HST to the line:

- For Terminate testing, see Figure 6 on page 44.
- For Monitor testing, see Figure 3 on page 28.
- For Drop and Insert testing, see Figure 8 on page 60.

8 Press the **Home** navigation key.

9 *For D&I mode only*. To enable (or disable) insertion for drop and insert testing, press the **Actions** soft key, and then select **Enable D&I** (or **Disable D&I**).

10 To start the test, press the **Restart** soft key.

You can hear received tones through the HST's speaker. The speaker is located on the bottom panel above the RS-232 connector.

11 *Optional*. To transmit a loop up or loop down tone, press the **Actions** soft key, and then select **Loop Action>Loop Up** or **Loop Down**.

The Loop Action Status screen appears, indicating that the HST is sending the loop up or loop down tone.

- If you transmitted a loop up tone, and the HST receives the same tone within 10 seconds, the screen indicates that the loop up action succeeded. If the HST does not receive the tone within 10 seconds, the screen indicates that the loop up action failed.
- If you transmitted a loop down tone, and the HST receives the same tone and then loses the tone within 10 seconds, the screen indicates that the loop down action succeeded. If this does not occur within 10 seconds, the screen indicates that the loop down action failed.

12 To adjust the speaker level, do one of the following:

- Press the **Actions** soft key, and then select **Enable Mute** or **Disable Mute**.
- Hold down the second function key (the blue key located at the lower right corner of the keypad) while pressing either the **1** key or the **4** key.

13 To enable (or disable) the HST's microphone, press the **Action** soft key, and then select **Enable Microphone** (or **Disable Microphone**).

The microphone appears as a small hole and is located next to the right most soft key. Enabling the microphone allows you to quickly check for audible faults, such as low levels and noise.

14 To view results, see "Viewing test results" on page 107.

NOTE:

If any of the following DS1 or DS3 alarms are present, all VF measurements will be disabled until the alarm condition ends: LOS, AIS, LOF, Yellow alarm, Blue alarm.

When the line is alarm and error free, the HST will clear the VF measurements and automatically restart the test.

You have completed VF analysis.

Viewing test results

The following procedure describes how to view test results.

To view test results

1. Configure and run a test.
2. Press the **Home** navigation key.
3. To view results, press the **Display** soft key, and then select **VF**.

   The VF results appear. For descriptions of test results, see "VF Test Results" on page 235.
4. To view other results, press the **Display** soft key, and select a different result category.

Troubleshooting

Table 13 describes situations that you may encounter when using the HST-3000.

Table 13 Issues and resolutions

Issue	Descriptions	Resolution
Voice frequency measurements are not available	If any of the following DS1 or DS3 alarms are present, all VF measurements will be disabled until the alarm condition ends: LOS, AIS, LOF, Yellow alarm, Blue alarm.	When the line is error and alarm free, the HST will clear the VF measurements and automatically restart the test.

PCM Signaling Analysis

5

This chapter describes how to use the HST-3000's optional PCM Signaling Analysis feature. Topics discussed in this chapter include the following:

About PCM signaling analysis

The HST-3000 PCM Signaling option allows you to perform signaling analysis for the robbed-bit in-band signaling standard. You can test against different trunk types and, with the VF (PCM) analysis option, you can establish a call to transmit or receive voice or tones without dropping the call. Signaling tests are applicable only to Mu Law digital encoded circuits. Testing is performed from a T1 access point.

With the PCM Signaling option, you can perform the following test operations:

– Monitor a call — The HST can analyze both directions of a user-specified DS0 channel on a T1 line for call activity. Call activity includes supervisory events and DTMF, MF, and DP digit recognition (DP digits on Loop Start and Ground Start trunks only). Each activity event is displayed in the test results.

– Place a call — The HST can emulate the CPE (PBX) or CO side of a network by originating a call over a user-specified DS0 channel on a duplex T1 circuit. Calls can incorporate DTMF digits, MF digits, DP digits (DP digits on Loop Start and Ground Start trunks only), as well as other signaling events.

– Receive a call — The HST can emulate the CPE (PBX) or CO side of a network by terminating a call over a specified DS0 channel on a duplex T1 circuit. Calls can incorporate DTMF digits, MF digits, DP digits (DP digits on Loop Start and Ground Start trunks only), as well as other signaling events.

– Digit/Event analysis — The HST can display the characteristics of each received DTMF, MF, DP digit (DP digits on Loop Start and Ground Start trunks only), and signaling event. Analysis results include digit/event delay and duration, digit address type (DTMF, MF, or DP). Digit analysis also includes upper and lower frequency and level measurements for DTMF and MF tones.

– Voice frequency (VF) analysis — After placing or receiving a standard PCM call, you can perform VF analysis while maintaining the call. In addition to signaling results, VF results, such as DC offset, frequency, and level measurements are available.

Test modes

You can perform signaling analysis in the following modes:

Terminate — In Terminate mode both sides of a T1 path are separated; the input signal is terminated at the receive side; and a totally independent signal is generated for the output.

Monitor — In Monitor mode you can select a DS0 channel from a duplex T1 circuit and monitor all channel activity. Channel activity includes all originating and terminating supervisory events and originating digits. In Monitor mode, you cannot insert data on a T1 line.

Drop and Insert (D&I) — When you select D&I mode (without enabling D&I) data passes through the HST's primary and secondary interfaces. You can monitor the originating and terminating sides of a call (see Figure 12 on page 112). When you enable D&I, you can place or receive a call on a user-specified DS0. The selected DS0 channel on the primary interface is terminated at the HST. Other DS0 channels pass through the HST. The selected channel on the secondary interface is held in the on-hook state (see Figure 13 on page 112).

Figure 12 shows the HST in drop and insert (D&I) mode with D&I disabled. When D&I is disabled, data passes through the HST.

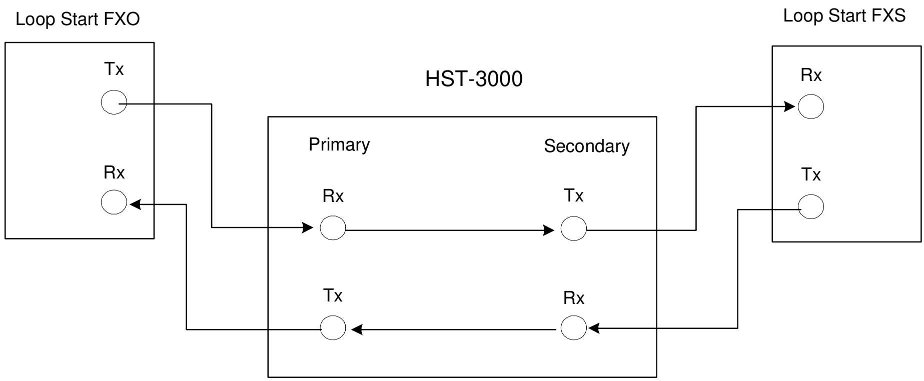


Figure 12 Drop and insert with D&I disabled

Figure 13 shows the HST configured as a loop start foreign exchange station (FXS), with D&I mode enabled. When D&I is enabled, the selected channel is terminated at the HST. Other channels pass through the HST. The selected channel on the secondary interface is held in the on-hook state.

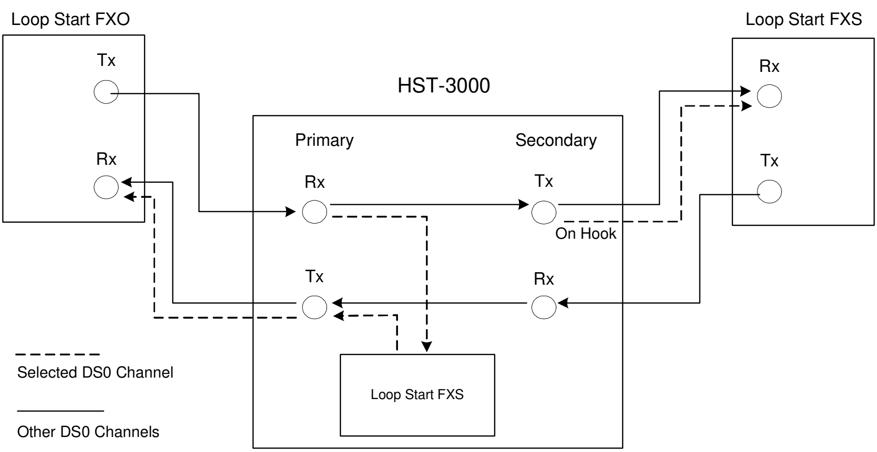


Figure 13 Drop and insert with D&I enabled

Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 14 describes how the LEDs operate.

Table 14 Status LEDs

LED	Description
Sync	A two-color LED that reports the signal status. – Solid green indicates a signal is present and there is frame synchronization on all active receivers. – Flashing green indicates auto-framing is running on at least one active receiver. – Solid red indicates that at least one of the active receivers does not have signal or frame synchronization. – If the Sync LED is not illuminated, no signal has been detected on any active receiver.
Data	This LED is not used in this application.
Error	An LED that reports error conditions. – If the Error LED is not illuminated it means all results are OK. – Solid red indicates an error.
Alarm	An LED that reports alarm status (Yellow Alarm or AIS). – If the Alarm LED is not illuminated, then no alarm was detected. – Solid red indicates an alarm was detected.
LpBk	The loopback LED is not used in this application.

Table 14 Status LEDs (Continued)

LED	Description
Batt	A three-color LED that indicates the battery status. – The LED is off when the battery has a useful charge. – It is green when the AC adapter is plugged in. – Solid red indicates the battery has 8 percent battery life, or below. – It flashes red when approximately five minutes of use remains. When this happens, the battery should be charged or replaced immediately. – If the LED is solid amber or flashing amber, the battery capacity indicator ("gas gauge") needs to be reset (see the *HST-3000 Base Unit User's Guide*).

Trunk type signaling

Trunk type signaling is used to define the On Hook and Off Hook status, and other states of the A, B, C, and D signaling bits. All trunk types are available regardless of the T1 Interface framing mode (for example, SLC trunk types can be selected without SLC framing). The available trunk types are as follows:

- Standard E&M (Ear and Mouthpiece)
- Ground Start
- Loop Start

Each type of trunk signaling is described in the following sections.

Standard E & M signaling

Standard E&M signaling is used on trunks between switches in the public switched telephone network (PSTN). Table 15 describes Standard E&M signaling. An X indicates a “don’t care” condition.

Table 15 Standard E&M signaling

Direction	Trunk Status	Signaling Bits
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=1 B=1 (C=1 D=1)
Receive	On Hook	A=0 B=X (C=0 D=X)
	Off Hook	A=1 B=X (C=1 D=X)

Loop start signaling

Loop start trunk signaling emulates standard signaling between a telephone and a switch. This is the most common type of trunk found in residential installations. Signaling for the various types of loop start trunks is as follows:

– FXS (foreign exchange station)
– FXO (foreign exchange office)
– SLC (subscriber line carrier) Station
– SLC Office

Table 16 describes each type of loop start trunk signaling. An X indicates a “don’t care” condition.

Table 16 Loop start trunk signaling

Direction	Trunk Status	Signaling Bits
FXS Signaling		
Transmit	On Hook	A=0 B=1 (C=0 D=1)
	Off Hook	A=1 B=1 (C=1 D=1) Loop closed

Table 16 Loop start trunk signaling (Continued)

Direction	Trunk Status	Signaling Bits
Receive	On Hook	A=0 B=1 (C=0 D=1)
	Off Hook	A=0 B=1 (C=0 D=1)
	Ringing	A=X B=0 (C=X D=0)
FXO Signaling		
Transmit	On Hook	A=0 B=1 (C=0 D=1)
	Off Hook	A=0 B=1 (C=0 D=1)
	Ringing	A=0 B=0 (C=0 D=0)
Receive	On Hook	A=0 B=X (C=0 D=X) Loop Idle
	Off Hook	A=1 B=X (C=1 D=X) Loop closed
SLC Station Signaling - ESF Framing		
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=1 B=0 (C=1 D=0)
Receive	On Hook	A=1 B=1 (C=1 D=1)
	Off Hook	A=1 B=1 (C=1 D=1)
	Ringing	A=1 B=1 (C=1 D=0)
SLC Station Signaling - D4/SF/SLC-96 Framing		
Transmit	On Hook	A=0 B=0
	Off Hook	A=1 B=0
Receive	On Hook	A=1 B=1
	Off Hook	A=1 B=1
	Ringing	A=1 B=0/1

Table 16 Loop start trunk signaling (Continued)

Direction	Trunk Status	Signaling Bits
SLC Office Signaling - ESF Framing		
Transmit	On Hook	A=1 B=1 (C=1 D=1)
	Off Hook	A=1 B=1 (C=1 D=1)
	Ringing	A=1 B=1 (C=1 D=0)
Receive	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=1 B=0 (C=1 D=0)
SLC Office Signaling - D4/SF/SLC-96 Framing		
Transmit	On Hook	A=1 B=1
	Off Hook	A=1 B=1
	Ringing	A=1 B=0/1
Receive	On Hook	A=0 B=0
	Off Hook	A=1 B=0

Ground start signaling

Ground Start trunk type circuits provide additional supervision to prevent outgoing calls on circuits with incoming calls present. The signaling for the various types of Ground Start trunks is as follows:

- FXS (Foreign Exchange Station)
- FXO (Foreign Exchange Office)
- SLC (Subscriber Line Carrier) Station
- SLC Office

Table 17 describes each type of ground start trunk signaling. An X indicates a “don’t care” condition.

Table 17 Ground start signaling

Direction	Trunk Status	Signaling Bits
FXS Signaling		
Transmit	On Hook	A=0 B=1 (C=0 D=1)
	Ground	A=0 B=0 (C=0 D=0) Ground on Ring
	Off Hook	A=1 B=1 (C=1 D=1) Loop closed after the far end, FXO sends A=0 (Ground on Tip)
Receive	On Hook	A=1 B=X (C=1 D=X) No Tip Ground
	Off Hook	A=0 B=1 (C=0 D=1) Tip Ground
	Ringing	A=X B=0 (C=X D=0)
FXO Signaling		
Transmit	On Hook	A=1 B=1 (C=1 D=1) No Ground on Tip
	Off Hook	A=0 B=1 (C=0 D=1) Tip Ground
	Ringing	A=0 B=0 (C=0 D=0)
Receive	On Hook	A=0 B=1 (C=0 D=1) Loop Idle
	Ground	A=0 B=0 (C=0 D=0) Ground on Ring
	Off Hook	A=1 B=1 (C=1 D=1) Loop closed

Table 17 Ground start signaling (Continued)

Direction	Trunk Status	Signaling Bits
SLC Station Signaling - ESF Framing		
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Ground	A=0 =1 (C=0 D=1)
	Off Hook	A=1 B=0 (C=1 D=0)
Receive	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=0 B=1 (C=0 D=0)
	Ringing	A=1 B=1 (C=1 D=0)
SLC Station Signaling D4/SF/SLC-96 Framing		
Transmit	On Hook	A=0 B=0
	Ground	A=0 B=1
	Off Hook	A=1 B=0
Receive	On Hook	A=0 B=0
	Off Hook	A=0 B=0/1
	Ringing	A=1 B=0/1
SLC Office Signaling - ESF Framing		
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=0 B=1 (C=0 D=0)
	Ringing	A=1 B=1 (C=1 D=0)
Receive	On Hook	A=0 B=0 (C=0 D=0)
	Ground	A=0 =1 (C=0 D=1)
	Off Hook	A=1 B=0 (C=1 D=0)

Table 17 Ground start signaling (Continued)

Direction	Trunk Status	Signaling Bits
SLC Office Signaling D4/SF/SLC-96 Framing		
Transmit	On Hook	A=0 B=0
	Off Hook	A=0 B=0/1
	Ringing	A=1 B=0/1
Receive	On Hook	A=0 B=0
	Ground	A=0 B=1
	Off Hook	A=1 B=0

Monitoring a call

You can monitor call activity on a specified DS0 channel or scan specific channels for call activity. The HST captures the call activity and displays the results. The following procedure describes how to monitor a call on a DS0 channel from a T1.

To monitor a call

1 Launch the **Signaling** application. See “Launching an application” on page 6.

2 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

3 Select **Test Mode**, and then select **Monitor**.

For descriptions of the test modes, see “Test modes” on page 111.

4 Review the remaining Summary Settings.

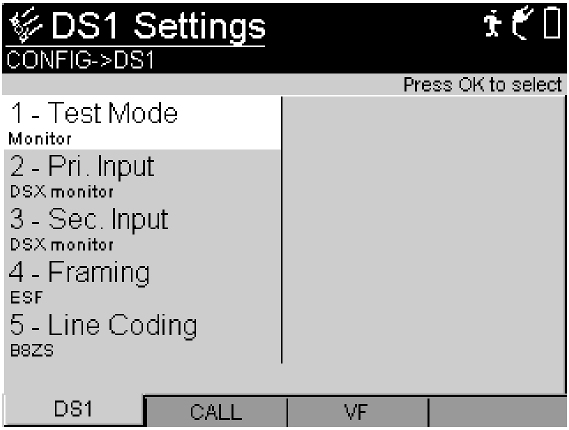
If the settings are appropriate for your test, press the **Home** key and proceed to step 8.

To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad
– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 5.

5 Go to the DS1 Settings menu.



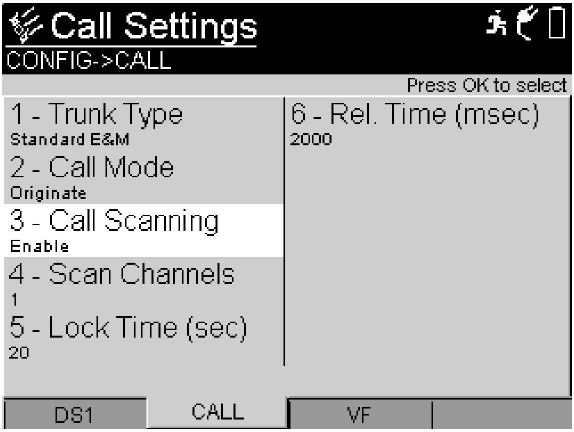
Configure the remaining settings by pressing the number key that corresponds to the option you want to configure. For example, press the **4** key to specify the framing format.

The following table describes the remaining settings.

Setting	Parameter
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate**: Used to terminate a line with 100 Ω – **DSX-Monitor** (default): Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary receiver (Rx) to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.
Framing	Select the framing format for the signal: – **Auto** – **Unframed** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion

Setting	Parameter
DS0 Channel	This option is not visible when call scanning is enabled. Enter a value, from **1** to **24**, for the channel you want to test, and then press the **OK** key.

Go to the Call Settings menu.



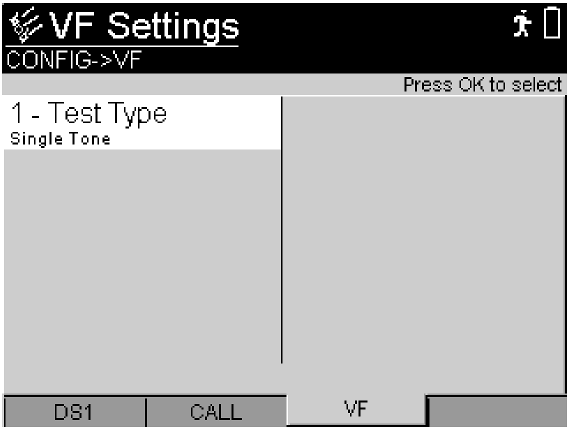
6 Press the number on the keypad that corresponds to the setting you want to configure.

Setting	Parameter
Trunk Type	Select one of the following trunk types: – **Standard E&M** – **Loop Start** – **Ground Start** For information about trunk types, see “Trunk type signaling” on page 114.

Setting	Parameter
Equipment (Pri)	For loop start and ground start trunk types, select the type of equipment that will be connected to the primary receiver: – **FXO** – **FXS** – **SLC Office** – **SLC Station** For additional information, see “Loop start signaling” on page 115 or “Ground start signaling” on page 117.
Call Mode	Specify how the call will originate and terminate for the primary and secondary paths: – **Originate** – **Terminate**
Call Scanning	When enabled, this setting causes the HST to scan specified channels for originating and terminating signaling events and digits. The call activity results are collected and displayed chronologically. When the HST is scanning for active channels, the speaker is muted. Select one of the following: – **Enable**: turns call scanning on – **Disable**: turns call scanning off

Setting	Parameter
Scan Channels	This setting is only available when call scanning is enabled. Use the arrow keys to highlight a DS0 channel, and then press the **OK** key to select the highlighted channel. You can select up to 24 channels. After you've selected the channels, press the **Commit** soft key to save your choices and return to the previous menu.
Lock Time	This setting is only available when call scanning is enabled. Enter a value, from **1** to **600** seconds, to indicate how long the HST will remain locked onto a channel.
Rel. Time	This setting is only available when call scanning is enabled. Enter a value, from **100** to **5000** milliseconds, to indicate how long the ends of the two inputs remain in the on-hook state (after completion of the call) before the HST begins scanning again.

Go to the VF Settings menu.



7 Select **Test Type**, and then select one of the following tests (For test descriptions, see "VF test options" on page 96):
   - **Quiet Tone**
   - **Holding Tone**
   - **Three Tone**
   - **Single Tone**
   - **Frequency Sweep**
   - **Impulse Noise**

8 Connect the HST to the line. See Figure 3 on page 28.

9 Press the **Home** navigation key.

10 To start the test, press the **Restart** soft key.

11 To enable voice frequency testing, press the **Action** soft key, and then select **Enable VF Testing**.

12 To view test results, see "Viewing test results" on page 133.

13 To stop a running test, press the **Cancel** key.

You have completed the monitor operation.

Placing or receiving calls

In Terminate and Drop and Insert (D&I) modes, you can use the HST-3000 to emulate a PBX, switch, or telephone to place or receive calls, and perform voice frequency (VF) testing on DS0 channels. The HST supports placing and receiving calls in either direction on a switched network.

The following procedure describes how to place and receive calls.

To place or receive a call

1. Launch the **Signaling** application. See "Launching an application" on page 6.
2. Press the **Configure** button.

   The Summary Settings menu appears, listing the key settings for the application you launched.
3. Select **Test Mode**, and then select **Monitor**.

   For descriptions of the test modes, see "Test modes" on page 111.
4. Review the remaining Summary Settings.

   If the settings are appropriate for your test, press the **Home** key and proceed to step 9.

   To change the settings, do one of the following:

   – Navigate to the desired item by selecting the item number using the keypad

   – Use the arrow keys to highlight the item and then press OK.

   If you want to configure additional settings, proceed to step 5.
5. Go to the DS1 Settings menu.

Select **Test Mode**, and then select one of the following modes:

– **Terminate**

– **Drop and Insert**

For descriptions of the operating modes, see "Test modes" on page 111.

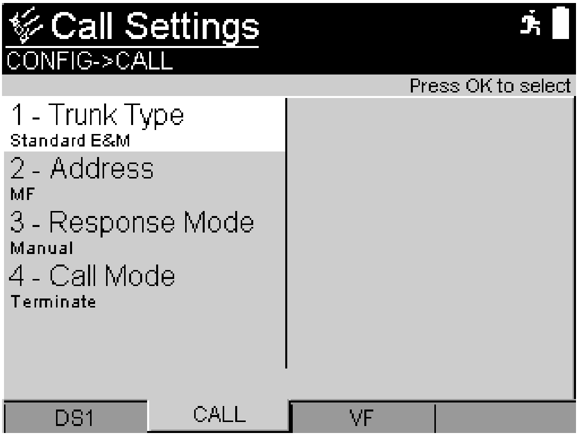
6 Configure the remaining settings by pressing the number key that corresponds to the setting you want to configure. For example, press the **4** key to specify the framing format.

The following table describes the remaining settings.

Setting	Parameters
Pri. Input	The primary input setting becomes effective immediately and should be set before the HST is connected to the line. Set the Primary receiver (Rx) to one of the following: – **Bridge**: High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** (default): Used to terminate a line with 100 Ω – **DSX-Monitor**: Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Sec. Input	Set the Secondary receiver (Rx) to one of the following: – **Bridge** – **Terminate** – **DSX-Monitor** For descriptions, see Pri. Input.

Setting	Parameters
Framing	Select the framing format for the signal: – **Auto** – **ESF**: D4 Extended SuperFrame format – **D4/SF**: D4 SuperFrame format – **SLC-96**: Subscriber Line Carrier
Idle Byte	Enter an 8-bit binary value. In terminate mode, this idle pattern will be transmitted on inactive channels on the primary Tx.
Line Coding	Select one of the following line coding options: – **B8ZS**: Bipolar 8 zeros substitution – **AMI**: Alternate mark inversion
DS0 Channel	Enter a number for the DS0 channel you want to test. You can select any one of 24 channels. After you enter the number, press the **OK** key.
LBO Level (Line Build Out)	Specify the level of cable loss for the output signal: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock	Specify the signal timing source for the Primary Tx output: – **Internal** – **Recovered from Primary Rx** – **Recovered from Secondary Rx**

Go to the Call Settings menu.



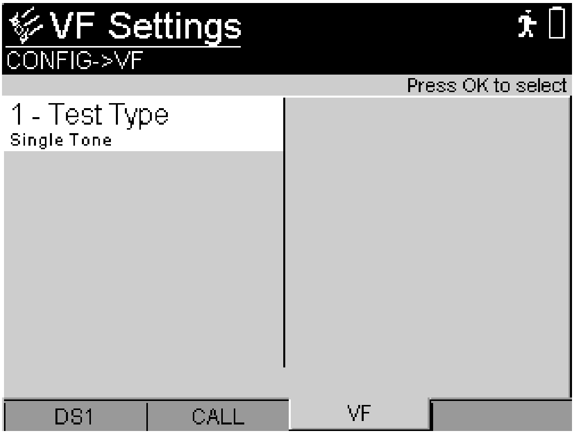
7 Configure the call settings by pressing the number key that corresponds to the setting you want to configure. For example, press the **1** key configure the trunk type.

The following table describes the setting parameters.

Setting	Parameters
Trunk Type	Select one of the following trunk types: – **Standard E&M** – **Loop Start** – **Ground Start** For information about trunk types, see “Trunk type signaling” on page 114.

Setting	Parameters
Equipment	For loop start and ground start trunk types, select one of the following signaling types: – **FXO** – **FXS** – **SLC Office** – **SLC Station** For additional information, see "Loop start signaling" on page 115 and "Ground start signaling" on page 117.
Address	Specify one of the following digit types: – **MF**: Multi frequency digit type – **DP**: Dial Pulse digit type – **DTMF**: Dual Tone Multi frequency
Response Mode	Specify one of the following modes: – **Auto** – **Manual**
Call Mode	Select one of the following: – **Originate**: This option indicates the HST will originate a call on a DS0 channel. The call receiver must be connected to the HST's primary interface. – **Terminate**: This option indicates the HST will terminate a call on a DS0 channel. The call originator must be connected to the HST's primary interface.

Go to the **VF** Settings menu.



8 Configure the voice frequency test settings. See page 102, step 5.

9 Connect the HST to the line:

– For terminate testing, see Figure 6 on page 44.

– For drop and insert testing, see Figure 8 on page 60.

10 Press the **Home** navigation key.

11 To start the test, press the **Restart** soft key.

12 Press the **Action** soft key, and then select one of the following options:

Option	Action
To enable/disable D&I testing	Select **Enable D&I** or **Disable D&I**. You must enable D&I before you can send a signaling event or digit on the test channel in Drop and Insert mode.

Option	Action
To send a signaling event, such as a on/off hook, ring, key pulse (KP), start signal (ST), or A, B, C, or D key	Select the signaling event you want to send. Options vary based on the selected trunk type and whether you are placing or receiving a call.
To enable/disable voice frequency testing	Select **Enable VF Testing** or **Disable VF Testing**.
To enable or disable the HST's microphone	Select **Enable Microphone** or **Disable Microphone**. **NOTE:** You cannot transmit tones (DTMF/MF/VF) while the microphone is enabled.

13 To send dial digits, use the HST keypad.

14 To stop a running test, press the **Cancel** key.

You have completed testing.

Viewing test results

The following procedure describes how to view test results.

To view test results

1. Configure and run a test.
2. Press the **Home** navigation key.
3. To view signaling events, press the **Display** soft key, and then select **Call**.

   Signaling event results appear.
4. For information about these results, see "Call results" on page 251.

5 To display upper and lower frequency and power information for a DTMF or MF digit, do the following:

   a Use the arrow keys to highlight the event, and then press the **OK** key.

   b The HST displays the power and frequency information.

   c Press the **OK** key again to view the call results.

6 To view additional results, press the **Display** soft key, and then select a test result category.

   For descriptions of test results, see "Signaling Test Results" on page 247.

7 To save test results, see the following sections:
   - "Saving signaling events" on page 134
   - "Saving test results" on page 135

Saving signaling events

The following procedure describes how to save current signaling events to a file. In this procedure only the results (signaling events) that appear in the Call result category are saved. For information on saving other test results, see "Saving test results" on page 135.

To save signaling events

1 Configure and start a test. See the following sections:
   - "Monitoring a call" on page 120
   - "Placing or receiving calls" on page 127

2 Press the **Results** soft key.

3 Select **Capture Sig Events**.

   A dialog box prompts you for a file name. The default file name is `SigEventsCapture.txt`.

4 To accept the default file name, press the **OK** key. To change the default file name, use the keypad to enter a file name, and then press the **OK** key.

The results in the Call category are saved to the file in the following directory: `/results/T1` directory.

5 For information about managing files on the HST, see "Managing Files" in the *HST Base Unit User's Guide*.

You have finished saving signaling events.

Saving test results

The following procedure describes how to save current test results, except the signaling event results that appear in the Call category. For information about saving Call events, see "Saving signaling events" on page 134.

To save test results (except Call results)

1 Configure and start a test. For information, see the following sections:

– "Monitoring a call" on page 120

– "Placing or receiving calls" on page 127

2 Press the **Results** soft key.

3 Select **Save**.

A dialog box appears prompting you for a file name. The default file name is `Results.txt`.

4 To save the file with the default name, press the **OK** key. To change the default name, use the HST keypad to enter a new file name, and then press the **OK** key.

The HST saves the results. A status message appears telling you whether the results were successfully saved.

Results are saved to the following directory: `/results/T1` directory.

5. Press the **OK** key.
6. For information about managing files on the HST, see "Managing Files" in the *HST Base Unit User's Guide*.

You have finished saving results.

ISDN PRI testing

6

This chapter provides information on testing ISDN PRI service using the HST-3000 ISDN PRI testing option. Topics discussed in this chapter include the following:

– "Verifying the switch to a backup D Channel" on page 175
– "Monitoring ISDN PRI service" on page 177
– "Interpreting D Channel decode messages" on page 184
– "Viewing test results" on page 193
– "Troubleshooting" on page 193

About ISDN PRI testing

The HST-3000 ISDN PRI testing option enables you to install and maintain ISDN PRI services over T1 interfaces. Using the option, you can place, receive, and analyze calls, test data services using BERT analysis, test voice services using a microphone/speaker audio headset, and monitor physical (layer 1), LAPD (layer 2), and Q.931 (layer 3) results.

Features and capabilities

Using the ISDN PRI testing option, you can:

– Store frequently used numbers in a phone book, and then select a number from the phone book when placing a call.

– Place and receive calls using the standard transmit-receive DS1 interfaces. After a call is established, you can insert voice traffic into the associated B Channel, or perform BERT analysis on the B Channel.

– Emulate a network termination device such as a PBX or terminal equipment device (for example, an ISDN phone) using Terminal equipment (TE) mode.

– Emulate a switch or network termination device using Network termination (NT) mode.

- Process calls for switches using the following call control protocols:
  - AT&T 5ESS
  - Nortel DMS 100
  - National ISDN-1 (NI-1) and National ISDN-2 (NI-2)
  - Siemens EWSP
- Verify that ISDN PRI service using NFAS switches to a backup D Channel as needed.
- Passively monitor and analyze ISDN PRI service while the network is in-service.
- Isolate and locate problems by viewing D channel decode text for all captured transmitted and received frames when you monitor or terminate ISDN PRI service. After viewing the decode text, you can save the text to a file on the HST-3000.
- Perform BERT analysis of two B Channels simultaneously.
- Transfer B Channels for two connected calls to verify video conferencing applications.
- Use the Multimode Call Summary Results screen to process up to 23 calls simultaneously.
- Import and export files with captured frames using FTP, and generate ASCII print output of the files from the HST.

Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 18 describes the LEDs.

Table 18 Status LEDs

LED	Description
Sync	A two-color LED that reports the signal status. – Green indicates a signal is present and there is frame synchronization on all active receivers. – Red indicates that at least one of the active receivers does not have signal or frame synchronization. – If the Sync LED is not illuminated, no signal has been detected on any active receiver.
Data	A two-color LED that reports pattern synchronization status. – Green indicates pattern synchronization has been achieved for each call you are BER testing. – Red indicates that the receiver for at least one call you are BER testing does not have pattern synchronization. – If the Data LED is not illuminated, it means the selected traffic pattern is live, or no pattern synchronization has been detected on the applicable receivers.
Error	An LED that reports error conditions. – Solid red indicates an error. – If the Error LED is not illuminated it means all results are OK.
Alarm	An LED that reports alarm status (Yellow Alarm or AIS). – Solid red indicates an alarm was detected. – If the Alarm LED is not illuminated, then no alarm was detected.

Table 18 Status LEDs (Continued)

LED	Description
LpBk	An LED that shows when the HST is in loopback. **NOTE:** The LpBk LED is not applicable when testing ISDN PRI.
Batt	A three-color LED that indicates the battery status. – The Batt LED is off when the battery has a useful charge. – Solid green indicates the AC adapter is plugged in. – Solid red indicates the battery has 8 percent battery life, or below. – Flashing red indicates about five minutes of use remains. When this happens, the battery should be charged or replaced immediately. For information about recharging or changing the battery, see the *HST-3000 Base Unit User's Guide*. – Solid or flashing amber indicates the battery capacity indicator ("gas gauge") needs to be reset (see the *HST-3000 Base Unit User's Guide*).

Operating Modes

With the ISDN PRI testing option, the HST-3000 can operate in the following modes:

Terminate Mode — This mode is for testing out-of-service lines using the Primary and Secondary T1 transmitter (Tx) and the Primary and Secondary T1 receiver (Rx). In Terminate mode, you can use the HST to emulate terminal equipment (TE) such as a PBX or an Integrated Access Device (IAD), or a network termination (NT) device such as a switch.

Monitor Mode — This mode allows you to monitor traffic on in-service ISDN PRI lines. Both the Primary and Secondary T1 receiver can be used simultaneously.

Headset connector

When you place and receive voice calls from the HST-3000, you can use a 2.54mm microphone/speaker audio headset to insert voice data into the associated B channels. The headset connects to the HST-3000 through the headset connector located on the top panel (see Figure 14).

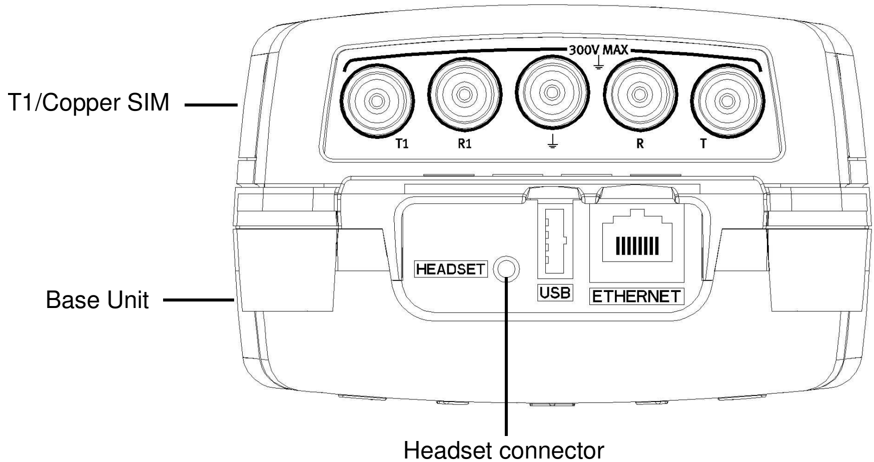


Figure 14 Headset connector located on the top panel

Using the Restart soft key

When you use the HST-3000 to place and receive ISDN PRI calls, pressing the **Restart** soft key clears statistical results and restarts your test.

Pressing Restart does not:

- Disrupt current calls.
- Clear D-channel decode text. A separate Clear Buffer action is available for clearing the decode message buffer (see “Clearing the message buffer” on page 191).

Setting up the phone book

You can define and store frequently used phone numbers in the HST phone book, and then speed dial a number when placing a call. Each phone book entry consists of a name, phone number, numbering type, and numbering plan.

To set up the HST phone book

1 If the HST is off, press the green power button to power on the unit.

It may take several seconds for the unit to fully power on. When a menu appears, you can begin using the unit.

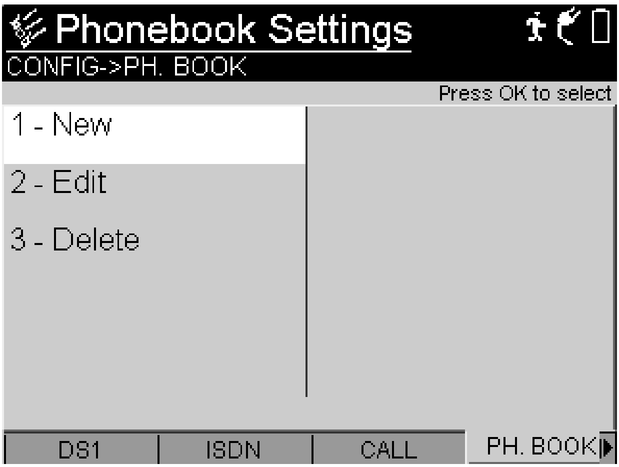
Go to the T1 Measurements menu.

2 Select **ISDN PRI**.

The HST-3000 launches the test application, and the Summary Results screen appears.

3 Press the **Configure** navigation key.

Go to the Phonebook Settings menu.



4 To add a new entry, select **New.**

The Name dialog box appears.

5 Type the name for the entry using up to 20 characters, and then press **OK**.

The Number dialog box appears.

6 Type the phone number for the entry, and then press **OK**.

The Numbering Type dialog box appears.

7 Select the numbering type for the entry, and then press **OK**.

The Numbering Plan dialog box appears.

8 Select a numbering plan, and then press **OK**.

The HST stores the new phone book entry, and the Phonebook Settings tab appears.

Placing calls on the primary T1

You can use the HST to place calls by emulating a PBX or TE device, or by emulating a switch or NT device. When you configure the HST to place a call, you specify the settings required to activate the physical layer (DS1 Settings) and initialize ISDN service over the D Channel (ISDN Settings).

After service is initialized, the HST establishes a data link and is ready to carry out ISDN call processing using the Call Settings you specify.

NOTE:

You will not hear a dial tone when you place calls from the HST. This is normal for devices placing ISDN calls.

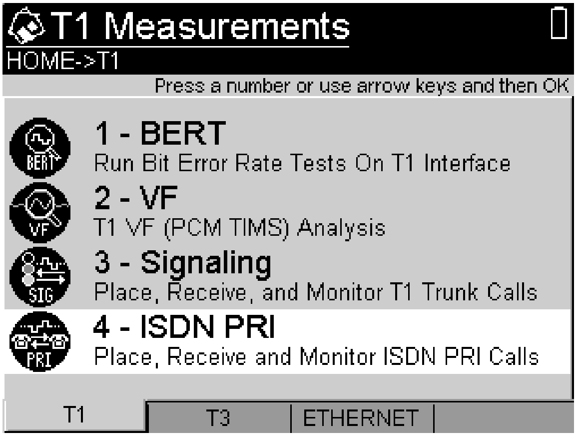
Use the following procedure to set up the HST-3000 to place calls on a single T1.

To place calls on a single T1

1 If the HST is off, press the green power button to power on the unit.

It may take several seconds for the unit to fully power on. When a menu appears, you can begin using the unit.

Go to the T1 Measurements menu.



2 Select **ISDN PRI**.

The HST-3000 launches the test application, and the Summary Results screen appears.

3 Press the **Configure** navigation key.

The Summary Settings screen appears. This screen provides the most important settings for the test.

4 Review the Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 9.

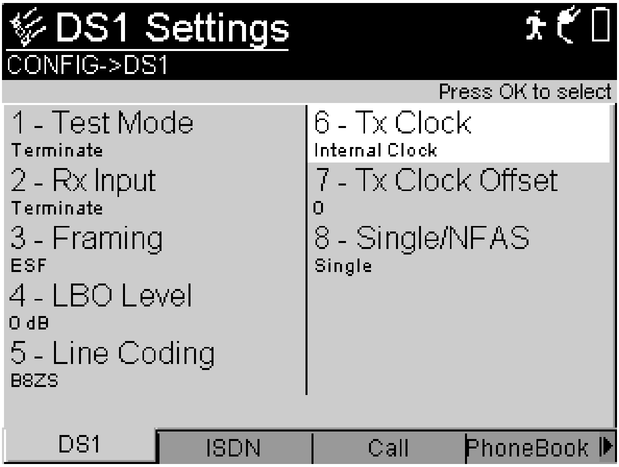
To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 5.

5 Go to the DS1 Settings menu.



To configure the DS1 settings, press the number key for the setting you want to specify.

You can also use the arrow keys to select the setting you want to change, and then press the **OK** key. If you want to exit a menu, press the **Cancel** key.

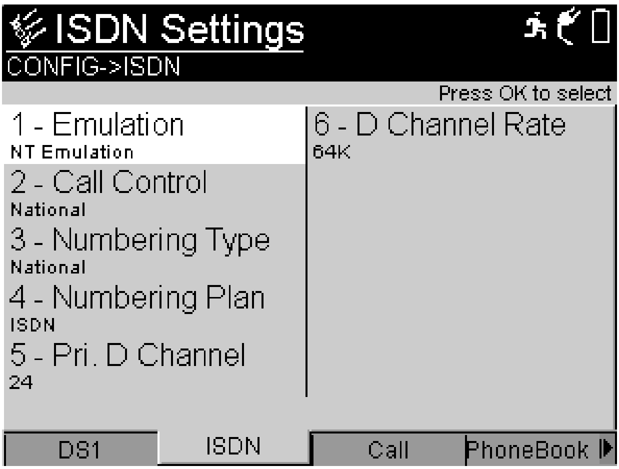
The following table describes the parameters.

Setting	Parameter
Test Mode	Select **Terminate** to place and receive calls while emulating a NT device or switch (NT Emulation), or a TE device or PBX (TE Emulation).

Setting	Parameter
Rx. Input	**NOTE:** The input setting becomes effective immediately and should be set before the HST is connected to the line. Set the input to one of the following: – **Bridge** — High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1 kΩ – **Terminate** — Used to terminate a line with 100 Ω – **DSX monitor** — Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20 dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Framing	Select the framing format for the signal: – **Auto** — Select Auto to allow the HST to automatically configure the framing. – **ESF** — Extended SuperFrame format – **D4/SF** — D4 SuperFrame format
LBO Level	Set the LBO level for the receiver to one of the following: **– 0 dB** **– -7.5 dB** **– -15.0 dB** **– -22.5 dB**
Line Coding	Select one of the following line coding parameters: – **B8ZS** (Bipolar 8 zeros substitution) – **AMI** (alternate mark inversion)

Setting	Parameter
Tx Clock	– If you are emulating a NT device, accept the default value, **Internal Clock**. – If you are emulating a TE device, select **Recovered**.
Tx Clock Offset	Enter the offset frequency generated by the 1544 kbps internal clock. You can specify a frequency within the following range: **-50** through **50** ppm. – To specify negative or positive numbers, press the **+/-** soft key. – To clear the entire field, press the **Clear** key. – To delete a single character, press the **Delete** soft key.
Single/NFAS	Set to **Single** to indicate that the D Channel is providing signaling for a *single* ISDN PRI.

Go to the ISDN Settings menu.

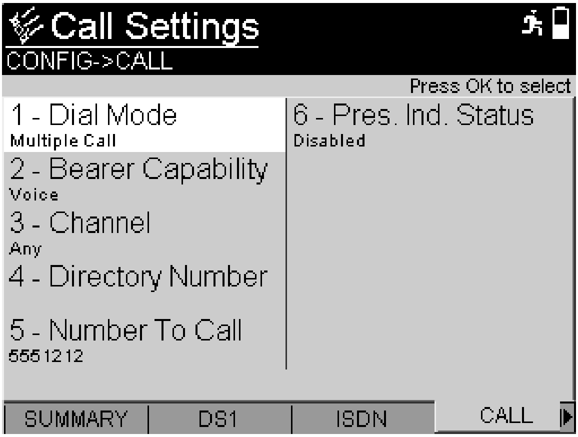


6 Select, and then define each of the following settings:

Setting	Parameter
Emulation	Select one of the following: – **TE Emulation** — If you select this setting, the HST places a call to the network as if the call was originated from a PBX or a TE device. – **NT Emulation** — If you select this setting, the HST places a call to a TE as if the call was originated by another TE on the network.
Call Control	Select one of the following: – **NATIONAL** — For National ISDN-1 (NI-1) or National ISDN-2 (NI-2) compliant switches. – **5ESS** — For AT&T 5ESS. – **DMS** — For Nortel DMS 100. **NOTE:** The majority of ISDN providers use the NATIONAL call control protocol. 5ESS and DMS are typically used by providers who have a custom or proprietary method for implementing ISDN.

Setting	Parameter
Numbering Type	Select one of the following: – **Unknown** – **International** – **National** – **Local** – **Auto** **NOTE:** The numbering type refers to the format and number of digits used when a caller dials a phone number. For example, National indicates a 10 digit number is used; Local indicates a 7 digit number is used.
Numbering Plan	Select one of the following: – **Unknown** – **ISDN** – **Private** **NOTE:** Calls using NATIONAL call control always use an ISDN numbering plan.
Pri. D Channel	Enter the time slot number for the primary D channel. The default is 24.
D Channel Rate	Set the D Channel Rate to one of the following: – **56K** – **64K** **NOTE:** 64K is typically the rate for D channels.

Go to the Call Settings menu.



7 Select, and then define each of the following settings for the next outgoing call:

Setting	Parameter
Dial Mode	Select one of the following: – **Multiple Call**, if you want to place up to 23 calls. – **Dual Call**, if you intend to perform BER analysis of two connected calls.
Bearer Capability	Select one of the following: – **Voice** – **3.1k Audio** – **Data**
Bearer Rate (Data calls only)	If you are placing a data call, select one of the following rates: – **64K** – **56K** – **Nx64K** – **H0**

<table>
<tr><th>Setting</th><th>Parameter</th></tr>
<tr><td>Bearer Interface ID</td><td>If you specified NFAS (on the DS1 settings menu), enter the Interface ID for the bearer channel. The default ID is 0.</td></tr>
<tr><td>Channel</td><td>Select a channel (1 - 24), or select Any to place the call on any available channel.
NOTE: The Channel parameter is not applicable for Nx64K or Nx56K data calls; use the Channel Map option to specify the FT1 channels.</td></tr>
<tr><td>Channel Map
(Nx64K or Nx56K bearer rates only)</td><td>If you selected Nx64K or Nx56K for a data call, specify the FT1 channels. Use the arrow keys to highlight a channel (timeslot), and then press OK to select the channel.
– Use Select All to select all 24 channels.
– Use Clear All to clear all selected channels.
– Use Commit to store the selected channels and return to the Call Settings screen.</td></tr>
<tr><td>H0 Channels
(H0 Bearer Rate only)</td><td>If you selected H0 as your bearer rate, specify one of the following H0 Channel ranges:
– 1 - 6
– 7 - 12
– 13 - 18
– 19 - 24</td></tr>
</table>

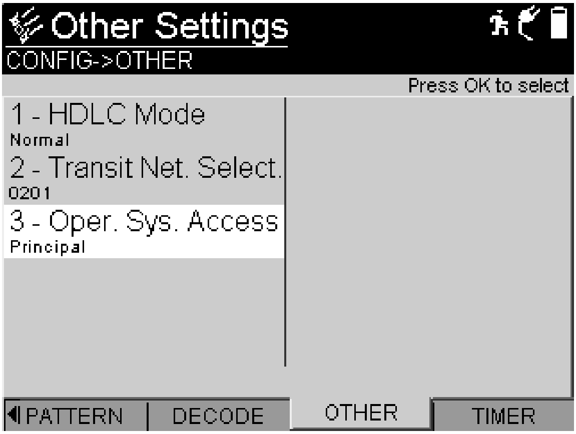
Setting	Parameter
Directory Number	Enter the number the HST is using to identify the line for the outgoing call using up to 30 digits. Think of this as the caller ID of the call placed from the HST.
Number to call	Enter the number to call using up to 30 digits, *, and #.
Call Answer Mode (Dual Call mode only)	If you want to change the current call answer mode for the HST, select one of the following modes: – **Prompt.** Prompt mode sets up the HST to prompt you to accept, reject, or ignore each incoming call as it comes in. If you ignore a call, you can answer or reject the call later. – **Accept.** Accept mode sets up the HST to automatically accept up to 2 incoming calls, and then reject any additional calls. You can always check the Summary Results screen to see if a call is active on the HST. – **Reject.** Reject mode sets up the HST to automatically reject all incoming calls.

Setting	Parameter
Pres. Ind. Status	Presentation Indicator Status. When enabled, it provides the ability to control the presentation indicator when a directory number (DN) is provided. This is necessary when making inter-LATA calls through certain switches.
Pres. Ind. (if *Pres. Ind. Status* is **Enabled**)	Presentation Indicator. This provides instructions on whether the calling line identity is allowed to be presented. – Presentation Allowed – Presentation Restricted – Number Not Available
Screening Ind. (if *Pres. Ind. Status* is **Enabled**)	Screening Indicator. This provides information on the source and the quality of the provided information. – Network Provided – User Provided Failed Screening – User Provided Passed Screening – User Provided Not Screened

NOTE:

The call settings you specify only apply to the next outgoing call you make using the HST. The settings do not impact currently active calls or incoming calls.

Go to the Other Settings menu.



8 Select, and then define each of the following settings:

Setting	Parameter
HDLC Mode	Set the HDLC mode to one of the following: – **Normal** – **Inverted** **NOTE:** Normal is typically the correct mode.
Transit Net. Sel.	Specify the transit network select code for the network that the call will be routed to.
Oper. Sys. Access	Specify one of the following for the operator system access: – **Principal.** If the default operator system for the network is used, select Principal. – **Alternate.** If an alternate operator system has been established by subscription, select Alternate. – **None.** If no operator system is used, select None.

9 Connect the HST-3000 to the test access point (see Figure 15):

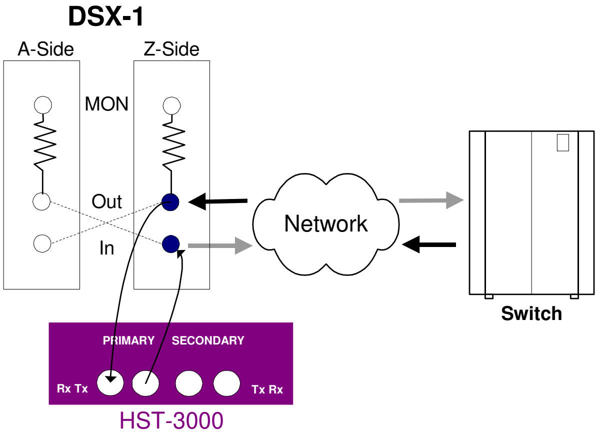


Figure 15 Single T1 terminate mode connection

10 Verify that the Sync LED is illuminated, indicating that the T1 signal is present and frame synchronization has occurred.

11 Press the **Home** navigation key, and then do the following:

   a Use the Display soft key to select the Summary category.

   b Verify that the LAPD State result says `Mult. Frm. Est.`

12 Press the **Action** soft key, and then do one of the following:

   – If you specified a number to call in step 7 on page 151, select **Dial Call 1**.

   – If you want to speed dial a number from the HST phone book, select **Speed Dial (Call 1)**.

The Speed-Dial List appears, listing each of the entries you defined in the phone book. Press the number key for the entry you want to speed dial, or use the arrow keys to select the entry, and then press the **OK** key.

13 .Verify that the call status is `CONNECTED` on the Summary Results, Call 1 Results, or Call 2 Results screen.

> **NOTE:**
>
> If the call status is not `CONNECTED`, you can view the cause value (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen. See "Q.931 Cause Values" on page 270 for descriptions of each code.

14 *Optional*. If you want to place a second call, do one of the following:

– If you selected **ANY** channel for the call in step 7, select **Dial Call 2** or **Speed Dial (Call 2)**.

– If you selected a specific channel for the call in step 7, repeat steps step 10 on page 156 through step 11 on page 156, and then use the Action soft key to select **Dial Call 2** or **Speed Dial (Call 2)**.

Test results, the D-Chan Ready status, the D Channel service status (if applicable), and the status of each call placed appear on the Summary Results screen.

– For information on inserting DTMF tones, see "Transmitting DTMF tones" on page 160.

– For information on inserting BERT errors into the B Channel, see "Performing BER analysis of a call" on page 171.

– For instructions on inserting voice traffic into the B Channel, see "Inserting voice traffic into a call" on page 169.

– For information on viewing D Channel decode information, see "Interpreting D Channel decode messages" on page 184.

– For general information about viewing results, see "Viewing test results" on page 193.

– For information on disconnecting a call, see "Disconnecting a call" on page 159.

You have placed an ISDN PRI call.

Using the HST in Multiple Call mode

In Multiple Call mode, you can process up to 23 calls on the Call Summary Results screen. In Figure 16, all 23 calls are connected.

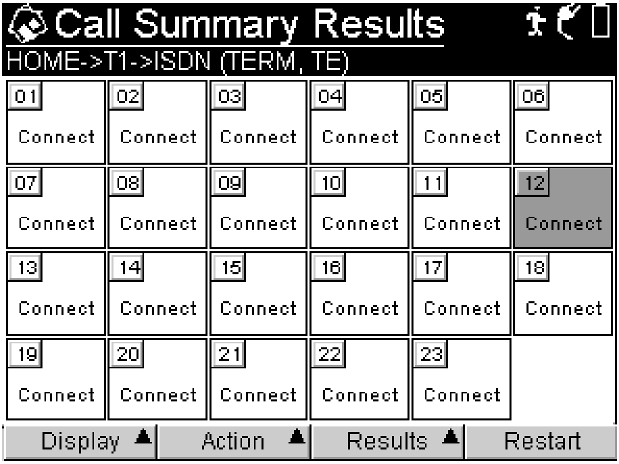


Figure 16 Call Summary Results

To process a call on the Call Summary Results screen

1 Use the arrow keys to highlight the call on the summary screen.

2 Do one of the following:

– If you want to view detailed information about the call, press **OK**. The Call results category screen appears, listing detailed call information (see "Call results" on page 264).

– If you want to dial, speed dial, BER test, or disconnect the call, press the **Action** soft key, and then select the action you want to perform.

You have processed a call.

Disconnecting a call

You can disconnect connected calls on the HST using the Action soft key.

To disconnect a call

1 Use the Action soft key to select **Disconnect Call 1**, **Disconnect Call 2**, or **Disconnect Call**.

2 Verify that the call status is `DISCONNECTED` on the Summary Results, Call 1 Results, Call 2 Results or Call Summary Results screen.

NOTE:

If the call status is not `DISCONNECTED`, you can view the cause value (indicating the reason the call was not disconnected) on the Call 1 Results or Call 2 Results screen. See "Q.931 Cause Values" on page 270 for descriptions of each code.

Transmitting DTMF tones

After a call's channel is assigned, you can display the Call 1, Call 2, or Call Summary Results screen, and then use the keypad to insert and transmit DTMF tones.

When you transmit DTMF tones, the HST temporarily disables the microphone.

To transmit DTMF tones

1. Place a call (see "Placing calls on the primary T1" on page 144 or "Placing calls on the secondary T1" on page 160).
2. Select the Display soft key, and then select **Call 1**, **Call 2**, or **Call**.
3. Select the Action soft key, and then choose **Audio Call 1**, **Audio Call 2**, or **Audio Call** to connect the call to the audio and speaker.
4. Enter the DTMF tones using the keypad.

The HST transmits the tones.

Placing calls on the secondary T1

When you place calls on a secondary T1, the HST-3000 uses the majority of the DS1 and ISDN settings you specify for calls placed on both the Primary and Secondary line. For example, calls placed on both lines will use the same line coding, call control, numbering type, HDLC mode, TNS, and OSA.

To place calls on a secondary T1, in addition to the shared DS1 and ISDN settings, you need to specify settings for the secondary line, such as the input settings (Bridge, Terminate, or DSX-Monitor), LBO level, interface ID, and D Channel number.

Finally, you need to specify the call settings for each call you place on the secondary T1 (including the secondary interface ID), and then dial the call(s).

The shared and Primary T1 settings are described in "Placing calls on the primary T1" on page 144. Use the procedure below to specify the remaining settings, and then place calls on the secondary line.

To place calls on the secondary T1

1 Follow step 1 through step 3 of "Placing calls on the primary T1" on page 144.

2 Press the **Configure** button.

   The Summary Settings menu appears, listing the key settings for the application you launched.

3 Review the Summary Settings.

   If the settings are appropriate for your test, press the **Home** key and proceed to step 7.

   To change the settings, do one of the following:

   – Navigate to the desired item by selecting the item number using the keypad

   – Use the arrow keys to highlight the item and then press OK.

   If you want to configure additional settings, proceed to step 4.

4 Go to the DS1 Settings menu.

Select, and then define each of the following settings for the secondary line:

Setting	Parameter
Rx. Input	**NOTE:** The input setting becomes effective immediately and should be set before the HST is connected to the line. Set the input to one of the following: – **Bridge** — High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1 kΩ – **Terminate** — Used to terminate a line with 100 Ω – **DSX monitor** — Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20 dB gain applied to the input signal to compensate for the reduced PMP amplitude.
LBO Level	Set the LBO level for the secondary receiver to one of the following: – **0 dB** – **-7.5 dB** – **-15.0 dB** – **-22.5 dB**
Tx Clock	– If you are emulating a NT device, accept the default value, **Internal Clock**. – If you are emulating a TE device, select **Recovered**.

Setting	Parameter
Tx Clock Off-set	If you are using an internal clock, enter the offset frequency generated by the 1544 kbps internal clock. You can specify a frequency within the following range: **-50** through **50** ppm. – To specify negative or positive numbers, press the **+/-** soft key. – To clear the entire field, press the **Clear** key. – To delete a single character, press the **Delete** soft key.
Single/NFAS	Set to **NFAS**. **NOTE:** You must select TE Emulation on the ISDN Settings tab to select NFAS.

Go to the ISDN Settings menu.

5 Select, and then define each of the following settings:

Setting	Parameter
D Channel Backup	– If you are emulating a device using NFAS with a second backup D channel, accept the default **Enable**. – If you are emulating a device without a second backup D channel, select **Disable**.
Pri. Interface ID	Enter the IID for the primary interface. The default is **0**.
Pri. D Channel	Specify the time slot number for the primary D channel. The default is 24.
Sec. Interface ID	Enter the IID for the secondary interface.

Setting	Parameter
Sec. D Channel	If you enabled D channel Backup, specify the time slot number for the backup D channel. The default is 24.

Go to the Call Settings menu.

6 Select, and then define each of the following settings:

Setting	Parameter
Bearer Capability	Select one of the following: – **Voice** – **3.1K Audio** – **Data**
Bearer Rate (Data calls only)	If you are placing a data call, select one of the following rates: – **64K** – **56K** – **Nx64K** – **H0**
Bearer Interface ID	Enter the Interface ID for the bearer channel.
Channel	Select a channel (1 - 24), or select **Any** to place the call on any available channel. **NOTE:** The Channel parameter is not applicable for Nx64K data calls; use the Channel Map option to specify the FT1 channels.

Setting	Parameter
Channel Map (Nx64K bearer rates only)	If you selected Nx64K for a data call, specify the FT1 channels. Use the arrow keys to highlight a channel (timeslot), and then press OK to select the channel. – Use **Select All** to select all 24 channels. – Use **Clear All** to clear all selected channels. – Use **Commit** to store the selected channels and return to the Call Settings screen.
H0 Channels (H0 Bearer Rate only)	If you selected H0 as your bearer rate, specify one of the following H0 Channel ranges: – **1 - 6** – **7 - 12** – **13 - 18** – **19 - 24**
Directory Number	Enter the number the HST is using to identify the line for the outgoing call. Think of this as the caller ID of the call placed from the HST. You can enter up to 30 digits.
Number to call	Enter the number to call using up to 30 digits, *, and #.
Call Answer Mode	See “Call Answer Mode” on page 153.

7 Connect the HST-3000 to the test access point. Figure 17 illustrates a NFAS connection.

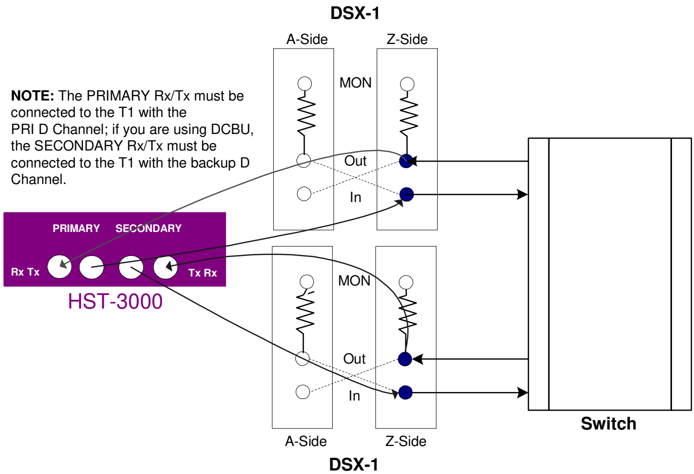


Figure 17 NFAS connection

8 Press the **Home** navigation key, and then do the following:

   a Use the Display soft key to select the Summary category.

   b Verify that the LAPD State result says `Mult. Frm. Est.`

9 Press the **Action** soft key, and then select **Dial Call 1**, or, if you want to speed dial a number from the HST phone book, select **Speed Dial (Call 1)**.

   The call is placed on the secondary line.

10 *Optional*. If you want to place a second call, do one of the following:

- If you selected **ANY** channel for the call in the Call Settings, select **Dial Call 2** or **Speed Dial (Call 2)**.
- If you selected a specific channel for the call in the Call Settings, repeat steps step 1 on page 161 through step 9 on page 166, and then use the Action soft key to select **Dial Call 2** or **Speed Dial (Call 2)**.

Test results, the D-Chan Ready status, the D Channel service status (if applicable), and the status of each call placed appear on the Summary Results screen.

- For information on inserting DTMF tones, see “Transmitting DTMF tones” on page 160.
- For information on inserting BERT errors into the B Channel, see “Performing BER analysis of a call” on page 171.
- For instructions on inserting voice traffic into the B Channel, see “Inserting voice traffic into a call” on page 169.
- For information on viewing D Channel decode information, see “Interpreting D Channel decode messages” on page 184.
- For general information about viewing results, see “Viewing test results” on page 193.
- For information on disconnecting a call, see “Disconnecting a call” on page 159.

You have placed calls on a secondary T1.

Receiving a call

If you set up the HST-3000 to prompt you whenever a call comes into the unit, a popup dialog box will appear on the current results screen prompting you to accept, reject, or ignore each incoming call. If you choose to ignore a call, you can accept or reject it later using the Answer Call or Reject Call action (available using the Action soft key).

Accepting a call

You can accept up to two calls on the HST.

When you accept a call, the call automatically connects to the microphone, and the payload is dropped to the speaker. If you are using a headset, the call connects to the headset, and the payload is dropped to the headset speaker.

You can insert voice traffic into the B channel associated with the call by speaking into the microphone or headset (see "Inserting voice traffic into a call" on page 169), or you can insert BERT tests patterns into the B channel (see "Performing BER analysis of a call" on page 171).

To accept a call when prompted

– Press **OK**.

To accept a call using the Action soft key

1 Display the Summary Results screen, and then verify that a call is coming into the unit.
2 Press the **Action** soft key, and then choose **Answer Call 1** or **Answer Call 2**.

The HST-3000 accepts the call.

Rejecting a call

When you reject a call, the HST-3000 disconnects the call.

To reject a call when prompted

– Press **Cancel**.

To reject a call using the Action soft key

1 Display the Summary Results screen, and then verify that a call is coming into the unit.

2 Press the **Action** soft key, and then choose **Disconnect Call 1** or **Disconnect Call 2**.

The HST-3000 rejects the call.

Ignoring a call

When you ignore a call, the HST-3000 closes the dialog box, but keeps the incoming call so you can choose to answer or reject it later using the Action soft key.

To ignore a call when prompted

– Press the up arrow button to select **Ignore**.

The HST-3000 ignores the call.

Inserting voice traffic into a call

When you place or receive a voice call using the HST, you can use the microphone on the HST or a headset to insert voice traffic into the call's B Channel.

To insert voice traffic into a call

1 If you are using an audio headset, connect the headset to the headset connector on the top panel of the HST (see Figure 14 on page 142).

2 Do one of the following:
   - If you are placing a call, specify the DS1, ISDN, and Call settings for the call (see “Placing calls on the primary T1” on page 144 or “Placing calls on the secondary T1” on page 160).
   - If you are receiving a call, accept the call (see “Accepting a call” on page 168).

3 Verify that the call is connected on the Summary Results, Call 1 Results, or Call 2 Results screen. The call status must be `CONNECTED`.

NOTE:

If the call status is not `CONNECTED`, you can view the cause value (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen. See “Q.931 Cause Values” on page 270 for descriptions of each code.

4 If no other call is currently connected to the audio or speaker, the HST automatically connects the call.

   If you are currently BER testing or idling another call, select the Action soft key, and then choose **Audio Call 1** or **Audio Call 2** to connect the call to the audio and speaker.

5 Speak into the microphone or the headset.

Voice traffic is inserted into the call.

NOTE:

You can only insert voice traffic into a single call at a time. If two calls are active, you can stop transmitting voice traffic on one call using the IDLE Call 1 or IDLE Call 2 action, and then insert voice traffic on the other call. The idle call remains active, allowing you to insert voice traffic at a later time, or perform BERT analysis of the call’s B Channel (see “Performing BER analysis of a call” on page 171).

Performing BER analysis of a call

When you place or receive calls using the HST, you can perform BER analysis of the B channel used after each call is established. In addition to providing T1 results, the HST provides statistics collected on the D Channel and results based on the BER analysis of the B Channel.

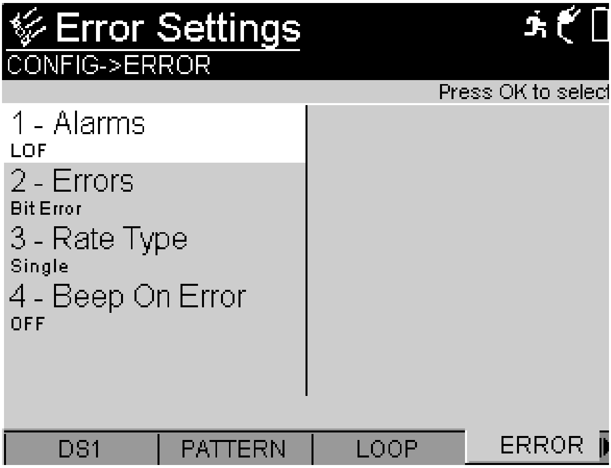
NOTE:

If you intend to BER test two calls simultaneously, be certain to specify **Dual Call** as the Dial Mode on the Call Settings menu. When the HST is in Multiple Call mode, you can only BER test a single call at a time.

To BER test a B Channel

1 Do one of the following:
   – If you are placing a call, specify the DS1, ISDN, and Call settings for the B Channel (see “Placing calls on the primary T1” on page 144 or “Placing calls on the secondary T1” on page 160).
   – If you are receiving a call, accept the call (see “Accepting a call” on page 168).
2 Press the **Configure** key.
3 Go to the Patterns menu, and then specify the pattern to insert into the B Channel (see “BERT patterns” on page 282 for a complete list of available patterns).
4 To indicate how bit errors will be inserted for the call (a single error, multiple errors, or at a specific rate), do the following:

Go to the Error Settings menu.



This screen is only available if a call is active and a BERT is running.

a Press the number key, on the keypad, that corresponds to the setting you want to configure.

The following table shows the available settings.

Setting	Parameters
Errors	N/A. For ISDN, this parameter is always set to Bit Error.
Rate Type	Select **Rate Type**, and then indicate how bit errors will be inserted: – **Single** – **Multiple** – **Rate** **NOTE:** If you are BER testing more than one call, you can specify a different rate type for each call, and then insert the error or errors for each call using the actions described in step 10 on page 174.

Setting	Parameters
Error Count	If you selected Multiple as the Rate type, enter the number of errors to be inserted. The range is **1** though **50**.
Rate	If you selected Rate as the Rate type, select the insertion rate for bit errors.
Beep On Error	Select whether an audible beep will sound when an error is detected.

5 Connect the HST-3000 to the test access point.

– For an illustration of a connection to a single T1, see Figure 15 on page 156.

– For an illustration of an NFAS connection, see Figure 17 on page 166.

6 Press the **Home** navigation key, and then use the Action soft key to select **Dial Call 1**.

7 Wait for the call to be connected (indicated by a `Connected` status on the Summary Results screen for the call).

8 To start transmitting the BERT pattern, press the **Action** soft key, and then select **BERT Call 1**.

9 If you want to BER test a second call, repeat step 1 on page 171 through step 7 on page 173, and then press the **Action** soft key to select **BERT Call 2**.

10 *Optional*. To insert errors into the B Channel, press the **Action** soft key, and then select one of the following:

- **Bit Error (Call 1)** or **Bit Error (Call 2)**—Inserts a single bit error. This action appears if you selected Single as the rate type for the call in step 4.
- **# Bit Errors (Call 1)** or **# Bit Errors (Call 2)**—Where # represents the number of bit errors that will be inserted. This action appears if you selected Multiple as the Rate type for the call in step 4.
- **Enable Bit Errors at *Rate* (Call 1)** or **Enable Bit Errors at *Rate* (Call 2)**—Where *Rate* represents the actual rate you specified. This action appears if you selected Rate as the Rate type for the call in step 4.

The error or errors are inserted into the B Channel.

11 Check the Summary Results or BERT Results screen on the HST units at each end of the circuit to verify that they received the inserted errors.

12 *Optional*. If you want to insert voice traffic into the B Channel, do the following:

a Press the **Action** soft key, and then select **IDLE Call 1** or **IDLE Call 2**.

The HST stops transmitting the BERT pattern, and the call remains active.

b Press the **Action** soft key to select **Audio Call 1**, **Audio Call 2**, or **Audio Call**.

c Speak into the microphone on the HST or the headset.

13 To disconnect each call, press the **Action** soft key, and then select **Disconnect Call 1**, **Disconnect Call 2**, or **Disconnect Call**.

BER testing is complete.

Transferring the B Channel for connected calls

You can transfer the B Channel for two connected calls.

To transfer the B channel

1. Verify that each call is connected (indicated by a `Connected` status on both the Call 1 Results and Call 2 Results screens).
2. Press the Action soft key, and then select **B Channel Transfer**.

The HST sends a message to the switch to swap the B Channels for the two calls, and then disconnects each call.

Verifying the switch to a backup D Channel

When you use the HST to place calls in Emulate PBX (TE) mode, you can verify that ISDN PRI service using NFAS with a backup D Channel switches to the backup D Channel as needed.

To verify the switch to a backup D Channel

1. Specify the DS1, ISDN, and Call settings for a call (see “Placing calls on the primary T1” on page 144 or “Placing calls on the secondary T1” on page 160).

   When verifying the switch to a backup D Channel, be certain to specify the following settings:

Setting:	Set to:
DS1, Single/NFAS	NFAS
ISDN, D Channel Backup	Enable
ISDN, Pri. Interface ID	The interface ID for the primary interface.

Setting:	Set to:
ISDN, Pri D Channel	The time slot number for the primary D channel.
ISDN, Sec. Interface ID	The interface ID for the secondary interface.
ISDN, Sec D Channel	The time slot number for the secondary D channel.
ISDN, D Channel Rate	56K or 64K

2 Connect the HST-3000 to the test access point. See Figure 17 on page 166 for an illustration of a connection for PRI service using NFAS with a backup D channel.

3 Use the **Display** soft key to select the Summary result category, and then verify that the Primary D Channel Service State result for the primary line displays `IN SERVICE`.

4 Initiate the switch to the backup D Channel by doing one of the following:

   – From the HST user interface, manually drop the primary D channel by pressing the **Action** soft key, and then selecting **Drop D Channel**.

   – From the HST, physically disconnect the T1 interface for the primary D channel.

   The primary D Channel is out-of-service and in-active, and signaling switches to the backup D Channel.

5 Use the Display soft key to select the **ISDN** result category.

   The ISDN Results screen appears.

6 Verify that the Secondary D Channel Service State result displays `IN SERVICE`.

The switch to a backup D Channel is verified.

NOTE:

To re-establish signaling on the primary D Channel, you must first put the primary D Channel back in-service by physically connecting the T1 interface for the primary D Channel (if necessary), and then selecting the **Establish D Channel** action. After the primary D Channel is in-service, you can drop the backup D Channel, and signaling will resume on the primary D Channel.

Monitoring ISDN PRI service

The HST-3000 allows you to monitor and analyze ISDN PRI service while the network is in-service. During a monitor test, the HST monitors all D Channel frames present, and then decodes received D Channel information. The HST also tracks active calls and the B Channels used.

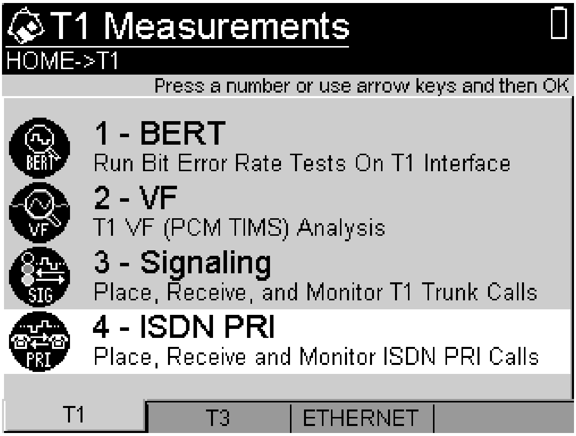
The following procedure describes how to monitor ISDN PRI service.

To monitor ISDN PRI service

1 If the HST is off, press the green power button to power on the unit.

It may take several seconds for the unit to fully power on. When a menu appears, you can begin using the unit.

Go to the T1 Measurements menu.



2 Select **ISDN PRI**.

The HST-3000 launches the test application, and the Summary Results screen appears.

3 Press the **Configure** button.

The Summary Settings menu appears, listing the key settings for the application you launched.

4 Select **Test Mode** and then select **Monitor**.

5 Review the remaining Summary Settings.

If the settings are appropriate for your test, press the **Home** key and proceed to step 9.

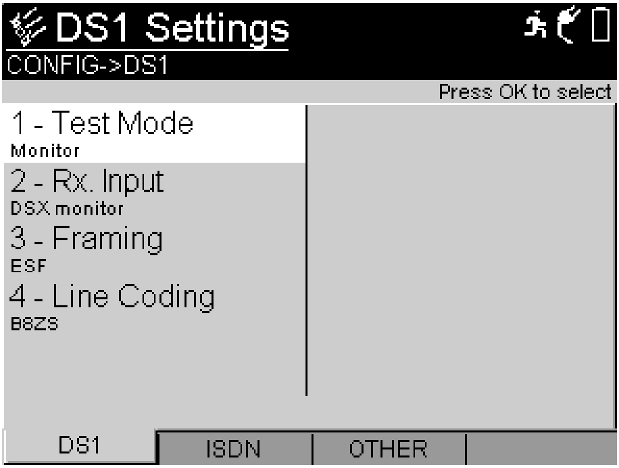
To change the settings, do one of the following:

– Navigate to the desired item by selecting the item number using the keypad

– Use the arrow keys to highlight the item and then press OK.

If you want to configure additional settings, proceed to step 6.

6 Go to the DS1 Settings menu.



To configure the DS1 settings, press the number key for the option you want to configure. For example, press the **1** key to specify the input setting.

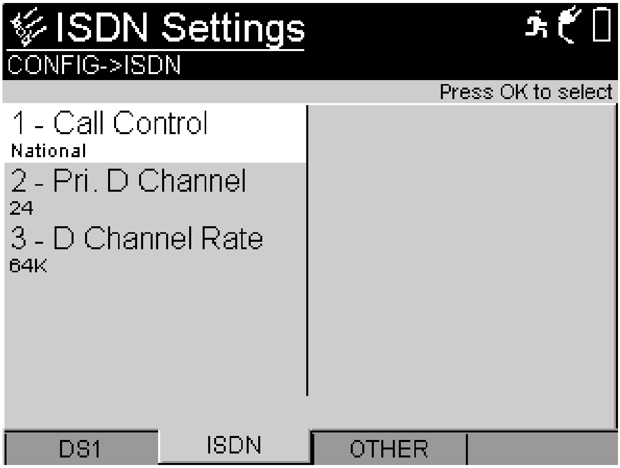
You can also use the arrow keys to select the option you want to change, and then press the **OK** key. Press the **Cancel** key to exit a menu.

The following table describes the settings.

Settings	Parameters
Test Mode	Select **Monitor** to passively monitor and analyze ISDN PRI service while a network is in-service.

Settings	**Parameters**
Rx. Input	**NOTE:** The input setting becomes effective immediately and should be set before the HST is connected to the line. Set the input to one of the following: – **Bridge** — High impedance setting used to connect to the line in a bridged arrangement, resistive termination >1k Ω – **Terminate** — Used to terminate a line with 100 Ω – **DSX monitor** — Used to connect to a protected monitor point (PMP) on the network equipment under test; provides a resistive termination of 100 Ω with 20dB gain applied to the input signal to compensate for the reduced PMP amplitude.
Framing	Select the framing format for the signal: – **Auto** — Select Auto to allow the HST to automatically configure the framing. – **ESF** — Extended SuperFrame format – **D4/SF** — D4 SuperFrame format
Line Coding	Select one of the following line coding parameters: – **B8ZS** (Bipolar 8 zeros substitution) – **AMI** (alternate mark inversion)

Go to the ISDN Settings menu.

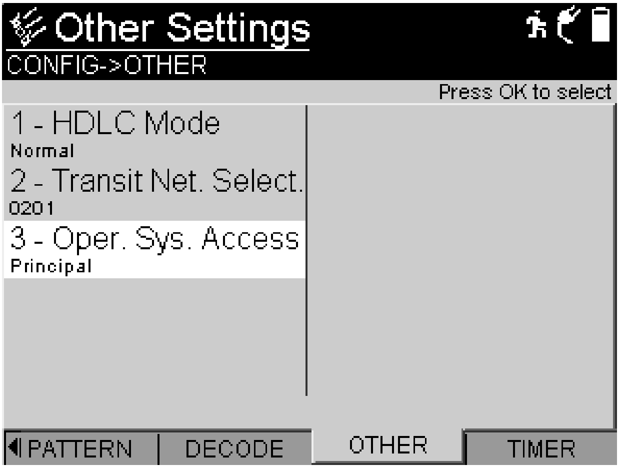


7 Select, and then define each of the following settings:

Settings	Parameter
Call Control	Select one of the following: – **NATIONAL** — For National ISDN-1 (NI-1) or National ISDN-2 (NI-2) compliant switches. – **5ESS** — For AT&T 5ESS. – **DMS** — For Nortel DMS 100. **NOTE:** The majority of ISDN providers use the NATIONAL call control protocol. 5ESS and DMS are typically used by providers who have a custom or proprietary method for implementing ISDN.
Pri. D Channel	Enter the time slot number for the primary D channel. The default is 24.

Settings	Parameter
D Channel Rate	Set the D Channel Rate to one of the following: – **56K** – **64K** **NOTE:** 64K is typically the rate for D channels.

Go to the Other Setting menu.



8 Select, and then define each of the following settings:

Settings	Parameter
HDLC Mode	Set the HDLC mode to one of the following: – **Normal** – **Inverted** **NOTE:** Normal is typically the correct mode.
Transit Net. Sel.	Specify the transit network select code for the network that calls will be routed from.

Settings	Parameter
Oper. Sys. Access	Specify one of the following for the operator system access: – **Principal.** If the default operator system for the network is used, select **Principal**. – **Alternate.** If an alternate operator system has been established by subscription, select **Alternate**. – **None.** If no operator system is used, select **None**.

9 Connect the HST-3000 to the test access point (see Figure 18):

– Connect the HST T1 Primary Rx jack to the DSX-1 A-side MON jack.

– Connect the HST T1 Secondary Rx jack to the DSX-1 Z-Side MON jack

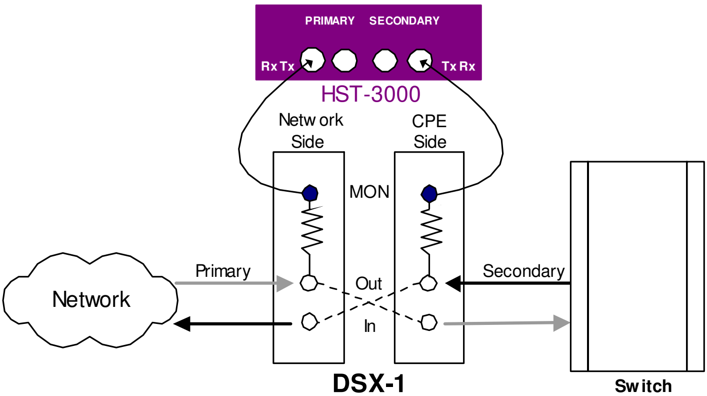


Figure 18 Monitor connections

10 Press the **Home** navigation key, and then press the **Restart** soft key to begin the test.

Test results appear in the Summary category.

- For information on viewing D channel decode information, see "Interpreting D Channel decode messages" on page 184.
- For general information about viewing results, see "Viewing test results" on page 193.

11 To stop a running test, press the **Cancel** key.

You have finished monitoring ISDN PRI service.

Interpreting D Channel decode messages

When you monitor or terminate ISDN PRI service, you can isolate and locate problems by viewing D channel decode messages for all captured transmitted and received frames. Before observing the D channel decode messages, you can define a filter to indicate which messages you want to store to the decode buffer for analysis.

The decode messages fall into two categories:

- Messages concerning the establishment and maintenance of the D channel link (layer 2 messages). These are often referred to as LAPD (Link Access Procedure D-Channel) messages.
- Messages concerning the ISDN calls, such as the reason a call is rejected, who is disconnecting a call, and the call's bearer capability (layer 3 messages). These are often referred to as Q.931 messages.

Figure 19 illustrates a sample Q.931 message indicating that a call is being setup.

```
2:
TE->NT:C  SAPI:000 TEI:000
TIME: 15:36:37.055
I   Ns=023  Nr=023  P/F=0
PD=08..............Call Reference: 00001
M 05 SETUP
I 04 BEARER CAPABILITY...........Len=  3
  80 Coding Standard...............CCITT
     Transfer Capa................Speech
  90 Transfer Mode...............Circuit
     Transfer Rate.............64 kbit/s
  A2 Layer 1 Protocol..............u-law
I 18 CHANNEL ID..................Len=  3
  A1 Indicated Channel.........Preferred
     Channel Selection................B1
     Channel Identifier.........Not D-CH
I 70 CALLED PARTY NUMBER.........Len=  7
  A1 Type of Number.......National Number
     Numbering Plan ID...............ISDN
     384060
```

Figure 19 Sample Q.931 message

You can easily determine the source of each message by looking at the message prefix on the first line. Messages originating from a TE device begin with `TE->NT`; messages originating from a NT device begin with `NT->TE`. The message in Figure 19 originated from a TE device.

Each call processed by the D channel is assigned a unique call reference number, which is reported on the fourth line of most layer 3 decode messages. The message in Figure 19 has a call reference number of `00001`. All messages exchanged in reference to the call will have the same call reference number. When viewing decode messages on a D channel processing a number of calls, it is important to verify the call reference number for each message because messages for each call are not presented as a group. A message indicating one call has been connected may be followed immediately by a message with a different call reference number indicating a different call has been disconnected.

For details on filtering D channel decode messages, see "Filtering D channel decode messages" on page 186.

For details on viewing and navigating through D channel decode messages, see "Viewing and navigating decode messages" on page 191.

For descriptions of each individual decode message, see "D Channel Decode results" on page 267.

Filtering D channel decode messages

Before observing the D channel decode messages, you can define a filter to indicate which messages you want to capture and store to the decode buffer for analysis. For example, you can define a filter to capture messages pertaining to calls placed from a specific number, or calls placed on a particular B channel.

To filter D channel decode messages

1. If the HST is off, press the green power button to power on the unit.

   It may take several seconds for the unit to fully power on. When a menu appears, you can begin using the unit.

   Go to the T1 Measurements menu.

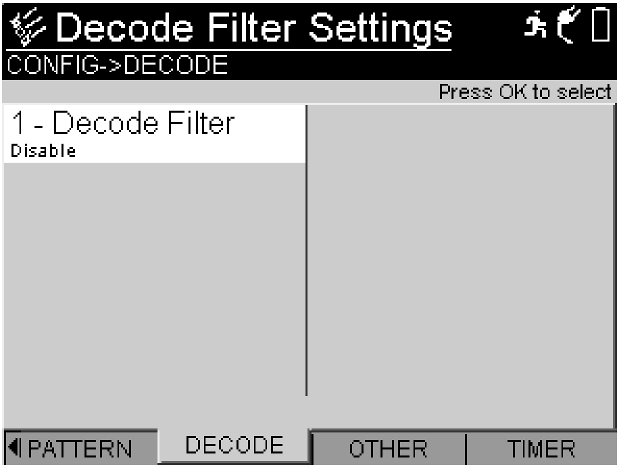
2. Select **ISDN PRI**.

   The HST-3000 launches the test application, and the Summary Results screen appears.

3. Press the **Configure** navigation key.

4. Press the **DECODE** soft key.

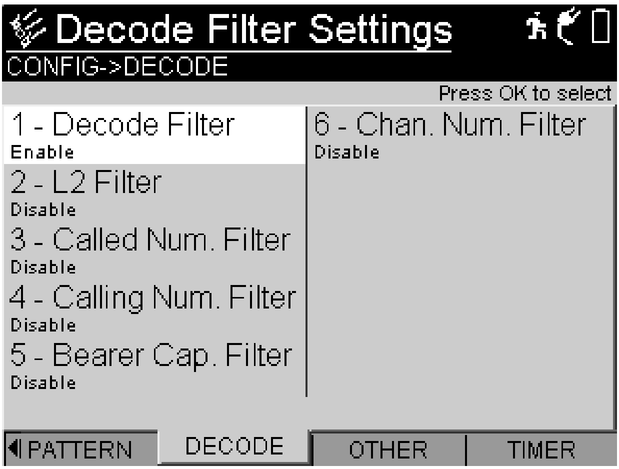
The Decode Filter Settings menu appears.



By default, the filter is disabled, and no filter settings appear.

5 To enable the filter, select **1**, and then select **Enable** to indicate that you want to specify filter criteria.

Filter settings appear.



6 Enable each filter you want to use for the D channel decode messages, and then specify the filter criteria as follows:

Filter	Criteria
L2 Filter	Enable this filter to capture and store only layer 2 LAPD frames to the decode message buffer. No additional criteria is required.
Called Num. Filter	Called Number[1] Enable this filter if you want to capture and store messages for *calls placed to a particular number*, then specify the called number.
Calling Num. Filter	Calling Number[1] Enable this filter if you want to capture and store messages for *calls placed from a particular number*, then specify the calling number.
Bearer Cap Filter	Bearer Cap[1] Enable this filter if you want to capture and store messages for voice, 3.1k audio, or data calls, then specify the type of call.
Chan. Num. Filter	Channel Number[1] Enable this filter if you want to capture and store messages for calls placed on a particular channel, then specify the channel.

1. These fields only appear if the associated filter is enabled.

7 Press the **Home** navigation key, and then press the **Restart** soft key to begin the test.

Test results appear in the Summary category.

– For information on interpreting D channel decode information, see "Interpreting D Channel decode messages" on page 184.
– For details on viewing and navigating through D channel decode messages, see "Viewing and navigating decode messages" on page 191.
– For descriptions of each individual decode message, see "D Channel Decode results" on page 267.

The HST-3000 filters the D channel decode messages and then stores them to the decode message buffer. To stop the test, press the **Cancel** key.

LAPD messages

LAPD messages are useful when verifying the status of the D channel link. Complaints prompting you to look at LAPD messages include:

– The D channel won't go in service.
– D channel communications are lost for no known reason.
– Callers are experiencing excessive delays or timeouts when trying to place calls.

Using the LAPD messages, you can determine why a D channel link is not established, whether a link is being terminated, and why a link is being terminated. Three types of frames are transmitted in LAPD: Information frames, which carry detailed call information, Unnumbered frames, which are used to establish or terminate D channel communications, and Supervisory frames, which are used to maintain link communications after a link has been established.

For detailed descriptions of unnumbered frame messages, see "LAPD Unnumbered frame messages" on page 267. For detailed descriptions of supervisory frame messages, see "LAPD Supervisory frame messages" on page 268.

Q.931 messages

Q.931 messages are useful for observing the call setup process, and identifying key information about each call, such as the called party number, transfer capability (which indicates whether the call is a voice or data call), and the channel selection (the B channel the call is placed on).

Each Q.931 message begins with a message prefix on the first line which indicates where the message originated. Messages originating from a TE device begin with `TE->NT`; messages originating from a NT device begin with `NT->TE`. Then, the call reference number for the message appears on the second line. The third line indicates the type of message being sent (for example, `SETUP` or `CONNECT`).

Finally, a variety of different information elements pertaining to the call are listed. For `SETUP` messages, the elements roughly correspond to the settings required to place a call from the HST, such as the DS1, ISDN, and Call settings listed in "Placing calls on the primary T1" on page 144 and "Placing calls on the secondary T1" on page 160. Additional call settings are also listed in the `SETUP` messages.

For `DISCONNECT` messages, the cause, or reason for the call being disconnected is reported. For example, if the call is disconnected simply because one of the users hangs up the phone, the cause is reported as a `Normal Clearing`. See "Q.931 Cause Values" on page 270 for descriptions of each cause value.

If a call cannot be connected, and as a result a `RELEASE` message is issued in response to a `SETUP` request, the `RELEASE` message will report the cause for the disconnection.

For detailed descriptions of Q.931 messages, see "Q.931 messages" on page 269.

Viewing and navigating decode messages

The D-Chan Decode Results screen displays decode text messages in the order they are received on the HST.

To navigate through the messages

- Use the up and down arrows to scroll through the text of a message.
- Use **Previous** (**<**) to view the previous message in the message buffer.
- Use **Next** (**>**) to view the next message in the message buffer.
- Use **Home** (**2nd fnc + <**) to view the first message in the message buffer.
- Use **End** (**2nd fnc + >**) to view the last message in the message buffer.

> **NOTE:**
>
> You can easily determine how many messages have been captured by looking at the Message count (for example, Message 2 of 125), located to the right above the decode text on the D-Chan Decode Results screen.

Clearing the message buffer

The HST decode message buffer can store up to 32,000 bytes of decode text data. When you monitor or terminate ISDN PRI service, the HST captures D Channel frames and displays the associated decode text messages until the buffer becomes full. When the buffer is full, the HST stops capturing frames. You can clear the message buffer, enabling the HST to continue capturing frames.

To clear the HST message buffer

- On any results screen (for example, the D-Chan Decode Results screen), press the **Action** soft key, and then select **Clear D-Chan Decodes**.

The message buffer is cleared.

> **NOTE:**
>
> You can easily determine how full the buffer is by looking at the % Full indicator, located to the left above the decode text on the D-Chan Decode result category screen.

Capturing decode text in an ASCII text file

You can capture all of the decode text stored in the message buffer and store it in an ASCII text file. You can then view the text file at a later time. For details on viewing text files on the HST, refer to the *HST-3000 Base Unit User's Guide*.

To capture decode text

1. Press the **Results** soft key.
2. Select **Capture D-chan decodes**.

   A dialog box appears prompting you to enter the file name for the .txt file.
3. Enter the name of the file.
4. Press the **Ok** key.

The decode text is captured in the ASCII text file.

> **NOTE:**
>
> You can transfer decode text files to and from the HST using FTP. You can also export text files by printing the files to the HST's serial port. For details on file transfers, refer to the *HST-3000 Base Unit User's Guide.*

Viewing test results

The following procedure describes how to view test results.

To view test results

1. Configure and run a test.
2. Press the **Home** navigation key.
3. Press the **Display** soft key.

   The test categories appear.
4. Select a category.

   The test results for the selected category appear. For descriptions of test results, see "ISDN PRI Test Results" on page 255.

Troubleshooting

Table 19 describes situations that you may encounter when using the HST-3000 to test ISDN PRI service, and then helps you resolve the situation.

Table 19 Issues and resolutions

Issue	Description	Resolution
No dial tone detected on HST	This is normal for ISDN devices placing calls.	None.
Is my call connected?	When placing or receiving a call on the HST, you want to verify that the call is connected.	Check the call status on one of the following screens: – Summary Results – Call 1 Results – Call 2 Results – Call Summary Results (in Multiple Call mode)

Table 19 Issues and resolutions (Continued)

Issue	Description	Resolution
Call will not connect	Calls may not connect because the HST is not configured properly for the outgoing call, or for a variety of other reasons (such as an invalid call reference value).	Verify the following: – Make sure you specified the number you want to call as the **Number to call** (under Call Settings); not the Directory Number. – Make sure you specified the correct call control protocol (under ISDN Settings). The majority of ISDN providers use the NATIONAL (NI-1 or NI-2) protocol. – If the HST is configured correctly for the call, check the cause value on the Call 1 Results or Call 2 Results screen.
I can't BERT a call.	– If the HST is configured for multiple call mode, you can only BERT a single call at a time. – If the HST is configured for dual call mode, you can only BERT two calls at a time.	– If you want to BERT a second call, verify that the HST is in dual call mode. – Verify that you are already BER testing two other calls (see "Performing BER analysis of a call" on page 171).
I can't insert voice traffic into a call.	You can only insert voice traffic on a single call at a time on the HST.	Verify that you are not transmitting voice traffic on another call (see "Inserting voice traffic into a call" on page 169).
Decode messages are not captured.	The HST stops capturing decode messages when the message buffer is full.	Clear the message buffer (see "Clearing the message buffer" on page 191).

Table 19 Issues and resolutions (Continued)

Issue	Description	Resolution
Decode messages are not correct.	To receive correct decode messages, the network (NT) side must be connected to the HST's primary input, and the customer (TE) side must be connected to the HST's secondary input.	Verify that the proper connections have been made to the HST (see "Monitoring ISDN PRI service" on page 177).

Automated T1 Testing

7

This chapter describes the HST-3000 automated T1 testing feature. Topics discussed in this chapter include the following:

About automated testing

The HST-3000, with a T1 SIM attached, provides an automated T1 BERT feature. Bit error rate testing is commonly used in isolating faults, stress testing, and end-to-end circuit qualification. The automated T1 BERT feature allows you to quickly run a standard BERT. You can configure options, such as the framing format, line coding, and BERT patterns, and then store the test configuration for future use. You can store multiple test configurations on the HST. This allows you to save specific test configurations for specific jobs.

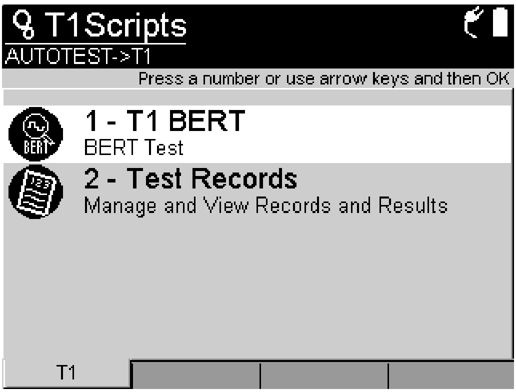
Additionally, you can save automated test results and associate results with work order information. Work order information can be saved on the HST as a test record. For more information about test records, see the *Base Unit User's guide*.

To access the T1 auto test options

1 Press the **AutoTest** navigation key.

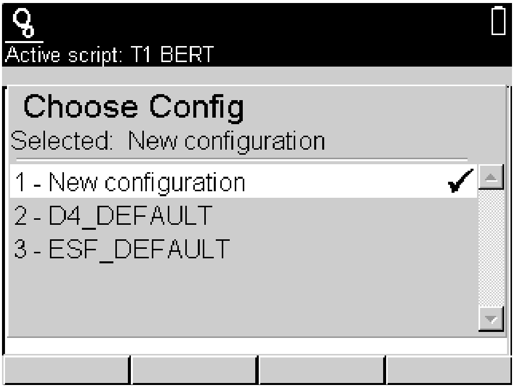
2 Press the **T1** soft key.

The T1 Scripts menu appears.



3 Select **T1 BERT**.

The Choose Config menu appears with a list of available test configurations.



4 For information about using the auto test options, see the following sections:

– "Running a T1 BERT test script" on page 200
– "Creating and editing test configurations" on page 203
– "Associating test results with a test record" on page 207
– "Viewing auto test results" on page 210

NOTE:

For information about copper auto testing, see the *HST-3000 Copper User's Guide*. For information about test records see the *HST-3000 Base Unit User's Guide*.

Custom test scripts

JDSU can provide customized test scripts for your particular solution, and provide training on the use of scripts. For information about purchasing customized test scripts, contact your JDSU sales representative.

Running a T1 BERT test script

The following procedure describes how to run a T1 test script. The T1 test script is only available when you are operating the HST with a T1 SIM attached. Scripts automatically run in Terminate mode.

To run a T1 test configuration

1 Connect the HST to the line you want to test:

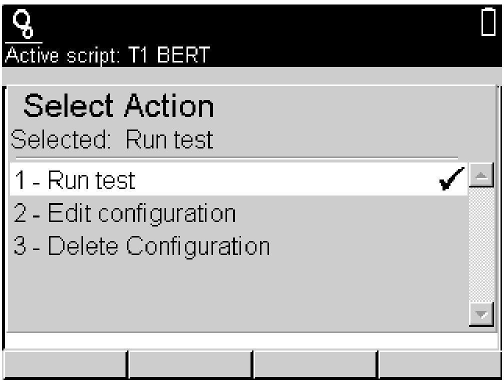
– For loopback connections, see Figure 5 on page 43

– For end-to-end testing see Figure 6 on page 44

2 Access the Choose Config menu. See the procedure, "To access the T1 auto test options" on page 198.

3 Select a test configuration.

The Select Action menu appears.

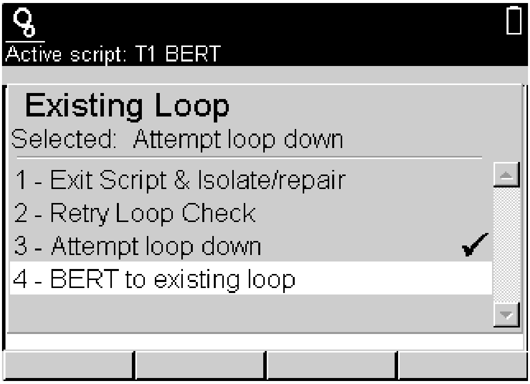


4 Select **Run test**.

The HST configures the test, checks for a DS1 signal, and then checks for a loop. When a loop is detected, the HST displays a "Loop Detected" message.

5 Press the **OK** key.

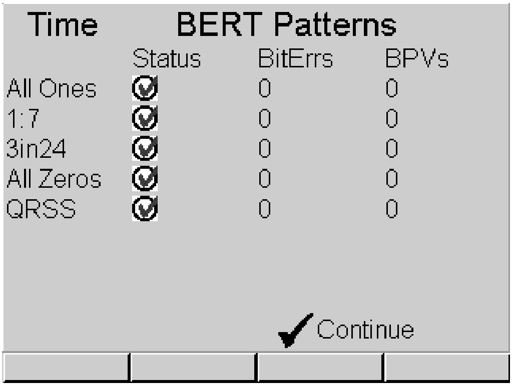
The Existing Loop menu appears.



6 Select one of the following options:

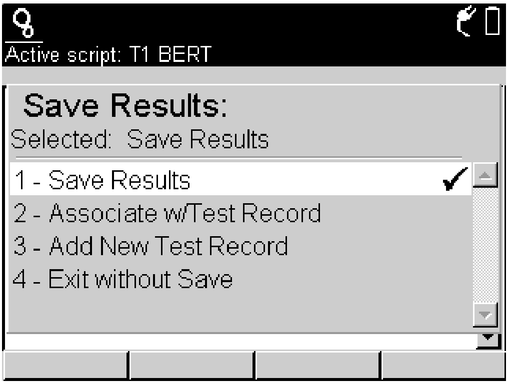
Option	**Action**
To run a BERT on the detected loop	– Select **BERT to existing loop**. The HST begins running the test. – Continue to step 7 on page 202.
To exit the test	Select **Exit Script & Isolate/repair**. The T1 Scripts menu appears.
To have the HST attempt to detect the loop again	Select **Retry Loop Check**.
To send a loop down command	Select **Attempt to loop down**. The HST sends a loop down code.

As the HST runs the script, results appear.



7 When the test stops, press the **OK** key to continue.

The Save Results menu appears.



8 Select one of the following options:

Option	Action
To save test results to a file on the HST	– Select **Save Results**. – Enter a file name for the test results – Press the **OK** key. The HST saves the results to a file. – Press the **Exit** soft key to return to the scripts menu.
To exit the menu without saving the test results	Select **Exit without Save**.
To associate the test results with a test record	See "Associating test results with a test record" on page 207.

You have completed the procedure.

Creating and editing test configurations

The following procedure describes how to setup a test configuration.

To setup a test configuration

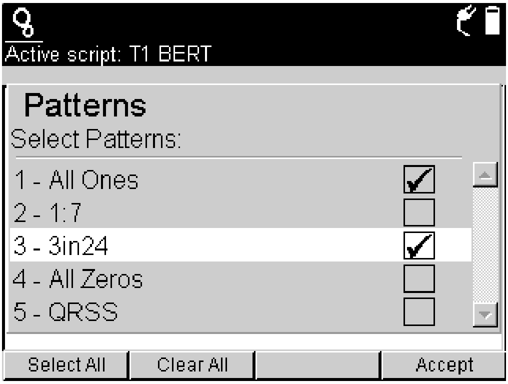
1. Connect the HST to the line you want to test:
   - For loopback connections, see Figure 5 on page 43
   - For end-to-end testing see Figure 6 on page 44
2. Access the Choose Config menu. See the procedure, "To access the T1 auto test options" on page 198.
3. Select **New configuration**.
4. Select a framing format: **ESF**, **D4**, or **Unframed**.
5. Select the line coding: **AMI** or **B8ZS**.

A select pattern menu appears.

6 Select the BERT patterns:

a Choose **Select Patterns**.

The Patterns menu appears.

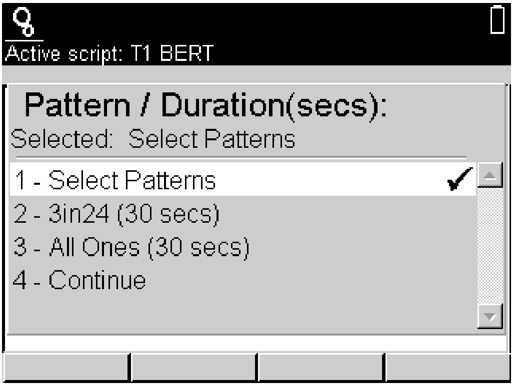


b Use the up and down arrow keys to highlight a pattern, and then press the **OK** key to select the pattern. To select all available patterns, press the **Select All** soft key. To deselect a pattern, highlight it, and then press the **OK** key.

A pattern is selected when a checkmark (√) appears in the corresponding check box.

c After you have chosen the BERT patterns, press the **Accept** soft key.

The Pattern/Duration(secs) menu appears.



7 Indicate how long each pattern should be transmitted:

a Select a BERT pattern/duration.

Pattern/duration options appear in the format *Pattern (xx secs)*, where *Pattern* indicates the selected BERT pattern and *(xx secs)* indicates how long the pattern will transmit. Example: *3in24 (30 secs)*.

b Enter a number to indicate how long (in seconds) the pattern will be transmitted.

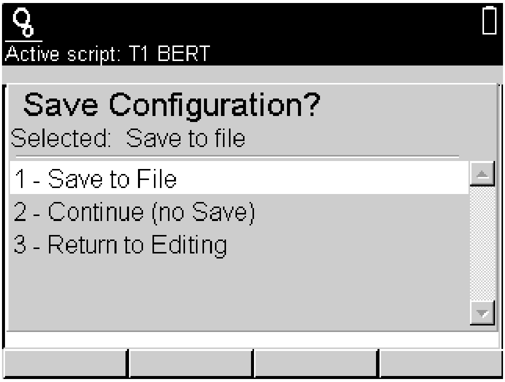
c Press the **OK** key.

d Repeat step 7 for each BERT pattern.

e If you want to select different BERT patterns, press **Select Pattern** (see step 6 on page 204).

8 When you have finished specifying the duration for each patter, select **Continue**.

The Save Configuration menu appears.



9 Select one of the following options:

Option	Action
To save and run the test configuration	– Select **Save to File**. – Enter a name for the test configuration. – Press the **OK** key. The HST saves and runs the test configuration.
To run the test configuration without saving it	Select **Continue (no Save)**. The HST runs the test configuration without saving it.
To make changes to the test configuration	– Select **Return to Editing**. The Edit configuration menu appears. – Select the parameter you want to change: Framing, Coding, or Patterns/Durations.

After the test runs, the Save Results menu appears.

10 You can save the results, associate them with a test record, or exit the menu. See step 8 on page 203.

You have completed the procedure.

Associating test results with a test record

After you run a test, you can associate results with work order information. The HST lets you save work order information in a test record. You can associate one T1 BERT auto test result file with one test record, and up to two copper auto results with a test record. This means you can, potentially, associate three result files with a single test record.

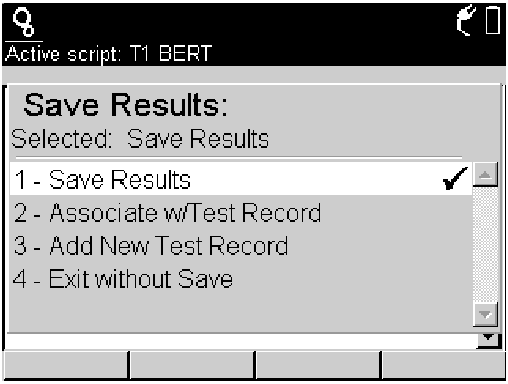
The following procedures describes how to associate test results with a new or existing test record. For additional information about test records, see the section, “Managing test records” in the *HST-3000 Base Unit User’s Guide*.

Associating results with a new test record

To associate results with a new test record

1 Run a test configuration. See the following sections:
   – “Running a T1 BERT test script” on page 200
   – “Creating and editing test configurations” on page 203

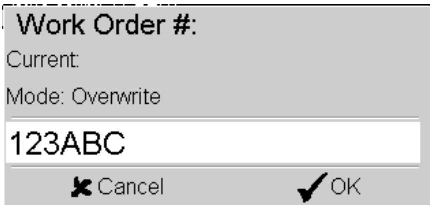
After the test runs, the Save Results menu appears.



2 Select **Add New Test Record**.

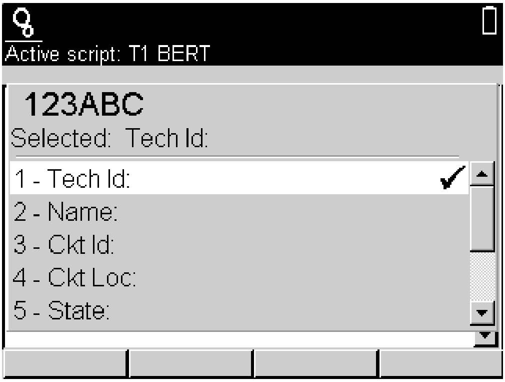
3 Enter a name for the test result file, and then press the **OK** key.

A work order number prompt appears.



4 Enter a work order number, and then press the **OK** key.

A prompt for the work order information appears.



5 Select an item, such as Tech ID, and then enter the information for that item.

6 Repeat step 5 for the items you want to define.

If necessary, you can leave items in the test record blank.

7 When you have finished entering the record information, select **Exit** (option number 8) to move to the next menu. You may have to use the arrow keys to find the Continue option.

A save test record prompt appears.

8 Select **Save**.

The results are saved and associated with the new test result record.

You have completed the procedure.

Associating results with an existing test record

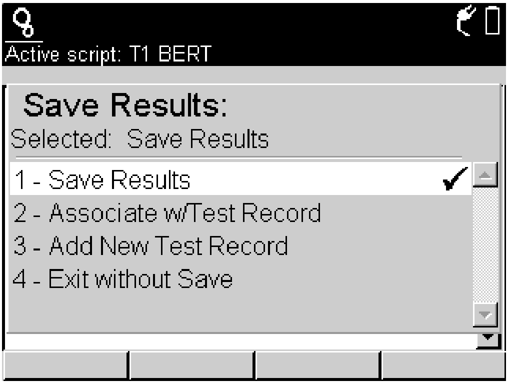
To associate results with an existing test record

1 Run a test configuration. See the following sections:

– "Running a T1 BERT test script" on page 200

– "Creating and editing test configurations" on page 203

After the test runs, the Save Results menu appears.



2 Select **Associate w/Test Record**.

3 Enter a name for the test result file, and then press the **OK** key.

A list of existing test records appears.

4 Select a test record to associate with the result file.

The results are saved and associated with selected test record.

5 To view test results, see "Viewing auto test results" on page 210.

6 Press the **Exit** soft key to return to the T1 Scripts menu.

You have completed the procedure.

Viewing auto test results

The following procedure describes how to view auto test results that have been saved on the HST.

To view test results

1 Access the Choose Config menu. See the procedure, "To access the T1 auto test options" on page 198.

2 Select **Review Stored Results**. If no results have been saved, the Review Stored Results option will not be available.

The Choose Result File menu appears.

3 Select one of the following options:

Option	Action
View results that have been associated with a test record	– Select **Associated Results**. A list of test records appears. – Select a test record. A list of options appears. – Select the results you want to view. The test results appear.
View results that have not been associated with a test record	– Select **Unassociated Results**. A list of result files appears. – Select a file. The test results appear.

4 To exit the test results, press the **OK** key.

You have completed the procedure.

T1, FT1, DDS, and Pulse Shape Test Results

A

This appendix describes the test result categories and the results within each category that are available when performing T1 and fractional T1 tests. Topics discussed in this appendix include the following:

About test results

After you start a test, the Summary result category automatically displays a large "All Summary Results OK" message if no errors or alarms have been detected (see Figure 20).

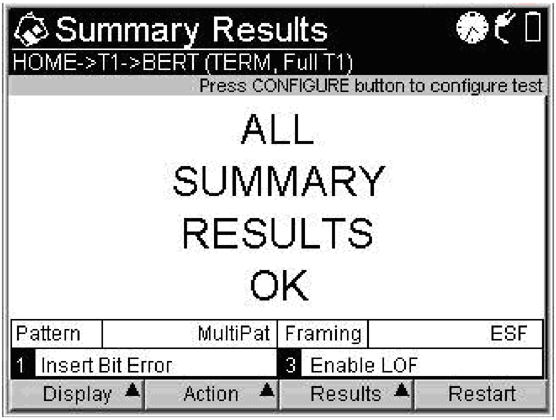


Figure 20 T1 Summary Results

If errors are detected, the results are displayed. To view test results in other categories, press the **Display** soft key, and then select a category.

The following sections describe the test results for each of the categories. The test results for each category are listed alphabetically.

Summary results

The Summary category automatically displays error results that are non-zero, key results that are out-of-specification, or key informational results. This allows quick access to the results without having to search each category. Table 20 describes the results that appear in the Summary category.

Table 20 Summary results

Result	Definition
AIS	Alarm indication signal. This signal tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Alarms	Number of alarm indication signals detected since test start.
B8ZS Detect	B8ZS clear channel coding is detected in the received DS1 signal when the line coding is set to AMI.
Bit Errors	Number of received bits that have a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved.
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since start of test.
CRC Errors	Number of Cyclical Redundancy Check-6 errors detected since the beginning of the test. A CRC algorithm is performed on an ESF frame on the transmitting end. It is then recalculated at the receiving end. If the measurements are not equal, it indicates an error occurred in the packet.
DDS Frame Errors	Number of frame errors received on the DDS channel since test start.

Table 20 Summary results (Continued)

Result	Definition
DDS Frame Sync	Indicates whether frame synchronization was detected on the DDS channel.
DS1 Idle	DS1 idle condition is detected.
DS1 Idle Hist	Idle history. DS1 idle condition was detected in the past.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS line coding, and 16 or more in AMI line coding.
Excs Zeros Cnt	Number of strings of eight or more consecutive zeros, in B8ZS line coding, or 16 or more zeros in AMI line coding. Does not count if pattern synchronization present.
Frame Errors	Number of frame errors received since start of test.
Frame Losses	Number of times frame synchronization was lost.
Frame Sync	Indicates whether frame synchronization is detected.
Max Consec Zeros	Number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Indicates a ones density alarm was detected but no longer exits.
Pattern Losses	Number of times pattern synchronization was lost.
Pattern Slips	Number of pattern slips detected since start of test (PRBS patterns only).

Table 20 Summary results (Continued)

Result	Definition
Pattern Sync	Indicates whether pattern synchronization is detected.
RX Freq Hist	Indicates that the receive frequency previously deviated from the nominal range.
Signal Losses	Number of times the signal was lost or absent (limited to 1 loss in every 100 milliseconds).
Signal Present	Indicates the presence of a signal on the line.
Yellow Alarm	Indicates whether a yellow alarm is detected.
Yellow Alarm Losses	Number of yellow alarms detected since test start.

Signal results

The Signal category shows signal level, frequency, and loss seconds results. Results in this category accumulate after test restart. Table 21 describes the results that appear in the Signal category.

Table 21 Signal test results

Result	Description
ESF Sync Message	Indicates the extended superframe synchronization status message embedded in T1 ESF signals. Possible messages include: Not for Sync; Stratum 1; Stratum 2; Stratum 3; Stratum 4; Sync Unknown.

Table 21 Signal test results (Continued)

Result	Description
Frame Slips	Number of frame slips (absolute value) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously.
Rx Frequency	Frequency of the clock recovered from the received DS1 in Hz.
RX Level dBdsx	DS1 power of signal received in a T1 test. The value is displayed as xxx dBdsx in a range from +6.0 dBdsx to -40.0 dBdsx.
RX Level dBm	DS1 power of signal received in a T1 test. The value is displayed as + xx.x dBm in a range from +22.5 dBm to -23.5 dBdm. Will only be valid for unframed all ones signal.
Rx Level Volts Peak-Peak	The value is displayed as + xx.x V in a range from +12.0 V to 0.06 V.
Signal Loss Seconds	Number of test seconds in which the signal was not present for any part of the second.
Signal Losses	Number of times the signal was lost or absent (equal to 1 loss in every 100 milliseconds).
Signal Present	Indicates whether a T1 signal is present.
Simplex Curr mA	The simplex current (in milliamps) between the Rx and Tx connectors. The measurement range is ±180 mA with an accuracy of ±4% ±4 mA. **NOTE:** Only available on Primary Tx/Rx pair side when in Terminate mode.

Table 21 Signal test results (Continued)

Result	Description
Timing Slips	Number of bit slips (±) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously. Counts from 0 to + or - 191, and then rolls over to 0. Resets to 0 if signal present is lost on the analyzed T1 or on the reference T1. A positive results indicates that the analyzed T1 is faster than the reference T1.
Tx Frequency	Current transmitter clock frequency in Hertz (1 Hz resolution).

Interface (T1) results

The Interface (T1) category lists results related to framing. Table 22 describes the results that appear in the Interface (T1) category.

Table 22 Interface test results

Result	Description
AIS Alarms	Number of alarm indication signals detected since test start.
BPV Err Seconds	Number of test seconds in which one or more BPVs are received.
BPV Rate	Ratio of BPVs received over total bits received.
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS) sequences since start of test.

Table 22 Interface test results (Continued)

Result	Description
CRC Error Rate	Ratio of CRC errors to the number of extended superframes received.
CRC Error Seconds	Number of test seconds in which one or more CRC-6 errors occurred.
CRC Errors	Number of Cyclical Redundancy Check-6 errors detected since the beginning of the test. A CRC algorithm is performed on an ESF frame on the transmitting end. It is then recalculated at the receiving end. If the measurements are not equal, it indicates an error occurred in the packet.
CRC SES	Number of seconds during which the total number of CRC errors and frame synchronization losses equaled 320 or more.
DDS Error Correction Count	Number of error corrections detected on a DDS channel.
DDS Error Correction Secs	Number of seconds in which errors were detected on the DDS channel.
DDS Frame Error Rate	Ratio of frame errors to received framing bits, on the DDS channel, since initial frame synchronization.
DDS Frame Errors	Number of frame errors received on the DDS channel since start of test.
DDS Frame Sync	Indicates whether frame synchronization was detected on the DDS channel.
DDS Rx Byte	Provides a sample, every second, of the data received on the line. The data byte samples are in binary form. **NOTE:** If the secondary channel is on, or the primary channel data rate is 64 Kbps, the last bit is the multiplexed secondary channel/control bit.

Table 22 Interface test results (Continued)

Result	Description
DDS Rx Code	Provides a brief text description (decode), every second, for the received byte codes.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS coding, and 16 or more in AMI coding.
Frame Erred Seconds	Number of seconds during which one or more frame errors occurred since initial DS1 frame synchronization.
Frame Error Rate	Ratio of frame errors to received framing bits since initial frame synchronization.
Frame Errors	Number of frame errors detected since initial frame synchronization.
Frame Loss Seconds	Number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial DS1 frame synchronization.
Frame Losses	Number of times frame synchronization was lost.
Frame SES	Severely errored seconds. Number of seconds during which the total number of frame errors equals 12 or more (D4 framing only).
Frame Sync	Frame synchronization is not detected.
Max Consec Zeros	Number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).

Table 22 Interface test results (Continued)

Result	Description
T1 Alarm Sec	Number of test seconds where at least one of the following results was present for a portion of the test: Yellow Alarm, AIS, or Insufficient Pulse Density.
Yellow Alarms	Number of yellow alarms detected since test start.

BERT results

The BERT category lists results related to the bit error rate test pattern. Table 23 describes the results that appear in the BERT category.

Table 23 Test (BERT) results

Result	Description
% Error Free Seconds	Ratio, expressed as a percentage, of seconds during which no pattern bit errors were detected, to the total number of seconds while pattern synchronization is present.
Bit Error Rate	Ratio of bit errors to received pattern data bits.
Bit Errors	Number of received bits with a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved.
Error Free Seconds	Number of seconds during which no pattern bit errors are detected while DS1 pattern synchronization is present.
Error Seconds	Number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization.

Table 23 Test (BERT) results (Continued)

Result	Description
Pattern Losses	Number of times the received pattern is lost relative to the expected (therefore, internally generated) test pattern.
Pattern Slips	Number of pattern slips detected since start of test (PRBS patterns only).
Pattern Sync	Pattern synchronization is not detected.
Pattern Sync Hist	Pattern synchronization is was detected but no longer exists.
Round Trip Delay	Calculates round trip delay for T1 applications. The result is given in milliseconds. NOTE: Only applicable when the Delay test pattern is selected during test set up.
Sync Loss Seconds	Number of seconds during which the receiver lost pattern synchronization, even momentarily, since initial pattern synchronization.

Pulse shape results

When you select the Pulse Shape result, the HST displays a graphical representation of the T1 pulse. Using the Action soft key, you can apply masks to measure conformance to ANSI T1.403 or T1.102 specifications. Results are described in Table 24.

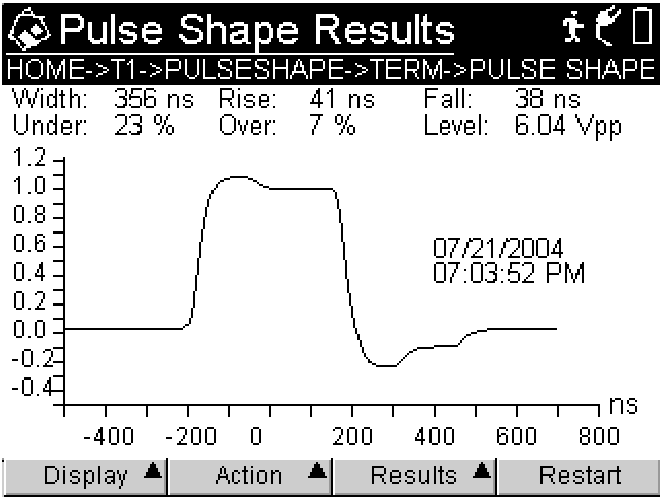


Figure 21 Pulse shape graph

Table 24 describes the pulse shape results. Results are listed in alphabetical order.

Table 24 Pulse shape results

Result	Description
Fall	Fall Time. This indicates the fall time of the trailing edge between the 90% and 10% points of the waveform (less than 117 ns for DSX (CB119) or less than 125 ns for NI (ANSI)).
Level	Signal power level measured in volts peak-peak (Vpp)

Table 24 Pulse shape results (Continued)

Result	Description
Over	Overshoot. The overshoot is the amount of the leading edge that rises above the 100% point of the waveform (less than 15% of the normalized pulse for DSX (CB119) or less than 20% of the normalized pulse for NI (ANSI)).
Pass/Fail	This result is only available when a mask is enabled. A “Pass” result indicates the pulse shape conforms to the mask specifications. A “Fail” result indicates the pulse shape does not conform to the mask specifications.
Rise	Rise Time. This indicates the rise time of the leading edge between the 10% and 90% points of the waveform (less than 140 ns for DSX (CB119) or less than 152 ns for NI (ANSI)).
Under	Undershoot. The undershoot is the amount of the trailing edge that falls below the zero point of the waveform (less than 45% of the normalized pulse for both DSX (CB119) and NI (ANSI)).
Width	Pulse Width. This indicates the pulse width at the 50% point of the waveform (350 ns ±56 ns for DSX (CB119) or 356 ns ±56 ns for NI (ANSI)).

LED results

The LED category shows the current and historical status for alarms. Table 25 describes the results that appear in the LED category. Results are listed in alphabetical order.

Table 25 LED results

Result	Description
AIS	Alarm indication signal. This signal tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Hist	Alarm indication signal history. Alarm indication signal was previously detected.
B8ZS	B8ZS clear channel coding is detected in the received DS1 signal.
B8ZS Hist	B8ZS clear channel coding was previously detected in the received DS1 signal.
DDS Alt. Loop Sync	Indicates whether alternating loop synchronization is detected.
DDS Alt. Loop Sync Hist	Indicates alternating loop synchronization was previously detected.
DS1 Idle	Indicates whether a DS1 idle condition is detected.
DS1 Idle Hist	Indicates a DS1 idle condition was previously detected.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS coding, and 16 or more in AMI coding.
Excess Zeros Hist	Excess zeros history. Indicates the Excess Zeros alarm occurred previously.
Frame Sync	T1 frame synchronization was not detected.

Table 25 LED results (Continued)

Result	Description
Frame Sync History	Frame synchronization history. Frame synchronization was lost and later detected.
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Ones density history. Ones Density alarm was previously detected.
Pattern Sync	Pattern synchronization was not lost
Pattern Sync History	Pattern synchronization was previously detected.
Signal	Indicates the presence of a signal on the line.
Signal History	Indicates the signal was previously detected.
Yellow Alarm	Indicates whether a yellow alarm signal is detected.
Yellow Alarm Hist	Indicates a yellow alarm was previously detected.

Traffic results

The Traffic category provides a means to scan signaling bit transitions on all 24 channels of a duplex T1 circuit. Table 26 describes the results that appear in the Traffic category.

Table 26 Traffic test results

Result	Description
AB(CD) Bits	Signaling bits received on each T1 line.

Performance results

The HST-3000 provides performance analysis results in accordance with the ANSI T1.231 and ITU-T G.821 standards. The following sections describe the results for each standard.

T1.231 results

Table 27 lists the T1.231 performance results in alphabetical order.

Table 27 T1.231 Performance results

Result	Description
AISS-P	Alarm indication signal second - Path Count of one-second intervals containing one or more AIS defects.
CV-L	Code violation -Line. Count of both BPVs and excess zeroes occurring over the accumulation period.
CV-P	Code violation - Path. Count of frame synchronization bit errors (FE) in the D4/SF format[1], or a count of CRC-6[2] errors in the extended super-frame (ESF) format occurring during the accumulation period.
ES-L	Errored second - Line. Count of one-second intervals with one or more BPVs, or one or more excess zeroes, or one or more LOS defects.

Table 27 T1.231 Performance results (Continued)

Result	Description
ES-P	Errored second - Path. In DS1 ESF, this result is a count of one-second intervals containing any of the following: – CRC-6 errors – SEF defects – AIS defects In DS1 D4/SF, this result is a count of one-second intervals containing any of the following: – FE errors – SEF defects – AIS defects
ESA-P	Errored second type A - Path. This result applies to DS1 ESF paths only. Count of one-second intervals with exactly one CRC-6 error, and no SEF or AIS defects.
ESB-P	Errored second type B - Path. This result applies to DS1 ESF paths only. Count of one-second intervals with no less than 2, and not more than 319 CRC-6 errors, no SEF defects, and no AIS defects.
LOSS-L	Loss of signal second - Line. Count of one-second intervals containing one or more LOS defects
SAS-P	Severely errored frame/Alarm indication signal second - Path. Count of one-second intervals containing one or more SEF defects or one or more AIS defects.

Table 27 T1.231 Performance results (Continued)

Result	Description
SES-L	Severely errored second - Line. Count of one-second intervals with 1544 or more BPVs plus excess zeros, or one or more LOS defects.
SES-P	Severely errored second - Path. This parameter applies to both D4/SF and ESF frame formats of DS1. In the case of ESF, this result is a count of one-second intervals with 320 or more CRC-6 errors, or one or more SEF or AIS defects. In the case of D4/SF, this result is a count of one-second intervals with 8 or more FE events or an SEF or AIS defect.
UAS-P	Unavailable second - Path. Count of one-second intervals for which the DS1 path is unavailable. The DS1 path becomes unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in unavailable time. Once unavailable, the DS1 path becomes available at the onset of 10 contiguous seconds with no SESs. The 10 seconds with no SESs are excluded from unavailable time

1. Because there is no redundancy check mechanism in the DS1 D4/SF format to verify the correctness of frame payload bits, the FE primitive is substituted as a code violation primitive.
2. Some implementations may include other detectable errors, for example, FE.

G.821 results

Table 28 describes the G.821 performance results in alphabetical order.

Table 28 G.821 performance results

Result	Description
AS	Available seconds. A count of the number of seconds a circuit is available as specified in G.821, calculated as total test time minus unavailable seconds.
ASR	Available seconds ratio. The ratio, expressed as a percentage, of available seconds to the number of test seconds.
CSES	Consecutive severely errored seconds. A count of the number of groups of three or more contiguous seconds in which an error rate greater than 10^{-3} was found in each second.
EFS	Error free seconds. The number of seconds during which no pattern bit errors are detected while DS1 pattern synchronization is present. This count is inhibited during unavailable seconds.
EFSR	Error free seconds ratio. The ratio, expressed as a percentage, of seconds during which no pattern bit errors were detected, to the total number of seconds while pattern synchronization is present
ES	Errored seconds. The number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization. This count is inhibited during unavailable seconds.
ESR	Errored seconds ratio. The ratio, expressed as a percentage, of seconds during which one or more pattern bit errors are detected, to the total number of seconds while pattern synchronization is present.

Table 28 G.821 performance results (Continued)

Result	Description
SES	Severely errored seconds. Seconds during which the bit error ratio was greater than 10^{-3} within available time.
SESR	Severely errored seconds ratio. The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.
TS	Total seconds. Total number of seconds during which pattern synchronization is present.
UAS	Unavailable seconds. A count of unavailable time per the ITU-T G.821 standard.
UASR	Unavailable seconds ratio. The ratio, expressed as a percentage, of available seconds to the number of test seconds.
Verdict	"Pass" indicates conformance to the G.821 standard. "Fail" indicates the circuit did not conform to the G.821 standard.

Event Table results

The Event Table category displays the date and time that significant events, errors, or alarms occurred during the course of your test. This category is not available in the Pulse Shape application.

Event Histogram results

A histogram is a display or print output of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time (seconds, minutes, or hours). This category is not available in the Pulse Shape application.

Use the up and down arrow keys to scroll through each of the events reported in the histogram.

NOTE:

When viewing a histogram, the left and right arrow keys can not be used to navigate through the other result categories. Use the Display softkey to select and then view another category.

Time results

The time category lists the current date, time, and the amount of elapsed time since test restart. Table 29 describes the results that appear in the Time category.

Table 29 Time test results

Result	Description
% Complete	When timed testing is enabled, this result indicates test progress as a percentage.
Date	Current day and month.
Elapsed Time	Amount time in hours, minutes, and seconds (hh:mm:ss) since the last test restart.
Time	Current time of day in hours, minutes, and seconds (hh:mm:ss).

Table 29 Time test results (Continued)

Result	Description
Time Remaining	Amount of time remaining until the test is complete.

Channel results

Table 30 describes the results in the Channel category.

Table 30 Channel test results

Result	Description
Received Byte	Data byte samples in binary form. Applicable only in fractional T1 testing.

Saving and printing results

For information about saving and printing test results, see the *HST-3000 Base Unit User's Guide*.

VF Test Results

B

This appendix describes the test results that are available when performing voice analysis (VF) using the PCM TIMS option. Topics discussed in this appendix include the following:

About test results

After you start a test, the Summary result category automatically displays an "All Summary Results OK" message if no errors or alarms have been detected. If errors are detected, the Summary results are displayed. To view test results in other categories, press the **Display** soft key, and then select a result category.

The following sections describe the test results for each of the categories. The test results for each category are listed alphabetically.

Summary results

The Summary category automatically displays error results that are non-zero, key results that are out-of-specification, or key informational results. This allows quick access to the results without having to search each category. Table 31 describes the results that appear in the Summary category.

Table 31 Summary results

Result	Definition
AIS	Alarm indication signal. This signal tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Alarms	Number of alarm indication signals detected since test start.
B8ZS Detect	B8ZS clear channel coding is detected in the received DS1 signal when the line coding is set to AMI.
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since start of test.

Table 31 Summary results (Continued)

Result	Definition
CRC Errors	Number of Cyclical Redundancy Check-6 errors detected since the beginning of the test. A CRC algorithm is performed on an ESF frame on the transmitting end. It is then recalculated at the receiving end. If the measurements are not equal, it indicates an error occurred in the packet.
DS1 Idle	Indicates whether a DS1 idle condition is detected.
DS1 Idle Hist	Indicates a DS1 idle condition was previously detected.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS coding, and 16 or more in AMI coding.
Excess Zeros Count	Number of strings of eight or more consecutive zeros in B8ZS line coding or 16 or more zeros in AMI line coding. Does not count if pattern synchronization is detected.
Frame Errors	Number of frame errors received since start of test.
Frame Losses	Number of times frame synchronization was lost.
Frame Sync	Indicates whether frame synchronization is detected.
Holding Tone	The tone, near 1Khz, transmitted over a telecommunication circuit for performing noise-with-tone, jitter and transient measurements.
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Ones density history. Ones Density alarm was detected but no longer exits.

Table 31 Summary results (Continued)

Result	Definition
RX Frequency Hist	Indicates a loss of the received frequency.
Signal Losses	Number of times the signal was lost or absent (limited to 1 loss in every 100 milli-seconds).
Signal Present	Indicates the presence of a signal on the line.
Yellow Alarm	Indicates whether a yellow alarm is detected.
Yellow Alarms	Number of yellow alarms detected since test start.
Max Consecutive Zeros	Number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).

Signal results

For signal results, see “Signal results” on page 217.

Interface results

For interface results, see “Interface (T1) results” on page 219.

VF results

Table 32 describes the results in the VF (voice frequency) category.

Table 32 VF test results

Result	Description	Operating Mode	Test
1004 Hz Frequency	Frequency measurement of the 1004 Hz test tone.	Monitor Terminate	Three Tone
1004 Hz Level	Level measures of the 1004 Hz test tone.	Monitor Terminate	Three Tone
2804 Hz Frequency	Frequency measurement of the 2804 Hz test tone.	Monitor Terminate	Three Tone
2804 Hz Level	Level measurement of the 2804 Hz test tone.	Monitor Terminate	Three Tone
2804 Hz Gain Slope	The difference between the levels at 1004 Hz and 2804 Hz.	Monitor Terminate	Three Tone
3.4 Hz Flat Notched dBrn	Measurement, using a 1010 Hz notch filter, of the noise level on a channel with a holding tone at the transmitted end, expressed in dBrn. The measurement range is 22 to 90 dBrn with 1 dBrn resolution.	Monitor Terminate D&I	Quiet Holding Tone
3.4 kHz Flat dBrn	Measurement of the low frequency noise present on the test channel, expressed in dBrn. The measurement range is 22 to 90 dBrn with 1 dBrn resolution.	Monitor Terminate D&I	Quiet Tone Holding Tone

Table 32 VF test results (Continued)

Result	Description	Operating Mode	Test
3.4 kHz Flat Notched SNR	Ratio of the test tone signal level to the level of the background noise using the 1010 Hz notch filter. Generally, higher ratios indicate lower noise and better quality while lower ratios indicate more noise and poor quality.	Monitor Terminate D&I	Quiet Holding Tone
3.4 kHz Flat SNR	Ratio of the test tone signal level to the level of the background noise on the test channel. Accuracy is 1 dB, from 0 to 45 dB. For this measurement a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test.	Monitor Terminate D&I	Quiet Tone Holding Tone
404 Hz Frequency	Frequency measurement of the 404 Hz test tone.	Monitor Terminate	Three Tone
404 Hz Gain Slope	The difference between the levels at 404 Hz and 1004 Hz.	Monitor Terminate	Three Tone
404 Hz Level	Level measurement of the 404 Hz test tone.	Monitor Terminate	Three Tone

Table 32 VF test results (Continued)

Result	Description	Operating Mode	Test
Cmsg dBrnC Dmsg dBrnC	Measurement, using C- or D-Message weighting, of the noise on an idle channel or circuit (a channel or circuit with a termination at one end and no holding tone at the transmitting end), expressed in dBrnC. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution.	Monitor Terminate D&I	Quiet Tone Holding Tone
Cmsg Notched dBrnC Dmsg Notched dBrnc	Measurement, using C- or D-Message weighting and a 1010 Hz notch filter, of the noise level on a channel with a holding tone at the transmitted end, expressed in dBrnC. The measurement range is 22 to 90 dBrnC with 1 dBrnC resolution.	Monitor Terminate D&I	Quiet Tone Holding Tone
Cmsg Notched SNR Dmsg Notched SNR	Ratio, in dB, (using C- or D-Message weighting) of the test tone's level to the level of the background noise on the test channel using the 1010 Hz notch filter.	Monitor Terminate D&I	Quiet Tone

Table 32 VF test results (Continued)

Result	Description	Operating Mode	Test
Cmsg SNR Dmsg SNR	Ratio, in dB, (using C- or D-Message weighting) of the test tone's level to the level of the background noise on the test channel (accuracy is 1 dB, from 0 to 45 dB). For this measurement, a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test.	Monitor Terminate D&I	Quiet Tone Holding Tone
DC Offset	Measurement of DC offset from -128 mV to 128 mV with a resolution of 1 mV.	Monitor Terminate D&I	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep
Frequency Hz	Measurement of the VF frequency in Hertz from 20 to 3904 Hz with an accuracy of 1 Hz.	Monitor Terminate D&I	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep
Holding Tone Present	Measurement of the 1004 Hz tone transmitted over a circuit for performing noise-with-tone, jitter, and transient measurements.	Monitor Terminate D&I	Quiet Tone Holding Tone
Impulse Noise Count	Number of times the impulse noise level has exceeded the specified threshold.	Monitor Terminate D&I	Impulse Noise

Table 32 VF test results (Continued)

Result	Description	Operating Mode	Test
Level dBm	Measurement of the VF level in dBm, with an accuracy of 0.2 dB from 200 Hz to 3900 Hz (+3 dBm to -40.0 dBm) and 0.1 dB from 1002 Hz to 1022 Hz (0 to -19 dBm).	Monitor Terminate D&I	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep
Tone 1 Frequency	Frequency measurement of the 404 Hz test tone.	Monitor	Three Tone
Tone 1 Level	Level measurement of the 404 Hz test tone.	Monitor	Three Tone
Tone 2 Frequency	Frequency measurement of the 1004 Hz test tone.	Monitor	Three Tone
Tone 2 Level	Level measurement of the 1004 Hz test tone.	Monitor	Three Tone
Tone 3 Frequency	Frequency measurement of the 2804 Hz test tone.	Monitor	Three Tone
Tone 3 Level	Level measurement of the 2804 Hz test tone.	Monitor	Three Tone

LED results

The LED category shows the current and historical status for alarms. Table 33 describes the results that appear in the LED category.

Table 33 LED results

Result	Description
AIS	Alarm indication signal. This signal tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Hist	Alarm indication signal history. Alarm indication signal was previously detected.
B8ZS	B8ZS clear channel coding is detected in the received DS1 signal.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS coding, and 16 or more in AMI coding.
Excess Zeros Hist	Excess zeros history. Indicates the Excess Zeros alarm occurred previously.
Frame Sync	T1 frame synchronization was not detected.
Frame Sync History	Frame synchronization history. Frame synchronization was lost and later detected.
Idle	DS1 idle condition is detected.
Idle Hist	Idle history. DS1 idle condition was previously detected.
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Ones density history. Ones Density alarm was previously detected.

Table 33 LED results (Continued)

Result	Description
Signal Present	Indicates the presence of a signal on the line.
Signal History	Signal history. Signal was previously detected.
Yellow Alarm	Yellow alarm signal is detected.
Yellow Alarm Hist	Yellow alarm history. Yellow alarm was previously detected.

Event Table results

The Event Table category displays the date and time that significant events, errors, or alarms occurred during the course of your test.

Event Histogram results

A histogram is a display or print output of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time (seconds, minutes, or hours).

Use the up and down arrow keys to scroll through each of the events reported in the histogram.

NOTE:
When viewing a histogram, the left and right arrow keys can not be used to navigate through the other result categories. Use the Display softkey to select and then view another category.

Time results

For time results, see "Time results" on page 233.

Signaling Test Results

C

This appendix describes the test result categories and the results within each category that are available when performing T1 and fractional T1 tests. Topics discussed in this appendix include the following:

About test results

After you start a test, the Summary result category automatically displays a large “All Summary Results OK” message if no errors or alarms have been detected. If errors are detected, the Summary results are displayed. To view test results in other categories, press the **Display** soft key, and then select a result category.

The following sections describe the test results for each of the categories. The test results for each category are listed alphabetically.

Summary results

The Summary category automatically displays error results that are non-zero, key results that are out-of-specification, or key informational results. This allows quick access to the results without having to search each category. Table 34 describes the results that appear in the Summary category.

Table 34 Summary results

Result	Definition
AIS	The alarm indication signal (AIS) tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Alarms	Number of alarm indication signals detected since test start.
B8ZS Detect	B8ZS clear channel coding is detected in the received DS1 signal when the line coding is set to AMI.
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since start of test.

Table 34 Summary results (Continued)

Result	Definition
CRC Errors	Number of Cyclical Redundancy Check-6 errors detected since the beginning of the test. A CRC algorithm is performed on an ESF frame on the transmitting end. It is then recalculated at the receiving end. If the measurements are not equal, it indicates an error occurred in the packet.
DS1 Idle	Indicates whether a DS1 idle condition is detected.
DS1 Idle Hist	Indicates a DS1 idle condition was previously detected.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS line coding, and 16 or more in AMI line coding.
Excess Zeros Count	Number of strings of eight or more consecutive zeros in B8ZS line coding or 16 or more zeros in AMI line coding. Does not count if pattern sync present.
Frame Errors	Number of frame errors received since start of test.
Frame Losses	Number of times frame synchronization was lost.
Frame Sync	Frame synchronization is not detected.
Max Consecutive Zeros	Number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Ones density history. Ones Density alarm was detected but no longer exits.

Table 34 Summary results (Continued)

Result	Definition
RX Frequency Hist	Indicates the receive frequency was previously detected.
Signal Losses	Number of times the signal was lost or absent (limited to 1 loss in every 100 milliseconds).
Signal Present	Indicates the presence of a signal on the line.
Yellow Alarm	Indicates whether a yellow alarm, or remote alarm indication signal (RAI), is detected.
Yellow Alarms	Number of yellow alarms detected since test start.

Signal results

See “Signal test results” on page 217.

Interface results

See “Interface test results” on page 219.

Call results

The Call Results screen lists all signaling events and digits chronologically.

Indicates the channel being tested

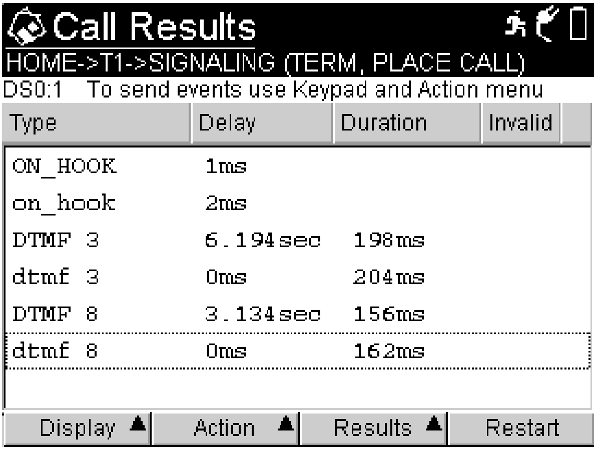


Figure 22 Call results

To display upper and lower tone frequency, and power information for DTMF and MF digits, highlight the event, and then press the **OK** key. The HST displays the frequency and power information. Press the **OK** key again to return to the call results. Table 35 on page 252 describes the call results.

For each signaling event/digit, the following information is available:

Table 35 Call results

Result	Description
Type	Indicates the type of signaling event/digit, for example: `DTMF 1`, `MF 4`, `ON_HOOK`, `RING`. Terminating events appear in lowercase, for example: `on_hook`, `dtmf a`. Originating events appear in all upper-case, for example: `ON_HOOK`, `DTMF A`
Delay	Indicates the amount of time between the previous signaling event/digit and the start of the current event/digit. This result is applicable to all signaling events and digits, with the exception of the first event or digit. If an event is in progress and another event is received, the delay will be zero.
Duration	Indicates how long an event or digit lasts. This applies to all interpretable digits received and the following signaling events: wink, dial tone.

VF results

See Table 32 on page 239.

LED results

See “LED results” on page 226.

Traffic results

The Traffic category provides a means to scan signaling bit transitions on all 24 channels of a duplex T1 circuit. Table 36 describes the results that appear in the Traffic category.

Table 36 Traffic test results

Result	Description
CH	Indicates the channel. You can view the signaling bits for all 24 channels.
AB(CD) Bits	Signaling bits received on each T1 line.

Event Table results

The Event Table category displays the date and time that significant events, errors, or alarms occurred during the course of your test.

Event Histogram results

A histogram is a display or print output of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time (seconds, minutes, or hours).

Use the up and down arrow keys to scroll through each of the events reported in the histogram.

NOTE:

When viewing a histogram, the left and right arrow keys can not be used to navigate through the other result categories. Use the Display softkey to select and then view another category.

Time results

See "Time test results" on page 233.

Channel results

Table 37 describes the results in the Channel category.

Table 37 Channel test results

Result	Description
CH	Indicates the channel.
T1 Rx Byte	Data byte samples in binary form. Applicable only in fractional T1 testing.

ISDN PRI Test Results

D

This appendix describes the test result categories and the results within each category that are available when performing ISDN PRI tests. Topics discussed in this appendix include the following:

Summary results

The Summary category automatically displays error results that are non-zero, key results that are out-of-specification, or key informational results. This allows quick access to the results without having to search each category.

> **NOTE:**
>
> BERT errors and alarms always appear in the Primary column on the Summary Results screen, even if you are testing NFAS, NFAS with DCBU, or a call on the secondary line.

Table 38 describes the results that appear in the Summary category.

Table 38 Summary results

Result	Definition
Aborted Frames	Count of the number of LAPD frames aborted since the test started. The count excludes out of frame (OOF) aborts.
AIS	Alarm indication signal. This signal tells downstream equipment that a piece of upstream equipment has detected loss of signal or loss of framing.
AIS Alarms	Number of alarm indication signals detected since test start.
B8ZS Detect	B8ZS clear channel coding is detected in the received DS1 signal when the line coding is set to AMI.
Bit Errors	Number of received bits that have a value opposite that of the expected pattern, after pattern synchronization has been achieved.

Table 38 Summary results (Continued)

Result	Definition
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since start of test.
Call 1 Bit Errors	Number of received bits with a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved on Call 1.
Call 2 Bit Errors	Number of received bits with a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved on Call 2.
Call 1 Status	Displays one of the following call states for Call 1: – Idle – Incoming – Outgoing – Connected – Releasing – Alerting – Proceeding **NOTE:** See Table 40 on page 265 for descriptions of each state.
Call 2 Status	Displays the call state for Call 2. For a list of call states, *see* "Call 1 Status".
Call Failure Count	Number of failed incoming and outgoing calls.
CRC Error Frames	Counts the number of CRC errored frames on the D channel.
D-Chan Ready	Displays "Active" if the data link is established; "Inactive" if the data link is not established.
D-Chan Ready Hist	Displays "Inactive" if the data link was established, but was lost.

Table 38 Summary results (Continued)

Result	Definition
D-Chan Srvc	Displays one of the following states for the primary and if applicable, secondary D Channel: – Out Of Srvc. – In Service – Standby – Maint. OOS – Wait – Maint. Busy **NOTE:** This result only appears when placing ISDN PRI calls in terminate mode.
DS1 Idle	DS1 idle condition is detected.
DS1 Idle Hist	Idle history. DS1 idle condition was detected in the past.
Excess Zeros	Alarm that indicates 8 or more consecutive excess zeros were detected in B8ZS line coding, and 16 or more in AMI line coding.
Excs Zeros Cnt	Number of strings of eight or more consecutive zeros in B8ZS line coding or 16 or more zeros in AMI line coding. Does not count if pattern sync present.
Excess Zeros Hist	Indicates an excess zeros condition was detected in the past.
Frame Count	Number of valid frames received since the beginning of the test.
Frame Errors	Number of frame errors received since start of the test.
Frame Losses	Number of times frame synchronization was lost since the start of the test.
Frame Sync	Frame synchronization is not detected.
Invalid SAPI Count	Number of frames received with an invalid SAPI (service access point identifier).

Table 38 Summary results (Continued)

Result	Definition
LAPD State	Displays one of the following messages about the process of establishing the data link: – TEI Unassigned – Assign Await. TEI – Est. Await. TEI – TEI Assigned – Await. Est. – Await. Rel. – Mult. Frm. Est. – Timer Recovery – Link Unknown **NOTE:** This result only appears when testing in Terminate mode.
Link Status	Indicates whether the link is active, or in standby mode.
Link Status History	Indicates that the LAPD State result was `Mult. Frm. Est.`, and then changed to another state.
Max Consec Zeros	Number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).
Ones Density	Alarm that indicates the T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits).
Ones Density Hist	Ones density history. Ones Density alarm was detected but no longer exits.
Pattern Losses	Number of times pattern synchronization was lost.
Pattern Slips	Number of pattern slips detected since start of test (PRBS patterns only).
Pattern Sync	Indicates the pattern synchronization status for a call you are BER testing.

Table 38 Summary results (Continued)

Result	Definition
RX Freq Hist	Indicates the receive frequency was previously detected.
Short Frames	Number of short ISDN frames (frames with less than 3 octets plus an FCS) detected.
Signal Losses	Number of times the signal was lost (limited to 1 loss in every 100 milliseconds).
Signal Present	Indicates the presence of a signal on the line.
Yellow Alarm	Indicates whether a yellow alarm is detected.
Yellow Alarm Hist	Indicates a yellow alarm was detected in the past.
Yellow Alarm Losses	Number of yellow alarms detected since test start.

ISDN results

The ISDN category shows layer 2 results such as the frame count and D channel service state for the primary, and if applicable, secondary line. Results in this category accumulate after test restart. Table 39 describes the results that appear in the ISDN category.

Table 39 ISDN test results

Result	Description
Aborted Frames	Count of the number of LAPD frames aborted since the test started. The count excludes out of frame (OOF) aborts.

Table 39 ISDN test results (Continued)

Result	Description
Average % Utilization	The average bandwidth utilized by the received traffic since the last test restart, expressed as a percentage of the line rate of available bandwidth. The average is calculated over the time period elapsed since the last test restart.
Call Clearing Count	Total number of cleared calls for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Connect Count	Number of calls connected for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Failure Count	Number of failed incoming and outgoing calls for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Placement Count	Number of outgoing calls placed for the primary, and if applicable, secondary line. Count appears in the Primary result column.
CRC Error Frames	Counts the number of CRC errored frames on the D channel.

Table 39 ISDN test results (Continued)

Result	Description
D-Chan Service	Displays one of the following states for the primary and if applicable, secondary D Channel: – Out Of Srvc. – In Service – Standby – Maint. OOS – Wait – Maint. Busy **NOTE:** This result only appears when placing ISDN PRI calls in terminate mode.
Erred Frame Count	Number of valid frames with one or more of the following error conditions: – undefined control field – “S” or “U” frames with incorrect length – “I” frame with a long information field.
Frame Count	Number of valid frames received since the beginning of the test.
Frame Reject Frames	Number of frame-reject (FRMR) frames that indicate an improper frame has arrived.
Frame Sync	T1 frame synchronization was not detected.
Invalid SAPI Count	Number of frames received with an invalid SAPI (service access point identifier).

Table 39 ISDN test results (Continued)

Result	Description
LAPD State	Displays one of the following messages about the process of establishing the data link: – TEI Unassigned – Assign Await. TEI – Est. Await. TEI – TEI Assigned – Await. Est. – Await. Rel. – Mult. Frm. Est. – Timer Recovery – Link Unknown
Link Status	Indicates whether the link is active, or in standby mode.
Maximum % Utilization	The maximum percent of link utilization in any one second since the start of the test.
Reject Frame Count	Number of reject (REJ) supervisory frames used by a data link layer entity to request retransmission of "I" frames starting with the frame numbered N(R).
Rx Frame Count	Number of LAPD frames received since the start of the test.
Short Frames	Number of short ISDN frames (frames with less than 3 octets plus an FCS) detected.
Valid Frame Count	Number of valid LAPD frames received since the start of the test.

Call Summary results

In Multiple Call mode, you can view the call state for up to 23 calls on the Call Summary Results screen. In Figure 23, all 23 calls are connected..

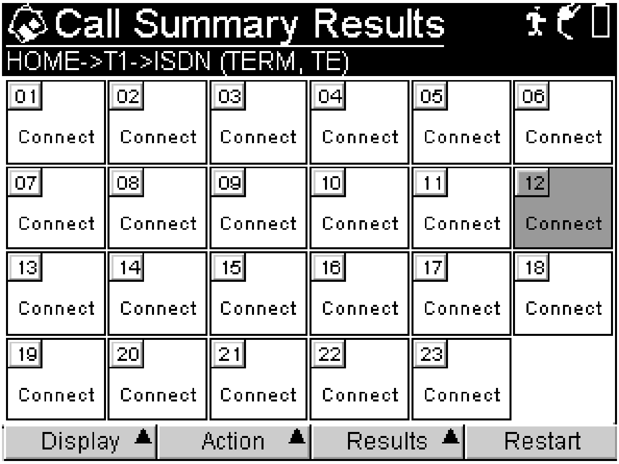


Figure 23 Call Summary Results

NOTE:

You can also use the Action soft key to dial, speed dial, BER test, or disconnect the highlighted call on the Call Summary Results screen. See "Using the HST in Multiple Call mode" on page 158.

Call results

The Call result categories show the progression of incoming and outgoing calls using call states. A display area is also provided which simulates the display area of an ISDN telephone, listing the phone number and the name of the caller. If a call's channel is assigned, you can transmit DTMF tones for the displayed call using the keypad.

In Dual Call mode, Call 1 and Call 2 appear as result category selections in the Display menu. In Multiple Call mode, Call appears as a result category selection. When selected, information is displayed for the call that is currently selected on the Call Summary Results display.

Call states

Table 40 lists the valid call states that may appear for a call as a Call Status result.

Table 40 Call states

State	Indicates
Alerting	An outgoing call has been routed to the destination ISDN device or phone, and is in the process of ringing. **NOTE:** Some ISDN devices (for example, the HST), do not literally ring.
Connected	An incoming or outgoing call is established.
Idle	The HST is ready to place or receive the call.
Incoming	An incoming call is waiting to be accepted, rejected, or ignored.
Outgoing	The HST is in the process of initializing an outgoing call.
Proceeding	A switch has recognized and is processing the outgoing call.
Releasing	The HST is in the process of releasing the call.

Call test results

Table 41 lists the call test results.

Table 41 Call test results

Result	Description
Call 1 Display	Simulates the display area of an ISDN telephone for Call 1. Lists the phone number and the name of the caller.
Call 1 Status	Displays one of the following call states for Call 1: – Idle – Incoming – Outgoing – Connected – Releasing – Alerting – Proceeding **NOTE:** See Table 40 on page 265 for descriptions of each state.
Call 2 Display	Simulates the display area of an ISDN telephone for Call 2. Lists the phone number and the name of the caller.
Call 2 Status	Displays the call state for Call 2. For a list of call states, *see* "Call 1 Status".

In addition to the results listed in Table 41, Q.931 cause values indicating the reason a call is disconnected are displayed on the Call 1/Call 2 Results screen. For details, see "Q.931 Cause Values" on page 270.

D Channel Decode results

The D Channel Decode category displays ISDN Call Control messages from a D Channel Decode message buffer. You can scroll through the text using the arrow keypad.

For an overview on interpreting decode messages, see "Interpreting D Channel decode messages" on page 184.

LAPD Unnumbered frame messages

Table 42 lists each of the LAPD unnumbered frame decode messages. For an overview of LAPD messages, see "LAPD messages" on page 189.

Table 42 LAPD unnumbered frame decodes

Message…	Sent to…
DISC (Disconnect)	Disconnect or terminate the D channel link. This message should not be confused with the Q.931 `DISCONNECT` message which is used to disconnect a call.
DM (Disconnect Mode)	Indicate one of the following: – The link partner is not ready to establish a D channel link with the device sending a `SABME` message. – The link partner cannot terminate the link (in response to a `DISC` message), typically because communications have already been disconnected.
FRMR (Frame Reject)	Indicate that an unrecoverable link-level problem has occurred. This message is transmitted when re-transmitting a frame will not correct the problem, and indicates a potential high level protocol issue between the link partners.

Table 42 LAPD unnumbered frame decodes (Continued)

Message…	Sent to…
SABME (Set Asynchronous Balanced Mode with Extended Sequence Numbering)	Establish initial D channel communications. – An affirmative response from the link partner is a UA message. – A negative response (indicating the link partner is not ready to establish a link) is a DM message.
UA (Unnumbered Acknowledgement)	Acknowledge one of the following: – A `SABME` message from the device initiating D channel communications. – A `DISC` message from the device terminating the D channel link.
UI (Unnumbered Information)	Request an exchange of information between the link partners.

LAPD Supervisory frame messages

Table 43 lists each of the LAPD supervisory frame decode messages. For an overview of LAPD messages, see "LAPD messages" on page 189.

Table 43 LAPD supervisory frame decodes

Message…	Sent to…
REJ (Reject)	Force re-transmission of bad frames. Frequent REJ frames indicate miscommunication on the D channel, typically due to errored frames during transmission.
RNR (Receiver Not Ready)	Indicate that a link partner is experiencing difficulty (such as buffer depletion), and cannot accept any additional information frames (call related messages) at this time. RNR messages should occur rarely, and should be investigated immediately when they occur.

Table 43 LAPD supervisory frame decodes (Continued)

Message…	Sent to…
RR (Receiver Ready)	Keep the signal alive between the link partners, and acknowledge receipt of frames. RR messages are the most common messages observed in D channel decodes. When there are no call-related messages to send, the link partners transmit RR frames to make sure the link stays in service. **NOTE:** When you are viewing a large number of decode messages to troubleshoot call processing, you can typically ignore the RR messages since they are simply used to keep the D channel signal alive.

Q.931 messages

Table 44 lists common Q.931 decode messages.

Table 44 Q.931 decodes

Message…	Sent to…
ALERTING	Indicate that a SETUP message has been received by an ISDN device or phone, and that the device or phone is in the process of ringing. **NOTE:** Some ISDN devices (for example, the HST), do not literally ring.
CALL PROCEEDING	Indicate that a SETUP message has been received by a switch, and that the switch is attempting to process the call.
CONNECT	Indicate that the call has been completed and that the calling party is connected with the called party.
CONNECT ACK	Acknowledge that the CONNECT message has been received.

Table 44 Q.931 decodes (Continued)

Message…	Sent to…
DISCONNECT	Disconnect the call. Can be sent from the calling device or the called device. **NOTE:** `DISCONNECT` messages report the cause for the disconnection.
RELEASE	Release the call in response to a `DISCONNECT` message, or because a call cannot be connected. **NOTE:** If a call cannot be connected, and as a result a `RELEASE` message is issued in response to a `SETUP` request, the `RELEASE` message will report the cause for the disconnection.
RELEASE COMPLETE	Acknowledge that a `RELEASE` message has been received, and disconnect the call. **NOTE:** A call is not disconnected until the `RELEASE COMPLETE` message is observed.
SETUP	Originate a call.

In addition to the messages listed in Table 41, additional messages concerning the call (such as the operator system access used), and Q.931 cause values indicating the reason a call is disconnected appear on the D Channel Decode screen. For details, see "Q.931 Cause Values" on page 270.

Q.931 Cause Values

Cause values indicating the reason a call is disconnected are displayed on the D Channel Decode Results screen and the Call 1/Call 2 Results screen.

For each disconnected call, the D Channel Decode Results screen displays the following cause information in either the `DISCONNECT` or `RELEASE` message:

– A location code, indicating where the disconnect originated (for example, on a private network or a transit network).
– A class code, indicating the type of disconnect (for example, due to a protocol error).
– The cause value issued by the ISDN Network. This value corresponds to a Q.931 cause code (see the cause codes listed in Table 45 on page 272).
– An abbreviated description indicating the reason the call was disconnected.

The Call 1/Call 2 Results screen simply provides the cause value and an abbreviated description of the cause of the disconnect.

NOTE:

The cause codes listed in Table 45 on page 272 do not appear on the D Channel Decode Results or Call 1/Call 2 Results screens. The codes correspond to those listed in the International Telecommunications Union (ITU) Q.931 standards.

Table 45 lists and explains the most commonly encountered cause codes for ISDN PRI calls.

Table 45 Common Q.931 Cause Codes

Cause Code	D Channel Decode Description	Call 1/Call 2 Description	Typically Indicates
16	`Normal clearing`	`NORMAL CALL CLEARING`	No fault is detected; the call is finished.
18	`No user responding`	`NO USER RESPONSE`	The receiving equipment did not respond to the call attempt within the allowed time.
28	`Invalid number format`	`INVALID NUMBER FORMAT`	The receiving equipment considers the number to be incomplete or in an incorrect format. For example, numbers sent as a subscriber plan are expected to be 7 digits or less; numbers sent as national dialing plans are expected to be more than 7 digits.
31	`Normal unspecified`	`NORMAL UNSPECIFIED`	Any number of unspecified conditions, but may indicate the call is terminating into a “fast busy” (all trunks are busy).

Table 45 Common Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description	Typically Indicates
57	`Bearer capability not authorized`	`BEARCAP NOT AUTHORIZED`	The calling party has requested a call type or service that is not implemented on the receiving equipment for the line. Often seen when trying to place voice calls on data only lines or data calls on voice only lines.
88	`Incompatible destination`	`INCOMPATIBLE DESTINATION`	The destination device is not capable of supporting the type of call requested. Usually seen when trying to place data calls to a voice phone.

Table 45 Common Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description	Typically Indicates
100	`Invalid information element contents`	`INVALID INFO ELEMENT CONTENT`	A protocol problem where the receiving equipment does not understand one of the fields inside of the call setup message. If you receive this message, do the following: – Verify that the call control is correct for the call. – Contact a Tier 2 or Tier 3 technician or switch vendor to isolate and resolve the problem.
102	`Recovery on timer expiry`	`RECOVERY ON TIMER EXPIRY`	No response received to generated messages. Often seen on PRI NFAS circuits when equipment is trying to generate call activity on the backup D channel and not on the currently active D channel.

Table 45 lists less frequently encountered cause codes for ISDN PRI calls.

Table 46 Q.931 Cause Codes

Cause Code	D Channel Decode Description	Call 1/Call 2 Description
1	Unassigned Number	UNASSIGNED NUMBER
2	No route to specified network	NO ROUTE TO TRANSIT NETWORK
3	No route to destination	NO ROUTE TO DESTINATION
6	Channel unacceptable	CHANNEL IS UNACCEPTABLE
7	Call awarded delivered in est. ch.	CALL AWARDED
17	User busy	USER BUSY
19	User alerting no answer	ALERTING BUT NO ANSWER
22	Number changed	NUMBER CHANGED
26	Non-selected user clearing	NON-SELECTED USER CLEARING
27	Destination out of order	DESTINATION OUT OF ORDER
29	Requested facility rejected	REQUEST FACILITY REJECTED
30	Response to STATUS ENQuiry	RESPONSE TO STATUS ENQUIRY
34	No channel available	NO CIRCUIT/CHAN AVAILABLE
35	Queued	QUEUED
41	Temporary failure	TEMPORARY FAILURE
42	Network congestion	NETWORK CONGESTION
43	Access information discarded	ACCESS INFO DISCARDED

Table 46 Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description
44	Requested circ/channel not avail.	REQ. CHANNEL NOT AVAILABLE
47	Resources unavailable-unspecified	RESOURCE UNAVAILABLE
50	Requested facility not subscribed	REQ FACILITY NOT SUBSCRIBED
52	Outgoing calls barred	OUTGOING CALLS BARRED
54	Incoming calls barred	INCOMING CALLS BARRED
58	Bearer capability not presently available	BEARCAP NOT AVAILABLE
63	Service or option not available	SERVICE NOT AVAILABLE
65	Bearer service not implemented	BEARER SERVICE NOT IMPLE-MENTED
66	Channel type not implemented	CHANNEL TYPE NOT IMPLE-MENTED
69	Requested facility not implemented	REQ FACILITY NOT IMPLE-MENTED
70	Only restricted dig. info. bearer	RESTRICTED DIGITAL ONLY
79	Service/option not implemented unspecified	SERVICE NOT IMPLEMENTED
81	Invalid Call Reference value	INVALID CALL REFERENCE VALUE
82	Identified channel does not exist	CHANNEL DOES NOT EXIST
90	Destination address missing	NO DESTINATION ADDRESS

Table 46 Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description
91	Transit network does not exist	TRANSIT NETWORK NOT EXIST
95	Invalid messageunspec-ified	INVALID MESSAGE
96	Mandatory information element missing	INFO ELEMENT MISSING
97	Message type nonexist-ant or not implemented	MESSAGE TYPE NON-EXISTENT
98	Message not compatible with call state	MESSAGE NOT COMPATIBLE
99	Info element nonexistant or not implemented	INFO ELEMENT NON-EXISTENT
101	Message not compatible with call state	MESSAGE NOT COMPATIBLE
111	Protocol error unspecified	PROTOCOL ERROR
127	Interworking unspecified	INTERWORKING

LED results

The LED category shows the current and historical status for alarms. Table 47 describes LED results specific to ISDN PRI testing. Results are listed in alphabetical order.

Table 47 LED results

Result	Description
Call 1Pattern Sync	Illuminates if pattern synchronization was not lost on Call 1.
Call 2 Pattern Sync	Illuminates if pattern synchronization was not lost on Call 2.
Call 1Pattern Sync History	Illuminates if pattern synchronization was previously detected on Call 1.
Call 2 Pattern Sync History	Illuminates if pattern synchronization was previously detected on Call 2.
D-Chan Ready	Illuminates if the data link is established; clear if the data link is not established.
D-Chan Ready Hist	Illuminates if the data link was established, but was lost.

For descriptions of the other T1 LED results, see "LED results" on page 226.

Event Table results

The Event Table category displays the date and time that significant events, errors, or alarms occurred during the course of your test.

Event Histogram results

A histogram is a display or print output of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time (seconds, minutes, or hours).

Use the up and down arrow keys to scroll through each of the events reported in the histogram.

NOTE:

When viewing a histogram, the left and right arrow keys can not be used to navigate through the other result categories. Use the Display softkey to select and then view another category.

BERT Patterns, Errors, Alarms, and Loop Codes

E

This appendix describes the available BERT patterns, errors, and alarms you can use when performing a test. Topics discussed in this appendix include the following:

BERT patterns

Table 48 describes the BERT patterns available for the following applications: T1, fractional T1, T1 DDS, and ISDN PRI testing. The patterns listed do not apply to all test applications.

Table 48 T1, FT1, T1 DDS, and ISDN PRI BERT patterns

Pattern	Description
63	Selects the 2^6 -1 Pseudorandom pattern, which generates a maximum of 5 sequential 0s and 6 sequential 1s. Simulates live data for circuits less than 9.6 kbps.
511	Selects the 2^9 -1 Pseudorandom pattern, which generates a maximum of 8 sequential 0s and 9 sequential 1s. Simulates live data for circuits less than 9.6 kbps.
2047	Simulates live T1 data. A pseudorandom pattern based on an 11-bit shift register. Selects the 2^{11} -1 Pseudorandom pattern, which generates a maximum of 10 sequential 0s and 11 sequential 1s. Simulates live data for circuits 56 kbps and lower. (Used for DDS and ISDN.)
1:7	Stresses the minimum ones density requirement (12.5%) for T1 circuits using AMI coding. This pattern is used to test timing clock recovery and can be transmitted framed and unframed.
2 in 8	Generally used to test mis-optioned equipment for B8ZS encoding.
2^15-1	Selects the 2^{15}-1 pseudorandom pattern, which generates a maximum of 14 sequential 0s and 15 sequential 1s. Simulates live data for 56 kbps to 2Mbps circuits.
2^15-1 INV	Selects the inverted 2^{15}-1 pseudorandom pattern, which generates a maximum of 14 sequential 1s and 15 sequential 0s. Simulates live data for 56 kbps to 2Mbps circuits.
2^20-1	Selects the 2^{20} -1 pseudorandom pattern, which generates a maximum of 19 sequential 0s and 20 sequential 1s. Simulates live data for DS2 circuits.

Table 48 T1, FT1, T1 DDS, and ISDN PRI BERT patterns (Continued)

Pattern	Description
2^20-1 INV	Selects the inverted 2^{20} -1 pseudorandom pattern, which generates a maximum of 19 sequential 1s and 20 sequential 0s. Simulates live data for DS2 circuits.
2^23-1	Selects the 2^{23} -1 pseudorandom pattern, which generates a maximum of 22 sequential 0s and 23 sequential 1s. Usually used to simulate live data for DS3 and SONET circuits.
2^23-1 INV	Selects the inverted 2^{23} -1 pseudorandom pattern, which generates a maximum of 22 sequential 1s and 23 sequential 0s. Usually used to simulate live data for DS3 and SONET circuits.
2047QRS	(fractional T1 only) Selects the 2^{11} -1 Pseudorandom pattern, which generates a maximum of 7 sequential 0s and 11 sequential 1s.
3 in 24	Stresses the minimum ones density (12.5%) and the maximum zeros requirement (15) of T1 circuits. When the pattern is framed, at least n ones must appear in 8(n+1) bits where n = 1 to 23. This pattern is used to test timing clock recovery and can be transmitted framed and unframed.
511QRS	Selects the 2^{9} -1 Pseudorandom pattern, which generates a maximum of 7 sequential 0s and 9 sequential 1s.
All Ones	Provides a fixed test pattern of all ones (AMI pulses). Generally this pattern is used to stress span repeater current regulator circuits. It can also be used as an AIS in unframed circuits, a keep alive signal, or an idle code. This pattern is required to accurately measure the T1 signal power in dBm (n42 RX LVL result).
All Zeros	Used to test T1 circuits for B8ZS clear channel capability (CCC). The Line Code should be set for B8ZS when sending the All Zeros pattern. This pattern can be transmitted framed or unframed.
AUTO	Used when you want to configure your transmitted pattern to the received pattern detected by your instrument.
AUTO-R	Used when you want your instrument to automatically redetect the received BERT pattern after losing pattern sync.

Table 48 T1, FT1, T1 DDS, and ISDN PRI BERT patterns (Continued)

Pattern	Description
BRIDGETAP	**NOTE:** BRIDGETAP is only available in the FULL T1 channel format. Transmits 21 consecutive test patterns: ALL ONES, 1:1, 1:3, 1:5, 1:6, 1:7, 2:8, 2:9, 2:10, 2:11, 2:12, 2:13, 2:14, 3 IN 18, 3 IN 19, 3 IN 20, 3 IN 21, 3 IN 22, 3 IN 23, 3 IN 24, and QRSS. When BRIDGETAP is selected a test restart occurs and the pattern is transmitted. As each pattern is transmitted, it is identified in the display in lowercase letters. The BRIDGETAP test takes approximately ten minutes. This automated test pattern sequence is used during initial installation to identify bridge taps or stress the T1 span during routine maintenance. When a bridge tap exists on the line, reflections occur during the transmission of data which interfere with the performance of the T1 span.
DDS1	Selects a pattern consisting of 100 octets of 0xFF, followed by 100 octets of 0x00, transmitted right to left. Stresses a DDS circuit's minimum and maximum power recovery.
DDS2	Selects a pattern consisting of 100 octets of 0x7E, followed by 100 octets of 0x00, transmitted right to left. Ensures a DDS circuit can properly pass the signal. Provides a minimum ones density and simulates bit-oriented protocol flags.
DDS3	Selects a fixed pattern consisting of F0011 0010 [0x32], transmitted right to left. Used to simulate a signal transmitted over the DDS circuit. Medium stress for a DDS circuit. DDS3 (32 hex) is the EBCDIC Sync Idle Character
DDS3R	Selects a fixed pattern the reverse of DDS3.
DDS4	Selects a fixed pattern consisting of F0100 0000 [0x40], transmitted right to left. Moderately stresses the DDS clock recovery circuitry. DDS4 (40 hex) is the EBCDIC space character.
DDS5	Selects a rotating pattern consisting of DDS patterns 1-4.
DDS6	Selects a fixed pattern consisting of seven octets of 0x7F, followed by one octet of 0xFF, transmitted right to left. Simulates a DDS signal transition from idle mode to data mode. Detects marginal equipment in multipoint applications.

Table 48 T1, FT1, T1 DDS, and ISDN PRI BERT patterns (Continued)

Pattern	Description
Delay	Used for measuring round trip delay. Delay pattern measurement requires a transmitter/receiver loopback, with the transmit rate equal to the receive rate. This test measures round trip delay once per second (or until the previous delay measurement is complete) for the length of the test, provided pattern sync is present. Normal BER test results (such as bit errors and pattern sync) are not available during delay testing.
Live	Used in monitor mode to avoid false “errors” when the monitored circuit contains live traffic rather than BERT patterns.
MULTIPAT	**NOTE:** MULTIPAT is only available in the FULL T1 channel format. Transmits five consecutive test patterns: ALL ONES, 1:7, 2 IN 8, 3 IN 24, and QRSS. When MULTIPAT is selected, a test restart occurs and the pattern is transmitted. As each pattern is transmitted, it is identified in the display in lowercase letters. This automated test pattern sequence is used during the acceptance testing of a new T1 span or while troubleshooting an existing T1 span.
QRSS	Simulates live T1 data. T1 QRSS is a modified 2-1 pseudorandom pattern that allows a maximum of 15 sequential zeros and 20 sequential ones. The Ones Density alarm is disabled when this pattern is transmitted. This is the most popular pattern for T1 installation and maintenance. 2^{20}-1 pseudorandom pattern with 14-zero suppression.
T1-1 (MIN/MAX)	Minimum/Maximum Density Stress Pattern - Generates rapid transitions from low ones density octets to high ones density octets. This pattern is used to test the ability of repeaters to adjust to rapid changes in ones density.
T1-2/96	Selects the 96 octet fixed stress pattern (transmitted right to left). Stresses repeater preamplifier and Automatic Line Build Out (ALBO) circuitry. Detects marginal equipment using rapid transitions between low and high ones density.
T1-3/54	Provides a fixed 54-octet HEX pattern used to stress test T1 circuits and equipment.

Table 48 T1, FT1, T1 DDS, and ISDN PRI BERT patterns (Continued)

Pattern	Description
T1-4/120	Selects the 120 octet fixed stress pattern (transmitted right to left). Stresses circuits and equipment. Should not be used on ESF circuits because it contains false ESF framing bits.
T1-5/53	Provides a fixed 53-octet HEX pattern used to stress test T1 circuits and equipment.
T1-6/55 (55 Octet)	Provides a fixed unframed 55-octet HEX pattern and a variant of the MIN/MAX repeater stress pattern used to test the repeaters' ability to lock onto the incoming clock when the data changes from high ones density to low ones density.
T1DALY	Provides a fixed framed 55-octet HEX pattern used with framed T1 circuits without causing excess zeros (excess zeros is more than 15 consecutive zeros). This pattern is a variant of T1-6.
User Bit Pattern	Selects a user-defined pattern from 3 to 32 bits long.
User Byte Pattern	Selects a user-defined pattern from 1 to 64 bytes long.

Alarms

Table 49 lists the alarms you can insert.

Table 49 Alarms

Alarm	Description
LOF	Loss of framing
LOS	Loss of signal
AIS	Alarm indication signal
Yellow Alarm	Remote alarm indication signal (RAI)

Errors

Table 50 lists the errors you can insert.

Table 50 Errors

Error	Description
Bit Error	Payload bit error
BPV	Bipolar violation
CRC Error	Cyclical redundancy check error
Frame Error	Frame error or FAS

Error/alarm criteria

Table 51 shows the criteria that will cause an error or alarm to register on the HST-3000.

Table 51 Error/alarm criteria

Error/Alarm	Criteria
Signal Loss	175 +/- 75 consecutive zeros
Frame Loss	D4/SF: 2 out of 5 Ft bits in error ESF: 2 out of 5 frame bits in error SLC-96: 2 out of 5 Ft bits in error
Excess Zeroes	AMI: 16 or more consecutive zeros B8ZS: 8 or more consecutive zeros
B8ZS Sequence Detected	Instrument set to AMI and a B8ZS signal is detected
Yellow Alarm (RAI)	D1D Bit 2 is 0 for 255 consecutive channels D4 Bit 2 is 0 for 255 consecutive channels ESF 256 bits +/- 16 bits of pattern received on FDL SLC-96 Bit 2 is 0 for 255 consecutive channels
AIS (Blue Alarm)	Unframed all ones signal

Table 51 Error/alarm criteria (Continued)

Error/Alarm	Criteria
IDLE	D4/SF: As per [7] Annex D.2 ESF: As per [7] Annex D.3
Ones Density	QRSS alarm suppressed Other patterns: At least n ones in 8(n+1) bits

T1 DDS loop codes

Table 52 describes the latching and alternating loop codes available in T1 DDS testing.

Table 52 DDS loop codes

Loop Code	Description
Alternating Loop codes	
CSU	Enables an alternating channel service unit loop code.
CSU 1st Repeater	Enables an alternating channel service unit loop code that bypasses one repeater.
CSU 2nd Repeater	Enables a channel service unit loop code that bypasses two repeaters.
DSU	Enables an alternating data service unit loop code.
HL96NY	Enables an alternating HL96NY loop code.
OCU	Enables an alternating office channel unit loop code.
OCU + HL96	Enables an alternating office channel unit loop code that bypasses an HL96 terminal.

Table 52 DDS loop codes (Continued)

Loop Code	Description
56Kbps 1st Repeater	Enables an alternating repeater loop code to be sent to the first repeater in the local loop.
56Kbps 2nd Repeater	Enables an alternating repeater loop code to be sent to a second repeater in the local loop (bypassing the first repeater).
Latching Loop Codes	
CSU	Enables a latching channel service unit loop code.
DS0-DP	Enables a latching DS0 data port loop code to be sent to one of eight data port locations.
DSU	Enables a latching data service unit loop code.
LSI	Enables a latching line side interface loop code.
NEI	Enables a latching network element interface loop code (latching DDS termination sequence).
OCU	Enables a latching office channel unit loop code.
V54	Enables a latching V.54 loop code.
Data Port	This option appears when you select the DS0-DP loop code. Enter a number, from **1** to **8**, for the data port location. Press the **OK** key.

T1 and FT1 loop codes

After you specify the type of loop code test you want to perform (see page 37), you must configure the loop code settings. Table 53 shows the available loop code test settings for T1 and FT1 testing.

For information about T1 DDS loop codes, see “Terminate testing” on page 31 and “T1 DDS loop codes” on page 288.

Table 53 T1 and FT1 loop codes

Parameter	Options
NIU loop code test	
NIU Loop Code	Specify one of the following: – **Facility 1** – **Facility 2** – **Facility 3** – **ESF Net** [1]
Auto Response	Select one of the following – **Respond Off** – **Respond On**
CSU loop code test	
CSU Loop Code	Specify one of the following: – **Basic CSU** – **ESF Line**[1] – **ESF Payload**[1]
Auto Response	Select one of the following: – **Respond Off** – **Respond On**
HDSL loop code test	

Table 53 T1 and FT1 loop codes (Continued)

Parameter	Options
HDSL Model	Select one of the following units: – **Adtran HRE** (Standard & Abbreviated) – **Adtran HTU-C** (Standard & Abbreviated) – **Adtran HTU-R** (Standard & Abbreviated) – **ADC/Pair Gain HDU** (A2LB & Generic) – **ADC/Pair Gain HLU** (A2LB & Generic) – **ADC/Pair Gain HRU** (A2LB & Generic)
Test Direction	Specify the test direction: – **CO to Customer** – **Customer to CO**
Code Type	Select one of the following: – **Long Code** – **Short Code**
Address	Select one of the following – **1** – **2**
FT1 CSU (V.54) loop code test	
Auto Response	Select one of the following: – **Respond Off** – **Respond On**

Table 53 T1 and FT1 loop codes (Continued)

Parameter	Options
Repeater loop code	
Repeater Model	Select one of the following repeaters: – **Teltrend 7231LW IOR** – **Teltrend 7231LP IOR** – **Teltrend 9132LW IHR** – **Teltrend 9132LP IHR** – **Teltrend 7239LW ILR** – **Teltrend 7239LP ILR** – **Teltrend 7239LBE ILR** – **Westell 3130-56 IOR A/B** – **Westell 3130-56 IOR C** – **Westell 3130-80 IOR** – **Westell 3150-56 ILR AB** – **Westell 3150-56 ILR C** – **Westell 3151-56 ILR** – **Westell 3150-80 ILR** – **Westell 3150-81 ILR** – **Xel 7853-200 ILR**
Address	Depending on the repeater model you select, you may need specify an address. Select either **1** or **2**.
MSS (maintenance switch system) loop code	
MSS Model	The only supported switch is the **Westell 3171-60 series**.
Card Number	Enter a card number. Valid card numbers are from **1** to **28**.

Table 53 T1 and FT1 loop codes (Continued)

Parameter	Options
User-defined loop code	
Loop Code Name	Default names appear as User1, User2, User3, and so on. To change a pattern name, use the arrow keys to highlight a name, and then press the **Edit** soft key. Use the keypad to keys to enter letters.
Bit Pattern	Enter a pattern. The pattern can be 1 to 16 digits long. Press the **OK** key to accept the change.
Type	Specify the type of loop code: – **Loop Up** – **Loop Down** – **Other**
Delivery	Select either **In Band** or **Out of Band**.

1. Available if the framing format is ESF.

VF Loopback Tones

When testing VF circuits, the HST can transmit and detect the 2713 Hz tone at -10.0 dBm to initiate loop up and loop down sequences at the far end.

Specifications

F

This appendix contains specifications for the T1 testing option. Topics discussed in this appendix include the following:

Receiver specifications

Table 54 lists specifications for the Primary and Secondary T1 receivers (Rx).

Table 54 Rx specifications

Parameter	Specification
Connectors	Two bantam jacks
Frequency	1.544 MHz ± 5 kHz
Bit rate	1544 kbps
Jitter tolerance	Telcordia GR-499-CORE Issue 2 1998
Line coding	AMI, B8ZS

Table 55 lists the input sensitivity specifications for the Primary and Secondary T1 receivers.

Table 55 Rx sensitivity specifications

Termination Type	Impedance	Input Range
Bridge	>1000 Ω	+6 to -35.0 dBdsx of cable loss
Terminate	100 Ω ±5%	+6 to -35.0 dBdsx of cable loss
DSX Monitor	100 Ω ±5%	-20 to -30 dBdsx of resistive loss plus 0 to -6 dB of cable loss

Transmitter specifications

Table 56 on page 297 lists specifications for the Primary and Secondary T1 transmitters (Tx).

Table 56 Tx specifications

Parameter	Specification
Connectors	Two bantam jacks
Output	6 V peak-peak into 100 Ω
Line build out (LBO) level	0 dB, -7.5 dB, -15.0 dB or -22.5 dB of cable loss at 772 kHz
LBO level tolerance	± 2 dB at 772 kHz for -7.5 dB, -15.0 dB and -22.5 dB relative to signal at 0 dBdsx
Line code	AMI, B8ZS
Clock source[1] (Timing)	Internal clock 1544 Kbps (±3 ppm, ±1 ppm/ year accuracy) Recovered from Rx Primary
Pulse shape	With output terminated in 100 Ω resistive load and 0 dB LBO selected, the HST-3000 meets ITU-T Recommendation G.703 and ANSI T1.102-1993
Output jitter	T1.102-1993 Table 9

1. Timing can drift approximately 1ppm per year from the unit's date of manufacture. If you need keep the drift from going beyond ± 3 ppm, JDSU recommends that you establish a calibration schedule.

Test configurations

Table 57 lists specifications for T1 testing option configurations.

Table 57 T1 configuration specifications

Parameter	Specification
Operating modes	Terminate, Monitor, Drop and Insert
Tests	Bit error rate test (BERT)
Framing	Unframed, D4/SF, ESF, SLC-96
Error types	Bit, BPV, Frame, CRC
Alarm types	LOS, LOF, AIS, Yellow Alarm
Loopback codes	NIU, CSU, FT CSU, HDSL, Repeater, MSS, and User Definable

Frequency and level measurements

Table 58 lists frequency and level measurement specifications.

Table 58 T1 measurement specifications

Parameter	Specification
Simplex current (mA)	Range: ±10 mA to ±180 mA Accuracy: ±4% ±4 mA Resolution: 1 mA
Frequency (Hz)	Range: 1.544 MHz ± 5 kHz Accuracy: ± 3 ppm, ± 1 ppm per year Resolution: 1 Hz

Table 58 T1 measurement specifications (Continued)

Parameter	Specification
Level dBdsx[1]	Range: +6 dBdsx to -40 dBdsx Accuracy: – ±1.0 dB between +6 and -15 dBdsx – ±2.0 dB between -16 and -30 dBdsx – ±3.0 dB between -31 and -40 dBdsx Resolution: 0.1 dBdsx
Level dBm[2]	Accuracy: – ±1 dBm from +22.5 dBm to +1.5 dBm – ±2 dBm from +1.5 dBm to -13.5 dBm – ±3 dBm from -13.5 dBm to -23.5 dBm Resolution: 0.1 dB
Level V p-p	Range: 60 mV to 12.0 V Resolution: 0.05 V

1. The designation dBdsx is a level measurement in dB relative to dsx level, which is 6 V peak-peak. A signal with a peak-peak level of 6V corresponds to 0 dBdsx.
2. Available when unframed all ones (AIS) signal is detected.

Glossary

Numerics

5ESS — Abbreviation used on HST user interface for AT&T 5ESS Version 9 or later call control.Enter all new terms in alphabetical order.

A

AIS — Alarm Indication Signal (Blue Alarm). A continuous stream of unframed 1's sent to indicate that the terminal equipment has failed, has lost its signal source or has been temporarily removed from service.

AMI — Alternate Mark Inversion. A line code which inverts the polarity of alternate 1s.

B

B8ZS — Bipolar 8 Zeros Substitution. A bipolar line code which suppresses consecutive patterns of 8 zeros.

B channel — Channel which carries the payload of ISDN call.

Base Unit — The HST-3000 base unit houses the keypad, display screen, battery, and some connectors. Service interface modules (SIMs) connect to the base unit to provide testing functionality.

BERT — Bit Error Rate Test. A known pattern of bits is transmitted, and errors received are counted to figure the BER. The Bit Error Rate test is used to measure transmission quality.

Blue Alarm — See AIS.

BPV — Bipolar Violation. A BPV is a violation that occurs when two consecutive non-zero elements of the same polarity occur in a bipolar signal.

Bridge — A high impedance tap into an T1 circuit (at a bridge point where no monitor point access is provided) that does not disrupt the existing communication line.

Bridgetap — Automated test that transmits 21 consecutive test patterns.

C

CO — Central Office.

CPE — Customer Premise Equipment.

CRC — Cyclic Redundancy Check. A code word used to confirm that a bit stream contains valid data. In ESF framing mode this is 6 bits long and is based on the polynomial (x^6+x+1).

CSU — Channel Service Unit. A device to terminate a digital channel on a customer's premises.

D

D4/SF — Type D4 Superframe.

DS1 — An interface providing a framed or unframed 1.544 Mb/s bit stream.

D channel — Channel used in ISDN for signaling and supervisory functions.

DCBU — D channel backup. If non-facility associated switching (NFAS) is used to provide ISDN service over multiple T1 lines (using a single D channel for signaling), a backup D channel is used in case the primary D channel fails. You can verify the switch to a backup D channel when testing ISDN PRI service using the HST.

DMS — Abbreviation used on HST user interface for Nortel DMS 100 Version BCS32, or Nortel DMS 100 Version BCS38 or later.

DSX — Digital System Cross-connect frame.

DTMF — Dual-Tone Multi-Frequency. Combination of two tones, one high frequency and one low frequency used in touchtone dialing. You can enter DTMF tones when you process ISDN PRI calls using the HST.

DP — Dial Pulse.

E

ES — Errored Second. A second during which at least one error or alarm occurred.

ESF — Extended Superframe. The F bits from 24 consecutive frames are used to provide frame alignment, frame CRC and out-of-band signalling.

F

Frame Loss — Criteria is as follows: D4D - 2 out of 5 Ft bits in error; ESF - 2 out of 5 frame bits in error.

FT1 — Fractional T1.

FXO — Foreign Exchange Channel Unit - Office End.

FXS — Foreign Exchange Channel Unit - Station End.

H

HDLC — High level data link control. You can transmit normal or inverted HDLC bits when testing ISDN PRI service using the HST.

Hz — Hertz (cycles per second).

I

ISDN — Integrated Services Digital Network. A set of communications standards allowing a single wire or optical fibre to carry voice, digital network services and video. *See* PRI.

K

KP — Keypulse.

L

LBO — Line Build Out. An optional attenuation which can be applied to the output signal to simulate long lengths of cable.

LOF — Loss of Frame. A condition indicating that the receiving equipment has lost frame delineation.

LOS — Loss Of Signal (Red Alarm). A condition when no pulses of positive or negative polarity are received for more than 175 pulse counts.

M

Multipat — Automated test that transmits 5 consecutive test patterns: ALL ONES, 1:7, 2:8, 3 in 24, and QRSS.

MF — Multifrequency.

N

NFAS — Non-facility associated signaling. An ISDN PRI service that permits a single D channel to provide signaling for multiple ISDN PRIs. NFAS allows the channel that would normally be used for signaling on the additional PRIs to be used as a standard B channel. *See* DCBU.

NIU — Network Interface Unit. Electronic device at the point of interconnection between the service provider communications facilities and terminal equipment at a subscriber's premises.

NT — Network termination (device). Device which provides the physical connection at the customer premises to the local exchange, such as an ISDN data service unit/channel service unit (DSU/CSU). You can use the HST to emulate a NT device when testing ISDN PRI service.

O

OSA — Operator system access. The operator system used to place and receive calls. You can indicate that the principal (default) operator system is used, that an alternate operator system has been established by subscription, or that no operator system is used when processing calls using the HST-3000.

P

Pattern sync — The condition when the received test pattern matches the transmitted test pattern. In order to detect pattern sync the instrument must be transmitting a known test pattern in at least one channel (if framed) or continuously (if unframed).

PBX — Private Branch Exchange. A telephone exchange owned by the customer who uses telephone services, located on the customer premises. You can use the HST to emulate a PBX when testing ISDN PRI service.

PCM — Pulse Code Modulation.

PPS — Pulses Per Second (used for DP digits).

Primary Rate Interface —

ISDN service carried on a T1 line. PRI service provides 23 B (bearer) channels, which carry voice and data call payloads, and a single D channel, which handles signaling for the circuit. ISDN providers can implement NFAS to use a single D channel for signaling on multiple PRIs. *See* NFAS and DCBU.

PSDS — Public Switched Digital Service.

Q

QRSS — Quasi-Random Signal Sequence.

R

RAI — See Yellow Alarm.

Red alarm — See LOS.

Rx — Receiver or input.

RT — Remote Terminal.

S

SF — Super Frame.

SIM — Service Interface Module. SIMs connect to the HST-3000 base unit to provide testing functionality.

SLC — Subscriber Loop Carrier.

STD E&M — Standard ear and mouthpiece.

ST2P — Start signal two prime.

ST3P — Start signal three prime.

ST — Start signal.

STP — Start signal prime.

T

TE1 — Terminal equipment type 1. Terminal equipment that supports ISDN standards and can be connected directly to an ISDN network (for example, an ISDN phone, a PC or laptop with ISDN capabilities, etc.). You can use the HST to emulate a TE1 device when testing ISDN PRI service.

TNS — Transit network select. A code representing the network that calls are routed to. You can specify the TNS when processing calls on the HST-3000.

TNV — Telephone-network voltage.

Tx — Transmitter or output.

Y

Yellow Alarm — A terminal will transmit a yellow alarm when it loses its incoming signal.

In SF(D4) framing formats the yellow alarm is formed by setting bit 2 in every channel to zero for at least one second.

In ESF framing the yellow alarm is formed by repeatedly sending 8 ones followed by 8 zeros in the ESF data link.

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