# HST-3000

## BRI Testing

User's Guide

JDSU

# HST-3000

## BRI 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-061101. The catalog number for a CD-ROM containing all HST-3000 user documentation 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 Directive Compliance***

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

This 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 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 returned is 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 the equipment to JDSU for appropriate disposal. If the equipment was imported by a reseller whose name or logo is marked on the equipment, then the owner should return the equipment directly to the reseller.

Instructions for returning waste equipment 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, 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 ISDN basic rate interface (BRI) testing SIM. 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.

This guide includes task-based instructions that describe how to configure, use, and troubleshoot the HST-3000 for BRI physical transmission testing.

## Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the HST-3000 BRI testing SIM efficiently and effectively. We assume that you are familiar with the ISDN communications standard and basic telecommunications safety, concepts, and terminology.

## Terminology

The following terms have a specific meaning when they are used in this guide (also see “Glossary” on page 105):

- **HST-3000** — Handheld Services Tester 3000. In this user’s guide, “HST-3000” is used to refer to the HST-3000 family of products or to the combination of a base unit and attached SIM. “HST” is also sometimes used to refer to the base unit/SIM combination.
- **SIM** — Service Interface Module. Sometimes referred to generically as the module. The SIM provides test application functionality.

## Application-oriented user guide

The *HST-3000 BRI Testing User's Guide* is an application-oriented user's guide containing information about using the HST-3000 BRI testing SIM to perform test operations on ISDN lines with the basic rate interface. This guide includes an overview of testing features, instructions for using the HST-3000 in monitor and terminate test operations, and test result descriptions. This guide also contains testing 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 Acterna'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 the booklet included with the HST-3000 user documentation CD-ROM jewel case.

# Technical assistance

If you need assistance or have questions related to the use of this product, call or e-mail JDSU's Technical Assistance Center (TAC) for customer support. Before contacting TAC, you should have the serial numbers for your HST-3000 unit. See "Locating the serial number" in the HST-3000 Base Unit User's Guide for more information.

Table 1 lists TAC information. For the latest TAC contact information, go to www.jdsu.com, or contact your local sales office for assistance. For contact information for regional sales offices, see the back cover of this guide.

**Table 1** Technical assistance centers

| Region | Phone Number | |
|---|---|---|
| Americas | 1-866-ACTERNA<br>301-353-1550 | (1-866-228-3762)<br>tac@jdsu.com |
| Europe, Africa, and Mid-East | +49 (0) 7121 86 1345<br>(JDSU Germany) | hotline.europe@jdsu.com |
| Asia and the Pacific | +852 2892 0990<br>(Hong Kong)<br><br>+8610 6833 7477<br>(Beijing-China) | |

During off-hours, you can request assistance by doing one of the following: leave a voice mail message at the Technical Assistance number, e-mail the North American Technical Assistance Center, tac@jdsu.com, or submit your question using our online Technical Assistance Request form at www.jdsu.com.

# Conventions

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

**Table 2** Typographical conventions

| Description | Example |
|---|---|
| User interface actions and buttons or switches you have to press appear in this **typeface**. | Press the **OK** key. |
| Code and output messages appear in this `typeface`. | `All results okay` |
| Text you must type exactly as shown appears in this **`typeface`**. | Type: **`a:\set.exe`** in the dialog box. |
| Variables appear in this ***typeface***. | Type the new ***hostname***. |
| Book references appear in this *typeface*. | Refer to *Newton's Telecom Dictionary* |

**Table 3** Keyboard/menu conventions

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

**Table 4** Symbol conventions

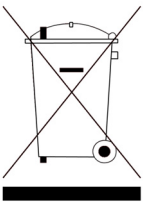
| | |
|---|---|
|  | This symbol represents a general hazard. |
|  | This symbol represents a risk of electrical shock. |
|  | This symbol represents a risk of explosion |
|  | This symbol represents a Note indicating related information or tip. |
|  | This symbol, located on the equipment or its packaging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

**Table 5** Safety definitions

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

# Getting Started

# 1

This chapter provides basic information about the HST-3000 ISDN BRI testing option. Topics discussed in this chapter include the following:

# About ISDN BRI testing

The HST-3000 ISDN BRI SIM enables you to install and maintain ISDN BRI services. Using the HST with the BRI SIM, 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.

## What's new

This release of the ISDN BRI SIM now allows you to do the following:

- Loopback 2 B channels and the D channel for analysis when emulating central office equipment in LT (line termination) mode.
- Request that a device on the far end send a stream of traffic with continuous CRC errors.
- Schedule timed tests.

## S/T Interface software option

If you purchase the S/T Interface software option, (part number: HST3000-ST), you can also use the ISDN BRI SIM to do the following:

- Emulate terminal equipment devices (for example, an ISDN phone or terminal adapter), and place circuit or packet calls using ISDN TE mode for the S/T interface.
- Emulate a network termination device, and passively monitor BRI service using ISDN NT1 mode for the BRI interface (S/T and U interfaces).

## Features and capabilities

Using the ISDN BRI SIM, 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 up to two calls simultaneously using the standard transmit-receive interfaces. After a call is established, you can insert voice traffic into the associated B Channel, or perform BERT analysis of the B Channel.
- BERT (IDSL) of the physical line.
- Perform BERT analysis of two B Channels simultaneously.
- Emulate central office equipment using Line Termination (LT) mode.
- Emulate terminal equipment devices using Terminal Equipment (TE) mode for a U interface.
- Process calls for the following switches:
  - AT&T 5ESS
  - Nortel DMS 100
  - National ISDN-1 (NI-1) and National ISDN-2 (NI-2) compliant switches
  - Siemens EWSD
- Monitor and analyze ISDN BRI 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 BRI service. After viewing the decode text, you can save the text to a file on the HST-3000.
- Place D channel packet calls on the U or S/T interface, and then send a FOX message to verify that the correct text is received on the far end of the circuit.

# About BRI interfaces and the HST emulation modes

The HST ISDN BRI SIM offers six emulation modes for testing the U, S/T, and BRI interfaces. Each mode allows the HST to emulate a specific network device or devices when testing ISDN BRI service. Figure 1 illustrates the BRI interfaces.

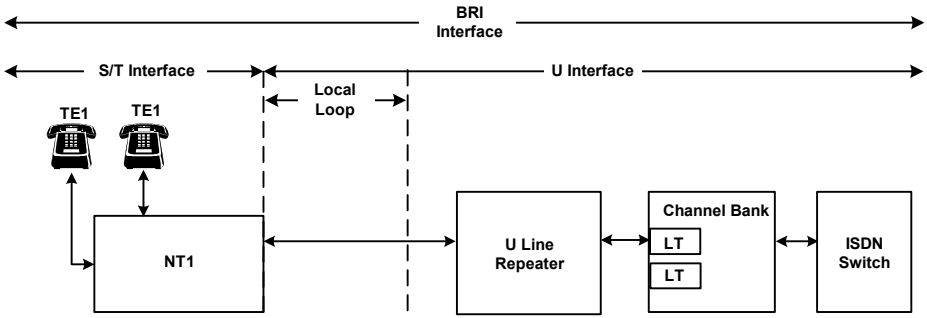



**Figure 1** BRI interfaces

For details on testing ISDN BRI service using the HST, refer to Chapter 2 “BRI Testing”.

## U interface

The U interface is the physical 2-wire echo cancelling interface spanning from the central office, to the local loop, and finally, to the customer premises. Each of the modes available for testing the U interface is described below, and illustrated in Figure 2.

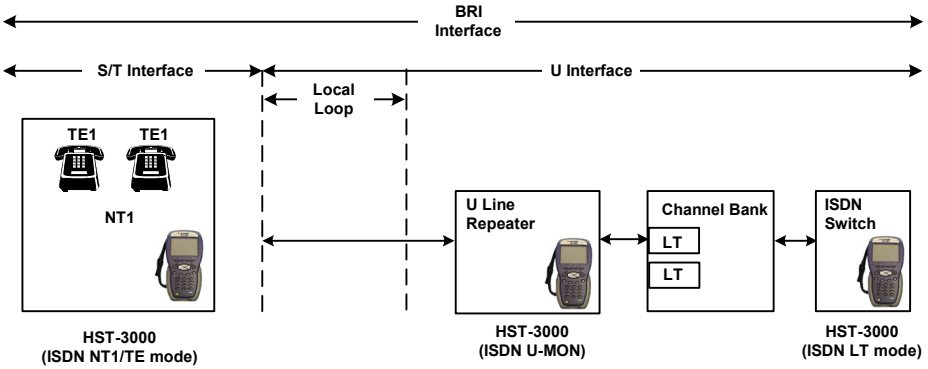



**Figure 2** HST emulation modes for the U Interface

***ISDN NT1/TE*** In **ISDN NT1/TE** mode, the HST emulates a NT1, *while simultaneously emulating up to two TE devices*. Using this mode, you can place circuit and packet calls on the U interface.

***ISDN LT*** In **ISDN LT** mode, the HST emulates an ISDN switch. Using this mode, you can place circuit mode calls on the U interface.

***ISDN U-MON*** In **ISDN U-MON** mode, the HST emulates a line repeater, allowing you to passively monitor ISDN BRI service on the U interface.

**S/T interface** The S/T interface is the standard 4-wire (2 RX, 2 TX) interface used by ISDN terminals on the terminal side of a NT1. In **ISDN TE** mode, the HST emulates a TE device, allowing you to place circuit and packet calls on the S/T interface (see Figure 3).

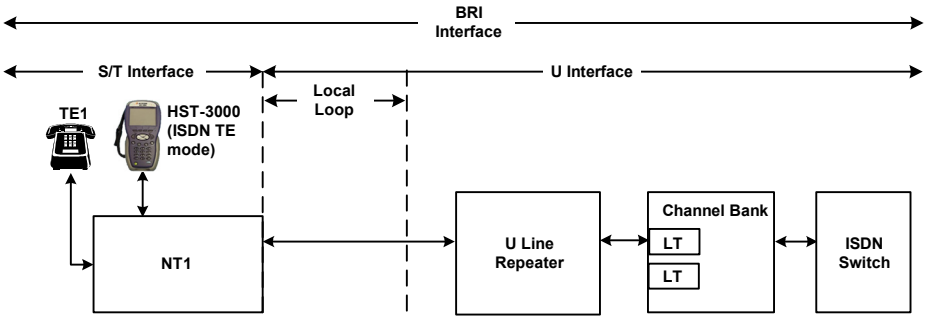



**Figure 3** ISDN TE mode for the S/T Interface

**BRI interface** The BRI interface spans both the U interface and the S/T interface. Each of the modes available for testing the BRI interface is described below.

***ISDN NT1*** In **ISDN NT1** mode, the HST emulates a NT1 device, allowing you to monitor ISDN service on the entire BRI interface (see Figure 4).

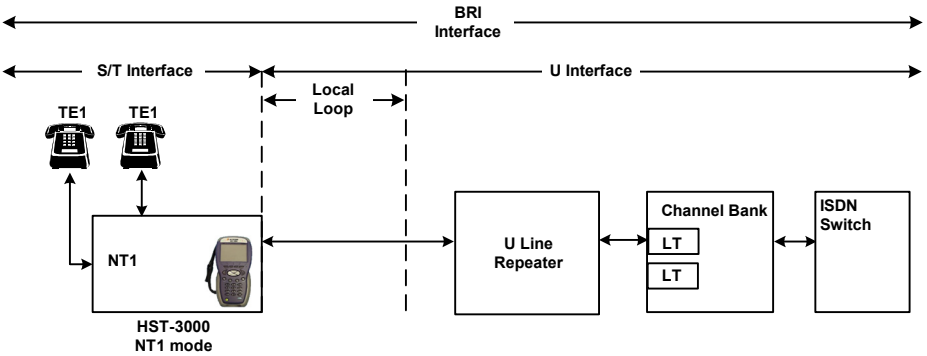



**Figure 4** ISDN NT1 emulation mode

***BERT (IDSL)*** In **BERT (IDSL)** mode, you can configure the HST to use one of the emulation modes illustrated in Figure 5, and then BER test the physical layer.

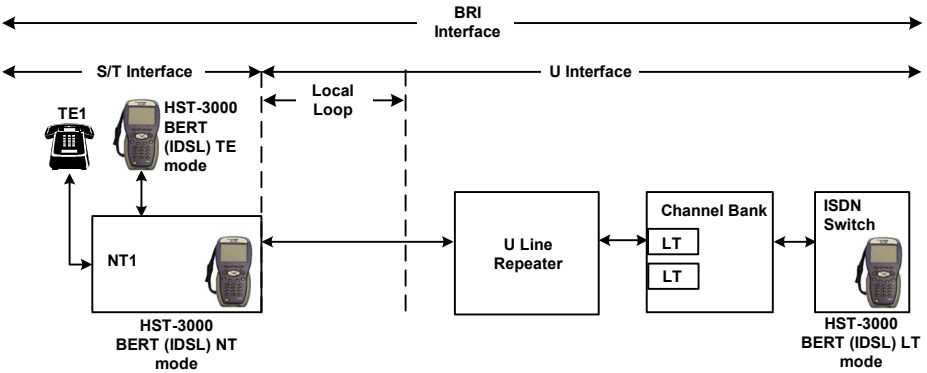



**Figure 5** HST emulation modes for BER testing the BRI Interface

# Status LEDs

There are six status LEDs located on the front of the HST-3000, above the LCD screen. Table 6 describes the LEDs.

**Table 6** Status LEDs

| LED | Description |
|---|---|
| Sync | **Solid green** — HST-3000 is synchronized with incoming signal; in H8 or J8 sync state, H8 or J8 Active state, H7 Pending state, or J7 sync.<br>**Solid red** — At least one of the receivers does not have signal or frame synchronization.<br>**Not illuminated** — HST-3000 not synchronized. |
| Data | **Solid green** — Pattern synchronization achieved for each active call or receiver.<br>**Solid red** — Pattern synchronization was achieved for each active call or receiver and then lost.<br>**Not illuminated** — Pattern synchronization not detected on at least one active call or receiver. |
| Error | **Not illuminated** — All results OK.<br>**Solid red** — Error condition exists. Causes of the error appear on the Summary Results page. (See "Viewing test results" on page 63 for information about displaying the Summary Results page). |
| Alarm | Not supported for BRI testing. |
| LpBk | **Solid green** — B1, B2, B1+B2, or 2B+D channels have been looped up on the HST-3000 by a response to an EOC message, or the channels have been manually looped up.<br>**Not illuminated** — No payload channels are currently looped. |

**Table 6** Status LEDs (Continued)

| LED | Description |
|---|---|
| Batt | **Not illuminated** — Battery has a useful charge.<br>**Solid green** — AC adapter is plugged in.<br>**Solid red** — Battery is approximately 20 percent or below of full charge.<br>**Flashing red** — Approximately five minutes of use remains. Immediately attach AC adapter or replace battery.<br>**Solid amber** — Battery capacity indicator ("gas gauge") needs to be reset (see the *HST-3000 Base Unit User's Guide*). |

# BRI connectors

A SIM with the BRI testing option has the physical interfaces needed to perform ISDN testing. The U and U mon connectors are located on the side of the SIM. Figure 6 shows a BRI SIM with three 8-pin modular connectors.

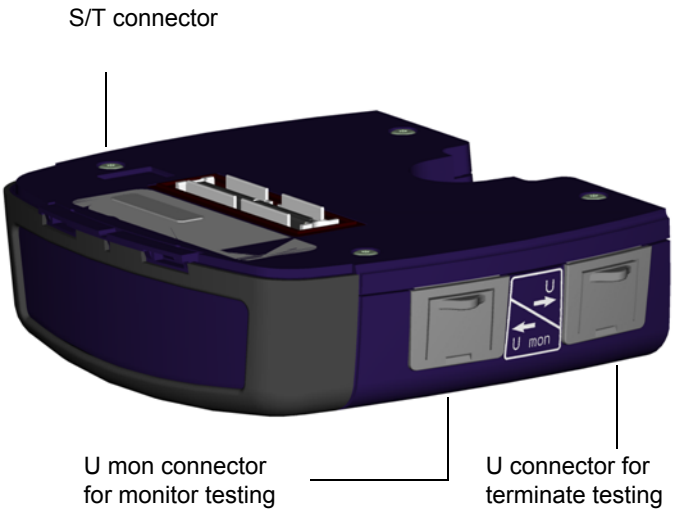



**Figure 6** BRI interface connectors

**DANGER: ELECTRICAL SHOCK**

The S/T connector, located on the right side of the base unit when the SIM is installed, does not include a lightning protector. Connecting an outside plant line to the S/T connector during an electrical storm can result in serious injury or death. Do not connect an outside plant line to the S/T connector.

**NOTE:**

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

**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.

## Instrument settings and user preferences

For information about changing instrument and preference settings, such as date and time format, port settings, sound, and screen settings, see the *HST-3000 Base Unit User's Guide*.

# BRI Testing

# 2

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

– "Clearing history results" on page 63

## Accessing the test configuration menus

The following procedure describes how to view the menus you will use to configure the test settings.

**To access the test configuration menus**

1 Press the green power button to turn on the HST.

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

2 Select the test application.

3 Press the **Configure** navigation key.

The test configuration soft keys appear. You will use these keys to specify the settings for your test operations.

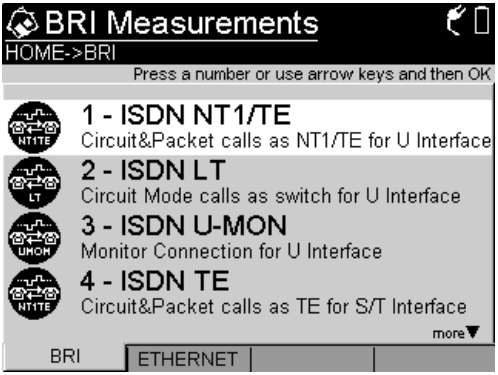
## Setting up the phone book

You can define and store frequently used phone numbers in the HST phone book, and then speed dial a number when placing a call.

**To set up the HST phone book**

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

The BRI Measurements menu may take several seconds to appear.




**2** Select one of the following:

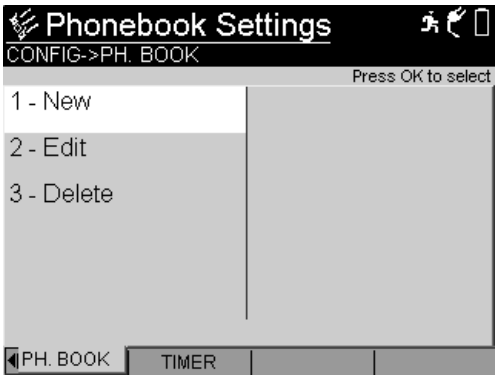
- **ISDN NT1/TE**
- **ISDN LT**
- **ISDN TE**

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

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

**4** Press the **PH. BOOK** soft key.

The Phonebook Settings menu appears.



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

The Name dialog box appears.

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

The Number dialog box appears.

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

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

## Placing circuit calls

You can use the HST to place circuit calls by:

– Emulating a NT1 with one or two TE devices on the U interface (see Figure 2 on page 5).
– Emulating an ISDN switch on the U interface (see Figure 2 on page 5).
– Emulating a TE device on the S/T interface (see Figure 3 on page 6).

When you configure the HST to place a call, you specify the settings required to activate the physical layer and initialize ISDN service over the D channel (ISDN Settings).

After service is initialized, the HST establishes a data link and is ready to conduct ISDN call processing using the call settings you specify.

**NOTE:**

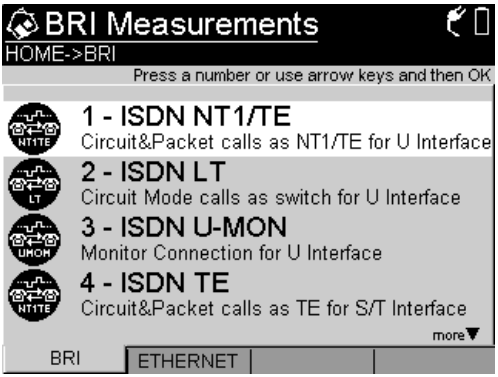
You will not hear a dial tone when you place voice calls from the HST using enbloc dialing. This is normal for devices placing ISDN calls.

Use the following procedure to set up the HST-3000 to place circuit calls.

**To place circuit calls**

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

The BRI Measurements menu may take several seconds to appear.




**2** Select one of the following:

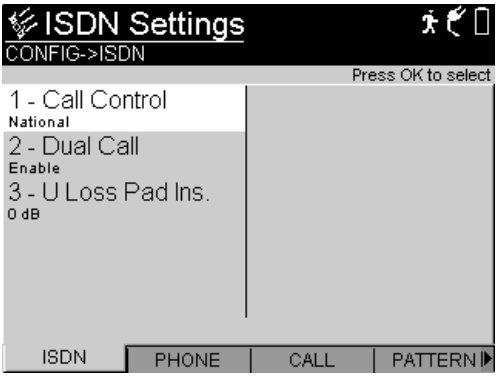
- **ISDN NT1/TE**. Select this option to place calls while emulating an NT1 with up to two TE devices on the U interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).
- **ISDN LT**. Select this option to place calls while emulating a switch or LT device on the U interface. In this mode, the HST places calls to a TE as if the calls originated by another TE on the network.
- **ISDN TE**. Select this option to place calls while emulating a TE device on the S/T interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).

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

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

**4** Press the **ISDN** soft key.

The ISDN settings menu appears.




**5** Press the number key for the ISDN setting you want to configure.

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

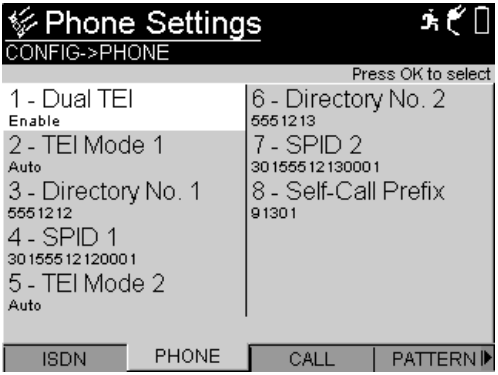
The table below describes the settings.

| Setting | Parameters |
|---|---|
| Loop Address | Address on the NT device used for looping. (Available in LT mode only.) |
| EOC message | Code for looping an NT device. Table 26 on page 103 lists the available codes. (Available in LT mode only.) |
| Call Control | Type of switch protocol.<br>– **National** — Selects National ISDN-2 (NI-2) as the switch protocol<br>– **5ESSMP**<br>– **5ESSPP**<br>– **DMSF**<br>**NOTE:** The majority of ISDN providers use the National switch protocol. 5ESS and DMS are typically used by providers who have a custom or proprietary method for implementing ISDN. |

| Setting | Parameters |
|---|---|
| Dual Call | – **Disable** — Allows one call.<br>– **Enable** — Allows two independent calls. |
| U Loss Pad Ins | Enables emulation of various cable losses. The selected cable loss affects the transmit and receive data path. (Available in NT1/TE or LT modes only.)<br>– **0 dB** — Provides no line build-out.<br>– **2 dB** — Provides -2 dB line build-out, simulating 2 dB of data loss.<br>– **4 dB** — Provides -4 dB line build-out, simulating 4 dB of data loss.<br>– **6 dB** — Provides -6 dB line build-out, simulating 6 dB of data loss. |
| Line Termination | Specifies the line termination. (Available in TE or NT1 mode for the S/T interface only.)<br>– **Bridge** — Selects Bridge. Bridge is the default setting.<br>– **50 Ohm**<br>– **100 Ohm** |

**6** Press the **PHONE** soft key.

The Phone Settings menu appears.

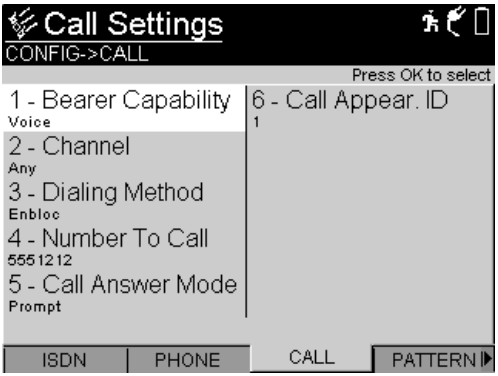


**7** Select, and then define each of the following settings:

| Setting | Parameters |
|---|---|
| Dual TEI | Allows the HST to simulate one of two independent terminal endpoint identifiers: **Enable** or **Disable**. Enable is only available if Dual Call is enabled on the ISDN Settings menu (see page 19). If you enable Dual TEI, the TEI Mode 2, Directory No. 2, and SPID 2 fields appear. |
| TEI Mode 1 | Method of determining the terminal endpoint identifier: **Auto** or **Fixed**. If you enable Dual TEI, the TEI Mode 2 field also appears. |
| TEI 1 | Value for the terminal endpoint identifier. (Available only if TEI Mode 1 is Fixed.) |
| Directory No. 1 | Number used to identify the line for the outgoing call. This is the caller ID of the call placed from the HST. If you enable Dual TEI, the Directory No. 2 field also appears. |
| SPID 1 | ID number of the service profile you want to emulate. (Available only in NT1/TE mode.) If you enable Dual TEI, the SPID 2 field also appears. |

**8** Press the **CALL** soft key.

The Call Settings menu appears.




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

| Setting | Parameters |
|---|---|
| Bearer Capability | Type of information carried by the B channel. Select one of the following:<br>– **Voice**<br>– **3.1K Audio**<br>– **Data**<br>**NOTE: Packet** is also displayed (if you selected Disabled as the Dual Call setting in step 5 on page 18); however, you should not select the Packet setting if you are placing a circuit call. For details on placing packet calls, see "Placing a packet call" on page 25. |
| Bearer Rate | Data rate on the bearer channel. (Available only if Bearer Capability is Data):<br>– **64K**<br>– **56K** |

| Setting | Parameters |
|---|---|
| Channel | Channel on which to place the call. (Available only if Bearer Capability is Voice, 3.1K Audio, or Data).<br>– **Any**<br>– **B1**<br>– **B2** |
| Dialing Method | Method by which the HST-3000 places the call.<br>– **Overlap** — You type the phone number during the test.<br>– **Enbloc** — HST-3000 sends the phone number you specify in the Number to Call field. |
| Number to Call | Phone number you want to dial. Enter up to 30 digits, *, and #. |
| Call Answer Mode | Method by which HST-300 answers incoming calls.<br>– **Prompt** — Prompts 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.<br>– **Accept** — Automatically accepts up to 2 incoming calls, and then rejects any additional calls. You can always check the Summary Results screen to see if a call is active on the HST.<br>– **Reject** — Automatically rejects all incoming calls. |

| Setting | Parameters |
|---|---|
| Call Appear ID | Appearance ID included in the call header.<br>– If you are using NATIONAL or DMSF call control, enter a number ranging from 1 to 255, or press the **None** soft-key.<br>– If you are using 5ESSMP or 5ESSPP call control, enter a number ranging from 1 to 255, or press the **Auto** soft-key. |

**NOTE:**

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

**10** Do the following:

- Connect the **U** connector to the CO (network) side of the line.
- If you selected ISDN TE in step 2, connect the **S/T** connector to the S/T interface.

**11** Verify that the Sync LED is illuminated to ensure that the HST is synchronized with a valid signal.

**12** Verify the link is up by doing the following:

**a** Press the **Home** navigation key.

**b** Press the **Display** soft key, and then select **LED**.

**c** Verify the Active LED is on.

**d** Verify the TEI 1 Ready LED is on.

**13** Press the **Action** soft key, and then select **Send Auto SPID 1** to request a list of available SPIDs from the switch.

The HST then assigns the first available SPID or SPIDs to the call.

**14** *Optional*. If you specified National as the Call Control in step 5 on page 18, and you would like to download additional call parameters from the poll switch, do the following:

**a** Press the **Action** soft key, and then select **Poll Switch 1**.

**b** Press the **Display** soft key, and then select the **ISDN** result category.

The PD Status result displays each of the following status results in succession:

**Polling Switch** — Indicates that the HST is establishing communication with the polling switch. If the HST does not receive a response from the switch within two seconds, the PD Status result changes to **PD No Response**.

**Collecting Data** — Indicates that the HST is collecting data from the polling switch.

**Results Ready** — Indicates that data collection is complete.

The PD Display result then displays the lines of decoded parameter download data.

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

– If you specified a number to call in step 9, 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 **OK**.

**16** 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 code (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen.

**17** If you want to place a second call, do the following:

**a** Ensure you selected Enabled for the Dual Call setting in step 5 on page 18.

**b** Repeat steps 6-16 starting on page 19.

**c** Press the Action soft key, and then select **Send Auto SPID 2** to request a list of available SPIDs from the switch. The HST then assigns the first available SPID or SPIDs to the call.

**d** Press the **Action** soft key, and then select **Dial Call 2**, or **Speed Dial (Call 2)**.

You have placed ISDN BRI circuit calls.

## Placing a packet call

You can use the HST to place packet calls on the D channel by:

– Emulating a NT1 with one or two TE devices on the U interface (see Figure 2 on page 5).

– Emulating a TE device on the S/T interface (see Figure 3 on page 6).

When you configure the HST to place a packet call, you specify the settings required to activate the physical layer and initialize ISDN service over the D channel (ISDN Settings).

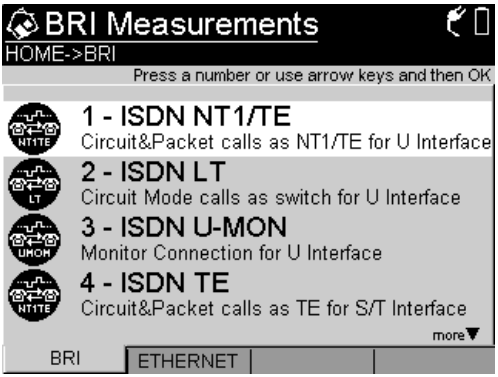
After service is initialized, the HST establishes a data link, and you can transmit an ASCII FOX message using the Send Fox action.

Use the following procedure to set up the HST-3000 to place packet calls.

**To place packet calls on the D channel**

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

The BRI Measurements menu may take several seconds to appear.




**2** Select one of the following:

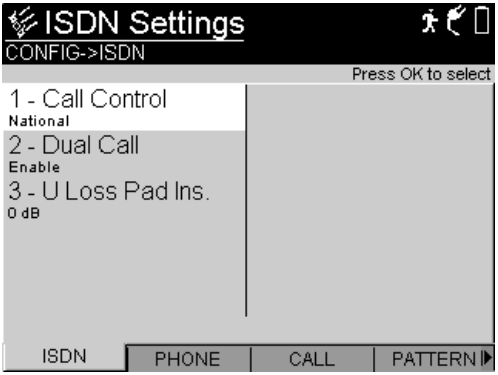
- **ISDN NT1/TE**. Select this option to place calls while emulating an NT1 with up to two TE devices on the U interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).
- **ISDN TE**. Select this option to place calls while emulating a TE device on the S/T interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).

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

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

**4** Press the **ISDN** soft key.

The ISDN settings menu appears.




**5** Press the number key for the ISDN setting you want to configure.

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

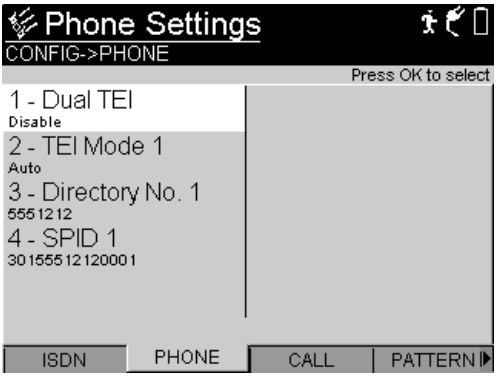
The table below describes the settings.

| Setting | Parameters |
|---|---|
| Call Control | Type of switch protocol.<br>– **National** — Selects National ISDN-2 (NI-2) as the switch protocol<br>– **5ESSMP**<br>– **5ESSPP**<br>– **DMSF**<br>**NOTE:** The majority of ISDN providers use the National switch protocol. 5ESS and DMS are typically used by providers who have a custom or proprietary method for implementing ISDN. |
| Dual Call | Select **Disable**.<br>**NOTE:** You can not place packet calls on the D channel if Dual Call is enabled. |

| Setting | Parameters |
|---|---|
| U Loss Pad Ins | Enables emulation of various cable losses. The selected cable loss affects the transmit and receive data path. (Available in NT1/TE or LT modes only.)<br>– **0.0 dB** — Provides no line build-out.<br>– **2.0 dB** — Provides -2 dB line build-out, simulating 2 dB of data loss.<br>– **4.0 dB** — Provides -4 dB line build-out, simulating 4 dB of data loss.<br>– **6.0 dB** — Provides -6 dB line build-out, simulating 6 dB of data loss. |
| Line Termination | Specifies the line termination. (Available in ISDN TE mode for the S/T interface only.)<br>– **Bridge** — Selects Bridge. Bridge is the default setting.<br>– **50 Ohm**<br>– **100 Ohm** |

**6** Press the **PHONE** soft key.

The Phone Settings menu appears.

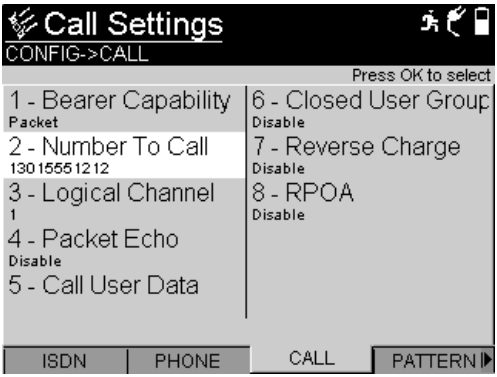


**7** Select, and then define each of the following settings:

| Setting | Parameters |
|---|---|
| Dual TEI | Accept the **Disable** setting. You can not enable Dual TEI when Dual Call mode is disabled for packet calls. |
| TEI Mode 1 | Method of determining the terminal endpoint identifier: **Auto** or **Fixed**. If you select Fixed, the TEI 1 setting appears. |
| TEI 1 | Value for the terminal endpoint identifier. (Available only if TEI Mode 1 is Fixed.) |
| Directory No. 1 | Number used to identify the line for the outgoing call. This is the caller ID of the call placed from the HST. |
| SPID 1 | Prefix and suffix for the call's directory number. The HST assigns the prefix, directory number, and suffix as the service profile identifier (SPID) for the call. (Available only in NT1/TE mode.) |

**8** Press the **CALL** soft key.

The Call Settings menu appears.



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

| Setting | Parameters |
|---|---|
| Bearer Capability | Select **Packet**. |
| Number to Call | Phone number you want to dial. Enter up to 30 digits, *, and #. |
| Logical Channel | Logical channel on the D channel to place the call on (0 through 15). |
| Packet Echo | Select one of the following:<br>– **Enable**. The HST will transmit received packets back to the originator.<br>– **Disable**. Packet Echo is disabled by default. |
| Call User Data | If you want to identify the data the HST is transmitting with a specific user or call:<br>– Select the setting to display the Call User Data dialog box.<br>– Type identifying text into the field provided.<br>– Select **OK** to store the call user data, and return to the Call Settings menu.<br>The Call User Data is disabled by default. |
| Closed User Group | If you want to secure the connection because you are testing circuits to ATMS or point-of-sales terminals:<br>– Select the setting to display the Closed User Group dialog box.<br>– Type the password for the circuit, ranging from 0-9999.<br>– Select **OK** to store the password, and return to the Call Settings menu.<br>The Closed User Group password is disabled by default. |

| Setting | Parameters |
|---|---|
| Reverse Charge | If you want to place collect packet calls, select **Enable**.<br>The Reverse Charge setting is disabled by default. |
| RPOA | If you want to specify a prefix to identify the ISDN's Recognized Private Operating Agency (RPOA) do this:<br>– Select the setting to display the RPOA dialog box.<br>– Type the setting for the circuit, ranging from 0-9999.<br>– Select **OK** to store the setting, and return to the Call Settings menu.<br>The RPOA setting is disabled by default.<br>**NOTE:** For ISDN X.25, the RPOA is usually the data network identification code (DNIC) for the ISDN's long distance carrier. |

**10** Do the following:

– Connect the **U** connector to the CO (network) side of the line.

– If you selected ISDN TE in step 2, connect the **S/T** connector to the S/T interface.

**11** Verify that the Sync LED is illuminated to ensure that the HST is synchronized with a valid signal.

**12** Verify the link is up by doing the following:

**a** Press the **Home** navigation key.

**b** Press the **Display** soft key, and then select **LED**.

**c** Verify the Active LED is on.

**d** Verify the TEI 1 Ready LED is on.

**13** Press **Restart** to clear any errors.

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

- If you specified a number to call in step 9, 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 **OK**.

**15** 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 code (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen.

**16** Press the **Action** soft key, and then select the **Send FOX** action to transmit the ASCII FOX text to the loopback port or test device on the far end of the circuit.

**17** Do one of the following:

– If you transmitted the FOX text to a loopback port, verify that the HST displays the looped back text on the Call 1 Results screen.


– If you transmitted the FOX text to another test device, verify that the correct text was received on the far end.

You have placed a packet call.

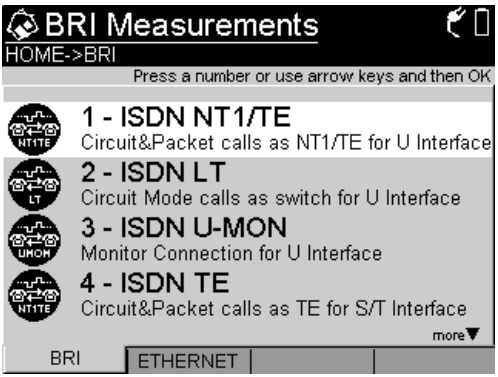
## Placing a self call

You can configure the HST-3000 to place calls to itself to verify dual call systems. After you place the calls, Call 1 can BER test Call 2.

**To place a self call**

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

The BRI Measurements menu may take several seconds to appear.




**2** Select one of the following:

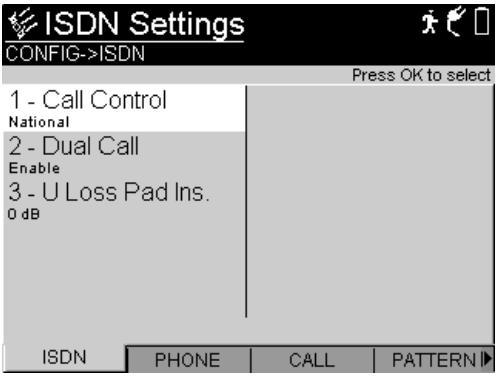
- **ISDN NT1/TE**. Select this option to place calls while emulating an NT1 with up to two TE devices on the U interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).
- **ISDN LT**. Select this option to place calls while emulating a switch or LT device on the U interface. In this mode, the HST places calls to a TE as if the calls originated by another TE on the network.
- **ISDN TE**. Select this option to place calls while emulating a TE device on the S/T interface. In this mode, the HST places calls to the network as if the calls originated from a customer-side device (such as an ISDN phone).

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

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

**4** Press the **ISDN** soft key.

The ISDN settings menu appears.



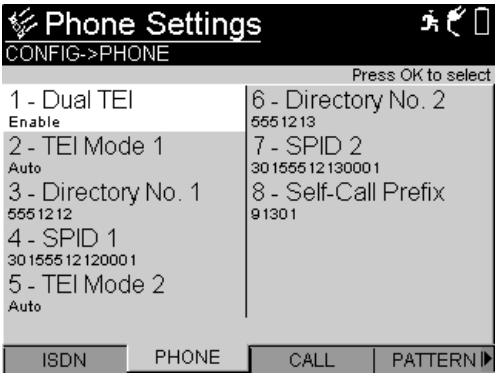

**5** Set the Dual Call setting to **Enable**, and then configure the other ISDN settings as appropriate.

– For details on each of the ISDN settings for circuit calls, refer to step 5 on page 18 of “Placing circuit calls”.

– For details on each of the ISDN settings for packet calls, refer to step 5 on page 27 of “Placing a packet call”.

**6** Press the **PHONE** soft key.

The Phone Settings menu appears.



7 In the Self Call Prefix setting, enter the prefix required for the type of service you are testing.

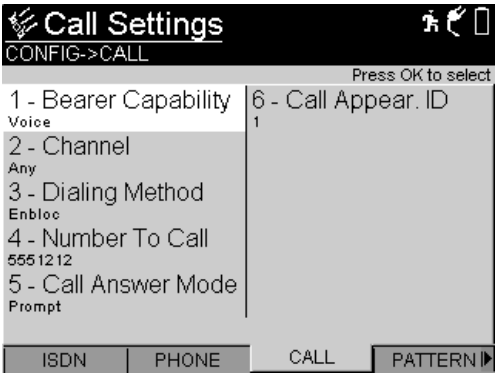
- If you are testing Centrex service, be certain to enter the escape number used to access an outside line (for example, 9).
- If you are testing service using ten digit numbers, be certain to enter the area code.

8 Configure the other Phone settings as appropriate.

- For details on each of the Phone settings for circuit calls, refer to step 7 on page 20 of "Placing circuit calls".
- For details on each of the Phone settings for packet calls, refer to step 7 on page 29 of "Placing a packet call".

9 Press the **CALL** soft key.

The Call Settings menu appears.




**NOTE:**

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

**10** Configure the Call settings as appropriate.

- For details on each of the Call settings for circuit calls, refer to step 9 on page 21 of "Placing circuit calls".
- For details on each of the Call settings for packet calls, refer to step 9 on page 30 of "Placing a packet call".

**11** Select the BER pattern, and if you plan on inserting errors, configure the error settings (see step 3-4 on page 43 of "Performing BER analysis of calls").

**12** Do the following:

- Connect the **U** connector to the CO (network) side of the line.
- If you selected ISDN TE in step 2, connect the **S/T** connector to the S/T interface.

**13** Verify that the Sync LED is illuminated to ensure that the HST is synchronized with a valid signal.

**14** Verify the link is up by doing the following:

**a** Press the **Home** navigation key.

**b** Press the **Display** soft key, and then select **LED**.

**c** Verify the Active LED is on.

**d** Verify the TEI 1 Ready LED is on.

**15** Press the **Action** soft key, and then select **Self-Call BERT**.

**16** Verify that the call status is `CONNECTED` on the Summary Results, Call 1 Results, and Call 2 Results screen.

**NOTE:**

If the call status is not `CONNECTED`, you can view the cause code (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen.

You have placed a self call, and Call 1 is BER testing Call 2.

# Receiving and disconnecting a call

If you set up the HST-3000 to prompt you whenever a call comes into the unit, a popup dialog box appears 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 Disconnect 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.

When you accept a second call, it remains in an idle state. To drop its payload to the speaker, press the Action soft key, and then select **Audio Call 2**.

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 41), or you can insert BER test patterns (see "Performing BER analysis of calls" on page 42).

**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 select **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 alive 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.

## Disconnecting a call

**To disconnect a call**

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

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

**NOTE:**

If the call status is not `DISCONNECTED`, you can view the cause code (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 90 for descriptions of each code.

## Transmitting DTMF tones

After a call's channel is assigned, you can display the Call 1 or Call 2 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 circuit calls" on page 16).
2. Press the **Display** soft key, and then select **Call 1** or **Call 2**.
3. Select the Action soft key, and then choose **Audio Call 1** or **Audio Call 2** to connect the call to the audio and speaker.
4. Enter the DTMF tones using the keypad.

The HST transmits the tones.

## Completing a call with overlap dialing

Using overlap dialing, you manually complete a call after connecting to the switch.

**To complete a call using overlap dialing**

1. Place a call (see "Placing circuit calls" on page 16).

   In step 9 of that procedure, select **Overlap** as the Dialing Method.
2. Press the **Action** soft key, and then select **Dial Call 1** or **Dial Call 2**.
3. Type the number using the keypad.

When the LT device recognizes the number, `CONNECTED` appears on the display.

# 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.
2. Do one of the following:
   - If you are placing a call, specify the ISDN and call settings for the call (see "Placing circuit calls" on page 16).
   - If you are receiving a call, accept the call (see "Accepting a call" on page 38).
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 code (indicating the reason the call was not connected) on the Call 1 Results or Call 2 Results screen.

4. If you are not analyzing voice traffic on another call, the HST automatically connects the call to the speaker and microphone or the headset.

   If you are currently BER testing or idling another call, and if Audio Call 1 and Audio Call 2 are not activated, select the **Action** soft key, and then choose **Audio Call 1** or **Audio Call 2** to connect the call to the speaker and microphone or the headset.
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.

## Performing BER analysis of calls

When you place or receive calls in NT1/TE, LT, or TE mode, you can perform BER analysis of the associated B channels. In addition to providing general ISDN results, the HST provides statistics collected on the D channel and results based on the BER analysis of the B channels.

**NOTE:**

When you BER test two connected calls simultaneously, the HST uses the same BER pattern for each call; however, you can specify different error insertion settings for each individual call.

**To BER test B channels for connected calls**

1 Do one of the following:
   - If you are placing a call, specify the ISDN and Call settings for the B channel (see "Placing circuit calls" on page 16).
   - If you are receiving a call, accept the call (see "Accepting a call" on page 38).

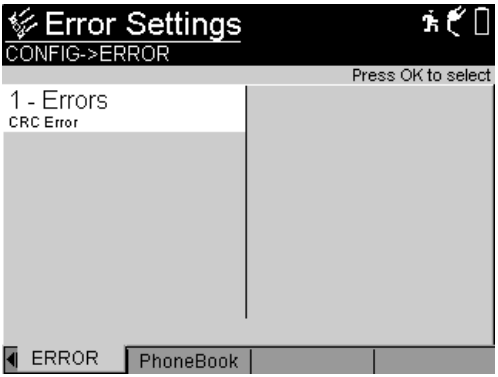
2 Press the **Configure** navigation key.

3 Press the **PATTERN** soft key, and then specify the pattern to insert into the B channels (see "BERT patterns" on page 100 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:

**a** Press the **ERROR** soft key.

The Error Settings menu appears.




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

The table below shows the available settings.

| Setting | Parameters |
|---|---|
| Errors | Select **Bit Error** |
| Rate Type | Select **Rate Type**, and then indicate how bit errors will be inserted. (Available only if Errors is Bit Error).<br>– **Single**<br>– **Rate**<br>– **Multiple**<br>**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 8 on page 44. |
| Error Count | If you selected Multiple as the Rate type, enter the number of errors to be inserted. |

| Setting | Parameters |
|---|---|
| Rate | If you selected Rate as the Rate type, select the insertion rate for bit errors. |

5 Verify that the Sync LED is illuminated to ensure that the HST is synchronized with a valid signal.

6 Press the **Home** navigation key.

7 To start transmitting the BERT pattern, press the **Action** soft key, and then select **BERT Call 1** or **BERT Call 2**.

8 *Optional*. To insert errors into the B Channels for each connected call, 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 is inserted into the B Channel.

9 *Optional*. To loop the HST-3000, press the **Action** soft key, and then do the following:

**a** Select **Loop Action**, and then press the right arrow key to display a list of channels to loop.

**b** Use the up and down arrow keys to choose the channel to loop, and then select **OK**.

**10** *Optional*. If you want to transmit a different BERT pattern, change the method of bit error insertion, transmit CRC or FEBE errors, or 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** Do one of the following:

| To… | Do This… |
|---|---|
| Transmit a different BERT pattern | – Specify the pattern to insert into the B channels. See step 3 on page 42.<br>– Press the **Action** soft key, and then select **BERT Call 1** or **BERT Call 2** to begin transmitting the new pattern. |
| Indicate how bit errors will be inserted | – Specify the method (see step b on page 43).<br>– Press the **Action** soft key, and then select **BERT Call 1** or **BERT Call 2** to begin transmitting the pattern.<br>– Press the **Action** soft key, and then select an action to insert the error into the B channel. |
| Insert voice traffic | – Press the Action soft key, and then select **Audio Call 1** or **Audio Call 2**.<br>– Speak into the microphone on the HST or the headset. |

| To… | Do This… |
|---|---|
| Insert CRC or FEBE errors | – Specify CRC or FEBE as the error type (on the Error Settings menu).<br>– Press the **Action** soft key, and then select an action to insert the errors into the B channel. |

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

BERT analysis of the call is complete.

## Inserting CRC or FEBE errors

In LT mode, you can insert a continuous stream of CRC or FEBE errors into the BRI U interface.

### To insert CRC or FEBE errors

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

The BRI Measurements menu may take several seconds to appear.

**2** Select **ISDN LT**.

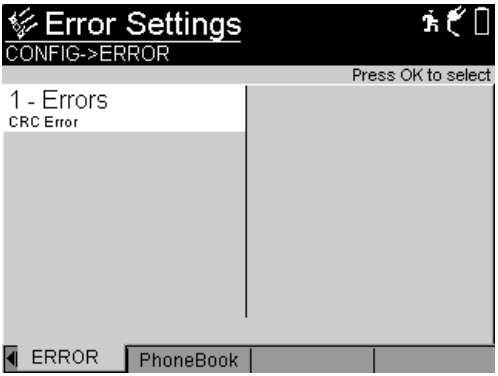
The HST-3000 starts the test.

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

**4** Press the **ISDN** soft key, and then specify the ISDN settings (see step 4 and step 5 on page 18 of "Placing circuit calls").

**5** Press the **ERROR** soft key.

The Error Settings menu appears.




6 Specify **CRC** or **FEBE** as the Errors setting.

7 Connect the **U** connector to the CO (network) side of the line.

8 Press the **Home** navigation key to display results.

9 To insert errors into the BRI U interface, press the **Action** soft key, and then select one of the following:

- **Enable CRC Error**—Inserts a continuous stream of CRC errors. This action appears if you selected CRC Error as the error type in step 6.
- **Enable FEBE Error**—Inserts a continuous stream of FEBE errors. This action appears if you selected FEBE Error as the error type in step 6.

The errors are inserted into the BRI U interface.

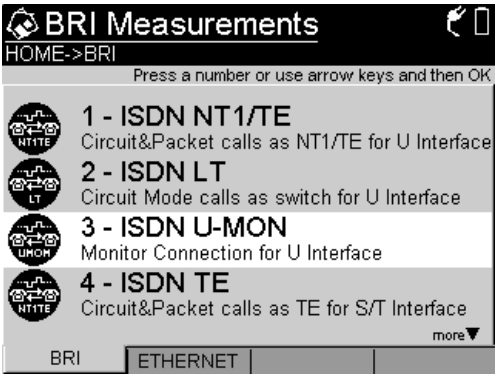
## Monitoring BRI service from the U interface

The HST-3000 allows you to monitor and analyze ISDN BRI service from the U interface while the network is in-service. During the test, the HST emulates a repeater, and monitors all D channel frames present. It then decodes the received D channel information.

**To monitor ISDN BRI service from the U interface**

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

The BRI Measurements menu may take several seconds to appear.




**2** Select **ISDN U-MON**.

The HST-3000 starts the monitor test.

**3** *Optional*. To specify the switch protocol (call control) or clock source the HST uses while emulating a repeater, press the **Configure** navigation key, and then specify the following settings:

| Setting | Parameters |
|---|---|
| Call Control | Type of switch protocol.<br>– **National** — Selects National ISDN-2 (NI-2) as the switch protocol. National is the default setting.<br>– **5ESSMP**<br>– **5ESSPP**<br>– **DMSF** |
| Clock Source | – **Internal**<br>– **External** |

4 Connect the **U** connector to the CO (network) side of the line.

5 Connect the **U mon** connector to the CPE (customer) side of the line.

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

7 Press the **Display** soft key, and then select **D-Chan Decode**.

D-channel decode messages appear in the Decode results category. For information about interpreting these messages, see "Interpreting D channel decode messages" on page 57.

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

You have finished monitoring BRI service from the U interface.

**NOTE:**

When repeater power is present, the total nominal voltage drop from the U connector to the U mon connector, and from the U mon connector to the U connector, is 11 volts.

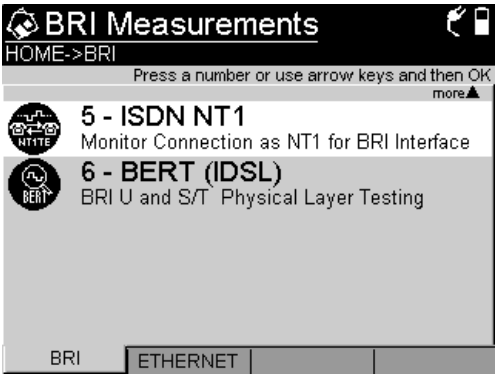
## Emulating a NT1 on the BRI interface

The HST-3000 allows you to monitor and analyze BRI service from the U and S/T interface while the network is in-service. During the test, the HST emulates an NT1 device and monitors all D channel frames present. It then decodes the received D channel information.

### To monitor BRI service from the BRI interface

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

The BRI Measurements menu may take several seconds to appear.




**2** Select **ISDN NT1**.

**3** *Optional*. To specify the switch protocol (call control), line termination, or cable loss the HST uses while emulating an NT1, press the **Configure** navigation key, and then specify the following settings:

| Setting | Parameters |
|---|---|
| Call Control | Type of switch protocol.<br>– **National** — Selects National ISDN-2 (NI-2) as the switch protocol. National is the default setting.<br>– **5ESSMP**<br>– **5ESSPP**<br>– **DMSF** |
| Line Termination | Sets the line termination.<br>– **Bridge** — Selects Bridge. Bridge is the default setting.<br>– **50 Ohm**<br>– **100 Ohm** |

| Setting | Parameters |
|---|---|
| – U Loss Pad Ins | Sets the cable loss for the transmit and receive data path.<br>– **0 dB** — Provides no line build-out. 0.0 dB is the default setting.<br>– **2 dB** — Provides -2 dB line build-out, simulating 2 dB of data loss.<br>– **4 dB** — Provides -4 dB line build-out, simulating 4 dB of data loss.<br>– **6 dB** — Provides -6 dB line build-out, simulating 6 dB of data loss. |

4 Connect the **U** connector to the CO (network) side of the line.

5 Connect the S/T connector to the S/T interface towards the TE device.

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

7 Press the **Display** soft key, and then select the following:

- **D-Chan Decode** to display D-channel decode messages in the Decode results category. For information about interpreting these messages, see "Interpreting D channel decode messages" on page 57.
- **Interface** to display interface results for the network side of the BRI interface (under the To CO column), or the customer side of the BRI interface (under the To CPE column).

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

You have finished monitoring BRI service from the BRI interface.

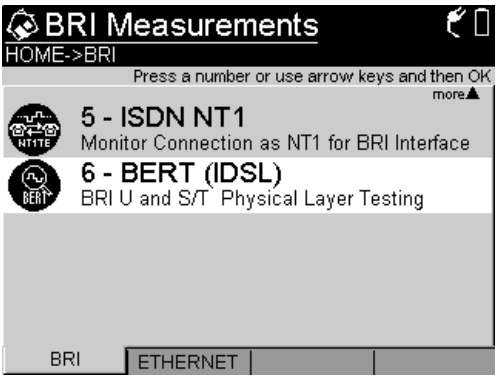
# Testing the physical layer

You can use the HST-3000 to perform bit error rate tests (BERT or BER testing) and insert CRC and FEBE errors to check the functioning of the physical line on the U interface.

**To test the physical layer on the U interface**

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

   The BRI Measurements menu may take several seconds to appear.



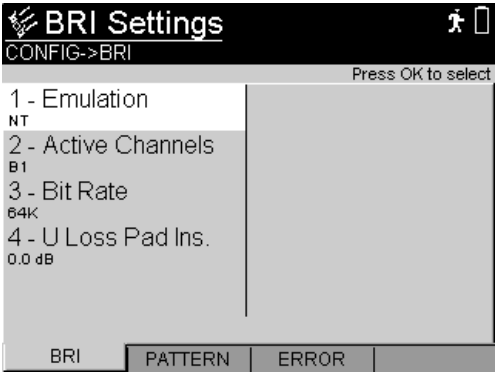

2. Select **BERT (IDSL)**.

   The HST-3000 launches the test application.

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

4. Press the **BRI** soft key.

The BRI Settings menu appears.




**5** Press the number key for the BRI setting you want to configure.

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 table below describes the parameters.

| Setting | Parameters |
|---|---|
| Emulation | Sets the emulation mode for the HST.<br>– **LT** — Emulate an LT device.<br>– **NT** — Emulate an NT device.<br>– **TE** — Emulate a TE device. |

| Setting | Parameters |
|---|---|
| Active Channels | The BRI channels you want to test:<br>– **B1.** Starts a BER test, sending the pattern on the B1 channel**.**<br>– **B2.** Starts a BER test, sending the pattern on the B2 channel.<br>– **B1,B2.** Starts a dual BER test, sending identical patterns on the B1 and B2 channels.<br>– **2B**. Starts a 128K BER test, sending one pattern over both bearer channels.<br>– **2B+D**. Starts a BER test, sending one pattern over both bearer channels and the D channel (available in LT mode only). |
| Bit Rate | Bit rate over the tested channel: **56K** or **64K**. |
| Loop Address | Address on the NT device used for looping. (Available in LT mode only.) |
| EOC Message | Code supplied by the LT for looping an NT device. Table 26 on page 103 lists the available codes. (Available in LT mode only.) |
| U Loss Pad Ins | Enables emulation of various cable losses. The selected cable loss affects the transmit and receive data path.<br>– **0 dB** — Provides no line build-out.<br>– **2 dB** — Provides -2 dB line build-out, simulating 2 dB of data loss.<br>– **4 dB** — Provides -4 dB line build-out, simulating 4 dB of data loss.<br>– **6 dB** — Provides -6 dB line build-out, simulating 6 dB of data loss. |

**6** Press the **PATTERN** soft key.

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

| Setting | Parameters |
|---|---|
| Pattern | Test pattern to inject. Table 22 on page 100 lists available test patterns. |
| User Bit Patt | User-defined bit pattern, 3-32 characters of zeros and ones. (Available only if Pattern is set to User Bit Pattern.) |

**8** Press the **ERROR** soft key.

Select and then define each of the following settings:

| Setting | Parameters |
|---|---|
| Errors | Type of error to inject.<br>– **Bit Error**<br>– **CRC Error**<br>– **FEBE Error** |
| Rate Type | Method by which bit errors are inserted. (Available only if Errors is Bit Error.)<br>– **Single**<br>– **Rate**<br>– **Multiple** |
| Count | Number of errors to insert. (Available only if Rate Type is Multiple.) |
| Rate | Insertion rate of errors. (Available only if Rate Type is set to Rate.) |

**9** *Optional*. If you want to run a timed test, press the **Event** soft key to display the Event Settings menu, and then do the following:

**a** Select **Timed Test**, and then select **Enable**.

The Timed Test Dur setting appears and the timed test icon appears in the upper right corner of the display screen.

**b** To specify how long the test should run, select **Timed Test Dur**, and then enter the test duration in hours, minutes, and seconds.

**10** Connect the **U** connector on the HST-3000 to the CO (network) side of the line.

**11** Verify that the Sync LED is illuminated to ensure that the HST is synchronized with a valid signal.

**12** Verify that the Data LED is illuminated to ensure that the HST has obtained pattern synchronization.

**13** Press the **Home** navigation key to display results.

**14** To insert errors into the line, press the **Action** soft key, and then select one of the following:

- **Enable Bit Error**—Inserts a single bit error. This action appears if you selected Single as the rate type in step 8.
- **Enable # Bit Errors**—Where # represents the number of bit errors that will be inserted. This action appears if you selected Multiple as the Rate type in step 8.
- **Enable Bit Error *Rate***—Where *Rate* represents the actual rate you specified. This action appears if you selected Rate as the Rate type in step 8.
- **Enable FEBE Error**—Inserts a continuous stream of FEBE errors. This action appears if you selected FEBE Error as the error type in step 8.
- **Enable CRC Error**—Inserts a continuous stream of CRC errors. This action appears if you selected CRC Error as the error type in step 8.

The error or errors are inserted into the line.

**15** *Optional*. To loop the HST-3000 while in NT mode, press the **Action** soft key, and then do the following:

**a** Select **Loop Action**, and then press the right arrow key to display a list of channels.

**b** Use the up and down arrow keys to choose the channel to loop, and then select **OK**.

BER testing is complete.

## Interpreting D channel decode messages

When you monitor or terminate ISDN BRI service, you can isolate and locate problems by viewing D channel decode messages for all captured transmitted and received frames.

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

```
TE->NT:C  SAPI:000 TEI:064
TIME: 12:14:51.628
I   Ns=004  Nr=005  P/F=1
PD=08..............Call Reference: 00008
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=  1
  83 Indicated Channel..........Preferred
     Channel Selection..............ANY
     Channel Identifier..........Not D-CH
I 6C CALLING PARTY NUMBER.........Len=  9
  21 Type of Address.............National
     Numbering Plan ID..............ISDN
  80 Presentation Ind.............Allowed
     Screen Ind.........user-not screened
     5551212
I 96 Shift.....Locking Codeset=6
I 7B CALL APPEARANCE..............Len=  1
  81 Call Appearance = 001
Hex:00 81 08 0B 08 01 08 05 04 03 80
    90 A2 18 01 83 6C 09 21 80 35 35
    35 31 32 31 32 96 7B 01 81
```

**Figure 7** 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 7 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 each decode message. The message in Figure 7 has a call reference number of `00008`. All messages exchanged in

reference to the call 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 indicating a different call has been disconnected.

For details on viewing and navigating through D channel decode messages, see "Viewing and navigating decode messages" on page 60.

For descriptions of each individual decode message, see "D-Chan decode results" on page 86.

## 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 does not 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, if 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 86. For detailed descriptions of supervisory frame messages, see "LAPD Supervisory frame messages" on page 88.

## 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 carrying the call).

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`. The call reference number for the message appears on the fourth line. The fifth line indicates the type of message being sent (for example, `SETUP` or `CONNECT`).

Finally, 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 ISDN and Call settings listed in "Placing circuit calls" on page 16. 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`.

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

For detailed descriptions of Q.931 messages, see "Q.931 messages" on page 89.

## 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 BRI 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.

## Restarting tests

When you use the HST-3000 to place and receive ISDN BRI calls, pressing the **Restart** soft key clears statistical and historical 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 61).

**NOTE:**

You can use the Clear History action to clear history results while continuing to accumulate statistical results (see "Clearing history results" on page 63).

## 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 "Test Results" on page 69.

## 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** navigation key.
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.

# Troubleshooting

# 3

This chapter describes how to identify and correct problems related to the BRI testing with the HST-3000. Topics discussed in this chapter include the following:

# Resolving problems

Table 7 describes situations that you may encounter when using the HST-3000 to test ISDN BRI service, and then helps you resolve the situation.

**Table 7** Issues and resolutions

| Issue | Description | Resolution |
|---|---|---|
| No dial tone detected on HST | You will not hear a dial tone when you place voice calls from the HST using enbloc dialing. This is normal for devices placing ISDN calls. | N/A. |
| 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:<br>– Summary Results<br>– Call 1 Results<br>– Call 2 Results |
| 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:<br>– Make sure you specified the number you want to call as the **Number to call** (under Call Settings); not the Directory number.<br>– 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.<br>– If the HST is configured correctly for the call, check the cause code on the Call 1 Results or Call 2 Results screen. |

**Table 7** Issues and resolutions (Continued)

| Issue | Description | Resolution |
|---|---|---|
| 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 61). |
| HST-3000 does not synchronize to ISDN line. | Sync LED does not illuminate solid green when attached to the ISDN line. | – Verify the correct mode is selected for what the HST-3000 is trying to emulate (NT1/TE, LT, NT1 for BRI interface).<br>– Verify the test cord is plugged into the jack on the BRI SIM corresponding to the selected mode. Most CPE turn-up testing is performed with the HST-3000 configured as an NT1/TE with the test cord in the U 2-wire interface jack. |

# Test Results

# A

This appendix describes the test result categories and the results within each category that are available when performing ISDN BRI 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, see “Viewing test results” on page 63.

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 8 describes the results that appear in the Summary category.

**Table 8** Summary results

| Result | Definition |
|---|---|
| Aborted Frm Count<br>LT Aborted Frm Count<br>NT Aborted Frm Count | Counts the aborted ISDN frames detected, excluding Out of Frame aborts. |
| Active<br>NT Active | Value of activation overhead bit. |
| Bit Errors | Number of received bits that have a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved. |
| Call Failure Count | Number of calls placed but did not connect. |

**Table 8** Summary results (Continued)

| Result | Definition |
|---|---|
| Call1/Call2 State | Displays one of the following call states:<br>– Idle<br>– Incoming<br>– Outgoing<br>– Connected<br>– Releasing<br>– Alerting<br>– Proceeding<br>– Dialing<br>**NOTE:** See Table 13 on page 83 for descriptions of each state. |
| CRC Err Frm Count<br>LT CRC Err Frm Count<br>NT CRC Err Frm Count | Counts number of CRC errored frames on the D channel. |
| CRC Errors<br>LT CRC Errors<br>NT CRC Errors | Number of Cyclical Redundancy Check-6 NEBEs (near-end block errors) detected since the beginning of the test. A CRC algorithm is performed on a 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 frame. |
| D-Channel 1 Ready<br>D-Channel 2 Ready | Displays “Active” if the data link is established; “Inactive” if the data link is not established. |
| D-Channel 1 Ready History<br>D-Channel 2 Ready History | Displays “Inactive” if the data link was established, but was lost. |

**Table 8** Summary results (Continued)

| Result | Definition |
|---|---|
| FEBE Errors<br>LT FEBE Errors<br>NT FEBE Errors | Number of Cyclical Redundancy Check-6 FEBEs (far-end block errors) detected since the beginning of the test. A CRC algorithm is performed on a 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 frame. |
| Invalid SAPI Count | Number of frames with unapproved Service Access Point Identifier. |
| Pattern Losses | Number of pattern synchronization losses. |
| Pattern Slips | Number of pattern synchronization slips. |
| Pattern Sync | Indicates the pattern synchronization status for a call you are BER testing. |
| Short Frm Count<br>LT Short Frm Count<br>NT Short Frm Count | Counts the short ISDN frames detected. A short frame is a frame with less than 3 octets plus an FCS. |
| SPID 1 Status<br>SPID 2 Status | Indicates if SPID successfully assigned. |

**Table 8** Summary results (Continued)

| Result | Definition |
|---|---|
| TEI 1 Ready<br>TEI 2 Ready | Indicates if Layer 2 successful on TEI. If `TEI Not Assigned`, `Awaiting TEI`, `Link Not Established`, `Inactive`, `Awaiting Establishment`, `Timer Recovery`, `Awaiting Release`, `TEI Denied`, `Link Unknown`, then Layer 2 not achieved and indicator is off. |

## Interface results

The Interface category lists results related to the physical interface. Table 9 describes the results that appear in the Interface category

**NOTE:**

When you display the category in ISDN NT1 mode, results for the network side of the BRI interface appear in the To CO column; results for the customer side of the BRI interface appear in the To CPE column.

**Table 9** Interface test results

| Result | Description |
|---|---|
| ACT | Value of activation overhead bit. |
| AIB | Value of transmitted alarm indication overhead bit. |

**Table 9** Interface test results (Continued)

| Result | Description |
|---|---|
| BPV Errors | Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since start of test. Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| BPV Errored Secs | Number of seconds during which BPV errors were detected. Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| CRC Errored Secs | Number of seconds during which CRC errors were detected. |
| CRC Errors | Number of Cyclical Redundancy Check-6 NEBEs (near-end block errors) detected since the beginning of the test. A CRC algorithm is performed on a 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 frame. |
| DEA | Value of transmitted deactivation overhead bit. |
| FEBE Errored Secs | Number of seconds during which FEBE errors were detected. |
| FEBE Errors | Number of Cyclical Redundancy Check-6 FEBEs (far-end block errors) detected since the beginning of the test. A CRC algorithm is performed on a frame on the receiving end. It is then recalculated at the transmitting end. If the measurements are not equal, it indicates an error occurred in the frame. |

**Table 9** Interface test results (Continued)

| Result | Description |
|---|---|
| Frame Errors | Number of frame errors received since start of test. Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| Frame Errored Secs | Number of seconds during which frame errors were detected. Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| Invalid SAPI Count | Number of frames received with an invalid SAPI (service access point identifier). Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| Layer1 State | Displays the current interface activation state. Its major activation states are awaiting signal, synchronized, and alerting. For the LT result, displays current J state for the LT side of line. For the NT result, displays current H state for the NT side of line. |
| Loop State | Displays current loop state and channel looped. Valid results include the following: No Loop, Loop B1, Loop B2, Loop B1+B2, 2B+D. Appears in NT1/TE mode only. |
| PS1 | – `Normal` indicates that at least 28 volts is present on the line.<br>– `Reversed` indicates reversed polarity of the voltage.<br>– `Not present` indicates that less than 28 volts is present on the line.<br>Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |

**Table 9** Interface test results (Continued)

| Result | Description |
|---|---|
| PS2 | – `Normal` indicates that at least 36 volts is present on the line.<br>– `Reversed` indicates reversed polarity of the voltage.<br>– `Not present` indicates that less than 36 volts is present on the line.<br>Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |
| Repeater Power | Indicates if high-voltage current is present for the repeater. Voltage threshold is 42 V ±3 V. Appears in NT1/TE mode only. |
| Rx EOC Address | Value received in the address portion of an EOC message. |
| Rx EOC Message | Embedded Operations Channel message. Valid results include the following: Loopback B1, Loopback B2, Loopback 2B+D, Normal, Request Corrupt CRC. |
| Rx Level VPP | Current present on the S/T interface, expressed in volts peak-to-peak. Appears in TE mode for the S/T interface only. |
| Sealing Curr Active | Indicates if low-voltage sealing current is present on the U interface. Appears in NT1/TE mode only. |
| Tx EOC Address | Value transmitted in the address portion of an EOC message. |
| Tx EOC Message | Embedded Operations Channel message. Valid results include the following: Loopback B1, Loopback B2, Loopback 2B+D, Normal, Request Corrupt CRC. |

**Table 9** Interface test results (Continued)

| Result | Description |
|---|---|
| Valid Frame Count | Number of valid LAPD frames since the start of the test. Appears in TE mode for the S/T interface or NT1 mode for the BRI interface only. |

## BERT results

The BERT category lists results related to bit error rate tests. Table 10 describes the results that appear in the BERT category.

**Table 10** BERT results

| Result | Description |
|---|---|
| % Error Free Seconds | Ratio of error free seconds to the total number of seconds during which pattern synchronization was maintained through any part of the second. |
| Bit Error Rate | Ratio of bit errors to received pattern data bits. |
| Bit Errors | Number of received bits that have a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved. |
| Error Free Seconds | Seconds during which pattern synchronization was maintained through the entire second and no bit error occurred. |
| Error Seconds | Counts test seconds where one or more bit errors occurred. |

**Table 10** BERT results (Continued)

| Result | Description |
|---|---|
| Pattern | Pattern selected on the HST for BER tests. |
| Pattern Losses | Number of pattern synchronization losses. |
| Pattern Slips | Number of pattern synchronization slips. |
| Pattern Sync | Indicates if pattern synchronization is achieved. |
| Round Trip Delay | Calculates round trip delay. The result is given in milliseconds. Only applicable when the Delay pattern is selected during test set up. |
| Sync Loss Seconds | Number of seconds, after initial pattern synchronization, where pattern synchronization was not present for any length of time. |

## LED results

The LED category shows the current and historical status for alarms. Table 11 describes the results that appear in the LED category.

**Table 11** LED results

| Result | Description |
|---|---|
| Active | Indicates the HST is sending an activation overhead bit. |
| 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. |

**Table 11** LED results (Continued)

| Result | Description |
|---|---|
| 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. |
| TEI 1 Ready<br>TEI 2 Ready | Indicates if Layer 2 successful on TEI. If TEI Not Assigned, Awaiting TEI, Link Not Established, Awaiting Establishment, Timer Recovery, Awaiting Release, TEI Denied, Link Unknown, then Layer 2 not achieved and indicator is off. |
| TEI 1 Ready History<br>TEI 2 Ready History | Indicates if TEI achieved but later lost Layer 2. |
| Pattern Sync | Pattern synchronization achieved. |
| Pattern Sync History | Indicates if pattern synchronization was achieved and then subsequently lost. |
| Repeater Power | Indicates if high-voltage current is present for the repeater. Voltage threshold is 42 V ±3 V. |
| Sealing Curr Active | Indicates if active sealing current is present on the U interface. |
| Sync'd | Frame synchronization detected. |

# ISDN results

The ISDN category shows results pertaining to the throughput of frames and their utilization. Results in this category accumulate after test restart. Table 12 describes the results that appear in the ISDN category.

**Table 12** ISDN test results

| Result | Description |
|---|---|
| Aborted Frm Count | Counts the aborted ISDN frames detected, excluding Out of Frame aborts. |
| Average % Utilization | The average percent of link utilization on the D channel since the start of the test. Calculated as (total octets in frames ÷ total octets received). |
| Call Clearing Count | Number of calls placed and subsequently disconnected. |
| Call Connect Count | Number of calls placed and subsequently connected. |
| Call Failure Count | Number of calls placed but did not connect. |
| Call Placement Count | Number of calls placed. |
| CRC Err Frm Count | Counts number of CRC errors within a frame on the D channel. |
| 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, or "I" frame with a long information field. |
| Frame Reject Frames | Number of frame-reject (FRMR) frames used to indicate that an improper frame has arrived. |

**Table 12** ISDN test results (Continued)

| Result | Description |
|---|---|
| Invalid SAPI Count | Number of frames with unapproved Service Access Point Identifier. |
| LAPD State 1<br>LAPD State 2 | Displays one of the following messages about the process of establishing the data link:<br>– TEI Unassigned<br>– Assign Await. TEI<br>– Est. Await. TEI<br>– TEI Assigned<br>– Await. Est.<br>– Await. Rel.<br>– Mult. Frm. Est.<br>– Timer Recovery<br>– Link Unknown |
| Max % Utilization | The maximum percent of link utilization on the D channel in any one second since the start of the test. |
| PD Display | Displays decoded lines of call parameters downloaded from a poll switch. |

**Table 12** ISDN test results (Continued)

| Result | Description |
|---|---|
| PD Status | Displays each of the following results in succession as the HST collects call parameters from a poll switch:<br>– Polling Switch — Indicates that the HST is establishing communication with the polling switch. If the HST does not receive a response from the switch within two seconds, the result changes to PD No Response.<br>– Collecting Data — Indicates that the HST is collecting data from the polling switch.<br>– Results Ready — Indicates that data collection is complete. |
| Reject Frame Count | Number of reject frame (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 | Counts the number of frames received. |
| Short Frm Count | Number of the short ISDN frames detected. A short frame is a frame with less than 3 octets plus an FCS. |
| SPID 1 Assigned<br>SPID 2 Assigned | SPID number assigned by the LT (NT1/TE mode only). |
| Valid Frame Count | Number of valid LAPD frames received since the start of the test. |

# Call 1/Call 2

The Call 1 and Call 2 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.

## Call states

Table 13 lists the valid call states that may appear for a call as a Call Status result.

**Table 13** 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.<br>**NOTE:** Some ISDN devices (for example, the HST), do not literally ring. |
| Connected | An incoming or outgoing call is established. |
| Dialing | LT device is ready to accept overlap dialing. |
| 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 14 lists the call test results.

**Table 14** Call 1/Call 2 results

| Result | Description |
|---|---|
| TEI | Displays the TEI assigned by the network. |
| Call 1/Call 2 | Displays the current status of the call:<br>– Call Status — Displays current call status.<br>– Call Type — Displays DATA or VOICE call type.<br>– Caller ID — Displays the number from where the call is being placed.<br>– Channel # — Displays the Bearer Channel being used by the call.<br>– Cause Code — Displays the plain English text for the Cause Code.<br>– Location — Displays the location of the Cause Code. |
| Call 1/Call 2 State | Displays the current call state. See Table 13 on page 83 for descriptions of each state. |
| SPID Status | Displays the SPID status. This result can have the values: `Valid`, `Invalid`, `Unassigned`. |

## D-Chan Decode

The D-Chan Decode category lists results related to the hexadecimal codes recovered from ISDN frames. Table 15 describes the results that appear in the D-Chan Decode category.

**Table 15** D-Chan Decode results

| Result | Description |
|---|---|
| Current Decode Frame | Indicates current frame being decoded. |
| D Channel Buffer % Full | Percentage utilization of available memory for D channel messages. |
| Decode Frame Count | Counts number of frames decoded. |
| Frame Decode | Displays textual translations of messages received and transmitted on the D-channel. Messages are captured in the order they are transmitted and/or received. |

## Time results

The time category lists the current date, time, and the amount of elapsed time since test restart. Table 16 describes the results that appear in the Time category.

**Table 16** Time test results

| Result | Description |
|---|---|
| Date | Current day and month. |
| Elapsed Time | Amount time in hours, minutes, and seconds (hh:mm:ss) since the last test restart. |

**Table 16** Time test results (Continued)

| Result | Description |
|---|---|
| Time | Current time of day in hours, minutes, and seconds (hh:mm:ss). |

## D-Chan decode results

The D-Chan 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 57.

### LAPD Unnumbered frame messages

Table 17 lists each of the LAPD unnumbered frame decode messages. For an overview of LAPD messages, see "LAPD messages" on page 59.

**Table 17** LAPD unnumbered frame decodes

| Message… | Sent to… |
|---|---|
| SABME (Set Asynchronous Balanced Mode with Extended Sequence Numbering) | Establish initial D channel communications.<br>– An affirmative response from the link partner is a UA message.<br>– 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:<br>– A `SABME` message from the device initiating D channel communications.<br>– A `DISC` message from the device terminating the D channel link. |

**Table 17** LAPD unnumbered frame decodes (Continued)

| Message… | Sent to… |
|---|---|
| DISC<br>(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<br>(Disconnect Mode) | Indicate one of the following:<br>– The link partner is not ready to establish a D channel link with the device sending a `SABME` message.<br>– The link partner cannot terminate the link (in response to a `DISC` message), typically because communications have already been disconnected. |
| FRMR<br>(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. |
| UI<br>(Unnumbered Information) | Request an exchange of information between the link partners. |

## LAPD Supervisory frame messages

Table 18 lists each of the LAPD supervisory frame decode messages. For an overview of LAPD messages, see "LAPD messages" on page 59.

**Table 18** LAPD supervisory frame decodes

| Message… | Sent to… |
|---|---|
| RR<br>(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.<br>**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. |
| RNR<br>(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. |
| REJ<br>(Reject) | Force re-transmission of bad frames. Frequent REJ frames indicate miscommunication on the D channel, typically due to errored frames during transmission. |

## Q.931 messages

Table 19 lists each of the Q.931 decode messages. For an overview of Q.931 messages, see "Q.931 messages" on page 60.

**Table 19** Q.931 decodes

| Message… | Sent to… |
|---|---|
| SETUP | Originate a call. |
| CALL PROCEEDING | Indicate that a SETUP message has been received, and that the device is attempting to process the call. |
| ALERTING | Indicate that a SETUP message has been received, and that the device 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. |
| DISCONNECT | Disconnect the call. Can be sent from the calling device or the called device.<br>**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.<br>**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.<br>**NOTE:** A call is not disconnected until the RELEASE COMPLETE message is observed. |

# 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 value 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 20 on page 91).
- 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 20 on page 91 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 20 lists and explains the most commonly encountered cause codes for ISDN BRI calls.

**Table 20** 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 20** 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 20** 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:<br>– Verify that the call control is correct for the call.<br>– 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 when B channels are not active. |

Table 20 lists less frequently encountered cause codes for ISDN BRI calls.

**Table 21** Q.931 Cause Codes

| Cause Code | D Channel Decode Description | Call 1/Call 2 Description |
|---|---|---|
| 1 | `Unassigned Number` | `UNASSIGNED NUMBER` |

**Table 21** Q.931 Cause Codes (Continued)

| Cause Code | D Channel Decode Description | Call 1/Call 2 Description |
|---|---|---|
| 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 |
| 38 | | NETWORK OUT OF ORDER |
| 41 | Temporary failure | TEMPORARY FAILURE |
| 42 | Network congestion | NETWORK CONGESTION |
| 43 | Access information discarded | ACCESS INFO DISCARDED |

**Table 21** 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 |
| 49 | | QUALITY OF SERVICE UNAVAIL |
| 50 | Requested facility not subscribed | REQ FACILITY NOT SUBSCRIBED |
| 52 | Outgoing calls barred | OUTGOING CALLS BARRED |
| 53 | Service Operation violated | |
| 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 |

**Table 21** Q.931 Cause Codes (Continued)

| Cause Code | D Channel Decode Description | Call 1/Call 2 Description |
|---|---|---|
| 82 | Identified channel does not exist | CHANNEL DOES NOT EXIST |
| 83 | | NO CALL ID |
| 84 | | CALL ID IN USE |
| 85 | | NO CALL SUSPEND |
| 86 | | CALL CLEARED |
| 90 | Destination address missing | NO DESTINATION ADDRESS |
| 91 | Transit network does not exist | TRANSIT NETWORK NOT EXIST |
| 95 | Invalid message unspecified | INVALID MESSAGE |
| 96 | Mandatory information element missing | INFO ELEMENT MISSING |
| 97 | Message type nonexistent or not implemented | MESSAGE TYPE NON-EXISTENT |
| 98 | Message not compatible with call state | MESSAGE NOT COMPATIBLE |
| 99 | Info element nonexistent 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 |

**Table 21** Q.931 Cause Codes (Continued)

| Cause Code | D Channel Decode Description | Call 1/Call 2 Description |
|---|---|---|
| 0 | | UNKNOWN CAUSE VALUE |

## Saving and printing results

For information about saving and printing test results, see the *HST-3000 Base Unit User's Guide*.

# BERT Patterns

# B

This appendix describes the patterns available for BER testing. Topics discussed in this appendix include the following:

# BERT patterns

Table 22 shows the BERT patterns available for ISDN BRI testing.

**Table 22** ISDN BERT patterns

| Pattern | Description |
|---|---|
| All Ones | Provides a fixed test pattern of all ones. 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. |
| All Zeros | Provides a fixed test pattern of all zeros. |
| 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. |
| 511 | Selects the $2^9$ -1 Pseudorandom pattern, which generates a maximum of 7 sequential 0s and 9 sequential 1s. |
| 2047 | 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. |
| 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. |
| 2^20-1 | Selects the $2^{20}$ -1 pseudorandom pattern, which generates a maximum of 19 sequential 0s and 20 sequential 1s. Simulates live data. |
| 2^23-1 | Selects the $2^{23}$ -1 pseudorandom pattern, which generates a maximum of 22 sequential 0s and 23 sequential 1s. |
| User Bit Pattern | Selects a user-defined pattern from 3 to 32 bits long. |

# Specifications

# C

This appendix contains specifications for the BRI testing option. Topics discussed in this appendix include the following:

# Interface

This section describes interface specifications.

**Table 23** Interface specifications

| Parameter | Specification |
|---|---|
| Line interface | 2B1Q per ANSI T1.601 (1992), providing 0 dB, 2 dB, 4 dB, 6 dB line build-out. |
| PS1 | At least 28 volts is present on the line. |
| PS2 | At least 36 volts is present on the line. |
| Maximum voltage | 42 V ±3 V |

# Test configurations

This section describes configurations available for BRI testing.

## BRI testing configurations

Table 24 lists specifications for BRI testing option configurations.

**Table 24** BRI configuration specifications

| Parameter | Specification |
|---|---|
| Operating modes | Terminate, Monitor |
| Tests | Bit error rate test (BERT) |
| Error types | Frame, CRC, FEBE |

## Loopback modes

Table 25 describes the available loopback modes.

**Table 25** Loopback modes

| Mode | Loopback Type | Loopbacks Available |
|---|---|---|
| LT BERT | Transmission of EOC loopback requests to the NT (manual loopback not available) | See Table 26. |
| NT BERT | Manual or auto response to loop-back requests | None, B1, B2, B1+B2, 2B+D |
| U Monitor | N/A | N/A |

## EOC loopback codes

Table 26 describes the EOC (Embedded Operations Channel) message codes for various testing modes.

**Table 26** EOC message codes

| Loopback Type | Loopbacks Available |
|---|---|
| Return to Normal | Removes the current loopback and any bad CRCs. |
| B1 Loopback | Requests far-end loopback of B1 channel. |
| B2 Loopback | Requests far-end loopback of B2 channel. |
| 2B+D Loopback | Requests far-end loopback of B1, B2 and D channels. |
| Send Bad CRC | Requests far-end device to send a continuous stream of traffic with bad CRC. |

# Glossary

## B

**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.

**B-Channel —** Bearer Channel. Portion of the BRI interface that typically carries information. *See* Circuit mode calls.

**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.

**BRI —** Basic Rate Interface. An ISDN configuration which consists of two B-channels that can carry voice or data at rate of 64Kbps, and one D-channel, which carries call-control information.

**BRI interface —** The interface spanning both the U interface (central office side) and the S/T interface (customer premises side) of the network.

## C

**Cause Code —** Reason an ISDN call was disconnected.

**Circuit mode calls —** Calls placed on the B channels of the BRI interface.

**CRC —** Cyclic Redundancy Check. A code word used to confirm that a bit stream contains valid data.

## D

**D-Channel —** Portion of BRI interface that provides signaling. May also be used to carry packet calls for data transfers. *See* Packet mode calls.

**DNIC —** Data network identification code. An address used to reach a host computer system residing on a packet switched network. A DNIC is often used as the prefix that identifies the RPOA when dialing packet calls. *See* RPOA.

## E

**EOC —** Embedded Operations Channel. A portion of the ISDN signal that contains instructions for a network device. EOC commands are often used to loopback an NT device on the far end.

**ES —** Errored Second. A second during which at least one error or alarm occurred.

## F

**FEBE —** Far End Block Error. A block error detected at a device on the customer premises.

**Frame Check Sequence —** Bits added to the end of a frame for error detection.

**FTP —** File Transfer Protocol. A protocol used for exchanging files over the Internet.

## I

**ISDN —** Integrated Services Digital Network. A set of communications standards allowing a single wire or optical fiber to carry voice, digital network services and video.

## L

**LAPD —** Link Access Procedure-D. A protocol for ISDN connections.

**LBO —** Line Build Out. An optional attenuation which can be applied to the output signal to simulate long lengths of cable.

**Loopback —** A command instructing a network device to return a received signal. You can issue EOC commands from the HST to loopback the received signal on a far end NT device.

**LT —** Line Termination. A mode in which the HST-3000 simulates a line termination device, such as a central office switch.

## N

**NT1 —** Network Termination type 1. A mode in which the HST-3000 simulates the ISDN

device responsible for the termination of the ISDN transmission facility at the customer premises.

## P

**Packet mode calls —** Calls placed on the D channel of the BRI interface for data transfers.

**Pattern —** A fixed or pseudo-random string of ones and zeroes used to perform a BER test. ISDN signals must have certain patterns to achieve synchronization between two devices.

**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).

## Q

**Q.931 —** A message-oriented protocol used on ISDN networks.

**RPOA —** Recognized Private Operating Agency. Some RPOAs require that you specify the RPOA's identifying prefix before the directory number when placing a call. For ISDN X.25, the prefix is typically the data network identification code (DNIC) for the ISDN's long distance carrier.

## S

**Short Frame —** An ISDN frame with less than 3 octets plus a frame check sequence.

**SIM —** Service Interface Module. SIMs connect to the HST-3000 base unit to provide testing functionality.

**SPID —** Service Profile ID. Identifies the types of services and features supported for a given ISDN device. SPIDs are optional in the ISDN standard, but usually required in North America.

**S/T interface —** The standard 4-wire (2 RX, 2 TX) ISDN interface used by ISDN terminals on the terminal side of a NT1.

## T

**TE —** Terminal Equipment. A mode in which the HST-3000 simulates a a termination device, such as an ISDN telephone.

**TEI —** Terminal Endpoint Identifier. The ID of an ISDN device on the customer premises.

## U

**U interface —** The physical 2-wire echo cancelling interface spanning the local loop and the customer premises.

**U Loss Pad Insertion —** An optional attenuation which can be applied to the output signal to simulate long lengths of cable.

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