MSAM, Transport Module, DMC, 40G Module, CSAM, and T-BERD 5800

PDH, SONET, SDH, NextGen, and OTN Testing Manual

MSAM, Transport Module, DMC, 40G Module, CSAM, and T-BERD 5800

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Ordering information

The catalog number for a printed getting started manual is ML-22046563. The catalog number for a printed PDH/SONET testing manual is ML-22046567. The catalog number for electronic manuals on USB is CEML-21138299.

WEEE and Battery Directive Compliance

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

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

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About this Manual

This prefix explains how to use this manual. Topics discussed include the following:

Purpose and scope

The purpose of this manual is to help you successfully use the PDH, SONET, NextGen, and OTN test capabilities of the 5800, MSAM and the Transport Module.

Assumptions

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

Terminology

The T-BERD 8000 is branded as the MTS-8000 in Europe, and it is interchangeably referred to as the T-BERD 8000, MTS 8000, MTS-8000, MTS8000 and Media Test Set 8000 throughout supporting documentation.

The T-BERD 6000A is branded as the MTS-6000A in Europe, and it is interchangeably referred to as the T-BERD 6000A, MTS 6000A, MTS6000A and Media Test Set 6000 throughout supporting documentation.

The T-BERD 5800 is branded as the MTS-5800 in Europe, and it is interchangeably referred to as the T-BERD 5800, MTS 5800, MTS-5800, MTS5800 and Media Test Set 5800 throughout supporting documentation.

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

- **Assembly** — Used throughout this manual to refer to a complete *set of components* assembled as an instrument and used for testing. This manual supports three assemblies:
  - ***40/100G Transport Module assembly***, consisting of an T-BERD ⁄ MTS 8000 base unit and 40/100G Transport Module
  - ***CSAM assembly***, consisting of a CSAM and either a DMCv2 or 6000Av2 base unit.
  - ***MSAM assembly***, consisting of a MSAM, Physical Interface Modules (PIMs), and a T-BERD ⁄ MTS 6000A base unit
  - ***DMC assembly***, consisting of up to two MSAMs or CSAMs (if DMCv2), up to four PIMs, a Dual Module Carrier (DMC), and a T-BERD ⁄ MTS 8000 base unit.
- **Application module**—Used throughout this manual to refer to the component that provides test functionality to the assembled instrument. This manual supports two application modules: the ***Transport Module***, and the ***MSAM***.
- **Component**—Used throughout this manual to refer to an individual hardware *component* which is connected to the other components to build a test instrument (assembly). This manual supports the following components: the Transport Module, the MSAM, and the DMC. The base units are documented in separate manuals.
- **T-BERD / MTS 5800**—The MSAM of products (may be T-BERD/MTS 5802, 5812P, and so on).
- **T-BERD ⁄ MTS 8000, 6000A, and 5800**—The family of products, typically a combination of a base unit, a battery module, and one or more application modules. The Dual Module Carrier (DMC) can be used on the T-BERD / MTS 8000 platform to test using two MSAMs.

- **Base unit**—The unit which connects to the application module and power adapter, providing the user interface and a variety of connectivity and work flow tools. If optioned to do so, the base unit also allows you to measure emitted power, received power, and optical link loss on fiber optic networks.
- **CSAM 100G Services Application Module**—Referred to generically as “the instrument” when inserted in the T-BERD / MTS 6000A base unit or the DMC with a PIM. The CSAM provides testing functionality for the base unit.
- **DMC**—Dual Module Carrier. The DMC is a two slot chassis which you can connect to the T-BERD / MTS 8000 base unit to test using up to two MSAM application modules and four Physical Interface Modules (PIMs).
- **MSAM Multiple Services Application Module**—Referred to generically as “the instrument” when inserted in the T-BERD / MTS 6000A base unit or the DMC with a PIM. The MSAM provides testing functionality for the base unit.
- **Transport Module**—Referred to generically as “the instrument” when connected to the T-BERD / MTS 8000 base unit. The Transport Module provides testing functionality for the base unit.
- **PIM—**The physical interface module inserted into one of up to two ports provided on the MSAM chassis. PIMs supply the physical connectors (interfaces) required to connect the MSAM to the circuit under test. A variety of cables, SFPs, and XFPs are offered as options, and can used to connect the PIMs to the circuit.
- **Battery Module—**The module connected to the back of the T-BERD / MTS 8000 base unit, which supplies power whenever it is not provided using the power adapter.
- **OC-n**—Used to refer to each of the optical SONET rates supported by the instrument (OC-3, OC-12, OC-48, and OC-192), where *“n”* represents the user-selected line rate.
- **STM-n**—Used to refer to each of the optical SDH rates supported by the instrument (STM-1, STM-4, STM-16, and STM-64), where *“n”* represents the user-selected line rate.
- **STS-1**—Used to refer to the electrical equivalent of OC-1 (51.84 Mbps) supported by the instrument.
- **STM-1e**—Used to refer to the electrical equivalent of STM-1 (155.52 Mbps) supported by the MSAM.
- **OTN**—Optical Transport Network.
- **OTU1**—Optical Transport Unit 1. A 2.7G OTN signal designed to carry a SONET OC-48 or SDH STM-16 client signal. OTU1 is used on the user interface to identify the applications used for 2.7G OTN testing.
- **OTU2**—Optical Transport Unit 2. A 10.7G, 11.05G, or 11.1G OTN signal designed to carry SONET OC-192, SDH STM-64, or 10GigE Ethernet WAN and LAN client signals. OTU2 is used on the user interface to identify the applications used for 10.7G, 11.05G, or 11.1G OTN testing.
- **OTU3** — Optical transport Unit 3. A 43G OTN signal designed to carry 40Gig Bulk BERT payloads and ODU3 encoded signals. OTU3 is available on the CSAM and 40/100G High Speed Transport Module.
- **OTU4** — Optical transport Unit 4. A 111.8G OTN signal designed to carry 100GigE Ethernet and Bulk BERT and ODU4 encoded signals. OTU4 is available on the CSAM and 40/100G High Speed Transport Module.
- **10/100/1000 Ethernet**—Used to represent 10/100/1000 Mbps Ethernet.
- **1GigE**—Used to represent 1 Gigabit Ethernet.
- **10GigE**—Used to represent 10 Gigabit Ethernet.
- **40GigE**—Used to represent 40 Gigabit Ethernet.
- **100GigE**—Used to represent 100 Gigabit Ethernet.

– **FC**—Used to represent Fibre Channel.
– **JDSU Ethernet test set**—A test set marketed by JDSU and designed to transmit an Acterna Test Packet (ATP) payload. ATP packets carry a time stamp used to calculate a variety of test results. The FST-2802 TestPad, the SmartClass Ethernet tester, the HST-3000 with an Ethernet SIM, the T-BERD/MTS 8000 Transport Module, and the MSAM can all be configured to transmit and analyze ATP payloads, and can be used in end-to-end and loop back configurations during testing.
– **SFP**—Small form-factor pluggable module. Used throughout this manual to represent pluggable optical modules.
– **XFP**—10 Gigabit small form-factor pluggable module. Used throughout this manual to represent pluggable optical modules used to connect to the family of 10 Gbps circuits (ranging from 9.95 Gbps to 11.3 Gbps).
– **QSFP+** — 40Gigabit Quad Small Form-Factor Pluggable optical transceiver. A variety of optional QSFP+s are available for testing 40 Gigabit fiber circuits.
– **CFP** — 100Gigabit Form-Factor Pluggable optical transceiver. A variety of optional CFPs are available for testing 100Gigabit fiber circuits.
– **Xv**—Used as a suffix throughout the user interface for virtual channels carried in a SONET or SDH container, where X serves as a placeholder for the number of virtual channels, and “v” indicates that the concatenation is virtual (rather than true concatenation). For example, if you are testing virtual channels carried in a high order STS-3c, you would select an STS-3c-Xv payload when you launched your application. You can then specify the number of members (channels) when you create the virtual channel group (VCG).

PDH, SONET, SDH, NextGen, and OTN Testing Manual

This is the PDH, SONET, SDH, NextGen, and OTN testing manual for theT-BERD / MTS 5800, MSAM and the Transport Module. The manual is application-oriented and contains information about using these instruments to test service carried on each of the listed networks. It includes an overview of testing features, instructions for using the instruments to generate and transmit traffic over a circuit, and detailed test result descriptions. This manual also provides contact information for JDSU’s Technical Assistance Center (TAC).

Use this manual in conjunction with the following manuals:

– *8000 Base Unit User Manual*. This manual provides an overview, specifications, and instructions for proper operation of the base unit.
– *6000A Base Unit User Manual*. This manual provides an overview, specifications, and instructions for proper operation of the base unit.
– *T-BERD / MTS 8000, 6000A, and 5800 Multiple Services Application Module, 40/100G Transport Module, Dual Module Carrier, and Handheld Network Test Family Getting Started Manual.* This manual provides an overview of the connectors provided on the hardware components, instructions for connecting to the circuit you are testing, and specifications for the hardware components.
– *Ethernet, IP, TCP/UDP, Triple Play, Fibre Channel, and IP Video Testing Manual*. This manual provides instructions for testing each of the services listed, and detailed test result descriptions. When using your instrument for NextGen and OTN testing, details concerning Ethernet settings and test results are provided in this manual.
– *Remote Control Reference Manual*. This manual provides the remote control commands used when developing scripts to automate your testing. This manual is provided electronically on jdsu.com.

NOTE:

Many applications also require you to purchase and install certain testing options; others require specific hardware connectors to connect to circuits for testing. For example, if your instrument does not have a connector or PIM designed to support OC-3 testing, you can not transmit and analyze a signal or traffic over an OC-3 circuit.

You can quickly determine whether or not your instrument supports certain applications by exploring the technologies, rates, and test modes presented on the Test menu and by reviewing the settings available when you configure a test.

Conventions

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

Table 1 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 2 Keyboard and menu conventions

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

Table 3 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, battery, or packaging indicates that the equipment or battery must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Safety and compliance information

Safety and compliance information for the instrument are provided in printed form and ship with your instrument.

Technical assistance

Table 4 lists contact information for technical assistance. For the latest TAC contact information, go to www.jdsu.com or contact your local sales office for assistance. Contact information for regional sales headquarters is listed on the back cover of this manual.

Table 4 Technical assistance centers

Region	**Phone Number**	
Americas	1-855-ASK-JDSU 301-353-1560	(1-855-275-5378) tac@jdsu.com
Europe, Africa, and Mid-East	+49 (0) 7121 86 1345 (JDSU Germany)	hotline.europe@jdsu.com
Asia and the Pacific	+852 2892 0990 (Hong Kong) +86 10 6655 5988 (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.

1

Basic Testing

This chapter explains basic testing concepts and procedures common to each PDH, SONET, SDH, NextGen, and OTN test. Detailed information about concepts and procedures shared by all supported test applications are provided in the Getting Started manual that shipped with your instrument or upgrade.

When a test is configured to establish a connection to a remote unit, the connection process queries the remote unit for its software version. If the version level of the remote and local unit are different, a notice will be displayed encouraging the user to update the older unit to avoid incompatibility issues and to achieve optimal performance. See “Setting up the instrument” in the *Getting Started* manual that shipped with this unit.

Topics discussed in this chapter include the following:

Step 1: Selecting a test application

The Test menu on the Main screen lists each of the available test applications.

If you are testing using an MSAM, the applications are listed for the PIM or PIMs that are inserted in your MSAM chassis. If you have a dual port chassis, by default, the first application you select will be for port 1 (P1).

To select an application

1. Select **Test**. The Test menu appears.
2. Select the technology (for example, SONET), signal, payload, and test mode for your test application.

   The instrument displays a message asking you to wait while it loads the application.
3. Wait for the Main screen to appear, and then proceed to "Step 2: Configuring a test" on page 2.

The test application is selected.

> **NOTE:**
> When testing using an MSAM, only the applications for currently inserted PIMs will appear on the Test menu. For example, if an SFP and XFP PIM are inserted in the MSAM chassis, you will not see DS1 applications.
>
> Other applications, such as the NextGen GFP applications only appear if you purchased the associated testing options.

Step 2: Configuring a test

Before you configure a test, be certain to complete the information that you want to include when you generate reports of your test results. For details, refer to the Getting Started manual that shipped with your instrument.

Configuring a test involves displaying the setup screens, specifying test settings, and optionally saving the test setup. Key settings are also available on the Main screen, on the Quick Config tabs. Changing key settings while running a test (for example, changing the pattern transmitted) triggers an automatic restart of the test.

To display the setup screens

1. Using the Test menu, select a test application (see "Step 1: Selecting a test application" on page 2).
2. Select the **Setup** soft key.

A setup screen with a series of tabs appears. The tabs displayed vary based on the test application you selected. See Figure 1.

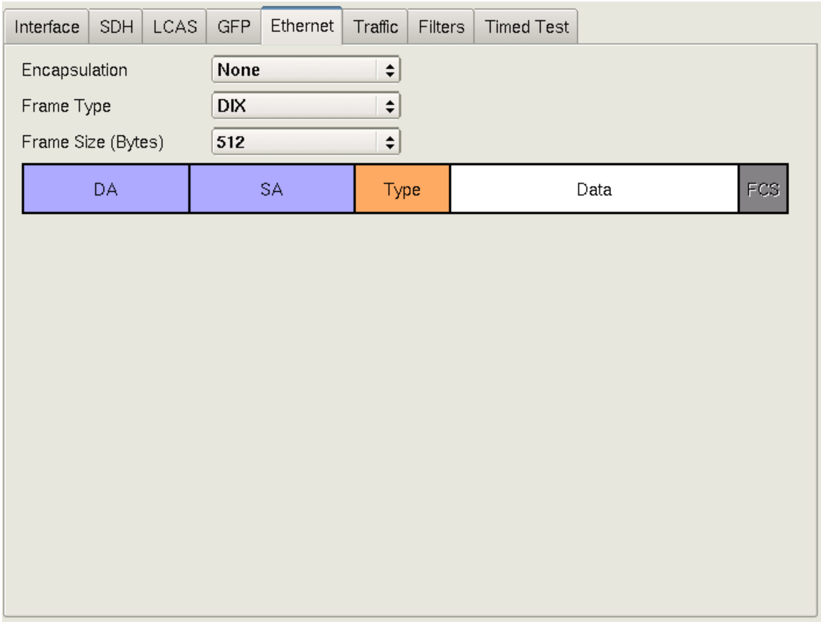


Figure 1 Setup Screen (Ethernet Settings tab for GFP testing)

3 To navigate to a different setup screen, select the corresponding tab at the top of the screen. For example, to display the Traffic setup screen, select the Traffic tab.

4 After you finish specifying the test settings, select the **Results** soft key to return to the Main screen.

For detailed instructions, refer to the Getting Started manual that shipped with your instrument or upgrade, and to each of the testing chapters in this manual.

Step 3: Connecting the instrument to the circuit

For detailed instructions on connecting your instrument to the circuit, refer to the Getting Started Manual.

When connecting the unit to optical circuits, bear in mind that applied power must not exceed the power level specified on the panel for each optical connector.

Step 4: Starting the test

After you configure a test, connect the unit to the circuit, and, turn the laser ON, the test starts automatically, and test results immediately accumulate.

NOTE: Temperature stabilized lasers

When testing 10 Gigabit, 40 Gigabit or 100 Gigabit optical circuits, some lasers (particularly 1550 nm lasers) are temperature stabilized; therefore, they need to reach a certain temperature before you can use them to transmit a signal. This is expected behavior, and does not indicate that there is something wrong with the laser or test instrument.

It typically takes up to one minute for the temperature to stabilize. If you have turned the laser on, but no signal is present on the receiving instrument or device, simply wait for one minute.

After you start a test, use the buttons at the bottom of the screen to perform actions such as turning the laser on and off, starting and stopping traffic, starting and stopping a local loop back, and inserting errors, anomalies, alarms, or defects.

Table 5 lists some common Action buttons.

Table 5 Action buttons

Button	Action
Laser On/Off	Turns the laser on or off when testing optical rates.
Insert Error/Anomaly	Inserts an error or anomaly into the transmitted traffic.
Insert Alarm/Defect	Inserts an alarm or defect into the transmitted traffic.

Step 5: Viewing test results

Test results appear in the Results Windows of the Main screen.

Setting the result group and category

To set the result group and category

1. Using the Test menu, select a test application see “Step 1: Selecting a test application” on page 2), and then configure your test (see “Step 2: Configuring a test” on page 2).
2. Select the **Results** soft key to return to the Main screen.
3. Connect your module to the circuit (see “Step 3: Connecting the instrument to the circuit” on page 3).
4. If you are testing an optical interface, select the **Laser** button.
5. If you selected an Ethernet, Fibre Channel, or SONET/SDH GFP test application, select the **Start Traffic** button to start generating and analyzing traffic.

   Results appear in the Results Windows.
6. *Optional*. Insert errors or anomalies into the traffic stream, or use the Action buttons to perform other actions. These buttons only appear if applicable to your test application.

7 Use the Group and Category buttons to specify the type of results you want to observe. Figure 2 illustrates buttons for a standard SONET application.

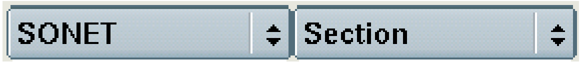


Figure 2 Result Group and Category buttons

Results for the category you selected appear in the result window.

8 *Optional*. To observe results for a different group or category in another result window, press the buttons at the top of the window to specify the group and category.

For descriptions of each result, refer to Chapter 7 “Test Results”.

> **TIP:**
> If you want to provide a screen shot of key test results, on the Main screen, select **Tools > Capture Screenshot**. A screen shot will be captured and stored as a JPG file in the `./acterna/user/disk/bert/images` folder. You can include the screen shot when you create reports.

Additional test result information

For detailed information on the following topics, refer to the Getting Started manual that shipped with your instrument or upgrade.

– Expanding and collapsing result measurements
– Changing the result layout
– Using the entire screen for results
– About histogram results
– Viewing a histogram
– About the Event log
– About result graphs
– Clearing History results
– Creating and maintaining Custom result groups

For descriptions of each result, refer to Chapter 7 “Test Results”.

Running multiple tests

You can significantly reduce your testing time by terminating traffic over multiple circuits simultaneously.

For example, you can transmit traffic from the DS1 and DS3 PIMs to a network element, and then loop the traffic back to your unit to analyze the signals and verify that the network element is operating properly.

For details, refer to the Getting Started manual that shipped with your instrument or upgrade.

2

T-Carrier and PDH Testing

This chapter provides step-by-step instructions for testing T-Carrier and PDH networks. Topics discussed in this chapter include the following:

About T-Carrier and PDH testing

If your instrument is configured and optioned to do so, you can use it to analyze the performance of DS1 and DS3, and E1, E3, and E4 networks by performing BER tests, and verifying that performance conforms to the industry test standards.

When you configure the instrument for T-Carrier or PDH testing, a number of the test parameters vary depending on the protocol (T-Carrier or PDH), rate, and payload you select.

NOTE:

You can also test muxed T-Carrier and PDH payloads when testing SONET and SDH networks. For a list of payloads supported, see Chapter 3 “SONET and SDH Testing”.

Features and capabilities

When testing T-Carrier and PDH service, you can generate and analyze muxed and bulk payloads ranging from 1.544 Mbps to 139.264 Mbps for a variety of transport rates. The module also allows supports the following:

– BERT patterns—You can transmit and detect BERT patterns for each rate available on the instrument.
– Error/anomaly and alarm/defect insertion—You can insert a variety of errors, anomalies, alarms, and defects into traffic, such as Bit/TSE errors and REBE alarms.
– Performance measurement—You can verify that performance complies with ITU-T G.821, G.826, and M.2100, and ANSI T1.510.
– Intrusive through mode testing—You can monitor a received signal in through mode, and then pass the signal through the unit to the transmitter. The instrument will resolve any received line code violations before transmitting the signal.
– Drop and insert testing from a SONET/SDH access point—When testing in through mode, you can insert one channel while non-intrusively passing the remainder of the signal through unaffected. For example, you can monitor an OC-48 signal, and then drop a DS3 signal and insert a BER pattern into the DS3 signal, leaving the rest of the signal as it was received. For details, see “Drop and insert testing” on page 66 of Chapter 3 “SONET and SDH Testing”. (N/A for CSAM and 40/100G Transport Module)
– Loop code insertion—You can loop up MUX devices using CSU, NIU, HDSL (including generic device), and FEAC loop codes. You can also optionally define up to ten user-programmable loop codes. For details, see “Looping up MUX devices” on page 14
– DS1 loop codes can be transmitted from within a channelized DS3 application.
– Round trip delay measurement—You can verify that a circuit complies with round trip delay requirements as specified in a customer’s service level agreement.
– Service disruption measurements—You can measure service disruption time resulting from signal loss or a variety of errors, anomalies, alarms, or defects. For details, see “Measuring service disruption time” on page 21.
– DS1 jitter measurements—If your MSAM is configured and optioned to do so, you can measure jitter on a DS1 interface. The measurement is provided in the Interface result group, under the Signal category. For details, see Chapter 4 “Jitter and Wander Testing”.
– PCM signal analysis—If your instrument is configured and optioned to do so, you can analyze signals for the robbed-bit-in-band signaling standard by testing against different trunk types. These tests are performed from a DS1 (T1) access point. For details, see “Analyzing PCM signals” on page 23.

- VF call analysis—If your instrument is configured and optioned to do so, you can establish a VF (voice frequency) call, then transmit or receive voice or tones without dropping the call. These tests are performed from a DS1 (T1) access point. For details, see "Analyzing VF circuits" on page 30.
- Fractional T1 testing—If your instrument is configured and optioned to do so, you can commission and maintain fractional T1 (FT1) transmission circuits. Typically this involves out-of-service testing to ensure that the physical layer is clean and there are no problems with network equipment or improper provisioning. For details, see "Analyzing PCM signals" on page 23.
- ISDN PRI testing—If your instrument is configured and optioned to do so, you can place and receive one ISDN call and decode/monitor the D-Channel. For details, see "ISDN PRI testing" on page 34.
- Monitoring HDLC-based protocols on DS1/DS3 interface— If your instrument is configured and optioned to do so, monitoring of DS1/DS3 interfaces supporting HDLC-based protocols such as PPP and Frame Relay is possible.

Understanding the LED panel

When you setup the instrument, you can specify whether the T-Carrier and PDH LED panels should emulate the LEDs on the ANT platform or the TestPad 2000 platform. If the LEDs are not what you expect or are accustomed to seeing, verify that the correct emulation mode is selected for your module.

Understanding the graphical user interface

The names of various elements on the graphical user interface change depending on whether you select a T-Carrier or PDH test application. For example, the button that you use to insert errors or anomalies is labeled **Insert Error** if you selected a T-Carrier application; the same button is labeled **Insert Anomaly** if you selected a PDH application.

Understanding T-Carrier and PDH test results

Many T-Carrier and PDH standards are identical; therefore, the instrument provides similar results for both test applications. See "T-Carrier and PDH results" on page 177 for a description of each test result.

T-Carrier test applications

Table 6 lists each of the T-Carrier test applications.

Table 6 T-Carrier test applications

Signal	Payload Rate	Test Modes
DS1	DS1 BERT	Terminate Through Dual Monitor
	DS1 Signaling[a]	Terminate Dual Monitor
	DS1 ISDN PRI	Terminate Dual Monitor
	DS1 VF[a]	Terminate Dual Monitor
DS3	DS3 BERT	Terminate Through Dual Monitor
	E1 BERT	Terminate Through Dual Monitor
	DS1 BERT	Terminate Through Dual Monitor

a. MSAMv1 when installed in T-BERD/MTS 6000Av2 base unit does not provide a a voice path to a headset.

PDH test applications

Table 7 lists each of the PDH test applications.

Table 7 PDH test applications

Signal	Payload Rate	Test Modes
E1	E1 BERT	Terminate Through Dual Monitor
E3	E3 BERT	Terminate Through Monitor
	E1 BERT	Terminate Through Monitor

Table 7 PDH test applications (Continued)

Signal	Payload Rate	Test Modes
E4	E4 BERT	Terminate Through Monitor
	E3 BERT	Terminate Through Monitor
	E1 BERT	Terminate Through Monitor

Fractional T1 testing

If your instrument is optioned and configured to do so, you can analyze FT1 circuits for contiguous and non-contiguous channels in 56 kbps or 64 kbps formats.

To configure a FT1 payload

1 Using the Test Menu, select the DS1 terminate test application for the payload rate you are testing (refer to Table 6 on page 10).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Select the Payload tab, then specify the following settings:

Setting	Value
Payload Type	Select **Fractional Rate**.
Select DSO Channels	Select the displayed channels that you want to analyze. When selected, a green check mark appears to the left of the channel number. – To select all channels, select **Select All**. – To clear all channels, select **Clear All**. At least one channel must be selected.
Idle Code	Enter the idle code in an 8 bit format.
Tx Bit Rate	Select **N x 56** or **N x 64**.

The FT1 payload settings are specified. You can observe test results for each channel in the Payload result group, under the Channel and Traffic categories. For details, see “Channel test results” on page 185 and “Traffic test results” on page 185.

HDLC/ PPP over T1

The HDLC monitor feature enables a technician to monitor HDLC encapsulated traffic over T1 and T3 circuits. Applications for both DS1 and DS3 interfaces are available. The DS3 monitor application is not supported on fractional-T3.

The DS1 Ping application runs Ping over IP over PPP over HDLC over T1circuits. It is a transmit and receive IPv4 application with all the capabilities of an Ethernet Ping application with the exception of pinging host name.

The DS1 HDLC and PPP Ping data can be captured via Wireshark.

HDLC applications

Table 9 lists each of the T-Carrier HDLC applications.

Table 8 T1 HDLC applications

Interface	Payload/Rate	Test Modes
DS1	HDLC	Dual Monitor
DS3	HDLC/	Dual Monitor

To monitor HDLC

1. Using the Test Menu, select the terminate test application for the payload and rate you are testing (refer toTable 9 on page 13).
2. Select the **Setup** soft key. A series of setup tabs appears.
3. On the Interface tab, select the Rx Input type for both inputs and the line code associated with each.
4. On the Framing tab, select the desired framing -

   For DS1:

   ESF

   D4(SF)

   SLC-96

   For DS3:

   M13

   C-Bit
5. On the Payload tab, select the type of payload desired-**Bulk** or **Fractional Rate**.
6. On the HDLC tab, select the Mode and the CRC type.
7. On the Capture tab, specify the buffer size, Frame slicing and the action to be taken when the buffer is filled.
8. On the Timed Test tab, specify a specific test length or delayed start time for this test.
9. To return to the Main screen.select the **Results** soft key.
10. Connect a cable from the DS1 (or DS3) jack to the circuit under test.

The HDLC is being monitored.

PPP applications

Table 9 lists each of the PPP applications.

Table 9 T1 PPP applications

Interface	Payload/Rate	Test Modes
DS1	PPP Ping	Terminate

To configure Ping

1. Using the Test Menu, select the terminate test application for the payload and rate you are testing (refer toTable 9 on page 13).
2. Select the **Setup** soft key. A series of setup tabs appears.
3. On the Interface tab, select the Rx Input type, Line code type, Clock Source, Clock Offset (-100ppm to 100ppm) and LBO (select from list).
4. On the Framing tab, select the desired framing - **ESF**, **D4(SF)** or **SLC-96**
5. On the Payload tab, select the payload type desired- **Bulk** or **Fractional Rate**
6. On the HDLC tab, select the Mode and the CRC type.
7. On the PPP tab, specify the PPP and IP modes and optional authentication credentials, if desired.
8. On the IP tab, specify the following-

   IP addresses - Source and Destination

   DNS Source

   Ping parameters -

   Type - **Single, Multiple**, **Continuous**, or **Fast**

   Packet Size

   TOS Type and Value

   TTL (hops)
9. On the Capture tab specify the **Buffer Size**, **Frame slicing** and the **Action to be taken when the buffer is filled**.
10. On the Timed Test tab, specify a **Test length** or **Delayed start time** for this test.
11. To return to the Main screen.select the **Results** soft key.
12. Connect a cable from the DS1 jack to the circuit under test.

Ping is configured.

HDLC/PPP Actions and Messages

Ping activities such as establishing a PPP session or initiating a ping must be started from the actions bar at the bottom of the main screen.

Initiating a PPP session

1. Configure the instrument for Ping (see “To configure Ping” on page 13)
2. Select the **Action** soft key at the bottom of the main screen.

3 Select the **PPP Log On** button to establish the PPP Session. A message indicating a PPP Session has been started will appear at the top of the screen.

The PPP session has been established.

Closing a PPP session

1 Select the **Action** soft key at the bottom of the main screen.

2 Select the **PPP Log Off** button.

The PPP session has been closed.

Pinging a remote device

1 Select the **Action** soft key at the bottom of the main screen.

2 Select the **PING** button.

The unit will Ping the remote device using the configured parameters

Capturing data

1 Select the Action soft key at the bottom of the main screen.

2 Select the **Capture** button.

3 To stop capturing data, press the **Capture** button again.

The HDLC/ PPP/IP data has been captured.

Loop back testing

You can qualify DS1 and DS3 circuit performance by transmitting traffic from a near-end unit, and then looping the traffic through a far end unit to test for errors or anomalies.

To loop up a far end instrument

1 Using the Test Menu, select the terminate test application for the payload and rate you are testing (refer to Table 6 on page 10).

2 Select **Loop Up**.

A message appears briefly in the message bar indicating that the loop up of the network element on the far end was successful.

3 Select **Restart**.

The module on the far end is looped up, and traffic is passed from the receiver through to the transmitter back to the near-end module.

To loop down the far end module

– Select **Loop Down**.

A message appears briefly in the message bar indicating that the loop down of the instrument on the far end was successful.

Looping up MUX devices

When testing DS1 or DS3 circuits, you can use your unit to loop up MUX devices by transmitting loop codes. If you are testing a DS1 payload, you can also define and store up to ten custom loop codes (see “Defining custom loop codes” on page 15).

To transmit a loop code

1. Using the Test Menu, select the DS1 or DS3 terminate test application for the payload rate you are testing (refer to Table 6 on page 10 for a list of applications).
2. Select the **Setup** soft key. A series of setup tabs appears.
3. Select the Loop tab, and then specify the following:

Payload Rate	DS1 Loop Type/ DS3 Tx FEAC Loop Select	Settings
DS1 BERT	HDSL	– HDSL Model. Select the model for the HDSL device or Generic HLU, HDU or HRU if model not known. – Test Direction. Specify **CO to Customer** or **Customer to CO**. – Code Type. Specify a **Short** (required for Generic) or **Long** loop code.
	NIU	– NIU Code. Select the NIU code for the device. – Auto Response. Specify **Respond On** or **Respond Off**.
	CSU	– CSU Code. Select the CSU code for the device. – Auto Response. Specify **Respond On** or **Respond Off**.
	Repeater	– Select model number of repeater from drop-down list – Enter the Address or Exchange and Location Code
	MSS	– Enter the Card Number of the MSS device
	User Defined	See “Defining custom loop codes” on page 15.
DS3 BERT	NIU Loop	N/A
	DS3 Loop	N/A
	DS1 Codes	HDSL,NIU,CSIU - See above

4. To return to the Main screen, select the **Results** soft key.
5. Select **Loop Up**.

   A message appears briefly in the message bar indicating that the loop up of the device was successful.

The MUX device is looped up, and traffic is passed from its receiver through to its transmitter back to the near-end module.

Defining custom loop codes

You can define and store up to ten custom loop codes for looping up DS1 MUX devices.

To define a custom loop code

1. Using the Test Menu, select the DS1 terminate test application for the payload rate you are testing (refer to Table 6 on page 10 for a list of applications).
2. Select the **Setup** soft key. A series of setup tabs appears.

3 Select the Loop tab, and then do the following:

a In Loop Type, specify **User Defined**.

A list of loop codes appears, allowing you to select a previously defined loop code, or to define a new one. See Figure 3.

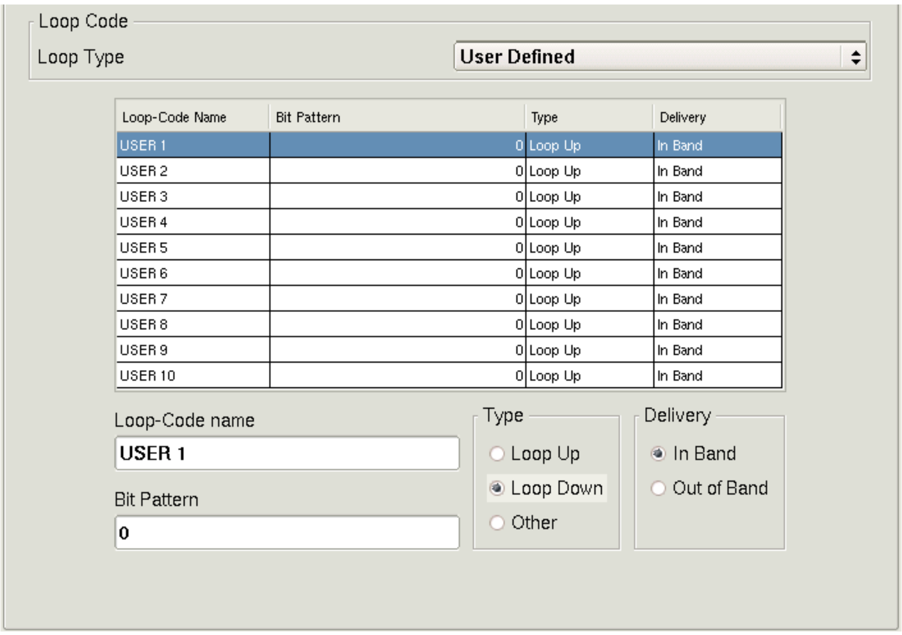


Figure 3 User Defined Loop Codes

b On the list, select the loop code you want to define.

c In Loop-Code name, use the keypad to type a unique name for the loop code using up to twenty five characters.

d In Bit Pattern, use the keypad to type the bit pattern using up to 16 digits.

e Under Type, indicate whether you want to use the loop code to Loop Up or Loop Down a MUX device, or select **Other**, and then manually specify the loop code pattern.

f Under Delivery, indicate whether you want to send the loop code **In Band**, or **Out of Band**.

4 To return to the Main screen, select the **Results** soft key.

The loop code is defined.

BER testing

The following procedure illustrates a typical scenario for:

– Setting up the MSAM to terminate a T-Carrier or PDH signal for BER testing.
– Inserting errors, anomalies, alarms, and defects.

NOTE: Changing BERT patterns

If you change a BERT pattern during the course of your test, be certain to press the **Restart** soft key to ensure that you regain pattern sync.

To perform a T-Carrier or PDH BER test

1 Using the Test Menu, select the terminate test application for the signal and payload rate you are testing (refer to Table 6 on page 10 and Table 7 on page 10 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Select the Interface tab, and then specify the applicable settings for the interface rate and payload you selected: specify the input sensitivity, line coding method, clock source and offset, and the line build out (LBO).

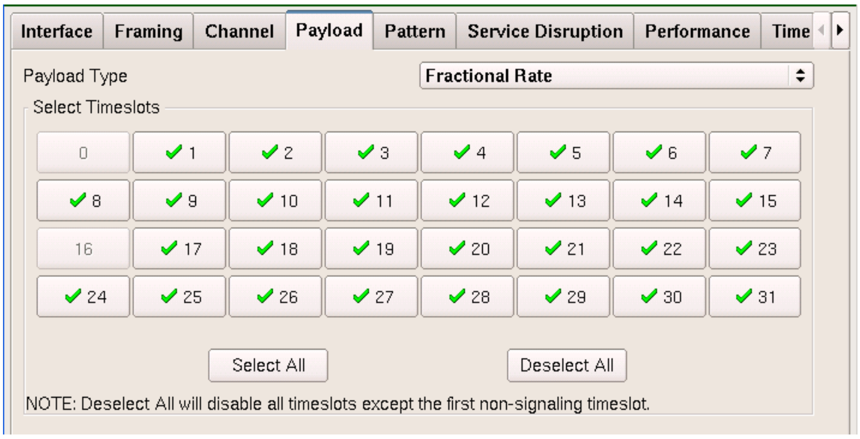
4 If the Channel tab is available (muxed PDH rates), specify:

- The channel or channels to analyze on the receiver.
- The Tx=Rx setting. If you want to transmit traffic on the same channel you specified for the receiver, select YES. If you want to transmit traffic on a different channel, or all channels, select NO.
- If you selected NO for the Tx=Rx setting, specify the channel you want to transmit traffic on, or set the Tx ALL setting to YES to transmit traffic over all available channels.

If you are running a PDH application, and want to specify timeslots for your test, proceed to step 5, otherwise, proceed to step 7.

5 Select the Payload tab, select the arrow to the right of the Payload Type field, and then specify one of the following:

- **Bulk**. Proceed to step 7.
- **Fractional Rate**. The Select Timeslot box appears. Proceed to step 6.



6 To change the timeslots you want to test, do one of the following:

To...	Do...
Select individual timeslots	Select the timeslot(s). The check mark appears.
Clear individual timeslots	Select the timeslot(s). The check mark is removed.
Select all the timeslots	Select the **Select All** button.
Clear all the timeslots	Select the **Deselect All** button.

7 Specify the framing and BERT pattern by doing one of the following:

a Manually specify the framing and pattern

– Select the Framing tab, and then specify the framing settings for the received and transmitted signals and, if applicable, the muxed payloads dropped from the signals:

Rates **Muxed Payloads**	**Framing types**
DS1	– Unframed – ESF – SF – SLC-96
DS3	– Unframed – M13 – C-Bit[a]
E1	– PCM31C – PCM31 – PCM30C – PCM30 – Unframed
E3	– Framed – Unframed
E4	– Framed – Unframed

a. For C-Bit framing, a Tx Far End Alarm type can be chosen from the drop-down list. Select **Idle** for no far end alarm. Units receiving frame errors will transmit FEBE for each frame error in all cases.

NOTE:

You can also specify frame settings using the Framing quick configuration button provided on the Main screen.

– Select the Pattern tab, and then select the **Pattern Mode** and specify a BERT **Pattern** (for example, 2^23-1).

NOTE:

Patterns **2^20-1 ITU** or **2^20-1 Inv ITU** require that the far end unit be an MSAM containing v13.0 or higher software in order to achieve pattern sync.

If the far end unit is an HST-3000 or MSAM containing software below v13.0, patterns **2^20-1 ANSI** or **2^20-1 Inv ANSI** should be selected as an acceptable substitute.

b Automatically detect the framing and the received BER pattern

– On the Main screen, press the **Auto** button:

A window appears indicating that the module detected the input signal and then detected the received pattern.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 Using a hard loop or loop code, loop back the far-end of the network.

11 Verify the following LEDs:

- If your module is in TestPad mode, verify that the following LEDs are green:

T-Carrier	PDH
Signal Present	Signal Present
Frame Sync	MFAS Sync
Pattern Sync	Pattern Sync

- If your module is in ANT mode, verify that the following LEDs *are not red*:

T-Carrier and PDH
LOS
LOF
LSS

12 Verify that `All Summary Results OK` appears in the results window.

13 *Optional*. Insert five Bit / TSE errors (see "Verifying performance" on page 19), and then verify that the five errors were received in the BERT result category.

14 Run the test for an appropriate length of time.

The BER test is finished.

Verifying performance

You can use the MSAM to verifying that performance on a circuit conforms to industry test recommendations.

To verify performance

1 Using the Test Menu, select the terminate test application for the signal and payload you are testing (refer to Table 6 on page 10 and Table 7 on page 10 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Select the Performance tab, and then do the following:

a In **Path Allocation**, enter the percentage of the circuit (path) you are testing. For example, if the segment of the circuit you are testing constitutes 50% of the entire circuit, enter `50.000000`.

b If you want to set a threshold (limit) after which the module will indicate that the Verdict result is `Rejected`, do the following:

- In **Enable UAS Limit**, select **Yes**.
- In **UAS Limit**, specify the number of unavailable seconds after which the module will display `Rejected` for the UAS result *for the entire duration of the test*. For example, if you want the unit to display `Rejected` after 10 unavailable seconds, specify `10`.

   c On the left side of the tab, select another test recommendation (G.821, G.826, or M.2100) and then repeat step a and step b for each specification.

4 Display and observe Summary results in one window, and the test results for the associated performance recommendation in a second window (see “Step 5: Viewing test results” on page 4).

   For example, if you configured the test for the G.826 recommendation, set a result window to display G.826 results for the applicable receiver.

   – If key results do not conform to the associated recommendations, they appear in the performance category with a `Rejected` value.
   – If all results in a performance category conform to the associated recommendations, the Verdict result indicates: `Accepted`.

For additional information on performance results, see “ITU-T recommended performance test results” on page 203.

Measuring round trip delay

You can use the instrument to measure round trip delay by transmitting a delay pattern, and then looping the pattern back to the module. The module calculates the amount of time it took the pattern to traverse the loop, and then reports the duration (delay) in milliseconds (ms).

To measure round trip delay

1 Using the Test Menu, select the test application for the signal and payload you are testing (refer to Table 6 on page 10 and Table 7 on page 10 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Specify the Interface and Framing settings if the defaults are not acceptable (for details on the settings, refer to the associated steps in “BER testing” on page 16).

4 Select the **Pattern** tab, and then select the **Delay** pattern.

5 To return to the Main screen, select the **Results** soft key.

6 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

7 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

8 Loop back the far-end of the network.

9 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

T-Carrier	PDH
Signal Present	Signal Present
Frame Sync	MFAS Sync
Pattern Sync	Pattern Sync

– If your module is in ANT mode, verify that the following LEDs *are not red*:

T-Carrier and PDH
LOS
LOF
LSS

10 To observe the delay result, set one of the result windows to display the Signal category.

Round trip delay is measured.

Measuring service disruption time

You can use the instrument to measure the service disruption time resulting from a switch in service to a protect line. Before measuring the disruption time, you can:

– Indicate which events to measure (such as a Signal Loss or LOF).

– Establish an acceptable length of time for the measurements by specifying a Threshold Time. Measured times for an event that are less than or equal to the Threshold Time pass the test, measured times that exceed the Threshold Time fail the test.

– Specify a Separation Time to indicate that the unit should count *separate events* that occur within a very brief period of time as a *single event*. For example, if you specify a Separation time of 300.000 ms and select AIS-L as an event trigger, if more than one AIS-L occurs during a 300.000 ms period, the unit will interpret the events as a *single AIS-L disruption*. The count will not increase when another AIS-L occurs until at least 300.000 ms has transpired since the previous AIS-L.

To measure service disruption time

1 Using the Test Menu, select the test application for the signal and payload you are testing (refer to Table 6 on page 10 and Table 7 on page 10 for a list of applications).

2 Select the **Setup** soft key, and then select the Service Disruption tab.

3 Under Event Settings, do the following:

a Select **Enable Service Disruption**.

b *Optional*. To edit the displayed Separation Time, select the field, and then type the new time in milliseconds (ms), or select **Default** to restore the time to its default value (300.000 ms). This is the duration during which each trigger of a specific type will be counted as a single disruption event.

c *Optional*. To edit the displayed Threshold Time, press the keypad icon, and then type the new time in milliseconds (ms), or select **Default** to restore the time to its default value (50.000 ms). Disruption measurements that exceed this duration will be interpreted as failed.

4 Under Event Triggers, do one of the following:
   - To measure disruption time for each of the triggers listed, select **Set ALL**.
   - To measure disruption time for a specific trigger or group of triggers, select **Clear ALL**, and then select each of the triggers for the measurements.

5 If additional settings need to be modified to reflect the network configuration, select the appropriate tab, and then modify the settings as required.

6 To return to the Main screen, select the **Results** soft key.

7 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

8 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

9 To force the switch to a protect line, use one of the following methods:
   - Interrupt the signal. Physically interrupt the signal by pulling the signal within the SONET/SDH ring.
   - Insert errors. Use another unit through mode to insert errors until the network switches to the backup lines.
   - Use the network element's software to force a protection switch.

   The network switches to a protect line, the instrument detects that service has been disrupted, and then begins to measure the disruption time in milliseconds until the condition returns to normal.

10 To observe the service disruption results, set one of the result windows to display the Service Disruption Log, and set another window to display the Service Disruption Log Stats.

Service disruption is measured for each of the triggers you selected. For details on the associated test results, see "Service Disruption Results" on page 201.

Monitoring the circuit

You can use the instrument to monitor T-Carrier and PDH signals and muxed payloads within the signals.

1 Using the Test Menu, select a monitor test application for the signal and payload you are testing (refer to Table 6 on page 10 and Table 7 on page 10 for a list of applications).

2 If the current test configuration needs to be modified to reflect the network configuration, select the **Setup** soft key, and then modify the settings as required.

3 To return to the Main screen, select the **Results** soft key.

4 Connect a cable from the appropriate RX 1 connector to the network's TRANSMIT access connector.

   If you are monitoring two signals, connect a second cable from the appropriate Rx 2 connector to the second network TRANSMIT access connector.

5 Observe the test results (see "Step 5: Viewing test results" on page 4).

You are monitoring the circuit.

Analyzing PCM signals

If your instrument is configured and optioned to do so, you can use it to do the following:

Monitor a call—The instrument can analyze both directions of a user-specified DS0 channel on a T1 line for call activity. Call activity includes supervisory events and DTMF, MF, and DP digit recognition. Each activity event is displayed in the test results.

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

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

Analyze digits or events—The instrument can display the characteristics of each received DTMF, MF, DP digit, and signaling event. Analysis results include digit/event delay and duration, digit address type (DTMF, MF, or DP). You must use a headset for audio analysis.

Analyze voice frequencies (VF)—After placing or receiving a standard PCM call, you can perform VF analysis while maintaining the call. In addition to signaling results, VF results, such as DC offset, frequency, and level measurements are available. For details, see "Analyzing VF circuits" on page 30.

Test modes

You can perform signaling analysis in the following modes:

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

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

Trunk type signaling

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

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

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

Standard E & M signaling

Standard E&M signaling is used on trunks between switches in the public switched telephone network (PSTN). Table 10 describes Standard E&M signaling. An X indicates a "don't care" condition.

Table 10 Standard E&M signaling

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

Loop start signaling

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

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

Table 11 describes each type of loop start trunk signaling. An X indicates a "don't care" condition.

Table 11 Loop start trunk signaling

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

Table 11 Loop start trunk signaling (Continued)

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

Ground start signaling

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

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

Table 12 describes each type of ground start trunk signaling. An X indicates a “don’t care” condition.

Table 12 Ground start signaling

Direction	Trunk Status	Signaling Bits
FXS Signaling		

Table 12 Ground start signaling (Continued)

Direction	Trunk Status	Signaling Bits
Transmit	On Hook	A=0 B=1 (C=0 D=1)
	Ground	A=0 B=0 (C=0 D=0) Ground on Ring
	Off Hook	A=1 B=1 (C=1 D=1) Loop closed after the far end, FXO sends A=0 (Ground on Tip)
Receive	On Hook	A=1 B=X (C=1 D=X) No Tip Ground
	Off Hook	A=0 B=1 (C=0 D=1) Tip Ground
	Ringing	A=X B=0 (C=X D=0)
FXO Signaling		
Transmit	On Hook	A=1 B=1 (C=1 D=1) No Ground on Tip
	Off Hook	A=0 B=1 (C=0 D=1) Tip Ground
	Ringing	A=0 B=0 (C=0 D=0)
Receive	On Hook	A=0 B=1 (C=0 D=1) Loop Idle
	Ground	A=0 B=0 (C=0 D=0) Ground on Ring
	Off Hook	A=1 B=1 (C=1 D=1) Loop closed
SLC Station Signaling - ESF Framing		
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Ground	A=0 =1 (C=0 D=1)
	Off Hook	A=1 B=0 (C=1 D=0)
Receive	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=0 B=1 (C=0 D=0)
	Ringing	A=1 B=1 (C=1 D=0)
SLC Station Signaling D4/SF/SLC-96 Framing		
Transmit	On Hook	A=0 B=0
	Ground	A=0 B=1
	Off Hook	A=1 B=0
Receive	On Hook	A=0 B=0
	Off Hook	A=0 B=0/1
	Ringing	A=1 B=0/1
SLC Office Signaling - ESF Framing		
Transmit	On Hook	A=0 B=0 (C=0 D=0)
	Off Hook	A=0 B=1 (C=0 D=0)
	Ringing	A=1 B=1 (C=1 D=0)
Receive	On Hook	A=0 B=0 (C=0 D=0)
	Ground	A=0 =1 (C=0 D=1)
	Off Hook	A=1 B=0 (C=1 D=0)

Table 12 Ground start signaling (Continued)

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

Connecting a headset

Before monitoring or placing calls, you should connect a USB headset to listen to the calls. To verify that your headset has been tested and recommended by JDSU for use with your instrument, contact your local JDSU representative.

Specifying call settings

Before monitoring or placing calls, you must specify settings such as the trunk type, equipment type (if applicable), and call mode.

To specify call settings

1 Using the Test Menu, select the DS1 Signaling application (refer to Table 6 on page 10 for a list of applications and test modes).

2 If the current test configuration needs to be modified to reflect the network configuration, select the **Setup** soft key, and then modify the settings as required.

3 Select the **Call** tab, then specify the following settings:

Setting	Value
Trunk Type	Select one of the following trunk types: – **Standard E&M** – **Loop Start** – **Ground Start** For information about trunk types, see "Trunk type signaling" on page 23.
Equipment (Loop Start or Ground Start only)	For loop start and ground start trunk types, if you are monitoring calls, select the type of equipment that will be connected to the primary receiver; otherwise, select the type of equipment the instrument is emulating: – **FXO** – **FXS** – **SLC Office** – **SLC Station** For additional information, see "Loop start signaling" on page 24 or "Ground start signaling" on page 25.

Setting	Value
Address (Terminate Mode only)	Select one of the following address types: – **DTMF** – **MF** – **DP**
Response Mode	Select **Auto** or **Manual**. If you select Auto, when testing in terminate mode the instrument will automatically respond to supervisory events as applicable for the selected trunk type.
Call Mode	Select **Originate** or **Terminate**.

The call settings are specified.

Monitoring a call

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

To monitor a call

1. Using the Test Menu, select the DS1 Signaling application in Dual Monitor mode (refer to Table 6 on page 10 for a list of applications and test modes).
2. If the current test configuration needs to be modified to reflect the network configuration, select the **Setup** soft key, and then modify the settings as required.
3. Specify the calls settings (see "Specifying call settings" on page 27).
4. If you want to scan specific channels for originating and terminating signaling events and digits, select the **Call Scan** tab, then specify the following settings:

Setting	Value
Call Scanning	Select **Enable**.
Select Scan Channels (Call Scanning must be Enabled)	Select the displayed channels (timeslots) that you want to analyze. When selected, a green check mark appears to the left of the channel number. – To select all channels, select **Select All**. – To clear all channels, select **Clear All**. At least one channel must be selected.
Lock Time (sec)	Select the field to display a keypad, then enter the lock time in seconds.
Release Time (msec)	Select the field to display a keypad, then enter the release time in sec-onds.

   The instrument will collect call activity results and display them in the Payload result group, under the Call category for the selected receiver. When the instrument is scanning for active channels, the speaker is muted.

5. Select the **Results** soft key to return to the Main screen.
6. Select the **Restart** soft key, then observe the call results (see "Observing call results" on page 29).

You are monitoring a call, and results associated with the call appear.

Placing or receiving calls

In Terminate mode, you can use the instrument to emulate a PBX, switch, or telephone to place or receive calls, and perform voice frequency (VF) testing on DS0 channels. You can place calls in either direction on a switched network.

To place or receive a call

1. Using the Test Menu, select the DS1 Signaling application in Terminate mode (refer to Table 6 on page 10 for a list of applications and test modes).
2. If the current test configuration needs to be modified to reflect the network configuration, select the **Setup** soft key, and then modify the settings as required.
3. Specify the calls settings (see “Specifying call settings” on page 27), then select the **Results** soft key to return to the Main screen.
4. Connect the instrument to the line.
5. Select the **Restart** soft key, then observe the call results (see “Observing call results” on page 29).
6. Select the **Signaling** Action tab, and then use the action keys to perform the various signal events for the trunk type you selected. Available actions will vary depending on whether you are placing or receiving a call.

Keys	Action
Signaling Events, such as: – On Hook – Off Hook – Push To Talk – VF Testing – Ring – Idle Additional keys may appear as appropriate for your call.	Performs the associated signaling event. Actions vary depending on the selected trunk type and whether you are placing or receiving a call.
VF Testing	Starts VF testing. For details, see “Analyzing VF circuits” on page 30.
DTMF Dial DP Dial MF Dial	Displays a keypad so you can dial a call manually.

You placed or received a call.

Observing call results

When monitoring, placing, or receiving calls, you can observe more results if you use a single result pane.

To observe call results

1. Select **View > Result Windows > Single**.
2. In the result window, select the receiver you want to observe calls for.
3. Set the result group to **Payload**, and the category to **Call**.

Analyzing VF circuits

If your instrument is configured and optioned to do so, you can use it to do the following:

- Measure Standard Tone—Analyze a DS0 channel for standard VF characteristics such as tone frequency, tone level, and DC offset.
- Measure Noise—Test a DS0 channel for spectral noise analysis by filtering the received signal using C-message, D-message, 3.4 kHz, and 1,010 Hz notch filters.
- Transmit Standard Tones—Insert a single voice frequency tone over a specified DS0 channel. Tone characteristics include pre-defined and user-defined frequencies and levels.
- Transmit Loop back Tones—Insert 2713 Hz loop up and loop down tones at -10.0 dBm on the test channel.
- Insert Three-tone Steps—Insert the repeated transmission of three tones (404, 1004, and 2804 Hz) over a specified DS0 channel at a user-specified level and duration.
- Frequency Sweep—Transmit a user-defined range of tones (from 500 Hz to 3500 Hz) over a specified DS0 channel. You can configure a block out range (notch); the frequency separation between tones; the level, tone duration, and sweep direction.
- Measure Impulse Noise—Measure impulse noise on a specified DS0 channel according to a user-defined threshold. You can also apply C- or D-message and notched filters.
- Configure Signaling Bits—You can configure and transmit AB(CD) signaling bits with either 2-bit or 4-bit binary values, depending on the specified framing format.
- Verify Path Continuity and Audible Faults—The audible output from the instrument's speaker allows you to verify path continuity and identify audible faults, such as low levels, noise, and echo.

VF tests

Using the instrument, you can perform the following types of tests: Quiet Tone, Holding Tone, Three Tone, Single Tone, Frequency Sweep, and Impulse Noise. You can also specify values for AB(CD) signaling bits. The following sections provide an overview of each test type. For instructions on performing tests, see "Running VF analysis tests" on page 31.

Quiet tone test

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

Holding tone test

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

Three tone test

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

Single tone test

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

Frequency sweep test

This test lets you transmit a specified range of tones on the test channel. You can configure the upper and lower bounds of the range to be anywhere from 20 Hz to 3904 Hz. You can also set a blocked (notched) frequency range as well as the step size, the amount of frequency separation between tones.

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

Impulse noise test

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

User-defined signaling bits

Depending on the specified line framing format, you can assign 2- or 4-bit values to the AB(CD) signaling bits. If the framing format is set to D4/SF or SLC-96, you can configure a 2-bit value. If the framing format is set to ESF, you can configure a 4-bit value. This feature is only available in Terminate mode. Also, you cannot define signaling bits if you are accessing the VF settings from the PCM Signaling application (see "Analyzing PCM signals" on page 23).

Running VF analysis tests

The following procedure describes how to run VF analysis tests when the instrument is connected to a T1 line.

To run VF analysis tests

1. Using the Test Menu, select the DS1 VF application (refer to Table 6 on page 10 for a list of applications and test modes).
2. If the current test configuration needs to be modified to reflect the network configuration, select the **Setup** soft key, and then modify the settings as required.
3. Specify the calls settings (see "Specifying call settings" on page 27), then select the **Results** soft key to return to the Main screen.
4. If you want to scan specific channels for originating and terminating signaling events and digits, select the **Call Scan** tab, then specify the settings. For details, see step 4 on page 31 of "Monitoring a call".

5 Select the **VF** tab.

– If you are running the Impulse Noise test, proceed directly to step 7 on page 33.
– If you are running the Quiet Tone or Holding Tone test, proceed directly to step 8 on page 33.
– For all other tests, specify the following settings:

Setting	Value	Single Tone	Three Tone	Frequency Sweep
Test Type	Select one of the following test types: – **Single Tone** – **Holding Tone** – **Frequency Sweep** – **Impulse Noise**	X	X	X
Frequency	Select one of the following frequencies: – **404 Hz** – **1004 Hz** – **1804 Hz** – **2713 Hz** – **2804 Hz** – **User Frequency**	X		
User Frequency (Hz)[a]	If you indicated that you want to specify the frequency by selecting User Frequency, specify the frequency in Hz.	X		
Level	Select the decibel level for the tones: – **0 dBm** – **3 dBm** – **-10 dBm** – **-13 dBm** – **-16 dBm** – **User Level**	X	X	X
User Level (dBm)[b]	Specify the level the at which the tones will be transmitted. You can enter a value from -40.0 dBm to 3.0 dBm.	X	X	X
404Hz Duration 1004Hz Duration 2804Hz Duration	Enter the number of seconds for the duration for each tone. The minimum is **2** seconds the maximum is **60** seconds. The default duration is 5 seconds.		X	

a. Frequency must be User Frequency
b. Level must be User Level

6 If you are running the Frequency Sweep test, specify the following settings; otherwise, proceed directly to step 8 on page 33.

Setting	**Value**
Tone Duration (sec)	Enter a value, from 2 to 10 seconds, to indicate how long each tone will be transmitted.
Step Size (Hz)	Enter a value, from 10 to 1000 Hz, to indicate the amount of separation between tones.
Sweep Direction	Select one of the following: – **Up**, to begin the sweep from the start frequency. – **Down**, to begin the sweep from the stop frequency.
Sweep Frequency Range (Hz)	These settings specify the frequencies at which the sweep starts and stops, based on the direction specified. For Start and Stop, specify a range from 10 to 3904 Hz.
Skip Frequency Range (Hz)	These settings indicate a range of frequencies that will not be transmitted as part of the sweep. For Low and High, specify a range from 10 to 3904 Hz. The default skip range is 2450 Hz to 2750 Hz.

7 If you are running the Impulse noise test, specify the following settings; otherwise, proceed directly to step 8 on page 33:

Setting	**Value**
Test Type	Select **Impulse Noise**.
Impulse Noise	Enter a value, from 60 to 93 dBm, to indicate when the instrument will detect impulse noise.
Filter Type	Apply one of the following filters: – **No Filter** – **C Message** – **C Notched** – **D Message** – **D Notched**
Select Scan Channels (Call Scanning must be Enabled)	Select the displayed channels (timeslots) that you want to analyze. When selected, a green check mark appears to the left of the channel number. – To select all channels, select **Select All**. – To clear all channels, select **Clear All**. At least one channel must be selected.
Lock Time (sec)	Select the field to display a keypad, then enter the lock time in seconds.
Release Time (msec)	Select the field to display a keypad, then enter the release time in seconds.

8 Connect the instrument to the line.

9 Press the **Results** soft key.

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

You can hear received tones through the instruments speaker or your headset.

11 Select the **Signaling** Action tab, and then select the **VF Testing** key.

12 Use the action keys to perform the various signal events for the trunk type you selected. Available actions will vary depending on whether you are placing or receiving a call. For details, see step 6 on page 29 of "Placing or receiving calls".

You are running a VF test, and can observe results in the VF category (see "Observing VF results".

Observing VF results

When monitoring, placing, or receiving calls, you can observe more results if you use a single result pane.

To observe call results

1. Select **View > Result Windows > Single**.
2. In the result window, select the receiver you want to observe calls for.
3. Set the result group to **Payload**, and the category to **VF**.

ISDN PRI testing

If your instrument is configured and optioned to do so, you can use it to install and maintain ISDN PRI services over T1 interfaces. Using the instrument, 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.

> **NOTE:**
> MSAMv1 when used in T-BERD/MTS 6000AV2 base unit does not provide a voice path to a headset for monitoring.

Before testing, review each of the following sections:

– "Features and capabilities" on page 35
– "Specifying General settings" on page 35
– "Specifying Call settings" on page 37
– "Specifying Decode filter settings" on page 38
– "Placing calls" on page 39
– "Receiving calls" on page 40
– "Inserting voice traffic into a call" on page 41
– "Performing BER analysis of a call" on page 41
– "Transmitting DTMF tones" on page 42
– "Disconnecting a call" on page 42
– "Observing ISDN PRI results" on page 42

Features and capabilities

Using your instrument, you can also do the following:

- Place and receive calls using the standard transmit-receive DS1 interfaces. After a call is established, you can insert voice traffic into the associated B Channel, or perform BERT analysis on the B Channel.
- Emulate a network termination device such as a PBX or terminal equipment device (for example, an ISDN phone) using Terminal equipment (TE) mode.
- Emulate a switch or network termination device using Network termination (NT) mode.
- Process calls for switches using the following call control protocols:
  - AT&T 5ESS
  - Nortel DMS 100
  - National ISDN-2 (NI-2)
- Passively monitor and analyze ISDN PRI service while the network is in-service.
- Isolate and locate problems by viewing D channel decode text for all captured transmitted and received frames when you monitor or terminate ISDN PRI service. After viewing the decode text, you can save the text to a file on the instrument.
- Perform BERT analysis of a B channel.

Specifying General settings

Before monitoring or placing ISDN PRI calls, you must specify settings such as the emulation mode (TE or NT), call control, numbering plan, and the D Channel number and rate.

To specify general settings

1. Using the Test Menu, select the DS1 ISDN PRI application (refer to Table 6 on page 10 for a list of applications and test modes).
2. Select the **Setup** soft key, then select the **ISDN** tab. Select the **General** subtab, then specify the following settings:

Setting	Value
Emulation	Select an emulation mode: – **TE Emulation**. If you select this setting, the instrument places a call to the network as if the call was originated from a PBX or a TE device. – **NT Emulation**. If you select this setting, the instrument places a call to a TE as if the call was originated by another TE on the network.
Call Control	**Select one of the following:** – **N1-2 (National)**. For National ISDN-2 (NI-2) compliant switches. – **5ESS.** For AT&T 5ESS. – **DMS 100.** For Nortel DMS 100. **NOTE:** The majority of ISDN providers use the N1-2 call control protocol. 5ESS and DMS 100 are typically used by providers who have a custom or proprietary method for implementing ISDN.

Setting	Value
Numbering Type	Select one of the following: – **National** – **Auto** – **International** – **Local** – **Unknown** **NOTE:** The numbering type refers to the format and number of digits used when a caller dials a phone number. For example, National indicates a 10 digit number is used; Local indicates a 7 digit number is used.
Numbering Plan (5ESS and DMS 100 only)	Select one of the following: – **Unknown** – **ISDN** – **Private** **NOTE:** Calls using NATIONAL call control always use an ISDN numbering plan.
D Channel	Enter the time slot number for the D channel. The default is 24.
D Channel Rate	Set the D Channel Rate to one of the following: – **56K** – **64K** **NOTE:** 64K is typically the rate for D channels.
HDLC Mode	Set the HDLC mode to one of the following: – **Normal** – **Inverted** **NOTE:** Normal is typically the correct mode.
Transit Network ID	Specify the transit network ID for the network that the call will be routed to.
Operator System Access	Specify one of the following for the operator system access: – **Principal**. If the default operator system for the network is used, select Principal. – **Alternate.** If an alternate operator system has been established by subscription, select Alternate. – **None.** If no operator system is used, select None.

The general settings for the call are specified.

Specifying Call settings

Before monitoring or placing ISDN PRI calls, you must specify settings for the calls such as the call type, bearer rate (for data calls), and the number to call.

1. Using the Test Menu, select the DS1 ISDN PRI application (refer to Table 6 on page 10 for a list of applications and test modes).
2. Select the **Setup** soft key, then select the **ISDN** tab. Select the **Call** subtab, then specify the following settings:

Setting	Value
Call Type	Select a call type: – **Voice** – **3.1k Audio** – **Data**
Bearer Rate (Data calls only)	If you are placing a data call, select one of the following rates: – **64K** – **56K** – **Nx64K** – **H0**
B Channel	Select a channel (1 - 24), or select **Any** to place the call on any available channel. **NOTE:** The Channel parameter is not applicable for Nx64K or H0 data calls. Use the Channel Map option to specify the FT1 channels for Nx64K calls, and the H0 setting to select a range of channels for H0 calls.
Channel Map	If you selected Nx56K for a data call, select the FT1 channels. When selected, a green check mark appears to the left of the channel number.
H0 Channel	If you selected H0 as your bearer rate, specify one of the following H0 Channel ranges: – **1 - 6** – **7 - 12** – **13 - 18** – **19 - 24**
Directory Number	Enter the number the instrument is using to identify the line for the outgoing call using up to 30 digits. Think of this as the caller ID of the call placed from the instrument.
Number to Call	Select number from list of previously dialed numbers or enter the number to call using up to 30 digits, *, and #.
Call Answer Mode	If you want to change the current call answer mode for the instrument, select one of the following modes: – **Prompt.** Prompt mode sets up the instrument to prompt you to accept, reject, or ignore each incoming call as it comes in. If you ignore a call, you can answer or reject the call later. – **Accept.** Accept mode sets up the instrument to automatically accept the first incoming call, and then reject any additional calls. You can always check the Summary Results screen to see if a call is active on the instrument. – **Reject.** Reject mode sets up the instruments to automatically reject all incoming calls.

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

The call settings are specified.

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

Specifying Decode filter settings

Before monitoring or placing ISDN PRI calls, you can optionally specify filter settings for the calls such as the call type, bearer rate (for data calls), and the number to call.

1 Using the Test Menu, select the DS1 ISDN PRI application (refer to Table 6 on page 10 for a list of applications and test modes).

2 Select the **Setup** soft key, then select the **ISDN** tab. Select the **Decode** subtab, then specify the following settings:

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

The decode filter settings are specified. The instrument will filter the D channel decode messages and then store them in the decode message buffer.

Placing calls

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

After service is initialized, the instrument establishes a data link and is ready to carry out ISDN call processing using the settings you specified.

> **NOTE:**
> You will not hear a dial tone when you place calls from the instrument. This is normal for devices placing ISDN calls.

To place an ISDN PRI call

1. Using the Test Menu, select the DS1 ISDN PRI application in Terminate mode (refer to Table 6 on page 10 for a list of applications and test modes).
2. Select the **Setup** soft key, then select the **Interface** tab. Specify the applicable settings for the DS1 interface rate:
   – Receiver Settings: Specify the input sensitivity and, if applicable, the line coding method for the receiver or receivers.
   – Transmitter Settings: Specify the clock source and offset, and the line build out (LBO) and line coding method for the transmitter.
3. Specify the following settings:
   – Framing settings: ESF or D4(SF)
   – Pattern settings (if you intend to BER test the call)
   – ISDN settings (see "Specifying General settings" on page 35, "Specifying Call settings" on page 37, and "Specifying Decode filter settings" on page 38).
4. Connect the instrument to the test access point.
5. Select the **Results** soft key to return to the Main screen, then verify the following:
   – The Signal Present and Frame Sync LEDs are illuminated.
   – In the ISDN Stats result category, verify that the LAPD State result says `Mult. Frm. Est`.
6. Select the Call Controls tab on the Action bar, then select the **Connect Call** button.
7. Answer the call on the receiving device.
8. Verify that the call status is `CONNECTED` by observing the Call Status result screen. If it is not connected, the cause value (indicating the reason the call was not connected) appears on the screen. See "Understanding the Q.931 Cause Values" on page 246 for descriptions of each code.

After the call is connected, additional action buttons appear on your instrument. For example, buttons appear that allow you to BERT, idle, and disconnect the call. You can also use a button to insert DTMF tones.

The call is placed.

To prepare to call to a different number using the same configuration, select Phone Number on the Quick Config Bar. Select a new number from list of previously dialed numbers or enter the desired number using the on-screen keypad.

In addition to the telephone number, other Quick Config items available are Framing, Pattern and B Channel options (1-24).

Receiving calls

If you set up the instrument to prompt you whenever a call comes in, Action buttons will appear prompting you to accept, reject, or ignore each incoming call. If you choose to ignore a call, you can accept or reject it later using the **Answer Call** or **Reject Call** button.

To receive an ISDN PRI call

1. Using the Test Menu, select the DS1 ISDN PRI application in Terminate or Dual Monitor mode (refer to Table 6 on page 10 for a list of applications and test modes).
2. Select the **Setup** soft key, then select the **Interface** tab. Specify the applicable settings for the DS1 interface rate:
   - Receiver Settings: Specify the input sensitivity and, if applicable, the line coding method for the receiver or receivers.
   - Transmitter Settings: Specify the clock source and offset, and the line build out (LBO) and line coding method for the transmitter.
3. Specify the following settings:
   - Framing settings: ESF or D4(SF)
   - Pattern settings (if you intend to BER test the call)
   - ISDN settings (see "Specifying General settings" on page 35, "Specifying Call settings" on page 37, and "Specifying Decode filter settings" on page 38).
4. Connect the instrument to the test access point.
5. Select the **Results** soft key to return to the Main screen, then verify the following:
   - The Signal Present and Frame Sync LEDs are illuminated.
   - In the ISDN Stats result category, verify that the LAPD State result says `Mult. Frm. Est`.
6. Place the call using the test instrument or device on the far end. A message appears on your instrument indicating that a call is coming in.
7. Select the Call Controls tab on the Action bar, then do one of the following:
   - To answer the call, select the **Answer Call**.
   - To ignore the call, select **Ignore Call**.
   - To reject the call, select **Reject Call**.
8. Verify that the call status is `CONNECTED` by observing the Call Status result screen. If it is not connected, the cause value (indicating the reason the call was not connected) appears on the screen. See "Understanding the Q.931 Cause Values" on page 246 for descriptions of each code.

The call is received and connected.

Inserting voice traffic into a call

When you place or receive a voice call using the instrument, you can use a USB or Bluetooth headset to insert voice traffic into the call's B Channel. Be certain to use a JDSU recommended headset with the instrument.

To insert voice traffic into a call

1. If you are using a headset, connect it to the instrument's USB port or via a Bluetooth connection (for more information see System-Bluetooth setting in the *MSAM, Transport Module, DMC, 40G Module, CSAM, and T-BERD 5800Getting Started Manual*.
2. Do one of the following:
   - If you are placing a call, specify the required settings for the call (see "Placing calls" on page 39).
   - If you are receiving a call, accept the call (see "Receiving calls" on page 40).
3. Verify that the call status is `CONNECTED` by observing the Call Status result screen. If it is not connected, the cause value (indicating the reason the call was not connected) appears on the screen. See "Understanding the Q.931 Cause Values" on page 246 for descriptions of each code.
4. If no other call is currently using the headset, the instrument automatically connects the call.
5. Speak into the headset.

Voice traffic is inserted into the call.

Performing BER analysis of a call

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

To BER test a B Channel

1. Select the **Setup** soft key, then select the **Pattern** tab.
2. Select a BERT pattern (for example, 2^23-1).

> **NOTE:**
>
> If a call is connected, both ends are configured for BER analysis (rather than audio), and your interface settings are specified, you can automatically detect the correct BERT pattern for the circuit by pressing the **Auto** button on the Main screen.

3. Do one of the following:
   - If you are placing a call, see "Placing calls" on page 39.
   - If you are receiving a call, accept the call (see "Receiving calls" on page 40).
4. On the Main screen, verify the following:
   - The Signal Present and Frame Sync LEDs are illuminated.
   - In the ISDN Stats result category, verify that the LAPD State result says `Mult. Frm. Est.`
5. Verify that the call status is `CONNECTED` by observing the Call Status result screen. If it is not connected, the cause value (indicating the reason the call was not connected) appears on the screen. See "Understanding the Q.931 Cause Values" on page 246 for descriptions of each code.

6 Select the Call Controls tab on the Action bar, then select **BERT Call** to start transmitting the pattern.

7 *Optional*. Insert five Bit / TSE errors (see "Verifying performance" on page 19), and then verify that the five errors were received in the BERT result category.

The error or errors are inserted into the B Channel.

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

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

   a Select **Audio Call**.

   b Speak into the headset.

10 To disconnect the call, select **Disconnect Call**.

BER testing is complete.

Transmitting DTMF tones

To insert DTMF tones into a connected call

1 On the Call Controls tab, select **DTMF**. A keypad appears.

2 Use the keypad to enter the tones.

3 Select **Exit** to return to the Main screen.

The tones are inserted, and can be heard on the receiving device.

Disconnecting a call

To disconnect a call, do the following

– On the Call Controls tab, select **Disconnect Call**.

Observing ISDN PRI results

You can observe test results for during IDSN testing in the ISDN and Call result groups. For details, see "Channel test results" on page 185 and "Traffic test results" on page 185.

3

SONET and SDH Testing

This chapter provides step-by-step instructions to perform SONET and SDH tests. Topics discussed in this chapter include the following:

About SONET and SDH testing

If your instrument is configured and optioned to do so, you can use it to analyze the performance of SONET and SDH networks by performing BER tests, manipulating and analyzing overhead bytes, adjusting pointers, and verifying that performance conforms to the industry performance standards.

When you configure the instrument for SONET or SDH testing, a number of the test parameters vary depending on the protocol (SONET or SDH), rate, and payload you select.

Features and capabilities

When testing SONET and SDH service, you can generate and analyze muxed and bulk payloads ranging from 51 Mbps to 100 Gbps for a variety of transport rates. The instruments also support the following:

– BER testing—You can transmit and detect BERT patterns for each rate available on the instrument.
– Error/anomaly and alarm/defect insertion—You can insert a variety of errors, anomalies, alarms, and defects into traffic, such as frame, code, and logic errors.
– Overhead byte manipulation and analysis—You can manipulate the value of selected overhead bytes, such as the K1, K2, S1,and Z1 bytes.
– Performance measurement—You can verify that performance complies with ITU-T G.826, G.828, G.829, M.2101, T1.231, and T1.514 recommendations, with the exception of the 40G/100G High Speed Transport Module.
– Round trip delay measurement—You can verify that a circuit complies with round trip delay requirements as specified in a customer's service level agreement.
– Tandem connection monitoring—You can monitor and compare performance of Path segments with the aid of the N bytes in the Path overhead.
– Intrusive through mode testing—You can monitor a received signal in through mode, and then pass the signal through the unit to the transmitter. The unit will resolve any received line code violations before transmitting the signal. You can also optionally insert errors or alarms into the transmitted signal (see "Inserting errors, anomalies, alarms, and defects" on page 68).
– Drop and insert testing—When testing in through mode, you can insert one channel while non-intrusively passing the remainder of the signal through unaffected. For example, you can monitor an OC-48 signal, and then drop a DS3 signal and insert a BER pattern into the DS3 signal, leaving the rest of the signal as it was received. For details, see "Drop and insert testing" on page 66. (N/A for CSAM and 40/100G Transport Module)
– Service disruption measurements—You can measure service disruption time resulting from signal loss or a variety of errors, anomalies, alarms, or defects. For details, see "Measuring service disruption time" on page 71.
– Pointer Stress Sequences—You can adjust pointers using the Pointer Stress Sequences. For details, see "Adjusting pointers" on page 81.
– SDH alarm suppression.
– Multiplexed SDH signal analysis from OTN interfaces. You now generate and analyze bulk BERT payloads in multiplexed SDH signals down to VC-3. For details, refer to Chapter 6 "OTN Testing".
– Multiplexed SONET signal analysis from OTN interfaces. You can generate and analyze bulk BERT payloads in multiplexed SONET signals down to STS-1. For details, refer to Chapter 6 "OTN Testing".

– NextGen testing—If your instrument is configured and optioned to do so, you can verify and troubleshoot NextGen service on your network. For details, refer to Chapter 5 "NextGen Testing".
– J-Scan (automatic tributary discovery)—The J-Scan application helps you discover the structure of a SONET or SDH circuit, and then displays a navigable map of the circuit and its tributaries. You can then check the status for each of the tributaries, and select them for detailed testing. The network map can also be saved to a report for future reference. For details, refer to "Running J-Scan" on page 60.
– Improved latency resolution—When transmitting high-order SDH or SONET signals carrying Bulk BERT payloads, latency (delay) can now be measured with a 100 µs resolution for STS-1 and AU-3 or VC-3 signals, and 10 µs for signals up to VC-4-64c or STS-192c. All other signals and mappings are measured with 1 ms resolution.
– Path overhead captures—You can capture high or low path overhead bytes for a particular tributary for analysis. When configuring the capture, you can indicate that you want to capture it manually, or specify a trigger to automate the capture. For details, see "Capturing POH bytes" on page 74.
– STL Layer Testing—the STL layer applies to the OC_768/STM-256 interfaces on the CSAM and 40/100G Transport Module. With LR 4 optics (4 wavelengths), errors and alarms can be injected for testing. With serial (FR) optics, the STL layer is used but a number of alarms/errors are non-deterministic. (The CSAM has non serial optics.)

Understanding the LED panel

When you setup the instrument, you can specify whether the SDH and SONET LED panels should emulate the LEDs on the JDSU ANT platform or the JDSU TestPad 2000 platform. If the LEDs are not what you expect or are accustomed to seeing, verify that the correct emulation mode is selected for your module.

SONET and SDH LEDs are also available when running OTN, 10GigE WAN, and NextGen applications.

Understanding the graphical user interface

The names of various elements on the graphical user interface change depending on whether you select a SONET or SDH test application. For example, the button that you use to insert errors or anomalies is labeled **Insert Error** if you selected a SONET application; the same button is labeled **Insert Anomaly** if you selected a SDH application.

Additional elements are available when the instrument is used for NextGen testing. For details, refer to "About the NextGen user interface" on page 112.

Understanding SONET and SDH test results

Many SDH and SONET standards are identical; therefore, the instrument provides similar results for SONET and SDH test applications. See "SONET/SDH results" on page 189 for a description of each test result.

Additional test results are available when the instrument is used for NextGen testing. For details, refer to "Understanding the NextGen test results" on page 115.

SONET and SDH test modes

Terminate and monitor test modes are supported for each of the SONET and SDH applications:

Terminate mode—Select terminate mode to generate, transmit, and analyze traffic. In terminate mode, the module generates traffic independent of the received traffic, and allows you to select a tributary to analyze down to the lowest level available depending on the framing and mapping. The specified tributary will be used for carrying the data generated by the module. The same mapping, tributary, and BERT pattern selections will apply to both transmitted and received traffic.

The transmitter and receiver are set at the same rate using an internal, recovered, or 1.5/2M reference transmit clock.

Monitor mode—Select monitor mode to monitor and analyze traffic. When monitoring traffic for optical rates a splitter may be required to connect to the circuit under test.

Through mode—Select through mode if you want your unit to emulate section terminating equipment or a repeater. When you test in through mode, the unit can originate specific bytes in the section overhead, and then clean up any errors detected in the received signal for those specific bytes.

When testing in through mode, all data from sub-rates is untouched, and is passed through the unit as it was received. For example, if you drop a DS1 from a DS3 signal, no errors, anomalies, alarms, or defects can be inserted into the DS1 signal.

Drop and insert mode—Select drop and insert mode if you want to insert one channel of a dropped signal while non-intrusively passing the remainder of the signal through unaffected. The inserted channel carries a BERT pattern which allows you to analyze the payload for the dropped signal. For example, if you drop a DS3 from an STS-1 signal, you can select a specific DS3 channel, and then insert a BERT pattern as the payload before transmitting the signal for analysis. (N/A for CSAM and 40/100G Transport Module)

In addition to inserting a BERT payload, you can also manipulate specific overhead bytes, including path layer errors, alarms, and path parameters (for example, the path trace byte). For this reason, the unit will automatically recalculate SONET and SDH B1 and B2 overhead bytes.

SONET test applications

Table 13 lists each of the SONET test applications, In addition to these applications, a J-Scan application is available (in Monitor mode) for each interface line rate except OC768.

NextGen (VCAT, LCAS, and GFP) test applications are listed and explained in Chapter 5 “NextGen Testing”.

Table 13 SONET test applications

Signal	Rate		Payload	Test Mode
STS-1			Bulk BERT	Terminate Through Monitor Dual Monitor Drop+Insert
	DS3		DS3 BERT	Terminate Through Monitor Drop+Insert
			DS1 BERT E1 BERT	Terminate Through Monitor
	VT-1.5		BULK BERT DS1 BERT	Terminate Through Single Monitor
OC-3			STS-3c Bulk BERT	Terminate Through Monitor Drop+Insert
	STS-1		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			DS1 BERT E1 BERT	Terminate Through Monitor
	VT-1.5		Bulk BERT DS1 BERT	Terminate Through Monitor

Table 13 SONET test applications (Continued)

Signal	Rate		Payload	Test Mode
OC-12			STS-12c Bulk BERT STS-3c Bulk BERT	Terminate Through Monitor Drop+Insert
	STS-1		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			DS1 BERT E1 BERT	Terminate Through Monitor
	VT-1.5		Bulk BERT DS1 BERT	Terminate Through Monitor
OC-48			STS-48c Bulk BERT STS-12c Bulk BERT STS-3c Bulk BERT	Terminate Through Monitor Drop+Insert
	STS-1		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			DS1 BERT E1 BERT	Terminate Through Monitor
	VT-1.5		Bulk BERT DS1 BERT	Terminate Through Monitor

Table 13 SONET test applications (Continued)

Signal	Rate		Payload	Test Mode
OC-192			STS-192c Bulk BERT STS-48c Bulk BERT STS-12c Bulk BERT STS-3c Bulk BERT	Terminate Through Monitor Drop+Insert
	STS-1		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			DS1 BERT E1 BERT	Terminate Through Monitor
	VT-1.5		Bulk BERT DS1 BERT	Terminate Through Monitor
OC-768			STL BERT	Terminate Monitor
			STS-768c Bulk BERT STS-192c Bulk BERT STS-48c Bulk BERT STS-12c Bulk BERT STS-3c Bulk BERT	Terminate Through Monitor
	STS-1		Bulk BERT	Terminate Through Monitor

SDH test applications

If your unit is configured and optioned to do so, you can test SDH interfaces ranging from STM-1e to STM-256.

– For STM-1e applications, see Table 14 on page 50.
– For STM-1 applications, see Table 15 on page 52.
– For STM-4 applications, see Table 16 on page 54.
– For STM-16 applications, see Table 17 on page 55.
– For STM-64 applications, see Table 18 on page 57.
– For STM-256 applications, see Table 19 on page 58

In addition to the applications listed in Table 14 on page 50 through Table 19 on page 58, a J-Scan application is available (in Monitor mode) for all interface line rates except STM-256.

NextGen (VCAT, LCAS, and GFP) test applications are listed and explained in Chapter 5 “NextGen Testing”.

STM-1e test applications

Table 14 lists each of the supported STM-1e terminate and monitor test applications.

Table 14 STM-1e test applications

Rate			Payload	Test Mode
AU-4	VC-4		Bulk BERT	Terminate Through Monitor Drop+Insert
		E4	E4 BERT	Terminate Through Monitor Drop+Insert
			E3 BERT E1 BERT	Terminate Through Monitor
	VC-3		Bulk BERT	Terminate Through Monitor
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

Table 14 STM-1e test applications (Continued)

Rate			Payload	Test Mode
AU-3	VC-3		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

STM-1 test applications

Table 15 lists each of the supported STM-1 terminate and monitor test applications.

Table 15 STM-1 test applications

Rate			Payload	Test Mode
AU-4	VC-4		Bulk BERT	Terminate Through Monitor Drop+Insert
		E4	E4 BERT	Terminate Through Monitor Drop+Insert
			E3 BERT E1 BERT	Terminate Through Monitor
	VC-3		Bulk BERT	Terminate Through Monitor
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

Table 15 STM-1 test applications (Continued)

Rate			Payload	Test Mode
AU-3	VC-3		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

STM-4 test applications

Table 16 lists each of the supported STM-4 terminate and monitor test applications.

Table 16 STM-4 test applications

Rate			Payload	Test Mode
AU-4			VC-4-4c Bulk BERT	Terminate Through Monitor Drop+Insert
	VC-4		Bulk BERT	Terminate Through Monitor Drop+Insert
		E4	E4 BERT	Terminate Through Monitor Drop+Insert
			E3 BERT E1 BERT	Terminate Through Monitor
	VC-3		Bulk BERT	Terminate Through Monitor
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

STM-16 test applications

Table 17 lists each of the supported STM-16 terminate and monitor test applications.

Table 17 STM-16 test applications

Rate			Payload	Test Mode
AU-4			VC-4-16c Bulk BERT VC-4-4c Bulk BERT	Terminate Through Monitor Drop+Insert
	VC-4		Bulk BERT	Terminate Through Monitor Drop+Insert
		E4	E4 BERT	Terminate Through Monitor Drop+Insert
			E3 BERT E1 BERT	Terminate Through Monitor
	VC-3		Bulk BERT	Terminate Through Monitor
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

Table 17 STM-16 test applications (Continued)

Rate			Payload	Test Mode
AU-3	VC-3		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

STM-64 test applications

Table 18 lists each of the supported STM-64 terminate and monitor test applications.

Table 18 STM-64 test applications

Rate			Payload	Test Mode
AU-4			VC-4-64c Bulk BERT VC-4-16c Bulk BERT VC-4-4c Bulk BERT	Terminate Through Monitor Drop+Insert
	VC-4		Bulk BERT	Terminate Through Monitor Drop+Insert
		E4	E4 BERT	Terminate Through Monitor Drop+Insert
			E3 BERT E1 BERT	Terminate Through Monitor
	VC-3		Bulk BERT	Terminate Through Monitor
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

Table 18 STM-64 test applications (Continued)

Rate			Payload	Test Mode
AU-3	VC-3		Bulk BERT	Terminate Through Monitor Drop+Insert
		DS3	DS3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT DS1 BERT	Terminate Through Monitor
		E3	E3 BERT	Terminate Through Monitor Drop+Insert
			E1 BERT	Terminate Through Monitor
	VC-12		Bulk BERT E1 BERT	Terminate Through Monitor

STM-256 test applications

Table 19 lists each of the supported STM-256 terminate, through and monitor test applications.

Table 19 STM-256 test applications

Rate		Payload	Test Mode
		STL BERT	Terminate Monitor
AU-4	VC-4	VC-4-256c Bulk BERT VC-4-64c Bulk BERT VC-4-16c Bulk BERT VC-4-4c Bulk BERT	Terminate Through Monitor
		Bulk BERT	Terminate Through Monitor
AU-3	VC-3	Bulk BERT	Terminate Through Monitor

Specifying the Tx clock source

You specify the Tx clock (timing) source on the Interface setup screen.

To set the Tx clock source

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 18 on page 57 for a list of applications).
2. Select the **Setup** soft key, and then select the **Interface** tab. Select the arrows to the right of the Clock Source field, and then select one of the following:
   – Internal. Select Internal to derive timing from the MSAM's clock, and then specify any required frequency offset in PPM.
   – Recovered. Select Recovered to recover timing from the received signal.
   – External - Bits/Sets. Select External - Bits/Sets timing to derive timing from one of the following signals, in the following order: BITS, SETS, 2.048 MHz, or 10 MHz clock.
3. Select the **Results** soft key to return to the Main screen, or select another tab to specify additional test settings.

The Tx clock source is specified.

Measuring optical power

You can use your instrument to measure the optical power of a received signal.

To measure optical power

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 18 on page 57 for a list of applications).
2. Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.
3. Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.
4. Select the **Laser** button.
5. Loop back the far-end of the network.

6 Verify the following LEDs

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

7 Display the Interface result group, and then observe the Optical Rx Level (dBm) test result.

Optical power is measured.

Running J-Scan

The J-Scan application helps you discover the structure of a SONET or SDH circuit, and displays a list and a map of the containers and channels detected. You can then use the list or map to select a particular channel for further testing. The map can be saved to a report for future reference. (N/A for CSAM and 40/100G Transport Module).

For the purpose of clarity, the term "channel" is used throughout this section to refer to the various channels, paths, or tributaries detected in SONET or SDH container signals.

Displaying a map of the signal structure

To display a map showing the SONET or SDH signal structure

1 Connect the instrument to the interface for the circuit you are testing (refer to the Getting Started Manual for your instrument).

2 Using the Test Menu, select the J-Scan application for the interface the instrument is connected to (refer to Table 13 on page 47 through Table 18 on page 57 for a list of applications).

3 Verify that a signal is present, and that you have frame synchronization.

4 Select the **J-Scan** softkey. The instrument automatically displays a map showing the high path structure of the detected containers and channels (see Figure 4).

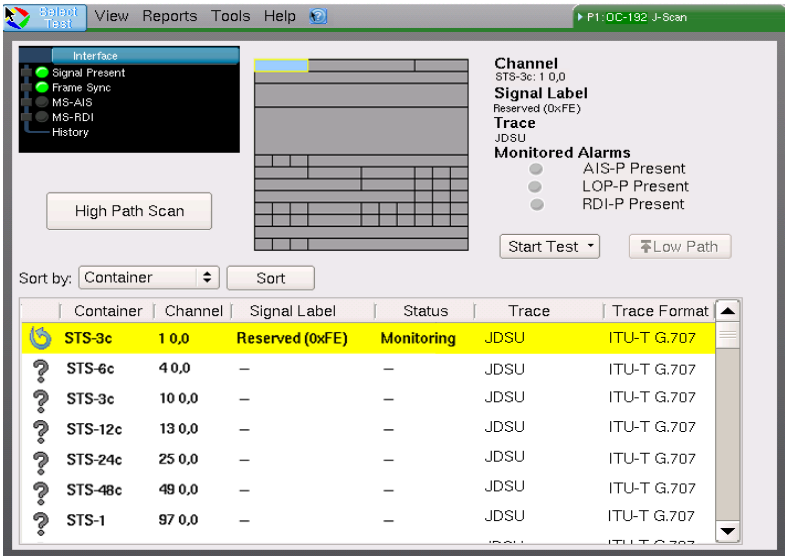


Figure 4 Signal Map Page

If you want to see the Path Trace (J1) for a particular SONET circuit, it is provided in the standard SONET Path results on the Main screen.

5 If you want to display a map of the low path tributaries (SONET VT-1.5 or SDH VC-12), select the **Low Path** button.

A map of the signal structure is displayed, and the first channel is monitored.

Sorting the channels

After displaying the channels, you can sort them by Container ID or Channel ID. This may be useful before scanning the channels to check their status, especially if there are multiple containers.

To sort the displayed containers and channels

1 In **Sort by**, select the criteria (Container or Channel).

2 Select **Sort**.

The containers and channels are sorted using the criteria you selected. After scanning the mapped channels for their labels and status, you can also optionally sort the containers and channels by Signal label or Status.

Scanning the map

After the instrument displays a map of the containers and channels, you can do the following:

– Scan the map using the **High Path Scan** or **Low Path Scan** button to quickly determine the signal label and status for each monitored channel.

– Select a particular channel to observe detailed test results on the Main screen.

– Test a particular channel thoroughly using the **Start Test** button.

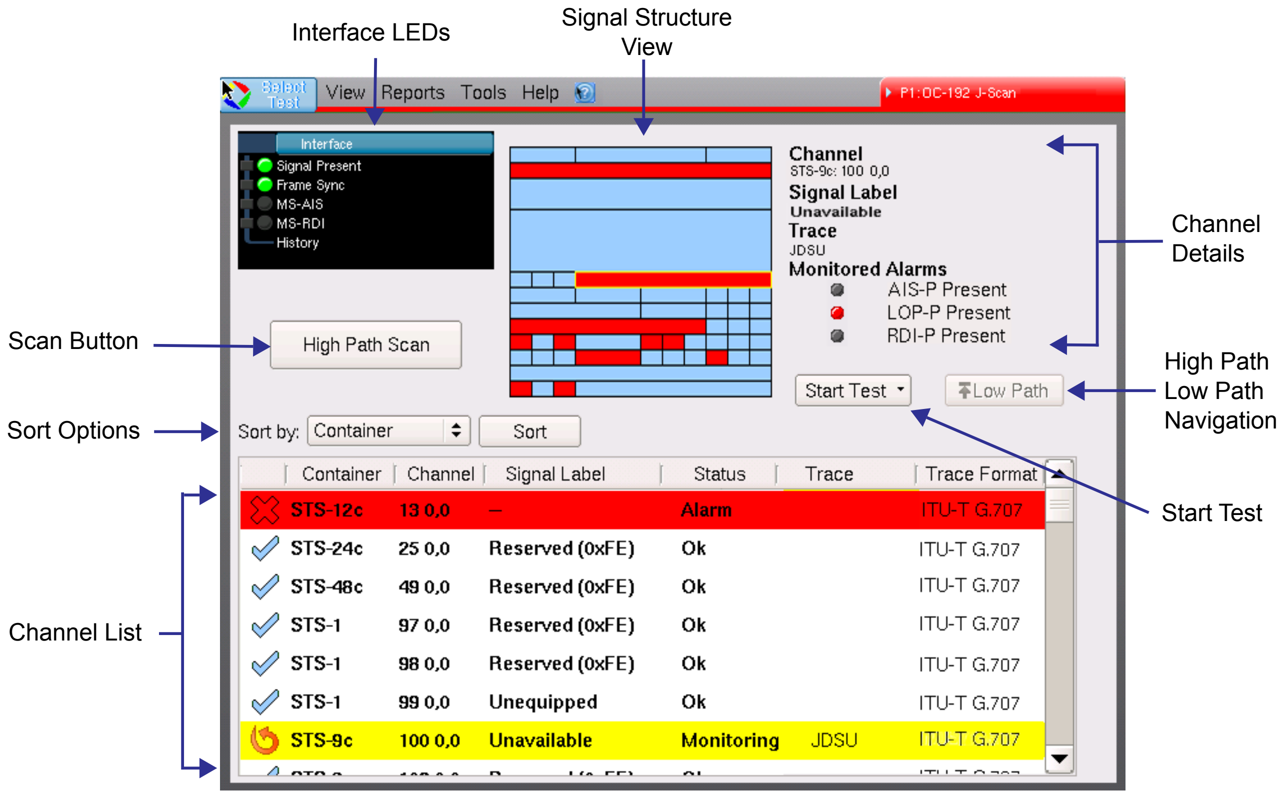


Figure 5 Scanned Monitored, Errored, and Ok Channels

To scan the mapped channels

1. Display the signal map (see "Displaying a map of the signal structure" on page 60). *Remember to use the Low Path button if you want to observe VT-1.5 or VC-12 tributaries*.
2. Do one of the following:
   – If you want to scan high path tributaries, select **High Path Scan**.
   – If you want to scan low path tributaries, select **Low Path Scan**.

The instrument scans the channels, and then displays the Signal Label and Status for each channel sequentially. In Figure 5, all displayed channels have been scanned. The STS-12c channel is errored due to an Alarm condition, and the instrument is actively monitoring the STS-9c channel.

NOTE:
STS-6c, STS-9c, and STS-24c channels are not standard and therefore are rarely encountered; however, the instrument can detect and monitor them.

Testing a channel

You can test a particular channel by selecting it on the map, and then launching the test using the Start Test button.

To test a channel

1 Select the channel on the list or map.

2 Select **Start Test**, and then select the test for the channel.

The instrument selects the channel, launches the test, and takes you automatically to the Main screen where you can observe results for the tested channel.

Using Restart to reset the status

When running the J-Scan application, pressing the **Restart** soft key clears the Signal Label and Status for each channel. It does not re-scan the circuit for currently active channels. You can then actively re-scan the circuit using the **High Path Scan** or **Low Path Scan** button.

Understanding J-Scan results

When you run the J-Scan application, the list and map of the channels is color coded.

– Errored channels appear in red with an X to the left of the Container ID.
– Unerrored channels appear on a white background with a blue check mark to the left of the Container ID.
– Monitored channels appear in yellow, with a circular arrow to the left of the Container ID.

Detailed test results for the *currently selected channel* are available on the Main screen. For example, if you ran the application from a SONET interface, the standard Section, Line, Path, and VT results are all provided for the channel that you selected from the list or map of the circuit.

For details, see “Step 5: Viewing test results” on page 4 of Chapter 1 “Basic Testing”, and “SONET/SDH results” on page 189 of Chapter 7 “Test Results”.

Saving the J-Scan Results

At anytime, the J-Scan results, including the network map, can be saved.

To save the report, select the Reports icon in the lower left corner of the screen to configure and save the report.

For more information see “Creating and Printing Reports” in *MSAM, Transport Module, DMC, 40G Module, CSAM, and T-BERD 5800Getting Started Manual*.

Re-scanning the circuit

To re-scan the circuit after launching the J-Scan application

– Press **Low Path Scan** or **High Path Scan**.

The instrument re-scans the circuit to provide the Signal Label and Status for each channel.

BER testing

The following procedure illustrates a typical scenario for:

– Setting up an instrument to terminate a SONET or SDH signal for BER testing.
– Inserting errors, anomalies, alarms, and defects on concatenated signals.

> **NOTE: Changing BERT patterns**
> If you change a BERT pattern during the course of your test, be certain to press the **Restart** soft key to ensure that you regain pattern sync.

Specifying a BERT pattern

You can configure your instrument to transmit a variety of ITU or ANSI patterns when performing BER tests.

To specify a BER pattern

1 Using the Test Menu, select an application with a BERT payload for the interface, administrative unit (if applicable), and virtual container you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key, then the **Pattern** tab. Select from the following TX and RX patterns (except where noted):
   – PRBS 31
   – PRBS 31 Inv
   – PRBS 23
   – PRBS 23 Inv
   – PRBS 9
   – PRBS 9 Inv
   – Delay
   – Live (RX only)

> **NOTE:**
> You can automatically detect and transmit the correct BERT pattern for the circuit by pressing the Auto button on the Main screen after you specify you interface settings. See “Detecting the received BER pattern” on page 66.

3 Select the Results soft key to return to the Main screen.

The pattern is specified.

Running a BER test

To run a SONET or SDH BER test

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 If you selected a E1 BERT payload, and you want to specify timeslots for your test, proceed to step 3, otherwise, proceed to step 8.

3 Select the PDH tab, and then select the N x 64 Setup tab.

4 Select the arrow to the right of the Payload Type field, and then specify one of the following:
- **Bulk**. Proceed to step 8.
- **Fractional 2M**. The Timeslot configuration appears. Proceed to step 5.

5 You can view the currently selected timeslots in the Timeslot screen. To change the timeslots you want to test, select the **Configure** button.

The Configure Timeslot screen appears.

6 To configure the timeslot

To...	Do...
Select all the timeslots	Select the **Select All** button.
Deselect all the timeslots	Select the **Clear All** button.
Select a timeslot	Select the checkbox to the right of the timeslot number.
Clear a timeslot	Clear the checkbox to the right of the timeslot number.

7 Do one of the following:
- To confirm and finish the timeslot configuration, select **OK**.
- To cancel configuring the timeslot, select **Cancel**.

8 Specify the BERT pattern (see "Specifying a BERT pattern" on page 64).

9 Select the **Results** soft key to return to the Main screen.

10 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

11 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

12 If you are testing an optical signal, select the **Laser** button.

13 Loop back the far-end of the network.

14 Verify the following LEDs
- If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

- If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF

SONET and SDH
LSS

15 Verify that `All Results OK` appears in the results display.

16 *Optional*. Insert five Bit / TSE errors (see “Inserting errors, anomalies, alarms, and defects” on page 68), and then verify that the five errors were received in the BERT result category.

17 Run the test for an appropriate length of time.

The BER test is finished.

Detecting the received BER pattern

The instrument can also automatically detect the BER pattern on the received signal.

To detect the received BER pattern

1 On the Main screen, press the **Auto** button:

A window appears indicating that the module detected the input signal and then detected the received pattern.

2 Select **Results** to return to the Main screen, or **Setup** to configure additional test parameters.

The pattern is detected.

Drop and insert testing

The following procedure (N/A for CSAM and 40/100G Transport Module) illustrates a typical scenario for:

– Setting up the instrument to drop a received signal for analysis, and then BERT test the signal or a particular channel on the signal.
– Manipulating overhead bytes for the transmitted signal.
– Inserting errors, anomalies, alarms, and defects into the transmitted signal.

To drop a signal and then insert a BERT payload, error, anomaly, alarm, or defect

1 Using the Test Menu, select the drop and insert test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 18 on page 57 for a list of applications).

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 If you are testing a particular channel for the dropped signal, in the panel on the left side of the tab, select **Channel**, and then do the following:

a Select the keypad next to the channel field, and then type the number corresponding to the channel you are testing. The labels that appear for the channel fields vary depending on the signal you are dropping for testing. For example, if you are dropping a DS3 signal from an STS-1, you can specify an STS-N channel for testing. If you are dropping a VC-3 from an AU-3, you can specify an STM-N channel *and* an AU-3 channel for testing.

   b If you want to transmit the BERT pattern in the same channel that you are analyzing on the receiver, in the corresponding Tx=Rx field, select **Yes**; otherwise, select **No**, and then specify the channel to transmit with the BERT pattern.

   If you selected the E1 BERT payload, and you want to specify timeslots for your test, proceed to step 4, otherwise, proceed to step 9.

4 Select the PDH tab, and then select the N x 64 Setup tab.

5 Select the arrow to the right of the Payload Type field, and then specify one of the following:
   – **Bulk**. Proceed to step 9.
   – **Fractional 2M**. The Timeslot configuration appears. Proceed to step 6.

6 You can view the currently selected timeslots in the Timeslot screen. To change the timeslots you want to test, select the **Configure** button.

   The Configure Timeslot screen appears.

7 To configure the timeslot

To...	Do...
Select all the timeslots	Select the **Select All** button.
Deselect all the timeslots	Select the **Clear All** button.
Select a timeslot	Select the checkbox to the right of the timeslot number.
Clear a timeslot	Clear the checkbox to the right of the timeslot number.

8 Do one of the following:
   – To confirm and finish the timeslot configuration, select **OK**.
   – To cancel configuring the timeslot, select **Cancel**.

9 To specify the BERT pattern to insert into the payload, select the **Pattern** tab, and then from following Tx and Rx patterns (except as indicated):
   – PRBS 31
   – PRBS 31 Inv
   – PRBS 23
   – PRBS 23 Inv
   – PRBS 9
   – PRBS 9 Inv
   – Delay
   – Live (Rx only

10 Select the **Results** soft key to return to the Main screen.

11 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

12 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

13 Select the **Laser** button.

14 Loop back the far-end of the network.

15 Verify the following LEDs

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH	PDH
Signal Present	Signal Present	Frame Sync
Frame Sync	Frame Sync	C-Bit Sync[a]
Path Ptr Present	AU Ptr Present	Pattern Sync
Concat Payload[b]	Concat Payload[a]	
Pattern Sync	Pattern Sync	

a. If you specified C-Bit framing for a dropped PDH signal
b. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH	PDH
LOS	LOF
LOF	FTM
LSS	LSS

16 Verify that `All Results OK` appears in the results display.

17 Select **DI On** to generate and transmit the signal with the BERT pattern you specified.

18 *Optional*. Manipulate overhead bytes for the transmitted signal (see “Manipulating overhead bytes” on page 73).

19 *Optional*. Use the buttons provided on the Main screen to insert errors, anomalies, alarms, or defects (see “Inserting errors, anomalies, alarms, and defects” on page 68).

20 Run the test for an appropriate length of time.

The drop and insert test is finished.

Inserting errors, anomalies, alarms, and defects

You can insert multiple types of errors or anomalies and alarms or defects simultaneously.

NOTE:

Synchronous Transport Lane (STL) specification requires 32-byte lane spacing but some serial CFP hardware exists that does not conform to this specification. The CSAM and 40/100G Transport Module are shipped with a **CFP Skew** value at **0**. If, at a later time, hardware changes require a skew value of **32**, that can be set via the Expert Optics selections accessed via the **Setup** soft key and then the **Interface** and **Connection** tabs.

Inserting errors or anomalies

To insert errors or anomalies

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).
2. Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.
3. Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.
4. Select the **Laser** button.
5. On the Main screen, select the error or anomaly tab and then select the error or anomaly to be inserted from the list.
6. Do the following:
   – For STL applications, select the **Lane** tab and then select the lanes into which the Error is to be inserted.
   – If you selected a Frame/FAS Word error, select the keypad icon, type the number of errors you want to insert (ranging from 1 to 32, or 1to 128 for STL), and then select **OK**.
   – If you selected any other type of error, specify the insert type (**Single**, **Burst** (or **Multiple)** or **Rate**).
   – If you specified Burst (or Multiple), select the keypad icon, type the number of errors or anomalies you want to insert, and then select **OK**.
   – If you specified Rate, select one of the error or anomaly rates for the signal you selected when you configured your test
7. Press the **Error Insert** or **Anomaly Insert** button.

   Error or anomaly insertion starts, and the associated button turns yellow.

Test results associated with the error or anomaly appear in the Status result category.

To stop insertion

– Press the **Error Insert** or **Anomaly Insert** button again.

Error or anomaly insertion stops, and the associated button turns grey.

Inserting alarms or defects

To insert alarms or defects

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).
2. Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.
3. Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.
4. On the Main screen, select the alarm or defect tab.'
5. For STL applications, select the **Lane** tab and then select the lanes into which the alarm or defect is to be inserted.
6. Select the **Laser** button.

7 Select an alarm or defect type.

8 Press the **Alarm Insert** or **Defect Insert** button.

The module inserts an alarm or defect, and the button turns yellow.

Test results associated with the alarm or defect appear in the Status result category.

To stop insertion

– Press the **Alarm Insert** or **Defect Insert** button again.

> **NOTE:**
> When HP-UNEQ or UNEQ-P alarm/defect insertion is stopped, the C2 path overhead byte will be populated by the value configured on the Setup overhead tab.

Alarm or defect insertion stops, and the button turns grey.

Measuring round trip delay

You can use the instrument to measure round trip delay by transmitting a delay pattern, and then looping the pattern back to the module. The module calculates the amount of time it took the pattern to traverse the loop, and then reports the duration (delay) in milliseconds (ms).

To measure round trip delay

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Specify the Interface settings if the defaults are not acceptable.

4 Select the **Pattern** tab, and then select the **Delay** pattern.

5 To return to the Main screen, select the **Results** soft key.

6 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

7 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

8 If you are testing an optical signal, select the **Laser** button.

9 Loop back the far-end of the network.

10 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

11 To observe the delay result, set one of the result windows to display the Signal category.

Round trip delay is measured.

Measuring service disruption time

You can use the instrument to measure the service disruption time resulting from a switch in service to a protect line. Before measuring the disruption time, you can:

– Indicate which events to measure (such as a Signal Loss or LOF).
– Establish an acceptable length of time for the measurements by specifying a Threshold Time. Measured times for an event that are less than or equal to the Threshold Time pass the test, measured times that exceed the Threshold Time fail the test.
– Specify a Separation Time to indicate that the unit should count *separate events* that occur within a very brief period of time as a *single event*. For example, if you specify a Separation time of 300.000 ms and select AIS-L as an event trigger, if more than one AIS-L occurs during a 300.000 ms period, the unit will interpret the events as a *single AIS-L disruption*. The count will not increase when another AIS-L occurs until at least 300.000 ms has transpired since the previous AIS-L.

To measure service disruption time

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Select the Service Disruption tab.

4 Under Event Settings, do the following:

a Select **Enable Service Disruption**.

b *Optional*. To edit the displayed Separation Time, press the keypad icon, and then type the new time in milliseconds (ms), or select **Default** to restore the time to its default value (300.0 ms). This is the duration during which each trigger of a specific type will be counted as a single disruption event.

c *Optional*. To edit the displayed Threshold Time, press the keypad icon, and then type the new time in milliseconds (ms), or select **Default** to restore the time to its default value (50.0 ms). Disruption measurements that exceed this duration will be interpreted as failed.

5 Under Event Triggers, do one of the following:
   – To measure disruption time for each of the triggers listed, select **Set ALL**.
   – To measure disruption time for a specific trigger or group of triggers, select **Clear ALL**, and then select each of the triggers for measurements.

   NOTE: The available triggers vary depending on the test application you selected. For example, DS3 triggers do not appear if you selected an OC-3 > STS-1 > Bulk BERT > Terminate application; however, they do appear if you selected an OC-3 > STS-1 > DS3 > DS3 BERT > Terminate application.

6 If additional settings need to be modified to reflect the network configuration, select the appropriate tab, and then modify the settings as required.

7 To return to the Main screen, select the **Results** soft key.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 To force the switch to a protect line, use one of the following methods:
   – Interrupt the signal. Physically interrupt the signal by pulling the signal from the add-drop multiplexer (ADM).
   – Insert errors. Use another unit in through mode to insert errors until the network switches to the backup lines.

   The network switches to a protect line, the MSAM detects that service has been disrupted, and then the module begins to measure the disruption time in milliseconds until the condition returns to normal.

11 To observe the service disruption results, set one of the result windows to display the Service Disruption Log, and set another window to display the Service Disruption Log Stats.

Service disruption is measured for each of the triggers you selected. For details on the associated test results, see "Service Disruption Results" on page 201.

Viewing a TOH group

You can specify the TOH (Transport Overhead) group you want to view when testing using the instrument.

To view a TOH group

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select **Overhead**.

   A graphical display of the overhead bytes appears.

4 Under Overhead Bytes, select the field to the right of the Analysis Channel, type the TOH group number, and then select **OK**.

The selected TOH channel group appears in the Sonet Overhead result display.

Manipulating overhead bytes

The following procedure describes how to manipulate the value of selected overhead bytes, and then view the byte values in the Overhead result category.

To manipulate an overhead byte

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **SONET** or **SDH Overhead** soft key.

Figure 6 shows the display for a classic SONET application.

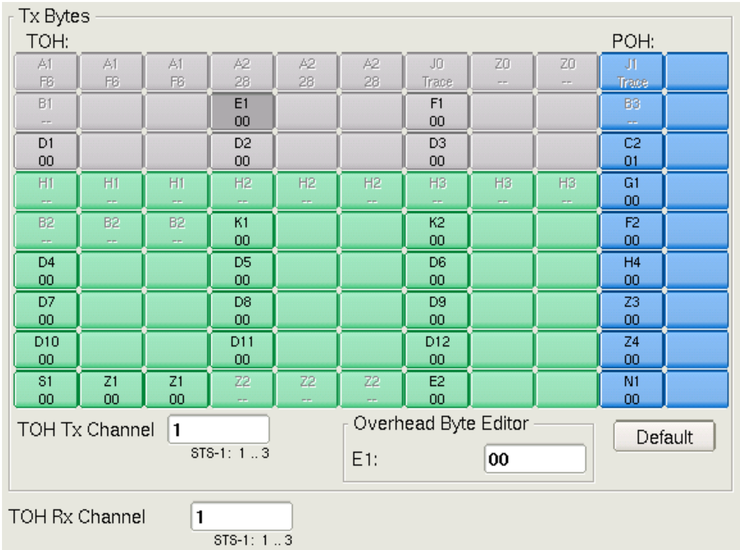


Figure 6 Overhead byte display - Classic SONET application

The Line/Multiplexor Section bytes appear in green; the Section/Regenerator Section bytes appear in grey. Path/High Path overhead bytes appear in blue.

– Bytes labeled using a black font can be manipulated.
– Bytes labeled using a white font cannot be manipulated.
– The Default button restores any bytes you changed to their default value.

3 To change the value of a byte, do the following:

a Select the byte you want to manipulate.

b Select the Overhead Byte Editor field, type the new byte value, and then select **OK**.

The new value appears in the field and will be transmitted in the overhead when you start your test.

4 Select the **Results** soft key to return to the Main screen.

5 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

6 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

7 If you are testing an optical signal, select the **Laser** button.

8 Loop back the far-end of the network.

9 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

10 To view overhead byte values on the Main screen, select the SONET or SDH result group, and then select the **Overhead** result category.

The overhead byte is manipulated.

Capturing POH bytes

You can now capture high and low path overhead bytes. When configuring the capture, you can indicate that you want to capture it manually, or specify a trigger to automate the capture. Path capture is currently supported on the MSAM only.

To capture a POH byte

1 If you haven't already done so, use the Test Menu to select the BERT test application for the interface you are testing.

– Refer to Table 13 on page 47 through Table 19 on page 58 for a list of SONET and SDH applications.

– Refer to Table 25 on page 118 through Table 32 on page 128 for a list of NextGen applications.

2 Select the **SONET Overhead** soft key, and then select the POH Byte Capture tab.

3 Specify values for the following settings:

Setting	Value
Tributary Settings	When running classic SONET or SDH tests, specify the settings that identify the tributary you are capturing the byte for in the associated fields.
Rx VCG Member (NextGen applications only)	Select the member you want to capture the byte for.

Setting	Value
Trigger	Select one of the following: – Manual (only method available for CSAM and 40/100G Transport Module). – Alarm. – Compare Byte. – Compare Not Byte.
Alarm Type (only appears if Trigger is Alarm)	Select the type of alarm that will trigger an automatic capture: – AIS-L – RDI-L – AIS-P – LOP-P
Compare (Binary) (only appears if Trigger is Compare Byte or Compare Not Byte).	Specify the received byte value that you want matched, or the value that should not be matched to force an automatic capture. For example, if you want the instrument to capture the byte if it receives 01100110, enter 01100110. You can also enter X using the Don't Care button to wildcard the match (or don't match) value.
Select Byte	In the blue panel, select the byte to capture.

4 Select the **Start** button to the right of the Capture Settings, then observe the capture log at the bottom right of the screen.

The POH byte is captured.

Specifying the J0 or J1 identifier

You can specify the J0 (Section or RSOH trace) or J1 (Path HP trace) identifier using a variety of formats.

To specify the J0 or J1 trace identifier

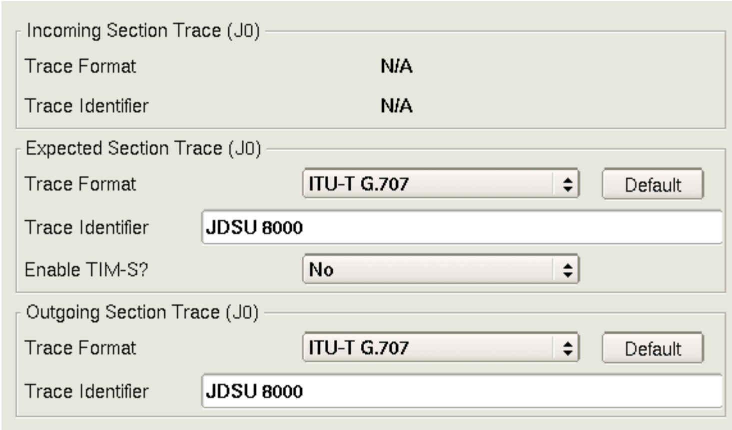
1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select one of the following:

- **Section** or **RS**, if you want to edit the J0 trace identifier.
- **Path** or **HP**, if you want to edit the J1 trace identifier.

Settings appear for the traces.



4 To change a trace, do the following:

  a Select a trace format (for example, `Single Byte`).

  b If you selected the Single Byte format, select the keypad icon to the right of the Trace Identifier field, type the byte value, and then select **OK**.

  c If you selected any format other than Single Byte, select the keypad icon to the right of the Trace Identifier field, type the identifier, and then select **OK**.

The new identifier will be transmitted in the overhead when you start your test.

> **NOTE:**
> You can reset the trace and expected trace format or identifier at any time using the **Default** buttons.

5 *Optional*. If you want the unit to display a TIM-P alarm if the expected and incoming trace values do not match, select **Yes**; otherwise, select **No**.

6 Repeat step 2 on page 75 for the Outgoing Path Trace format and identifier.

7 Select the **Results** soft key to return to the Main screen.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 If you are testing an optical signal, select the **Laser** button.

11 Loop up the far-end of the network.

12 Verify the following LEDs

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

13 To view the J0 or J1 trace values, select the SONET or SDH result group, and then select the Section/RSOH and Path/HP result categories.

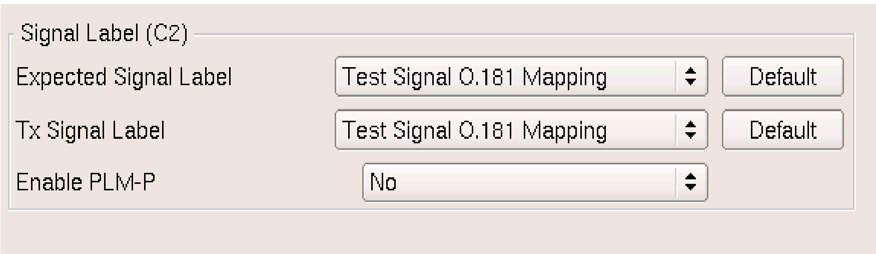
The trace byte or identifier is inserted into the overhead.

Inserting the C2 Path signal label

You can insert the C2 Path signal label using a variety of formats.

To insert the C2 Path signal label

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).
2. Select the **Setup** soft key, and then select the SONET or SDH tab.
3. In the panel on the left side of the tab, select Signal Label.
   Settings appear for the label.



4. Select the Signal Label and Expected Signal Label.
   The new label will be transmitted in the overhead when you start your test.

5 *Optional*. If you want the unit to display an HP-PLM alarm if the labels in received payloads do not match the expected label, select **Yes**; otherwise, select **No**.

> **NOTE:**
> You can reset the label and expected label at any time using the **Default** buttons.

6 Select the **Results** soft key to return to the Main screen.

7 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

8 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

9 If you are testing an optical signal, select the **Laser** button.

10 Loop back the far-end of the network.

11 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

12 To view the C2 label, select and display the SONET or SDH result group, and then select the Overhead and Path/MSOH result categories.

The C2 Path signal label is inserted into the overhead.

Manipulating K1 or K2 APS bytes

You can manipulate the K1 or K2 APS bytes for ring or linear network topologies.

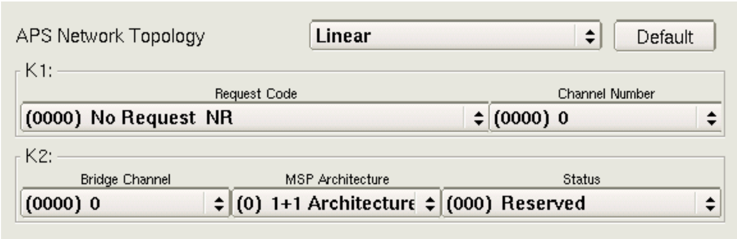
To manipulate K1 or K2 bytes

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select **APS (K1/K2)**.

Settings appear for the bytes.



4 In APS Network Topology, specify **Ring** or **Linear** as the topology.

5 If you selected a linear topology, skip this step, and proceed to step 6 on page 79. If you selected a Ring topology, do the following:

- **a** For the K1 byte, specify a Bridge Request Code (for example, `0001 RR-R`) and a Destination Node ID (for example, `0001 1`),
- **b** For the K2 byte, specify a Source Node ID (for example, `0001 1`), Path Code (for example, `0 Short`), and Status code (for example, `001 Br`).

6 If you selected a linear topology, do the following:

- **a** For the K1 byte, specify a Request Code (for example, 0001 DnR) and a Channel Number (for example, `0001 1`).
- **b** For the K2 byte, specify a Bridge Channel (for example, `0010 2`), MSP Architecture (for example, `0 1+1`), and Status (for example, `001 Unknown`).

7 Select the **Results** soft key to return to the Main screen.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 If you are testing an optical signal, select the **Laser** button.

11 Loop back the far-end of the network.

12 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

13 To view the K1 or K2 byte transitions, select the K1/K2 Linear or K1/K2 Ring result category.

The K1 and K2 bytes are manipulated. You can view them in the K1/K2 Log provided in the SONET or SDH result group.

Manipulating the S1 byte

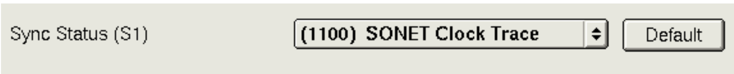
You can modify the S1 byte (used to indicate the synchronization status of the network) before transmitting traffic when testing SONET or SDH interfaces.

To manipulate the S1 byte

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select **Sync Status**.
Settings appear for the bytes.



4 Select a sync status byte (for example, `(1100 SONET Clock Trace`).

5 Select the **Results** soft key to return to the Main screen.

6 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

7 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

8 If you are testing an optical signal, select the **Laser** button.

9 Loop back the far-end of the network.

10 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

11 To view the transmitted Sync Status (S1) byte, select the Line result category.

The S1 byte is manipulated. You can observe it in the Line/MSOH result category provided in the SONET or SDH result group

Adjusting pointers

You can adjust pointers manually or by using the Pointer Stress Sequences, and then optionally measure induced jitter on a dropped T-Carrier or PDH signal.

Adjusting pointers manually

The following procedure describes how to manually adjust pointers.

To adjust pointers manually

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).
2. Configure your test settings (refer to the applicable test procedure in this chapter), and then start the test.
3. On the Main screen, on the Pointer toolbar, select one of the following:
   – Increment: Increases the pointer value by one.
   – Decrement: Decreases the pointer value by one.
   – +2 NDF: Sets the new data flag, and increases the pointer value by two.
   – -2 NDF: Sets the new data flag, and decreases the pointer value by two.
4. Select the **Path/VT Pointer Adjust** (for SONET), or **AU/TU Pointer Adjust** (for SDH) action button to adjust the appropriate pointer.

5 To observe the pointer value, number of adjustments, and pointer increments and decrements, do one of the following:
   – If you are testing a SONET circuit, select the **Path** or **VT** result categories provided in the SONET result group.
   – If you are testing a SDH circuit, select the **HP** or **LP** results categories provided in the SDH result group.

The pointer is manually adjusted.

Adjusting pointers using pointer stress sequences

You can adjust the pointers using the Pointer Stress Sequences to induce jitter in PDH signals demuxed from SONET and SDH signals. The Pointer Stress Sequence test combined with a PDH jitter test allow you to determine if a network element produces excessive jitter when stressful pointer operations occur. This test uses the pointer sequences specified in G.783 recommendations. For details, refer to the *ITU-T Recommendation G.783.*

The following procedure describes how to adjust pointers using a pointer stress sequence.

To adjust pointers with a pointer sequence

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Configure your test settings (refer to the applicable test procedure in this chapter), and then start the test.

3 Select the **Setup** soft key, and then select the SONET or SDH tab.

4 In the panel on the left side of the tab, do one of the following:
   – If you are testing a SONET circuit, select **Path Pointer** or **VT Pointer**.
   – If you are testing a SDH circuit, select **AU Pointer** or **TU Pointer**.

   Settings appear for the pointer test sequences. Figure 7 illustrates the settings that appear when you select one of the H sequences for SONET tests.

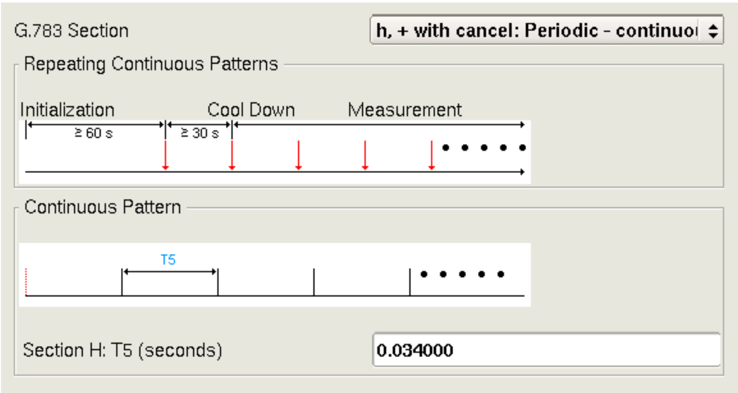


Figure 7 Pointer Stress Sequence Settings

5 In G.783 Section, select the pointer sequence you want to apply to the test. For details on each test pattern, refer to the *ITU-T Recommendation G.783*.

6 Specify the time variables in seconds for the test sequence you selected by doing the following:

   a Select the keypad icon to the right of the T field.

   b Type the value in seconds, and then select **OK**. The value you specified appears in the corresponding field.

   For details on the adjustable values, refer to the *ITU-T Recommendation G.783*.

7 Select the **Results** soft key to return to the Main screen.

8 On the Main screen, do one of the following:

- If you are testing a SONET circuit, in the Path or VT Pointer field, select **Sequence**.
- If you are testing a SDH circuit, in the AU or TU Pointer fields, select **Sequence**.

9 Do one of the following:

- If you are testing a SONET circuit, select the **Path Pointer Adjust** or **VT Pointer Adjust** action button to adjust the pointer.
- If you are testing a SDH circuit, select the **AU Pointer Adjust** or **TU Pointer Adjust** action button to adjust the pointer.

The pointer is adjusted by the test sequence.

Verifying performance

You can verify that performance complies with the ITU-T and ANSI recommendations for error and anomaly performance.

To verify performance

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Select the Setup soft key, and then select the Performance tab.

3 Select a recommendation (specification).

4 Specify the Path allocation percentage by doing the following:

   a Select the Path Allocation% field.

   b Type the percentage or threshold, and then select **OK**. The percentage or threshold appears in the corresponding field.

5 If you want to enable the UAS limit, select **Yes**.

6 To view the performance measurements, press the **Results** soft key to return to the Main screen.

7 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Path Ptr Present	AU Ptr Present
Concat Payload[a]	Concat Payload[a]
Pattern Sync	Pattern Sync

a. If you selected a concatenated payload when you configured your test.

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS
Ptr Justifications

8 To observe performance results, select the SONET or SDH result group, and then select the result category for the specification you specified.

Performance measurements are verified.

Monitoring the circuit

Use the monitor applications whenever you want to analyze the received signal and pass the signal unchanged through to the unit's transmitter.

To monitor a circuit

1 Using the Test Menu, select the monitor test application for the signal, rate, and payload you are testing (refer to Table 13 on page 47 through Table 19 on page 58 for a list of applications).

2 Connect the module to the circuit.

3 Observe the test results.

The circuit is monitored.

4

Jitter and Wander Testing

This chapter provides step-by-step instructions for measuring jitter on T-Carrier, PDH, SONET or SDH networks and wander on T-Carrier and PDH networks using the instrument. Topics discussed in this chapter include the following:

About jitter and wander testing

If your 5800, Transport Module or MSAM is configured and optioned to do so, you can use it to measure jitter and wander on a DS1, E1, E3, DS3, or E4 interface (Wander is available on MSAM and 40G/100G Transport Module only). If you purchase the optical jitter and wander testing option, you can measure jitter and wander on a OC-3, OC-12, OC-48, STM-1, STM-4, STM-16 or OTU1 2.7G interface. For details on the device and interface standards for measuring jitter and wander, refer to *ITU-T Recommendations O.172* and *O.173*.

The jitter option allows you to measure jitter manually or using automatic sequences to measure Maximum Tolerable Jitter (MTJ), Fast MTJ, and the Jitter Transfer Function (JTF). The wander option allows you to analyze system wander performance.

NOTE:

The maximum jitter or wander test duration of 48 days 23 hours 59 minutes and 56 seconds, but may be limited by file system storage capacity (actual time available may be less). When running a test, you can observe the remaining test time in the Time category of the Summary result group or in the Wander category of the Interface result group.

Multiple Services Application Module (MSAM) and T-BERD ⁄ MTS 5800:

Using the MSAM, you can measure jitter and wander on PDH and electrical SONET interfaces: DS1, DS3, E1, E3, E4, STS-1, and STM1e. Wander measurements and jitter measurements on other circuits are not supported.

A jitter-capable PIM is required to test jitter and wander. To verify whether the PIM is jitter-capable, view the Help>About menu and note the serial number. The serial number of a jitter-capable PIM starts with “P2”.

Using the T-BERD ⁄ MTS 5800, you can measure jitter on PDH and electrical SONET interfaces: DS1, DS3, E1, E3, E4, STS-1, and STM1e. Jitter measurements on other circuits are not supported.

For information about jitter and wander principles and specifications, see “Principles of Jitter and Wander Testing” on page 249.

Features and capabilities

The jitter and wander features include the following:

- Jitter modulation—You can generate jitter with a specific amplitude and frequency, and then modulate the transmitted signal using the generated jitter.
- Automatic Measurement Sequences—You can configure the test sequences to run automatically and measure MTJ, Fast MTJ, and JTF. You can then view graphical or tabular jitter results by selecting the Jitter Graph or Jitter Table category in the Interface result group.
- Wander measurement—If you purchased the optical or electrical wander test option, you can test and analyze the wander results in a graphical manner. You can also export the wander TIE result to be analyzed on a remote PC using the O.172 MTIE/TDEV Offline Analysis software shipped with your instrument. For details, see “” on page 108.
- 1PPS Analysis and Wander—If your instrument is configured and optioned to do so, you can now use it to conduct wander measurements at a test interface against an external 1PPS reference signal. An optional GPS 1PPS signal is used as the reference signal.

– Timing Reference Wander - If your instrument is configured and optioned to do so, wander analysis of 2.048MHz and 10.0MHz timing reference signals can be performed. These timing references signals can be characterized against external BITS, SETS, 2.048MHz and 10.0 MHz signals connected to the external reference input connector.

Understanding the graphical user interface

The names of various elements on the graphical user interface change depending on the interface you select. For example, the button that you use to insert errors or anomalies is labeled **Insert Error** if you selected a T-Carrier application; the same button is labeled **Insert Anomaly** if you selected a PDH application.

The buttons or soft keys also change depending on the test you select. For example, the Calibration button only appears when you are measuring JTF; and the Wander Analysis soft key only appears when you select the wander testing applications.

When you are testing jitter or wander, you need to use the buttons on the following action bars:

Action Bar	Used to...
Jitter Tx	Transmit jitter
Jitter AMS	Measure jitter with Automatic Measurement Sequences

If a particular toolbar is not available on the Main screen, select **View > Actions Panel**, and then select the action bar that you need.

Accessing jitter and wander test results

When you configure your instrument to measure jitter or wander, measurement results are available in the Interface result group.

Jitter and wander test applications

Table 20 to 22 list each of the jitter and wander test applications for T-Carrier, PDH, SONET and SDH interfaces.

Interface	Applications...
T-Carrier/PDH	See Table 20 on page 87
SONET	See Table 21 on page 88
SDH	See Table 22 on page 89

Table 20 lists each of the jitter and wander test applications for the T-Carrier and PDH interfaces.

Table 20 T-Carrier and PDH jitter and wander test applications

Signal	Payload	Test Mode
DS1 Jitter DS1 Wander	DS1 BERT	Terminate

Table 20 T-Carrier and PDH jitter and wander test applications (Continued)

Signal	Payload	Test Mode
DS3 Jitter DS3 Wander	DS3 BERT E1 BERT DS1 BERT	Terminate
E1 Jitter E1 Wander	E1 BERT	Terminate
E3 Jitter E3 Wander	E3 BERT E1 BERT	Terminate
E4 Jitter E4 Wander	E4 BERT E3 BERT E1 BERT	Terminate

Table 21 lists each of the jitter and wander test applications for the SONET interface.

Table 21 SONET jitter and wander test applications

Signal	Payload			Test Mode
STS-1 Jitter STS-1 Wander			Bulk BERT	Terminate
	DS3		DS3 BERT DS1 BERT E1 BERT	Terminate
	VT-1.5		Bulk BERT DS1 BERT	Terminate
OC-3 Jitter OC-3 Wander			STS-3c Bulk BERT	Terminate
	STS-1		Bulk BERT	Terminate
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
	VT-1.5		Bulk BERT DS1 BERT	Terminate
OC-12 Jitter OC-12 Wander			STS-12c Bulk BERT	Terminate
			STS-3c Bulk BERT	Terminate
	STS-1		Bulk BERT	Terminate
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
	VT-1.5		Bulk BERT DS1 BERT	Terminate

Table 21 SONET jitter and wander test applications (Continued)

Signal	Payload			Test Mode
OC-48 Jitter OC-48 Wander			STS-48c Bulk BERT	Terminate
			STS-12c Bulk BERT	Terminate
			STS-3c Bulk BERT	Terminate
	STS-1		Bulk BERT	Terminate
		DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
	VT-1.5		Bulk BERT DS1 BERT	Terminate

Table 22 lists each of the jitter and wander test applications for the SDH interface.

Table 22 SDH jitter and wander test applications

Signal	Payload				Test Mode
STM-1 Jitter STM-1e Jitter	AU-4	VC-4		Bulk BERT	Terminate
			E4	E4 BERT E3 BERT E1 BERT	Terminate
		VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT E1 BERT	Terminate
		VC-12		Bulk BERT E1 BERT	Terminate
	AU-3	VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT	Terminate
				E1 BERT	Terminate
		VC-12		Bulk BERT E1 BERT	Terminate
STM-4 Jitter	AU-4			VC-4-4c Bulk BERT	Terminate

Table 22 SDH jitter and wander test applications (Continued)

Signal	Payload				Test Mode
		VC-4		Bulk BERT	Terminate
			E4	E4 BERT E3 BERT E1 BERT	Terminate
		VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT E1 BERT	Terminate
		VC-12		Bulk BERT E1 BERT	Terminate
	AU-3	VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT	Terminate
				E1 BERT	Terminate
		VC-12		Bulk BERT E1 BERT	Terminate
STM-16 Jitter	AU-4			VC-4-16c Bulk BERT	Terminate
				VC-4-4c Bulk BERT	Terminate
		VC-4		Bulk BERT	Terminate
			E4	E4 BERT E3 BERT E1 BERT	Terminate
		VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT E1 BERT	Terminate
		VC-12		Bulk BERT	Terminate
				E1 BERT	Terminate

Table 22 SDH jitter and wander test applications (Continued)

Signal	Payload				Test Mode
	AU-3	VC-3		Bulk BERT	Terminate
			DS3	DS3 BERT E1 BERT DS1 BERT	Terminate
			E3	E3 BERT E1 BERT	Terminate
		VC-12		Bulk BERT E1 BERT	Terminate

Before testing

If you want to test optical jitter or wander, before selecting a test application, be certain to do the following:

– Connect the power adapter before launching the optical jitter/wander function.

– Verify that you have turned on the jitter/wander function by pressing the System button. If the Jitter icon is not highlighted in yellow, turn it on.

Transmitting jitter

You can use your instrument to manually generate and transmit a jittered signal.

To generate and transmit a jittered signal manually

1 Using the Test Menu, select the jitter test application for the signal and payload you are testing (see Table 20 on page 87 through Table 22 on page 89).

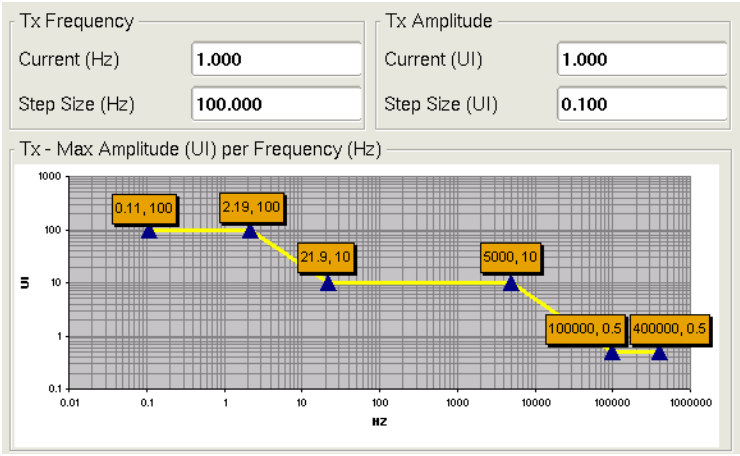
2 Do one of the following:
   – If you are testing on a T-Carrier or PDH interface, follow step 2 on page 17 through step 7 on page 17 in Chapter “This chapter provides step-by-step instructions for testing T-Carrier and PDH networks. Topics discussed in this chapter include the following:”.
   – If you are testing on a SONET or SDH interface, select the **Setup** soft key, and then follow step 2 on page 64 to step 8 on page 65 in Chapter 3 “SONET and SDH Testing”.

3 Select the Jitter tab, and then, in the panel on the left side of the tab, select **General**.

4 Under Tx Frequency, specify the following:
   – **Current** (Hz) — Specify the jitter frequency.
   – **Step Size** (Hz) — Specify how much to increase or decrease the jitter modulation frequency using the up or down buttons provided on the Jitter Tx toolbar on the main screen.

5 Under Tx Amplitude, specify the following:
   – **Current** (UI) — Specify the jitter amplitude.
   – **Step Size** (UI) — Specify how much to increase or decrease the jitter modulation amplitude using the up or down buttons provided on the Jitter Tx toolbar on the main screen.

The graphic under the settings illustrates the relationship between the maximum jitter modulation amplitude for a given jitter modulation frequency.



6 To return to the Main screen, select the **Results** soft key.

7 Connect a cable from the appropriate TX connector to the RX access connector on the device under test (DUT) or the network.

8 If you are testing an optical signal, select the **Laser** button.

The button label becomes Laser On.

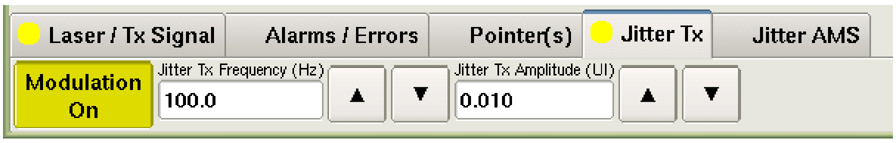
9 Verify the LEDs.

– If you are testing on a T-Carrier or PDH interface, see step 11 on page 19.

– If you are testing on a SONET or SDH interface, see step 14 on page 65.

– If you are testing on an OTN interface, see step 8 on page 173.

10 To start transmitting the jittered signal, select the **Modulation** button on the Jitter Tx action bar.



11 You can optionally increase or decrease the frequency or amplitude of the jittered signal using the corresponding up and down arrows.

The Transport Module starts to modulate the transmitted signal with the specified jitter.

Manually measuring jitter

You can use the Transport Module to detect jitter in high-band, wide-band, extended-band, or user-defined band ranges on received signals. You can also measure RMS jitter to determine the average amount of jitter for a specific period of time. Before measuring jitter, you must specify the jitter analysis frequency range on the received signal that you are analyzing for jitter. You can also optionally specify the thresholds for declaring phase hits.

Results for manual jitter measurement include:

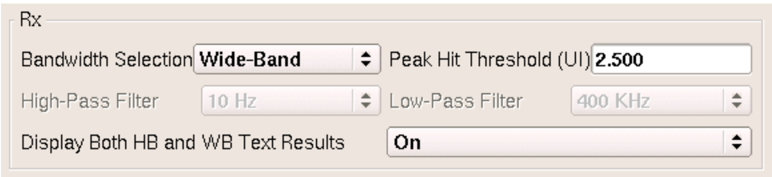
– Peak measurements, expressed in UIp (unit intervals peak).

– Peak-to-peak measurements, expressed in UIpp (unit intervals peak-to-peak).

- Jitter percent mask (the ratio of measured jitter to the ANSI/ITU-T tolerance mask for each range and rate).
- The maximum positive and negative jitter peaks and the maximum peak-to-peak.
- A count of phase hits. For details about how this count is derived, see "Phase hits" on page 251.
- RMS Jitter result.

To measure jitter manually

1. Using the Test Menu, select the jitter test application for the signal and payload you are testing (refer to Table 20 on page 87 through Table 22 on page 89).
2. Do one of the following:
   - If you are testing on a T-Carrier or PDH interface, follow step 2 on page 17 through step 7 on page 17 in Chapter "This chapter provides step-by-step instructions for testing T-Carrier and PDH networks. Topics discussed in this chapter include the following:".
   - If you are testing on a SONET or SDH interface, select the **Setup** soft key, and then follow step 2 to step 8 on page 65 in Chapter 3 "SONET and SDH Testing".
3. Select the Jitter tab, and then, in the panel on the left side of the tab, select **General**.
4. To specify the frequency range over which to capture the results, under Rx, specify one of the following in the Bandwidth Selection field:
   - **Wide-Band**, and then specify whether to display both High-Band and Wide-Band Results (ON) or only Wide-Band Results (Off).
   - **High-Band**
   - **Extended-Band**
   - **User-Band**, and then specify the High Pass and Low Pass filter as applicable.
   - **RMS-Band**



5. To specify thresholds for detecting jitter phase hits, use the keypad to type the threshold in UI in the Peak Hit Threshold field, and then select **OK**. For details about phase hits, see "Phase hits" on page 251.
6. To return to the Main screen, select the **Results** soft key.
7. Connect a cable from the appropriate RX connector to the network's TX access connector.
8. Verify the LEDs.
   - If you are testing on a T-Carrier or PDH interface, see step 11 on page 19.
   - If you are testing on a SONET or SDH interface, see step 14 on page 65.
9. Select **Restart**.
10. To observe the jitter results, set one of the result windows to display the Summary group, set another results window to display the Interface group, and then select one of the Jitter categories (see "Jitter results" on page 205).

Jitter is measured.

Automatic Measurement Sequences

You can configure the Transport Module to run test sequences that automatically measure Maximum Tolerable Jitter (MTJ), Fast MTJ, and the Jitter Transfer Function (JTF). You can use the default mask and scan points *or* customize the mask and scan points for your tests.

Measuring jitter tolerance

Two automated test sequences are available that help you determine a NE's ability to tolerate jitter:

– The automated MTJ sequence measures the Maximum Tolerable Jitter by transmitting a jittered test signal to the receiver of the NE. The sequence uses an algorithm to automatically increase the jittered signal's amplitude at various frequencies (in *search steps* specified as *mask points* and *scan points*) until the NE transmits errors exceeding the value specified on your instrument as the *sensor threshold*. For a detailed explanation of this sequence, see "MTJ test sequence" on page 252.

– The automated Fast MTJ sequence uses a subset of mask points and scan points to quickly measure MTJ. For a detailed explanation of this sequence, see "Fast MTJ test sequence" on page 252.

Measuring MTJ / Fast MTJ involves specifying the settling time for the device under test, the gate time and recovery time for the measurement, the error source, the sensor threshold, the mask (MTJ tests only), and scan points.

To measure MTJ or test Fast MTJ

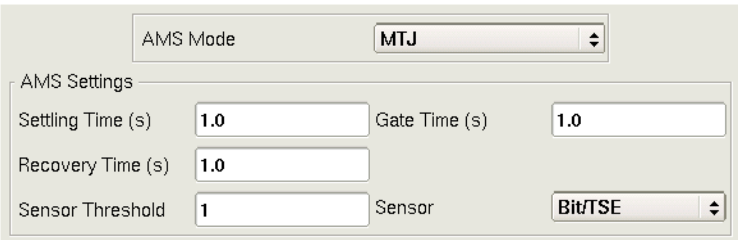
1 Using the Test Menu, select the jitter test application for the signal and payload you are testing (refer to Table 20 on page 87 through Table 22 on page 89).

2 Configure the transmit parameters. See step 2 of "Transmitting jitter" on page 91.

3 Configure the receive parameters. See step 2 of "Manually measuring jitter" on page 92.

4 In the panel on the left side of the Jitter tab, select **AMS Settings**.

The AMS settings appear.



5 In AMS Mode, indicate whether you want to measure MTJ or Fast MTJ, and then specify the following parameters:

– Settling Time (in seconds). See "Settling time" on page 267.

– Gate Time (in seconds). See "Gate time" on page 260.

– Recovery Time (in seconds).

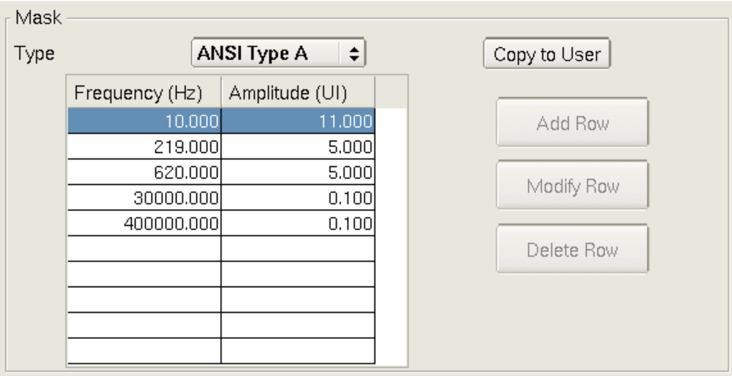
– Sensor Threshold, see "Sensor threshold" on page 267.

If you selected MTJ mode in step 4, proceed to step 6.

If you selected Fast MTJ mode in step 4, proceed to step 9 on page 95.

6 To configure mask settings, in the panel on the left side of the tab, select **AMS Mask**.

The mask settings appear.



7 In Mask Selection, indicate whether you want to use the standard mask defined by ANSI or ITU-T, or defined your own mask (User).

If you selected a standard mask, proceed to step 9.

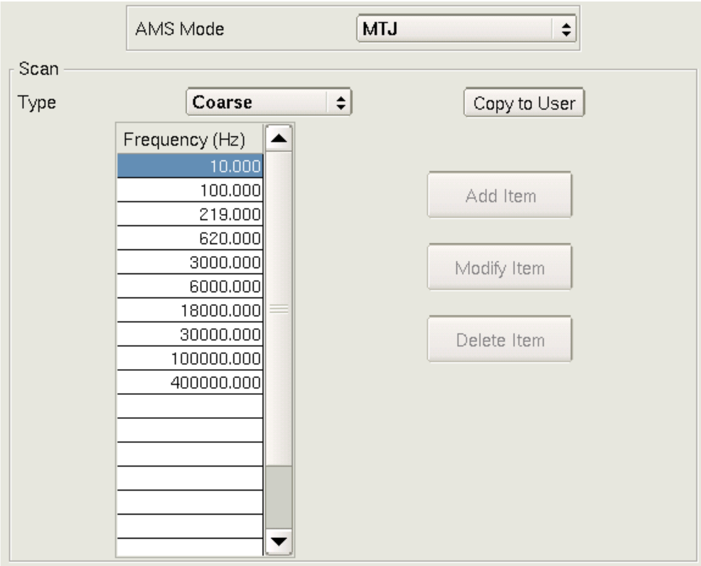
If you selected User, proceed to step 8.

8 To define your own mask, do the following:

To...	Do...
Add a mask point	**1** Select an empty row in the table. **2** Select **Add Row**. **3** Specify the frequency and amplitude for the new mask point. **4** Select **OK**.
Modify a mask point	– Select an existing row in the table. – Select **Modify Row**. – Specify the frequency and amplitude for the modified mask point. – Select **OK**.
Delete a mask point	– Select an existing row in the table. – Select **Delete Row**. – Select **OK**.
Use the standard mask setting as the basis of the user-defined mask	– In Mask Selection, select a standard mask, and then select **Copy to User** to copy the standard mask settings to the user-defined mask field. – Under Mask Selection, select **User**. – Edit the User mask by adding, modifying, or deleting the mask points copied from the standard mask. – Select **OK**.

9 To configure scan points, in the panel on the left side of the tab, select **AMS Scan**.

The scan settings appear.



10 Under Scan, select the arrows to the right of the Type field, and then select one of the following:

– **Coarse** — Provides a pre-defined lists of scan points

– **Fine** — Provides a pre-defined lists of 20 scan points

The Fine setting provides more frequencies than the Coarse setting. If you selected Fine or Coarse, proceed to step 12.

– **User** — Allows you to define up to 20 scan points. Proceed to step 11.

11 To define your own scan points, do the following:

To...	Do...
Add a scan point	**1** Select an empty row in the table. **2** Select **Add Item**. **3** For testing MTJ, specify the frequency for the new scan point. For testing Fast MTJ, specify the frequency and amplitude for the new scan point. **4** Select **OK**.
Modify a scan point	**1** Select an existing row in the table. **2** Select **Modify Item**. **3** For testing MTJ, specify the frequency for the modified scan point. For testing Fast MTJ, specify the frequency and amplitude for the modified scan point. **4** Select **OK**.
Delete a scan point	**1** Select an existing row in the table. **2** Select **Delete Item**. **3** Select **OK**.

To...	Do...
Use the standard scan points as the basis of the user-defined mask	**1** Under Scan Selection, select the arrows to the right of the Scan field, select **Fine** or **Coarse**, and then select **Copy to User** to copy the standard scan points to the user-defined Scan Points. **2** Under Scan Selection, select **User**. **3** Edit the User scan points by adding, modifying, or deleting the scan points copied from the standard scan points. **4** Select **OK**.

12 To return to the Main screen, select the **Results** soft key.

13 Connect a cable from the appropriate RX connector to the network's TX access connector.

14 Connect a cable from the appropriate TX connector to the network's RX access connector. See Figure 43 on page 252.

15 Configure the devices on the network as needed.

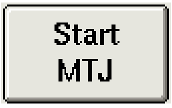
16 If you are testing an optical signal, select the **Laser** button.

17 Verify the LEDs.

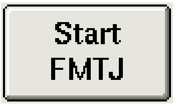
- If you are testing on a T-Carrier or PDH interface, see step 11 on page 19.
- If you are testing on a SONET or SDH interface, see step 14 on page 65.
- If you are testing on an OTN interface, see step 8 on page 173.

18 Do one of the following:

- To measure MTJ, select the Jitter AMS action bar, and then select the **Start MTJ** button.



- To test Fast MTJ, select the **Start FMTJ** button.



NOTE:

You cannot change settings or select any button on the Main screen while the automatic test sequence is running. To change settings when the test sequence is running, you must first stop the test by selecting the
Stop MTJ / FMTJ button.

After you change the settings, select the **Start MTJ / FMTJ** button again to restart the test sequence.

Selecting the Restart soft key will abort the test. To reactivate the test sequence, you must select the **Start MTJ / FMTJ** button.

19 Wait for the test to end or do one of the following:
   - Manually stop the test by selecting the **Stop MTJ** or **FMTJ** button again.
   - Restart the test by selecting the **Restart** soft key.

> **NOTE:**
> Restarting the test will abort the current test, clear the test results, and then restart the underlying test application.

The MTJ / Fast MTJ measurement is finished. You can observe the results by selecting MTJ Graph/ Fast MTJ Graph or MTJ Table/ Fast MTJ Table category in the Interface result group. For details about graphical and tabular jitter results, see "Graphical and Tabular jitter results" on page 208.

Measuring the jitter transfer function

Measuring JTF involves specifying transmit and receive parameters, the settling time for the device under test, and the recovery time for the measurement. To ensure optimum accuracy, the transmitter/receiver of the Transport Module must be calibrated before making JTF measurements.

To measure JTF

1 Using the Test Menu, select the jitter test application for the signal and payload you are testing (see Table 20 on page 87).

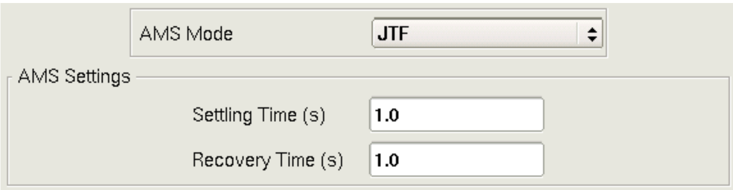
2 Configure the transmit parameters. See step 2 of the "Transmitting jitter" on page 91.

3 Configure the receive parameters. See step 2 of the "Manually measuring jitter" on page 92.

4 In the panel on the left side of the tab, select **AMS Settings**.

5 In AMS Mode, select **JTF.**

The settings appear.



> **NOTE:**
> You cannot view extended-band results in JTF mode. If you selected extended-band in step 3, when you select JTF in the AMS Mode field, the Transport Module will automatically change the bandwidth to wide-band.

6 Specify the following parameters:
   - Settling Time (in seconds). See "Settling time" on page 267.
   - Recovery Time (in seconds).

7 To configure mask settings, see step 6 to 8 of "Measuring jitter tolerance" on page 94.

8 To configure scan points, see step 9 to 11 of "Measuring jitter tolerance" on page 94.

9 To return to the Main screen, select the **Results** soft key.

10 To calibrate the test set, do the following:

   a Loop the transmitter back to the receiver.

b Select the **Start Calibration** button.

A message appears in the message bar indicating that the calibration is in progress.

11 After the test set is calibrated, connect a cable from the appropriate RX connector to the network's Tx access connector.

12 Connect a cable from the appropriate TX connector to the network's Rx access connector.

13 Configure the devices on the network as needed.

14 If you are testing an optical signal, select the **Laser** button.

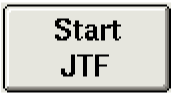
The button label becomes Laser On.

15 Verify the LEDs.

– If you are testing on a T-Carrier or PDH interface, see step 11 on page 19.

– If you are testing on a SONET or SDH interface, see step 14 on page 65.

16 Select the **Start JTF** button.



NOTE:

If you did not calibrate the test set before selecting the Start JTF button, a warning appears informing you that calibration is required. Calibrate the test set (see step 10 on page 98), and then proceed to step 16.

NOTE:

You cannot change settings or select any button on the Main screen while the automatic test sequence is running. To change settings when the test sequence is activated, you must first stop the test by selecting the
Stop JTF button.

After you change the settings, select the **Start JTF** button again to reactivate the test sequence.

Selecting the **Restart** soft key will abort the test. To reactivate the test sequence, you must select the **Start JTF** button.

17 Wait for the test to end by viewing the message displayed in the Message Bar or do one of the following:

– Manually stop the test by selecting the **Stop JTF** button again.

– Restart the test by selecting the **Restart** soft key.

NOTE:

Restarting the test will abort the current test, clear the test results, and then restart the underlying test application.

After the JTF measurement sequence starts, you can observe the results by selecting the JTF Graph or JTF Table category in the Interface result group.

Timing reference wander measurement

If the instrument is optioned to do so, measurements of other timing signals to an external reference can be performed to verify the performance of the clock network. If the clocks drift from their intended frequency range, the wander analysis will accurately characterize them.

Clock signals that may be verified are 1pps, 2.048MHz and 10.00MHz.They may be analyzed in comparison to external BITS, SETS, 2.048MHz and 10.0MHZreference timing signals (measurement against BITS or SETS requires CIB rev 008 or greater).

With TIE/MTIE (Time Interval Error, Maximum Time Interval Error) tests, the incoming timing reference clock is recovered and compared against the external clock interface. An analysis file is generated which can be displayed in real-time or saved for later offline analysis with a Wander analysis tool. Offline wander analysis may be conducted using the onboard Wander Analysis Tool or using the External Wander Analysis Tool, run on an external PC. For information on the Wander Analysis tools see "Analyzing wander" on page 105.

1PPS Analysis

If the instrument is optioned to do so, analysis measurements using a 1PPS reference from an optional GPS receiver can be taken to determine whether the 1PPS service provided by a PTP slave device is accurately traceable to external reference equipment.

To analyze 1PPS signals

1 Depending on which instrument you are using, refer to Figure 8 on page 101 through Figure 11 on page 102 to connect the cables.

   a Do one of the following:

   – For MSAMv2, Connect the BNC to SMA cable between the GPS receiver 1PPS output connector ("OUT B") and the SMA reference input ("EXT REF" or "EXT CLK" on 5800v2) connector panel.

   – For 5800v2, Connect the BNC to SMA cable between the GPS receiver 1PPS output connector ("OUT B") to the SMA Timing Cable Adapter's CLK1 connector, which is connected to the "EXT CLK" connector on your instrument.

   b Depending on the PTS Slave, do one of the following:

   – If connecting to a RJ45 jack on the PTP Slave, connect the RJ45 to USB cable from the MSAM's USB port to the RJ45 jack on the PTP Slave device under test.

   – If connecting to a SMA jack on the PTP Slave, connect the USB to SMA from the MSAM's USB port to the SMA jack on the PTP Slave device under test.

   – If connecting to a BNC jack on the PTP Slave, connect the BNC to SMA cable to the SMA to USB cable, and then plug the USB connector into the MSAM's USB port and the BNC connector into the BNC jack on the PTP Slave device under test.

c *Optional.* Connect the DB9 to USB serial cable from the Control Port on the GPS receiver to a PC.

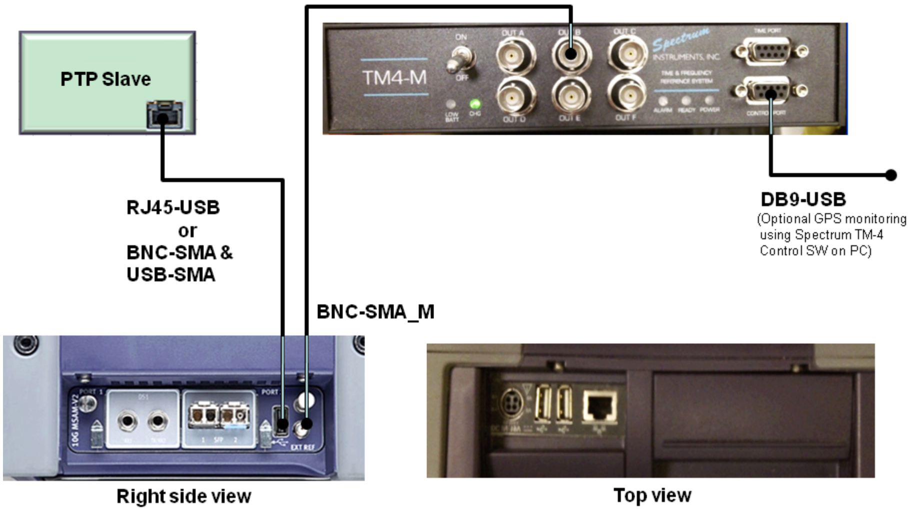


Figure 8 GPS Connections- MTS-6000A with MSAMv2

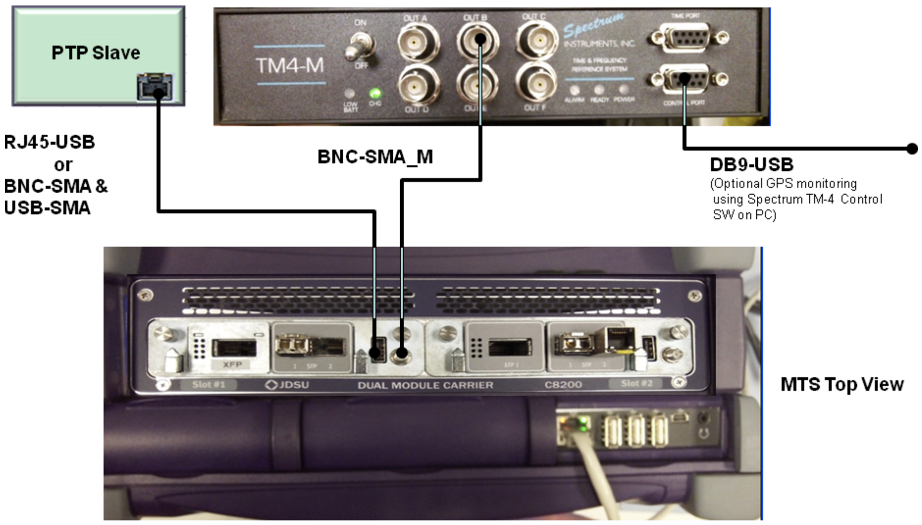


Figure 9 GPS Connections- MSAMv2 with MTS-8000v2

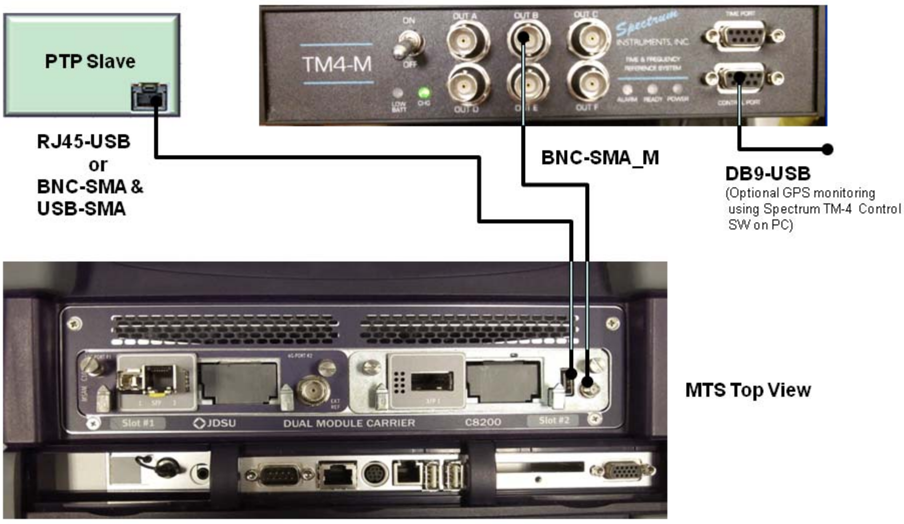


Figure 10 GPS Connections- MSAMv2 with MTS-8000v1

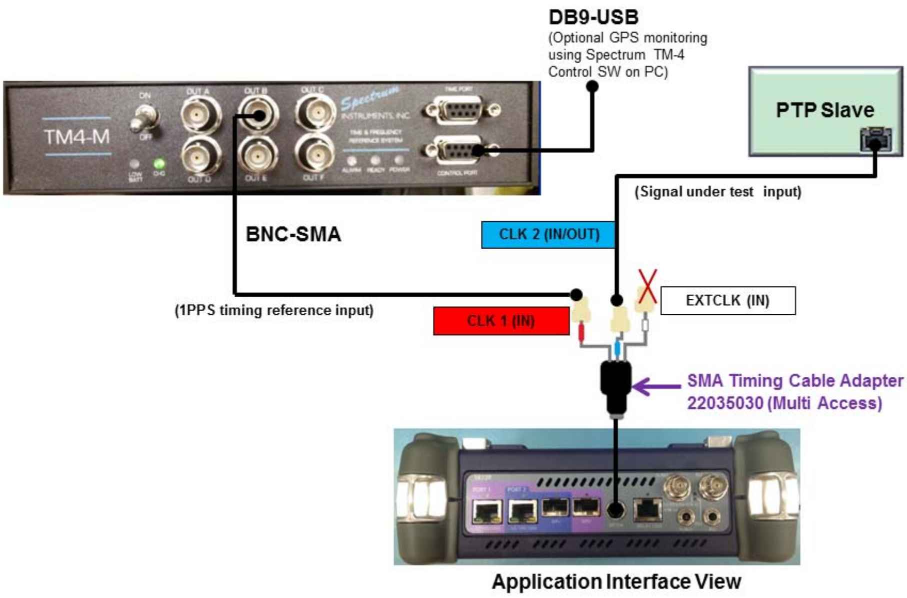


Figure 11 GPS Connections- 5800v2

2 Using the Test Menu, select the 1PPS Analysis application.

3 Before beginning the test, verify that the GPS receiver and instrument are synchronized and ready.

   a Verify that the appropriate LEDs on the GPS receiver are flashing or steadily on (refer to the instructions included with the GPS receiver).

   b Verify that the TOD Sync and 1PPS LEDs on the instrument are on.

4 Select the **Setup** soft key, and then do the following:

   a On the 1PPS Analysis tab, set the Maximum allowable time offset (ns). The Offset threshold can be set for any value between 100ns and 100,000ns, in 100ns increments. The default value is 1000ns.

   b On the Timed Test tab, set the test to either **Not Timed**, **Timed Test** or **Delayed Timed Test.**

   c Set the test duration and start time parameters for the Timed Test and Delay, if selected.

5 Select the **Return** soft key to return to the Results page.

The 1PPS Analysis test has been initiated.

Other reference timing wander applications

Table 23 lists each of the timing wander analysis applications for the timing reference interface.

Table 23 Timing wander analysis applications

Signal	Test Mode
2.048MHz Wander	Monitor
10.0MHz Wander	Monitor

To measure wander on timing reference signals

1 Using the Test Menu, select the monitor application for the signal you are testing (refer to Table 23 on page 103).

2 Select the **Setup** soft key.

3 On the Wander tab specify the desired Low Pass Filter/Sample Rate from the drop down box.Select the arrows to the right of the Low-Pass Filter field, and then select the desired Rx filter value.

   The filter you specify automatically determines the sampling rate for the wander measurement.

4 On the Timed Test tab define the starting time and length of test parameters.

5 Select the **Results** soft key.

6 Check that all signals are connected to the appropriate connectors on the instrument as detailed inTable 24 on page 103

Table 24 Reference Signal Input Connectors

Analyzed Signal	Interface	Applicable External Reference Signal	Reference Input Connector
2.048MHz	USB	BITS, SETS, 2.048MHz, 10.0 MHz	SMA
10.0 MHz	USB	BITS, SETS, 2.048MHz,10.0 MHz	SMA

7 Select **Restart**.

8 Run the test for an appropriate length of time. To ensure accuracy of your results, let the test run for at least one minute.

9 To view the wander results, set one of the result windows to display the Summary group, set another results window to display the Interface group, and then select the Wander category.

   To view the wander results in a graphical format, select the Wander Graph category. For more details, see "Wander results" on page 209.

TIE is measured.

Saving and exporting wander measurement data

You can save the TIE result data to a .hrd or the newer .chrd file on the base instrument's hard drive, export the saved file to a USB memory key, and then do further analysis of MTIE and TDEV by loading the file on a remote PC using the O.172 MTIE/TDEV Offline Analysis software application that shipped with your instrument.

To save the TIE data

1. Select the **Save TIE Data** soft key.
2. Select whether the data is to saved in **hrd** or the newer **chrd** format.
3. The wander data is saved into a file in the following folder on your instrument:

   `../acterna/storage/bert/user/bert/reports`

   The file name is automatically assigned with a `TIE_` prefix followed by date, time, test mode, and interface information as shown in the following example:

   `TIE_2007-08-16T15.59.19_TermDs1WanderTieEvalMsec.hrd`

The TIE data is saved.

To export the TIE data to a USB memory key

1. Insert a USB memory key into one of the two slots provided on the top panel of the base unit.
2. Select the **Export TIE Data** soft key.
3. Select the USB port to which the data is to be saved.
4. The Wander Data Files screen appears, listing the wander data files in:

   `../acterna/storage/bert/user/bert/reports`
5. Select the wander data file you want to export, and then press the **Export to USB** soft key.

   The File Export dialog box appears, indicating that the instrument is copying the selected report file to the USB memory key.

The TIE data is exported. If desired, it can now can be loaded into the PC-based Offline Wander Analysis Tool.

> **NOTE:**
> Restarting a test clears the wander history data. If you want to preserve the wander data for the current measurement, you must export the data before restarting a test.

Measuring and analyzing wander

If you purchased the optical or electrical wander testing option, you can analyze Time Interval Error (TIE) data and calculated MTIE/TDEV (Maximum Time Interval Error/Time Deviation) results to evaluate the condition of your network elements by using the Wander Analysis tool.

NOTE:

The time it takes to update the TIE data or calculate MTIE/TDEV depends on the amount of data collected. For faster processing, it is recommended that you export the wander data for offline analysis using the O.172 MTIE/TDEV Offline Analysis software that ships with the electrical wander or optical jitter and wander test option. For details about exporting wander data, see “” on page 108.

Also, due to intense resource requirements, the Wander test must be run exclusively. No other test may be run simultaneously on a instrument making wander measurements.

Wander Analysis can be done on TIE data that has just been collected on the instrument or on data that was previously collected and saved for later analysis. The Wander Analysis tool is not application specific- it can analyze valid TIE data collected from any wander application without regard to the currently loaded application.

Analyzing wander

After TIE data samples have been collected or recalled, the Transport Module or MSAM can do more detailed MTIE and TDEV calculations on them using the on-board Wander Analysis tool. This provides much more detail than the results available in the Interface/Wander category.

Loading Wander data

Wander TIE data that has been previously been saved to a file in the memory of the instrument can be recalled and loaded into the Wander Analysis tool for analysis and display.

Loading TIE data

1 From within any wander application, select the **Wander Analysis** soft key.

2 Select the **Load TIE Data** soft key. The TIE Load Data window appears.

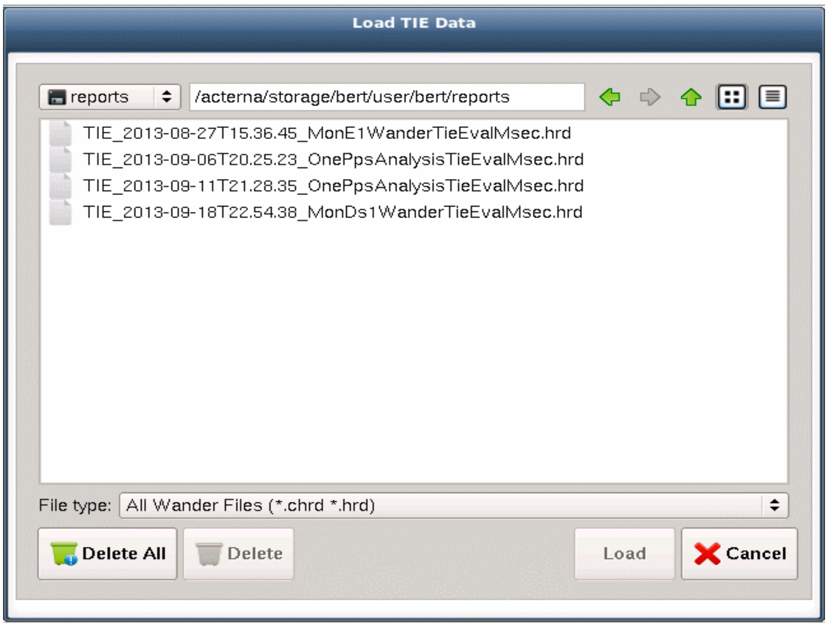


Figure 12 Load TIE Data Window

3 Select the desired file stored in the instrument's memory.

4 Select the **Load** button.

The stored TIE data will be loaded for analysis

Analyzing loaded data

After you have measured or recalled previously stored TIE data, the Transport Module can calculate MTIE and TDEV and display the results in a graphical format.

1 To collect current wander data, follow step 1 through step 5 of "1PPS Analysis" on page 100. or step 1 through step 9 of step "Other reference timing wander applications" on page 103. To load previously stored data, follow "Loading Wander data" on page 105.

2 Select the **Wander Analysis** soft key.

The graphical wander analysis screen appears with the TIE tab selected.

NOTE:

– You can run Wander Analysis while the test is in progress, however, if you modify the sample rate or restart the test, the wander data collected previously will be cleared. If you want to preserve the wander data for the previous measurement, save the data before restarting a test. Note: the saved data cannot be loaded into the On-board Wander Analysis tool; it calculates MTIE and TDEV on all the data accumulated so far.

– Wander analysis is restricted to the first 8.64 million samples. If your measurement contains more samples, you must export the wander data for offline analysis.

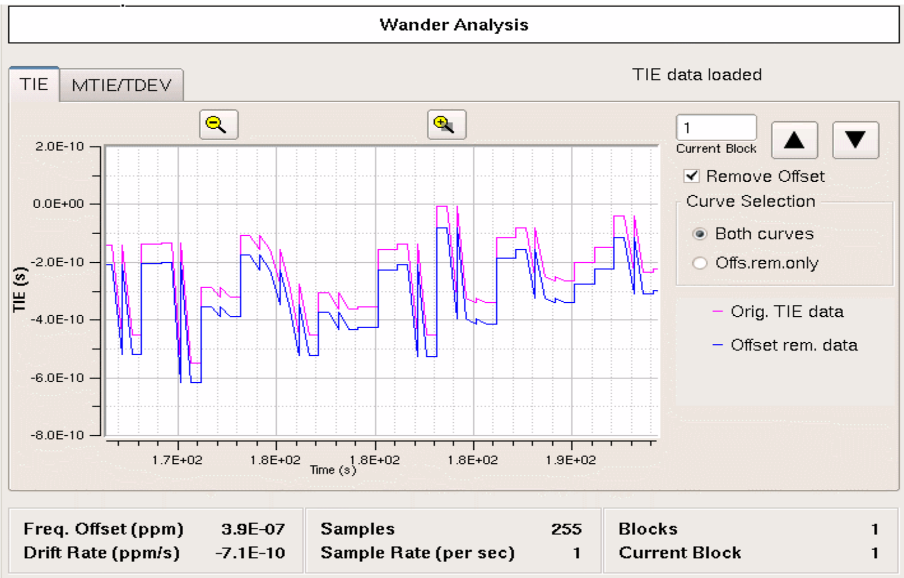
– Wander analysis is a memory intensive operation. Therefore, you can only process wander data while running a single application.

For detailed information about saving and exporting wander data, see "" on page 108.

3 Select the **Update TIE Data** soft key.

This refreshes the data in the Wander Analysis screen. All of the TIE samples accumulated so far (including those gathered since the tool itself was launched) are redrawn, and then MTIE and TDEV are recalculated.

The TIE graph appears. The Wander Analyzer automatically displays the last block of continuous valid data.



4 To observe another block of data, select the Current Block field, type the block number, and then select **OK**.

The data block you specified appears.

A block of TIE data is a contiguous subset of all TIE samples that is not interrupted by any alarms. For Wander measurements, TIE values are sampled at a constant rate. If an alarm occurs (e.g. LOS), the receiver is not able to produce meaningful TIE values and stops producing TIE entries until it is able to recover. These alarms separate the whole measurement into sections, or “blocks”.

5 If you want to observe the frequency offset curve, clear the **Remove Offset** checkbox.

6 To select the data curve to observe, under Curve Selection, do one of the following:

– To observe both TIE and frequency offset data curves, select **Both Curves**.

– To observe only the frequency offset data curve, select **Offs.rem.only**.

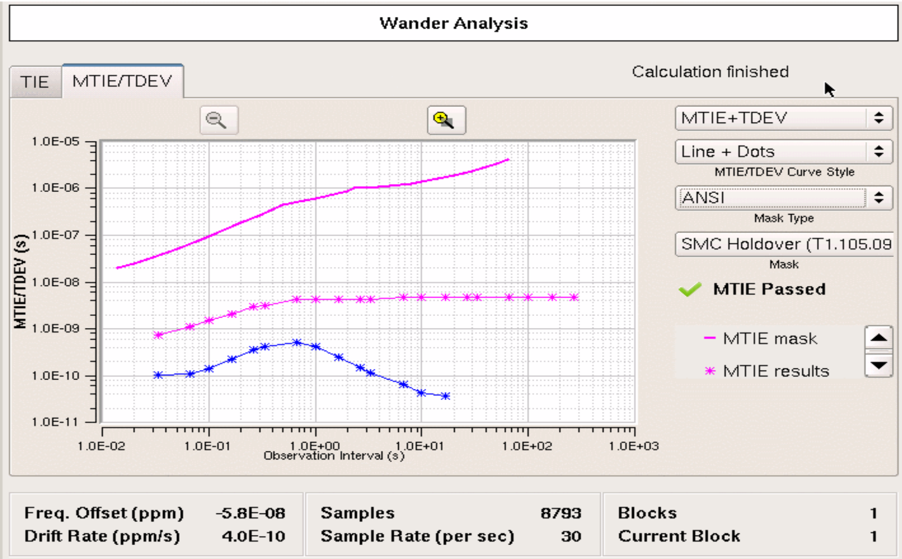
7 To refresh the graph, select the **Update TIE Data** soft key again.

8 To observe the MTIE/TDEV result graph, select the MTIE/TDEV tab.

The MTIE/TDEV graph screen appears.

9 Select **Calculate MTIE/TDEV** to start calculating MTIE and TDEV results.

The MTIE/TDEV graphs appear.



10 To customize the graph, do the following:

- **a** To select the data curves you want to observe, select **MTIE only**, **TDEV only**, or **MTIE+TDEV**.
- **b** To select the curve style, select the arrows to the right of the Curve Style field, and then select **Line+Dots**, or **Dots only**.

11 If you want to select a mask to compare the data against, do the following:

- **a** In the Mask Type field, specify a mask type.
- **b** In the Mask field, specify a mask to compare the data to.

The mask curve appears on the result graph.

If you do not want to compare the data against a mask, in the Mask field, select **None**.

12 Do one of the following:

- To stop calculating MTIE/TDEV before the calculation is complete, select the **Stop Calculation** soft key.
- To refresh the graph, select **Calculate MTIE/TDEV** again.
- To return to the Main screen, select the **Results** soft key.
- To stop wander analysis and return to the Main screen, select the **Close Analysis** soft key.

NOTE:

Selecting the Close Analysis soft key stops analyzing the data and clears test results. This will discard all MTIE and TDEV results calculated inside the Analysis tool. It will not discard the real-time MTIE results displayed in the Interface/Wander category. To return to the Main screen without ending the current analysis, use the **Results** soft key.

5

NextGen Testing

This chapter provides step-by-step instructions to perform NextGen tests using the instrument. Topics discussed in this chapter include the following:

About NextGen testing

If your MSAM is configured and optioned to do so (not available on CSAM, 40/100G Transport Module, or 5800v1 or 5800v2), you can use it to analyze the performance of NextGen networks by performing standard SONET and SDH tests to verify the physical layer, analyzing virtual concatenation groups (VCGs) in the SONET or SDH pipe, and running BER tests. After performance is verified at each of these layers, you can transmit and analyze generic framing procedure (GFP) traffic carrying Ethernet frames, and then run layer 2 and layer 3 Ethernet tests to verify that network performance conforms to all applicable ITU-T and IEEE standards.

> **NOTE:**
> The term “NextGen” is used throughout this chapter to represent Next Generation, New Generation, and MSTP networks.

The NextGen test applications are resource-intensive; therefore, when running them using an MSAM:

- It must be a *dual port* MSAM to run the applications.
- Only one NexGen application can be run at a time. If you have an MSAMv2, applications can be run from either *Port 1 or Port 2.* If you have an MSAMv1, tests can be run from *Port 1 only*.

Features and capabilities

When optioned to do so, the instrument supports the following:

- VCG generation and analysis—You can now actively create and transmit virtual concatenation groups (VCGs). You can populate the VCG payload with a BERT pattern to verify that a minimum of bit errors occur during transmission, detect errors for a VCG, and insert errors and alarms for a particular member of the group. Finally, you can verify the path for specific members, add or remove members, and determine whether pointer adjustments occurred within a 100 ms latch period.
- High and low order virtual concatenation—For SONET networks, VCG and GFP analysis is supported for high order STS-1c and STS-3c, and low order VT-1.5 paths. For SDH networks, high order VC-4, high and low order VC-3, and low order VC-12 paths are supported.
- LCAS capability—You can determine the link capacity adjustment scheme (LCAS) MST status of VCG members, and the last LCAS command issued remotely. LCAS results appear in the LCAS result group. You can also now control LCAS members on both the source and sink sides when testing in Terminate mode.
- GFP traffic—You can configure, transmit, and analyze GFP-F traffic carrying Ethernet frames. Frame and error counts and statistics are provided in the GFP result category.
- GFP and SONET alarm insertion. You can insert and observe CSF (client signal fail) and LFD (loss of frame delineation) alarms, and SONET alarms when testing GFP traffic. For details, see “Inserting GFP errors or alarms” on page 141.
- Differential delay measurement. You can measure differential delay for each VCG, and each member in a group. The measurements appear in the Diff. Delay category under the VCAT result group. For details, see “Specifying VCG settings” on page 131.
- Expanded LCAS support and protocol capture. You can manually add or remove members from a VCG, and insert and detect LCAS errors and alarms. You can also specify PLTC (partial loss of transport capacity) thresholds that indicate when your instrument will declare a PTLC for the sink and source devices. For details, see “LCAS testing” on page 138.

– Path overhead captures. You can capture high or low path overhead bytes for a particular VCG member for analysis. When configuring the capture, you can indicate that you want to capture it manually, or specify a trigger to automate the capture. For details, see “Capturing POH bytes” on page 74 of Chapter 3 “SONET and SDH Testing”.

Using LEDs as a guide when testing

At a basic level, you can use the LEDs as a guide to the various layers that need to be tested on the NextGen network.

Test 1: SONET/SDH physical layer

The SONET/SDH LEDs are used when testing the physical layer. For more detailed information, you can also observe results in the Interface group, under the Signal category, and in the SONET or SDH group, under a variety of categories.

The Path LEDs are used when verifying that no errors occurred associated with the payload mapping of the SONET/SDH overhead. For more detailed information, you can also observe results in the SONET or SDH group, under the Line/MSOH, Section/RSOH, Path or HP category. LP and VT result categories are also available.

Throughout this chapter these are referred to as “classic SONET/SDH” tests, and procedures for the tests are provided in Chapter 3 “SONET and SDH Testing”.

Test 2: VCAT verification

The VCAT LEDs are used to verify that virtual concatenation group (VCG) members are reassembled quickly and accurately by the far end MSPP or test instrument. LEDs let you know if there was a loss of sequence (SQM), or loss of framing due to an incorrect MFI (OOM or OOM2). For more detailed information, you can also observe results in the SONET or SDH group, in the VCAT category. The VCG Analysis soft key provided on the Main screen also allows you to observe results for individual members of a VCG.

Test 3: LCAS verification

If Link Capacity Adjustment Scheme (LCAS) testing is enabled, LEDs are provided for the sink and source devices that indicate whether a loss of capacity (LOC), a partial loss of transport capacity (PTLC), or total loss of transport capacity (TLTC) occurred for the group. An LED is also provided which indicates that the sink device is not using LCAS. In addition to the LEDS, you can monitor the status of each sink or source member in the LCAS result group, and observe errored members.

Test 4: BER analysis

When you transmit a BERT payload, the Pointer and Payload LEDs are used to determine whether pointers were incremented or decremented for the VCG, and whether or not the instrument obtained pattern sync. For more detailed information, you can also observe results in the Payload group, in the BERT category.

Test 5: GFP and Ethernet analysis

When you transmit GFP encapsulated Ethernet traffic, the GFP LEDs are used to determine whether there was a loss of framing pattern (LOF), and to verify that no client signal fail (CSF) alarms were detected due to issues with the Ethernet interface or link. For more detailed information, you can also observe results in the GFP group, in the Error Stats, Traffic, and Tx Results categories.

The Ethernet LEDs are used to verify that Ethernet traffic is handled correctly, and received accurately by the far end MSPP or test instrument. For more detailed information, you can also observe link statistics, link counts, errors, and more in the Ethernet group, in a variety of result categories.

When analyzing Ethernet traffic, you can run the standard layer 2 and layer 3 traffic applications, and the layer 3 Ping and Traceroute applications. Throughout this chapter these are referred to as "classic Ethernet" tests, and procedures for the tests are provided in the Ethernet testing manual that shipped with your instrument or upgrade.

For descriptions of each individual NextGen LED, refer to:

– "SONET and SDH LEDs (TestPad mode)" on page 189
– "SONET and SDH LEDs (ANT mode)" on page 191
– "NextGen LEDs" on page 211
– Ethernet LEDs are described in the Ethernet testing manual that shipped with your instrument or upgrade.

About the NextGen user interface

The elements described in this section are unique to the MSAM when the instrument is running NextGen applications.

Understanding the LED panel

The LED panel provides LED categories that are appropriate for the NextGen application that you selected. A Summary LED also appears at the top of the panel indicating whether or not any Summary Status errors occurred. If it is red, you can observe the errored results in the Summary result group, in the Status category.

The LED categories can be expanded by selecting the plus sign next to the category name, and collapsed by selecting the category name again. A red X next to a category indicates that errored results have been detected; if no X appears, no errored results occurred for the category.

BERT LEDs

When you configure your unit to transmit a BERT payload over an SDH or SONET circuit, SONET or SDH, Path, VCAT, Pointer, and Payload LED categories appear on the Main screen. The LED names reflect the emulation mode (TestPad or ANT) that you selected when you set up your instrument.

Figure 13 illustrates the LED categories that appear when you are transmitting a BERT payload over a SONET circuit with LCAS enabled, and the instrument is operating in TestPad mode.

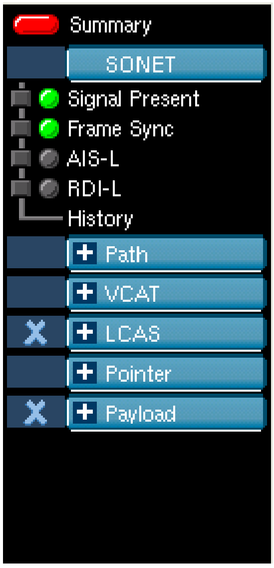


Figure 13 NextGen SONET LED Categories (BERT payload)

GFP LEDs

When you configure your unit to transmit and analyze GFP traffic over an SDH or SONET circuit, GFP and Ethernet LEDs also appear. Figure 14 illustrates the LED categories that appear when the instrument is operating in ANT mode with LCAS enabled.

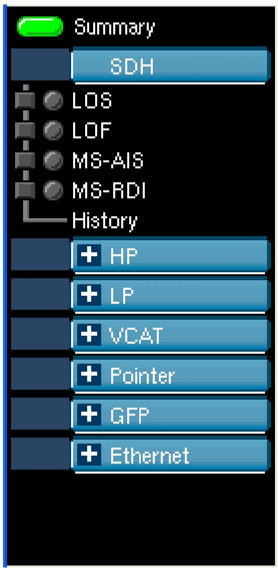


Figure 14 NextGen SDH LED categories (GFP Ethernet payload)

Understanding the graphical user interface

When you launch a NextGen application, the user interface is similar to the interface used for classic SONET and SDH applications, with additional features that are useful when testing NextGen networks. Figure 15 highlights some of the key elements that are used for NextGen testing.

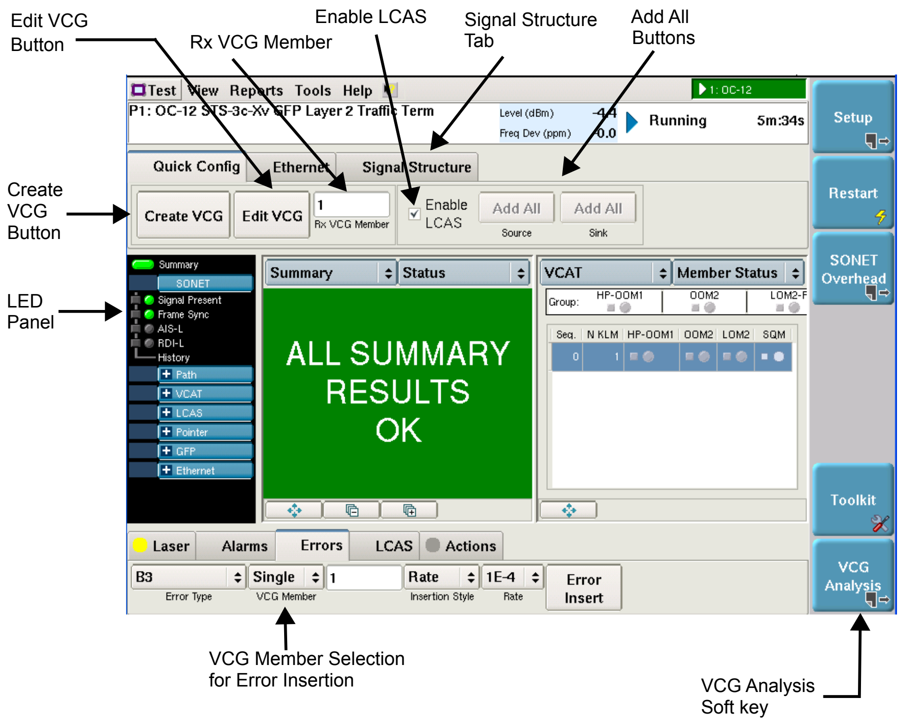


Figure 15 Main screen (NextGen GFP Application)

Create VCG quick configuration button

The Create VCG button allows you to define the VCAT pipe for the members that you want to analyze. Selecting the button presents the Define VCAT pipe dialog box, where you can specify the number of transmitted and received members for analysis, or you can specify the payload bandwidth you want to analyze. The instrument then automatically calculates the number of members or the payload bandwidth for you (based on the criteria that you specified).

For details, see “Creating a VCG for analysis” on page 130.

Edit VCG quick configuration button

The Edit VCG button allows you to add or remove members from defined VCGs. For details, see “Adding or deleting VCG members” on page 132.

Rx VCG Member Selection field

The Rx VCG Member Selection field allows you to specify a particular member for more detailed analysis. For example, if you are analyzing 3 members, specifying 2 in this field highlights test results for member 2 in the VCAT results group.

Enable LCAS

Select this option to enable LCAS on the Main screen rather than on the LCAS setup tab. To observe LCAS LEDs, be certain to press **Restart** to refresh the screen.

Add All buttons

If you enable LCAS, you can add sink and source members using the Add All buttons on the Main screen.

Signal Structure tab

The Signal Structure tab provides a picture of the signal structure you selected when you launched the application. Figure 16 illustrates the tab when you run a STM-64 > AU-4 > VC-12-Xv > BERT > Terminate application.

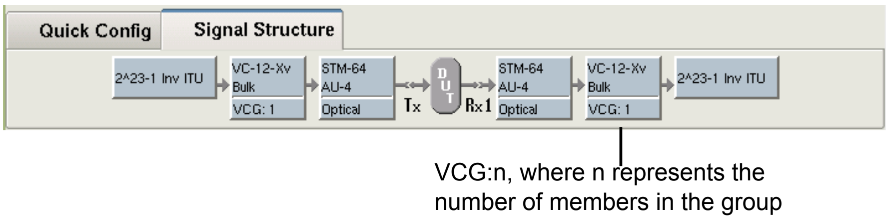


Figure 16 Signal Structure tab

LED Panel

The LED panel provides VCAT LEDs, in addition to the classic SONET or SDH LEDs. If you are transmitting GFP traffic, GFP and Ethernet LEDs are also provided. If LCAS is enabled, LCAS LEDs are provided.

VCG Member Selection for Error Insertion

The VCG Member Selection field on the Error toolbar allow you to select a specific member for error or alarm insertion. If the fields do not appear, the error or alarm is inserted for the entire VCG, or is not related to the group.

VCG Analysis soft key

The VCG Analysis soft key allows you to observe key results for both transmitted and received VCG members. You can also observe the results as a histogram. For details on VCG analysis, see "Analyzing a VCG" on page 134.

Understanding the NextGen test results

When you run NextGen applications, in addition to the classic SONET or SDH test results, results associated with the VCG are provided in the VCAT result group. If you are running an application with GFP traffic, GFP and classic Ethernet test results are also available.

For details, refer to "NextGen results" on page 210.

About the NextGen test modes

You can run NextGen applications in Terminate or Monitor mode. The classic layer 3 Ping and Traceroute applications can only be run in Terminate mode.

Monitor mode

Select monitor mode to monitor and analyze received traffic.Typically the instrument is positioned between an MSPP and a SONET/SDH network (as illustrated in Figure 17), and test traffic is monitored before turning up the new NextGen network.

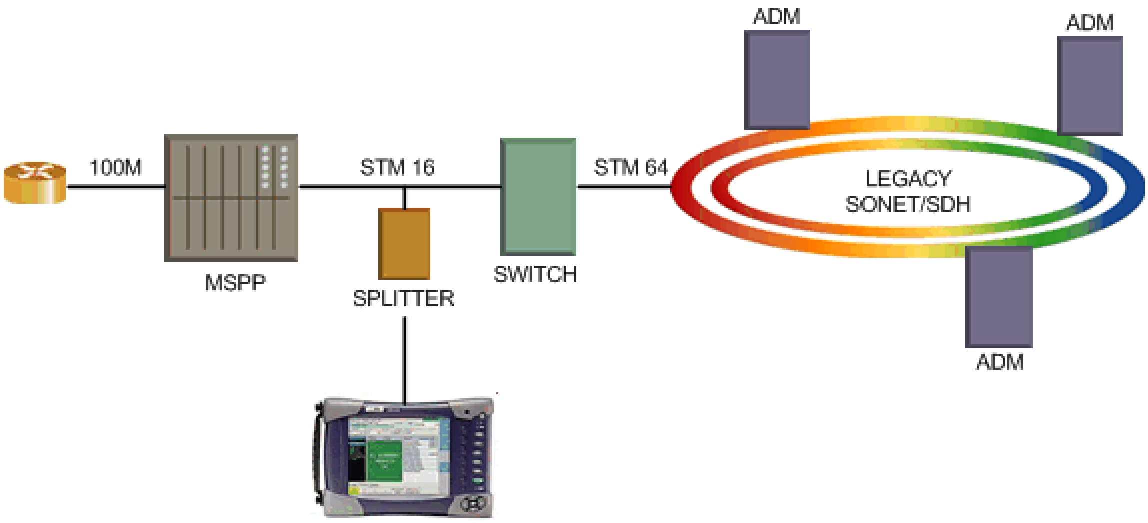


Figure 17 NextGen SONET/SDH Monitor Application

Terminate mode

Select terminate mode to generate, transmit, and analyze traffic over the NextGen network. In terminate mode, the instrument generates traffic independent of the received traffic, and allows you to select a virtual concatenation group to analyze. The specified VCG will be used to carry the data generated by the instrument. You can also define the number of members or the type of payload carried in the group (for example, 10M Ethernet).

The transmitter and receiver are set at the same rate using an internal, recovered, or external 1.5/2M reference transmit clock

When verifying Ethernet service at a NextGen interface, one test instrument is typically connected to the near end MSPP, and one is connected to the far end MSPP (as illustrated in Figure 18). The near end instrument then transmits GFP traffic upstream to the far end instrument, and the far end instrument transmits traffic downstream to the near end instrument. Classic Ethernet tests are performed, and results are observed to verify that the traffic is reassembled properly and no errors occurred.

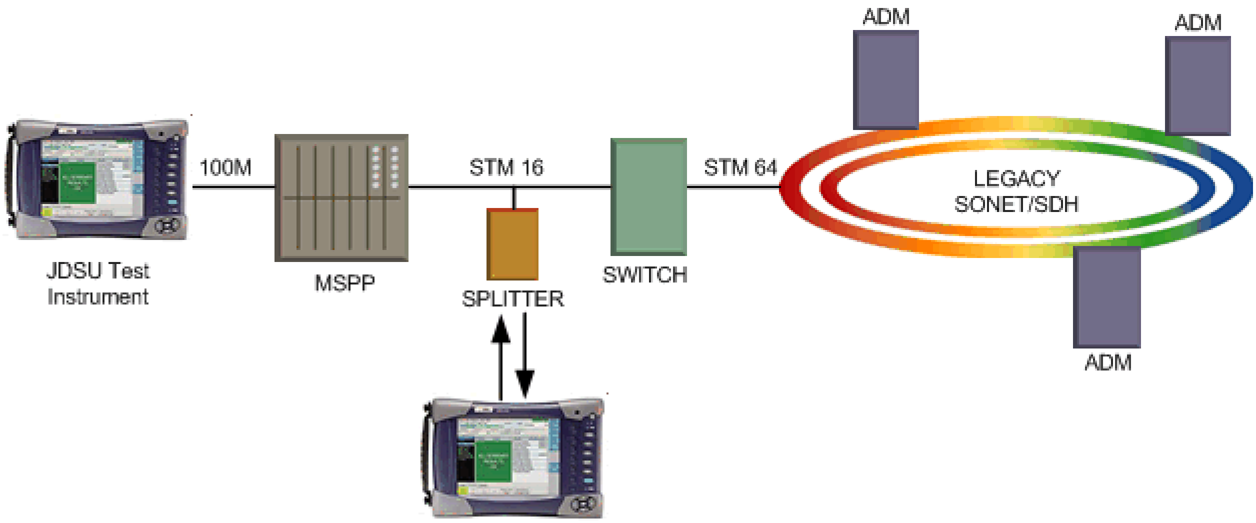


Figure 18 NextGen SONET/SDH Terminate Application

NextGen SONET applications

Table 25 on page 118 through Table 28 on page 121 list each of the NextGen SONET applications. Supported Ethernet rates are also listed for each interface.

OC-3 applications

Table 25 lists each of the applications for the OC-3 interface. .

Table 25 NextGen SONET OC-3 test applications

Signal	Container	Payload	Carrying[a]	Applications	Test Modes
OC-3	STS-3c-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	STS-1-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	VT-1.5-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

OC-12 applications

Table 26 lists each of the applications for the OC-12 interface.

Table 26 NextGen SONET OC-12 test applications

Signal	Container	Payload	Carrying[a]	Applications	Test Modes
OC-12	STS-3c-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	STS-1-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	VT-1.5-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

OC-48 applications

Table 27 lists each of the applications for the OC-48 interface.

Table 27 NextGen SONET OC-48 test applications

Signal	Container	Payload	Carrying[a]	Applications	Test Modes
OC-48	STS-3c-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	STS-1-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	VT-1.5-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

OC-192 applications

Table 28 lists each of the applications for the OC-192 interface.

Table 28 NextGen SONET OC-192 test applications

Signal	Container	Payload	Carrying[a]	Applications	Test Modes
OC-192	STS-3c-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	STS-1-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate
	VT-1.5-Xv	BERT	BER pattern	BERT	Terminate Monitor
		GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
				Ping	Terminate
				Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

NextGen SDH test applications

Table 29 on page 122 through Table 32 on page 128 list each of the NextGen SDH applications. Supported Ethernet rates are also listed for each interface.

STM-1 test applications

Table 29 lists each of the applications for the STM-1 interface.

Table 29 NextGen SDH STM-1 test applications

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
STM-1	AU-4	VC-4-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
	AU-3	VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

Table 29 NextGen SDH STM-1 test applications (Continued)

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
	AU-3 continued	VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

STM-4 test applications

Table 30 lists each of the applications for the STM-4 interface..

Table 30 NextGen SDH STM-4 test applications

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
STM-4	AU-4	VC-4-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
	AU-3	VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

Table 30 NextGen SDH STM-4 test applications (Continued)

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
	AU-3 continued	VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

STM-16 test applications

Table 31 lists each of the applications for the STM-16 interface..

Table 31 NextGen SDH STM-16 test applications

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
STM-16	AU-4	VC-4-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
	AU-3	VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

Table 31 NextGen SDH STM-16 test applications (Continued)

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
	AU-3 continued	VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

STM-64 test applications

Table 32 lists each of the applications for the STM-84 interface..

Table 32 NextGen SDH STM-64 test applications

Signal	Administrative Unit	Container	Payload	Carying[a]	Applications	Test Modes
STM-64	AU-4	VC-4-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
		VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate
	AU-3	VC-3-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	1000 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

Table 32 NextGen SDH STM-64 test applications (Continued)

Signal	Administrative Unit	Container	Payload	Carrying[a]	Applications	Test Modes
	AU-3 continued	VC-12-Xv	BERT	BER pattern	BERT	Terminate Monitor
			GFP Ethernet	100 Mbps Ethernet	Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
					Ping	Terminate
					Traceroute	Terminate

a. GFP Ethernet payload rates represent the upper limit for the signal and container.

Configuring NextGen tests

Configuring a NextGen test involves specifying settings for the following:

Settings	Refer to
Tx clock source	"Specifying the Tx clock source" on page 59 of Chapter 3 "SONET and SDH Testing".
SONET or SDH	"Running classic SONET/SDH tests" on page 129
VCAT	"VCG testing" on page 130
LCAS (if used on network)	"LCAS testing" on page 138
BERT	"BER testing" on page 139
GFP	"GFP testing" on page 140
Ethernet	Layer 2 and Layer 3 Ethernet settings. For details, see the Ethernet testing manual that shipped with your instrument or upgrade.

In many cases, the steps involved in specifying these settings are similar to those followed when configuring classic SONET, SDH, and Ethernet tests. After the settings are specified, you are ready to test various aspects of the NextGen network.

Running classic SONET/SDH tests

Before you test the NextGen network, you should verify that the legacy SONET or SDH network is operating properly by running the classic SONET/SDH tests, including:

– "Measuring optical power" on page 59
– "BER testing" on page 63
– "Drop and insert testing" on page 66
– "Inserting errors, anomalies, alarms, and defects" on page 68
– "Measuring round trip delay" on page 70

- "Measuring service disruption time" on page 71
- "Viewing a TOH group" on page 72
- "Manipulating overhead bytes" on page 73
- "Specifying the J0 or J1 identifier" on page 75
- "Manipulating K1 or K2 APS bytes" on page 78
- "Inserting the C2 Path signal label" on page 77
- "Manipulating the S1 byte" on page 80
- "Adjusting pointers" on page 81
- "Verifying performance" on page 83
- "Monitoring the circuit" on page 84

For a thorough overview of SONET/SDH testing, refer to Chapter 3 "SONET and SDH Testing".

VCG testing

After verifying that the legacy SONET or SDH network is operating properly, you can create, transmit, and analyze virtual concatenation groups and members to determine whether the elements on the NextGen network process traffic properly, and reassemble the members correctly at the far end.

Creating a VCG for analysis

You can define a VCG to be transmitted by the instrument (the Tx VCG), and a VCG to be analyzed by the instrument (the Rx VCG). When you create a VCG, the instrument numbers the channels sequentially beginning with 1 (one). You can optionally edit the sequence and channel numbers for the members after you create the VCG (see "Specifying VCG settings" on page 131).

The maximum bandwidth supported for any given group is 1.2 Gigabits (without GFP overhead).

To create a VCG

1. On the Quick Config tab of the Main screen, select the **Create VCG** button.
   The Create VCG dialog box appears.
2. The settings for both the transmitted VCG and the received (and analyzed) VCG are identical. To specify the settings, do the following:

Setting	Value
Define Tx VCG	Select this checkbox if you intend to define a VCG to be transmitted by the instrument.
Define Rx VCG	Select this checkbox if you intend to define a VCG to analyze.

Setting	Value
Payload Bandwidth (Mbps)	To define the VCG by specifying the bandwidth for the group (for example, 449 Mbps), select this radio button, then specify the bandwidth in Mbps. After you specify the bandwidth, the instrument then calculates the number of members the structure can support for the bandwidth. If necessary, the instrument automatically adjusts the bandwidth upwards to support the next highest number of members for the group. For example, if you specify a 300 Mbps bandwidth for a VC-4-Xv group, the instrument will automatically increase the bandwidth to 449 Mbps, create 3 members, and display the structure as VC-4-3v.
Number of Members	To define the VCG by specifying the number of members in the group, select this radio button, then enter the number of members in the adjacent field. After you specify the number of members, the instrument calculates the corresponding bandwidth and structure for you. For example, if you specify 6 members for a VC-4-Xv group, the instrument will calculate the required bandwidth for the group as 898.6 Mbps, and will display the structure as VC-4-6v.
Tx = Rx	If you want to apply the transmit settings to the received VCG to be analyzed, select this button.
Rx = Tx	If you want to apply the receive settings to the VCG to be transmitted, select this button.

3 Select **OK** to create the VCGs and return to the Main screen.

The VCGs are created.

Specifying VCG settings

After creating the VCGs, you can edit the sequence and channel numbers for the members, and add or remove members from the group.

To specify VCG settings

1 If you haven't already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select **VCG**.

Settings appear for the transmitted and received VCG members.

4 Specify the following settings for the group:

   a In **Result Scale (us)**, specify the scale for differential delay measurements in microseconds.

   b If you intend to test LCAS for the group, select **Enable LCAS**.

5 If you want to edit information for individual members of a group, do the following:

   a Select **Edit VCG Members**.

The Edit VCG Members dialog box appears. Two boxes appear listing each of the Tx members and each of the Rx members.

 A trash can icon appears to the left of each member, and the sequence number and channel number is also listed.

b Do the following:

Setting	Value
Address Format (low order path only)	Select one of the following: – KLM – Timeslot – Logical
Seq.	If you want to change the default sequence number for a member, select the field to display a keypad. A range of valid sequence numbers appears at the top of the keypad. Type the new sequence number, and then select **OK**. **NOTE:** The sequence number is used to determine whether a sequence mismatch occurred for the member during testing.
OC-N or STM-N	If you want to change the default channel number for a member, select the OC-N or STM-N field to display a keypad. A range of valid channel numbers appears at the top of the keypad. Type the new channel number, and then select **OK**.
Default	If you want to restore the default settings to the transmit or receive VCG, select the **Default** button under the corresponding list of channels.
Tx = Rx	If you want to apply the edited transmit settings to the received VCG to be analyzed, select this button (located under the list of Tx channels).
Rx = Tx	If you want to apply the edited receive settings to the VCG to be transmitted, select this button (located under the list of Rx channels.

6 Select **OK** to store the settings and return to the SONET or SDH setup tab. Select **OK** again to return to the Main screen.

The VCG settings are specified.

Adding or deleting VCG members

You can add new members, or delete current members from a group.

To add or delete VCG members

1 If you haven't already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.

2 Select the **Setup** soft key, and then select the SONET or SDH tab.

3 In the panel on the left side of the tab, select **VCG**.

Settings appear for the group.

4 Select **Edit VCG Members**.

The Edit VCG Members dialog box appears.

5 Do one of the following:

To	Do this
Add a member	Under the Tx or Rx member list, the New member settings are listed. Type the sequence number and channel number for the new member (under the appropriate list), and then select the plus (+) sign. The bandwidth required for the group, and the VC structure are automatically adjusted.
Delete a member	Select the trash can icon to the left of the member. The bandwidth required for the group, and the VC structure are automatically adjusted.

6 Select **OK** to store the settings and return to the SONET or SDH setup tab. Select **OK** again to return to the Main screen.

The members are added or deleted.

Inserting SONET or SDH errors and alarms

You can insert errors (anomalies) and alarms (defects) simultaneously. When running NextGen applications, the terms "errors" and "alarms" are used on the user interface (rather than "anomalies" and "defects").

To insert errors or alarms

1 If you haven't already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.

2 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

3 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

4 Select the **Laser** button.

5 On the Main screen, select the **Errors** or **Alarms** toolbar, and then select an error or alarm type.

– The LOF, AIS-L, and RDI-L alarms will impact *all members of the transmitted VCG*. All other alarms will impact the *currently selected VCG member*.

– The Frame Word, B1, B2, REI-L, and Bit/TSE errors will impact *all members of the transmitted VCG*. All other errors will impact the *currently selected VCG member*.

6 Specify the following for the alarm or error you selected:

Alarm or Error Type	Inserted into transmitted	Additional Settings
High Order Path Alarms and Errors		
LOF AIS-L (MS-AIS) RDI-L (MS-RDI)	SOH	None
Frame Word (FAS Word)	SOH	**Quantity.** Select the field, type the number of errors you want to insert (ranging from 1 to 32), and then select **OK**.

Alarm or Error Type	Inserted into transmitted	Additional Settings
B1 B2 REI-L (MS-REI)	SOH	**Insertion Type.** Select **Single** or **Rate**. If you select Rate, specify the rate for insertion.
AIS-P LOP-P RDI-P LOM-P LOM2 REI-P B3	Member	**VCG Member.** Select the field to display the currently transmitted members, and then select the member the alarm will be inserted into.
LOF MS-AIS MS-RDI Bit/TSE	VCG	N/A
Low Order Alarms and Errors		
Frame Word (FAS Word)	SOH	**Quantity.** Select the field, type the number of errors you want to insert (ranging from 1 to 32), and then select **OK**.
B1 B2 REI-L (MS-REI)	SOH	**Insertion Type.** Select **Single** or **Rate**. If you select Rate, specify the rate for insertion.
B3 LP-BIP LP-REI AU-AIS AU-LOP TU-AIS TU-LOP LOM2 LP-RDI	Member	**VCG Member.** Select the field to display the currently transmitted members, and then select the member the alarm or error will be inserted into.

7 Press the **Alarm Insert** or **Error Insert** button.

Alarm or error insertion starts, and the associated button turns yellow.

Test results associated with the error or anomaly appear in the Status result category. You can also use the VCG Analysis soft key to observe errors and alarms for the received group and individual members within the group. See "Analyzing a VCG" on page 134.

To stop insertion

– Press the **Alarm Insert** or **Error Insert** button again.

Alarm or error insertion stops, and the associated button turns grey.

Analyzing a VCG

Pressing the VCG Analysis soft key displays the VCG Analysis screen, which provides error and alarm LEDs for each member and for the VCG as a whole.

To analyze a VCG

– On the Main screen, select the **VCG Analysis** soft key.

  The VCG Analysis screen appears, with tabs that allow you to observe test results for the received VCG, transmitted VCG, and results in a histogram format.

The default view is of the received VCG, and the Rx tab is selected (see Figure 19).

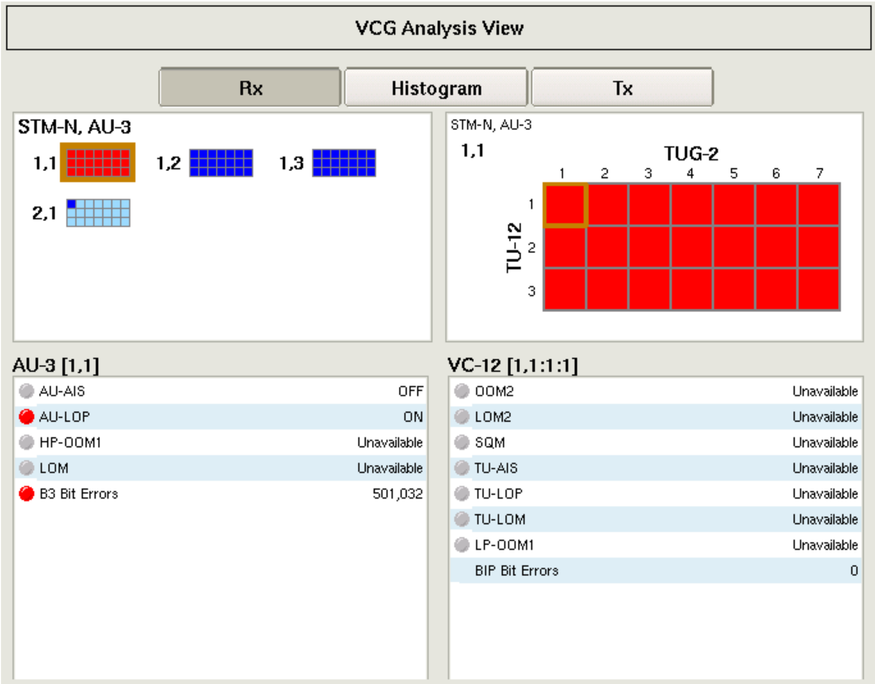


Figure 19 VCG Analysis screen - Results for received member 1 with errored VC-12

Red indicates that a member or channel is errored. You can also use the graphics of the members and channels to select the member and channel that you want to observe results for.

Selecting the Tx tab displays the same layout for the transmitted VCG members, without the test results (because the transmitted members are not being analyzed). For an example, see Figure 20).

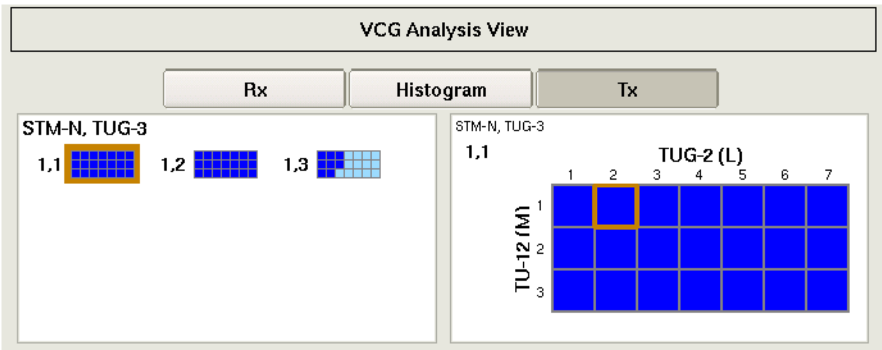


Figure 20 VCG Analysis screen - Tx tab view

If you select the Histogram tab, results appear for the VCG in a histogram format (see Figure 21).

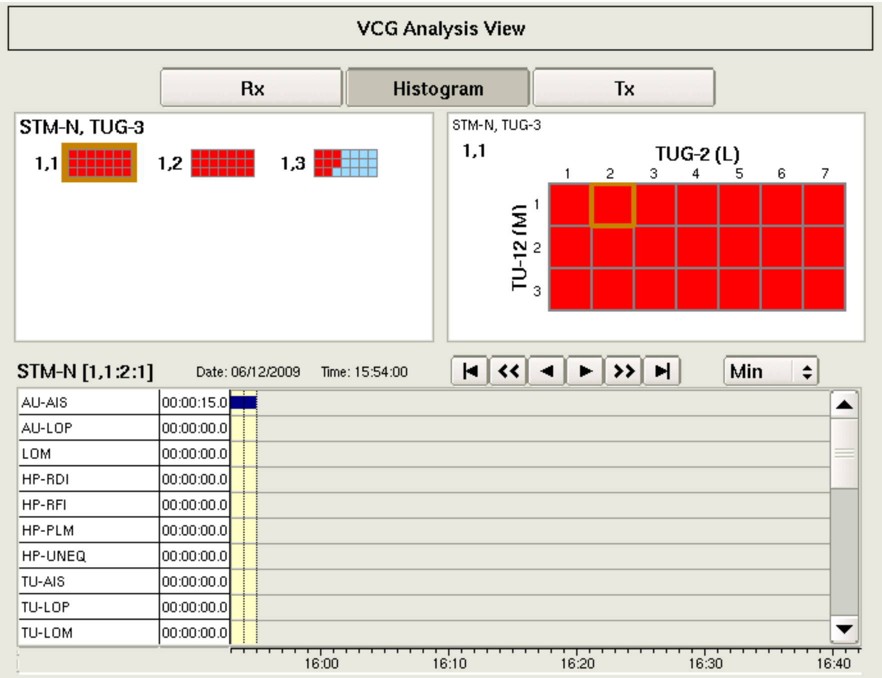


Figure 21 VCG Analysis screen - Histogram results for entire group

Results are also provided in the VCAT result group. For descriptions, see “VCAT results” on page 213.

Manipulating overhead bytes

Pressing the SONET Overhead or SDH Overhead soft key displays the Overhead Byte screen, which allows you to manipulate the value of selected overhead bytes, and then view the transmitted and received byte values.

To manipulate an overhead byte

1. If you haven’t already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.
2. Select the **SONET Overhead** or **SDH Overhead** soft key.

Figure 22 shows the display for a NextGen SONET application.

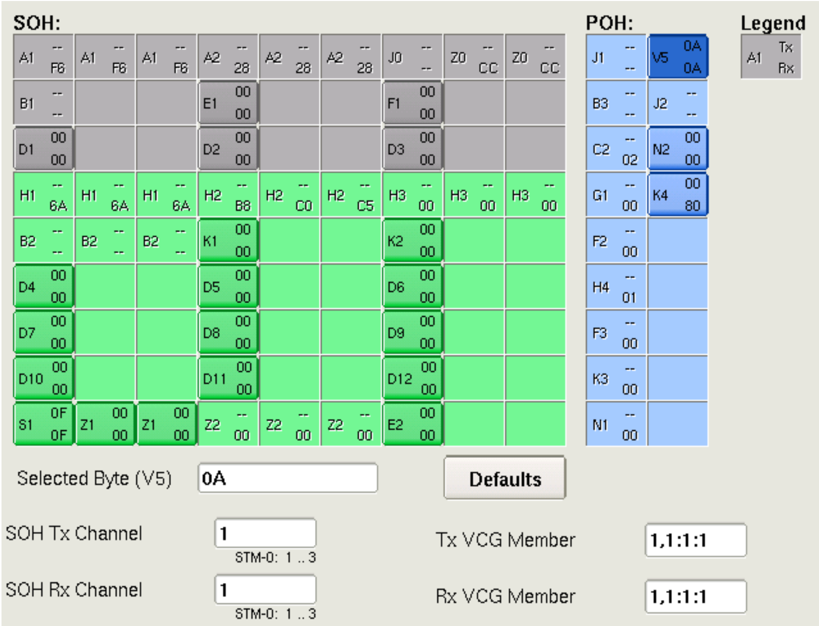


Figure 22 Overhead Byte screen - NextGen SONET application

The Line/Multiplexor Section bytes appear in green; the Section/Regenerator Section bytes appear in grey. Path/High Path overhead bytes appear in blue.

– Byte values on the top are the transmitted values, values on the bottom are the received values.
– Bytes labeled using a black font can be manipulated.
– Bytes labeled using a grey font cannot be manipulated.
– High order overhead bytes can not be modified if you are running a low order application.
– The Defaults button restores any byte you changed to its default values.

3 To change the value of a byte, do the following:

   a Select the byte you want to manipulate.

   b Select the Selected Byte field, type the new byte value, and then select **OK**.

   The new value appears in the field.

4 If you are manipulating TOH or SOH bytes, specify the Tx and Rx channels for the byte.

5 If you are manipulating POH bytes, specify the Tx and Rx channels for the byte.

6 Select the Tx and Rx VCG member for the overhead byte.

7 Select the **Results** soft key to return to the Main screen.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 If you are testing an optical signal, select the **Laser** button.

11 Loop back the far-end of the network.

12 Verify the following LEDs:

– If your module is in TestPad mode, verify that the following LEDs are green:

SONET	SDH
Signal Present	Signal Present
Frame Sync	Frame Sync
Pattern Sync	Pattern Sync

– If your module is in ANT mode, verify that the following LEDs *are not* red:

SONET and SDH
LOS
LOF
LSS

13 Observe the byte values.

The overhead byte is manipulated.

LCAS testing

After creating and analyzing virtual concatenation groups and members, you can optionally enable LCAS testing, and then add or remove members for each VCG. You can also control when your instrument declares PLTC for both source and sink devices.

Enabling LCAS

To enable LCAS and specify PLTC thresholds

1 If you haven't already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.

2 Select the **Setup** soft key, and then select the LCAS tab.

3 Select **Enable LCAS**.

4 For both source and sink devices, in **PLTC Threshold (members)**, specify the number of members that must be lost on either side for the instrument to declare a PLTC error.

LCAS is enabled; use the Results soft key to return to the Main screen.

Monitoring the LCAS MST status for VCG members

To observe the MST status for each member

1 Set the Result group to LCAS, and the category to Member Status (Sink) or Member Status (Source).

2 Display the results in a full window by selecting **View > Results > Full Size**.

3 Observe the LCAS results for each member. The MST status, and the last LCAS command issued remotely for each member is provided.

You are monitoring the LCAS status of the VCG members.

Adding or removing members

When LCAS is enabled, you can manually add or remove members from the source or sink groups. You can also use the DNU (Do Not Use) action key to indicate that a particular member should not be used in the group.

To add or remove members

1. If you haven't already done so, use the Test Menu to select the NextGen test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.
2. Verify that the laser is on, and that traffic has been started.
3. Verify that LCAS is enabled (see "Enabling LCAS" on page 138), then press **Restart**.
4. On the Main screen, select the **LCAS** tab on the Action bar, then do one of the following:
   – To add a member, specify the member number for the source or sink group, then select **Add**. Members must be available to see the Add button; if all members in the group are already used, a Remove button is provided instead.
   – To remove a member, specify the member number for the source or sink side, then select **Remove**. Members must be in a group to see the Remove button; if no members are used, an Add button is provided instead.
   – To indicate that a particular member should not be used in the group, specify the member number, then select **Force DNU**. The member will not be used on the source or sink side.

Members are added or removed.

BER testing

After verifying that the elements on the NextGen network process VCAT traffic properly, and if applicable, monitoring LCAS members, you should transmit a BER pattern in the VCG payload to verify that data carried in the VCAT payloads is accurate.

> **NOTE: Changing BERT patterns**
> If you change a BERT pattern during the course of your test, be certain to press the **Restart** soft key to ensure that you regain pattern sync.

To run a VCAT BER test

1. If you haven't already done so, use the Test Menu to select the NextGen BER test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.
2. Select the **Setup** soft key, and then select the Pattern tab.
3. Specify the pattern for the test (see "Specifying a BERT pattern" on page 64 of Chapter 3 "SONET and SDH Testing".

   The instrument can also automatically detect the BER pattern on the received signal. For details, see "Detecting the received BER pattern" on page 66.

4 Select the **Results** soft key to return to the Main screen.

5 Do one of the following:
  – If your instrument is in TestPad mode, verify that the Payload Pattern Sync LED is illuminated.
  – If your instrument is in ANT mode, verify that the LSS LED is not illuminated.

6 Verify that `All Results OK` appears in the results display.

7 *Optional*. Insert five Bit / TSE errors (see "Inserting errors, anomalies, alarms, and defects" on page 68), and then verify that the five errors were received in the BERT result category.

8 Run the test for an appropriate length of time.

The BER test is finished.

GFP testing

After verifying that the network is handling VCAT members and the data carried in the payloads properly, you should verify that the network can support GFP encapsulated Ethernet traffic.

Specifying GFP settings

Before analyzing GFP encapsulated Ethernet traffic, you must specify settings that characterize the traffic on the GFP setup tab. You also specify filter settings to analyze only received GFP traffic that satisfies the criteria.

To specify GFP settings

1 If you haven't already done so, use the Test Menu to select the NextGen GFP Ethernet test application for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.

2 Select the **Setup** soft key, and then select the GFP tab.

3 Use the graphical display of a GFP frame to specify the following:

Frame Label	Setting	Value
PFI	PFI	Enable or disable the Payload FCS Indicator (PFI). – When enabled, GFP traffic will use the optional payload FCS. – When disabled, the traffic will not use the payload FCS.
EXI	EXI	Select the type of Extension Header Identifier (EXI) used: – No Extension Header – Linear Frame – Ring Frame
CID	CID	If you selected Linear Frame as the EXI, enter the Channel ID (CID) in a hexidecimal format.

4 Under Rx Filter, specify the following settings to filter results for received traffic:

Setting	Value
Filter on CID	– If you want to analyze received traffic for a particular channel, select **Enabled**. – If you want to analyze received traffic for any channel, select **Disabled**.
CID Filter Value	If you enabled the CID filter, specify the channel ID carried in the traffic that you want to analyze.

5 If you need to specify other settings for the test, select the appropriate tab; otherwise, press **Results** to return to the Main screen.

The GFP settings are specified.

Specifying Ethernet and IP settings

After you specify the GFP settings, you should specify the classic Ethernet and IP settings. For step-by-step instructions, refer to the Ethernet testing manual that shipped with your instrument or upgrade. Required settings include:

– Ethernet frame settings
– Ethernet filter settings
– Traffic load settings
– IPv4 packet settings
– IPv4 filter setting

Transmitting and analyzing GFP traffic

For step-by-step instructions on running the tests, see the Ethernet testing manual that shipped with your instrument or upgrade. In addition to the layer 2 and layer 3 tests, you can also run an automated RFC 2544 test to verify the Ethernet and IP service.

> **NOTE:**
> When running NextGen Sonet/SDH/OTN with GFP Ethernet client applications and two units lose sync by turning off the laser or disconnect the cable while traffic is still on, it may take multiple loop up/loop down attempts to successfully loop back up. Turn the traffic off before turning off the laser or disconnecting the cable.

Inserting GFP errors or alarms

In addition to the classic SONET, SDH, Ethernet, and IP errors and alarms, action buttons on the Main screen allow you to insert a variety of GFP errors and alarms into the traffic stream. If you insert errors at a specific rate (for example, 1E-3), the errors are inserted even after you restart a test or change the test configuration.

To insert GFP errors or alarms

1 On the Main screen, select the Error tab or the Alarm tab on the Action bar.

2 If you are inserting errors, select the GFP Error type, and then select the appropriate settings for the following errors:

Errors	Insert Style	Rate	Number of Bits
Idle Frame Error	Single	N/A	N/A
Short Frame Error	Single	N/A	N/A
PFCS Error	Single	N/A	N/A
	Rate	– Cont (Continuous) – 1E-1 through 1E-9	N/A
Core Header Error	Single	N/A	N/A
	Rate	– Cont (Continuous) – 1E-1 through 1E-9	– Single – Multiple
Ext Header Error	Single	N/A	N/A
	Rate	– Cont (Continuous) – 1E-1 through 1E-9	– Single – Multiple
Type Header Error	Single	N/A	N/A
	Rate	– Cont (Continuous) – 1E-1 through 1E-9	– Single – Multiple
EXI Error	N/A	N/A	– Single – Multiple
PFI Error	N/A	N/A	N/A
PLI Error	N/A	N/A	– Single – Multiple

3 Do one of the following:

– If you are inserting GFP alarms, select the GFP Alarm Type, then select **CSF Alarm**, or **LFD Alarm**.

– If you are inserting SONET alarms, select the appropriate alarm type, and then specify any additional settings. For details on SONET or SDH alarm insertion, see “Inserting SONET or SDH errors and alarms” on page 133.

4 Press the **Error Insert** or **Alarm Insert** button.

– If you are inserting errors at a particular rate, the button turns yellow. To stop insertion, press the button again. Error insertion stops, and the button turns grey.

– If you are inserting alarms, the button turns yellow, and the alarm is inserted continuously until you turn it off.

Errors or alarms are inserted into the traffic stream.

Monitoring NextGen circuits

You can monitor received signals for BERT errors, or you can monitor received signals carrying GFP traffic.

Monitoring the circuit for BERT errors

Use the Monitor BERT application whenever you want to analyze the received signal for BERT errors.

To monitor NextGen circuits

1. If you haven't already done so, use the Test Menu to select the NextGen BERT test application in Monitor mode for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.
2. Connect the module to the circuit.
3. Verify that the green Signal Present, and Frame Sync LEDs are illuminated.
4. At a minimum, observe the results in the Summary group, VCAT group, and Payload group.

The circuit is monitored.

Monitoring a circuit carrying GFP traffic

Use a GFP monitor application whenever you want to analyze a received signal carrying GFP traffic. When you configure your test, you can specify settings that indicate the expected received payload and determine which frames will pass through the receive filter and be counted in the test result categories for filtered traffic. The settings may also impact other results.

NOTE:
You must turn the laser on using the associated button to pass the signal through the unit's transmitter.

To monitor GFP traffic

1. If you haven't already done so, use the Test Menu to select the NextGen GFP test application in Monitor mode for the interface you are testing. Refer to Table 25 on page 118 through Table 32 on page 128 for a list of applications.
2. Connect the module to the circuit.
3. Select the **Setup** soft key, select the GFP tab, and then specify the GFP filter settings (see step 4 on page 141 of "Specifying GFP settings").
4. Select the Filters tab, and then specify the Ethernet, and if applicable, the IP filter settings. For detailed instructions, see the Ethernet testing manual that shipped with your instrument or upgrade.
5. Press **Results** to return to the Main screen.
6. If you are testing an optical interface, select the **Laser** button.
7. Verify that the green Signal Present, Sync Acquired, and Link Active LEDs are illuminated.
8. At a minimum, observe the Summary, VCAT, and GFP results.

The GFP traffic is monitored.

Capturing POH bytes

You can now capture path overhead bytes during NextGen testing. When configuring the capture, you can indicate that you want to capture it manually, or specify a trigger to automate the capture.

For details, see "Capturing POH bytes" on page 74 of Chapter 3 "SONET and SDH Testing".

6

OTN Testing

This chapter provides step-by-step instructions for performing OTN tests. Topics discussed in this chapter include the following:

About OTN testing

If your instrument is configured and optioned to do so, you can use it to analyze the performance of OTU1 (2.7G), OTU2 (10.7G, 11.05G, and 11.1G), OTU3 (43.02G) and OTU4 (111.8G) networks by performing FEC tests, BER tests, and inserting errors and alarms to verify that network performance conforms to G.709 standards.

When you configure the instrument for OTN testing, a number of the test parameters vary depending on the line rate (SONET, SDH, or Ethernet), and payload (SONET, SDH, bulk BERT, or Layer 1 BERT) you select.

OTN tests are available on the MSAM, CSAM, 5800v2 and 40G/100G Transport Module.

The OTN test applications are resource-intensive; therefore, if you are using an MSAM:

– For MSAMv1, you must have a *dual port* MSAM (C0404 or C1004) to run the OTN applications.
– For MSAMv2 (C0404-v2 or C1010-v2)), OTN applications can be run from either port, although only one application may be run at a time.

Features and capabilities

When testing OTN circuits, you can generate and analyze bulk BERT payloads at SONET, SDH, and 10 Gigabit Ethernet line rates. You can also generate and analyze SONET and SDH payloads encapsulated in an OTN wrapper at OTU1 (2.7G), OTU2 (10.7G), OTU1e(11.05G), OTU2e (11.1G) and OTU3 (43.02G) line rates, and Ethernet client signals at OTU2 line rates (11.05 and 11.095 Gbps) on 10 GigE LAN circuits. High-speed OTN circuits can be analyzed using BERT and Ethernet payloads at OTU3 (43.02G) and OTU4 (111.8G) rates using the 40G/100G High-Speed Transport Module. The following are also supported:

– FEC testing—You can use the module to verify that network elements on an OTN network are configured to handle errors properly.
– BERT patterns—You can transmit and detect BERT patterns for each rate available on the MSAM.
– Error/anomaly and alarm/defect insertion—You can insert a variety of errors, anomalies, alarms, and defects into traffic, such as FAS and logic errors.
– Section Monitoring (SM), Path Monitoring (PM), and TCM identifiers—You can specify outgoing and expected identifiers, and indicate whether or not you want the module to show a trace identifier mismatch (TIM) whenever the expected and received identifiers do not match.
– FTFL identifiers—You can specify outgoing FTFL identifiers.
– Payload types—You can specify transmitted and expected payload types, and indicate whether the module should show test results associated with payload type mismatches in the OPU result category.
– 1GigE_LAN traffic—You can configure a 1GigE payload in an ODU client.
– 10 GigE LAN traffic—You can configure VLAN and Q-in-Q encapsulated traffic, and transmit a constant or flooded load of traffic over the circuit. You can also filter received traffic to analyze only VLAN or Q-in-Q traffic. For details on configuring Ethernet traffic, see the Ethernet testing manual that shipped with your instrument.
– 10GigE traffic— You can configure VLAN and Q-in-Q encapsulated traffic and map it into OTU4 via GMP.

- ODU Multiplexing—A variety of ODU multiplexed signals are available for transport and/or analysis.
  - ODU1 payload carried in an OTU2 signal at a 10.7G line rate.
  - ODU0 payload carried in an OTU1 signal at 2.7G line rate or OTU2 signal at a 10.7G line rate.
  - ODUflex with up to eight 1.25G timeslots in OTU2 signal at 10.7G line rate.
  - GMP-mapped ODU4 multiplexed payloads for high-speed L2 and L3 circuits.
- OTU1, OTU2, OTU1e/2e, OTU3 and OTU4 scrambling—You can scramble signals carried at the line rate for the interface you are testing. Scrambling of multiplexed signals is not supported.
- SDH client signal analysis—You can analyze multiplexed SDH signals carried in an OTN signal down to VC-3. This applies to STM-16 in OTU1, STM-64 in OTU2 and STM-256 in OTU3.
- SONET client signal analysis—You can analyze multiplexed SONET signals carried in an OTN signal down to STS-1. This applies to STS-48 in OTU1, STS-192 in OTU2 and STS-768 in OTU3.
- Service disruption measurements—You can measure service disruption time resulting from signal loss or a variety of errors, anomalies, alarms, or defects. For details, see “Measuring service disruption time” on page 173.
- OTL layer testing— the OTL layer applies to the OTU3 and OTU4 interfaces on the CSAM or 40/100G Transport Module. With LR4 optics (4 wavelengths) errors and alarms can be injected/analyzed for testing.
- Static skew injection- Bit-level static skew injection and alarm threshold setting for excessive skew is possible in all 40G/100G applications.

Understanding the LED panel

When you configure your unit to transmit a bulk BERT payload, Summary and OTN LEDs appear on the Main screen. Figure 23 illustrates the OTN LEDs that appear when your unit is operating in TestPad mode.

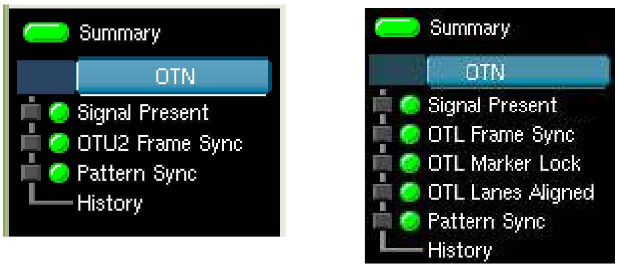


Figure 23 OTN LEDs (bulk BERT payloads)

When you configure your unit to transmit a SONET or SDH client signal in an OTN wrapper, Summary, OTN, and SONET or SDH LEDs also appear. Figure 24 illustrates the OTN and SDH LEDs that appear when your unit is operating in TestPad mode.

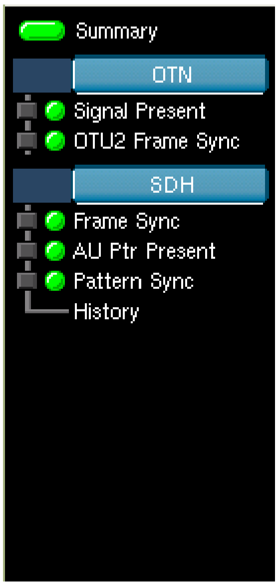


Figure 24 OTN LEDs (SDH payload)

When you configure your instrument to transmit an Ethernet client signal in an OTN wrapper, Summary, OTN, and Ethernet LEDs appear. Figure 25 illustrates the OTN and Ethernet LEDs that appear when your unit is operating in TestPad mode.

Figure 25 OTN LEDs (Ethernet payloads)

When you configure your unit to transmit an ODU1 bulk BERT payload in a 10.7G OTU2 wrapper, Frame Sync LEDs are provided for the OTU2 wrapper and the ODU1 payload as illustrated in Figure 26.

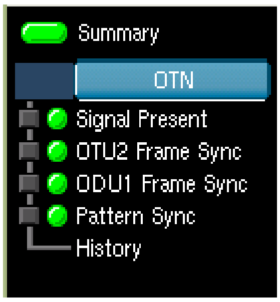


Figure 26 OTN LEDs (ODU1 in OTU2)

When you configure your unit to transmit an ODU0 payload in an OTU1 wrapper, Frame Sync LEDs are provided for the ODU0 payload and the OTU1 wrapper as illustrated in Figure 27.

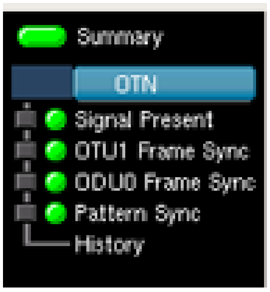


Figure 27 OTN LEDs (ODU0 in OTU1)

When you configure your unit to transmit an ODUflex payload in an OTU2 wrapper, ODU Frame Sync LEDs are provided for the ODUflex payload and the OTU2 wrapper as illustrated in Figure 29.

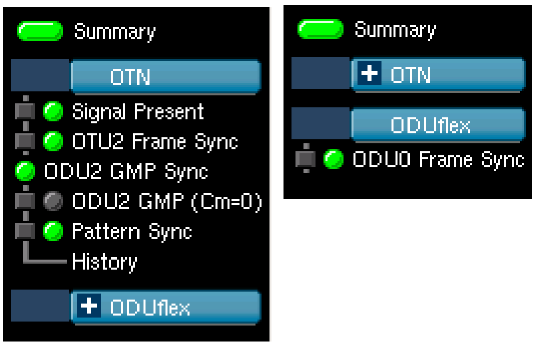


Figure 28 OTN LEDs (ODUflex payload)

When you configure your unit to transmit an ODU01 or ODU0 payload in an OTU3 or OTU4 wrapper, or ODU2 or ODU 1 payload in an OTU3 or OTU4 wrapper, ODU1 and ODU2 Frame Sync LEDs are provided as well as the lane status LEDs as illustrated in Figure 29.

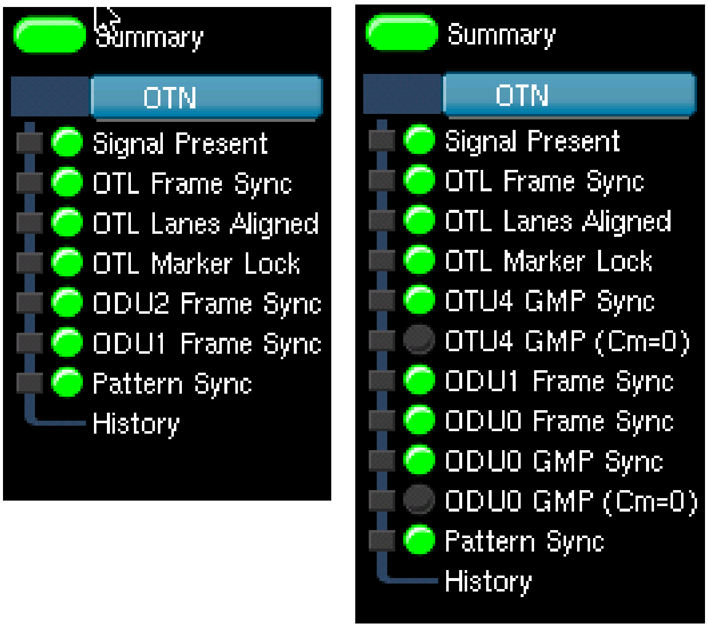


Figure 29 OTU3 & OTU4 LEDs (ODU1 & ODU2 payload)

Understanding the graphical user interface

The names of various elements on the graphical user interface change depending on whether you are testing at a SONET, SDH or Ethernet line rate. For example, the button that you use to insert SONET or Ethernet errors is labeled **Insert Error**; the same button is labeled **Insert Anomaly** if you are inserting SDH anomalies.

Understanding OTN test results

When you configure your unit to transmit or monitor a bulk BERT payload over an OTN circuit, test result associated with the interface, FEC, framing, OTU/ODU/OPU, FTFL, TCM1 through TCM6, and the payload are provided in the OTN result group. For details, refer to “OTN results” on page 217.

When you configure your unit to transmit or monitor an OTU1 Bulk BERT payload carried in an OTU2 wrapper, test groups and results are provided for both the OTU1 signal and the OTU2 wrapper.

When you configure your unit to transmit or monitor a SONET or SDH client signal over an OTN circuit, streamlined SONET and SDH test results are also available in the SONET or SDH result groups. For details, refer to “SONET/SDH results” on page 189.

When you configure your unit to transmit or monitor an Ethernet client signal over an OTN circuit, streamlined Ethernet test results are also available in the Ethernet result group. For details, refer to the Ethernet testing manual that shipped with your instrument or upgrade.

OTN test applications

Table 33 lists each of the OTN test applications.

Table 33 OTN test applications

Signal	Rate	Client			Payload	Test Mode
OTU1	2.7Gig				Bulk BERT	Terminate Monitor
		STS-48	STS-48c - STS-1		Bulk BERT	Terminate Monitor
		STM-16	AU-4	VC-4 - VC-16c	Bulk BERT	Terminate Monitor
			AU-3	VC-3	Bulk BERT	Terminate Monitor
		ODU0			Bulk BERT	Terminate Monitor
					Layer 2 Traffic	Terminate Monitor
					Layer3 Traffic	Terminate Monitor
OTU2	10.7Gig				Bulk BERT	Terminate Monitor
		STS-192	STS-192c - STS-1		Bulk BERT	Terminate Monitor
		STM-64	AU-4	VC-4 - VC-64c	Bulk BERT	Terminate Monitor
			AU-3	VC-3	Bulk BERT	Terminate Monitor
		ODU1			Bulk BERT	Terminate Monitor
		ODU0			Bulk BERT	Terminate Monitor
					Layer 2 Traffic	Terminate Monitor
					Layer 3 Traffic	Terminate Monitor
		ODUflex			Bulk Bert	Terminate Monitor
					Layer 2 Traffic	Terminate

Table 33 OTN test applications (Continued)

Signal	Rate	Client	Payload	Test Mode
OTU2, OTU1e	11.05 Gig		Bulk BERT	Terminate Monitor
			Layer 1 BERT	Terminate Monitor
			Layer 2 Traffic	Terminate Monitor
OTU2, OTU2e	11.1 Gig		Bulk BERT	Terminate Monitor
			Layer 1 BERT	Terminate Monitor
			Layer 2 Traffic	Terminate Monitor

Table 33 OTN test applications (Continued)

Signal	Rate	Client		Payload	Test Mode
OTU3	43.02Gig			Bulk BERT	Terminate Monitor
				Layer 2 Traffic	Terminate Monitor
				Layer 2 Traffic Multistreams	Terminate Monitor
				Layer 3 Ping (IPv4 & v6)	
				Layer 3 Traceroute (IPv4 & v6)	
				Layer 3 Traffic	Terminate Monitor
				Layer 3 Traffic Multistreams	Terminate Monitor
		OTL3.4		OTL BERT	Terminate Monitor
		ODU0		Bulk BERT	Terminate Monitor
		ODU 1		Bulk BERT	Terminate Monitor
		ODU2e		Bulk BERT	Terminate Monitor
		ODU2		Bulk BERT	Terminate Monitor
				Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
		ODU1	ODU0	Bulk BERT	Terminate Monitor
		ODU2	ODU1	Bulk BERT	Terminate Monitor
		ODU 2	ODU0	Bulk BERT	Terminate Monitor
		STS-768		STS-768c Bulk BERT STS-192c Bulk BERT STS-48c Bulk BERT STS-12c Bulk BERT STS-3c Bulk BERT	Terminate Monitor
				STS-1 Bulk BERT	Terminate Monitor

Table 33 OTN test applications (Continued)

Signal	Rate	Client		Payload	Test Mode
		STM-256	AU4	VC-4-256c Bulk BERT VC-4-64c Bulk BERT VC-4-16c Bulk BERT VC-4-4c Bulk BERT	Terminate Monitor
				VC-4 Bulk BERT	Terminate Monitor
			AU3	VC-3 Bulk BERT	Terminate Monitor
OTU4	111.8			Bulk BERT	Terminate Monitor
				Layer 2 Traffic	Terminate Monitor
				Layer 2 Traffic Multistreams	Terminate
				Layer 3 Ping[a]	Terminate
				Layer 3 Traceroute[a]	Terminate
				Layer 3 Traffic[a]	Terminate Monitor
				Layer 3 Traffic Multistreams	Terminate
		OTL4.10		OTL BERT	Terminate Monitor
		ODU0		Bulk BERT	Terminate Monitor
		ODU 1		Bulk BERT	Terminate Monitor
		ODU2e		Bulk BERT	Terminate Monitor
		ODU2		Bulk BERT	Terminate Monitor
				Layer 2 Traffic	Terminate Monitor
				Layer 3 Traffic	Terminate Monitor
		ODU1	ODU0	Bulk BERT	Terminate Monitor
		ODU2	ODU1	Bulk BERT	Terminate Monitor
		ODU 2	ODU0	Bulk BERT	Terminate Monitor

a. IPv4 and IPv6 applications are available. IPv4 and IPv6 applications are also available when running layer 3 multiple stream applications.

Specifying the Tx clock source

You specify the Tx clock (timing) source on the Interface setup screen.

To set the Tx clock source

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key, select the **Interface** tab, and then select the **Signal** tab. Select the arrows to the right of the Clock Source field, and then select one of the following:
   – **Internal.** Select Internal to derive timing from the MSAM’s clock, and then specify any required frequency offset in PPM.
   – **Recovered.** Select Recovered to recover timing from the received signal.
   – **External.** Select External - Bits/Sets timing to derive timing from one of the following signals, in the following order: BITS, SETS, 2.048 MHz, or a 10 MHz clock.
3. Select the **Results** soft key to return to the Main screen, or select another tab to specify additional test settings.

The Tx clock source is specified.

Skew Injection

For all 40G and 100G OTL applications, you can specify bit-level static skew injection at the lane level. Refer to the *T-BERD ⁄ MTS 8000 and T-BERD ⁄ MTS 6000A Transport Module, 40/100G Transport Module, CSAM, and Multiple Services Application Module (MSAM) Ethernet, IP, TCP/UDP, Fibre Channel, VoIP, and IP Video Testing Manual*.

Specifying channels or timeslots

When running an OTN application from a 2.7G or 10.7G interface and analyzing a multiplexed signal, the timeslot or channel to be analyzed, and the timeslot or channel you would like to use for the transmitted signal. You can also indicate that the timeslot or channel for the transmitted signal should automatically be set to the same timeslot or channel that you are analyzing.

To specify the channels or timeslots

1. Using the Test Menu, select the interface and test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Select the **Setup** soft key, and then do the following:

Multiplexed signal	Do this...
SONET or SDH	– Select the **SONET** or **SDH** setup tab. – Select **Channel** from the list of settings on the left. – In **STS-N Rx** or **STM-N Rx**, specify the timeslot you want to analyze for the received signal. – If you want to use the same timeslot for the transmitted signal, set **STS-N Tx=Rx** or **STM-N Tx=Rx** to **Yes**. – If you want to use a different timeslot for the transmitted signal, set **STS-N Tx=Rx** or **STM-N Tx=Rx** to **No**. – If you want to use *all available timeslots* for the transmitted signal, set **STS-N Tx All** or **STM-N Tx All** to **Yes**. – If you want to use a single timeslot for the transmitted signal, specify the timeslot in **STS-N Tx or STM-N Tx**.
OTU*x*	– Select the **OTU*x*** setup tab (value of *x* depends on active application). – Select **Trib(utary) slot** from the list of parameters on the left. – In **OTU*x* Rx**, specify the timeslot you want to analyze on the received signal. – If you want to use the same timeslot for the transmitted signal, set **ODU1 Tx=Rx** to **Yes**. For OTU3 or OTU4, in the TX portion of the window, define the Tributary Slot Size, if applicable. Then select the tributary ports to be redefined, specify the Port number desired and then populate the new port assignment by selecting the Apply button. Be aware of the on-screen alerts concerning acceptability of setup parameters and application status. – If you want to use a different timeslot for the transmitted signal, set **ODU1 Tx=Rx** to **No**, and then specify the transmitted timeslot in **ODU1 Tx**. For OTU3 or OTU4, in the RX portion of the window, repeat the port definitions/assignments similarly to those in the Tx portion of the window.
ODUflex	– Select the **OTU2** setup tab. – Select **Timeslot** from the list of settings on the left. – If you want to use the same timeslot(s) for the transmitted signal, set **ODUflex Rx=Tx to Yes.** – If you want to use different timeslot for the transmitted signal, set **ODUflex Rx=Tx** to **No**, and then select the received timeslot(s) in **ODUflex Tributary Ports.** – Define the Tx ODUflex Port by entering the port number. Deselect timeslots that are not to be used by clicking on any of the eight **ODUflex Tributary Ports.**

3 Select the **Results** soft key to return to the Main screen, or select another tab to specify additional test settings.

The channels or timeslots are specified.

BER testing layer 1

If you are transmitting or analyzing an Ethernet client signal over an OTN circuit, you can generate and receive layer 1 test patterns, and monitor and analyze received signals. For detailed instructions, refer to the Ethernet testing manual that shipped with your instrument or upgrade.

NOTE: Changing BERT patterns
If you change a BERT pattern during the course of your test, be certain to press the **Restart** soft key to ensure that you regain pattern sync.

Configuring 1 GigE, 10 GigE, 100 GigE LAN traffic

If you are transmitting or analyzing an Ethernet client signal over an OTN circuit, you can configure settings for transmitted traffic and specify filter settings to analyze a particular type of traffic. For detailed configuration instructions, see the Ethernet testing manual that shipped with your instrument.

To configure 1 GigE, 10 GigE or 100 GigE LAN traffic

1. Using the Test Menu, select the interface and test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key, and then do the following to configure (or filter) the traffic:
   a. To characterize transmitted Ethernet traffic, select **Ethernet**, and then specify the frame settings.
   b. To specify settings that filter received traffic, select **Ethernet Filter**, and then characterize the traffic you want to analyze.
   c. To configure the traffic load, select **Traffic**, and then specify the constant or flooded load settings. For details, see the Ethernet testing manual that shipped with your instrument.

   You can not transmit a burst or ramped load of traffic over an OTN circuit.
3. Select the **Results** soft key to return to the Main screen, or select another tab to specify additional test settings.

1 GigE, 10 GigE or 100 GigE LAN traffic is configured.

Configuring OTN with SONET or SDH Clients

If you are transmitting or analyzing a SONET or SDH client over an OTN circuit, you can configure settings for the transmitted traffic within the OTN signal.

To configure SONET or SDH traffic

1. Using the Test Menu, select the interface and test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key, and then configure transmitted SONET or SDH traffic by selecting **SONET or SDH** tab. For detailed configuration instructions of the SONET or SDH signal, see "SONET and SDH Testing" on page 43.

3 Select the **Results** soft key to return to the Main screen, or select another tab to specify additional test settings.

SONET or SDH traffic is configured.

Measuring optical power

You can use the instrument to measure the optical power of a received signal.

To measure optical power

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

3 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

4 Verify the following LEDs:
  – If your module is in TestPad mode, verify that the Signal Present, Frame Sync, and Pattern Sync LEDs are green.
  – If your module is in ANT mode, verify that the LOS, LOF, and LSS LEDs *are not* red.

5 Display the Interface result group, and then observe the Optical Rx Level (dBm) test result. For OTL applications with compatible optics, the Interface result group provides values that are the sum of the individual lanes.

6 *Optional*: For QSFP+ and CFP optics that support individual OTL lane measurements, the Interface:Lambda result group will display the results for each of the lanes in the OTL signal (4 lanes for OTL3.4 and ten lanes for OTL4.10).

Optical power is measured.

Inserting errors, anomalies, alarms, and defects

You can insert multiple types of errors or anomalies and alarms or defects simultaneously into the traffic stream.

Inserting errors or anomalies

To insert errors or anomalies

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

3 Select the **Laser** button.

4 Display the Alarms/Errors action bar, then select an error or anomaly type (for example, correctable or uncorrectable FEC word errors, bit errors, FAS, or MFAS errors, or SM, PM, or TCM errors).

5. Do the following:
   - For OTU3 or OTU4 (**OTL FAS**, **OTL MFAS**, **OTL LLM**, **Code**, **Alignment Marker,** or **Bip-8**) or STL (**FAS** or **LLM**) lane errors, select the lane into which the error is to be inserted.
   - If you selected a FAS or MFAS Word (non-OTL), specify the number of errors you want to insert, and then select **OK**.
   - If you selected any other type of error, specify the insert type (**Single**, **Burst** or **Rate**).
   - If you specified **Rate** or **Burst**, select one of the available rates or burst counts.
6. Press the **Error Insert** or **Anomaly Insert** button.

   Error or anomaly insertion starts, and the associated button turns yellow.

Test results associated with the error or anomaly appear in the Summary Status result category, and in the categories provided for each type of error or anomaly. For example, test results associated with bit error insertion are provided in the Payload BERT category; results associated with FEC testing are provided in the OTN FEC category. Refer to “OTN results” on page 217 for descriptions of each OTN test result.

To stop insertion

- Press the **Error Insert** or **Anomaly Insert** button again.

Error or anomaly insertion stops, and the associated button turns grey.

Inserting alarms or defects

To insert alarms or defects

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.
3. Select the **Laser** button.
4. Select an alarm or defect type.
5. For alarms that apply to multi-lane applications, specify the number of the lane in which the alarm is to be inserted orselect **All**.
6. Press the **Alarm Insert** or **Defect Insert** button.

   The module inserts an alarm or defect, and the button turns yellow.

Test results associated with the alarm or defect appear in the Status result category.

To stop insertion

- Press the **Alarm Insert** or **Defect Insert** button again.

Alarm or defect insertion stops, and the button turns grey.

Observing and manipulating overhead bytes

The following procedure describes how to observe the value of OTN overhead bytes, and manipulate the values for key bytes.

To observe and manipulate OTN overhead bytes

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.
3. Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.
4. Select the **Laser** button.
5. Press the **OTN Overhead** soft key.

The OTN Overhead screen appears:

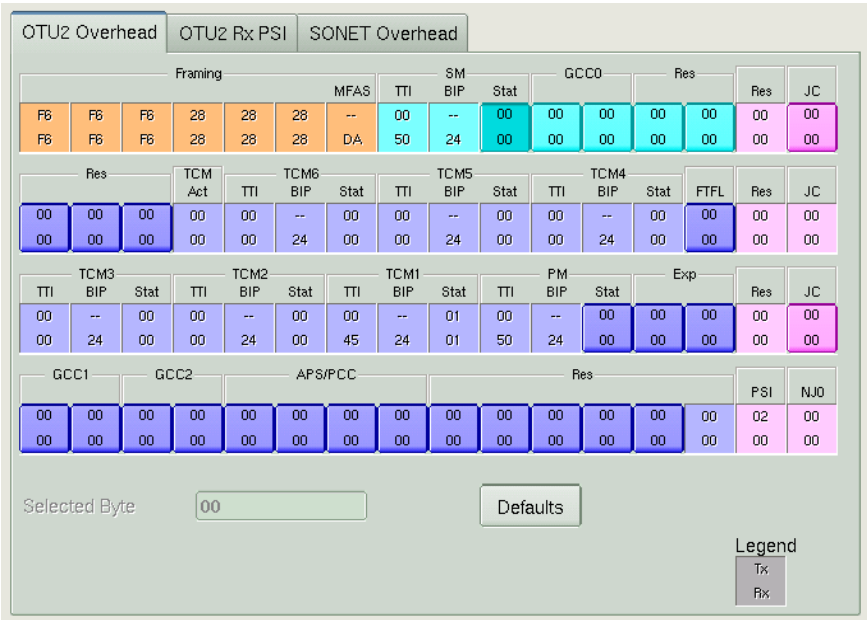


Figure 30 OTN Overhead screen (SONET Client in an OTU2 signal)

Figure 30 illustrates the screen when your unit is configured to analyze SONET bulk BERT payload carried in an OTU2 signal. Tabs are provided that allow you to observe and manipulate the bytes for both signals.

The Overhead tabs allow you to manipulate bytes. The values at the top of each byte on the Overhead tabs indicate the transmitted value; the values at the bottom of each byte indicate the received value.

The Rx PSI tabs allow you to observe the Payload Structure Identifier (PSI) bytes carried in received traffic. These byte can not be changed.

6. *Optional.* Bytes with values in black on the Overhead tab(s) can be manipulated; bytes with values in grey can not. If you want to manipulate a byte value, do the following:
   a. Select the byte on the graphical display.
   b. In the **Selected Byte** field, type the new value, then press OK.

   You can restore the values to their defaults at any time using the **Defaults** button.

The bytes are displayed and can be manipulated.

Scrambling the signal

You can scramble the signal at the line rate for the interface you are testing. For example, if you are analyzing an OTN signal carrying an STS-48c bulk BERT payload from a 2.7G interface, you can scramble the 2.7G OTN signal. The STS-48c bulk BERT payload will not be scrambled.

To scramble the signal

1. Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.
3. Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.
4. Select the **Laser** button.
5. Select the **Setup** soft key. A series of setup tabs appears.
6. Select the **Interface** tab, and then do the following:
   a. If more than one sub-tab is available, select the **Signal** sub-tab.
   b. If you want to descramble the received signal, in Rx - Descramble, select the **Descramble** setting.
   c. If you want to scramble the transmitted signal, in Tx - Scramble, select the **Scramble** setting.

The signals are scrambled and descrambled as specified.

FEC testing

Using the instrument, you can verify that network elements on an OTN network are configured to handle errors properly. FEC (forward error correction) testing involves:

– Stressing network elements by transmitting the maximum number of errors (to ensure that they are corrected as expected).
– Verifying that alarms are triggered as expected on network elements when errors exceeding the maximum are transmitted.

When you configure your unit for FEC testing, you can control how FEC is handled for outgoing and incoming traffic.

To verify the FEC capabilities of your network elements

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 On the Interface tab, specify the transmit clock settings if the defaults are not acceptable (see “Specifying the Tx clock source” on page 156).

4 Select the **OTN** tab, and then select **FEC** from the pane on the left of the tab.

5 In Outgoing FEC, if you want your unit to include valid FEC bytes in outgoing traffic, select **Turn On.** If you select **Turn Off (send zeros)**, zeros are transmitted in place of the FEC bytes.

6 If you are determining how a network element handles correctable FEC errors, in Incoming FEC, select the following:

To:	Select this:
Identify any correctable FEC errors that unexpectedly have not been corrected by the network element, but warrant additional attention with a yellow Summary pane.	Find and fix errors
Identify any correctable FEC errors that unexpectedly have not been corrected by the network element, and indicate that a problem requiring correction has occurred with a red Summary pane.	Find, but don’t fix errors
Ignore all FEC errors. FEC results will not be available.	Ignore

7 If you selected a SONET or SDH line rate and payload in step 1, select the SONET or SDH tab, and then specify the applicable SONET or SDH settings. For details on specifying these settings refer to Chapter 3 “SONET and SDH Testing”.

8 To return to the Main screen, select the **Results** soft key.

9 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

10 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

11 Select the **Laser** button.

12 Insert FEC errors (see “Inserting errors, anomalies, alarms, and defects” on page 159), and then observe the behavior of the Summary pane as described in step 6.

Test results associated with FEC testing appear in the Status and FEC result categories. For descriptions of each of the results, refer to “FEC test results” on page 222.

GMP Mapping

Depending upon the application loaded, Generic Mapping Procedure (GMP) may be offered as a payload mapping option. The Cm values (Nominal and Effective) and Payload Offset are accessible from the Mapping menu item on the OTUn Setup page.

Set Mapping Parameters

1. Using the Test Menu, select the terminate test application for the ODU rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key. A series of setup tabs appears.
3. On the ODUn tab, select the Mapping submenu.
4. The three GMP parameters appear on the screen
   - a **Nominal Cm Value** - displays the programmed nominal Cm value of the loaded application (not able to be modified) in payload bytes per frame.
   - b **Effective Cm Value** - initial value will equal **Nominal Value** of payload bytes per frame resulting in a **Payload Offset** value of 0.0ppm. Entry of a new value in this field will result in a recalculation of the **Payload Offset**.
   - c **Payload Offset** - initial value will be 0ppm. Entry of a new value in this field will result in a recalculation of the **Effective Cm Value**.

GFP Mapping

Depending upon the OTN application selected, Generic Framing Procedure (GFP) may be offered as a payload framing option. The identification of Payload FCS (PFI) and Extension Header (EXI) as well as incoming filter definitions are made on the GFP tab of the Setup page for any multiplexed OTN signal.

Set Framing parameters

1. Using the Test Menu, select the terminate test application for the OTN rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key. A series of setup tabs appears.
3. Select the **GFP** tab.
4. On the frame diagram, select and define the following identifiers, as necessary:

a **PFI** - Enabled/Disabled

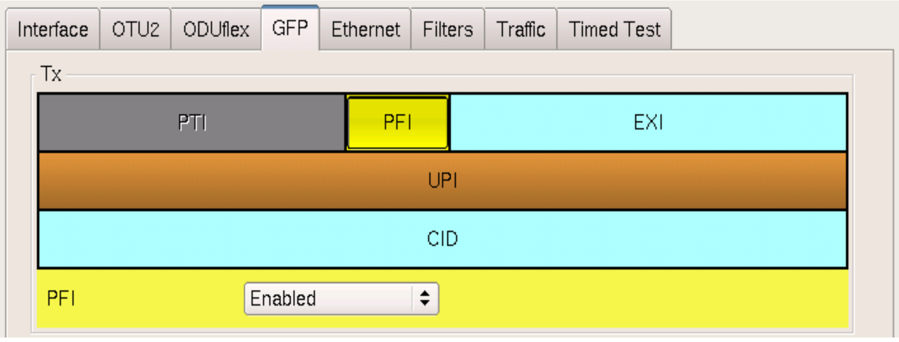


Figure 31 GFP PFI Enabling

b **EXI** - select Linear Frame or Ring Frame. For Linear Frame, select CID on the diagram, then specify the CID value.

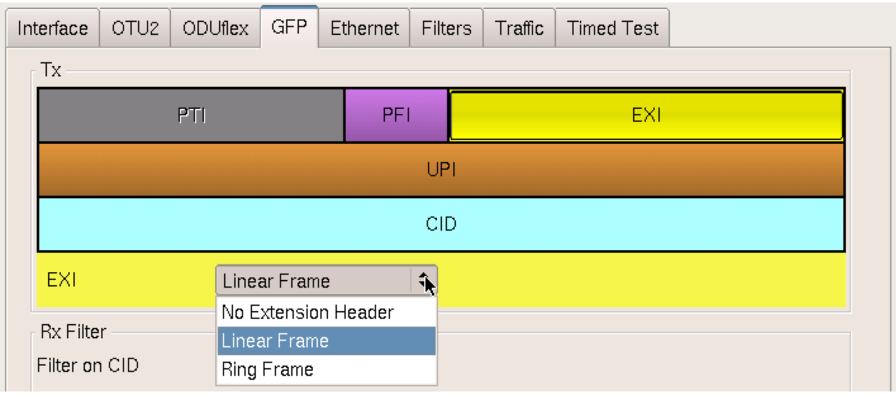


Figure 32 GFP EXI Options

5 To filter the incoming results, in the Rx Filter window pane:

a Toggle **Filter on CID** (channel identifier) to enable, then enter the CID value (between 0 and 255).

b Toggle **Filter on UPI** (User Payload Identifier) to enable, then specify the UPI Filter value from the drop-down list.

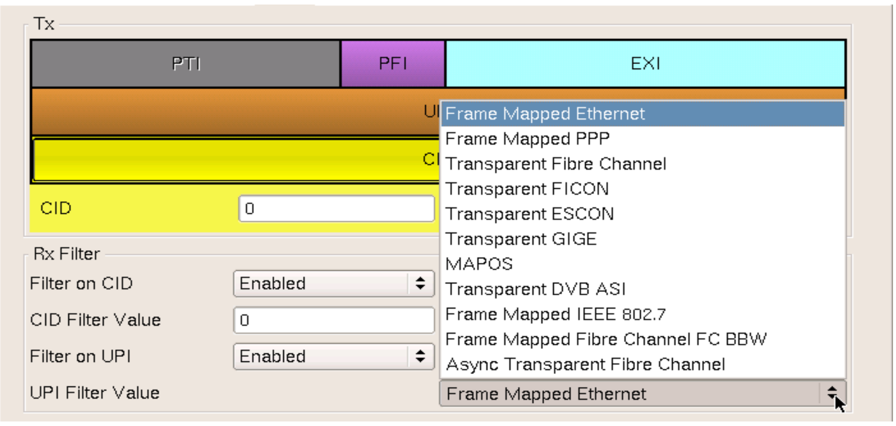


Figure 33 GFP Filter on UPI Options

Generic Frame Procedure mapping has been configured.

Transcoding

1027B HI BER detection can be enabled.

Enabling 1027B HI BER detection

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key.
3. Select the OTU3 tab.
4. Select **Enabled** from the drop down box.
5. Select the **Results** soft key.

1207B HI BER detection has been enabled.

Specifying SM, PM, and TCM trace identifiers

You can specify the SM, PM, and TCM source and destination trace identifiers for transmitted traffic, and you can also specify the identifiers that you expect in received traffic. After specifying the identifiers, you can indicate whether your unit should show a Trace Identifier Mismatch (TIM) when expected and received identifiers do not match.

To specify the SM, PM, and TCM trace identifiers

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key.
3. To define the trace identifiers for OTU, select the **OTUn** tab or for ODU trace identifiers, select **ODUn** tab and then select one of the following from the pane on the left side of the tab:
   – **SM Traces**, if you want to edit the expected or outgoing (transmitted) SM trace identifier.
   – **PM Traces**, if you want to edit the expected or outgoing (transmitted) PM trace identifier.
   – **TCM1 - TCM6**, if you want to edit the expected or outgoing (transmitted TCM trace identifiers.

Settings appear for the traces. Figure 34 illustrates the SM trace settings.

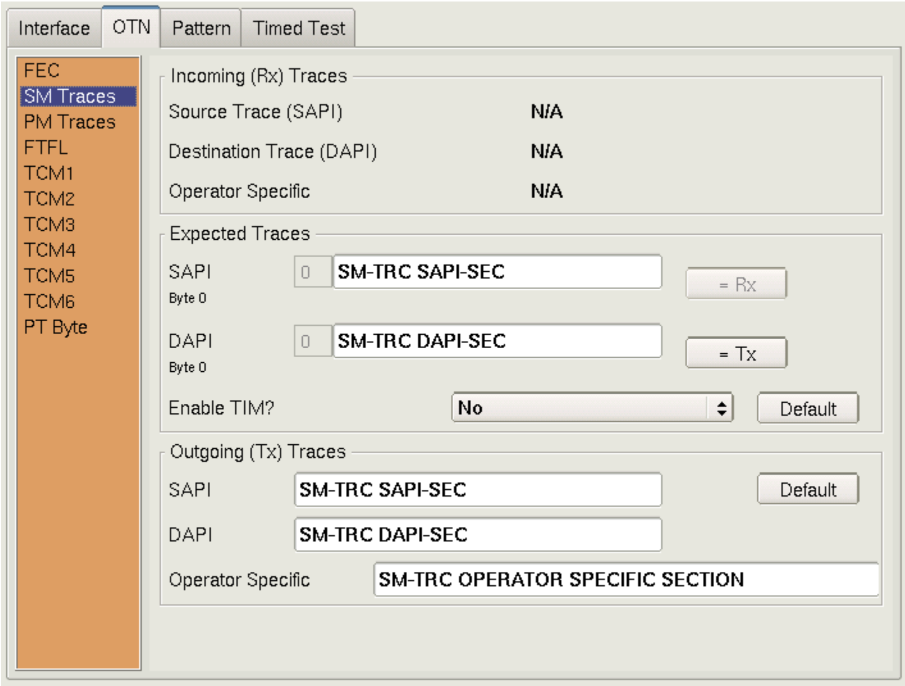


Figure 34 SM Trace Identifier settings

4 Do one of the following:

– If you are specifying SM or PM identifiers, skip this step and proceed to proceed to step 5.

– If you are specifying TCM trace identifiers, in Incoming (Rx) TCM, specify **Analyze** to analyze received signals for TCM trace identifiers, or **Don't Care** if you do not want to analyze the signals.

5 For the Expected Traces, do the following:

– If you want to manually specify the identifiers, select the SAPI or DAPI field, type the corresponding identifier, and then select **OK**.

– Use the **= Rx button** if you want the expected SAPI and DAPI to be the same as the received SAPI and DAPI, or use the **= Tx button** if you want the expected SAPI and DAPI to be the same as the transmitted SAPI and DAPI. The currently received SAPI and DAPI are displayed in the **Incoming (Rx) Traces SM** area at the top of the tab.

– *Optional.* If you want the unit to display a SM-TIM, PM-TIM, or TIM alarm if the expected and incoming trace values do not match, select **on SAPI mismatch**, **on DAPI mismatch**, or **on SAPI or DAPI mismatch**; otherwise, select **No**.

NOTE:

You can reset the expected trace and outgoing trace identifiers at any time using the **Default** buttons.

6 Do one of the following:

– If you are specifying SM or PM identifiers, specify the Outgoing (Tx) Trace identifiers.

– If you are specifying TCM trace identifiers, and you want to transmit identifiers, in Outgoing (Tx) TCM, specify **Enable**, and then specify the identifiers.

– If you are specifying TCM trace identifiers, and you do not want to transmit TCM identifiers, in Outgoing (Tx) TCM, specify **Don't Care**.

7 Select the **Results** soft key to return to the Main screen.

8 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

10 Select the **Laser** button.

11 Loop up the far-end of the network.

12 Verify the following LEDs:

– If your module is in TestPad mode, verify that the Signal Present, Frame Sync, and Pattern Sync LEDs are green.

– If your module is in ANT mode, verify that the LOS, LOF, and LSS LEDs *are not* red.

13 To view the trace identifier results, select the OTN result group, and then select the OTU, ODU, or TCM result categories. If mismatches occurs, the results also appear in the Summary Status result category.

The SM, PM, or TCM trace identifiers are specified.

Specifying FTFL identifiers

You can specify the FTFL (fault type fault location) identifiers for Forward/Downstream and Backward/Upstream signals using up to nine characters, or 118 characters for operator specific identifiers.

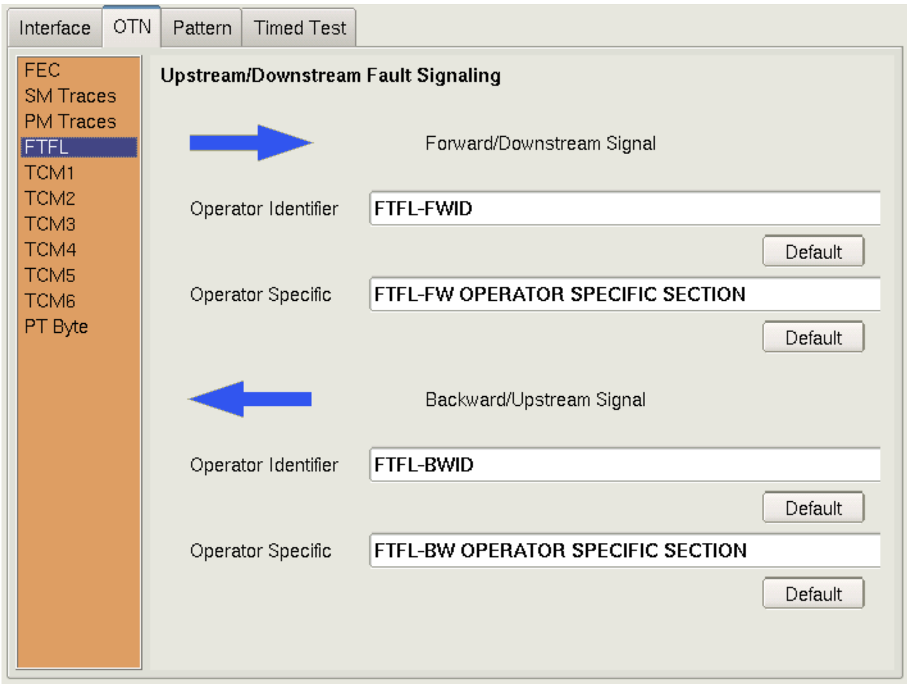
To specify the FTFL identifiers

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Select the **Setup** soft key. A series of setup tabs appears.

3 Select the **OTN** tab, and then select FTFL from the pane on the left side of the tab.

Settings appear for the identifiers.



4 For the Forward/Downstream and Backward/Upstream signals, select each identifier field, type the corresponding identifier, and then select **OK**.

NOTE:
You can reset the identifiers at any time using the **Default** buttons.

5 Select the **Results** soft key to return to the Main screen.

6 Connect a cable from the appropriate RX connector to the network's TRANSMIT access connector.

7 Connect a cable from the appropriate TX connector to the network's RECEIVE access connector.

8 Select the **Laser** button.

9 Loop up the far-end of the network.

10 Verify the following LEDs:

- If your module is in TestPad mode, verify that the Signal Present, Frame Sync, and Pattern Sync LEDs are green.
- If your module is in ANT mode, verify that the LOS, LOF, and LSS LEDs *are not* red.

11 To view the FTFL identifier results, select the OTN result group, and then select the FTFL result category.

The FTFL identifiers are specified.

Specifying GCC BERT Channels

You can specify a GCC channel in both the OTU signal and ODU client.

To specify the GCC channel

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key.
3. Select the **OTUn** or **ODUn** tab (depending upon the application)
4. Select **GCC BERT** from the column on the left side of the **screen.**
5. Specify the GCC channel to be used.
6. Select the **Results** soft key to return to the Main screen.

The GCC channel is set.

ODU RTD

Path delay between two Path Connection Monitoring End Points (P-CMEP) by activating a DMp signal can be measured. Round Trip Delay (RTD) can also be measured on TCM channels.

Activating ODU RTD measurements

1. Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).
2. Select the **Setup** soft key.
3. Select the **OTUn** tab.
4. Select all the channels on which RTD is to be measured by placing a check mark in their box.
5. Select the **Results** soft key.
6. To initiate RTD measurements, select the **RTD Measurement** action button.

ODU RTD measurements have been activated.

Specifying the transmitted and expected payload type

You can specify the payload type for transmitted traffic, and an expected payload type for received traffic.

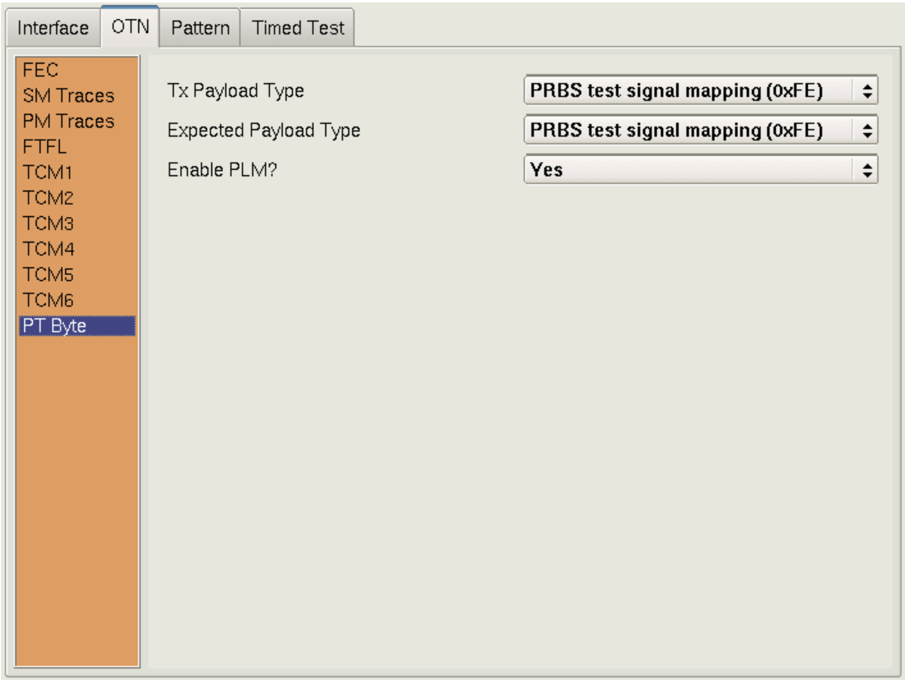
To specify the payload type

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Select the **Setup** soft key.

3 Select the **OTN, OTUn**, or the **ODUn** tab (depending upon the application and the SFP or XFP installed) and then select **PT Byte** from the pane on the left side of the tab.

Settings appear for the payload type.



NOTE:

In the background channels, the unit transmits valid OTN frame structure and correct SM/PM BIPs, with the payload type byte set to ‘FD’ (Null test signal mapping) and the client data is all zeros.

4 In Tx Payload Type, specify the payload type for transmitted traffic.

5 In Expected Payload type, specify the payload expected in received traffic.

6 If you want the unit to show test results associated with a mismatched received and expected payload type, in Show Payload Type mismatch, select **Yes**; otherwise, select **No**.

7 Select the **Results** soft key to return to the Main screen.

8 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

9 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

10 Select the **Laser** button.

11 Loop up the far-end of the network.

12 Verify the following LEDs:

– If your module is in TestPad mode, verify that the Signal Present, Frame Sync, and Pattern Sync LEDs are green.

– If your module is in ANT mode, verify that the LOS, LOF, and LSS LEDs *are not* red.

13 To view results associated with mismatched payloads, select the OTN result group, and then select the OPU result category. If a mismatch occurs, the results also appear in the Summary group.

The payload types are specified.

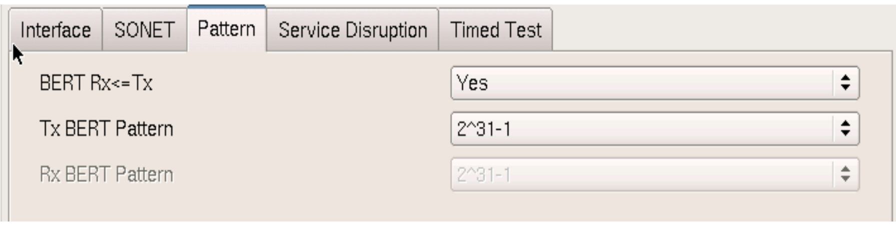
BER testing

The following procedure illustrates a typical scenario for setting up the instrument to terminate an OTN signal for BER testing.

To perform an OTN BER test

1 Using the Test Menu, select the test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Select the **Setup** soft key, and then select the Pattern tab.



a For OTU3 or OTU4 applications, select whether the received BERT pattern should be the same as the transmitted pattern (Rx<=Tx).

b Select the pattern mode (ANSI or ITU), if applicable to the application selected.

c Select a BERT Tx pattern (for example, 2^23-1).

d Select a BERT RX pattern (if Rx<=Tx was set to NO).

NOTE:
You can automatically detect and transmit the correct BERT pattern for the circuit by pressing the Auto button on the Main screen after you specify your interface settings. See “Detecting the received BER pattern” on page 66.

3 Select the **Results** soft key to return to the Main screen.

4 Connect a cable from the appropriate RX connector to the network’s TRANSMIT access connector.

5 Connect a cable from the appropriate TX connector to the network’s RECEIVE access connector.

6 Select the **Laser** button.

7 Loop back the far-end of the network.

8 Verify the following LEDs:
   – If your module is in TestPad mode, verify that the Signal Present, Frame Sync, and Pattern Sync OTN LEDs are green.
   – If your module is in ANT mode, verify that the LOS, LOF, and LSS OTN LEDs *are not* red.

9 Verify that `All Results OK` appears in the results display.

10 *Optional*. Insert five Bit / TSE errors (see “Inserting errors, anomalies, alarms, and defects” on page 159), and then verify that the five errors were received in the BERT Payload result category.

11 Run the test for an appropriate length of time.

The BER test is finished.

Measuring service disruption time

You can use the instrument to measure the service disruption time resulting from a switch in service to a protect line. For a detailed description of this application, see “Measuring service disruption time” on page 71 of Chapter 3 “SONET and SDH Testing”.

To measure service disruption time

1 Using the Test Menu, select the terminate test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152) for a list of applications).

2 Follow step 2 on page 71 through step 11 on page 72 of “Measuring service disruption time” in Chapter 3 “SONET and SDH Testing”.

Service disruption is measured for each of the triggers you selected. For details on the associated test results, see “Service Disruption Results” on page 201.

Monitoring the circuit

Use the monitor applications whenever you want to analyze the received signal.

To monitor a circuit

1 Using the Test Menu, select the monitor test application for the signal, rate, and payload you are testing (refer to Table 33 on page 152 for a list of applications).

2 Connect the module to the circuit.

3 Observe the test results.

You are monitoring the circuit.

7

Test Results

This chapter describes the categories and test results that are available when performing T-Carrier, PDH, SONET, SDH, NextGen, and OTN tests. Topics discussed in this chapter include the following:

About test results

After you connect the instrument to the circuit and press the START/STOP button, results for the configured test accumulate and appear in the Result Windows in the center of the screen. The result groups and categories available depend on their applicability to the test you configured. For example, if you select, configure, and start a SONET test application, 10 Gigabit Ethernet LAN categories are not available because they are not applicable when running a SONET application.

A number of enhancements have been made to the test result layout; for details, see "Step 5: Viewing test results" on page 4.

The following sections describe the test results for each of the categories.

Summary Status results

When running most applications, the Summary Status category displays a large "ALL SUMMARY RESULTS OK" message on a green background if no errors, anomalies, alarms, or defects have been detected (see Figure 35).

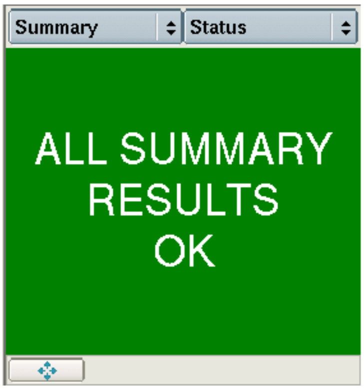


Figure 35 ALL SUMMARY RESULTS OK message

If errors, anomalies, alarms, or defects *have* been detected, the background is red, and the errored results are displayed (see Figure 36).

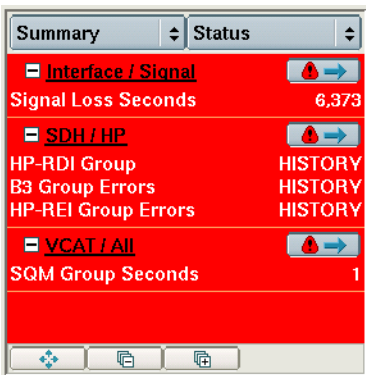


Figure 36 Errored Summary Status results (NextGen application)

This allows you to immediately view errored results without searching through each category. The errored results are listed by group and category. To see all results for the group/category, select the arrow key to the right of the group/category name. You can also collapse or expand the results by selecting the box to the left of the name.

If OoS (out of sequence) Layer 3 Packets, B8ZS Detect, Path Pointer Adjustment, or correctable FEC conditions occur, and *no other errors occurred*, the background is yellow, indicating you should research each condition displayed. In some instances, the conditions constitute errors; in other instances, the conditions are expected and should not be interpreted as errors.

If Pattern Invert On appears, this indicates either the unit is receiving an inverted BERT pattern while expecting an upright pattern or it is receiving an upright BERT pattern while expecting an inverted pattern.

T-Carrier and PDH results

Signal, Frame, BER, and performance results are available when performing T-Carrier and PDH testing. Categories discussed in this section include the following:

– “LEDs (TestPad mode)” on page 177
– “LEDs (ANT mode)” on page 179
– “Interface test results” on page 179
– “Frame test results” on page 180
– “BERT test results” on page 183
– “HDLC results” on page 183
– “PPP results” on page 184
– “Ping results” on page 184
– “Channel test results” on page 185
– “Traffic test results” on page 185
– “ISDN test results” on page 185
– “VF results” on page 187

LEDs (TestPad mode)

Table 34 describes each of the T-Carrier and PDH LEDs in TestPad mode. If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red Signal Present LED), the Frame Sync and Pattern Sync LEDs do not indicate that there is an alarm because you can not attain frame or pattern synchronization without a signal.

Table 34 T-Carrier and PDH LEDs (TestPad Mode)

LED	Rates	Description
B8ZS Detect	DS1	Yellow – B8ZS clear channel coding is detected in the received signal. Red – B8ZS was detected, then lost since the last test start or restart.
C-Bit Sync	DS3	Green – C-Bit synchronization is detected. Red – C-Bit synchronization was detected, then lost since the last test start or restart.
CRC-4 Sync	E1	Green – CRC-4 synchronization is detected. Red – CRC-4 synchronization was detected, then lost since the last test start or restart.
Frame Sync	DS1, DS3, E1, E3, E4	Green – Frame synchronization is detected. Red – Frame synchronization was not detected.
MFAS Sync	E1	Green – MFAS synchronization is detected. Red – MFAS synchronization was detected, then lost since the last test start or restart.
Pattern Sync	DS1, DS3, E1, E3, E4	Green – Synchronization is established with BERT pattern. Red – Synchronization with the received BERT pattern has been lost since the last test restart.
Signal Present	DS1, DS3, E1, E3, E4	Green – A signal is present. Red – Received signal has been lost since the last test start or restart.

LEDs (ANT mode)

Table 35 describes each of the T-Carrier and PDH LEDs in ANT mode. If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the LOF and LSS LEDs do not indicate that there is an alarm because you can not detect framing patterns attain sequence synchronization without a signal.

Table 35 T-Carrier and PDH LEDs (ANT mode)

LED	Description
LOS	Illuminates Red if no signal is detected. Extinguishes when signal is detected.
LOF	Illuminates Red if no framing pattern is detected. Extinguishes when framing pattern is detected.
FTM	Illuminates Yellow if the received framing does not match the expected framing (for example, if M13 framing is expected, but C-Bit framing is detected). Extinguishes when the received and expected framing types match
LSS	Illuminates Red if loss of sequence synchronization is detected. Extinguishes when sequence synchronization is detected.

Interface test results

Table 36 describes each of the results available in the Interface result group. In instances where the result name varies for T-Carrier and PDH test applications, the T-Carrier name appears first, followed by the PDH name.

Table 36 T-Carrier/PDH Interface test results

Test Result	Description
BPV Error Seconds	The number of seconds during which BPVs occurred since the last test start or restart.
BPVs	Number of bipolar violations (BPVs) detected in the received signal (that are not BPVs embedded in valid B8ZS sequences) since the last test start or restart.
BPV Rate	The ratio of BPVs to received bits since detecting a signal.
Line Code Error Rate	The ratio of line codes to received bits since detecting a signal.
Line Code Error Seconds	The number of seconds during which line codes occurred since the last test start or restart.
Line Code Errors	Number of line codes detected in the received signal (that are not line codes embedded in valid B8ZS sequences) since the last test start or restart.
LOS Count	Count of the number of times LOS was present since the last test start or restart.
LOS Seconds	Number of seconds during which an LOS was present since the last test start or restart.
Negative timing slips	Number of bit slips counted when the DS1 test signal slips behind the DS1 reference signal after both signals are present simultaneously. (Only appears in Dual Monitor mode and only on Rx2)

Table 36 T-Carrier/PDH Interface test results (Continued)

Test Result	Description
Positive timing slips	Number of bit slips counted when the DS1 test signal slips ahead of the DS1 reference signal after both signals are present simultaneously. (Only appears in Dual Monitor mode and only on Rx2)
Round Trip Delay (ms)	The round trip delay for the last delay pattern sent and successfully received by the MSAM. Calculated in milliseconds.
Rx Freq Max Deviation (ppm)	Maximum received frequency deviation.
Rx Frequency (Hz)	Frequency of the clock recovered from the received signal, expressed in Hz.
Rx Frequency Deviation (ppm)	Current received frequency deviation. Displayed in PPM.
Rx Level (dBdsx)	Power level of the received signal, expressed in dBdsx.
Rx Level (dBm)	Power level of the received signal, expressed in dBm.
Rx Level (Vpp)	Power level of the received signal, expressed in Vpp.
Signal Loss Seconds	Number of seconds during which a signal was not present.
Signal Losses	Count of the number of times signal was not present.
Tx Clock Source	Displays the timing source (INTERNAL, RECOVERED, or BITS).
Tx Freq Max Deviation (ppm)	Maximum transmitted frequency deviation.
Tx Frequency (Hz)	Current transmitter clock frequency, expressed in Hz.
Tx Frequency Deviation (ppm)	Current transmitted frequency deviation. Displayed in PPM.

Frame test results

Table 37 describes each of the results available in the Frame category. Only those results that apply to the interface you are testing appear in the category. The results begin accumulating after initial frame synchronization on the incoming signal.

Table 37 T-Carrier/PDH Frame results

Test Result	Description
AIS Alarm Count	Count of AIS alarms detected since initial frame synchronization.
AIS Seconds	Count of asynchronous test seconds in which AIS was present for any portion of the test second.
C-Bit Parity Errors	Count of C-Bit parity errors detected since initial DS3 frame synchronization.
C-Bit Parity Error Bit Rate	The ratio of C-bit parity errors to the number of bits over which C-bit parity was calculated.
C-Bit Parity Error Seconds	The number of seconds during which one or more C-bit parity error occurred since initial DS3 frame synchronization.
C-Bit Sync Loss Seconds	The number of seconds during which sync loss occurred due to C-Bit parity errors since initial DS3 frame synchronization.
CRC Error Rate	The ratio of CRC errors to the number of extended superframes received.

Table 37 T-Carrier/PDH Frame results (Continued)

Test Result	Description
CRC Errors	The number of CRC errors detected since initial frame synchronization. CRC errors are counted only when ESF framing is present in the received data.
CRC Error Seconds	The number of seconds during which one or more CRC errors occurred.
CRC Sync Losses	Count of the number of times sync loss occurred due to CRC errors.
CRC Sync Loss Seconds	The number of seconds during which sync loss occurred due to CRC errors since initial frame synchronization.
Far End OOF Seconds	The number of seconds during which the received X-bits are zero within the 1 second interval.
FAS Bit Error Rate	The ratio of FAS bit errors to the number of bits over which FAS was calculated.
FAS Bit Error Seconds	Count of seconds during which FAS bit errors were detected since initial frame synchronization.
FAS Bit Errors	Count of FAS bit errors since initial frame synchronization.
FAS Word Error Rate	The ratio of FAS word errors to received framing bits since initially acquiring frame synchronization.
FAS Word Error Seconds	Count of seconds during which FAS word errors were detected since initial frame synchronization.
FAS Word Errors	Count of FAS word errors received since initial frame synchronization.
FEAC Word	Display of the FEAC message carried in the C-bit FEAC channel.
FEBEs	Count of FEBEs detected since initial frame synchronization.
FEBE Rate	The ratio of FEBEs to the number of bits over which C-bit parity was calculated.
FEBE Seconds	The number of seconds during which at least one FEBE occurred since initial DS3 C-bit frame synchronization.
Frame Error Rate	The ratio of frame errors to received framing bits since initially acquiring frame synchronization.
Frame Error Seconds	The number of seconds during which one or more frame errors occurred since initial frame synchronization.
Frame Errors	The number of frame errors detected since initial frame synchronization. ***NOTE:*** *If three Frame Errors are found, a FEBE may be generated. Disregard this FEBE.*
Frame Sync Loss Seconds	The number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial frame synchronization.
Frame Sync Losses	A count of discrete losses of frame synchronization since initial frame synchronization or last test restart.
LOFs	Count of the number of times LOF was present since initial frame synchronization.
LOF Seconds	Number of seconds during which an LOF was present since initial frame synchronization.

Table 37 T-Carrier/PDH Frame results (Continued)

Test Result	Description
MF-AIS Seconds	Number of seconds during with MF-AIS was detected.
MF-RDI Seconds	Number of seconds during which MF-RDI was detected.
MFAS Sync Losses	Count of the number of MFAS synchronization losses since initial frame synchronization.
MFAS Sync Loss Seconds	Count of the number of seconds during which one or more MFAS synchronization losses occurred or during which frame synchronization could not be achieved, since initial frame synchronization.
MFAS Word Error Rate	The ratio of MFAS word errors to received framing bits since initially acquiring frame synchronization.
MFAS Word Errors	Count of MFAS word errors since initial frame synchronization.
National Bit	
near-end OOF Seconds	The number of seconds during which an out-of-frame condition or an AIS is detected.
Non-Frame Alignment Word	Display of the Non-Frame Alignment word carried in the C-bit FEAC channel.
Parity Error Bit Rate	The ratio of parity errors to the number of bits over which parity was calculated.
Parity Error Seconds	The number of seconds during which one or more parity errors occurred since initial DS3 frame synchronization.
Parity Errors	Count of M-Frames that contain a mismatch between either parity bit (P-bits) and the parity calculated from the information bits in the previous M-frame.
RAI Seconds	The number of seconds during which one or more RAI errors occurred since initial frame synchronization.
RDI Alarm Count	Count of RDI alarms detected since initial frame synchronization.
RDI Seconds	The number of seconds during which one or more RDI errors occurred since initial frame synchronization.
REBEs	Count of the number of REBEs (Remote End Block Errors) detected in the E bits since initial frame synchronization.
Rx X-Bits	The current status of the received X-bits when in a framed mode. The result is available after receiving DS3 frame synchronization.
Sa4 Sa5 Sa6 Sa7 Sa8	Displays the value of the associated bit (Sa 4 through Sa 8) over the previous 8 received frames.
Tx X-Bits	The current setting of the transmitted X-bits when in a framed mode.

BERT test results

Table 41 describes each of the results available under the Payload group, in the BERT category.

Table 38 T-Carrier/PDH BERT test results

Test Result	Description
Bit/TSE Error Rate	Ratio of bit or Test Sequence Error (TSE) errors to received pattern data bits since initial frame synchronization.
Bit/TSE Errors	Count of the number of bit or Test Sequence Error (TSE) errors that occurred after initial pattern synchronization.
Pattern Slip Seconds	Count of the number of seconds during which one or more pattern slips occurred after initial pattern synchronization.
Pattern Sync Loss Seconds	Number of seconds during which pattern synchronization was lost after initial pattern synchronization.
Pattern Sync Losses	Count of the number of times synchronization is lost after initial pattern synchronization.

HDLC results

Table 41 describes each of the results available under the HDLC group.

Table 39 HDLC test results

Test Result	Description
Tx Frame Count	Count of the total number of HDLC frames sent since the last restart of the test.
Rx Frame Count	Count of the total number of HDLC frames received since the last restart of the test.
Rx Octet Count	Count of the total number of HDLC frame octets received since start of the test.
Short Frame Count	Count of the total number of short HDLC frame since the last restart of the test.
Aborted Frame Count	Count of the total number of HDLC frames aborted since the last restart of the test.
FCS Errored Frames	Count of the total number of HDLC frames with bad FCS received since the last restart of the test.
Average % utilization	Average value of the utilization of the physical bandwidth since the last restart of the test.
Current % Utilization	Current value of the utilization of the physical bandwidth.
Maximum % Utilization	Maximum (peak) value of the current utilization of the physical bandwidth since the last restart of the test.
Average Throughput	Average value of the throughput (in kbps) since the last restart of the test.
Instantaneous Throughput	Current value of the throughput (in kbps).
Maximum Throughput	Maximum (peak) value of the throughput (in kbps) since the last restart of the test.
Average Frame Rate	Average number of frames received per second since the last restart of the test.

Table 39 HDLC test results (Continued)

Test Result	Description
Average Frame Size	The average value of the HDLC frame size (total octets / total frames)

PPP results

Table 40 describes each of the results available under the PPP group.

Table 40 PPP test results

Test Result	Description
PPP Session Status	The current value of the PPP session status.
Source IP Address	User-configured IP address of the local device.
IP Subnet Mask	User-configured IP subnet mask.
IP Gateway	User-configured IP gateway address.
Preferred DNS Address	User-configured address of the primary DNS server.
Alternate DNS Address	User-configured address of the primary DNS server
Remote IP Address	User-configured IP address of the remote device
Destination IP Address	User-configured IP address of the destination device.
Resolved Host Name	

Ping results

Table 41 describes each of the results available under the Ping group.

Table 41 Ping test results

Test Result	Description
Ping Requests Tx	Number of requests for Ping response transmitted since the last restart of the test.
Ping Replies Rx	Number of replies to ping requests received since the last restart of the test.
Lost Pings	Calculated number of ping packets to have been not returned since the last restart of the test.
Lost Pings %	Calculated percentage of ping packets to have been not returned since the last restart of the test.
Ping Requests Rx	Number of requests for Ping response received since the last restart of the test.
Ping Replies Tx	Number of responses to Ping requests transmitted since the last restart of the test.
Delay Average	Calculated average ping delay since the last restart of the test.
Delay Minimum	Minimum ping delay value since the last restart of the test.
Delay Maximum	Maximum ping delay value since the last restart of the test.

Channel test results

In addition to the standard result groups, when your instrument is configured for fractional T1 testing, the Payload result group provides a Channel category. The Rx Byte for each channel appears in the category.

Traffic test results

In addition to the standard result groups, when your instrument is configured for fractional T1 testing, the Payload result group provides a Traffic category. The ABCD signaling bit value for each channel appears in the category.

ISDN test results

In addition to the standard result groups, when your instrument is configured for ISDN testing, statistics, decodes, and information concerning the call status are provided under the ISDN and Call result groups.

Stats

The ISDN Stats category shows layer 2 results such as the frame count and D channel service state for the primary, and if applicable, secondary line. Results in this category accumulate after test restart. Table 42 describes the results that appear in the ISDN category.D-Chan Decodes

Table 42 Stats test results

Result	Description
Average % Utilization	The average bandwidth utilized by the received traffic since the last test restart, expressed as a percentage of the line rate of available bandwidth. The average is calculated over the time period elapsed since the last test restart.
Call Clearing Count	Total number of cleared calls for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Connect Count	Number of calls connected for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Failure Count	Number of failed incoming and outgoing calls for the primary, and if applicable, secondary line. Count appears in the Primary result column.
Call Placement Count	Number of outgoing calls placed for the primary, and if applicable, secondary line. Count appears in the Primary result column.
CRC Errored Frames	Counts the number of CRC errored frames on the D channel.
Errored Frame Count	Number of valid frames with one or more of the following error conditions: – undefined control field – “S” or “U” frames with incorrect length – “I” frame with a long information field.
Frame Reject Frames	Number of frame-reject (FRMR) frames that indicate an improper frame has arrived.
Frame Sync	T1 frame synchronization was not detected.
Invalid SAPI Count	Number of frames received with an invalid SAPI (service access point identifier).

Table 42 Stats test results (Continued)

Result	Description
LAPD State	Displays one of the following messages about the process of establishing the data link: – TEI Unassigned – Assign Await. TEI – Est. Await. TEI – TEI Assigned – Await. Est. – Await. Rel. – Mult. Frm. Est. – Timer Recovery – Link Unknown
Maximum % Utilization	The maximum percent of link utilization in any one second since the last restart of the test.
Reject Frame Count	Number of reject (REJ) supervisory frames used by a data link layer entity to request retransmission of “I” frames starting with the frame numbered N(R).
Rx Frame Count	Number of LAPD frames received since the last restart of the test.
Short Frames	Number of short ISDN frames (frames with less than 3 octets plus an FCS) detected.
Valid Frame Count	Number of valid LAPD frames received since the last restart of the test.

Call states

Table 43 lists the valid call states that may appear for a call in the Status result category.

Table 43 Call states

State	Indicates
Alerting	An outgoing call has been routed to the destination ISDN device or phone, and is in the process of ringing. **NOTE:** Some ISDN devices (for example, the HST-3000), do not literally ring.
Connected	An incoming or outgoing call is established.
Idle	The instrument is ready to place or receive the call.
Incoming	An incoming call is waiting to be accepted, rejected, or ignored.
Outgoing	The instrument is in the process of initializing an outgoing call.
Proceeding	A switch has recognized and is processing the outgoing call.
Releasing	The instrument is in the process of releasing the call.

In addition to the call states listed in Table 43, Q.931 cause values indicating the reason a call is disconnected are displayed in the Status category. For details, see “Understanding the Q.931 Cause Values” on page 246. A history of all call activity is also provided in the History category.

VF results

In addition to the standard result groups, when your instrument is configured for VF testing, VF results are provided under the Payload result group. Table 44 describes each of the results available.

Table 44 VF test results

Result	Description	Operating Mode	Test
1004Hz Frequency	Frequency measurement of the 1004 Hz test tone.	Dual Monitor Terminate	Three Tone
1004Hz Level	Level measures of the 1004 Hz test tone.	Dual Monitor Terminate	Three Tone
2804Hz Frequency	Frequency measurement of the 2804 Hz test tone.	Dual Monitor Terminate	Three Tone
2804Hz Level	Level measurement of the 2804 Hz test tone.	Dual Monitor Terminate	Three Tone
2804Hz Gain Slope	The difference between the levels at 1004 Hz and 2804 Hz.	Dual Monitor Terminate	Three Tone
3.4Hz Flat Notched dBrnC	Measurement, using a 1010 Hz notch filter, of the noise level on a channel with a holding tone at the transmitted end, expressed in dBrn. The measurement range is 22 to 90 dBrn with 1 dBrn resolution.	Dual Monitor Terminate	Quiet Holding Tone
3.4kHz Flat dBrnC	Measurement of the low frequency noise present on the test channel, expressed in dBrn. The measurement range is 22 to 90 dBrn with 1 dBrn resolution.	Dual Monitor Terminate	Quiet Tone Holding Tone
3.4kHz Flat Notched SNR	Ratio of the test tone signal level to the level of the background noise using the 1010 Hz notch filter. Generally, higher ratios indicate lower noise and better quality while lower ratios indicate more noise and poor quality.	Dual Monitor Terminate	Quiet Holding Tone
3.4kHz Flat SNR	Ratio of the test tone signal level to the level of the background noise on the test channel. Accuracy is 1 dB, from 0 to 45 dB. For this measurement a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test.	Dual Monitor Terminate	Quiet Tone Holding Tone
404Hz Frequency	Frequency measurement of the 404 Hz test tone.	Dual Monitor Terminate	Three Tone
404Hz Gain Slope	The difference between the levels at 404 Hz and 1004 Hz.	Dual Monitor Terminate	Three Tone
404Hz Level	Level measurement of the 404 Hz test tone.	Dual Monitor Terminate	Three Tone

Table 44 VF test results (Continued)

Result	Description	Operating Mode	Test
Cmsg dBrnC Dmsg dBrnC	Measurement, using C- or D-Message weighting, of the noise on an idle channel or circuit (a channel or circuit with a termination at one end and no holding tone at the transmitting end), expressed in dBrnC. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution.	Dual Monitor Terminate	Quiet Tone Holding Tone
Cmsg Notched dBrnC Dmsg Notched dBrnC	Measurement, using C- or D-Message weighting and a 1010 Hz notch filter, of the noise level on a channel with a holding tone at the transmitted end, expressed in dBrnC. The measurement range is 22 to 90 dBrnC with 1 dBrnC resolution.	Dual Monitor Terminate	Quiet Tone Holding Tone
Cmsg Notched SNR Dmsg Notched SNR	Ratio, in dB, (using C- or D-Message weighting) of the test tone's level to the level of the background noise on the test channel using the 1010 Hz notch filter.	Dual Monitor Terminate	Quiet Tone
Cmsg SNR Dmsg SNR	Ratio, in dB, (using C- or D-Message weighting) of the test tone's level to the level of the background noise on the test channel (accuracy is 1 dB, from 0 to 45 dB). For this measurement, a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test.	Dual Monitor Terminate	Quiet Tone Holding Tone
DC Offset mV	Measurement of DC offset from -128 mV to 128 mV with a resolution of 1 mV.	Dual Monitor Terminate	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep
Frequency Hz	Measurement of the VF frequency in Hertz from 20 to 3904 Hz with an accuracy of 1 Hz.	Dual Monitor Terminate	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep
Holding Tone Pres.	Measurement of the 1004 Hz tone transmitted over a circuit for performing noise-with-tone, jitter, and transient measurements.	Dual Monitor Terminate	Quiet Tone Holding Tone
Impulse Noise Count	Number of times the impulse noise level has exceeded the specified threshold.	Dual Monitor Terminate	Impulse Noise
Level dBm	Measurement of the VF level in dBm, with an accuracy of 0.2 dB from 200 Hz to 3900 Hz (+3 dBm to -40.0 dBm) and 0.1 dB from 1002 Hz to 1022 Hz (0 to -19 dBm).	Dual Monitor Terminate	Quiet Tone Holding Tone Three Tone Single Tone Frequency Sweep

SONET/SDH results

Interface, BER, and performance results are available when performing SONET, SDH, and 10 Gigabit Ethernet WAN testing. Categories discussed in this section include the following:

NOTE:
When you configure your unit to transmit or monitor a SONET or SDH client signal over an OTN circuit, SONET and SDH LED behavior and test results are streamlined. For example, if your unit is operating in TestPad mode and the signal is lost, the Signal Present History LED turns red, and Signal Present and Signal Loss Seconds results are provided in the SONET/SDH Summary Status category.

SONET and SDH LEDs (TestPad mode)

Table 45 describes each of the SONET and SDH LEDs in TestPad mode for the lower rate applications. If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red Signal Present LED), the Frame Sync and Pattern Sync LEDs do not indicate that there is an alarm because you can not attain frame or pattern synchronization without a signal

Table 45 SONET and SDH LEDs (TestPad Mode)

SONET LED	SDH LED	Description
Signal Present	Signal Present	Green – A signal is present. Red – No signal is present.

Table 45 SONET and SDH LEDs (TestPad Mode) (Continued)

SONET LED	SDH LED	Description
Frame Sync	Frame Sync	Green – Synchronization is established with framing of signal. Red – Frame synchronization has not been established.
Path Ptr Present	AU Ptr Present	Green – Valid SONET or SDH pointer value is present. Red – An invalid Path pointer has been received on the selected receive channel since the last test start or restart.
Concat Payload	Concat Payload	Green – A concatenated payload has been detected. Red – A concatenated payload was detected, but has been lost since the last test start or restart.
Pattern Sync	Pattern Sync	Green – Synchronization is established with BERT pattern. Red – Synchronization with the received BERT pattern has not been established.

Table 46 describes each of the SONET and SDH STL LEDs in TestPad mode for the highest rate applications. If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red Signal Present LED), the Frame Sync and Pattern Sync LEDs do not indicate that there is an alarm because you can not attain frame or pattern synchronization without a signal

Table 46 SONET and SDH STL LEDs (TestPad Mode)

SONET LED	SDH LED	Description
Signal Present	Signal Present	Green – A signal is present. Red – No signal is present.
STL Frame Sync	STL Frame Sync	Green – Synchronization is established with framing of signal. Red – Frame synchronization has not been established.
STL Marker Lock	STL Marker Lock	Green – Synchronization is established with Marker Lock signal. Red – Synchronization has not been established with Marker Lock signal.

Table 46 SONET and SDH STL LEDs (TestPad Mode) (Continued)

SONET LED	SDH LED	Description
STL Lanes Aligned	STL Lanes Aligned	Green – Synchronization has been established within acceptable parameters between lanes. Red – Synchronization has not been established within acceptable parameters between lanes.
Path Ptr Present	AU Ptr Present	Green – Valid SONET or SDH pointer value is present. Red – An invalid Path pointer has been received on the selected receive channel since the last test start or restart.
Pattern Sync	Pattern Sync	Green – Synchronization is established with BERT pattern. Red – Synchronization with the received BERT pattern has not been established.

SONET and SDH LEDs (ANT mode)

Table 48 describes each of the SONET and SDH LEDs in ANT mode for the lower rate applications. If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the LOF and LSS LEDs do not indicate that there is an alarm because you can not detect framing patterns or attain sequence synchronization without a signal.

Table 47 SONET and SDH LEDs (ANT mode)

LED	Description
LOS	Illuminates Red if no signal or an invalid signal is detected. Extinguishes when a valid signal is detected.
LOF	Illuminates Red if no framing pattern is detected. Extinguishes when framing pattern is detected.
LOP-P	Illuminates Red if no payload position pointer is detected in the signal overhead. Extinguishes when payload position pointer is detected.
LSS	Illuminates Red if synchronization is not established with the received BERT pattern. Extinguishes when pattern sync is established.

Table 48 describes each of the SONET and SDH STL LEDs in ANT mode for the highest rate applications. If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the STL LOF and LSS LEDs do not indicate that there is an alarm because you can not detect framing patterns or attain sequence synchronization without a signal.

Table 48 SONET and SDH STL LEDs (ANT mode)

SONET LED	SDH LED	Description
LOS	LOS	Illuminates Red if no signal or an invalid signal is detected. Extinguishes when a valid signal is detected.
STL LOF	STL LOF	Illuminates Red if no framing pattern is detected. Extinguishes when framing pattern is detected.
STL LOR	STL LOR	Illuminates Red if marker recovery error is in out-of-recovery state. Extinguishes when recovery state is reestablished.
STL LOL	STL LOL	Illuminates Red if no marker lock loss is detected or if inter-lane skew is beyond the threshold. Extinguishes when marker lock is detected.
LOP-P	AU-LOP	Illuminates Red if no payload position pointer is detected in the signal overhead. Extinguishes when payload position pointer is detected.
LSS	LSS	Illuminates Red if synchronization is not established with the received BERT pattern. Extinguishes when pattern sync is established.

CFP Auto-FIFO Reset

Some CFP are equipped with a feature that automatically schedules a transmit (Tx) or Receive (RX) FIFO Reset upon detection of a Los of Lane (LOL) Alignment. As FIFO resets will have a significant effect on the reported results of currently running applications, they are asynchronous involving delays on the order of several hundred microseconds.

Specific to the OpNext 100G LR4 CFP, and as per the manufacturer's recommendation, the 40G/100G High Speed Transport Module will execute software monitored and assisted transmit and receive FIFO resets.

A FIFO will be reset any time it has regained synchronization (lock) after having lost it:

- For the Tx FIFO, this typically occurs just as the optics gets activated (i.e. as it starts receiving data from host).
- For the Rx FIFO, this typically occurs any time network data is lost and regained (e.g. during LOS transition from on to off).

This automatic FIFO-resetting mechanism will be gated (blocked) if:

- SONET/SDH service disruption is enabled for service disruption measurement accuracy (see "Measuring service disruption time" on page 71); or
- OTN service disruption is enabled for service disruption measurement accuracy (see "Measuring service disruption time" on page 173); or
- Ethernet service disruption has decoupled TX from RX for service disruption measurement accuracy (refer to*T-BERD / MTS-8000 and T-BERD / MTS-6000A Ethernet, IP, TCP/EUDP, Fibre Channel, VOIP and IP Video Testing Manual*).

The manual FIFO reset on the expert configuration page will not be blocked or gated (refer to*T-BERD / MTS-8000 and T-BERD / MTS-6000A Getting Started Manual)*.

Interface test results

Table 49 lists and describes each of the test results available in the Interface result group. All results are displayed under the Signal tab, except as noted. Result names are identical for SONET and SDH test applications.

Table 49 Interface test results

Test Result	Description
Signal Losses	Count of the number of times signal was not present.
Signal Loss Seconds	Number of seconds during which a signal was not present.
CFP Optical Rx Overload	The value of the received optical power in dBm. Will display under the Lambda heading for optics accommodating reporting of individual parallel lasers.
LOS Count	Count of the number of times LOS was present since the last test start or restart.
LOS Seconds	Number of seconds during which an LOS was present since the last test start or restart.
Optical Rx Level (dBm)	Displays the receive level for optical signals in dBm.
Optical Rx Level (dBm) [component]	Displays the receive level for each laser of a multi-laser optical signals in dBm (optic dependent) (Lambda tab)
Round Trip Delay (ms)	The round trip delay for the last delay pattern sent and successfully received by the MSAM. Calculated in milliseconds, with a resolution of 1 ms.
Rx Frequency (Hz)	Frequency of the clock recovered from the received signal, expressed in Hz.
Rx Frequency Deviation (ppm)	Current received frequency deviation, expressed in ppm.
Rx Freq Max Deviation (ppm)	Maximum received frequency deviation, expressed in ppm.
Invalid Rx Signal Seconds	Number of seconds during which an invalid signal was received.
Tx Clock Source	Displays the timing source (INTERNAL, RECOVERED, or BITS).
Tx Freq Max Deviation (ppm)	Maximum transmitted frequency deviation, expressed in ppm.
Tx Frequency (Hz)	Current transmitter clock frequency, expressed in Hz.
Tx Frequency Deviation (ppm)	Current transmitted frequency deviation, expressed in ppm.

STL Stat results

Table 50 lists and describes each of the test results available in the STL Stats category when performing STL testing.

Table 50 STL Stats

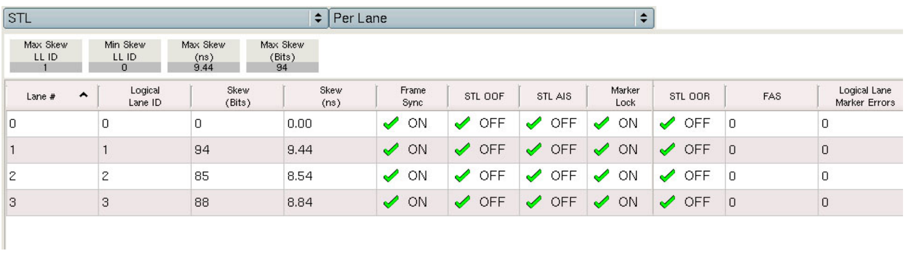
STL Stat Result	Description
SEF Seconds	Count of asynchronous test seconds in which an OOF was counted since the last test start or restart.
AIS Seconds	Count of the number of seconds containing at least one AIS error in any logical lane.
Marker Lock Loss Seconds	The number of seconds during which a Marker Loss was detected since the last test start or restart.
OOR Seconds	The number of seconds during which an OOR was detected since the last test start or restart.
Lane Aligned Loss Seconds	The number of seconds during which an LOL was detected since the last test start or restart.(ANT Mode)
OOL Seconds	The number of seconds during which an OOL was detected since the last test start or restart.
FAS Errors	Count of the total number of FAS errors across all logical lanes (sum).
FAS Error Rate	Ratio of the total number of FAS errors across all logical lanes (sum) to total number of frames.
FAS Error Seconds	Count of the number of seconds containing at least one FAS error in any logical lane.
(Logical) Lane Marker (LLM) Errors	Count of the total number of LLM errors across all logical lanes (sum).
(Logical) Lane Marker (LLM) Error Rate	Ratio of the total number of LLM errors across all logical lanes (sum) to total number of Lane Markers.
(Logical) Lane Marker (LLM) Error Seconds	Count of the number of seconds containing at least one LLM error in any logical lane.
Frame Sync Loss Seconds	Number of seconds frame synchronization was not present since the last test start or restart.
Max Skew (bits)	Shows maximum skew value, in bits, for any logical lane since the last restart of the test.
Cur Max Skew (bits)	Shows current maximum skew value, in bits, for any logical lane.
Max Skew (ns)	Shows maximum skew value, in nsecs, for any logical lane since the last restart of the test.
Cur Max Skew (ns)	Shows current maximum skew value, in nsecs, for any logical lane.
Max Logical Lane Skew	Shows ID for logical lane having the highest skew.
Min Logical Lane Skew	Shows Logical Lane ID for logical lane having the least skew.

STL Per Lane results

Table 51 lists and describes each of the test results shown in the STL Per Lane display when performing STL testing.

Table 51 STL Per Lane results

STL Stat Result	Description
Max Skew LL ID	Shows Logical Lane ID for logical lane having the greatest skew.
Min Skew LL ID	Shows Logical Lane ID for logical lane having the least skew.
Max Skew (ns)	Shows skew value in nsecs for logical lane having the greatest skew.
Max Skew (bits)	Shows skew value in bits for logical lane having the greatest skew.
Lane #	Shows the Logical Lanes in the signal, #0 - #3.
Logical ID	Shows Lane ID for each logical lane.
Skew (bits)	Shows skew value in bits for each logical lane.
Skew (ns)	Shows skew value in nsecs for each logical lane.
Frame Sync	Display of sync status for each logical lane.
STL OOF	Display of OOF status for each logical lane.
STL AIS	Display of AIS status for each logical lane.
Marker Lock	Display of marker lock status for each logical lane.
STL OOR	Display of OOR status for each logical lane.
FAS	Count of FAS errors for each logical lane since the last restart of the test.
(Logical) Lane Marker (LLM) Errors	Count of the total number of LLM errors in each logical lane since the last restart of the test.


STL | Per Lane

Max Skew LL ID	Min Skew LL ID	Max Skew (ns)	Max Skew (Bits)
1	0	9.44	94

Lane #	Logical Lane ID	Skew (Bits)	Skew (ns)	Frame Sync	STL OOF	STL AIS	Marker Lock	STL OOR	FAS	Logical Lane Marker Errors
0	0	0	0.00	ON	OFF	OFF	ON	OFF	0	0
1	1	94	9.44	ON	OFF	OFF	ON	OFF	0	0
2	2	85	8.54	ON	OFF	OFF	ON	OFF	0	0
3	3	88	8.84	ON	OFF	OFF	ON	OFF	0	0

Figure 37 STL Per Lane results table

Section/RSOH test results

Table 52 lists and describes each of the test results available in the Section and RSOH categories.

Table 52 Section/RSOH results

SONET Result	SDH Result	Description
B1 Error Rate	B1 Error Rate	The ratio of Section BIP errors to the total number of received bits.
B1 Errors	B1 Errors	Count of errors in the even parity BIP-8 (B1) byte used as a parity check against the preceding frame. Up to eight B1 errors may be counted per frame.
Frame Sync Loss Seconds	LOF Seconds	Number of seconds frame synchronization was not present since the last test start or restart.
Frame Sync Losses	LOF Count	Count of frame synchronization losses since the last test start or restart.
Frame Word Error Rate	FAS Word Error Rate	The ratio of frame word errors to the total number of received frame words.
Frame Word Errors	FAS Word Errors	Count of errored frame alignment signal (FAS) subsets (subset of bytes A1 and A2) received since gaining initial frame synchronization.
Section Trace (J0)	RS Trace (J0)	Displays the 16 or 64-byte Section trace ASCII message that is carried in the Section overhead byte (J0).
SEF Count	OOF Count	Count of four contiguous errored frame alignment words (A1/A2 pair) detected since the last test start or restart.
SEF Seconds	OOF Seconds	Count of asynchronous test seconds in which an OOF was counted since the last test start or restart.

Line/MSOH test results

Table 53 lists and describes each of the test results available in the Line and MSOH categories.

Table 53 Line/MSOH results

SONET Result	SDH Result	Description
AIS-L Seconds	MS-AIS Seconds	The number of seconds during which a Line AIS is detected since the last test start or restart.
APS K1 Bridged Request Code (Ring)	APS K1 Bridged Requested Code (Ring)	The number of the channel bridged bits 1-4 on the protection line. If 0, then no line is bridged to the APS line.
APS K1 Channel Number (Linear)	APS K1 Channel Number (Linear)	Displays the value of the destination node bit field carried in the K1 byte. It is typically set when APS events occur in the network.
APS K1 Destination Node ID (Ring)	APS K1 Destination Node ID (Ring)	Displays the value of the destination node bit field carried in the K1 byte. It is typically set when APS events occur in the network.
APS K1 Request Code (Linear)	APS K1 Request Code (Linear)	The number of the channel bridged bits 1-4 on the protection line. If 0, then no line is bridged to the APS line.
APS K2 Bridge Channel (Linear)	APS K2 Bridge Channel (Linear)	Displays the value of the source node bit field carried in the K2 byte. It is typically set when APS events occur in the network.

Table 53 Line/MSOH results (Continued)

SONET Result	SDH Result	Description
APS K2 MSP Architecture (Linear)	APS K2 MSP Architecture (Linear)	Displays the value of the Path code bit field carried in the K2 byte. It is typically set when APS events occur in the network.
APS K2 Path Code (Ring)	APS K2 Path Code (Ring)	Displays the value of the Path code bit field carried in the K2 byte. It is typically set when APS events occur in the network.
APS K2 Source Node ID (Ring)	APS K2 Source Node (Ring)	Displays the value of the source node bit field carried in the K2 byte. It is typically set when APS events occur in the network.
APS K2 Status (Linear)	APS K2 Status (Linear)	Displays the status code carried in bits 6-8 of the K2 byte. It is typically set when APS events occur in the network.
APS K2 Status (Ring)	APS K2 Status (Ring)	Displays the status code carried in bits 6-8 of the K2 byte. It is typically set when APS events occur in the network.
APS Message Count	APS Message Count	Count of the number of APS messages since the last test start or restart.
B2 Error Rate	B2 Error Rate	The B2 Errors/Total number of received bits, less the SOH. The denominator of the message is the total number of non-Section received bits instead of the number of B2 so that the result is used to approximate overall received bit error rate. This approximation works on the assumption that only one bit error occurs per SOH frame per bit position.
B2 Errors	B2 Errors	Count of errors in the even parity Line B2 byte used as a parity check against the preceding frame less the regenerator or section overhead. Up to eight B2 errors may be counted per STS.
RDI-L Seconds	MS-RDI Seconds	The number of seconds in which the RDI alarm has been active since the last test start or restart. The second is Incremented each time the instrument detects a 110 pattern in the Line overhead APS byte (K2), bits 6 to 8, for five consecutive frames. Line RDI is removed after detecting a pattern other than 110 in bits 6-8 of byte K2 for five consecutive frames.
REI-L Rate	MS-REI Rate	The ratio of Line REIs to the total number of received bits in the previous frame, less the SOH overhead.
REI-L Errors	MS-REI Errors	Count of the number of REI errors present. Up to 8 REI errors may be counted per frame.
Sync Status (S1)	Sync Status (S1)	Displays the S1 byte message, carried in bits 5 through 8, after frame synchronization and signal presence are detected.

Path/HP test results

Table 54 lists and describes each of the test results available in the Path and HP categories.

Table 54 Path/HP results

SONET Result	SDH Result	Description
AIS-P Seconds	AU-AIS Seconds	Count of asynchronous test seconds in which Path AIS was present for any portion of the test second.
B3 Error Rate	B3 Error Rate	Rate of Path BIP byte (B3) errors divided by the total number of received bits less the SOH and LOH.
B3 Errors	B3 Errors	Count of B3 errors (indicating an error in the previous frame since initial SONET frame synchronization) since the last test start or restart.
Concat Payload Losses	Concat Losses	Count of the number of times the concatenated pointer was invalid when testing a concatenated payload.
Concat Payload Loss Seconds	Concat Loss Seconds	Count of the number of seconds that the concatenated pointer was invalid when testing a concatenated payload.
LOP-P Seconds	AU-LOP Seconds	Count of the number of seconds that Path LOP was present since the last test start or restart.
NDF-P Count	N/A	Count of the number of new data flags (NDF) since the last test start or restart.
Path Pointer Decrements	AU Pointer Decrements	Count of the number of times the pointer bytes (H1 and H2) indicated a decrement to the Path payload pointer since initial frame synchronization.
Path Pointer Increments	AU Pointer Increments	Count of the number of times the pointer bytes (H1 and H2) indicated an increment to the Path payload pointer since initial frame synchronization.
Path Pointer Adjustments	AU Pointer Adjustments	Count of the number of negative and positive Path pointer adjustments on the selected receive channel since the last test start or restart.
Path Pointer Size	AU Pointer Size (SS Bits)	The binary setting of the size bits in the H1 byte. The normal setting for the pointer size bits is 00 to indicate a SONET payload, or 10 to indicate a SDH payload.
Path Pointer Value	AU Pointer Value	The current Path pointer value from 0 to 782. UNAVAILABLE appears under a number of error conditions, such as Line AIS, etc. OUT OF RANGE appears if the pointer value is outside 0 to 782.
Path Trace (J1)	Path Trace (J1)	Displays the 16 or 64-byte Path trace ASCII message which is carried in the Path overhead byte (J1).
PLM-P Seconds (C2)	PLM-P Seconds (C2)	The number of seconds in which payload mismatch Path errors occurred since the last test start or restart. **NOTE:** You can disable PLM-P Alarm results on the Overhead setup screen. See "Inserting the C2 Path signal label" on page 77.
RDI-P Seconds	HP-RDI Seconds	The number of seconds in which the RDI alarm is active since the last test start or restart.
REI-P Rate	HP-REI Rate	The ratio of Path REIs to the total number of received bits, less the SOH and the LOH overhead.

Table 54 Path/HP results (Continued)

SONET Result	SDH Result	Description
REI-P Errors	HP-REI Errors	Count of the number of REI errors present. Up to 8 REI errors may be counted per frame.
Signal Label (C2)	Signal Label (C2)	Displays the value of the signal label (C2) byte, indicating the type of data in the Path.
TIM-P Seconds (J1)	HP-TIM Seconds	Count of the number of seconds in which the Path trace identifier (J1) is different than the expected value since the last test start or restart.
Tx Path Pointer Size	Tx AU Pointer Size (SS Bits)	The binary setting of the size bits in the transmitted H1 byte.
Tx Path Pointer Value	Tx AU Pointer Value	The transmitted Path pointer value from 0 to 782.
UNEQ-P Seconds	UNEQ-P Seconds	Number of seconds the Path Label was "`Unequipped`".

LP/VT test results

Table 55 lists and describes each of the test results available in the LP and VT categories.

Table 55 LP/VT results

SONET Result	SDH Result	Description
AIS-VT Seconds	LP-AIS Seconds	Count of asynchronous test seconds in which VT/LP-AIS was present for any portion of the test second.
BIP-VT Error Rate	LP-BIP Error Rate	Rate of VT/LP BIP byte (V5) errors divided by the total number of received bits less the SOH and LOH, and POH.
BIP-VT Errors	LP-BIP	Count of BIP-VT errors (indicating an error in the previous frame since initial SONET frame synchronization) since the last test start or restart.
LOP-VT Seconds	TU-LOP Seconds	Count of the number of seconds that VT LOP was present since the last test start or restart.
NDF-VT Count	TU-NDF	Count of the number of new data flags (NDF) since the last test start or restart.
VT Pointer Decrements	TU Pointer Decrements	Count of the number of times the pointer bytes indicated a decrement to the VT payload pointer since initial frame synchronization.
VT Pointer Increments	TU Pointer Increments	Count of the number of times the pointer bytes indicated an increment to the VT payload pointer since initial frame synchronization.
VT Pointer Adjustments	TU Pointer Adjustments	Count of the number of negative and positive VT pointer adjustments on the selected receive channel since the last test start or restart.
VT Pointer Size	TU Pointer Size	The binary setting of the size bits in the H1 byte. The normal setting for the pointer size bits is 00 to indicate a SONET payload, or 10 to indicate a SDH payload.
VT Pointer Value	TU Pointer Value	The current VT pointer value from 0 to 103 or 139. UNAVAILABLE appears under a number of error conditions, such as Line AIS, etc. OUT OF RANGE appears if the pointer value is outside the range.

Table 55 LP/VT results (Continued)

SONET Result	SDH Result	Description
VT Trace (J2)	LP Trace (J2)	Displays the 16 or 64-byte VT trace ASCII message which is carried in the VT overhead byte (J2).
PLM-VT Seconds (V5)	LP-PLM Seconds (V5)	The number of seconds in which payload mismatch VT errors occurred since the last test start or restart. **NOTE:** You can disable PLM-P Alarm results on the Overhead setup screen. See "Inserting the C2 Path signal label" on page 77.
RFI-VT Seconds	LP-RFI Seconds	The number of seconds in which the VT-RFI alarm is active since the last test start or restart.
REI-VT Rate	LP-REI Rate	The ratio of VT REIs to the total number of received bits, less the SOH, LOH and the POH overhead.
REI-VT Errors	LP-REI Errors	Count of the number of REI errors present. Up to 2 REI errors may be counted per multi-frame.
VT Signal Label (V5)	LP Signal Label (V5)	Displays the value of the signal label (V5) byte, indicating the type of data in the VT.
TIM-VT Seconds (J2)	LP-TIM (J2) Seconds	Count of the number of seconds in which the Path trace identifier (J2) is different than the expected value since the last test start or restart.
Tx VT Pointer Size	Tx TU Pointer Size	The binary setting of the size bits in the transmitted H1 byte.
Tx VT Pointer Value	Tx TU Pointer Value	The transmitted Path pointer value from 0 to 103 or 139.
VT-LOM Seconds	TU-LOM Seconds	Number of seconds a Loss of Multiframe alignment occurred.
UNEQ-VT Seconds	UNEQ-LP Seconds	Number of seconds the Path Label was "`Unequipped`".

Payload BERT test results

Table 56 lists and describes each of the test results available in the BERT category.

Table 56 BERT results

SONET Result	SDH Result	Description
Bit / TSE Error Rate	TSE/Bit Error Rate	Rate of BIT or TSE errors divided by the total number of received bits in the path payload.
BIT / TSE Errors	TSE/Bit Errors	Count of the number of BIT or TSE Errors since the last test start or restart.
BIT / TSE Error Seconds (40G)	BIT / TSE Error Seconds (40G)	Count of the number of seconds containing pattern bit errors since the beginning of the test.
BIT / TSE Error Free Seconds	BIT / TSE Error Free Seconds	Count of the number of seconds containing no pattern bit errors since the beginning of the test.
BIT / TSE Error Free Seconds %	BIT / TSE Error Free Seconds %	The ratio of seconds containing no pattern bit errors to the total test time.
Pattern Sync Loss Seconds	Pattern Sync Loss Seconds	Count of the number of seconds during which the receiver has lost pattern synchronization, even momentarily, since initial pattern synchronization.(Test Pad Mode)

Table 56 BERT results (Continued)

SONET Result	SDH Result	Description
Pattern Sync Losses	Pattern Sync Losses	Count of the number of times pattern synchronization is lost since the last test start or restart.(Test Pad Mode)
LSS Count	LSS Count	Count of the total number of LSS Errors since the last test start or restart.(ANT Mode)
LSS Seconds	LSS Seconds	Count of the number of seconds during which the LSS appeared.(ANT Mode)
Round Trip Delay (ms) (Current)	Round Trip Delay (ms) (Current)	The minimum round trip delay calculated in microseconds, with the resolution as follows: – 10 µs resolution for concatenated mappings of STS-3c or VC-4 or above carrying Bulk BERT payloads. – 100 µs resolution for STS-1, AU-3, and VC-3 mappings carrying Bulk BERT payloads. – 1 ms resolution for all other mappings or payloads. **NOTE:** You must originate transmit a DELAY pattern to measure round trip delay. If a unit is in loop back mode, or if the far end unit is not looped back, invalid results appear because the unit is not originating the traffic.
Round Trip Delay, Min (ms)	Round Trip Delay, Min (ms)	The minimum round trip delay calculated in microseconds, with the resolution calculated as it is for the current measurement.
Round Trip Delay, Max (ms)	Round Trip Delay, Max (ms)	The maximum round trip delay calculated in microseconds, with the resolution calculated as it is for the current measurement.
Round Trip Delay (ms), Average	Round Trip Delay (ms), Average	The average round-trip delay calculated from all round-trip delay results reported since the last restart of the test.

Service Disruption Results

To observe results associated with service disruption measurements, you must enable service disruption when you configure your test (see "Measuring service disruption time" on page 71).

SD Summary

The SD - Summary category provides the service disruption number, the start time, and the duration for the disruption.

SD Details

The SD - Details category displays a log providing the time a disruption event (such as a Bit/TSE error) occurred, and it's duration in milliseconds. The MSAM alerts you when the log becomes full and prompts you to clear it.

SD Statistics

The SD - Statistics category displays the longest, shortest, last (most recent), and average disruptions logged during the course of your test. It also provides a total count of disruptions.

TCM test results

Table 57 lists and describes each of the test results available in the TCM (Rx Forward) and TCM (Rx Backward) categories. Result names are identical for SONET and SDH test applications.

Table 57 TCM (Rx Forward) and TCM (Rx Backward) results

Result	Rx Forward	Rx Backward	Description
B3 Errors	√	√	Count of B3 errors indicating local network errors since the last test start or restart.
TC-LTC	√	√	Indicates the receive side has lost frame sync with the TCM multiframe contained in the TCM byte (N1 or N2), resulting in Loss of Tandem connection (LTC).(N/A for CSAM and 40/100G Transport Module)
TC-LTC History	√	√	Indicates the receive side has lost frame sync with the TCM multiframe since the last test start or restart.
TC-AIS	√	N/A	Current value of the High Path or Low Path Alarm Indicator Signal, depending on which Section is being monitored.(N/A for CSAM and 40/100G Transport Module)
TC-AIS History	√	N/A	Displays the previous value of the High Path or Low Path Alarm Indicator Signal, depending on which Section is being monitored.(N/A for CSAM and 40/100G Transport Module)
TC-APId Label	√	√	Text string of the Tandem Connection Access Point Identifier.
TC-DIFF	√	N/A	Displays the difference between the incoming BIP value and the IEC value in the TCM multiframe.
TC-IEC	√	N/A	Cumulative value of the Incoming Error Count since the last test start or restart.
TC-ODI	N/A	√	Displays the Outgoing Defect Indication (ODI) status carried in the TCM Multi-frame.(N/A for CSAM and 40/100G Transport Module)
TC-OEI	N/A	√	Displays the Outgoing Error Indication (OEI) count carried in the TCM Multi-frame.(N/A for CSAM and 40/100G Transport Module)
TC-RDI	N/A	√	Displays the Remote Defect Indication (RDI) status carried in the TCM Multi-frame.(N/A 40/100G Transport Module)
TC-REI	N/A	√	Displays the Remote Error Indication (REI) status carried in the TCM Multi-frame.(N/A for CSAM and 40/100G Transport Module)
TC-UNEQ	√	N/A	Indicates there is no TCM information carried in the TCM byte; the byte value is zero.
TC-UNEQ History	√	N/A	Indicates there was no TCM information carried in the TCM byte at some point since the last test start or restart.

T1.231 test results

Table 51 lists and describes each of the test results available in the T1.231 category when performing SONET testing.

Table 58 T1.231 results

SONET Result	Description
Line AIS Seconds	Count of the number of seconds during which AIS occurred since the last test start or restart.
Line ES	Count of the number of Line or Multiplex SOH errored seconds since the last test start or restart.
Line SES	Count of the number of Line or Multiplex SOH severely errored seconds since the last test start or restart.
Line UAS	Count of the number of Line or Multiplex SOH unavailable seconds since the last test start or restart.
Path ES	Count of the number of Path or HP POH errored seconds since the last test start or restart.
Path SES	Count of the number of Path or HP POH severely errored seconds since the last test start or restart.
Path UAS	Count of the number of Path or HP POH unavailable seconds since the last test start or restart.
Section ES	Count of the number of Section or Regenerator SOH errored seconds since the last test start or restart.
Section SES	Count of the number of Section or Regenerator SOH severely errored seconds since the last test start or restart.
Section UAS	Count of the number of Section or Regenerator SOH unavailable seconds since the last test start or restart.

ITU-T recommended performance test results

When configured for T-Carrier, PDH, SONET, and SDH tests, the MSAM provides performance analysis results in accordance with ITU-T recommendations. If all results in a category conform to the associated recommendation, the Verdict result indicates: `ACCEPT`.

You can view performance results for multiple categories simultaneously. For example, you can display the G.821 Errored Seconds and the G.826 Errored Block results simultaneously in separate results windows.

ITU-T performance results are not supported on the CSAM or 40/100G High Speed Transport Module.

HP, LP, RS, MS, ISM, and OOS designations

HP (high path), LP (low path) RS (regeneration section), MS (multiplex section), ISM (in service measurement), and OOS (out of service measurement) designations are captured in the result category name. For example, the `G.826 HP ISM` category provides performance results associated with in service measurements on the high path.

NE and FE designations

NE (near-end) and FE (far end) designations are captured in each of the performance result names. For example, the `ES (NE)` result provides the number of available seconds during which one or more relevant anomalies or defects were present on the *near-end* of the circuit under test.

Performance result descriptions

Table 59 lists and describes each of the performance test results.

Table 59 ITU-T and ANSI recommended performance test results

Test Result	Description
% ES	The ratio of errored seconds to the number of available seconds.
% SES	The ratio of severely errored seconds to the number of available seconds.
BBE	The number of errored blocks not occurring as part of an SES.
BBER	The ratio of Background Block Errors (BBE) to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
EB	Number of blocks containing one or more errored bits.
ES	The number of available seconds during which one or more relevant anomalies or defects were present.
ESR	The ratio of errored seconds to the number of available seconds.
SEP	A count of severely errored periods, defined as a sequence of between 3 to 9 consecutive severely errored seconds.
SEPI	The number of SEP events in available time, divided by the total available time in seconds.
SES	Seconds during which one or more defects were present or the anomaly rate exceeded the ITU-T recommended threshold.
SESR	The ratio of severely errored seconds to the number of available seconds.
UAS	A count of the number of test seconds which met the associated ITU-T recommendation's definition of unavailable time.
Verdict	ACCEPT indicates that the test results have met the ITU-T recommendation's performance objectives. REJECT indicates that the test results did not meet the performance objectives. UNCERTAIN only appears for M.2101 and indicates that the test results fall between the S1 and S2 thresholds.

Table 60 indicates which test results are available in each result category. Some results only appear if you are testing a particular interface. For example, the BBE and BBER results are only available when testing a DS1, E1, SONET, or SDH interface.

Table 60 ITU-T recommended performance test results

Test Result	G.821 OOS[a] M.2100 ISM M.2100 OOS	G.826 ISM G.826 OOS	G.829 ISM	G.828 ISM G.828 OOS M.2101 ISM M.2101 OOS	T1.231	T1.514 ISM T1.514 OOS
% ES						√
% SES						√
BBE BBER[b]		√	√	√		√
ES	√	√	√	√	√	√
ESR	√	√	√	√		
SEP				√		√
SEPI				√		√
SES	√	√	√	√	√	√
SESR	√	√	√	√		
UAS	√	√	√	√	√	√
Verdict	√	√		√		

a. G.828 OOS results not available on 40G SONET and SDH.

b. BBE and BBER results only appear when testing E1, DS1, SONET and SDH interfaces. They are not applicable when testing DS3, E3, or E4 interfaces.

Jitter results

When configured for jitter tests on a T-Carrier, PDH, SONET, SDH, or OTN interface, the MSAM provides jitter results in the Summary and Interface result groups. The module also allows you to view the jitter results in a graphical or tabular format.

You can view jitter results for multiple categories simultaneously. For example, you can display the Jitter and the Jitter Graph results simultaneously in separate results windows. You can also change the layout of the test results on the Main screen to use the entire result window when viewing graphical result. See “Changing the result layout” on page 5.

HB, WB, Ext Band, and User-band designations

HB (high-band), WB (wide-band), Ext Band (extended-band), and User-Band designations are captured in each of the Jitter result names. For example, the `WB Jitter (UIpp)` result provides the current amount of peak-to-peak jitter measured in the wide-band, expressed in UIPP (unit intervals peak-to-peak).

Jitter results, Summary group

Table 61 lists and describes each of the test results in the Jitter category under the Summary result group. These results only appear if the associated error condition occurs during the course of your test.

Table 61 Jitter test results in the Summary result group

Test Result	Description
AMS Test Status	Displays `Fail` if a MTJ, FMTJ, or JTF test fails.
Ext Band Jitter Phase Hits	A count of the total number of phase hits detected in the extended-band since the last test start or restart.
HB Jitter Phase Hits	A count of the total number of phase hits detected in the high-band since the last test start or restart.
HB Max % Mask	Displays the maximum percentage of jitter detected in the high-band when the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate was exceeded since the last test start or restart. For example, if the limit was exceeded by three percent, `103%` appears.
HB % Mask	Displays the current percentage of jitter detected in the high-band if the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate is exceeded. For example, if the limit is currently exceeded by one percent, `101%` appears.
Jitter Rx Status	Displays `Searching` while the unit attempts to lock the PLL (Phase Locked Loop). After the PLL is locked, the `Searching` result disappears from the Summary result group, and valid jitter results accumulate.
User Band Jitter Phase Hits	A count of the total number of phase hits detected in the user-band since the last test start or restart.
WB Jitter Phase Hits	A count of the total number of phase hits detected in the wide-band since the last test start or restart.
WB Max % Mask	Displays the maximum percentage of jitter detected in the wide-band when the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate was exceeded since the last test start or restart. For example, if the limit was exceeded by three percent, `103%` appears.
WB % Mask	Displays the current percentage of jitter detected in the wide-band if the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate is exceeded. For example, if the limit is currently exceeded by one percent, `101%` appears.

Jitter results, Interface group

Table 62 lists and describes each of the test results in the Jitter category available in the Interface result group.

Table 62 Jitter test results in the Interface result group

Test Result	Description
Ext Band Jitter - Peak (UI)	The negative peak jitter measured in the extended-band over the last second, expressed in UI.
Ext Band Jitter (UIpp)	The peak-to-peak jitter measured in the extended-band over the last second, expressed in UIpp.
Ext Band Jitter + Peak (UI)	The positive peak jitter measured in the extended-band over the last second, expressed in UI.

Table 62 Jitter test results in the Interface result group (Continued)

Test Result	Description
Ext Band Jitter Phase Hits	A count of the total number of phase hits detected in the extended-band since starting or restarting the test.
Ext Band Max Jitter - Peak (UI)	The maximum negative peak jitter measured in the extended-band since starting or restarting the test, expressed in UI.
Ext Band Max Jitter (UIpp)	The maximum peak-to-peak jitter measured in the extended-band since starting or restarting the test, expressed in UIpp.
Ext Band Max Jitter + Peak (UI)	The maximum positive peak jitter measured in the extended-band since starting or restarting the test, expressed in UI.
HB % Mask	Percentage indicating how close the current level of jitter detected in the high-band is to exceeding the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate. For example, if the current level of jitter measured in the high-band is 80% of that specified as the tolerable level, `80 %` appears.
HB Jitter - Peak (UI)	The negative peak jitter measured in the high-band over the last second, expressed in UI.
HB Jitter (UIpp)	The peak-to-peak jitter, measured in the high-band over the last second, expressed in UIpp.
HB Jitter + Peak (UI)	The positive peak jitter measured in the high-band over the last second, expressed in UI.
HB Jitter Phase Hits	A count of the total number of phase hits detected in the high-band since starting or restarting the test.
HB Max % Mask	The maximum value of the `HB % Mask` percentage detected since starting or restarting the test. For example, if the maximum level of jitter measured in the high-band was 95% of that specified as the tolerable level, `95 %` appears.
HB Max Jitter - Peak (UI)	The maximum negative peak jitter measured in the high-band since starting or restarting the test, expressed in UI.
HB Max Jitter (UIpp)	The maximum peak-to-peak jitter, measured in the high-band since starting or restarting the test, expressed in UIpp.
HB Max Jitter + Peak (UI)	The maximum positive peak jitter measured in the high-band since starting or restarting the test, expressed in UI.
JTF Rx Jitter (UIpp)	The peak-to-peak jitter measured over the last seconds when testing JTF, expressed in UIpp.
Rms Jitter (UI)	Root mean squared jitter, or the value of one standard deviation of the normal distribution expressed in UI.
User Band Jitter - Peak (UI)	The negative peak jitter measured in the user-band over the last second, expressed in UI.
User Band Jitter (UIpp)	The peak-to-peak jitter, measured in the user-band over the last test second, expressed in UIpp.
User Band Jitter + Peak (UI)	The positive peak jitter measured in the user-band over the last second, expressed in UI.
User Band Jitter Phase Hits	Count of the total number of phase hits detected in the user-band since the last test start or restart.
User Band Max Jitter - Peak (UI)	The maximum negative peak jitter measured in the user-band since starting or restarting the test, expressed in UI.
User Band Max Jitter (UIpp)	The maximum peak-to-peak jitter measured in the user-band since starting or restarting the test, expressed in UIpp.
User Band Max Jitter + Peak (UI)	The maximum positive peak jitter measured in the user-band since starting or restarting the test, expressed in UI.

Table 62 Jitter test results in the Interface result group (Continued)

Test Result	Description
WB % Mask	Percentage indicating how close the current level of jitter detected in the wide-band is to exceeding the limit of tolerable jitter specified in ANSI and ITU-T specifications for the line rate. For example, if the current level of jitter measured in the wide-band is 80% of that specified as the tolerable level, `80 %` appears.
WB Jitter - Peak (UI)	The negative peak jitter measured in the wide-band over the last second, expressed in UI.
WB Jitter (UIpp)	The peak-to-peak jitter measured in the wide-band over the last second, expressed in UIpp.
WB Jitter + Peak (UI)	The positive peak jitter measured in the wide-band over the last second, expressed in UI.
WB Jitter Phase Hits	Count of the total number of phase hits detected in the wide-band since starting or restarting the test.
WB Max % Mask	The maximum value of the `WB % Mask` percentage detected since starting or restarting the test. For example, if the maximum level of jitter measured in the wide-band was 95% of that specified as the tolerable level, `95 %` appears.
WB Max Jitter - Peak (UI)	The maximum negative peak jitter measured in the wide-band since starting or restarting the test, expressed in UI.
WB Max Jitter (UIpp)	The maximum peak-to-peak jitter measured in the wide-band since starting or restarting the test, expressed in UIpp.
WB Max Jitter + Peak (UI)	The maximum positive peak jitter measured in the wide-band since starting or restarting the test, expressed in UI.

Graphical and Tabular jitter results

When testing jitter, you can view results in a graphical or tabular format by selecting the corresponding result categories in the Interface group.

A sample Jitter Graph result is provided in Figure 38.

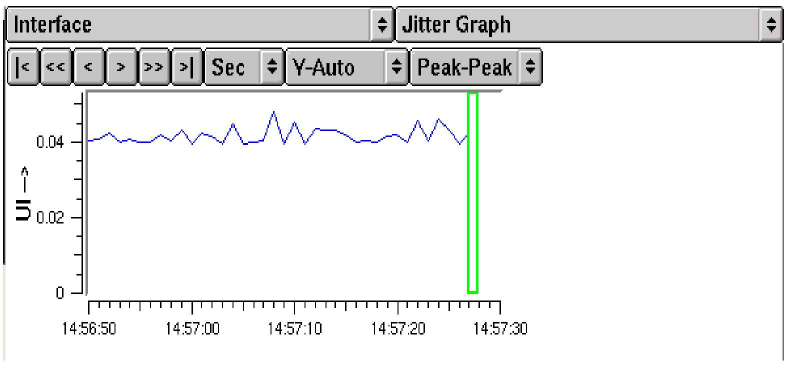


Figure 38 Jitter Graph result

Jitter Graph

The jitter graph is available when manually testing jitter, and when measuring MTJ and Fast MTJ.

MTJ Graph and Table

The MTJ graph and table are available when measuring MTJ and Fast MTJ.

JTF Graph

The JTF graph is available when measuring JTF.

Wander results

When configured for wander tests on a T-Carrier, PDH, SONET, SDH, or OTN interface, the Transport Module provides wander results in the Interface result group. Table 63 lists and describes each of the test results available in the Wander result category.

Table 63 Wander test results

Test Result	Description
TIE	The aggregate variation in time delay of the received signal with respect to the reference since the last test start or restart.
Max. TIE	The maximum aggregated Time Interval Error measured since the last test start or restart.
Min. TIE	The minimum aggregated Time interval error measured since the last test start or restart.
MTIE	The largest peak-to-peak TIE detected since the test started.
Wander Time Remaining	The remaining time left in the wander test in days, hours, minutes, seconds, based on file size and/or disk space constraints
Wander Reference Present	Whether the external reference signal is available when timing reference wander is being measured.
Wander RX Status	The clocks locked status. “True” if both data and reference clock are valid.

When testing wander, you can view results in a graphical format by selecting the Wander Graph result categories in the Interface group (see Figure 39).

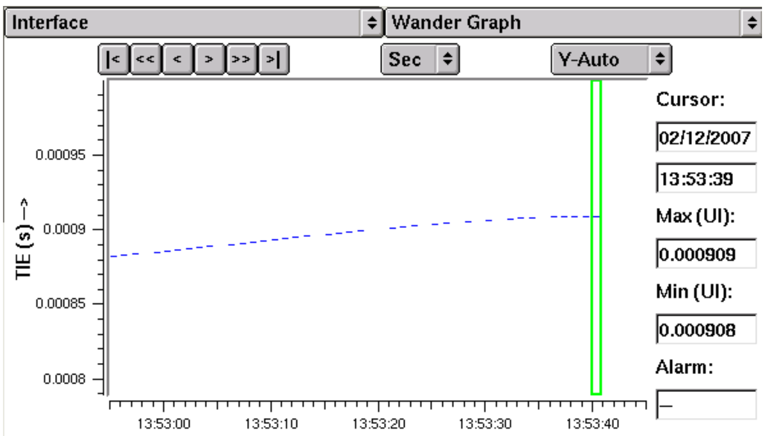


Figure 39 Wander Graph result

1PPS Analysis Results

Test results from the 1pps Analysis indicate the offset between the reference 1PPS signal received from the GPS and the test unit's 1PPS signal. The variation in the period of the received 1pps GPS signal over long time periods of many hours to several days, is often recorded.

The status of the Reference and Input clocks signals is reported in both the LED panel and the Summary window. The LED panel shows current and past status. The current status is indicated by an LED (GREEN) in the right column and the past status by an LED (RED) in the right column. The Summary Status window indicates whether the Input and Reference clocks are being presented with a valid signal.

The 1PPS Analysis Summary results show the Status parameters, an Event Log, a Histogram or a display of the current time on the unit.

The 1PPS minimum pulse width that can be detected is 20uS.

The 1PPS Analysis results are shown in Table 64.

Table 64 1PPS Analysis results

Result	Description	Parameter Measured
Offset (ns)	Offset between reference and unit's 1PPS signal	Current Minimum Maximum
MTIE (s)	Maximum Peak-to-Peak Time Interval Error (MTIE)	Maximum
TIE (s)	Time Interval Error	Current Minimum Maximum

A TIE graph is also able to be displayed that shows the current time interval error.

NextGen results

Test results associated with the SONET or SDH interface, VCAT (analyzed VCGs and their members), LCAS, and GFP traffic are available when testing NextGen networks. Layer 2 and layer 3 Ethernet results are also available. Results discussed in this section include the following:

– "NextGen LEDs" on page 211
– "VCAT results" on page 213
– "LCAS results" on page 213
– "GFP results" on page 215

In addition to the NextGen results, classic SONET and SDH results are available when running NextGen BERT and GFP applications, and layer 2 and layer 3 Ethernet results are available when running NextGen GFP applications. For descriptions of these results refer to:

- "SONET/SDH results" on page 189
- Layer 2 and layer 3 test results are described in the Ethernet testing manual that shipped with your instrument or upgrade.

Common NextGen results

OOM1, OOM2, LOM, and LOM2 results are derived per ITU-T recommendation G.783. Explanations of each of the results are provided in Table 65.

Table 65 ITU-T G.783 NextGen results

Result	HO mapping VC-4 / VC-3 or HO mapping STS-3-c / STS-1-Xv LO mapping VC-3	LO mapping VC-11 / VC-12 or VT1.5-Xv
HP-OOM1 or LP-OOM1	Indicates an error occurred in the MFI1 (multi-frame indicator) located in bits 5, 6, 7, or 8 of the H4 byte.	HP-OOM1 Indicates an error occurred in the multi-frame counter (0, 1, 2, 3) of the H4 byte. LP-OOM1 indicates an error occurred in the extended overhead multi-frame located in bit 1 of the K4 byte.
OOM2	Indicates an error occurred in the MFI2 located in the first multi-frame numbers 0 or 1, in bits 1, 2, 3, or 4 of the H4 byte.	Indicates an error occurred in the virtual concatenation frame counter multi-frame located in bit 2 of the K4 byte.
LOM	N/A	Declared if HP-OOM1 occurs, and the frame realignment process is not recovered in 8 VC-3 / VC-4 frames.
LOM2	Declared if HP-OOM1 or OOM2, or LP-OOM1 or OOM2 occurs, and the H4 two-stage frame realignment process is not recovered in 40 to 80 VC-3/VC-4 frames.	Declared if LP-OOM1 or OOM2 occurs, and the K4 (bit 1 and 2) two-stage frame realignment process is not recovered in 200 to 400 VC-12 frames.

NextGen LEDs

In addition to the VCAT and GFP LEDs, classic SONET and SDH LEDs are available when running NextGEn BERT and GFP applications, and layer 2 and layer 3 LEDs are available when running GFP applications.

For descriptions of these LEDs, refer to:

- "SONET and SDH LEDs (TestPad mode)" on page 189
- "SONET and SDH LEDs (ANT mode)" on page 191
- Layer 2 and layer 3 LEDs are described in the Ethernet testing manual that shipped with your instrument or upgrade.

VCAT LEDs

Table 66 describes each of the VCAT LEDs

Table 66 VCAT LEDs

LED	Description
LOA-GP	Illuminates Red if a low order alarm (LOA) was detected for the group since the last test start or restart.
OOM2-GP	Illuminates Red if an out of multi-framing error (OOA) was detected for the group since the last test start or restart.
SQM-GP	Illuminates Red if a sequence mismatch indicator (SQM) was detected since the last test start or restart.

LCAS LEDs

Table 67 describes each of the LCAS LEDs

Table 67 LCAS LEDs

LED	Description
LOC Source LOC Sink	Illuminates Red if a LOC was detected for the source or sink group since the last test start or restart.
PLTC Source PLTC Sink	Illuminates Red if a PLTC was detected for the source or sink group since the last test start or restart. When you enable LCAS on your instrument, you can specify the source and sink PLTC thresholds (see “Enabling LCAS” on page 138).
TLTC Source TLTC Sink	Illuminates Red if a TLTC was detected for the source or sink group since the last test start or restart.
Non-LCAS Sink	Illuminates Red if the sink device does not support LCAS (or LCAS is not enabled).

GFP LEDs

Table 68 describes each of the GFP LEDs.

Table 68 GFP LEDs

LED	Description
LOF Alarm	Illuminates Red if a loss of frame (LOF) alarm was detected for the group since the last test start or restart.
CSF Alarm	Illuminates Red if a client signal fail (CSF) alarm was detected for the group since the last test start or restart.
Payload FCS	Illuminates Red if a payload FCS error was detected for the group since the last test start or restart.
LFD Alarm	Illuminates Red if an LFD alarm was detected since the last test start or restart.
Pattern Loss	Illuminates Red if pattern loss was detected since the last test start or restart.
LPAC	Illuminates Red if LPAC was detected since the last test start or restart.

VCAT results

The VCAT results (in the VCAT result group) are provided for each member in an analyzed VCG. At the top of the result pane, LEDs indicate whether or not HP OOM1, LP OOM1, OOM 2, LOM2, SQM, or LOA errors or alarms occurred for the group since the last restart. Additional LEDs indicate whether errors or alarms occurred for each member in the group.

You can also observe detailed test results for each VCG and VCG member using the VCG Analysis soft key. For details, see “Analyzing a VCG” on page 134.

Table 69 lists each of the VCAT results provided under the SONET or SDH result group.

Table 69 VCAT results

Result	Description
SEQ	Displays the sequence number for each analyzed member.
N KLM	Displays the KLM mapping number for the analyzed member.
LOA	Illuminates Red if a low order alarm (LOA) was detected for the member since the last test start or restart.
HP-OOM1	Illuminates Red if a high path out of multi-framing error (OOA) was detected for the member since the last test start or restart.
LP-OOM1	Illuminates Red if a low path out of multi-framing error (OOA) was detected for the member since the last test start or restart.
OOM2	Illuminates Red if an out of multi-framing error (OOA) was detected for the member since the last test start or restart.
SQM	Illuminates Red if a sequence mismatch indicator (SQM) was detected for the member since the last test start or restart.

LCAS results

If LCAS is enabled, test results associated with LCAS controlled VCG groups and members appear in the LCAS group, in the Member Status (Sink), Member Status (Source), Errors, and Group categories.

Member Status

Information for each member is provided in the Member Status (Source) and Member Status (Sink) result categories (see Table 70).

Table 70 Member Status (Source and Sink) results

Result	Source	Sink	Description
N KLM	√	√	Displays the KLM mapping number for the analyzed member.
Seq	√	√	Displays the sequence number for the analyzed member.
Invalid		√	Illuminates red if a SSF (service signal failure) is detected for the analyzed member
State	√	√	Displays the LCAS MST status for each member (Ok, or Fail).

Table 70 Member Status (Source and Sink) results (Continued)

Result	Source	Sink	Description
Control	√	√	Displays the last command received for each analyzed member. Values include the following: FIXED, IDLE, ADD, NORM, EOS or DNU
Rec MST	√		Displays the received member status for the analyzed member.
Tx MST		√	Displays the transmit member status for the analyzed member.

Errors

In addition to the N KLM, Seq, and Invalid results, the Error result category provides a count of received control packets and CRC error statistics for the received members (see Table 71).

Table 71 Error results

Result	Description
N KLM	Displays the KLM mapping number for the analyzed member.
Seq	Displays the sequence number for the analyzed member.
Invalid	Illuminates red if a SSF (service signal failure) is detected for the analyzed member
Rx Control Packets	Displays a count of the control packets received for each analyzed member.
CRC-8 Errors	Count of the number of CRC-8 errors detected for the analyzed member since the last test start or restart.
CRC-8 Error Seconds	Count of the number of seconds CRC-8 errors were detected since the last test start or restart.
CRC-8 Error Ratio	The ratio of frames with CRC-8 errors to the total number of frames received since the last test start or restart.

Group

Statistics for all members in a group are provided in the Group result category (see Table 72).

Table 72 Group results

Result	Source	Sink	Description
Non-LCAS Alarm Seconds		√	Count of the number of seconds in which LCAS packets do not appear even though LCAS is enabled on the instrument.
FOP-CRC Seconds		√	Count of the number of seconds during which an FOP-CRC occurred since the last test start or restart.
LOC Seconds	√	√	Count of the number of seconds during which an LOC occurred since the last test start or restart.
PLTC Seconds	√	√	Count of the number of seconds during which a PLTC occurred since the last test start or restart.
TLTC Seconds	√	√	Count of the number of seconds during which a TLTC occurred since the last test start or restart.
Tx Resequence Ack		√	Count of resequence acknowledgements transmitted by the sink group analyzed.

Table 72 Group results (Continued)

Result	Source	Sink	Description
Rx Resequence Ack	√		Count of resequence acknowledgements received by the source group analyzed.

GFP results

Test results associated with GFP encapsulated traffic appear in the GFP result group, in the Error Stats, Rx Traffic, and Tx Traffic categories.

Error Stats

Statistics and counts of errored GFP traffic appear in the Error Stats category (see Table 73).

Table 73 GFP Error Stats results

Sub-category	Result	Description
Payload	FCS Errors	Count of the number of payload FCS errors detected since the last test start or restart.
	FCS Error Seconds	Count of the number of seconds payload FCS errors were detected since the last test start or restart.
	FCS Error Ratio	The ratio of frames with payload FCS errors to the total number of GFP frames received since the last test start or restart.
	FCS Error Rate	The rate of frames with payload FCS errors since the last test start or restart expressed in frames per second.
Core Header Type Header Extension Header	Single Bit Errors	Count of GFP frames with a single bit error in the corresponding header section (Core, Type, or Extension).
	Single Bit Error Seconds	Count of the seconds during which GFP frames were received with a single bit error in the header since the last test start or restart.
	Single Bit Error Ratio	Ratio of GFP frames with single bit errors in the header to the total number of frames received since the last test start or restart.
	Single Bit Error Rate	The rate of GFP frames with single bit errors in the header since the last test start or restart expressed in frames per second.
	Multi Bit Errors	Count of GFP frames with multiple bit errors in the corresponding header section (Core, Type, or Extension).
	Multi Bit Error Seconds	Count of the seconds during which GFP frames were received with a multiple bit errors in the header since the last test start or restart.
	Multi Bit Error Ratio	Ratio of GFP frames with multiple bit errors in the header to the total number of frames received since the last test start or restart.
	Multi Bit Error Rate	The rate of GFP frames with multiple bit errors in the header since the last test start or restart expressed in frames per second.

Rx Traffic

Statistics and counts of GFP frames appear in the Rx Traffic category (see Table 74).

Table 74 GFP Traffic results

Result	Description
CID Mismatches	Count of the number of GFP frames with channel identifiers that do not match the CID specified in the receive filter since the last test start or restart.
Client Data Frame Rate (fps)	Rate calculated by dividing the number of client data frames frames received by the total number of frames received during the last test second. Expressed in frames per second (fps).
Client Data Frame Ratio	The ratio of client data frames to the total frames received since initial frame synchronization.
Client Data Frames	Count of client data frames received since the last test start or restart.
Client Mgmt Frame Rate (fps)	Rate calculated by dividing the number of client management frames received by the total number of frames received during the last test second. Expressed in frames per second (fps).
Client Mgmt Frame Ratio	The ratio of client management frames to the total frames received since initial frame synchronization.
Client Mgmt Frames	Count of client management frames received since the last test start or restart.
Discarded Frames	Count of GFP frames received that are discarded due to chore header errors, type header errors, or extension header errors since the last test start or restart.
Idle Frame Rate (fps)	Rate calculated by dividing the number of idle frames received by the total number of frames received during the last test second. Expressed in frames per second (fps).
Idle Frame Ratio	Ratio of idle frames to the total number of frames received since the last test start or restart.
Idle Frames	Count of idle frames received since the last test start or restart.
Invalid Frames	Count of the number of invalid frames received since the last test start or restart.
Total Frames	Count of the total number of frames received since the last test start or restart.
Total Rx Bandwidth (bps)	The current bandwidth utilized by the received traffic expressed in bps. This measurement is an average taken over the prior second of test time.
Total Rx Util %	The current bandwidth utilized by the received traffic expressed as a percentage of the line rate of available bandwidth. This measurement is an average taken over the prior second of test time.
UPI Mismatches	Count of the number of GFP frames with user payload indicator that do not match the UPI specified in the receive filter since the last test start or restart.

Tx Traffic

Statistics and counts of transmitted GFP frames appear in the Tx Traffic category (see Table 75).

Table 75 Tx Results results

Result	Description
Total Tx Bandwidth (bps)	The current bandwidth utilized by transmitted traffic expressed in bps. This measurement is an average taken over the prior second of test time.
Total Tx Util %	The current bandwidth utilized by transmitted traffic expressed as a percentage of the line rate of available bandwidth. This measurement is an average taken over the prior second of test time.
Transmit Octet Count	Count of the number of bytes transmitted since the last test start or restart excluding idle frames.
Tx Errored Frame Count	Count of the total number of errored frames transmitted since the last test start or restart.
Tx Errored Frame Count	Count of the total number of errored frames transmitted since the last test start or restart.
Tx Errored Frame Rate	Rate of errored frames transmitted since the last test start or restart. Expressed in frames per second (fps).
Tx Frame Count	Count of the total number of frames transmitted since the last test start or restart.
Tx Idle Frame Count	Count of idle frames transmitted since the last test start or restart.
Tx Idle Frame Rate	Rate of idle frames transmitted since the last test start or restart. Expressed in frames per second (fps).

OTN results

Test results associated with the test interface, FEC, and framing are available when testing OTN networks. Categories discussed in this section include the following:

– “OTN LEDs (TestPad mode)” on page 218
– “OTN LEDs (ANT mode)” on page 220
– “Interface test results” on page 221
– “FEC test results” on page 222
– “Framing test results” on page 223
– “OTL Stats results” on page 224
– “OTL Per Lane results” on page 225
– “OTU test results” on page 226
– “ODU test results” on page 226
– “Transcoding Results/Stats” on page 227
– “FTFL test results” on page 228
– “TCM1 - TCM 6 test results” on page 229
– “OPU results” on page 230
– “GMP results” on page 230
– “GFP-T results” on page 232

– "GFP results" on page 232
– "Payload BERT results" on page 233

NOTE:
When you configure your unit to transmit a SONET or SDH client signal over an OTN circuit, streamlined SONET and SDH test results are also available. For details, refer to "SONET/SDH results" on page 189.

OTN LEDs (TestPad mode)

Table 76 describes each of the OTN LEDs in TestPad mode when you configure your unit to transmit a SONET or SDH payload in an OTN (OTU1 or OTU2) wrapper. SONET or SDH LEDs (such as the Path Ptr Present or AU Ptr Present LED) also appear in the SONET or SDH LED group (see "SONET and SDH LEDs (TestPad mode)" on page 189).

If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red Signal Present LED), the Frame Sync and Pattern Sync LEDs do not indicate that there is an alarm because you can not attain frame or pattern synchronization without a signal.

Table 76 OTN/SONET and SDH LEDs (TestPad Mode)

SONET LED	SDH LED	Description
Signal Present	Signal Present	Green – A signal is present. Red – No signal is present.
Frame Sync	Frame Sync	Green – Synchronization is established with framing of signal. Red – Frame synchronization has not been established.
Pattern Sync	Pattern Sync	Green – Synchronization is established with BERT pattern. Red – Synchronization with the received BERT pattern has not been established.

Table 77 describes each of the OTN LEDs in TestPad mode when you configure your unit to transmit a SONET or SDH STL payload in an OTU3 wrapper. SONET or SDH LEDs (such as the Path Ptr Present or AU Ptr Present LED) also appear in the SONET or SDH LED group (see "SONET and SDH LEDs (TestPad mode)" on page 189).

If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red Signal Present LED), the Frame Sync and Pattern Sync LEDs do not indicate that there is an alarm because you can not attain frame or pattern synchronization without a signal.

Table 77 OTN/SONET and SDH STL LEDs (TestPad Mode)

SONET LED	SDH LED	Description
Signal Present	Signal Present	Green – A signal is present. Red – No signal is present.
OTL Frame Sync	OTL Frame Sync	Green – Synchronization is established with framing of signal. Red – Frame synchronization has not been established.
OTL Marker Lock	OTL Marker Lock	Green – Synchronization is established with Marker Lock signal. Red – Synchronization has not been established with Marker Lock signal.
OTL Lanes Aligned	OTL Lanes Aligned	Green – Synchronization has been established within acceptable parameters between lanes. Red – Synchronization has not been established within acceptable parameters between lanes.

Table 78 describes each of the OTN LEDs in TestPad mode when you configure your unit to transmit an OTU3 or OTU4 payload in an OTN wrapper. Marker Lock and Frame Alignment are only

If the instrument loses an LED event, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by extinguished Signal Present LED), the Frame Sync LED does not indicate that there is an alarm because you can not attain frame synchronization without a signal.

Table 78 OTN/OTU3 or OTU4 LEDs (Test Pad Mode)

OTU LED	Description
Signal Present	Green – A signal is present. Red – A signal was present in the past but is no longer present.

Table 78 OTN/OTU3 or OTU4 LEDs (Test Pad Mode) (Continued)

OTU LED	Description
Frame Sync	Green – Synchronization is established with framing of signal. Red – Frame synchronization was established in the past but is no longer established.
Marker Lock	Green – Synchronization is established with Marker Lock of signal. Red – Marker Lock synchronization was established in the past but is no longer established.
Lanes Aligned	Green – Alignment of signals between lanes is currently occurring. Red – Lanes are no longer aligned.
Pattern Sync	Green – Synchronization is established with BERT pattern. Red – Synchronization with the received BERT pattern was established in the past but is no longer established.

OTN LEDs (ANT mode)

Table 79 describes each of the SONET and SDH LEDs in ANT mode.If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the LOF and LSS LEDs do not indicate that there is an alarm because you can not detect framing patterns or attain sequence synchronization without a signal.

Table 79 OTN/SONET and SDH LEDs (ANT mode)

LED	Description
LOS	Illuminates Red if no signal or an invalid signal is detected. Extinguishes when a valid signal is detected.
LOF	Illuminates Red if no framing pattern is detected. Extinguishes when framing pattern is detected.
LSS	Illuminates Red if synchronization is not established with the received BERT pattern. Extinguishes when pattern sync is established.

Table 80 describes each of the SONET and SDH OTL LEDs in ANT mode when you configure your unit to transmit a SONET or SDH STL payload in an OTU3 wrapper. If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the OTL LOF and OTL LOL LEDs do not indicate that there is an alarm because you can not detect framing patterns or attain lane synchronization without a signal.

Table 80 OTN/SONET and SDH OTL LEDs (ANT mode)

LED	Description
LOS	Illuminates Red if no signal or an invalid signal is detected. Extinguishes when a valid signal is detected.

Table 80 OTN/SONET and SDH OTL LEDs (ANT mode) (Continued)

LED	Description
OTL LOF	Illuminates Red if OTL Loss of Frame is detected. Extinguishes when OTL framing has been established.
OTL LOR	Illuminates Red if Loss of Recovery signal is detected. Extinguishes when Recovery has been regained.
OTL LOL	Illuminates Red if Loss of Lane Alignment is detected. Extinguishes when lanes have achieved proper alignment.

Table 81 describes each of the OTN/OTU LEDs in ANT mode.If an error occurs at a higher level, LEDs at lower levels do not indicate alarms. For example, if there is no signal present (indicated by a red LOS LED), the LOF and LSS LEDs do not indicate that there is an alarm because you can not detect framing patterns or attain sequence synchronization without a signal.

Table 81 OTN/OTU LEDs (ANT Mode)

LED	Description
LOS	Illuminates Red if no signal or an invalid signal is detected. Extinguishes when a valid signal is detected.
LOF	Illuminates Red if no framing pattern is detected. Extinguishes when framing pattern is detected.
LSS	Illuminates Red if synchronization is not established with the received BERT pattern. Extinguishes when pattern sync is established.
LOML	Illuminates Red if no Marker Lock (any lane) is detected. Extinguishes when Marker Lock has been reestablished (OTU3 and OTU4 only).
LOL	Illuminates Red if no Lane Alignment (any lane) is detected. Extinguishes when Lane Alignment has been reestablished (OTU3 and OTU4 only).

Interface test results

Table 82 lists and describes each of the test results available in the OTN Interface result group.

Table 82 Interface test results

Test Result	Description
(CFP) Optical Rx Overload	Displays ON if the received optical power level is greater than the receiver shutdown specification as stated in the specifications appendix of the Getting Started guide that shipped with your instrument, or as stated in the vendor specifications for the SFP, XFP, QSFP+ or CFP you have inserted.
Invalid Rx Signal Seconds	Count of the number of seconds during which an invalid signal was received since the last test start or restart.
Link Loss Seconds	Count of the number of seconds during which the link was not detected since initial frame synchronization.
Local Fault Seconds	Count of the number of seconds during which a Local Fault was detected.
Optical Rx Level (dBm)	Displays the receive level (average power for all lasers) for optical signals in dBm. For some optics, the Interface Lambda results detail the received value for each laser.

Table 82 Interface test results (Continued)

Test Result	Description
Reference Frequency	Displays the external timing for the received signal.
Remote Fault Seconds	Count of the number of seconds during which a Remote Fault was detected since initial signal detection.
Round Trip Delay (ms)	The round trip delay for the last delay pattern sent and successfully received by the instrument. Calculated in milliseconds. Your unit must be configured to transmit a SONET or SDH payload carrying a Delay pattern to observe this result.
Rx Freq Max Deviation (ppm)	Maximum received frequency deviation, expressed in ppm.
Rx Frequency (Hz)	Frequency of the clock recovered from the received signal, expressed in Hz.
Rx Frequency Deviation (ppm)	Current received frequency deviation, from nominal, expressed in ppm.
Signal Loss Seconds	Number of seconds during which the signal was not detected since the last test start or restart.
Signal Losses	The number of times the signal has not been detected since the last test start or restart.
Sync Loss Seconds	Number of seconds during which synchronization was not achieved since the last test start or restart.
Tx Clock Source	Displays the timing source (INTERNAL, RECOVERED, or BITS).
Tx Freq Max Deviation (ppm)	Maximum transmitted frequency deviation, expressed in ppm.
Tx Frequency (Hz)	Current transmitter clock frequency, expressed in Hz.
Tx Frequency Deviation (ppm)	Current transmitted frequency deviation, expressed in ppm.

FEC test results

Table 83 lists and describes each of the test results available in the OTN FEC result category. If you set up your instrument to ignore FEC errors, these results are not available.

Table 83 FEC test results

Test Result	Description
Uncorrected Word Errors	Count of uncorrectable word errors received since initial frame synchronization.
Uncorrected Word Error Rate	The current ratio of uncorrectable word errors, to the total bits received since initial frame synchronization.
Uncorrected Word Error Seconds	A count of the number of seconds during which uncorrected word errors have been received.
Corrected Word Errors[a] Correctable Word Errors	Count of corrected or correctable word errors received since initial frame synchronization.
Corrected Word Error Rate Correctable Word Error Rate	The current ratio of corrected or correctable word errors to the total bits received since initial frame synchronization.

Table 83 FEC test results (Continued)

Test Result	Description
Corrected Word Error Seconds Correctable Word Error Seconds	A count of the number of seconds during which corrected (if FEC Rx Find & Fix is on) or correctable (if FEC Rx Find & Fix is off) word errors have been received.
Corrected Bit Errors Correctable Bit Errors	Count of corrected or correctable bit errors received since initial frame synchronization.
Corrected Bit Error Rate Correctable Bit Error Rate	The current ratio of corrected or correctable bit errors to the total bits received since initial frame synchronization.
Corrected Bit Error Seconds Correctable Bit Error Seconds	A count of the number of seconds during which corrected (if FEC Rx Find & Fix is on) or correctable (if FEC Rx Find & Fix is off) bit errors have been received.

a. “Corrected” results appear if your unit is configured to fix FEC errors; “Correctable” results appear if it is configured to find, but not fix received FEC errors.

Framing test results

Table 84 lists and describes each of the test results available in the OTN Framing result category.

Table 84 Framing test results

Test Result	Description
FAS Error Rate	The ratio of FAS errors to the total number of frames received since initial frame synchronization.
FAS Error Seconds	A count of the number of seconds during which FAS errors occurred, since initial frame synchronization.
FAS Errors	A count of FAS errors since initial frame synchronization.
Frame Sync Loss Seconds	Count of the number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial frame synchronization.
Frame Sync Losses	A count of discrete losses of frame synchronization since initial frame synchronization.
LOF	A count of LOFs since initial frame synchronization.
LOF Seconds	Count of the number of seconds during which one or more LOFs occurred, since initial frame synchronization.
MFAS Error Rate	The ratio of MFAS errors to the total number of frames received since initial frame synchronization.
MFAS Errors	A count of MFAS errors since initial frame synchronization.
Multiframe Sync Loss Seconds	Count of the number of seconds during which one or more MFAS synchronization losses occurred or during which MFAS synchronization could not be achieved, since initial frame synchronization.
OOF Seconds	Count of asynchronous test seconds in which an OOF was detected since initial frame synchronization. OOF is declared if the unit fails to find an FAS sub-pattern for five consecutive frames.

Table 84 Framing test results (Continued)

Test Result	Description
OOM Seconds	Count of asynchronous test seconds in which an OOM was detected since initial frame synchronization. OOM is declared if the received MFAS is out of sequence for five consecutive frames.

OTL Stats results

Table 85 lists and describes each of the test results available in the OTL Stats result category.

Table 85 OTL Stats Results

Test Result	Description
Current Maximum Skew (bits)	A count of the Maximum skew (measured in bits) detected between any two lanes since marker lock during the current period.
Current Maximum Skew (ns)	A count of the Maximum skew (measured in ns) detected between any two lanes since marker lock during the current period.
FAS Error Rate	The ratio of FAS errors to the total number of frames (across all lanes) received since initial frame synchronization.
FAS Error Seconds	A count of the number of seconds during which FAS errors occurred (across all lanes) since initial frame synchronization.
FAS Errors	A count of FAS errors (across all lanes) since initial frame synchronization.
Frame Sync Loss Seconds	Count of the number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial frame synchronization.
Lanes Aligned Loss Seconds (Test Pad mode)	A count of the number of seconds during which LOML, or other factors indicating improper lane alignment, was detected.
Logical Lane Marker (LLM) Error Rate	The ratio of LLM errors to the total number of lane markers received since initial Marker Lock.
Logical Lane Marker (LLM) Error Seconds	A count of the number of seconds during which LLM errors occurred, since initial Marker Lock.
Logical Lane Marker (LLM) Errors	Count of the number of Logical Lane Marker errors (all lanes combined)
Loss of Frame (LOF) Seconds	Count of the number of seconds during which one or more LOFs occurred, since initial frame synchronization.
Loss of Lane (LOL) Alignment Seconds (ANT Mode)	A count of the number of seconds during which LOML, or other factors indicating improper lane alignment, was detected.
Loss of Marker Lock (LOML) Seconds (ANT Mode)	Count of the number of seconds during which one or more Marker Lock losses occurred, since signal presence was detected.
Marker Lock (ML) Loss Seconds (Test Pad mode)	Count of the number of seconds during which one or more Marker Lock losses occurred, since signal presence was detected.
Maximum Skew (bits)	A count of the Maximum skew (measured in bits) detected between any two lanes since marker lock during the test.
Maximum Skew (ns)	A count of the Maximum skew (measured in ns) detected between any two lanes since marker lock during the test.

Table 85 OTL Stats Results (Continued)

Test Result	Description
MFAS Error Rate	The ratio of MFAS errors to the total number of frames received since initial frame synchronization.
MFAS Error Seconds	A count of the number of seconds during which MFAS errors occurred since initial frame synchronization.
MFAS Errors	A count of MFAS errors since initial frame synchronization.
Out of Frame (OOF) Seconds (ANT Mode)	Count of asynchronous test seconds in which an OOF was detected since initial frame synchronization. OOF is declared if the unit fails to find an FAS sub-pattern for five consecutive frames.

OTL Per Lane results

Table 86 lists and describes each of the test results shown in the OTL Per Lane display when performing OTL testing.

Table 86 OTL Per Lane results

STL Stat Result	Description
Max Skew LL ID	Shows Logical Lane ID for logical lane having the greatest skew.
Min Skew LL ID	Shows Logical Lane ID for logical lane having the least skew.
Max Skew (ns)	Shows skew value in nsecs for logical lane having the greatest skew.
Max Skew (bits)	Shows skew value in bits for logical lane having the greatest skew.
Lane #	Shows the Logical Lanes in the signal; 43G- #0 - #3, 112G- #0 - #19.
Logical Lane ID	Shows Lane ID for each logical lane.
Skew (bits)	Shows skew value in bits for each logical lane.
Skew (ns)	Shows skew value in nsecs for each logical lane.
Frame Sync	Display of sync status for each logical lane.(TestPad)
OTL LOF	Display of LOF status for each logical lane.(ANT)
OTL OOF	Display of OTL OOF status for each logical lane.
OOMFAS	Display of OOMFAS status for each logical lane.
Marker Lock	Display of marker lock status for each logical lane.(TestPad)
OTL LOR	Display of LOR status for each logical lane. (ANT mode)
OTL OOR	Display of OTL OOR status for each logical lane.
FAS	Count of FAS errors for each logical lane since the last restart of the test.
MFAS	Count of MFAS errors for each logical lane since the last restart of the test.
OOLLM (112G)	Display of OOLLM status for each logical lane.
Logical Lane Marker Errors (112G)	Count of LLM errors for each logical lane since the last restart of the test.

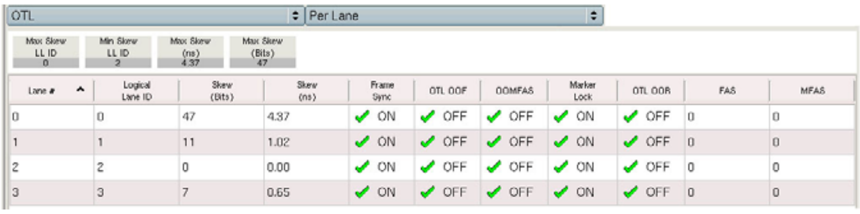


Figure 40 OTL Per Lane Result Table

OTU test results

Table 87 lists and describes each of the test results available in the OTN OTU result category.

Table 87 OTU test results

Test Result	Description
OTU-AIS Seconds	Count of asynchronous test seconds in which OTU-AIS was present for any portion of the test second since initial frame synchronization.
SM-IAE Seconds	Count of asynchronous test seconds in which SM-IAE was present for any portion of the test second since initial frame synchronization.
SM-BIP Errors	Count of SM-BIP errors since initial frame synchronization.
SM-BIP Error Rate	The ratio of SM-BIP errors to the total number of bits received since initial frame synchronization.
SM-BDI Seconds	Count of asynchronous test seconds in which SM-BDI was present for any portion of the test second since initial frame synchronization.
SM-BIAE Seconds	Count of asynchronous test seconds in which SM-BIAE was present for any portion of the test second since initial frame synchronization.
SM-BEI Errors	Count of SM-BEI errors since initial frame synchronization.
SM-BEI Error Rate	The ratio of SM-BEI errors to the total number of bits received since initial frame synchronization.
SM-TIM Seconds	Count of asynchronous test seconds in which SM-TIM was present for any portion of the test second since initial frame synchronization.
SM-SAPI	Displays the SM-SAPI identifier after multi-frame synchronization is gained.
SM-DAPI	Displays the SM-DAPI identifier after multi-frame synchronization is gained.
SM-Operator Specific	Displays the operator specific identifier after multi-frame synchronization is gained.

ODU test results

Table 88 lists and describes each of the test results available in the OTN ODU result category.

Table 88 ODU test results

Test Result	Description
GCC0 BERT Bit Counts	Count of GCC0 PRBS15 Bits received since last test restart.

Table 88 ODU test results (Continued)

Test Result	Description
GCC0 BERT Bit Error Counts	Count of GCC0 PRBS15 Bit Errors received since last test restart.
GCC0 BERT Bit Errors	Ratio of GCC0 PRBS15 Errors to PRBS15 Bits received since last test restart.
ODU-AIS Seconds	Count of asynchronous test seconds in which ODU-AIS was present for any portion of the test second since initial frame synchronization.
ODU-LCK Seconds	Count of asynchronous test seconds in which ODU-LCK was present for any portion of the test second since initial frame synchronization.
ODU-OCI Seconds	Count of asynchronous test seconds in which ODU-OCI was present for any portion of the test second since initial frame synchronization.
PM-BIP Errors	Count of PM-BIP errors since initial frame synchronization.
PM-BIP Error Rate	The ratio of PM-BIP errors to the total number of bits received since initial frame synchronization.
PM-BDI Seconds	Count of asynchronous test seconds in which PM-BDI was present for any portion of the test second since initial frame synchronization.
PM-BEI Errors	Count of PM-BEI errors since initial frame synchronization.
PM-BEI Error Rate	The ratio of PM-BEI errors to the total number of bits received since initial frame synchronization.
PM-TIM Seconds	Count of asynchronous test seconds in which PM-TIM was present for any portion of the test second since initial frame synchronization.
PM-SAPI	Displays the PM-SAPI identifier after multi-frame synchronization is gained.
PM-DAPI	Displays the PM-DAPI identifier after multi-frame synchronization is gained.
PM-Operator Specific	Displays the operator specific identifier after multi-frame synchronization is gained.
PM-Round Trip Delay	Displays the RTD value between local and remote unit as measured on the PM channel.

Transcoding Results/Stats

Table 89 lists and describes each of the test results available for the Transcoding test.

Table 89 Transcoding /Stats Results

Test Result	Description
Sync Acquired(1027b) (Present)	Status of the 1027B LOBL LED.
Sync Acquired(1027b) (History)	Past status of the 1027B LOBL LED.
HI BER (1027b) (Present)	Status of the 1027B HI BER LED.
HI BER (1027b) (History)	Past status of the 1027B HI BER LED.
Sync Loss Seconds (Across all lanes)	Length of time there has been a Loss of Block Lock as measured across all lanes.

Table 89 Transcoding /Stats Results

Test Result	Description
HI BER Seconds	A report of the number of seconds that an excessive number of BER errors has been received as summed across all lanes.
1027B Flag Parity Errors	Display of the total number 1027B flag parity errors received since the last sync lock.
1027B Flag Parity Error Ratio	Display of the ratio of 1027B flag parity errors received to the total number of frames received since the last sync lock.
513B Marker Sequence violation count	Display of the total number of 513B Marker Sequence violations received since the last sync lock.
513B Marker Sequence violation rate	Display of the ratio of 513B Marker Sequence violations to received transcoded lane markers since last sync lock.
513B Marker Sequence violation second	Display of the total number of seconds in which a 513B Marker Sequence Violation occurred.
Total OTN BIP-8 Error count	Display of the total number of OTN BIP-8 Errors across all lanes received since last sync lock.
Total OTN BIP-8 Error Rate	Display of the ratio of OTN BIP-8 Errors received to received transcoded lane markers since the test was started/restarted.
Total Ingress BIP-8 Error count	Display of the total number of Ingress BIP-8 Errors received since the test was started/restarted.
Total Ingress BIP-8 Error Ratio	Display of the ratio of Ingress BIP-8 Error to total blocks received since last sync lock.
OTN BIP-8 Error count Per Lane	Display of the total number of OTN BIP-8 Errors received in each lane since last sync lock.
OTN BIP-8 Error Rate Per Lane	Display of the ratio of OTN BIP-8 Errors received in each lane to received transcoded lane markers since the test was started/ restarted.
Ingress BIP-8 Error count Per Lane	Display of the total number of Ingress BIP-8 Errors received in each lane since the test was started/restarted.
Ingress BIP-8 Error rate Per Lane	Display of the ratio of Ingress BIP-8 Errors received in each lane to received transcoded lane markers since the test was started/ restarted.

FTFL test results

Table 90 lists and describes each of the test results available in the OTN FTFL result category.

Table 90 FTFL test results

Test Result	Description
Forward-Fault Type	Indicates whether there is no signal, the signal failed, or the signal is degraded for the forward/downstream signal. Appears after multi-frame synchronization is gained.
Forward-SD Seconds	Count of asynchronous test seconds in which the forward/downstream signal was degraded after multi-frame synchronization was gained
Forward-SF Seconds	Count of asynchronous test seconds in which the forward/downstream signal failed after multi-frame synchronization was gained.

Table 90 FTFL test results (Continued)

Test Result	Description
Forward-Operator Identifier	Displays the received forward/downstream operator identifier after multi-frame synchronization was gained.
Forward-Operator Specific	Displays the forward/downstream operator identifier after multi-frame synchronization was gained.
Backward-Fault Type	Indicates whether there is no signal, the signal failed, or the signal is degraded for the backward/upstream signal. Appears after multi-frame synchronization is gained.
Backward-SF Seconds	Count of asynchronous test seconds in which the backward/upstream signal failed after multi-frame synchronization was gained.
Backward-SD Seconds	Count of asynchronous test seconds in which the backward/upstream signal was degraded after multi-frame synchronization was gained.
Backward-Operator Identifier	Displays the backward/upstream operator identifier after multi-frame synchronization was gained.
Backward-Operator Specific	Displays the backward/upstream operator identifier after multi-frame synchronization was gained.

TCM1 - TCM 6 test results

Table 91 lists and describes each of the test results available in each of the OTN TCM result categories.

Table 91 TCM test results

Test Result	Description
IAE Seconds	Count of asynchronous test seconds in which IAE was present for any portion of the test second since initial frame synchronization.
BIP Errors	Count of BIP errors since initial frame synchronization.
BIP Error Rate	The ratio of BIP errors to the total number of bits received since initial frame synchronization.
BDI Seconds	Count of asynchronous test seconds in which BDI was present for any portion of the test second since initial frame synchronization.
BIAE Seconds	Count of asynchronous test seconds in which BIAE was present for any portion of the test second since initial frame synchronization.
BEI Errors	Count of BEI errors since initial frame synchronization.
BEI Error Rate	The ratio of BEI errors to the total number of bits received since initial frame synchronization.
TIM Seconds	Count of asynchronous test seconds in which TIM was present for any portion of the test second since initial frame synchronization.
SAPI	Displays the SAPI identifier after multi-frame synchronization is gained.
DAPI	Displays the DAPI identifier after multi-frame synchronization is gained.
Operator Specific	Displays the operator specific identifier after multi-frame synchronization is gained.
RTD- Recent	Round trip delay measured on the TCM channel.
RTD- Last	The round trip delay measured in the last (previous) test.

OPU results

Table 92 lists and describes each of the test results available in each of the OTN OPU result category.

Table 92 OPU test results

Test Result	Description
Payload Type Mismatch Seconds	Count of asynchronous test seconds in which the expected and received payload types do not match after multi-frame synchronization was gained.
Payload Type	Displays the received payload type after multiframe synchronization was gained.
MSI Mismatch Seconds	The number of seconds during which the MSI was mismatched.

GMP results

Table 93 lists and describes each of the test results available in each of the ODU GMP result category.

Table 93 ODU-GMP test results

Test Result	Description
Sync Status	Displays the condition of the GMP sync signal.
OoS Status	Displays the condition of the OTM Overhead Signal.
CM parameters	Displays the following parameters of the GMP CM value- – Effective- GMP Effective value – Minimum- value of lowest CM value since the start – Maximum- value of highest CM value since the start – Unchanged- number of CM values since the start which were unchanged from the previous value – +1- number of CM values since the start which were incremented by one from the previous value – +2- number of CM values since the start which were incremented by two from the previous value – -1- number of CM values since the start which were decremented by one from the previous value – -2- number of CM values since the start which were decremented by two from the previous value – New- number of CM values since the last test start or restart that were previously not recorded
CM=0 Alarm	Displays the condition that CM=0 and received signal may not be GMP mapped.
CRC-5 Errors	Displays the following parameters of CRC-5 Errors – Bit Errors- number of CRC-5 error bits detected – Bit Error Rate- ratio of CRC-5 error bits to total bits
CRC-8 Errors	Displays the following CRC-8 Error results – Bit- Errors- number of CRC-8 error bits detected – Bit Error Rate- ratio of CRC-8 error bits to total bits received

Table 94 lists and describes each of the test results available in the OTU4 GMP result category.

Table 94 OTU4-GMP results

Test Result	Description
Sync Status	Displays the condition of the GMP sync signal.
Sync Loss Seconds	Count of the number of seconds in which a GMP Loss of Sync was detected since the last test start or restart.
OoS Status	– Displays the condition of the OoS signal.
OoS Seconds	– Count of the number of seconds in which an OoS signal was detected since the last test start or restart.
GMP Alarm (CM=0)	Displays the condition that CM=0 indicating received signal may not be GMP mapped.
CM value parameters	Displays the following parameters of the GMP CM Rx Payload value- – Effective- GMP CM Server value. – Deviation- Payload rate deviation from nominal in ppm since GMP sync was attained. – Minimum- lowest CM value of payload offset since the last test start or restart. – Maximum- highest CM value of payload offset payload offset since the last test start or restart. – Unchanged- number of CM values of payload offset which were unchanged since the last test start or restart. – +1- number of CM values of payload offset since the last test start or restart which were incremented by one from the previous value. – +2- number of CM values of payload offset since the last test start or restart which were incremented by two from the previous value. – -1- number of CM values of payload offset since the last test start or restart which were decremented by one from the previous value. – -2- number of CM values since the last test start or restart which were decremented by two from the previous value. – New- number of CM values since the last test start or restart that were previously not recorded.
CRC-5 Errors	– Bit Errors- number of CRC-5 error bits detected – Bit Error Rate- ratio of CRC-5 error bits to total bits – Bit Error Seconds- Count of the number of seconds containing a CRC-5 Bit Error
CRC-8 Errors	Displays the following CRC-8 Error results – Bit- Errors- number of CRC-8 error bits detected – Bit Error Rate- ratio of CRC-8 error bits to total bits received – Bit Error Seconds- Count of the number of seconds containing a CRC-8 Bit Error

GFP-T results

Table 95 lists and describes each of the test results available in the GFP-T result category.

Table 95 GFP-T test results

Test Result	Description
CRC-16 Errors	Displays the following CRC-16 Error results – Correctable Errors- the number of correctable errors occurring since the last test restart. – Uncorrectable Errors- the number of uncorrectable errors occurring since the last test restart.
10B_ERR	Display the following parameters of 10B_ERR errors- – Errors – Error Seconds – Error Ratio- – Error Rate
Rx Traffic	Displays the following parameters of the GFP-T Rx Traffic. – Superblocks- number received since last restart – Superblocks Per Frame- number received

GFP results

Table 96 lists and describes each of the test results available in the GFP result category.

Table 96 GFP test results

Test Result	Description
Core Header	Displays the following Core Header error results – Single Bit Errors- the number of Single Bit errors occurring since the last test restart. – Single Bit Error Seconds- how many seconds of Single Bit errors have occurred since the last test restart. – Single Bit Error Ratio- the ratio of Single Bit errors occurring since the last test restart. – Single Bit Error Rate- the frequency of Single Bit error occurrence – Multi-Bit Errors- the number of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Seconds- how many seconds of Multi-Bit errors have occurred since the last test restart. – Multi-Bit Error Ratio- the ratio of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Rate- the frequency of Multi-Bit error occurrence

Table 96 GFP test results (Continued)

Test Result	Description
Type Header	Displays the following Type Header error results – Single Bit Errors- the number of Single Bit errors occurring since the last test restart. – Single Bit Error Seconds- how many seconds of Single Bit errors have occurred since the last test restart. – Single Bit Error Ratio- the ratio of Single Bit errors occurring since the last test restart. – Single Bit Error Rate- the frequency of Single Bit error occurrence – Multi-Bit Errors- the number of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Seconds- how many seconds of Multi-Bit errors have occurred since the last test restart. – Multi-Bit Error Ratio- the ratio of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Rate- the frequency of Multi-Bit error occurrence
Extension Header	Displays the following Extension Header error results – Single Bit Errors- the number of Single Bit errors occurring since the last test restart. – Single Bit Error Seconds- how many seconds of Single Bit errors have occurred since the last test restart. – Single Bit Error Ratio- the ratio of frames containing Single Bit errors to error-free frames occurring since the last test restart. – Single Bit Error Rate- the frequency of Single Bit error occurrence – Multi-Bit Errors- the number of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Seconds- how many seconds of Multi-Bit errors have occurred since the last test restart. – Multi-Bit Error Ratio- the ratio of Multi-Bit errors occurring since the last test restart. – Multi-Bit Error Rate- the frequency of Multi-Bit error occurrence
Payload FCS	Displays the following Extension Header error results – Single Bit Errors- the number of Payload FCS errors occurring since the last test restart. – Single Bit Error Seconds- the number of seconds since the last test restart during which one or more Payload FCS errors have occurred. – Single Bit Error Ratio- the ratio of frames containing Payload FCS errors to the total number of frames since the last test restart. – Single Bit Error Rate- the rate at which Payload FCS errors are being detected.

Payload BERT results

Table 97 lists and describes each of the test results available in the Payload BERT result category.

Table 97 BERT test results

Test Result	Description
Bit/TSE Errors	Count of Pattern Bit Errors since initial pattern synchronization.
Bit/TSE Error Rate	Ratio of Pattern Bit Errors to total number of Pattern bits since initial pattern synchronization.

Table 97 BERT test results (Continued)

Test Result	Description
Bit/TSE Error-Free Seconds	Count of number of seconds where no Pattern Bit Errors occurred since initial pattern synchronization.
Bit/TSE Error-Free Seconds %	Ratio of number of seconds where no Pattern Bit Errors occurred to total number of seconds since initial pattern synchronization.
LSS Seconds	Count of seconds during which OTL BERT pattern is detected as missing.(ANT Mode)
LSS	Count of number of times OTL BERT pattern is detected as missing.(ANT Mode)
Pattern Sync Loss Seconds	Number of seconds during which pattern synchronization was lost after initial pattern synchronization.(TestPad Mode)
Pattern Sync Losses	Count of the number of times synchronization is lost after initial pattern synchronization.(TestPad Mode)

Graphical results

The Graphs result group provides test results such as Latency (RTD), Throughput, Packet Jitter, and Errors graphically. When viewing results graphically, a legend is provided under the graph with colors indicating what each color represents on the graph.

You can customize the graphs to suit your needs by doing the following:

– To simplify the graph, you can select the legend, and then choose the data that you want to observe, and hide the rest.
– If you are running a multiple streams application, you can select the legend, and then choose the data that you want to observe for each analyzed stream and hide the rest.

Graphs require significant system resources; therefore, you can optionally disable automatic graph generation if you intend to run other resource intense applications.

To disable graph generation

1. On the Main screen, select **Tools > Customize ....**
   The Customize User Interface Look and Feel screen appears.
2. Clear the **Generate Graphs** setting, and then select **Close** to return to the Main screen.

The MSAM will not automatically generate graphs. You can select the Generate Graphs setting at any time to resume automatic graph generation.

Histogram results

The Histogram result category provides a display of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time (seconds, minutes, or hours).

A sample histogram is provided in Figure 41.

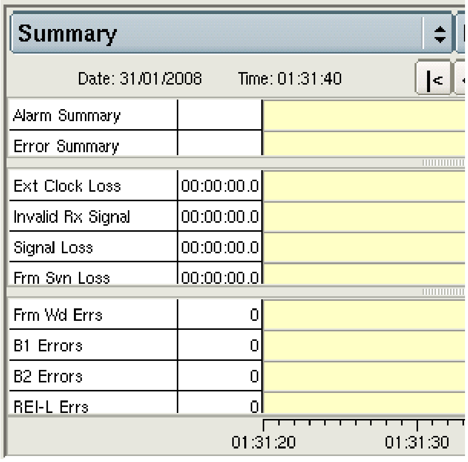


Figure 41 Sample histogram

Results are updated once per second.

> **NOTE:**
> Histograms are best viewed using full-sized result window. See "Changing the result layout" on page 5.

Event Log results

The event log result category provides a display listing any significant events, errors or alarms that occur during the course of your test. The log displays the value for each error or alarm, and provides the date and time that the error or alarm occurred.

Events are updated once per second. For instructions on customizing your event log display, see "About the Event log" on page 5.

> **NOTE:**
> Event logs are best viewed using full-sized result window. See "Changing the result layout" on page 5.

Time test results

The Time category provides the current date, time, and the time elapsed since the last test start or restart. Table 98 describes each of the Time results.

Table 98 Time results

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

8

Troubleshooting

This chapter describes how to identify and correct issues encountered when testing using the instrument.

If you experience problems when testing using your instrument, you may be able to solve these problems on your own after referring to this section. If you experience significant problems with the module, call the Technical Assistance Center (see "Technical assistance" on page xx).

Topics discussed in this chapter include the following:

Before testing

The following section addresses questions that may be asked about assembling the various components before testing.

The test application I need is not available

Only the applications for *currently inserted PIMs* will appear on the Test menu. For example, if an SFP and XFP PIM are inserted in the MSAM chassis, you will not see DS1 applications. Other applications only appear if you purchased the associated testing option.

Resolution

Insert the appropriate PIM for the application.

Can I hot-swap PIMs?

No, PIMs are not hot-swappable.

Resolution

You must turn the BERT module OFF before inserting or swapping PIMs.

How can I determine whether I need to swap a PIM or swap SFP transceivers?

Tables listing the line rates supported by each PIM are provided in the *Getting Started Manual* that shipped with your instrument or upgrade. Details concerning each of the JDSU recommended optics (transceivers) are available on the instrument itself (by selecting the corresponding option from the Help menu). You can also observe details for the currently inserted SFP or XFP on the Interface setup tab of the MSAM user interface.

I am receiving unexpected errors when running optical applications

SFP transceivers are designed for specific interfaces and line rates.

Resolution

Verify that the SFP you inserted into the PIM is designed to support the interface you are connected to for testing. This information is provided on the Interface setup tab of the MSAM user interface.

Basic testing

The following section addresses questions that may be asked about performing tests using the instrument.

Optical Overload Protection message

When in optical mode, the instrument displays a warning that the Optical Overload Protection is activated, or the instrument does not detect a signal.

Resolution

Applied power must not exceed the power level specified in the vendor specifications provided for your SFP or XFP.

User interface is not launching

The BERT icon is highlighted in yellow, but the user interface is not launching.

Resolution

Press the Results or the Start/Stop key to display the user interface.

Inconsistent test results

I am getting inconsistent test results.

Resolution

Verify the following:

- Verify that your test leads are good and are connected properly for the test you are performing.
- Verify that the correct timing source is selected on the Interface setup screen.
- Verify that the correct line interface is selected.
- Verify that the correct mapping, tributaries, and analysis rates are selected.

Result values are blank

Why are the result values blank?

Resolution

Results are blank if gating criteria have not been met. Criteria examples include Signal Present, Frame Sync Present, Pointer Present, and BERT Pattern Sync Present.

Unit on far end will not loop up

The unit on the far end will not respond to a Loop Up command.

Resolution

Verify that the application running on the far end is not configured to automatically transmit traffic when the laser is turned on. If so, it can not respond to a Loop Up command. Turn the setting off.

A receiving instrument is showing many bit errors

I am transmitting an ATP payload carrying a BERT pattern, and the receiving instrument is showing a large number of bit errors.

Resolution

Verify that the receiving instrument is not using a Version 1 Transport Module. You can determine this by checking the serial number for the module. If there is no V2 or V3 prefix for the serial number, you are using a version 1 module.

Even when running software version 8.x, version 1 Transport Modules will not support ATP payloads carrying BERT patterns. Version 2 and Version 3 Transport Modules do support the payloads.

Which MSAM or application module is selected?

When testing using an 8000 and two MSAMs (via a DMC), or an 8000 using multiple application modules, which test is in the foreground, and which is running in the background?

Resolution

On the Main screen, a button appears in the menu bar indicating which DMC slot and port, or which 8000 application module and port is currently selected.

VF testing

Voice frequency measurements are not available

My instrument is configured for VF testing, and I selected the VF testing action key. No results appear.

Resolution

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

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

Upgrades and options

The following section addresses questions that may be asked about upgrading or installing test options for the instrument.

How do I upgrade my instrument?

Upgrades are installed from a USB key. Instructions are provided with each software upgrade.

How do I install test options?

Test options are enabled by entering a JDSU provided challenge code. Instructions are provided when you order test options.

Do software and test options move with the MSAM or Transport Module?

Test options are available when you connect the MSAM or Transport Module to a different base unit; however, the base unit software and BERT (MSAM/Transport Module) software reside on the base unit.

A

Principles of ISDN Testing

This appendix explains basic ISDN principles, and describes the messages displayed when testing using the instrument.

Topics discussed in this appendix include the following:

For step-by-step instructions on ISDN testing, refer to Chapter "This chapter provides step-by-step instructions for testing T-Carrier and PDH networks. Topics discussed in this chapter include the following:". For descriptions of each of the available ISDN test results, refer to Chapter 7 "Test Results".

About ISDN

If your instrument is optioned and configured to do so, you can use it to install and maintain ISDN PRI services over T1 interfaces. Using the instrument 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.

Understanding LAPD messages

LAPD Unnumbered frame messages

Table 99 lists each of the LAPD unnumbered frame decode messages.

Table 99 LAPD unnumbered frame decodes

Message…	Sent to…
DISC (Disconnect)	Disconnect or terminate the D channel link. This message should not be confused with the Q.931 `DISCONNECT` message which is used to disconnect a call.
DM (Disconnect Mode)	Indicate one of the following: – The link partner is not ready to establish a D channel link with the device sending a `SABME` message. – The link partner cannot terminate the link (in response to a `DISC` message), typically because communications have already been disconnected.
FRMR (Frame Reject)	Indicate that an unrecoverable link-level problem has occurred. This message is transmitted when re-transmitting a frame will not correct the problem, and indicates a potential high level protocol issue between the link partners.
SABME (Set Asynchronous Balanced Mode with Extended Sequence Numbering)	Establish initial D channel communications. – An affirmative response from the link partner is a UA message. – A negative response (indicating the link partner is not ready to establish a link) is a DM message.
UA (Unnumbered Acknowledge-ment)	Acknowledge one of the following: – A `SABME` message from the device initiating D channel communi-cations. – A `DISC` message from the device terminating the D channel link.
UI (Unnumbered Information)	Request an exchange of information between the link partners.

LAPD Supervisory frame messages

Table 100 lists each of the LAPD supervisory frame decode messages.

Table 100 LAPD supervisory frame decodes

Message…	**Sent to…**
REJ (Reject)	Force re-transmission of bad frames. Frequent REJ frames indicate mis-communication on the D channel, typically due to errored frames during transmission.
RNR (Receiver Not Ready)	Indicate that a link partner is experiencing difficulty (such as buffer depletion), and cannot accept any additional information frames (call related messages) at this time. RNR messages should occur rarely, and should be investigated immediately when they occur.
RR (Receiver Ready)	Keep the signal alive between the link partners, and acknowledge receipt of frames. RR messages are the most common messages observed in D channel decodes. When there are no call-related messages to send, the link partners transmit RR frames to make sure the link stays in service. **NOTE:** When you are viewing a large number of decode messages to troubleshoot call processing, you can typically ignore the RR messages since they are simply used to keep the D channel signal alive.

Q.931 messages

Table 101 lists common Q.931 decode messages.

Table 101 Q.931 decodes

Message…	**Sent to…**
ALERTING	Indicate that a SETUP message has been received by an ISDN device or phone, and that the device or phone is in the process of ringing. **NOTE:** Some ISDN devices (for example, the HST-3000), do not literally ring.
CALL PROCEEDING	Indicate that a SETUP message has been received by a switch, and that the switch is attempting to process the call.
CONNECT	Indicate that the call has been completed and that the calling party is connected with the called party.
CONNECT ACK	Acknowledge that the CONNECT message has been received.
DISCONNECT	Disconnect the call. Can be sent from the calling device or the called device. **NOTE:** DISCONNECT messages report the cause for the disconnection.
RELEASE	Release the call in response to a DISCONNECT message, or because a call cannot be connected. **NOTE:** If a call cannot be connected, and as a result a RELEASE message is issued in response to a SETUP request, the RELEASE message will report the cause for the disconnection.
RELEASE COMPLETE	Acknowledge that a RELEASE message has been received, and disconnect the call. **NOTE:** A call is not disconnected until the RELEASE COMPLETE message is observed.
SETUP	Originate a call.

In addition to the messages listed in Table 101, additional messages concerning the call (such as the operator system access used), and Q.931 cause values indicating the reason a call is disconnected appear on the D Channel Decode screen. For details, see "Understanding the Q.931 Cause Values" on page 246.

Understanding the Q.931 Cause Values

Cause values indicating the reason a call is disconnected are displayed on the D Chan Decode results screen and the Call Status result screen.

For each disconnected call, the D Channel Decode Results screen displays the following cause information in either the `DISCONNECT` or `RELEASE` message:

- A location code, indicating where the disconnect originated (for example, on a private network or a transit network).
- A class code, indicating the type of disconnect (for example, due to a protocol error).
- The cause value issued by the ISDN Network. This value corresponds to a Q.931 cause code (see the cause codes listed in Table 102 on page 246).
- An abbreviated description indicating the reason the call was disconnected.

The Call Status screen simply provides the cause value and an abbreviated description of the cause of the disconnect.

NOTE:
The cause codes listed in Table 102 on page 246 do not appear on the D Channel Decode or Call Status result screens. The codes correspond to those listed in the International Telecommunications Union (ITU) Q.931 standards.

Table 102 lists and explains the most commonly encountered cause codes for ISDN PRI calls.

Table 102 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).
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.

Table 102 Common Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description	Typically Indicates
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.
100	`Invalid information element contents`	`INVALID INFO ELEMENT CONTENT`	A protocol problem where the receiving equipment does not understand one of the fields inside of the call setup message. If you receive this message, do the following: – Verify that the call control is correct for the call. – Contact a Tier 2 or Tier 3 technician or switch vendor to isolate and resolve the problem.
102	`Recovery on timer expiry`	`RECOVERY ON TIMER EXPIRY`	No response received to generated messages. Often seen on PRI NFAS circuits when equipment is trying to generate call activity on the backup D channel and not on the currently active D channel.

Table 102 lists less frequently encountered cause codes for ISDN PRI calls.

Table 103 Q.931 Cause Codes

Cause Code	D Channel Decode Description	Call 1/Call 2 Description
1	`Unassigned Number`	`UNASSIGNED NUMBER`
2	`No route to specified network`	`NO ROUTE TO TRANSIT NETWORK`
3	`No route to destination`	`NO ROUTE TO DESTINATION`
6	`Channel unacceptable`	`CHANNEL IS UNACCEPTABLE`
7	`Call awarded delivered in est. ch.`	`CALL AWARDED`
17	`User busy`	`USER BUSY`
19	`User alerting no answer`	`ALERTING BUT NO ANSWER`
22	`Number changed`	`NUMBER CHANGED`
26	`Non-selected user clearing`	`NON-SELECTED USER CLEARING`
27	`Destination out of order`	`DESTINATION OUT OF ORDER`
29	`Requested facility rejected`	`REQUEST FACILITY REJECTED`
30	`Response to STATUS ENQuiry`	`RESPONSE TO STATUS ENQUIRY`
34	`No channel available`	`NO CIRCUIT/CHAN AVAILABLE`
35	`Queued`	`QUEUED`
41	`Temporary failure`	`TEMPORARY FAILURE`
42	`Network congestion`	`NETWORK CONGESTION`
43	`Access information discarded`	`ACCESS INFO DISCARDED`
44	`Requested circ/channel not avail.`	`REQ. CHANNEL NOT AVAILABLE`
47	`Resources unavailableunspecified`	`RESOURCE UNAVAILABLE`

Table 103 Q.931 Cause Codes (Continued)

Cause Code	D Channel Decode Description	Call 1/Call 2 Description
50	Requested facility not subscribed	REQ FACILITY NOT SUBSCRIBED
52	Outgoing calls barred	OUTGOING CALLS BARRED
54	Incoming calls barred	INCOMING CALLS BARRED
58	Bearer capability not presently available	BEARCAP NOT AVAILABLE
63	Service or option not available	SERVICE NOT AVAILABLE
65	Bearer service not implemented	BEARER SERVICE NOT IMPLEMENTED
66	Channel type not implemented	CHANNEL TYPE NOT IMPLEMENTED
69	Requested facility not implemented	REQ FACILITY NOT IMPLEMENTED
70	Only restricted dig. info. bearer	RESTRICTED DIGITAL ONLY
79	Service/option not implemented unspecified	SERVICE NOT IMPLEMENTED
81	Invalid Call Reference value	INVALID CALL REFERENCE VALUE
82	Identified channel does not exist	CHANNEL DOES NOT EXIST
90	Destination address missing	NO DESTINATION ADDRESS
91	Transit network does not exist	TRANSIT NETWORK NOT EXIST
95	Invalid messageunspecified	INVALID MESSAGE
96	Mandatory information element miss-ing	INFO ELEMENT MISSING
97	Message type nonexistant or not implemented	MESSAGE TYPE NON-EXISTENT
98	Message not compatible with call state	MESSAGE NOT COMPATIBLE
99	Info element nonexistant or not implemented	INFO ELEMENT NON-EXISTENT
101	Message not compatible with call state	MESSAGE NOT COMPATIBLE
111	Protocol error unspecified	PROTOCOL ERROR
127	Interworking unspecified	INTERWORKING

B

Principles of Jitter and Wander Testing

This appendix explains basic jitter and wander principles, and describes the measurements available when testing using the MSAM.

Topics discussed in this appendix include the following:

For step-by-step instructions on measuring jitter or wander, refer to Chapter 4 "Jitter and Wander Testing". For descriptions of each of the available jitter and wander test results, refer to "Jitter results" on page 205 and "Wander results" on page 209.

About jitter

Jitter is defined as any phase modulation with a frequency above 10 Hz in a digital signal. This unwanted phase modulation is always present in devices, systems and networks. In order to ensure interoperability between devices, and to minimize signal degradation due to jitter accumulation, the ANSI and ITU-T have established limits for:

– The maximum acceptable level of jitter transmitted by a device.
– The level of received jitter that must be tolerated by a device.

These limits have been published in a variety of standards for different devices and interfaces. The MSAM generates and analyzes jitter in accordance with the following standards:

– *ITU-T Recommendations G.823, G.825, O.172 (04/2005) and O.173 (03/2003)*
– *Telcordia GR-499-CORE Issue 2-1998, GR-253-CORE Issue 4-2005*
– *ANSI Standards T1.102 - 1993, Table 9, T1.404-1994 section 5.10*

Jitter measurements

Per *ITU-T Recommendation O.172 (04/2005), Section 9 and 0.173 (03/2003), Section 8*, jitter analysis involves measuring output jitter, jitter over time, jitter tolerance, phase hits, and the amount of jitter transferred from the receiver to the transmitter of a network element. This section provides an overview of each of the key jitter measurements.

Intrinsic jitter

Even if a network element (NE) receives a jitter-free digital signal or clock, a certain amount of jitter always occurs when the NE transmits the received signal to the next NE on the circuit. This jitter is produced by the NE itself as a result of clock thermal noise, drift in clock oscillators, or drift in clock data recovery circuits. This effect is known as *intrinsic jitter*.

Output jitter

Output jitter is the overall jitter measured at a NE's transmitter, and is specified in unit intervals (UI). An amplitude of one UI corresponds to one clock period at the transmitted line rate, and is independent of bit rate and signal coding. The result is displayed as a peak-to-peak value or as an RMS (root mean square) value over a specific frequency range. Peak-to-peak measurements provide a better indication of the effect of jitter on network performance, because extreme fluctuations trigger more errors on the circuit. RMS measurements help you determine the average amount of jitter.

When measuring output jitter, typically a live traffic signal or a rate-based standard traffic pattern is transmitted to the device under test (DUT). This involves demodulating the jitter from the live traffic at the transmitter of a network element (NE), filtering the jittered signal through high-pass and low-pass filters, and then measuring the peak-to-peak and the RMS amplitude of the jitter over the specified measurement time interval, for example, 60 seconds. Output jitter results are strongly influenced by the data transmitted by the signal. For example, jitter measurements for a signal transmitting a 1010 pattern can vary significantly from those obtained for a signal transmitting a PRBS (Pseudo Random Binary Sequence).

To detect rare violations of the permitted jitter level, the received jitter amplitude is compared with a selected jitter amplitude mask, and then is observed to determine the number of events that exceed the user-specified *sensor threshold*. Test results then provide the number of events exceeding the threshold (such as phase hits).

Jitter over time

You can record the positive and negative peak values, peak-to-peak values, or the root mean square (RMS) value of jitter over a period of time. Peak values are momentary values, whereas RMS values represent the average amount of jitter during a certain integration period. Measured values have a resolution of one second. This presentation format is particularly useful for long-term in-service monitoring and for troubleshooting. The MSAM offers a number of possibilities for in-service analysis. For example, anomalies and defects can be recorded with a time-stamp during a long-term jitter measurement. This helps to correlate increased jitter and transmission errors.

Phase hits

The MSAM declares a phase hit if a demodulated jitter signal exceeds a preset positive or negative threshold value.

– When analyzing jitter on an electrical circuit, subsequent phase hits are only counted if the amplitude drops below or rises above the hysteresis for the analysis rate (equal to 100% of the threshold), and then exceeds the positive or negative threshold again.
– When analyzing jitter on an optical circuit, subsequent phase hits are only counted if the amplitude drops below or rises above the hysteresis (25 mUI), and then exceeds the positive or negative threshold again.

Figure 42 illustrates jitter phase hits in a demodulated jitter signal.

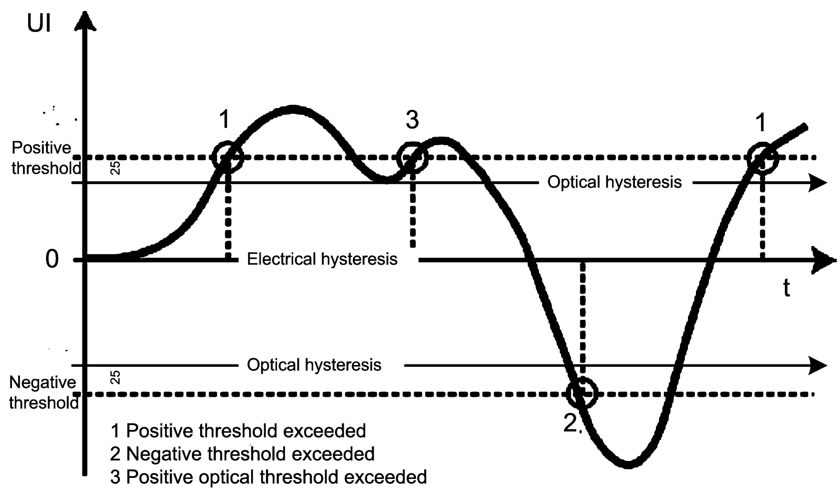


Figure 42 Phase hits in a demodulated jitter signal

Jitter tolerance

Jitter tolerance is a measurement used to verify the resilience of equipment to input jitter. The measurement allows you to determine the maximum level of jitter that network elements (NE) on a circuit can tolerate without transmitting errors. Figure 43 illustrates the connections required to measure jitter tolerance.

Figure 43 Jitter Tolerance Measurement Connections

Two automated test sequences are available that help you determine a NE's ability to tolerate jitter.

MTJ test sequence

The automated MTJ sequence measures the Maximum Tolerable Jitter by transmitting a jittered test signal to the receiver of the NE. The sequence uses an algorithm to automatically increase the jittered signal's amplitude at various frequencies (in *search steps* specified as *mask points* and *scan points*) until the NE transmits errors exceeding the value specified on your unit as the *sensor threshold*. The MTJ value is the value for the search step immediately preceding the step that caused the threshold error.

The unit begins the sequence by transmitting a jittered signal with an amplitude of 50% of the tolerance value. Depending on the result, it then increases or decreases the amplitude by half of the set value until reaching the finest resolution, while allowing the network element a programmable recovery time between measurements. The unit records the measurement curve, allowing you to observe the entire measurement in the MTJ Graph result category.

Fast MTJ test sequence

The automated Fast MTJ sequence uses a *subset* of mask points and scan points to quickly measure MTJ. If the NE tolerates jitter without transmitting errors exceeding the number specified for the sensor threshold, the measurement indicates that the NE passed the test. If the NE transmits errors exceeding the number specified for the threshold, the measurement indicates that the NE failed. This test sequence provides no information about the tolerance reserve of the network element's receiver.

Jitter Transfer Function (JTF)

Jitter transfer indicates how much jitter is transferred from the receiver to the transmitter of the network element you are testing. Jitter may increase or decrease when passing through an NE.

Most often, if a received signal is jittered, some residual jitter will remain when the signal is transmitted. As the signal passes through the NE, high-frequency jitter is generally suppressed. Low-frequency jitter components normally appear unchanged. The received jitter may even be amplified slightly by the NE. This can cause problems if several similar network elements, such as regenerators, are connected consecutively. Even a slight jitter gain can accumulate as the signal progresses through the circuit to produce high jitter values. The jitter tolerance for the next network element on the circuit could then potentially be exceeded, resulting in an increased bit error rate.

Test set calibration

To ensure optimum accuracy when measuring JTF, the transmitter and receiver of your unit must be normalized by performing a loop-back calibration. The transmitter is looped to the receiver, and then the unit determines the intrinsic error of the analyzer at every selected scan frequency. The unit then corrects the intrinsic error and applies it to the test results for the device under test when you measure JTF. Figure 44 illustrates the connection required to calibrate the unit.

Figure 44 Connection For Test Set Calibration

JTF measurement

After the unit is calibrated, you can reconnect the Transport Module to the DUT to start measuring JTF. Figure 45 illustrates the connections required to measure JTF.

Figure 45 Jitter Transfer Function measurement connections

When measuring JTF, the unit transmits a signal modulated with sinusoidal jitter to the receiver of the device under test. A signal with the highest possible jitter amplitude tolerable at the receiver should be transmitted, since a high amplitude results in a better signal-to-noise ratio and therefore provides a more accurate measurement by reducing the occurrence of spurious jitter. The jitter amplitude at the DUT's transmitter is measured, and then the unit calculates the JTF. The unit continues to measures JTF at a number of pre-selected frequencies.

The jitter is measured selectively using a band-pass filter that is tuned to the modulation frequency. This ensures that interference frequencies outside the pass band of the filter do not affect the result.

The Jitter Transfer Function is calculated from the logarithmic ratio of output jitter to input jitter on a point by point basis, per *ITU-T Recommendation O.172 (04/2005), Section 9.5, and O.173 (03/2003), Section 8.6.*

About wander

Slow, periodic and non-periodic phase changes in the 0 Hz to 10 Hz frequency range are known as wander. Because phase changes can take place at any speed, a reference clock must always be used when measuring wander. Wander can also be described as the phase difference between a very precise reference clock and the signal under test. The phase difference is sampled over time and is expressed in nanoseconds.

Most wander measurements are taken over a significant period of time, spanning an entire day or even more than one day. To ensure accuracy of your wander measurements, let each wander test run for at least one minute.

Wander measurements

Per *ITU-T Recommendation O.172, Section 10* wander analysis involves measuring the Time Interval Error (TIE), calculating the Maximum Time Interval Error (MTIE), and calculating the Time Deviation (TDEV).

The Time Interval Error (TIE) for a series of measurements is then used to calculate the Maximum Time Interval Error (MTIE) and the Time Deviation (TDEV). The calculated MTIE and TDEV are then compared the standard ITU-T or ANSI masks.

Maximum Time Interval Error (MTIE) is a measure of wander that characterizes frequency offsets and phase transients. It is a function of parameter τ called the Observation Interval. MTIE(τ) is the largest peak-to-peak TIE detected since the test started.

Time Deviation (TDEV). is a measure of wander that characterizes its spectral content. It is also a function of parameter τ (the Observation Interval). TDEV(τ) can be said to be the RMS of filtered TIE, where a band-pass filter is centered on a frequency of 0.42/τ.

Reference clock requirements

When measuring wander using the Transport Module, the external reference signal must conform to the clock frequencies and input levels specified below:

- If a valid BITS signal is present on the `Rx 2 BITS/REF` receiver, the BITS signal is selected as the wander reference.
- If a valid BITS reference signal is not present on the `Rx 2 BITS/REF` receiver, the unit will examine the `Rx 2/SETS/REF` receiver.
- If a valid SETS signal is present on the `Rx 2/SETS/REF` receiver, the SETS signal is selected as the wander reference.
- If a valid SETS signal is not present, the unit will examine the `Rx 2 SETS/REF` receiver for a 2.048 MHz clock signal.
- If a valid 2.048 MHz clock signal is not present on the `Rx 2 SETS/REF` receiver, the unit will check for a 10 MHz clock signal to use as the wander reference.

If none of the above signals are present, the internal reference is selected as the wander reference.

NOTE:
If the unit loses the reference clock signal, a message appears in the Message Bar and Message Log indicating that the reference clock was lost.

Wander over time

Wander can accumulate in a network, causing incorrect synchronization or even a total loss of synchronization. The accumulated phase changes in the node clock result in a frequency offset, which ideally should be zero over long observation periods. This is true for a node clock that is properly locked to the nearest higher level in the hierarchy. An unlocked clock, running in hold-over mode, may have a substantial frequency offset and a frequency drift that could be high. However, a locked clock can also have a measurable frequency offset over shorter observation times.

You can view the frequency offset in the TIE graph (see “Analyzing wander” on page 105). The higher the frequency offset for a certain observation time, the higher the TIE value for the same time. Figure 46 provides a sample TIE graph illustrating wander measurement over time.

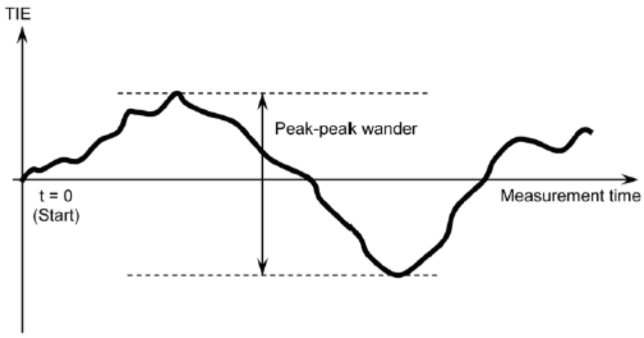


Figure 46 Example: Wander measurement over time

TIE and MTIE

The TIE value represents the time deviation of the signal under test relative to a reference source. MTIE is the maximum time interval error (peak-to-peak value) in the clock signal being measured that occurs within a specified observation interval in seconds. The MSAM measures TIE and MTIE per Per *ITU-T Recommendation O.172, [10.2] and [10.4]* respectively.

Time Deviation (TDEV)

The TDEV value is a measure of the expected time variation of a signal as a function of integration time. It is calculated from the TIE sample. The TDEV value can provide information about the spectral content of the phase or the time noise of a signal. The MSAM measures TDEV per Per *ITU-T Recommendation O.172, [10.5]*.

Frequency offset

Frequency offset is calculated per *ANSI T1. 101-199X / T1X1.3/98-002*.

Drift rate

Drift rate is calculated per *ANSI T1.101-199X /T1X1.3/98-002*.

Glossary

Symbols/Numerics

1PPS — 1 Pulse per Second. A signal used as a timing reference, commonly a part of a GPS signal.

10G — Used to represent 10 Gigabit Ethernet.

10GigE — Used throughout this manual to represent 10 Gigabit Ethernet.

2M — *See E1*. The E1 PIMs are used when testing 2M interfaces.

802.11b — IEEE standard for wireless LANs. You can establish wireless LAN connections to the T-BERD ⁄ MTS 8000, 6000A, and 5800 using an 802.11 PCMCIA card.

802.3 — The IEEE specification for Ethernet. 802.3 also specifies a frame type that places the frame length in the Length/Type field of the Ethernet header, as opposed to the DIX Type II frame type which utilizes the Length/Type field to identify the payload Ethertype.

A

AC — Alternating Current. An AC power adapter is supplied with the T-BERD ⁄ MTS 8000, 6000A, and 5800.

ADM — Add-drop multiplexer. A multiplexer capable of extracting and inserting lower-rate signals from a higher-rate multiplexed signal without completely de multiplexing the signal. In SONET, a device which can either insert or drop DS1, DS2, and DS3 channels or SONET signals into/from a SONET bit stream.

AIS — Alarm Indication Signal. A continuous stream of unframed 1's sent to indicate that the terminal equipment has failed, has lost its signal source or has been temporarily removed from service.

AMI — Alternate Mark Inversion. A line code which inverts the polarity of alternate 1s.

AMS — Automatic measurement sequence.

Analysis Rate — The bit rate of the data stream being analyzed by the BERT engine. The analyzed data stream can be the full payload or a demultiplexed tributary from the line interface signal.

APS — Automatic protection switching. In SONET/SDH, the protocols which ensure a transition from working to standby lines in the event of equipment or facility failure. APS is controlled via the K1 and K2 bytes in the Section Overhead.

ARP — Address Resolution Protocol. Method for determining a host's hardware address if only the IP address is known. The instrument automatically sends ARP requests during layer 3 IP testing.

ATM — Asynchronous transfer mode. A communications transport technology that formats, multiplexes, cross-connects, and switches voice, video, and data traffic.

ATP — Acterna test packet. A test packet that contains a time stamp and sequence number for measuring round trip delay and counting out-of-sequence frames.

AU — Administrative unit.

B

BBE — Background Block Error. An errored block (EB) not part of a severely errored second (SES).

BBER — Background block error ratio. Ratio of BBE to total blocks received not part of an SES.

B channel — Channel which carries the payload of ISDN call.

BDI — Backward Defect Indication.

BEI — Backward Error Indication.

BER — Bit Error Rate.

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.

BIP — Bit interleaved parity. A field used to perform a parity check between network elements for error checking.

Bridge — A high impedance tap into an E-1 or T-1 circuit (where no monitor point access is provided) that does not disrupt the existing communication line.

C

CCM — Continuity Check Message.

CDP — Cisco Discovery Protocol.

CE — Customer Edge.

CFM — Connectivity Fault Management.

CFP — 1C Form-factor Pluggable module.

CID — Channel Identifier. Field used to identify the virtual channel carrying GFP traffic. The CID resides in the GFP header for each frame.

Concat — Concatenated.

CSF — Client signal fail. A GFP alarm.

CSU — Channel service unit. A device to terminate a digital channel on a customer's premises.

Curr — Current.

D

DA — Destination address.

DALY — A stress pattern consisting of a framed 55 octet hex pattern used with framed DS1 circuits without causing excess zeros.

DB-9 — Standard 9-pin RS-232 serial port or connector.

DB-25 — 25-pin RS-232 serial port or connector.

D channel — Channel used in ISDN for signaling and supervisory functions.

DDS — Digital data system. An all digital service that provides terminal-to-computer and computer-to-computer data transmission.

Dec — Decrement.

DHCP — Dynamic Host Configuration Protocol. A communications protocol that assigns IP addresses dynamically as needed. Also supports static IP address assignment.

DIX — Digital, Intel, and Xerox. Ethernet Type II frame format.

DNU — Do Not Use. During LCAS testing, you can indicate that a particular VCG member on the source or sink sides should not be used.

DSX — Digital System Crossconnect frame.

DS1 — Digital signal level 1. 1.544 Mbps.

DS3 — Digital signal level 3. 44.736 Mbps.

DTMF — Dual-Tone Multi-Frequency. Combination of two tones, one high frequency and one low frequency used in touch-tone dialing. You can enter DTMF tones when you process ISDN PRI calls using the instrument.

E

E1 — Electrical data signal level 1. 2.048 Mbps.

E3 — Electrical data signal level 3. 34.3688 Mbps.

E4 — Electrical data signal level 4. 139.264 Mbps.

EB — Errored blocks.

EDD — Ethernet demarcation device.

EFM — Ethernet First Mile.

Err — Error.

Erred — Errored.

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

ESR — Errored seconds ratio.

Ethernet — A LAN protocol. Using the instrument, you can test and verify Ethernet network elements and services.

Ethernet link partner — The nearest Ethernet device on a link. The instrument auto-negotiates its capabilities with this device when you initialize a link.

ETSI — European Telecommunications Standards Institute.

EXI — Extension Header Identifier. Field used to identify the type of extension header used by GFP traffic.

F

FAS — Frame Alignment Signal.

FCS — Frame check sequence. A value calculated by an originating device and inserted into an Ethernet frame. The receiving device performs the same calculation, and compares its FCS value with the FCS value in the frame. If the values don't match (suggesting the frame is errored), an FCS error is declared. Switching devices will discard the frame.

FDX — Full Duplex.

FE — Far End. Used by the ITU performance measures to indicate which end of the network is being tested.

FEBE — Far end block error. An alarm signal transmitted from a network element receiving a signal containing framing or parity errors to the network element sending the errored signal.

FEC — Forward Error Correction.

FT1 — Fractional T1.

FTFL — Fault Type Fault Location.

FTP — File transfer protocol. Protocol used on LANs and the Internet to transfer files.

Frame Loss — Loss of frame synchronization.

G

GARP — Generic Attribute Registration Protocol.

Gate time — Time duration for error measurement. During this period the error source is accumulated if it is an error or recorded if it is an alarm.

GigE — Used throughout this manual to represent Gigabit Ethernet.

Global Addresses — Second IPv6 source address assigned to an interface. The global address is not used locally, and is broader in scope, typically to get past a router. If you use auto-configuration to establish a link, the global address is provided automatically.

GMRP — GARP Multicast Registration Protocol.

GP — Group. Suffix used on the GUI to indicate that a result or setting applies to a VCG rather than a particular member of the group.

GUI — Graphical User Interface. Layout of commands in a user-friendly environment. *See also* UI (user interface).

GVRP — GARP VLAN Registration Protocol.

H

HBER — High bit error ratio.

HEC — Header Error Check. Cyclic Redundancy Check (CRC) carried in the core, type, or extension header of a GFP frame.

HDX — Half duplex.

High order path — For SONET circuits, virtual STS-1c and STS-3c paths are considered high order paths. For SDH circuits, VC-3 and VC-4 paths are considered high order paths.

Histogram — Print output of specific results in a bar graph format.

HP — High Path. The SDH equivalent of Path for SONET.

Hz — Hertz (cycles per second).

I

IAE — Incoming Alignment Error.

IGMP — Internet Group Management Protocol.

Inc — Increment.

Internet Protocol — Commonly referred to as “IP”. Protocol specifying the format and address scheme of packets transmitted over the Internet. Typically used with TCP.

IP — *See* Internet Protocol.

IPoE — Internet Protocol over Ethernet. Used on the GUI and through this guide to see the applications used to establish a standard layer 3 (IP) connection.

IPv4 — Internet Protocol Version 4.

IPv6 — Internet Protocol Version 6.

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. *See* PRI.

ISM — In-Service Monitoring.

ISO — International Organization for Standardization.

ISP — Internet service provider. A vendor who provides access to the Internet and the World Wide Web.

ITU — International Telecommunications Union based in Geneva, Switzerland.

J

Jabber — An Ethernet frame that exceeds the IEEE 802.3 maximum length of 1518 bytes (or 1522 bytes with a VLAN tag) and contains an errored FCS.

J-Connect — Utility that allows you to detect other JDSU test instruments on a particular subnet, and use a detected instrument’s addresses to automatically populate key traffic settings. Also known as JDSU-Discovery.

JDSU Discovery — See J-Connect.

J-Mentor — Utility provided on the instrument that allows you to capture data for analysis when testing from an Ethernet interface.

J-Proof — Application used to verify Ethernet Layer 2 Transparency.

J-Scan — Utility used to scan and detect the signal structure and mappings from a SONET or SDH interface. Also referred to in other documents as the Auto-Discovery feature.

Jumbo frame — An Ethernet frame that exceeds the IEEE 802.3 maximum length of 1518 bytes (or 1522 bytes with a VLAN tag). You can transmit jumbo frames using the T-BERD ⁄ MTS 8000, 6000A, and 5800.

Just — Justification.

K

KLM — An STM-N frame comprises N x 270 columns (numbered 1 to N x 270). The first N x 9 columns contain the SOH and AU-4/AU-4-Xc pointer(s). The remaining N x 261 columns contain the higher order data payload (tributaries). In an AU-4 structured frame, the payload columns may be addressed by a three figure address (K, L, M), where K represents the TUG-3 number, L the TUG-2 number, and M the TU-1 number. In an AU-3 structured frame, only L and M are used.

L

LAN — Local Access Network.

LACP — Link Aggregation Control Protocol.

LBM — Loop Back Message.

LBR — Loop Back Reply.

LCAS — Link Capacity Adjustment Scheme. Used in combination with virtual concatenation (VC) on NextGen networks to dynamically increase or decrease bandwidth.

LCD — Liquid Crystal Display.

LCK — Locked defect.

LED — Light emitting diode.

LFD — Loss of frame delineation. A GFP alarm.

LL — Logical Lane

LLB — Line Loop Back.

LLC — Logical link control. Three bytes carried in 802.3 frames which specify the memory buffer the data frame is placed in.

LLM — Logical Lane Marker

LLDP — Link Layer Discovery Protocol.

LiION — Lithium Ion. The T-BERD ⁄ MTS 8000, 6000A, and 5800 can be equipped with a rechargeable Lithium Ion battery.

Line — The layer in a SONET network that describes the region between two line-terminating pieces of equipment, typically add-drop multiplexers or terminal multiplexers.

Link-Local Address — IPv6 address assigned to a device locally in an IP network when there is no other assignment method available, such as a DHCP server. These addresses must always go through duplicate address detection (DAD), even if you manually specify the address. *See also* DAD and Global Addresses.

LOAML — Loss of Alignment Marker Lock

LOC — Loss of Continuity or Capacity.

LOF — Loss of Frame. A condition indicating that the receiving equipment has lost frame synchronization.

LOL — Los of Lane Alignment

LOM — Loss of Multi framing.

LOP — Loss of pointer. A condition indicating loss of a pointer to a virtual tributary or path.

LOR — Loss of Recovery

LOS — Loss Of Signal (Red Alarm). A condition when no pulses of positive or negative polarity are received for more than 175 pulse counts.

Low order path — For SONET circuits, virtual VT-1.5 paths are considered low order paths. For SDH circuits, VC-12 paths are considered low order paths.

LPAC — Loss of performance assessment capability. A condition indicating that cells that can be analyzed by the MSAM haven't been received for a period of 10 seconds. This condition is typically due to receipt of errored or non-masked cells.

M

M13 — A frame format used for multiplexing 28 DS1 signals into a single DS3. The multiplexer equivalent of T-1.

Medium Dependent Interface port. RJ-45 interface used by Ethernet NICs and routers that does not require use of a crossover cable (MDI ports do not cross the transmit and receive lines). An MDI port on one device connects to an MDI-X port on another device. MDI interfaces transmit using pins 1 and 2, and receive using pins 3 and 6. The MSAM supports cable diagnostics of MDI interfaces. *See also* MDI-X port.

MDI — Media Delivery Index (video applications).

MDI-X port — Medium Dependent Interface Crossover port. RJ-45 interface used by Ethernet NICs and routers that requires use of a cross-over cable (MDI-X ports cross transmit and receive lines. An MDI-X port on one device connects to an MDI port on another device. MDI-X interfaces transmit using pins 3 and 6, and receive using pins 1 and 2. The MSAM supports cable diagnostics of MDI-X interfaces.

MEG — Maintenance Entity Group.

MFAS — Multi Frame Alignment Signal.

MPEG — Set of standards for compression of audio and video and multimedia delivery developed by the Moving Pictures Expert Group.

MPLS — Multiple Path Label Switching. A mechanism using labels rather than routing tables to transmit layer 3 IP traffic over a layer 2 Ethernet network.

MS — Multiplex Section. The SDH equivalent of line in SONET.

Msg — Message.

MPLS — Multiprotocol Label

Switching. A form of frame encapsulation that uses labels rather than routing tables to transmit layer 3 traffic over a

layer 2 Ethernet network.

MPTS — Multiple program transport stream.

MSAM — Multiple Services Application Module. Application module used in combination with the T-BERD / MTS 6000A base unit or a T-BERD / MTS 8000 and DMC for testing from a variety of interfaces.

MSOH — Multiplexer Section Overhead.

MSPP — MSPP. Multi-service provisioning platform. Typically next generation SONET multiplexors capable of aggregating multiple access technologies such as Ethernet, TDM, and ATM onto a SONET ring.

MSTP — Multiple Spanning Tree Protocol.

Multipat — Multiple patterns. An automated sequence of 5 BERT patterns for three minutes each. The Multipat sequence consists of ALL ONES, 1:7, 2 in 8, 3 in 24, and QRSS.

Multiplex — MUX. To transmit two or more signals over a single channel.

Multiplexer — Electronic equipment which allows two or more signals to pass over one communication circuit.

MUX — See Multiplex.

N

NDF — New data flag.

NE — Near-end. Used by ITU performance measurements to indicate which end of the network is being tested.

NFAS — Non-facility-associated signaling. Signaling that is separated from the channel carrying the information. Also known as out-of-band signaling.

NIU — Network Interface Unit. Electronic device at the point of interconnection between the service provider communications facilities and terminal equipment at a subscriber's premises.

NOC — Network Operations Center.

NSA — Non-service affecting.

NT — Network termination (device). Device which provides the physical connection at the customer premises to the local exchange, such as an ISDN data service unit/channel service unit (DSU/CSU). You can use the instrument to emulate a NT device when testing ISDN PRI service.

O

OAM — Operations, Administration, and Maintenance. The instrument allows you to run link and service layer OAM applications.

OC-12 — Optical carrier 12. A SONET channel of 622.08 Mbps.

OC-3 — Optical carrier 3. A SONET channel equal to three DS3s (155.52 Mbps).

OC-48 — Optical Carrier 48. SONET channel of 2.488 Gbps.

OC-192 — Optical Carrier 192. SONET channel of 9.953 Gbps.

ODU — Optical channel data unit.

OOF — Out of framing.

OOL — Out of Lane Alignment

OOLLM — Out of Logical Lane Marker

OOM — Out of multi framing.

OOR — Out of Recovery

OOS — Out of sequence.

OPU — Optical channel payload unit.

OTL — Optical Transport Lane layer.

OTN — Optical Transport Network. Network protocol that facilitates the transmission of different types of client signals, such as SONET, SDH, and Ethernet over a single optical network through the use of an OTN wrapper, which provides the overhead required for proper network management.

OTU1 — Used on the MSAM user interface to identify the test applications used for 2.7G OTN testing.

OTU2 — Used on the MSAM user interface to identify the test applications used for 10.7G, 11.05G, and 11.1G OTN testing.

OWD — One-Way Delay

P

Packet — Bundle of data, configured for transmission. Consists of data to be transmitted and control information.

Packet Delay Variation — The difference in one-way-delay as experienced by a series of packets.

Path — The layer in SONET network that describes the region between two Path-terminating pieces of equipment, typically terminal multiplexers.

Pattern sync — The condition occurring when the data received matches the data that is expected for a period of time defined by the pattern selected.

PBX — Private Branch Exchange. A telephone exchange owned by the customer who uses telephone services, located on the customer premises. You can use the HST-3000 to emulate a PBX when testing ISDN PRI service.

PCAP — File format used for packet captures on the instrument.

PCM — Pulse Code Modulation.

PCR — Program Clock Reference.

Peak-to-peak — The difference between the maximum positive and the maximum negative amplitudes of a waveform.

PE — Provider edge.

PFI — Payload FCS Indicator. Field used in GFP frames that indicates use of an optional payload FCS.

Phase hit — Instance where a demodulated signal exceeds a pre-set positive or negative threshold value.

PLM-P — Payload mismatch Path.

PLTC — Partial loss of transport capacity. Indicates that one or more members were not correctly added to a VCG when using LCAS.

PM — Path monitoring.

PMT — Program Map Table.

Pointer — A value that alerts SONET equipment of the starting point of a floating synchronous payload envelope within a SONET frame.

PPS — Pulses Per Second (used for DP digits).

Primary Rate Interface — ISDN service carried on a T1 line. PRI service provides 23 B (bearer) channels, which carry voice and data call payloads, and a single D channel, which handles signaling for the circuit.

Pseudo wires — Point-to-point connections used to carry each type of service between two PE routers in a VPLS network.

PSTN — Public switched telephone network.

PTI — Payload Type Indicator. Field used in GFP frames to indicate whether the frame is a management frame or a data frame. The instrument allows you to configure data frames only.

PTP —

Ptr — See Pointer.

Q

Q-in-Q — Also known as VLAN stacking, enables service providers to use a single VLAN to support customers who have multiple VLANs. Q-in-Q VLANs can also be used to provide virtual access and connections to multiple services available over the ISPs, ASPs, and storage services.

QoS — Quality of Service.

QRSS — Quasi-Random Signal Sequence. A modified 2^20-1 pseudo random test signal, modified for use in AMI circuits

QSFP+ — Quad Small Form-Factor Pluggable module.

RDI — Remote Defect Indication. A terminal will transmit an RDI when it loses its incoming signal.

REI — Remote Error Indicator.

RFI — Remote Failure Indicator.

RJ 48-11 — Modular telephone jack, typically used for telephones, modems, and fax machines.

RS — Regenerator Section. The SDH equivalent of Section for SONET.

RSOH — Regenerator section overhead.

RSTP — Rapid Spanning Tree Protocol.

RS-232 — Set of standards specifying electrical, functional and mechanical interfaces used for communicating between computers, terminals and modems.

RTP — Real-time Transport Protocol. Standardized packet format for delivering audio and video over the Internet. MPEG video streams are often encapsulated in RTP packets.

Runt — An Ethernet frame that is shorter than the IEEE 802.3 minimum frame length of 64 bytes and contains an errored FCS, or a Fibre Channel frame that is shorter than the minimum 28 byte frame length containing an errored CRC.

Rx — Receive or receiver or input.

S

SA — 1. Source address. 2. Service affecting.

SD — Signal degradation.

SDH — Synchronous Data Hierarchy.

Secs — Seconds.

Sect — See Section.

Section — The layer in a SONET network that describes the region between two Section-terminated pieces of equipment, typically regenerators, add-drop multiplexers, or terminal multiplexers.

Sensor threshold — The number of alarms or errors allowed by the MTJ/Fast MTJ sensor that will result in a pass status for a particular transmit amplitude and frequency point.

Service disruption time — The time between Ethernet (maximum inter-frame gap) when service switches to a protect line. The Svc Disruption (us) result in the Link Stats category displays the service disruption time.

SEF — Severely errored frames.

SEP — Severely errored periods.

SEPI — Severely errored period intensity.

SES — Severely errored seconds.

SESR — Severely erred seconds ratio.

Settling time — The amount of time a DUT is allowed to settle and adjust to a change in the frequency or amplitude of a received signal. You can specify the settling time for modulated signals transmitted from the instrument when configuring the automated measurement sequences (AMS). The module resumes error measurement after the specified time elapses.

SF — Signal fail.

SFD — Start of frame delimiter. Part of an Ethernet frame preamble that indicates that the destination address frame is about to begin.

SFP — Small form-factor pluggable module. Used throughout this guide to represent pluggable optical transceivers (modules).

Sk — LCAS sink (receiver).

SLA — Service Level Agreement.

SM — Section monitoring.

So — LCAS source (transmitter).

SNAP — SubNetwork Access Protocol. Protocol used in 802.3 frames which specifies a vendor code and an Ethertype. When you transmit pings using the instrument, you can transmit 802.3 frames with logical link control (LLC) and SNAP.

SOH — Section overhead.

SONET — Synchronous optical network.

SPE — Synchronous Payload Envelope.

SSF — Service Signal Failure.

STL — Synchronous Transport Lane

STM-1 — A SDH signal of 155.52 Mbps.

STM-1e — Electrical SDH signal of 155.52 Mbps.

STM-4 — A SDH signal of 622 Mbps.

STM-16 — A SDH signal of 2.488 Gbps.

STM-64 — A SDH signal of 9.953 Gbps.

STP — Spanning Tree Protocol.

STS-1 — Synchronous transmit signal of 51.84 Mbps.

SVLAN — Stacked VLAN. Used in Q-in-Q traffic to provide a second encapsulation tag, expanding the number of VLANs available. Often considered the VLAN assigned to the service provider (as opposed to the customer).

Sync — Synchronization.

T

TCM — Tandem connection monitoring.

TCP — Transmission Control Protocol. Layer 4 protocol that allows two devices to establish a connection and exchange streams of data.

TDEV — Time Deviation. A measure of the phase error variation versus the integration time. It is calculated based on the TIE. *See also TIE and MTIE*.

TE1 — Terminal equipment type 1. Terminal equipment that supports ISDN standards and can be connected directly to an ISDN network (for example, an ISDN phone, a PC or laptop with ISDN capabilities, etc.). You can use the instrument to emulate a TE1 device when testing ISDN PRI service.

TNS — Transit network select. A code representing the network that calls are routed to. You can specify the TNS when processing calls on the instrument.

Term — See Terminate.

Terminate — An application where the test set is terminating the circuit. In these applications, the test set sends and receives traffic.

Through — An application where the test set is used in series with a network circuit to monitor the traffic on that circuit.

TIE — Time Interval Error. Represents the time deviation of the signal under test relative to a reference source. Used to calculate MTIE and TDEV.

TIM — Trail trace identifier mismatch.

TLTC — Total Loss of Transport Capacity. Indicates that no VCG member was added when using LCAS.

TNV — Telephone-network voltage.

TOH — Transport Overhead.

Transit network ID — A code representing the network that calls are routed to. You can specify the ID when processing calls on the instrument.

TU — Tributary unit.

Tx — Transmit or transmitter or output.

U

UAS — Unavailable seconds.

UI — Unit Interval. One bit period at the data rate being measured.

us — Microseconds (also expressed as μs).

USB — Universal Serial Bus. A bus designed to handle a broad range of devices, such as keyboards, mouses, printers, modems, and hubs.

V

VBR — Variable bit rate. An ATM service which supports a variable rate to transport services such as voice.

VC — Virtual container.

VCI — Virtual channel identifier. In an ATM cell header, the address assigned to a virtual channel. Multiple virtual channels can be bundled in a virtual Path.

VDC — Volts Direct Current.

VF — Voice Frequency.

VLAN — Virtual LAN.

VNC — Virtual Network Computing. A thin client system that enables you to run applications on a VNC server from any other computer connected to the Internet. Using VNC, you can run the T-BERD ⁄ MTS 8000, 6000A, and 5800 from a remote workstation, and you can run remote applications from the T-BERD ⁄ MTS 8000, 6000A, and 5800.

VPI — Virtual Path identifier. An in ATM cell header, the address assigned to a virtual Path. A virtual Path consists of a bundle of virtual channels.

VPLS — Virtual Private LAN Service. An MPLS application which provides multi-point to multi-point layer 2 VPN services, allowing geographically dispersed sites to share an ethernet broadcast domain by connecting each site to an MPLS-based network.

VT — A signal grouping used to transport signals smaller than DS3 within a SONET frame.

VTP — VLAN Trunk Protocol.

VT 1.5 — Virtual tributary. 1.5 equals 1.544 Mbps.

W

WAN — Wide area network.

X

XFP — 10 Gigabit Small Form Factor Pluggable Module.

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