User Guide

SONET/SDH Application

FTB-8100 Series for FTB-200

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Telecom Test and Measurement

EXFO
EXPERTISE REACHING OUT

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Units of Measurement

Units of measurement in this publication conform to SI standards and practices.

April 6, 2011
Version number: 5.0.0

Contents

Certification Information

Federal Communications Commission (FCC) and Industry Canada (IC) Information

Electronic test and measurement equipment is exempt from FCC Part 15 compliance in the United States and from IC ICES 003 compliance in Canada. However, EXFO Inc. (EXFO) makes reasonable efforts to ensure compliance to the applicable standards.

The limits set by these standards are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

European Union (CE) Information

Electronic test and measurement equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has been tested and found to comply with the limits for a Class A digital device. Please refer to the *CE Declaration of Conformity* on page xi.

For continued compliance to the requirements of the EMC Directive:

1. For the **BNC/AUX** port(s) use double-shielded coaxial cable, type 734A or equivalent.
2. For the **REF OUT** port use double shielded cable, type LMR-240 ULTRAFLEX or equivalent, with a maximum length of 3m.

Note: *If the equipment described herein bears the CE symbol, the said equipment complies with the applicable European Union Directive and Standards mentioned in the Declaration of Conformity.*

Laser

This product complies with 21 CFR 1040.10 and with EN 60825-1.

This product may employ a Class 1 or Class 1M laser SFP or XFP. The laser classification is reproduced on the SFP/XFP.

CE Declaration of Conformity

EXFO CE **DECLARATION OF CONFORMITY**

Application of Council Directive(s):	2006/95/EC - The Low Voltage Directive 2004/108/EC - The EMC Directive 2006/66/EC - The Battery Directive 93/68/EEC - CE Marking And their amendments
Manufacturer's Name:	EXFO Inc.
Manufacturer's Address:	400 Godin Avenue Quebec, Quebec Canada, G1M 2K2
Equipment Type/Environment:	Test & Measurement / Industrial
Trade Name/Model No.:	Transport Blazer Series / FTB-8105/8115/8120/8120NG/8130/8130NG/8140 AND IQS-8105/8115/8120/8120NG/8130/8130NG/8140

Standard(s) to which Conformity is Declared:

EN 61010-1:2001 Edition 2.0	**Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.**
EN 61326-1:2006	**Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements**
EN 60825-1:2007 Edition 2.0	**Safety of laser products – Part 1: Equipment classification and requirements**
EN 55022: 2006 + A1: 2007	**Information technology equipment — Radio disturbance characteristics — Limits and methods of measurement**

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Manufacturer

Signature:

Full Name:	Stephen Bull, E. Eng
Position:	Vice-President Research and Development
Address:	400 Godin Avenue, Quebec (Quebec), Canada, G1M 2K2
Date:	February 1, 2009

EXFO CE **DECLARATION OF CONFORMITY**

Application of Council Directive(s):	2006/95/EC - The Low Voltage Directive 2004/108/EC - The EMC Directive 2006/66/EC - The Battery Directive 93/68/EEC - CE Marking And their amendments
Manufacturer's Name:	EXFO Inc.
Manufacturer's Address:	400 Godin Avenue Quebec, Quebec Canada, G1M 2K2
Equipment Type/Environment:	Test & Measurement / Industrial
Trade Name/Model No.:	Next-Generation Multiservice Test Modules / FTB-8120NGE/8130NGE AND IQS-8120NGE/8130NGE Power Blazer

Standard(s) to which Conformity is Declared:

EN 61010-1:2001 Edition 2.0	**Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.**
EN 61326-1:2006	**Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements**
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Date:	February 1, 2009

1 Introducing the FTB-8100 Series Transport Blazer

Fully integrated test solution supporting next-generation SONET/SDH, optical transport network (OTN), Ethernet, and Fibre Channel test functions.

This user guide covers the FTB-8100 Series of modules including the FTB-8105, FTB-8115, FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, and FTB-8130NGE.

This user guide only covers the "SONET/SDH Application" which covers DSn/PDH, next-generation SONET/SDH, and OTN test fuctions. Refer to the "Ethernet and Fibre Channel Application" user guide for more information on Ethernet and Fibre Channel test functions.

SONET/SDH and OTN Service Turn-up and Troubleshooting

The FTB-8100 Series Transport Blazer modules offer a wide range of SONET/SDH and OTN test functions, allowing users to perform tests ranging from simple bit error rate (BER) testing to advanced characterization and troubleshooting procedures.

Next-Generation SONET/SDH Testing (available on the FTB-400/500 platform only)

The FTB-8120NG, and FTB-8130NG, FTB-8120NGE, and FTB-8130NGE modules support Next-Generation SONET/SDH capabilities in addition to providing SONET/SDH test functions.

Available Next-Generation SONET/SDH test functionality include generic framing procedure (GFP), virtual concatenation (VCAT) and link capacity adjustment scheme (LCAS).

SmartMode: Real-Time Signal Structure Discovery and Monitoring

The Transport Blazer supports a unique feature called SmartMode, which automatically discovers the signal structure of the OC-n/STM-n line including mixed mappings and virtual concatenation (VCAT) members. In addition to this in-depth multichannel visibility, SmartMode performs real-time monitoring of all discovered high-order paths and user selected low-order paths simultaneously, providing users with the industry’s most powerful SONET/SDH multichannel monitoring and troubleshooting solution.

Multiplatform Support and Versatility

The FTB-8105/15/20/30 modules share a unique architecture that allows them to be supported and interchangeable on both the FTB-400/500 Universal Test System and the FTB-200 Compact Platform. This cross-platform support provides users with added flexibility by enabling them to select the appropriate platform that suits their testing needs. EXFO is the first and only test solution provider to offer this versatility, delivering single to multi-application test solutions with the same hardware module, which in turn dramatically reduces capital expenditures.

Key Features

- DS0/E0 to OC-192/STM-64/OTU-2; 10 Mbit/s to 10 Gbit/s LAN/WAN as well as 1x, 2x, 4x, and 10x Fibre Channel testing (Ethernet and Fibre Channel testing is only available with the FTB-8120NGE, and FTB-8130NGE modules)
- Supports SONET, SDH, DSn, PDH and Next-Generation SONET/SDH (available on the FTB-400/500 platform only) and OTN testing
- Overclocked OTU2 rates: OTU1e (11.049 Gbps), OTU2e (11.096 Gbps), OTU1f (11.270 Gbps), and OTU2f (11.317 Gbps)
- EoOTN testing using internally generated 10 GigE LAN and mapping onto OTU1e and OTU2e rates (FTB-8130NG and FTB-8130NGE)
- Ethernet-over-SONET/SDH (EoS) testing for GFP, VCAT and LCAS(available on the FTB-400/500 platform only)
- Comprehensive Fibre Channel test capabilities, including framed and unframed BERT, buffer-to-buffer credit estimation, and round-trip latency measurements
- Fully integrated solution for assessing the performance of Ethernet transport networks, including RFC 2544 and BER test functionalities
- SmartMode signal structure discovery for rates of up to 10 Gbps, with simultaneous monitoring of all discovered STS/AU and user selected VT/TUs channels.
- Intuitive, feature-rich graphical user interface (GUI) with available automated test scripting and available multi-user remote management capabilities
- Supported on FTB-200 and FTB-500 platforms, optimizing capital expenditures

Module-Related Information

This user guide describes the functionality of the Transport Blazer on the FTB-200.

- **FTB-8100 Series** indicates that the statement applies to all modules: FTB-8105, FTB-8115, FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, and FTB-8130NGE.
- **FTB-8115/20/30** indicate that the statement applies to the following modules: FTB-8115, FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, and FTB-8130NGE.
- **FTB-8105**, **FTB-8115**, **FTB-8120**, **FTB-8120NG**, **FTB-8120NGE**, **FTB-8130**, **FTB-8130NG**, and **FTB-8130NGE** indicate that the statement applies to the specified module(s) only.

Platform-Related Information

This user guide covers the following FTB-200 platform versions:

- **FTB-200**: Platform running **ToolBox CE**.
- **FTB-200 v2**: Platform running **Compact ToolBox**.

Note: *In this user guie, FTB-200 will be used to cover both FTB-200 and FTB-200 v2 platforms unless otherwise indicated.*

Conventions

Before using the product described in this manual, you should understand the following conventions:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in *death or serious injury*. Do not proceed unless you understand and meet the required conditions.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in *minor or moderate injury*. Do not proceed unless you understand and meet the required conditions.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in *component damage*. Do not proceed unless you understand and meet the required conditions.

IMPORTANT

Refers to information about this product you should not overlook.

2 Safety Information

Laser Safety Warnings

WARNING

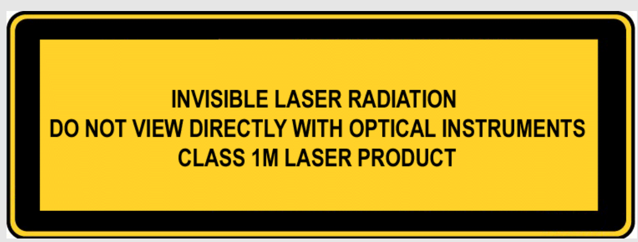
When the LASER LED is on or flashing, the FTB-8100 Series is transmitting an optical signal.

WARNING

Do not install or terminate fibres while a laser source is active. Never look directly into a live fibre, and ensure that your eyes are protected at all times.

WARNING

This product may employ a Class 1M SFP or XFP. Check pluggable transceiver label for laser classification. Applies to FTB-8115, FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, and FTB-8130NGE modules only.



WARNING

Use of optical instruments with this product will increase eye hazard.

Installation Instruction Warnings

CAUTION

This unit is designed for indoor use only.

CAUTION

For FTB-8105/15/20/30: Except for the Dual Bantam connector and the RJ-48C port, all telecom (electrical) interfaces are SELV (Safety Extra Low Voltage) circuitry intended for intra-building use only.

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.

CAUTION

No user serviceable parts are contained inside. Contact the manufacturer regarding service of this equipment.

IMPORTANT

All wiring and installation must be in accordance with local building and electrical codes acceptable to the authorities in the countries where the equipment is installed and used.

CAUTION

Electrostatic Discharge (ESD) Sensitive Equipment:

Plug-in modules can be damaged by static electrical discharge. To minimize the risk of damage, dissipate static electricity by touching a grounded unpainted metal object

- **before removing, inserting, or handling the module.**
- **before connecting or disconnecting cables to/from the module.**
- **before inserting or removing SFP/XFPs to/from the module.**

3 Getting Started

If the FTB-8100 Series Transport Blazer has been purchased at the same time as the FTB-200, the FTB-8100 Series module is pre-installed with the appropriate Compact ToolBox/ToolBox CE software version.

Compact ToolBox/ToolBox CE Installation

Compact ToolBox or ToolBox CE is the baseline software and thus needs to be installed on the FTB-200 before using the FTB-8100 Series module.

Note: *Refer to the FTB-200 platform user guide for more information on Compact ToolBox/ToolBox CE installation procedure.*

Inserting and Removing Test Modules

CAUTION

Never insert or remove a module while the FTB-200 is turned on. This will result in immediate and irreparable damage to both the module and unit.

Note: *Refer to the FTB-200 platform user guide for more information on how to insert a module into the FTB-200 or to remove a module from the FTB-200.*

WARNING

When the laser safety LED is flashing on the SONET/SDH Application, at least one of your modules is emitting an optical signal. Please check all modules, as it might not be the one you are currently using.

Turning the Unit On

Turn on the FTB-200. Refer to the FTB-200 platform user guide for more information.

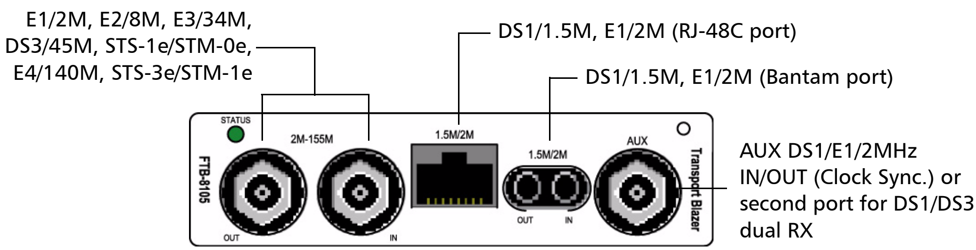
4 Physical Interfaces and LEDs

This section describes the connectors (ports) and LEDs available on each module.

Modules

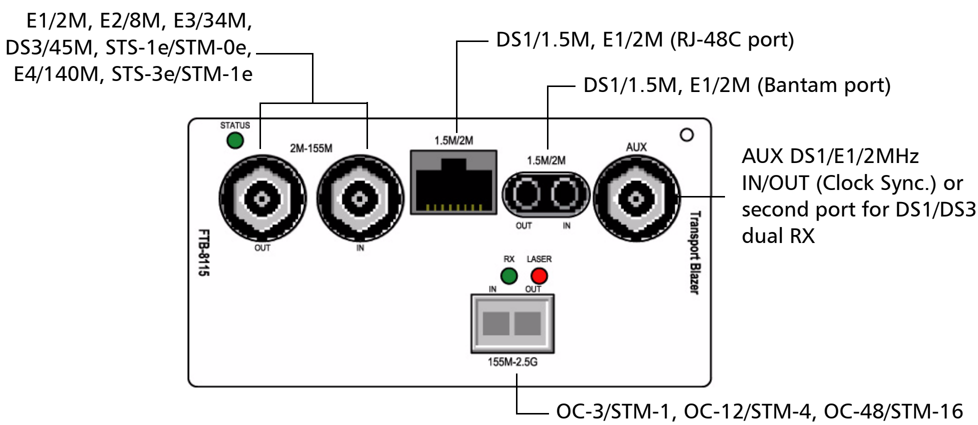
FTB-8105 Module

SONET/SDH analyzer up to 155 Mbps.



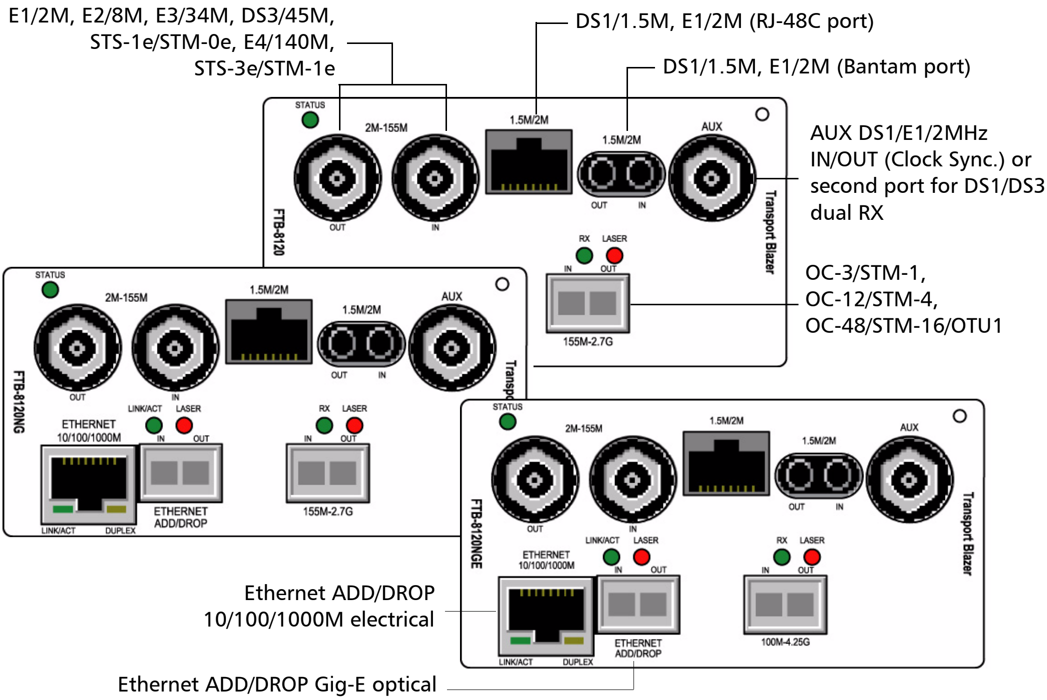
FTB-8115 Module

SONET/SDH analyzer up to 2.5 Gbps.



FTB-8120/FTB-8120NG/FTB-8120NGE Module

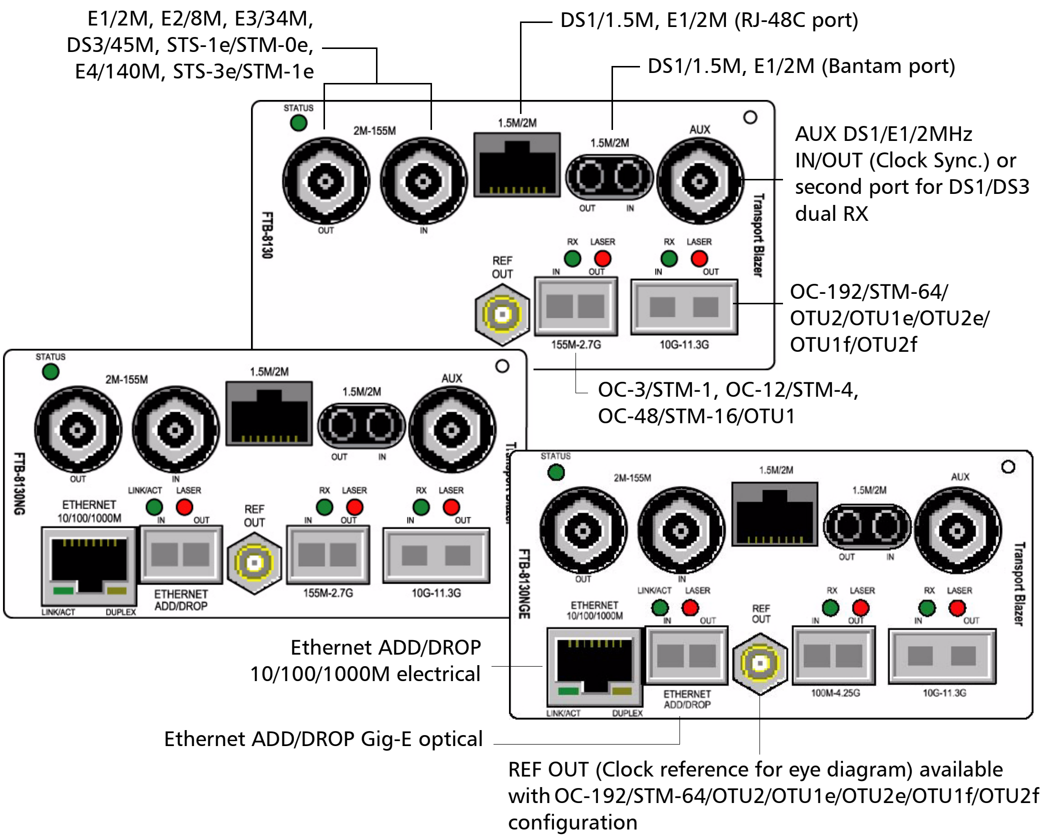
SONET/SDH/OTN analyzer up to 2.7 Gbps. The **FTB-8120NGE** also offers 1 Gbps Ethernet and up to 4x Fibre Channel testing; refer to the "Ethernet and Fibre Channel Application" user guide for more information. Next-Generation features are available on the FTB-400/500 platform only.



FTB-8130/FTB-8130NG/FTB-8130NGE Module

SONET/SDH/OTN analyzer up to 11.1 Gbps. The **FTB-8130NGE** also offers 10 Gbps Ethernet and up to 10x Fibre Channel; refer to the “Ethernet and Fibre Channel Application” user guide for more information.

Next-Generation features are available on the FTB-400/500 platform only.



Port Availability on FTB-8100 Series Module

The following table shows the list of available ports as well as a description and signals supported for each module. For Ethernet and Fibre Channel ports, refer to the “Ethernet and Fibre Channel Application” user guide.

Port labelled	Description	Supported signal(s)	Module
155M-2.5G	Optical IN/OUT port small form factor pluggable (SFP)	OC-3/STM-1, OC-12/STM-4, OC-48/STM-16	FTB-8115
155M-2.7G	Optical IN/OUT port small form factor pluggable (SFP)	OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OTU1	FTB-8120 FTB-8120NG FTB-8130 FTB-8130NG
100M-4.25G	Optical IN/OUT port small form factor pluggable (SFP)	OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OTU1, Ethernet 100Mbps, Ethernet 1000Mbps, FC 1x, FC 2x, FC 4x	FTB-8120NGE FTB-8130NGE
10G-11.3G	Optical IN/OUT port 10G small form factor pluggable (XFP)	OC-192/STM-64, OTU2, OTU2e, OTU1e, OTU1f, OTU2f, Ethernet 10Gig (FTB-8130NGE), FC 10x (FTB-8130NGE)	FTB-8130 FTB-8130NG FTB-8130NGE
2M/8M/34M/45M/52M/140M/155M, or 2M-155M	Electrical IN/OUT port BNC	E1/2M, E2/8M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M	FTB-8105/15/20/30
1.5M/2M	Electrical IN/OUT port Bantam	DS1/1.5M, E1/2M	FTB-8100 Series
1.5M/2M	Electrical port RJ-48C	DS1/1.5M, E1/2M	FTB-8100 Series
AUX	Electrical port BNC	DS1/1.5M/E1/2M/2 MHz signal for external clock synchronization, or DS1/DS3 signal for Dual RX test.	FTB-8100 Series

Port labelled	Description	Supported signal(s)	Module
REF OUT	Reference output port SMA	See *Clock Interface Connections* on page 21 for more information.	FTB-8130 FTB-8130NG FTB-8130NGE
Ethernet 10/100/1000M[a]	Electrical Ethernet port RJ-45	10/100/1000 Mbps (electrical)	FTB-8120NG FTB-8130NG FTB-8120NGE FTB-8130NGE
Gig-E / ETHERNET ADD/DROP[a]	Optical IN/OUT Ethernet port small form pluggable (SFP)	1000 Mbps (optical)	FTB-8120NG FTB-8130NG FTB-8120NGE FTB-8130NGE

a. Only used when the module is used on the FTB-400/500 platform.

OTN/OC-N/STM-N Interface Connections

For FTB-8115/FTB-8120/FTB-8120NG/FTB-8120NGE/FTB-8130/FTB-8130NG/FTB-8130NGE, plug the supplied SFP/XFP module into the respective slot on the module. Only use EXFO qualified SFP/XFPs. Using non-qualified SFP/XFPs can affect the Performance and accuracy of the optical port.

Description	Wavelength	Reach	Part Number
Multirate (155/622 Mbps, 2.5/2.7 Gbps/FC 1x/2x) optical SFP transceiver module with LC connector	1310 nm	short (15 Km)	FTB-8190
	1310 nm	intermediate (40 Km)	FTB-8191
	1550 nm	intermediate (40 Km)	FTB-8193
	1550 nm	long (80 Km)	FTB-8192
Multirate (10/10.7 Gbps) optical XFP transceiver module with LC connector	1310 nm	Short (10 Km)	FTB-81900
	1550 nm	Intermediate (40 Km)	FTB-81901
	1550 nm	Long (80 Km)	FTB-81902
Multirate (10/11.3 Gbps) optical XFP transceiver module with LC connector	1310 nm	Short (10 Km)	FTB-81903

Note: *Do not replace a SFP/XFP while the test is running to avoid distorting statistics. First stop the test case, replace the SFP/XFP and then restart the test.*

Carefully connect optical fibre cables to the SFP/XFP's IN and OUT ports. To ensure good signal quality, make sure that the optical fibre connector is fully inserted into the optical connector port.

CAUTION

To prevent exceeding the maximum input power level please use an attenuator when a loopback configuration is used.

- **LASER** red LED: The LASER LED is on when the FTB-8100 Series is emitting an optical laser signal.
- **RX** green LED: The **RX** LED is on when the FTB-8100 Series is receiving an optical laser signal.

Electrical SONET/DSn/SDH/PDH Interface Connection

- **2M-155M** port: The FTB-8105/15/20/30 provides two BNC connectors, labeled **2M-155M IN** and **OUT**, for E1/2M, E2/8M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M testing capability. Connector type is BNC for coaxial 75-ohm cable connection.
- **1.5M/2M** Bantam port: The FTB-8105/15/20/30 provides an IN/OUT Bantam connectors for DS1/1.5M and E1/2M testing capability.
- **1.5M/2M** RJ-48C port: The FTB-8105/15/20/30 provides an IN/OUT RJ-48C connectors for DS1/1.5M and E1/2M testing capability.

Note: *Dual RX test case uses the BNC labelled AUX as the second RX port.*

Connect the signal to be tested to the corresponding port.

Clock Interface Connections

- **AUX** port: The FTB-8100 Series provides one connector, labeled **AUX**, that can be used either for DS1 (1.5M)/E1 (2M)/2 MHz external clock synchronization signal or as the second RX port for **Dual RX** (DS1 or DS3) testing. This port is unidirectional and can be used either for input or output. Connector type is BNC for coaxial 75-ohm cable connection. An adapter cable (BNC to Bantam) is required for Bantam connection (not supplied).
- **REF OUT port:** The FTB-8130/FTB-8130NG/FTB-8130NGE provides one connector, labeled **REF OUT**, that can be used for the following clock signals. Connector type is SMA.

  For OC-192/STM-64/OTU2/OTU1e/OTU2e/OTU1f/OTU2f

Clock divider	Output frequency for					
	OC-192/ STM-64	OTU2	OTU1e	OTU2e	OTU1f	OTU2f
16	622.08 MHz	669.33 MHz	690.57 MHz	693.48 MHz	704.38 MHz	707.35 MHz
32	311.04 MHz	334.66 MHz	345.29 MHz	346.74 MHz	352.19 MHz	353.68 MHz
64	155.52 MHz	167.33 MHz	172.64 MHz	173.37 MHz	176.10 MHz	176.84 MHz

Ethernet 10/100/1000Base-T Interface Connection

ETHERNET 10/100/1000M port: The FTB-8120NG/FTB-8130NG/FTB-8120NGE/FTB-8130NGE provides an Ethernet port for electrical 10/100/1000 Mbps Ethernet connection allowing Ethernet testing through GFP.

Note: *GFP testing is only supported on the FTB-400/500 platforms.*

Ethernet ADD/DROP Gig-E Interface Connection

Note: *GFP testing is only supported on the FTB-400/500 platforms, not available on the FTB-200.*

ETHERNET ADD/DROP port: The FTB-8120NG/FTB-8130NG/FTB-8120NGE/FTB-8130NGE provides a 1Gig-E port for optical 1000Base-X Ethernet connection allowing GFP and Ethernet testing.

Status LED

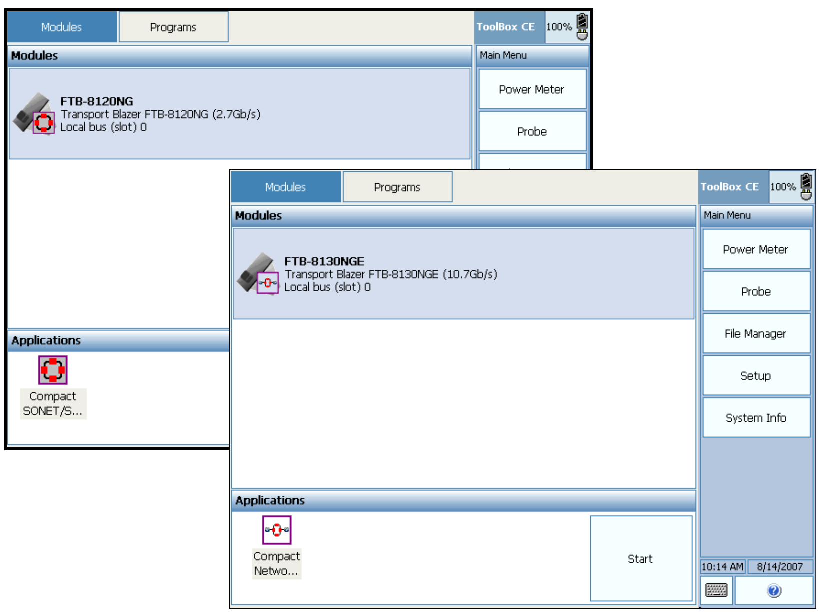
Indicates the status of the FTB-8100 Series module. The **STATUS** LED is green when the module is active and operates normally. The **STATUS** LED is yellow when the module is in the booting process. The **STATUS** LED is red to indicate a failure of the module.

5 Introducing and Using the Graphical User Interface

Starting the FTB-8100 Series Transport Blazer Application

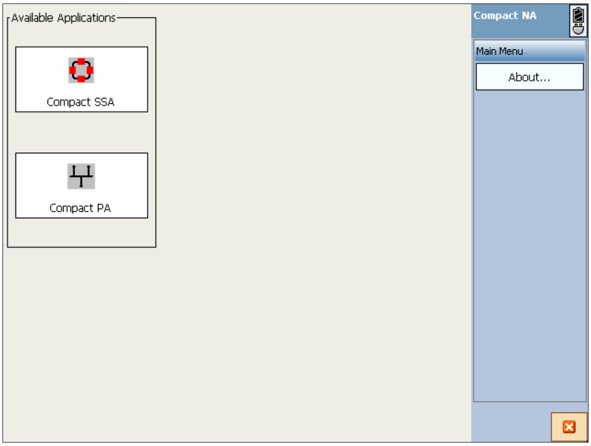
To Start the FTB-8100 Series Application:

1. Once your FTB-8100 Series module is installed, turn on the FTB-200.
2. In the ToolBox CE main window, under **Modules**, press FTB-8105, FTB-8115, FTB-8120, FTB-8120NG, FTB-8130, FTB-8130NG, FTB-8120NGE, or FTB-8130NGE once to select the module.



3. Press **Start** to start the module application or the **Compact Network Analyzer**.

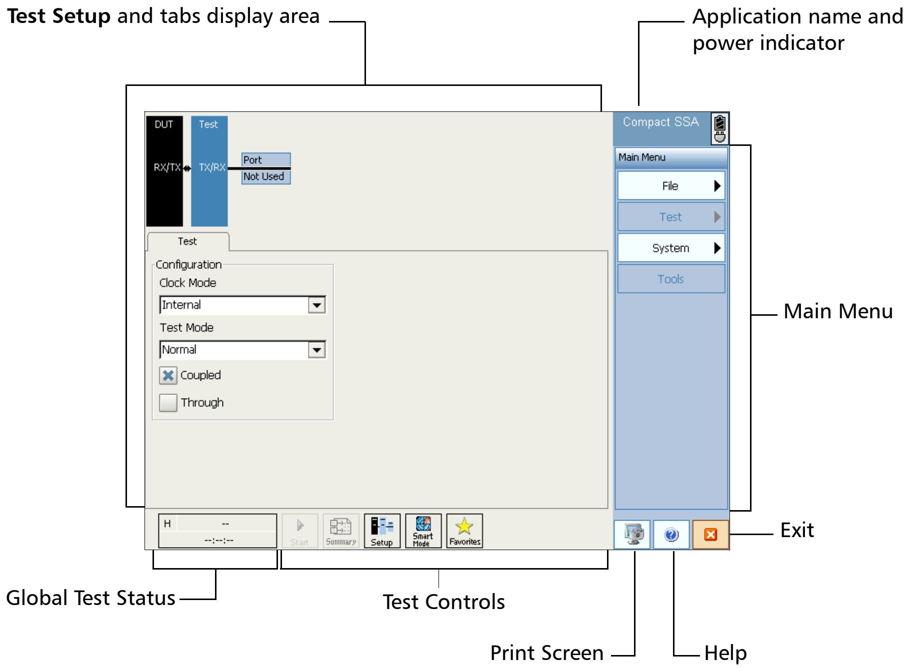
4. This step applies to the FTB-8120NGE/FTB-8130NGE module only. The **Compact Network Analyzer** allows to either run the **Compact SSA** (SONET/SDH) or the **Compact PA** (Packet Analyzer). Both analyzers cannot run simultaneously. Press **Compact SSA** to start the module for SONET/SDH/OTN test.



Note: *Refer to the Ethernet and Fibre Channel Application user guide for more information on Packet Analyzer.*

The exit button (X) closes the **Network Analyzer**, **SONET/SDH Analyzer**, and/or **Packet Analyzer** applications. If a test is created, a user confirmation is required before closing the applications.

Main Window



Test Setup and Tabs Display Area

The **Test Setup** window is displayed by default when the SUI is launched, allowing the creation of the test case by passing through the signal structure. This area is also used to display the test configuration and result tabs. Refer to *Introducing the Test Setup* on page 54 for more information on Test Setup.

Application Name and Power Indicator

Displays the **Compact SSA** software application name and provides the battery and/or DC power source indicator.

Main Menu

The main menu gives access to the following main menu items.

- **File** gives access to the following controls:
  - **New** clears the current test. A user's confirmation is required before clearing the test. The **New** button is only available when the test is created and not running.
  - **Open** allows setting up the test case by loading a previously saved configuration. Press **Open**, select an existing file and press **OK** to confirm. The default directory is \Data\My Documents\SonetSdhAnalyzerG2\Configuration. The configuration file extension is **cfg**.

Note: *An error message is displayed and the configuration is not loaded when the file is corrupted, the module is not properly installed, the hardware or software options are not compatible, invalid configuration (FTB-8105/15/20/30), or when the resources or power are not sufficient. Refer to* Solving Common Problems *on page 401 for more information.*

  - **Save As** saves the current test configuration. The **Save As** button is not available while the test is running or when no test is created.

    Select an existing file, or type a new name in the **File name** field and press **OK**. The default directory is \data\My Documents\SonetSdhAnalyzerG2\Configuration.
  - **Report** generates a report of the current test. Not available on the FTB-200 v2, refer to **Report** button from the *Global Test Status and Controls* on page 31. See *Test Report Generation* on page 36 for more information.
  - **About** gives information on the company, contact information, and unit software/hardware information.

Note: ***Open*** *is not available when the test is running.* ***New, Save As*** *and* ***Report*** *are only available when the test is created and not running.*

- **Test**: gives access to the following tab groups. Test is only available when the test is created.
  - **Port** allows port configuration and monitoring. Refer to *Port Tabs* on page 113.
  - **OTN** allows Optical Transport Network configuration and monitoring. Refer to *OTN Tabs* on page 129.
  - **SONET** allows SONET configuration and monitoring. Refer to *SONET Tabs* on page 167.
  - **SDH** allows SDH configuration and monitoring. Refer to *SDH Tabs* on page 249.
  - **DSn/PDH** allows DSn/PDH configuration and monitoring. Refer to *DSn Tabs* on page 213 and *PDH Tabs* on page 301.
  - **Pattern** allows pattern configuration and monitoring. Refer to *BERT Tabs* on page 335.
  - **Advanced Test** allows advanced features configuration and monitoring. Refer to *Advanced Tabs* on page 341.
- **System** gives access to tabs containing general functions related to the FTB-8120NGE/8130NGE operation. Refer to *System Tab* on page 371 for more information.
- **Tools**: Future use.

The following control buttons are available within any of the main menu items:

- **Back** allows to return to the previous menu level.
- **Main Menu** allows to return to the main menu.

Print Screen

Print Screen allows to do a screen shot of the current window and save it to a file.

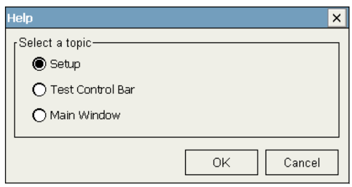
Type a name in the **Name** field or use the default name and press **OK**. The default file name is **ScreenX**. The default directory is \Data\My Documents\SonetSdhAnalyzerG2\ScreenShot. The file type is BMP.

The BMP file can be saved to the following locations:

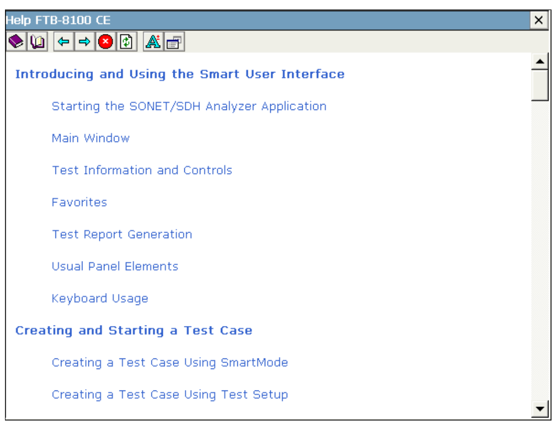
- Local memory (FTB-200): The file is saved locally on the FTB-200 memory.
- Network drive: The file is saved on a network drive.
- USB drive or Compact Flash: The file is saved on a removable drive.

Help

The help button (?) displays the help information on the current window. A window pops up to select the area of the application where help is required. Press **OK** and the help information is immediately displayed.



It is also possible to navigate through the help information once the help window is open.



Exit

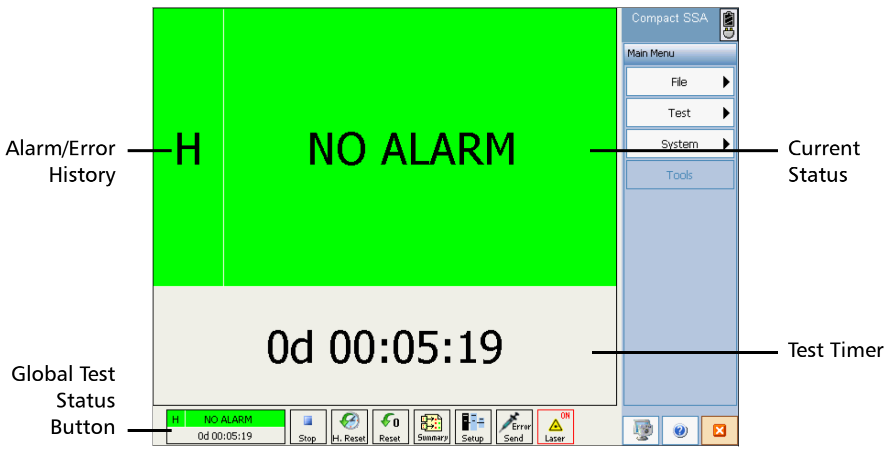
For FTB-8105, FTB-8115, FTB-8120, FTB-8120NG, FTB-8130, and FTB-8130NG: The exit button (X) closes the current application. If a test is created, a user confirmation is required before closing the application.

For FTB-8120NGE, and FTB-8130NGE: The exit button (X) switches from the current application to the **Network Analyzer** application. If the test is running, a user confirmation is required to stop the test before switching the application. The swiching puts the application in idle mode meaning that the test case configuration is kept and will be recovered when returning to that application.

Global Test Status and Controls

Global Test Status

The global test status button displays the alarm, and test timer. Clicking on this button maximizes the view of these status. The maximized view is useful to facilitate distant viewing of these status.



To minimize the view, either click on the global test status button or click anywhere on the maximized status area.

➤ **H** (History): Indicates if alarms/errors occurred in the past. A grey background indicates that the test did not run yet, a green background indicates that no alarm/error has occurred, while a red background indicates that at least one alarm/error has occurred.

➤ Current status: Indicates the current alarm/error status of the test. A grey background indicates that the test is not running (**--**), a green background indicates that there is no alarm/error active (**NO ALARM**), while a red background indicates that at least one alarm/error condition is active (**ALARM**).

Note: *The history and current alarm/error status are monitored once the test is started.*

- ➤ The test timer indicates the time elapsed since the beginning of the test. The test timer format is “day hour:minute:second”.

Test Controls

Button	Description
Start	Starts the test. Start is available when the test is created and not running. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab.
Stop	Stops the test.[a]
H. Reset	Resets the history (H) alarm and error LEDs.[a]
Reset	Resets counters (seconds, count, and rate), test timer and both history (H) and current (C) LEDs for the entire test case. Also resets the logger.[a]
Report	For FTB-200 v2, generates a report of the current test and allows to view saved reports. See *Test Report Generation* on page 36 for more information.
Summary	Gives access to the alarm summary, test summary, logger, and test preferences tabs. Refer to *Summary Tabs* on page 97 for more information.
Setup	Gives access to the Test Setup window to create the test by selecting and configuring each node of the test path. Refer to *Creating and Starting a Test Case* on page 51 for more information.
Smart Mode	Allows signal discovery and alarm/error monitoring. The test can be launched according with the detected signal structure. **SmartMode** is only available for SONET/SDH signals. See *Smart Mode* on page 83.[b]
Favorites	Provides access to 10 default or customer defined test case configurations. See *Favorites* on page 34 for more information.[b]
Error Send	Generates pattern bit error according to the amount selected on the **Pattern TX** tab. Refer to *Pattern Error Injection* on page 337.[a]

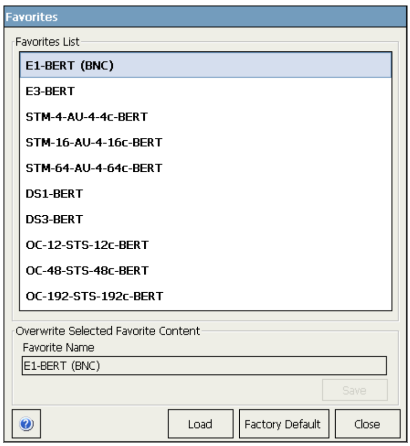
Button	Description
	Indicates that the laser control is off. Pressing this button will activate the laser immediately by emitting an optical laser signal. This button is only available for optical interfaces. The laser is On by default when the test is created unless otherwise set from the *Default Test Preferences* on page 382.
	Indicates that the laser control is on. Pressing this button will turn off the laser. This button is only available for optical interfaces. The laser is On by default when the test is created unless otherwise set from the *Default Test Preferences* on page 382. The laser control button is not affected when turning off the laser by generating a LOS for example.
	Allows the detection of the **Line Coding**, **Framing**, and **Test Pattern** of the selected DS1 or DS3 input signal. Upon detection of specific alarms, the detection may not be possible, press **Retry** to invoke the detection again.[b]

a. Only available when the test is running.
b. Only available when the test is not running (Stop).

Favorites

Favorites gives access to 10 factory test case configurations. Favorites is available when no test is running.

Press  .



Favorites List

Allows to select a test case configuration. The test case configuration selected by default is the first one in the list.

Note: *Test cases not supported by the current FTB-8100 Series model and its options will not be created.*

Note: *Favorites may or may not be compatible from one version of software to another. They also may or may not be compatible from one module to another depending on the hardware and software option installed.*

Overwrite Selected Favorite Content

The factory test case configurations can be modified as well as their default names.

- **Favorite Name**: Allows changing the name of the test case configuration file. A maximum of 32 characters are allowed in the name.
- **Save**: Saves the current test case configuration using the specified favorite name.

Load

Loads the selected test case configuration. Loading a favorite configuration automatically clears the current test case.

Factory Default

Resets and regenerates the favorites list based on the module model and its enabled options.

Note: *A Default Favorites list is created the first time a specific module is used, based on its module type and options. A favorites list is generated for each module type used (FTB-8105, FTB-8115, FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, and FTB-8130NGE). The favorites list for a specific module type is common for all modules of the same type on the FTB-200. The favorites list is not updated even when either a new software option is installed or another module having different options is used. For these reasons, the* ***Factory Default*** *button allows to recreate the favorites list based on the current module and its options.*

Test Report Generation

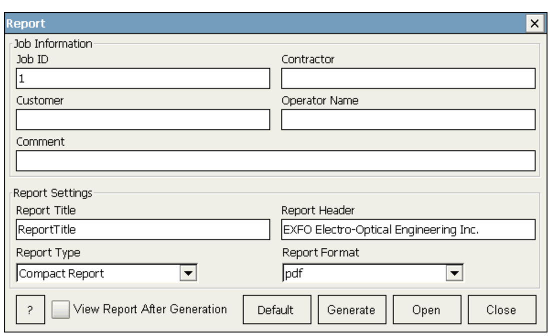
Note: *For Compact ToolBox, see Under Compact ToolBox* on page 38.

Under ToolBox CE

Press **Report** from the **File** menu to generate a report for the current test. Alternatively press the F3 button to access the report window. The report contains all the information about the test including the job information, system information, interface setup, test summary, test configuration, results, etc.

Note: *The Report button is not available while the test is running or the SmartMode alarm scan is running.*

Note: *Nothing prevents the configuration and alarm/error injection setup while the test has been stopped; thus, the report should be printed before changing any test parameters to avoid printing discrepancy between the configuration and results.*



➤ **Job Information**: These parameters are used to identify the source of the report and are not mandatory. Enter the following job information if required: **Job ID, Contractor, Customer, Operator Name,** and **Comment.** Up to 256 characters are allowed for each parameter.

- **Report Settings**: These parameters are used to identify the report and are not mandatory. Enter the following report information if needed: **Report Title**, **Report Header**, and **Report** Type.

  Report Type: Allows the selection of the report type:

  - **Compact Report** presents the essential information related to the test case and its results. The **Compact Report** can be viewed directly on the FTB-200.
  - **Full Report** presents all information related to the test case. The **Full Report** can only be viewed on a PC using the **EXFO Protocol Report Generator**. Refer to *Report Generator* on page 479 for more information.

  Report Format: Allows the selection of the report format: **TXT** or **PDF**. Available when **Compact Report** is selected.

- **View Report After Generation**: Allows displaying the report once it is generated. The **View Report After Generation** check box is only available with **Compact Report Type** and is not selected by default.
- **Default** button: Press **Default** to restore the default report settings.
- **Generate** button: Allows generating and saving the report. Select an existing file, or type a new name in the **File name** field and press **OK**. The default directory is \Data\My Documents*SonetSdhAnalyzerG2*\Report. The file extension is **txt** for **Compact Report** type, and **rxml** for **Full Report** type. The file extension is **txt** for **Compact Report** type, and **rxml** for **Full Report** type. The report file can be saved on the following locations:

  - Local memory (FTB-200): The file is saved locally on the FTB-200 memory.
  - Network drive: The file is saved on a network drive.
  - USB drive or Compact Flash: The file is saved on a removable drive.

IMPORTANT

To view a **Full Report**, the saved file needs to be transferred to a PC and processed by the Report Generator tool. Refer to *Report Generator* on page 479 for more information.

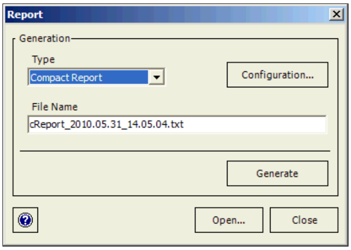
- **Open Report** button: Allows loading a previously saved **Compact Report** file. Select a generated report file by typing its name in the **Data Filename** field or click on **Browse** to select the file. The default directory is Data\My Documents\SonetSdhAnalyzerG2\Report.
- **Close** button: Closes the report generation settings window.

Under Compact ToolBox

Press **Report** from the *Global Test Status and Controls* to generate a report for the current test. Alternatively press the F3 button to access the report window. The report contains all the information about the test including the job information, system information, interface setup, test summary, test configuration, results, etc.

Note: *Nothing prevents the configuration and alarm/error injection setup while the test has been stopped; thus, the report should be saved before changing any test parameters to avoid discrepancy between the configuration and results.*

➤ Generation



- **Type**: Allows the selection of the report type:

  Compact Report presents the essential information related to the test case and its results.

  Full Report presents all information related to the test case.

- **File Name**: Type a new name in the **File Name** field if required. Click on the **Configuration** button to change the file format. It is also possible to change the file name from the configuration window.

- **Configuration**: Allows to set the report settings (see *Configuration* on page 40).

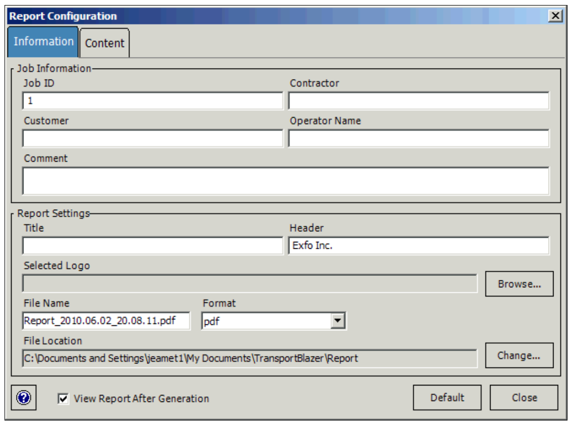
- **Generate**: Allows generating and saving the report. In **Full Report** type, the **Generate** button is not available when no report section is selected (see *Sections Tab* on page 1).

- **Open**: Allows loading a previously saved report file. Select a generated report file and click **Open**. The default directory is \My Documents\<Product Name>\Reports.

- **Close**: Closes the report generation settings window.

➤ **Configuration**

Information tab



➤ **Job Information**: These parameters are used to identify the source of the report and are not mandatory. Enter the following job information if required: **Job ID, Contractor, Customer, Operator Name,** and **Comment.** Up to 256 characters are allowed for each parameter.

➤ **Report Settings**: These parameters are used to identify the report and are not mandatory. Enter the following report information if needed: **Title**, **Header, Selected Logo**, **File Name**, and **Format**.

Press **Browse** to select a different logo, then press **Open**.

Type a new name in the **File Name** field if required.

Format: Select the report file format. Choices are **html**, **csv**, **pdf**, and **txt**. The **CSV** format (comma separated file format) generates a report with comma delimiter for English OS and semicolon for other OS languages. The default setting is **html**. **Html** and **csv** are only available with **Full Report** type.

File Location: Indicates the location where the repport file will be saved. Use the **Change** button to select a different location. The default file location is \My Documents\<Product Name>\Reports.

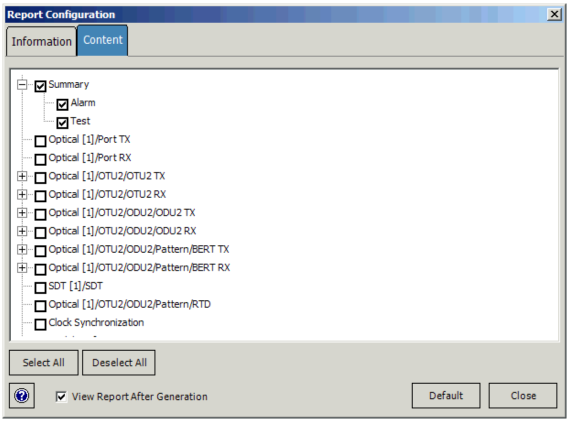
- **View Report After Generation**: Allows displaying the report once it is generated. However, the report can only be displayed when the Windows application supporting the selected **Report Format** is installed. When the Windows application supporting the selected **Report Format** is is not installed, the following message replaces the **View Report After Generation** text and its check box: **No application is currently available to automatically display the report**. The **View Report After Generation** check box is not selected by default.

Note: *If the html report contains special characters, please make sure that the encoding in your Web browser is set to Western European ISO. To set the encoding to Western European ISO, right press the report from Internet Explorer, select Encoding, and select Western European ISO.*

- **Default** button: Press **Default** to restore the default report settings.

Content tab

The **Content** tab is only available with **Full Report**.

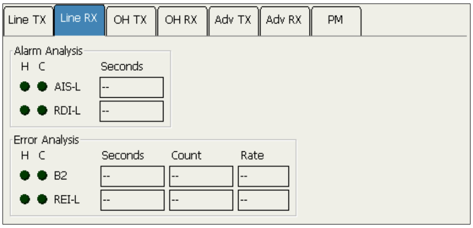


Each section can be selected to customize the report.

The **Select All** and **Deselect All** buttons are used to respectively select or deselect all the report sections.

Usual Tab Elements

Once the test is created, different tabs are available allowing test configuration and monitoring. The following section describes usual elements appearing on those tabs.



Status LEDs

- **H** (History) LED: Indicates that alarms/errors occurred in the past. A grey LED indicates that the test did not run yet, a green LED indicates that no alarm/error has occurred, while a red LED indicates that at least one alarm/error has occurred in the test.
- **C** (Current) LED: Gives the current status of the alarm/error. A grey LED indicates that the test is not running, a green LED indicates that there is no alarm/error, while a red LED indicates that at least one alarm/error condition has occurred in the last second.

Note: *The H and C LEDs are updated every second.*

Alarm/Error Measurements

Note: *Alarms/Errors are only monitored once the test is started.*

- **Seconds**: Gives the total number of the seconds in which one or more alarm/error occurred.
- **Count**: Gives the number of occurrences of a specific error. The count is displayed using integer value; exponential value (1.00000E10) is used when the count is bigger than the field display capacity.
- **Rate**: Calculates and displays the error rate. The rate is expressed using the exponential format with two decimal digits (example: 1.23E-04).
- Percentage values are expressed using one decimal digit. (example: 9.9%).
- Alphanumeric values display the extended ASCII character set including the *ITU T.50 Characters* on page 50. For Trace Messages using 64-bytes format, the last 2 bytes, Carriage Return and Line Feed, will be displayed within brackets (<cr> and <lf>).

Arrow Buttons

Button	Description
	Top arrow: Moves to the top of the list.
	Page up arrow: Moves one page up.
	Up arrow: Moves one row up.
	Down arrow: Moves one row down.
	Page down arrow: Moves one page down.
	End arrow: Moves to the end of the list.

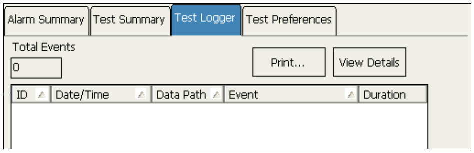
Table Sorting

Tables offer sorting capabilities on one or more columns.

An arrow next to the column label name, indicates the sorting column field and the sorting order. Pressing again on the selected sort column label will change the sort order.

Pressing another column label allows to sort using a different field.

Table Sort

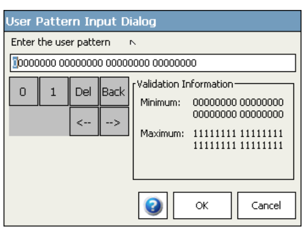


Keyboard Usage

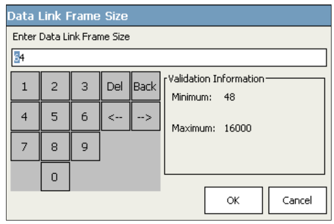
The GUI pops up different keyboards to modify data. Following are the usual keyboard keys:

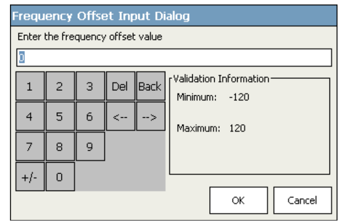
- Left arrow: Moves the cursor one position to the left.
- Right arrow: Moves the cursor one position to the right.
- **Del**: Deletes the value at the cursor position.
- **Back**: Deletes the value preceding the cursor position.
- **Help**: Displays the help information related to the keyboard usage. It is also possible to navigate through the help information.
- **OK** and **Enter**: Completes data entry.
- **Cancel**: Closes the keyboard and discards the keyboard entry.

- Binary keyboard: Allows entering 0 and 1 values.

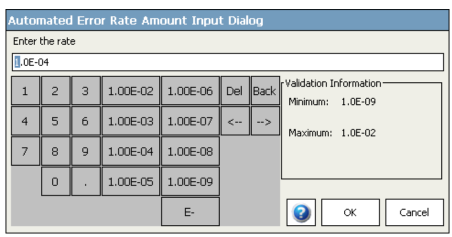


- Numerical keyboards: Allows entering integer/decimal values.
  - For integer unsigned or signed values.

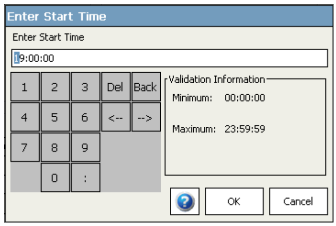




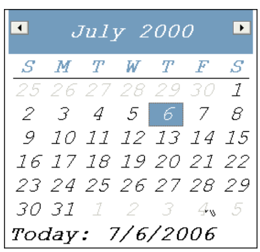
  - For rate values: Allows entering the rate values (0 through 9, and exponent).



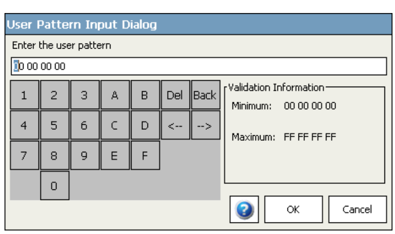
➤ Time Keyboard: Allows entering a time value.



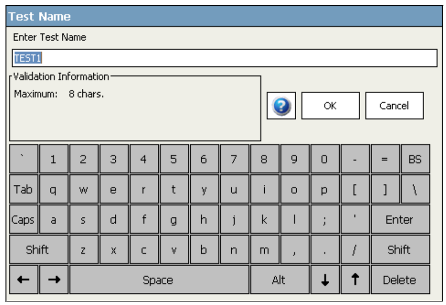
➤ Date keyboard: Allows selecting a date by pressing the date on the calendar. Use the left and right arrow to switch from one month to another or press the month area for quick month selection. Press the year area for quick year selection.



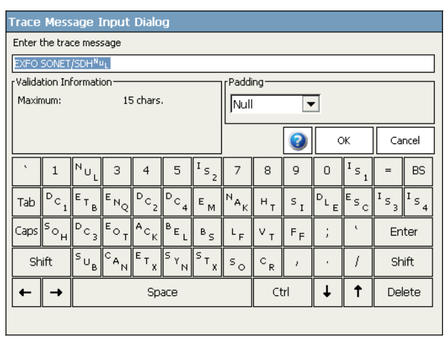
➤ Hexadecimal keyboards: Allows entering hexadecimal values (0 through 9 and A through F)



➤ Full keyboard: Allows entering numbers, letters and some other characters. The **Back**, **Del**, **Shift** and space bar keys have the same functionality as a regular PC keyboard.



➤ Trace message keyboard Allows entering alphanumerical characters (ITU T.50) required for TTI, FTFL, J0, J1, and J2 Trace fields. Press the **Ctrl** button to access these characters.



ITU T.50 Characters					
b7 to b1	**Character**	**Description**	**b7 to b1**	**Character**	**Description**
000 0000	NUL	Null	001 0000	DLE	Data Link Escape
000 0001	SOH	Start Of Heading	001 0001	DC1	Device Control 1
000 0010	STX	Start of Text	001 0010	DC2	Device Control 2
000 0011	ETX	End of Text	001 0011	DC3	Device Control 3
000 0100	EOT	End Of Transmission	001 0100	DC4	Device Control 4
000 0101	ENQ	Enquiry	001 0101	NAK	Negative Acknowledge
000 0110	ACK	Acknowledge	001 0110	SYN	Synchronous idle
000 0111	BEL	Bell	001 0111	ETB	End of Transmission Block
000 1000	BS	Backspace	001 1000	CAN	Cancel
000 1001	HT	Horizontal Tabulation	001 1001	EM	End of Medium
000 1010	LF	Line Feed	001 1010	SUB	Substitute character
000 1011	VT	Vertical Tabulation	001 1011	ESC	Escape
000 1100	FF	Form Feed	001 1100	IS4	Information Separator 4
000 1101	CR	Carriage Return	001 1101	IS3	Information Separator 3
000 1110	SO	Shift-Out	001 1110	IS2	Information Separator 2
000 1111	SI	Shift-In	001 1111	IS1	Information Separator 1

6 *Creating and Starting a Test Case*

A test case can be created using one of the following methods:

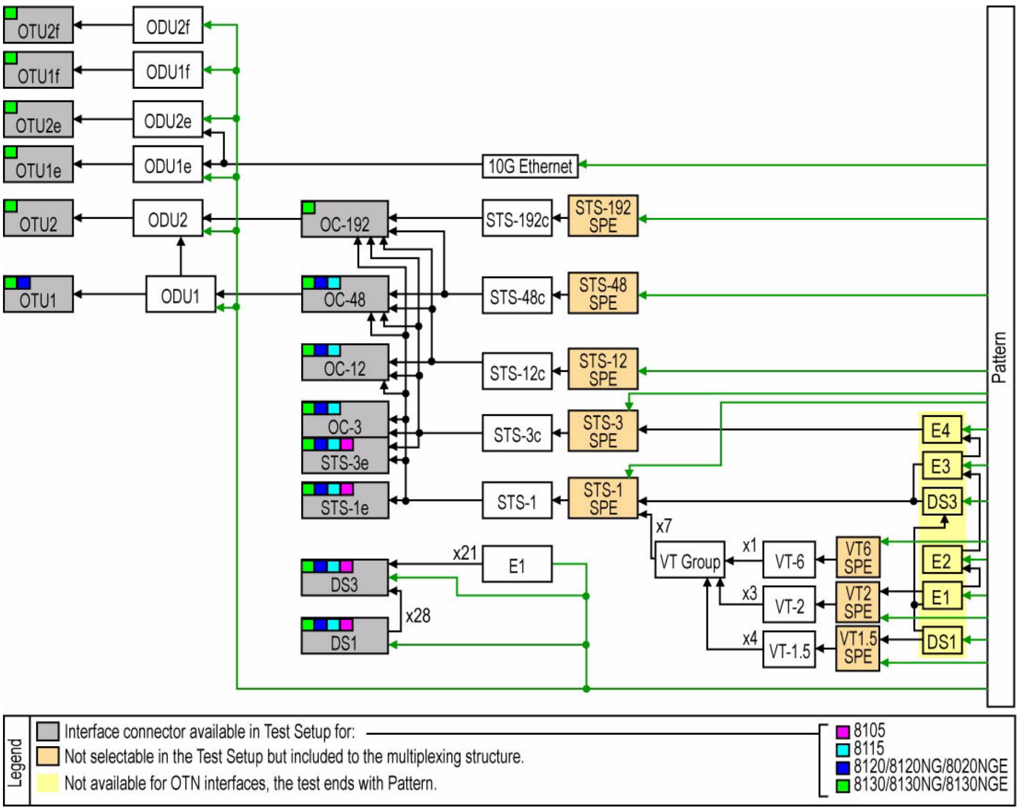
- **SmartMode** allows signal discovery and alarm/error monitoring. The test can be created according to the detected signal structure. **SmartMode** is only available for SONET/SDH signals. See *Creating and Starting a Test Case Using SmartMode* on page 94.
- **Test Setup** allows the creation of the test case by travelling through the signal structure. See *Introducing the Test Setup* on page 54.
- **Favorites** allows setting up the test case by selecting a predefined test configuration. Refer to *Favorites* on page 34.
- **Load Configuration** allows setting up the test case by loading a previously saved configuration. Refer to **Open** from the *Main Menu* on page 26.

Note: *Once the test case is created, press the* ***Start*** *button to start the test. Refer to* Global Test Status and Controls *on page 31 for more information on test management.*

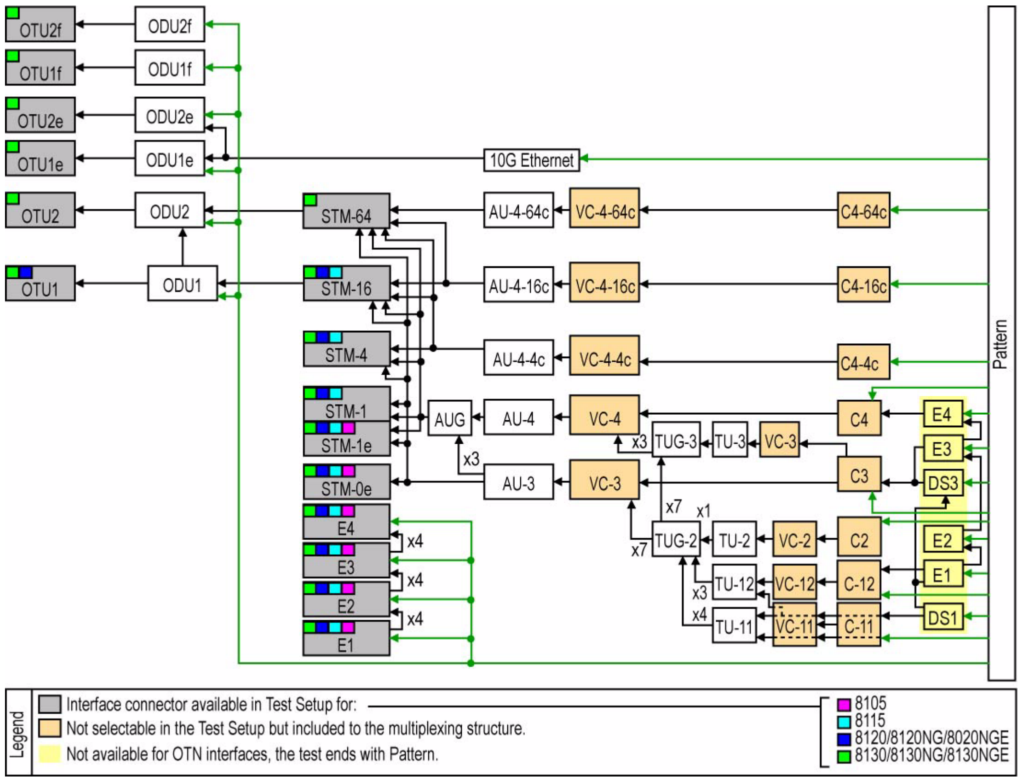
Supported Paths/Mappings

The supported test paths/mappings are presented in the following charts and depend on modules and enabled options. Optical interfaces are not supported on the FTB-8105.

OTN/SONET/DSn Interface Path/Mapping



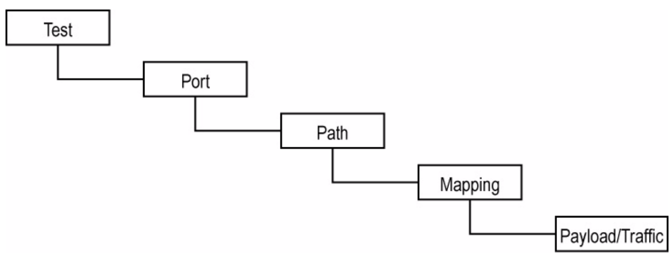
OTN/SDH/PDH Interface Path/Mapping



Introducing the Test Setup

The **Test Setup** window allows the creation of the test case by navigating through the signal structure. In the case where the GUI is not in the setup window, select the **Test Setup** button from the *Global Test Status and Controls* (refer to 31).

The test path is created through the configuration of each layer that must be crossed by the signal under test. The test path contains the following nodes:



- The **Test** node is the root of the test case. It allows the configuration of the clock mode and test mode.
- The **Port** node allows the selection and configuration of the signal.
- The **Path** node allows the selection and configuration of the HOP and LOP path of a SONET/SDH signal.
- The **Mapping** node allows the selection and configuration of the mapping of the selected signal.
- The **Payload/Traffic** node completes the test path by selecting the pattern.

Note: *For decoupled test mode, both TX and RX test nodes (Port, Path, Mapping, and Payload/Traffic nodes) have to be selected and configured independently.*

Typical Test Cases

The remaining of this chapter describes how to create the following typical DSn/PDH, SONET/SDH, OTN, and Ethernet over OTN test cases. The availability of test cases depend on the module and activated options.

➤ *Creating an Electrical DSn/PDH Test Case in Normal Mode* on page 56

➤ *Creating an Electrical DS1 or DS3 Test Case in Dual RX Mode* on page 59

➤ *Creating an Electrical DS1 Test Case in NI/CSU Emulation Mode* on page 63

➤ *Creating an Electrical SONET/SDH Test Case* on page 67

➤ *Creating an Optical SONET/SDH Test Case (FTB-8115/20/30)* on page 71

➤ *Creating an OTN (OTU1 and OTU2) Test Case* on page 75

➤ *Creating an OTN Overclocked (OTU1e/OTU2e/OTU1f/OTU2f) Test Case (FTB-8130, FTB-8130NG, and FTB-8130NGE)* on page 79.

Creating an Electrical DSn/PDH Test Case in Normal Mode

The following procedures describe the creation of an electrical DSn/PDH test case in **Normal** mode.

To create an Electrical DSn/PDH Test in Normal mode:

1. Test configuration:

1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

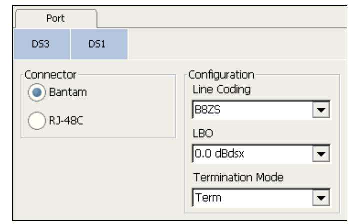
1b. Select **Normal** as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

1c. Select the **Coupled** check box to set the same settings for both the TX and RX signals or clear the **Coupled** check box to configure the TX and RX signal individually (decoupled).

1d. Select the **Through** check box to loop the RX signal to the TX port. The **Clock Mode** is automatically set to **Recovered** when the **Through** check box is selected.

2. Press the **Port** node.

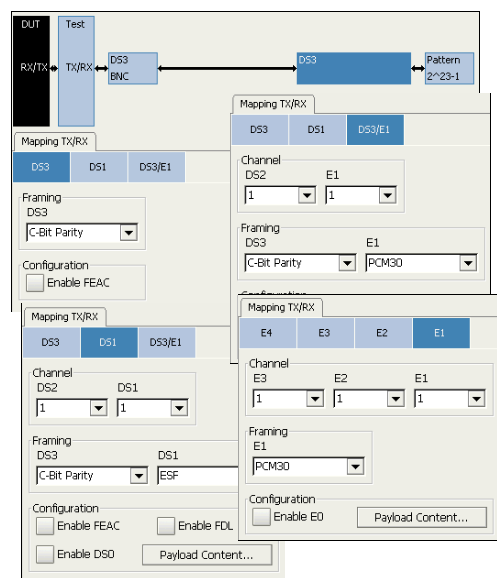
2a. Press **More** to see all available interfaces and press the desired interface: **DS3**, **DS1**, **E4**, **E3**, **E2**, or **E1**.



2b. For DS1/E1, select the connector type: **BNC** (E1 only), **Bantam**, or **RJ-48C**.

2c. Select the **Line Coding**, **LBO** (DSn interface only), and **Termination Mode**. **Term**, **Mon**, and **Bridge** (DS1/E1 only) termination mode are available. For more information, refer to *Port TX (Electrical Interfaces)* on page 114 for Line Coding and LBO, to RX - *DSn Tabs* on page 213 or *PDH Tabs* on page 301 for Termination Mode.

3. Press the **Mapping** node.



3a. Select the mapping. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

3b. Select the **Framing**. For more information, refer to DSn Tabs *on page 213* or PDH Tabs *on page 301*.

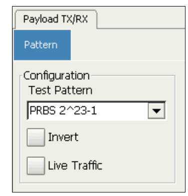
3c. For DS3, select the **Enable FEAC** check box to allow far end alarm and control testing.

3d. Select the **Channel** number(s) of the selected mapping.

3e. For DS1, select the **Enable FDL** check box to allow facility data link testing. For **Dual RX** test, FDL is only available for the primary DS1 TX/RX port.

3f. For DS1/E1, select the **Enable DS0/E0** check box to allow DS0 or E0 testing and select the **Paylaod Content**. Refer to *Payload Content* on page 216 for DSn and page 304 for PDH.

4. Press the **Pattern** node.



4a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

5. The test setup has been successfully created.

6. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *DSn Tabs* on page 213, *PDH Tabs* on page 301, *BERT Tabs* on page 335, *Advanced Tabs* on page 341, and *Common Tabs* on page 349.

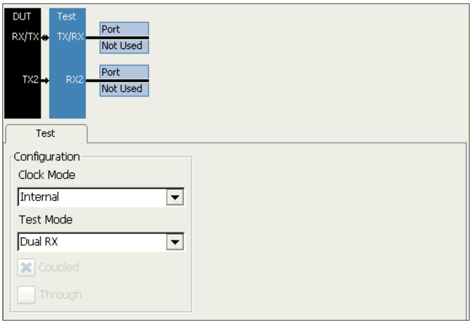
7. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

Creating an Electrical DS1 or DS3 Test Case in Dual RX Mode

The following procedures describe the creation of an electrical DS1 or DS3 test case in **Dual RX** mode.

To create an Electrical DS1 or DS3 Test in Dual RX mode:

1. Test configuration:



1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

1b. Select **Dual RX** (DS1 or DS3 signals) as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

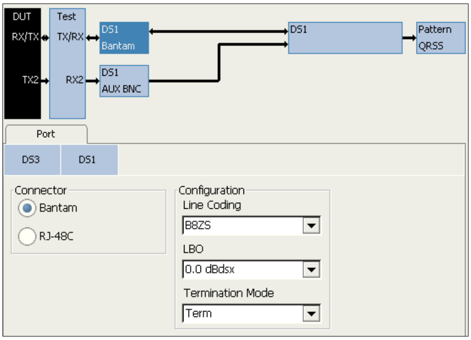
The **Coupled** check box is automatically selected for Dual RX mode meaning that the settings for both the TX and RX signals are the same.

2. Press the **TX/RX** or **RX2 Port** node.

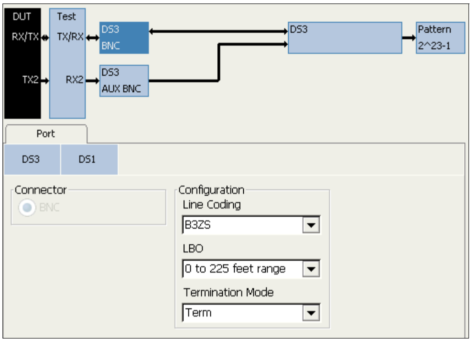
2a. Press the desired interface: **DS3**, or **DS1**.

2b. Select the connector type:

2c. For DS1: **Bantam**, or **RJ-48C**.

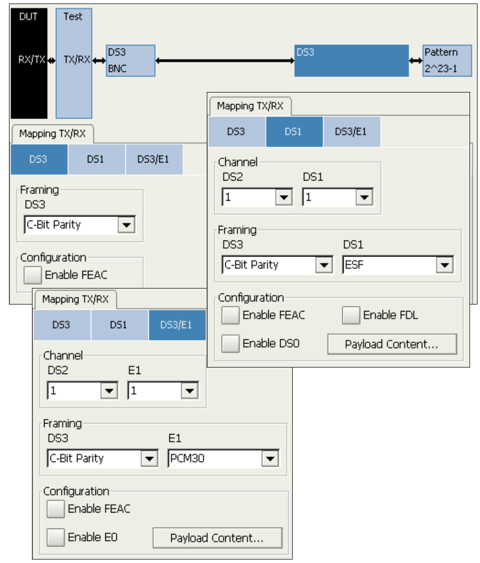


For DS3: The TX/RX connector is **BNC** while the **RX2** connector is the BNC AUX port.



2d. Select the **Line Coding**, **LBO**, and **Termination Mode**. **Term**, **Mon**, and **Bridge** (DS1 only) termination modes are available. For more information, refer *Port TX (Electrical Interfaces)* on page 114 for Line Coding and LBO, or RX *DSn Tabs* on page 213.

3. Press the **Mapping** node.



3a. Select the mapping. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

3b. Select the **Framing**. For more information, refer to DSn Tabs *on page 213*.

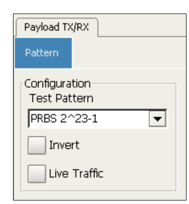
3c. For DS3, select the **Enable FEAC** check box to allow far end alarm and control testing.

3d. Select the **Channel** number(s) of the selected mapping.

3e. For DS1, select the **Enable FDL** check box to allow facility data link testing. FDL is only available for the main DS1 TX/RX port.

3f. For DS1, select the **Enable DS0/E0** check box to allow DS0 or E0 testing and select the **Paylaod Content**. Refer to *Payload Content* on page 216.

4. Press the **Pattern** node.



4a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

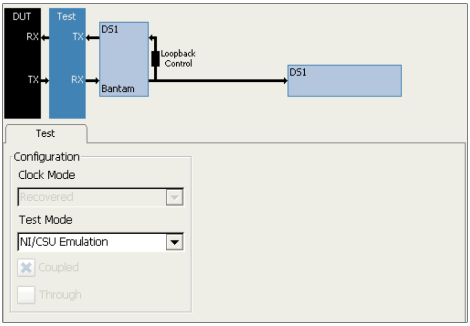
5. The test setup has been successfully created.
6. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *DSn Tabs* on page 213, *PDH Tabs* on page 301, *BERT Tabs* on page 335, *Advanced Tabs* on page 341, and *Common Tabs* on page 349.
7. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

Creating an Electrical DS1 Test Case in NI/CSU Emulation Mode

The following procedures describe the creation of an electrical DS1 test case in **NI/CSU Emulation** mode.

To create an Electrical DS1 Test in NI/CSU Emulation mode:

1. Test configuration:

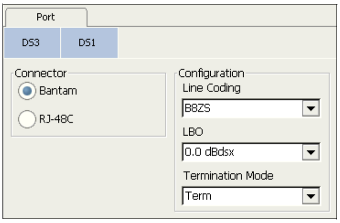


1a. Select **NI/CSU Emulation** as the **Test Mode**: **Normal**. Refer to Test Configuration *on page 98* for more information. The **Coupled** check box must be selected to allow **NI/CSU Emulation** mode selection.

The **Clock Mode** is automatically set to **Recovered**. Refer to *Clock Configuration* on page 101 for more information.

2. Press the **Port** node.

2a. Select the connector type: **Bantam**, or **RJ-48C**.

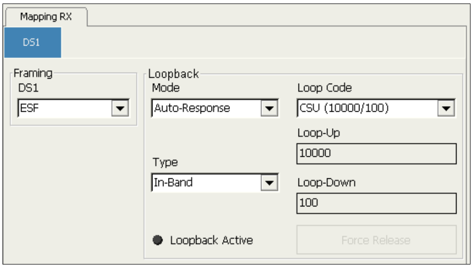


2b. Select the **Line Coding**, and **LBO**.

The **Termination Mode** is set to **Term**.

For more information, refer to *Port TX (Electrical Interfaces)* on page 114 for Line Coding and LBO, and to *DS1/1.5M RX* on page 222 for Termination Mode.

3. Press the DS1 **Mapping** node.



3a. Select the **Framing**. For more information, refer to *DS1/1.5M TX* on page 219.

3b. Select the loopback control **Mode**: **Manual** or **Auto-Response**.

3c. For **Manual**:

Select the **Type** of loopback code that will be applied: **None**, **Line**, or **Payload**. **Payload** is only available with SF and ESF framings.

The **Loopback Active** LED indicates the presence of an active loopback.

3d. For **Auto-Response**:

Select the **Type** of loopback code on which the module will respond: **In-Band** or **Out-of-Band**. **Out-of-Band** is only available when the interface framing is set to **ESF**.

Select the **Loop Code**:

In-Band loop code	Loop-UP Code	Loop-Down Code
CSU	10000	100
NIU FAC1	1100	1110
NIU FAC2	11000	11100
NIU FAC3	100000	100
Loop Code1 to **10**	Refer to *DSn Loop Codes* on page 387 for more information.	
User Defined	Loop-Up and Loop-Down range is from **000** to **1111111111111111**. The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up=**10000**, and Loop-Down=**100**).	

Out-of-Band loop code	Loop-UP Code	Loop-Down Code
Line	00001110 11111111	00111000 11111111
Payload	00010100 11111111	00110010 11111111
Reserved For Network Use	00010010 11111111	00100100 11111111
ISDN Line (NT2)	00101110 11111111	00100100 11111111
CI/CSU Line(NT1)	00100000 11111111	00100100 11111111

The **Loop-UP** and **Loop-Down** values are automatically updated to the **In-Band** or **Out-of-Band** selection (**Type**). However these fields are editable when the **Loop Code** is set to **User Defined**.

The **Force Release** button allows to release a loopback condition initiated from the network. Only available when a loopback is active.

The **Loopback Active** LED indicates the presence of an active loopback.

4. The test setup has been successfully created.

   The DS1 Loopback function is now operational; no need to start the test. However, the test may be started to monitor the condition of the DS1 line connection to that test equipment.

5. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, and *DSn Tabs* on page 213.

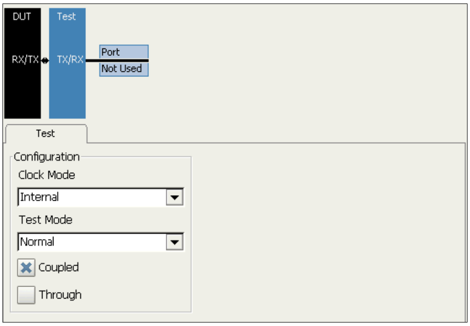
6. For additional configuration parameters and results, refer to the following chapters: Summary, Port, and DSn tabs.

7. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

Creating an Electrical SONET/SDH Test Case

To create an Electrical SONET/SDH Test on an FTB-8105/15/20/30:

1. Test configuration:



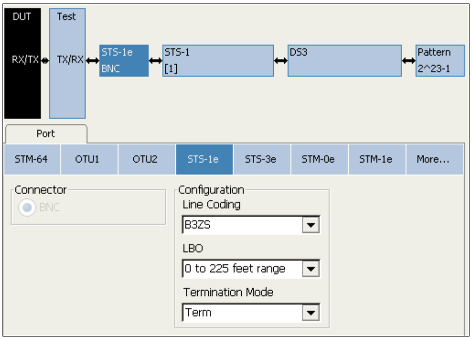
1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

1b. Select **Normal** as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

1c. Select the **Coupled** check box to set the same settings for both the TX and RX signals or clear the **Coupled** check box to configure the TX and RX signal individually (decoupled).

1d. Select the **Through** check box to loop the RX signal to the TX port. The **Clock Mode** is automatically set to **Recovered** when the **Through** check box is selected.

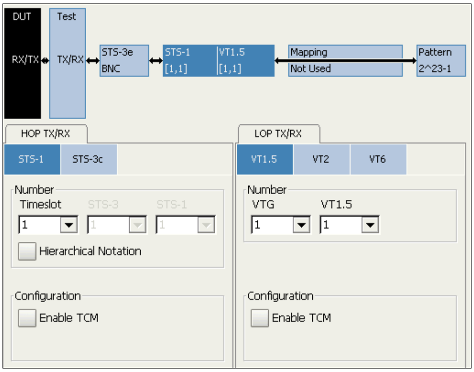
2. Press the **Port** node.



2a. Press **More** to see all available interfaces and press the desired interface: **STS-3e**, **STS-1e**, **STM-1e**, or **STM-0e**.

2b. Select the **Line Coding**, **LBO**, and **Termination Mode** (**Term** or **Mon**). For more information, refer *Port TX (Electrical Interfaces)* on page 114 for Line Coding and LBO, to RX - *DSn Tabs* on page 213 or *PDH Tabs* on page 301 for Termination Mode.

3. Press the **Path** node.



3a. Press the desired HOP. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

3b. For SONET, in the **Timeslot** list, select the timeslot number, or select **Hierarchical Notation** check box and in the **STS-3** and **STS-1** lists, select the slot numbers.
For SDH, in the **AU-3** and **AUG-x** lists, select the AU and AUG numbers.

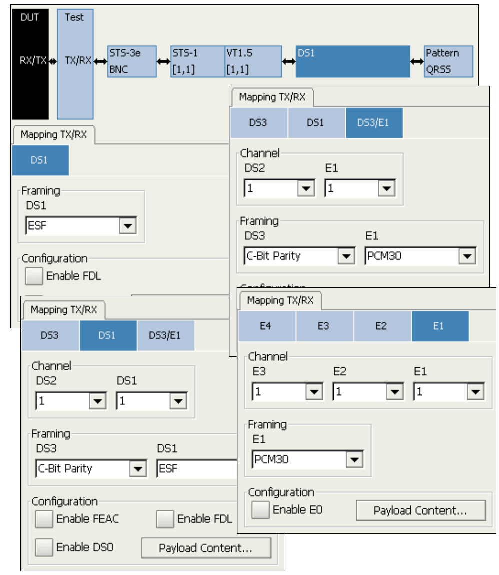
3c. Select the **Enable TCM** check box if needed.

3d. For non-concatenated HOP, select the LOP from the **LOP TX/RX** tab if required. Choices are **VT1.5**, **VT2**, and **VT6** for SONET; **TU-3**, **TU-2**, **TU-12**, and **TU-11** for SDH.

For SONET, select the **VTG** and **VT1.5** slot numbers.

For SDH, select the **TUG-x** and **TU-x** numbers.

4. Press the **Mapping** node.



4a. Press the desired path/mapping. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

4b. For DSn/PDH mapping level, select the **Framing**. For more information, refer to *DSn Tabs* or *PDH Tabs*.

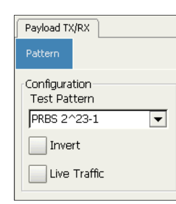
For DS3, select the **Enable FEAC** check box to allow far end alarm and control testing.

Select the **Channel** number(s) of the selected mapping.

For DS1, select the **Enable FDL** check box to allow facility data link testing.

For DS1/E1, select the **Enable DS0/E0** check box to allow DS0 or E0 testing and select the **Paylaod Content**. Refer to *Payload Content* on page 216 for DSn and page 304 for PDH.

5. Press the **Pattern** node.



5a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

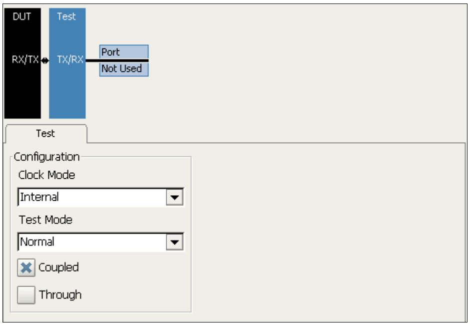
6. The test setup has been successfully created.
7. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *SONET Tabs* on page 167, *DSn Tabs* on page 213, *SDH Tabs* on page 249, *PDH Tabs* on page 301, *BERT Tabs* on page 335, *Advanced Tabs* on page 341, and *Common Tabs* on page 349.
8. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

Creating an Optical SONET/SDH Test Case (FTB-8115/20/30)

The following procedure describes a normal optical SONET/SDH the test case on the FTB-8115/20/30 modules.

To create an Optical SONET/SDH Test on an FTB-8115/20/30 module:

1. Test configuration:



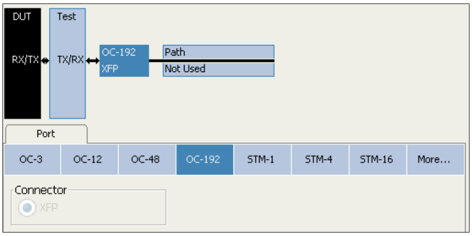
1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

1b. Select **Normal** as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

1c. Select the **Coupled** check box to set the same settings for both the TX and RX signals or clear the **Coupled** check box to configure the TX and RX signal individually (decoupled).

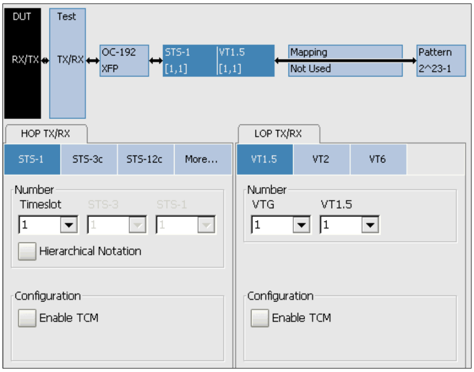
1d. Select the **Through** check box to loop the RX signal to the TX port. The **Clock Mode** is automatically set to **Recovered** when the **Through** check box is selected.

2. Press the **Port** node.



2a. Press **More** to see all available interfaces and press the desired interface: **OC-3**, **OC-12**, **OC-48**, **OC-192**, **STM-1**, **STM-4**, **STM-16**, **STM-64**. Choices depend on the rates available on the FTB-8115/20/30 module.

3. Press the **Path** node.



3a. Press the desired HOP. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

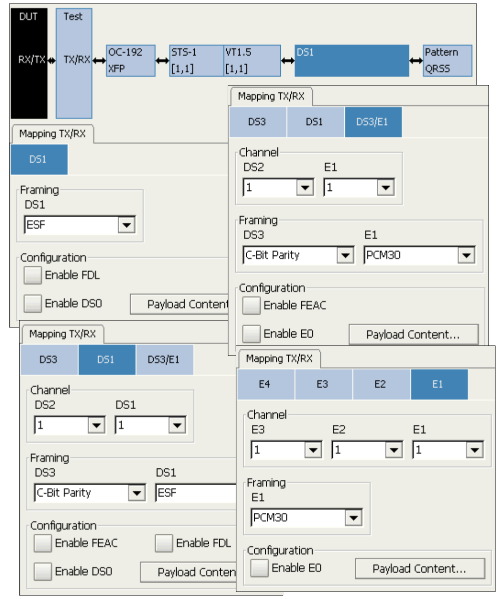
3b. For SONET, in the **Timeslot** list, select the timeslot number, or select **Hierarchical Notation** check box and in the **STS-3** and **STS-1** lists, select the slot numbers.
For SDH, in the **AU-3** and **AUG-x** lists, select the AU and AUG numbers.

3c. Select the **Enable TCM** check box if needed.

3d. For non-concatenated HOP, select the LOP from the **LOP TX/RX** tab if required. Choices are **VT1.5**, **VT2**, and **VT6** for SONET; **TU-3**, **TU-2**, **TU-12**, and **TU-11** for SDH.

For SONET, select the **VTG** and **VT1.5** slot numbers.

For SDH, select the **TU-x** and **TUG-x** numbers.



4. Press the **Mapping** node.

4a. Press the desired path/mapping. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

4b. For DSn/PDH mapping level, select the **Framing**. For more information, refer to *DSn Tabs* or *PDH Tabs*.

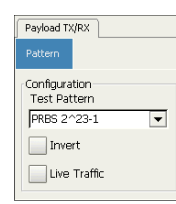
For DS3, select the **Enable FEAC** check box to allow far end alarm and control testing.

Select the **Channel** number(s) of the selected mapping.

For DS1, select the **Enable FDL** check box to allow facility data link testing.

For DS1/E1, select the **Enable DS0/E0** check box to allow DS0 or E0 testing and select the **Paylaod Content**. Refer to *Payload Content* on page 216 for DSn and page 304 for PDH.

5. Press the **Pattern** node.



5a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

6. The test setup has been successfully created.

7. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *SONET Tabs* on page 167, *DSn Tabs* on page 213, *SDH Tabs* on page 249, *PDH Tabs* on page 301, *BERT Tabs* on page 335, *Advanced Tabs* on page 341, and *Common Tabs* on page 349.

8. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

   8a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

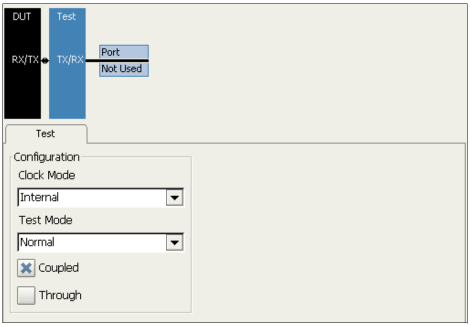
Creating an OTN (OTU1 and OTU2) Test Case

The following procedure describes OTU1 and OTU2 test cases.

➤ For OTU1e and OTU2e, see Creating an OTN Overclocked (OTU1e/OTU2e/OTU1f/OTU2f) Test Case (FTB-8130, FTB-8130NG, and FTB-8130NGE) *on page 79*.

To create an OTN Test on an FTB-8120, FTB-8120NG, FTB-8120NGE, FTB-8130, FTB-8130NG, or FTB-8130NGE module:

1. Test configuration:



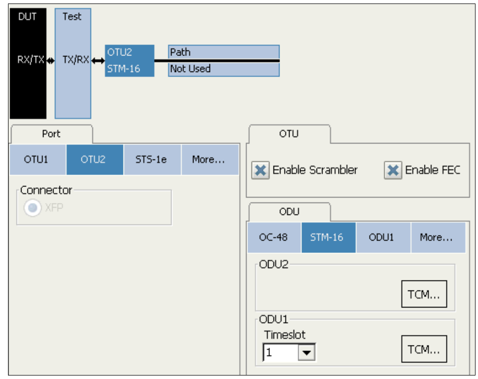
1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

1b. Select **Normal** as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

1c. Select the **Coupled** check box to set the same settings for both the TX and RX signals or clear the **Coupled** check box to configure the TX and RX signal individually (decoupled).

1d. Select the **Through** check box to loop the RX signal to the TX port. The **Clock Mode** is automatically set to **Recovered** when the **Through** check box is selected.

2. Press the **Port** node.



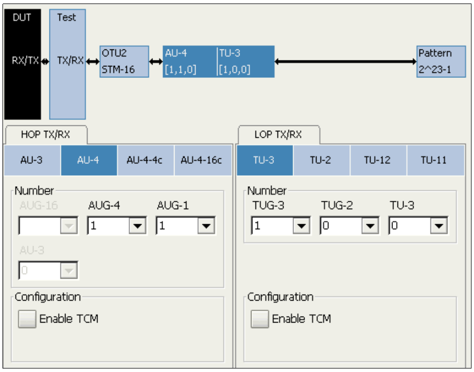
2a. Press **More** to see all available interfaces and press **OTU1** or **OTU2**. Choices depend on the rates available on the Transport Blazer module.

2b. Under OTU tab, select the **Enable FEC** and **Enable Scrambler** check boxes if needed. Refer to *FEC TX* on page 130 and *OTU TX* on page 133 for more information.

2c. Under ODU tab, select the mapping and the tributary slot when applicable.

2d. Press the TCM button and select ODU TCM (**TCM1** to **TCM6**) layers as required

3. Press the **Path** node (available when ODU is set to STS-n or STM-n).



3a. Press the desired HOP. Choices depend on the selected interface. See *Supported Paths/Mappings* on page 51 for more information.

3b. For SONET, in the **Timeslot** list, select the timeslot number, or select **Hierarchical Notation** check box and in the **STS-3** and **STS-1** lists, select the slot numbers.
For SDH, in the **AU-3** and **AUG-x** lists, select the AU and AUG numbers.

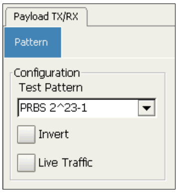
3c. Select the **Enable TCM** check box if needed.

3d. For non-concatenated HOP, select the LOP from the **LOP TX/RX** tab if required.

For SONET, select the **VTG** and **VT1.5** slot numbers.

For SDH, select the **TU-x** and **TUG-x** numbers.

4. Press the **Pattern** node.



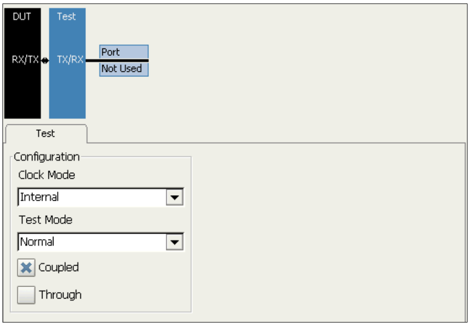
4a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.

5. The test setup has been successfully created.
6. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *OTN Tabs* on page 129, *SONET Tabs* on page 167, *SDH Tabs* on page 249, *BERT Tabs* on page 335, *Advanced Tabs* on page 341, and *Common Tabs* on page 349.
7. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

Creating an OTN Overclocked (OTU1e/OTU2e/OTU1f/OTU2f) Test Case (FTB-8130, FTB-8130NG, and FTB-8130NGE)

To create an OTN overclocked test on an FTB-8130, FTB-8130NG, or FTB-8130NGE module:

1. Test configuration:



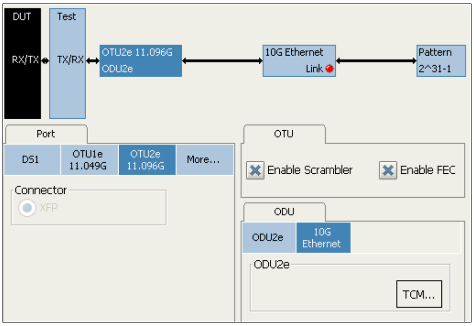
1a. Select the source **Clock Mode** that will be used for the test. Refer to *Clock Configuration* on page 101 for more information.

1b. Select **Normal** as the **Test Mode**. Refer to Test Configuration *on page 98* for more information.

1c. Make sure the **Coupled** check box is selected.

1d. Select the **Through** check box to loop the RX signal to the TX port. The **Clock Mode** is automatically set to **Recovered** when the **Through** check box is selected.

2. Press the **Port** node.



2a. Press **More** to see all available interfaces and press the desired interface: **OTU1e (11.049G)**, **OTU2e (11.096G)**, **OTU1f (11.270G)** or **OTU2f (11.317G)**.

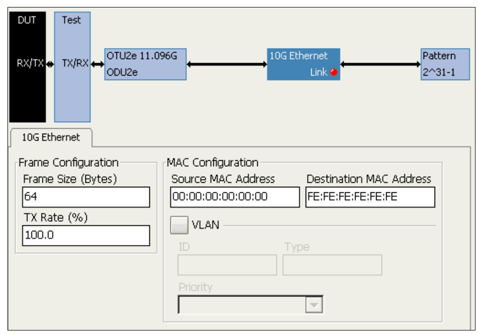
2b. Under OTU tab, select the **Enable FEC** and **Enable Scrambler** check boxes if needed. Refer to *FEC TX* on page 130 and *OTU TX* on page 133 for more information.

2c. Under ODU tab, select **10G Ethernet** as the mapping.

Link, located on the 10G Ethernet node, indicates the link status of the 10G Ethernet RX signal. A green LED indicates a link up while a red LED indicates a link down.

2d. Press the TCM button and select ODU TCM (**TCM1** to **TCM6**) layers as required.

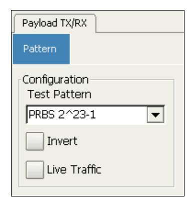
3. Press the 10G Ethernet node.



3a. For OTU1e/OTU2e, if required, select the **10G Ethernet** Ethernet parameters. Refer to *Configuration TX* on page 325 for more information.

4. Press the **Pattern** node.

4a. Set the pattern parameters. Refer to *Pattern TX* on page 335 and *Pattern RX* on page 338 for more information.



5. The test setup has been successfully created.
6. For additional configuration parameters and results, refer to *Summary Tabs* on page 97, *Port Tabs* on page 113, *OTN Tabs* on page 129, *10G Ethernet Tabs* on page 325 (OTU1e/OTU2e only), *BERT Tabs* on page 335, and *Advanced Tabs* on page 341.
7. Press the **Start** button to start the test. Pressing the start button while in test setup window, will automatically switch to the **Alarm** summary tab. Refer to Global Test Status and Controls *on page 31* for more information on test management.

7 Smart Mode

SmartMode allows to automatically identify the structure of the selected SONET/SDH signal rate that is connected to the **Transport Blazer** module. The identified signal structure can then, be used to simplify the setup of a test case. **SmartMode** allows also to monitor the basic SONET/SDH alarms/errors of each layer of the discovered signal structure.

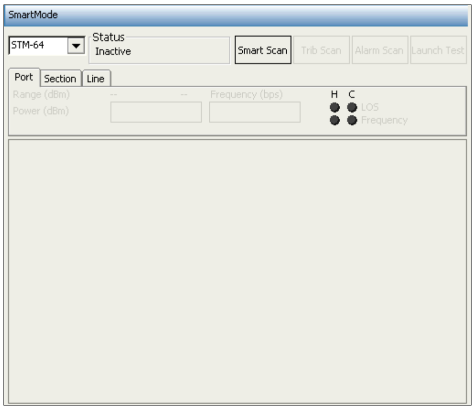
Note: *SmartMode is not available when a test is running. No other test functions are available when SmartMode is running (Smart Scan, Trib Scan or Alarm Scan).*

The **Smart Mode** window is displayed by default when the GUI is started

The following sections describe the **SmartMode** usage:

SmartMode Interface Description

Press  .



➤ **Not Scanned. Click here or on the Smart Scan button to scan** and **Smart Scan**: Allows starting the signal scan of the selected interface to discover the high order path (HOP) signal structure. Make sure that the selected interface rate corresponds to the interface connected to the module. A **Smart Scan** takes about 5 seconds to discover the signal structure. This button gives the same result as the **Smart Scan** button but it is only available the first time the **SmartMode** is run.

- **Status**: Indicates the status of the **SmartMode**. Possible choices are:

  Stopped indicates that **SmartMode** did not run yet.

  Inactive indicates that **SmartMode** is not running or not available.

  Smart Scan In-Progress indicates that the **Smart Scan** is scanning the selected/connected signal. Once the signal has been scanned, the **Alarm Scan In-Progress** message is displayed indicating that the **Alarm Scan** is running.

  Trib Scan In-Progress indicates that the **Trib Scan** is discovering the LOPs of the selected timeslot. Once the tributaries have been discovered, the **Alarm Scan In-Progress** message is displayed indicating that the Alarm Scan is running.

  Alarm Scan In-Progress indicates that the **Alarm Scan** is continuously scanning the alarms/errors.

- **Interface**: Allows the selection of the SONET/SDH interface connected to the module that will be used for the **Smart Scan**. Choices are:

  For SONET: **STS-1e**, **STS-3e**, **OC-3**, **OC-12**, **OC-48**, **OC-48 (OTU1)**, **OC-192**, and **OC-192 (OTU2)**.

  For SDH: **STM-0e**, **STM-1e**, **STM-1**, **STM-4**, **STM-16**, **STM-16 (OTU1)**, **STM-64**, and **STM-64 (OTU2)**.

  Choices depend on the rates available on the FTB-8100 Series module. The default setting is the highest rate supported by the module. The default highest rate will be SONET when both SONET and SDH are supported by the module. OTU1 and OTU2 structures are not scanned, only the SONET/SDH part of the OTN signal is scanned.

- **Smart Scan** button: Allows starting the signal scan of the selected interface to discover the high order path (HOP) signal structure. Make sure that the selected interface rate corresponds to the interface connected to the module. A Smart Scan takes about 5 seconds to discover the signal structure. The Smart Scan button gives the same result as the **Not Scanned. Click here or on the “Smart Scan” button to scan** button.

- **Trib Scan** button: Allows starting the **Trib Scan** of the selected HOP to discover its low order path (LOP) information. This button is only available when the selected timeslot contains LOPs (VT/TU/TUG equipped). A **Trib Scan** takes about 5 seconds to discover the signal structure.
- **Alarm Scan** button: Allows to monitor the **Port**, **Section**/**MS**, **Line**/**RS**, **HOP**, and **LOP** alarms and errors. **Alarm Scan** is automatically started after a successful **Smart Scan** or **Trib Scan**. **Alarm Scan** displays the information of the selected timeslot or tributary. The alarm scan monitors in parallel all the HOPs discovered during the scan as well as the LOPs of the selected HOP.
- **Launch Test**: Allows creating and starting the test case based on the scanned signal for the selected path. This automatically stops the **Alarm Scan** and disables the **SmartMode** functionality with the exception of the **Report**. To re-enable access to the **SmartMode** functions, the test must be cleared.

  Note that the default test preferences will be used for the test. For example, the laser will be Off if not enabled from the *Default Test Preferences* on page 382. However, the laser can be enabled once the test is started from the Test Setup or from the **Port TX** tab; first stop the test, enable the laser and re-start the test.

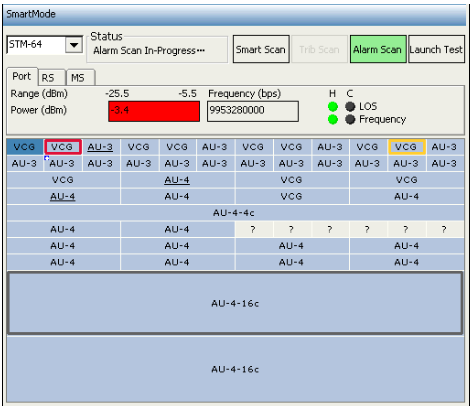
Using SmartMode for Alarm/Error Monitoring

Note: *The default test preferences will be used for alarm/error monitoring. Refer to* Default Test Preferences *on page 382 for the list of test preferences.*

To monitor alarms/errors using SmartMode:

1. Select the OTN/SONET/SDH signal interface rate corresponding to the signal connected to the module.
2. Press either the **Not Scanned. Click here or on the “Smart Scan” button to scan** or the **Smart Scan** button.

   The structure of the signal is displayed when the scan succeeds; otherwise, a LOS is declared. If the scan failed, make sure the selected interface rate corresponds to the signal connected to the module.



Frequency indicates current and history frequency alarm. Refer to *Port RX (Optical Interfaces)* on page 126 for more information.

LOS indicates current and history LOS alarm. Refer to *Port RX (Optical Interfaces)* on page 126 for more information.

Range indicates the minimum and maximum optical power values necessary to meet the standard BER for the test interface.

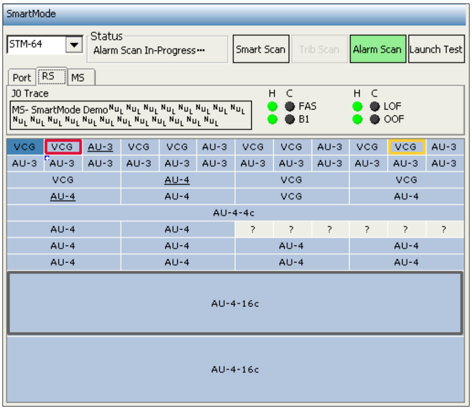
Power indicates the power level of the input signal in dBm. The background color of the **Power** field indicates the input presence as follow:

Background color	Description
Green	Power level in-range.
Yellow	Power level out of operational range.
Red	Power level crosses the “Close-to-damage” threshold.
Grey	LOS or invalid operational range value reported by the optical device (SFP/XFP).

Frequency (bps) indicates the received signal frequency in bps.

Note: *The port statistics are only refreshed (live) when the alarm scan is running.*

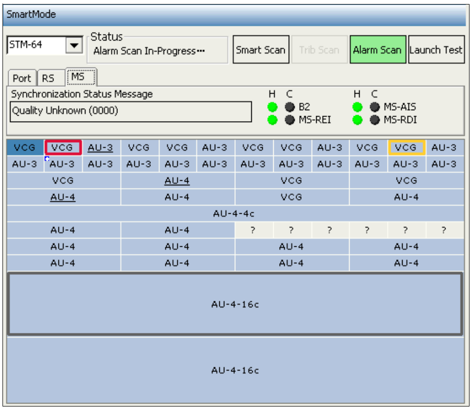
3. To see the **Section/RS** analysis, press the signal button and press the **Section/RS** tab.



J0 Trace indicates the J0 Trace value. Refer to *J0 Trace* on page 173 (SONET) or page 254 (SDH) for more information.

B1, LOF and **SEF** indicates Section/RS alarms/errors. Refer to *Section RX (SONET)* on page 172 and *Regenerator Section RX (SDH)* on page 255 for more information.

4. To see the **Line**/**MS** analysis, press the signal button and press the **Line**/**MS** Tab.

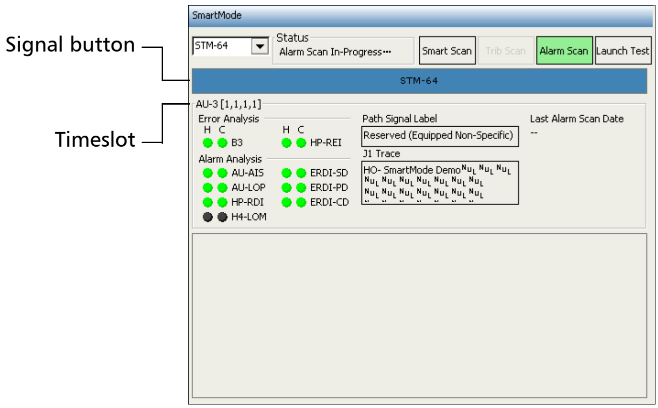


Synchronization Status message indicates the received synchronization status of the NE. Refer to *APS/Advanced Line OH TX/RX (SONET)* on page 186 and *Multiplex Section APS/Advanced OH TX/RX (SDH)* on page 268 for more information.

B2, **REI-L**, **AIS-L**, and **RDI-L** indicates **Line**/**MS** alarms/errors. Refer to *Line RX (SONET)* on page 178 and *Multiplex Section RX (SDH)* on page 261 for more information.

5. Selection of a timeslot for alarm/error analysis

Press a timeslot to select it. The alarms/errors displayed correspond to the selected timeslot. The following screen is displayed when a timeslot is selected. To select a different timeslot or to return to the signal analysis, press the signal button.



Timeslot indicates the selected path number being monitored.

Error Analysis gives current and history status of the main errors. Refer to *SONET Tabs* on page 167 or *SDH Tabs* on page 249 for the error descriptions.

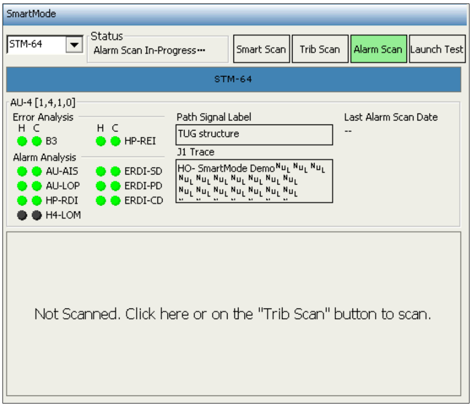
Alarm Analysis gives current and history status of the main alarms. Refer to *SONET Tabs* on page 167 or *SDH Tabs* on page 249 for the alarm descriptions.

Last Alarm Scan Date indicates the date and time of the last **Alarm Scan**. The date is only displayed when the **Alarm Scan** is stopped.

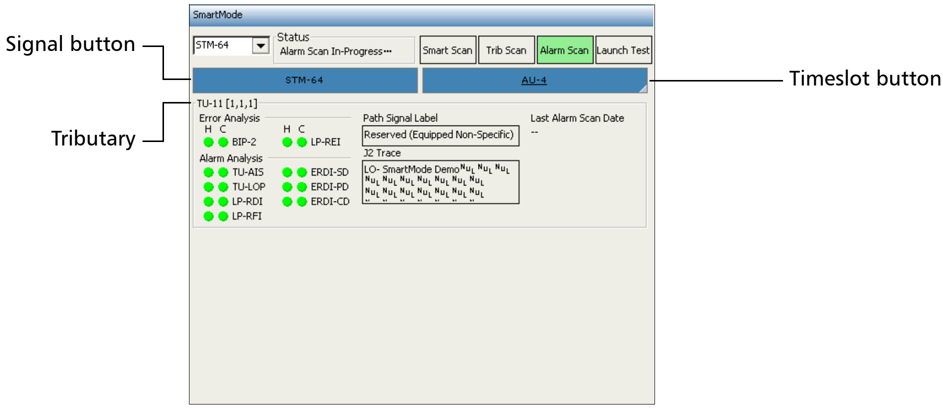
Path Signal Label (C2) indicates the path signal label of the selected timeslot. Refer to *Path Signal Label (C2)* on page 201 (SONET) or page 280 (SDH) for more information.

J1 Trace indicates the J1 Trace value of the selected timeslot. Refer to *J1 Trace* on page 199 (SONET) or page 297 (SDH) for more information.

6. For VT/TUG structured payload, press VT/TUG structured payload timeslot then, press **Not Scanned. Click here or on the “Trib Scan” button to scan** or **Trib Scan**. The LOP tributaries are displayed.



Press an LOP tributary then, the following tributary analysis is displayed.



To select a different tributary or to return to the timeslot analysis, press the timeslot button.

Tributary indicates the selected timeslot or the number associated to the virtual tributary or tributary unit.

Error Analysis gives current and history status of the main errors. Refer to *SONET Tabs* on page 167 or *SDH Tabs* on page 249 for the error descriptions.

Alarm Analysis gives current and history status of the main alarms. Refer to *SONET Tabs* on page 167 or *SDH Tabs* on page 249 for the alarm descriptions.

Last Alarm Scan Date indicates the date and time of the last **Alarm Scan**. The date is only displayed when the **Alarm Scan** is stopped.

Path Signal Label (V5) indicates the path signal label of the selected tributary. Refer to *Path Signal Label (V5)* on page 211 (SONET) or page 290 (SDH) for more information.

Extended Signal Label indicates the extended signal label of the selected tributary.

Extended Signal Label		
SONET	**SDH**	**Hex value**
Reserved	Reserved	00 to 07
Experimental or development mapping	Experimental mapping	08
ATM mapping	ATM mapping	09
Mapping of HDLC/PPP framed signal	Mapping of HDLC/PPP framed signal	0A
Mapping of HDLC/LAPS framed signal	Mapping of HDLC/LAPS framed signal	0B
Virtually Concatenated O.181 test signal	VCAT test signal, O.181 specific mapping	0C
GFP mapping	GFP mapping	0D
Reserved for proprietary use	Reserved	D0 to DF
Reserved	Reserved	FF

J2 Trace indicates the **J2 Trace** value for the selected tributary. Refer to *J2 Trace* on page 209 (SONET) or page 285 (SDH) for more information.

Last Trib Scan indicates the date and time of the last **Trib Scan**.

Creating and Starting a Test Case Using SmartMode

Note: *The default test preferences will be used for the test. For example, the laser will be Off if not enabled from the* Default Test Preferences *on page 382.*

To setup a test case using SmartMode:

1. Select the SONET/SDH signal corresponding to the signal connected to the module.
2. Press either **Not Scanned. Click here or on the "Smart Scan" button to scan** or **Smart Scan**. A **Trib Scan** is also required for LOP test purposes otherwise, a HOP test case will be created even if the signal contains LOP.
3. The structure of the signal is displayed when the scan succeeds. If the scan succeeds, press **Launch Test** to start the test.

Note: *The user must select the desired HOP and LOP timeslots before pressing* ***Launch Test*** *otherwise, the first valid timeslot scanned will be used.*

Legend

SmartMode uses visual indicators to identify particular information like alarms/errors, structured payload, selected timeslot/tributary, VCG, etc. The following table shows the different indicators.

Visual Indicator	Indicator Description	Description	Apply to
	Light blue color	Not selected	Timeslot, Tributary
	Dark blue color	Selected	Signal, Timeslot, Tributary
	Red color	Current alarm/error	
	Yellow color	History alarm/errors	
	Light gray color	Unequipped	Timeslot, Tributary
AU-3	Underlined timeslot (STS-1 is used as example)	VT/TUG Structured Payload	Timeslot
AU-3	Underlined timeslot with a little triangle in the bottom-right corner (STS-1 is used as example)	VT/TUG Structured payload Scanned. The little triangle summarizes LOP alarms/errors.	
AU-3	Little blue square in the top-left corner (STS-1 is used as example	Pointer Adjustment	Timeslot, Tributary
TU-12	Low Order Path (LOP)	Type of payload Examples: VCG, VT1.5, etc.	Tributary
?	Light gray background color with a question mark (?)	Unidentified	Timeslot, Tributary

8 Summary Tabs

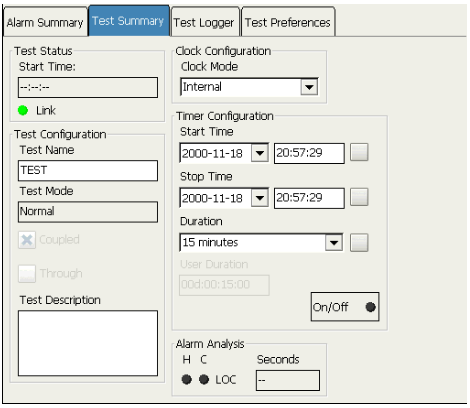
The summary tabs allow to configure the test parameters and to view the test status and results.

Test Summary

Gives the test configuration, status, preferences, and timer configuration.

Press 

, and **Test Summary**.

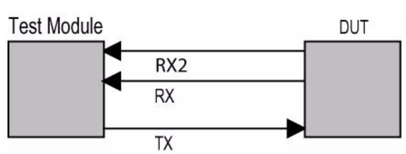


Test Status

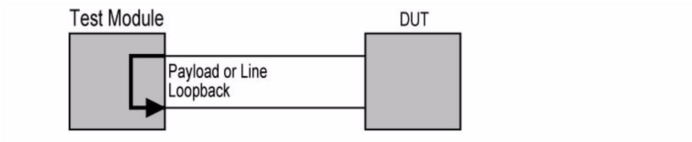
- **Start Time**: Indicates the date and time the test has been started. The date and time reset every time the test is restarted. The default time format is ISO (yyyy-mm-dd hh:mm:ss) unless otherwise set from the *Application Preferences* on page 380.
- **Link**: Indicates the status of the 10G Ethernet RX signal. Only available with OTU1e/OTU2e interface when **10G Ethernet** is selected.

Test Configuration

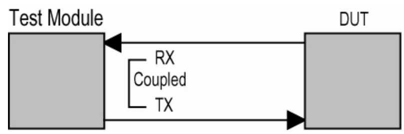
- **Test Name**: The name of the test connection is used to identify the test. A maximum of 8 characters are allowed. The default setting is **TEST**.
- **Test Mode**: Indicates the selected test mode.
  - **Normal**: Indicates that the unit is monitoring a signal in coupled/decoupled and/or through mode.
  - **Dual RX**: Indicates that the FTB-8105/15/20/30 unit is monitoring two DS1 or DS3 signals at the same time. Both RX ports are coupled at the exception of the termination mode. Du**al RX** is not available then the AUX connector is used for synchronization (refer to Clock Synchronization *on page 372* for more information).



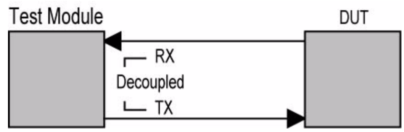
- **NI/CSU Emulation**: Indicates that the FTB-8105/15/20/30 unit is emulating the loopback capabilities of a network device in order to respond to an incoming loopback code of a DS1 signal. It can also be used to manually configure a payload or DS1 loopback adapted to the frame format.



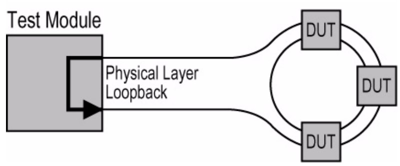
- **Coupled**:
  - Indicates that both TX and RX parameters are coupled when the **Coupled** check box is selected.



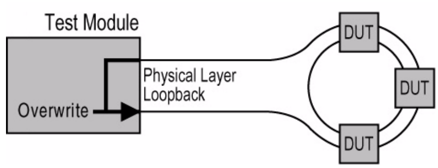
  - Indicates that TX and RX parameters are independent (decoupled) when the **Coupled** check box is cleared.



- **Through**: When enabled, indicates that the RX signal is looped to the TX port.



- **OTN Intrusive** and **SONET/SDH Intrusive** are mutually exclusive. When enabled, indicates that the RX signal is looped to the TX port with limited TX overwrite capabilities (For **SONET/SDH Intrusive**: OH and alarm/error generation). **SONET/SDH Intrusive** and **OTN Intrusive** are not available on FTB-8105/FTB-8115.



- **Test Description**: The test description is used to describe the test case. A maximum of 64 ASCII characters are allowed.

Clock Configuration

Note: ***Clock Mode*** *is only available when the test is not started.* ***External*** *and* ***Backplane*** *clock modes are not available with the OTU1e, OTU2e, OTU1f, and OTU2f interfaces.*

Clock Mode allows the clock source selection that will be used for the test.

Internal: Internal clock of the unit (STRATUM 3).

External: Clock from the connected DS1/E1/2M external clock signal (AUX-BNC port). Refer to *Clock Synchronization - RX* on page 374 to complete the external clock settings.

Recovered: Clock from the test optical/electrical port input signal. Recovered is the only choice available when the **Test Mode** is set to **Through** mode.

Alarm Analysis

LOC indicates that the FTB-8100 Series is unable to synchronize with the selected test clock.

Timer Configuration

Allows to automatically start and/or stop a test case at a given time or for a specific duration.

➤ **Start Time**: Allows the selection of the specific time the created test case will automatically start. The start time check box has to be checked to be included in the test timer.

Note: *A valid start time has to be subsequent to the current time.*

➤ **Stop Time**: Allows the selection of the specific time the test case will automatically stop. The stop time check box has to be checked to be included in the test timer.

Note: *A valid stop time has to be subsequent to the current time or to the start time, when enabled. The Stop Time must not exceed 30 days based on the start time. Stop Time cannot be enabled while Duration is enabled.*

➤ **Duration**: Allows the selection of the test duration based on the test case start time. The test case start time can be the time the user presses the start button or the time the test is automatically started when the Start Time has been enabled. The Duration check box has to be checked to be included in the test timer. Choices are **15 minutes**, **1**, **2**, **24**, **48**, **72 hours**, **7 days**, or **User Defined** (see User Duration below). The default setting is 15 minutes.

Note: *Duration cannot be enabled while Stop Time is enabled. When the test is started while duration is enabled, the stop time is calculated and the Stop Time field is updated to indicate the time the test will stop.*

➤ **User Duration**: Allows the selection of the test duration when **User Defined** has been selected for duration. Choices are from **1** second to **30 days**. The default setting is **15 minutes**.

- **On/Off** button allows enabling the test timer. An error message is displayed and the test timer is not enabled when the provided start time or stop time is not valid. It is not possible to enable the test timer while the test is running. When the timer is enabled (On), it is possible to disable it even when the test is running. This setting is disabled (Off) by default.

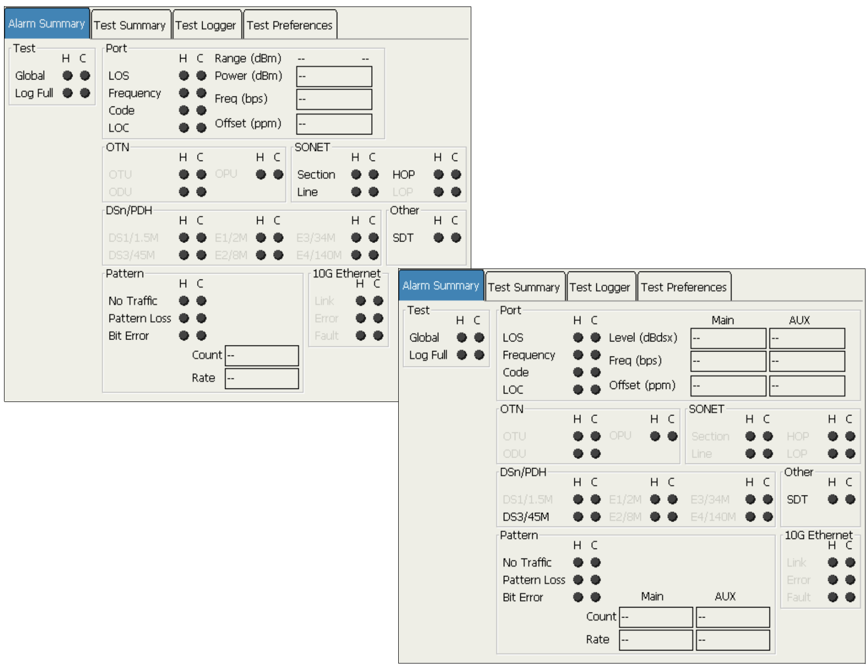
  When test timer is enabled, it is possible to manually stop a test case using the main test case Stop button. However, it is not possible to start the test case when the **Start Time** is enabled.

  The test timer is automatically disabled either when the user manually stops the test, or when the given stop time or duration has expired.

Alarm Summary

Press  , and **Alarm Summary**.

The alarm summary gives current and history summary of alarms and errors encountered during the test.



Note: *The list of available alarms and errors depends on the test case.*

- **Test**

  Global: Indicates the presence of any alarms/errors related to the test such as **Port**, OTN, SONET/SDH, DSn/PDH, Pattern, and **Other**.

  Log Full: Indicates that the logger reched it maximum capacity of 500 events.

- **Port**: Indicates the presence of any alarms/errors related to the physical port such as **LOS**, **Frequency**, **LOC**, and **Code Errors** (for electrical port: BPV, EXZ, or CV errors). Also indicates the port power measurement **Power (dBm)** and **Range (dBm)** for optical port, frequency **Freq (bps)**, and **Offset (ppm)**. For **Dual RX** test case, the measurement are available for both the Main (test port) and AUX ports. Refer to *Port Tabs* on page 113 for more information.

- **OTN**: Indicates the presence of any alarms/errors related to the OTN such as **OTU**, **ODU** (includes ODU TCM alarms), and **OPU**. Refer to *OTN Tabs* on page 129 for more information.

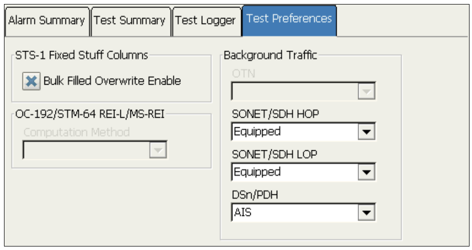
- **SONET/SDH**: Indicates the presence of any alarms/errors related to SONET/SDH testing such as **Section/RS**, **Line/MS**, **HOP** (High Order Path), and **LOP** (Low Order Path). Refer to *SONET Tabs* on page 167 and *SDH Tabs* on page 249 for more information.

- **DSn/PDH**: Indicates the presence of any alarms/errors related to DSn/PDH testing such as **DS1/1.5M**, **DS3/45M, E1/2M**, **E2/8M**, **E3/34M**, and **E4/140M**. Refer to *DSn Tabs* on page 213 and *PDH Tabs* on page 301 for more information.

- **10G Ethernet**: Indicates the presence of any alarms/errors related to 10G Ethernet testing such as **Errors** (**FCS**, **Jabber**, **Runt**, **Oversize** when enabled (refer to *Oversize Monitoring on page 331*), **Undersize**, **Block Error**, **Out-of-sequence**, or **Frame Loss**), **Link**, and **Fault**. Refer to *10G Ethernet Tabs* on page 325 for more information.
- **Pattern**: Indicates the presence of any alarms/errors related to pattern testing such as **Bit Error**, and **Pattern Loss**. Indicates also the **Bit Erro**r rate and count for both **Main** (test port) and **AUX** ports. Refer to *BERT Tabs* on page 335 for more information.
- **Other**: Indicates all other alarms/errors such as **SDT**. Refer to *Service Disruption Time (SDT)* on page 341 for more information.

Test Preferences

Press  , and **Test Preferences**.



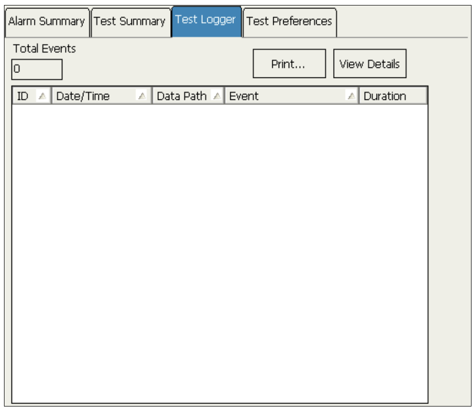
This window allows the configuration of the **STS-1 Fixed Stuff Column**, **OC-192/STM-64 REI-L/MS-REI**, and **Background Traffic** parameters.

Note: *Refer to* Default Test Preferences *on page 382 for the description of each parameter.*

Test Logger

Press  , and **Test Logger**.

The **Test Logger** tab lists the test status/events.



Total Events

Indicates the total number of recorded events.

Note: *The Logger lists a maximum of 500 events, over that amount the logger stops recording and the log full alarm is activated.*

Logger Table

An event is automatically listed in the logger and saved on the hard drive in case a power failure condition occurs.

The logger is cleared when one of the following conditions is met:

- ➤ A test case is stopped and restarted.
- ➤ The test case is cleared.
- ➤ When pressing (Reset).

Events are listed by **ID - Date/Time** by default. Events can also be sorted by **Data Path** or **Event** by pressing on the corresponding column title.

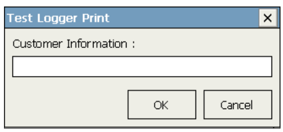
- ➤ **ID**: Indicates the Event number. Events are sequentially numbered.
- ➤ **Date/Time**: Indicates the date and time the Alarm/Error condition has been detected.
- ➤ **Data Path**: Indicates the origin of the alarm/error. [P1] and [P2] in the data path represent respectively the Port 1 and Port 2.
- ➤ **Event**: Indicates the alarm/error type.
- ➤ **Duration**: Indicates the number of seconds (day:hour:minute:second format) within which the alarm/error occurred.

Note: *In the Duration column,* ***Pending*** *indicates that the alarm/error condition persists or was persisting when the test was stopped.*

Print

Allows printing the list of logger entries. **Print** is only available when the test is stopped.

Press **Print**.



Customer Information is used to identify the printed logger. A maximum of 20 characters are allowed.

OK: Press **OK** to print the logger.

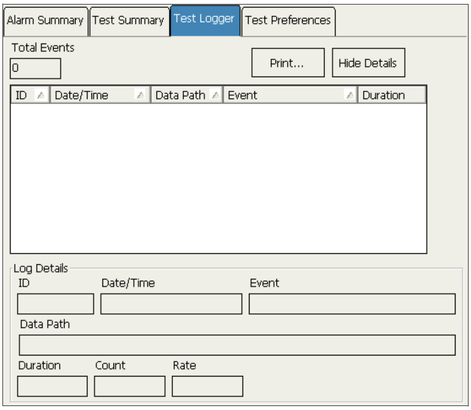
During the printing process, it is possible to press **Abort Printing** to abort the logger printing.

The printing process starts by checking if a valid printer (supported printers are **Printek MT2B** and **Printek MT2**) is connected to the PCMCIA interface card and is ready. If no printer is available, the printing will abort and an error message will be displayed (refer to *Solving Common Problems* on page 401 for more information).

Cancel: Press **Cancel** to abort printing and close the print window.

View/Hide Details

Allows to show detailed information on the selected event. Press **View Details** to display the **Log Details** section and select an event from the logger list. Press **Hide Details** to hide the **Log Details** section.



Log Details

The Log Details section is accessible by pressing **View Details**.

- **ID**: Indicates the event number.
- **Date/Time**: Indicates the date and time the alarm/error condition has been detected.
- **Event**: Indicates the Alarm/Error type.
- **Data Path**: Indicates the origin of the alarm/error. [P1] and [P2] in the data path represents respectively the **Port 1** and **Port 2**.
- **Duration**: Indicates the number of seconds (day:hour:minute:second format) within which the alarm/error occurred.
- **Count**: Indicates the number of occurrences of the error.
- **Rate**: Indicates the error rate.

Note: *In the **Duration**, **Count** and **Rate** columns, **Pending** indicates that the alarm/error condition persists or was persisting when the test was stopped.*

9 Port Tabs

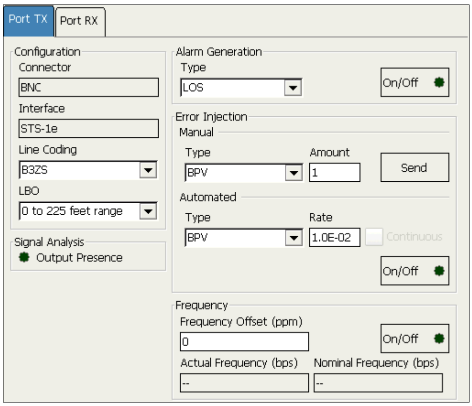
This section describes the electrical and optical port tabs.

Note: *The available tabs listed are a function of the test path activated.*

a. Not available on the FTB-8105.

Port TX (Electrical Interfaces)

Press **Main Menu**, **Test**, **Port**, and **Port TX**.



Configuration

- **Connector**: Indicates the physical port used for the test. For electrical port, possible connectors are: **Bantam** (port labelled **1.5M/2M**) or **BNC** (port labelled **2M/8M/34M/45M/52M/140M/155M**).
- **Interface**: Indicates the interface used for the test. Possible interfaces are: **DS1** or **E1** for the **Bantam** and **RJ-48C** connectors, and **STS-3e, STS-1e, STM-1e, STM-0e, DS3, E4, E3, E2**, or **E1** for **BNC** connector.

➤ Line Coding

Signal	Line Coding	Default setting
DS1	**AMI** and **B8ZS**	**B8ZS**
DS3	**B3ZS**	**B3ZS**
E1	**AMI** and **HDB3**	**HDB3**
E2	**HDB3**	**HDB3**
E3	**HDB3**	**HDB3**
E4	**CMI**	**CMI**
STS-1e/STM-0e	**B3ZS**	**B3ZS**
STS-3E/STM-1e	**CMI**	**CMI**

- **LBO** (Line Build Out): The **LBO** allows to meet the interface requirements over the full range of cable lengths. **LBO** is not available with E1, E2, E3, and E4 interfaces.

  For DS1:
  Preamplification values: **+3.0 dBdsx (533-655 ft)**, **+2.4 dBdsx (399-533 ft)**, **+1.8 dBdsx (266-399 ft)**, **+1.2 dBdsx (133-266 ft)**, and **+0.6 dBdsx (0-133 ft)**.
  Cable simulation (CSU Emulation mode) values: **0.0 dBdsx**, **-7.5 dBdsx**, **-15.0 dBdsx**, and **-22.5 dBdsx**.

  For DS3: **0 to 225 feet range**, **225 to 450 feet range**, and **Cable Simulation 900 ft)**.

  For STS-1e/STM-0e: **0 to 225 feet range**, **225 to 450 feet range**, and **Cable Simulation 900 ft)**.

  For STS-3e/STM-1e: **0 to 225 ft**.

Signal Analysis

Output Presence: Indicates the presence of a signal at the output port (green) or not (gray).

Alarm Generation

- **Type**

  LOS (Loss Of Signal): Turns off the output port signal.

- **On/Off** button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

➤ **Type**: The following error types are available with both manual and automated injection mode.

  BPV (DSn) or **CV** (PDH)

  EXZ (Excessive Zeros) is only available with DS1 and DS3 interfaces.

  The default setting is **BPV/CV**.

➤ **Amount**: Select the amount of error to be generated.

  Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

➤ **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.

➤ **Continuous**: **Continuous**, when activated, generates the selected error to its theoretical maximum. This setting is disabled by default.

➤ **On/Off** button: The **On/Off** button is used to activate/deactivate the selected automated error at the rate specified or continuously when continuous is enabled. This setting is disabled (Off) by default.

Frequency

Note: *Frequency offset generation is not available for 10Base-T test.*

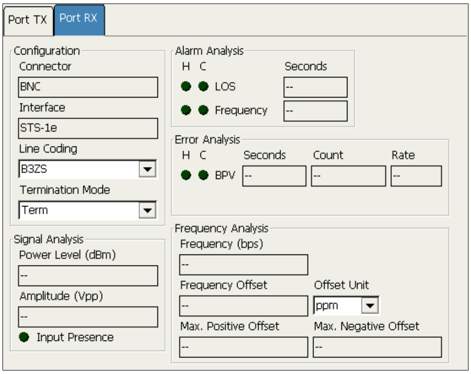
- **Frequency Offset (ppm)**: Allows entering a positive or a negative frequency offset in ppm. Choices are listed in the table below. The default setting is **0**. The frequency offset value can be changed on the fly even when activated (On).
- **Actual Frequency (bps)**: Indicates the frequency (actual frequency + Frequency offset) that will be used for transmission.
- **Nominal Frequency (bps)**: Indicates the nominal frequency of the signal. The nominal frequencies are listed in the table below.
- **On/Off** button: Allows enabling the frequency offset generation. This setting is disabled (Off) by default.

Interface	Frequency Offset[a]	Nominal Frequency
DS1	±140 ppm	1544000 bps
E1	± 70 ppm	2048000 bps
E2	± 50 ppm	8448000 bps
E3	± 50 ppm	34368000 bps
DS3	± 50 ppm	44736000 bps
STS-1e/STM-0e	± 50 ppm	51840000 bps
E4	± 50 ppm	139264000 bps
STS-3e/STM-1e	± 50 ppm	155520000 bps

a. The frequency offset range is guaranteed for a source signal at 0 ppm. In the event that the source signal already has an offset then, the output signal may exhibit an offset larger than the range specified.

Port RX (Electrical Interfaces)

Press **Main Menu**, **Test**, **Port**, and **Port RX**.



Configuration

Note: *See* Configuration *on page 114 for more information on **Connector**, **Interface**, and **Line Coding**.*

Termination Mode

Choices are: **Term, Mon,** and **Bridge**. **Bridge** is only available for DS1/E1 interfaces.

Alarm Analysis

Possible alarms that can be detected are:

- **LOS** (Loss Of Signal): The **LOS** alarm indicates absence of an input signal or an all-zeros pattern was detected.
- **Frequency**: The frequency alarm indicates if the received signal rate meets the standard rate specifications (green) or not (red).

Interface	Standard Rate Specification
DS1	1544000 ±57 bps (±36.6 ppm)
E1	2048000 ±112 bps (±54.6 ppm)
E2	8448000 ±293 bps (±34.6 ppm)
E3	34368000 ±846 bps (±24.6 ppm)
DS3	44736000 ±1101 bps (±24.6 ppm)
STS-1e/STM-0e	51840000 ±1276 bps (±24.6 ppm)
E4	139264000 ±2730 bps (±19.6 ppm)
STS-3e/STM-1e	155520000 ±3826 bps (±24.6 ppm)

Error Analysis

Possible errors that can be detected are:

- For DS1 and DS3

  BPV (Bipolar Violation): A **BPV** error indicates that pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.

  EXZ (Excessive Zeros)
  For **DS1** with **AMI Line Coding**: Indicates that more than 15 consecutive bit periods with no pulses have been received.
  For **DS1** with **B8ZS Line Coding**: Indicates that more than 7 consecutive bit periods with no pulses have been received.
  For **DS3**: Indicates that more than 2 consecutive bit periods with no pulses have been received.

- For E1, E2, E3, E4, STS-1e/STM-0e, and STS-3e/STM-1e

  CV (Code Violation): A **CV** error indicates that pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.

Signal Analysis

- **Power Level**: Indicates the power level of the input signal in dBm for E1, E2, E3, E4, STS-1e/STM-0e, and STS-3e/STM-1e. In order to get accurate power level reading (within specified tolerance), an all-ones signal must be present at the interface under test otherwise this value only provide indicative reading.
- **Level (Vref = 6.00 Vpp) / Level (Vref = 1.21 Vpp)**: Presents the received signal level in dBdsx for respectively DS1 and DS3. The dBdsx values are calculated with the following expressions:
  For DS1: 20 log (Vpp measured / 6.00)
  For DS3: 20 log (Vpp measured / 1.21)
- **Amplitude**: Indicates the amplitude of the input signal in Vpp.
- **Input Presence**: Indicates if there is a signal at the input port (green) or not (gray).

Frequency Analysis

The FTB-8100 Series allows the following frequency monitoring range.

Interface	Standard Rate Specification
DS1	1544000 ±140 ppm
E1	2048000 ±100 ppm
E2	8448000 ±100 ppm
E3	34368000 ±100 ppm
DS3	44736000 ±100 ppm
STS-1e/STM-0e	51840000 ±100 ppm
E4	139264000 ±100 ppm
STS-3e/STM-1e	155520000 ±100 ppm

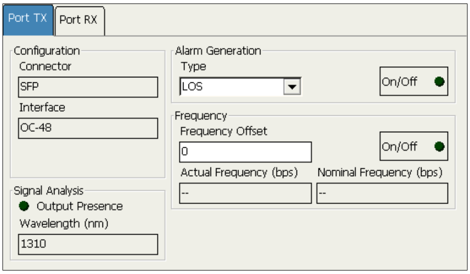
- **Actual Frequency (bps)**: Indicates the frequency of the input signal.
- **Frequency Offset**: Indicates the offset between the standard rate specification and the rate of the input signal.
- **Max. Positive Offset**: Indicates the offset between the standard rate specification and the largest rate recorded from the received signal.
- **Max. Negative Offset**: Indicates the offset between the standard rate specification and the smallest rate recorded from the received signal.

Offset Unit: Allows the selection of the frequency offset unit. Choices are **bps** and **ppm**. The default setting is **ppm**.

Port TX (Optical Interfaces - SONET)

Note: *Available with OTN, SONET, and SDH interfaces.*

Press **Main Menu**, **Test**, **Port**, and **Optical TX**.



Configuration

- **Connector**: Indicates the physical port used for the test. Possible connectors are **XFP** (port labelled **10G/10.7G**) or **SFP** (port labelled **155M-2.7G** or **155M-2.5G**).
- **Interface**: Indicates the test signal rate.

Signal Analysis

- **Output Presence**: Indicates the presence of a signal at the output port (green) or not (grey). The output presence LED is grey when there is no SFP/XFP.
- **Wavelength (nm)**: Indicates the detected SFP/XFP wavelength.Possible values are:
  850, **1310**, **1550 nm**, or **unknown** if the SFP/XFP is missing or not recognized.

Alarm Generation

- **Type: LOS (Loss Of Signal): Turns off the output port laser signal.**
- **On/Off** button: Allows enabling the alarm generation. This setting is disabled (Off) by default.

Frequency

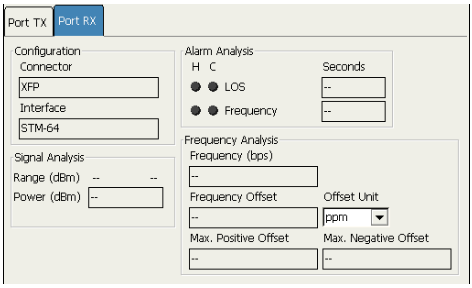
- **Frequency Offset (ppm)**: Allows entering a positive or a negative frequency offset in ppm. The default setting is **0**.
- **Actual Frequency (bps)**: Indicates the frequency (actual frequency + Frequency offset) used for transmission.
- **Nominal Frequency (bps)**: Indicates the nominal frequency of the signal.
- **On/Off** button: Allows enabling the frequency offset generation. This setting is disabled (Off) by default.

Interface	Frequency Offset[a]	Nominal Frequency
OC-3/STM-1	± 50 ppm	155520000 bps
OC-12/STM-4	± 50 ppm	622080000 bps
OC-48/STM-16	± 50 ppm	2488320000 bps
OTU1	± 50 ppm	2666057143 bps
OC-192/STM-64	± 50 ppm	9953280000 bps
OTU2	± 50 ppm	10709225316 bps
OTU1e	± 115 ppm	11049107143 bps
OTU2e	± 115 ppm	11095727848 bps
OTU1f	± 115 ppm	11270089286 bps
OTU2f	± 115 ppm	11317642405 bps

a. The frequency offset range is guaranteed for a source signal at 0 ppm offset. In the event that the source signal already has an offset then, the output signal may exhibit an offset larger than the range specified.

Port RX (Optical Interfaces)

Press **Main Menu**, **Test**, **Port**, and **Optical RX**.



Signal Analysis

- **Range** indicates the minimum and maximum optical power values necessary to meet the standard BER for the test interface.
- **Power (dBm)** indicates the power level of the input signal in dBm. The background color of the **Power Level** field indicates the input presence as follow:

Background color	Description
Green	Power level in-range.
Yellow	Power level out of operational range.
Red	Power level crosses the “Close-to-damage” threshold.
Grey	LOS or invalid operational range value reported by the optical device (SFP/XFP).

Alarm Analysis

- **LOS** (Loss Of Signal) indicates that there is no input signal or an all-zeros pattern on the incoming SONET/SDH signal persists for more than 100 μs.
- **Frequency** alarm indicates that the received signal rate meets the standard rate specifications (green) or not (red).

Interface	Standard Rate Specification
OC-3/STM-1	155520000 ±3826 bps (±24.6 ppm)
OC-12/STM-4	622080000 ±15304 bps (±24.6 ppm)
OC-48/STM-16	2488320000 ±61213 bps (±24.6 ppm)
OTU1	2666057143 ±65585 bps (±24.6 ppm)
OC-192/STM-64	9953280000 ± 244851 bps (±24.6 ppm)
OTU2	10709225316 ± 263446 bps (±24.6 ppm)
OTU1e	11049107143 ± 1155737 bps (±104.6 ppm)
OTU2e	11095727848 ± 1160613 bps (±104.6 ppm)
OTU1f	11270089286 ± 1178851 bps (±104.6 ppm)
OTU2f	11317642405 ± 1183825 bps (±104.6 ppm)

Frequency Analysis

The FTB-8100 Series allows the following frequency monitoring range.

Interface	Measurement range
OC-3/STM-1	155520000 ±100 ppm
OC-12/STM-4	622080000 ±100 ppm
OC-48/STM-16	2488320000 ±100 ppm
OTU1	2666057143 ±100 ppm
OC-192/STM-64	9953280000 ± 100 ppm
OTU2	10709225316 ±100 ppm
OTU1e	11049107143 ±120 ppm
OTU2e	11095727848 ±120 ppm
OTU1f	11270089286 ± 120 ppm
OTU2f	11317642405 ± 120 ppm

Actual Frequency (bps) indicates the frequency of the input signal in bps.

Frequency Offset indicates the offset between the standard rate specification and the rate of the input signal.

Max. Negative Offset indicates the offset between the standard rate specification and the smallest rate recorded from the received signal.

Max. Positive Offset indicates the offset between the standard rate specification and the largest rate recorded from the received signal.

Offset Unit allows the selection of the frequency offset unit. Choices are **bps** and **ppm**. The default setting is **ppm**.

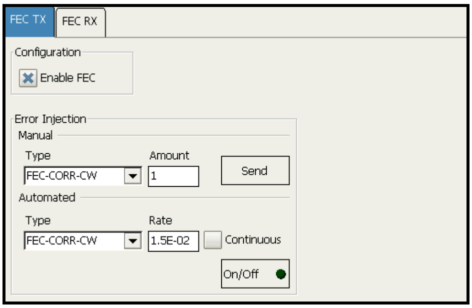
10 OTN Tabs

Note: *OTN tabs are only available for OTU1, OTU2, OTU1e, OTU2e, OTU1f, and OTU2f interfaces. OTN options need to be enabled to be available. Refer to* *Available Options* on page 392 *for more information.*

OTN	Tab	Page
FEC	*FEC TX*	130
	FEC RX	132
OTU2, OTU1, OTU1e, OTU2e, OTU1f, OTU2f	*OTU TX*	133
	OTU TTI TX	136
	OTU RX	137
	OTU TTI RX	140
ODU2 TCM, and ODU1 TCM	*ODU TCM TX*	142
	ODU TCM TTI TX	145
	ODU TCM RX	147
	ODU TCM TTI RX	150
ODU2, and ODU1	*ODU TX*	152
	ODU TTI/FTFL TX	154
	ODU RX	156
	ODU TTI/FTFL RX	158
OPU2, and OPU1	*OPU TX*	161
	OPU RX	164

FEC TX

Press **Main**, **Test**, **OTUk**, **FEC**, and **FEC TX**.



Configuration

Enable FEC allows detecting, reporting and correcting up to 8 symbol errors (Correctable) per codeword. Over 8 symbol errors, they are detected and reported as uncorrectable errors. This setting is enabled by default.

Note: ***Enable FEC*** *must be selected when* ***Enable Scrambler*** *is not selected in order to prevent potential alarms caused by a lack of transition on the optical signal. To disable* ***FEC****, first select* ***Enable Scrambler*** *then clear* ***Enable FEC****. See OTU TX* on page 133 *for more information on* ***Enable Scrambler****.*

Error Injection

Allows manual or automated error injection.

Note: *Error injection is only available when the Enable FEC check box is selected.*

- **Type**: The following error types are available with both manual and automated injection modes. The default setting is **FEC-CORR-CW**.

  FEC-CORR-CW (Forward Error Correction - Correctable - Codeword): Generates 8 symbols (bytes) containing 8 bits in error each, in each codeword.

  FEC-UNCORR-CW (Forward Error Correction - Uncorrectable - Codeword): Generates 16 symbol (bytes) containing 8 bits in error each, in each codeword.

  FEC-CORR-SYMB (Forward Error Correction - Correctable - Symbol): Generates 1 symbol (byte) containing 8 bits in error.

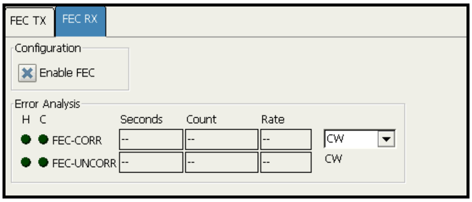
  FEC-CORR-BIT (Forward Error Correction - Correctable - Bit): Generates 1 symbol (byte) containing 1bit in error.

  FEC-STRESS-CW (Forward Error Correction - Stress - Codeword): Generates correctable errors composed of a random number of symbol errors (less or equal to 8) containing a random number of bits distributed all over the OTU frame.

- **Amount**: Select the amount of errors to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.5E-2**.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

FEC RX

Press **Main**, **Test**, **OTN**, **FEC**, and **FEC RX**.



Configuration

Note: *See* OTU TX *on page 133 for more information on* ***Enable FEC****.*

Error Analysis

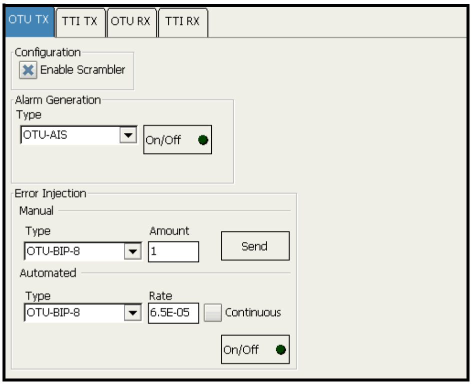
➤ **FEC-CORR** (FEC - Correctable): Gives statistics on codewords/symbols/bits corrected by the FEC.

CW/SYMB/BIT item list: FEC-CORR errors are displayed according with the select statistics. Available statistics are **Codeword** (**CW**), **Symbol** (**SYMB**), and **Bits** (**BIT**). The default setting is **CW** (**Codeword**).

➤ **FEC-UNCORR** (FEC - Uncorrectable): Gives statistics on the detected codewords (CW) having uncorrectable errors.

OTU TX

Press **Main**, **Test**, **OTN**, **OTU**, and **OTU TX**.



Configuration

Note: *Configuration for OTU TX and OTU RX are coupled.*

Enable Scrambler provides enough “0” and “1” transitions on the optical signal for clock recovery. The **Enable Scrambler** check box is selected by default.

Note: ***Enable Scrambler*** *must be selected when* ***Enable FEC*** *is not selected in order to prevent potential alarms caused by a lack of transition on the optical signal. To disable* ***Scrambler****, first select the* ***Enable FEC*** *check box then clear the* ***Enable Scrambler*** *check box. See* *FEC TX* on page 130 *for more information on Enable FEC.*

Error Injection

Allows manual or automated error injection.

- **Type**: The following error types are available with both manual and automated injection mode: **OTU-BIP-8**, **OTU-BEI**, **FAS**, and **MFAS**. The default setting is **OTU-BIP-8**.
- **Amount**: Select the amount of errors to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **6.5E-05**.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

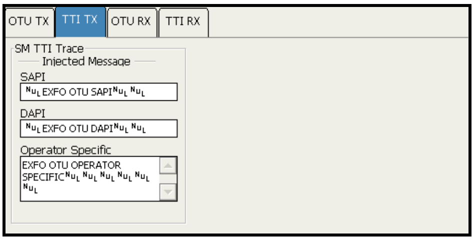
Type: The following alarm types are available. The default setting is **OTU-AIS**.

- **LOF** (Loss Of Frame): Generates error in FAS bits continuously.
- **OOF** (Out-Of-Frame): Generates error in all FAS bits for 5 consecutive OTU frames.
- **LOM** (Loss Of Multiframe): Generates error in MFAS bits continuously.
- **OOM** (Out-Of-Multiframe): Generates error in multiframe number for 5 consecutive OTU frames.
- **OTU-AIS** (OTU - Alarm Indication Signal): Generates polynomial number 11 (PN-11) over all OTU frame bits including FAS and MFAS continuously.
- **OTU-BDI** (OTU - Backward Defect Indication): Generates “1” for the BDI bit in the SM overhead field (byte 3, bit 5) continuously.
- **OTU-IAE** (OTU - Incoming Alignment Error): Generates “1” for the IAE bit in the SM overhead field (byte 3, bit 6) continuously.
- **OTU-BIAE** (OTU - Backward Incoming Alignment Error): Generates “1011” for the BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) continuously.

On/Off button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

OTU TTI TX

Press **Main**, **Test**, **OTN**, **OTU**, and **TTI TX**.



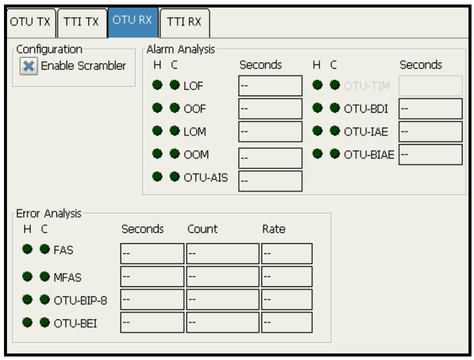
SM TTI Trace

Injected Message

- **SAPI** allows editing the Source Access point Identifier message to be generated (TTI bytes 1 to 15). A maximum of 15 characters are allowed. The default setting is **EXFO OTU SAPI**. The TTI byte 0 is set to NULL (all 0's).
- **DAPI** allows editing the Destination Access point Identifier message to be generated (TTI bytes 17 to 31). A maximum of 15 characters are allowed. The default setting is **EXFO OTU DAPI**. The TTI byte 16 is set to NULL (all 0's).
- **Operator Specific** allows editing the Operator Specific message to be generated (TTI bytes 32 to 63). A maximum of 32 characters are allowed. The default setting is **EXFO OTU OPERATOR SPECIFIC**.

OTU RX

Press **Main**, **Test**, **OTN**, **OTU**, and **OTU RX**.



Configuration

Note: *See* OTU TX *on page 133 for more information on* ***Enable Scrambler****.*

Alarm Analysis

Possible alarms that can be detected are:

- **LOF** (Loss Of Frame): LOF is declared when OOF is present for at least 3 ms.
- **OOF** (Out-Of-Frame): OOF is declared when FAS (bytes 3, 4, and 5) are in error for at least 5 consecutive OTU frames.
- **LOM** (Loss Of Multiframe): LOM is declared when OOM is present for at least 3 ms.
- **OOM** (Out-Of-Multiframe): OOM is declared when MFAS are in error for at least 5 consecutive OTU frames.

- **OTU-AIS** (OTU - Alarm Indication Signal): OTU-AIS is declared when polynomial number 11 (PN-11) is over all OTU frame bits including FAS and MFAS for at least 3 consecutive 8192 bit-interval.
- **OTU-TIM** (OTU - Trace Identifier Mismatch): OTU-TIM is declared when expected SM SAPI and/or SM DAPI do not match the received SM SAPI and/or DAPI for at least 3 consecutive TTI. This alarm is only available when the **Enable TIM SAPI** and/or **DAPI** check boxes are selected from *OTU TTI RX* on page 140.
- **OTU-BDI** (OTU - Backward Defect Indication): OTU-BDI is declared when the BDI bit in the SM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive OTU frames.
- **OTU-IAE** (OTU - Incoming Alignment Error): OTU-IAE is declared when IAE bit in the SM overhead field (byte 3, bit 6) is “1” for at least 5 consecutive OTU frames.
- **OTU-BIAE** (OTU - Backward Incoming Alignment Error): OTU-BIAE is declared when BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) are “1011” for at least 3 consecutive frames.

Note: *Refer to* Alarm/Error Measurements *on page 44* *for H/C LEDs and Seconds information.*

Error Analysis

Possible errors that can be detected are:

➤ **FAS** (Frame Alignment Signal): Indicates the FAS bits in error.

➤ **MFAS** (Multiframe Alignment Signal): Indicates the MFAS bits in error.

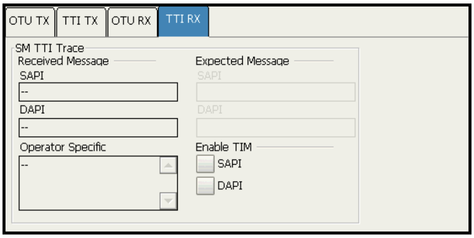
➤ **OTU-BIP-8** (OTU - Bit Interleave Parity-8): Indicates the SM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **OTU-BEI** (OTU - Backward Error Indication): Indicates SM BEI errors received from the DUT (value 0 to 8).

OTU BEI bits (1234)	BIP violations	ODUk BEI bits (1234)	BIP violations
0000	0	0101	5
0001	1	0110	6
0010	2	0111	7
0011	3	1000	8
0100	4	1001 to 1111	0

OTU TTI RX

Press **Main**, **Test**, **OTN**, **OTU**, and **TTI RX**.



SM TTI Trace

Received Message

➤ **SAPI** indicates the received TTI (Trail Trace Identifier) Source Access Point Identifier. When the **Enable TIM SAPI** check box is selected, the SAPI field background becomes pink when there is a mismatch with the expected value and the OTU-TIM alarm is declared.

➤ **DAPI** indicates the received TTI Destination Access Point Identifier. When the **Enable TIM DAPI** check box is selected, the DAPI field background becomes pink when there is a mismatch with the expected value and the OTU-TIM alarm is declared.

➤ **Operator Specific** indicates the received TTI Operator Identifier.

Expected Message

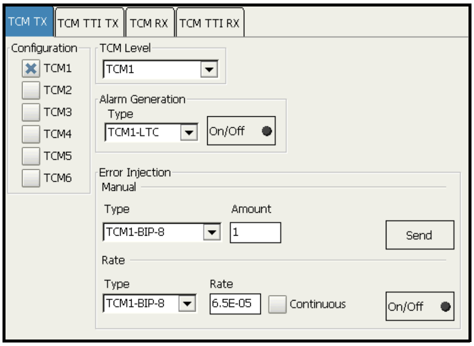
- **SAPI** allows editing the expected Source Access point Identifier (TTI bytes 1 to 15). Available when the **Enable TIM SAPI** check box is selected. The default setting is **EXFO OTU SAPI**. The TTI byte 0 is set to NULL (all 0's).
- **DAPI** allows editing the expected Destination Access point Identifier (TTI bytes 17 to 31). Available when the **Enable TIM DAPI** check box is selected. The default setting is **EXFO OTU DAPI**. The TTI byte 16 is set to NULL (all 0's).

Enable TIM

- **SAPI** allows editing the expected Source Access Point Identifier when the **SAPI** check box is selected. Enables also the OTU-TIM alarm monitoring. The **SAPI** check box is cleared by default.
- **DAPI** allows editing the expected Destination Access Point Identifier when the **DAPI** check box is selected. Enables also the OTU-TIM alarm monitoring. The **DAPI** check box is cleared by default.

ODU TCM TX

Press **Main**, **Test**, **OTN**, **ODU TCM**, and **TCM TX**.



Configuration

TCM1 to **TCM6** allows enabling TCM level 1 to level 6. **TCM1** to **TCM6** are disabled by default.

TCM Level

Allows the selection of the TCM level for alarm/error generation. Choices are from **TCM1** to **TCM6**, but only enabled TCM levels are available.

Alarm Generation

Type: The following alarm types are available. The default setting is **TCMi-LTC**.

- **TCMi-LTC** (TCMi - Loss of Tandem Connection): Generates "000" in the STAT field of TCMi overhead (byte 3, bits 6 to 8) continuously.
- **TCMi-BDI** (TCMi - Backward Defect Indication): Generates a "1" in the BDI bit of the TCMi overhead field (byte 3, bit 5) continuously.
- **TCMi-IAE** (TCMi - Incoming Alignment Error): Generates "1" in the IAE bit of the TCMi overhead (byte 3, bit 6) continuously.
- **TCMi-BIAE** (TCMi - Backward Incoming Alignment Error): Generates "1011" in the BEI/BIAE bits of the TCMi overhead (byte 3, bits 1 to 4) continuously.

On/Off button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

Error Injection

Allows manual or automated error injection.

➤ **Type**: The following error types are available with both manual and automated injection mode: **TCMi-BIP-8**, and **TCMi-BEI**. The default setting is **TCMi-BIP-8**.

➤ **Amount**: Select the amount of errors to be generated.

Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

➤ **Rate**: Press **Rate** field to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **6.5E-05**.

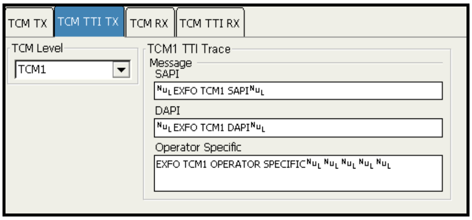
➤ **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or continuously when continuous is enabled. This setting is disabled (Off) by default.

Note: *"i" is the level (1 to 6) of the selected TCM.*

ODU TCM TTI TX

Press **Main**, **Test**, **OTN**, **ODU TCM**, and **TTI TX**.



TCM Level

Allows the selection of the TCM level for alarm/error generation. Choices are from **TCM1** to **TCM6**, but only enabled TCM levels are available (see *TCM Level* on page 142).

TCMi TTI Trace

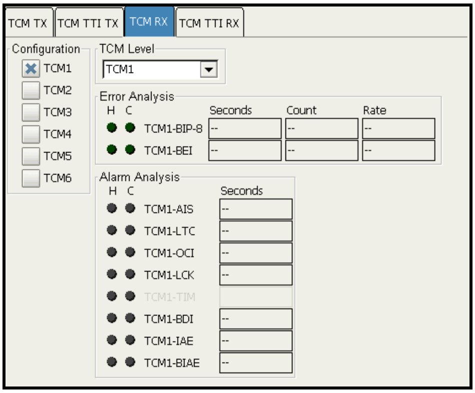
Message

- **SAPI** allows editing the Source Access Point Identifier to be generated (TTI bytes 1 to 15). A maximum of 15 characters are allowed. The default setting is **EXFO TCMi SAPI**. The TTI byte 0 is set to NULL (all 0's).
- **DAPI** allows editing the Destination Access Point Identifier to be generated (TTI bytes 17 to 31). A maximum of 15 characters are allowed. The default setting is **EXFO TCMi DAPI**. The TTI byte 16 is set to NULL (all 0's).
- **Operator Specific** allows editing the Operator Specific to be generated (TTI bytes 32 to 63). A maximum of 32 characters are allowed. The default setting is **EXFO TCMi OPERATOR SPECIFIC**.

Note: *"i" is the level (1 to 6) of the selected TCM.*

ODU TCM RX

Press **Main**, **Test**, **OTN**, **ODU TCM**, and **TCM RX**.



Configuration

TCM1 to **TCM6** allows enabling TCM level 1 to level 6. **TCM1** to **TCM6** are disabled by default.

TCM Level

Allows the selection of the TCM level for alarm/error analysis. Choices are from **TCM1** to **TCM6**, but only enabled TCM levels are available.

Error Analysis

- **TCMi-BIP-8** (TCMi - Bit Interleave Parity-8): Indicates TCMi BIP-8 mismatch between the received value and locally computed value (0 to 8).
- **TCMi-BEI** (TCMi - Backward Error Indication): Indicates that interleaved-bit blocks in error are detected by the corresponding ODUk tandem connection monitoring sink using the BIP-8 code.

ODU TCMi BEI bits (1234)	BIP violations	ODU TCMi BEI bits (1234)	BIP violations
0000	0	0101	5
0001	1	0110	6
0010	2	0111	7
0011	3	1000	8
0100	4	1001 to 1111	0

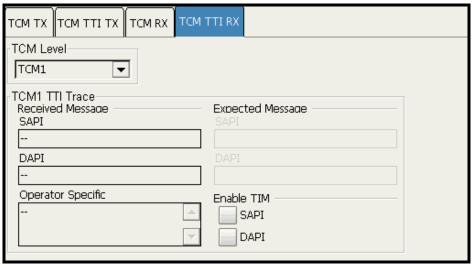
Alarm Analysis

- **TCMi-LTC** (TCMi - Loss of Tandem Connection): TCMi-LTC is declared when the STAT information in the TCMi Byte 3, bits 6, 7, and 8 are “000” for at least 3 consecutive frames.
- **TCMi-TIM** (TCMi -Trace Identification Mismatch): TCMi-TIM is declared when the expected TCMi SAPI and/or TCMi DAPI do not match the received TCMi SAPI and/or TCMi DAPI for at least 3 TTI. This alarm is only available when the Enable TIM SAPI and/or DAPI check boxes are selected from *ODU TCM TTI RX* on page 150.
- **TCMi-BDI** (TCMi - Backward Defect Indication): TCMi-BDI is declared when the BDI bit in the TCMi overhead field Byte 3, bit 5 is “1” for at least 5 consecutive frames.
- **TCMi-IAE** (TCMi - Incoming Alignment Error): TCMi-IAE is declared when the STAT information in the TCMi is “010” for at least 3 consecutive frames.
- **TCMi-BIAE** (TCMi - Backward Incoming Alignment Error): TCMi-BIAE is declared when the BEI/BIAE bits in the TCMi overhead field Byte 3, bits 1 to 4 are “1011” for at least 3 consecutive frames.

Note: *“i” is the level (1 to 6) of the selected TCM.*

ODU TCM TTI RX

Press **Main**, **Test**, **OTN**, **ODU TCM**, and **TTI RX**.



TCM Level

Allows the selection of the TCM level for alarm/error analysis. Choices are from **TCM1** to **TCM6**, but only enabled TCM levels from the ODU TCM tab are available.

TCMi TTI Trace

Received Message

- **SAPI** indicates the received TTI (Trail Trace identifier) Source Access Point Identifier. When the Enable TIM SAPI check box is selected, the SAPI field background becomes pink when there is a mismatch with the expected value and the TCMi-TIM alarm is declared.
- **DAPI** indicates the received TTI Destination Access Point Identifier. When the Enable TIM DAPI check box is selected, the DAPI field background becomes pink when there is a mismatch with the expected value and the TCMi-TIM alarm is declared.
- **Operator Specific** indicates the received TTI Operator Identifier.

Expected Message

- **SAPI** allows editing the expected Source Access point Identifier (TTI bytes 1 to 15). Available when **Enable TIM SAPI** is enabled. The default setting is **EXFO TCMi SAPI**. The TTI byte 0 is set to NULL (all 0's).
- **DAPI** allows editing the expected Destination Access point Identifier (TTI bytes 17 to 31). Available when **Enable TIM DAPI** is enabled. The default setting is **EXFO TCMi DAPI**. The TTI byte 16 is set to NULL (all 0's).
- **Enable TIM**

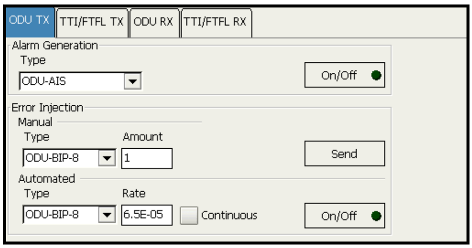
  SAPI allows editing the expected Source Access Point Identifier when the **SAPI** check box is selected. Enables also the TCMi-TIM alarm monitoring. The **SAPI** check box is cleared by default.

  DAPI allows editing the expected Destination Access Point Identifier when the **DAPI** check box is selected. Enables also the TCMi-TIM alarm monitoring. The **DAPI** check box is cleared by default.

Note: *"i" is the level (1 to 6) of the selected TCM.*

ODU TX

Press **Main**, **Test**, **OTN**, **ODU**, and **ODU TX**.



Error Injection

Allows manual or automated error injection.

➤ **Type**: The following error types are available with both manual and automated injection mode: **ODU-BIP-8**, and **ODU-BEI**. The default setting is **ODU-BIP-8**.

➤ **Amount**: Select the amount of errors to be generated. Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

➤ **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **6.5E-05**.

➤ **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

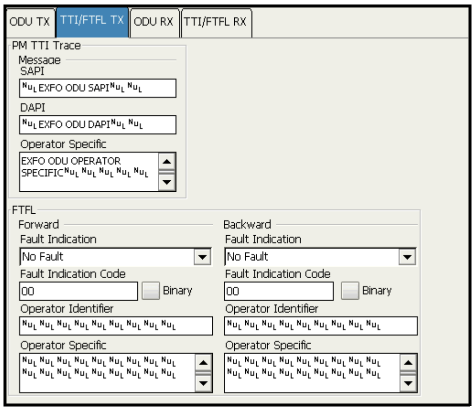
Type: The following alarm types are available. The default setting is **ODU-AIS**.

- **ODU-LOFLOM** (ODU - Loss of Frame Loss Of Multiframe): Generates error continuously in FAS and MFAS of a multiplexed test case. Only available for mapped ODU1 in ODU2.
- **ODU-AIS** (ODU - Alarm Indication Signal): Generates an all "1"s pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH), OTUk overhead (OTUk OH) and ODUk FTFL.
- **ODU-OCI** (ODU - Open Connection Indication): Generates a repeating "01100110" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).
- **ODU-LCK** (ODU - Locked): Generates a repeating "01010101" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).
- **ODU-BDI** (ODU - Backward Defect Indication): Generates a “1” in the BDI (byte 3, bit 5) of the PM overhead field continuously.
- **ODU-FSF** (ODU - Forward Signal Fail): Generates a “00000001” pattern in the FTFL Byte 0 continuously.
- **ODU-BSF** (ODU - Backward Signal Fail): Generates a “00000001” pattern in the FTFL Byte 128 continuously.
- **ODU-FSD** (ODU - Forward Signal Degrade): Generates a “00000010” pattern in the FTFL Byte 0 continuously.
- **ODU-BSD** (ODU - Backward Signal Degrade): Generates a “00000010” pattern in the FTFL Byte 128 continuously.

On/Off button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

ODU TTI/FTFL TX

Press **Main**, **Test**, **OTN**, **ODU**, and **ODU TTI TX**.



PM TTI Trace

Message

- **SAPI** allows editing the Source Access point Identifier message to be generated (TTI bytes 1 to 15). A maximum of 15 characters are allowed. The default setting is **EXFO ODU SAPI**. The TTI byte 0 is set to NULL (all 0’s).
- **DAPI** allows editing the Destination Access point Identifier message to be generated (TTI bytes 17 to 31). A maximum of 15 characters are allowed. The default setting is **EXFO ODU DAPI**. The TTI byte 16 is set to NULL (all 0’s).
- **Operator Specific** allows editing the Operator Specific message to be generated (TTI bytes 32 to 63). A maximum of 32 characters are allowed. The default setting is **EXFO ODU OPERATOR SPECIFIC**.

FTFL TX

Allows the configuration of the **Forward** and **Backward** ODU Fault Type Fault Location (FTFL) to be generated.

- **Fault Indication** and **Fault Indication Code** allows the selection of the FTFL fault indicator message/code (byte 0 for forward, byte 128 for backward) to be generated. The default setting is **No fault (00)**. Choices are:

Fault Indication	Fault Indication Code
No fault	00
Signal fail	01
Signal Degrade	02
Reserved	03[a]

a. Selecting **Reserved** will use the hexadecimal code 03 but, all codes from 03 to FF are reserved for future international standardization.

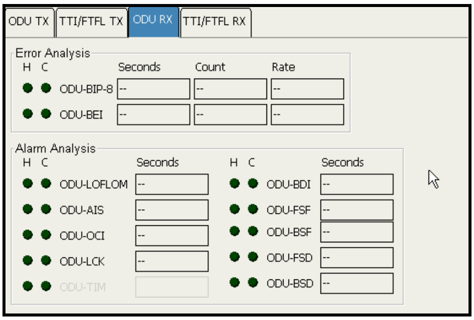
Note: *The Fault Indication Code field is automatically updated when the Fault Indication is changed and vice versa.*

Binary allows either displaying the Fault Indication Code in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.

- **Operator Identifier** allows editing the Operator Identifier (bytes 1 to 9 for forward, byte 129 to 137 for backward) to be generated. A maximum of 9 characters are allowed. By default no Operator Identifier is defined.
- **Operator Specific** allows editing the Operator Specific (bytes 10 to 127 for forward, byte 138 to 255 for backward) to be generated. A maximum of 118 characters are allowed. By default no Operator Specific is defined.

ODU RX

Press **Main**, **Test**, **OTN**, **ODU**, and **ODU RX**.



Error Analysis

➤ **ODU-BIP-8** (ODU - Bit Interleave Parity-8): Indicates the PM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **ODU-BEI** (ODU - Backward Error Indication): Indicates the interleaved block in error detected by the corresponding ODU path monitoring sink using the BIP-8 code.

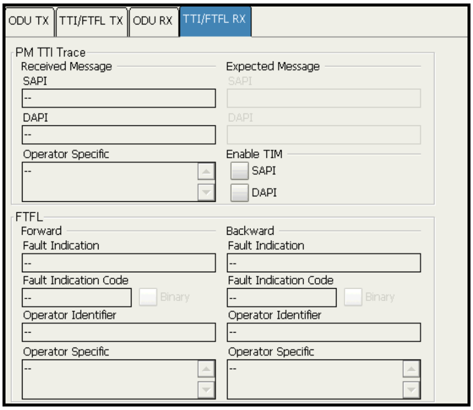
ODU BEI bits (1234)	BIP violations	ODU BEI bits (1234)	BIP violations
0000	0	0101	5
0001	1	0110	6
0010	2	0111	7
0011	3	1000	8
0100	4	1001 to 1111	0

Alarm Analysis

- **ODU-LOFLOM** (ODU - Loss of Frame Loss Of Multiframe): Indicates that OOF is present for at least 3 ms. Only available for mapped ODU1 in ODU2.
- **ODU-AIS** (ODU - Alarm Indication Signal): Indicates that the STAT information detected, PM byte 3, bits 6 to 8 is “111” for at least 3 consecutive frames.
- **ODU-OCI** (ODU - Open Connection Indication): Indicates that the STAT information detected, PM byte 3, bits 6 to 8 is “110” for at least 3 consecutive frames.
- **ODU-LCK** (ODU - Lock): Indicates that the STAT information detected, PM byte 3, bits 6 to 8 is “101” for at least 3 consecutive frames.
- **ODU-TIM** (ODU - Trace Identification Mismatch): ODU-TIM is declared when the received SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the Enable TIM SAPI and/or DAPI check boxes are selected from *ODU TTI/FTFL TX* on page 154.
- **ODU-BDI** (ODU - Backward Defect indication): ODU-BDI is declared when the BDI bit in the PM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive frames.
- **ODU-FSF** (ODU - Forward Signal Fail): ODU-FSF is declared when the received FTFL byte 0 is “00000001”.
- **ODU-BSF** (ODU - Backward Signal Fail): ODU-BSF is declared when the received FTFL byte 128 is “00000001”.
- **ODU-FSD** (ODU - Forward Signal Degrade): ODU-FSD is declared when the received FTFL byte 0 is “00000010”
- **ODU-BSD** (ODU - Backward Signal Degrade): ODU-BSD is declared when the received FTFL byte 128 is “00000010”.

ODU TTI/FTFL RX

Press **Main**, **Test**, **OTN**, **ODU**, and **ODU TTI RX**.



PM TTI Trace

Received Message

➤ **SAPI** indicates the received TTI (Trail Trace identifier) Source Access point Identifier. When TIM is enabled, the SAPI field background becomes pink when there is a mismatch with the expected value.

➤ **DAPI** indicates the received TTI Destination Access point Identifier. When TIM is enabled, the DAPI field background becomes pink when there is a mismatch with the expected value.

➤ **Operator Specific** indicates the received TTI Operator Identifier.

Expected Message

- **SAPI** allows editing the expected Source Access point Identifier (TTI bytes 1 to 15). Available when **Enable TIM SAPI** is enabled. The default setting is **EXFO ODU SAPI**. The TTI byte 0 is set to NULL (all zeros).
- **DAPI** allows editing the expected Destination Access point Identifier (TTI bytes 17 to 31). Available when **Enable TIM DAPI** is enabled. The default setting is **EXFO ODU DAPI**. The TTI byte 16 is set to NULL (all 0's).
- **Enable TIM**

  SAPI allows the edition of the expected Source Access Point Identifier when the **SAPI** check box is selected. Enables also the ODU-TIM alarm monitoring. The **SAPI** check box is cleared by default.

  DAPI allows the edition of the expected Destination Access Point Identifier when the DAPI check box is selected. Enables also the ODU-TIM alarm monitoring. The DAPI check box is cleared by default.

FTFL RX

Indicates the **Forward** and **Backward** ODU Fault Type Fault Location (FTFL).

- **Fault Indication** and **Fault Indication Code** displays the FTFL Fault Indication field (byte 0 for forward, byte 128 for backward). Possible Fault Indication are:

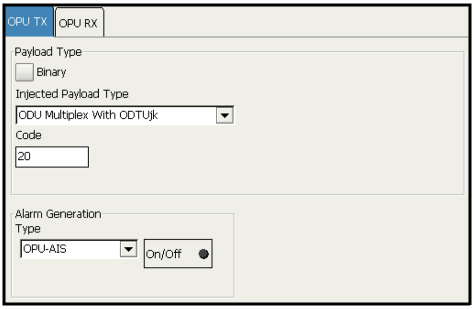
Fault Indication	Fault Indication Code
No fault	00
Signal fail	01
Signal Degrade	02
Reserved	03 to FF

  Binary allows either displaying Fault Indication Code in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.

- **Operator Identifier** displays the received operator identifier characters (bytes 1 to 9 for forward, byte 129 to 137 for backward).
- **Operator Specific** displays the received operator specific (bytes 10 to 127 for forward, byte 138 to 255 for backward).

OPU TX

Press **Main**, **Test**, **OTN**, **OPU**, and **OPU TX**.



Payload Type

➤ **Injected Payload Type** allows the selection of the payload signal type to be generated.

Note: *Changing the payload type will not affect the test structure, only the generated payload will use the selected payload type.*

Payload type	Hex Code	MSB 1234	LSB 5678
Reserved for International Standardization[a]	00	0000	0000
Experimental	01	0000	0001
Asynchronous CBR	02	0000	0010
Bit Synchronous CBR	03	0000	0011
ATM	04	0000	0100
GFP	05	0000	0101
Virtual Concatenation Signal	06	0000	0110

Payload type	Hex Code	MSB 1234	LSB 5678
1000Base-X into ODU0	07	0000	0111
FC-1200 into ODU2e	08	0000	1000
GFP Into Extended OPU2	09	0000	1001
OC-3/STM1 mapping inot ODU0	0A	0000	1010
OC-12/STM-4 into ODU0	0B	0000	1011
FC-100 into ODU0	0C	0000	1100
FC-200 into ODU1	0D	0000	1101
FC-400 into ODUflex	0E	0000	1110
FC-800 into ODUflex	0F	0000	1111
Bit Stream with Octet Timing	10	0001	0000
Bit Stream Without Octet Timing	11	0001	0001
ODU Multiplex with ODTUjk	20	0010	0000
ODU Muliplex with ODTUk.ts/ODTUjk	21	0010	0001
Not Available[b]	55	0101	0101
Reserved Codes for Proprietary Use[c]	80	1000	0000
NULL Test Signal	FD	1111	1101
PRBS Test Signal	FE	1111	1110

a. Selecting **Reserved for International Standardization** will use the hexadecimal code 00 but, all codes not listed in the previous table at the exception of those cover in notes b and c are reserved for future standardization.
b. Selecting **Not Available** will use the hexadecimal code 55 but, 66 and FF are also Not Available payload types.
c. Selecting **Reserved Proprietary** will use the hexadecimal code 80 but, all codes from 80 to 8F are reserved proprietary payload types.

Note: *Codes not listed in the previous table are reserved for future standardization (*Reserved For International Standardization).

Note: *The Code field is automatically updated when the Injected payload Type is changed and vice versa.*

- **Code** allows entering the code of the payload type. Choices are **00** to **FF**.
- **Binary** allows either displaying the payload code value in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.

Alarm Generation

Note: *Alarm generation is only available with multiplexed test case only.*

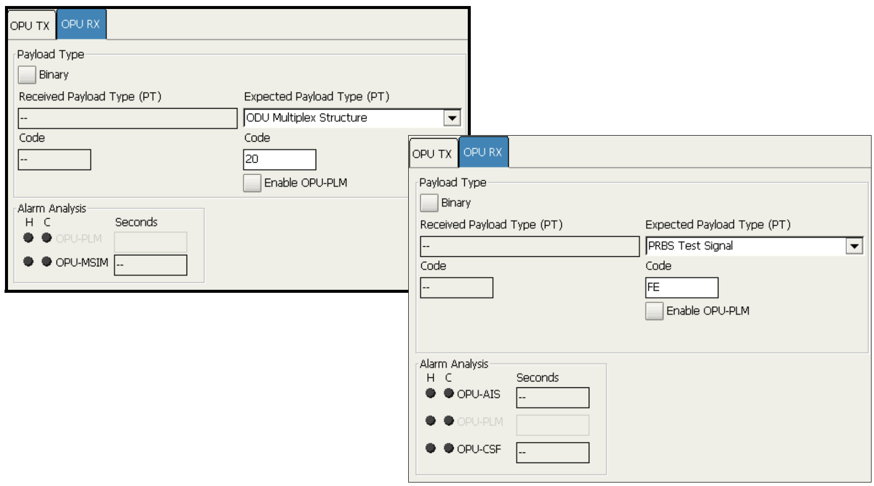
- **OPU-MSIM** (Multiplex Structure Identifier Mismatch): OPU-MSIM is an OPU alarm that is available for multiplexed test case only. The OPU-MSIM alarm is generated by corrupting the content of the PSI (bytes 2 to 5 for ODU1 in ODU2).

Note: *OPU-AIS and OPU-CSF are only available on the OPU client signal (designated as LO in the standard). In this case, OPU-MSIM is not available.*

- **OPU-AIS** (OPU - Alarm Indication Signal): The OPU-AIS alarm is generated by generating the PRBS 2^11-1 pattern.
- **OPU-CSF** (OPU - Client Signal Fail): The OPU-CSF alarm is generated by setting the bit 1 of the OPUk PSI[2] byte to “1”.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

OPU RX

Press **Main**, **Test**, **OTN**, **OPU**, and **OPU RX**.



Alarm Analysis

- **OPU-PLM** (Payload Mismatch): OPU-PLM is declared when the Payload Structure Identifier (PSI) field do not match the expected PT for at least 3 consecutive frames. See **Enable OPU-PLM** on page 165.
- **OPU-MSIM** (Multiplex Structure Identifier Mismatch): OPU-MSIM is an HO alarm that is available for multiplexed test case only. OPU-MSIM is declared when the RX Payload Structure Identifier (PSI) information do not match the expected HO Multiplex Structure Identifier configuration defined from the test case setup.

Note: *OPU-AIS and OPU-CSF are only available on the OPU client signal (designated as LO in the standard). In this case, OPU-MSIM is not available.*

OPU-AIS (OPU - Alarm Indication Signal): OPU-AIS is declared when a PRBS 2^11-1 pattern is received indicating a failure of the client signal.

OPU-CSF (OPU - Client Signal Fail): OPU-CSF is declared when bit 1 of the OPUk PSI[2] byte is set to "1" indicating a failure of the client signal mapped into the OPUk of the OTN signal.

Payload Type

- **Binary** allows either displaying the payload code value in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **Received Payload Type (PT)** indicates the received payload signal type. See *Payload Type* on page 161 for more information.

  Code indicates the corresponding payload type hexadecimal code.
- **Expected Payload Type** allows the selection of the expected payload type signal. See *Payload Type* on page 161 for choices.

Note: *The Code field is automatically updated when the Expected payload is changed and vice versa.*

Code allows entering the code of the payload type. Choices are **00** to **FF**. The default setting is **03**.

- **Enable OPU-PLM** allows enabling the OPU-PLM alarm analysis.

11 SONET Tabs

The SONET tabs allow configuration of different test parameters and display the test status and results.

Note: *The available tabs listed are a function of the test path activated.*

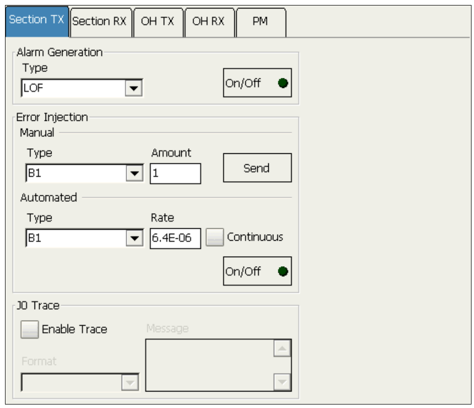
SONET	Tab	Page
Section	*Section TX (SONET)*	169
	Section RX (SONET)	172
	Section OH TX/RX (SONET)	174
	Performance Monitoring (PM)[a]	361
Line	*Line TX (SONET)*	176
	Line RX (SONET)	178
	Line OH TX/RX (SONET)	184
	APS/Advanced Line OH TX/RX (SONET)	186
	Performance Monitoring (PM)[a]	361
HOP	*HOP TX (SONET)*	193
	HOP RX (SONET)	197
	HOP OH TX/RX (SONET)	200
	HOP/LOP Pointer Adjust TX (SONET/SDH)[a]	349
	HOP/LOP Pointer Adjust RX (SONET/SDH)[a]	352
	TCM TX[a]	354
	TCM RX[a]	357
	Performance Monitoring (PM)[a]	361

SONET	Tab	Page
LOP	*LOP TX (SONET)*	203
	LOP RX (SONET)	207
	LOP OH TX/RX (SONET)	210
	HOP/LOP Pointer Adjust TX (SONET/SDH)[a]	349
	HOP/LOP Pointer Adjust RX (SONET/SDH)[a]	352
	TCM TX[a]	354
	TCM RX[a]	357
	Performance Monitoring (PM)[a]	361

a. These tabs are described in *Common Tabs* on page 349.

Section TX (SONET)

Press **Main**, **Test**, **SONET**, **Section**, and **Section TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **B1** and **FAS**.

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

- **Type**

  LOF (Loss Of Frame): Generates non-valid framing bytes (A1 and A2).

  SEF (Severely Errored Framing): Generates four consecutive errored framing patterns.

- **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default. Exceptionally for continuous SEF alarm, the On/Off button turns Off once the SEF alarm has been sent.

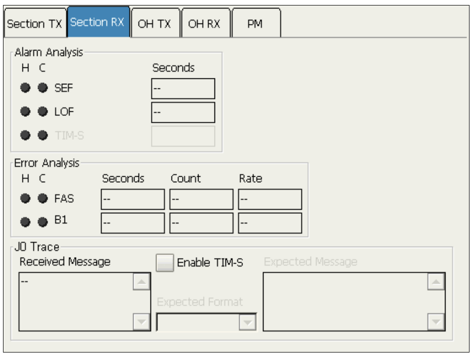
J0 Trace

- **Format**: Displays the J0 value in **16** or **64 bytes** format. The default setting is **16 bytes**.
- **Message**: Enter the J0 trace value in 16 or 64 bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer Section/RS trace test message** for 64 bytes.
- **Enable Trace**: Generates the defined J0 Trace message when the **Enable Trace** check box is selected. The **Enable Trace** check box has to be selected to give access to the trace format and message. When the **Enable Trace** check box is cleared, the J0 1-byte format is used and can be configured from the *Section OH TX* on page 174.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes ($<C_R>$ and $<L_F>$ bytes will be added at the end for a total of 64-bytes).*

Section RX (SONET)

Press **Main**, **Test**, **SONET**, **Section**, and **Section RX**.



Error Analysis

FAS (Frame Alignment Signal): A FAS defect indicates that at least one A1 or A2 byte of the FAS word is in error.

B1 (BIP-8, Bit-Interleave Parity - 8 bits): The B1 (BIP-8) error indicates a Section parity error by performing a routine even-parity check over all frames of the previous STS-n signal (located in the first STS-1 of an STS-n signal).

Alarm Analysis

- **SEF** (Severely Errored Framing): A SEF defect indicates that a minimum of four consecutive errored framing patterns are received.
- **LOF** (Loss Of Frame): A Loss Of Frame alarm indicates that a Severely Error Framing (SEF) defect on the incoming SONET signal persists for at least 3 milliseconds.
- **TIM-S** (Trace Identifier Mismatch - Section): The TIM-S defect indicates that the received J0 Trace doesn't match the expected message value. The TIM-S alarm is only available when **Enable TIM-S** check box from J0 Trace section has been selected.

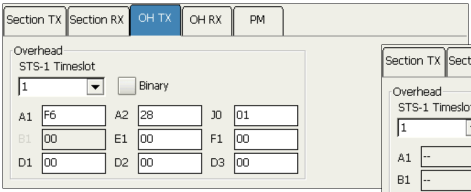
J0 Trace

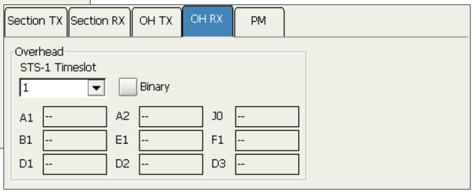
- **Received Message**: Displays the received J0 value. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, <C_R> and <L_F>, represent respectively a carriage return and a line feed.
- **Enable TIM-S** (Trace Identifier Mismatch - Section): Allows enabling the Trace Identifier Mismatch for the expected message defined. **Enable TIM-S** has to be enabled to give access to the expected trace format and message.
- **Expected Message**: Allows entering the expected J0 Trace message. J0 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer Section/RS trace test message** for 64 bytes.
- **Expected Format**: Allows the selection of the expected format: 16 or 64 bytes. The default setting is **16 bytes**.

Section OH TX/RX (SONET)

The **Section OH TX** allows changing the transport overhead information to be transmitted while the **Section OH RX** allows verification of the transport overhead information received. Refer to *Glossary* on page 413 for detailed overhead information.

Press **Main**, **Test**, **SONET**, **Section**, and **OH TX/RX**.





Section Overhead

- **Timeslot**: Select the timeslot number that will be used for verification. Choices are **1** to **3**, **12**, **48**, or **192** depending on the OC-N interface selected. The default setting is **1**.
- **Binary**: Allows either displaying all overhead values in binary (when the Binary check box is selected) or hexadecimal (when the Binary check box is cleared). This Binary check box is cleared by default.
- **A1** and **A2**: Framing. The value should be hexadecimal **F6** for A1 and **28** for A2.

- **J0/Z0**

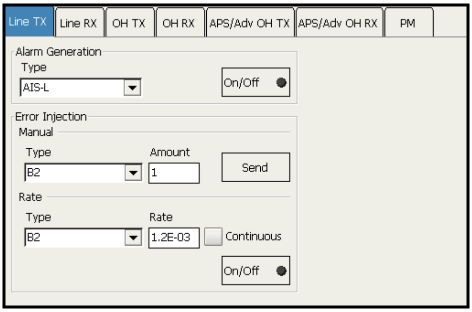
  J0: Trace: STS-1 #1 of an electrical or OC-N signal. J0 is only available when the **Enable Trace** check box from the *Section TX (SONET)* on page 169 is cleared.

  Z0: Growth: STS-1 #2 to STS-1 #N of a OC-N signal.

- **B1**: BIP-8. This byte is not programmable from this tab
- **E1**: Orderwire.
- **F1**: User.
- **D1, D2**, and **D3**: Data Communications Channel (DCC).

Line TX (SONET)

Press **Main**, **Test**, **SONET**, **Line**, and **Line TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **B2** (BIP-8), and **REI-L** (Remote Error Indication). The default setting is **B2**.

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

- **Type**

  AIS-L (Alarm Indication Signal - Line): Generates a SONET signal that contains a valid Section Overthead (SOH) and an all-ones pattern on the SPE.

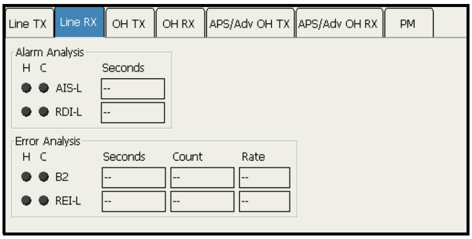
  RDI-L (Remote Defect Indication - Line): Generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.

  The default setting is **AIS-L**

- **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

Line RX (SONET)

Press **Main**, **Test**, **SONET**, **Line**, and **Line RX**.



Error Analysis

➤ **B2** (BIP-8, Bit-Interleave Parity - 8 bits): The B2 (BIP-8) error indicates a Line parity error by performing an even-parity check over all bits of the LOH and SPE of the previous frame (located in every STS-1 of an STS-n signal).

➤ **REI-L** (Remote Error Indicator - Line):

For STS-1e: The REI-L error is declared when the M0 byte located in the first STS-1 indicates that one or more BIP violations have been detected.

M0, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
000 1000	8 BIP violations
000 1001	0 BIP violation
:	:
111 1111	0 BIP violation

For STS-3e and OC-3: The REI-L error is declared when the M1 byte located in the STS-1 #3 indicates that one or more BIP violations have been detected

M1, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
001 1000	24 BIP violations
001 1001	0 BIP violation
:	:
111 1111	0 BIP violation

For OC-12: The REI-L error is declared when the M1 byte located in the STS-1 #7 indicates that one or more BIP violations have been detected.

M1, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
110 0000	96 BIP violations
110 0001	0 BIP violation
:	:
111 1111	0 BIP violation

For OC-48: The REI-L error is declared when the M1 byte located in the STS-1 #7 indicates that one or more BIP violations have been detected.

M1	Indicates
0000 0000	0 BIP violation
0000 0001	1 BIP violation
0000 0010	2 BIP violations
:	:
1111 1111	255 BIP violations

For OC-192: The REI-L error is declared when either the M1 byte located in the STS-1 #7 indicates that one or more BIP violations have been detected, or the combination of the M0 and M1 bytes indicates that one or more BIP violations have been detected. Refer to *OC-192/STM-64 REI-L/MS-REI* on page 386 for REI-L computation method.

M1	Indicates
0000 0000	0 BIP violation
0000 0001	1 BIP violation
0000 0010	2 BIP violations
:	:
1111 1111	255 BIP violations

M0 Located in STS-1 #4	M1 Located in STS-1 #7	Indicates
0000 0000	0000 0000	0 BIP violation
0000 0000	0000 0001	1 BIP violation
0000 0000	0000 0010	2 BIP violations
:	:	
0000 0110	0000 0000	1536 BIP violations
0000 0110	0000 0001	0 BIP violation
:		:
1111 1111	1111 1111	0 BIP violation

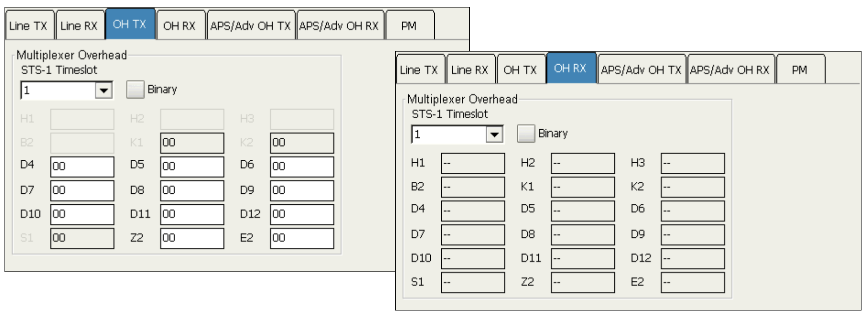
Alarm Analysis

- **AIS-L** (Alarm Indication Signal - Line): The AIS-L alarm is declared when bits 6, 7 and 8 of the K2 byte contain the “111” pattern in five consecutive frames.
- **RDI-L** (Remote Defect Indication - Line): The RDI-L alarm is declared when bits 6, 7, and 8 of the K2 byte contain the “110” pattern in five consecutive frames.

Line OH TX/RX (SONET)

The Line OH TX allows changing the line overhead information to be transmitted while the Line OH RX allows verification of the line overhead information received.

Press **Main**, **Test**, **SONET**, **Line**, and **OH TX/RX**.



Line Overhead

- **Timeslot**: Select the timeslot number that will be used for the test.

  Choices are **1** to **3**, **12**, **48**, or **192** depending on the OC-N interface selected. The default setting is **1**.

- **Binary**: Allows either displaying all overhead values in binary (when the Binary check box is selected) or hexadecimal (when the Binary check box is cleared). This Binary check box is cleared by default.
- **H1** and **H2**: Pointer
- **H3**: Pointer Action
- **B2**: BIP-8
- **K1** and **K2**: Automatic Protection Switching (APS)
- **D4** through **D12**: Data Communications Channel (DCC)

- **S1/Z1**

  S1: Synchronization Status (STS-1 #1 of an electrical or OC-N signal)

  Z1: Growth (STS-1 #2, STS-1 #3, up to STS-1 #N of a OC-N (N>3) signal)

- **M0** or **M1/Z2**

  M0: REI-L (STS-1 #1 of an STS-1e signal; STS-1 #4 of OC-192 signal)

  M1: REI-L (STS-1 #3 of STS-3e or OC-3 signal; STS-1 #7 of an OC-12/OC-48/OC-192 signal)

  Z2: Growth (STS-1 #1 up to STS-1 #48 except for timeslots used by M0 and M1).

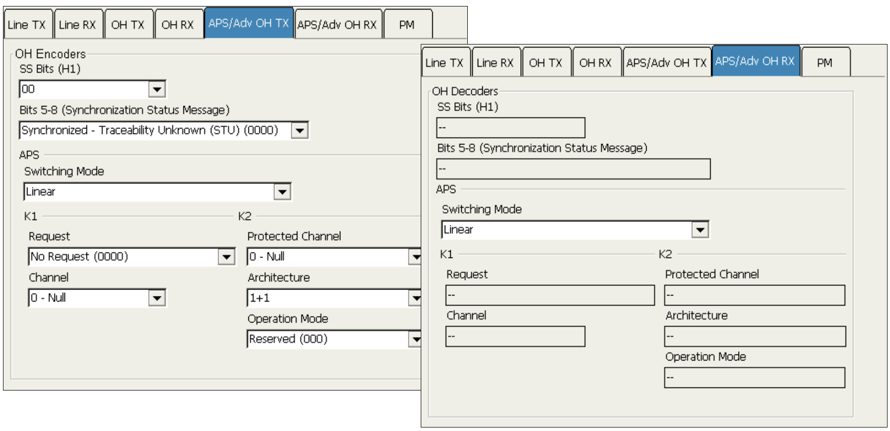
  Undefined "--" for all other timeslots not covered by M0, M1, and Z2.

- **E2**: Orderwire

APS/Advanced Line OH TX/RX (SONET)

The Line OH TX allows changing the line overhead information to be transmitted while the Line OH RX allows verification of the line overhead information received.

Press **Main**, **Test**, **SONET**, **Line**, and **APS/Adv OH TX/RX**.



Advanced

Gives access to the advanced section of the **Line OH TX/RX** signal.

APS

➤ **Switching Mode**

Allows the switching mode selection and is available on both TX and RX tabs. Choices are **Linear** and **Ring**. The default setting is **Linear**.

- **K1**
  - **Request**: Bits 1 through 4 of the K1 byte. The default setting is **No Request** (0000). Choices are:

Bits 1 to 4	Linear mode	Ring mode
0000	No Request	No Request
0001	Do Not Revert	Reverse Request - Ring
0010	Reverse Request	Reverse Request - Span
0011	Not Used	Exerciser - Ring
0100	Exerciser	Exerciser - Span
0101	Not Used	Wait-to-Restore
0110	Wait-to-Restore	Manual Switch - Ring
0111	Not Used	Manual Switch - Span
1000	Manual Switch	Signal Degrade - Ring
1001	Not Used	Signal Degrade - Span
1010	Signal Degrade - Low Priority	Signal Degrade -Protection
1011	Signal Degrade - High Priority	Signal Fail Ring
1100	Signal Fail - Low Priority	Signal Fail Span
1101	Signal Fail - High Priority	Force Switch - Ring
1110	Force Switch	Force Switch -Span
1111	Lockout of Protection	Lockout of Protection - Span/SF - P

➤ Channel/Destination Node ID

Bits 5 through 8 of the K1 byte. Channel if available with Linear switching mode while Destination Node ID is available with Ring switching mode. The default setting is **Null Channel** for **Linear** switching mode and **0** for **Ring** switching mode.

Bits 5 to 8	Channel ID (Linear mode)	Destination Node ID (Ring mode)
0000	0 - Null	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	10
1011	11	11
1100	12	12
1101	13	13
1110	14	14
1111	15 - Extra Traffic	15

- **K2**
  - **Protected Channel/Source Node ID**: Bits 1 through 4 of the K2 byte. **Protected Channel** is available with **Linear** switching mode while Source Node ID is available with **Ring** switching mode. The default setting is **Null Channel** for **Linear** switching mode and **0** for **Ring** switching mode.

Bits 1 to 4	Protected Channel (Linear mode)	Source Node ID (Ring mode)
0000	0 - Null	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	10
1011	11	11
1100	12	12
1101	13	13
1110	14	14
1111	15 - Extra Traffic	15

➤ **Architecture/Bridge Request**: Bit 5 of the K2 byte. **Architecture** is available with **Linear** switching mode while **Bridge Request** is available with **Ring** switching mode. The default setting is **1+1** for Linear switching mode and **Short Path Request** for Ring switching mode.

Bit 5	Architecture (Linear mode)	Bridge Request (Ring mode)
0	1+1	Short Path
1	1:n	Long Path

➤ **Operation Mode**: Bits 6 through 8 of the K2 byte. The default setting is **Reserved (000)** for Linear switching mode and **Idle** for Ring switching mode.

Bits 6 to 8	Linear mode	Ring mode
000	Reserved	Idle
001	Reserved	Bridged
010	Reserved	Bridged and Switched
011	Reserved	Extra Traffic - Protection
100	Unidirectional	Reserved
101	Bidirectional	Reserved
110	RDI-L	RDI-L
111	AIS-L	AIS-L

SS Bits (H1)

➤ Bits 5 and 6 of the H1 byte represent the SS bits.

SS Bits	Description
00	SONET
01	Undefined
10	SDH
11	Undefined

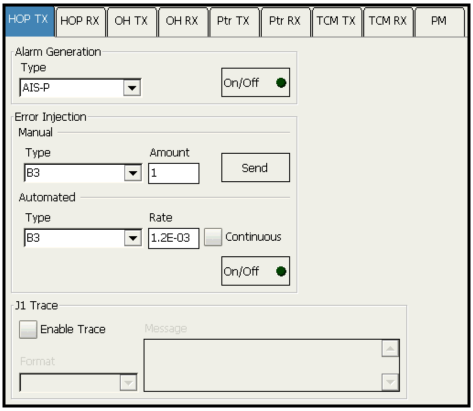
Bits 5-8 (Synchronization Status Message)

➤ Bits 5 through 8 of the S1 byte are used to convey synchronization status of the NE. The default setting is **Synchronized - Traceability Unknown (0000)**. Choices are:

Bits 5 to 8	Description	Bits 5 to 8	Description
0000	Synchronized - Traceability Unknown	1000	Reserved
0001	Stratum 1 Traceable	1001	Reserved
0010	Reserved	1010	Stratum 3 Traceable
0011	Reserved	1011	Reserved
0100	Transit Node Clock Traceable	1100	SONET Minimum Clock Traceable
0101	Reserved	1101	Stratum 3E Traceable
0110	Reserved	1110	Provisionable by the Network Operator
0111	Stratum 2 Traceable	1111	Don’t Use for Synchronization

HOP TX (SONET)

Press **Main**, **Test**, **SONET**, **HOP**, and **HOP TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available with both manual and automated injection modes: **B3** (BIP-8, Bit-Interleave Parity - 8 bits), and **REI-P** (Remote Error Indicator - Path).

For **Manual** method:

➤ **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

➤ **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.

➤ **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

Type

- **AIS-P** (Alarm Indication Signal - Path): Generates an all-ones pattern over H1, H2, H3, and SPE.
- **RDI-P** (Remote Defect Indication - Path): Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.
- **ERDI-PSD** (Enhanced RDI - Path Server Defect): Generates a “101” pattern for bits 5, 6 and 7 of the G1 byte.
- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect): Generates a “110” pattern for bits 5, 6 and 7 of the G1 byte.
- **ERDI-PPD** (Enhanced RDI - Path Payload Defect): Generates a “010” pattern for bits 5, 6 and 7 of the G1 byte.
- **LOM** (Loss Of Multiframe): Generates a wrong H4 byte multiframe indicator sequence.
- **LOP-P** (Loss Of Pointer - Path): Generates a non-valid pointer.
- **PDI-P** (Payload Defect Indication - Path): For VT-structured STS-1 SPE, generates a VT-structured STS-1 SPE with payload defect. For non-VT-structured STS-1 or STS-Nc SPE, generates a payload defect by inserting the hexadecimal FC code in the C2 byte.
- **UNEQ-P** (Unequipped - Path): Generates an all-zeros pattern over POH and SPE.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

J1 Trace

- **Format**: Displays the J1 value in 16-bytes or 64-bytes format. Enter the J1 trace value in 16 or 64-bytes format as selected. The default setting is **16-bytes**.

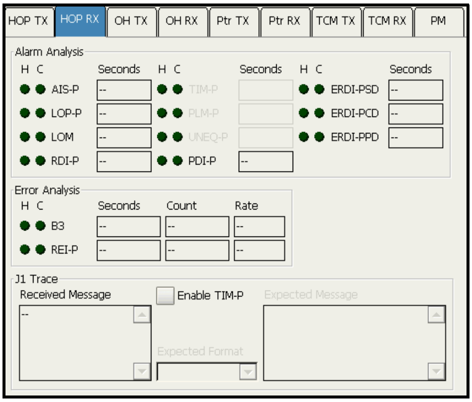
- **Message**: Enter the J1 trace value in 16 or 64 bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes.

- **Enable Trace**: Generates the defined J1 Trace message defined when the **Enable Trace** check box is selected. The **Enable Trace** check box has to be selected to give access to the trace format and message. When the **Enable Trace** check box is cleared, the J1 1-byte format is used and can be configured from the **HOP OH TX** on page 200.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C_R> and <L_F> bytes will be added at the end for a total of 64 bytes).*

HOP RX (SONET)

Press **Main**, **Test**, **SONET**, **HOP**, and **HOP RX**.



Error Analysis

➤ **B3** (BIP-8, Bit-Interleave Parity - 8 bits): The B3 (BIP-8) error indicates a Path parity error by performing an even-parity check over all bits of the previous SPE.

➤ **REI-P** (Remote Error Indicator - Path): The REI-P error is declared when bits 1 through 4 of the G1 byte contain one pattern from the following binary range: “0001” through “1000” (1 to 8) (located in every STS-1 of an STS-n signal).

Alarm Analysis

- **AIS-P** (Alarm Indication Signal - Path): The AIS-P alarm is declared when the H1 and H2 bytes for an STS path contain an all-ones pattern in three consecutive frames or more.
- **LOP-P** (Loss Of Pointer - Path): The LOP alarm indicates that a valid pointer is not found in N consecutive frames (where $8 \leq N \leq 10$), or that N consecutive NDFs ("1001" pattern) are detected (non-concatenated payloads).
- **LOM** (Loss Of Multiframe): For VT structured SONET frames, the LOM alarm indicates that the system loss track of the H4 byte multiframe indicator sequence.
- **RDI-P** (Remote Defect Indication - Path): The RDI-P alarm is declared when bits 5, 6, and 7 of the G1 byte contain the "100" or "111" pattern in five consecutive frames.
- **TIM-P** (Trace Identifier Mismatch - Path): The TIM-P defect indicates that the received J1 Trace doesn't match the expected message value. The TIM-P alarm is only available when **Enable TIM-P** check box from J1 Trace section has been selected.
- **PLM-P** (Payload Label Mismatch - Path): The PLM-P is declared upon receipt of five consecutive frames with mismatched STS signal labels (C2 byte).
- **UNEQ-P** (Unequipped - Path): UNEQ-P is declared when the C2 bytes contain "00 H" in five consecutive frames.
- **PDI-P** (Payload Defect Indication - Path): For VT-tructured STS-1 SPE, the PDI-P is declared when detecting LOP-V, AIS-V, DS3 AIS, DS3 LOS, or DS3 OOF defect on any VT or DS3 payload that it embeds into the STS SPE that it is originating. For non-VT-structured STS-1 or STS-Nc SPE, thePDI-P is declared when receiving the hexadecimal FC code (C2 byte).

- **ERDI-PSD** (Enhanced RDI - Path Server Defect): The ERDI-PSD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “101” pattern in five consecutive frames.
- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect): The ERDI-PCD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five consecutive frames.
- **ERDI-PPD** (Enhanced RDI - Path Payload Defect): The ERDI-PPD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five consecutive frames.

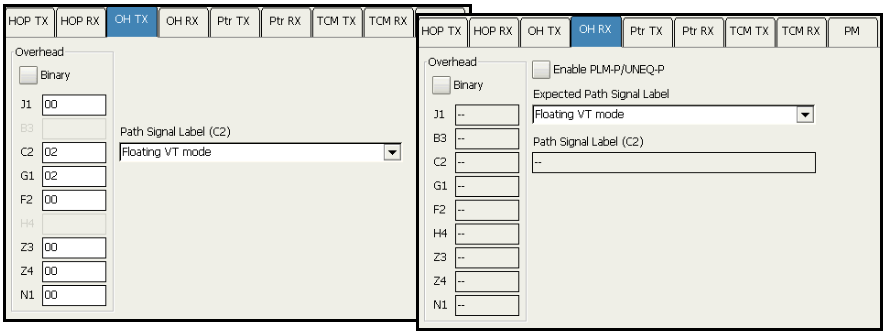
J1 Trace

- **Received Message**: Displays the J1 value in 16-bytes or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, <C_R> and <L_F>, represent respectively a carriage return and a line feed.
- **Enable TIM-P** (Trace Identifier Mismatch - Path): Allows enabling the Trace Identifier Mismatch for the expected message defined. When the **Enable TIM-P** check box is cleared, the J1 1-byte is available from the **HOP OH RX (SONET)** on page 200. The **Enable TIM-P** check box has to be selected to give access to the expected trace format and message.
- **Expected Message**: Allows entering the message that is expected. J1 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64** bytes. The default setting is **16 bytes**.

HOP OH TX/RX (SONET)

The HOP OH TX allows changing the high order path overhead information to be transmitted while the HOP OH RX allows verification of the high order path overhead information received.

Press **Main**, **Test**, **SONET**, **HOP**, and **OH TX/RX**.



Path Overhead

- **Binary**: Allows either displaying all overhead values in binary (when the Binary check box is selected) or hexadecimal (when the Binary check box is cleared). This Binary check box is cleared by default.
- **J1**[1]: Trace. J1 is only available when **Enable Trace** from the *HOP TX (SONET)* on page 193 is disabled.
- **B3**[1]: BIP-8
- **C2**: Signal Label. Entering a C2 byte value will automatically update the Path Signal Label (C2) selection and vice versa.
- **G1**: Path Status
- **F2**: User Channel

1. These bytes are not programmable from the HOP OH TX tab.

- **H4**: Multiframe Indicator.This byte is not programmable with LOP or VCAT.
- **Z3** and **Z4**: Growth
- **N1**: Tandem Connection Monitoring

Path Signal Label (C2)

The C2 byte is allocated to indicate the content of the STS SPE, including the status of the mapped payloads.

Note: *Selecting the C2 byte from the list will automatically update the C2 byte from the Path Overhead section and vice versa.*

C2 (Hex.)	Description	C2 (Hex.)	Description
00*	Unequipped	16	Mapping of HDLC over SONET
01	Equipped - Non-Specific	17	SDL with self-synchronization scrambler
02	Floating VT Mode	18	Mapping of HDLC/LAPS
03	Locked VT Mode	19	SDL with use of a set-reset scrambler
04	Asynchronous Mapping for DS3	1A	10 Gbps Ethernet (IEEE 802.3)
05	Mapping under development	1B	GFP
12	Asynchronous Mapping for 140M (DS4NA)	CF	Reserved (Obsolete HDLC/PPP framed)
13	Mapping for ATM	E1[a] to FC[a]	STS-1 w/1 VTx Payload Defects, STS-1 w/2 VTx Payload Defects, ... STS-1 w/28 VTx or STS-n/nc with Payload Defects
14	Mapping for DQDB	FE	Test Signal, ITU-T 0.181 specific mapping
15	Asynchronous Mapping for FDDI	FF[a]	STS SPE AIS (TCM)

a. These values cannot be selected as Expected Path Signal Label.

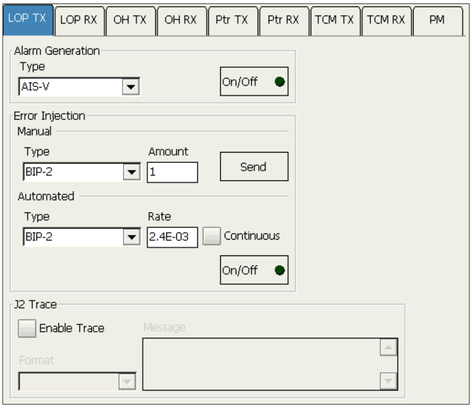
For HOP OH RX tab only:

➤ **Expected Path Signal Label**: Allows selecting the expected Path Signal Label.

➤ **Enable PLM-P/UNEQ-P** (Payload Label Mismatch - Path / Unequipped - Path): Enables the Payload Label Mismatch and UNEQ-P monitoring.

LOP TX (SONET)

Press **Main**, **Test**, **SONET**, **LOP**, and **LOP TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **BIP-2** (Bit-Interleave Parity - 2 bits) and **REI-V** (Remote Error Indicator - VT).

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

➤ **Type**: The following alarms are available:

AIS-V (Alarm Indication Signal - VT): Generates an all-ones pattern for the V1 and V2 bytes of the VT path and payload.

RDI-V (Remote Defect indication - VT): Generates “1” for the bit 8 of the V5 byte and a “00” pattern for bits 6 and 7 of the Z7 byte.

ERDI-VSD (Enhanced RDI - VT Server Defect): Generates a “101” pattern for bits 5, 6, and 7 of the Z7 byte, and “1” for bit 8 of the V5 byte.

ERDI-VCD (Enhanced RDI - VT Connectivity Defect): Generates a “110” pattern for bits 5, 6, and 7 of the Z7 byte, and “1” for bit 8 of the V5 byte.

ERDI-VPD (Enhanced RDI - VT Payload Defect): Generates a “010” pattern for bits 5, 6, and 7 of the Z7 byte, and “0” for bit 8 of the V5 byte.

RFI-V (Remote Failure Indication - VT): Generates “1” for the bit 4 of the V5 byte.

LOP-V (Loss of Pointer - VT): Generates a non-valid pointer.

UNEQ-V (Unequipped - VT): Generates samples of unequipped VT signal label (bits 5 through 7 of V5 byte are set to “000”).

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

J2 Trace

Enable Trace: Generates the J2 Trace message defined when the **Enable Trace** check box is selected. The **Enable Trace** check box has to be selected to give access to the trace format and message. When the **Enable Trace** check box is cleared, the J2 1-byte format is used and can be configured from the *LOP OH TX/RX (SONET)* on page 210.

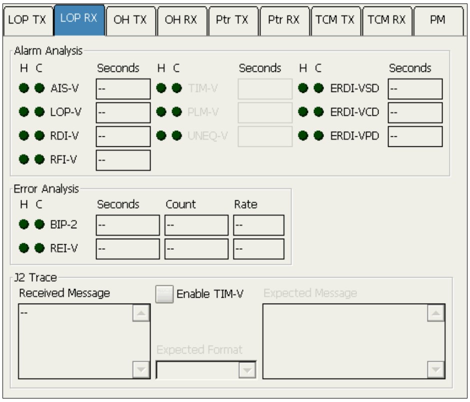
Format: Select the display format for J2. Choices are **16** and **64 bytes**. The default setting is **16-bytes**.

Message: Enter the J2 value in 16-bytes or 64-bytes format. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer low order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<cr> and <L*$_F$*> bytes will be added at the end for a total of 64 bytes). J2 value should be ASCII suitable characters including the ITU T.50 Characters* on page 50.

LOP RX (SONET)

Press **Main**, **Test**, **SONET**, **LOP**, and **LOP RX**.



Error Analysis

➤ **BIP-2** (Bit-Interleave Parity - 2 bits): The BIP-2 error indicates a parity error by performing a routine even-parity check over all VT1.5 bytes of the previous frame of a composite signal (VT1.5/VT2/VT6).

➤ **REI-V** (Remote Error Indicator): The REI-V error is declared when bit 3 of the V5 byte is set to “1”.

Note: *Refer to* Alarm/Error Measurements *on page 44 for **H/C LEDs**, **Seconds**, **Count**, and **Rate** information.*

Alarm Analysis

- **AIS-V** (Alarm Indication Signal - VT): The AIS-V alarm is declared when V1 and V2 bytes for the VT path contain an all-ones pattern in three consecutive superframes.
- **LOP-V** (Loss Of Pointer - VT): The LOP alarm indicates that a valid pointer is not found in N consecutive superframes (where $8 \leq N \leq 10$), or if N consecutive NDFs ("1001" pattern) are detected.
- **RDI-V** (Remote Defect Indication - VT): The RDI-V alarm is declared when bit 8 of the V5 byte contains "1" in five consecutive VT superframes while bits 6 and 7 of the Z7 byte contain the "00" or "11" pattern.
- **RFI-V** (Remote Failure Indication - VT): The RFI-V alarm is declared when bit 4 of the V5 byte contains "1" in five consecutive superframes.
- **TIM-V** (Trace Identifier Mismatch - VT): The TIM-V defect indicates that the received J2 Trace doesn't match the expected message value. The TIM-V alarm is only available when **Enable TIM-V** check box from J2 Trace section has been selected.
- The TIM-V alarm result is only available when TIM-V from J2 Trace section has been enabled.
- **PLM-V** (Payload Label Mismatch - VT): The PLM-V is declared upon receipt of five consecutive superframes with mismatched VT Signal (bits 5 through 7 of the V5 byte are "000", "001" or "111").
- **UNEQ-V** (Unequipped - VT): UNEQ-V is declared when bit 5 through 7 of the V5 byte contain "000" for five consecutive superframes.
- **ERDI-VSD** (Enhanced RDI - VT Server Defect): The ERDI-VSD alarm is declared when bits 5, 6, and 7 of the Z7 byte contain the "101" pattern, and bit 8 of the V5 byte contain "1", in five consecutive VT superframes.

- **ERDI-VCD** (Enhanced RDI - VT Connectivity Defect): The ERDI-VCD alarm is declared when bits 5, 6, and 7 of the Z7 byte contain the “110” pattern, and bit 8 of the V5 byte contain “1”, in five consecutive VT superframes.
- **ERDI-VPD** (Enhanced RDI - VT Path Payload Defect): The ERDI-VPD alarm is declared when bits 5, 6, and 7 of the Z7 byte contain the “010” pattern, and bit 8 of the V5 byte contain “0”, in five consecutive VT superframes.

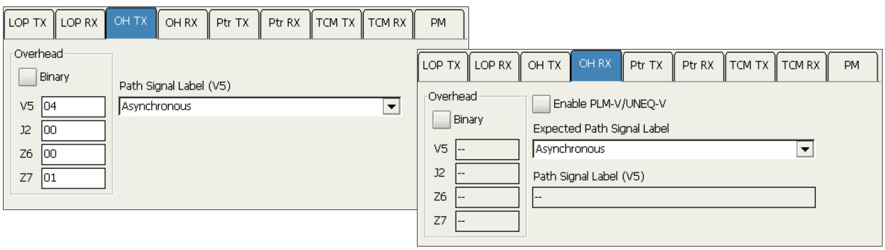
J2 Trace

- **Received Message**: Displays the J2 value in 16-bytes or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, $<C_R>$ and $<L_F>$, represent respectively a carriage return and a line feed.
- **Enable TIM-V** (Trace Identifier Mismatch - VT): Allows enabling the Trace Identifier Mismatch for the expected message defined. The Enable TIM-V check box has to be selected to give access to the expected trace format and message. When the Enable TIM-V check box is cleared, the J2 1-byte is available from the **LOP OH RX** on page 210.
- **Expected Message**: Allows entering the message that is expected. J2 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64** bytes. The default setting is **16 bytes**.

LOP OH TX/RX (SONET)

The LOP OH TX allows changing the low order path overhead information to be transmitted while the LOP OH RX allows verification of the low order path overhead information received.

Press **Main**, **Test**, **SONET**, **LOP**, and **OH TX/RX**.



Path Overhead

- **Binary** allows either displaying all overhead values in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **V5** (VT Path Overhead)
- **J2** (VT Path Trace). J2 is only available when **Enable Trace** from the *LOP TX (SONET)* on page 203 is disabled.
- **Z6**: VT Tandem Connection Monitoring
- **Z7**: Extended signal label

Path Signal Label (V5)

The V5 byte is allocated to indicate the content of the VT path, including the status of the mapped payloads.

Bits 5, 6, 7 of V5	Description
000[a]	Unequipped
001	Reserved (Equipped - Non-specific)
010	Asynchronous
011	Bit Synchronous
100	Byte Synchronous
101	Extended Signal Label
110	Test Signal, ITU-T 0.181 specific mapping
111[a]	VT SPE AIS (TCM)

a. These bytes cannot be selected in receive mode.

For LOP OH RX tab only:

➤ **Expected Path Signal Label**: Allows selecting the expected Path Signal Label.

➤ **Enable PLM-V/UNEQ-V** (Payload Label Mismatch - VT / Unequipped - VT): Allows enabling the Signal Label Mismatch for the expected message defined.

12 DSn Tabs

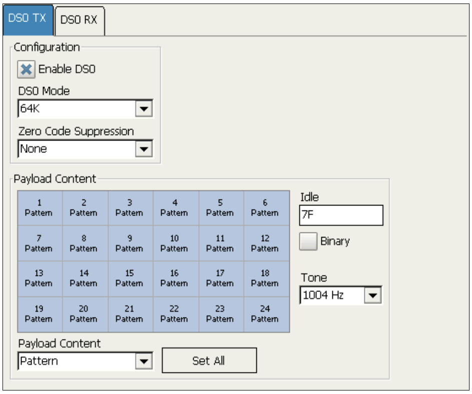
The DSn tabs allow configuration of different test parameters and to view the test status and results.

Note: *The available tabs listed are a function of the test path activated.*

a. This tab is described in the *Common Tabs* section.

DS0/64K TX

Press **Main**, **Test**, **DSn/PDH**, **DS0**, and **DS0 TX**.



Note: *DS0/64K TX configuration is not available when the selected framing from the DS1/1.5M TX* on page 219 *is unframed.*

Configuration

➤ **Enable DS0**: Allows the activation of DS0/64K testing. This setting is disabled (Off) by default unless otherwise set during the test setup.

➤ **DS0 Mode**: Allows the selection of the channel timeslot data rate for the pattern payload content. Choices are **56K** and **64K**. The default setting is **64K**.

56K: A timeslot data rate of 56 Kbps uses 7 bits to carry the payload information.

64K: A timeslot data rate of 64 Kbps uses 8 bits to carry the payload information.

- **Zero Code Suppression**: Allows the selection of the Zero Code Suppression (ZCS) method used to replace the all-zero bytes of the Idle and Tone payload contents. The ZCS mechanism is a global parameter meaning that all channel timeslots configured with Tone/Idle data, use the same ZCS method. Choices are **None**, **Jammed Bit 8**, **GTE**, and **BELL**. The default setting is **None**.

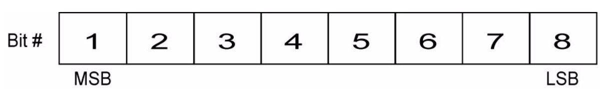
  None: No Zero Code Suppression

  Jammed Bit 8: Every 8th (LSB) bit is forced to **1**.

  GTE: Bit 8 of an all zero channel byte is replaced by **1**, except in signaling frames where bit 7 is forced to **1**.

  Bell: Bit 7 of an all zero channel byte is replaced by **1**.

Note: *Bit 8 is the Least-Significant Bit (LSB) and bit 1 is the Most-Significant Bit (MSB).*



Payload Content

Select the payload content by pressing once or several times on each timeslot until the desired content appears (or use the Set All buttons). Choices are **Pattern**, **Idle**, and **Tone**. The default setting is **Pattern**.

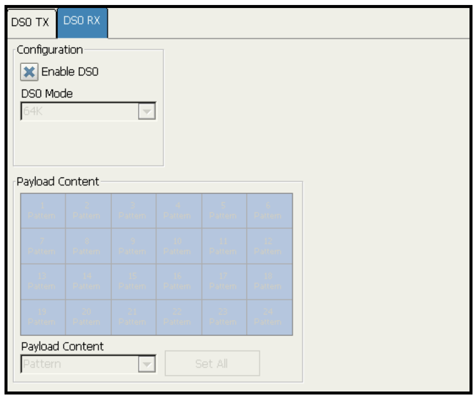
- **Pattern**: Uses the selected pattern from the *Pattern TX* on page 335.
- **Idle**: Uses the Idle code byte from the Idle field. Choices are **00** to **FF**. The selected Idle code applies to all timeslots set to Idle. The default setting is **7F**.

  Binary: Allows either displaying the Idle code values in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **Tone**: Allows the selection of a tone for digital milliwatt testing. The signal output power, when converted to analog, is 0 dBm. Choices are **1000 Hz** and **1004 Hz**. The selected Tone applies to all timeslots set to Tone. The default setting is **1004 Hz**.
- **Payload Content**: Allows the selection of the payload content that will be applied when pressing **Set All**. Choices are **Pattern**, **Idle** and **Tone**.
- **Set All**: Allows to set the payload content of all timeslots to the selected payload content with its Pattern, Idle, or Tone value.

Note: *The timeslots set to Idle or Tone can be changed from Idle to Tone and vice versa even when the test is running; the Idle and Tone values can also be changed.*

DS0/64K RX

Press **Main**, **Test**, **DSn/PDH**, **DS0**, and **DS0 RX**.



Note: *DS0/64K RX configuration is not available when the selected framing from the DS1/1.5M RX* on page 222 *is unframed.*

Configuration

Note: *See* DS0/64K RX *on page 217 for more information on **Enable DS0** and **DS0 Mode**.*

- **Enable**: Allows the activation of DS0/64K testing. This setting is disabled (Off) by default unless otherwise set during the test setup.
- **DS0 Mode**: For decoupled test mode, allows the selection of the channel timeslot data rate. Choices are **56K** and **64K**. The default setting is **64K**.

  56K: A timeslot data rate of 56 Kbps uses 7 bits to carry the payload information.

  64K: A timeslot data rate of 64 Kbps uses 8 bits to carry the payload information.

Payload Content

Note: *Payload content configuration is only available for decoupled test mode, otherwise the payload content is coupled with the DS0/64K TX configuration.*

Select the payload content by pressing once or several times on each timeslot until the desired content appears (or use the Set All buttons). Choices are **None** and **Pattern**. The default setting is **Pattern**.

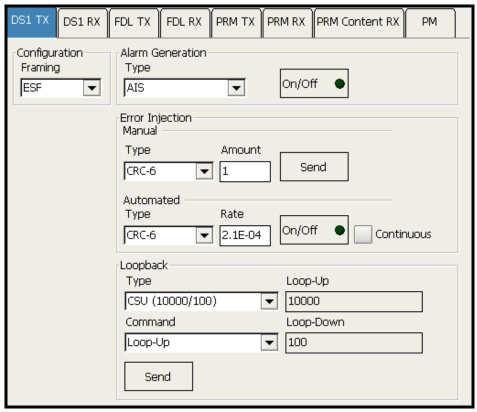
➤ **Pattern**: Uses the pattern from the received signal.

➤ **None**: Does not use the pattern.

➤ **Set All**: Allows to set the payload content of all timeslots with (Pattern) or without (None) the selected Pattern.

DS1/1.5M TX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **DS1 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed**, **SF**, and **ESF**. The default setting is **ESF**.

Alarm Generation

➤ **Type**: Select the type of alarm to be generated. Choices are **AIS**, **RAI**, and **OOF**. The default setting is **AIS**.

Note: *Choices depend on the selected framing.*

➤ **On/Off** button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

Note: *Error injection is not available when the framing is set to **Unframed**.*

- **Type**: The following error types are available with both manual and automated injection modes. Choices are **Framing Bit** and **CRC-6**. CRC-6 is only available with ESF framing.

Note: *Choices depend on the selected framing.*

- **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Loopback

The Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

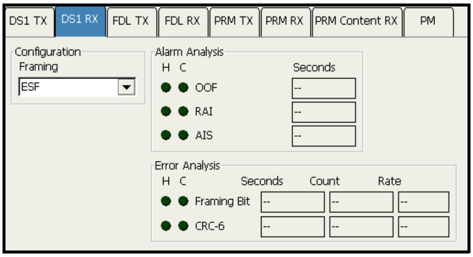
- **Type** allows the selection of the type of loopback. Choices are **CSU (10000/100)**, **NIU FAC1 (1100/1110)**, **NIU FAC2 (11000/11100)**, **NIU FAC3 (100000/100)**, 10 predefined Loop Codes (refer to *DSn Loop Codes* on page 387), and **User Defined**.

Loopback Type	Command	
	Loop-Up	Loop-Down
CSU (10000/100)	10000	100
NIU FAC1 (1100/1110)	1100	1110
NIU FAC2 (11000/11100)	11000	11100
NIU FAC3 (100000/100)	100000	100

- **Loop-Up** and **Loop-Down**: Indicates respectively the **Loop-Up** and **Loop-Down** code corresponding to the selected loopback type. When the selected loopback type is **User Defined**, enter the **Loop-Up** and **Loop-Down** loopcode values from 3 to 16 bits (000 to 1111111111111111).
- **Command**: Allows the selection of the loopback codes that will be used to overwrite the traffic that will be generated. Choices are **Loop-Up** and **Loop-Down**. The default setting is **Loop-Up**.
- **Send**: Allows the injection of the selected loop code. The loop code will be generated continuously for a maximum of 10 seconds or until the loopback is confirmed. After 10 seconds, if the loopback has failed, a Loop-Down command is sent. A pop-up window appears indicating the loop code injection progress and result.

DS1/1.5M RX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **DS1 RX**.



Configuration

Note: *See* DS1/1.5M TX *on page 219 for more information on **Framing**.*

Error Analysis

Possible errors that can be detected are:

➤ **Framing Bit**: A Framing Bit error indicates that an incorrect value appeared in a bit position reserved for framing.

➤ **CRC-6** (Cyclical Redundancy Check): A CRC-6 error indicates that one or more bit errors have been detected in a block of data through cyclical redundancy check. CRC-6 is only available with ESF framing.

Alarm Analysis

Possible alarms that can be detected are:

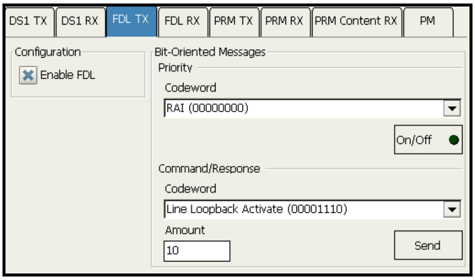
- **OOF** (Out-OF-Frame): A OOF error indicates that four consecutive frame bit errors are detected.
- **RAI** (Yellow) (Remote Alarm Indication):

  For SF framing: The RAI alarm is declared when bit 2 in each timeslot contains “0”.

  For ESF framing: The RAI alarm is declared when eight “ones” followed by eight “zeros” pattern is received continuously in the data link (FDL).
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.

FDL TX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **FDL TX**.



Note: *FDL TX is only available for DS1 interface with ESF framing. For Dual RX test, FDL is only available for the primary DS1 TX/RX port.*

The FDL TX tab is used to set and configure the Bit-Oriented Messages (BOM) of the Extended Super-Frame (ESF).

Configuration

Enable FDL: Allows the activation of the Facility Data Link testing. This setting is disabled (Off) by default unless otherwise set during the test setup.

Bit-Oriented Messages

The Bit-Oriented Messages are priority messages sent over the Data-Link. These messages are mostly used for networking operation and maintenance. A Bit-Oriented Message consists of 8 consecutive ones followed by a byte starting and ending by zeros.

➤ **Priority**

Priority Codeword	Pattern
RAI	00000000 11111111
Loopback Retention and Acknowledge	00101010 11111111
RAI-CI	00111110 11111111

On/Off allows generating the selected codeword priority message.

➤ Command/Response

Command/Response Codeword	Pattern
Line Loopback Activate	00001110 11111111
Line Loopback Deactivate	00111000 11111111
Payload Loopback Activate	00010100 11111111
Payload Loopback Deactivate	00110010 11111111
Reserved for Network Use	00010010 11111111 (Loopback Activate)
Universal Loopback (Deactivate)	00100100 11111111
ISDN Line Loopback (NT2)	00101110 11111111
CI/CSU Line Loopback (NT1)	00100000 11111111
For network use	00011100 11111111 (indication of NT1 power off)
Protection Switch Line 1 b	01000010 11111111
Protection Switch Line 2	01000100 11111111
Protection Switch Line 3	01000110 11111111
Protection Switch Line 4	01001000 11111111
Protection Switch Line 5	01001010 11111111
Protection Switch Line 6	01001100 11111111
Protection Switch Line 7	01001110 11111111
Protection Switch Line 8	01010000 11111111
Protection Switch Line 9	01010010 11111111
Protection Switch Line 10	01010100 11111111
Protection Switch Line 11	01010110 11111111
Protection Switch Line 12	01011000 11111111

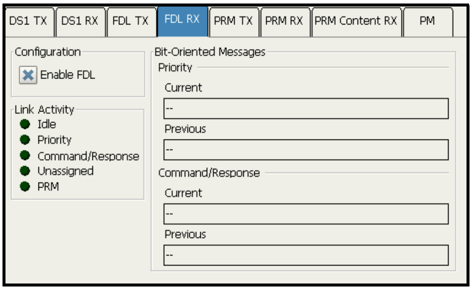
Command/Response Codeword	Pattern
Protection Switch Line 13	01011010 11111111
Protection Switch Line 14	01011100 11111111
Protection Switch Line 15	01011110 11111111
Protection Switch Line 16	01100000 11111111
Protection Switch Line 17	01100010 11111111
Protection Switch Line 18	01100100 11111111
Protection Switch Line 19	01100110 11111111
Protection Switch Line 20	01101000 11111111
Protection Switch Line 21	01101010 11111111
Protection Switch Line 22	01101100 11111111
Protection Switch Line 23	01101110 11111111
Protection Switch Line 24	01110000 11111111
Protection Switch Line 25	01110010 11111111
Protection Switch Line 26	01110100 11111111
Protection Switch Line 27	01110110 11111111
Protection Switch Acknowledge	00011000 11111111
Protection Switch Release	00100110 11111111
Do Not use for Synchronization	00110000 11111111
Stratum 2 Traceable	00001100 11111111
SONET Minimum Clock Traceable	00100010 11111111
Stratum 4 Traceable	00101000 11111111
Stratum 1 Traceable	00000100 11111111
Synchronization Traceability Unknown	00001000 11111111
Stratum 3 Traceable	00010000 11111111

Command/Response Codeword	Pattern
Reserved for Network Synchronization	01000000 11111111
Transmit Node Clock (TNC)	01111000 11111111
Stratum 3E Traceable	01111100 11111111
Under study for maintenance	00101100 11111111
Under study for maintenance	00110100 11111111
Reserved for network use	00010110 11111111
Reserved for network use	00011010 11111111
Reserved for network use	00011110 11111111
Reserved for network use	00111010 11111111
Reserved for customer	00000110 11111111
Reserved for customer	00001010 11111111
Reserved for customer	00000010 11111111
Reserved for customer	00110110 11111111
Reserved for customer	00111100 11111111
Reserved for customer	01111010 11111111

- **Amount** allows the selection of the number of message to be generated. Choices are **1** to **15**. The default value is **10**.
- **Send** allows to manually generate the selected amount of messages.

FDL RX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **FDL RX**.



Note: *FDL RX is only available for DS1 interface with ESF framing. For **Dual RX** test, FDL is only available for the primary DS1 TX/RX port.*

Note: *Path and test signal identification are not supported.*

Configuration

Note: *See* FDL TX *on page 224 for more information on **Enable FDL**.*

Bit-Oriented Messages

The Bit-Oriented Messages are priority messages send over the Data-Link. These messages are mostly used for networking operation and maintenance. A Bit-Oriented Message consists of 8 consecutive 1s followed by a byte starting and ending by zeros.

➤ **Priority**

Note: *See Priority* on page 225 *for the list of possible* ***Priority*** *codeword messages.*

Current indicates the priority message detected in the last second. If no priority message has been detected, "--" is displayed.

Previous indicates the last priority message detected excluding the current message. If no priority message has been detected since the beginning of the test, "--" is displayed.

➤ **Command/Response**

Note: *See Command/Response* on page 226 *for the list of possible Command/Response codeword messages.*

Current indicates the command/response message detected in the last second. If no priority message has been detected, "--" is displayed.

Previous indicates the last command/response message detected excluding the current message. If no command/response message has been detected since the beginning of the test, "--" is displayed.

Link Activity

Indicates the activity of the following parameters during the last second of measurement A link activity is indicated by an LED.

Idle indicates that only idle codes have been detected in the last second.

Priority indicates that at least one valid priority message has been detected in the last second.

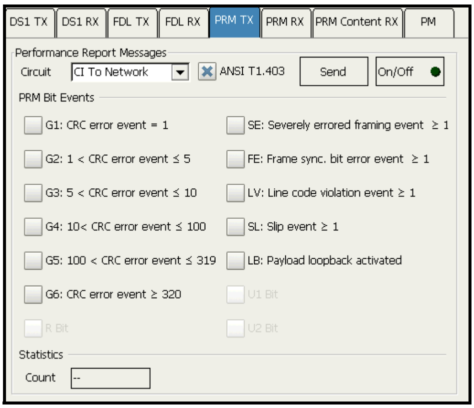
Command/Response indicates that a least one valid command and response has been detected in the last second.

Unassigned indicates that at least one unassigned message has been detected in the last second. Therefore, since an unassigned message is part of a Command/Response codewords, the Command/Response LED will also be red.

PRM indicates that at least one PRM has been detected in the last second.

PRM TX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **PRM TX**.



Note: *FDL PRM TX is only available for DS1 interface with ESF framing when Enable FDL from FDL TX/RX is enabled. For **Dual RX** test, FDL is only available for the primary DS1 TX/RX port.*

Performance Report Messages

- **Circuit** allows the selection of the circuit type. Choices are **CI to Network** and **Network to CI**. The default setting is **CI to Network**.
- **ANSI T1-403** allows the generation of a compliant ANSI T1.403 PRM Message.
- **Manual**

  Send allows to manually send the selected PRM Message(s).
- **Continuous**

  On/Off allows to generate the selected PRM Message(s) continuously.

- **PRM Bit Events**: Allows the activation of the following PRM bit events. All PRM bit events are disabled by default.

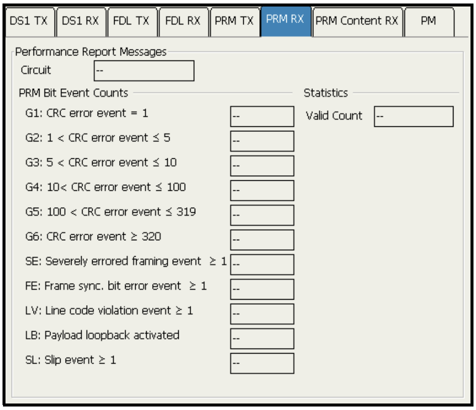
  G1: CRC error event = 1
  G2: 1 < CRC error event ≤ 5
  G3: 5 < CRC error event ≤ 10
  G4: 10 < CRC error event ≤ 100
  G5: 100 < CRC Error Event ≤ 319
  G6: CRC error event ≥ 320
  R Bit (Reserved - Default value is 0)
  SE: Severely errored framing event ≥ 1
  FE: Frame synchronization bit error event ≥ 1
  LV: Line code violation event ≥ 1
  SL: Slip event ≥ 1
  LB: Payload loopback activated
  U1: Bit
  U2: Bit

Statistics

Count indicates the number of PRM messages sent.

PRM RX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **PRM RX**.



Note: *FDL PRM RX is only available for DS1 interface with ESF framing when **Enable FDL** from **FDL TX/RX** is enabled. For **Dual RX** test, FDL is only available for the primary DS1 TX/RX port.*

Performance Report Message

- **Circuit** indicates the selected circuit type which can be **CI to Network** or **Network to CI**.
- **PRM Bit Event Counts**: Indicates the count of the detected valid PRM bit events.

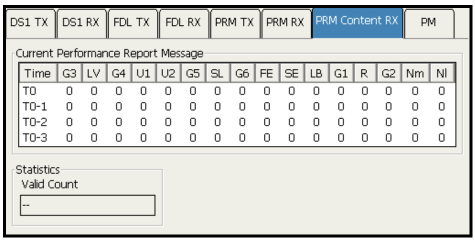
G1: CRC Error Event = 1	SE: Severely-Errored Framing Event ≥ 1
G2: 1 < CRC Error Event ≤ 5	FE: Frame Sync. Bit Error Event ≥ 1
G3: 5 < CRC Error Event ≤ 10	LV: Line Code Violation Event ≥ 1
G4: 10 < CRC Error Event ≤ 100	SL: Controlled Slip Event ≥ 1
G5: 100 < CRC Error Event ≤ 319	LB: Payload Loopback Activated
G6: CRC Error Event ≥ 320	

Statistics

Valid Count indicates the number of valid PRM messages received.

PRM Content RX

Press **Main**, **Test**, **DSn/PDH**, **DS1**, and **PRM Content RX**.



Note: *FDL* ***PRM Content RX*** *is only available for DS1 interface with ESF framing when* ***Enable FDL*** *from* ***FDL TX/RX*** *is enabled. For Dual RX test, FDL is only available for the primary DS1 TX/RX port.*

Current Performance Report Message

Each PRM is listed into four lines called Time (t0, t0-1, t0-2 and t0-3).

Where:

➤ **Time**

t0 represents the valid PRM message received in the last second of measurement (bytes 5 and 6).
t0-1 represents the message one PRM ago (bytes 7 and 8).
t0-2 represents the message two PRM ago (bytes 9 and 10).
t0-3 represents the message three PRM ago (bytes 11 and 12).

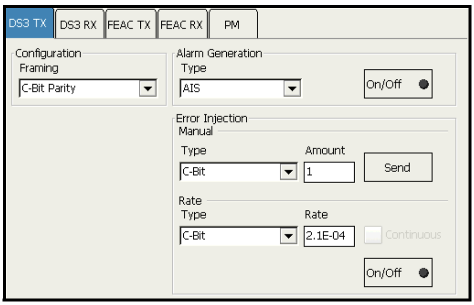
➤ **G3**: 5 < CRC Error Event ≤ 10
LV: Line Code Violation Event ≥ 1
G4: 10 < CRC Error Event ≤ 100
U1: Under study for synchronization
U2: Under study for synchronization
G5: 100 < CRC Error Event ≤ 319
SL: Controlled Slip Event ≥ 1
G6: CRC Error Event ≥ 320
FE: Frame Sync. Bit Error Event ≥ 1
SE: Severely-Errored Framing Event ≥ 1
LB: Payload Loopback Activated
G1: CRC Error Event = 1
R: Reserved
G2: 1 < CRC Error Event ≤ 5
Nm and **Nl**: One-second report modulo 4 counter.

Statistics

Valid Count indicates the number of valid PRM messages received.

DS3/45M TX

Press **Main**, **Test**, **DSn/PDH**, **DS3**, and **DS3 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed**, **M13**, and **C-Bit Parity**. The default setting is **C-Bit Parity**.

Alarm Generation

- **Type**: Select the type of alarm to be generated. Choices are **AIS**, **RDI**, **OOF**, and **Idle**. The default setting is **AIS**.
- **On/Off** button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

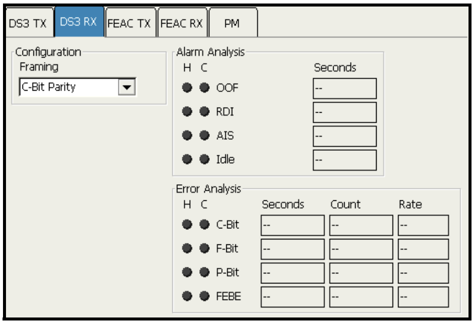
Allows manual or automated error injection.

Note: *Error injection is not available when the framing is set to **Unframed**.*

- **Type**: The following error types are available with both manual and automated injection modes. Choices are **C-bit**, **F-bit**, **P-bit**, and **FEBE**. Choices depend also on the selected framing. The default setting is **C-bit**.
- **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.
- **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

DS3/45M RX

Press **Main**, **Test**, **DSn/PDH**, **DS3**, and **DS3 RX**.



Configuration

Note: *See* DS3/45M TX *on page 238 for more information on **Framing**.*

Error Analysis

Possible errors that can be detected are:

- **C-Bit** (Control-Bit): A C-Bit error indicates that the three C-bits reserved to control bit stuffing are different of “111” and “000”.
- **F-Bit** (Framing-Bit): A F-Bit error indicates that the frame alignment pattern received is different of “1001”.
- **P-Bit** (Parity-Bit): A P-Bit error indicates that the P-Bits does not match the parity of all the information bits following the first X-Bit of the previous DS3 frame.
- **FEBE** (Far-End Block Error): A FEBE is detected when the three FEBE bits reserved for framing or parity error detection contain the “000” pattern.

Alarm Analysis

Possible alarms that can be detected are:

- **OOF** (Out-OF-Frame): A OOF error indicates that four consecutive frame bit errors are detected.
- **RDI** (Remote Defect Indicator): The RDI alarm is declared when both X-bits of the M-Frame are set to "0".
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when the M-frame contains zeros (0) for C-bits, ones (1) for X-bits, 1010... repeating sequence with a one (1) immediately following any of the control bit positions for the information bits.
- **Idle** (DS3 Idle): The Idle alarm is declared when subframe 3 of the M-frame contains zeros (0) for the three C-bits, ones (1) for X-bits, 1100... repeating sequence with the first two bits following each control bit set to 11 for the information bits.

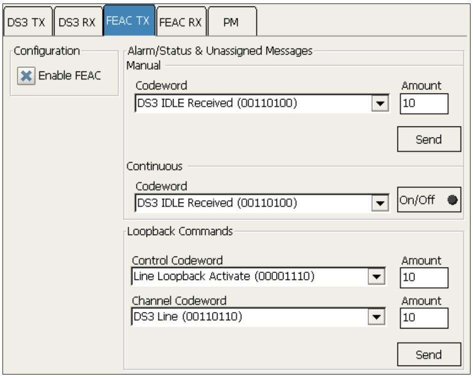
DS3 FEAC TX

The Far-End Alarm and Control signal *(FEAC)* provides Communication Channel capability over a DS3 in a network applications using C-bit Parity configuration.

The DS3 FEAC TX tab is used to configure and send alarms/status information and control signals (loopback commands) to other network elements.

Note: *The DS3 FEAC tab is available when the DS3 framing is set to C-Bit Parity* *(see page 238).*

Press **Main**, **Test**, **DSn/PDH**, **DS3**, and **FEAC TX**.



Configuration

Enable FEAC: Enables DS3 FEAC codeword configuration and analysis.

Alarm/Status Unassigned Messages

Allows manual or continuous alarm/status injection.

➤ **Codeword**: Select the codeword alarm/status to be generated either manually or continuously.

The FEAC message format is a 16 bit codeword (0xxxxxx0 11111111) with the rightmost bit transmitted first. The 0xxxxxx0 represents the message codeword.

Codeword	
DS3 Equipment Failure SA (00110010)	User Defined (00001100)
DS3 Loss of Signal (LOS) (00011100)	User Defined (00010000)
DS3 Out-of-Frame (00000000)	User Defined (00010100)
DS3 AIS Received (00101100)	User Defined (00010110)
DS3 Idle Signal Received (00110100)	User Defined (00011000)
DS3 Equipment Failure NSA (00011110)	User Defined (00011010)
DS3 NUI Loop Up (00010010)	User Defined (00100000)
DS3 NUI Loop Down (00100100)	User Defined (00100010)
Common Equipment Failure NSA (00111010)	User Defined (00101000)
Multiple DS1 LOS (00101010)	User Defined (00101110)
DS1 Equipment Failure SA (00001010)	User Defined (00110000)
Single DS1 LOS (00111100)	User Defined (00111110)
DS1 Equipment Failure NSA (00000110)	User Defined (01000000)
User Defined (00000010)	User Defined (01111010)
User Defined (00000100)	User Defined (01111100)
User Defined (00001000)	User Defined (01111110)

- **Amount**: Select the amount of codeword to be generated. Choices are **1** through **15**. The default setting is **10**.
- **Send** button: Press **Send** to manually generate error(s) according to the Codeword and the Amount of Errors selected.
- **On/Off** button: The On/Off button is used to activate/deactivate the transmission of the selected continuous codeword continuously. This setting is disabled (Off) by default.

Loopback Commands

- **Control Codeword**: Select the loopack control codeword to be generated. Choices are **Line Loopback Activate (00001110)** and **Line Loopback Deactivate (00111000)**.

  Amount: Select the amount of **Control Codeword** to be generated. Choices are **1** through **15**. The default setting is **10**.

➤ **Channel Codeword**: Select the channel codeword to be generated.

Channel Codeword	
DS3 Line (00110110)	DS1 Line-No15 (01011110)
DS1 Line-No1 (01000010)	DS1 Line-No16 (01100000)
DS1 Line-No2 (01000100)	DS1 Line-No17 (01100010)
DS1 Line-No3 (01000110)	DS1 Line-No18 (01100100)
DS1 Line-No4 (01001000)	DS1 Line-No19 (01100110)
DS1 Line-No5 (01001010)	DS1 Line-No20 (01101000)
DS1 Line-No6 (01001100)	DS1 Line-No21 (01101010)
DS1 Line-No7 (01001110)	DS1 Line-No22 (01101100)
DS1 Line-No8 (01010000)	DS1 Line-No23 (01101110)
DS1 Line-No9 (01010010)	DS1 Line-No24 (01110000)
DS1 Line-No10 (01010100)	DS1 Line-No25 (01110010)
DS1 Line-No11 (01010110)	DS1 Line-No26 (01110100)
DS1 Line-No12 (01011000)	DS1 Line-No27 (01110110)
DS1 Line-No13 (01011010)	DS1 Line-No28 (01111000)
DS1 Line-No14 (01011100)	DS1 Line-All (00100110)

Amount: Select the amount of Channel Codeword to be generated. Choices are **1** through **15**. The default setting is **10**.

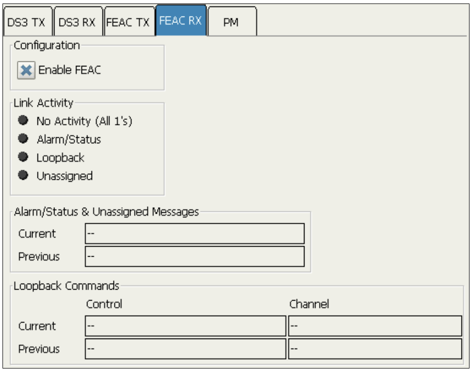
➤ **Send** button: Press **Send** to generate the defined loopback command.

DS3 FEAC RX

The DS3 FEAC RX tab gives current and previous alarms/status and loopback commands as well as the link activity for the received DS3 signal.

Note: *The DS3 FEAC RX tab is available when the DS3 framing is set to C-Bit Parity (see page 238).*

Press **Main**, **Test**, **DSn/PDH**, **DS3**, and **FEAC RX**.



Configuration

Enable FEAC: Enables DS3 FEAC codeword configuration and analysis.

Link Activity

- **No Activity (All 1's)**: An all ones pattern (11111111 11111111) has been detected in the last second.
- **Alarm/Status**: An Alarm/Status codeword has been detected in the last second. An Alarm/Status is only detected when receiving at least 10 consecutive occurrences of a specific codeword.

- **Loopback**: A Loopback command message has been detected in the last second. A valid loopback command is detected only when receiving 10 consecutive occurrences of a specific **Loopback Command** immediately followed by 10 occurrences of a specific **Channel Codeword**.
- **Unassigned**: An unassigned message has been detected in the last second. An Unassigned message is only detected when receiving at least 10 consecutive occurrences of a specific unassigned codeword. An **Alarm/Status** codeword is also reported since **Unassigned** is part of the **Alarm/Status** group.

Alarm/Status Unassigned Messages

Displays the current and previously received **Codeword** messages.

Current: Indicates the last valid message, if any, received in the last second of measurment.

Previous: Indicates the message, if any, that was received just before the current measurement.

Loopback Commands

Current: Displays the valid message received in the last second of measurement. A valid message is detected only when receiving 10 consecutive occurrences of a specific **Loopback Command** immediately followed by 10 occurrences of a specific **Channel Codeword**. See DS3 FEAC TX *on page 242* for more information.

Previous: Displays the last valid message received excluding the actual **Current** message.

13 SDH Tabs

The SDH tabs allow configuration of different test parameters and to view the test status and results.

Note: *The available tabs listed are a function of the test path activated.*

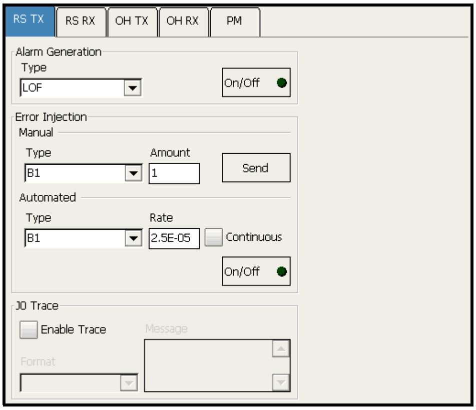
SDH	Tab	Page
RS	*Regenerator Section TX (SDH)*	251
	Regenerator Section RX (SDH)	255
	Regenerator Section OH TX/RX (SDH)	257
	Performance Monitoring (PM)[a]	361
MS	*Multiplex Section TX (SDH)*	259
	Multiplex Section RX (SDH)	261
	Multiplex Section OH TX/RX (SDH)	266
	Multiplex Section APS/Advanced OH TX/RX (SDH)	268
	Performance Monitoring (PM)[a]	361
HOP	*HOP TX (SDH)*	272
	HOP RX (SDH)	276
	HOP OH TX/RX (SDH)	279
	HOP/LOP Pointer Adjust TX (SONET/SDH)[a]	349
	HOP/LOP Pointer Adjust RX (SONET/SDH)[a]	352
	TCM TX[a]	354
	TCM RX[a]	357
	Performance Monitoring (PM)[a]	361

SDH	Tab	Page
LOP	*LOP TX (SDH)*	282
	LOP RX (SDH)	286
	LOP OH TX/RX (SDH)	289
	LOP TX (SDH, TU-3 path)	291
	LOP RX (SDH, TU-3 path)	295
	LOP OH TX/RX (SDH, TU-3 path)	298
	HOP/LOP Pointer Adjust TX (SONET/SDH)[a]	349
	HOP/LOP Pointer Adjust RX (SONET/SDH)[a]	352
	TCM TX[a]	354
	TCM RX[a]	357
	Performance Monitoring (PM)[a]	361

a. These tabs are described in *Common Tabs* on page 349.

Regenerator Section TX (SDH)

Press **Main**, **Test**, **SDH**, **RS**, and **RS TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **B1** and **FAS**.

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

➤ **Type**

LOF (Loss Of Frame): Generates non-valid framing bytes (A1 and A2).

OOF (Out of Frame): Generates four consecutive errored framing patterns.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default. Exceptionally for continuous OOF alarm, the On/Off button turns Off once the OOF alarm has been sent.

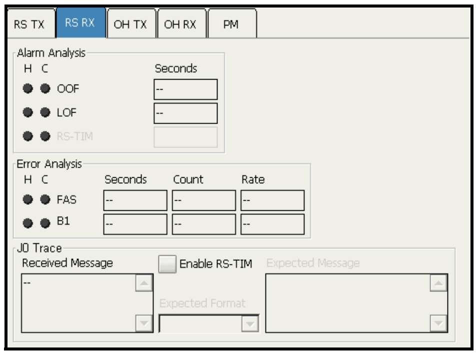
J0 Trace

- **Format**: Displays the J0 value in **16** or **64 bytes** format. The default setting is **16 bytes**.
- **Message**: Enter the J0 trace value in 16 or 64 bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer Section/RS trace test message** for 64 bytes.
- **Enable Trace**: Generates the defined J0 Trace message when the **Enable Trace** check box is selected. The **Enable Trace** check box has to be selected to give access to the trace format and message. When the **Enable Trace** check box is cleared, the J0 1-byte format is used and can be configured from the *Regenerator Section OH TX (SDH)* on page 257.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C_R> and <L_F> bytes will be added at the end for a total of 64-bytes).*

Regenerator Section RX (SDH)

Press **Main**, **Test**, **SDH**, **RS**, and **RS RX**.



Error Analysis

FAS (Frame Alignment Signal): A FAS defect indicates that at least one A1 or A2 byte of the FAS word is in error.

B1 (BIP-8, Bit-Interleave Parity - 8 bits): The BIP-8 error indicates a Regenerator Section parity error by performing a routine even-parity check over all frames of the previous STM-n signal.

Alarm Analysis

- **OOF** (Out Of Frame): A OOF alarm indicates that a minimum of four consecutive errored framing patterns are received.
- **LOF** (Loss Of Frame): A LOF alarm indicates that an Out Of Frame (OOF) defect on the incoming optical signal persists for 3 milliseconds.
- **RS-TIM** (Regenerator Section - Trace Identifier Mismatch): The RS-TIM defect indicates that the received J0 Trace doesn't match the expected message value. RS-TIM alarm is only available when the **Enable RS-TIM** check box is selected.

Note: *Refer to* Alarm/Error Measurements *on page 44 for **H/C LEDs**, and **Seconds** information.*

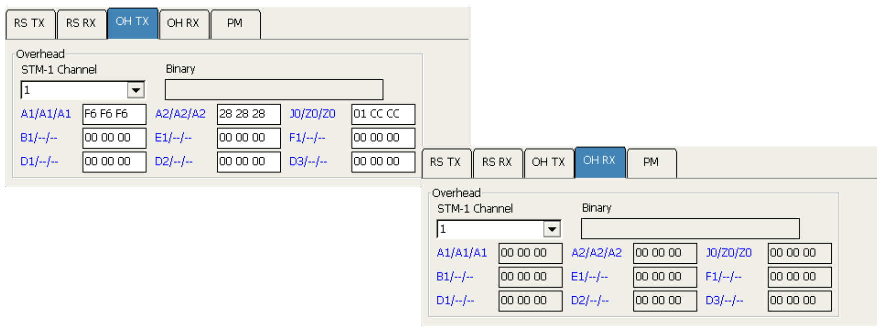
J0 Trace

- **Received Message**: Displays the J0 value in 16 or 64 bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, <C_R> and <L_F>, represent respectively a carriage return and a line feed.
- **Enable RS-TIM** (Regenerator Section - Trace Identifier Mismatch): Enables the Trace Identifier Mismatch for the expected message defined when the **Enable RS-TIM** check box is selected. The **Enable RS-TIM** check box has to be selected to give access to the expected trace format and message. When the **Enable RS-TIM** check box is selected, the J0 1-byte is available from the *Regenerator Section OH TX/RX (SDH)* on page 257.
- **Expected Message**: Allows entering the message that is expected. J0 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer Section/RS trace test message** for 64 bytes.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64 bytes**. The default setting is **16 bytes**.

Regenerator Section OH TX/RX (SDH)

The **Regenerator Section OH TX** allows changing the regenerator transport overhead information to be transmitted while the **Regenerator Section OH RX** allows verification of the information received. Refer to *Glossary* on page 413 for detailed overhead information.

Press **Main**, **Test**, **SDH**, **RS**, and **OH TX/RX**.



Regenerator Section Overhead

➤ **STM-1 Channel**: Select the channel number that will be used for verification. Choices are **1** for STM-1, **1** to **4** for STM-4, **1** to **16** for STM-16, and **1** to **64** for STM-64.

➤ **Binary**: Allows either displaying all overhead values in binary (when the **Binary** check box is selected) or hexadecimal (when the **Binary** check box is cleared). This **Binary** check box is cleared by default.

➤ **A1** and **A2**: Framing. The value should be hexadecimal **F6** for A1 and **28** for A2.

➤ **J0/Z0**

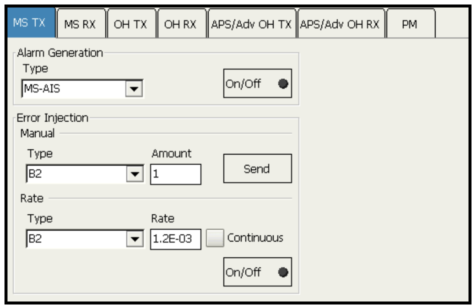
J0: Trace: STM-1 of a STM-N signal. J0 is only available when **Enable Trace** from the *Regenerator Section TX (SDH)* on page 251 is disabled.

Z0: Growth

- **B1**: BIP-8. This byte is not programmable from this tab.
- **E1**: Orderwire
- **F1**: User
- **D1, D2**, and **D3**: Data Communications Channel (DCC)

Multiplex Section TX (SDH)

Press **Main**, **Test**, **SDH**, **MS**, and **MS TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available with both manual and automated injection modes: **B2** (BIP-8), and **MS-REI** (Multiplex Section - Remote Error Indication). The default setting is **B2**.

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

- **Type**

  MS-AIS (Multiplex Section - Alarm Indication Signal): Generates an SDH signal that contains a valid Regenerator Section Overthead (RSOH) and an all-ones pattern on the SPE.

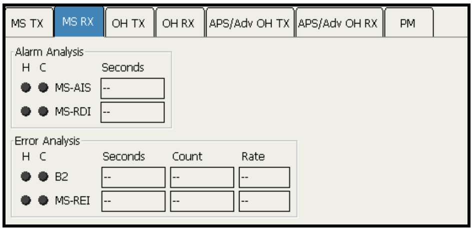
  MS-RDI (Multiplex Section - Remote Defect Indication): Generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.

  The default setting is **MS-AIS**.

- **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

Multiplex Section RX (SDH)

Press **Main**, **Test**, **SDH**, **MS**, and **MS RX**.



Alarm Analysis

➤ **MS-AIS** (Multiplex Section - Alarm Indication Signal): The MS-AIS alarm is declared when bits 6, 7 and 8 of the K2 byte contain the “111” pattern in three consecutive frames.

➤ **MS-RDI** (Multiplex Section - Remote Defect Indication): The MS-RDI alarm is declared when bits 6, 7, and 8 of the K2 byte contain the “110” pattern in five consecutive frames.

Note: *Refer to* Alarm/Error Measurements *on page 44 for **H**/**C LEDs**, and **Seconds** information.*

Error Analysis

- **B2** (BIP-Nx24, Bit-Interleave Parity - Nx24 bits): The B2 error indicates a Multiplex Section parity error by performing an even-parity check over all bits (except those in the RSOH bytes) of the previous frame of a STM-N signal.
- **MS-REI** (Multiplex Section - Remote Error Indicator):

  For STM-0e: The MS-REI error is declared the M1 byte located in the STM-1 channel 1 (first timeslot) indicates that one or more BIP violations have been detected.

M1, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
000 1000	8 BIP violations
000 1001	0 BIP violation
:	:
111 1111	0 BIP violation

For STM-1e and STM-1o: The MS-REI error is declared when the M1 byte located in the STM-1 channel 1 (timeslot #3) indicates that one or more BIP violations have been detected

M1, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
001 1000	24 BIP violations
001 1001	0 BIP violation
:	:
111 1111	0 BIP violation

For STM-4: The MS-REI error is declared when the M1 byte located in the STM-1 channel 3 (timeslot #7) indicates that one or more BIP violations have been detected.

M1, bits 234 5678	Indicates
000 0000	0 BIP violation
000 0001	1 BIP violation
000 0010	2 BIP violations
:	:
110 0000	96 BIP violations
110 0001	0 BIP violation
:	:
111 1111	0 BIP violation

For STM-16: The MS-REI error is declared when the M1 byte located in the STM-1 channel 3 (timeslot #7) indicates that one or more BIP violations have been detected.

M1	Indicates
0000 0000	0 BIP violation
0000 0001	1 BIP violation
0000 0010	2 BIP violations
:	:
1111 1111	255 BIP violations

For STM-64: The MS-REI error is declared when either the M1 byte located in the timeslot #7 (STM-1 channel 3) indicates that one or more BIP violations have been detected, or the combination of the M0 and M1 bytes indicates that one or more BIP violations have been detected. Refer to *OC-192/STM-64 REI-L/MS-REI* on page 386 for MS-REI computation method.

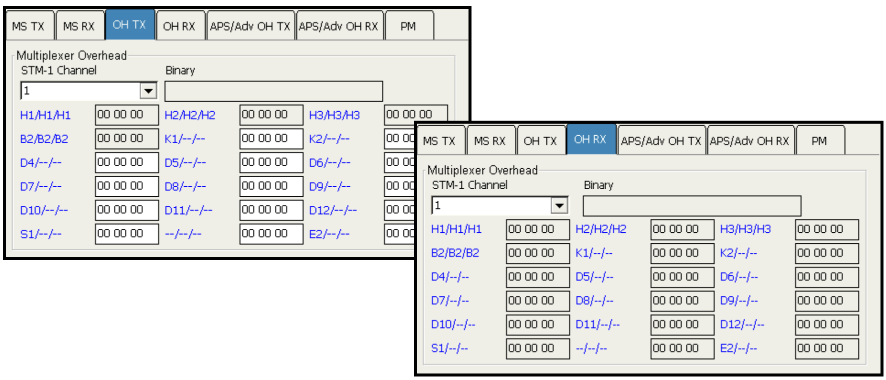
M1	Indicates
0000 0000	0 BIP violation
0000 0001	1 BIP violation
0000 0010	2 BIP violations
:	:
1111 1111	255 BIP violations

M0 Located in STM-1 channel 2 (timeslot #4)	M1 Located in STM-1 channel 3 (timeslot #7)	Indicates
0000 0000	0000 0000	0 BIP violation
0000 0000	0000 0001	1 BIP violation
0000 0000	0000 0010	2 BIP violations
:	:	
0000 0110	0000 0000	1536 BIP violations
0000 0110	0000 0001	0 BIP violation
:		:
1111 1111	1111 1111	0 BIP violation

Multiplex Section OH TX/RX (SDH)

The **Multiplex Section OH TX** allows changing the multiplex transport overhead information to be transmitted while the **Multiplex Section OH RX** allows verification of the multiplex transport overhead information received.

Press **Main**, **Test**, **SDH**, **MS**, and **OH TX/RX**.



Multiplex Section Overhead

➤ **STM-1 Channel**: Select the timeslot number that will be used for the test. Choices are **1** for STM-1, **1** to **4** for STM-4, **1** to **16** for STM-16, and **1** to **64** for STM-64. The default setting is **1**.

➤ **Binary**: Allows either displaying all overhead values in binary (when the **Binary** check box is selected) or hexadecimal (when the **Binary** check box is cleared). This **Binary** check box is cleared by default.

➤ **H1** and **H2**: Pointer

➤ **H3**: Pointer Action

➤ **B2**: BIP-8

➤ **K1** and **K2**: Automatic Protection Switching (APS)

- **D4** through **D12**: Data Communications Channel (DCC)
- **S1**: Synchronization Status.
- **M0** or **M1**

  M0: REI-L [STM-1 channel 1 of a STM-0e signal; STM-1 channel 2 of an STM-64 signal]

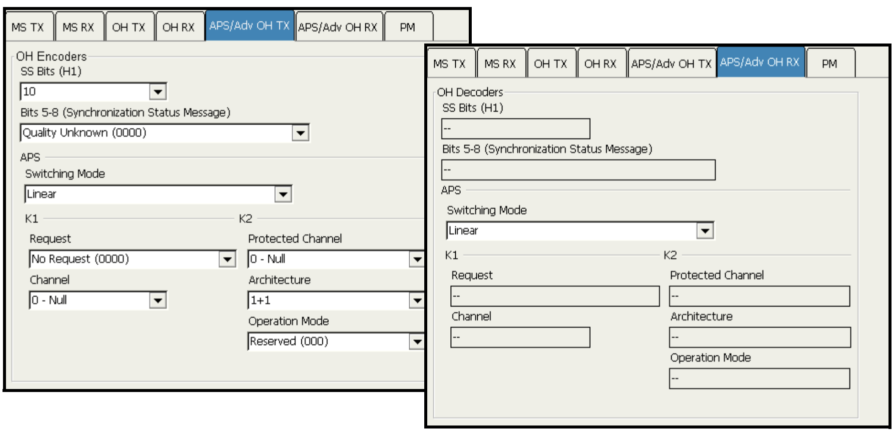
  M1: REI-L [STM-1 channel 1 of a STM-1e or STM-1o signal; STM-1 channel 3 of an STM-4/16/64 signal]

  Undefined "--" for all other timeslots not covered by M0 and M1.
- **E2**: Orderwire

Multiplex Section APS/Advanced OH TX/RX (SDH)

The **APS/Advanced MS OH TX** allows changing the multiplex transport overhead information to be transmitted while the **APS/Advanced MS OH RX** allows verification of the multiplex transport overhead information received.

Press **Main**, **Test**, **SDH**, **MS**, and **APS/Adv OH TX/RX**.



Advanced

APS

➤ **Switching Mode**

Allows the switching mode selection and is available on both TX and RX tabs. Choices are **Linear** and **Ring**. The default setting is **Linear**.

- **K1**
  - **Request**: Bits 1 through 4 of the K1 byte. The default setting is **No Request** (0000). Refer to *K1* on page 187 for available/possible choices.
  - **Channel ID/Destination Node ID**: Bits 5 through 8 of the K1 byte. Channel if available with Linear switching mode while Destination Node ID is available with Ring switching mode. The default setting is **Null Channel** for **Linear** switching mode and **0** for **Ring** switching mode. Refer to *Channel/Destination Node ID* on page 188 for available/possible choices.
- **K2**
  - **Protected Channel/Source Node ID**: Bits 1 through 4 of the K2 byte. **Protected Channel** is available with **Linear** switching mode while **Source Node ID** is available with **Ring** switching mode. The default setting is **Null Channel** for **Linear** switching mode and **0** for **Ring** switching mode. Refer to *K2* on page 189 for available/possible choices.
  - **Architecture/Bridge Request**: Bit 5 of the K2 byte. **Architecture** is available with **Linear** switching mode while **Bridge Request** is available with **Ring** switching mode. The default setting is **1+1** for **Linear** switching mode and **Short Path Request** for **Ring** switching mode. Refer to *K2* on page 189 for available/possible choices.

➤ **Operation Mode**: Bits 6 through 8 of the K2 byte. The default setting is **Reserved (000)** for Linear switching mode and **Idle** for Ring switching mode.

Bits 6 to 8	Linear mode	Ring mode
000	Reserved	Idle
001	Reserved	Bridged
010	Reserved	Bridged and Switched
011	Reserved	Extra Traffic - Protection
100	Unidirectional	Reserved
101	Bidirectional	Reserved
110	MS-RDI	MS-RDI
111	MS-AIS	MS-AIS

SS Bits (H1)

➤ Bits 5 and 6 of the H1 byte represent the SS bits.

SS Bits	Description
00	SONET
01	Undefined
10	SDH
11	Undefined

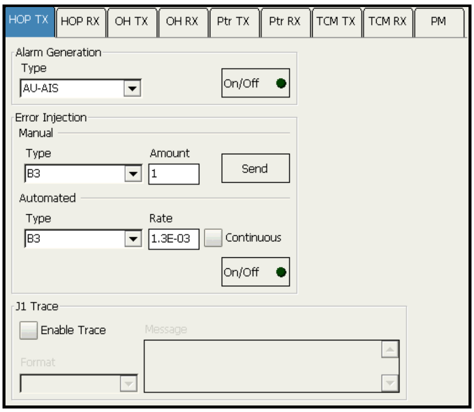
Bits 5-8 (Synchronization Status Message)

➤ Bits 5 through 8 of the S1 byte are used to convey synchronization status of the NE. The default setting is **Synchronized - Traceability Unknown (0000)**. Choices are:

Bits 5 to 8	Description	Bits 5 to 8	Description
0000	Quality Unknown	1000	SSU-B
0001	Reserved	1001	Reserved
0010	ITU G.811 (PRC)	1010	Reserved
0011	Reserved	1011	ITU-T G.813 Option I (SEC)
0100	SSU-A	1100	Reserved
0101	Reserved	1101	Reserved
0110	Reserved	1110	Reserved
0111	Reserved	1111	Do not use for synchronization

HOP TX (SDH)

Press **Main**, **Test**, **SDH**, **HOP**, and **HOP TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **B3** (BIP-8, Bit-Interleave Parity - 8 bits) and **HP-REI** (High Order path - Remote Error Indicator).

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

➤ **Type**

AU-AIS (Administrative Unit - Alarm Indication Signal): Generates an all-ones patterns over the H1, H2, H3, and SPE.

HP-RDI (High Order Path - Remote Defect Indication): Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.

ERDI-SD (Enhanced RDI - Server Defect): Generates a “101” pattern for the bits 5, 6 and 7 of the G1 byte.

ERDI-CD (Enhanced RDI - Connectivity Defect): Generates a “110” pattern for the bits 5, 6 and 7 of the G1 byte.

ERDI-PD (Enhanced RDI - Payload Defect): Generates a “010” pattern for the bits 5, 6 and 7 of the G1 byte.

H4-LOM (H4 - Loss Of Multiframe) (available with TU-11,.TU-12 and TU-2): Generates a wrong H4 byte multiframe indicator sequence.**AU-LOP** (Administrative Unit - Loss Of Pointer): Generates a non-valid pointer.

HP-UNEQ (High Order Path - Unequipped): Generates an all-ones pattern over POH and SPE.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

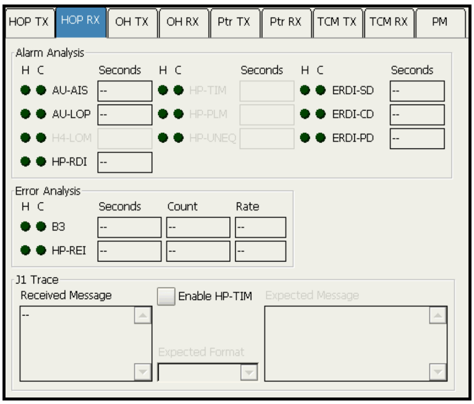
J1 Trace

- **Format**: Displays the J1 value in 16 or 64 bytes format. The default setting is **16 bytes**.
- **Message**: Enter the J1 trace value in 16 or 64 bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.
- **Enable Trace**: Generates the defined J1 Trace message when the **Enable Trace** check box is selected. The **Enable Trace** check box has to be selected to give access to the trace format and message. When the **Enable Trace** check box is not selected, the J0 1-byte format is used and can be configured from the **HOP OH TX (SDH)** on page 279.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C_R> and <L_F> bytes will be added at the end for a total of 64 bytes).*

HOP RX (SDH)

Press **Main**, **Test**, **SDH**, **HOP**, and **HOP RX**.



Error Analysis

➤ **B3** (BIP-8, Bit-Interleave Parity - 8 bits): The B3 error indicates a High Order Path parity error by performing an even-parity check over all bits of the previous VC-N.

➤ **HP-REI** (High Order Path - Remote Error Indicator): The HP-REI error is declared when bits 1 through 4 of the G1 byte contain one pattern from the following binary range: “0001” through “1000” (1 to 8) (located in every STM-1 of an STM-n signal).

Alarm Analysis

- **AU-AIS** (Administrative Unit - Alarm Indication Signal): The AU-AIS alarm is declared when the H1 and H2 bytes contain an all-ones pattern in three consecutive frames.
- **AU-LOP** (Administrative Unit - Loss Of Pointer): The LOP alarm indicates that a valid pointer is not found in N consecutive frames (where $8 \leq N \leq 10$), or that N consecutive NDFs ("1001" pattern) are detected (non-concatenated payloads).
- **H4-LOM** (H4 - Loss Of Multiframe): For TU structured optical frames, the H4-LOM alarm indicates that the system loss track of the H4 byte multiframe indicator sequence.
- **HP-RDI** (High Order Path - Remote Defect Indication): The HP-RDI alarm is declared when bits 5, 6 and 7 of the G1 byte contain the "100" or "111" pattern in five consecutive frames.
- **HP-TIM** (High Order Path - Trace Identifier Mismatch): The HP-TIM defect indicates that the received J1 Trace doesn't match the expected message value. The HP-TIM alarm result is only available when **Enable HP-TIM** check box from J1 Trace section has been selected.
- **HP-PLM** (High Order Path - Payload Label Mismatch): The HP-PLM is declared upon receipt of five consecutive frames with mismatched VC signal labels (C2 byte).
- **HP-UNEQ** (High Order Path - Unequipped): HP-UNEQ is declared when the C2 bytes contain "00 H" in five consecutive frames.
- **ERDI-SD** (Enhanced RDI - Server Defect): The ERDI-SD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the "101" pattern in five consecutive frames.

- **ERDI-CD** (Enhanced RDI - Connectivity Defect): The ERDI-CD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five consecutive frames.
- **ERDI-PD** (Enhanced RDI - Payload Defect): The ERDI-PD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five consecutive frames.

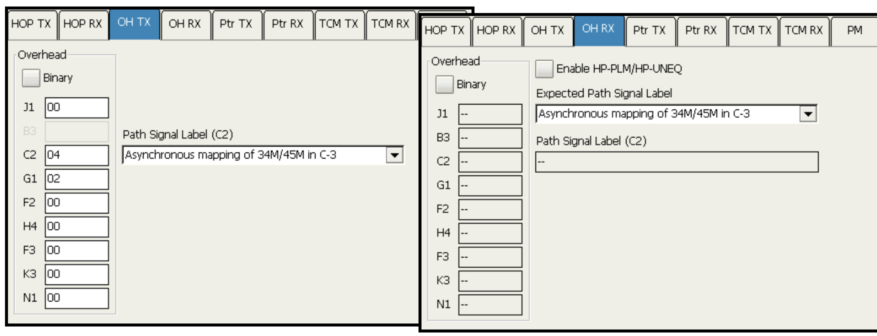
J1 Trace

- **Received Message**: Displays the J1 value in 16-bytes or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, $<C_R>$ and $<L_F>$, represent respectively a carriage return and a line feed.
- **Enable HP-TIM**: Enables the Trace Identifier Mismatch for the expected message defined when the **Enable HP-TIM** check box is selected. The **Enable HP-TIM** check box has to be selected to give access to the expected trace format and message.When the **Enable HP-TIM** check box is cleared, the J1 1-byte is available from the **HOP OH RX (SDH)** on page 279.
- **Expected Message**: Allows entering the message that is expected. J1 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64 bytes**. The default setting is **16 bytes**.

HOP OH TX/RX (SDH)

The **HOP OH TX** allows changing the high order path transport overhead information to be transmitted while the **HOP OH RX** allows verification of the high order path transport overhead information received.

Press **Main**, **Test**, **SDH**, **HOP**, and **OH TX/RX**.



Path Overhead

- **Binary**: Allows either displaying all overhead values in binary (when the Binary check box is selected) or hexadecimal (when the Binary check box is cleared). This Binary check box is cleared by default.
- **J1**: Trace. J1 is only available when **Enable Trace** from the *HOP TX (SDH)* on page 272 is disabled.
- **B3**: BIP-8. This byte is not programmable from the HOP OH TX tab.
- **C2**: Path Signal Label. Entering a C2 byte will automatically update the Path Signal Label (C2) selection and vice versa.
- **G1**: Path Status
- **F2**: User Channel

- **H4**: Multiframe Indicator. This byte is not programmable with LOP or VCAT.
- **F3**: User Channel
- **K3**: Automatic Protection Switching (APS)
- **N1**: (Network operator byte) Tandem Connection Monitoring (TCM)

Path Signal Label (C2)

The C2 byte is allocated to indicate the content of the VC, including the status of the mapped payloads.

C2 (Hex.)	Description	C2 (Hex.)	Description
00[a]	Unequipped or supervisory-unequipped	17	Reserved (SDL self-synch scrambler)
01	Reserved (Equipped - Non-Specific)	18	Mapping of HDLC/LAPS
02	TUG Structure	19	Reserved (SDL set-reset scrambler)
03	Locked TU-n	1A	Mapping of 10 Gbps Ethernet (IEEE 802.3)
04	Asynchronous Mapping of 34M/45M in C-3	1B	GFP
05	Experimental Mapping	1C	Mapping 10 Gbps FC
12	Asynchronous Mapping of 140M in C-4	20	Asynchronous Mapping of ODUk
13	ATM Mapping	CF	Reserved (obsolete HDLC/PPP framed)
14	MAN DQDB	FE	Test Signal, ITU-T 0.181 specific mapping
15	FDDI [3]-[11] Mapping	FF[a]	VC-AIS (TCM)
16	Mapping of HDLC/PPP		

a. These values cannot be selected as Expected Path Signal Label.

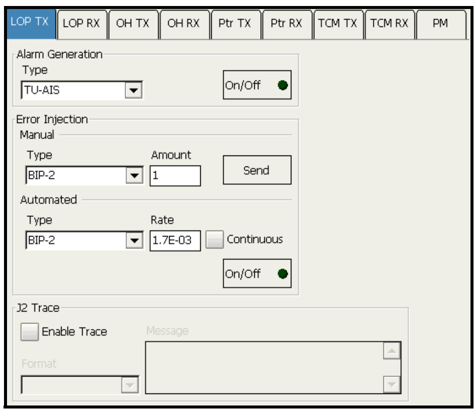
For HOP OH RX tab only:

- **Expected Path Signal Label**: Allows selecting the expected Path Signal Label.
- **Enable HP-PLM/HP-UNEQ** (High Order Path - Payload Label Mismatch / Unequipped): Enables the Payload Label Mismatch and Unequipped monitoring..

LOP TX (SDH)

Note: *See LOP TX (SDH, TU-3 path)* on page 291 *for TU-3 path test case.*

Press **Main**, **Test**, **SDH**, **LOP**, and **LOP TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **BIP-2** (Bit-Interleave Parity - 2 bits) and **LP-REI** (Low Order Path - Remote Error Indicator).

For **Manual** method:

- **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

- **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
- **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

➤ **Type**: The following errors are available:

 TU-AIS (Tributary Unit - Alarm Indication Signal): Generates an all-ones pattern for the V1 and V2 bytes of the TU path and payload.

 LP-RDI (Low Order Path - Remote Defect Indication): Generates “1” for the bit 8 of the V5 byte and a “00” pattern for bits 6 and 7 of the K4 byte.

 ERDI-SD (Enhanced RDI - Server Defect): Generates a **101** pattern for bits 5, 6, and 7 of the K4 byte, and **1** for bit 8 of the V5 byte.

 ERDI-CD (Enhanced RDI - Connectivity Defect): Generates a **110** pattern for bits 5, 6, and 7 of the K4 byte, and **1** for bit 8 of the V5 byte.

 ERDI-PD (Enhanced RDI - Path Payload Defect): Generates a “010” pattern for bits 5, 6, and 7 of the K4 byte, and “0” for bit 8 of the V5 byte.

 LP-RFI (Low Order Path - Remote Failure Indication) (available with VC-11 only): Generates “1” for the bit 4 of the V5 byte.

 TU-LOP (Tributary Unit - Loss of Pointer): Generates a non-valid pointer.

 LP-UNEQ (Low Order Path - Unequipped): Generates unequipped LP signal label (bits 5 through 7 of V5 byte are set to “000”).

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

J2 Trace

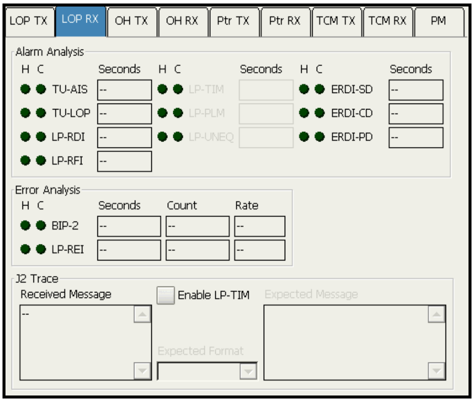
- **Enable Trace**: Enable Trace, when enabled, generates the J2 Trace message defined. **Enable Trace** has to be enabled to give access to the trace format and message. When the J2 Trace is disabled, the J2 1-byte format is used and can be configured from the *LOP OH TX/RX (SDH, TU-3 path)* on page 298.
- **Format**: Select the display format for J2. Choices are **16** and **64 bytes**. The default setting is **16-bytes**.
- **Message**: Enter the J2 value in 16-bytes or 64-bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer low order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C_R> and <L_F> bytes will be added at the end for a total of 64 bytes). J1 value should be ASCII suitable characters including the* *ITU T.50 Characters* on page 50.

LOP RX (SDH)

Note: *See LOP RX (SDH, TU-3 path)* on page 295 *for TU-3 path test case.*

Press **Main**, **Test**, **SDH**, **LOP**, and **LOP RX**.



Error Analysis

➤ **BIP-2** (Bit-Interleave Parity - 2 bits): The BIP-2 error indicates a Low Order Path parity error by performing a routine even-parity check over all bytes of the previous VC frame.

➤ **LP-REI** (Low Order Path Remote Error Indicator): The LP-REI error is declared when bit 3 of the V5 byte is set to “1”.

Note: *Refer to* Alarm/Error Measurements *on page 44 for* ***H/C LEDs***, ***Seconds***, ***Count***, *and* ***Rate*** *information.*

Alarm Analysis

- **TU-AIS** (Tributary Unit - Alarm Indication Signal): The TU-AIS alarm is declared when V1 and V2 bytes for the TU path contain an all-ones pattern in five consecutive superframes.
- **TU-LOP** (Tributary Unit - Loss Of Pointer): The TU-LOP alarm indicates that a valid pointer is not found in N consecutive superframes (where $8 \leq N \leq 10$), or if N consecutive NDFs ("1001" pattern) are detected.
- **LP-RDI** (Tributary Unit - Remote Defect Indication): The LP-RDI alarm is declared when bit 8 of V5 byte contains "1" in five consecutive TU superframes while bits 6 and 7 of the K4 byte contain the "00" or "11" pattern.
- **LP-RFI** (Low Order Path - Remote Failure Indication) (available with VC-11 only): The LP-RFI alarm is declared when bit 4 of V5 byte contains "1" in five consecutive superframes.
- **LP-TIM** (Low Order Path - Trace Identifier Mismatch): The LP-TIM defect indicates that none of the sampled LP trace strings match the expected message value. The LP-TIM alarm result is only available when LP-TIM from J2 Trace section has been enabled.
- **LP-PLM** (Low Order Path - Payload Label Mismatch): The LP-PLM is declared upon receipt of five consecutive superframes with mismatched LP Signal (bits 5 through 7 of the V5 byte are "000", "001" or "111")
- **LP-UNEQ** (Low Order Path - Unequipped): LP-UNEQ is declared when bit 5 through 7 of the V5 byte contain "000" for five consecutive superframes.
- **ERDI-SD** (Enhanced RDI - Server Defect): The ERDI-SD alarm is declared when bits 5, 6, and 7 of the K4 byte contain the "101" pattern, and bit 8 of the V5 byte contain "1", in five consecutive LP superframes.

- **ERDI-CD** (Enhanced RDI - Connectivity Defect): The ERDI-CD alarm is declared when bits 5, 6, and 7 of the K4 byte contain the “110” pattern, and bit 8 of the V5 byte contain “1”, in five consecutive LP superframes.
- **ERDI-PD** (Enhanced RDI - Path Payload Defect): The ERDI-PD alarm is declared when bits 5, 6, and 7 of the K4 byte contain the “010” pattern, and bit 8 of the V5 byte contain “0”, in five consecutive LP superframes.

Note: *Refer to* Alarm/Error Measurements *on page 44 for **H/C LEDs**, and **Seconds** information.*

J2 Trace

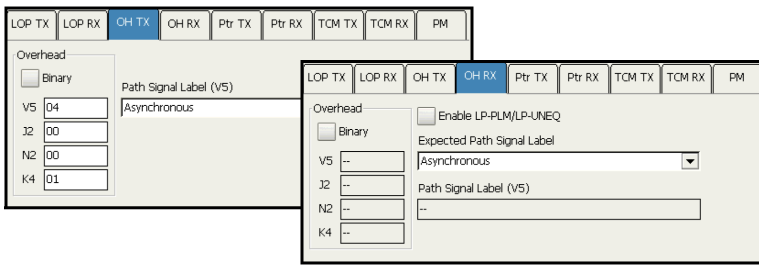
- **Received Message**: Displays the J2 value in 16-bytes or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, <C_R> and <L_F>, represent respectively a carriage return and a line feed.
- **Enable LP-TIM** (Low Order Path - Trace Identifier Mismatch): Allows enabling the Trace Identifier Mismatch for the expected message defined. **Enable LP-TIM** has to be enabled to give access to the expected trace format and message. When Enable LP-TIM is disabled, the J2 1-byte is available from the *LOP OH TX/RX (SDH)* on page 289.
- **Expected Message**: Allows entering the message that is expected. J2 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64 bytes**. The default setting is **16 bytes**.

LOP OH TX/RX (SDH)

The LOP OH TX allows changing the low order path transport overhead information to be transmitted while the LOP OH RX allows verification of the low order path transport overhead information received.

Note: *See LOP OH TX/RX (SDH, TU-3 path)* on page 298 *for TU-3 path test case.*

Press **Main**, **Test**, **SDH**, **LOP**, and **OH TX/RX**.



Path Overhead

Enter the path overhead values in hexadecimal or binary.

- **Binary** allows either displaying all overhead values in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **V5** (VC Path Overhead)
- **J2** (Path Trace). J2 is only available when **Enable Trace** from the *LOP TX (SDH)* on page 282 is disabled.
- **N2** (Network operator byte) Tandem Connection Monitoring
- **K4** (Extended signal label)

Path Signal Label (V5)

The V5 byte is allocated to indicate the content of the VC path, including the status of the mapped payloads.

Bits 5, 6, 7 of V5	Description
000[a]	Unequipped or supervisory-unequipped
001	Reserved (Equipped - Non-specific)
010	Asynchronous
011	Bit Synchronous
100	Byte Synchronous
101	Extended Signal Label
110	Test Signal, ITU-T 0.181 specific mapping
111[a]	VC-AIS (TCM)

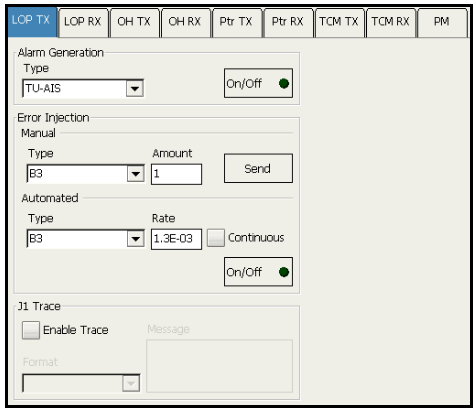
a. These bytes cannot be selected in receive mode.

For HOP OH RX tab only:

- **Expected Path Signal Label**: Allows selecting the expected Path Signal Label.
- **Enable LP-PLM/LP-UNEQ** (Low Order Path - Payload Label Mismatch / Unequipped): Allows enabling the Signal Label Mismatch for the expected message defined.

LOP TX (SDH, TU-3 path)

Press **Main**, **Test**, **SDH**, **LOP**, and **LOP TX**.



Error Injection

Allows **Manual** or **Automated** error injection methods.

➤ **Type**: The following errors are available: **B3** (BIP-8, Bit-Interleave Parity - 8 bits) and **LP-REI** (Low Order Path - Remote Error Indicator).

For **Manual** method:

➤ **Amount**: Select the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the **Error Type** and the **Amount of Errors** selected.

For **Rate** method:

➤ **Rate**: Select the injection rate for the selected error. The rate must be within the minimum and maximum values specified.

➤ **Continuous**: Generates the selected error to its theoretical maximum rate when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Alarm Generation

Allows **Continuous** alarm generation method.

➤ **Type**: The following errors are available:

TU-AIS (Tributary Unit - Alarm Indication Signal): Generates an all-ones patterns for the path and payload.

LP-RDI (Low Order Path - Remote Defect Indication): Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.

ERDI-SD (Enhanced RDI - Server Defect): Generates a “101” pattern for the bits 5, 6 and 7 of the G1 byte.

ERDI-CD (Enhanced RDI - Connectivity Defect): Generates a “110” pattern for the bits 5, 6 and 7 of the G1 byte.

ERDI-PD (Enhanced RDI - Path Payload Defect): Generates a “010” pattern for the bits 5, 6 and 7 of the G1 byte.

TU-LOP (Tributary Unit - Loss of Pointer): Generates a non-valid pointer.

LP-UNEQ (Low Order Path - Unequipped): Generates samples of unequipped signal labels (C2 is set to “00 H”).

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

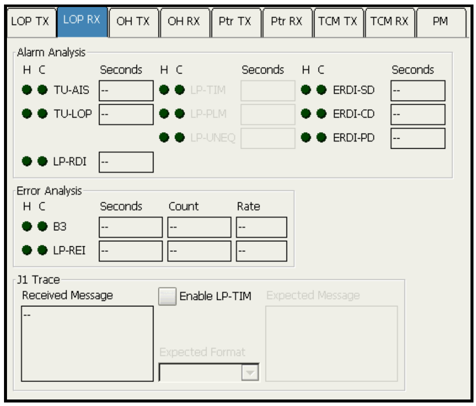
J1 Trace

- **Enable Trace**: Enable Trace, when enabled, generates the J1 Trace message defined. **Enable Trace** has to be enabled to give access to the trace format and message. When the J1 Trace is disabled, the J1 1-byte format is used and can be configured from the *LOP OH TX* on page 289.
- **Format**: Displays the J1 value in **16-bytes** or **64-bytes** format. The default setting is **16-bytes**.
- **Message**: Enter the J1 trace value in 16 or 64 bytes format as selected. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer low order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.

Note: *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C_R> and <L_F> bytes will be added at the end for a total of 64 bytes). J1 value should be ASCII suitable characters including the ITU T.50 Characters* on page 50.

LOP RX (SDH, TU-3 path)

Press **Main**, **Test**, **SDH**, **LOP**, and **LOP RX**.



Error Analysis

- **B3** (BIP-8, Bit-Interleave Parity - 8 bits): The B3 error indicates a High Order Path parity error by performing a routine even-parity check over all High Order Path bits of the previous VC-N.
- **LP-REI** (Low Order Path Remote Error Indicator): The LP-REI error indicates the count of B3 errors detected.

Note: *Refer to* Alarm/Error Measurements *on page 44 for* ***H/C LEDs****,* ***Seconds****,* ***Count****, and* ***Rate*** *information.*

Alarm Analysis

- **TU-AIS** (Tributary Unit - Alarm Indication Signal): The TU-AIS alarm is declared when the H1 and H2 bytes contain an all-ones pattern in three consecutive frames
- **TU-LOP** (Tributary Unit - Loss Of Pointer): For non-concatenated payloads, the TU-LOP alarm indicates that a valid pointer is not found in N consecutive frames (where $8 \leq N \leq 10$), or N consecutive NDFs (“1001” pattern) are detected.
- **LP-RDI** (Tributary Unit - Remote Defect Indication): The LP-RDI alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “100” or “111” pattern in five consecutive frames.
- **LP-TIM** (Low Order Path - Trace Identifier Mismatch): The LP-TIM defect indicates that none of the sampled path trace strings match the expected message value. The LP-TIM alarm result is only available when LP-TIM from J1 Trace section has been enabled.
- **LP-PLM** (Low Order Path - Payload Label Mismatch): The LP-PLM is declared upon receipt of five consecutive frames with mismatched VC signal labels.
- **LP-UNEQ** (Low Order Path - Unequipped): LP-UNEQ is declared when the C2 bytes contain “00 H” in five consecutive frames.
- **ERDI-SD** (Enhanced RDI - Server Defect): The ERDI-SD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “101” pattern in five consecutive frames.

- **ERDI-CD** (Enhanced RDI - Connectivity Defect): The ERDI-CD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five consecutive frames.
- **ERDI-PD** (Enhanced RDI - Path Payload Defect): The ERDI-PD alarm is declared when bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five consecutive frames.

Note: *Refer to* Alarm/Error Measurements *on page 44 for **H**/**C LEDs**, and **Seconds** information.*

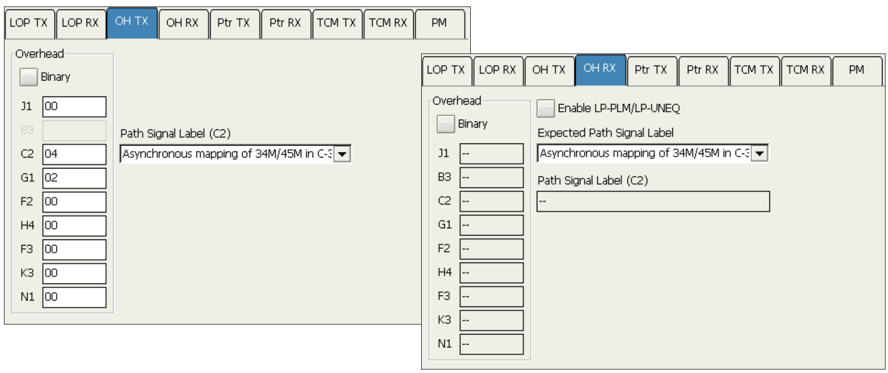
J1 Trace

- **Received Message**: Displays the J1 value in 16-bytes or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, $<C_R>$ and $<L_F>$, represent respectively a carriage return and a line feed.
- **Enable LP-TIM** (Trace Identifier Mismatch - Path): Allows enabling the Trace Identifier Mismatch for the expected message defined. **Enable LP-TIM** has to be enabled to give access to the expected trace format and message. When Enable LP-TIM is disabled, the J1 1-byte is available from the *LOP OH RX (SDH, TU-3 path)* on page 298.
- **Expected Message**: Allows entering the message that is expected. J1 value should be ASCII suitable characters. The default message is **EXFO SONET/SDH** for 16 bytes and **EXFO SONET/SDH Analyzer high order path trace test message** for 64 bytes. However, with VCAT/LCAS the default message will be **EXFO** followed by the VCG number (VCAT and LCAS) and the SQ (VCAT only) number (for example **EXFO-VCG1-SQ0**) for both 16 and 64 bytes formats.
- **Expected Format**: Allows the selection of the format expected. Choices are **16** or **64 bytes**. The default setting is **16 bytes**.

LOP OH TX/RX (SDH, TU-3 path)

The **LOP OH TX** allows changing the low order path transport overhead information to be transmitted while the **LOP OH RX** allows verification of the low order path transport overhead information received.

Press **Main**, **Test**, **SDH**, **LOP**, and **OH TX/RX**.



Path Signal Label (C2)

The C2 byte is allocated to indicate the content of the VC, including the status of the mapped payloads. See *Path Signal Label (C2)* on page 280 for available/possible choices.

For LOP OH RX tab only:

- **Expected Path Signal Label**: Allows selecting the expected Path Signal Label.
- **Enable LP-PLM/LP-UNEQ** (Low Order Path - Payload Label Mismatch / Unequipped): Allows enabling the Signal Label Mismatch for the expected message defined.

Path Overhead

- **Binary**: Allows either displaying all overhead values in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **J1**: Trace
- **B3**: BIP-8. This byte is not programmable from the HOP OH TX tab.
- **C2**: Path Signal Label
- **G1**: Path Status
- **F2**: User Channel
- **H4**: Multiframe Indicator
- **F3**: User Channel
- **K3**: Automatic Protection Switching (APS)
- **N1**: (Network Operator) Tandem Connection Monitoring (TCM)

14 PDH Tabs

The PDH tabs allow configuration of different test parameters and to view the test status and results.

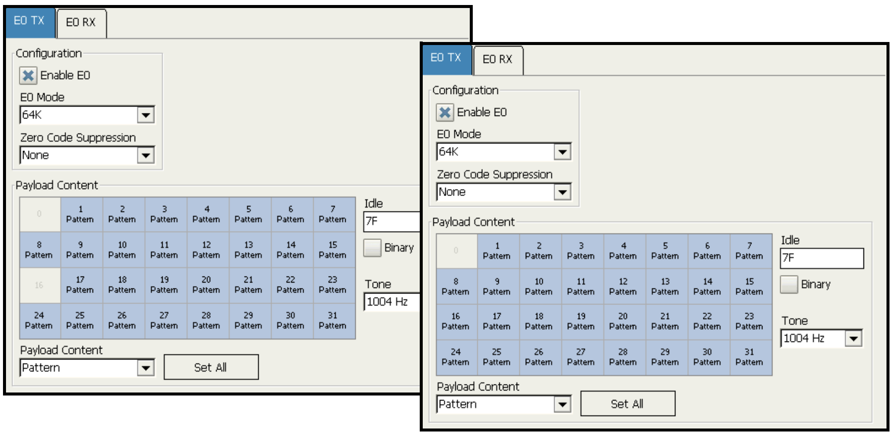
Note: *The available tabs listed are a function of the test path activated.*

Signal	Tab	Page
E0/64K	*E0/64K TX*	302
	E0/64K RX	305
E1/2M	*E1/2M TX*	310
	E1/2M RX	310
	Performance Monitoring (PM)[a]	361
E2/8M	*E2/8M TX*	313
	E2/8M RX	315
	Performance Monitoring (PM)[a]	361
E3/34M	*E3/34M TX*	317
	E3/34M RX	319
	Performance Monitoring (PM)[a]	361
E4/140M	*E4/140M TX*	321
	E4/140M RX	323
	Performance Monitoring (PM)[a]	361

a. This tab is described in the *Common Tabs* section.

E0/64K TX

Press **Main**, **Test**, **DSn/PDH**, **E0**, and **E0 TX**.



Note: *E0/64K TX configuration is not available when the selected framing from the E1/2M TX* on page 307 *is unframed. The framing structure PCM-30 and PCM30 CRC-4 have 30 channel timeslots while PCM-31 and PCM-31 CRC-4 have 31 channel timeslots.*

Configuration

➤ **Enable E0**: Allows the activation of E0/64K testing. This setting is disabled (Off) by default unless otherwise set during the test setup.

➤ **E0 Mode**: Allows the selection of the channel timeslot data rate for the pattern payload content. Choices are **56K** and **64K**. The default setting is **64K**.

56K: A timeslot data rate of 56 Kbps uses 7 bits to carry the payload information.

64K: A timeslot data rate of 64 Kbps uses 8 bits to carry the payload information.

➤ **Zero Code Suppression**: Allows the selection of the Zero Code Suppression (ZCS) method used to replace the all-zero bytes of all Idle and Tone payload contents. The ZCS mechanism is a global parameter meaning that all channel timeslots configured with Tone/Idle data, use the same ZCS method. Choices are **None** and **Jammed Bit 8**. The default setting is **None**.

None: No Zero Code Suppression

Jammed Bit 8: Every 8th (LSB) bit is forced to **1**.

Note: *Bit 8 is the Least-Significant Bit (LSB) and bit 1 is the Most-Significant Bit (MSB).*

Bit #	1	2	3	4	5	6	7	8
	MSB							LSB

Payload Content

Select the payload content by pressing once or several times on each timeslot until the desired content appears (or use the Set All buttons). Choices are **Pattern**, **Idle**, and **Tone**. The default setting is **Pattern**.

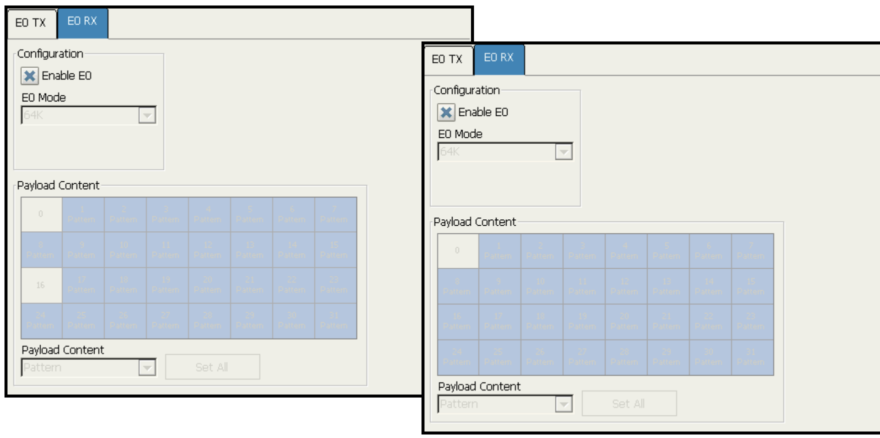
- **Pattern**: Uses the selected pattern from the *Pattern TX* on page 335.
- **Idle**: Uses the Idle code byte from the Idle field. Choices are **00** to **FF**. The selected Idle code applies to all timeslots set to Idle. The default setting is **7F**.

  Binary: Allows either displaying the Idle code values in binary (when enabled) or hexadecimal (when disabled). This setting is disabled by default.
- **Tone**: Allows the selection of a tone for digital milliwatt testing. The signal output power, when converted to analog, is 0 dBm. Choices are **1000 Hz** and **1004 Hz**. The selected Tone applies to all timeslots set to Tone. The default setting is **1004 Hz**.
- **Payload Content**: Allows the selection of the payload content that will be applied when pressing **Set All**. Choices are **Pattern**, **Idle**, and **Tone**.
- **Set All**: Allows to set the payload content of all timeslots to the selected payload content with its Pattern, Idle, or Tone value.

Note: *The timeslots set to Idle or Tone can be changed from Idle to Tone and vice versa even when the test is running; the Idle and Tone values can also be changed.*

E0/64K RX

Press **Main**, **Test**, **DSn/PDH**, **E0**, and **E0 RX**.



Note: *E0/64K RX configuration is not available when the selected framing from the E1/2M RX* on page 310 *is unframed. The framing structure PCM-30 and PCM30 CRC-4 have 30 channel timeslots while PCM-31 and PCM-31 CRC-4 have 31 channel timeslots.*

Configuration

Note: *See* E0/64K TX *on page 302 for more information on* ***Enable E0*** *and* ***E0 Mode****.*

Payload Content

Note: *Payload content configuration is only available for decoupled test mode, otherwise the payload content is coupled with the E0/64K TX configuration.*

Select the payload content by pressing once or several times on each timeslot until the desired content appears (or use the Set All buttons). Choices are **None** and **Pattern**. The default setting is **Pattern**.

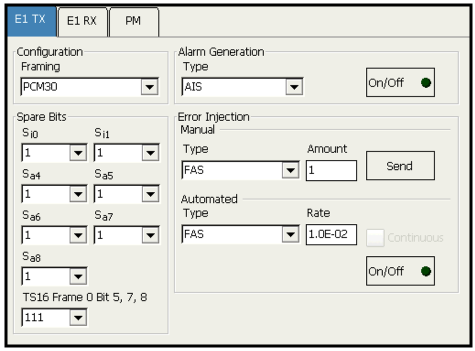
➤ **Pattern**: Uses the pattern from the received signal.

➤ **None**: Does not use the pattern.

➤ **Set All**: Allows to set the payload content of all timeslots with (Pattern) or without (None) the selected Pattern.

E1/2M TX

Press **Main**, **Test**, **DSn/PDH**, **E1**, and **E1 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed**, **PCM30**, **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**. The default setting is **PCM30**.

Alarm Generation

Type: Select the type of alarm to be generated. Choices are **AIS**, **RAI**, **LOF**, **RAI MF**, **LOMF**, **CRC LOMF**, and **TS16 AIS**. The default setting is **AIS**.

Note: *Only AIS is available when the framing is set to Unframed. CRC LOMF is available when the framing is set to PCM30 CRC-4 or PCM31 CRC-4.*

On/Off button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

➤ **Type**: The following error types are available with both manual and automated injection modes. Choices are **FAS**, **CRC-4**, and **E-bit**. The default setting is **FAS**.

Note: *Available choices depend on the selected framing.*

➤ **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.

➤ **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.

➤ **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Spare Bits

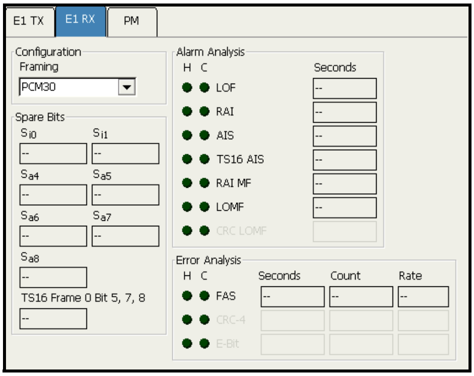
Note: ***Spare Bits*** *are not available when* ***Framing*** *is set to* ***Unframed****.*

Press the individual drop list and select the value for each spare bit.

- $\mathbf{S_{i0}}$ is located in the bit 1 of the frame containing the frame alignment signal (FAS). S_{i0} is reserved for national use and should be set to 1 when not used. Choices are **0** and **1**. The default setting is **1**.
- $\mathbf{S_{i1}}$ is located in the bit 1 of the frame not containing the frame alignment signal (FAS). S_{i1} is reserved for national use and should be set to 1 when not used. Choices are **0** and **1**. The default setting is **1**.
- $\mathbf{S}_{a4}$ to $\mathbf{S}_{a8}$ are located in bit 4 to 8 of frame number 1, 3, 5 and 7 of sub-multiframe 1 and 2. S_{a4} to S_{a8} is reserved for national use and should be set to 1 when not used. Choices are **0** and **1** or **0000** to **1111** depending on the selected framing. The default setting is **1** or **1111** depending on the selected framing.
- **TS16 Frame 0 Bit 5, 7, 8** are located in bit 5, 7 and 8 from Timeslot 16 of frame 0 of a E1 signal. TS16 Frame 0 Bit 5, 7, 8 are reserved for national use and should be set to 1 when not used. Choices are **000** to **111**. The default setting is **111**.

E1/2M RX

Press **Main**, **Test**, **DSn/PDH**, **E1**, and **E1 RX**.



Configuration

Note: *See* E1/2M TX *on page 307 for more information on* ***Framing****.*

Error Analysis

- **FAS** (Frame Alignment Signal): A FAS error indicates that bits 2 to 8 of the frame containing the FAS differ from 0011011.
- **CRC-4** (Cyclical Redundancy Check): A CRC-4 error indicates that one or more bit errors are detected in a block of data through cyclical redundancy check.
- **E-Bit** (CRC-4 Error Signal): A E-Bit error indicates that bit 1 of sub-multiframe (SMF) II in frame 13 and/or 15 is set to 0 indicating a sub-multiframe error.

Alarm Analysis

Note: *Only AIS is available when the **Framing** is set to **Unframed**.*

- **LOF** (Loss Of Frame): The LOF alarm indicates that three consecutive incorrect frame alignment signals have been received.
- **RAI** (Yellow) (Remote Alarm Indication): The RAI alarm is declared when bit 3 in timeslot 0 is set to “1”.
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.
- **TS16 AIS** (TimeSlot 16 Alarm Indication Signal): The TS16 AIS alarm is declared when timeslot 16 is received as all-ones for all frames of two consecutive multiframes.
- **RAI MF** (Remote Alarm Indication Multi-Frame): The RAI MF alarm is declared when bit 6 of timeslot 16 of frame 0 is set to “1”.
- **LOMF** (Loss Of MultiFrame): The LOMF alarm indicates that two consecutive multiframes alignment signals (bits 1 through 4 of TS16 of frame 0) have been received with an error.
- **CRC LOMF** (CRC Loss Of MultiFrame): The CRC LOMF indicates that the first bit of the NFAS in frames 1, 3, 5, 7, 9 and 11 differ from 0, 0, 1, 0, 1 and 1 respectively. CRC LOMF is available when the framing is set to PCM30 CRC-4 or PCM31 CRC-4 and is based on CRC-4 errors.

Note: *In most cases the CRC LOMF will be reported at the same time as LOF since the CRC LOMF leads to a LOF as per ITU G.706.*

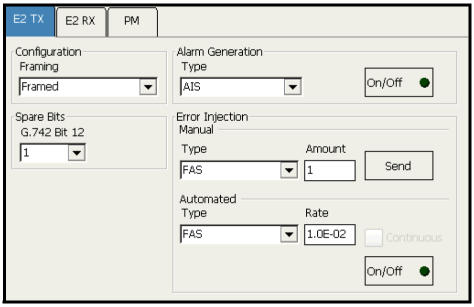
Spare Bits

Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

- $\mathbf{S_{i0}}$ is located in the bit 1 of the frame containing the frame alignment signal (FAS). Possible values are **0** and **1**.
- $\mathbf{S_{i1}}$ is located in the bit 1 of the frame not containing the frame alignment signal (FAS). Possible values are **0** and **1**.
- $\mathbf{S}_{a4}$ to $\mathbf{S}_{a8}$ are located in bit 4 to 8 of frame number 1, 3, 5 and 7 of sub-multiframe 1 and 2. Possible values are **0** and **1** or **0000** to **1111**.
- **TS16 Frame 0 Bit 5, 7, 8** are located in bit 5, 7 and 8 from Timeslot 16 of frame 0 of a E1 signal. Possible values are **000** to **111**.

E2/8M TX

Press **Main**, **Test**, **DSn/PDH**, **E2**, and **E2 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed** and **Framed.** The default setting is **Framed**.

Alarm Generation

Type: Select the type of alarm to be generated. Choices are **AIS**, **RAI**, and **LOF**. The default setting is **AIS**.

Note: *Only AIS is available when the framing is set to Unframed.*

On/Off button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

- **Type**: Only the **FAS** error is available with both manual and automated injection modes.
- **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.
- **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Spare Bits

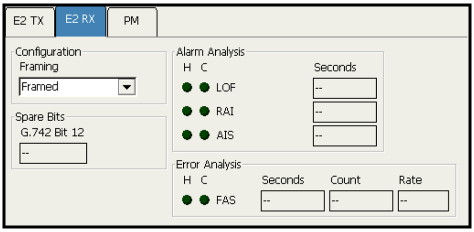
Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

Press the drop list and select the value for the spare bit.

G.742 Bit 12 represents Bit 12 from Timeslot 1, 2, 3 and 4 respectively. Bit 12 is reserved for national use and should be set to 1 when not used. Choices are **0** and **1**. The default setting is **1**.

E2/8M RX

Press **Main**, **Test**, **DSn/PDH**, **E2**, and **E2 RX**.



Configuration

Note: *See* E2/8M TX *on page 313 for more information on* ***Framing****.*

Error Analysis

FAS (Frame Alignment Signal): A FAS error indicates that bits 1 to 10 of the first frame differ from 1111010000.

Alarm Analysis

Note: *Only AIS is available when the framing is set to Unframed.*

- **LOF** (Loss Of Frame): The LOF alarm indicates that four consecutive incorrect frame alignment signals have been received.
- **RAI** (Remote Alarm Indication): The RAI alarm is declared when bit 11 of a framed E2 is set to “1”.
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.

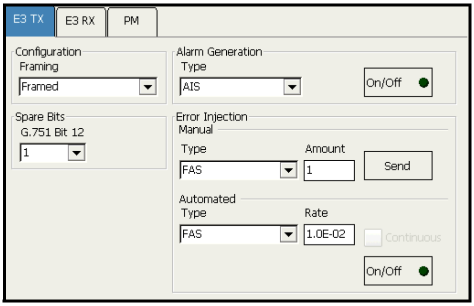
Spare Bits

Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

G.742 Bit 12 represent Bit 12 from Timeslot 1, 2, 3 and 4 respectively. Possible values are **0** and **1**.

E3/34M TX

Press **Main**, **Test**, **DSn/PDH**, **E3**, and **E3 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed** and **Framed.** The default setting is **Framed**.

Alarm Generation

Type: Select the type of alarm to be generated. Choices are **LOF**, **RAI**, and **AIS**. The default setting is **AIS**.

Note: *Only AIS is available when the framing is set to Unframed.*

On/Off button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

- **Type**: Only the **FAS** error is available with both manual and automated injection modes.
- **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s)
- **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.
- **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Spare Bits

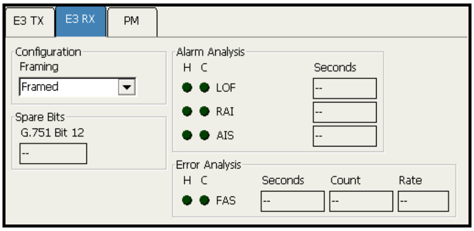
Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

Press the drop list and select the value for the spare bit.

G.751 Bit 12 is reserved for national use and should be set to 1 when not used. Choices are **0** and **1**. The default setting is **1**.

E3/34M RX

Press **Main**, **Test**, **DSn/PDH**, **E3**, and **E3 RX**.



Configuration

Note: *See* E3/34M TX *on page 317 for more information on **Framing**.*

Error Analysis

FAS (Frame Alignment Signal): A FAS error indicates that bits 1 to 10 of the first frame differ from 1111010000.

Alarm Analysis

Note: *Only AIS is available when the framing is set to Unframed.*

LOF (Loss Of Frame): The LOF alarm indicates that four consecutive incorrect frame alignment signals have been received.

RAI (Remote Alarm Indication): The RAI alarm is declared when bit 11 of a framed E3 is set to “1”.

AIS (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.

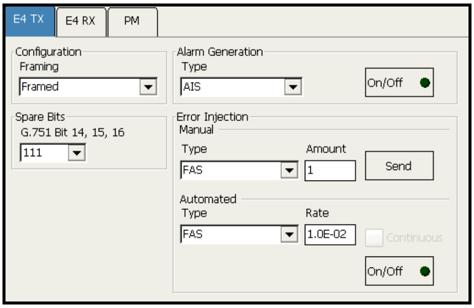
Spare Bits

Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

G.751 Bit 12 is reserved for national use. Possible values are **0** and **1**. The default setting is **1**.

E4/140M TX

Press **Main**, **Test**, **DSn/PDH**, **E4**, and **E4 TX**.



Configuration

Framing: Select the framing that will be used for transmission. Choices are **Unframed** and **Framed**. The default setting is **Framed**.

Alarm Generation

Type: Select the type of alarm to be generated. Choices are **AIS**, **RAI**, and **LOF**. The default setting is **AIS**.

Note: *Only AIS is available when the framing is set to Unframed.*

On/Off button: Press **On/Off** to enable/disable the alarm generation.

Error Injection

Allows manual or automated error injection.

➤ **Type**: Only **FAS** is available with both manual and automated injection modes.

➤ **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.

➤ **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.

➤ **Rate**: Press **Rate** to select the injection rate for the selected error. The rate must be within the minimum and maximum values specified. The default setting is **1.0E-2**.

➤ **Continuous**: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected. The **Continuous** check box is cleared by default.

➤ **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Spare Bits

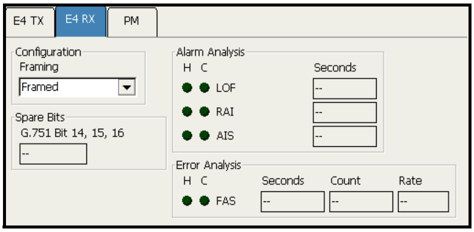
Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

Press the drop list and select the value for the spare bit.

G.751 Bit 14, 15, 16 are reserved for national use and should be set to 1 when not used. Choices are **000** to **111**. The default setting is **111**.

E4/140M RX

Press **Main**, **Test**, **DSn/PDH**, **E4**, and **E4 RX**.



Configuration

Note: *See* E4/140M TX *on page 321 for more information on* ***Framing***.

Error Analysis

FAS (Frame Alignment Signal): A FAS error indicates that bits 1 to 12 of the first frame differ from 111110100000.

Alarm Analysis

Note: *Only AIS is available when the framing is set to Unframed.*

- **LOF** (Loss Of Frame): The LOF alarm indicates that four consecutive incorrect frame alignment signals have been received.
- **RAI** (Remote Alarm Indication): The RAI alarm is declared when bit 13 of a framed E4 is set to “1”.
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.

Spare Bits

Note: *Spare Bits are not available when **Framing** is set to **Unframed**.*

G.751 Bit 14, 15, 16 are reserved for national use. Possible values are **000** to **111**.

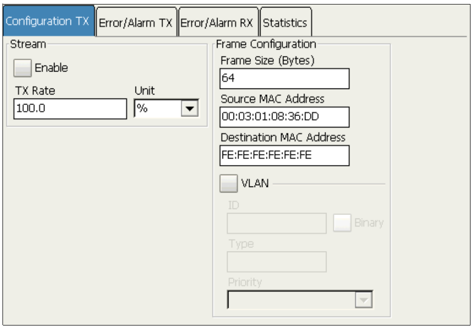
15 10G Ethernet Tabs

This section describes the 10G Ethernet tabs.

Configuration TX

Allows the configuration and activation of one stream.

Press **Main Menu**, **Test**, **10G Ethernet**, and **Configuration TX**.



Note: *The **Stream** and **Frame Configuration** parameters are only available for editing when the **Enable** check box is cleared.*

Stream

- **Enable**: Allows enabling the stream. The stream will be generated only when the test is started.

Note: *The stream can be enabled/disabled even when the test is started and running. A stream cannot be enabled if its MAC address is not valid.*

Note: *The stream is automatically enabled when the test is started and automatically disabled when the test is stopped.*

- **TX Rate**: Allows the selection of the stream rate. The default TX rate is **100%**. TX Rate is only available when the stream is not enabled.

  Unit choices are **%**, **bps**, **Kbps**, **Mbps**, **Gbps**, **Bps**, **KBps**, **MBps**, **GBps, fps**, and **IFG**. The default setting is **%**.

Frame Configuration

Note: *The following frame configuration parameters are only available when the stream is not enabled.*

- **Frame Size (Bytes)**: Select the frame size for the stream.

VLAN	Frame Size	
	Minimum	Maximum
None	48	16000
1 Tag	52	16000

Note: *Sending traffic with frame size >1518 in switched network may result in losing all frames.*

- **Source MAC Address**: A default and unique Source Media Access Control (MAC) address of the module is automatically given to the stream. Press the Source MAC address field if the stream MAC address has to be changed and enter the new MAC address.
- **Destination MAC Address**: Enter the destination MAC address of the stream. The default setting is **FE:FE:FE:FE:FE:FE**.
- **VLAN**: When enabled, allows the configuration of VLAN. This setting is disabled by default.

Note: *Enabling/disabling VLAN will affect the Frame Size value.*

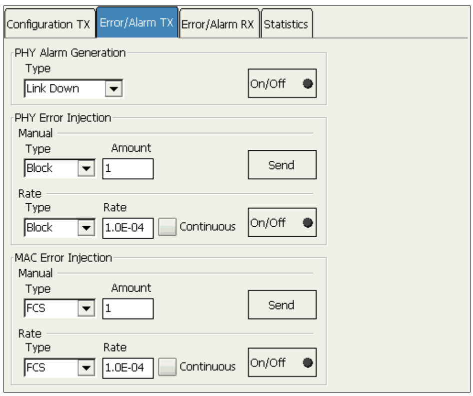
- **ID**: Enter the VLAN ID. Choices are **0** through **4095**. The value **4095** is reserved while **0** and **1** have specific utility; refer to *VLAN* on page 477 for more information.

  Binary: When selected, allows entering the VLAN ID in binary. The **Binary** check box is cleared by default.
- **Type**: Indicates the supported VLAN Ethernet Type (**8100**).
- **Priority**: Select the VLAN user priority. Choices are **0** to **7**; refer to *VLAN* on page 477 for more information. The default setting is **0** (**000 - Low Priority**).

Error/Alarm TX

Allows Ethernet alarm/error generation.

Press **Main Menu**, **Test**, **10G Ethernet**, and **Error/Alarm TX**.



PHY Alarm Generation

➤ **Type**: The following alarms are available:

Link Down: Generates a continuous PCS error (block error).

Local Fault: Generates a local fault sequence.

Remote Fault: Generates a remote fault sequence.

➤ **On/Off** button: The **On/Off** button is used to activate/deactivate the selected alarm. This setting is disabled (Off) by default.

PHY Error Injection

- **Type**: The following error is available with both manual and automated injection modes: **Block**.
- **Amount**: Allows the selection of the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the error type and the amount of error.
- **Rate**: Press the **Rate** field to select the rate for the automated error. Choices are: **1.0E-02**, **1.0E-03**, **1.0E-04**, **1.0E-05**, **1.0E-06**, **1.0E-07**, **1.0E-08**, **1.0E-09** or user definable from **1.0E-09** to **1.0E-02**. The default setting is **1.0E-04**.
- **Continuous**: Generates the selected error for each generated frame when the **Continuous** check box is selected while the **On/Off** button is enabled (On). The **Continuous** check box is cleared by default.
- **On/Off** button: The **On/Off** button is used to activate/deactivate the selected automated error at the rate specified or continuously. This setting is disabled (Off) by default.

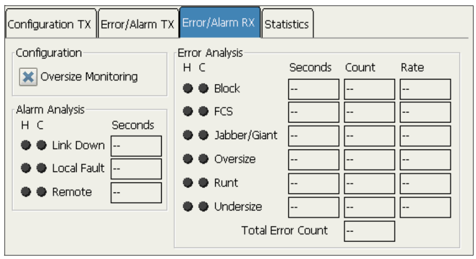
MAC Error Injection

- **Type**: The following error is available with both manual and automated injection modes: **FCS**.
- **Amount**: Allows the selection of the amount of manual error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the error type and the amount of selected error.
- **Rate**: Press the **Rate** field to select the rate for the automated error. Choices are: **1.0E-02**, **1.0E-03**, **1.0E-04**, **1.0E-05**, **1.0E-06**, **1.0E-07**, **1.0E-08**, **1.0E-09** or user definable from **1.0E-09** to **1.0E-02**. The default setting is **1.0E-04**.
- **Continuous**: Generates the selected error for each generated frame when the **Continuous** check box is selected while the **On/Off** button is enabled (On). The **Continuous** check box is cleared by default.
- **On/Off** button: The **On/Off** button is used to activate/deactivate the selected automated error at the rate specified or continuously. This setting is disabled (Off) by default.

Error/Alarm RX

The alarm/errors statistics are gathered on all received frames, independently of the destination MAC address.

Press **Main Menu**, **Test**, **10G Ethernet**, and **Error/Alarm TX**.



Configuration

Oversize Monitoring: Enables the monitoring of the **Oversize** error.

Alarm Analysis

- **Link Down**: Indicates that the Ethernet connection is down. The Ethernet connection is down when there is a local or a remote fault condition.
- **Remote**: Indicates that a Remote Fault event is detected.
- **Local Fault**: Indicates that impairments such as LOS, AIS, and OCI are affecting the traffic.

Note: *Alarms/Errors are updated only during test execution.*

Error Analysis

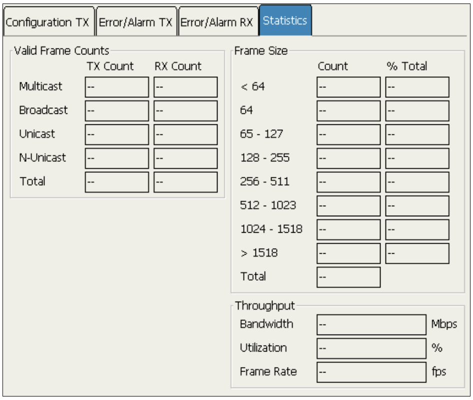
- **FCS**: The number of received frames with an invalid FCS.
- **Jabber/Giant**: The number of received frames larger than 1518 (no VLAN tag), or 1522 (1 VLAN tag) bytes with an invalid FCS.
- **Oversize**: The number of received frames larger than 1518 (no VLAN tag), or 1522 (1 VLAN tag) bytes with a valid FCS. **Oversize** error analysis is only available when **Oversize Monitoring** is enabled (see page 331).
- **Runt**: The number of received frames that are smaller than 64 bytes with an invalid FCS.
- **Undersize**: The number of received frames smaller than 64 bytes with a valid FCS.
- **Block**: The number of frames received with an errored block condition.

Total Error Count: Indicates the total number of errors including all the above errors at the exception of **Oversize** when the **Oversize Monitoring** check box is not selected.

Statistics

Frame statistics are gathered for all Ethernet frames transmitted/received with a valid FCS.

Press **Main Menu**, **Test**, **10G Ethernet**, and **Statistics**.



TX/RX Count

- **Multicast**: The number of Multicast frames transmitted/received without any FCS errors. Broadcast frames are not counted as multicast frames.
- **Broadcast**: The number of Broadcast frames transmitted/received without any FCS errors. Broadcast frames have a MAC address equal to **FF-FF-FF-FF-FF-FF**.
- **Unicast**: The number of Unicast frames transmitted/received without any FCS errors.
- **N-Unicast (Non-Unicast)**: The sum of Multicast and Broadcast frames transmitted/received without any FCS errors.
- **Total**: The number of frames transmitted/received without any FCS error.

Frame Size

- **Count**: Gives the count of each received frame size (valid and invalid).
- **% Total**: Gives the percentage ratio of each received frame size based on the total count of frames.
- **< 64**: frames with less than 64 bytes.
- **64**: frames equal to 64 bytes.
- **65 - 127**: frames from 65 to 127 bytes.
- **128 - 255**: frames from 128 to 255 bytes.
- **256 - 511**: frames from 256 to 511 bytes.
- **512 - 1023**: frames from 512 to 1023 bytes.
- **1024 - 1518**: frames from 1024 to 1518 or 1522 (VLAN Tag) bytes.
- **> 1518**: frames with more than 1518 or 1522 (VLAN Tag) bytes.
- **Total**: Gives the total of all received valid and invalid frames.

Throughput

- **Bandwidth**: Gives the received data rate expressed in Mbps.
- **Utilization**: Gives the percentage of line rate utilization.
- **Frame Rate**: Gives the received number of frames (including bad frames, Broadcast frames and Multicast frames) in fps (Frame Per Second).

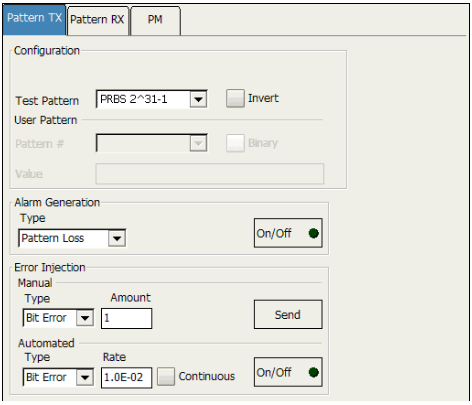
16 BERT Tabs

This section describes the BERT tabs.

a. This tab is described in the *Common Tabs* section.

Pattern TX

Press **Main Menu**, **Test**, **BERT**, and **Pattern TX**.



Configuration

➤ **Test Pattern**: Select the test pattern from the list. Choices are:

PRBS 2^31-1, **PRBS 2^23-1**, **PRBS 2^20-1**, **PRBS 2^15-1**, **PRBS 2^11-1**, **PRBS 2^9-1**, **1100**, **1010**, **1111**, **0000**, **QRSS**, **1in8**, **1in16**, **3in24**, **T1 DALY**, **55 OCTET**, **NULL CLIENT**, and **User Pattern**.Choices depend on the selected test case.

- **Invert**: The generated test pattern will be inverted if the **Invert** check box is selected meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011. When the **Invert** check box is selected, its label becomes **Invert (Non-ITU)** indicating that the pattern is inverted compared to the standard definition. The **Invert** check box is cleared by default.
- **User Pattern**

  User Pattern is available when **User Pattern** is selected as the test pattern.

  Pattern #: Up to 10 patterns can be programmed. Select the pattern number to configure. The default setting is **1**.

  Value: Enter the pattern value (4 bytes). The default setting is **00 00 00 00**.

  Binary: Allows displaying the pattern value either in binary (when the **Binary** check box is selected) or hexadecimal (when the **Binary** check box is cleared). The **Binary** check box is cleared by default.

Note: *The User Pattern for TX and RX tabs share the same pattern list.*

Alarm Generation

Type: The only available type of pattern alarm is **Pattern Loss**.

On/Off button: Press the On/Off button to enable/disable the pattern alarm generation. This setting is disabled (Off) by default.

Error Injection

Allows selection and configuration of a manual or automated pattern error that will be generated.

Type: The only available type of pattern error is **Bit Error**.

Amount: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.

Send button: Press **Send** to manually generate the pattern error according to the pattern error type and the amount.

Rate: Press the **Rate** field to select the rate for the selected pattern error. The rate must be within the minimum and maximum values specified.

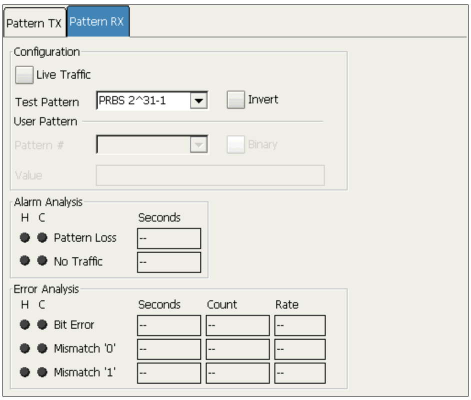
Continuous: Generates the selected error to its theoretical maximum when the **Continuous** check box is selected while the **On/Off** button is enabled (On). The **Continuous** check box is cleared by default.

On/Off button: The On/Off button is used to activate/deactivate the selected automated pattern error at the rate specified or at its theoretical maximum rate when the **Continuous** check box is selected. This setting is disabled (Off) by default.

Note: *Manual and Automated error injection can run simultaneously.*

Pattern RX

Press **Main Menu**, **Test**, **BERT**, and **Pattern TX**.



Configuration

Note: *See* Configuration *on page 335 for more information on **Test Pattern**, **Invert**, and **User Pattern**.*

Live Traffic: When enabled, Live Traffic analyzes the line traffic without test pattern thus squelching the pattern loss, bit error, and no traffic (10G Ethernet only) indications.

Alarm Analysis

Pattern Loss is declared when the bit error ratio is ≥ 0.20 during an integration interval of 1 second, or it can be unambiguously identified that the test sequence and the reference sequence are out of phase.

No Traffic is declared when no BERT traffic has been received in the last second. Only available when **10G Ethernet** is selected.

Error Analysis

Bit Error: A Bit Error indicates that there are logic errors in the bit stream (i.e., zeros that should be ones and vice versa).

Note: *The following errors are only available for 10G Ethernet.*

Mismatch '0': A Mismatch '0' Error indicates a bit error on a binary "0" (for example ones that should be zeros) found in the test pattern only.

Mismatch '1': A Mismatch '1' Error indicates a bit error on a binary "1" (for example zeros that should be ones) found in the test pattern only.

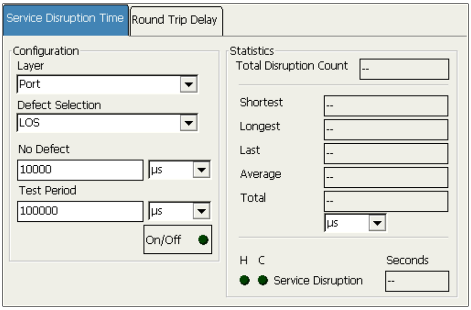
17 Advanced Tabs

Note: *The available tabs listed are a function of the test path activated.*

Service Disruption Time (SDT)

The Service Disruption Time (SDT) corresponds to the time during which there is a disruption of service due to the network switching from the active channels to the backup channels or vice versa.

Press **Main**, **Test**, **Advanced Test**, and **Service Disruption Time**.



Configuration

Select the criteria that will be used for the SDT measurement.

Note: *The service disruption measurements are cleared when changing the criteria.*

- **Layer**: Select on which layer the service disruption time test will be performed. Choices are **Port**, **FEC**, **OTUk**, **ODUk**, **OPUk**, **OTU-1e**, **ODU-1e**, **OPU-1e**, **OTU-2e**, **ODU-2e**, **OPU-2e**, **OTU-1f**, **ODU-1f**, **OPU-1f**, **OTU-2f**, **ODU-2f**, **OPU-2f**, **Section/Regenerator**, **Line/Multiplex**, **HOP**, **LOP**, **DS1**, **DS3**, **E1**, **E2**, **E3**, **E4**, and **Pattern**. Where **k** is either 1, or 2. With ODU MUX, ODU1 and OPU1 are not available. Choices depend on the selected test path.
- **Defect Selection**: Choices depend on the selected layer. Refer to the specific layer tab for possible alarms/errors.

Note: *The Service Disruption Time measurement supports a parent defect approach where the SDT measurement is triggered when the selected defect or a higher defect in the signal structure hierarchy is detected. For example, if Bit Error is selected, an OPU-AIS error will raise the SDT trigger.*

Note: *No defect is available with the layer Pattern when Live Traffic from the Pattern RX* on page 338 *is enabled.*

- **No Defect time**: Represents the period without any defects before stopping SDT measurement. Choices are from **5 μs** to **1999999 μs**. The maximum value is adjusted with respect to the test period (the max No Defect time is obtained when the Test Period value is set to its maximum value: 30000000 ms). The default setting is **10000 μs**. Unit measurement selections are **μs**, **ms**, and **s**.
- **Test Period**: Represents the period of time used to calculate the SDT measurement. Choices are **6 μs** to **5 minutes**. Unit choices are **μs**, **ms**, **s**, and **min**. The default setting is **100000 μs**.

- **On/Off** button: Press On/Off to enable/disable the disruption time measurements. However, the measurement will only start if the test is already started, or when the test will be started.

Note: *Stopping the SDT test will stop the measurement without clearing the results. The SDT test is automatically stopped without clearing results when the test is stopped. However, starting the test again while the STD is still On (enabled) will reset the results before restarting.*

Statistics

- **Total Disruption Count**: Indicates the number of disruptions that happened since the beginning of the SDT test.
- **Shortest**: Indicates the shortest measured disruption time.
- **Longest**: Indicates the longest measured disruption time.
- **Last**: Indicates the length of the last measured disruption time.
- **Average**: Indicates the average length of all measured disruption times.
- **Total**: Indicates the total length of all measured disruption times.
- **Unit**: Select the unit for the statistics. Choices are **µs**, **ms**, **s**, and **min**. The default setting is **ms**.

Note: *When the measured SDT is equal or longer than the Test Period, then the SDT equals the* ***Test Period time****.*

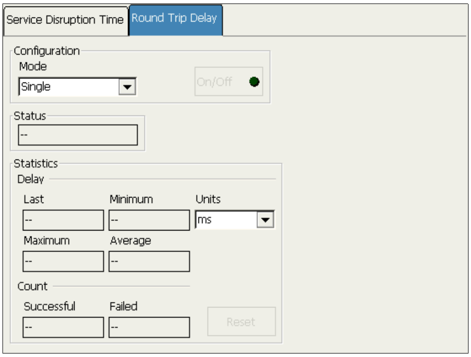
- **Service Disruption**: Indicates the time (in seconds) during which there is a disruption of service due to the absence of traffic or to the detection of defects. The H and C LEDs indicate respectively the current (C) and history (H) SDT measurement states.

  The **C** (Current) LED is green when there is no SDT. The **C** LED is red if there is an SDT, and last until the next No Defect Time has been met or the test period is elapsed.

  The **H** (History) LED indicates if any SDT occurred in the past (LED is red) or not (LED is green).

Round Trip Delay (RTD)

Press **Main**, **Test**, **Advanced**, and **Round Trip Delay**.



Round Trip Delay (RTD) measurements are needed to quantify the time it takes for the signals to reach their destination. Usually, transport delay is due to two factors: long configured paths and transit times through the network elements along the path. Therefore, RTD measurements are significant in systems that require two-way interactive communication, such as voice telephony, or data systems where the round-trip time directly affects the throughput rate.

Note: *To do Round Trip Delay test, the remote NE should be configured to provide a loopback. However a local DSn test can be configured to use loopback codes allowing RTD testing.*

Note: *Be aware that RTD requires error free operation conditions to provides reliable results. Therefore, RTD results could be affected by error injection or error introduced by the network.*

Configuration

- **Mode**: Allows the selection of the round trip delay test mode. Choices are **Single** and **Continuous**. The default setting is **Single**.

  Single allows testing the round trip delay once when pressing **On/Off**.

  Continuous allows testing the round trip delay continuously in a repetitive manner (one RTD measurement every 2 seconds) when pressing **On/Off**.

- **On/Off** button: Allows enabling the round trip delay measurement.

  For **Single** mode, the test is performed once and stops (the On/Off button turns Off by itself). The On/Off button is only available when the test is running.

  For **Continuous** mode, the test is performed continuously until the RTD test or the test case itself is stopped. However, the measurement will only start if the test is running or when it will be started.The On/Off button turns Off by itself when the auto-calibration fails.

Note: *The Round Trip Delay (RTD) auto-calibration generates some bit errors when turning On the RTD while the test is running or when starting the test case while the On/Off button is On. A far end testing equipment will detect those bit errors.*

Status

Indicates the test status of the RTD test. The status is only available when the test case is running.

- **Ready** indicates that the last calibration sequence has been successful and the test is now ready to perform RTD measurement.
- **Running** indicates that the RTD test is running.
- **Cancelled** indicates that the RTD test has been stopped before its completion.
- **Calibration Failed** indicates that the test calibration failed due to at least one of the following conditions:
  - Internal errors.
  - Bit error/alarm injection like Pattern Loss.

  Therefore the RTD statistics becomes unavailable since the test does not allow RTD testing.
- **Disabled**: Indicates that the RTD feature is disabled. For example, this condition occurs for DS0/E0 test case having all its timeslots set to Idle/Tone.
- **--**: Indicates the the RTD measurement is not ready.

Statistics

- **Delay**: Indicates the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback.

  Last indicates the result of the last Round Trip Delay measurement.

  Minimum indicates the minimum Round Trip Delay recorded.

  Maximum indicates the maximum Round Trip Delay recorded.

  Average indicates the average Round Trip Delay value.

  Unit measurement selections are **ms** and **μs**. The default setting is **ms**.

- **Count**

  Indicates the total number of **Successful** and **Failed** measurements.

  A measurement is declared **Successful** when the RTD is smaller or equal to 2 seconds.

  A measurement is declared **Failed** when the RTD is > 2 seconds.

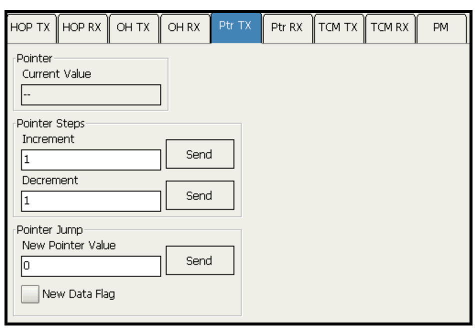
- **Reset** button: Resets the RTD results and measurement counts.

18 Common Tabs

Note: *The available tabs listed are a function of the test path activated.*

HOP/LOP Pointer Adjust TX (SONET/SDH)

Press **Main**, **Test**, **SONET/SDH**, **HOP/LOP**, and **Ptr TX**.



Pointer

Current Value indicates the current pointer value.

Pointer Steps

➤ **Increment**

For HOP: Select the number of positive pointer adjustment to include into the STS-n (SONET) or AU-n (SDH). For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 frames. Choices are **1** to **1000**. The default setting is **1**.

For LOP: Select the number of positive pointer adjustment to include into the VTn (SONET) or TU-n (SDH). For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 multiframes. Choices are **1** to **1000**. The default setting is **1**.

➤ **Decrement**

For HOP: Select the number of negative pointer adjustments to include into the STS-n (SONET) or AU-n (SDH). For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 frames. Choices are **1** to **1000**. The default setting is **1**.

For LOP: Select the number of negative pointer adjustments to include into the VTn (SONET) or TU-n (SDH). For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 multiframes. Choices are **1** to **1000**. The default setting is **1**.

➤ **Send** buttons: Press the corresponding **Send** button to send positive or negative pointer adjustments.

Pointer Jump

- **New Pointer Value**: The default setting is **0**. Choices are:

  For high order path: **0** to **782**

  For low order path:

Path	Range
VT1.5	0 to 103
VT2	0 to 139
VT6	0 to 427
TU-3	0 to 764
TU-2	0 to 427
TU-12	0 to 139
TU-11	0 to 103

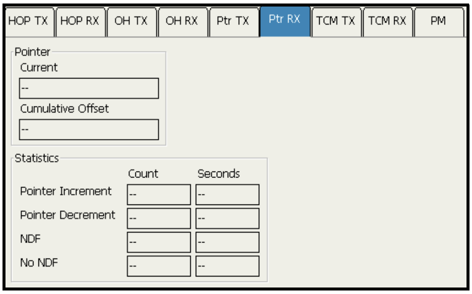
- **Send** button: Allows to send the new pointer value.
- **New Data Flag** (NDF): Allows enabling the New Data Flag.

  For HOP: When NDF is enabled, bits 1 to 4 of the pointer word (H1 and H2 bytes) are set to “1001” when executing a pointer jump.

  For LOP: When NDF is enabled, bits 1 to 4 of the pointer word (V1 and V2 bytes) are set to “1001” when executing a pointer jump.

HOP/LOP Pointer Adjust RX (SONET/SDH)

Press **Main**, **Test**, **SONET/SDH**, **HOP/LOP**, and **Ptr RX**.



Pointer

➤ **Current Value** displays the value of the pointer:

➤ For HOP: Displays the value for the pointer, H1 and H2, indicating the offset in bytes between the pointer and the first byte of the STS-n (SONET) or AU-n (SDH).

➤ For LOP: Displays the value of the pointer, V1 and V2, indicating the offset in bytes between the pointer and the first byte of the VTn (SONET) or TU-n (SDH) of the high order path. However, TU-3 considered a low order path, uses the H1, H2, H3 bytes for its location.

➤ **Cumulative Offset** indicates the difference between the pointer increment and the pointer decrement. A pointer jump will reset this value to **0**.

Statistics

- **Pointer Increment** gives statistics on positive pointer adjustment detected.
- **Pointer Decrement** gives statistics on negative pointer adjustment detected.
- **NDF (New Data Flag)** gives statistics on pointer jumps containing a New Data Flag.

  For HOP: Bits 1 to 4 of the pointer word (H1 and H2) detected are “1001”.

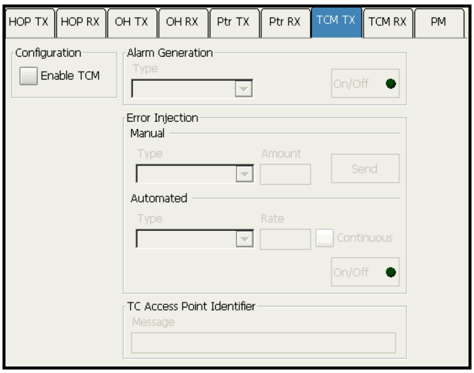
  For LOP: Bits 1 to 4 of the pointer word (V1 and V2) detected are “1001”.
- **No NDF (No New Data Flag)** gives statistics on normal pointer jumps containing no NDF.

  For HOP: Bit 1 to 4 of the pointer word (H1 and H2) detected are “0110”.

  For LOP: Bit 1 to 4 of the pointer word (V1 and V2) detected are “0110”.

TCM TX

Press **Main**, **Test**, **SONET/SDH**, **HOP/LOP**, and **TCM TX**.



The TCM Generator tab allows generating alarms and errors for the Tandem Connection sub-layer providing the capability to better identify the source of a problem or of a failure when travelling through more than one independently operated networks.

Configuration

Enable TCM: Allows the activation of the Tandem Connection Monitoring (TCM). This setting is disabled by default.

Error Injection

Allows manual or automated error injection.

- **Type**: The following error types are available with both manual and automated injection modes. The default setting is **TC-IEC** for HOP and **TC-BIP** for LOP.

  TC-IEC (Tandem Connection - Incoming Error Count): Available for HOP only. Bits 1 to 4 of the N1 byte.

  TC-BIP (Tandem Connection - Bit Interleaved parity): Available for LOP only. Bits 1 and 2 of the Z6/N2 byte contain the BIP-2 computation of the payload.

  TC-REI (Tandem Connection - Remote Error Indication): Bit 5 of N1 or Z6/N2 byte is set to **1**.

  OEI (Outgoing Error indication): Bit 6 of the N1 or Z6/N2 byte is set to **1**.

- **Amount**: Select the amount of error to be generated. Choices are **1** through **50**. The default setting is **1**.
- **Send** button: Press **Send** to manually generate error(s) according to the Error Type and the Amount of Errors selected.
- **Rate**: Press **Rate** to select the injection rate for the selected error. Choices and default setting depend on the test path.
- **Continuous**: When activated, generates the selected error to its theoretical maximum rate. This setting is disabled by default.
- **On/Off** button: The On/Off button is used to activate/deactivate the selected automated error at the rate specified or continuously when continuous is enabled. This setting is disabled (Off) by default.

Alarm Generation

- **TC-RDI** (Tandem Connection - Remote Defect Indication): Generates a TC-RDI defect. Bit 8 of the N1/Z6/N2 byte multiframe 73 is set to “1”.
- **ODI** (Outgoing Defect Indication): Generates a ODI defect. Bit 7 of the N1/Z6/N2 byte frame 74 is set to “1”.
- **TC-IAIS** (Tandem Connection - Incoming Alarm Indication Signal): Generates an incoming AIS defect.
  For HOP: Bits 1 through 4 of the N1 byte are set to “1110”.
  For LOP: Bit 4 of the Z6/N2 byte is set to “1”.
- **TC-LTC** (Tandem Connection - Loss of Tandem Connection): Generates a wrong FAS multiframe indicator sequence.
- **TC-UNEQ** (Tandem Connection - Unequipped):
  For HOP: Generates an all “0”s pattern in the higher order path signal label byte (C2), the TCM byte (N1) and the path trace byte (J1), and a valid BIP-8 bytes (B3).
  For LOP: Generates an all “0”s pattern in the lower order path signal label (bit 5, 6, 7 of byte V5), the TCM byte (Z6/N2) and the path trace byte (J2), and a valid BIP-2 (bits 1, 2 of V5 byte).

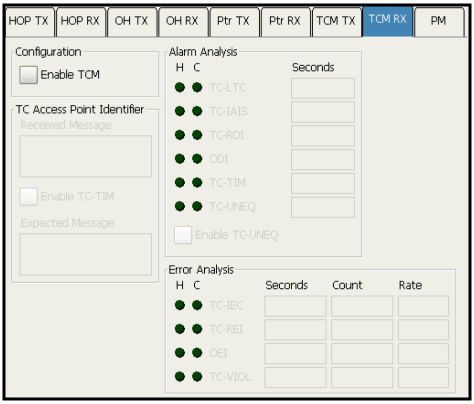
TC Access Point Identifier

Message allows the selection of the APId (Access Point Identifier) message to be generated. Up to 15 characters are allowed (a CRC-7 byte will be added in front for a total of 16 bytes). The default setting is **EXFO TCM**.

Note: *The message value should be ACSII suitable characters.*

TCM RX

Press **Main**, **Test**, **SONET/SDH**, **HOP/LOP**, and **TCM RX**.



The TCM Analyzer tab gives alarms and errors status for the Tandem Connection sub-layer.

Configuration

Enable TCM: Allows the activation of the Tandem Connection Monitoring (TCM). This setting is disabled by default.

Error Analysis

➤ **TC-REI** (Tandem Connection - Remote Error Indication): The TC-REI indicates errored blocks caused within the Tandem Connection (bit 5 of the N1/Z6/N2 byte).

➤ **TC-VIOL** (Tandem Connection - Violations):
For HOP: TC-VIOL indicates the number of B3 parity violation within the tandem connection for STS-1 SPE/VC-3 and above.
For LOP: TC-VIOL indicates the number of violation within the tandem connection for VT6 SPE/VC-2 and below.

- **OEI** (Outgoing Error Indication): The OEI indicates errored blocks of the outgoing VTn/VC-n (bit 6 of the N1 byte).
- **TC-IEC** (Tandem Connection - Incoming Error Count): The TC-IEC indicates the number of B3 parity violations detected at the TC Source for STS-1 SPE/VC-3 and above (bits 1 to 4 of the N1 byte). Available for HOP only.

Number of BIP-8 violations	Bit 1	Bit 2	Bit 3	Bit 4
0	**0**	**0**	**0**	**0**
1	**0**	**0**	**0**	**1**
2	**0**	**0**	**1**	**0**
3	**0**	**0**	**1**	**1**
4	**0**	**1**	**0**	**0**
5	**0**	**1**	**0**	**1**
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
0	1	0	0	1
0	1	0	1	0
0	1	0	1	1
0	1	1	0	0
0	1	1	0	1
0 (IAIS)	1	1	1	0
0	1	1	1	1

Alarm Analysis

- **TC-RDI** (Tandem Connection - Remote Defect Indication):
  For SONET: The TC-RDI is declared when bit 8 of the N1/Z6 byte frame 73 is set to “1”.
  For SDH: The TC-RDI is declared when bit 8 of the N1/N2 byte multiframe 73 is set to “1”.
- **ODI** (Outgoing Defect Indication):
  For SONET: The ODI is declared when bit 7 of the N1/Z6 byte frame 74 is set to “1”.
  For SDH: The ODI is declared when bit 7 of the N1/N2 byte multiframe 74 is set to “1”.
- **TC-IAIS** (Tandem Connection - Incoming Alarm Indication Signal):
  For HOP: The TC-IAIS is declared when bits 1 through 4 of the N1 byte are set to “1110”.
  For LOP: The TC-IAIS is declared when bit 4 of the Z6/N2 byte is set to “1”.
- **TC-LTC** (Tandem Connection - Loss of Tandem Connection): The TC-LTC is declared when receiving a wrong FAS multiframe.
- **TC-TIM** (Tandem Connection - Trace Identifier Mismatch): The TC-TIM is declared when the received message differs from the defined expected message. The TC-TIM is also declared when receiving invalid ASCII characters or when errors are detected with CRC-7.
- **TC-UNEQ** (Tandem Connection - Unequipped):
  For HOP: TC-UNEQ is declared when receiving an all “0”s pattern in the higher order path signal label byte (C2), the TCM byte (N1) and the path trace byte (J1), and a valid BIP-8 bytes (B3).
  For LOP: TC-UNEQ is declared when receiving an all “0”s pattern in the lower order path signal label (bit 5, 6, 7 of byte V5), the TCM byte (Z6/N2) and the path trace byte (J2), and a valid BIP-2 (bits 1, 2 of V5 byte).

Note: *The VT SPE / VC payload and the remaining path overhead bytes are unspecified.*

TC-Access Point Identifier

- **Received Message** displays the APId (Access Point Identifier) message received.

Note: *The <crc7> string represents the CRC-7 byte.*

- **Expected Message** allows the edition of the expected APId (Access Point Identifier) message. Up to 15 characters are allowed (a CRC-7 byte will be added in front for a total of 16 bytes). The default setting is **EXFO TCM**.

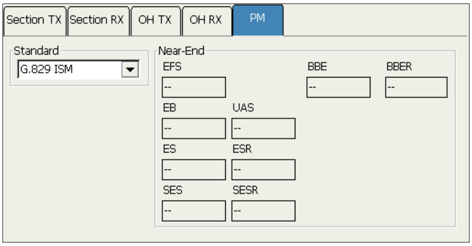
Note: *The message value should be ACSII suitable characters.*

- **Enable TC-TIM** has to be enabled to give access to the edition of the expected message and to enable the TC-TIM alarm analysis.

Performance Monitoring (PM)

The Performance Monitoring tab gives error performance events and parameters for the DSn/PDH or SONET/SDH circuit under test.

For SONET/SDH: Press **Main**, **Test**, **SONET/SDH**, **HOP/LOP**, and **PM**.
For DSn/PDH: Press press **Main**, **Test**, **DSn/PDH**, **DS1/DS3/E1/E2/E3/E4**, and **PM**.
For Pattern: Press **Main**, **Test**, **Pattern**, and **PM**.



Standard

Select the desired standard from the list. The default setting is **G.826 ISM**. Choices are **G.821**, **G.826 ISM**, **G.828 ISM**, **G.829 ISM**, **M.2100 ISM**, **M.2100 OOSM**, and **M.2101 ISM.**

Note: *G.821 and M.2100 OOSM are only available when receive Live Traffic from the* Pattern RX *on page 338 is not activated.*

Standard's availability

Analyzed Signal	G.821	G.826 ISM	G.828 ISM	G.829 ISM	M2100 ISM	M2100 OOSM	M2101 ISM
Pattern	X					X	
DS1/DS3 / E1/E2/E3/E4		X			X		
STS-Ne/VTn / STM-Ne/AU-n/ TU-n			X				X
OC-N Section / STM-N RS				X			
OC-N Line / STM-N MS				X			X

Near-End

- **EFS** (Error Free Second) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the number of seconds within which no error occurred.
- **EC** (Error Count) (**G.821** only): Gives the number of bit errors.
- **EB** (Errored Block) (**G.826**, **G.828**, and **G.829**): Gives the count of blocks in which one or more bits are in error.
- **ES** (Errored Second):

  For G.821, and **M.2100 OOSM**: Gives the number of seconds within which one or more bit error occurred, or during which Loss Of Signal (LOS) or AIS is detected.

  For G.826, **G.828**, **G.829**, **M.2100 ISM**, and **M.2101**: Gives the number of seconds within which one or more anomalies (FAS, EB, etc.) occurred, or at least one defect occurred.
- **SES** (Severely Errored Second)

  For G.821, and **M.2100 OOSM**: Gives the number of seconds within which a bit error ratio is $\geq 10^{-3}$, or during which one defect (LOS/AIS) is detected.

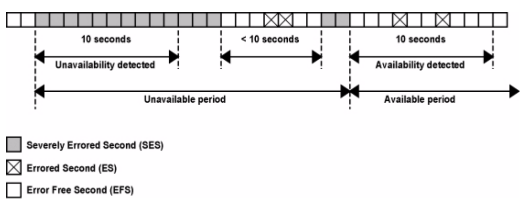
  For G.826, **G.828**, **G.829** and **M.2101**: Gives the number of seconds within which anomalies (FAS, EB, etc.) are ≥ X% or at least one defect occurred. X = 30% for DSn/PDH signals; see the following table for SONET/SDH signals SES threshold.

	STS-1 STM-0	OC-3 STM-1	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30%	30%	30%	30%	30%
Line/MS	15%	15%	25%	30%	30%
Section/RS	10%	30%	30%	30%	30%

For **M.2100 ISM**: Gives the count of the seconds within which anomalies (frame bit errors, CRC block errors, etc.) are ≥ Y or at least one defect occurred. Y depends on the type of DSn/PDH signal as described in the following table.

Signal	SES Threshold
DS1 (SF)	8 frame bit errors (Near-End)
DS1 (ESF)	320 CRC-6 block errors (Near-End) 320 CRC-6 block errors (Far-End, if FDL enabled)
E1 (Framed without CRC-4)	28 frame bit errors (Near-End)
E1 (Framed with CRC-4)	805 CRC-4 block errors (Near-End) 805 E-bit errors (Far-End)
DS3 (M13)	2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End)
DS3 (C-bit Parity)	2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End) 2444 FEBE errors (Far-End)
E2 (Framed)	41 frame bit errors (Near-End)
E3 (Framed)	52 frame bit errors (Near-End)
E4 (Framed)	69 frame bit errors (Near-End)

- **BBE** (Background Block Error) (**G.826**, **G.828**, **G.829**, and **M.2101**): Gives the count of Errored Block not occurring as part of a SES.
- **UAS** (Unavailable Second): Gives the count of the seconds corresponding to the periods of unavailable time that begins at the onset of 10 consecutive SES events, including these 10 seconds. A period of available time shall begin at the onset of 10 consecutive non-SES events, including these 10 seconds.



- **ESR** (Errored Second Ratio) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the ratio of the number of ES in available time (AS) during a fixed measurement interval.

  ESR = ES ÷ AS

- **SESR** (Severely Errored Second Ratio) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the ratio of the number of SES in available time (AS) during a fixed measurement interval.

  SESR = SES ÷ AS

- **BBER** (Background Block Error Ratio) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the ratio of BBE in available time (AS) to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.

- **DM** (Degraded Minutes) (**G.821** only): A Degraded Minute is the number of minutes in which the estimated error rate exceeds 10^{-6} but does not exceed 10^{-3}. DM is determined by collecting all of the Available Seconds, removing any SES grouping the result in 60-second long groups and counting a 60-second long group as degraded if the cumulative errors during the seconds present in the group exceed 10^{-6}.
- **SEP** (Severely Errored Period) (**G.828** only): A sequence between 3 to 9 consecutive SES. The sequence is terminated by a second which is not a SES.
- **SEPI** (Severely Errored Period Intensity) (**G.828** only): Gives the count of SEP events in available time, divided by the total available time in seconds.

Far-End

- **EFS** (Error Free Second): Gives the count of the seconds within which no error occurred or when a defect is detected on the near-end.
- **EC** (Error Count) (**G.821** only): Gives the number of bit errors.
- **EB** (Errored Block) (**G.826**, **G.828**, and **G.829**): Gives the count of blocks in which one or more bits are in error.
- **ES** (Errored Second): For **G.826**, **G.828**, **G.829**, **M.2100 ISM**, and **M.2101**: Gives the count of the seconds within which one or more anomalies (FAS, EB, etc.) occurred or at least one defect occurred.
- **SES** (Severely Errored Second):

  For **G.826**, **G.828**, **G.829**, and **M.2101**: Gives the count of the seconds within which anomalies (FAS, EB, etc.) is ≥ X% or at least one defect occurred. X = 30% for DSn/PDH signals; see the following table for SONET/SDH signals.

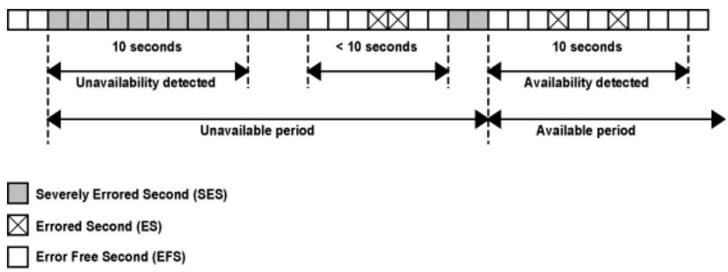
	STS-1 STM-0	OC-3 STM-1	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30%	30%	30%	30%	30%
Line/MS	15%	15%	25%	30%	30%
Section/RS	10%	30%	30%	30%	30%

For M.2100 ISM: Gives the count of the seconds within which anomalies (frame bit errors, CRC block errors, etc.) are ≥ Y or at least one defect occurred. Y depends on the type of DSn/PDH signal as described in the following table.

Signal	SES Threshold
DS1 (SF)	8 frame bit errors (Near-End)
DS1 (ESF)	320 CRC-6 block errors (Near-End) 320 CRC-6 block errors (Far-End, if FDL enabled)
E1 (Framed without CRC-4)	28 frame bit errors (Near-End)
E1 (Framed with CRC-4)	805 CRC-4 block errors (Near-End) 805 E-bit errors (Far-End)
DS3 (M13)	2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End)
DS3 (C-bit Parity)	2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End) 2444 FEBE errors (Far-End)
E2 (Framed)	41 frame bit errors (Near-End)
E3 (Framed)	52 frame bit errors (Near-End)
E4 (Framed)	69 frame bit errors (Near-End)

➤ **BBE** (Background Block Error) (G.828 and G.829 Line): Gives the count of Errored Blocks not occurring as part of an SES.

➤ **UAS** (Unavailable Second): Gives the count of the seconds corresponding to the period of unavailable time that begins at the onset of 10 consecutive SES events, including these 10 seconds. A period of available time shall begin at the onset of 10 consecutive non-SES events, including these 10 seconds.



➤ **ESR** (Errored Second Ratio): Gives the ratio of the number of ES in available time to total seconds in available time during a fixed measurement interval.

ESR = ES ÷ AS

➤ **SESR** (Severely Errored Second Ratio): Gives the ratio of the number of SES in available time to total seconds in available time during a fixed measurement interval.

SESR = SES ÷ AS

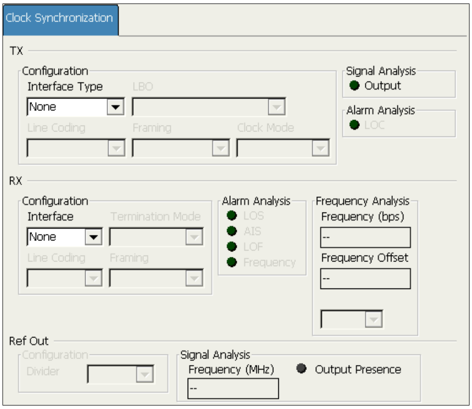
➤ **BBER** (Background Block Error Ratio): Gives the ratio of BBE in available time to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.

19 System Tab

The System tab gives access to tabs containing general functions related to the FTB-8100 Series operation.

Clock Synchronization

Press **Main**, **System**, **Clock Synch**, and **Clock Synchronization**.



Note: *TX and RX clock configuration is not available when the test mode is set to **Dual RX**. Refer to* Test Configuration *on page 98 for more information.*

TX

Note: *TX clock configuration is only possible when the RX clock is set to None.*

Configuration: Allows the configuration of the clock that will be generated. First select the Interface Type then, the other parameters will become accessible for configuration.

➤ **Interface Type**: Allows the selection of the clock interface signal (DS1/E1/2M) that will be generated. Choices are: **None**, **DS1**, **E1**, and **2 MHz**. The default setting is **None**.

- **LBO** (Line Build Out): Allows the selection of the interface Line Build Out that meets the interface requirements over the full range of cable lengths. Available with DS1 interface only. Choices are: **+3.0 dBdsx (533-655 ft)**, **+2.4 dBdsx (399-533 ft)**, **+1.8 dBdsx (266-399 ft)**, **+1.2 dBdsx (133-266 ft)**, and **+0.6 dBdsx (0-133 ft)**.
- **Line Coding**: Allows the selection of the interface line coding. Choices are **AMI** and **B8ZS** for DS1; **AMI** and **HDB3** for E1.

Note: *Line Coding is not available with 2 MHz interface.*

- **Framing**: Allows the selection of the interface framing. Choices are **SF** and **ESF** for DS1; **PCM 30**, **PCM 30 CRC-4**, **PCM 31**, and **PCM 31 CRC-4** for E1.

Note: *Framing is not available with 2 MHz interface.*

- **Clock Mode**: Allows the selection of the source clock that will be used to generate the clock on the selected interface type. Choices are:

  Internal: Internal clock of the unit (STRATUM 3).

  Recovered: Clock from the test optical/electrical port input signal.

  Backplane: 8 kHz clock from another module on the FTB-200. Note that the other module must support the backplane clock feature and must be enabled (refer to *Backplane* on page 378 for more information).

Signal Analysis

➤ **Output Presence**: Indicates the presence of a signal at the output interface/port (green) or not (gray).

Alarm Analysis

➤ **LOC** (Loss Of Clock): Indicates if the module is able to synchronize with the selected clock mode and generates a valid synchronization signal at the AUX output port (green) or not (red; no signal is generated at the AUX output port).

RX

Note: *RX clock configuration is only possible when the TX clock is set to None.*

Configuration: Allows the selection and configuration of the input clock. This clock will be used for test synchronization if External clock has been selected during test setup.

➤ **Interface Type**: Allows the configuration of the clock that will be received. First select the Interface Type then, the other parameters will become accessible for configuration. Choices are: **None**, **DS1**, **E1**, and **2 MHz**.

➤ **Termination Mode**: Specifies how the unit is connected to the synchronization signal. Choices are:

For DS1:
Term: Provides an input that terminates the DS1 signal.
Mon: Provides high-input impedance and compensation for resistive loss. This setting is useful for monitoring DS1 signals at DSX monitor points, which are resistor-isolated.
Bridge: Provides high-input impedance for bridging lines that are already terminated. This setting is useful for bridging directly across copper cable pairs.

For E1:
Term: Provides an input that terminates the E1 signal.
Monitor: Provides high-input impedance and compensation for resistive loss. This setting is useful for monitoring E1 signals at monitor points, which are resistor-isolated.
Bridge: Provides high-input impedance for bridging lines that are already terminated. This setting is useful for bridging directly across copper cable pairs.

➤ **Line Coding**: Allows the selection of the interface line coding. Line Coding is not available with 2 MHz interface. Choices are:

 For DS1: **AMI** and **B8ZS**. The default setting is **B8ZS**.

 For E1: **AMI** and **HDB3**. The default setting is **HDB3**.

➤ **Framing**: Allows the selection of the interface framing. Framing is not available with 2 MHz interface. Choices are:

 For DS1: **SF**, and **ESF**. The default setting is **SF**.

 For E1: **PCM30**, **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**. The default setting is **PCM30**.

Alarm Analysis

Note: *AIS and LOF alarms are not available for 2MHz clock.*

- **LOS** (Loss Of Signal): The LOS alarm indicates absence of an input signal or an all-zeros signal is received.
- **AIS** (Alarm Indication Signal): The AIS alarm is declared when an unframed all-ones signal is received.
- **LOF** (Loss Of Frame):

  For DS1: The LOF alarm indicates that there was no valid framing pattern for 40 milliseconds and there was at least one OOF error during this period.

  - With SF Framing: The Loss-of-Frame condition will be assumed when 2 terminal frame and/or signaling frame errors in 5 consecutive frames have been received.
  - With ESF Framing: The Loss-of-Frame condition will be assumed when 2 FPS frame errors in 5 consecutive frames have been received.

  For E1: The LOF alarm indicates that three consecutive incorrect frame alignment signals have been received.

- **Frequency**: The Frequency alarm indicates if the received signal rate meets (green) or not (red) the following rate specifications.

Signal	Rate specification
DS1	1544000 ±15 bps (±9.2 ppm)
E1	2048000 ±19 bps (±9.2 ppm)
2MHz	2048000 ±19 Hz (±9.2 ppm)

Frequency Analysis

- **Frequency (bps)** displays the received signal rate in bps for DS1 and E1 interfaces and in Hz for 2 MHz interface.
- **Frequency Offset** displays the positive or negative frequency offset between the standard rate specification and the rate from the received signal. Frequency unit can be set to **bps**, or **ppm** for DS1/E1 and is set to Hz for 2 MHz. The default setting is **bps** for DS1/E1 and **Hz** for 2 MHz.

Backplane

The backplane feature allows sharing the same backplane 8 kHz clock for synchronization group purposes. The other module must support the backplane clock feature to be able to use the generated backplane clock.

Configuration: Allows the selection and configuration of the backplane 8 kHz clock that will be generated when enabled.

➤ **Clock Mode**: Allows the clock source selection. The default setting is **Internal**.

    Internal: Internal clock of the unit (STRATUM 3).

    External: Clock received from the connected DS1/E1/2M external clock signal (**AUX** port). See *Clock Synchronization - RX* on page 374 to complete the external clock settings.

    Recovered: Clock from the test optical/electrical port input signal. Not available with OTU1e/OTU2e/OTU1f/OTU2f.

➤ **Enable**: Allows enabling the selected backplane clock.

Alarm Analysis

LOC (Loss Of Clock): Indicates if the module is able (green) or unable (red) to synchronize with the selected test clock.

REF OUT/Ref Output

Note: *REF OUT is only available with the FTB-8130, FTB-8130NG, andFTB-8130NGE models. The REF OUT signal is automatically enabled on the REF OUT port (SMA connector) when the laser of the* ***10G/11.3G*** *port is turned ON.*

Configuration

➤ **Divider**: Allows the selection of the transmit test clock divider. Choices are **16**, **32**, and **64**. The following table shows the corresponding output frequency in MHz.

For OC-192/STM-64/OTU2/OTU1e/OTU2e/OTU1f/OTU2f

Clock divider	Output frequency for					
	OC-192/ STM-64	OTU2	OTU1e	OTU2e	OTU1f	OTU2f
16	622.08 MHz	669.33 MHz	690.57 MHz	693.48 MHz	704.38 MHz	707.35 MHz
32	311.04 MHz	334.66 MHz	345.29 MHz	346.74 MHz	352.19 MHz	353.68 MHz
64	155.52 MHz	167.33 MHz	172.64 MHz	173.37 MHz	176.10 MHz	176.84 MHz

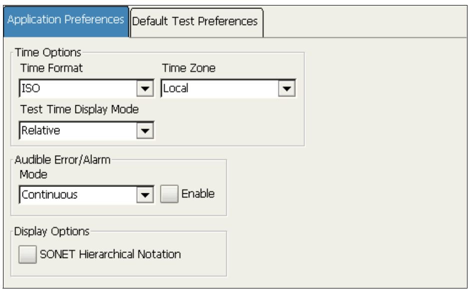
Signal Analysis

➤ **Frequency (MHz)**: Displays the generated signal frequency in MHz.

➤ **Output Presence**: Indicates the presence of a signal at the REF OUT port (green) or not (gray).

Application Preferences

Press **Main**, **System**, **Preferences**, and **Application Preferences**.



Note: *The application preferences are saved per slot on the FTB-200 meaning that the configuration will not follow the module when changing the module from one slot to another. However, a configuration on a specific slot will remain when replacing a module by another module of the same model.*

Time Options

➤ **Time Format**: Sets the absolute time format of the GUI (current time and timers). The default setting is **ISO**. Choices are:

ISO displays the time and timers with the yyyy-mm-dd hh:mm:ss format.

USA displays the time and timers with the mm/dd/yy hh:mm:ss AM/PM format.

➤ **Time Zone**: Allows the selection of the time zone source. The default setting is **Local**.

UTC/GMT displays the time base on the UTC time zone.

Local displays the time from the FTB-200 unit.

- **Test Time Display Mode**: Allows the selection of the test time mode displayed in the Logger panel. The default setting is **Relative**.

  Relative displays the time elapsed since the beginning of the test for a test event.

  Absolute displays the date and time of a test event.

Display Options

- **SONET Hierarchical Notation** when enabled sets the test setup grid to present STS-3 and STS-1 [STS-3#,STS-1#] numbers for the OC-n interface.

Audible Error/Alarm

- **Mode** allows the selection of the audible sound duration. The default setting is **Continuous**. Choices are:

  Single: Generates an audible sound and stops even if the alarm/error persists.

  Continuous: Generates an audible sound once the alarm/error is detected and lasts for the alarm/error duration.

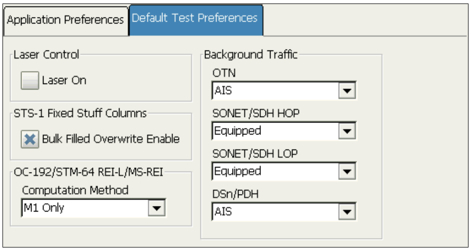
Note: *The F2 button located on the FTB-200 front panel can be used to stop (mute) the audible error/alarm.*

- **Enable** allows enabling the audible error/alarm. This setting is disabled by default.
- **Display Options**

  SONET Hierarchical Notation allows enabling the SONET two-level numbering convention. Refer to *SONET Numbering Convention* on page 447 for more information.

Default Test Preferences

Press **Main**, **System**, **Preferences**, and **Default Test Preferences**.



Allows setting the default test parameters that will be applied every time a test is created manually using **Test Setup** or when using SmartMode. Changes to the default test preferences will only apply when a new test case is created.

Note: *The default test preferences are saved per slot on the FTB-200 meaning that the configuration will not follow the module when changing the module from one slot to another. However, a configuration on a specific slot will remain when replacing a module by another module of the same model.*

Configuration

➤ **Laser On**: Selects **Laser On** every time a test is created manually using the wizard or when using SmartMode. The **Laser On** check box is selected by default.

➤ **STS-1 Fixed Stuff Columns**

Enable Bulk Filled Override fills up the bytes of the STS-1 SPE's columns 30 and 59 with the selected pattern from the tab *Pattern TX* on page 335 when the **Enable Bulk Filled Override** check box is selected. The **Enable Bulk Filled Override** check box is selected by default.

- **SmartMode - Launh Test**

  Allows the configuration of the default TX/RX **Test Pattern** that will be used when starting a test case using SmartMode.

  Test Pattern: Select the test pattern from the list. Choices are **PRBS 2^31-1, PRBS 2^23-1**, **PRBS 2^20-1**, **PRBS 2^15-1**, **PRBS 2^11-1**, **PRBS 2^9-1**, **1100**, **1010**, **1111**, **0000**, **1in8**, and **1in16**.

  Invert: Allows the inversion of the test pattern. When enabled, every 0 in the pattern will be changed for 1 and every 1 for 0. For example the pattern 1100 will be sent as 0011. This check box is cleared by default.

  RX Live Traffic: Analyzes the line traffic without test pattern thus squelching the pattern loss and bit error indication. This check box is cleared by default meaning that the **Test Pattern** and **Invert** configuration will be used as well for the RX direction.

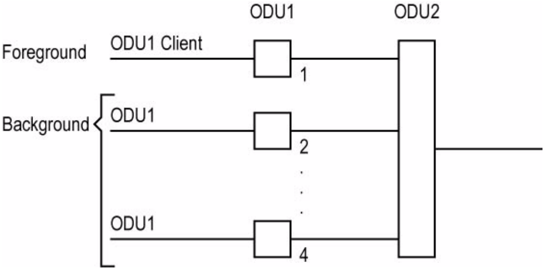
- **Background Traffic**

  The Background Traffic is used to generate traffic on the channels/paths/timeslots that are not part of the defined test.

  - **OTN**

    Allows the selection of the ODU multiplexed background traffic. Choices are **AIS**, **NULL Client (All Zeros)**, and **PRBS31 pattern**.

    For ODU2 background traffic (ODU1 client):

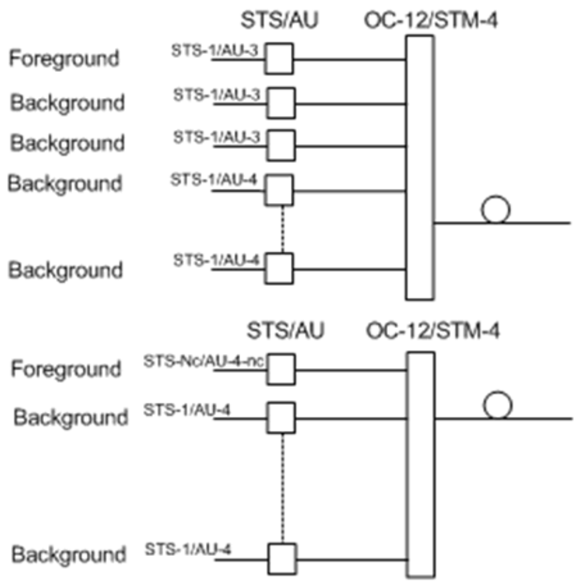


    The above example shows that ODU2 that contains ODU1 foreground traffic uses ODU1 background traffic.

➤ **SONET/SDH HOP**

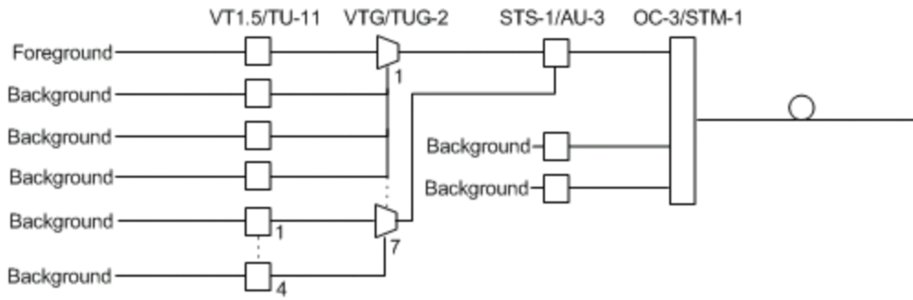
Allows the selection of the default high order path background traffic. Choices are **AIS**, **Unequipped**, and **Equipped** (**PRBS 2^23-1** pattern). The default setting is **Equipped**.

The following diagram shows a test case data path that is terminated right after SONET/SDH high order path. High order background traffic is automatically adapted to the rate (STS-1, AU-4, or AU-4) signal level for the paths that are not defined in the test case.



➤ SONET/SDH LOP

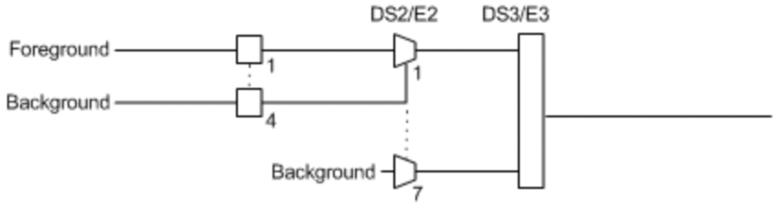
Allows the selection of the default low order path background traffic. Choices are **AIS**, **Unequipped**, and **Equipped** (**PRBS 2^23-1** pattern). The default setting is **Equipped**.



The diagram above shows a test case data path that is terminated at the SONET/SDH low order path. The remaining STS-1 or AU-3 timeslot not involved in the test case are filled with background traffic of STS-1 or AU-3 level depending on the interface being SONET or SDH. At the low order path level, the data path not involved in the data path defined in the test case are filled with a background traffic equivalent to the VT Group (VTG) or Tributary Unit Group (TUG) type defined by the traffic selected in the data path. Further, the remaining VTG or TUG within the high order path, selected in the test case, are respectively filled with traffic of equivalent rate for SONET and SDH data paths.

- **DSn/PDH**

  Allows the selection of the default timeslot background traffic. Choices are **AIS** and **All zeros**. The default setting is **AIS**.



  The diagram above shows a test case defined with DSn/PDH traffic where the background traffic is also inserted for the unused timeslots in a test case data path. The insertion is similar to the low order path SONET/SDH terminated signal where the background traffic format inserted uses the same rate as the one defined in the test case data path.

- **LCAS Auto-Add at Startup**

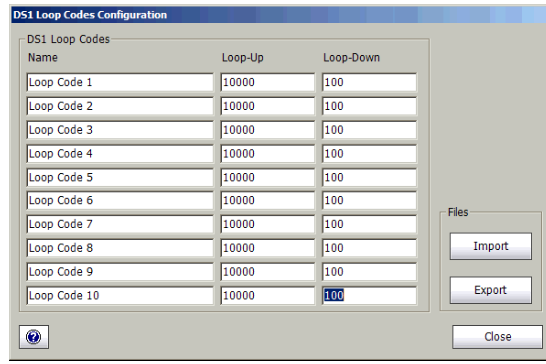
  Source/Sink Enable: This setting allows to enable by default the **Add Member(s)** at Start for **Source** and **Sink** every time a test is created manually using **Test Setup** or when using **SmartMode**. This setting is disabled by default.

- **OC-192/STM-64 REI-L/MS-REI**

  Computation Method: Allows to select the default method used to calculate the REI-L/MS-REI error for OC-192 and STM-64 interfaces.

  Choices are **M1 only** and both **M0 and M1**. The default setting is **M1 only**.

➤ DSn Loop Codes



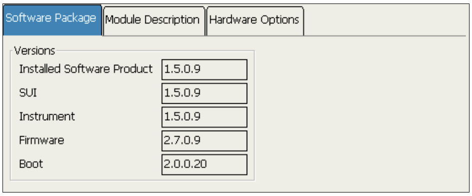
Allows the configuration of 10 DS1 loop code pairs. Press the **Configuration** button to configure each loop code name, Loop-Up and Loop-Down values. The name field allows up to 16 characters long. Loop-Up and Loop-Down range is from **000** to **1111111111111111**. The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up=**10000**, and Loop-Down=**100**).

The **Import** button allows to import loop codes from a previously saved file.

The **Export** button allows to save loop codes to a file.

Module Information - Software Package

Press **Main**, **System**, **Module Information**, and **Software Package**.

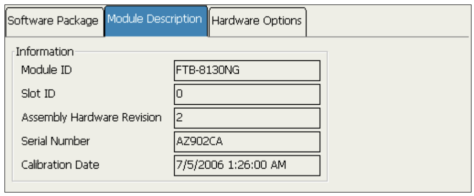


Versions

- **Installed Software Product**: Indicates the software product version.
- **GUI**: Indicates the SUI version.
- **Instrument**: Indicates the Instrument version.
- **Firmware**: Indicates the firmware version.
- **Boot**: Indicates the boot version.

Module Information - Module Description

Press **Main**, **System**, **Module Information**, and **Module Description**.

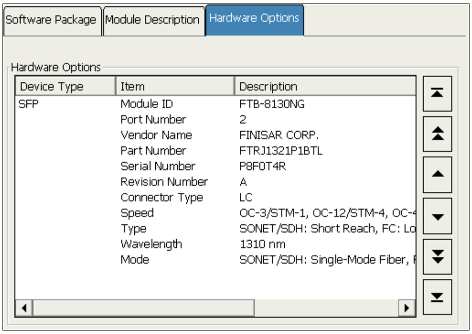


Information

- **Module ID** indicates the module part number.
- **Slot ID** indicates the slot number where the FTB-8120NGE/8130NGE is inserted to.
- **Assembly Hardware Revision**: Indicates the product assembly hardware revision.
- **Serial Number**: Indicates the module serial number.
- **Calibration Date**: Indicates the last module's calibration date.

Module Information - Hardware Options

Press **Main**, **System**, **Module Information**, and **Hardware Options**.



Gives hardware information related to the SFP/XFP.

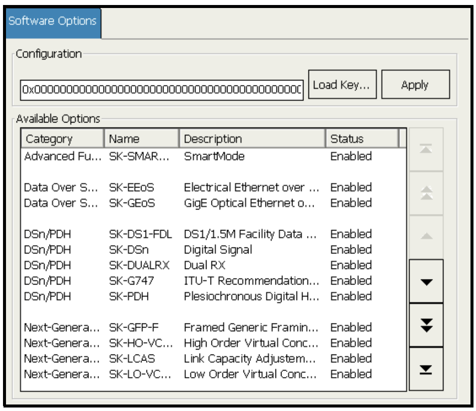
➤ **SFP/XFP/**: The following information is available for the inserted SFP/XFP.

Module ID
Port Number
Vendor Name
Part Number
Serial Number
Revision Number
Connector Type: LC, MT-RJ,SC, ST, FC, etc.
Speed: 100Base-FX/LX, 1000Base-SX, FC-1X, FC-2X, FC-4X, 10G, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16/OTU1, or OC-192/STM-64/OTU2
Type: Reach type: FC: Short Distance, LR/LW, SONET/SDH Short Reach (SR), Intermediate Reach (IR), Long Reach (LR) etc.
Wavelength: 850nm, 1310nm and 1550nm.
Mode: FC: Multi-Mode(M6) Fiber, SONET/SDH: Single-Mode Fiber (SMF), SONET/SDH Multi-Mode Fiber (MMF), etc.

Software Options

Allows the installation of software options. A software option key will be generated by EXFO for each option bought.

Press **Main**, **System**, **Software Options**, and **Software Options**.



Note: *Software option installation is only possible when no test case is created.*

Configuration

The software license key can be either entered (typed) or loaded (using the **Load Key** button).

➤ **Software Option key** allows typing the software option key.

➤ **Load Key** button allows selecting a file containing the option key.

The default directory is \Data\My Documents\SonetSdhAnalyzerG2\Key.

➤ **Apply** button sends the option key to the FTB-8100 Series. A confirmation message will be displayed. The application is automatically closed. The application must be restarted manually.

Available Options

The available software options are listed with the **Status** indicating what software options are installed (enabled) or not (disabled) on the module.

Category	Name	Description
Advanced	SK-SMARTMODE	SmartMode
DSn/PDH	SK-DSn	Digital Signal
	SK-DS1-FDL	DS1/1.5M Facility Data Link
	SK-DS3-FEAC	DS3/45M Far-End Alarm and Control
	SK-DUALRX	Dual DS1/DS3 RX
	SK-G747	ITU-T Recommendation G.747
	SK-PDH	Plesiochronous Digital Hierarchy
OTN[a]	SK-OTU1	Optical Transport Unit-1 (G.709)
	SK-OTU2[b]	Optical Transport Unit-2 (G.709)
	SK-EoOTN[a]	10G Ethernet over Optical Transport Unit 2
	SK-OTU2-1e-2e[a]	Optical Transport Unit 2 Overclocked (10G-Ethernet)
	SK-OTU2-1f-2f[a]	Optical Transport Unit 2 Overclocked (10G-Fibre Channel)
	SK-ODUMUX[a]	ODU Multiplexing
Rate	SK-155M	155 Mbps
	SK-622M	622 Mbps
	SK-2488M	2.488 Gbps
	SK-9953M	9.953 Gbps
SONET/SDH	SK-SONET	Synchronous Optical Network
	SK-SDH	Synchronous Digital Hierarchy
	SK-TCM	Tandem Connection Monitoring

a. Not available on the FTB-8105 and FTB-8115 models.
b. Only available on the FTB-8130, FTB-8130NG, FTB-8130NGE, and FTB-8140 models.

20 Suspend and Resume

Suspend and Resume allow respectively the FTB-200 and its running applications to stop (Suspend) and to be quickly re-initialized (Resume) when the unit is turned back on.

Suspend Mode

To enter suspend mode, hold down the On/Off button a few seconds until the unit beeps once. In Suspend Mode, the FTB-8100 Series Transport Blazer module is directly turned off and its configuration and injection information are kept in static RAM. The Suspend Mode remains active as long as battery power or AC power is available. If the battery is drained the information is lost and the Resume operation in no more possible.

The following conditions prevent the activation of the Suspend Mode:

- A firmware download is in-progress
- Resume operation is in-progress.

Note: *The test will be stopped when entering the suspend mode meaning that the test logger content will be lost.*

Resume Operation

To enter the resume operation, turn on the unit by pressing the On/Off button. During the resume operation, the module is re-initialized and once its booting cycle is completed the test is created with the configuration maintained in static RAM.

In the event a power failure or manual shutdown of the FTB-200 occurs, while the resume operation is in-progress, the resume operation is terminated and all the test configuration information is lost.

The following conditions prevent the resume operation:

- The module status has changed (mismatch in serial number or module is missing).
- A module failure is detected.

21 Power Failure Recovery

The automatic power failure recovery is used to re-create and restart the test that was running before the power failure. A test that was created and not running before the power failure will be re-created but not started. The configuration of the test is saved automatically once the test is created. The logger, injections, and configuration are periodically saved.

The following requirements control the power failure recovery process:

1. The power failure occurred while the test case is created. A power failure condition occurs when the AC power is down while the unit's battery has not sufficient power to keep the unit running.
2. The Application Startup is enabled for this module from **ToolBox CE**. Refer to the **ToolBox CE** user guide for more information.

Automatic Power Failure Recovery

If the requirements number 1 and 2 are met, the saved configuration will be loaded when the unit is rebooted after a power failure. Thus, the test that was running will be re-created, configured, and restarted; the test that was not running will be re-created and configured.

Manual Power Failure Recovery

If only the requirement number 1 is met, the saved configuration will be loaded when the FTB-8100 Series is manually started from **ToolBox CE**. Thus, the test that was running will be re-created, configured, and restarted.

Note: *The power failure recovery is disabled when the GUI terminates normally or when the test case is cleared.*

When Using the Test Timer

Refer to *Timer Configuration* on page 102 for more information on test timer.

The test that was running will be re-created and started after a power failure if all the following conditions are met:

- The test was running.
- Application Startup is enabled on the FTB-200.
- The start time has not expired during the power failure.
- The stop time or the duration has not expired during the power failure.

When Using SmartMode

SmartMode is not supported meaning that SmartMode will return to its default factory settings after a power failure recovery.

22 Maintenance

To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the unit free of dust.
- Clean the unit casing and front panel with a cloth slightly dampened with water.
- Store unit at room temperature in a clean and dry area. Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the unit, turn off the power immediately and let the unit dry completely.

WARNING

Use of controls, adjustments, and procedures for operation and maintenance other than those specified herein may result in hazardous radiation exposure.

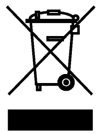
Recalibrating the Unit

Manufacturing and service center calibrations are based on the ISO/IEC 17025 Standard, which states that calibration documents must not contain a recommended calibration interval, unless this has been previously agreed upon with the customer.

Validity of specifications depends on operating conditions. For example, the calibration validity period can be longer or shorter depending on the intensity of use, environmental conditions and unit maintenance. You should determine the adequate calibration interval for your unit according to your accuracy requirements.

Under normal use, EXFO recommends calibrating your unit every two years.

Recycling and Disposal (Applies to European Union Only)



Recycle or dispose of your product (including electric and electronic accessories) properly, in accordance with local regulations. Do not dispose of it in ordinary garbage receptacles.

This equipment was sold after August 13, 2005 (as identified by the black rectangle).

- Unless otherwise noted in a separate agreement between EXFO and a customer, distributor, or commercial partner, EXFO will cover costs related to the collection, treatment, recovery, and disposal of end-of-lifecycle waste generated by electronic equipment introduced after August 13, 2005 to an European Union member state with legislation regarding Directive 2002/96/EC.
- Except for reasons of safety or environmental benefit, equipment manufactured by EXFO, under its brand name, is generally designed to facilitate dismantling and reclamation.

For complete recycling/disposal procedures and contact information, visit the EXFO Web site at www.exfo.com/recycle.

23 Troubleshooting

Solving Common Problems

Before calling EXFO's technical support, please read the following usual problems that can occur and their respective solution.

Problem	Possible Cause	Solution
OC-N/STM-N Optical Laser LED is off and the connector is not generating the signal.	➤ The **Laser On** option is disabled. ➤ The SFP XFP is not compatible with the FTB-8115/20/30.	➤ Ensure that the **Laser** button is enabled (On). ➤ Ensure to use a compatible SFP/XFP. Refer to *OTN/OC-N/STM-N Interface Connections* on page 18.
Unable to create a Dual RX test case from a previously save configuration using load configuration.	➤ The AUX connector is used for synchronization.	➤ Press Main, System, Clock Synch, and select **None** for RX Interface Type.
Logger Printing Problem.	➤ The printer interface card (PCMCIA) and its drivers are not correctly installed or No communication can be established with the printer. ➤ Printer supplies are missing to execute the print operation	➤ Check the interface card and printer to ensure they are properly installed d and powered. ➤ Check paper or other printer supplies are present.

Finding Information on the EXFO Web Site

The EXFO Web site provides answers to frequently asked questions (FAQs) regarding the use of your FTB-8100 Series Transport Blazer.

To access FAQs:

1. Type http://www.exfo.com in your Internet browser.
2. Click the **Support** tab.
3. Click **FAQs** and follow the on-screen instructions. You will be given a list of questions pertaining to your subject.

The EXFO Web site also provides the product's most recent technical specifications.

Contacting the Technical Support Group

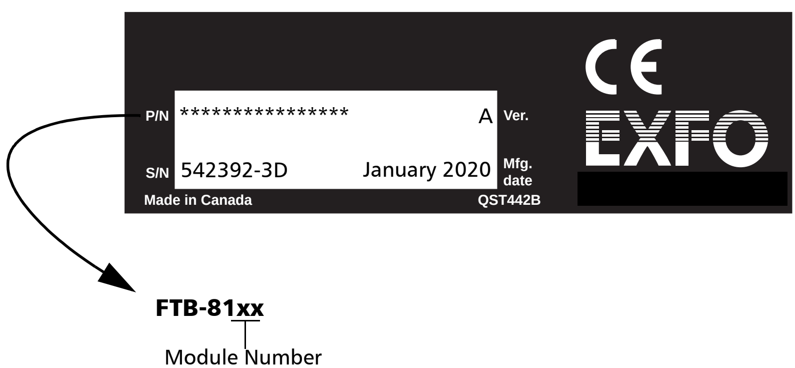
To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers. The Technical Support Group is available to take your calls from Monday to Friday, 8:00 a.m. to 7:00 p.m. (Eastern Time in North America).

For detailed information about technical support, visit the EXFO Web site at www.exfo.com.

Technical Support Group
400 Godin Avenue
Quebec (Quebec) G1M 2K2
CANADA

1 866 683-0155 (USA and Canada)
Tel.: 1 418 683-5498
Fax: 1 418 683-9224
support@exfo.com

To accelerate the process, please have information such as the name and the serial number (see the product identification label), as well as a description of your problem, close at hand.



Transportation

Maintain a temperature range within specifications when transporting the unit. Transportation damage can occur from improper handling. The following steps are recommended to minimize the possibility of damage:

- Pack the unit in its original packing material when shipping.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

24 Warranty

General Information

EXFO Inc. (EXFO) warrants this equipment against defects in material and workmanship for a period of one year from the date of original shipment. EXFO also warrants that this equipment will meet applicable specifications under normal use.

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product, as well as verify and adjust the product free of charge should the equipment need to be repaired or if the original calibration is erroneous. If the equipment is sent back for verification of calibration during the warranty period and found to meet all published specifications, EXFO will charge standard calibration fees.

IMPORTANT

The warranty can become null and void if:

- **unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-EXFO personnel.**
- **warranty sticker has been removed.**
- **case screws, other than those specified in this guide, have been removed.**
- **case has been opened, other than as explained in this guide.**
- **unit serial number has been altered, erased, or removed.**
- **unit has been misused, neglected, or damaged by accident.**

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Liability

EXFO shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the product may be a part.

EXFO shall not be liable for damages resulting from improper usage or unauthorized modification of the product, its accompanying accessories and software.

Exclusions

EXFO reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, batteries and universal interfaces (EUI) used with EXFO products are not covered by this warranty.

This warranty excludes failure resulting from: improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond the control of EXFO.

IMPORTANT

EXFO will charge a fee for replacing optical connectors that were damaged due to misuse or bad cleaning.

Certification

EXFO certifies that this equipment met its published specifications at the time of shipment from the factory.

Service and Repairs

EXFO commits to providing product service and repair for five years following the date of purchase.

To send any equipment for service or repair:

1. Call one of EXFO's authorized service centers (see *EXFO Service Centers Worldwide* on page 408). Support personnel will determine if the equipment requires service, repair, or calibration.
2. If equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) number and provide an address for return.
3. If possible, back up your data before sending the unit for repair.
4. Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.
5. Return the equipment, prepaid, to the address given to you by support personnel. Be sure to write the RMA number on the shipping slip. *EXFO will refuse and return any package that does not bear an RMA number.*

Note: *A test setup fee will apply to any returned unit that, after test, is found to meet the applicable specifications.*

After repair, the equipment will be returned with a repair report. If the equipment is not under warranty, you will be invoiced for the cost appearing on this report. EXFO will pay return-to-customer shipping costs for equipment under warranty. Shipping insurance is at your expense.

Routine recalibration is not included in any of the warranty plans. Since calibrations/verifications are not covered by the basic or extended warranties, you may elect to purchase FlexCare Calibration/Verification Packages for a definite period of time. Contact an authorized service center (see *EXFO Service Centers Worldwide* on page 408).

EXFO Service Centers Worldwide

If your product requires servicing, contact your nearest authorized service center.

EXFO Headquarters Service Center
400 Godin Avenue
Quebec (Quebec) G1M 2K2
CANADA

1 866 683-0155 (USA and Canada)
Tel.: 1 418 683-5498
Fax: 1 418 683-9224
quebec.service@exfo.com

EXFO Europe Service Center
Omega Enterprise Park, Electron Way
Chandlers Ford, Hampshire S053 4SE
ENGLAND

Tel.: +44 2380 246810
Fax: +44 2380 246801
europe.service@exfo.com

EXFO Telecom Equipment (Shenzhen) Ltd.
3rd Floor, Building 10,
Yu Sheng Industrial Park (Gu Shu Crossing), No. 467,
National Highway 107,
Xixiang, Bao An District,
Shenzhen, China, 518126

Tel: +86 (755) 2955 3100
Fax: +86 (755) 2955 3101
beijing.service@exfo.com

A Specifications

Note: *Specifications are subject to change without notice.*

Electrical Interfaces for FTB-8105/15/20/30

		DS1	E1/2M		E2/8M	E3/34M	DS3/45M	STS-1e/STM-0e/52M	E4/140M	STS-3e/STM-1e/155M
Tx Pulse Amplitude		2.4 to 3.6 V	3.0 V	2.37 V	2.37 V	1.0 ± 0.1 V	0.36 to 0.85 V		1.0 ± 0.1 Vpp	0.5 V
Tx Pulse Mask		GR-499 Figure 9.5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 16	G.703 Figure 17	DS-3 GR-499 Figure 9-8 45-M G.703 Figure 14	GR-253 Figure 4-10/4-11	G.703 Figure 18/19	STS-3e GR-253 Figure 4-12/4-13/4-14 STM-1e/155M G.703 Figure 4-14/22, 23
Tx LBO Preamplification		Power dBdsx +0.6 dBdsx (0-133 ft) +1.2 dBdsx (133-266 ft) +1.8 dBdsx (266-399 ft) +2.4 dBdsx (399-533 ft) +3.0 dBdsx (533-655 ft)					0 to 225 ft 225 to 450 ft	0 to 225 ft 255 to 450 ft		0 to 225 ft
Cable Simulation		Power dBdsx −22.5 dBdsx −15.0 dBdsx −7.5 dBdsx 0 dBdsx					450 to 900 (927) ft	450 to 900 (927) ft		
Rx Level Sensitivity		For 772 kHz: TERM: ≤ 26 dB (cable loss only) at 0 dBdsx Tx DSX-MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only) Note: measurement units = dBdsx	For 1024 kHz: TERM: ≤ 6 dB (cable loss only) MON: ≤ 25 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only) Note: measurement units = dBm	For 1024 kHz: TERM: ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only) Note: measurement units = dBm	For 4224 kHz: TERM: ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 17.184 MHz: TERM: ≤ 12 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 22.368 MHz: TERM: ≤ 10 dB (cable loss only) DSX-MON: ≤ 26.5 dB (21.5 dB resistive loss + cable loss ≤ 5 dB) Note: measurement units = dBm	For 25.92 MHz: TERM: ≤ 10 dB (cable loss only) MON: ≤ 25 dB (20 dB resistive loss + cable loss ≤ 5 dB) Note: measurement units = dBm	For 70 MHz: TERM: ≤ 12 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 78 MHz: TERM: ≤ 12.7 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm
Transmit Bit Rate		1.544 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	8.448 Mbit/s ± 4.6 ppm	34.368 Mbit/s ± 4.6 ppm	44.736 Mbit/s ± 4.6 ppm	51.84 Mbit/s ± 4.6 ppm	139.264 Mbit/s ±4.6 ppm	155.52 Mbit/s ± 4.6 ppm
Receive Bit Rate		1.544 Mbit/s ± 140 ppm	2.048 Mbit/s ± 100 ppm	2.048 Mbit/s ± 100 ppm	8.448 Mbit/s ± 100 ppm	34.368 Mbit/s ± 100 ppm	44.736 Mbit/s ± 100 ppm	51.84 Mbit/s ± 100 ppm	139.264 Mbit/s ± 100 ppm	155.52 Mbit/s ± 100 ppm
Measurement Accuracy	Frequency	±4.6 ppm	±4.6 ppm	±4.6 ppm	± 4.6 ppm	±4.6 ppm	±4.6 ppm	±4.6 ppm	±4.6 ppm	±4.6 ppm
	Electrical Power	DSX range: ±1.0 dB DSX-MON range: ± 2.0 dB	NORMAL: ±1.0 dB MONITOR: ± 2.0 dB	NORMAL: ±1.0 dB MONITOR: ± 2.0 dB	NORMAL: ±1.0 dB MONITOR: ± 2.0 dB	NORMAL: ±1.0 dB MONITOR: ±2.0 dB	DSX range: ±1.0 dB DSX-MON range: ±2.0 dB	DSX range: ±1.0 dB DSX-MON range: ±2.0 dB	NORMAL: ±1.0 dB MONITOR: ±2.0 dB	NORMAL: ±1.0 dB MONITOR: ±2.0 dB
Peak-to-Peak Voltage		±10 % down to 500 mVpp	± 10% down to 500 mVpp	± 10% down to 500 mVpp	± 10% down to 400 mVpp	±10% down to 200 mVpp	±10% down to 200 mVpp	±10% down to 200 mVpp	±10% down to 200 mVpp	±10% down to 200 mVpp
Frequency Offset Generation		1.544 Mbit/s ± 140 ppm	2.048 Mbit/s ± 70 ppm	2.048 Mbit/s ± 70 ppm	8.448 Mbit/s ± 50 ppm	34.368 Mbit/s ± 50 ppm	44.736 Mbit/s ± 50 ppm	51.84 Mbit/s ± 50 ppm	139.264 Mbit/s ± 50 ppm	155.52 Mbit/s ± 50 ppm
Intrinsic Jitter (Tx)		ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1 G.751 section 2.3	GR-449 section 7.3 (categories I and II)	GR-253 section 5.6.2.2 (category II)	G.823 section 5.1	G.825 section 5.1 GR-253 section 5.6.2.2
Input Jitter Tolerance		AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	GR-449 section 7.3 (categories I and II)	GR-253 section 5.6.2.2 (category II)	G.823 section 7.1 G.751 section 3.3	G.825 section 5.2 GR-253 section 5.6.2.3
Line Coding		AMI and B8ZS	AMI and HDB3	AMI and HDB3	HDB3	HDB3	B3ZS	B3ZS	CMI	CMI
Input Impedance (Resistive Termination)		100 ohms ± 5%, balanced	120 ohms ± 5%, balanced	75 ohms ± 5%, unbalanced	75 ohms ± 5%, unbalanced	75 ohms ± 5%, unbalanced	75 ohms ±5%, unbalanced	75 ohms ±5%, unbalanced	75 ohms ± 10%, unbalanced	75 ohms ± 5%, unbalanced
Connector Type		BANTAM and RJ-48C	BANTAM and RJ-48C	BNC	BNC	BNC	BNC	BNC	BNC	BNC

Optical Interfaces

Optical Interface for FTB-8105/15/20/30

Refer to page 18 for more information on supported SFP/XFPs.

		OC-3/STM-1				OC-12/STM-4				OC-48/STM-16/OTU1				OC-192/STM-64/OTU2		
		15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	10 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm
Level Tx		−5 to 0 dBm	−2 to +3 dBm	−5 to 0 dBm	−2 to +3 dBm	−5 to 0 dBm	−2 to +3 dBm	−5 to 0 dBm	−2 to +3 dBm	−5 to 0 dBm	−2 to +3 dBm	−5 to 0 dBm	−2 to +3 dBm	−6 to −1 dBm	−1 to +2 dBm	0 to +4 dBm
Rx Operating Range		−23 to −10 dBm	−30 to −15 dBm	−23 to −10 dBm	−30 to −15 dBm	−22 to 0 dBm	−27 to −9 dBm	−22 to 0 dBm	−29 to −9 dBm	−18 to 0 dBm	−27 to −9 dBm	−18 to 0 dBm	−28 to −9 dBm	−11 to −1 dBm	−14 to −1 dBm	−24 to −9 dBm
Transmit Bit Rate		155.52 Mbit/s ± 4.6 ppm				622.08 Mbit/s ± 4.6 ppm				2.48832 Gbit/s ± 4.6 ppm 2.66606 Gbit/s ± 4.6 ppm (OTU1)				9.95328 Gbit/s ± 4.6 ppm (OC-192/STM-64) 10.70922 Gbit/s ± 4.6 ppm (OTU2) 11.0491 Gbit/s ± 4.6 ppm (OTU1e) 11.0957 Gbit/s ± 4.6 ppm (OTU2e)	9.95328 Gbit/s ± 4.6 ppm 10.70922 Gbit/s ± 4.6 ppm (OTU2)	
Receive Bit Rate		155.52 Mbit/s ± 100 ppm				622.08 Mbit/s ± 100 ppm				2.48832 Gbit/s ± 100 ppm 2.66606 Gbit/s ± 100 ppm (OTU1)				9.95328 Gbit/s ± 4.6 ppm (OC-192/STM-64) 10.70922 Gbit/s ± 4.6 ppm (OTU2) 11.0491 Gbit/s ± 4.6 ppm (OTU1e) 11.0957 Gbit/s ± 4.6 ppm (OTU2e)	9.95328 Gbit/s ± 4.6 ppm 10.70922 Gbit/s ± 4.6 ppm (OTU2)	
Operational Wavelength Range		1261 to 1360 nm	1263 to 1360 nm	1430 to 1580 nm	1480 to 1580 nm	1270 to 1360 nm	1280 to 1335 nm	1430 to 1580 nm	1480 to 1580 nm	1260 to 1360 nm	1280 to 1335 nm	1430 to 1580 nm	1500 to 1580 nm	1290 to 1330 nm	1530 to 1565 nm	1530 to 1565 nm
Spectral Width		1 nm (−20 dB)				1 nm (−20 dB)				1 nm (−20 dB)				1 nm (−20 dB)		
Frequency Offset Generation		± 50 ppm				± 50 ppm				± 50 ppm				± 50 ppm [a]		
Measurement Accuracy	Frequency Optical Power	± 4.6 ppm ± 2 dB				± 4.6 ppm ± 2 dB				± 4.6 ppm ± 2 dB				± 4.6 ppm ± 2 dB		
Maximum Rx before Damage [b]		+ 3 dBm				+ 3 dBm				+ 3 dBm				+ 3 dBm		
Jitter Compliance		GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.825 (SDH)		
Line Coding		NRZ				NRZ				NRZ				NRZ		
Eye Safety		SFP/XFP transceivers comply with IEC 60825 and 21 CFR 1040.10 (except for deviations pursuant to Laser Notice No. 50, dated July 2001), for Class 1 or 1M lasers.														
Connector [c]		Dual LC				Dual LC				Dual LC				Dual LC		
Transceiver Type [d]		SFP				SFP				SFP				XFP		

Notes

a. In order not to exceed the maximum receiver power level before damage, an attenuator must be used.

b. External adaptors can be used for other type of connectors. For example FC/PC.

c. SFP/XFP Compliance: The FTB-8100 Series selected SFP/XFP shall meet the requirements stated in the “Small Form-factor Pluggable (SFP) Transceiver MultiSource Agreement (MSA)”. The FTB-8100 Series selected SFP/XFP shall meet the requirements stated in the “Specification for Diagnostic Monitoring Interface for Optical Xcvrs”.

Synchronization Interfaces for FTB-8105/15/20/30

SYNCHRONISATION INTERFACES

	External Clock DS1/1.5M	External Clock E1/2M	External Clock E1/2M	Trigger 2 MHz
Tx Pulse Amplitude	2.4 to 3.6 V	3.0 V	2.37 V	0.75 to 1.5 V
Tx Pulse Mask	GR-499 figure 9.5	G.703 figure 15	G.703 figure 15	G.703 figure 20
Tx LBO Preamplification	Typical power dBdsx +0.6 dBdsx (0-133 ft) +1.2 dBdsx (133-266 ft) +1.8 dBdsx (266-399 ft) +2.4 dBdsx (399-533 ft) +3.0 dBdsx (533-655 ft)			
Rx Level Sensivity	TERM: ≤ 6 dB (cable loss only) (at 772 kHz for T1) DSX-MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	TERM: = ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	TERM: = ≤ 6 dB (cable loss only) MON: ≤ 26 dB (resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	≤ 6 dB (cable loss only)
Transmission Bit Rate	1.544 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	
Reception Bit Rate	1.544 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	
Intrinsic Jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 6.1	G.823 section 6.1	G.703 table 11
Input Jitter Tolerance	AT&T PUB 62411 GR-499 SECTION 7.3	G.823 section 7.2 G.813	G.823 section 7.2 G.813	
Line Coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	
Input Impedance (Resistive Termination)	75 ohms ± 5%, unbalanced	75 ohms ± 5%, unbalanced	75 ohms ± 5%, unbalanced	75 ohms ± 5%, unbalanced
Connector Type	BNC [a]	BNC [a]	BNC	BNC

NOTES

a. Adaptation cable required for BANTAM.

b. SFP/XFP transceivers comply with IEC 60825 and 21 CFR 1040.10 (except for deviations pursuant to Laser Notice 50, dated July, 2001), for Class 1 or 1M lasers.

REF-OUT INTERFACE

Parameter	Value				
Tx pulse amplitude	600 ± 150 mVpp				
Transmission frequency					
	SONET/SDH/ 10 GigE WAN	**10 GigE LAN**	**OTU2**	**OTU1e**	**OTU2e**
Clock divider = 16	622.08 MHz	644.53 MHz	669.33 MHz	690.57 MHz	693.48 MHz
Clock divider = 32	311.04 MHz	322.266 MHz	334.66 MHz	345.29 MHz	346.74 MHz
Clock divider = 64	155.52 MHz	161.133 MHz	167.33 MHz	172.64 MHz	173.37 MHz
Output configuration	AC coupled				
Load impedance	50 ohms				
Maximum cable length	3 meters				
Connector Type	SMA				

General Specifications

For FTB-8105/15/20/30

	FTB-8115, FTB-8120, FTB-8120NG, FTB-8130, FTB-8130NG	FTB-8105
Size (H x W x D)	51 x 96 x 288 mm (2” x 3 3/4” x 11 3/8”)	25 x 96 x 288 mm (1” x 3 3/4” x 11 3/8”)
Weight (without transceiver)	0.9 kg (2.0 lb)	0.5 kg (1.1 lb)
Temperature - operating - storing	0 °C to 40 °C (32 °F to 104 °F) -40 °C to 60 °C (-40 °F to 140 °F)	

B Glossary

SONET/DSn/SDH/PDH Nomenclature

The GUI will used the International or European nomenclature based on the SONET and SDH software options installed on the FTB-8100 Series.

Software option	Nomenclature
SONET only	International
SDH only	European
SONET and SDH	International

Signal Rates

Rate	SONET/DSn	SDH/PDH	
		International	European
1.544 Mbps	DS1	-	1.5M
2.048 Mbps	-	E1	2M
8.448 Mbps	-	E2	8M
34.368 Mbps	-	E3	34M
44.736 Mbps	DS3	-	45M
51.84 Mbps	STS-1e	STM-0e	52M
139.264 Mbps	-	E4	140M
155.52 Mbps	STS-3e / OC-3	STM-1e / STM-1	155M / STM-1
622.08 Mbps	OC-12	STM-4	STM-4
2.48832 Gbps	OC-48	STM-16	STM-16
2.666057143 Gbps	OTU1	OTU1	OTU1
9.95328 Gbps	OC-192	STM-64	STM-64

Rate	Signal
10.709225316 Gbps	OTU2
11.0491 Gbps	OTU1e
11.0957 Gbps	OTU2e
11.2701 Gbps	OTU1f
11.3176 Gbps	OTU2f

SONET/SDH High and LowOrder Path Nomenclature

Path Type	SDH	SONET
High Order	AU-3	STS-1
	AU-4	STS-3c
	AU-4-4c	STS-12c
	AU-4-16c	STS-48c
	AU-4-64c	STS-192c
Low Order	TUG-3	-
	TUG-2	VTG
	TU-11	VT1.5
	TU-12	VT2
	TU-2	VT6
	TU-3	-

SONET/SDH Alarms and Errors Nomenclature

Layer	SONET	SDH
Physical	BPV	CV
Section / Regenerator Section	LOF	LOF
	SEF	OOF
	TIM-S	RS-TIM
	B1	B1
Line / Multiplex Section	AIS-L	MS-AIS
	RDI-L	MS-RDI
	B2	B2
	REI-L	MS-REI
High Order Path	AIS-P	AU-AIS
	LOP-P	AU-LOP
	LOM	H4-LOM
	PDI-P	-
	RDI-P	HP-RDI
	ERDI-PCD	ERDI-CD
	ERDI-PPD	ERDI-PD
	ERDI-PSD	ERDI-SD
	PLM-P	HP-PLM
	UNEQ-P	HP-UNEQ
	TIM-P	HP-TIM
	B3	B3
	REI-P	HP-REI

Layer	SONET	SDH
Low Order Path	AIS-V	TU-AIS
	LOP-V	TU-LOP
	RDI-V	LP-RDI
	ERDI-VCD	ERDI-CD
	ERDI-VPD	ERDI-PD
	ERDI-VSD	ERDI-SD
	RFI-V	LP-RFI
	UNEQ-V	LP-UNEQ
	TIM-V	LP-TIM
	PLM-V	LP-PLM
	BIP-2	BIP-2
	REI-V	LP-REI

Acronym List

140M	Digital signal (139.264 Mbps)
155M	Digital signal (155.52 Mbps)
2M	Digital signal (2.048 Mbps)
34M	Digital signal (34.368 Mbps)
45M	Digital signal (44.736 Mbps)
52M	Digital signal (51.84 Mbps)
8M	Digital signal (8.448 Mbps)
?	Help
_	Minimize

A

A	Ampere
AC	Alternating Current
AcPT	Accepted Payload Type
AcSTAT	Accepted STAT information in the TCMi
AIS	Alarm Indication Signal
AIS-L	Alarm Indication Signal - Line
AIS-P	Alarm Indication Signal - Path
AIS-V	Alarm Indication Signal - VT
AMI	Alternate Mark Inversion
ANSI	American National Standards Institute
APId	Access Point Identifier
APS	Automatic Protection Switching

AS	Available Second
ASCII	American Standard Code for Information Interchange
ATM	Asynchronous Transfer Mode
AU-AIS	Administrative Unit - Alarm Indication Signal
AU-LOP	Administrative Unit - Loss of Pointer
AU-n	Administrative Unit-n
AUG	Administrative Unit Group
AUX	Auxiliary
AWG	American Wire Gage

B

B1	BIP-8 - Section
B2	BIP-8 - Line
B3	BIP-8 - Path
B3ZS	Bipolar with 3 zero substitution
B8ZS	Bipolar with 8 zero substitution
BBE	Background Block Error
BBER	Background Block Error Ratio
BDI	Backward Defect Indication
BEI	Backward Error Indication
BER	Bit Error Rate
BIAE	Backward Incoming Alignment Error
BIP	Bit-Interleaved Parity
BIP-2	Bit-Interleaved Parity - 2 bits
BIP-8	Bit-Interleaved Parity - 8 bits

BNC	bayonet-Neill-Concelman
BOM	Bit-Oriented Messages
bps	Bit Per Second
Bps	Byte Per Second
BPV	Bipolar Violation
BSD	Backward Signal Degrade
BSF	Backward Signal Fail

C

C	Current
C-bit	Control bit
CAGE	Commerce And Government Entities
CBR	Constant Bit Rate
CD	Compact Disk
CE	European Conformity
CFR	Code of Federal Regulations
CMI	Coded Mark Inversion
CORR	Correctable
<C_R>	Carriage Return
CRC	Cyclic Redundancy Check
CRC-4	Cyclic Redundancy Check (a four-bit word that detects bit errors)
CRC-6	Cyclic Redundancy Check (a six-bit word that detects bit errors)
CRC-7	Cyclic Redundancy Check (a seven-bit word that detects bit errors)

CRC LOMF	Cyclic Redundancy Check Loss Of Multiframe
CSF	Client Signal Fail
CSU	Customer Service Unit
CV	Code Violation
CW	Codeword

D

DAPI	Destination Access Point Identifier
dB	Decibel
dBdsx	Decibel DSX1
dBm	Decibel - milliwatts
DCC	Data Communication Channel
DM	Degraded Minutes
DPSK	Differential Phase Shift Keying
DQDB	Distributed Queue Dual Bus
DS0	Digital Signal-level 0 (64 kbps)
DS1	Digital Signal-level 1 (1.544 Mbps)
DS3	Digital Signal-level 3 (44.736 Mbps)
DSn	Digital Signal-level n
DSX1	Digital Signal Level 1 Cross Connect
DUT	Device Under Test

E

E-bit	CRC-4 Error Signal
E0	European standard for digital transmission-level 0 (64 Kbps).
E1	European standard for digital transmission-level 1 (2.048 Mbps).
E2	European standard for digital transmission-level 2 (8.448 Mbps).
E3	European standard for digital transmission-level 3 (34.368 Mbps).
E4	European standard for digital transmission-level 4 (139.264 Mbps).
EB	Errored Block
EC	Error Count
EFS	Error Free Second
EMC	Electromagnetic Compatibility
ERDI-CD	Enhanced Remote Defect Indication - Connectivity Defect
ERDI-PCD	Enhanced Remote Defect Indication - Path Connectivity Defect
ERDI-PD	Enhanced Remote Defect Indication - Payload Defect
ERDI-PPD	Enhanced Remote Defect Indication - Path Payload Defect
ERDI-PSD	Enhanced Remote Defect Indication - Path Server Defect
ERDI-SD	Enhanced Remote Defect Indication - Server Defect
ERDI-VCD	Enhanced Remote Defect Indication - VT Connectivity Defect

ERDI-VPD	Enhanced Remote Defect Indication - VT Payload Defect
ERDI-VSD	Enhanced Remote Defect Indication - VT Server Defect
ES	Errored Second
ESD	Electrostatic Discharge
ESF	Extended Superframe
ESR	Errored Second Ratio
EUI	EXFO Universal Interfaces
EXP	Experimental
EXZ	Excessive Zeros

F

F-bit	Framing bit
FAS	Frame Alignment Signal
FC	Fibre Channel
FCC	Federal Communications Commission
FDDI	Fiber Distributed Data Interface
FDL	Facility Data Link
FEAC	Far End Alarm and Control
FEBE	Far-End Block Error
FEC	Forward Error Correction
FIF	Fault Indication Field
fps	frame per second
FSD	Forward Signal Degrade
FSF	Forward Signal Fail

ft	Feet
FTFL	Fault Type Fault Location

G

GCC	General Communication Channel
Gbps	Gigabit per second
GBps	Gigabyte per second
GCCx	General Communication Channel-x
GFP	Generic Framing Procedure
GFP-F	Generic Framing Procedure - framed
GFP-T	Generic Framing Procedure - transparent
GID	Group Identifier
GMP	Generic Mapping Procedure
GMP OOS	
GMT	Greenwich Mean Time
GUI	Graphical User Interface

H

H	History
H4-LOM	H4 - Loss Of Multiframe
HDB3	High Density Bipolar 3 Code
HDLC	High-Level Data Link Control
HO	High Order
HOP	High Order Path
HP-PLM	High Order Path - Payload Label Mismatch

HP-POH	Higher-Order Path Overhead
HP-RDI	High Order path - Remote Defect Indication
HP-REI	High Order path - Remote Error Indicator
HP-TIM	High Order Path - Trace Identifier Mismatch
HP-UNEQ	High Order Path - Unequipped

I

IAE	Incoming Alignment Error
IC	Industry Canada
ID	Identification
IEEE	Institute of Electrical & Electronics Engineers
IFG	Inter Frame Gap
IN	INput
IR	Intermediate Reach
ISDN	Integrated Services Digital Network
ISM	In-Service Monitoring
ISO	International Organization for Standardization
ITU	International Telecommunication Union

J

JC	Justification Control

K

Kbps	Kilobit per second
KBps	Kilobyte per second

L

LAPS	Link Access Procedure for SDH
LBO	Line Build Out
LCAS	Link Capacity Adjustment Scheme
LED	Light-Emitting Diode
LCK	Locked
lf	Line Feed
LO	Low Order
LOC	Loss Of Clock
LOF	Loss Of Frame
LOFLOM	Loss of Frame Loss Of Multiframe
LOH	Line Overhead
LOM	Loss Of Multiframe
LOMF	Loss Of Multiframe
LOP	Loss Of Pointer
LOP	Low Order Path
LOP-P	Loss Of Pointer - Path
LOP-V	Loss Of Pointer - VT
LOS	Loss Of Signal
LP-PLM	Low Order Path - Payload Label Mismatch
LP-RDI	Low Order Path - Remote Defect Indication

LP-REI	Low Order Path - Remote Error Indicator
LP-RFI	Low Order Path - Remote Failure Indication
LP-TIM	Low Order Path - Trace Identifier Mismatch
LP-UNEQ	Low Order Path - Unequipped
LR	Long Reach
LSB	Least-Significant Bit
LSS	Loss of Sequence Synchronization
LTC	Loss of Tandem Connection

M

MAC	Media Access Control
Mbps	Megabit per second
MBps	Megabyte per second
MFAS	Multiframe Alignment Signal
MMF	Multi-Mode Fiber
MS	Multiplex Section
MS-AIS	Multiplex Section - Alarm Indication Signal
MS-RDI	Multiplex Section - Remote Defect Indication
MS-REI	Multiplex Section - Remote Error Indicator
MSB	Most-Significant Bit
MSIM	Multiplex Structure Identifier Mismatch
MSOH	Multiplex Section Overhead
MUX	Multiplexer
MUX/DEMUX	Multiplexer/Demultiplexer

N

NATO	North Atlantic Treaty Organization
NDF	New Data Flag
NE	Network Element
NI/CSU	Network Interface/Customer Service Unit
NJO	Negative Justification Opportunity
nm	Nanometer
NORM	Normal

O

OC-3	Optical Carrier for 3rd level (155.52 Mbps)
OC-12	Optical Carrier for 12th level (622.08 Mbps)
OC-48	Optical Carrier for 48th level (2488.32 Mbps)
OC-192	Optical Carrier for 192th level (9.95328 Gbps)
OC-768	Optical Carrier for 768th level (39.81312 Gbps)
OCI	Open Connection Indication
ODU	Optical Data Unit
ODI	Outgoing Defect Indication
OEI	Outgoing Error indication
OH	Overhead
OOF	Out-Of-Frame
OOM	Out-Of-Multiframe
OOSM	Out-Of-Service Monitoring
OPU	Optical Payload Unit
OTN	Optical Transport Network

OTU	Optical Transport Unit
OTU1	Optical Transport Unit 2.666 Gbps
OTU1e	Optical Transport Unit 11.049 Gbps
OTU1f	Optical Transport Unit 11.270 Gbps
OTU2	Optical Transport Unit 10.709 Gbps
OTU2e	Optical Transport Unit 11.096 Gbps
OTU2f	Optical Transport Unit 11.317 Gbps
OTU3	Optical Transport Unit 43.018 Gbps
OUT	OUTput

P

P-bit	Parity bit
PC	Personal Computer
PCC	Protection Communication Channel
PCM	Pulse Code Modulation
PDH	Plesiochronous Digital Hierarchy
PDI-P	Payload Defect Indication - Path
PLM	Payload Label Mismatch
PLM-P	Payload Label Mismatch - Path
PLM-V	Payload Label Mismatch - VT
PM	Path Monitoring
PM	Performance Monitoring
PN-11	Polynominal Number 11
POH	Path Overhead
ppm	Parts Per Million

PPP	Point-to-Point Protocol
PRBS	Pseudo Random Bit Sequence
PRM	Performance Report Messages
PSI	Payload Structure Identifier
PT	Payload Type
PTE	Path Terminating Equipment

Q

QRSS	Quasi-Random Signal Source

R

RAI	Remote Alarm Indication
RAI MF	Remote Alarm Indication MultiFrame
RAM	Random-Access Memory
RDI	Remote Defect Indication test (replaces the former names FERF and RAI)
RDI-L	Remote Defect Indication - Line
RDI-P	Remote Defect Indication - Path
RDI-V	Remote Defect Indication - VT
REF OUT	Reference Output
REI	Remote Error Indication
REI-L	Remote Error Indication - Line
REI-P	Remote Error Indication - Path
REI-V	Remote Error Indication - VT
RES	Reserved

RFI	Remote Failure Indication
RFI-V	Remote Failure Indication - VT
RMA	Return Merchandise Authorization
RS	Regenerator Section
RS-TIM	Regenerator Section - Trace Identifier Mismatch
RSOH	Regenerator Section Overhead
RTD	Round Trip Delay
RX	Receive

S

SAPI	Source Access Point Identifier
SDH	Synchronous Digital Hierarchy
SDT	Service Disruption Time
SEF	Severely Errored Framing
SELV	Safety Extra Low Voltage
SEP	Severely Errored Period
SEPI	Severely Errored Period Intensity
SES	Severely Errored Second
SESR	Severely Errored Second Ratio
SF	Superframe
SFP	Small Form Factor Pluggable
SI	International System
SK	Software Key
SM	Section Monitoring
SMA	Sub-Miniature A connector

SMF	Single Mode Fiber
SOH	Section Overhead
SONET	Synchronous Optical NETwork
SPE	Synchronous Payload Envelope
SR	Short Reach
SSA	SONET SDH Analyzer
SSMB	Synchronization Status Message Byte
STM-0e	Electrical Synchronous Transport Module (51 Mbps)
STM-1	Synchronous Transport Module for 1st level (155.52 Mbps)
STM-1e	Electrical Synchronous Transport Module for 1st level (155.52 Mbps)
STM-4	Synchronous Transport Module for 4th level (622.08 Mbps)
STM-16	Synchronous Transport Module for 16th level (2.48832 Gbps)
STM-64	Optical Carrier for 64th level (9.95328 Gbps)
STM-256	Optical Carrier for 256th level (39.81312 Gbps)
STS-1	Synchronous Transport Signal-Level 1 (51.84 Mbps)
STS-3	Synchronous Transport Signal-Level 3 (155.52 Mbps)
STS-12	Synchronous Transport Signal-Level 12 (622.08 Mbps)
STS-48	Synchronous Transport Signal-Level 48 (2.48832 Gbps)
STS-192	Synchronous Transport Signal-Level 192 (9.95328 Gbps)
STS-768	Synchronous Transport Signal-Level 768 (39.81312 Gbps)
SYMB	Symbol

T

TC	Tandem Connection
TCM	Tandem Connection Monitoring
TCM ACT	Tandem Connection Monitoring Activation
TERM	Terminal
TIM	Trace Identifier Mismatch
TIM-P	Trace Identifier Mismatch - Path
TIM-S	Trace Identifier Mismatch - Section
TIM-V	Trace Identifier Mismatch - VT
TNC	Transmit Node Clock
TS16 AIS	TimeSlot 16 Alarm Indication Signal
TTI	Trail Trace Identifier
TU	Tributary Unit
TU-11	Tributary Unit - 11
TU-12	Tributary Unit - 12
TU-AIS	Tributary Unit - Alarm Indication Signal
TU-LOP	Tributary Unit - Loss Of Pointer
TUG	Tributary Unit Group
TX	Transmit

U

UAS	Unavailable Second
UNCORR	Uncorrectable
UNEQ-P	Unequipped - Path
UNEQ-V	Unequipped - VT

μs	microsecond
USA	United States of America
USB	Universal Serial Bus
UTC	Universal Time Coordinated

V

V	Volt
VC	Virtual Container
VC-11	Virtual Container-11
VC-12	Virtual Container-12
VC-AIS	Virtual Container - Alarm Indication Signal
VC-3	Virtual Container-3
VC-4	Virtual Container-4
VC-n	Virtual Container-n
VCAT	Virtual Concatenation
VLAN	Virtual Local Area Network
Vpp	Volt peak-to-peak
VT	Virtual Tributary
VTG	Virtual Tributary Group
VT1.5	Virtual Tributary-1.5
VT2	Virtual Tributary-2
VT3	Virtual Tributary-3
VT6	Virtual Tributary-6

X

X	Exit application
XFP	10G Small Form Factor Pluggable

Z

ZCS	Zero Code Suppression

G.709 Optical Transport Network (OTN)

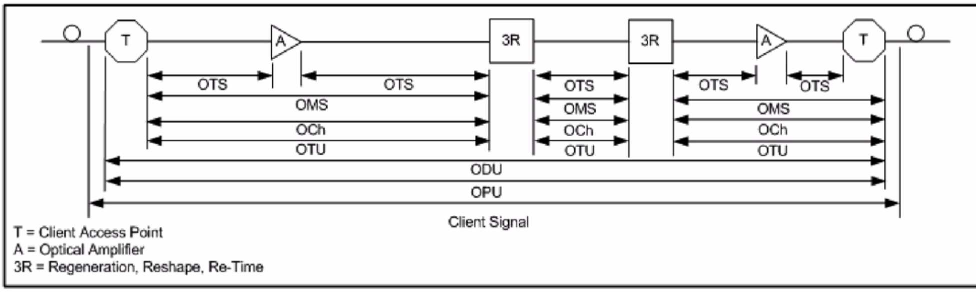
Overview

The optical transport network (OTN) combines the benefits of SONET/SDH technology with the bandwidth expansion capabilities offered by dense wavelength-division multiplexing (DWDM) technology.

The OTN consists of the following layers:

- Optical Transport Section (OTS)
- Optical Multiplex Section (OMS)
- Optical Channel (OCh)
- Optical Transport Unit (OTU)
- Optical Data Unit (ODU)
- Optical Channel Payload Unit (OPU)

Each of these layers and their functions are distributed along the network and activated when they reach their termination points, which are illustrated in the following figure.



OTN Layer Termination Points

The termination of the OTS, OMS and OCh layers is performed at the optical level of the OTN. It is at the termination of the OTU layer that further functionality can be added. This layer is the digital layer—also known as the “digital wrapper”—and offers specific overhead to manage the OTN’s digital functions. The OTU also introduces a new dimension to optical networking by adding forward error correction (FEC) to the network elements, allowing operators to limit the number of required regenerators used in the network which, in turn, lowers its cost.

FEC allows an increase in the optical link budget by providing a new method to correct errors, thereby reducing the impact of network noise and other optical phenomena experienced by the client signal traveling through the network.

The OTU also encapsulates two additional layers—the ODU and the OPU—which provide access to the payload (SONET, SDH, etc.). These layers are normally terminated at the same location.

The OTU, ODU (including the ODU tandem connection) and OPU layers can all be analyzed and monitored. As per ITU G.709, current test solutions offer these possibilities using three line rates:

➤ OTU1 (255/238 x 2.488 320 Gbps ˜ 2.666057143 Gbps) also referred to as 2.7 Gbps

➤ OTU2 (255/237 x 9.953280 Gbps ˜ 10.709225316 Gbps) also referred to as 10.7 Gbps

➤ OTU3 (255/236 x 39.813120 Gbps ˜ 43.018413559 Gbps) also referred to as 43 Gbps

Each line rate is adapted to service different client signals:

➤ OC-48/STM-16 is transported via OTU1

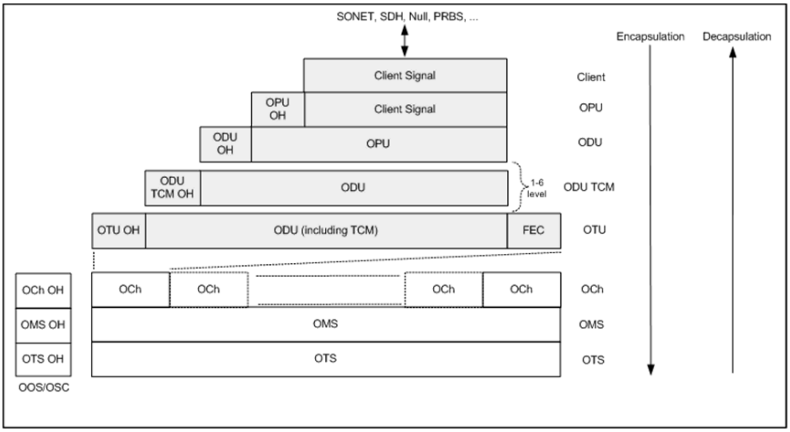
➤ OC-192/STM-64 is transported via OTU2

➤ OC-768/STM-256 is transported via OTU3

➤ Null Client (All 0s) is transported via OTUk (k = 1, 2, 3)

➤ PRBS 231-1 is transported via OTUk (k = 1, 2, 3)

In order to map client signals via ITU G.709, they are encapsulated using the structure illustrated in the following figure.



Basic OTN Transport Structure

As depicted above, to create an OTU frame, a client signal rate is first adapted at the OPU layer. The adaptation consists of adjusting the client signal rate to the OPU rate. Its overhead contains information to support the adaptation of the client signal. Once adapted, the OPU is mapped into the ODU. The ODU maps the OPU and adds the overhead necessary to ensure end-to-end supervision and tandem connection monitoring (up to six levels). Finally, the ODU is mapped into an OTU, which provides framing as well as section monitoring and FEC.

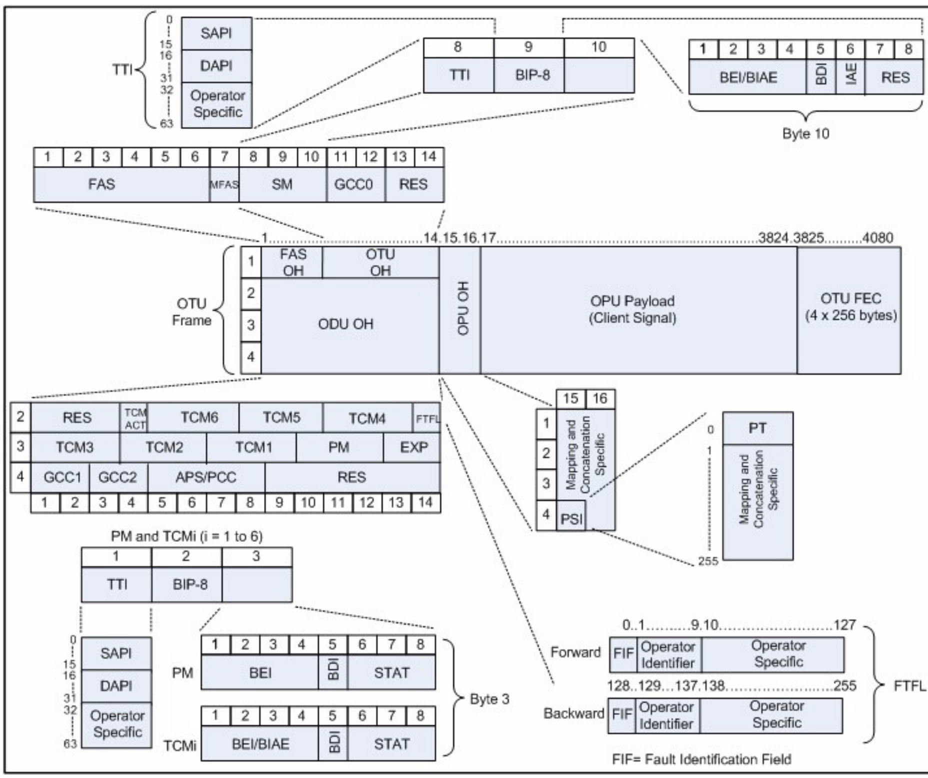
Following the OTN structure presented in figure *Basic OTN Transport Structure* on page 437, OTUks (k = 1, 2, 3) are transported using the OCh; each unit is assigned a specific wavelength of the ITU grid. Several channels can be mapped into the OMS and then transported via the OTS layer. The OCh, OMS and OTS layers each have their own overhead for management purposes at the optical level. The overhead of these optical layers is transported outside of the ITU grid in an out-of-band channel called the optical supervisory channel (OSC).

When the OTU frame structure is complete (OPU, ODU and OTU), ITU G.709 provides OAM&P functions that are supported by the overhead.

OTU Frame Structure and Overhead

As shown in the figure below, the OTU frame is broken down into the following components:

- Framing
- OTU, ODU, OPU overhead
- OTU FEC



OTU Frame Description

- Framing

  The OTU framing is divided into two portions: FAS and MFAS.

  The frame alignment signal (FAS) uses the first six bytes and, similarly to SONET/SDH, it is used to provide framing for the entire signal. In order to provide enough 1/0 transitions for synchronization, scrambling is used over the entire OTU frame, except for the FAS bytes.

  The multiframe alignment signal (MFAS) byte is used to extend command and management functions over several frames. The MFAS counts from 0 to 255, providing a 256 multiframe structure.

- Overhead

  Each portion of the OTU frame has its own specific overhead functions. They are displayed in figure *OTU Frame Description* on page 439, and are briefly described below. Further details can be found about these overhead fields in the ITU G.709 standard.

  - Optical Transport Unit (OTU)

    The OTU overhead is comprised of the SM, GCC0 and RES bytes.

    The section monitoring (SM) bytes are used for the trail trace identifier (TTI), parity (BIP-8) and the backward error indicator (BEI), or backward incoming alignment error (BIAE), backward defect indicator (BDI), and incoming alignment error (IAE). The TTI is distributed over the multiframe and is 64 bytes in length. It is repeated four times over the multiframe.

    General communication channel 0 (GCC0) is a clear channel used for transmission of information between OTU termination points.

    The reserved (RES) bytes are currently undefined in the standard.

- Optical Data Unit (ODU)

  The ODU overhead is broken into several fields: RES, PM, TCMi, TCM ACT, FTFL, EXP, GCC1/GCC2 and APS/PCC.

  The reserved (RES) bytes are undefined and are set aside for future applications.

  The path monitoring (PM) field is similar to the SM field described above. It contains the TTI, BIP-8, BEI, BDI and Status (STAT) field.

  There are six tandem connection monitoring (TCMi) fields, which contain the BEI/BIAE, BDI and STAT fields. The STAT field is used in the PM and TCMi fields to provide an indication of the presence or absence of maintenance signals.

  The tandem connection monitoring activation/deactivation (TCM ACT) field is currently undefined in the standards.

  The fault type and fault location reporting communication channel (FTFL) is a message spread over a 256-byte multiframe that provides the ability to send forward and backward path-level fault indications.

  The experimental (EXP) field is a field that is not subject to standards and is available for network operator applications.

  General communication channels 1 and 2 (GCC1/GCC2) fields are very similar to the GCC0 field except that each channel is available in the ODU.

  The automatic protection switching and protection communication channel (APS/PCC) supports up to eight levels of nested APS/PCC signals, which are associated to a dedicated-connection monitoring level depending on the value of the multiframe.

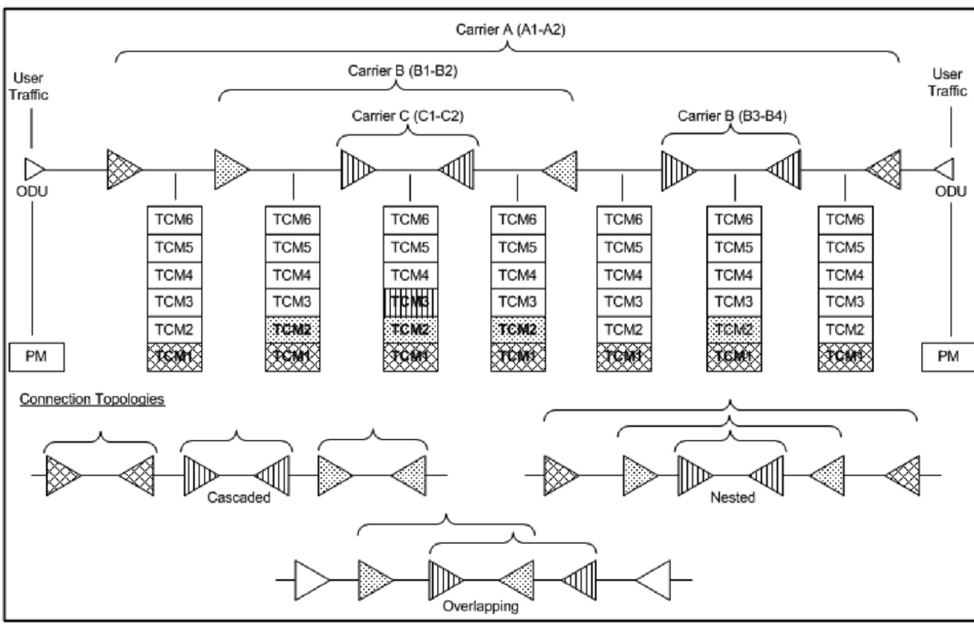
- Optical Payload Unit (OPU)

  The primary overhead field associated to the OPU is the Payload Structure Identifier (PSI). This is a 256 bytes multi-frame where its first byte is defined as the Payload Type (PT). The remaining 255 bytes are currently reserved.

  The other fields in the OPU overhead are dependent on the mapping and concatenation capabilities associated to the OPU. For an asynchronous mapping (the client signal and OPU clock are different) Justification Control (JC) bytes are available to compensate for clock rate differences, two methods are supported Asynchronous Mapping Procedure (AMP) and Generic Mapping Procedure (GMP). For a purely Bit-Synchronous Mapping Procedure (BMP) (client source and OPU clock are the same), the JC bytes become reserved (set to 0). Concatenation bytes are also available as described in ITU G.709.

Tandem Connection Monitoring (TCM)

TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network. SONET/SDH allowed a single level of TCM to be configured, while ITU G.709 allows six levels of tandem connection monitoring to be configured. The assignment of monitored connections is currently a manual process that involves an understanding between the different parties. There are various types of monitored connection topologies: cascaded, nested and overlapping. Examples of these topologies are provided in the following figure.



Tandem Connection Monitoring

Each of the six TCMi fields in the ODU overhead is assigned to a monitored connection. There can be from zero to six connections that can be configured for each connection. In the figure *Tandem Connection Monitoring* on page 443, there are three different connections that are actually monitored. Carrier C, due to its location, can monitor three TCM levels as the ODU passes through its portion of the network.

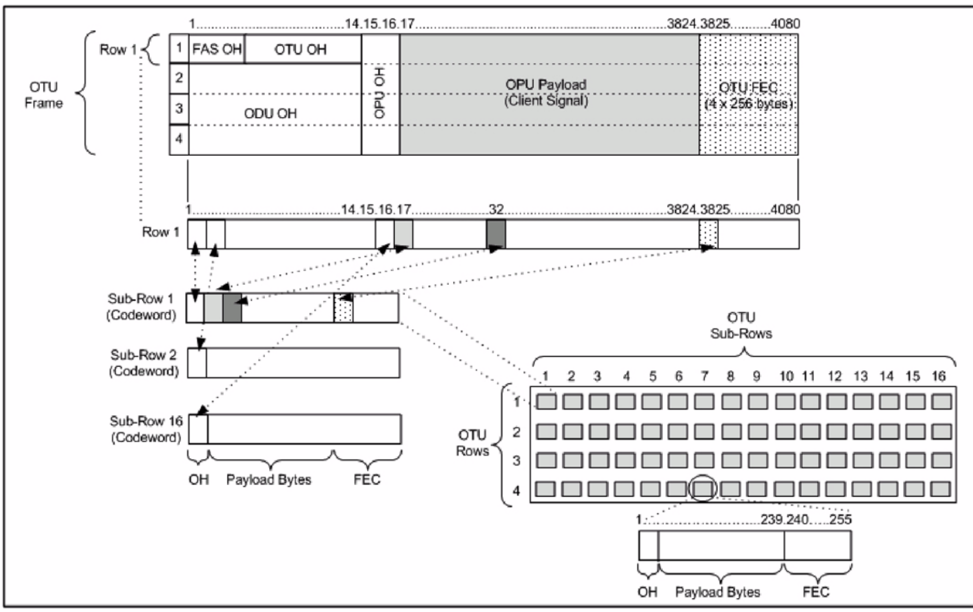
In addition to monitoring maintenance signals, using the STAT field associated with each TCM level, the TCM connection also monitors the BIP-8 and BEI errors for each connection level. Maintenance signals are used to advertise upstream maintenance conditions affecting the traffic and errors provide an indication of the quality of service offered at each segment of the network, which provides a valuable tool for the user and carrier to isolate faulty sections of the network.

Forward Error Correction (FEC)

The ITU G.709 standard supports forward error correction (FEC) in the OTU frame and is the last part added to the frame before the frame is scrambled. FEC provides a method to significantly reduce the number of transmitted errors due to noise, as well as other optical phenomena that occur at high transmission speeds. This enables providers to support longer spans in between optical repeaters.

An OTU frame is divided into four rows. Each row is broken down into 16 sub-rows comprised of 255 bytes each, as shown in figure *Forward Error Correction* on page 446. A sub-row is composed of interleaved bytes. The interleave is executed so that the first sub-row contains the first overhead (OH) byte, the first payload byte and the first FEC byte, and so on for the remaining sub-rows of each row in the frame. The first FEC byte starts at position 240 for all sub-rows.

The FEC uses a Reed-Solomon RS (255/239) coding technique. This means that 239 bytes are required to compute a 16-byte parity check. The FEC can correct up to eight (bytes) errors per sub-row (codeword) or detect up to 16 byte errors without correcting any. Combined with the byte interleave capability included in ITU G.709 implementation, the FEC is more resilient in regards to error burst, where up to 128 consecutive bytes can be corrected per OTU frame row.



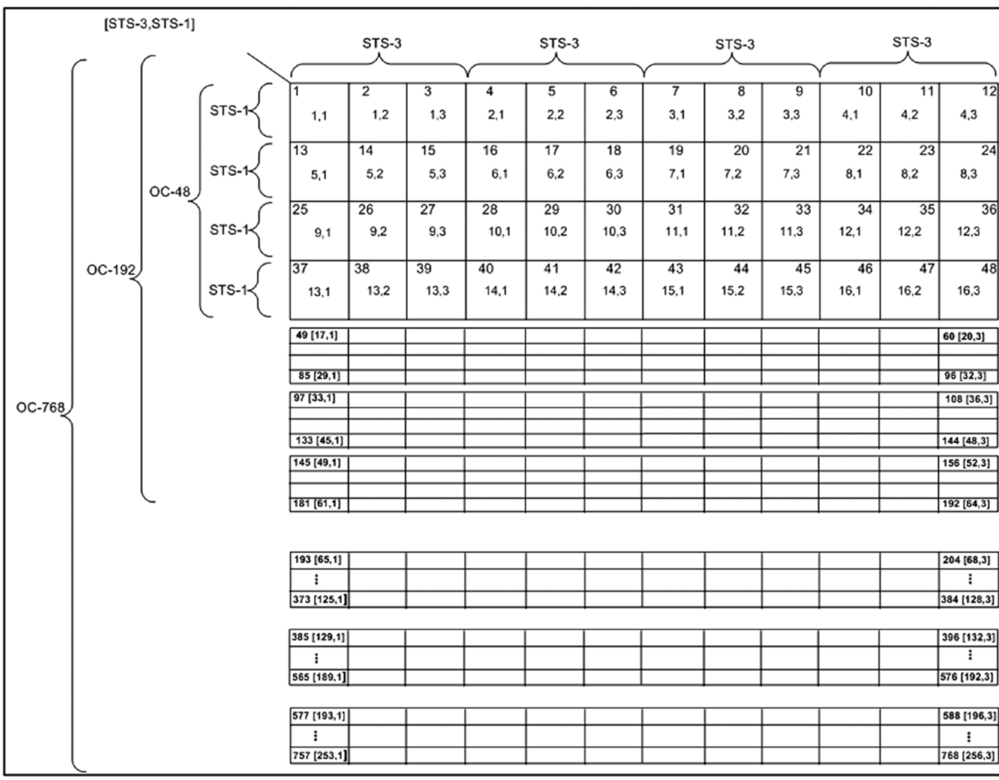
Forward Error Correction

SONET Numbering Convention

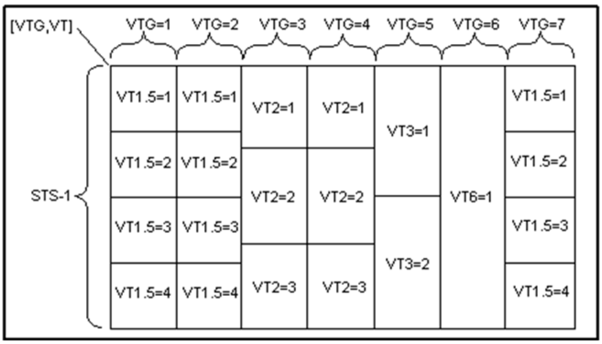
The FTB-8100 Series supports the Timeslot (default) and hierarchical two-level numbering conventions as per GR-253.

Hierarchical Notation

The FTB-8100 Series supports numbering SONET high order path STS-1s and STS-3c using the two-level “STS-3#,STS-1#”convention in an OC-N. For example: STS-1 [2,3].



The FTB-8100 Series supports numbering SONET low order path using the two-level “VTGroup#,VT#” convention for numbering VTs within an STS-1. For example: VT1.5 [1,3], VT2 [3,2], VT6 [6,1].



The FTB-8100 Series supports numbering SONET high order path STS-nc within an OC-N using the two-level “STS-3#,STS-1#”. For example: STS-12c [5,1].

Note: *For STS-1e the numbering is limited to the A value as only one STS-1 exits.*

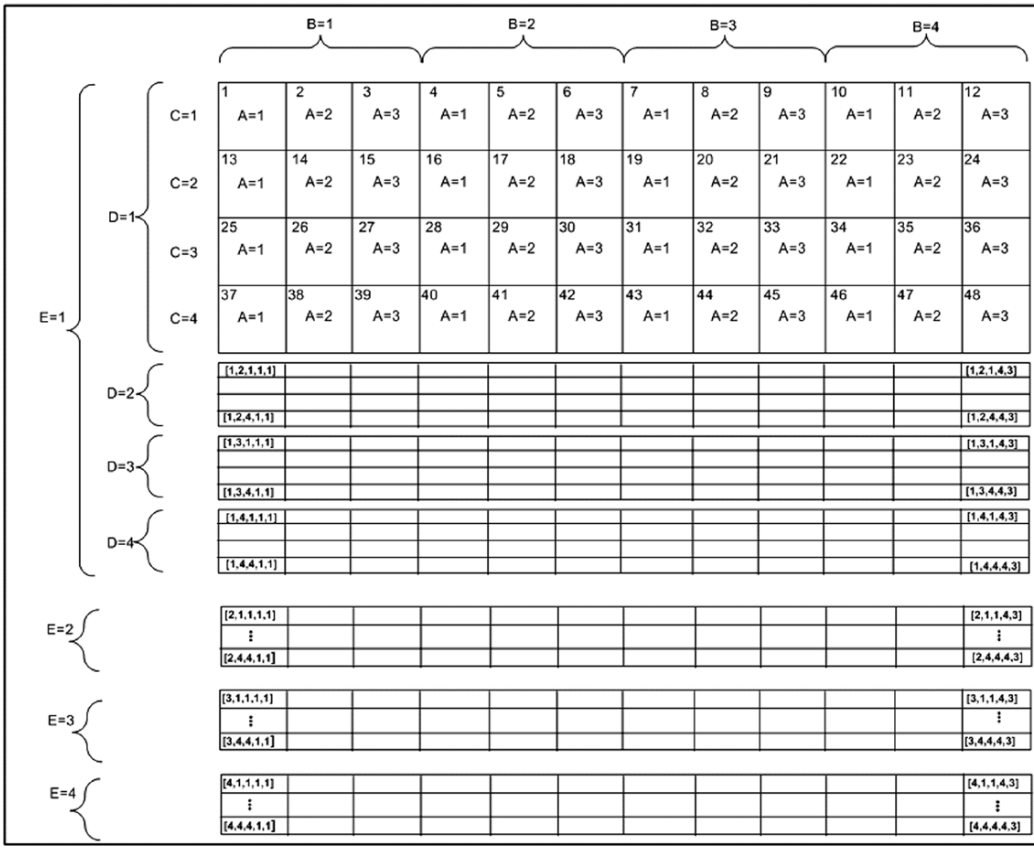
SDH Numbering Convention

As per ITU G.707, the high order paths are defined using a 2 to 5 level convention E,D,C,B,A depending on the rate of the STM-n used.

- E: the AUG-64 are numbered 1 to 4
- D: the AUG-16 are numbered 1 to 4
- C: the AUG-4 are numbered 1 to 4
- B: the AUG-1 are numbered 1 to 4
- A: the AU-3 are numbered 1 to 3

So for the naming is as follows for each of the following rate:

- [E,D,C,B,A] for STM-256
- [D,C,B,A] for STM-64
- [C,B,A] for STM-16
- [B,A] for STM-4
- [0] for AU-4 in STM-1
- [A] for AU-3 in STM-1
- [A] for the AU-3 in STM-0e, A=0.



The low order paths are defined using a 2 or 3 level convention K,L,M depending on the rate of the AU-4 or AU-3 used to multiplex the low order signals.

- K: the TUG-3 are numbered 1 to 3
- L: the TUG-2 are numbered within the TUG-3 0 or from 1 to 7
- M: the TU-2, TU-12, TU-11 are numbered within the TUG-2 1, 1 to 3, 1 to 4 respectively

Examples for AU-4 (3 level convention)

TU-3: [K,0,0]

TU-2: [K,L,0]

TU-12:[K,L,M] where M = 1 to 3

TU-11:[K,L,M] where M = 1 to 4

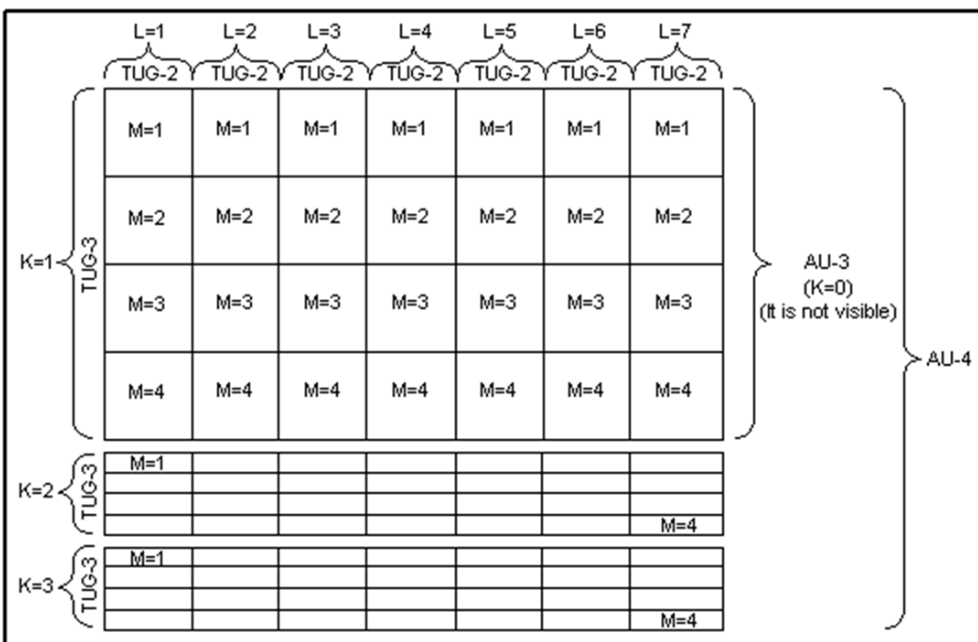
Example for AU-3 (2 level convention)

TU-2: [L,0]

TU-12: [L,M] M is numbered 1 to 3

TU-11: [L,M] M is numbered 1 to 4

The GUI Grid indicates the TUG-2 [x] and TUG-3 [x] values.



DSn/PDH Numbering Convention

The DS1 numbering in DS3 shall be numbered with respect to the DS2 muxing [DS2,DS1]. For example a DS3 has 7 DS2 and a DS2 has 4 DS1, so an example would be for a DS1 number [3,2]. The DS3 shall have a single number to represent its position. That is [1] all the time whether it is used in an STS-1 or it is the DS3 electrical interface.

The PDH do not have special grouping of the E1, E2, E3 or E4. This means that the PDH has a single number. For example E1 number 2 shall be number [2].

The E1 in DS3 via G.747 numbering uses the naming [DS2,E1]. However in the grid the label shall adapt itself to DS2 [x] or 6.3M [x] (where x = 1 to 7) with respect to the interface standard used: European or International.

SONET - Section Overhead (SOH)

The section contains overhead information (SOH) used by all SONET equipment along a network path, including signal regenerators.

	Transport Overhead				Path Overhead
Section Overhead	Framing A1	Framing A2	Trace/Growth J0/Z0		Trace J1
	BIP-8 B1	Orderwire E1	User F1		BIP-8 B3
	Data Com D1	Data Com D2	Data Com D3		Signal Label C2
Line Overhead	Pointer H1	Pointer H2	Pointer Action H3		Path Status G1
	BIP-8 B2	APS K1	APS K2		User Channel F2
	Data Com D4	Data Com D5	Data Com D6		Indicator H4
	Data Com D7	Data Com D8	Data Com D9		Growth/User Z3
	Data Com D10	Data Com D11	Data Com D12		Growth Z4
	Sync/Growth S1/Z1	REI/Growth M0 or M1/Z2	Orderwire E2		Growth/User N1

A1 and A2: Framing

A1 and A2 provide frame alignment of each STS-1 frame within a composite signal (STS-1 to STS-n). They must appear in every STS-1 of a composite signal. The value is hexadecimal F628.

J0: Trace

The J0 (Trace) byte is used to trace the origin of an STS-1 frame as it travels across the SONET network. This byte is only defined for the first STS-1 frame of a composite signal STS-1 to STS-n (STS-1 of an electrical or OC-N signal).

Z0: Growth

The Z0 (Growth) byte was used to uniquely identify the STS in question. This byte had to be defined in every STS-1 to STS-n frame of a composite signal. For speed reasons, a Section Trace is a much better use of this byte.

B1: BIP-8

The BIP-8 (Bit-Interleaved Parity) byte provides section error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the previous frame of a composite signal (STS-1 to STS-n). This byte is only defined for the first STS-1 frame of a composite signal.

E1: Orderwire

The Orderwire provides a 64 Kbps voice channel for communication between two STEs (Section Terminating Equipment). This byte is only defined for the first STS-1 frame of a composite signal.

F1: User

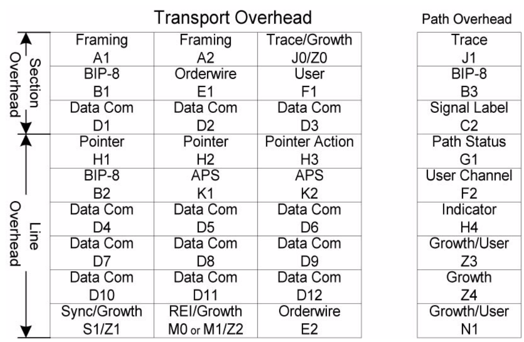
The User byte is reserved for user purposes. This byte is only defined for the first STS-1 frame of a composite signal.

D1, D2 and D3: Data Communications Channel (DCC)

The Data Communication Channel (D1, D2 and D3) provides a 192 Kbps data communication between two STEs for operation functions such as OAM&P. This byte is only defined for the first STS-1 frame of a composite signal.

SONET - Line Overhead (LOH)

This section contains overhead information (LOH) processed by all SONET equipment along a network path, excluding signal regenerators.



H1 and H2: Pointer

H1 and H2 bytes are combined to form a pointer indicating where the path overhead begins within each SPE.

H3: Pointer Action

H3 is an extra byte used to compensate for the SPE timing variation. The H1 and H2 pointer tell the receiver when the H3 pointer is used. This byte must be defined in every STS-1 to STS-n frame of a composite signal.

B2: BIP-8

The BIP-8 (Bit-Interleaved Parity) byte provides line error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the LOH and the STS-1 frame capacity of the previous frame of a composite signal (STS-1 to STS-n). Note that the SOH is not used to calculate the parity check. This byte must be defined in every STS-1 to STS-n frame of a composite signal.

K1 and K2: Automatic Protection Switching (APS)

The K1 and K2 bytes communicate APS between two LTE. This byte is only defined for the first STS-1 frame of a composite signal.

D4 - D12: Data Communications Channel (DCC)

The D4 through D12 bytes provides a 576 Kbps data communications channel between two LTEs for administration, monitoring and other communications. These bytes are only defined for the first STS-1 frame of a composite signal.

S1: Synchronization Status

The S1 byte is used to carry the synchronization status of the SONET device. This byte is only defined for the first STS-1 frame of a composite signal (STS-1 of an electrical or OC-N signal).

Z1: Growth

The Z1 byte is allocated for future growth. This byte is located in the second STS-1 through STS-n frame of a composite signal (STS-1 #2, STS-1 #3, up to STS-1 #N of a OC-N (N>3) signal).

M0: STS-1 REI-L

Bits 5 through 8 of M0 byte are used for line Remote Error Indication (REI-L). Bits 1 through 4 are currently undefined. The M0 byte is defined only for the STS-1 in an STS-1 electrical signal.

M1: STS-n REI-L

The M1 byte is used for line Remote Error Indication (REI-L). This byte is located in the third STS-1 of an STS-n signal (n > 3).

Z2: Growth/FEBE (Far-End Block Error)

The Z2 byte is allocated for future growth. This byte is located in the first and second STS-1s of an STS-3, and the first, second, and fourth through n of a STS-n signal ($12 \leq n \leq 48$).

E2: Orderwire

The Orderwire provides a 64 Kbps voice channel for communication between LTEs. This byte is only defined for the first STS-1 frame of a composite signal.

SONET - Path Overhead (POH)

This section contains overhead information (POH) processed by SONET STS-1 terminating equipment.

Transport Overhead

Section Overhead	Framing A1	Framing A2	Trace/Growth J0/Z0
	BIP-8 B1	Orderwire E1	User F1
	Data Com D1	Data Com D2	Data Com D3
Line Overhead	Pointer H1	Pointer H2	Pointer Action H3
	BIP-8 B2	APS K1	APS K2
	Data Com D4	Data Com D5	Data Com D6
	Data Com D7	Data Com D8	Data Com D9
	Data Com D10	Data Com D11	Data Com D12
	Sync/Growth S1/Z1	REI/Growth M0 or M1/Z2	Orderwire E2

Path Overhead
Trace J1
BIP-8 B3
Signal Label C2
Path Status G1
User Channel F2
Indicator H4
Growth/User Z3
Growth Z4
Growth/User N1

J1: Trace

The J1 Trace byte provides a 16 or 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

B3: BIP-8

The BIP-8 (Bit-Interleaved Parity) byte provides path error monitoring. The byte is calculated by performing a even-parity check over all bits of the previous SPE.

C2: Signal Label

C2 provides an identification byte for the STS SPE.

➤ STS Path Signal Label Assignments:

C2 (Hex.)	Description
00	Unequipped
01	Equipped - Non-Specific
02	Floating VT Mode
03	Locked VT Mode
04	Asynchronous Mapping for DS3
05	Mapping under development
12	Asynchronous Mapping for 140M (DS4NA)
13	Mapping for ATM
14	Mapping for DQDB
15	Asynchronous Mapping for FDDI
16	Mapping of HDLC over SONET
17	SDL with self-synchronization scrambler
18	Mapping of HDLC/LAPS
19	SDL with use of a set-reset scrambler
1A	10 Gbps Ethernet (IEEE 802.3)
1B	GFP
CF	Reserved (Obsolete HDLC/PPP framed)
E1 to FC	STS-1 w/1 VTx Payload Defects, STS-1 w/2 VTx Payload Defects, ... STS-1 w/28 VTx or STS-n/nc with Payload Defects
FE	Test Signal, ITU-T 0.181 specific mapping

G1: Status

The G1 byte provides a method to communicate the far-end path status back to the path originating equipment.

F2: User Channel

The User Channel provides a 64 Kbps channel for communication between two PTEs. This byte is only defined for the first STS-1 frame of a composite signal.

H4: Multiframe Indicator

The H4 byte provides a multiframe phase indication of a VT payload to identify phases of a SF as well as to convey the control packet information in VCAT.

Z3 and Z4: Growth

The Z3 and Z4 bytes are allocated for future growth.

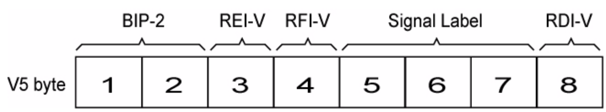
N1: Tandem Connection

The N1 byte (formerly referred to as the Z5 byte) is allocated for Tandem Connection Maintenance and the Path Data Channel.

SONET - VT Path Overhead

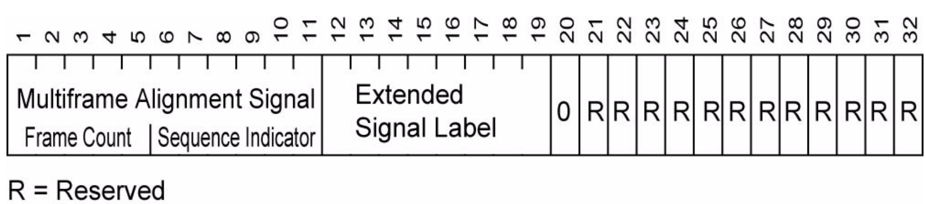
V5: VT Path overhead

The V5 byte provides the same functions for VT paths that the B3, C2, and G1 bytes provide for STS paths.



Note: *If the signal label in V5 (bits 5, 6, and 7) is 101 the contents of the extended signal label is valid and contains in a 32 bit frame multiframe as shown below. See Z7 Structure shown below.*

Z7 Structure



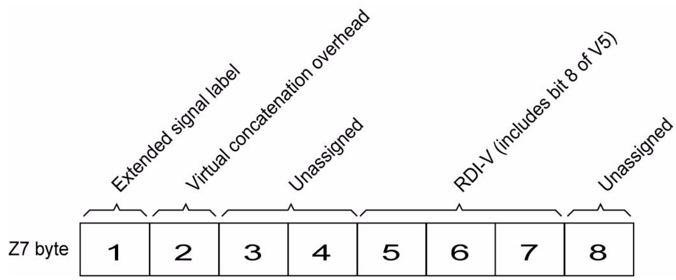
J2: VT Path Trace

The J2 Trace byte provides a 16 byte fixed string allowing the receiving VT PTE to verify its continued connection to the intended transmitting VT PTE.

Z6: VT Path Growth

The Z6 byte is allocated for future growth.

Z7: VT Path Growth



Bit 1 of the Z7 byte is allocated for an extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see *Z7 Structure* on page 461) contain the extended signal label.

Bit 2 of the Z7 byte is allocated for virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see *Z7 Structure* on page 461) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator.

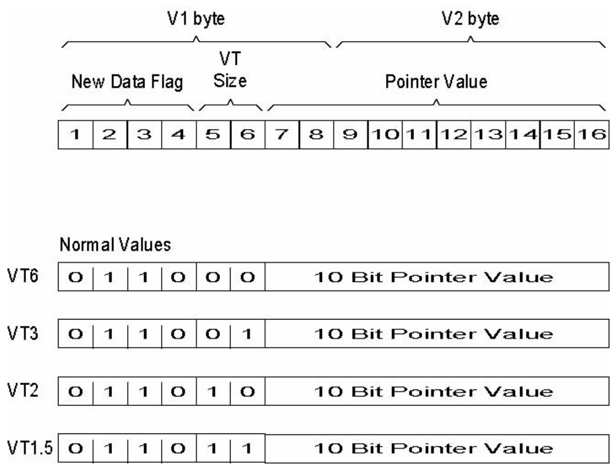
Bits 3, and 4 of the Z7 byte are unassigned and reserved for APS signaling for protection at the lower order path level.

Bits 5 through 7 of the Z7 byte in combination with bit 8 of V5 are allocated for RDI -V/ERDI-V signal.

Bit 8 of the Z7 byte is unassigned and reserved for a lower order path data link.

VT Payload Pointer

The VT Payload Pointer provides a method of allowing flexible and dynamic alignment of the VT SPE within the VT Superframe.



➤ **New Data Flag**

NDF is enabled when at least 3 out of 4 bits match “1001”.

NDF is disabled (normal value) when at least 3 out of 4 bits match “0110”.

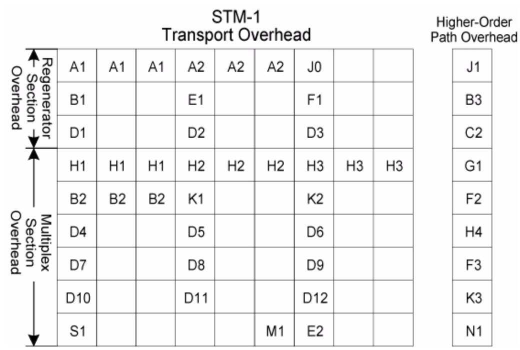
➤ Pointer Value

The pointer value indicates the offset between the pointer word and the first byte fo the VT SPE. The V1 through V4 bytes are not counted in the offset calculation. The pointer is a binary number with the following range:

Path	Range	
VT1.5	0	103
VT2	0	139
VT3	0	211
VT6	0	427

SDH - Regenerator Section Overhead (RSOH)

The section contains regenerator section overhead information (RSOH) used by all SDH equipment along a network path, including signal regenerators.



A1 and A2: Framing

A1 and A2 indicate the beginning of the STM-N frame. They must appear in every STM-1 of a composite signal. The value in hexadecimal is F628.

J0: RS Trace Message

The J0 (Trace) byte is used to trace the origin of an STM-1 frame as it travels across the SDH network. This byte is only defined for the first STM-1 of an STM-N signal.

Z0: Growth

These bytes are reserved for future international standardization. They are located at positions S[1,6N+2] to S[1,7N] of an STM-N signal (N > 1).

B1: RS BIP-8

The BIP-8 (Bit-Interleaved Parity) byte provides section error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the previous STM-N frame. This byte is only defined for the first STM-1 frame of a composite signal.

E1: RS Orderwire

The Orderwire provides a 64 kbps voice channel for communication between two STEs. This byte is only defined for the first STM-1 frame of a composite signal.

F1: RS User Channel

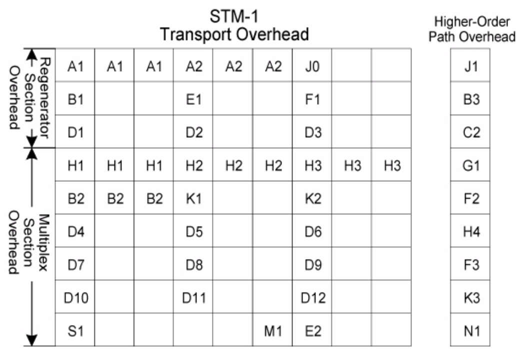
The User Channel byte is reserved for user purposes. This byte is only defined for the first STM-1 frame of a composite signal.

D1, D2 and D3: RS DCC (Data Communications Channel)

The Data Communication Channel (D1, D2 and D3) provides a 192 kbps data communication between two STEs for operation functions such as OAM&P. This byte is only defined for the first STM-1 frame of a composite signal.

SDH - Multiplex Section Overhead (MSOH)

This section contains multiplex section overhead information (MSOH) processed by all SDH equipment along a network path, excluding signal regenerators.



H1 and H2: Pointer

H1 and H2 bytes are combined to form a pointer indicating where the VC (Virtual Container) framed begins within each SPE.

H3: Pointer Action

H3 is an extra byte used to compensate for the SPE timing variation. The H1 and H2 pointer tell the receiver when the H3 pointer is used. This byte must be defined in every STM-1 of an STM-N signal in the event of negative justification, otherwise it is not defined.

B2: MS BIP-N*24

The MS BIP-N*24 (Bit-Interleaved Parity) byte provides line error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the MSOH and the STM-N frame of the previous STM-N frame. Note that the RSOH is not used to calculate the parity check. This byte must be defined in every STM-1 of an STM-N signal.

K1 and K2: APS Channel (Automatic Protection Switching)

The K1 and K2 bytes communicate APS between two LTEs. This byte is only defined for the first STM-1 frame of an STM-N signal.

D4 through D12: MS DCC (Data Communications Channel)

The D4 through D12 bytes provides a 576 kbps data communications channel between two LTEs for administration, monitoring and other communications. These bytes are only defined for the first STM-1 frame of an STM-N signal.

S1: SSMB (Synchronization Status Message Byte)

Bits 5 to 8 of the S1 byte are used to carry the synchronization messages of the SDH device. This byte is only defined for the first STM-1 frame of an STM-N signal.

M1: MS-REI (Remote Error Indicator)

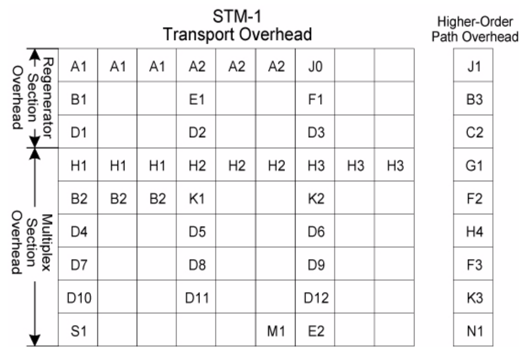
The M1 byte of a STM-1 or the first STM-1 of an STM-N signal is used for MS layer Remote Error Indication (MS-REI). This byte is located in the third STM-1 of an STS-N signal (N > 1).

E2: MS Orderwire

The MS Orderwire provides a 64 kbps voice channel for communication between LTEs. This byte is only defined for the first STM-1 frame of an STM-N signal.

SDH - Higher-Order Path Overhead (HP-POH)

This section contains higher-order path overhead information (HPOH) processed by SDH STM-1 terminating equipment.



J1: Higher-Order VC-N Path Trace

The higher-order VC-N path trace byte provides a 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

B3: Path BIP-8

The path BIP-8 (Bit-Interleaved Parity) byte provides path error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the previous SPE.

C2: Path Signal Label

C2 specifies the mapping type in the VC-N.

C2 (Hex.)	Description
00	Unequipped or supervisory-unequipped
01	Reserved (Equipped - Non-Specific)
02	TUG Structure
03	Locked TU-n
04	Asynchronous Mapping of 34M/45M in C-3
05	Experimental Mapping
12	Asynchronous Mapping of 140M in C-4
13	ATM Mapping
14	MAN DQDB
15	FDDI [3]-[11] Mapping
16	Mapping of HDLC/PPP
17	Reserved (SDL self-synch scrambler)
18	Mapping of HDLC/LAPS
19	Reserved (SDL set-reset scrambler)
1A	Mapping of 10 Gbps Ethernet (IEEE 802.3)
1B	GFP
1C	Mapping 10 Gbps FC
20	Asynchronous Mapping of ODUk
CF	Reserved (obsolete HDLC/PPP framed)
FE	Test Signal, ITU-T 0.181 specific mapping
FF	VC-AIS (TCM)

G1: Path Status

The G1 byte provides a method to communicate the far-end path status back to the path originating equipment.

F2: Path User Channel

The Path User Channel provides a 64 kbps channel for communication between two PTEs. This byte is only defined for the first STM-1 frame of an STM-N signal.

H4: Position and Sequence Indicator

The H4 byte provides a multiframe phase indication of a VC-3/4 payload to identify phases of a SF as well as to convey the control packet information in VCAT.

F3: Path User Channel

The Path User Channel provides a channel for communication purposes between path elements and is payload dependent.

K3: APS Signaling

Bits 1 to 4 of the K3 byte are used for APS signaling. K3 bits 5 to 8 are reserved for future use.

N1: Network Operator (TCM)

The N1 byte is allocated to provide a Higher-Order Tandem Connection Monitoring (HO-TCM) function.

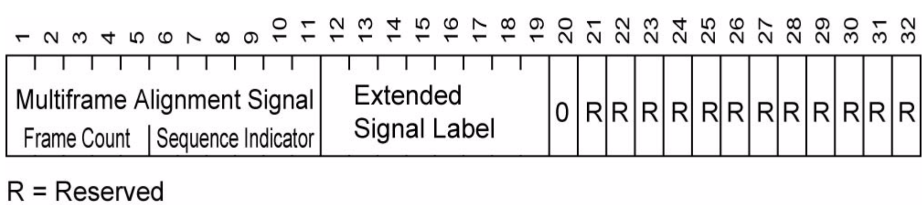
SDH - Lower-Order Path Overhead

V5: VC Path Overhead

The V5 byte provides the same functions for VC paths overhead that the B3, C2, and G1 bytes provide for STM paths.

Note: *If the signal label in V5 (bits 5, 6, and 7) is 101 the contents of the extended signal label is valid and contains in a 32 bit frame multiframe. See K4 Structure shown below.*

K4 Structure



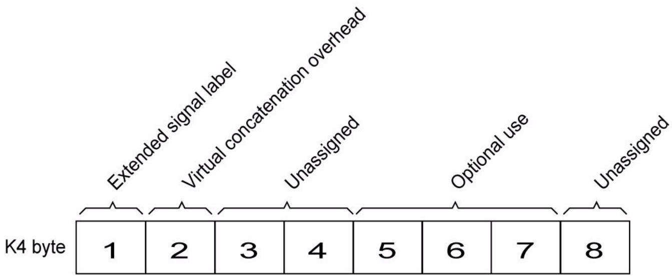
J2: Path Trace

The J2 byte is used to repetitively transmit a Lower-Order Access Path Identifier so that a path receiving terminal can verify its continued connection to the intended transmitter.

N2: Network Operator Byte

The N2 byte is allocated for Tandem Connection Monitoring for the VC2, VC-12, and VC-11 level.

K4: Extended Signal Label



Bit 1 of the K4 byte is allocated for an extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see *K4 Structure* on page 472) contain the extended signal label.

Bit 2 of the K4 byte is allocated for virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see *K4 Structure* on page 472) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator.

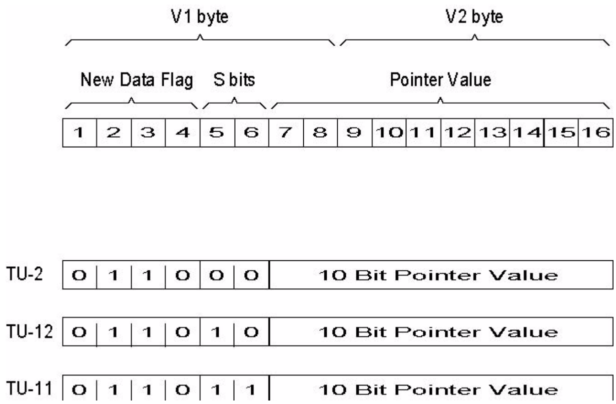
Bits 3, and 4 of the K4 byte are unassigned and reserved for APS signaling for protection at the lower order path level.

Bits 5 through 7 of the K4 byte are allocated for optional use.

Bit 8 of the K4 byte is unassigned and reserved for a lower order path data link.

VT Payload Pointer

The VT Payload Pointer provides a method of allowing flexible and dynamic alignment of the VT SPE within the VT Superframe.



➤ **New Data Flag**

NDF is enabled when at least 3 out of 4 bits match “1001”. NDF is disabled when at least 3 out of 4 bits match “0110”.

➤ **Pointer Value**

The pointer value indicates the offset between the V2 byte and the first byte fo the VC-2/VC-1. The pointer bytes are not counted in the offset calculation. The pointer is a binary number with the following range:

Path	Range	
TU-2	0	427
TU-12	0	139
TU-11	0	103

10G Ethernet

The OTN Overclocked technology provides the capability to transparently transport 10G base-R Ethernet signals into OPU2 as specified in ITU-T. Two optical rates are provided:

- 11.0957 Gbits/s, +/- 100 ppm, designated OTU2e
- 11.0491 Gbits/s, +/- 100 ppm, designated OTU1e

The OTU2e uses the mapping scheme of CBR10G into OPU2 as defined in G.709. The client signal, 10GbE LAN and the OPU fixed stuff bytes are accommodated into an OPU-like signal designated OPU2e. This signal is then wrapped in an ODU2e and then in an OTU2e signal.

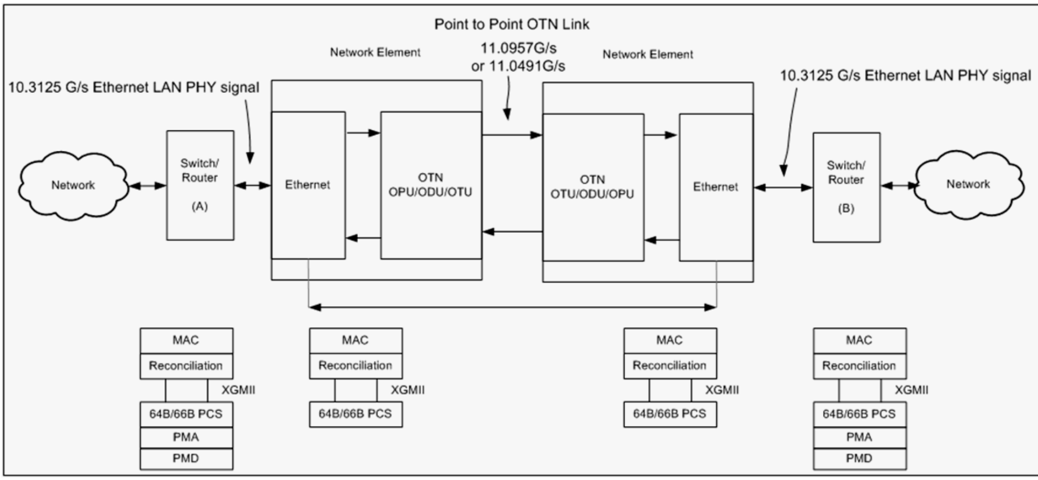
The OTU1e uses the mapping scheme of CBR2G5 into OPU1 as defined in G.709. The client signal, 10GbE LAN is accommodated into an OPU-like signal designated OPU1e (note that the fixed stuff bytes are not left free) this is why the 10GbE signal can be transported at a lower rate than OTU2e. This signal is then wrapped in an ODU1e and then in an OTU1e signal.

The transparent transport of the 10G base-R means that the full 10G Ethernet data rate i.e. 10.3125 Gb/s is transported over OTN. This means that the following information is transported:

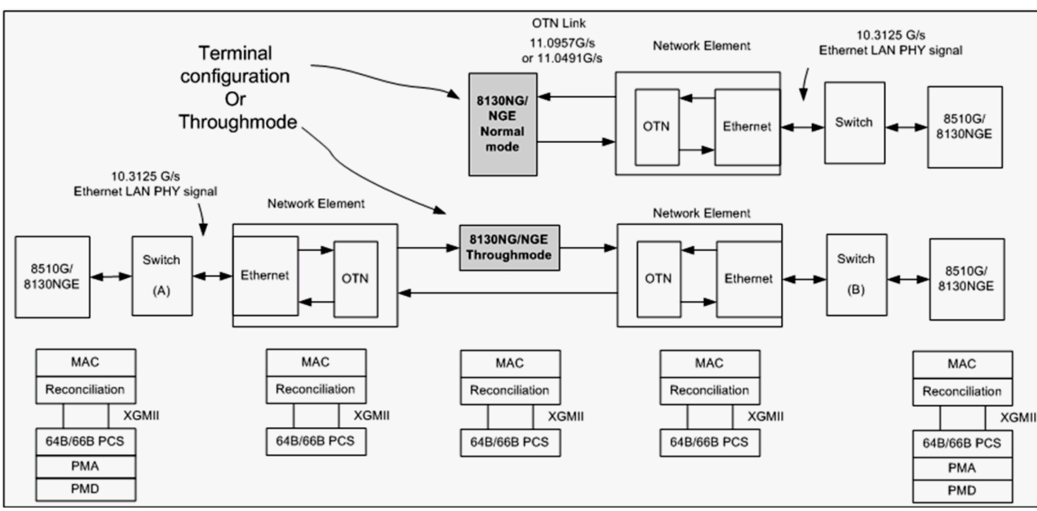
- PCS 64B/66B coded information
- IPG (inter-frame filler), MAC FCS, Preamble and SFD (start of frame delimiter) and Ordered Sets (Remote Fault indication)

The OTN clocking is derived from the Ethernet client signal which is +/- 100 ppm, this is outside the clock tolerance allocated by the G.709 standard which translates in unspecified jitter performance thus limiting the application to Point to Point data path.

The following figure presents a typical network application



The following figure presents a typical test application.



The Ethernet layer provides the equivalent functionality of the BERT Framed Layer 2 Test application supported on EXFO's Datacom product family with the particularity that there is no Ethernet Physical port as such. The Ethernet frame has its Ethertype field set to 0x88B7.

VLAN

Special VID/B-VID values (IEEE Std 802.1Q-1998)

ID	Description
0	The null VLAN ID. Indicates that the tag header contains only user priority information; no VLAN identifier is present in the frame. This VID value must not be configured as a PVID, configured in any Filtering Database entry, or used in any Management operation.
1	The default PVID value used for classifying frames on ingress through a Bridge Port. The PVID value can be changed on a per-Port basis.
4095	Reserved for implementation use. This VID value shall not be configured as a PVID, configured in any Filtering Database entry, used in any Management operation, or transmitted in a tag header.

VLAN/B-VLAN Priority

0	000 - Low Priority	4	100 - High Priority
1	001 - Low Priority	5	101 - High Priority
2	010 - Low Priority	6	110 - High Priority
3	011 - Low Priority	7	111 - High Priority

C Report Generator

The report generator is an application running on a PC that takes the raw test results collected on the FTB-200 to convert them into html, csv, pdf, or txt format. Not supported on the FTB-200 v2.

The report generator tool creates reports in the language of the OS and if the language is not supported by the report generator application, the report will be generated in English. Currently supported languages are English and Simplified Chinese.

The EXFO Protocol Report Generator is a unified tool that supports 81xx and 85xx modules.

Report Generator Installation

Requirements

The following system requirements must be met before installing the EXFO Protocol Report Generator software.

- At least a pentium II PC running at 233Mhz, 512M RAM, and 250MB of hard disk space per Report Generator instance.
- Ethernet connection (10 or 10/100Mbps), USB drive, Compact Flash, or a USB connection using ActiveSync.
- Windows 2000 or XP.

Note: *Some Windows applications such as PDF reader, Excel, etc. may be required to open the generated reports.*

Installation

Multiple versions of this tool can be installed to support previous versions of the products. However this tool is designed to gradually achieve n-3 backward compatibility as new versions are added. However, it is recommended to remove previously installed EXFO Protocol Report Generator applications before installing a new version to free up disk space.

To remove the EXFO Protocol Report Generator application:

Use Windows Add/Remove Program utility to remove the EXFO Protocol Report Generator.

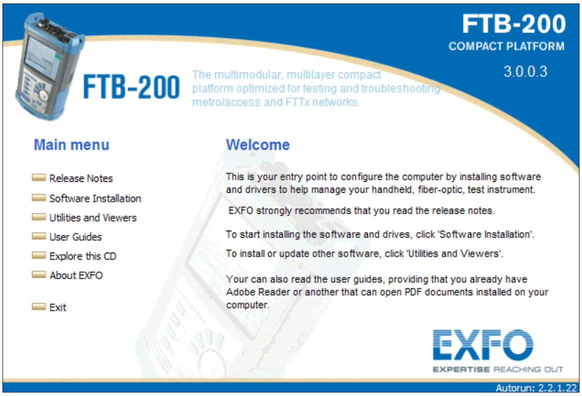
Removing the EXFO Protocol Report Generator application will not affect the user's data, meaning that report files will not be deleted from the PC.

To install the report generator tool on the PC that will be used for report generation:

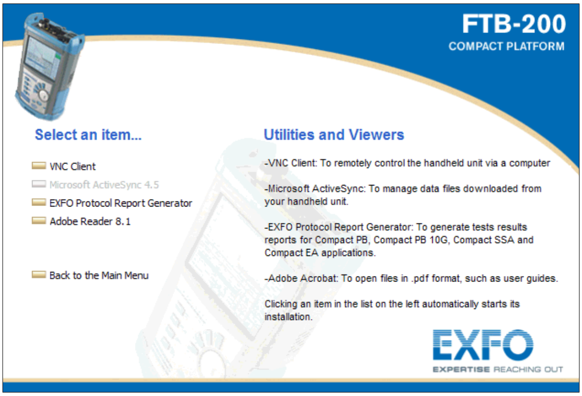
1. On a Windows 2000 or XP PC, insert the supplied ToolBox CE CD into the CD drive. A menu will be automatically loaded. If the menu is not automatically loaded, do the following:

   ➤ From Windows, click the **Start** button, click **RUN**, select the **Setup.exe** program located on the supplied CD, click **Open** and click **OK**.

2. From the main menu, click **Utilities and Viewers**.



3. From the **Utilities and Viewers** menu, click **EXFO Protocol Report Generator** and follow the on-screen steps to complete the installation.



Note: *The installation of Microsoft .NET Framework v2.0 Package is required to be able to use the report generator. The .NET Framework will be automatically installed if not already on the PC. During the installation ensure to always keep the default values. At the end of the Microsoft .NET installation, click* ***OK****.*

Note: *The report generator software will be installed in the* ***C:\Program Files\EXFO\Applications\Protocol Report Generator\Version x.x.x*** *directory. A shortcut will be created on the Windows desktop.*

4. Click **Finish**.

Transferring the Generated Test Report to the PC

Transfer the saved report to the PC

1. **Local memory (FTB-200)**: If the report has been saved to the FTB-200 local folder, the report file need to be transferred to the PC using one of the following methods:

   1a. **Network drive**: Connect the FTB-200 and the PC to the network and transfer the file to a network drive or directly on a shared folder on the PC.

   1b. **USB connection (ActiveSync)**: Establish an ActiveSync connection between the PC (USB host) and the FTB-200 (USB client) using the supplied client/host USB cable. ActiveSync is available on the supplied ToolBox CE CD; click **Utilities and Viewers** and click **Microsoft ActiveSync 4.1** to install it.

   The default FTB-200 local folder is \Data\My Documents**folder**\Report. The following table lists the corresponding **folder** for each supported model/application.

Model	Application	Folder
FTB-8105/FTB-8115/ FTB-8120/FTB-8120NG/ FTB-8130/FTB-8130NG	SONET/SDH Analyzer	**SonetSdhAnalyzerG2**
FTB-8120NGE/ FTB-8130NGE	Packet Analyzer	**PacketAnalyzer**
	SONET/SDH Analyzer	**SonetSdhAnalyzerG2**

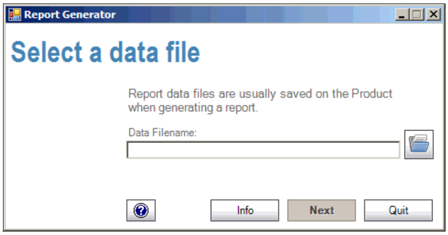
2. **USB drive or Compact Flash**: If the report has been saved on a removable drive/media, plug the USB drive or the compact flash to the PC.

3. **Network drive**: If the report has been saved on a network drive, connect the PC to the network and retrieve the file from the network drive.

Launching and Using the Report Generator Tool

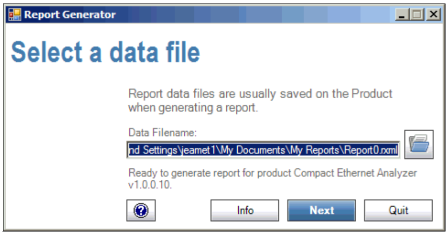
➤ Click the report generator application shortcut from the Windows desktop. Alternatively, from Windows, click **Start**, select **All Programs**, **EXFO**, **EXFO Protocol Report Generator** and click the appropriate software version.

The following window is displayed.

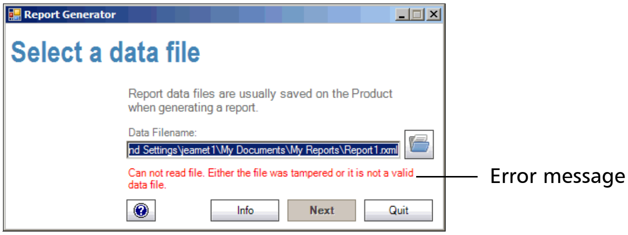


➤ Select a generated report file by typing its name in the **Data Filename** field or click **Browse** to select the file. The default directory is *My Documents/My Reports*.

If the selected file is compatible, click **Next** to load the report file.



If the file is not compatible, an error message is displayed and the **Next** button is disabled.

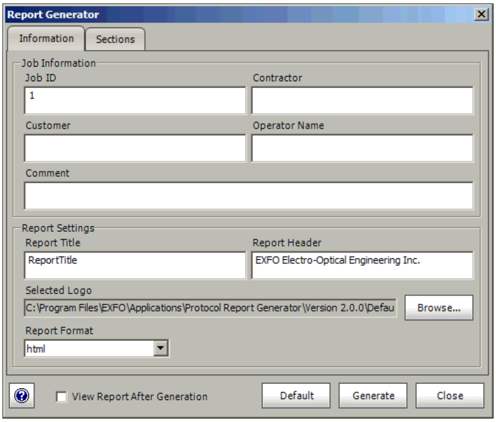


➤ **Info** button: Gives copyrights information and the list of supported product versions and associated applications.

➤ **Quit** button: Closes the Report Generator application.

Information

The Compact Report Generator allows to edit the following job information that was entered at the time the report was saved.

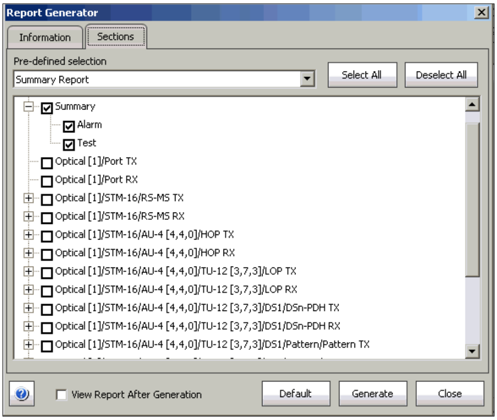


➤ **Job Information**: These parameters are used to identify the source of the report and are not mandatory. Enter the following job information if required: **Job ID, Contractor, Customer, Operator Name,** and **Comment.** Up to 256 characters are allowed for each parameter.

➤ **Report Settings**: These parameters are used to identify the report and are not mandatory. Enter the following report information if needed: **Report Title, and Report Header,** and **Selected Logo** (the default logo is EXFO). Click **Browse** to select a different logo then, click **Open**.

Report Format: Select the report file format. Choices are **html**, **csv**, **pdf**, and **txt**. The CSV format (spread sheet file format) generates a report with comma delimiter for English OS and semicolon for other OS languages. The default setting is **html**.

Sections



- **Pre-defined selection**: Allows the selection of the type of report and the underneath window allows to select what will be part of the report. The default setting is **Summary Report**. Choices are:
  - **Summary Report** selects the **Summary** report section only.
  - **Test Case Report** selects all the report sections.
- **Select All** selects all report sections.
- **Deselect All** deselects all report sections.

Help Button (?)

Displays the help information related to the test report. It is also possible to navigate through the remainder of the help information.

View Report After Generation

Allows viewing the report once it is generated. This setting is disabled by default. Every report format is viewable, as long as their default viewer is installed on the PC.

- Internet Explorer for HTML
- Notepad for TXT
- Adobe Acrobat Reader for PDF
- Microsoft Excel for CSV

Note: *If the html report contains special characters, please make sure that the encoding in your Web browser is set to Western European ISO. To set the encoding to Western European ISO, right click the report from Internet Explorer, select Encoding, and select Western European ISO.*

Default Button

Click **Default** to restore the default report settings.

Generate Button

Allows generating and saving the report. Select an existing file, or type a new name in the File name field and click Save. The default directory is **My Documents/My Reports**.

Note: *Once generated, the report file can manually be loaded using the corresponding Windows program application. The default directory is **My Documents/My Reports**.*

Close Button

Closes the report generator window and returns to the select data file window.

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NOTICE
通告

CHINESE REGULATION ON RESTRICTION OF HAZARDOUS SUBSTANCES
中国关于危害物质限制的规定

NAMES AND CONTENTS OF THE TOXIC OR HAZARDOUS SUBSTANCES OR ELEMENTS CONTAINED IN THIS EXFO PRODUCT
包含在本 EXFO 产品中的有毒有害物质或元素的名称和含量

O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下。
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11363-2006 标准规定的限量要求。

Part Name 部件名称	Toxic or hazardous Substances and Elements 有毒有害物质和元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 隔 (Cd)	Hexavalent Chromium 六价铬 (Cr VI)	Polybrominated biphenyls 多溴联苯 (PBB)	Polybrominated diphenyl ethers 多溴二苯醚 (PBDE)
Enclosure 外壳	O	O	O	O	O	O
Electronic and electrical sub-assembly 电子和电子组件	X	O	X	O	X	X
Optical sub-assembly[a] 光学组件[a]	X	O	O	O	O	O
Mechanical sub-assembly[a] 机械组件[a]	O	O	O	O	O	O

a. If applicable.
如果适用。

MARKING REQUIREMENTS
标注要求

Product 产品	Environmental protection use period (years) 环境保护使用期限 (年)	Logo 标志
This Exfo product 本 EXFO 产品	10	
Battery[a] 电池 [a]	5	

a. If applicable.
如果适用。

P/N: 1060481

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Printed in Canada (2011-04)

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