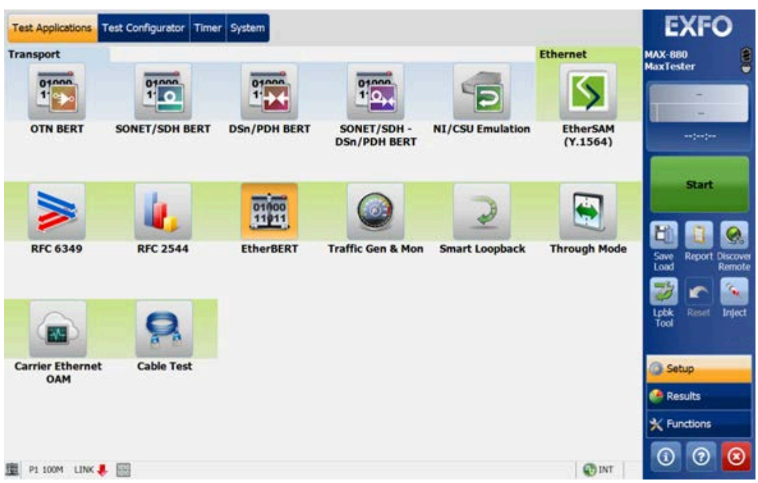
User Guide

ETHERNET AND TRANSPORT TESTER

MAX-800 Series

MaxTester Application



www.EXFO.com

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Units of Measurement

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

Patents

The exhaustive list of patents is available at EXFO.com/patent.

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Contents

Regulatory Information

USA Electromagnetic Interference Regulatory Statement

Electronic test and measurement equipment is exempt from FCC part 15, subpart B compliance in the United States of America. However, EXFO Inc. 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 documentation, 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.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Canada Electromagnetic Interference Regulatory Statement

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

This is a class A, group 1 product.

- Class A equipment: Equipment that is, by virtue of its characteristics, highly unlikely to be used in a residential environment, including a home business shall be classified as class A and shall comply with the class A limits specified in the applicable ICES standard. Characteristics considered in this assessment include price, marketing and advertising methodology, the degree to which the functional design inhibits applications suitable to residential environments, or any combination of features that would effectively preclude the use of such equipment in a residential environment.
- Class B equipment: Equipment that cannot be classified as Class A shall comply with the Class B limits specified in the applicable ICES standard.
- Group 1 equipment: group 1 contains all equipment which is not classified as group 2 equipment, and includes equipment such as laboratory and scientific equipment, industrial process, measurement and control equipment.

  Group 2 equipment: group 2 contains all ISM RF equipment in which radio-frequency energy in the frequency range 9 kHz to 400 GHz is intentionally generated and used or only used locally, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material for inspection/analysis purposes, or for transfer of electromagnetic energy.

Supplier’s Declaration of Conformity (SDoC)

The SDoC for your product is as follows:

CAN ICES-001 (A) / NMB-001 (A)

EU and UK Electromagnetic Compatibility Regulatory Statement

Warning: This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures. Your product is suitable for use in industrial electromagnetic environments.

Simplified EU and UK Declaration of Conformity

The full text of the declaration of conformity is available at the following Internet address: *www.exfo.com/en/resources/legal-documentation*.

EU Economic Operator

EXFO Solutions SAS
2, rue Jacqueline Auriol,
Saint-Jacques-de-la-Lande,
35091 Rennes Cedex 9
FRANCE

1 Introducing the Ethernet and Transport Tester

Turnkey field-test solution for deploying, validating, and troubleshooting networks up to 100G.

Test Applications

Intelligent Apps

Test Applications	Available on MAX-...
iOptics	Only with MAX-iOptics configuration (based on 890)

Transport

Test Applications	Available on MAX-...
DSn/PDH BERT	880
NI/CSU Emulation	880
OTN BERT	880, 890, 890Q
SONET/SDH BERT	880, 890, 890Q
SONET/SDH - DSn/PDH BERT	880

Ethernet

Test Applications	Available on MAX-...
Cable Test	860, 860G, 880
Carrier Ethernet OAM	860, 860G, 880, 890, 890Q
EtherBERT	860, 860G, 880, 890, 890Q
EtherSAM (Y.1564)	860, 860G, 880, 890, 890Q
RFC 2544	860, 860G, 880, 890, 890Q

Test Applications	Available on MAX-...
RFC 6349	860, 860G, 880, 890, 890Q
Smart Loopback	860, 860G, 880, 890, 890Q
Through Mode	860, 860G, 880, 890, 890Q
Traffic Gen & Mon	860, 860G, 880, 890, 890Q

Technical Specifications

To obtain this product's technical specifications, visit the EXFO Web site at *www.exfo.com*.

Conventions

Before using the product described in this guide, 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

WARNING

Do not install or terminate fibers while a light source is active. Never look directly into a live fiber and ensure that your eyes are protected at all times.

WARNING

The use of controls, adjustments and procedures, namely for operation and maintenance, other than those specified herein may result in hazardous radiation exposure or impair the protection provided by this unit.

WARNING

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

WARNING

Use only accessories designed for your unit and approved by EXFO. For a complete list of accessories available for your unit, refer to its technical specifications or contact EXFO.

IMPORTANT

Refer to the documentation provided by the manufacturers of any accessories used with your EXFO product. It may contain environmental and/or operating conditions limiting their use.

IMPORTANT

When you see the following symbol on your unit **, make sure that you refer to the instructions provided in your user documentation. Ensure that you understand and meet the required conditions before using your product.**

IMPORTANT

When you see the following symbol on your unit **, it indicates that the unit is equipped with a laser source, or that it can be used with instruments equipped with a laser source. These instruments include, but are not limited to, modules and external optical units.**

IMPORTANT

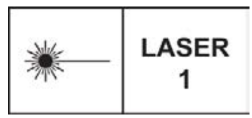
Other safety instructions relevant for your product are located throughout this documentation, depending on the action to perform. Make sure to read them carefully when they apply to your situation.

Laser Safety Information

Your instrument is in compliance with standards IEC 60825-1: 2014 and 21 CFR 1040.10, as per Laser Notice No. 42, dated December 18, 1989.

Laser radiation may be encountered at the optical output port.

The following label indicates that a product contains a Class 1 source:



WARNING

When the LASER LED is on or flashing, the unit is transmitting an optical signal on the transceiver ports.

Note: *Refer to the MAX-800 Series MaxTester Unit user guide for additional test equipment safety information and ratings.*

Installation Instruction Warnings

CAUTION
When you use the unit outdoors, ensure that it is protected from liquids, dust, direct sunlight, precipitation, and full wind pressure.

CAUTION
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.

CAUTION
For the dual Bantam connector and the RJ-48C ports, use only No. 26 AWG or larger telecommunication line cord to reduce the risk of fire.

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.

WARNING
Use only accessories designed for your unit and approved by EXFO.

CAUTION

Electrostatic Discharge (ESD) Sensitive Equipment:

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

- before connecting or disconnecting cables to/from the **unit**.
- before inserting or removing a transceiver to/from the **unit**.

3 Getting Started

The MaxTester has been shipped with the latest software version.

Note:

Turning On the Unit

Turn on the MAX-800 Series. Refer to the MAX-800 Series MaxTester Unit user guide for more information.

Starting the Application

The MAX-800 Series can be configured and controlled by starting the MaxTester application(s) as described in the following table:

Model	Application	Comment
860 860G 880 890	**MaxTester**	Only one application available.
890Q	**MaxTester - A** **MaxTester - B**	An application for each part of the unit. Both **A** and **B** applications can run simultaneously.

To start the application:

From **Mini ToolBox X** tap the desired MaxTester application button.

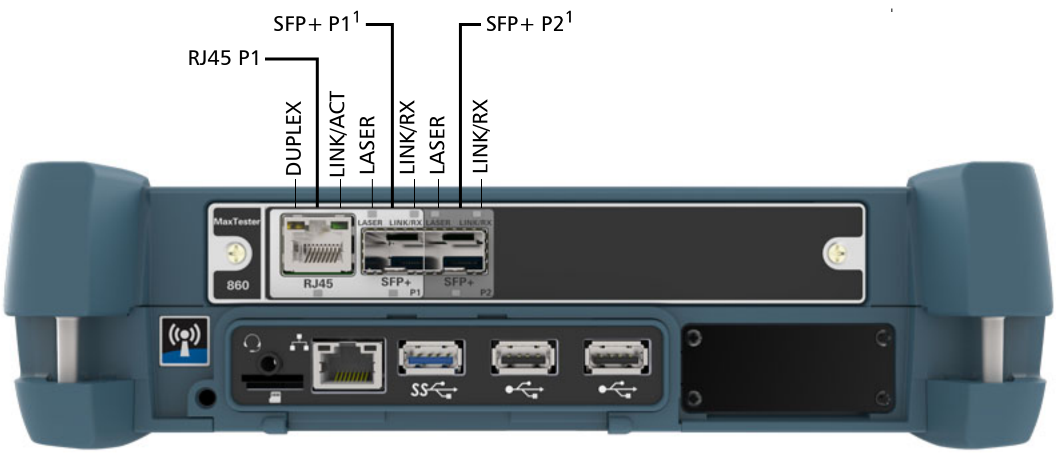
4 Physical Interfaces and LEDs

This section describes all connectors (ports) and LEDs available on the MAX-800 Series.

CAUTION

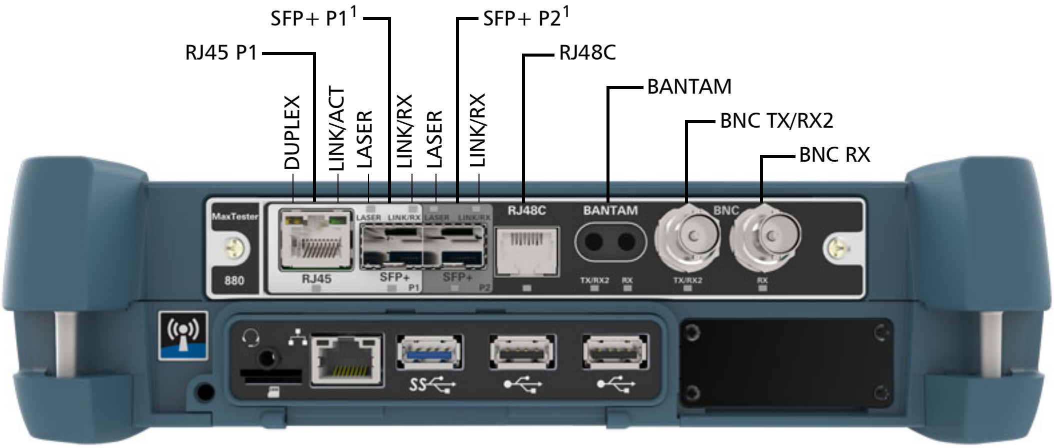
To prevent exceeding the maximum input/output power level, please refer to this product's technical specifications at www.exfo.com.

MAX-860 and MAX-860G Models



1. Laser radiation is emitted from this port when LASER LED is on.

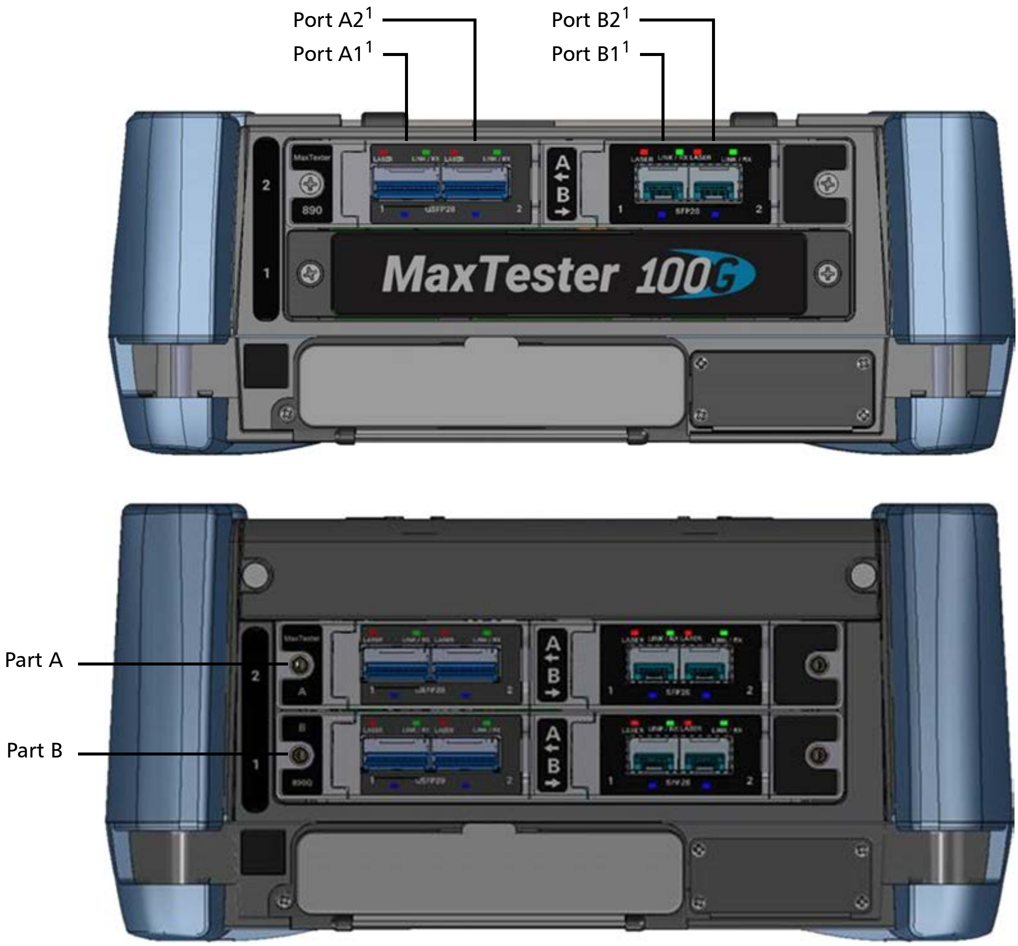
MAX-880 Model



1. Laser radiation is emitted from this port when LASER LED is on.

MAX-890 and MAX-890Q Models

The MAX-890Q model provides twice the amount of ports and capabilities than the MAX-890. The MAX-890Q is divided into two parts labelled **A** and **B** respectively.



1. Laser radiation is emitted from this port when LASER LED is on.

Port Availability

860/860G/880

The following table shows the list of available ports as well as a description and signals supported for each model.

Connector	Labelled	Description and supported signal(s)	Model		
			860	860G	880
Bantam	**BANTAM TX/RX2 RX**	**TX** and **RX**: DS1/1.5M, E1/2M **RX2**: DS1/1.5M	-	-	X
		Clock IN/OUT: DS1/1.5M, E1/2M, 2 MHz			
BNC	**BNC TX/RX2**	**TX**: E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M **RX2**: DS3	-	-	X
		Clock OUT: DS1/1.5M, E1/2M, 2MHz			
	BNC RX	E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M	-	-	X
		Clock IN: DS1/1.5M, E1/2M, 2MHz, 1 PPS			
	BNC EXT CLK	Clock IN: DS1/1.5M, E1/2M, 2MHz, 1 PPS	-	-	X
RJ45	**RJ45 P1**	Ethernet 10/100/1000 Mbit/s electrical	X	X	X
RJ48C	**RJ48C**	DS1/1.5M, E1/2M	-	-	X
		Clock IN/OUT: DS1/1.5M, E1/2M, 2MHz			
SFP/SFP+	**SFP+ P1** or **SFP+ P2**	Ethernet 100 Mbit/s, 1000 Mbit/s optical	X	X	X
		Ethernet 10 Gbit/s LAN/WAN optical	-	X	X
		OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64[a] OTU1, OTU2	-	-	X
	SFP+ P2	Ethernet 10/100/1000 Mbit/s electrical (using active copper SFP)	X	X	X

a. Port **SFP+ P2** is used with OC-192/STM-64 in **Decoupled (TX≠RX)** mode.

890/890Q

The following table shows the list of available ports as well as a description and signals supported on both models.

Connector	Labelled[a]		Description	Supported Signal(s)
QSFP28 (dual port)	**A**	**1** **2**	Optical IN/OUT port QSFP28 transceiver	Ethernet 100 Gbit/s OTU4
			Optical IN/OUT port QSFP56 transceiver	Ethernet 100 Gbit/s
			Optical IN/OUT port QSFP+ transceiver	Ethernet 40 Gbit/s OTU3
SFP28 (dual port)	**B**	**1** **2**	Optical IN/OUT port SFP/SFP+/SFP28 transceiver	Ethernet 100/1000 Mbit/s, 10 Gbit/s optical Ethernet 10/100/1000 Mbit/s electrical (using active copper SFP) OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64 OTU1, OTU2, OTU1e, OTU2e, OTU1f, OTU2f

a. The ports are listed/referred as follows in the GUI: **Port**, unit's port (**A** or **B**), transceiver port (**1** or **2**), and connector type; for example **Port B1 - SFP28**.

Transceivers

Carefully connect optical fibre cables to the transceiver 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.

CAUTION

Before inserting an optical module into the interface receptacle, inspect the receptacle to make sure nothing is inside.

WARNING

Use only EXFO supported transceivers. Refer to www.exfo.com for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

Note: *Do not replace the transceiver while the test is running to avoid distorting results. First stop the test, replace the transceiver, select the connector type (refer to* Modify Structure *on page 76), and then restart the test.*

RJ45

The electrical port is RJ45 for category 5 unshielded twisted pair (UTP). Refer to *Ethernet Cables* on page 475 for cable specifications.

BNC

Connector type is BNC for coaxial 75-ohm cable connection. An adapter cable (BNC to Bantam) is required for Bantam external clock connection (not supplied).

LEDs

➤ **LASER** red LED is on when the **unit** is emitting an optical laser signal.

➤ **LINK/RX** green LED is on when the link is up, off when the link is down, and flashing when frames are transmitted/received.

➤ **DUPLEX** green LED is on for Full Duplex mode, off for Half Duplex mode, and flashing when collisions are detected.

➤ Port blue LED is on when this port is selected for the test, and flashing when this port is selected for clock input.

5 Graphical User Interface Overview

This chapter describes the MaxTester graphical user interface.

Main Application Window

The following main application window is displayed when the MaxTester application is started.

Main Window

The main window is used to setup a test and to view the test status and results.

Status Bar

The status bar displays the following information.

Icon and/or text	Description	Test Application
Test icon	Icon representing the active test application.	All
P1, **P2**	Port identification number: Port x	All
A1, **A2**, **B1**, **B2**	Port identification number composed of the port type of the MAX-890/890Q (**A** or **B**) and the transceiver port (**1** or **2**)	All
TX/RX, **TX**, **RX**	Indicates the direction of the signal per port.	Transport
Interface/ Signal	The interface or signal rate per port: 1GE Optical, 40G, OTU1, OTU2, OTU3, etc.	All
LINK	For single or dual port, the status per port: Green arrow: Link up. Red arrow: Link down. Gray arrow: Awaiting incoming data to provide a status.	Transport Ethernet
Power level	The received signal level per port in **dBdsx** for DSn signal or **dBm** for PDH and optical signals. For Transport electrical interface, LOS on red background indicates that there is no electrical signal power. For optical interface, the following background color are used as power level qualifier: Green: Power level in range[a]. Yellow: Power level out-of-range[b]. Red with "LOS": Loss of signal[b]. Red with "Power": Power level is close to damage. Gray: Invalid operational range value.	All except Cable Test
Amplitude	Amplitude indicates the received signal amplitude per port. Only available with electrical interfaces.	Transport
	Laser ON[b]. The laser icon is not displayed when the laser is off. The laser icon is only displayed for optical interfaces. The laser is ON by default when the test is created. The laser control is not affected when turning off the laser by generating a LOS for example. Refer to *Laser Button* on page 423.	All

Icon and/or text	Description	Test Application
	For single or dual port, the status of the received signal pattern per port: Green: Pattern is synchronized. Red: Loss of pattern. Gray: Test is not running (EtherBERT test) or the **No Pattern Analysis (Live)** check box is selected.	Transport EtherBERT
	Connection established between two testing units in Dual Test Set (DTS) or in Loop Up mode.	Ethernet
	Connection not established between two testing units in Dual Test Set (DTS) or in Loop Up mode.	Ethernet
	Loopback Tool enabled on the port unused by the main test application.	Ethernet
	Clock synchronization signal. The icon is followed by the clock mode: **INT** for Internal, **EXT** for External, **RCV** for Recovered. Green: Clock Synchronized. Red: Loss of clock.	Transport Ethernet
	Indicates a manual change in the OH bytes transmitted. Not displayed when using the default OH values.	Transport
	The test is in loopback mode. Not displayed when not in loopback mode.	NI-CSU Emulation
	Alarm/error is currently injected. Not displayed when there is no alarm/error injection.	Transport EtherBERT

a. For all lanes for parallel interface.
b. For at least one lane for parallel interface.

The following status are also displayed:

➤ Battery/AC icons indicate the battery level and if the platform is connected to an AC power source. Refer to the platform user guide for more information.

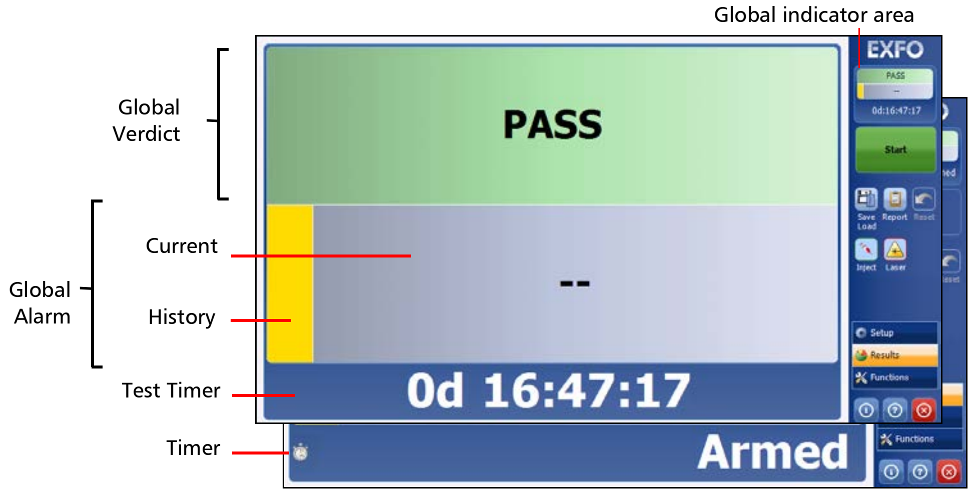
➤ Date and Time indicate the current date and time.

Title Bar

The Title Bar displays the software application name and the battery level indicator.

Global Indicator

The global indicator area displays the global pass/fail verdict, global alarm, and the test duration.



The global indicator area can be maximized for distant viewing. Tap anywhere within the global indicator area to display a maximized view. Tap again to exit the maximized view.

Global Verdict

Reports the global test verdict status when supported by the test application and enabled (when applicable).

Verdict	Description
PASS	**PASS** is displayed with a green background when all result values meet the configured threshold criteria.
FAIL	**FAIL** is displayed with a red background when any result value does not meet the configured threshold criteria or when a specific alarm is detected (refer to each test application for additional information).
"--"	**"--"** is displayed with a gray background when at least one of the following conditions is met: - Pass/Fail verdict is not enabled - there is no defined criterion - the test has not run yet.

Global Alarm

Indicates the current and history alarm/error status of the test.

Background color	Alarm/ Error	Text displayed	Description
Gray	Current	**--**	No test result available.
	History		
Green	Current	**No Alarm**	No alarm/error has occurred in the last second.
	History		No alarm/error has occurred during the test.
Red	Current	**Alarms** or the name of the alarm.	An alarm/error occurred in the last second.
	History		
Amber	History		No current alarm/error but at least one alarm/error has occurred during the test.

Test Timer

The test timer without the timer icon indicates the time elapsed since the beginning of the test. No timer action is active. The test timer format is “day hour:minute:second”.

Timer

The timer icon with **Armed** indicates that a start time is active.

The timer icon with the Test Timer indicates that a duration and/or a stop time is active.

Test Control

Note: *Refer to* Test Control *on page 417 for more information.*

Test Menu

The test menu displays the following buttons:

➤ **Setup** allows configuring the selected test. Refer to *Setup* on page 67 for more information.

➤ **Results** allows viewing test results. Refer to *Test Results* on page 237 for more information.

➤ **Functions** allows configuring additional test functions (refer to *Test Functions* on page 335).

Application Buttons

- **Help** (?) displays the help information related to the content of the active main window. It is also possible to navigate through the remainder of the help information.
- **Exit** (x) closes the application.
- **About** (i) mainly displays the product version details and technical support information.
  - **Send diagnostics** collects diagnostic information from the current MAX-800 Series application/module in order to help EXFO technical support investigating any issue encountered with this unit.

    Use the **Describe details** field to provide additional information about the problem.

    Enter a contact E-mail address in the **Your e-mail** field.

    Select the **Display report after saving** check box to automatically open the .zip file once generated.

    Click **Save Report** to generate, save, and send the report to EXFO technical support. Once the report is generated and saved a pop-up is displayed showing its file name and location on disk, click **OK**. If the **Display report after saving** check box is selected, the .zip file is open in File Explorer.
  - **Module Details** button displays the unit details such as its ID, Serial Number, Software Product Version, etc.
  - **View License Agreement** button displays the details of the product license agreement.
  - **Software Options** button displays the list of software options.

Note: *For information on how to install and activate software options, refer to the platform User Guide. The MaxTester Application application must be restarted once a new software option is installed in order to activate it.*

Software Option	Description
10G_LAN	Ethernet 10G LAN optical interface
10G_WAN	Ethernet 10G WAN optical interface
100GE	Ethernet 100G
100optical	Ethernet 100Base-FX optical interface
155M	155 Mbit/s (SONET/SDH)
2488M	2.488 Gbit/s (SONET/SDH)
40GE	Ethernet 40G
52M	52 Mbit/s (SONET/SDH)
622M	622 Mbit/s (SONET/SDH)
9953M	9.953 Gbit/s (SONET/SDH)
CABLE_TEST	Cable Test Application
DS1-FDL	DS1/1.5M Facility Data Link
ETH-OAM	Carrier Ethernet OAM test application
GCC-BERT	OTN Overhead BERT and Synchronization validation
GigE_Electrical	Ethernet 1000Base-T electrical interface
GigE_Optical	Ethernet 1000Base-X optical interface
iOptics	Intelligent Pluggable Optic Test Application
LINK-OAM	Link OAM
MPLS	MPLS Encapsulation
MPLS_40-100GE	MPLS Encapsulation (40/100GE)
NI-CSU	NI/CSU Emulation
OTU1	Optical Transport Unit-1 (2.7 Gbit/s)
OTU2	Optical Transport Unit-2 (10.7 Gbit/s)
OTU2-1e-2e	Optical Transport Unit-2 Overclocked (11.049/11.096 Gbit/s)
OTU2-1f-2f	Optical Transport Unit-2 Overclocked (11.270/11.317 Gbit/s)
OTU3	Optical Transport Unit-3 (43.018 Gbit/s)
OTU4	Optical Transport Unit-4 (111.81 Gbit/s)
PDH	Plesiochronous Digital Hierarchy
RFC6349	RFC 6349 test application (up to 10GE)
RFC6349_40-100GE	RFC 6349 test application (40/100GE)

Software Option	Description
SDH	Synchronous Digital Hierarchy
SONET	Synchronous Optical Network
TCM	Tandem Connection Monitoring STS/AU and VT/TU (SONET/SDH)
TST-OAM	Test Over Service OAM

Zoomed-In/Zoomed-Out Views

Some configuration and result blocks give access to zoomed views allowing more detailed configurations/results.

The block title contains the magnifier (+) icon when a zoomed view is available.

To zoom-in, tap the magnifier (+) icon or anywhere on the block.

To zoom-out, tap on the magnifier (-) icon or anywhere on the block title.

Arrow Buttons

 Moves to the top of the list.

 Moves one page up.

 Moves one line up.

 Moves one line down.

 Moves one page down.

 Moves to the end of the list.

Keyboard Usage

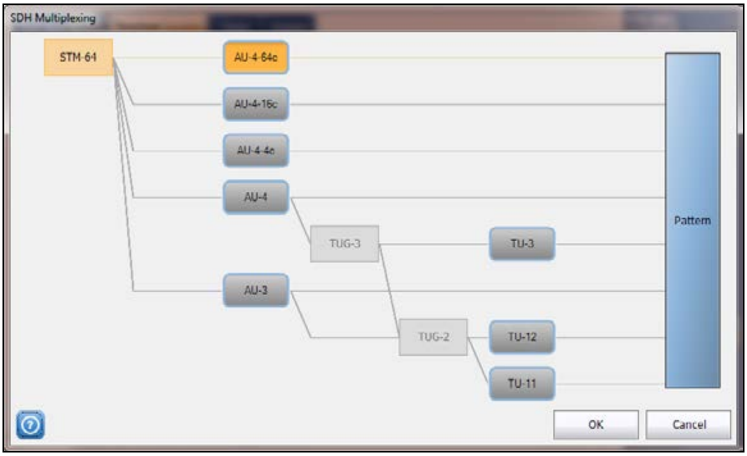
The GUI pops up different keyboards to modify data. Following are the usual keyboard keys:

- Left arrow moves the cursor one position to the left.
- Right arrow moves the cursor one position to the right.
- Up arrow increases the value by one.
- Down arrow decreases the value by one.
- **Del** deletes the value at the cursor position.
- **Back** deletes the value preceding the cursor position.
- **OK** completes data entry.
- **Cancel** closes the keyboard and discards the keyboard entry.
- **Previous...** allows the selection of previously configured values. This button is only available for certain fields like IP Address, MAC Address, etc.

Note: *For certain text fields, the GUI pops up or uses the unit's on-screen keyboard. Refer to the MAX-800 Series (MaxTester Unit) user guide for more information on how to use it.*

For full keyboard, the **Back**, **Del**, **Shift**, and **Space** bar keys have the same functionality as a regular PC keyboard.

For multiplexing keyboard, tap on all mapped signals that have to be added/removed to/from the test path. A mapped signal with an orange background color is part of the test path. A mapped signal with a gray background color is not part of the test path.



The Trace message keyboard allows entering alphanumerical characters (ITU T.50) required for Trace fields. Tap the **Control Characters** 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 Test Setup - Test Applications

The MaxTester offers the following test applications.

Intelligent Apps

Transport

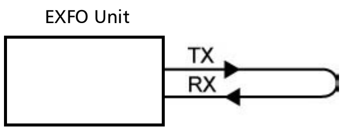
Ethernet

iOptics

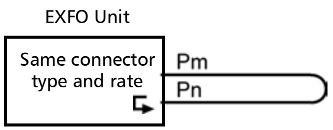
iOptics test application provides a quick assessment of the proper operation of an optical transceiver before using it in a network or test environment. The validation is done by running sub-tests in addition to monitoring transceiver power consumption and temperature. Result and verdict are reported for each sub-test and monitoring task. Transceiver's manufacturing information is also automatically collected.

➤ Typical iOptics test applications:

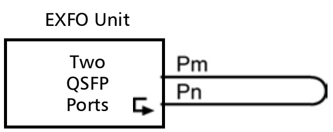
For standard transceivers:

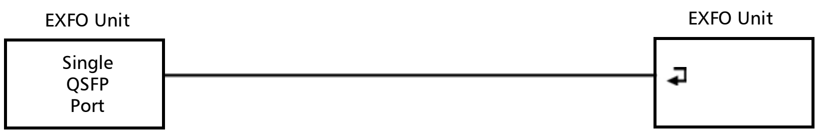


For bidirectional transceivers:



For an Active Optical Cable (AOC):

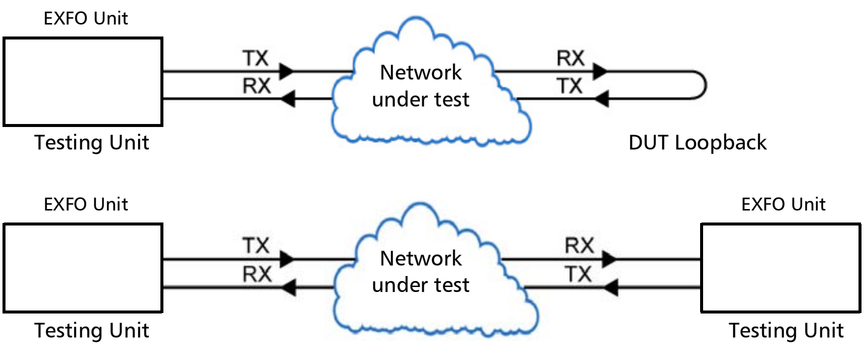




OTN BERT

Allows OTN (framed and unframed) traffic generation with specific test pattern for Bit Error Rate analysis.

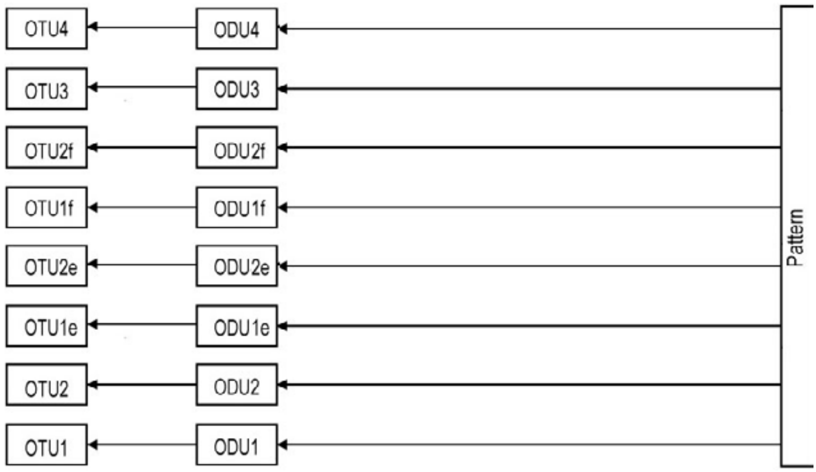
➤ Typical OTN BERT test applications:



➤ Path/Mapping

The **OTN BERT** test application offers the following path/mapping structures depending on the inserted transceiver and enabled options.

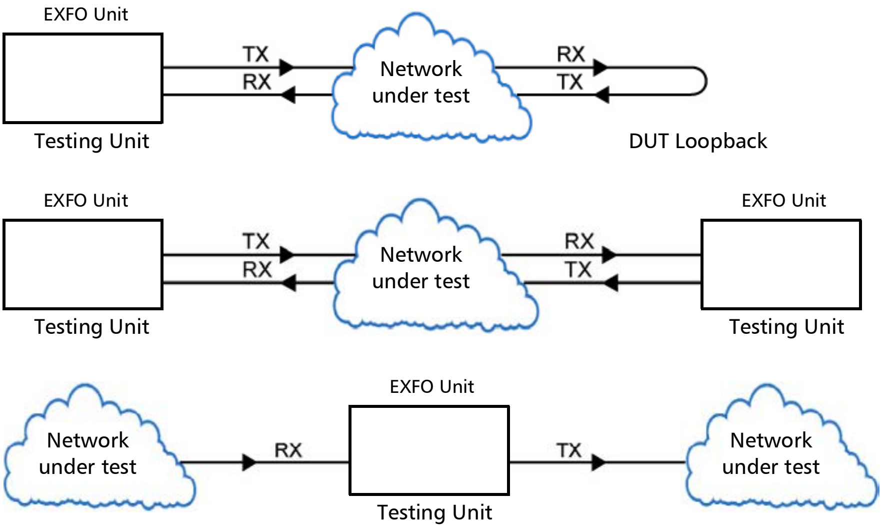
Up to OTU4 for 890/890Q and up to OTU2 for 880.



SONET/SDH BERT

Allows the validation of the SONET or SDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

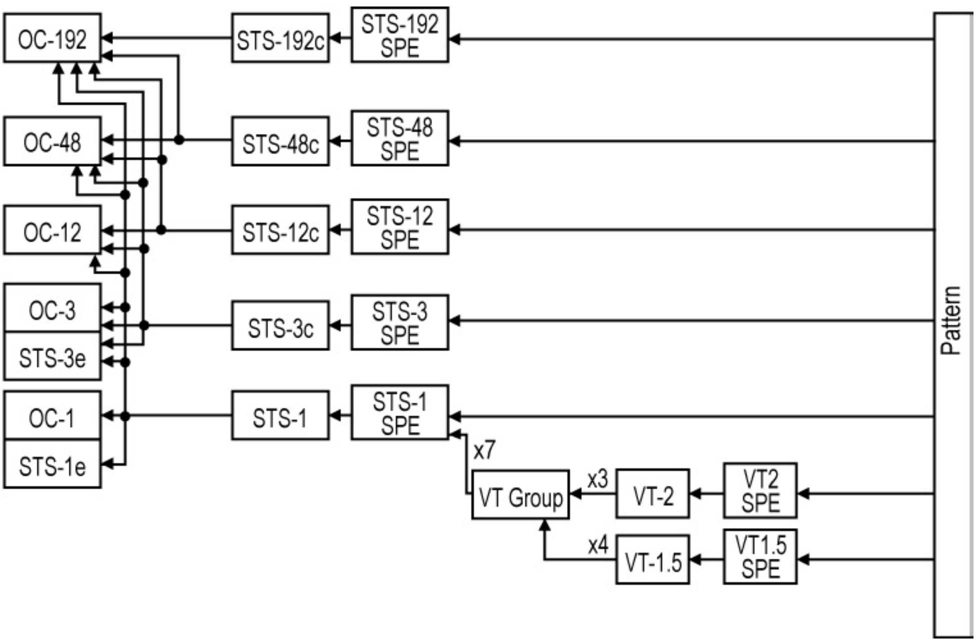
➤ Typical SONET/SDH BERT test applications:



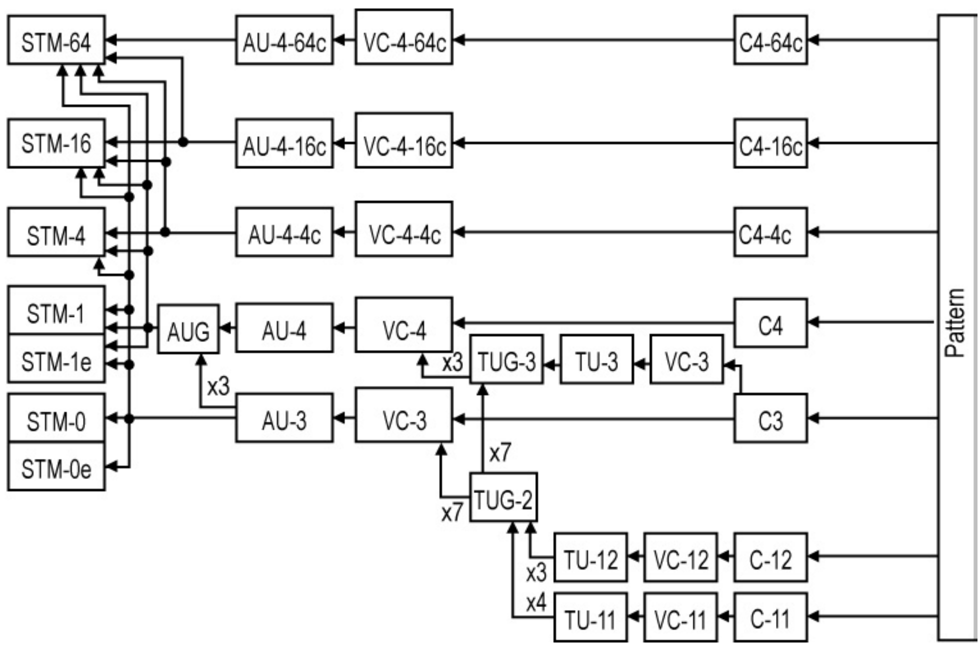
➤ Path/Mapping

The **SONET/SDH BERT** test application offers the following path/mapping structures depending on the inserted transceiver, and enabled options.

For SONET BERT



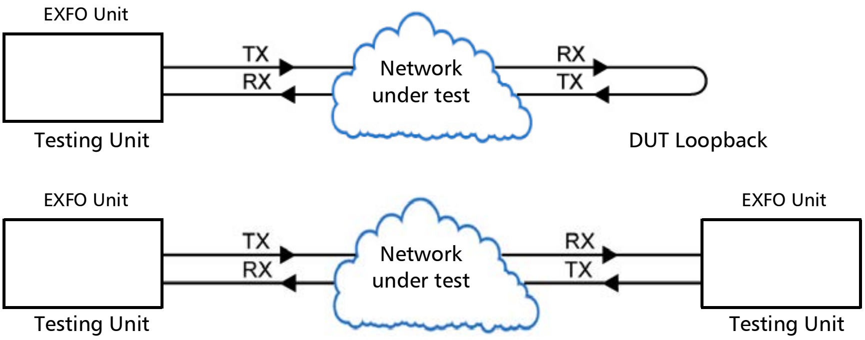
For SDH BERT


STM-64
AU-4-64c
VC-4-64c
C4-64c
STM-16
AU-4-16c
VC-4-16c
C4-16c
STM-4
AU-4-4c
VC-4-4c
C4-4c
STM-1
STM-1e
AUG
AU-4
VC-4
C4
x3
TUG-3
TU-3
VC-3
x3
STM-0
STM-0e
AU-3
VC-3
C3
x7
TUG-2
x7
TU-12
VC-12
C-12
x3
x4
TU-11
VC-11
C-11
Pattern

DSn/PDH BERT

Allows validation of the DSn or PDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

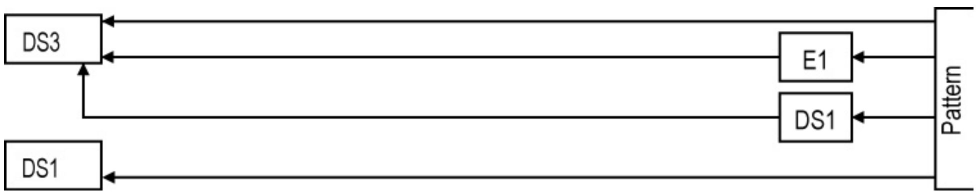
➤ Typical DSn/PDH BERT test applications:



➤ Path/Mapping

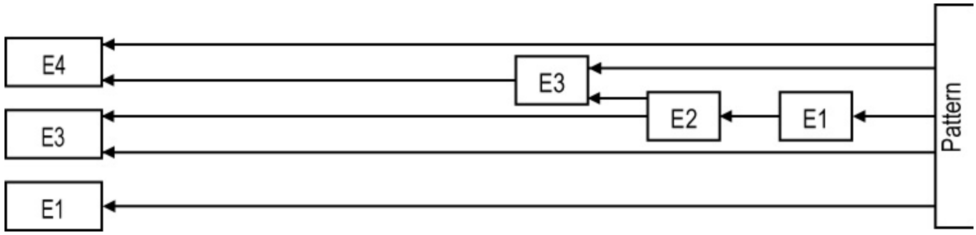
The **DSn/PDH BERT** test application offers the following path/mapping structures depending on model and enabled options.

For DSn:



Note: *It is possible to enable DS0/E0 from* Signal - Signal Configuration - DSn/PDH *on page 206.*

For PDH:

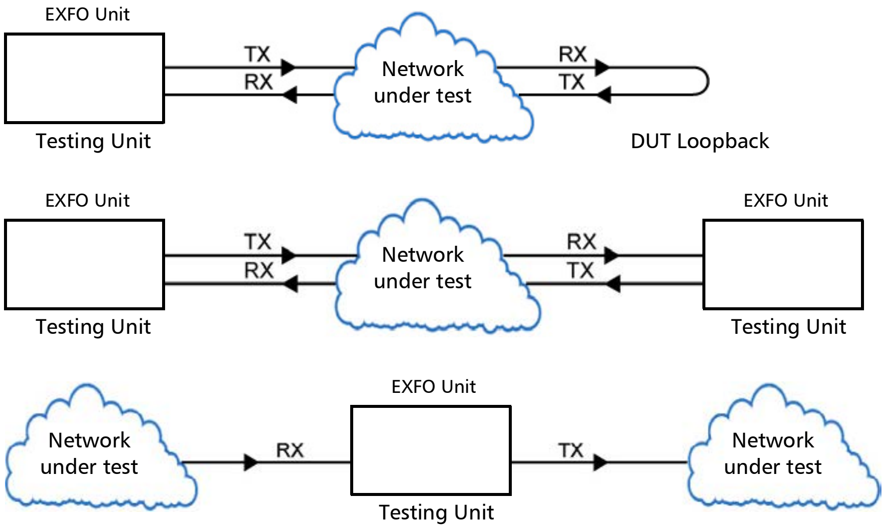


Note: *It is possible to enable E0 from* Signal - Signal Configuration - DSn/PDH *on page 206.*

SONET/SDH - DSn/PDH BERT

Allows validation of the DSn or PDH embedded in SONET or SDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

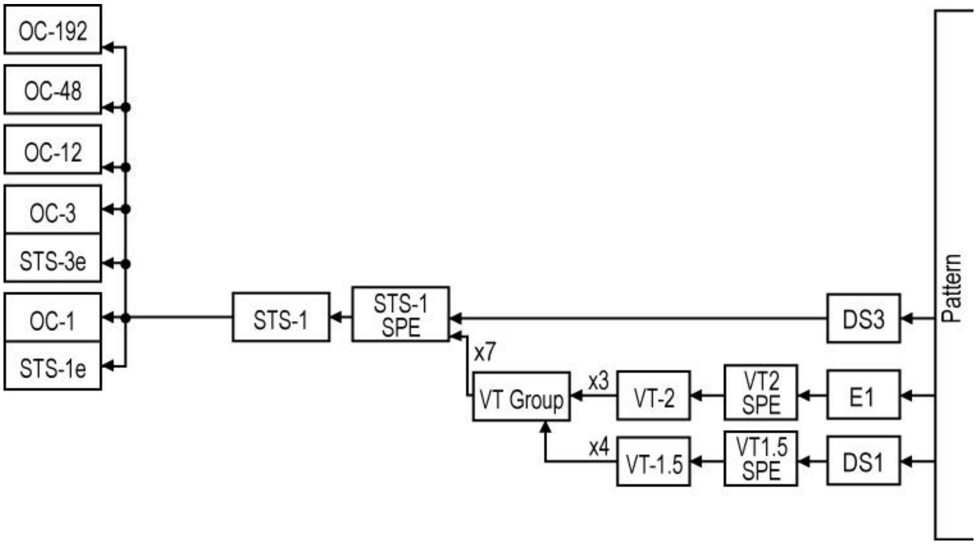
➤ Typical SONET/SDH - DSn/PDH BERT test applications:



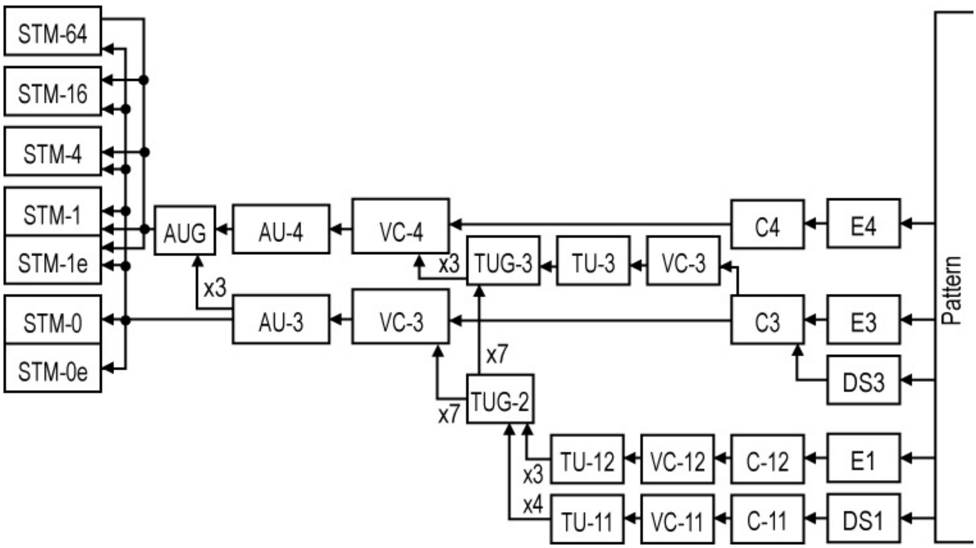
➤ Path/Mapping

The **SONET/SDH - DSn/PDH BERT** test application offers the following path/mapping structures depending on the model and enabled options.

For SONET:



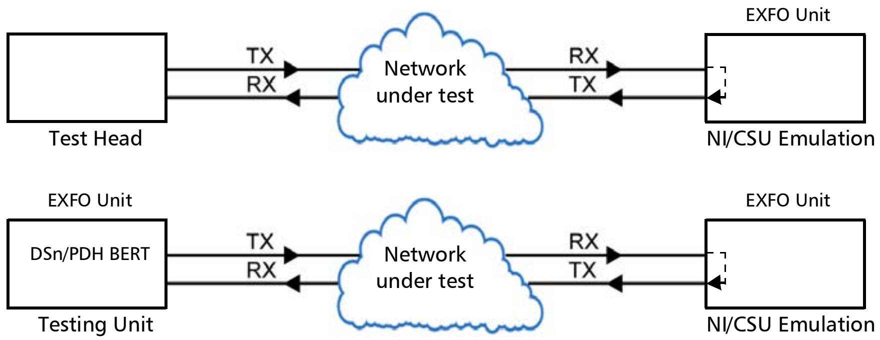
For SDH:


STM-64
STM-16
STM-4
STM-1
STM-1e
STM-0
STM-0e
AUG
AU-4
VC-4
AU-3
VC-3
x3
TUG-3
TU-3
VC-3
x7
TUG-2
x7
TU-12
VC-12
C-12
x3
x4
TU-11
VC-11
C-11
C4
E4
C3
E3
DS3
E1
DS1
Pattern

NI/CSU Emulation

Allows DS1 testing in NI/CSU (Network Interface/Customer Service Unit) emulation mode.

Typical NI/CSU Emulation test applications:



EtherSAM (Y.1564)

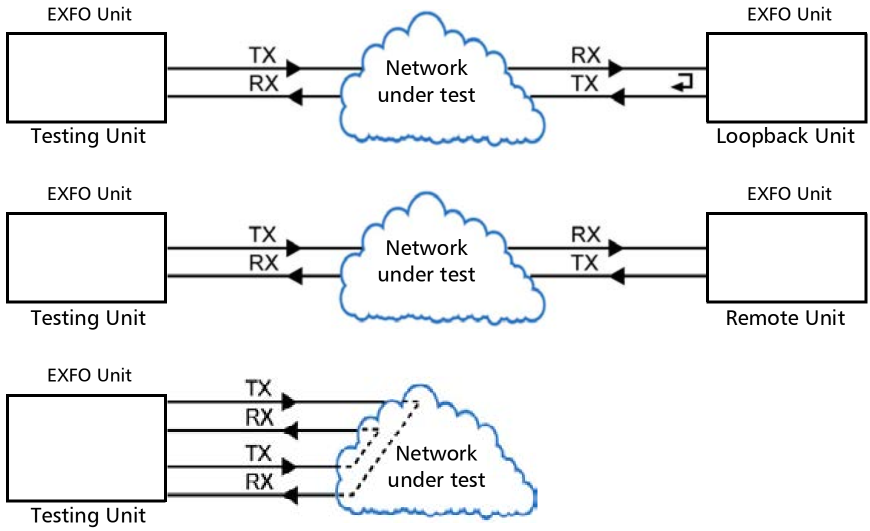
EtherSAM can simulate all types of services that will run on the network and simultaneously qualify all key SLA parameters for each of these services. Moreover, it validates the QoS mechanisms provisioned in the network to prioritize the different service types, resulting in more accurate validation and much faster deployment and troubleshooting.

The **EtherSAM (Y.1564)** test, in single port configuration, has to be executed in conjunction with a remote unit. The remote unit can be either in loopback configuration for unidirectional testing or in EtherSAM **Dual Test Set** mode for bidirectional testing.

The **Dual Test Set** test allows bi-directional testing between two compatible units providing independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

The **Dual Port** topology allows simultaneous and bidirectional traffic generation and analysis at 100 percent wire-speed at any packet size.

➤ Typical EtherSAM (Y.1564) test applications:



RFC 2544

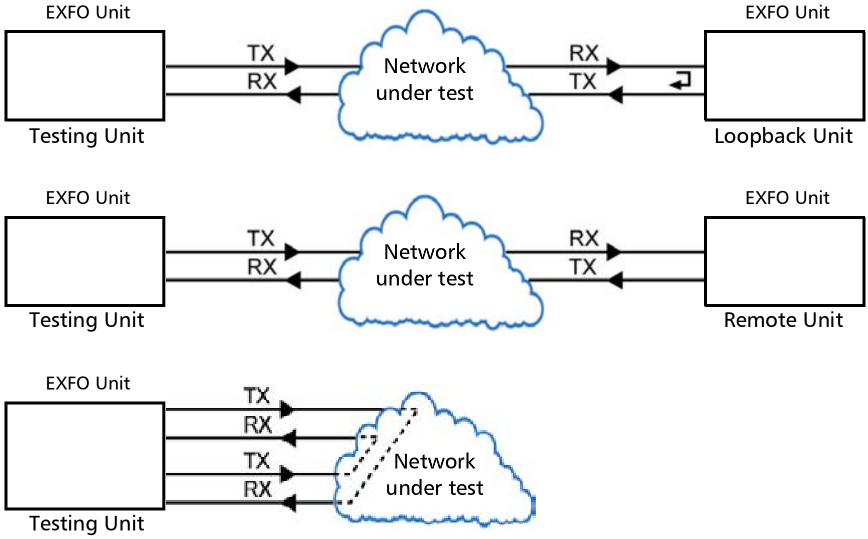
RFC 2544 allows Ethernet Throughput, Back-to-Back, Frame Loss, and Latency performance testing in accordance with RFC 2544 specifications.

The **RFC 2544** test, in single port configuration, has to be executed in conjunction with a remote unit. The remote unit can be either in loopback configuration for unidirectional testing or in RFC 2544 **Dual Test Set** mode for bidirectional testing.

The **Dual Test Set** test allows bi-directional testing between two compatible units providing independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

The **Dual Port** topology allows simultaneous and bidirectional traffic generation and analysis at 100 percent wire-speed at any packet size.

➤ Typical RFC 2544 testapplications:

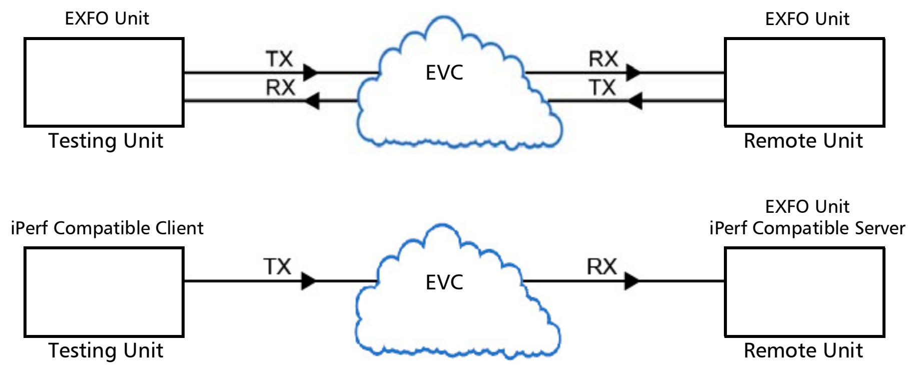


RFC 6349

RFC 6349 is used to confirm that the Ethernet service is able to properly carry TCP traffic.

The **RFC 6349** test has to be executed in conjunction with a remote compatible unit in **RFC 6349 DTS** or **TCP Throughput DTS** operation mode allowing bidirectional testing. For iPerf Compatible Server operation mode (iPerf v2), a remote iPerf Compatible Client is required at the other end for unidirectional testing. The test provides independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

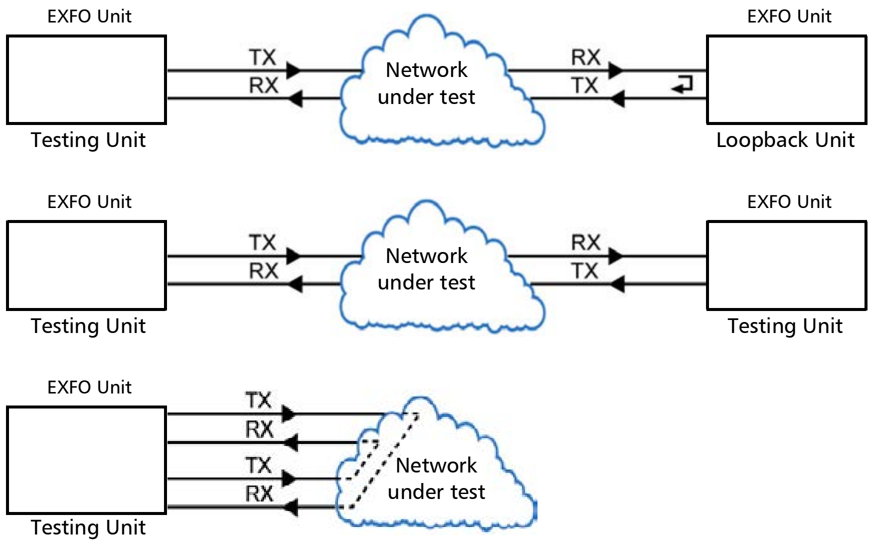
➤ Typical RFC 6349 test application:

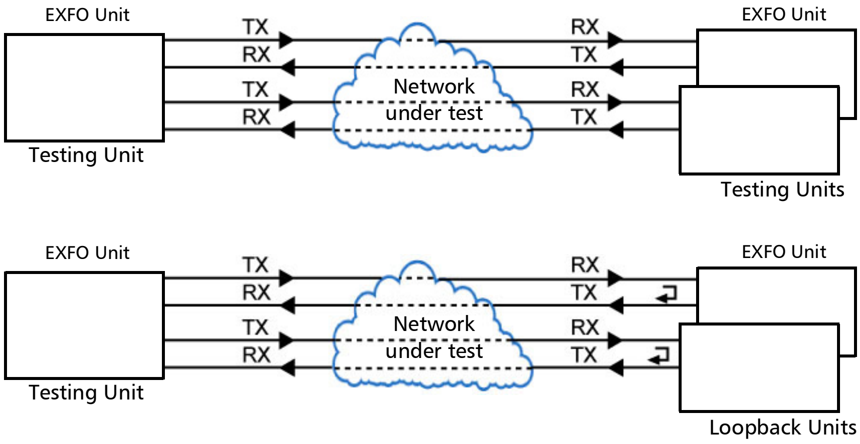


EtherBERT

Allows Ethernet Layer 1 up to Layer 4 and Unframed Layer 1 traffic generation with specific test pattern for Bit Error Rate analysis.

➤ Typical EtherBERT test applications:

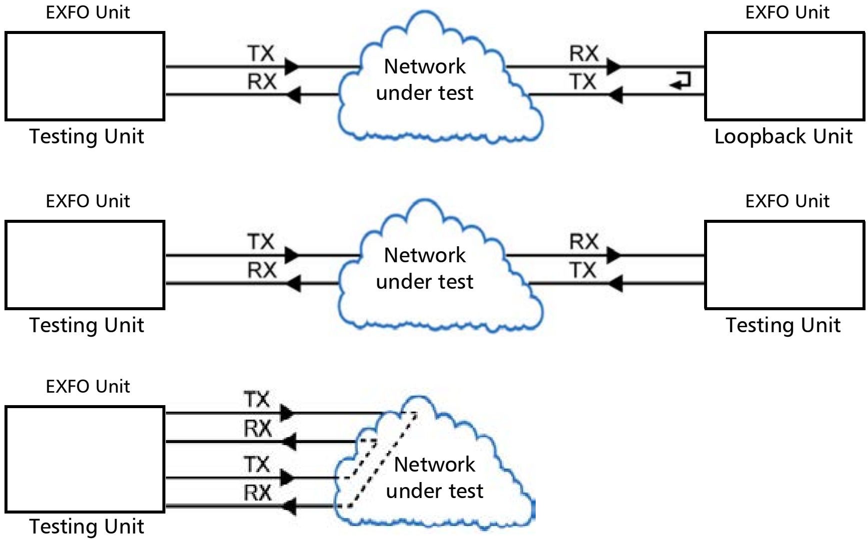


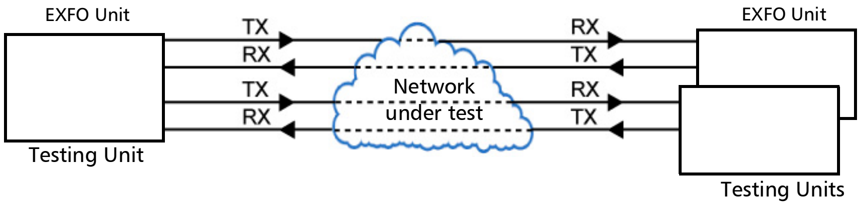

EXFO Unit
TX
RX
TX
RX
Testing Unit
Network
under test
RX
TX
RX
TX
EXFO Unit
Testing Units
EXFO Unit
TX
RX
TX
RX
Testing Unit
Network
under test
RX
TX
RX
TX
EXFO Unit
Loopback Units

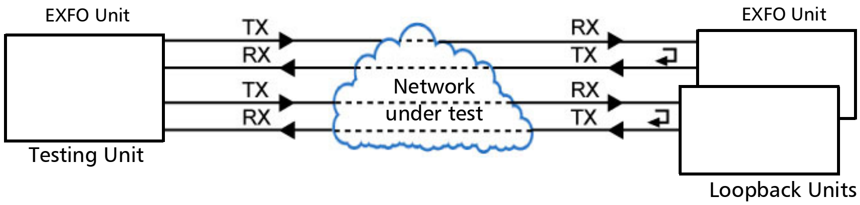
Traffic Gen & Mon

Allows Ethernet traffic generation and analysis of up to 16 streams.

➤ Typical Traffic Gen & Mon test applications:




EXFO Unit
TX
RX
TX
RX
Network
under test
RX
TX
RX
TX
EXFO Unit
Testing Unit
Testing Units

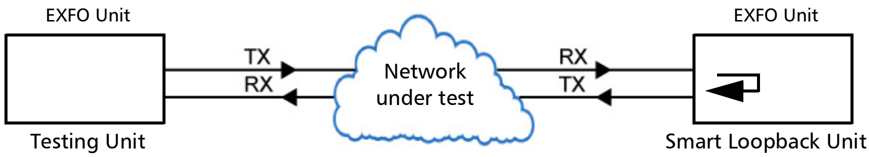

EXFO Unit
TX
RX
TX
RX
Network
under test
RX
TX
RX
TX
EXFO Unit
Testing Unit
Loopback Units

Smart Loopback

Allows transmitting back the received Ethernet stream of data while interchanging the source and destination MAC addresses, IP addresses, and/or UDP/TCP ports. However in **Transparent (Pseudo-Physical**) mode the Smart Loopback operates as a physical loopback by transmitting all received frames unaltered and without discrimination.

The Smart Loopback test can be created locally (refer to *Ethernet Test Applications* on page 65) or remotely using either an EXFO unit (refer to *Discover Remote* on page 418) or a Third-Party device (see *Third-Party Remote Loopback* on page 56).

➤ Typical Smart Loopback test application:



Third-Party Remote Loopback

The Third-party Remote Loopback feature provides the capability to be discovered and react to loop-up and loop-down commands from a third party device. This feature is used for unidirectional testing, where the test stream is transmitted from the third party device to a remote EXFO device. The looped back test stream is received and analyzed by the third-party device.

The third-party loopback supports three levels of messages:

- Layer 2: Only MAC addresses are swapped.
- Layer 3: MAC and IP addresses are swapped.
- Layer 4: MAC and IP addresses are swapped along with the UDP port.

To emulate a third-party remote device, the loopback mode is set in the function of the layer of loop messages received. The loop messages are:

- Layer 2: Ethernet
- Layer 3: IP
- Layer 4: UDP/TCP

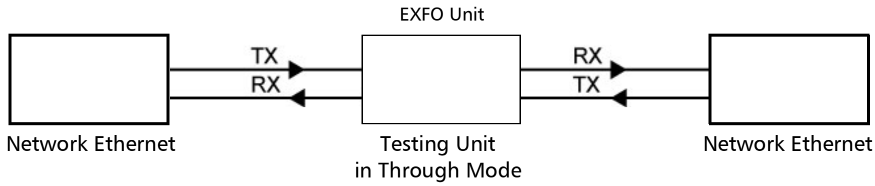
On receipt of the third-party loop-up command as per requested layer, the loopback mode is set and initiated on the unit.

Supported Interfaces/Rates: 10M to 10G LAN/WAN and 100G.

Through Mode

The Through Mode test application allows traffic to pass through the unit using two electrical or optical ports for in-service troubleshooting of live traffic between the carrier/service provider network and the customer’s network.

➤ Typical Through Mode test application:



Carrier Ethernet OAM

The Carrier Ethernet OAM test application supports the following tests: **Ethernet OAM (S-OAM)**, **MPLS-TP OAM**, and **Link OAM**.

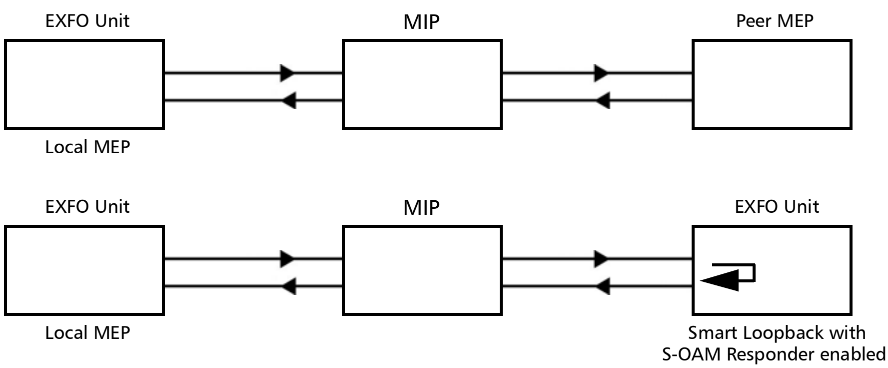
Ethernet OAM and MPLS TP OAM

The Ethernet Service OAM tests are divided into two main categories:

Performance Monitoring measures parameters such as frame delay, frame loss, and synthetic loss (Y.1731/MEF).

Connectivity Fault Management provides the capability for detecting, verifying, and isolating connectivity failure (Y.1731/802.1ag/MEF).

➤ Typical Ethernet OAM and MPLS TP OAM test applications:

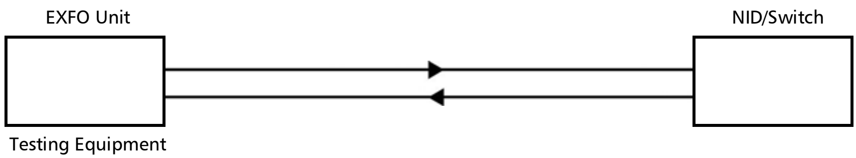


➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

Link OAM

The Link OAM test validates the Link OAM protocol capabilities and the Ethernet link connection of a remote equipment.

➤ Typical Link OAM test application:



Cable Test

The cable test application is used to diagnose un-shielded twisted pairs (UTP) cables (up to Category 6e/Class E).

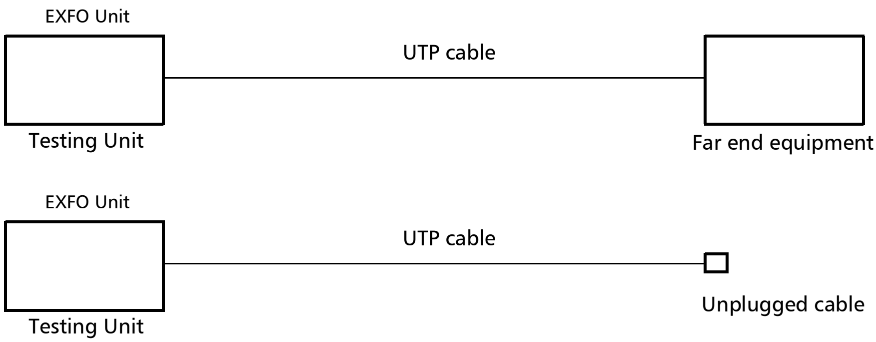
Cable test can be performed everywhere in the network where an electrical 10/100/1000 Mbit/s Ethernet interface is available for testing. Only the pairs used by the Ethernet signal will be tested. For 10BASE-T, and 100BASE-TX, pair 2 and 3 will be tested; for 1000 Base-T, all pairs will be tested. However, if the Ethernet signal is unknown, all four pairs will be tested.

Even if a link up is not required when testing with a far end equipment, it is preferable to have the far end equipment powered up to maximize the cable test results.

Supported Ethernet cable categories are: Category 3/Class C, Category 4, Category 5, Category 5e/Class D, and Category 6e/Class E.

Note: *Cable test result is reliable for cable length of 10 meters to 120 meters (32.81 feet to 393.7 feet).*

➤ Typical Cable Test applications:



7 Selecting and Starting a Test

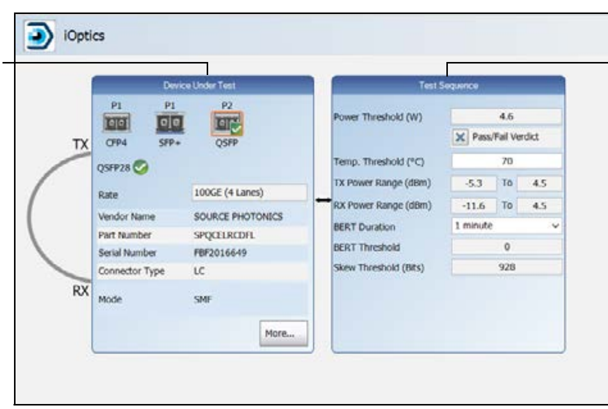
A test can be created either by selecting the test from the Test Applications tab or by loading a previously saved configuration (refer to *Save/Load Button* on page 436 for more information).

Intelligent Apps

iOptics

To select, configure, and start iOptics:

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Intelligent Apps**, tap the **iOptics** icon.
3. From the **Test Configurator** tab, select the interface/port and its rate.



3a. From the **Optical Device Under Test** block, tap the desired port icon.

3b. Once the transceiver is correctly detected , select its rate.

3c. From the **Test Sequence** block, select the test parameters and thresholds (refer to *Test Sequence - iOptics* on page 228).

Note: *The iOptics test application uses **Internal** timing for clock synchronization.*

4. Ensure the laser is ON and tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop|TX Button* on page 440). The **Summary** result page will be automatically displayed when the test is started. For additional results, refer to *Test Results* on page 237. The test automatically stops when the transceiver is invalid or missing.

5. When the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 430 for more information).

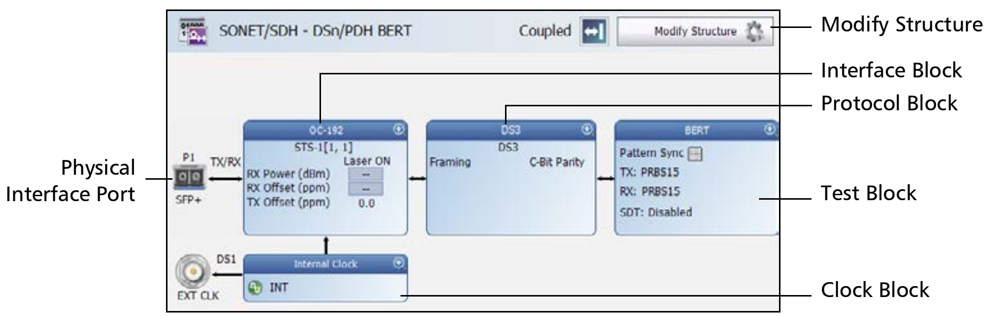
Transport Test Applications

To select, configure, and start a Transport test:

1. From the test menu, tap **Setup**.

2. From the **Test Applications** tab, under **Transport**, tap a test icon.

3. From the **Test Configurator** tab configure the signal structure and its parameters.



3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. Refer respectively to:
Modify Structure - DSn/PDH BERT on page 79
Modify Structure - NI/CSU Emulation on page 87
Modify Structure - OTN BERT on page 88
Modify Structure - SONET/SDH BERT on page 98
Modify Structure - SONET/SDH - DSn/PDH BERT on page 101

3b. For QSFP interface, check for the optical validation check mark indicating that the transceiver matches the configured interface/rate (refer to *Physical Interface Port - Test Configurator Overview* on page 72).

3c. Tap the interface block to configure the signal parameters (refer to page 67).

3d. For an embedded signal, tap the protocol block to configure the signal (refer to page 67).

3e. Tap the test block to configure the specific test settings (refer to page 67). Not available with **NI/CSU Emulation** test application.

3f. Tap the clock block to configure the clock synchronization (refer to *Clock* on page 118).

4. Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 229).

5. For additional test configurations refer to *Test Functions* on page 335.

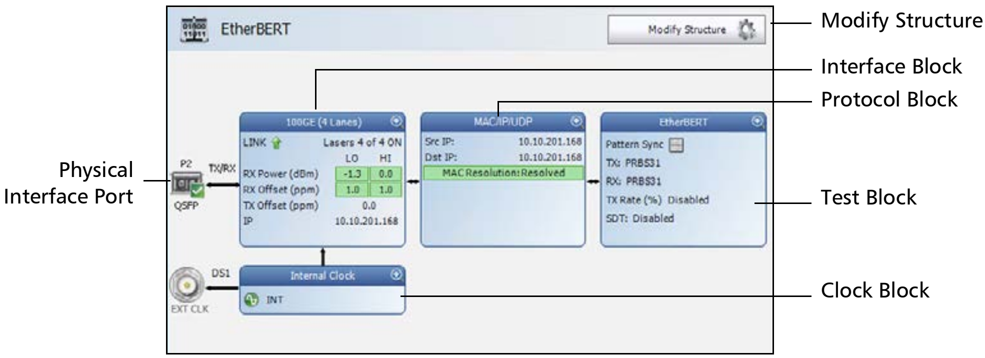
6. Tap the **Start** button from the right navigation bar to start the test. (refer to *Start/Stop|TX Button* on page 440). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results, refer to *Test Results* on page 237.

7. Tap the **Stop** button to stop the test. By default the generate report pop-up is displayed. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 430).

Ethernet Test Applications

To select, configure, and start an Ethernet test:

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Ethernet**, tap a test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. Refer respectively to:
Modify Structure - Cable Test on page 77
Modify Structure - Carrier Ethernet OAM on page 78
Modify Structure - EtherBERT on page 81
Modify Structure - EtherSAM on page 85
Modify Structure - RFC 2544 on page 92
Modify Structure - RFC 6349 on page 94
Modify Structure - Smart Loopback on page 96
Modify Structure - Through Mode on page 104
Modify Structure - Traffic Gen & Mon on page 106

3b. For QSFP interface, check for the optical validation check mark indicating that the transceiver matches the configured interface/rate (refer to *Physical Interface Port - Test Configurator Overview* on page 72).

3c. Tap the interface block to configure the interface parameters (refer to page 67). For **Dual Port** topology, there is an interface block for each port. Ensure that the link is up and the power level (when supported) is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 22).

3d. Tap the protocol block[1] to configure the frame structure and its parameters. For RFC 2544, EtherBERT, and Traffic Gen & Mon in Dual Port topology, there is a protocol block for each port.

3e. Tap the test block[2] to configure the specific test settings.

3f. Tap the clock block[3] to configure the clock synchronization (refer to *Clock* on page 118).

4. Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 229).

5. For additional test configurations refer to *Test Functions* on page 335.

6. Tap the **Start** button to start the test (refer to *Start/Stop|TX Button* on page 440). The **Summary** result page is automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 237.

7. Depending on the test, when the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 430 for more information).

---

1. Not available with Smart Loopback, Through Mode, and Cable Test.
2. Not available with Traffic Gen & Mon and Through Mode.
3. Not available with **Dual Port** topology. Not available when using an active copper SFP. However the clock is either set to **Internal** or **Auto** (1GE electrical).

8 Setup

The **Setup** menu offers the following structure:

- **Test Applications**, see page 33.
- **Test Configurator**, see page 67.
- **Timer**, see page 229.
- **System**, see page 227.

Test Configurator

The following table shows the setup structure for each test application.

Intelligent Apps

Test Applications	Block	Subtab or Pop Up	Page
iOptics	Device Under Test	Device Under Test Details	123
	Test Sequence	-	228

Transport

Test Application	Section	Page or Pop Up	Page
DSn/PDH BERT	Button	Modify Structure	79
		Signal Auto-Detect	108
	Interface	Signal	199
	Test	BERT	109
	Clock	Clock	118
NI/CSU Emulation	Button	Modify Structure	87
		Signal Auto-Detect	108
	Interface	Signal	199
	Clock	Clock	118

Test Application	Section	Page or Pop Up	Page
OTN BERT	Button	Modify Structure	88
	Interface	QSFP/SFP	117
		Frequency	139
		FTFL/PT	141
		Signal	199
		Traces (OTN)	231
	Test	BERT	109
	Clock	Clock	118
SONET/SDH BERT	Button	Modify Structure	98
	Interface	SFP	117
		Labels	151
		Signal	199
		Traces (SONET/SDH)	234
	Test	BERT	109
	Clock	Clock	118
SONET/SDH - DSn/PDH BERT	Button	Modify Structure	101
	Interface	SFP	117
		Labels	151
		Signal	199
		Traces (SONET/SDH)	234
	Protocol	Signal (DSn/PDH)	206
	Test	BERT	109
	Clock	Clock	118

Ethernet

Test Application	Section	Page or Pop Up	Page
Cable Test	Button	Modify Structure	77
	Interface	Interface	145
		Network	163
	Test	Cable Test	115
Carrier Ethernet OAM	Button	Modify Structure	78
	Interface	SFP	117
		Interface	145
		Network	163
	Test	Link OAM	152
		S-OAM / MPLS-TP OAM	181
	Clock	Clock	118
EtherBERT	Button	Modify Structure	81
	Interface	QSFP/SFP	117
		Frequency	139
		Interface	145
		Network	163
	Protocol	MAC/IP/UDP	154
	Test	EtherBERT	126
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	Clock	Clock	118

Test Application	Section	Page or Pop Up	Page
EtherSAM (Y.1564)	Button	Modify Structure	85
	Interface	QSFP/SFP	117
		Frequency	139
		Interface	145
		Network	163
	Protocol	MAC/IP/UDP	154
		Global (Services)	190
		Profile (Services)	193
	Test	Burst (EtherSAM)	132
		Global (EtherSAM)	134
		Ramp (EtherSAM)	138
	Clock	Clock	118
RFC 2544	Button	Modify Structure	92
	Interface	QSFP/SFP	117
		Frequency	139
		Interface	145
		Network	163
	Protocol	MAC/IP/UDP	154
	Test	Global	166
		Subtests	169
	Clock	Clock	118
RFC 6349	Button	Modify Structure	94
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Test Application	Section	Page or Pop Up	Page
Smart Loopback	Button	Modify Structure	96
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Traffic Gen & Mon	Button	Modify Structure	106
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		Profile (Streams)	220
	Clock	Clock	118

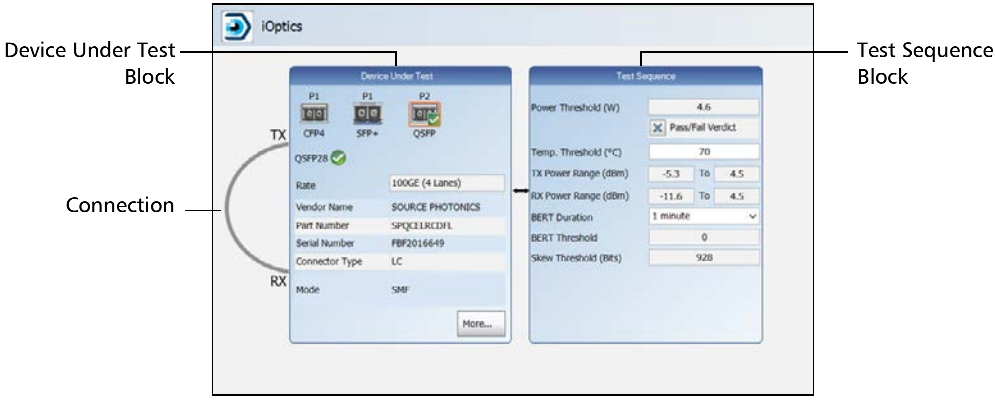
Test Configurator Overview

The **Test Configurator** tab displays the interconnected blocks composing the test structure. Each block of the test structure gives an overview of its configuration/status. Availability of each block depends on the selected test application and its structure. Arrows are used to indicate the interconnection between blocks as well as the direction of the clock and data flow. Tap on a block or the **More** button for **Intelligent Apps**, to change the configuration parameters of this block.

From the **Test** menu, tap **Setup**, and the **Test Configurator** tab.

➤ Intelligent Apps:

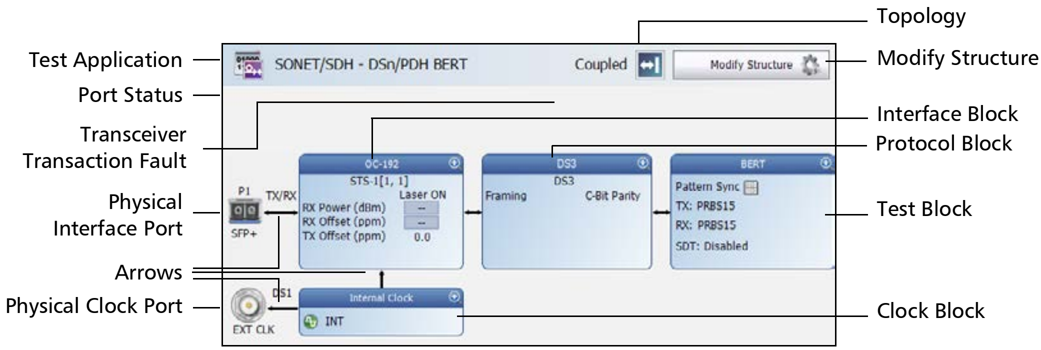
iOptics:



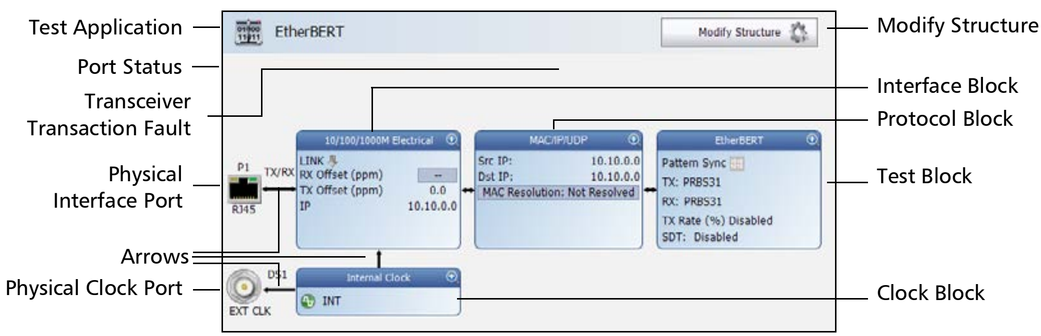
➤ **Device Under Test** block displays and allows changing the basic interface/port settings. Tap on the **More** button to access more information and settings.

➤ **Test Sequence** block allows changing the basic test settings.

➤ Transport Test Applications:



➤ Ethernet Test Applications:



➤ Test Application indicates the selected test application.

- ➤ Topology, for Transport Test Applications, indicates the selected test topology.
- ➤ Modify Structure button, allows the configuration of the physical port and the signal interface structure.

- Port Status indicates:

  Port status icon and its description for a QSFP interface is only displayed when validating or if there is a problem as described in the following table.

	Validating transceiver.
	Missing transceiver, or Unable to validate transceiver.
	Invalid transceiver (or mismatch with the selected signal/interface).
	Valid transceiver matching the selected interface/rate. This icon is not displayed here, it is only displayed for the Physical Interface Port. Using a non-EXFO supported transceiver may report that the transceiver is valid but the device may not operate as intended.

- Transceiver Transaction Fault indicates that the module is unable to discover the transceiver device or experiences abnormal communication conditions; refer to page 227 for more information.
- Physical Interface Port indicates the physical interface port. For **Dual Port** topology, there is a physical interface for each port.

  The status icon for a physical QSFP interface is displayed as described in Port Status above.
- Connection, available with iOptics, graphically represents the connection used for the test. For AOC, the cable length is also displayed.
- Arrows are used to indicate the interconnection between blocks as well as the direction of the clock and data flow.

  A line with an arrow on both ends indicates a bidirectional communication (TX/RX).

  A line with a single arrow indicates a unidirectional communication, either **TX** when going out of a block or **RX** when going into a block.

A line going out of a block returning back to the same block, indicates a loopback communication.

- Physical Clock Port indicates the direction, TX or RX, of the selected clock; not displayed when **Ext Clock Out** is set to **None**. The arrow next to the physical clock image indicates if a clock is generated (TX, arrow pointing to the left) or received (RX, arrow pointing to the right) at/from the physical EXT CLK port.
- Interface Block displays an overview of the interface settings and status. Tap on the interface block to change the settings and to see detailed status. For **Dual Port** topology, there is an interface block for each port.
- Protocol Block displays an overview of either the frame structure and its parameters for Ethernet test applications or the embedded signal for Transport test applications. This block is not present for all tests. Tap on the protocol block to change the settings and to see detailed status. For RFC 2544, EtherBERT, and Traffic Gen & Mon in **Dual Port** topology, there is a protocol block for each port.
- Test Block displays an overview of the test settings and status. Tap on the test block to change the settings and to see detailed status.
- Clock Block displays an overview of the clock settings and status (only available on MAX-860G using 10G WAN interface and on MAX-880). Tap on the clock area to change the settings and to see detailed status. For **Dual Port** topology, the clock block is not present but the clock is set to **Internal**.

Modify Structure

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Transport

Modify Structure - DSn/PDH BERT
Modify Structure - NI/CSU Emulation
Modify Structure - OTN BERT
Modify Structure - SONET/SDH BERT
Modify Structure - SONET/SDH - DSn/PDH BERT

Ethernet

Modify Structure - Cable Test
Modify Structure - Carrier Ethernet OAM
Modify Structure - EtherBERT
Modify Structure - EtherSAM
Modify Structure - RFC 2544
Modify Structure - RFC 6349
Modify Structure - Smart Loopback
Modify Structure - Through Mode
Modify Structure - Traffic Gen & Mon

Modify Structure - Cable Test

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** is set to **10/100/1000M Electrical**.

Unit	Interface/Rate	Connector
860 860G 880	**10/100/1000M Electrical**	**Port 1 - RJ45**

➤ **Connector** is set to **Port 1 - RJ45** (see **Interface/Rate** table above).

Modify Structure - Carrier Ethernet OAM

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
890 890Q	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

➤ **OAM Type** selects the type of Carrier OAM network: **Ethernet OAM** (S-OAM; default), **MPLS-TP OAM**, or **Link OAM**.

Modify Structure - DSn/PDH BERT

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Note: *For **Dual RX** topology both RX and RX2 configurations are coupled.*

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860 860G 880	**DS1 [1.544 Mbit/s]**	**Bantam** **RJ48C**
	E1 [2.048 Mbit/s]	**Bantam** **BNC** **RJ48C**
	DS3 [44.736 Mbit/s] **E3 [34.368 Mbit/s]** **E4 [139.264 Mbit/s]**	**BNC**

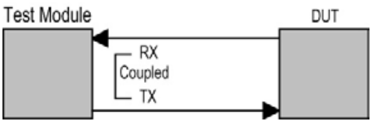
➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

➤ **DSn Multiplexing** / **PDH Multiplexing** allows the selection of the DSn/PDH multiplexing.

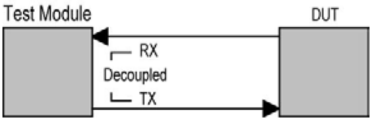
Interface/Rate	DSn/PDH Multiplexing
DS3	**None** (default)**, DS1, E1**
DS1	**None**
E4	**None** (default)**, E3, E3/E2/E1**
E3	**None** (default)**, E2/E1**
E1	**None**

➤ **Client** is set to **Pattern**.

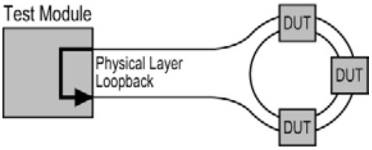
- **Topology** allows the selection of the network test topology.
  - **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



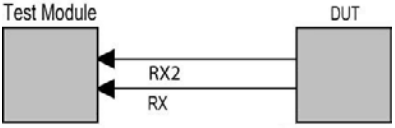
  - **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled.



  - **Through** loops the RX signal to the TX port without TX overwrite capabilities.



  - **Dual RX** uses two DS1 or DS3 signals at the same time. Both RX ports are coupled at the exception of the termination mode. Only available with DS1 and DS3 signal rates.



Modify Structure - EtherBERT

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Note: *For **Dual Port** topology each port is configurable individually.*

Interface allows the selection of the interface rate. For Dual Port, both ports must be either 10GE and less, or 40/100GE.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2 - QSFP28**
	10GE LAN **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port A1/A2/B1/B2 - SFP28 (RJ45)**

a. Only available as a second port when the test application requires two ports.
b. Ethernet 10/100/1000M electrical is supported when using an active copper SFP.

➤ **PHY Type** allows selecting the transceiver PHY type:

For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

➤ **Connector** allows the selection of the physical port (see **Interface** table above).

➤ **Framing** allows the selection of the test framing type; otherwise the framing is set to **Framed Layer 2**. See *Network* on page 163 for more information on frame format. The framing is not configurable and set to **Framed Layer 2** for: 40GE/100GE dual port topology.

➤ **Framed Layer 1**: Frame of x bytes that allows connection to any interface that complies with 802.3 Ethernet PHY or DWDM fibre. Available with rate up to 10G WAN.

IFG (Min. 12 bytes)	Preamble (7 bytes)	SFD (1 byte)	Test Pattern (Length: 48 to 10/16 Kbytes)

➤ **Framed Layer 2**: Frames of x bytes without network layer (**None**) that complies with IEEE 802a Ethernet II standard. To set the frame length, see Frame Size on page 336.

SOF	Destination Address	Source Address	Type	Test Pattern (Configurable length)	FCS	IFG

➤ **Framed Layer 3/4** (default): Frames of x bytes with UDP (default) or TCP network layer that complies with IEEE 802a Ethernet II standard. To set the frame length, see Frame Size on page 336.

SOF	Destination Address	Source Address	Type	IP Header	UDP Header	BERT Tag	Test Pattern (Configurable length)	FCS	IFG

SOF	Destination Address	Source Address	Type	IP Header	TCP Header	BERT Tag	Test Pattern (Configurable length)	TCP Checksum Canceller	FCS	IFG

➤ **Unframed (Interop)** is only available with optical interface up to 10G LAN:

For **Seed A** and **Seed B**, available with 10G LAN, the pattern is generated by the PCS scrambler from a specific seed. The pattern is not encoded.

For **PRBS31 Unscrambled**, available with 10G LAN, the pattern is generated at the PCS layer. The pattern is not encoded and not scrambled.

For **PRBS** and **User Pattern**: Pattern generated by the PCS scrambler. The pattern is encoded.

IFG (Min. 12 bytes)	Preamble (7 bytes)	SFD (1 byte)	Test Pattern (Length: infinite)

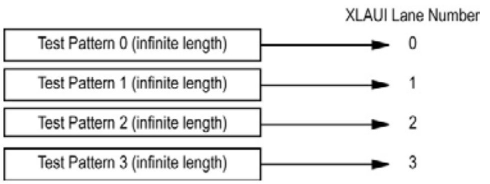
➤ **Unframed** is only available with optical interface up to 10G LAN. Encoded pattern generated by the PCS scrambler.

IFG (Min. 12 bytes)	Preamble (7 bytes)	SFD (1 byte)	Test Pattern (Length: infinite)

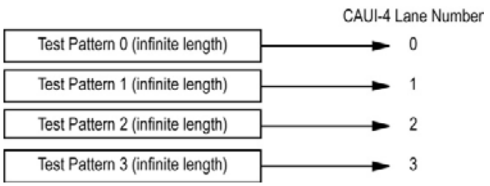
➤ **Unframed with Sync** is only available with optical interface up to 10G LAN: Pattern of a length corresponding to the number of bytes transmitted in 1 second.

IFG (Min. 12 bytes)	Preamble (7 bytes)	SFD (1 byte)	Test Pattern (Length: about 1 second)

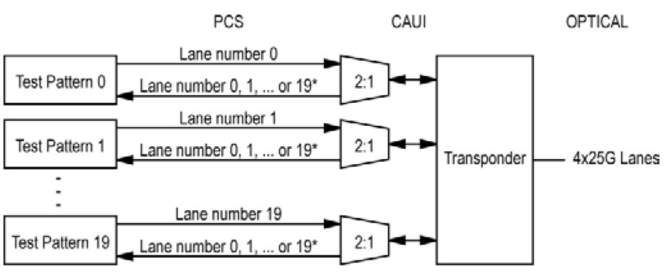
- **4 Unframed XLAUI**: Independent infinite length test pattern in each XLAUI lane (no blocks). Available with 40GE (4 Lanes).



- **4 Unframed CAUI-4**: Independent infinite length test pattern in each CAUI-4 lane (no blocks). Available with 100GE (4 Lanes).



- **20 Unframed PCS**: Independent infinite length test pattern in each PCS lane (no blocks and no lane markers). Available with 100GE (4 Lanes).



* It is not possible to predict on which Lane a generated pattern will be detected on the receive side.

- **Topology** allows the selection of the network test topology: **Single Port** (default) or **Dual Port**. Both ports must be from the same group of rates, either rates up to 10G WAN framed/unframed, or 40/100G Framed Layer 2.

Modify Structure - EtherSAM

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Note: *For **Dual Port** topology each port is configurable individually.*

➤ **Interface** allows the selection of the interface rate. For Dual Port, both ports must be either 10GE and less, or 40/100GE.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2 - QSFP28**
	10GE LAN **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

a. Only available as a second port when the test application requires two ports.
b. Ethernet 10/100/1000M electrical is supported when using an active copper SFP.

- **PHY Type** allows selecting the transceiver PHY type:

  For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

  For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

  For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

- **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

- **Topology** allows the selection of the network test topology:
  Single Port (default) or **Dual Port**. Available for rates up to 10G WAN.

Modify Structure - NI/CSU Emulation

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
880	**DS1 [1.544 Mbit/s]**	**Bantam** **RJ48C**

➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

Modify Structure - OTN BERT

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

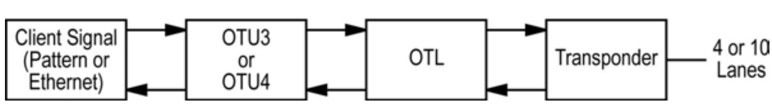
➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860 860G 880	**OTU2 [10.709 Gbit/s]** **OTU1 [2.666 Gbit/s]**	**Port 1 - SFP+**
890 890Q	**OTU4 (4 Lanes) [111.81 Gbit/s]**	**Port A1/A2 - QSFP28**
	OTU3 (4 Lanes) [43.018 Gbit/s]	**Port A1/A2 - QSFP28**
	OTU2f [11.318 Gbit/s] **OTU1f [11.270 Gbit/s]** **OTU2e [11.096 Gbit/s]** **OTU1e [11.049 Gbit/s]** **OTU2 [10.709 Gbit/s]** **OTU1 [2.666 Gbit/s]**	**Port B1/B2 - SFP28**

➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

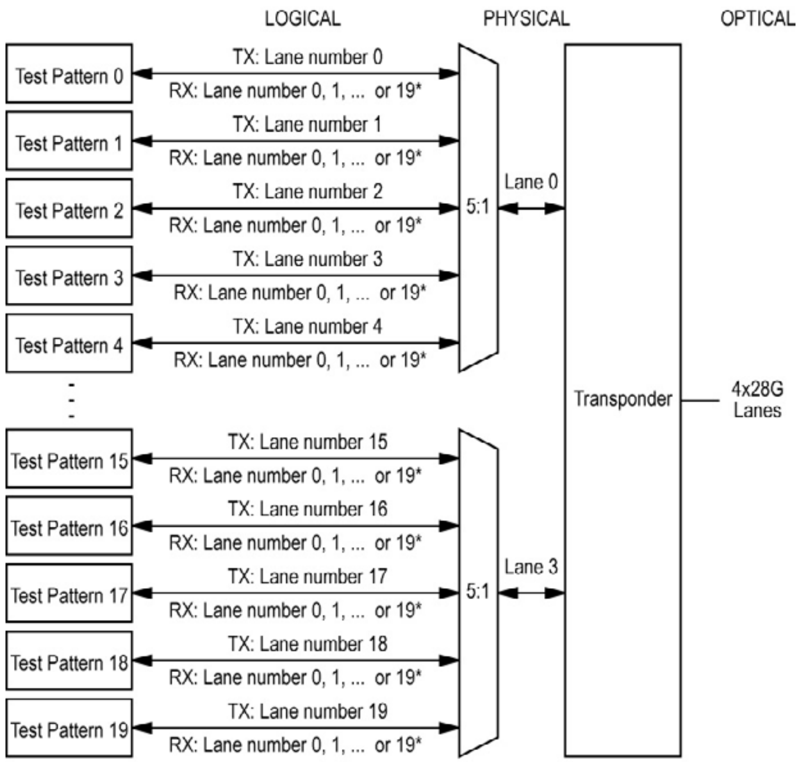
➤ **Framing** allows the selection of the test framing type for parallel interfaces and is set to **Framed** for serial interfaces.

  ➤ **Framed** (default): A single Pattern or Ethernet client applied toward the physical lanes.



➤ **4 Unframed Physical Lanes**: Independent test pattern in each physical lane. Available with: **OTU3 (4 Lanes) [43.018 Gbit/s]**, and **OTU4 (4 Lanes) [111.81 Gbit/s]**

➤ **20 Unframed Logical Lanes**: Independent test pattern in each logical lane. Available with **OTU4 (4 Lanes) [111.81 Gbit/s]**.

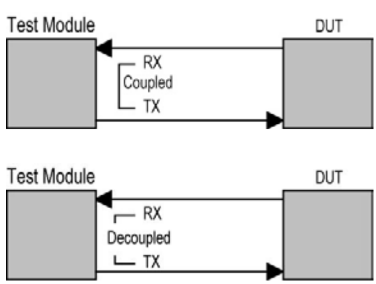


* It is not possible to predict on which Lane a generated pattern will be detected on the receive side.

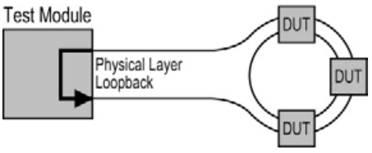
- **OTN Multiplexing / Config Mux**, available with OTN BERT, indicates the OTN test mapping.

Interface/Rate	OTN Multiplexing
OTU1 [2.666 Gbit/s]	ODU1
OTU2 [10.709 Gbit/s]	ODU2
OTU1e [11.049 Gbit/s]	ODU1e
OTU2e [11.096 Gbit/s]	ODU2e
OTU1f [11.270 Gbit/s]	ODU1f
OTU2f [11.318 Gbit/s]	ODU2f
OTU3 (4 Lanes) [43.018 Gbit/s]	ODU3
OTU4 (4 Lanes) [111.81 Gbit/s]	ODU4

- **Client** is set to **Pattern**.
- **Topology** allows the selection of the network test topology.
  - **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



➤ **Through** loops the RX signal to the TX port without TX overwrite capabilities.



Modify Structure - RFC 2544

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Note: *For **Dual Port** topology each port is configurable individually.*

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2 - QSFP28**
	10GE LAN **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

a. Only available as a second port when the test application requires two ports.
b. Ethernet 10/100/1000M electrical is supported when using an active copper SFP.

- **PHY Type** allows selecting the transceiver PHY type:

  For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

  For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

  For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

- **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

- **Topology** allows the selection of the network test topology: **Single Port** (default) or **Dual Port**. Available for rates up to 10G WAN.

Modify Structure - RFC 6349

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate[a]	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
860G 880	**10GE LAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2 - QSFP28**
	10GE LAN **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

a. Only rates up to 10GE LAN are supported with **iPerf Compatible Server** operation mode.

➤ **PHY Type** allows selecting the transceiver PHY type:

For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

Connector allows the selection of the physical port (see the **Interface/Rate** table above).

Modify Structure - Smart Loopback

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2/B1/B2 - QSFP28**
	10GE LAN **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

➤ **PHY Type** allows selecting the transceiver PHY type:

For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

- **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).
- **Loopback Mode**

  Transparent (Pseudo-Physical) check box when selected (cleared by default) determines that the Smart Loopback operates as a physical loopback by transmitting all received frames unaltered and without discrimination. When the check box is cleared, the Loopback mode is selectable from *Loopback* on page 216.

  In transparent mode, the **Network** tab and the **Ping & Trace Route** functions are not available.

Note: *The **Transparent** mode is intended to be used for point-to-point topology, not for switched or routed networks. Use the **Transparent** mode with caution because all received frames are looped back without discrimination.*

Modify Structure - SONET/SDH BERT

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860 860G 880	**OC-192 [9.953 Gbit/s]** **STM-64 [9.953 Gbit/s]** **OC-48 [2.488 Gbit/s]** **OC-12 [622.08 Mbit/s]** **OC-3 [155.520 Mbit/s]** **OC-1 [51.840 Mbit/s]** **STM-16 [2.488 Gbit/s]** **STM-4 [622.080 Mbit/s]** **STM-1 [155.520 Mbit/s]** **STM-0 [51.840 Mbit/s]**	**Port 1 - SFP+**[a]
	STS-3e [155.520 Mbit/s] **STS-1e [51.840 Mbit/s]** **STM-1e [155.520 Mbit/s]** **STM-0e [51.840 Mbit/s]**	**BNC**
890 890Q	**OC-192 [9.953 Gbit/s]** **STM-64 [9.953 Gbit/s]** **OC-48 [2.488 Gbit/s]** **OC-12 [622.08 Mbit/s]** **OC-3 [155.520 Mbit/s]** **OC-1 [51.840 Mbit/s]** **STM-16 [2.488 Gbit/s]** **STM-4 [622.080 Mbit/s]** **STM-1 [155.520 Mbit/s]** **STM-0 [51.840 Mbit/s]**	**Port B1/B2 - SFP28**

a. **Port 2 is used with OC-192/STM-64 in Decoupled (TX≠RX) mode.**

➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

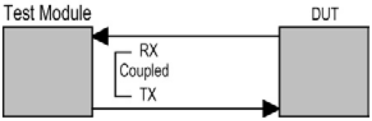
➤ **Framing** is set to **Framed**.

➤ **SONET/SDH Multiplexing / Config Mux** button allows the selection of SONET/SDH multiplexing.

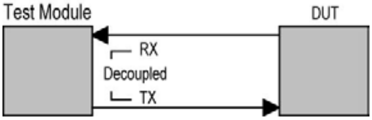
Interface/Rate	SONET/SDH Multiplexing
OC-192	**STS-192c, STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-64	**AU-4-64c, AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-48	**STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-16	**AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-12	**STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-4	**AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-3	**STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-1	**AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-1	**STS-1, STS-1/VT2, STS-1/VT1.5**
STS-3e	**STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STS-1e	**STS-1, STS-1/VT2, STS-1/VT1.5**
STM-0	**AU-3, AU-3/TU-12, AU-3/TU-11**
STM-1e	**AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
STM-0e	**AU-3, AU-3/TU-12, AU-3/TU-11**

➤ **Client** is set to **Pattern**.

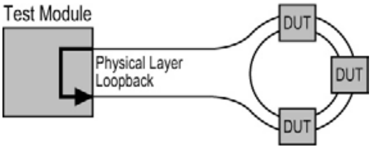
- **Topology** allows the selection of the network test topology.
  - **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



  - **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled.



  - **Through** loops the RX signal to the TX port without TX overwrite capabilities.



Modify Structure - SONET/SDH - DSn/PDH BERT

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface/Rate** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860 860G 880	**OC-192 [9.953 Gbit/s]** **STM-64 [9.953 Gbit/s]** **OC-48 [2.488 Gbit/s]** **OC-12 [622.08 Mbit/s]** **OC-3 [155.520 Mbit/s]** **OC-1 [51.840 Mbit/s]** **STM-16 [2.488 Gbit/s]** **STM-4 [622.080 Mbit/s]** **STM-1 [155.520 Mbit/s]** **STM-0 [51.840 Mbit/s]**	**Port 1 - SFP+**[a]
	STS-3e [155.520 Mbit/s] **STS-1e [51.840 Mbit/s]** **STM-1e [155.520 Mbit/s]** **STM-0e [51.840 Mbit/s]**	**BNC**
890 890Q	**OC-192 [9.953 Gbit/s]** **STM-64 [9.953 Gbit/s]** **OC-48 [2.488 Gbit/s]** **OC-12 [622.08 Mbit/s]** **OC-3 [155.520 Mbit/s]** **OC-1 [51.840 Mbit/s]** **STM-16 [2.488 Gbit/s]** **STM-4 [622.080 Mbit/s]** **STM-1 [155.520 Mbit/s]** **STM-0 [51.840 Mbit/s]**	**Port B1/B2 - SFP28**

a. **Port 2 is used with OC-192/STM-64 in Decoupled (TX≠RX) mode.**

➤ **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

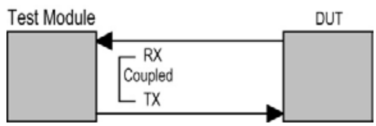
➤ **SONET/SDH Multiplexing / Config Mux** button allows the selection of SONET/SDH multiplexing.

Interface/Rate	SONET/SDH Multiplexing
OC-192	**STS-192c, STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-64	**AU-4-64c, AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-48	**STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-16	**AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-12	**STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-4	**AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-3	**STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STM-1	**AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
OC-1	**STS-1, STS-1/VT2, STS-1/VT1.5**
STS-3e	**STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5**
STS-1e	**STS-1, STS-1/VT2, STS-1/VT1.5**
STM-0	**AU-3, AU-3/TU-12, AU-3/TU-11**
STM-1e	**AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11**
STM-0e	**AU-3, AU-3/TU-12, AU-3/TU-11**

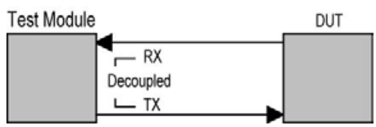
➤ **Embedded DSn / Embedded PDH** either indicates or allows the selection of the embedded DSn/PDH signal. Refer to *SONET/SDH - DSn/PDH BERT* on page 42 for supported path/mapping.

➤ **Client** is set to **Pattern**.

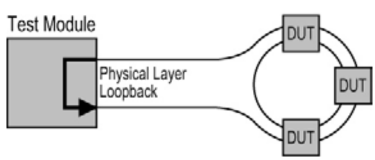
- **Topology** allows the selection of the network test topology.
  - **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



  - **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled.



  - **Through** loops the RX signal to the TX port without TX overwrite capabilities.



Modify Structure - Through Mode

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

➤ **Interface** allows the selection of the interface rate.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
860G 880	**10GE LAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45**
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	10GE LAN **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

➤ **Primary Port** / **Secondary Port** allows selecting the unit's ports that are respectively used as primary and secondary ports. The configuration of the network configuration parameters will be available on the Primary Port only.

- **PHY Type** allows selecting the transceiver PHY type:

  For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

  For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

  For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

Modify Structure - Traffic Gen & Mon

From the test menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

Note: *For **Dual Port** topology each port is configurable individually.*

➤ **Interface/Rate** allows the selection of the interface rate. For Dual Port, both ports must be either 10GE and less, or 40/100GE.

Unit	Interface/Rate	Connector
860	**1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
860G 880	**10GE LAN** **10GE WAN** **1GE Optical** **100M Optical**	**Port 1 - SFP+** **Port 2 - SFP+**
	10/100/1000M Electrical	**Port 1 - RJ45** **Port 2 - SFP+ (RJ45)**[a, b]
890 890Q	**100GE (4 Lanes) [103.125 Gbit/s]**	**Port A1/A2 - QSFP28**
	100GE (2 Lanes) [106.25 Gbit/s] **100GE (1 Lane) [106.25 Gbit/s]**	**Port A1/A2 - QSFP28**
	40GE (4 Lanes) [41.25 Gbit/s]	**Port A1/A2/B1/B2 - QSFP28**
	10GE LAN **10GE WAN** **1GE Optical** **100M Optical**	**Port B1/B2 - SFP28**
	10/100/1000M Electrical	**Port B1/B2 - SFP28 (RJ45)**

a. Only available as a second port when the test application requires two ports.
b. Ethernet 10/100/1000M electrical is supported when using an active copper SFP.

- **PHY Type** allows selecting the transceiver PHY type:

  For 100GE (4 Lanes): **LR4/ER4** (default), **SR4**, **CWDM4**, **CLR4**, **AOC**, or **Other**. The PHY type when set to any except **LR4/ER4**, provides access to RS-FEC configuration (see page 145).

  For 100GE (1 Lane): **DR1/FR1/LR1** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

  For 100GE (2 Lanes): **SRBD** (default and dimmed); ensure the other end of the circuit has the FEC enabled.

- **Connector** allows the selection of the physical port (see the **Interface/Rate** table above).

- **Topology** allows the selection of the network test topology:
  Single Port (default) or **Dual Port**. Available for rates up to 10G WAN.

Signal Auto-Detect

The Signal Auto-Detect allows the detection of the DS1/DS3 interface **Line Coding** (DS1), **Framing**, and **Test Pattern**.

Signal Auto-Detect is only available:

- with DS1 and DS3 interfaces.
- when the test is stopped.
- when Loopback is not activated for NI/CSU Emulation test.

Note: *Test Pattern is not detected with NI/CSU Emulation test application. and ISDN PRI test applications.*

During the detection process, the following messages may be displayed: **Detecting**, **Successful**, and/or **Failed**.

When the auto-detection is successful, the detected parameters are automatically applied as the test interface configuration.

Upon detection of specific alarms, the detection may not be possible, tap **Retry** to invoke the detection again.

BERT and Unframed BERT

From the test menu, tap **Setup**, **Test Configurator**, and tap on the **BERT** or **Unframed BERT** block.

Pattern

The icon next to the **Pattern** label indicates the status of the received pattern signal. Refer to *Status Bar* on page 22 for more information.

- **Coupled RX to TX** check box, when selected (default), couples both the TX and RX signal with the same test pattern. For a framed test, the **Coupled RX to TX** check box is selected and cannot be cleared. For unframed parallel test, the **Coupled RX to TX** check box is selectable (selected by default) when **All Lanes** is selected.
- **No Pattern Analysis (Live)** check box when cleared (default), monitors the received traffic pattern. For live traffic, the **No Pattern Analysis (Live)** check box should be selected as the traffic is a live pattern thus there is no analysis of pattern loss, bit error, and no traffic indications. Only available with a framed test.
- **TX Pattern / RX Pattern** allows selecting the test pattern for each direction. When **User Pattern** is selected, enter the payload pattern hexadecimal value. For Multi-Pattern, see *Multi-Pattern Configuration* on page 113.

  For 40/100G interfaces:

Test	Framing	Pattern
OTN BERT	Framed	**PRBS9**, **PRBS15**, **PRBS20**, **PRBS23**, **PRBS31** (default), **Null Client**, and **User Pattern**.
	Unframed	**PRBS9**, **PRBS11**[a], **PRBS15**, **PRBS20**[a], **PRBS23**, **PRBS31** (default)

a. Not available with OTU4 - **4 Unframed Physical Lanes**.

For interfaces up to 10G:

Pattern	DS0/E0	DS1	DS3/E1	E3/E4	SONET/SDH	OTN
0000, 1010, 1100, 1111, 1in8, 1in16, 2in8	X	X	X	X	X	-
3in24	X	X	X	X (E3 only)	-	-
T1 DALY, 55 OCTET, Multi-Pattern	-	X	-	-	-	-
PRBS11	X[a]	X	X	X	X	
PRBS15	-	X	X[a]	X	X[b]	X
PRBS9, PRBS20, User Pattern	X	X	X	X	X	X
PRBS23	-	X	X	X[a]	X[c]	X
PRBS31	-	X	X	X	X[d]	X[a]
QRSS	-	X[a]	-	-	-	-
Null Client	-	-	-	-	-	X

a. Default value.
b. Default value for VT1.5/TU-11/TU-12.
c. Default value for HOP and all other SONET/SDH concatenations from STS-1/AU-3/AU-4/TU-3 up to STS-48c/AU-4-16c.
d. Default value for STS-192c/AU-4-64c.

- **Invert** check box, when selected (cleared by default), inverts the generated/expected test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011. Patterns **PRBS15**, **PRBS23**, and **PRBS31** are defined inverted as per ITU standard but EXFO uses non-inverted patterns for Transport test applications. Not available when pattern is Multi-Pattern.

- **All Lanes** check box when selected allows setting the same TX and/or RX test pattern for all lanes; when cleared (default) allows setting a different test pattern for each lane: **TX Pattern** with **Invert** and **RX Pattern** with **Invert**). Available with unframed parallel interfaces.

  Pattern Sync, available for each lane when the **All Lanes** check box is cleared, indicates the status of the received signal pattern. Refer to *Status Bar* on page 22 for more information.

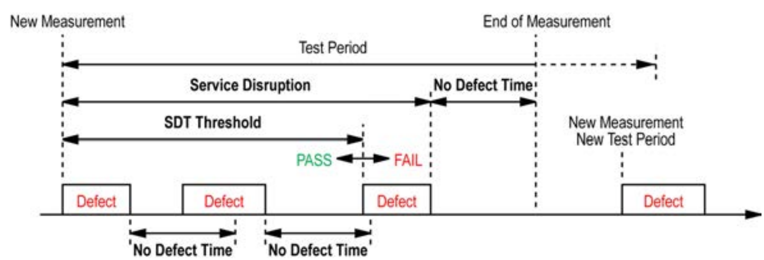
Bit Error

- **Pass/Fail Verdict** enables or disables the bit-error-rate pass/fail verdict by selecting either **Bit Error Count**, **Bit Error Rate** (default), or **Disabled**.
- **BER Threshold** allows entering the maximum bit error count/rate allowed before declaring a fail verdict: **0** (default) to **999999** for count; **1.0E-14** to **1.9E-01** for rate (default value is **1.0E-12** for framed; **2.1E-5** for **CLR4** unframed; **5.0E-5** for **SR4**, **CWDM4**, **AOC**, and **Other** unframed). The **BER Threshold** applies to individual pattern for **Multi-Pattern**.

Service Disruption

Note: *Not available with Unframed OTN, and Multi-Pattern.*

The presence of a specific Defect triggers the service disruption measurement; this includes any defect above in the hierarchy. If a measurement exceeds the Test Period of 5 minutes, a service disruption equal to the Test Period is recorded. The service disruption measurements are cleared when changing the criteria.



➤ **Defect** allows choosing on which layer and defect the service disruption time test will be performed. Choices depend on the selected test path.

Layer	Defect
Interface	OTN/SONET/SDH: LOS[a] DSn: **LOS**, **BPV**, **EXZ** PDH: **LOS**, **CV**
Section/RS	**LOF-S/RS-LOF**, **B1**
Line/MS	**AIS-L/MS-AIS**, **RDI-L/MS-RDI**, **REI-L/MS-REI**, **B2**
STS/AU Path	**AIS-P/AU-AIS**, **LOP-P/AU-LOP**, **RDI-P/HP-RDI**, **REI-P/HP-REI**, **B3**, **UNEQ-P/HP-UNEQ**, **PDI-P (SONET)**
VT/TU Path	**AIS-V/TU-AIS**, **LOP-V/TU-LOP**, **UNEQ-V/LP-UNEQ**, **RDI-V/LP-RDI**, **REI-V/LP-REI**, **BIP-2**
DS1	**AIS**, **OOF**, **RAI**, **Framing Bit**, **CRC-6**
DS3	**AIS**, **OOF**, **Idle**, **RDI**, **F-Bit**, **C-Bit**, **P-Bit**, **FEBE**
E1	**AIS**, **CRC-4**, **E-Bit**, **LOMF**, **TS16 AIS**, **LOF**, **FAS**, **RAI**, **RAI MF**
E4, E3, E2	**AIS**, **LOF**, **FAS**, **RAI**
OTL[b]	**LOF**, **OOF**, **LOL**, **LOR**, **OOR**, **Inv. Marker**, **FAS**
FEC	**FEC CORR**, **FEC UNCORR**
OTUk	**AIS**, **LOF**, **OOF**, **LOM**, **OOM**, **BDI**, **IAE**, **BIAE**, **BIP-8**, **BEI**, **FAS**, **MFAS**
ODUk	**AIS**, **OCI**, **LCK**, **BDI**, **BIP-8**, **BEI**, **FSF**, **BSF**, **FSD**, **BSD**
OPUk	**AIS**, **CSF**, **PLM**[c], **LOOMFI**[d], **OOMFI**[d], **OMFI**[d]
BER[e]	**Pattern Loss**, **Bit Error** (default)

a. Not available with QSFP transceivers.
b. The service disruption time measurement is available per lane for OTL defects at the exception of LOL which is global for all lanes. Refer to *OTL-SDT* on page 259 for results per lanes.
c. Available when the PLM check box is selected (refer to page 144 for more information).
d. Available with OPU4 only.
e. Available when the **No Pattern Analysis (Live)** check box (see page 109) is cleared.

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 trigger an SDT event.*

- **No Defect Time (ms)** allows selecting the period without any defects before stopping SDT measurement: **0.005 ms** to **2000 ms** (default is **300 ms**).
- **Disruption Monitoring** check box when selected (disabled by default) enables the disruption time measurements. However, the measurement will only start if the test is already started, or when the test will be started. Clearing the **Disruption Monitoring** check box or stopping the test, stops the measurement without clearing the results. Starting the test while the **Disruption Monitoring** check box is selected resets the results.
- **Pass/Fail Verdict** check box when selected (cleared by default) enables service disruption pass/fail verdict and allows setting the threshold value.
- **SDT Threshold (ms)** allows configuring the acceptable maximum service disruption time before failing the test: **0.001** to **299999.999 ms** (default is **50** ms).

Multi-Pattern Configuration

Note: *Only available for **DSn/PDH BERT** test application with DS1 signal (DS0 disabled) and when the pattern is **Multi-Pattern**.*

The **Multi-Pattern** feature allows sending each pattern for a specific duration, sequentially and continuously.

- **Pattern** represents a sequence of patterns that will be generated: **1111**, **1in8**, **2in8**, **3in24**, and **QRSS**.
- **Enable** check box allows enabling the generation of each pattern individually in the pattern sequence. All patterns are enabled by default. All 1’s (1111) is disabled for unframed test.

- **Individual Pattern Duration** specifies the transmission duration of each pattern: **15 s**, **30 s**, **45 s**, **1 min**, **2 min**, **3 min** (default),... up to **15 min**.

Restore < Test Application > Defaults

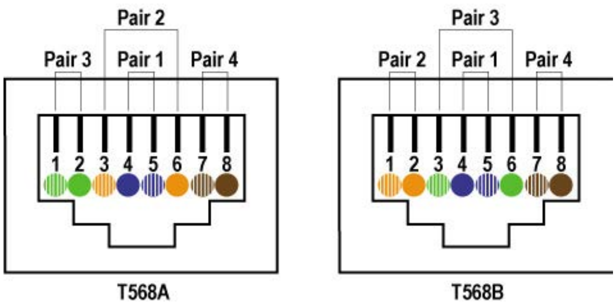
Reverts the test application to its default factory settings.

Cable Test

From the test menu, tap **Setup**, **Test Configurator**, and the **Cable Test** block.

Global Options

➤ **Wiring Standard** is the pin-to-pair assignment corresponding to the UTP cable used: **T568A** (default) or **T568B**.



➤ **Length Unit** is the unit used for cable length and distance to fault results: **Meter** (default) or **Feet**.

Pass/Fail Verdict

Pass/Fail Verdict check box when selected (default) enables the cable test pass/fail verdict and allows setting the threshold values.

- **Prop. Delay Threshold (ns)** is the maximum time for a pulse to reach the far end: **0** to **1000** ns (default is **1000** ns for 10 Mbit/s, **556** ns for 100 Mbit/s, and **570** ns for 1 Gbit/s).
- **Delay Skew Threshold (ns)** is the maximum time between the fastest and slowest pairs of a 1000BASE-T signal: **0** to **120** ns (default is **50** ns).
- **Length Threshold (m)** is the maximum acceptable cable length: **0** to **120** m (0 to 394 feet) (default is **100** m (328 ft)).

Restore Cable Test Defaults

Reverts the test application to its default factory settings.

QSFP/SFP

This tab gives hardware information related to the inserted transceiver module.

From the test menu, tap **Setup**, **Test Configurator**, tap on the interface block and on the QSFP/SFP tab.

Parameters

The following parameters are retrieved from the transceiver:

Parameter	QSFP28	SFP SFP+ SFP28
Module ID	X	X
Vendor Name	X	X
Part Number	X	X
Serial Number	X	X
Hardware Revision	X	X
Revision Compliance	X	-
Connector Type	X	X
Speed	X	X
Type/Compliance Code	X	X
Wavelength	-	X
Mode	X	X
Power Class	X	X
Temperature (Actual/Max)[a]	X	X
CLEI Code	X	-

a. Displays respectively the current and the maximum temperature recorded.

Clock

Allows the configuration of the clock synchronization. Only available on MAX-860G using 10G WAN interface and on MAX-880.

From the **Test** menu, tap **Setup**, **Test Configurator**, and tap on the clock block.

Clock Synchronization

Clock Mode allows selecting the clock source that will be used for transmission (TX). The clock mode for One-way Latency measurement mode is limited to **External 1PPS**.

- **Internal**: Internal clock of the unit (STRATUM 3).
- **Recovered**: Line clock from the input port signal involved in the test. Available with Transport test applications, CPRI/OBSAI RRH, and Ethernet applications using 10G WAN. The clock mode is forced to **Recovered** for 1GE electrical interface using **Slave** local clock (see **Local Clock** on page 146).
- **External**: Clock signal from the EXT CLK port. Only available on MAX-880 model.
- **External 1PPS**: 1PPS clock signal from the EXT CLK port. Only available on MAX-880 model.

Ext Clock In

Note: *Available when the **Clock Mode** is set to **External** or **External 1PPS**.* Only available on MAX-880 model.

Allows setting the external clock for test synchronization.

➤ **Interface** allows the selection of the clock interface: **DS1** (default), **E1**, **2 MHz**, or **1PPS**. **1PPS** is automatically selected in **One-Way** latency measurement mode (**Dual Test Set**.

Ext Clock In on a green background indicates that a valid clock is received.

LOS on a red background indicates that the received clock is not valid.

LOPPS-L, available with 1PPS, on a green background indicates that a valid clock is received.

➤ **Connector** either indicates the connector type used for the clock or allows the selection of **Bantam** or **RJ48C** when the BNC connector is used by the test application. The unit connector blue LED used for Ext Clock In is flashing.

➤ **Termination** mode specifies how the unit is connected to the synchronization signal. The **Termination** mode is set to **TERM** for 2MHz and configurable for DS1 and E1.

For DS1:

➤ **TERM** provides an input that terminates the DS1 signal.

➤ **DSX-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.
- **MON** 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:
  For DS1: **AMI** and **B8ZS** (default).
  For E1: **AMI** and **HDB3** (default).
- **Framing**: Allows the selection of the interface framing.

  For DS1: **SF**, **SLC-96**, and **ESF** (default).
  For E1: **PCM30** (default), **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**.
- **Frequency (MHz)** displays the frequency of the received signal rate.
- **Offset (ppm)** displays the positive or negative frequency offset between the standard rate specification and the rate from the received signal. The background color is used to indicate if the received clock meets (green) or not (red) the standard rate specification.

Signal	Standard Rate specification
DS1	1544000 ± 8 bit/s (± 4.6 ppm)
E1	2048000 ± 10 bit/s (± 4.6 ppm)
2MHz	2048000 ± 10 bit/s (± 4.6 ppm)

Ext Clock Out

Note: *Available on MAX-880 model only and when the **Clock Mode** is set to **Internal**, or **Recovered**.*

Allows setting the clock that will be generated.

- **Interface Type** allows the selection of the clock interface: **DS1** (default), **E1**, and **2MHz**.

  Ext Clock Out on a green background indicates that a valid clock is generated on the clock port.

  LOC on a red background indicates that no clock is generated on the clock port.

- **Connector** either indicates the connector type used for the clock or allows the selection of **Bantam** or **RJ48C** when the BNC connector is used by the test application.
- **LBO** (Line Build Out), available with DS1 only, allows the selection of the interface Line Build Out that meets the interface requirements over the full range of cable lengths: **DSX-1 (0-133 ft)** (default), **DSX-1 (133-266 ft)**, **DSX-1 (266-399 ft)**, **DSX-1 (399-533 ft)**, and **DSX-1 (533-655 ft)**.
- **Line Coding** allows the selection of the interface line coding:
  For DS1: **AMI** and **B8ZS** (default).
  For E1: **AMI** and **HDB3** (default).
- **Framing**, available with DS1 and E1, allows the selection of the interface framing.

  For DS1: **SF**, **SLC-96**, and **ESF** (default).
  For E1: **PCM30** (default), **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**.

Tributary Synchronization

Note: *Only available with SONET/SDH - DSn/PDH and DSn/PDH test applications. Not supported in Through topology.*

Clock Mode allows selecting the source clock that will be used for tributary transmission (TX); default is **Internal**. The availability of clock modes is as follows:

Clock Synchronization	Tributary Synchronization
Internal	Internal
Recovered	Internal Recovered
External	Internal External

- **Internal**: Internal clock of the unit (STRATUM 3).
- **Recovered**: Line clock from the input port signal involved in the test.
- **External**: Clock signal from the EXT CLK port.

Device Under Test - iOptics

From the test menu, tap **Setup**, and **Test Configurator**.

➤ Transceiver selection: Tap on a transceiver icon to select the interface/port. The selected transceiver is highlighted with an amber contour. The selected transceiver type and its status are displayed.

Status	Description
	Validating the transceiver.
	Transceiver correctly detected.
	Incompatible transceiver detected.
	Missing transceiver.

➤ For standard optical transceivers, a fiber loopback patch cord is required to perform the test with applicable attenuation to protect the optical device. Ensure the laser is turned on.

➤ For bidirectional transceivers using compatible transceivers, same rate and connector type, for upstream and downstream respectively. Connect a fiber patch cord with the necessary attenuator between the port under test and the port in transparent loopback mode and ensure the laser is turned on.

➤ For an Active Optical Cable (AOC):

Connect the other end of the cable to the port automatically selected and configured in transparent loopback and ensure the laser is turned on.

➤ **Tunable**: For transceivers having tunable capability, **(Tunable)** is written next to the transceiver module ID.

➤ **Rate**: Once the transceiver is correctly detected , select the interface rate. Rates depend on the selected port, the inserted transceiver, and the rates supported on the module.

Transceiver	Rate			
	Transport	Ethernet	Fibre Channel	CPRI/OBSAI
QSFP28	OTU4 (4 Lanes)	100GE (4 Lanes) 100GE (2 Lanes) 100GE (1 Lane)	-	-
QSFP+	OTU3e2 (4 Lanes) OTU3e1 (4 Lanes) OTU3 (4 Lanes)	40GE (4 Lanes)	-	-
SFP28	-	25GE	32X	-
SFP/SFP+	OTU2 OTU1e OTU2e OTU1f OTU2f OTU1 OC-192/STM-64 OC-48/STM-16 OC-12/STM-4 OC-3/STM-1 OC-1/STM-0	10GE WAN 10GE LAN 1GE Optical 100M Optical	1X 2X 4X 8X 10X 16X	CPRI - 1.2G CPRI - 2.4G CPRI - 3.1G CPRI - 4.9G CPRI - 6.1G CPRI - 9.8G CPRI - 10.1G OBSAI- 1.5G OBSAI - 3.1G OBSAI - 6.1G

➤ **Bidirectional** check box when selected (default, when the transceiver reports that it is bidirectional) allows testing bidirectional transceivers. Available with Ethernet and CPRI rates up to 25G.

➤ **Vendor Name**, **Part Number**, **Serial Number**, **Connector Type**, **Wavelength**, and **Mode** are information retrieved from the transceiver (see page 125).

Modify button beside **Wavelength**, available with tunable transceivers, is used to configure the transceiver wavelength. Refer to *Modify Wavelength (SFP)* on page 565.

- **More** gives additional module information and settings.

  Device Under Test tab:

  - **Parameters** are retrieved from the transceiver (see *Parameters* on page 117).
  - **Lasers OFF at Start-Up** allows turning off all lasers automatically when starting the module or when switching from one test application to another. This check box is cleared by default.

EtherBERT and Unframed BERT

From the test menu, tap **Setup**, **Test Configurator** and tap on the **EtherBERT** or **Unframed BERT** block.

Pattern

- **Coupled RX to TX** check box, when selected (default), couples both the TX and RX signal with the same test pattern. For unframed parallel test, the **Coupled RX to TX** check box is selectable (selected by default) when **All Lanes** is selected. For **Seed A**, **Seed B**, and **PRBS31 Unscrambled** patterns, the **Coupled RX to TX** check box is selected and not configurable.
- **No Pattern Analysis (Live)** check box when cleared (default), monitors the incoming traffic pattern and Round-Trip Latency. For live traffic, the **No Pattern Analysis (Live)** check box should be selected as the traffic is a live pattern and in this case no monitoring is required. Only available with framed test.
- **TX Pattern / RX Pattern** allows selecting the test pattern for each direction. When **User Pattern** is selected, enter the payload pattern hexadecimal value. The patterns are not configurable and set to **PRBS31** for: 40/100GE dual port topology.

Framing	Pattern
Framed	**PRBS9**, **PRBS11**, **PRBS15**, **PRBS20**, **PRBS23**, **PRBS31** (default), **CSPAT**[a], **CJTPAT**[a], **CRPAT**[a], **Short CRTPAT**[a], **Long CRTPAT**[a], **User Pattern**
Unframed (Interop)	**PRBS9**, **PRBS11**, **PRBS15**, **PRBS20**, **PRBS23**, **PRBS31** (default), **Seed A**, **Seed B**, **PRBS31 Unscrambled**, **User Pattern**
Unframed parallel	**PRBS9**, **PRBS11**[b], **PRBS15**, **PRBS20**[b], **PRBS23**, **PRBS31** (default)

a. Only available for 1G optical with **Framed Layer 1** (see Framing on page 82).
b. Not available with 100GE - **4 Unframed CAUI-4**.

- **Invert** check box, when selected (cleared by default), inverts the generated/expected test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011. Patterns **PRBS15**, **PRBS23**, and **PRBS31** are defined inverted as per ITU standard but EXFO uses non-inverted patterns for Ethernet test applications.

- **All Lanes** check box when selected allows setting the same TX and/or RX test pattern for all lanes; when cleared (default) allows setting a different test pattern for each lane: **TX Pattern** with **Invert** and **RX Pattern** with **Invert**). Available with unframed parallel interfaces.

  Pattern Sync, available for each lane when the **All Lanes** check box is cleared, indicates the status of the received signal pattern. Refer to *Status Bar* on page 22 for more information.

Bit Error / Pattern Error

Note: *__Bit Error__ is available with all patterns at the exception of __Seed A__ and __Seed B__ for which __Pattern Error__ is available.*

- **Pass/Fail Verdict** enables and sets the bit/pattern error rate/count threshold prior to run the test. This allows for a simple pass/fail verdict, leaving no room for misinterpretation of the test results. To enable the pass/fail verdict, select either **Bit Error Count** / **Pattern Error Count**or **Bit Error Rate** / **Pattern Error Rate** (default is **Disabled**).

- **BER Threshold** allows entering maximum bit/pattern error count allowed before declaring a fail verdict: **0** (default) to **999999** for count; **1.0E-14** to **1.9E-01** for rate (the default value is **1.0E-12**).

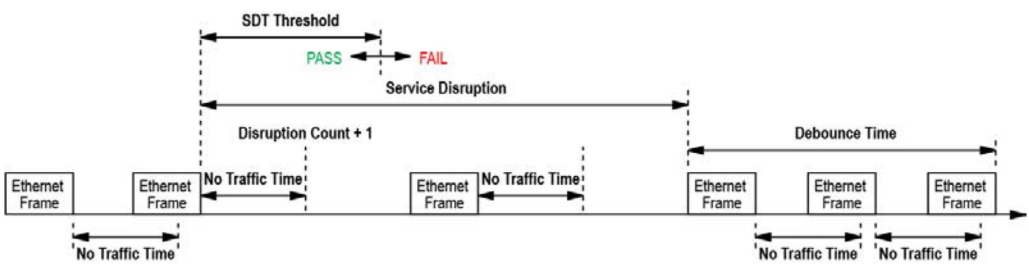
Service Disruption

Note: *Not available with:* ***No Pattern Analysis (Live)*** *check box selected;* ***Seed A****,* ***Seed B****, or* ***PRBS31 Unscrambled*** *patterns.*

The absence of traffic exceeding the configured **No Traffic Time** triggers the service disruption measurement.

For a **Framed**, **Unframed**, or **Unframed with Sync** test, the service disruption event is closed when valid Ethernet frames are received for at least the **Debounce Time** without any service disruption event. Reaching the Test Period or stopping the test also closes the SDT event.

For an **Unframed (Interop)** test, the service disruption event is closed when either the Test Period of 5 minutes is reached or the test is stopped.



- **No Traffic Time (ms)** is the time acceptable between two Ethernet frames without any service disruption event: **0.005 ms** to **1000 ms** (default is **1 ms**).
- **Debounce Time (ms)** allows setting the period without any service disruption event before stopping the current SDT measurement: **0** (default) to **500** ms.
- **Disruption Monitoring** check box when selected (disabled by default) enables the disruption time measurements. However, the measurement will only start if the test is already started, or when the test will be started. Clearing the **Disruption Monitoring** check box or

stopping the test, stops the measurement without clearing the results. Starting the test while the **Disruption Monitoring** check box is selected resets the results.

➤ **Pass/Fail Verdict** check box when selected (cleared by default) enables service disruption pass/fail verdict and allows setting the threshold value.

➤ **SDT Threshold** allows configuring the acceptable maximum service disruption time before failing the test: **0.005** to **299999.999** ms (default is **50** ms). The threshold value cannot be less than the **No Traffic Time** value.

Shaping

➤ **TX Rate** allows the selection of the transmission rate in percentage of utilization (100 percent by default), Mbit/s, Gbit/s, Frame/s, or IFG. For Ethernet, the maximum percentage is 105 percent depending on the frame size selected.

➤ **Enable TX** check box is automatically selected when starting the test allowing stream generation. The **Enable TX** check box may also be selected or cleared while the test is running.

Latency

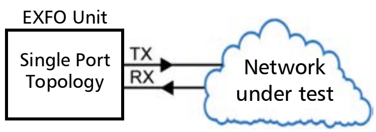
Note: *Available with Framed Layer 2 and higher. In Dual port topology, Latency is only available for rates up to 10G.*

➤ **Enable** check box when selected, cleared by default, enables latency measurements.

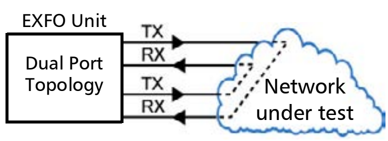
➤ **Mode**

Note: *For 88200NGE and 890 modules, only* ***Round-Trip Latency*** *is supported.*

Round-Trip Latency measurement provides the total delay measurement for both directions on a specific port.



One-Way P<m> ↔ P<n> provides the delay measurement of each direction independently between two separate ports of a single module. Only available when the rate and framing structure parameters are the same on both ports; changing any of these parameters automatically selects the **Round-Trip Latency** mode.



➤ **Pass/Fail Verdict** check box when selected enables the pass/fail verdict and allows setting the maximum latency threshold. This parameter is coupled on both ports for one-way measurement mode.

➤ **Unit** allows selecting the Latency unit: **ms** (default) or **µs**.

➤ **Round-Trip Threshold (ms)** is configurable from **5 µs** for 10Mbit/s, **1 µs** for 100Mbit/s and 10G WAN, or **100 ns** for all other rates up to **2 s** (default is **75** ms).

➤ **One-Way P<m> -> P<n> Threshold** is configurable at the current P<m> RX port: from **5 µs** for 10Mbit/s, **1 µs** for 100Mbit/s and 10G WAN, or **100 ns** for all other rates up to **2 s** (default is **75** ms).

Ethernet Frame

➤ **Frame Size (Bytes)** allows selecting the frame type (**Fixed** (default) or **EMIX**) and the frame size (**48**[1] to **16000**[2]). Sending traffic with frame size >1518 in switched network may result in losing all frames.

The following table lists each component that may affect the minimum size value.

Component	Description
VLAN	4 bytes per VLAN (up to 3 VLAN)
UDP	8 bytes
TCP	20 bytes
Ethernet Header	14 bytes
LLC and SNAP Headers	8 bytes
IPv4	20 bytes
IPv6	40 bytes
Latency	8 bytes

EMIX button is available when **EMIX** frame size is selected. The EMIX frame sequence is repeated continuously (refer to *EMIX* on page 551).

1. The minimum of 48 bytes is only available for rates up to 10GE, for higher rates the minimum frame size is 64 bytes. The minimum frame size will be adjusted according to the frame structure and components selected.

2. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

EtherSAM - Burst

Note: *The **Burst** settings are only available for configuration when the **Burst Test** check box is selected (see page 134).*

From the test menu, tap **Setup**, **Test Configurator**, tap on the test block, and on the **Burst** tab.

Note: *The burst configuration parameters are defined globally for all services but **CBS**, **EBS**, and **Burst Max Rate** parameters are as per each service configuration.*

Burst Sequence

The graphic illustrates the configured burst sequence that contains in order, from left to right:

➤ **Refill Delay** represents the pre-burst recuperation time in percentage that is equal to the remaining percentage not used by the post-burt time (**Refill Delay Ratio**).

➤ **Burst Frames** represents the burst frame ratio in percentage that is equal to the substraction of **100 % - Burst/IR Frame Ratio**.

➤ **Refill Delay** represents the post-burst recuperation time in percentage that is equal to the configured **Refill Delay Ratio**.

➤ **CIR or CIR+EIR Frames** represents the percentage of transmission at CIR or CIR+EIR rate. The **CIR or CIR+EIR Frames** percentage is equal to the configured **Burst/IR Frame Ratio**.

➤ The “. . .” next to the burst sequence indicates that the burst sequence is repeated the number of times specified in the **Number of Burst Sequence** field.

Parameters

- **Number of Burst Sequence** is the number of times, **1** to **100** (default is **2**), the burst sequence will be repeated for the CBS and EBS tests.
- **Refill Delay Ratio (%)** is the percentage of time required to refill the **CBS/EBS** token buckets. The refill delay ratio is used for post-burst delay and the remaining percentage is applied to the pre-burst delay. The **Refill Delay Ratio** is configurable from **0** to **100** percent (**50** percent is the default as well as the standard's minimum recommended value).
- **Burst/IR Frame Ratio (%)** is the percentage of frames transmitted at **CIR** rate for the **CBS** test and the percentage of frames transmitted at **CIR+EIR** rate for the **EBS** test. The **Burst/IR Frame Ratio** is configurable from **10** to **90** percent (**90** percent is the default as well as the standard's recommended percentage value).

Table

Note: *Test time values are only displayed for enabled services.*

- **Service No** indicates the service number.
- **Service Name** indicates the name of the service.
- **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for local (**L**) and remote (**R**) directions, or port to port directions.
- **CBS Test Time (s)** indicates the total time required to perform all burst sequence iterations of the CBS test for this service.
- **EBS Test Time (s)** indicates the total time required to perform all burst sequence iterations of the EBS test for this service.
- **Total Burst Test Time (s)** indicates the total time required to perform all burst sequence iterations of both **CBS** and **EBS** tests for this service.

EtherSAM - Global

From the test menu, tap **Setup**, **Test Configurator**, tap on the test block, and on the **Global** tab.

Dual Test Set

➤ **Dual Test Set** (DTS) check box when selected (cleared by default) enables the **Dual Test Set** testing mode. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit. Not available in **Dual Port** topology.

Note: *It is also possible using the **Discover Remote** button to connect to a remoteunit and automatically enable **Dual Test Set**. For more details, refer to* Discover Remote *on page 418.*

Disconnected indicates that there is no connection established with a remote unit.

NAT LAN/WAN and **WAN IP** indicate presence of NAT (Network Address Translation) router. The NAT router is automatically detected and graphically displayed with LAN/WAN indication as well as the WAN IP address when the unit is behind a NAT router.

Note: *When there is a NAT at the Remote site, it is required to create UDP/TCP port 62819 forwarding rule on this NAT router to allow DTS communication. In addition, when there is a NAT in both directions (L->R and R->L), it is also required to create port forwarding rules on the NAT router located at the Remote side for every service defined.*

➤ **Discover Remote** allows discovering remote unit supporting **Remote Loopback** and/or **Dual Test Set**. For more details, refer to *Discover Remote* on page 418.

Subtests

- **Service Configuration Test** verifies if the network configuration is correct for each service before starting a long term test (Service Performance Test). To test the network configuration, a ramp test and/or a burst test is/are executed for each configured service.

  - **Subtest Duration** indicates the **Service Configuration Test** duration based on the configured Services, Ramp, and Burst settings.

  - **Ramp Test** check box when selected (default) enables the ramp test:

    In the first stage of the test, when **CIR** check box is selected (see *SLA Parameters* on page 197), the throughput is increased incrementally in steps until the CIR level is reached. During the first stage, the maximum Jitter, Latency, Frame Loss, and throughput are measured and are compared to the SLA thresholds to declare a pass/fail verdict.

    In the second stage of the test, when the **CIR+EIR** check box is selected (see *SLA Parameters* on page 197), the throughput is increased to the **CIR+EIR** level to compare against expected maximum throughput threshold to declare a pass/fail verdict.

    In the third stage of the test, when the **Traffic Policing** check box is selected (see *Test Parameters* on page 196), the throughput is increased one step over the **CIR+EIR** if selected otherwise over the **CIR** to compare against expected maximum throughput threshold to declare a pass/fail verdict.

    The ramp test procedure is performed for each enabled service.

- **Burst Test** check box when selected (cleared by default) verifies that the expected burst size can be transmitted at maximum burst rate with minimal loss.

  CBS (Committed Burst Size) check box when selected (see *SLA Parameters* on page 197), verifies the performance of a committed burst size at **CIR**'s average **TX** rate.

  EBS (Excess Burst Size) check box when selected (see *SLA Parameters* on page 197), verifies the performance of an excess burst size at **CIR+EIR's** average **TX** rate.

  The maximum Jitter, Latency, Frame Loss, and throughput are measured. For **CBS**, the Jitter, Latency, and Frame Loss are compared to the SLA thresholds to declare a pass/fail verdict. For **EBS**, the throughput is compared to the SLA thresholds to declare a pass/fail verdict.

  The burst test procedure is performed for each enabled service.

- **Service Performance Test** check box when selected (default) verifies that the **SLA** parameters (see *SLA Parameters* on page 197) are met over time by running multiple services simultaneously. The maximum Jitter, Latency, Frame Loss, and average throughput are measured and compared to the configured thresholds to declare pass/fail verdicts. The **Service Performance Test** is only performed for services that have their **CIR** check box selected.

  Subtest Duration allows setting the duration time, in HH:MM:SS format, for the **Service Performance Test** (default is 10 minutes).

- **Global Test Duration Estimation** indicates the total estimate duration of the test.

Global Options

- **Per Direction Configuration** check box when selected (default) specifies that the values can be configured independently for each direction (local to remote and remote to local) for **Dual Test Set** or for each port direction for **Dual Port**; for **Dual Port** using a different rate on each port, the check box is forced selected. When the **Per Direction Configuration** check box is cleared the configuration will be coupled and the values apply to both directions/ports. For **Dual Test Set** the **Per Direction Configuration** is only available when the communication with the remote unit is established.
- **Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict. A global pass/fail verdict is given for the EtherSAM test, **Service Configuration Test**, and **Service Performance Test** (for each service). The pass/fail verdict is based on the following criteria: **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, and **Average - RX Rate**.
- **Latency Measurement Mode**, available with **Dual Test Set**, allows the selection of the latency measurement mode: **Round-Trip** (default) or **One-Way** (MAX-880 only for rates from 10M to 10GE).

  Synchronization with 1PPS interface/reference is required to perform One-Way Latency measurement. One-Way Latency is only possible when both local and remote 1PPS signal clocks are valid. The following alarms are available with One-Way Latency measurement.

  LOPPS-L and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) are declared when either no pulse is received or when no pulse is received within 1 second $\pm$ 6.6 μs after the previous pulse. LOPPS-R is only monitored once the DTS connection is established.

Restore EtherSAM Defaults

Reverts the test application to its default factory settings.

EtherSAM - Ramp

Note: *The **Ramp** tab is only available for configuration when the **Ramp Test** check box is selected (see page 134).*

From the test menu, tap **Setup**, **Test Configurator**, tap on the test block, and on the **Ramp** tab.

Note: *The ramp configuration parameters are defined globally for all services but the presence of CIR+EIR, and Traffic Policing steps are as per each service configuration. CIR, CIR+EIR, and Traffic Policing steps are part of the step list as soon as they are enabled for at least one service even if that service is not enabled.*

- **Dynamic Ramp** graph displays the percentage of each CIR level step in time.
- **Step Time** indicates the test duration for each ramp step: **5** (default) to **60** seconds.
- **Ramp Duration** indicates the total time required to perform all the ramp steps for each service.
- **Add Step** allows adding a new ramp step. Enter the CIR percentage from **1** to **99**. A maximum of 7 pre CIR steps can be added in the ramp configuration.
- **Delete Step** allows deleting a step from the ramp. Select the step from the list and tap on **Delete**.
- **Defaults** reverts the ramp configuration to its default factory settings.

Frequency

Note: *The Frequency tab is only available for parallel interfaces.*

From the test menu, tap **Setup**, **Test Configurator**, tap on the interface block, and on the **Frequency** tab.

TX Frequency

Frequency (GHz) indicates the frequency (actual frequency + Frequency offset) used for transmission.

- **Offset (ppm)** check box, when selected (cleared by default), enables the frequency offset generation. The frequency offset[1] range is ±120 ppm for Ethernet test applications, ±50 ppm for Transport Framed, and ±120 ppm for Transport Unframed test applications.
  - **Fixed** (default): uses a fixed offset frequency value for generation. Use the "+" or "-" button to respectively increment or decrement the frequency offset value based on the defined **Step Size (ppm)**, or directly type the frequency offset value in the field.

    Step Size (ppm), available with **Fixed** frequency, allows setting the increment/decrement value (from 0.1 to either 50 or 120 depending on the test configuration) that will be used when changing the frequency offset with the "+" or "-" button.
  - **Sweep** increases and decreases repetitively the frequency to cover the defined frequency offset range using a 1 ppm step at an average rate of up to 10 ppm/sec. Starting at offset 0 the min value is reached then repetitively increases to the maximum value then decreases to minimum value.

    Range (ppm), available with **Sweep** frequency offset mode, allows setting the range for frequency sweep generation.

1. 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.

RX Frequency

Note: *The following frequency statistics are available for each lane.*

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

Note: *For both **Frequency** and **Offset** the following background colors are used.*

Background color	Description
Green	The frequency is in range.
Red	The frequency is out-of-range or LOC Lane.
Gray	Pending state.

Note: *In the **Test Configurator** - **Interface** block, **LO** and **HI** report respectively the current lowest and highest RX frequency offset values from any lane.*

- **Max. Negative Offset (ppm)** indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.
- **Max. Positive Offset (ppm)** indicates the maximum positive frequency offset between the standard rate specification and the rate from the received signal.

Note: *Refer to* Interface *on page 512 for more information on standard rate specifications.*

FTFL/PT

From the test menu, tap **Setup**, **Test Configurator**, tap on the signal block, and on the **FFTFL/PT** tab.

FTFL

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

➤ **Fault Indication** and **Code** allow the selection of the FTFL fault indicator message/code (byte 0 for forward, byte 128 for backward) to be generated.

Fault Indication	Code (Hex)
No fault	**00** (default)
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 **Code** field is automatically updated when the **Fault Indication** is changed and vice versa.*

➤ **Operator Identifier** allows editing the Operator Identifier to be generated (bytes 1 to 9 for forward, bytes 129 to 137 for backward; 9 characters allowed; not defined by default).

➤ **Operator Specific** allows editing the Operator Specific to be generated (bytes 10 to 127 for forward, bytes 138 to 255 for backward; 118 characters allowed; not defined by default).

PT

Allows configuring the generated/expected payload type (PT). Changing the generated payload type does not alter the signal structure; it only modifies the OH value that is generated.

➤ **Payload Type** and **Code** allows the selection of the generated/expected payload signal type either by selecting the payload type from the list or by entering its code in hexadecimal (**00** to **FF**).

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

Payload type	Hex Code	MSB 1234	LSB 5678
Reserved for International Standardization[a]	00	0000	0000
Experimental mapping	01	0000	0001
Asynchronous CBR mapping	02	0000	0010
Bit Synchronous CBR mapping	03	0000	0011
ATM mapping	04	0000	0100
GFP mapping	05	0000	0101
Virtual Concatenation Signal	06	0000	0110
PCS Codeword Transparent Ethernet	07	0000	0111
FC-1200 into ODU2e	08	0000	1000
GFP mapping into extended OPU2	09	0000	1001
OC-3/STM-1 into 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

Payload type	Hex Code	MSB 1234	LSB 5678
Bit Stream with Octet Timing mapping	10	0001	0000
Bit Stream Without Octet Timing mapping	11	0001	0001
IB SDR mapping into ODUflex	12	0001	0010
IB DDR mapping into ODUflex	13	0001	0011
IB QDR mapping into ODUflex	14	0001	0100
SDI mapping into OPU0	15	0001	0101
(1.485/1.001) Gbit/s SDI mapping into OPU1	16	0001	0110
1.485 Gbit/s SDI mapping in to OPU1	17	0001	0111
(2.970/1.001) Gbit/s SDI mapping into OPUflex	18	0001	1000
2.970 Gbit/s SDI mapping into OPUflex	19	0001	1001
SBCON/ESCON mapping into OPU0	1A	0001	1010
DVB_ASI mapping into OPU0	1B	0001	1011
FC-1600 mapping into OPUflex	1C	0001	1100
FlexE Client mapping into OPUflex	1D	0001	1101
FlexE aware (partial rate) mapping into OPUflex	1E	0001	1110
FC-3200 mapping into OPUflex	1F	0001	1111
ODU Multiplex with ODTUjk	20	0010	0000
ODU Multiplex with ODTUk.ts/ODTUjk	21	0010	0001
ODU multiplex with ODTUCn.ts	22	0010	0010
25GBASE-R mapping into OPUflex	30	0011	0000
200GBASE-R mapping into OPUflex	31	0011	0001
400GBASE-R mapping into OPUflex	32	0011	0010
Not Available[b]	55	0101	0101
Reserved Codes for Proprietary Use[c]	80	1000	0000

Payload type	Hex Code	MSB 1234	LSB 5678
NULL Test Signal mapping	FD	1111	1101
PRBS Test Signal mapping	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 covered 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: *The **Code** field is automatically updated when the **Payload Type** is changed and vice versa.*

➤ **OPU-PLM** check box when selected enables the OPU-PLM alarm analysis.

Interface

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and the **Interface** tab.

LINK (Ethernet Test Applications)

➤ **LINK** indicates the port link status (at the PCS level for parallel interfaces): link up (green arrow), error or link down (red arrow), or awaiting incoming data to provide a status (gray arrow).

Note: *Refer to: Ethernet* on page 511*; Ethernet - PCS Lanes* on page 512*; RS-FEC (Ethernet)* on page 514 *for more information on alarms.*

➤ **RS-FEC** check box when selected (default), available with framed 100GE interface, enables the use of the RS-FEC; ensure both ends of the circuit have the FEC enabled. The **RS-FEC** check box should be selected when using a 100GBASE-SR4, 100G-CWDM4, or 100G AOC transceiver but may be cleared for testing purposes. The **RS-FEC** check box is selected and dimmed for: 100GE (1 Lane), 100GE (2 Lanes). Not available when the **PHY Type** is set to **LR4**/**ER4**.

➤ **Remote Fault Emulation** check box when selected, generates **Remote Fault** ordered sets when a **Link Fault** is received. Available for rates 10GE and up with EtherBERT (all framing at the exception of **Unframed (Interop)**), and Traffic Gen & Mon (framed). Not available on 860, 860G, and 880 models.

➤ **Auto-Negotiation** check box when selected (default), available with 10/100/1000M Electrical and 1GE Optical interfaces, indicates to the remote port which parameters to use. For 1GE Electrical interface and when using an active copper SFP, the **Auto-Negotiation** check box is selected and dimmed.

Note: *When the **Auto-Negotiation** check box is selected, the port **Speed**, **Duplex**, **Flow Control**, and **Local Clock** parameters can be set. Those settings are not applied immediately to the port, they are used only when the* *negotiation process is started and take effect only when the auto-negotiation succeeds. However current settings are applied immediately to the port when the **Auto-Negotiation** check box is cleared.*

- **Speed**, available with 10/100/1000M Electrical interface, allows the selection of the interface rate: **10M**, **100M**, **1GE**, or **Auto**. **Auto** is only available when the **Auto-Negotiation** check box is selected. The negotiated speed will be displayed next to the **Speed** field selection.
- **Duplex** is configurable for **10M** and **100M** electrical interfaces and choices depend on the test application: **Full Duplex** (default), **Half Duplex**, or **Auto** (available when the **Auto-Negotiation** check box is selected). For other rates the duplex is set to **Full Duplex**. **Half Duplex** is not available with an active copper SFP. The negotiated duplex will be displayed next to the **Duplex** field selection.
- **Flow Control** is configurable and choices depend on the test application: **Enable TX**, **Enable RX**, **Enable RX and TX**, **None** (default), or **Auto** (available when the **Auto-Negotiation** check box is selected). When the **Flow Control** is set to **None**, pause frames received are ignored.
- **Cable Mode**, available with 10/100/1000M Electrical interface, indicates the cable mode based on the test application configuration.

  Manual mode is selected when the **Auto-Negotiation** check box is cleared and allows selecting the type of cable: **MDI** (default) for straight through cable or **MDIX** for crossover cable.

  Automatic mode is selected when the **Auto-Negotiation** check box is selected and allows the unit to automatically detect the MDI or MDIX cable type.
- **Local Clock**, available with 1GE electrical interface, allows setting the source of the clock: **Master** (default), **Slave**[1], or **Auto** (available when the **Auto-Negotiation** check box is selected). Not available with SyncE test application.

1. **Slave** is the only available choice for Time Error / Wander test application.

WIS Button

Note: *The **WIS** button is available with 10GE WAN interface.*

- **J0 Trace** allows setting the trace value in 16 bytes format (default is **EXFO 10GigE**).
- **J1 Trace** allows setting the trace value in 16 bytes format allowing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). Default is **EXFO 10GigE**.

Note: *Trace values should be 7-bit T.50 suitable characters. The* **Padding** *drop list from the message keyboard allows selecting* **Null** *or* **Space** *to fill up the trace message up to15-byte value automatically. The **Ctrl Char.** button from the trace message keyboard, allows selecting the required character (see* Keyboard Usage *on page 30).*

- **Path Signal Label (C2)** byte is allocated to indicate the content of the STS SPE, including the status of the mapped payload.

C2 (Hex.)	Description
00	Unequipped
01	Equipped - Non-Specific
1A[a]	10 Gbit/s Ethernet (IEEE 802.3)
FE	Test Signal, ITU-T 0.181

a. Default value.

Physical Interface

Note: *For parallel interfaces, the following information is displayed for each optical lane.*

- **Optical Lane** indicates the optical lane number for parallel interfaces.

Optical Interface	Optical Lane Number
100GE (2 Lanes)	0 and 1
40GE (4 Lanes) [41.25 Gbit/s] 100GE (4 Lanes) [103.125 Gbit/s]	0 through 3

- **Laser** indicates the status of the laser: **ON** with the laser pictogram (emitting an optical laser signal) or **OFF**.
- **TX Power (dBm)** indicates, when supported, the transmit power level of the optical laser/lane in dBm.
- **Wavelength (nm)** indicates, when supported, the detected lane/laser wavelength.
- **RX Power (dBm)** indicates, when supported, the current received power level of the optical laser/lane in dBm.

  Green: Power level in range.
  Yellow: Power level out-of-range.
  Red: Loss of signal or power level is close to damage.
  Gray: Invalid operational range value or not available/supplied by the transceiver.

  For parallel interfaces, **LO** and **HI** report respectively the current lowest and highest RX power levels from any lane.
- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser/lane in dBm.
- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser/lane in dBm.

- **Laser ON/OFF** button, available with parallel interfaces, is used to activate the laser control per optical lane or for all lanes. Select the **Laser** check box to enable/disable the laser for each lane individually or select the **All Lanes** check box to enable/disable all optical lanes at once.
- **Lasers OFF at Start-Up** check box when selected (cleared by default) automatically turns OFF the laser for serial interfaces or all lasers for parallel interfaces when starting the unit or when switching from one test application to another. However the laser remains ON, on a remote unit receiving a request for a DTS connection or a loopback command.
- **Modify Wavelength**, available with tunable SFP transceivers, refer to *Modify Wavelength (SFP)* on page 565.
- **Power Range (dBm**) indicates the transceiver operational RX power range.

TX Frequency

Note: *The following TX Frequency information applies to serial interface only, refer to* TX Frequency *on page 139 for parallel interfaces. Not available when using an active copper SFP.*

- **Frequency (GHz)** indicates the frequency (actual frequency + Frequency offset) used for transmission.
- **Offset (ppm)** check box, when selected (cleared by default), allows setting the frequency offset that will be generated: ±120 ppm for all Ethernet rates at the exception of 10GE WAN which is ±50 ppm; not supported for 10M electrical. Use the “+” or “-” button to respectively increment or decrement the frequency offset value based on the defined **Increment/Decrement Size**, or directly type the frequency offset value in the field.

  Step Size (ppm) allows setting the increment/decrement value (from 0.1 to the maximum offset) that will be used when changing the frequency offset with the “+” or “-” button.

RX Frequency

Note: *The following RX Frequency information applies to serial interface only, refer to* RX Frequency *on page 140 for parallel interfaces. Not available when using an active copper SFP.*

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

Note: *For both **Frequency** and **Offset** the following background colors are used.*

Background color	Description
Green	The frequency is in range.
Red	The frequency is out-of-range or LOC Lane.
Gray	Pending state.

- **Max. Negative Offset (ppm)** indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.
- **Max. Positive Offset (ppm)** indicates the maximum positive frequency offset between the standard rate specification and the rate from the received signal.

Labels

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and on the **Labels** tab.

Labels

Note: *Selecting a Label byte to be generated automatically update the corresponding OH byte and vice versa. Refer to* OH - SONET/SDH *on page 370 for more information. Check boxes are coupled with settings from Labels* on page 250.

- **STS Path (C2)** / **AU Path (C2)**: The C2 byte is allocated to indicate the content of the STS SPE / VC, including the status of the mapped payloads.

  Generated allows the selection of C2 byte (refer to *C2* on page 378).

- **PLM-P/UNEQ-P / HP-PLM/HP-UNEQ** check box when selected (cleared by default) enables the Payload Mismatch and STS/AU UNEQ monitoring.

  Expected allows the selection of the expected C2 byte value (refer to *C2* on page 378).

- **VT Path (V5) / TU Path (V5)**: The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads.

  Generated allows the selection of the V5 byte value (refer to V5 on page 381).

- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box when selected (cleared by default) enables the Payload Mismatch and VT/TU UNEQ monitoring.

  Expected allows the selection of the expected V5 byte value (refer to V5 on page 381).

Link OAM

From the test menu, tap **Setup**, **Test Configurator**, and the **Link-OAM (802.3)** test block.

OAM Mode

Allows the selection of the OAM mode:

➤ **Active** (default) initiates the OAM discovery and send OAMPDU loopback control; doesn't respond to variable request nor generate Link Event Notification.

➤ **Passive** doesn't initiate OAM discovery nor send OAMPDU loopback control.

OAMPDU Destination MAC Address

Indicates and allows changing the default multicast OAM PDU destination MAC address: **01:80:C2:00:00:02**.

Default check box when cleared (default is selected), allows the configuration of the OAM PDU destination MAC address: **00:00:00:00:00:00** to **FF:FF:FF:FF:FF:FF**.

Pass/Fail Verdict

Pass/Fail Verdict check box when selected (default) enables the use of the pass/fail verdict. A global fail verdict is declared when any of the following condition is met: **Link Down**, any Link OAM alarm, **Remote Alarms** (if enabled), or **Remote Loopback** (if enabled).

➤ **Remote Alarms** check box when selected (default) considers the following alarms to declare the pass/fail verdict: **Critical Event**, **Dying Gasp**, and **Link Fault**.

➤ **Remote Loopback** check box when selected (default) considers successful/unsuccessful remote loopback request to declare the pass/fail verdict.

OAM Discovery Status

➤ **Local** reports the local OAM discovery status as follows:

Status	Description
Evaluating	OAM discovery is started.
Stable	OAM discovery is completed. Local OAM is satisfied with the remote OAM settings.
Unsatisfied	OAM discovery cannot complete successfully. Local OAM equipment is unsatisfied with the remote OAM settings.

➤ **Remote** reports the remote OAM discovery status as follows:

Status	Description
Evaluating	OAM discovery is started.
Stable	OAM discovery is completed. Remote OAM is satisfied with the local OAM settings.
Unsatisfied	OAM discovery cannot complete successfully. Remote OAM equipment is unsatisfied with the local OAM settings.

Loopback

➤ **Local** and **Remote**

- ➤ **Status** indicates the status of the local and remote loopback: **Enabled** represents a Looped-Up condition and **Disabled** a Looped-Down condition.
- ➤ **Enable**/**Disable** button allows respectively Looping-Up (**Enable**) or Looping-Down (**Disable**).

MAC/IP/UDP

Note: *Only available with Framed Layer 2 and higher.*

From the **Test** menu, tap **Setup**, **Test Configurator**, and...

For **RFC 2544** and **EtherBERT**, tap on the protocol block.

For **EtherSAM**, and **Traffic Gen & Mon**, tap on the protocol block, and on the **MAC/IP/UDP** tab.

- Stream selection, available with Traffic Gen & Mon, allows the configuration of up to 16 streams individually by either using the left/right arrow or by tapping over the stream numbers area then on a specific number.
- Service selection, available with EtherSAM, allows the configuration of up to 10 services individually by either using the left/right arrow or by tapping over the service numbers area then on a specific number.
- **Couple with Interface** check box when selected (default) couples the following settings with the interface (see *Network* on page 163) as default configuration; changing any Network setting re-applies the coupling process for that setting: **Frame Format**, **Network Layer**, **Source MAC Address**, and all **IP** and **VLAN**[1] settings. The **Source MAC Address** is always coupled when the Network Layer is set to IPv4 or IPv6.
- **Discovery**, available with Traffic Gen & Mon for rates up to 10GE WAN, allows scanning the remote interface to discover packet signatures that can be used for stream configuration. Refer to *Remote Interface Discovery* on page 568.

Modify Frame Structure

Note: *Refer to* Modify Frame Structure *on page 563.*

1. VLAN is not coupled for EtherSAM.

Preamble/SFD

Preamble/SFD indicates that the frame structure contains the Preamble and SFD.

MAC

- **Source MAC Address** either indicates or allows changing the source Media Access Control (MAC) address. The MAC address is editable per stream/service when either:
  - The **Network Layer** is set to **None** and the **MAC Address - Factory Default** check box (from the **Network** tab) is cleared.
  - The **Network Layer** is set to **None**, the **MAC Address - Factory Default** check box (from the **Network** tab) is selected, and the **Couple with Interface** check box is cleared.
- **Destination MAC Address** allows entering the destination MAC address for the stream. The default setting is the source MAC address. The destination MAC Address field is not accessible when the **Resolve MAC Address** check box is selected.
- **Resolve MAC Address** check box, when selected (default), sends a request to the network to retrieve the MAC address corresponding to the selected destination IP address. This setting is coupled with the **Resolve MAC Address** check box from *IP (IPv4) / IPv6* on page 159. Not available when the **Network Layer** is set to **None** (refer to *Modify Frame Structure* on page 154).
- **EtherType** is set to the following values by default and is configurable from **0x0000** to **0xFFFF** when the **Network Layer** is set to **None**:

  0x0000 when **Network Layer** is set to **None**
  0x0800 for IPv4
  0x86DD for IPv6
  0x8847 for MPLS
  0x88B7 when **Network Layer** is set to **None** with EtherBERT test

Note: *Depending on the **Layer Mode** (available with EtherSAM), some EtherType require to set the configuration parameters through the **Modify Frame Structure** pop-up instead of configuring its value from this field; in this case a pop-up message is displayed indicating the reason. The following EtherType are not supported for **Mixed** layer mode: 0x0001 to 0x05FF and 0x8870.*

- **OUI**, available when the frame format **802.3 SNAP** is selected, allows the selection of the Organizationally Unique Identifier (OUI):

  RFC1042 (0x000000) - (default)
  User Defined, available when **Network Layer** is set to **None**, allows entering the **OUI** value: **0x000000** (default) to **0xFFFFFF**.

- **Source Flooding** and **Destination Flooding** check boxes when selected (cleared by default) allows generation of frames using source/destination MAC addresses flooding as follows: The first frame is transmitted starting with the least significant bits of the source/destination MAC address covered by the range set to 0; each subsequent frame is transmitted by incrementing the least significant bits by 1; when the upper limit of the range is reached, the source/destination MAC address restarts over with the least significant bits covered by the range set to 0. Available with Traffic Gen & Mon when the **Network Layer** is set to **None** (see page 563).

- **Flood Range** is the range of the least significant bits used for the Source Flooding and/or Destination Flooding: **2 (1 bit)**, **4 (2 bits)**, **8 (3 bits)**, **16 (4 bits)**... up to **16777216 (24 bits)** (default). Available with Traffic Gen & Mon when the **Network Layer** is set to **None** (see page 563).

VLAN

Note: ***VLAN** is only available when **VLAN Tag** is enabled; refer to* Modify Frame Structure *on page 154.*

For each VLAN tag enabled (C-VLAN/S-VLAN/E-VLAN) the following parameters are configurable.

➤ **VLAN ID** allows selecting the VLAN ID: **0** through **4095** (default is **2**). Special 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.

➤ **Priority** allows selecting the VLAN priority: **0** (default) to **7**:

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

➤ **Type** allows selecting the VLAN Ethernet Type: **0x8100** (default for C-VLAN), **0x88A8** (default for S-VLAN), **0x9100** (default for E-VLAN), **0x9200**, or **0x9300**.

➤ **Drop Eligible** when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is not available when VLAN type is 0x8100. This setting is set to **No** by default.

MPLS

Note: *__MPLS__ is only available when __MPLS Label__ is enabled; refer to* Modify Frame Structure *on page 154.*

- **Label** allows the selection of the MPLS TX labels: **0** to **1048575** (default is **16**). Refer to for the list of MPLS labels.
- **COS** allows the selection of the Class Of Service.

  0 (000 - Low) (default)
  1 (001 - Low)
  2 (010 - Low)
  3 (011 - Low)
  4 (100 - High)
  5 (101 - High)
  6 (110 - High)
  7 (111 - High)
- **TTL** allows selecting the Time to Live: **0** to **255** (default is **128**).

S-OAM

Only available with EtherSAM when the __S-OAM__ check box is selected; refer to Modify Frame Structure *on page 154.* **MEG/MD Level** allows the selection of the Maintenance Entity Group Level / Maintenance Domain Level: **0** to **7** (default).

IP (IPv4) / IPv6

For **IPv4** only:

- **Automatic IP (DHCP)** check box when selected (cleared by default) allows obtaining an IP address dynamically from a DHCP (Dynamic Host Configuration Protocol) server.

Note: *__Source IP Address__, __Subnet Mask__, and __Default Gateway__ are not configurable when the __Automatic IP (DHCP)__ check box is selected.*

- **Source IP Address** allows entering the source IP address for the stream. The default setting is 10.10.x.y, where x and y are respectively the two least significant bytes of the port default MAC address. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Destination IP Address** allows entering the destination IP address for the stream. The default setting is the source IP address.
- **Subnet Mask** allows entering the Subnet Mask (default is **255.255.0.0**).
- **Default Gateway** check box when selected (cleared by default) allows entering a default Gateway IP address (default is **0.0.0.0)**.
- **TTL** allows selecting the Time to Live: **1** to **255** (default is **128**).
- **IP TOS/DS** allows entering either an hexadecimal value, **00** (default) to **FF**, or tap on the **TOS/DS Config** button to set each TOS or DS parameter individually (Refer to *TOS/DS Config* on page 572). Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.

For **IPv6** only; refer to *IPv6 Address Configuration* on page 555 for **Source Link-Local IPv6 Address**, **Source Global IPv6 Address**, and for additional settings.

- **IPv6 Destination Address** allows selecting the destination IP address for the stream that must start with **FE80**. The accepted range is from **0000:0000:0000:0000:0000:0000:0000:0001** to **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF.** The default address is **2001::**. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing the selection of a previously configured IP address.
- **Flow Label** is a number used to identify a series of related packets from a source to a destination: **0** (default) to **1048575**.
- **HOP Limit TTL** sets the Time To Live value: **1** to **255** (default is **128**).
- **Traffic Class (TOS/DS)** allows entering either an hexadecimal value, **00** (default) to **FF**, or tap on the **TOS/DS Config** button to set each TOS or DS parameter individually (Refer to *TOS/DS Config* on page 572). Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.

For both IPv4 and IPv6:

- **Quick Ping** button automatically starts the quick Ping utility for the stream destination IP address and provides either a successful or failed result. The quick Ping uses 3 attempts, a Delay of 1 second, a Timeout of 2 seconds, and a Data Size of 32 Bytes. Refer to *Ping & Trace Route* on page 390 for more options.

- **Resolve MAC Address** check box, when selected (default), sends a request to the network to retrieve the MAC address corresponding to the selected destination IP address. This setting is coupled with the **Resolve MAC Address** check box from *MAC* on page 155. The Resolve MAC address status is displayed as follows:

Status	Description
--	The **Resolve MAC address** is not enabled.
Resolving	The MAC address is being resolved.
Resolved	The MAC address is resolved.
Failed	The MAC address cannot be resolved.

- **Source IP Multiplicator** check box, when selected (cleared by default), allows changing the 7 LSB (Least Significant bit) of the source IP address as specified in the range: **1-128** (default) or **0-127**.

UDP

- **Source Port** allows configuring the source UDP port number: **0** to **65535** (default is **49184**).
- **Destination Port** allows configuring the destination UDP port number: **0** to **65535** (default is **7 (echo)**).

TCP

- **Source Port** allows configuring the source TCP port number: **0** to **65535** (default is **49184**).
- **Destination Port** allows configuring the destination TCP port number: **0** to **65535 (**default is **7 (echo)**).

Payload

For RFC 2544 and EtherBERT, indicates that the frame structure contains a Payload.

For Traffic Gen & Mon, allows the selection of both user defined header and pattern. Payload is not configurable when the **QoS Metrics Tags Insertion** check box is selected (see the **Global** tab).

- **User Defined Header** check box when selected (cleared by default) allows defining a 16-byte header.
- **Pattern** allows the selection of a pattern: **00** to **FF** (default is **CC**).

FCS

FCS indicates that the frame structure contains an Ethernet FCS.

Network

From the test menu tap **Setup**, **Test Configurator**, the interface block, and the **Network** tab.

Note: *For Through Mode test application, the Network tab is only available for the Primary Port but the configured parameters apply to both ports.*

MAC

- **MAC Address** indicates and allows changing, when the **Factory Default** check box is cleared, the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **Factory Default** check box when selected (default) indicates that the factory source MAC address is used.
- **Frame Format** (layer 2) allows selecting **Ethernet II** (default) or **802.3 SNAP** as the frame format.

IP

- **IP Version** allows selecting **IPv4** (default) or **IPv6**.

For **IPv4** only:

- **Automatic IP (DHCP)** check box when selected (cleared by default) allows obtaining an IP address dynamically from a DHCP (Dynamic Host Configuration Protocol) server.

Note: ***IP Address**, **Subnet Mask**, and **Default Gateway** are not configurable when the **Automatic IP (DHCP)** check box is selected.*

- **IP Address** allows entering the IP address of the port. The default address is 10.10.x.y, where x and y are respectively the two least significant bytes of the port default MAC address.
- **Subnet Mask** allows entering the Subnet Mask (default is **255.255.0.0**).

➤ **Default Gateway** check box when selected (cleared by default) allows entering a default Gateway IP address (default is **0.0.0.0)**.

For **IPv6** only; refer to *IPv6 Address Configuration* on page 555 (**Config...** button) for **Link-Local IPv6 Address**, **Global IPv6 Address**, **Default Gateway**, and for additional settings.

VLAN

➤ **VLAN Tag** check box when selected (cleared by default) enables and allows setting up to 3 stacked VLANs. For each VLAN tag enabled (C-VLAN, S-VLAN, E-VLAN) the following parameters are configurable.

➤ **VLAN ID** allows selecting the VLAN ID: **0** through **4095** (default is **2**). Special 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.

➤ **Priority** allows selecting the VLAN priority: **0** (default) to **7**:

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

- **Type** allows selecting the VLAN Ethernet Type: **0x8100** (default for C-VLAN), **0x88A8** (default for S-VLAN), **0x9100** (default for E-VLAN), **0x9200**, or **0x9300**.
- **Drop Eligible** when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is not available when VLAN type is 0x8100. This setting is set to **No** by default.

Note: *Not available with* ***Manual Loopback*** *remote operation mode.*

RFC 2544 - Global

From the test menu, tap **Setup**, **Test Configurator**, tap on the **RFC 2544** block, and on the **Global** tab.

Dual Test Set

➤ **Dual Test Set** (DTS) check box when selected (cleared by default) enables the **Dual Test Set** testing mode. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit. Not available in **Dual Port** topology.

Note: *It is also possible using the **Discover Remote** button to connect to a remoteunit and automatically enable **Dual Test Set**. For more details, refer to* Discover Remote *on page 418.*

Disconnected indicates that there is no connection established with a remote unit.

Connected indicates that the connection is established with a remote unit.

➤ **Discover Remote** allows discovering remote unit supporting **Remote Loopback** and/or **Dual Test Set**. For more details, refer to *Discover Remote* on page 418.

Global Options

➤ **Flow Direction** allows the selection of the traffic direction as follows:

  ➤ **TX to RX** for **Single Port** topology.

  ➤ **Port <m> to Port <n>**, **Port <n> to Port <m>**, and **Bidirectional** for **Dual Port** topology.

  ➤ **Local to Remote**, **Remote to Local**, or **Bidirectional** for **Dual Test Set**.

- **Coupled**, available with **Bidirectional** flow direction, defines if the decision to increase or decrease the TX Rate of the next iteration is taken either independently per direction (**Coupled** check box is cleared) or commonly for both directions (**Coupled** check box is selected).
- **Rate Unit** allows selecting either **%**, **Mbit/s**, or **Gbit/s** as the reference for the rate values.
- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict.

Subtests / Estimated Time

- **Subtests** allows enabling the **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** subtests individually.
- **Estimated Time (H:MM)** indicates the estimated time required to complete each subtest at best conditions. The total estimated time to complete all subtests is also displayed.

Frame Distribution

- **Frame Distribution** allows selecting either **RFC 2544** (default) or **User Defined** distribution.
- **Quantity** is only available when **User Defined** is selected and allows selecting the number of frames, from **1** to **10** (**7** by default), in the distribution.

➤ **Frame Size (Bytes)** either gives predefined frame size distribution values (**RFC 2544**) or allows entering the frame size values (**User Defined**).

Distribution	Frame Size
RFC 2544	**64**[a],**128**, **256**, **512**, **1024**, **1280**, and **1518**
User Defined	**64**[a] to **16000**

a. The minimum frame size will be adjusted according to the frame structure and components selected.

The following table lists each component that may affect the minimum size value.

Component	Description
VLAN	4 bytes per VLAN tag (up to 3 VLAN tags)
LLC and SNAP Headers	8 bytes
IPv4	20 bytes
IPv6	40 bytes
Using DTS	4 bytes

Restore RFC 2544 Defaults

Reverts the test application to its default factory settings.

RFC 2544 - Subtests

From the test menu, tap **Setup**, **Test Configurator**, **RFC 2544** block, and on the **Subtests** tab.

Allows the configuration of each enabled subtest.

Throughput

The objective of the **Throughput** test is to find the throughput of the device under test for which there is no frame loss. Starting at the specified maximum rate (**Max. Rate**), the rate converges towards the highest throughput without frame loss. The search is done with a halving/doubling method until a final value is reached. The test performs the number of trials defined (**Trials**). The throughput measurement is validated by the number of times specified (**Validations**) for the predefined duration (**Trial Duration**). The **Accuracy** and **Acceptable Errors** specify how precise the result must be. The test is performed for each defined frame size.

- **Max. Rate** is the maximum rate the test should begin with, in terms of a percentage of the line rate (**%**), **Mbit/s**, or **Gbit/s**. For **Dual Test Set** Max. Rate is configurable for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, **Max. Rate** is configurable for both port directions.

Interface Speed	Max. Rate		
	%	Mbit/s	Gbit/s
10 Mbit/s	0.0050 to 100.0000[a]	0.00001 to 10.000[a]	Not Applicable
100 Mbit/s	0.0050 to 100.0000[a]	0.0001 to 100.000[a]	Not Applicable
1000 Mbit/s	0.0050 to 100.0000[a]	0.001 to 1000.00[a]	0.000001 to 1.000[a]
10G LAN	0.0050 to 100.0000[a]	0.01 to 10000.000[a]	0.00001 to 10.000[a]
10G WAN[b]	0.0005 to 92.8571[a]	0.01 to 9285.71[a]	0.00001 to 9.28571[a]
40G	0.0050 to 100.0000[a]	2.00 to 40000.0[a]	0.00200 to 40.0000[a]
100G	0.0050 to 100.0000[a]	5.00 to 100000.0[a]	0.00500 to 100.0000[a]

a. Default value.
b. The maximum value for 10G WAN may be lower depending on the frame size. The maximum value will be adjusted for each frame size.

- **Trial Duration** is the time for each trial in minutes:seconds: **1** second (default) to **30** minutes.
- **Trials** is the number of times the test will be generated: **1** (default) to **50** trials.

➤ **Accuracy** is the accuracy measurement in percentage of the line rate (**%**), **Mbit/s**, or in **Gbit/s**. The accuracy is not based on the configured **Maximum Rate** but on the Ethernet line rate:

Interface Speed	Max. Rate		
	%	**Mbit/s**	**Gbit/s**
10 Mbit/s	0.01 to 10.0 (default 1.0)	0.01 to 1.0 (default 0.10)	Not Applicable
100 Mbit/s	0.01 to 10.0 (default 1.0)	0.1 to 10.0 (default 1.0)	Not Applicable
1000 Mbit/s	0.01 to 10.0 (default 1.0)	1 to 100.0 (default 10)	0.001 to 0.100 (default 0.010)
10G LAN	0.01 to 10.0 (default 1.0)	10.0 to 1000.0 (default 100)	0.01 to 1.00 (default 0.10)
10G WAN	0.01 to 10.0 (default 1.0)	10.0 to 1000.0 (default 100.00)	0.01 to 1.00 (default 0.1)
100G	0.01 to 10.0 (default 1.0)	100.0 to 10000.0 (default 1000.0)	0.10 to 10.00 (default 1.0000)

Note: *For Dual Test Set using different rates on local and remote, the accuracy on the remote will be set using the same percentage of its line rate as the local. For example, if the local interface is 1GE with an accuracy of 0.1 Gbit/s which correspond to an accuracy of 10% and the remote interface is 10GE, the 10% is applied to its line rate corresponding to an accuracy of 1 Gbit/s.*

Acceptable Errors represents the number of acceptable errors for the test: **0** (default) to **10**.

Validations represents the number of times the result should be validated: **1** (default) to **50** times.

Back-to-Back

The objective of the **Back-to-Back** test is to find the maximum number of frames that can be sent at maximum throughput without frame loss.
A burst of frames (**Burst Time**) is sent with minimum inter-frame gaps to the device under test and the number of forwarded frames is counted. If the count of transmitted frames is equal to the number of forwarded frames, the length of the burst is increased and the test is rerun. If the number of forwarded frames is less than the number of transmitted frames, the length of the burst is reduced and the test is rerun. The Back-to-Back value is the number of frames in the longest burst that the Device Under Test (DUT) can handle without the loss of any frames. The test performs the number of defined trials (**Trials**). The **Accuracy** and **Acceptable Errors** settings specify how precise that result must be. The test is performed for each defined frame size.

➤ **Burst Time** is expressed in seconds: **1** (default) to **5** seconds.

➤ **Trials** is the number of times the test will be generated: **1** (default) to **50** trials.

➤ **Accuracy (Frames)** is the accuracy measurement value in frames: **1** (default) to **50** frames.

➤ **Acceptable Errors** represents the number of acceptable errors for the test: **0** (default) to **10**.

➤ **Bursts** represents the number of burst that will be generated: **1** (default) to **10**.

Frame Loss

The objective of the **Frame Loss** test is to find the percentage of frames that are lost due to lack of resources. Starting at the specified maximum rate (**Max. Rate**), the test is performed for a specific frame size and for the specified duration **(Trial Duration)**. The test is repeated by decreasing the rate by the specified granularity (**Granularity**), then the test is repeated again until there are two successive trials in which no frames are lost. The test is performed for the defined number of trials (**Trials**). The test is performed for each defined frame size.

➤ **Max. Rate** is the maximum rate the test should begin with, in terms of a percentage of the line rate (**%**), **Mbit/s**, or **Gbit/s**. The accepted values are as shown in the Max. Rate table on page 170. For **Dual Test Set** the **Max. Rate** is configurable for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, **Max. Rate** is configurable for both port directions.

➤ **Trial Duration** is the time for each trial in minutes:seconds: **1** second (default) to **30** minutes.

➤ **Trials** is the number of times the test will be generated: **1** (default) to **50** trials.

➤ **Granularity** corresponds to the percentage interval between each throughput value used for the test: 1 % to 10 % (RFC) - (default). For example, 10 % granularity means that the test will be performed for 100 %, 90 %, 80 %... of the rate value.

Latency

The objective of the **Latency** test is to measure the time required for the frame to go through the device under test and return back to source. Starting by sending a stream of frames for the predefined duration **(Trial Duration)** and throughput (**Max. Rate**) at a particular frame size, an identifying dependent tag is included in one frame. The time at which this frame is transmitted is recorded (*timestamp A*). When the tagged frame comes back, the time is recorded again (*timestamp B*) and the Latency result is: *timestamp B - timestamp A*. The test is repeated for the defined number of times (**Trials**) and the average result is calculated. The test is performed for each defined frame size.

➤ **Trial Duration** is the time for each trial in minutes:seconds: **1** second (default) to **2** minutes.

➤ **Trials** is the number of times the test will be generated: **1** (default) to **50** trials.

➤ **Copy From Throughput**check box, when selected (default), uses the Throughput subtest results max rate value for each corresponding frame size. When the check box is cleared, it is possible to set the **Max. Rate** by tapping on the **Config. per Frame Size** button.

➤ **Margin %**, available when **Copy From Throughput** check box is selected, decreases the max rate value(s) from the Throughput subtest by a value corresponding to the percentage of the line rate specified: **0** (default) to **10** percent.

- **Measurement Mode**, available with **Dual Test Set**, allows the selection of the latency measurement mode for rates 10M to 10GE: **Round-Trip** (default) or **One-Way** (MAX-880 only). For other rates, the measurement mode is set to **Round-Trip**.

  Synchronization with a 1PPS interface/reference is required to perform One-Way Latency measurement. One-Way Latency is only possible when both the local and remote 1PPS signal clocks are valid. The following alarms are available with One-Way Latency measurement mode.

  LOPPS-L and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) are declared when either no pulse is received or when no pulse is received within 1 second ± 6.6 μs after the previous pulse. LOPPS-R is only monitored once the DTS connection is established.

- **Config. per Frame Size** is available when the **Copy From Throughput** check box is cleared and allows setting the **Max. Rate** for each frame size. For **Dual Test Set** the **Max. Rate** is configurable for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, **Max. Rate** is configurable for both port directions.

  All Frames check box when selected (cleared by default) allows entering the maximum rate that will be applied to all frame sizes.

Thresholds

Note: *Refer to Thresholds - RFC 2544* on page 570.

RFC 6349

From the test menu, tap **Setup**, **Test Configurator**, and the RFC 6349 block.

Connection

➤ **Operation Mode** allows the selection of the test operation mode:

- ➤ **RFC 6349 DTS** mainly validates how well a service can handle TCP.
- ➤ **TCP Throughput DTS** mainly measures the maximum TCP Throughput of the link under test.
- ➤ **iPerf Compatible Server** acts as a TCP responder. Not available for 40GE interface.

Once a Dual Test Set (DTS) connection is established with a remote module, it is not possible to change the Operation Mode until the remote is disconnected.

For **RFC 6349 DTS** and **TCP Throughput DTS** the connection is graphically displayed with its status as follows:

Operation Mode	Status	Description
RFC 6349 DTS **TCP Throughput DTS**	**Disconnected**	No connection established with a remote module.
	NAT LAN/WAN, WAN IP	Connection established with a remote module. NAT LAN/WAN and WAN IP indicate presence of NAT (Network Address Translation) router. The NAT router is automatically detected and graphically displayed with LAN/WAN indication as well as the WAN IP address when the MaxTester is behind a NAT router. When there is a NAT at the Remote site, it is required to create the following rules on this NAT router: 1- for UDP/TCP port 62819 to allow DTS communication. 2- for the defined TCP port (see TCP Port on page 177).

For **RFC 6349 DTS** and **TCP Throughput DTS**:

- **Discover Remote** button allows discovering remote modules supporting Dual Test Set. For more details, refer to *Discover Remote* on page 418.
- **Direction** allows the selection of the traffic direction: **Local to Remote**, **Remote to Local**, and **Bidirectional** (default).
- **TCP Port** is the port used by the server located at the remote side: **1** to **65535** (excluding **62819** that is used for DTS connection), default is **50201**. The port forwarding rule for the defined TCP port must be created on the NAT router when the remote is behind a NAT.

For **iPerf Compatible Server**:

- **Listening TCP Port** allows the selection of the port used by the server located at the remote side: **1** to **65535** (excluding **62819** that is used for DTS connection), default is **5001**.
- **Max Nb of Connection Allowed** for 100GE interface, allows selecting the maximum number of connections the iPerf compatible server is allowed to accept: **16** (default) or **128**. Using a maximum of 16 connections allocates more memory per connection useful when the path delay is large and only few connections are used.

Parameters

For **RFC 6349 DTS** and **TCP Throughput DTS**:

- **TOS/DS** (IPv4) or **Traffic Class (TOS/DS) -** (IPv6) allows entering either an hexadecimal value, **00** (default) to **FF**, or tap on the **TOS/DS Config** button to set each TOS or DS parameter individually. Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.
- **TOS/DS Config** button allows to set the Type of Service or the Differentiated Service parameters. Refer to *TOS/DS Config* on page 572.

For **RFC 6349 DTS**:

- **Multiple Connections** check box when selected (default) indicates that the applicable TCP Throughput phases are performed with multiple connections; otherwise TCP Throughput phases are performed within a single connection. For 40/100GE rate, this check box is selected and the **Window Size Target per Connection** can be used to set the target window.
- **Window Size Target per Connection**, available for 40/100GE rate, selects the target send window per connection: 1 MiB, 4 MiB, 8 MiB, 16 MiB (default), and 32 MiB.
- **CIR** is the Committed Information Rate per direction of the Ethernet Service under test: **1.0 Mbit/s** to Line Rate. The CIR is not used to actually transmit frames at this rate but to calculate a Bandwidth Delay Product (BDP) which in turn is used to set the maximum window size of the TCP connections.

  Rate Unit allows selecting either **Mbit/s** (default) or **Gbit/s** as the reference for the rate value.
- **Window Boost - Enable** check box when selected (cleared by default) boosts the BDP value which affects the maximum window size of the TCP connections.

  The Local-to-Remote and Remote-to-Local define respectively the BDP boost factor for each direction: **0.1** to **10.0** (default is **1.0**).

For **TCP Throughput DTS**:

- **Number of Connections** allows selecting the number of connections: **Auto** (default) or **Manual** (from 1 to the maximum number of connections allowed). In **Manual** mode, the value is readjusted downwards when connecting to a remote unit offering less connections than the configured value.

MTU (RFC 6349 DTS and TCP Throughput DTS)

- **Max MTU (bytes)** determines the Maximum Transfer Unit (MTU) to use when the client is generating TCP traffic toward the server: from **1080** to **9600** bytes (**1500** bytes by default).
- **Path MTU Discovery** check box when selected (default) allows performing a Packetization Layer Path MTU Discovery phase.

Window Sweep (RFC 6349 DTS)

- **Window Sweep** check box when selected (default) allows performing the Window Sweep phase.
- **Duration (per step)** is the duration of the Window Sweep phase per direction and per Window tested: 30 seconds (default) to 5 minutes.

TCP Throughput

For **RFC 6349 DTS** and **TCP Throughput DTS**:

- **Duration** is the duration of the TCP Throughput phase per direction: 15 seconds to 1 day (30 seconds by default).
- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict.
- **Threshold (% of ideal)** allows entering the TCP Throughput as a percentage of the Ideal L4 Throughput that will be used to declare the pass/fail verdict for both directions: **0** to **100** %; default is **95 %**. For **TCP Throughput DTS**, only available when the **Pass/Fail Verdict** check box is selected.

For **TCP Throughput DTS**:

- **CIR** is the Committed Information Rate per direction of the Ethernet Service under test: **1.0 Mbit/s** to Line Rate. The CIR is used as the threshold to declare the **Ideal L4** pass/fail verdict. Available when the **Pass/Fail Verdict** check box is selected.

Rate Unit allows selecting either **Mbit/s** (default) or **Gbit/s** as the reference for the rate value.

Advanced (RFC 6349 DTS)

Recommended Window Boost

- **Buffer Delay Weight** is a multiplicator applied to the Buffer Delay value used in the Suggested Window Boost formula: **0** to **10** (default is **1**).
- **TCP Throughput Weight** is a multiplicator applied to the TCP Throughput value used in the Suggested Window Boost formula: **0** (default) to **10**.

Restore RFC 6349 Defaults

Reverts the configured parameters to their default values.

S-OAM and MPLS-TP OAM

From the test menu, tap **Setup**, **Test Configurator**, and the **S-OAM (Y.1731/802.1ag/MEF)** or **MPLS-TP OAM (G.8113.1)** test block.

OAM Mode

Allows the selection of the OAM mode.

OAM Type	OAM Mode
S-OAM	**Y.1731** (default) supports both Connectivity Fault Management and Performance Monitoring which includes all S-OAM functions supported by this module.
	802.1ag supports Connectivity Fault Management including only the Continuity Check, Loopback, Link Trace, and RDI functions.
	MEF supports both Connectivity Fault Management and Performance Monitoring which includes all S-OAM functions supported by this module.
MPLS-TP OAM	G.8113.1 (default) supports both Connectivity Fault Management and Performance Monitoring which includes all MPLS-TP OAM functions supported by this module.

S-OAM and MPLS-TP OAM Responder

S-OAM Responder or **MPLS-TP OAM Responder** check box when selected (default) allows responding to LBM, LTM, DMM, LMM, and SLM valid messages (test running or not). LTM and SLM are only available with Ethernet OAM. Traffic statistics are also monitored (refer to *Responder* on page 332).

For S-OAM: A valid message must have its source MAC address matching the Peer MEP MAC address, destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address, VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 505 for more information.

For MPLS-TP OAM: A valid message must have its: destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; MPL Labels matching the local MPLS Label Stack configuration, including GAL; MEG Level matches the local MEG Level. For the Loopback function, a valid message must also have its: MEP ID of the target MEP ID TLV matching the Local MEP ID or ID Sub-Type is 0x00 (Discovery); and MEP ID and MEG ID of the requesting MEP ID TVL, if present, matching respectively the Peer MEP ID and the Local MEG ID.

Respond to... message	Respond with... message
LBM	LBR
LTM[a]	LTR
DMM	DMR
LMM	LMR
SLM[a]	SLR

a. Only available with Ethernet OAM.

Pass/Fail Verdict

Pass/Fail Verdict check box when selected (default) enables the use of the pass/fail verdict. A global fail verdict is declared when any of the following condition is met: **Link Down** alarm, **Loss Continuity** alarm, or any fail verdict for **Frame Delay**, **Frame Loss**, **Synthetic Loss** (Only applicable to Ethernet OAM), **Frame Delay Failure**, **Frame Loss Failure**, **Synthetic Loss Failure** (Only applicable to Ethernet OAM), **Loopback Failure**, or **Test Failure**.

Thresholds

Note: *Refer to* Thresholds (S-OAM) *on page 571.*

Next HOP Router (G.8113.1)

- **MAC Address**, available when **Resolve MAC** check box is cleared, allows entering the Next HOP Router MAC address: 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF, default is 01:00:5E:90:00:00. The MAC Address 01:00:5E:90:00:00 is reserved for point-to-point link and can be used when the unicast address is unknown (as per RFC-7213).
- **Resolve MAC** check box, when selected (cleared by default), sends a request to the network to retrieve the MAC address corresponding to the selected IP address.
- **IP Address**, available when **Resolve MAC** check box is selected, allows entering the Next HOP Router IP address: 0.0.0.0 to 255.255.255.255 for IPv4; default is the source IP address; ::1 to FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF for IPv6, default is 2001::.

Local Parameters

- **MEG ID** (Y.1731 and G.8113.1), the Maintenance Entity Group Level identification, allows defining a 13-bytes MEG ID value/message to be generated (default value is **EXFO MEG ID**). Values should be ASCII suitable characters including the *ITU T.50 Characters* on page 32.

  Padding allows the selection of the character (**Null** or **Space**) to used for remaining byte values.
- **MAID** (802.1ag and MEF) is a 45 bytes Maintenance Association Identification that is divided into two parameters:
  - **Domain ID** is an optional domain identification text field (0 byte (Domain ID not present), up to 44 bytes minus the **MA Name** field length) set to **EXFO Domain ID** by default.
  - **MA Name** (Short MA Name) is a Maintenance Association Name text field set to **EXFO MA Name** by default. The length of the **MA Name** field is from 1 to either 44 bytes minus the **Domain ID** field length when Domain ID is present or 45 bytes when not present.

- **MEG Level** (Y.1731, MEF, and G.8113.1) is the Maintenance Entity Group Level configurable from **0** to **7** (default).
- **MD Level** (802.1ag) is the Maintenance Domain Level and is configurable from **0** to **7** (default).
- **MEP ID** is the Maintenance Entity Group End Point Identification configurable from **0x0001** (default) to **0x1FFF**.

Peer MEP Parameters

- **MAC Address**, available with S-OAM Mode, allows entering the unique Media Access Control (MAC) address of the peer MEP (default is **00:00:00:00:00:00**).
- **MEP ID** is the Maintenance Entity Group End Point Identification configurable from **0x0001** (default) to **0x1FFF**.
- **OAM Quick Ping** verifies the bidirectional connectivity with the peer MEP. The **Successful** message is reported when at least one of three attempts has been successful otherwise **Failed** is reported.

Continuity Check

- **CC Function** check box when selected (default) allows transmitting and monitoring CCM frames.

The following parameters are only configurable when the **CC Function** check box is cleared.

- **Address Type**, available with S-OAM Mode, defines the destination address type of the CCM frames: **Unicast** or **Multicast** (default).
- **Priority**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 164), allows selecting the VLAN user priority: **0** to **7** (default).

- **Drop Eligible**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 164), is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **Period** determines the transmission period of the CCM frame: **3.33 ms**, **10 ms**, **100 ms** (default), **1 s**, **10 s**, **1 min**, or **10 min**.

MPLS-TP Label Stack (G.8113.1)

- **MPLS-TP Mode**

  PW (Pseudo-Wire) (default) provides an emulation of a point-to-point connection over a packet-switching network. The PW begins and ends at the LER or PE (Provider Edge).

  LSP (Label Switch Path) is a path through a MPLS network, it begins and ends at LER or LSR.

  Section is a segment between two adjacent LER/LSR.

- **Label 2** check box when selected enables the MPLS Label 2. The Label 2 check box is configurable for PW and LSP (cleared by default) and is forced cleared for Section.
- **Label 1** check box when selected enables the MPLS Label 1. The **Label 1** check box is forced selected for PW and LSP and forced cleared for Section.
- **GAL** check box when selected enables the Generic Associated Channel Label. The GAL check box is forced selected for LSP and Section and is configurable for PW (selected by default).
- **Label** is configurable for **Label 1** and **Label 2**: **16** to **1048575**, default is **16**. Label is not configurable for GAL and is set to **13**.
- **TC** sets the Traffic Class: **0** (default) to **7**.
- **TTL** sets the Time To Live: **1** to **255**, default is **128**.

Test Function

Note: *__Test Function__ parameters are not configurable when the __TX Enable__ check box is selected.*

- **Function** allows the selection of the test function to be performed.
  - **Loopback** (default) function is used to verify the bidirectional connectivity to a peer MEP (**Continuous** check box cleared) and to verify its capability to sustain close to line rate traffic (diagnostic test; **Continuous** check box selected).
  - **Test** function is used to generate a test signal and/or verify the integrity of received test signal from the peer MEP.
  - **Frame Delay** function is used to measure the round trip delay with the peer MEP.
  - **Frame Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point.
  - **Synthetic Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point using synthetic frames.
- **TX Enable** check box when selected (cleared by default) allows transmission of frames. However the transmission will only begin when the test is started or if the test is already running. When the **Continuous** check box is cleared, the **TX Enable** check box is automatically cleared once all frames have been transmitted.
- **Address Type**, available with S-OAM Mode, defines the destination address type of the frame: **Unicast** (default) or **Multicast**. Availability of address types depend on selected S**-OAM Mode** and **Test Function**.
- **Continuous** check box when selected (default) specifies that the frame generation is continuous. The **Continuous** check box is cleared for Multicast address type.

- **Requesting MEP ID TLV** (G.8113.1) check box when selected (default) determines if the Requesting MEP ID TLV is present in the LBM frame. The **Requesting MEP ID TLV** check box is cleared and not selectable when the **Continuous** check box is selected.

- **Priority**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 164), allows selecting the VLAN user priority: **0** (default) to **7**.

- **Drop Eligible**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 164), when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is only configurable with **Unicast** address type, otherwise is set to **No** (Default). Drop Eligible is set to **No** for **Frame Delay**, **Frame Loss**, and **Synthetic Loss** functions.

- **Period** determines the transmission period of frames which is set to **100 ms**. **Period** is not applicable for Multicast address type or when the **Continuous** check box is selected.

- **TX Rate (%)** is the transmission rate of the LBM frame: **0.0001** to **95 %** for 10M, **99.5 %** for 100M, **99.95 %** for 1G, **99.995 %** for 10G LAN, and **92.8521 %** for 10G WAN. Only available with Loopback test function when the **Continuous** check box is selected.

- **Frame Size** allows entering the frame size. The frame size range for Ethernet II frame format is as follows:
    - S-OAM Mode: 64 to 1518[1]. The minimum frame size is adjusted according to the frame structure and parameters selected. For Frame Loss function, the frame size is not configurable and set to the minimum value.
    - MPLS-TP OAM Mode: Minimum and maximum values are as follows. The minimum frame size is adjusted according to the frame structure and parameters selected.

Test Function	MPLS-TP Mode		
	PW	LSP	Section
Loopback	68[a] to 16000[1]	72 to 16000[1]	68 to 16000[1]
Test	68 to 1522	68 to 1522	64 to 1518
Frame Delay	68[ab] to 1522	72[b] to 1522	68[b] to 1518
Frame Loss[c]	68	68	64

a. Add 4 bytes when the **GAL** check box is selected.
b. Add 2 bytes when **Test ID** is selected as **TLV Type**.
c. The frame size is not configurable and set to the minimum value.

The following table lists each parameter that may affect the minimum and maximum[1] frame size value.

Parameter	Number of bytes to be added	Apply to
802.3 SNAP	8 bytes	Y.1731, MEF, G.8113.1
VLAN	4 bytes per VLAN (up to 3 VLAN)	

1. For the Loopback function the maximum frame size is 16000 bytes for all rates at the exception of 10/100/1000 Mbps electrical interface which is 10000 bytes.

Parameter	Number of bytes to be added	Apply to
Label 2	4 bytes	G.8113.1
Continuous	18 bytes for **Data** TLV Type 21 bytes for **Test** TLV Type	
Requesting MEP ID TLV	56 bytes	

Note: *Sending traffic with frame size >1518 in switched network may result in losing all frames.*

- **Frame Count** is the quantity of frames to be transmitted: **1** to **1000** at the exception of **Frame Loss** function which is **2** to **1000** (default is **10**); set to **1** for Loopback function with Multicast address type; not applicable when the **Continuous** check box is selected at the exception of **Synthetic Loss** function.
- **TLV Type** defines the TLV Type included in the frame: **Data** (Default), **Test** (**Loopback** (**Y.1731** and **G.8113.1**) and **Test** functions), and **Test ID** (**Frame Delay** function); is set to **Test** for the **Test** function; set to **Data** for **Synthetic Loss** function; not available for **Frame Loss** function.
- **Payload**, available with **Data** TLV Type, defines the repeating byte pattern used to fill the payload of the **Data** TLV: **0x00** to **0xFF** (default is **0xCC**).
- **Test Pattern**, available with **Test** TLV Type, defines the test pattern used to fill the **Test** TLV: **PRBS31** (default), **NULL**
- **Test ID**, available with **Test ID** TLV or **Synthetic Loss** function, defines the test ID: **0x00000000** to **0xFFFFFFFF** (default is **0x00000001**).

Restore Carrier Ethernet OAM Defaults

Reverts the Carrier Ethernet OAM test application to its default factory settings.

Services - Global

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the services block, the **Global** tab, and on the **General** button.

General Button

The following parameters are displayed and configurable per service.

- Check boxes:
  - The first check box (top-left) allows enabling sequentially service(s) within the limit of the link capacity when the **Service Performance Test** is enabled or enabling all services when the **Service Performance Test** is disabled.
  - The check boxes next to the service numbers allow enabling each service individually.

    When the **Service Performance Test** is enabled, up to 10 services can be enabled one after the other, as long as the **Total TX Rate** (bandwidth) is not reached (**Committed**). For example, if the first service is using the full bandwidth available, then no other service can be enabled. If the first enabled service uses half bandwidth, then at least another service can be enabled using up to half bandwidth. Thus, to enable a second service, first set the CIR value within the non-used bandwidth (**Available**), then enable it.

    When the **Service Performance Test** is disabled, up to 10 services can be enabled one after the other; the total TX rate is not limited.
- **Service Name** indicates the name of each service. Tap on the **Service Name** button to modify the name of each service. See *Services - Profile* on page 193 for more information.
- **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for local (**L**) and remote (**R**) directions, or for both port directions.

- **Frame Size** indicates the frame size of each service. Tap on the **Frame Size** button to modify the frame size of each service.
- **Framing** indicates the framing of each service. Tap on the **Framing** button to modify the **Frame Format**, **Network Layer**, **Transport Layer**, **VLAN**, and **MPLS** when applicable (see **Modify Frame Structure** from the *MAC/IP/UDP* on page 154).
- **VLAN (ID/Priority)** indicates the ID and Priority of each VLAN level for each service. Tap on the **VLAN** button to modify the VLAN settings (see **VLAN** from the *MAC/IP/UDP* on page 154).
- **Addressing** indicates the source and destination IP addresses for each services. Tap on the **Addressing** button to modify the addressing (see **MAC** and **IP** from the *MAC/IP/UDP* on page 154).

  Batch button allows bulk configuration for services addressing. Select the check box of each configuration parameter that needs to be copied and set its parameters. From **Apply To**, select all services the copy applies to and tap on the **Copy From** to proceed.

SLA Button

The SLA parameters are displayed and configurable per service. Click on the desired column button to access the configuration settings.

See *General Button* on page 190 for more information on check boxes, **Direction**, and **Service Name**.

See *SLA Parameters* on page 197 for more information on **CIR**, **CIR+EIR**, **CBS**, **EBS**, **Max Jitter**, **Max Latency**, and **Frame Loss Rate**.

Total TX Rate

Note: *Only available when the* **Service Performance Test** *check box is selected (see* EtherSAM - Global *on page 134). For* ***Dual Test Set****, the total TX rates are displayed for both* ***Local*** *and* ***Remote*** *directions.*

- **Committed** displays the total enabled TX rate (bandwidth) that will be generated by the selected service(s).
- **Available** displays the total TX rate (bandwidth) available for traffic generation.

Global Options

- **Rate Unit** allows selecting either **%**, **Mbit/s**, or **Gbit/s** as the reference for the rate values.
- **Latency Unit** allows selecting either **ms** (default) or **μs** as the reference unit for **Latency** and **Jitter**.

Copy Service Button

Copy Service button allows copying the services configuration to one or several services.

- **Copy Service** allow selecting the services number from which the configuration will be copied from.
- **To the following Services** allows selecting all services that will inherit the configuration from the selected service. An orange background represents a selected service. A service that is already enabled cannot be selected for copy.
- **Copy** allows confirming the service configuration copy for all selected services.

Services - Profile

The EtherSAM test application supports the configuration of up to 10 different services individually. All parameters are configurable per service.

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the services block, and on the **Profile** tab.

Service Selection and Activation

Select the service to be configured by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

- **Service** associates a name to the selected service number. Up to 16 characters are allowed. Default service names are **Service 1** to **Service 10**.
- **Enable** check box when selected (cleared by default) enables the selected service. However, the service will be generated only when the test is started. For **Dual Test Set**, services can only be enabled once the connection with the remote unit is established.

  When the **Service Performance Test** is enabled, up to 10 services can be enabled one after the other, as long as the **Total TX Rate** (bandwidth) is not reached (**Committed**). For example, if the first service is using the full bandwidth available, then no other service can be enabled. If the first enabled service uses half bandwidth, then at least another service can be enabled using up to half bandwidth. Thus, to enable a second service, first set the CIR value within the non-used bandwidth (**Available**), then enable it.

  When the **Service Performance Test** is disabled, up to 10 services can be enabled one after the other; the total TX rate is not limited.

Total TX Rate

Note: *Only available when the* **Service Performance Test** *check box is selected (see* EtherSAM - Global *on page 134).*

Indicates the total transmit rate of all services enabled for transmission. Unit selection is available from the *SLA Parameters* on page 197.

Profile

- **Profile** button allows selecting the emulation profile. The selected service profile icon, name, and configuration (when applicable) is displayed next to the **Profile** button. Refer to *Profile (Services)* on page 567.
- **Frame Size (Bytes)** indicates the frame size for **Voice** and **Video** profiles and allows changing the frame size for **Data** profile:

Profile and Codec	Type	Frame Size (bytes)	
		IPv4	IPv6
Voice Codec: - VoIP G.711 - VoIP G.723.1 - VoIP G.729	**Fixed**	 138 82 78	 158 102 98
Video Codec: All	**Fixed**	1374	1394
Data	**Fixed** (default)	64[a] (default) to 16000[b]	
	Random	64[a] to 1518[c]	
	EMIX	64[a] to 16000[b]	

a. The minimum value is adjusted according to the frame structure and components selected as shown in the following table.
b. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.
c. The maximum frame size value is adjusted for each enabled VLAN (+4 bytes per VLAN).

The following table lists each component that may affect the minimum frame size value.

Component	Description
VLAN	4 bytes per VLAN (up to 2 VLAN)
MPLS	4 bytes per label (up to two labels)
UDP	8 bytes
TCP	20 bytes
Ethernet Header	14 bytes
LLC and SNAP Headers	8 bytes
IPv4	20 bytes
IPv6	40 bytes
Using DTS	4 bytes

Note: *Sending traffic with frame size > 1518 in switched network may results in losing theses frames.*

➤ **EMIX** button is available when **EMIX** frame size is selected. The EMIX frame sequence is repeated continuously (refer to *EMIX* on page 551).

Test Parameters

Note: *Unit selection is available from the* SLA Parameters *on page 197.*

For **Dual Test Set**, parameters are configurable for both local (**L**) and remote (**R**) directions.

For **Dual Port** topology, parameters are configurable for both port directions.

- **Traffic Policing** check box when selected (default) allows stressing the rate limiting of the network by sending traffic at higher rate than committed by the SLA.
- **Burst Max Rate** allows setting the rate that is used for the CBS and EBS burst tests. Only available when the **Burst Test** is enabled (see *EtherSAM - Global* on page 134).

Note: *Changing a criteria value (CIR, CIR+EIR, Ramp Traffic Policing, or Burst Max Rate) may affect the other criteria values in order to comply to the following rules:*
CIR ≤ CIR+EIR ≤ Ramp Traffic Policing Rate ≤ Line Rate
CIR ≤ CIR+EIR ≤ Burst Max Rate ≤ Line Rate
However, make sure that the criteria values comply to the following rule with an adequate margin, as per ITU-T Y.1564 standard, for a burst test to be valid:
CIR < CIR+EIR < Burst Max Rate ≤ Line Rate

SLA Parameters

The Service-Level Agreement (SLA) parameters allow enabling and defining the pass/fail verdict thresholds for the service.

For **Dual Test Set**, parameters are configurable for both local (**L**) and remote (**R**) directions at the exception of Max Round-Trip Latency for which the value is unique.

For **Dual Port** topology, parameters are configurable for both port directions.

Information Rate

- Unit choices are **%** (default), **Mbit/s**, or **Gbit/s**. This unit is also used for **Total TX Rate** and for **Test Parameters** (**Traffic Policing** and **Burst Max Rate**).

Note: *At least one check box (**CIR** or **CIR+EIR**) has to be selected. Thus, clearing the CIR check box while CIR+EIR check box is cleared, will automatically select the CIR+EIR check box and vice versa.*

- **CIR** (Committed Information Rate) check box when selected (default) sets the service rate guaranteed by the SLA. The threshold value is configurable from **0.0001**[1] to **100** percent (default is **50** percent). CIR and preceding steps are not performed for services that have the CIR check box cleared.
- **CIR+EIR** check box when selected (cleared by default) sets the best effort allowed traffic for the service. The EIR (Excess Information Rate) value is equal to the CIR+EIR value minus CIR. The threshold value is configurable from **0.0001**[1] to **100** percent (default is **75** percent).

Burst Size settings are only available when the **Burst Test** is enabled (see *EtherSAM - Global* on page 134).

- Burst Size unit choices are **Bytes** (default) or **ms**.

1. The minimum rate is 1Mbit/s when the **Frame Size** is **Random**.

- **CBS** check box when selected (default) sets the maximum committed burst size to which services' frames will be sent and be CIR-compliant (default is **12144** bytes). The CBS minimum and maximum values are affected by the **CIR**, **Burst Max Rate**, and **Frame Size** values. CBS is only available when CIR check box is selected.
- **EBS** check box when selected (cleared by default) sets the maximum excess burst size to which services' frames will be sent and be CIR+EIR compliant (default is **12144** bytes). The EBS minimum and maximum values are affected by the **CIR+EIR**, **Burst Max Rate**, and **Frame Size values**. EBS is only available when **CIR+EIR** check box is selected.

Performance Criteria

- **Max Jitter** allows setting the maximum jitter value allowed for the service.
- **Max Round-Trip Latency** allows setting the maximum round-trip latency value allowed for the service. For **Dual Test Set**, only available with **Round-Trip Latency Measurement Mode** (see *Global Options* on page 137). Not available in **Dual Port** topology.
- **Max Latency**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Global Options* on page 137) and Dual Port topology, allows setting the maximum one-way latency allowed for the service.
- **Frame Loss Rate** allows setting the maximum rate of Frame Loss allowed for the service.

Note: *For Dual Test Set, the Frame Loss Rate is changed to percentage when the remote unit does not support exponential notation. In this case a Frame Loss Rate Threshold lower than 1.0E-06 (0.0001 %) is considered as 0 %.*

Signal

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and the **Signal** tab.

Physical Interface

Note: *The following settings are available with optical signal. For parallel interfaces, the following information is displayed for each optical lane.*

- **Optical Lane** indicates the optical lane number for parallel interfaces.

Optical Interface	Optical Lane Number
OTU3 (4 Lanes) [43.018 Gbit/s] **OTU4 (4 Lanes) [111.81 Gbit/s]**	0 through 3

- **Laser** indicates the status of the laser: **ON** with the laser pictogram (emitting an optical laser signal) or **OFF**.
- **TX Power (dBm)** indicates, when supported, the transmit power level of the optical laser/lane in dBm.
- **Wavelength (nm)** indicates, when supported, the detected lane/laser wavelength.
- **RX Power (dBm)** indicates, when supported, the current received power level of the optical laser/lane in dBm.

  Green: Power level in range.
  Yellow: Power level out-of-range.
  Red: Loss of signal or power level is close to damage.
  Gray: Invalid operational range value or not available/supplied by the transceiver.

- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser/lane in dBm.

- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser/lane in dBm.
- **Laser ON/OFF** button, available with parallel interfaces, is used to activate the laser control per optical lane or for all lanes. Select the **Laser** check box to enable/disable the laser for each lane individually or select the **All Lanes** check box to enable/disable all optical lanes at once.
- **Lasers OFF at Start-Up** check box when selected (cleared by default) automatically turns OFF the laser for serial interfaces or all lasers for parallel interfaces when starting the unit or when switching from one test application to another. However the laser remains ON, on a remote unit receiving a request for a DTS connection or a loopback command.
- **Power Range (dBm**) indicates the transceiver operational RX power range.

Note: *The following settings are available with electrical signal and their availability depend on the signal itself and its mapping.*

➤ **LBO** (Line Build Out) allows meeting the interface requirements over the full range of cable lengths.

Signal	LBO
DS1	Preamplification values: **DSX-1 (0-133 ft)**[a], **DSX-1 (133-266 ft)**, **DSX-1 (266-399 ft)**, **DSX-1 (399-533 ft)**, **DSX-1 (533-655 ft)**, Cable simulation (CSU Emulation mode) values: **CSU (0.0 dB)**, **CSU (-7.5 dB)**, **CSU (-15.0 dB)**, **CSU (-22.5 dB)**.
DS3	**0 to 225 ft range**[a], **225 to 450 ft range**, and **Cable Simulation 900 ft**.
E1/E3/E4	Not available
STS-1e/STM-0e	**0 to 225 ft range**[a], **225 to 450 ft range**, and **Cable Simulation 900 ft)**.
STS-3e/STM-1e	**0 to 225 ft range**.

a. Default value

➤ **Line Coding**

Signal	Line Coding
DS1	**AMI** and **B8ZS**[a]
DS3	**B3ZS**
E1	**AMI** and **HDB3**[a]
E3	**HDB3**
E4	**CMI**
STS-1e/STM-0e	**B3ZS**
STS-3e/STM-1e	**CMI**

a. Default value.

➤ **RX Termination**

Signal	Termination
DS1/E1	**Term**[a], **Mon,** and **Bridge**.
DS3/E3/E4/STS-1e/STM-0e/STS-3e/STM-1e	**Term**[a], and **Mon**

a. Default value.

➤ **Power** indicates the received signal level in dBdsx for DSn or dBm for PDH and SONET/SDH.

➤ **Amplitude** indicates the received signal amplitude as well as its MIN, and MAX received values.

TX Frequency

Note: *The following TX Frequency information applies to serial interface only, refer to* TX Frequency *on page 139 for parallel interfaces.*

➤ **Frequency (GHz)** indicates the frequency (actual frequency + Frequency offset) used for transmission.

➤ **Offset (ppm)** check box, when selected (cleared by default), allows setting the frequency offset that will be generated. Use the “+” or “-” button to respectively increment or decrement the frequency offset value based on the defined **Increment/Decrement Size**, or directly type the frequency offset value in the field. Possible offsets are:

Interface	Frequency Offset[a]	Nominal Frequency
DS1	±140 ppm	1544000 bit/s
E1	± 70 ppm	2048000 bit/s

Interface	Frequency Offset[a]	Nominal Frequency
E3	± 50 ppm	34368000 bit/s
DS3		44736000 bit/s
STS-1e/STM-0e		51840000 bit/s
E4		139264000 bit/s
STS-3e/STM-1e		155520000 bit/s
OC-1/STM-0	± 50 ppm	51840000 bit/s
OC-3/STM-1		155520000 bit/s
OC-12/STM-4		622080000 bit/s
OC-48/STM-16		2488320000 bit/s
OC-192/STM-64		9953280000 bit/s
OTU1	± 50 ppm	2666057143 bit/s
OTU2	± 50 ppm (Framed) ± 120 ppm (Unframed)	10709225316 bit/s
OTU1e	± 120 ppm	11049107143 bit/s
OTU2e		11095727848 bit/s
OTU1f		11270089286 bit/s
OTU2f		11317642405 bit/s

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.

Note: *Frequency offset is not available when* ***Through*** *mode is selected.*

Step Size (ppm) allows setting the increment/decrement value (from 0.1 to the maximum offset) that will be used when changing the frequency offset with the “+” or “-” button.

RX Frequency

Note: *The following RX Frequency information applies to serial interface only, refer to* RX Frequency *on page 140 for parallel interfaces.*

➤ **Frequency (GHz)** indicates the frequency of the input signal.

➤ **TX Power (dBm)** indicates, when supported, the transmit power level of the optical laser/lane in dBm.

Note: *For both* ***Frequency*** *and* ***Offset*** *the following background colors are used.*

Background color	Description
Green	The frequency is in range.
Red	The frequency is out-of-range or LOC Lane.
Gray	Pending state.

➤ **Max. Negative Offset (ppm)** indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.

➤ **Max. Positive Offset (ppm)** indicates the maximum positive frequency offset between the standard rate specification and the rate from the received signal.

Note: *Refer to* Interface *on page 512 for more information on standard rate specifications.*

Signal Configuration

- For OTN, see *Signal - Signal Configuration - OTN* on page 210 for more information.
- For SONET/SDH, see *Signal - Signal Configuration - SONET/SDH* on page 212 for more information.
- For DSn/PDH, see *Signal - Signal Configuration - DSn/PDH* on page 206 for more information.

Signal - Signal Configuration - DSn/PDH

For **SONET/SDH - DSn/PDH BERT**, from the test menu, tap **Setup**, **Test Configurator**, and the protocol block. Only **Framing** setting and the **Loopback** button are available.

For **DSn/PDH BERT** and **NI/CSU Emulation**, from the test menu, tap **Setup**, **Test Configurator**, and the interface block.

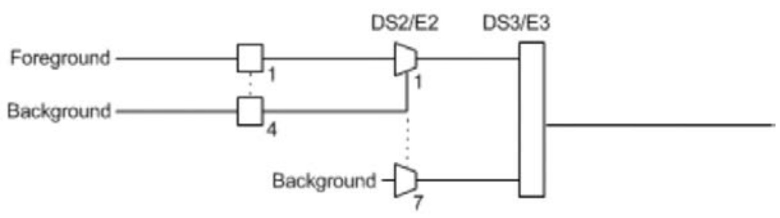
Signal Configuration

➤ **Framing** allows the selection of the framing used for transmission:

DS1	DS3	E1	E3/E4
Unframed SF ESF[a] SLC-96	Unframed C-Bit Parity[a] M13	Unframed PCM30[a] PCM30 CRC-4 PCM31 PCM31 CRC-4	Unframed Framed[a]

a. Default value

➤ **Background**, for multiplex test, allows the selection of the default timeslot background traffic: **AIS** (default) or **All Zeros**. The following diagram shows a test defined with DSn/PDH traffic where the background traffic is also inserted for the unused timeslots in a test 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 data path.



- **Channel**, for multiplex text case, allows the selection of the channel number of the mapped signal.
- **DS0/E0** check box when selected, cleared by default, activates the DS0/E0 testing. DS0/E0 configuration is not available when the framing is set to **Unframed**. Once selected, a summary of the payload content is displayed indicating the number of timeslot set to Pattern and Idle/Tone. The Modify DS0/E0 button is also displayed.
- **TX Signaling** check box when selected (cleared by default) allows generation of the signaling bits for either the 24 - DS0 channels or 30 - E0 channels (PCM-30 and PCM30 CRC-4). Only available when the **DS0/E0** check box is selected.
- **Modify DS0/E0** button is available when the **DS0/E0** check box is selected. Refer to *Modify DS0/E0* on page 560.
- **Loopback** (refer to *DS1 Loopback* on page 549)

For **NI/CSU Emulation** test the DS1 Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

- **Mode** selects the loopback control mode: **Manual** or **Auto-Response**.
- **Type**, for **Manual** mode, selects the type of loopback code that will be applied: **Line** or **Payload**. Payload is not available when the framing is **Unframed**.

  Type, for **Auto-Response**, selects the type of loopback code on which the unit will respond: **In-Band** or **Out-of-Band**. **Out-of-Band** is only available when the interface framing is set to ESF. The **Loop UP** and **Loop Down** values are automatically updated to the **In-Band** or **Out-of-Band** type selection.
- **Status** indicates either **Loopback Active** with a green loopback icon or **No Loopback** with a gray loopback icon.

➤ **Loop Code** selects the type of loopback that will be used to overwrite the traffic that will be generated.

In-Band loop code	Loop-UP Code	Loop-Down Code
CSU (10000/100)	10000	100
NIU FAC1 (1100/1110)	1100	1110
NIU FAC2 (11000/11100)	11000	11100
NIU FAC3 (100000/100)	100000	100
Loop Code 1 to **10**	Refer to **Modify Loop Codes** *allows the configuration of 10 DS1 loop code pairs. Configure each loop code Name, Loop-Up and Loop-Down values. The name field allows up to 16 characters. Loop-Up and Loop-Down range is from 3 to 16 bits (000 to 1111111111111111). The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up=10000, and Loop-Down=100).* **on page 209**.	

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

➤ **Force Release** button, available with **Auto-Response** mode when a loopback is active, allows releasing a loopback condition initiated from the network.

➤ **Activate** button, available with **Manual** mode when no loopback is active, allows sending a loopback condition.

➤ **Release** button, available with **Manual** mode when a loopback is active, allows releasing the loopback condition.

- **Loop Up** indicates the selected loop up code.
- **Loop Down** indicates the selected loop down code.
- **Modify Loop Codes** allows the configuration of 10 DS1 loop code pairs. Configure each loop code **Name**, **Loop-Up** and **Loop-Down** values. The name field allows up to 16 characters. **Loop-Up** and **Loop-Down** range is from 3 to 16 bits (**000** to **1111111111111111**). The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up=**10000**, and Loop-Down=**100**).

Signal - Signal Configuration - OTN

Note: *The following signal configuration parameters are available from the interface block.*

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and on the **Signal** tab.

Signal Configuration

➤ **OTU**<*n*>

Note: *At least one of the two check boxes, **FEC** or **Scrambler**, must be selected in order to prevent potential alarms caused by a lack of bit transition on the optical signal. For example to disable **FEC**, first select the **Scrambler** check box then clear the **FEC** check box.*

- ➤ **FEC** check box when selected (default) enables the FEC in TX/RX and allows detecting, reporting, and correcting up to 8 symbol errors (Correctable) per codeword. If there are over 8 symbol errors detected, they are reported as uncorrectable errors.
- ➤ **FEC-CORR Alarming** check box when cleared (selected by default) does not report the **FEC-CORR** error status (current/history), seconds, and does not affect the global test verdict. Only available when **FEC** is enabled.
- ➤ **Scrambler** check box when selected (default) provides enough “0” and “1” transitions on the optical signal for clock recovery.

Note: *When the **Scrambler** check box is cleared, the receiver circuitry is forced to operate in a condition which is outside of the specified OTN operating conditions, potentially causing alarms/errors. This configuration can be used for special analysis in a lab environment.*

- **ODU**<*n*>
  - **OPU Trib Port**, available for each OPU level of a mapped signal, indicates the OPU tributary port used for the test. Tap the **Modify Tributary Slots/Port** button to change the OPU tributary port (refer to *Modify Tributary Slots/Port* on page 953).
  - **OPU Trib Slots**, available for each OPU level of a mapped signal, indicates the OPU tributary slots used for the test. Tap the **Modify Tributary Slots/Port** button to change the OPU tributary slots (refer to *Modify Tributary Slots/Port* on page 953).
  - **TCM** indicates each Tandem Connection enabled; **No TCM** indicates that no TCM is enabled. To enable TCM, tap the **Config TCM** button (refer to *Config TCM* on page 547).
- **Config TCM** (refer to *Config TCM* on page 547).

Signal - Signal Configuration - SONET/SDH

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and the **Signal** tab.

Signal Configuration

➤ **OC/STM** Signal

➤ **Synchronization Status Message (S1)**: Bits 5 through 8 of the S1 byte are used to convey synchronization status of the NE. Not available with **Through** topology.

Bits 5 to 8	Description	
	SONET	SDH
0000[a]	Synchronized - Traceability Unknown (STU)	Quality Unknown
0001	Stratum 1 Traceable (ST1)	Reserved
0010	Reserved	ITU G.811 (PRC)
0011	Reserved	Reserved
0100	Transit Node Clock Traceable (TNC)	SSU-A
0101	Reserved	Reserved
0110	Reserved	Reserved
0111	Stratum 2 Traceable (ST2)	Reserved
1000	Reserved	SSU-B
1001	Reserved	Reserved
1010	Stratum 3 Traceable (ST3)	Reserved
1011	Reserved	ITU-T G.813 Option I (SEC)
1100	SONET Minimum Clock Traceable (SMC)	Reserved
1101	Stratum 3E Traceable (ST3E)	Reserved
1110	Provisionable by the Network Operator (PNO)	Reserved
1111	Don’t Use for Synchronization (DUS)	Do not use for synchronization

a. Default message.

  - **REI-L Computation Method / MS-REI Computation Method** (OC-192/STM-64 only): Allows selecting the default method used to calculate the REI-L/MS-REI error for OC-192 and STM-64 signals. Choices are **M1 Only** (default) and **M0 M1** (**M0** and **M1)**.

- **STS/AU** and **VT/TU** Mappings

  - **Timeslot** (SONET) allows the selection of the STS timeslot number. Refer to *SONET Numbering Convention* on page 499 for more information.

  - **Number** (SDH) allows the selection of the AU channel number. Refer to *SDH Numbering Convention* on page 500 for more information.

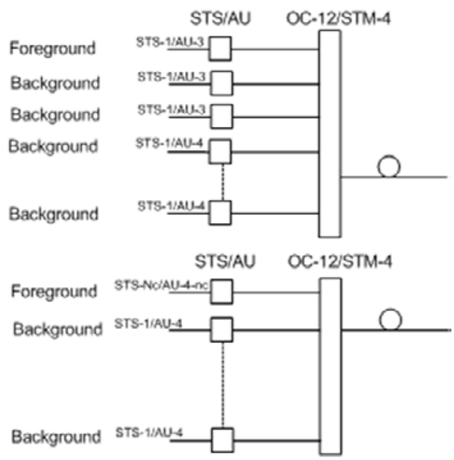
  - **TCM** check box when selected (cleared by default) allows Tandem Connection Monitoring (TCM).

  - **TC-UNEQ-P / TC-UNEQ-V / HPTC-UNEQ / LPTC-UNEQ** check boxes when selected (cleared by default) allows the monitoring of the corresponding Tandem Connection - Unequipped alarm. Only available when the **TCM** check box is selected.

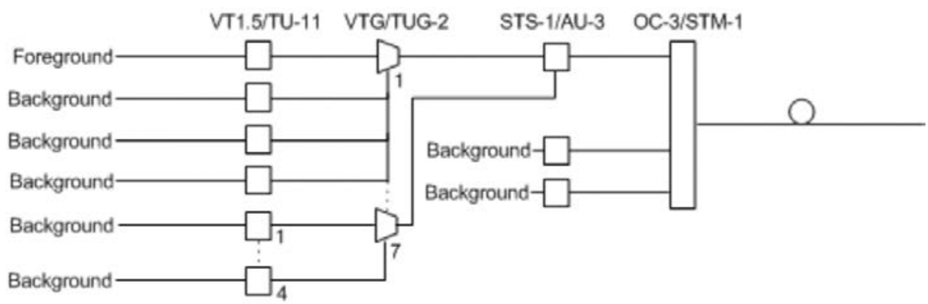
  - **Overwrite Fixed Stuff** (STS-1 only) check box when selected (default) fills up the bytes of the STS-1 SPE’s columns 30 and 59 with the selected pattern from the tab *BERT and Unframed BERT* on page 109.

➤ **Background** allows the selection of the high order path background traffic: **AIS**, **Equipped** (PRBS23) (default), or **Unequipped**.

STS/AU Path (SONET/SDH HOP): 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-3, or AU-4) signal level for the paths that are not defined in the test case.



VT/TU Path (SONET/SDH LOP): The following diagram 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.



Smart Loopback

Note: *The Smart Loopback block is only displayed when the **Transparent (Pseudo-Physical)** check box is cleared (see **Loopback Mode on page 97**).*

From the test menu, tap **Setup**, **Test Configurator**, and the Smart Loopback block.

Loopback

- **Mode** determines at which layer the Smart Loopback address/port swapping operation will be.
  - **Ethernet** swaps the MAC addresses of received packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **Ethernet (All Unicast)** swaps the MAC addresses of received packets having Unicast **Destination MAC** address.
  - **IP**, for Ethernet Layer 3 and 4, swaps the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.

- **UDP/TCP** (default), for Ethernet Layer 4, swaps the UDP or TCP ports and the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 3, swaps the MAC and IP addresses for packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.

- **Matching & Swapping** indicates the Loopback parameters that will be used based on the Loopback Mode selected.

Streams - Global

From the **Test** menu, tap **Setup**, **Test Configurator**, the protocol block, and the **Global** tab.

The following parameters are displayed and configurable per stream.

- Check boxes:

  The first check box (top-left) allows enabling stream(s) sequentially within the limit of the link capacity.

  The check boxes next to the stream numbers allow enabling each stream individually within the limit of the link capacity.

- **Stream Name**[1] indicates the name of each stream. Tap on the **Stream Name** button to modify the name of each stream.
- **Frame Size**[1] indicates the frame size of each stream. Tap on the **Frame Size** button to modify the frame size of each stream.
- **TX Rate**[1] indicates the transmission rate for each stream. Tap on the **TX Rate** button to modify the transmission rate (see page 223).
- **Framing** indicates the framing of each service. Tap on the **Framing** button to modify the **Frame Format**, **Network Layer**, **Transport Layer**, **VLAN**, and **MPLS** when applicable (see **Modify Frame Structure** from the *MAC/IP/UDP* on page 154).
- **VLAN** indicates the ID and Priority of each VLAN level for each stream. Tap on the **VLAN** button to modify the VLAN settings (see **VLAN** from the **MAC/IP/UDP** tab).
- **Addressing MAC/IP** indicates the source and destination MAC/IP addresses for each stream. Tap on the **Addressing MAC/IP** button to modify the customer addressing (see **MAC** and **IP** from the **MAC/IP/UDP** tab).

1. See the Profile tab for more information.

Batch button allows bulk configuration for stream addressing. Select the check box of each configuration parameter that needs to be copied and set its parameters. From **Apply To**, select all streams the copy applies to and tap on the **Copy From** to proceed.

The following parameters are global for all streams.

- **Total TX Rate** indicates the percentage of the total line utilization which is the TX rate sum of all enabled streams.
- **Link Capacity** indicates the total rate available for traffic generation.
- **Global Options**:
  - **Rate Unit** allows selecting either **%**, **Mbit/s**, or **Gbit/s**, **frame/s**, and **IFG** as the reference for the rate values.
  - **Latency Unit** allows selecting either **ms** (default) or **μs** as the reference unit for **Latency**.
  - **QoS Metrics Tags Insertion** check box when selected (default) automatically adds a stream analysis tag containing Jitter, Latency, Throughput, and sequence tags in all frames that is generated.
- **Copy Stream** button allows copying the stream configuration to one or several streams.

  Select the stream number the configuration will be copied from.

  From **To the following Streams**, select all streams that will inherit the configuration from the selected stream. An orange background represents a selected stream. A stream that is already enabled (Enable TX) cannot be selected for copy.

  Tap **Copy** to confirm the stream configuration for all selected streams.
- **Restore Default** button reverts the current test application to its default factory settings.

Streams - Profile

The Traffic Gen & Mon test application supports the configuration of up to 16 different streams individually.

From the **Test** menu, tap **Setup**, **Test Configurator**, the protocol block, and the **Profile** tab.

Note: *All parameters are configurable per stream.*

Stream Selection and Activation

Select the stream to be configured by either using the left/right arrow or by tapping over the stream numbers area then tapping on a specific stream number. An orange background indicates the selected stream while a green background indicates the streams that are enabled.

➤ **Stream** associates a name to the selected stream number. Default stream names are **Stream 1** to **Stream n**.

➤ **Enable** check box when selected (cleared by default) enables the selected stream. However, the stream will be generated only when the test is started while the global **Enable TX** check box is selected from the **Global** tab.

Profile

- **Profile** button allows the selection and configuration of either **Voice**, **Video**, or **Data** (default) emulation profile. The selected profile icon and its Codec for Voice and Video are displayed next to the **Profile** button. Refer to *Profile (Stream)* on page 566.

- **Frame Size (Bytes)** indicates the frame size for **Voice** and **Video** profiles and allows changing the frame size for **Data** profile:

Profile and Codec	Type	Frame Size (bytes)	
		IPv4	IPv6
Voice Codec: - VoIP G.711 - VoIP G.723.1 - VoIP G.729	**Fixed**	 138 82 78	 158 102 98
Video Codec: All	**Fixed**	1374	1394
Data	**Fixed** (default)	48[a] to 16000[b]	
	Random	64[a] to 1518[c]	
	EMIX	48[a] to 16000[b]	
	Sweep	48[a] to 16000[b]	

a. The minimum value is adjusted according to the frame structure and components selected as shown in the following table. The minimum of 48 bytes is only available for rates up to 10GE, for higher rates the minimum frame size is 64 bytes.
b. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.
c. The maximum frame size value is adjusted for each enabled VLAN (+4 bytes per VLAN).

The following table lists each component that may affect the minimum frame size value.

Component	Description
VLAN	4 bytes per VLAN (up to 2 VLAN)
MPLS	4 bytes per label (up to two labels)
LLC and SNAP Headers	8 bytes
UDP	8 bytes
Ethernet Header	14 bytes
IPv4	20 bytes
IPv6	40 bytes

➤ **Sweep** button is available when **Sweep** frame size is selected. The first frame is generated starting with the minimum number of bytes defined, then each subsequent frame is incremented by 1 byte until the maximum number of bytes is reached and start over with minimum.

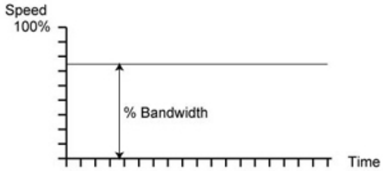
EMIX button is available when **EMIX** frame size is selected. The EMIX frame sequence is repeated continuously (refer to *EMIX* on page 551).

Shaping

➤ **TX Mode** allows the selection of the transmission mode for the selected stream when **Data** profile is selected. The TX Mode is forced to **Continuous** for Voice and Video profiles.

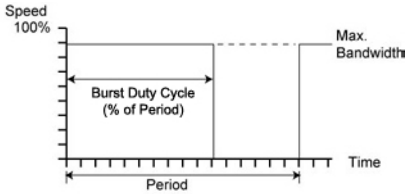
Continuous (default) transfers the selected frame continuously according to the selected percentage of bandwidth.

n-Frame transfers the selected number of frames.



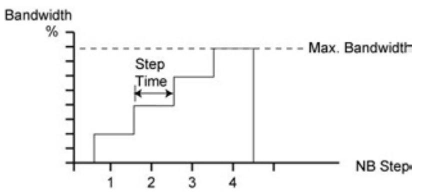
Burst transfers the selected frame at maximum bandwidth for the selected **Burst Duty Cycle** over the **Period**.

n-Burst transfers the selected number of Burst.



Ramp transfers the selected bandwidth in a stair shape according to the selected step time, number of steps, and maximum bandwidth.

n-Ramp transfers the selected number of Ramp.



➤ **TX Rate** / **Max TX Rate** indicates the transmission rate for Voice and Video profiles, and allows entering the transmission rate for Data profile.The available stream transmission rate will be calculated according to the selected TX Mode. The default setting is 100 percent for all interfaces at the exception of 10Gig-E WAN which is 92.8571 percent (depending on the frame format).

Unit choices are: **%** (default), **Mbit/s**, **Gbit/s**, **frame/s**, **IFG**. However **frame/s** and **IFG** are not available for **Random** and **Sweep** frame sizes.

➤ **Frame Count** is only available with n-Frame Transmit Mode. Enter the frame count number: **1** (default) to **267857142857**.

- **Shaping** button, refer to *Shaping* on page 569.
- **Total TX Rate** indicates the percentage of the total line utilization which is the sum of all TX rate enabled streams.

Note: *The Individual stream can be enabled/disabled even when the test is started and running. The streams can be enabled one after the other, up to 16, as long as the maximum rate is not reached. For example, if the first stream is using the full rate available, then no other stream can be enabled. However, if the first enabled stream uses half rate, then at least another stream can be enabled using up to half rate. Thus, to enable a second stream, first set the TX rate value within the non-used rate, then enable it. A stream cannot be enabled if its MAC address is not valid (it can be either not resolved or wrongly entered).*

- **Link Capacity** indicates the total rate available for traffic generation.

QoS Metrics

Note: *QoS Metrics settings apply to all streams.*

- **Global Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict for all streams.
- **Global Thresholds Type** button
  - **Throughput** allows selecting if the verdict is based on the **Current Throughput** (default) or **Average Throughput**.
  - **Frame Loss** allows selecting if the verdict is based on a frame loss **Count** (default) or **Rate**.
  - **Out-of-Sequence** allows selecting if the verdict is based on an Out-of-Sequence **Count** (default) or **Rate**.
- **Throughput (%)** check box when selected enables the throughput pass/fail verdict and allows setting the minimum and maximum threshold values.
- **Frame Loss Count/Rate** check box when selected enables the Frame Loss pass/fail verdict and allows setting the threshold of frame that are lost.

  For **Count**, enter the maximum count of frame that are lost before declaring a fail verdict: **0** (default) to **9999999999**.

  For **Rate**, enter the maximum rate of frame that are lost before declaring a fail verdict: **1.0E-14** (default) to **1.0E00**.

- **Out-of-Sequence Count/Rate** check box when selected enables the Out-of-Sequence pass/fail verdict and allows setting the threshold of frames that are Out-of-Sequence.

  For **Count**, enter the maximum count of frames that are Out-of-Sequence before declaring a fail verdict: **0** (default) to **9999999999**.

  For **Rate**, enter the maximum rate of frames that are Out-of-Sequence before declaring a fail verdict: **1.0E-14** (default) to **1.0E00**.

- **Jitter** check box when selected enables the Jitter verdict and allows setting the maximum Jitter before declaring a fail verdict.

- **Latency** check box when selected enables the Latency verdict and allows setting the maximum Latency before declaring a fail verdict.

System

From the **Test** menu, tap **Setup**, and **System**.

Factory Default

- **Restore Default** button restores the factory default settings for all test applications.
- **Restore Default at Start-Up** check box when cleared (default), reloads the last configuration settings when the application is launched; when selected, the factory settings are restored.

Notification Control

Transceiver Transaction Fault check box when selected (cleared by default) displays a transceiver transaction fault message in the **Test Configurator** page (see *Test Configurator Overview* on page 72) when either the module is unable to discover the transceiver device or experiences abnormal communication conditions such as: register access is blocked, read/write errors are detected, transceiver is present but unresponsive, etc. A transceiver fault message remains displayed until either the **Transceiver Transaction Fault** check box is cleared, the transceiver is removed, or when switching the test application.

Whether the **Transceiver Transaction Fault** check box is selected or cleared, a log file is generated/updated when a transceiver transaction fault occurs. The log file contains the information about the transceiver and the related fail condition(s); up to 5000 entries are allowed; a log full indication is recorded if the limit is reached. The file name is **TransactionFault.log** and is located in the **Users\Public\Public Documents\<product>\Logs** folder. The content of the file can be cleared manually by opening the file, erasing its content, and saving the file. The file can also be deleted from disk and will be automatically regenerated when a new transceiver transaction fault occurs.

Test Sequence - iOptics

From the test menu, tap **Setup**, and **Test Configurator**.

- **Control Pin Check** check box when selected (default) stimulates the **TX_DISABLE** pin for SFPs or the **Reset** pin for other transceivers. Clear this check box to bypass this test for transceiver not supporting the control pin.
- **Power Threshold (W)**[1] indicates the power consumption threshold based on the power level/class detected including uncertainty from the selected transceiver to declare the pass/fail verdict.

  Power Consumption - Pass/Fail Verdict[1] check box when selected (default) enables the power consumption pass/fail verdict based on the **Power Threshold** value. In the case where the Power Class needs to be disregarded, clear this check box to avoid reporting a fail verdict.
- **Temp. Threshold (°C)**[1] allows selecting the temperature threshold to declare the pass/fail verdict: **0** to **75 °C** (default is **70 °C)**.
- **TX Power Range (dBm)**[1] indicates, when supported, the optical device TX operational range to declare the pass/fail verdict.
- **RX Power Range (dBm)**[1] indicates the optical device RX operational range to declare the pass/fail verdict.
- **BERT Duration** is the time duration of the bit error test: **1 minute** (default), **2**, **3**, **4**, **5**, or **30 minutes**.
- **BERT Threshold** indicates the bit error test threshold (set to **0**) to declare the pass/fail verdict.
- **Skew Threshold (Bits)**, available with parallel interfaces, indicates the skew threshold that is automatically set based on the rate to declare the pass/fail verdict.

1. Not available when PHY Type is set to DAC.

Timer

Allows starting and/or stopping automatically the test at a given time or for a specific duration.

From the **Test** menu, tap **Setup**, and **Timer**.

Note: *For RFC 6349 the Timer is only available with operation modes **Dual Test Set** (local unit).*

Timer

Note: *For RFC 2544 and RFC 6349, only **Start Time** and the **ARM** button are available.*

- **Duration**: Selects the test duration based on the test start time. The test start time can be either the time the user starts the test or the time the test is automatically started when the start time is enabled. The **Duration** check box has to be selected to be included in the test timer. Choices are **15 minutes** (default), **1**, **2**, **4**, **6**, **12**, **24**, **72 hours**, **7 days**, and **User Defined**.

  When **User Defined** is selected, the field next to it becomes available to enter the test duration using the format: dd:hh:mm:ss.

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.*

- **Start Time** selects the time the test will automatically start. The **Start Time** check box has to be selected to be included in the test timer.

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

- **Stop Time** selects the time the test will automatically stop. The **Stop Time** check box has to be selected 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. The stop time cannot be enabled while **Duration** is enabled.*

- **ARM** button, available when the **Start Time** check box is selected (cleared by default), enables the start test timer. Not available while the test is running. It is not possible to start the test case when the start time is armed.

Note: *An icon is displayed in the global test status area indicating that the timer is enabled. **Armed** is displayed when the test start time is armed while the test is not started. Refer to* Global Indicator *on page 24 for more information.*

Traces - OTN

From the test menu tap **Setup**, **Test Configurator**, tap on the interface block, and on the **Traces** tab.

Note: *Configuration is coupled with settings from Traces - OTN* on page 322.

OTUx, ODUx, and TCMx Buttons

Tap on either OTUx or ODUx button. For ODUx when TCM is enabled (see Modify TCM on page 211), tap on a TCMx button to select a TCM level.

SM TTI Traces / PM TTI Traces / ODUx TCM TTI Traces

Note: *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; see* **Config TCM** *on page 211).*

- **SAPI** (Source Access Point Identifier) allows entering the SAPI message to be generated (TTI bytes 0 to 15). The expected SAPI message is available when the **SAPI OTU-TIM** / **SAPI ODU-TIM** check box is selected. A maximum of 16 characters is allowed.

TTI Traces	Default Message[a]
SM	EXFO OTU SAPI
PM	EXFO ODU SAPI
TCM	EXFO TCMi SAPI

a. The default message contains a NULL (all 0’s) character preceding it. NULL (all 0’s) characters are automatically appended to the message for bytes that are not defined.

➤ **DAPI** (Destination Access point Identifier) allows entering the DAPI message to be generated (TTI bytes 16 to 31). The expected DAPI message is available when the **DAPI OTU-TIM** / **DAPI ODU-TIM** check box is selected. A maximum of 16 characters is allowed.

TTI Traces	Default Message[a]
SM	EXFO OTU DAPI
PM	EXFO ODU DAPI
TCM	EXFO TCMi DAPI

a. The default message contains a NULL (all 0's) character preceding it. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined.

➤ **Operator Specific** allows entering the Operator Specific message to be generated (TTI bytes 32 to 63). A maximum of 32 characters are allowed.

TTI Traces	Default Message[a]
SM	EXFO OTU OPERATOR SPECIFIC
PM	EXFO ODU OPERATOR SPECIFIC
TCM	EXFO TCMi OPERATOR SPECIFIC

a. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined.

- **SAPI OTU-TIM / SAPI ODU-TIM** / **SAPI TCM-TIM** check box, when selected (cleared by default), allows editing the expected Source Access Point Identifier and also enables OTU/ODU/TCM-TIM alarm monitoring.
- **DAPI OTU-TIM / DAPI ODU-TIM** / **DAPI TCM-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier and also enables the OTU/ODU-TIM alarm monitoring.

Traces - SONET/SDH

From the test menu, tap **Setup**, **Test Configurator**, the interface block, and on the **Traces** tab.

Traces

Note: *Selecting a Trace byte to be generated will automatically update the corresponding OH byte. Refer to* OH - SONET/SDH *on page 370 for more information. Configuration is coupled with settings from Traces - SONET/SDH* on page 324.

➤ **Section (J0) / RS (J0)**, **STS Path (J1) / AU Path (J1) / TU-3 Path (J1)**, **VT Path (J2) / TU Path (J2)**

Format allows the selections of the J0/J1/J2 format: **1 Byte** (default), **16 Bytes**, or **64 Bytes**.

Generated, available when the 16 bytes or 64 bytes format is selected, allows entering the J0/J1/J2 trace value/message to be generated.

Format (bytes)	Default Traces	J0/J1/J2
1	**01**[a]	J0/J1/J2
16	**EXFO SONET/SDH**	J0/J1/J2
64	**EXFO SONET/SDH Analyzer Section/RS trace test message**	J0
	EXFO SONET/SDH Analyzer high order path trace test message	J1 (STS/AU)
	EXFO SONET/SDH Analyzer low order path trace test message	J1 (TU-3)/J2

a. Hexadecimal value. Refer to *OH - SONET/SDH* on page 370 to change this value.

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). Traces values should be ASCII suitable characters including the* ITU T.50 Characters *on page 32.*

- **TIM-S / RS-TIM**, **TIM-P / HP-TIM**, **TIM-V / LP-TIM** check box when selected (cleared by default) enables the corresponding Trace Identifier Mismatch for the expected message defined.

  Format allows the selection of the expected format: **16 Bytes** (default), or **64 Bytes**.

  Expected allows entering the expected J0 trace message.

TCM Access Point Identifier

Note: *Available when **TCM** is enabled from the* Signal - Signal Configuration - SONET/SDH *on page 212.*

- **STS Path (N1) / AU Path (N1)**, and **VT Path (Z6) / TU-Path (N2) / TU-Path (N1)** for (TU-3) allows entering the N1/N2/Z6 value/message to be generated.
- **TC-TIM-P / HPTC-TIM / TC-TIM-V / LPTC-TIM** check box when selected (cleared by default) enables the corresponding TCM Access Point Identifier and allows the configuration of the expected message.

9 Test Results

The Test Results menu offers the following structure:

Intelligent Apps

Test Applications	Page or Pop Up	Page
iOptics	Logger	255
	Summary	296

Transport

Test Application	Page, Sub-Page, or Pop Up	Page
DSn/PDH BERT	Alarms/Errors	243
	Logger	255
	Performance Monitoring	261
	Summary	281
NI/CSU Emulation	Logger	255
	Summary	301
OTN BERT	Alarms/Errors	243
	FTFL/PT	247
	Logger	255
	OTL-SDT	259
	Performance Monitoring	261
	Summary	281
	Traces	322

Test Application	Page, Sub-Page, or Pop Up	Page
SONET/SDH BERT	Alarms/Errors	243
	Labels	250
	Logger	255
	Performance Monitoring	261
	Summary	281
	Traces	324
SONET/SDH - DSn/PDH BERT	Alarms/Errors	243
	Labels	250
	Logger	255
	Performance Monitoring	261
	Summary	281
	Traces	324

Ethernet

Test Application	Page, Sub-Page, or Pop Up	Page
Cable Test	Summary	285
Carrier Ethernet OAM	Alarms/Errors	243
	Link OAM	251
	Logger	255
	MPLS-TP OAM	268
	S-OAM	268
	Summary	299 311
	Traffic - MPLS-TP OAM	331
	Traffic - S-OAM	331
	Traffic - Ethernet	331
	WIS	334
EtherBERT	Alarms/Errors	243
	Logger	255
	Summary	289
	Traffic - Ethernet	326
	WIS	334
EtherSAM (Y.1564)	Alarms/Errors	243
	Logger	255
	Service Configuration - Burst	273
	Service Configuration - Ramp	274
	Service Performance	261
	Summary	293
	Traffic - Ethernet	331
	WIS	334

Test Application	Page, Sub-Page, or Pop Up	Page
RFC 2544	Alarms/Errors	243
	Graph	249
	Logger	255
	Summary	302
	Traffic - Ethernet	331
	Traffic - Flow Control	328
	WIS	334
RFC 6349	Alarms/Errors	243
	Logger	255
	Summary	305
	TCP Throughput	321
	Traffic - Ethernet	331
	Traffic - Flow Control	328
	Window Sweep	333
Smart Loopback	Alarms/Errors	243
	Summary	310
	Traffic - Ethernet	331
	WIS	334
Through Mode	Alarms/Errors	243
	Logger	255
	Summary	316
	Traffic - Ethernet	331
	Traffic - Flow Control	328
	Traffic - Graph	330
	Traffic - MPLS	258

Test Application	Page, Sub-Page, or Pop Up	Page
Traffic Gen & Mon	Alarms/Errors	243
	Logger	255
	Streams - Frame Loss / Out-of-Sequence	278
	Streams - Jitter	278
	Streams - Latency	279
	Streams - MPLS	258
	Streams - Throughput	280
	Summary	318
	Traffic - Ethernet	331
	Traffic - Flow Control	328
	Traffic - Graph	330
	WIS	334

Alarms/Errors Overview

Note: *Refer to* Alarms/Errors *on page 507 for the complete list of alarms/errors and their availability.*

Current and history alarms/errors are displayed using different background colors as defined in the following table.

Background color	Alarm/ Error	Description
Gray	Current	No test result available or the results have no impact on the test verdict.
	History	
Green	Current	No alarm/error has occurred in the last second.
	History	No alarm/error has occurred during the test.
Red	Current	An alarm/error occurred in the last second.
	History	
Amber	History	At least one alarm/error has occurred during the test.

When an alarm/error label is dimmed, it indicates that the alarm/error is not monitored or not supported.

- **Seconds** gives the total number of 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 (for example: 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).

Note: *When an alarms/errors group displays a magnifying icon, tapping on it gives more information on alarm/error like Second, Count, and Rate.*

Pass/Fail Verdict

Note: *The verdict is not displayed when disabled or unavailable.*

The Pass/Fail verdict is represented by the following icons:

Icon	Verdict	Description
	PASS	Result value meet the configured threshold criterion.
	FAIL	Result value does not meet the configured threshold criterion.

Statistic Values

- **Current** indicates the average measurements in the last second.
- **Last** indicates the result of the last measurement.
- **Minimum** indicates the minimum value recorded.
- **Maximum** indicates the maximum value recorded.
- **Average** indicates the average value.

Buttons / Selectors

- <Port #>, available with **Dual Port** topology, allows selecting the port to be displayed.
- **Global**/<Port #>, available with **Dual Port** topology, allows selecting to display a brief summary for both ports (**Global**) or for a specific port.

Alarms/Errors

From the **Test** menu, tap **Results**, and the **Alarms/Errors** tab. Depending on the test structure, the Alarms/Errors page may be split in different tabs such as OTN and Ethernet; tap on the desired tab when required.

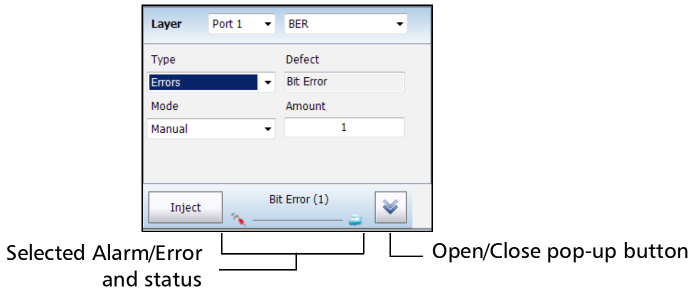
Note: *Refer to* Alarms/Errors *on page 507* *for the complete list of alarms/errors and their availability.*

Alarms/errors blocks containing the magnifier (+) icon in its title**,** opens a zoomed view giving more details like alarms/errors for each lane (parallel interface), errors in seconds, count, and rate.

When there is not enough room on the page to display the error in seconds, count, and rate, the error is displayed in **Seconds** per default. To select another unit, tap on the unit's button and select either **Seconds** (default), **Count**, or **Rate**.

Total, available with certain errors (parallel interface), indicates the total of all lanes when **Count** or **Rate** unit is selected.

Inject Button



- **Inject** generates the selected alarm/error.

  The selected alarm/error details and status are displayed next to the **Inject** button.

  The open/close pop-up button allows expanding (up arrow) or collapsing (down arrow) the pop-up for setting the alarm/error injection parameters.

- **Layer** allows selecting on which layer is the alarm/error to be generated. Choices depend on the test application and its interface.

  For **Dual Port** topology, select the port used for alarm/error injection.

- **Type** allows selecting the type of injection: **Alarms** or **Errors**.

- **Defect** allows selecting the alarm/error defect to be generated. Choices depend on the selected **Layer** and **Type**. Refer to *Alarms/Errors* on page 243 for more information.

- **Mode** allows selecting the injection mode for error type; injection mode is set to **Continuous** for alarm injection.

  - **Manual** generates the selected errors according to the defect and the amount selected.

  - **Rate** generates the selected error at the rate specified.

- **Max Rate** generates the selected error at its theoretical maximum rate.
- **Continuous** generates the selected alarm continuously.

- **Amount**, available with **Manual** mode, allows entering the amount of error to be generated: **1** (default) through **50** or **100** (depending on the selected error).
- **Rate**, available with **Rate** mode, allows selecting the error injection rate. The rate must be within the minimum and maximum values specified.
- **Max Rate**, available with **Max Rate** mode, allows generating the error to its theoretical maximum rate.
- **Lane**, available with parallel interfaces, allows selecting the physical lane that will be used for injection. Available for **Interface**, **OTL**, and **PCS** layers only.

FTFL/PT

From the test menu tap **Results**, and the **FTFL/PT** tab.

FTFL

Indicates the Forward and Backward ODU Fault Type Fault Location.

➤ **Fault Indication** and **Code** respectively displays the FTFL fault indicator message and its code in hexadecimal format (byte 0 for forward, byte 128 for backward).

Fault Indication	Code
No fault	00 (default)
Signal fail	01
Signal Degrade	02
Reserved	03

➤ **Operator Identifier** displays the received operator identifier (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).

PT

- **Payload Type** and **Code** displays the received payload signal type and its code in hexadecimal format. The expected payload signal type can be selected from the list or by entering its hexadecimal code. Refer to *PT* on page 142 for the list.
- **OPU-PLM** check box when selected enables the OPU-PLM alarm analysis.
- **Copy RX** uses the received payload type as the expected payload type.

Graph - RFC 2544

Displays the graph showing the **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** measurements. For **Dual Test Set** the graph shows results from **Local to Remote** and **Remote to Local** using distinctive colors. For **Dual Port** topology the graph shows results of both port directions.

From the **Test** menu, tap **Results**, and the **Graphs** tab.

- **All** button allows viewing the graphs of all subtests simultaneously.
- **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** buttons allow viewing an enlarged graph view of the selected subtest.
- **Displayed Results** allows selecting the displayed results mode, either **Minimum**, **Maximum** (default), **Average**, or **Current**.
- **Step**, available with Frame Loss, allows selecting the result step (100 percent by default) to be displayed.

The X axis shows the frame sizes while the Y axis shows the subtest results.

- **Frame Size (Bytes)** and **Step (%)**, available with Frame Loss, allows selecting either **Frame Size** (default) or **Step** as the X axis criterion.

Labels

From the test menu, tap **Results**, and **Labels**.

Labels

Note: *Check boxes are coupled with settings from Labels* on page 151.

- **STS Path (C2)** / **AU Path (C2)**: The C2 byte is allocated to indicate the content of the STS SPE / VC, including the status of the mapped payloads.

  Received displays the received C2 byte (refer to *C2* on page 378.

- **PLM-P/UNEQ-P / HP-PLM/HP-UNEQ** check box when selected (cleared by default) enables the Payload Mismatch and STS/AU UNEQ monitoring.

  Expected allows the selection of the expected C2 byte value (refer to *C2* on page 378).

- **VT Path (V5) / TU Path (V5)**: The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads.

  Received displays the received V5 byte (refer to V5 on page 381).

- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box when selected (cleared by default) enables the Payload Mismatch and VT/TU UNEQ monitoring.

  Expected allows the selection of the expected V5 byte value (refer to V5 on page 381).

Link OAM

From the **Test** menu, tap **Results**, and the **Link OAM** tab.

Remote MAC Address

Indicates the remote OAM link partner MAC address.

Remote OAM Information

- **OAM Version** indicates the protocol version supported by the DTE.
- **Revision** indicates the revision of the Information TLV.
- **Multiplexer Action** reports the Multiplexer Action:

  Forward indicates that the device is forwarding non-OAMPDUs to the lower sublayer.

  Discard indicates that the device is discarding non-OAMPDUs.
- **Parser Action** reports the Parser Action:

  Forward indicates that the device is forwarding non-OAMPDUs to the higher sublayer.

  Loopback indicates that the device is looping back non-OAMPDUs to the lower sublayer.

  Discard indicates that the device is discarding non-OAMPDUs.
- **OAM Mode** reports the OAM mode:

  Active indicates that the DTE is configured in **Active** mode.

  Passive indicates that the DTE is configured in **Passive** mode.
- **OUI** reports the 24-bit IEEE Organizationally Unique Identifier field identifying the vendor.
- **Maximum OAMPDU Size** reports the maximum OAMPDU size in bytes, supported by the DTE.

- **Vendor Specific Information** reports the 32-bit **Vendor Specific Information** field identifying the vendor's product model and version.
- **Unidirectional** reports unidirectional support capability:

  Supported indicates that the DTE is capable of sending OAMPDUs when the receive path is non-operational.

  Unsupported indicates that the DTE is not capable of sending OAMPDUs when the receive path is non-operational.
- **Remote Loopback** reports OAM remote loopback support capability:

  Supported indicates that the DTE is capable of OAM remote loopback mode.

  Unsupported indicates that the DTE is not capable of OAM remote loopback mode.
- **Variable Retrieval** reports variable retrieval capability:

  Supported indicates that the DTE supports sending Variable Response OAMPDUs.

  Unsupported indicates that the DTE does not support sending Variable Response OAMPDUs.
- **Link Events** reports link event capability:

  Supported indicates that the DTE supports interpreting Link Events.

  Unsupported indicates that the DTE does not support interpreting Link Events.

Remote Error Event Statistics

- **Date Stamp**[1] indicates the date the last Event Notification OAMPDU frame was received.
- **Time Stamp**[1] indicates the time the last Event Notification OAMPDU event was received by the test equipment.
- **Window**

Symbol Period	Errored symbol Window in second
Frame	Errored frame event Window in second
Frame Period	Errored frame period Window - duration period in number of 64 bytes frames
Frame Seconds	Errored frame seconds summary Window

- **Threshold**

Symbol Period	Errored symbol threshold in second
Frame	Errored frame event threshold in second
Frame Period	Errored frame period threshold in second
Frame Seconds	Errored frame seconds summary threshold in second

- **Error Count**

Symbol Period	The number of symbol errors in Window
Frame	The number of frame event errors in Window
Frame Period	The number of frame period errors in Window
Frame Seconds	The number of frame seconds summary errors in Window

1. **Date Stamp** and **Time Stamp** parameters differ from the 802.3 standard definitions.

➤ Error Running Total

Symbol Period	The number of symbol errors since the last reset
Frame	The number of frame event errors since the last reset
Frame Period	The number of frame period errors since the last reset
Frame Seconds	The number of frame seconds summary errors since the last reset

➤ Event Running Total

Symbol Period	The number of symbol events since the last reset
Frame	The number of frame events since the last reset
Frame Period	The number of frame period events since the last reset
Frame Seconds	The number of frame seconds events since the last reset

Inject Errored Frames

Generates 5 consecutive packets with FCS errors within a 1 second period.

Logger

The Logger page displays color-coded events and pass/fail verdict.

From the **Test** menu, tap **Results**, and the **Logger** tab.

Note: *For RFC 6349 the Logger is only available with operation modes **Dual Test Set** (local unit).*

Sort By

Select the sorting order of the event logger entries:

- **ID** (default) displays the event logger entries in numeric ascending order based on the **ID** column of the event logger table.
- **Event** displays the event Logger entries in alphanumeric ascending order based on the **Event** column of the event logger table.

Time Mode

- **Relative** displays the time/duration fields based on the time elapse since the beginning of the test or since the last test reset. The format of the time is Dd HH:MM:SS.
- **Absolute** (default) displays the time/duration fields based on the date and time the event occurred/ended. The time format depends on the MAX-800 Series time settings.

  For 24 hours, the time format is MM/DD HH:MM:SS.

  For 12 hours, the time format is MM/DD HH:MM:SS <AM or PM>.

Closure Format

- **Duration** (default): Indicates the number of seconds within which the event occurred. Test events like **Test Started** and **Test Stopped** will have no duration.
- **End Time**: Indicates at what time the event has been completed or cleared.

Save to CSV

Allows saving the logger content to a CSV file format.

Table

The logger table provides the following event logger information.

- **ID**: Indicates the event identification number. The events are sequentially numbered.
- **Start Time**: Indicates when the event has been started or detected.
- **Event**: Provides the event type and threshold crossing information.
- **Duration or End Time**, depending on the **Closure Format** selected, indicates either the duration or at what time the event has been completed or cleared.
- **Details**: Provides contextual information including the pass/fail verdict.

The following table displays the nature of information reported by type of event:

Type of Event	Nature of Information
Test Started	Start Date
Test Stopped	Pass/Fail Verdict
Alarm Events	Count value
Error Events	Current Count and Total Count

Type of Event	Nature of Information
SDT Events	Service Disruption Time
Threshold Crossing Event	Value at the end of the test

Note: *The Logger table can display up to 500 event entries. Once the Logger table reports 500 event entries, a log full indicator appears and no further entries are possible. However, the events in the Pending state will be updated if the test is still running.*

The Event Logger information will be cleared when:

- the test is reset or started.
- the unit is in suspended mode.
- stopping the current test and navigating to other tests.
- the unit is restarted.

Note: *An entry event remains in the Pending state as long as the event is not completed and it is highlighted on a yellow background color.*

Note: *The Threshold Crossing events are displayed in red text color.*

MPLS

For **Traffic Gen and Mon**, from the test menu, tap **Results**, **Streams**, and the **MPLS** tab.

For **Though Mode**, from the test menu, tap **Results**, **Traffic**, and the **MPLS** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

Label 1 and Label 2

The number of MPLS frames transmitted (TX) and received (RX) are displayed for both **Label 1** and **Label** 2 for each **Stream**. Not available for **Through Mode** test application.

Total TX/RX MPLS

- **Line Utilization** indicates the percentage of MPLS line rate utilization in TX and RX.
- **Ethernet BW (%)** (Ethernet Bandwidth) indicates the MPLS data rate in TX and RX.
- **Frame Rate (frames/s)** indicates the number of transmitted (TX) and received (RX) MPLS frames.
- **Frame Count** indicates the count of transmitted (TX) and received (RX) MPLS EtherType (0x8847 or 0x8848) frames regardless if FCS is good or not.

OTL-SDT

Note: *Only available for parallel interfaces when an OTL defect, at the exception of LOL, is selected for Service Disruption Time (refer to* Service Disruption *on page 111).*

From the test menu, tap **Results**, and the **OTL-SDT** tab.

Service Disruption

Note: *Service Disruption results are only available when* ***Disruption Monitoring*** *is enabled (refer to* BERT and Unframed BERT *on page 109).*

Service Disruption is the time during which there is a disruption of service due to the absence of traffic or to the detection of defects per lane.

Disruption Time

- **Defect** indicates on which layer and defect the service disruption time test is performed.
- **Lane** indicates the lane number.
- **Longest (ms)** indicates the longest measured disruption time per lane.
- **Shortest (ms)** indicates the shortest measured disruption time per lane.
- **Last (ms)** indicates the length of the last measured disruption time per lane.
- **Average (ms)** indicates the average duration of all measured disruption times per lane.
- **Total (ms)** indicates the total duration of all measured disruption times per lane.
- **Count** indicates the number of disruption events detected since the beginning of the SDT test per lane.

- **Longest Disruption** indicates the longest measured disruption time.
- **Lanes with Disruption** indicates the number of lanes with service disruption.

Note: *When a disruption event is equal to or longer than the test period which is fixed to 5 minutes, then the measured disruption time is equal to the test period.*

Performance Monitoring

Note: *This tab is only available with Transport test applications with Pattern client. Monitored performance parameters are reported, non-monitored values are left blank.*

The Performance Monitoring tab gives error performance events and parameters for the circuit under test.

From the **Test** menu, tap **Results**, and the **Performance Monitoring** tab.

Each button on top of the window represents a level of the analyzed signal for which the Performance Monitoring (PM) is available. Each button also displays the PM standard(s) available for this level. Tap a signal level button to get its PM results.

Analyzed Signal	Standard's availability						
	G.821	G.826 ISM	G.828 ISM	G.829 ISM	M.2100 ISM	M.2100 OOSM	M.2101 ISM
DS3/DS1/E4/E3/E2/E1		X			X		
Section/RS				X			
Line/MS				X			X
VTn/STS-n/AU-n/ TU-n			X				X
BERT	X					X	

Note: *G.821 and M.2100 OOSM are only available when* ***No Pattern Analysis (Live)*** *check box is cleared.*

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 (DSn/PDH), 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 (DSn/PDH), EB, etc.) are ≥ X percent or at least one defect occurred. X=30 percent for DSn/PDH signals; see the following table for SONET/SDH signals SES threshold.

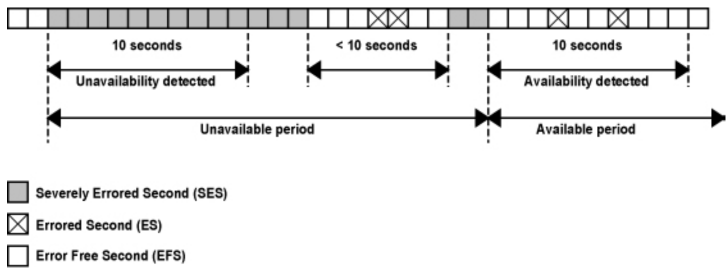
	OC-1 STS-1e STM-0 STM-0e	OC-3 STS-3e STM-1 STM-1e	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30 %	30 %	30 %	30 %	30 %
Line/MS	15 %	15 %	25 %	30 %	30 %
Section/RS	10 %	30 %	30 %	30 %	30 %

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.826**, **G.828**, **G.829**, and **M.2101**): 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 (DSn/PDH), 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 number of seconds within which anomalies (FAS (DSn/PDH), EB, etc.) are ≥ X percent or at least one defect occurred. X=30 percent for DSn/PDH signals; see the following table for SONET/SDH signals SES threshold.

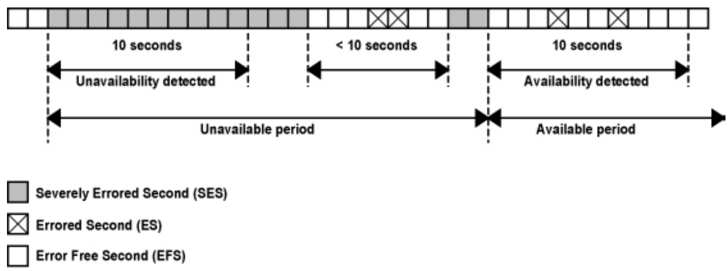
	OC-1 STS-1e STM-0 STM-0e	OC-3 STS-3e STM-1 STM-1e	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30 %	30 %	30 %	30 %	30 %
Line/MS	15 %	15 %	25 %	30 %	30 %
Section/RS	10 %	30 %	30 %	30 %	30 %

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.

S-OAM and MPLS-TP OAM

From the **Test** menu, tap **Results**, and the **S-OAM** or **MPLS-TP OAM** tab.

Loopback

- **Status** displays the status of the test function (refer to page 314).
- **TX LBM** indicates the count of transmitted LBM frames.
- **RX LBR** indicates the count of valid LBR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address, destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **LBR Timeout**

  For connectivity verification (Continuous check box cleared), indicates the count of LBR Timeout event which occurs if a reply (LBR frame with matching Transaction ID) to a transmitted LBM frame is not received within 5 seconds.

  For diagnostic test (Continuous check box selected), indicates the difference between the transmitted LBM frames and the received LBR frames.
- **Invalid LBR**

  For connectivity verification (Continuous check box cleared), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level or with an unexpected Transaction ID.

  For diagnostic test (Continuous check box is selected), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level.

- **Invalid Payload** indicates the count of received LBR frames having either a TLV type different than the one transmitted, Bit error or wrong data value detected in the data payload of a Data TLV, Bit error, Pattern Loss, or Pattern Type mismatch of a Test TLV.
- **Successful** indicates the count of received LBR frames having no errors.
- **Failed** indicates the count of LBR frames declared as invalid.

Test

- **Status** displays the status of the test function (refer to page 314).
- **TX TST** indicates the count of transmitted TST frames.
- **RX TST** indicates the count of valid TST frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address[1]; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid TST** indicates the count of TST frames received from the peer MEP with incorrect MEG/MD level.
- **Invalid Payload** indicates the count of received TST frames having either an unsupported pattern type, or bit error / pattern loss detected in the payload.
- **Successful** indicates the count of received TST frames having no errors.
- **Failed** indicates the count of TST frames declared as invalid.

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 505 for more information.

Frame Delay

- **Status** displays the status of the test function (refer to page 314).
- **TX DMM** indicates the count of transmitted DMM frames.
- **RX DMR** indicates the count of valid DMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration..
- **Invalid DMR** indicates the count of received DMR frames from the peer MEP having an incorrect MEG/MD Level, an incorrect Test ID (when applicable), or with a valid MEG/MD Level and valid Test ID (when applicable) but with a Frame Delay outside the 0.001 to 8000.000 ms range.
- **Delay (ms)**: **Current** indicates the average of frame delay measured in the last second. **Minimum**, **Maximum**, and **Average** indicates respectively the minimum, maximum, and average frame delays measured since the beginning of the test.
- **Successful** indicates the count of received DMR frames having no errors.
- **Failed** indicates the count of DMR frames declared as invalid.

Frame Loss

- **Status** displays the status of the test function (refer to page 314).
- **TX LMM** indicates the count of transmitted LMM frames.
- **RX LMR** indicates the count of valid LMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid LMR** indicates the count of LMR frames received from the peer MEP with incorrect MEG/MD level.
- **Frame Loss** is calculated (count and %) for both Near-End and Far-End over all valid LMR frames received.
- **Successful** indicates the count of received LMR frames having no errors.
- **Failed** indicates the count of LMR frames declared as invalid.

Synthetic Loss

Note: *Only available with Ethernet OAM.*

- **Status** displays the status of the test function (refer to page 314).
- **TX SLM** indicates the count of transmitted SLM frames.
- **RX SLR** indicates the count of valid SLR frames received. A valid frame has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs.
- **Invalid SLR** indicates the count of SLR frames received from the peer MEP with incorrect MEG/MD level, incorrect source MEP ID, or incorrect Test ID.
- **Synthetic Loss** is calculated (count and %) for both Near-End and Far-End over all frames received and is updated after each Synthetic Loss measurement period (after receiving the defined **Frame Count**, refer to page 189).
- **Successful** indicates the count of received SLR frames having no errors.
- **Failed** indicates the count of SLR frames declared as invalid.

Service Configuration - Burst

From the **Test** menu, tap **Results**, **Service Configuration**, and the **Burst** tab.

Service Name and Selection

Service Name indicates the name of the selected service.

Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

Committed/Excess

- **Committed - Burst test** is the **CBS** subtest.
- **Excess - Burst test** is the **EBS** subtest.
- **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for local (**L**) and remote (**R**) directions, or for both port directions.
- **Burst Size** indicates the size in bytes of the burst used for each subtest.
- **SLA Verified** indicates the committed SLA parameters that are used to declare the pass/fail verdict. See *Summary - EtherSAM* on page 293 for more information on **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, **Max Latency**, and **Max RX Rate**.
- **Informational** parameters are for information purpose only, they are not included in the test pass/fail verdict. See *Summary - EtherSAM* on page 293 for more information on **Frame Loss Rate**, **Max Jitter**, **Max Latency**, and **Round-Trip Latency**.
- **Average RX Rate** indicates the measured average utilization throughput for the CBS subtest.

Service Configuration - Ramp

From the **Test** menu, tap **Results**, **Service Configuration**, and the **Ramp** tab.

Service Name and Selection

Service Name indicates the name of the selected service. Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

Committed/Excess Steps

- **Committed Steps** indicate the pre CIR and CIR steps specified in the ramp configuration.
- **Excess Steps** indicate the **CIR+EIR** and **Traffic Policing** steps specified in the ramp configuration.
- **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for local (**L**) and remote (**R**) directions, or for both port directions.
- **TX Rate** indicates the transmission rate.
- **SLA Verified** indicates the committed SLA parameters that are used to declare the pass/fail verdict. See *Summary - EtherSAM* on page 293 for more information on **Frame Loss Rate**, **Max Jitter**, **Round-Trip Latency**, and **Max RX Rate**.

- **Informational** parameters are for information purpose only, they are not included in the test pass/fail verdict. See *Summary - EtherSAM* on page 293 for more information on **Frame Loss**, **Max Jitter**, and **Round-Trip Latency**.
- **Average RX Rate** indicates the measured average utilization throughput for each step.

Service Performance

From the **Test** menu, tap **Results**, and the **Service Performance** tab.

Service Name and Selection

Service Name indicates the name of the selected service.

Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

SLA Parameters

The configured **CIR**, **Max Jitter**, **Frame Loss Rate** and **Max Latency**/**Max Round-Trip Latency** SLA parameters are displayed. Refer to *Services - Profile* on page 193 for more information. For **Dual Test Set** or **Dual Port** topology, parameters are displayed respectively for both local (**L**) and remote (**R**) directions, or for both port directions.

Metrics

Current, **Average**, **Minimum**, **Maximum**, and **Estimate** (**Jitter**) measured values for each metric are reported. **Direction**, available with **Dual Test Set** or **Dual Port** topology indicates respectively results for local (**L**) and remote (**R**) directions, both port directions, and Round-Trip for Latency when in Round-Trip Latency Measurement Mode (see *Global Options* on page 137). For **Dual Test Set**, results for remote to local are obtained at the end of each step.

- **RX Rate** indicates the measured utilization throughput.
- **Jitter** indicates the measured delay variation.
- **Latency** indicates the measured round-trip latency (delay).

Note: *For the **Current** value, 0 is displayed when no RX rate has been measured in the last second.*

Note: *For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

Errors

For **Dual Test Set**, errors “”are reported for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, errors are reported for both port directions.

- **Frame Loss** indicates that a sequence number is missing in the received frames. The pass/fail verdict when enabled reports only the verdict when it is fail. ***Seconds***, ***Count***, *and **Rate** values are reported.*
- **Out-of-Sequence** indicates that the received frame sequence number is either smaller than the expected frame sequence number or is a duplicate number. The Out-Of-Sequence will not be considered in the global verdict. ***Seconds***, ***Count***, *and **Rate** values are reported.*

RX Frame Count

The **RX Frame Count** indicates the number of frames received matching the selected service ID. For **Dual Test Set**, the count is reported for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, the count is reported for both port directions.

Streams - Frame Loss / Out-of-Sequence

From the **Test** menu, tap **Results**, **Streams**, and the **Frame Loss / Out-Of-Sequence** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

- **Stream** indicates the stream identification number.
- **Thresholds** button allows setting the pass/fail thresholds (refer to *QoS Metrics* on page 225).
- **Frame Loss**: See *QoS Metrics* on page 514.
- **Out-Of-Sequence**: See *QoS Metrics* on page 514.

Streams - Jitter

From the **Test** menu, tap **Results**, **Streams**, and the **Jitter** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

- **Stream**: Indicates the stream identification number.
- **Jitter** is measured for each stream on all valid frames (in-sequence frames, valid Jitter tag, and no FCS error) received. **Current**, **Average**, **Minimum**, **Maximum**, and **Estimate** delay values are reported.

Note: *For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- **Thresholds** button allows setting the pass/fail thresholds (refer to *QoS Metrics* on page 225).

Streams - Latency

From the **Test** menu, tap **Results**, **Streams**, and the **Latency** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

- **Stream**: Indicates the stream identification number.
- **Latency** is measured for each stream on all valid frames (valid Latency tag, expected originator identifier value, and no FCS error) received. **Current**, **Average**, **Minimum**, and **Maximum** round-trip latency (delay) are reported.

Note: ***Latency** statistics are only available in loopback test topology.*

Note: *For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- **Thresholds** button allows setting the pass/fail thresholds (refer to *QoS Metrics* on page 225).

Streams - Throughput

From the **Test** menu, tap **Results**, **Streams**, and the **Throughput** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

- ➤ **Stream** indicates the stream identification number.
- ➤ **TX Rate** indicates the transmission rate.
- ➤ **RX Rate** is measured for each stream on all valid frames (valid Throughput tag with no FCS error). **Current**, **Average**, **Minimum**, and **Maximum** throughput results are reported.

Note: *A **Current** value of **0** indicates that no RX rate has been measured in the last second.*

- ➤ **Total** indicates the total TX and current measured RX throughput of all valid frames (valid Throughput tag with no FCS error).
- ➤ **Thresholds** button allows setting the pass/fail thresholds (refer to *QoS Metrics* on page 225).

Summary - OTN/SONET/SDH/DSn/PDH

Note: *Available with OTN BERT, SONET/SDH BERT, OTN-SONET/SDH BERT, DSn/PDH BERT, and SONET/SDH - DSn/PDH BERT.*

From the **Test** menu, tap **Results**, and the **Summary** tab.

➤ **Global**/<Port #>, available with **Dual Port** topology, allows selecting to display a brief summary for both ports (**Global**) or for a specific port.

➤ **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

--: Idle state, the test is not running or results are not available.

In Progress: The test is running.

Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

Aborted: The test is interrupted; stopped before the set timer.

➤ **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.

➤ **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.

➤ **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

BER and Multi-Pattern BER

Note: *See* BER *on page 510 for a description of each alarm/error.*

Note: *For Multi-Pattern, alarms/errors are available for each pattern. An arrow in front of a specific pattern indicates the pattern that is currently generated/analyzed.* ***All*** *represents the sum of alarms/errors as well as the consolidated rate for all patterns.*

- **Receiving Live Traffic - RX Pattern Analysis Disabled** when displayed, indicates that the **No Pattern Analysis (Live)** check box is selected and in this case no other information/statistics are available.
- **BER Threshold** is available when **Pass/Fail Verdict** is enabled[1].
- **Restart Sequence** button, available with multi-pattern, clears results and restarts the multi-pattern sequence with the first enabled pattern in the list. This is the only way to restart the multi-pattern sequence and to allow synchronization between two test sets.

  For back-to-back testing using two test sets, create a multi-pattern test on both units, tap the **Restart Sequence** button on each unit within 5 seconds apart. Once synchronized, start the test on each unit.

1. Refer to *BERT and Unframed BERT* on page 109 or *EtherBERT and Unframed BERT* on page 126.

- **Bit/Pattern Error Rate/Count** graphically displays a meter representing either the bit/pattern error rate or the bit/pattern error count depending on the Pass/Fail Verdict selection[1].

  When the verdict is enabled[1], the values under the threshold are presented in green while the values above are in red.

  When the verdict is disabled, the bit/pattern error rate is displayed in blue.

  The arrow pointer indicates the current received bit/pattern error rate/count.

  The Pass/Fail verdict is displayed just on top of the meter when enabled[1].

- **Bit/Pattern Error**, **Amount/Rate**, and **Inject**: The bit/pattern error injection and settings are coupled with the *Inject Button* on page 245. For Transport test applications, not available in Through modes or with Multi-Pattern.

Service Disruption

Note: *Service Disruption results are only available when **Disruption Monitoring** is enabled (refer to* BERT and Unframed BERT *on page 109). When Service Disruption is disabled, the message **Service disruption monitoring disabled** is displayed.*

Service Disruption is the time during which there is a disruption of service due to the detection of defects.

1. Refer to *BERT and Unframed BERT* on page 109 or *EtherBERT and Unframed BERT* on page 126.

➤ **Disruption Time**

Note: *For OTL defects, at the exception of LOL, the disruption time is displayed for the lane having the longest disruption time. See* OTL-SDT *on page 259 for results per lanes.*

Longest indicates the longest measured disruption time.

Shortest indicates the shortest measured disruption time.

Last indicates the length of the last measured disruption time.

Average indicates the average duration of all measured disruption times.

Total indicates the total duration of all measured disruption times.

➤ **Defect** indicates on which layer and defect the service disruption time test is performed. For OTL defect (parallel interface) also indicates within parenthesis the lane number having the longest disruption time.

➤ **Disruption Count**: Indicates the number of disruption events detected since the beginning of the SDT test.

Note: *When a disruption event is equal to or longer than the test period which is fixed to 5 minutes, then the measured disruption time is equal to the test period.*

➤ **SDT Threshold (ms)** allows configuring the acceptable maximum service disruption time before failing the test: **0.001** to **299999.999 ms** (default is **50** ms). Refer to *Service Disruption* on page 111.

Summary - Cable Test

From the **Test** menu, tap **Results**, and the **Summary** tab.

➤ **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled. The Pass/Fail verdict is based on the following criteria: **The worst pair's Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

--: Idle state, the test is not running or results are not available.

In Progress: The test is running.

Completed: The test is completed or manually stopped.

➤ **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.

Cable

Note: *When no value is available, "--" is displayed.*

➤ **Wire Map** indicates the Wire Map result for the pair having the worst Wire Map. The distance to fault is also displayed when a fault is identified. The Pass/Fail verdict is also displayed, when enabled.

➤ **Prop. Delay (ns)** indicates the propagation delay value for the pair having the longest propagation delay. The Pass/Fail verdict is also displayed when enabled.

- **Delay Skew (ns)** indicates the delay skew value for the pair having the worst delay skew. The Pass/Fail verdict is also displayed when enabled. The Delay Skew result is only available for 1000BASE-T interface when the link is up.
- **Length (m/ft)** indicates the length for the pair having the worst cable length value. The Pass/Fail verdict is also displayed when enabled.

Pairs

Note: *When no value is available, "--" is displayed.*

- **Pair** indicates the pair number.
- **Pins** indicates the pair's pin numbers and color of each wire corresponding to the selected wiring standard.

W-BL	White-Blue
BL	Blue
W-O	White-Orange
O	Orange
W-G	White-Green
G	Green
W-BR	White-Brown
BR	Brown

➤ **Wire Map Test Result** gives the wire map test result for each pair. When the link is up: The wire map result for each pair is given as seen by the module to get a link up. This means that the wire map result may not correspond to the type of cable tested depending on the cable(s) used and/or the configuration of the cable mode (MDI, MDIX, or auto-detection) on both the module and the far end equipment. For example, two crossed pair cables end to end used between the module and a far end equipment may give a straight pair (MDI) wire map result.

MDI	Straight pair.
MDIX	Crossed pair.
MDI (-)	For 1 Gbit/s, straight pair with swapped wires within pair.
MDIX (-)	For 1 Gbit/s, crossed pair with pair A swapped with pair B and/or pair C swapped with pair D.
Noise	Excessive noise on a pair most likely caused by a link partner running in 10/100 Mbit/s forced mode. In this case, no propagation delay or length is reported and there is no comparison with any threshold.

Note: *For 1 Gbit/s, both MDI and MDIX can be reported simultaneously since crossed pairs detection is performed independently for pairs A-B and C-D.*

When the link is down:

Short	Short-circuit between Tip and Ring wires of a pair or Tip or ring wire of a pair is connected with an alien wire grounded.
Open	No cable plugged in, remote end open, or either one or two wires of a pair are not connected.
Short-between-pairs	Short between one or two wires of a pair with one or two wires of another pair. Short between more than two pairs, including one or two wires for each pair.
Noise	Excessive noise on a pair most likely caused by a link partner running in 10/100 Mbit/s forced mode. In this case, no distance is reported and there is no comparison with any threshold.
Unknown	No fault has been identified but the link is down. To maximize the cable test result, it is preferable to have the far end equipment powered up.

If the determined **Wire Map** is either **MDI**, **MDIX**, **MDI (-)**, **MDIX (-)**, or **Noise** (Link up), the test is declared as **PASS**. If the determined Wire Map is either **Short**, **Short-between-pair**, **Open**, **Noise** (Link down), or **Unknown**, the test is declared as FAIL.

Note: *Refer to* Ethernet Cables *on page 475 for cable pinout.*

- **Distance To Fault (m/ft)** gives the distance to fault from the near end for each pair, unless the problem is due to excessive noise. Noise may be due to electrical noise causing communication error.
- **Prop. Delay (ns)** indicates the propagation delay of a signal through each pair.
- **Length (m/ft)** indicates the cable length of each pair.

Summary - EtherBERT

From the test menu, tap **Results**, and the **Summary** tab.

- **Global**/<Port #>, available with **Dual Port** topology, allows selecting to display a brief summary for both ports (**Global**) or for a specific port.
- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.
- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

BER

Note: *See* BER *on page 510 for a description of each alarm/error. For Pass/Fail Verdict, refer to* EtherBERT and Unframed BERT *on page 126.*

➤ **Receiving Live Traffic - RX Pattern Analysis Disabled** when displayed, indicates that the **No Pattern Analysis (Live)** check box is selected and in this case no other information/statistics are available.

➤ **BER Threshold** allows entering maximum bit/pattern error count allowed before declaring a fail verdict: **0** (default) to **999999** for count; **1.0E-14** to **1.9E-01** for rate (the default value is **1.0E-12**). Only available when the **Pass/Fail Verdict** is enabled.

➤ **Bit Error Rate** / **Pattern Error Rate** / **Bit Error Count** / **Pattern Error Count** graphically displays a meter representing either the bit/pattern error rate or the bit/pattern error count depending on the pass/fail verdict selection.

When the verdict is enabled, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit/pattern error rate is displayed in blue.

The arrow pointer indicates the current received bit/pattern error rate/count.

The Pass/Fail verdict icon is displayed just on top of the meter when enabled.

➤ **Bit Error** / **Pattern Error**, **Amount/Rate**, and **Inject**: The bit error injection and settings are coupled with the *Inject Button* on page 245.

Service Disruption

Note: *Service disruption results are only available when **Disruption Monitoring** is enabled; when disabled the message **Service disruption monitoring disabled** is displayed. Refer to* Service Disruption *on page 128.*

- **Disruption Time** is the time during which there is a disruption of service due to the absence of traffic. The service disruption event lasts until valid Ethernet frames are received for at least the **Debounce Time** without any service disruption event. The following measured disruption time values are reported: **Longest Shortest**, **Last**, **Average**, and **Total**. **Total** indicates the total duration of all measured disruption times.

Note: *When a disruption event is equal to or longer than the test period which is fixed to 5 minutes, then the measured disruption time is equal to the test period.*

- **Disruption Count** indicates the number of disruption events detected since the beginning of the SDT test.
- **SDT Threshold** allows configuring the acceptable maximum service disruption time before failing the test: **0.005** to **299999.999** ms (default is **50** ms). The threshold value cannot be less than the **No Traffic Time** value.

Latency

Note: *Latency results are only available when **Latency** is enabled (refer to* Latency *on page 129) with Framed Layer 2 and higher. When **Latency** is disabled, the message **Latency Measurement Disabled** is displayed. For Dual port topology, available for rates up to 10G, the measured latency and threshold configuration are available per port/direction.*

- **Round-Trip** latency (delay) is measured on all valid frames received and the **Current**, **Average**, **Minimum**, and **Maximum** values are reported.

  Round-Trip Threshold (ms) is configurable from **5 µs** for 10Mbit/s, **1 µs** for 100Mbit/s and 10G WAN, or **100 ns** for all other rates up to **2 s** (default is **75** ms).

- **One-Way P<m>** ↔ **P<n>** latency (delay) is measured on all valid frames received and the **Current**, **Average**, **Minimum**, and **Maximum** values are reported per port/direction:
  P<m> -> P<n>: Latency measurement at P<m> RX port.
  P<n> -> P<m>: Letency measurement at P<n> RX port.

  One-Way P<m> -> **P<n> Threshold** is configurable at the current P<m> RX port: from **5 µs** for 10Mbit/s, **1 µs** for 100Mbit/s and 10G WAN, or **100 ns** for all other rates up to **2 s** (default is **75** ms).

- **Unit** allows selecting the Latency unit: **ms** (default) or **µs**.

Summary - EtherSAM

From the **Test** menu, tap **Results**, and the **Summary** tab.

Note: *For **Dual Test Set**, only Start Time is displayed on the remote unit.*

- **Service Configuration/Performance Test** indicates the actual test status as follows:

Test Status	Description
"--"	Test has not started.
Disabled	Test/subtests is/are disabled.
Running	Test/subtest is currently running.
Data Transfer	Test/subtest is running but no test traffic is being transmitted.
Completed, <Verdict>	Test/subtest has completed with the test pass/fail verdict. A fail verdict is declared when a **Link Down** or **LOS** is detected, or when any SLA parameter fails.
Aborted, **<**reason**>**	Test/subtest has been aborted either manually (Stop) or automatically from an alarm and the reason why the test has been aborted is also displayed as follows: **Link down alarm**, **LOS alarm**, **Timeout during execution**, **DTS connection failed**, **Loss of remote connection (DTS)**, **LOPPS-L Alarm**[a], **LOPPS-R Alarm**[a], **LOPPS-L / LOPPS-R Alarm**[a], **Unresolved addresses**, **No test enabled**, **Invalid Burst Configuration**, **CIR disabled for all services**, **Excessive Refill Time**[b], **Stopped**, **NAT detection failed**

a. Available for **Dual Test Set** in **One-Way Latency** measurement mode.
b. An excessive refill occurs when the pre-burst and/or post-burst duration last for more than 2 seconds.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted.
- **Remote unit in Dual Test Set Mode** indicates that this unit is set as remote but the DTS Connection is not established.

- **Remote unit in use and locked for Dual Test Set** indicates that this unit is used for **Dual Test Set** as the remote unit.
- **Service Configuration/Performance Test**: Tap **Service Configuration Test** or **Service Performance Test** button to view the result summary of the corresponding test.
  - **Service** indicates the service's number and name. For **Service Configuration Test**, the number/name is highlighted in red per service when VLAN mismatch occurred; in **Dual Test Set** or **Dual Port** topology, the direction is also highlighted; in Dual Test Set, the **R -> L** direction label is gray when **VLAN Preservation** is not supported by the remote unit.
  - **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for both local (**L**) and remote (**R**) directions, or both port directions.
  - **Service Performance Test** column displays the pass/fail verdict icon indicating if the service complies to the configured SLA parameters.
  - **Service Configuration Test** column displays the pass/fail verdict icon indicating if the service complies to the configured SLA parameters.

Committed

- **Frame Loss Rate** indicates the rate of frames that are lost. The reported value is the maximum rate of Frame Loss from all burst sequences and ramp steps excluding the **CIR+EIR**, **EBS**, and **Traffic Policing** steps. Frame Loss is displayed as a percentage value when the remote unit does not support exponential notation.
- **Max. Jitter** indicates the maximum measured delay variation.
- **Max Latency** indicates the maximum measured round-trip latency (delay). For Dual Test Set the local to remote and remote to local values are reported for One-Way Latency Measurement Mode while a single round-trip value is reported for Round-Trip Latency Measurement Mode (see *Global Options* on page 137).
- **Avg RX Rate**, for **Service Performance Test**, indicates the measured average utilization throughput.

Excess

Max RX Rate, for **Service Configuration Test**, indicates the measured maximum utilization throughput.

- **VLAN Preservation** indicates if any VLAN mismatch (including VLAN level, VLAN ID, Priority, and Drop Eligible) occurred during any step of a Ramp or Burst tests as follows:

Grey: Undefined
Green: No Mismatch detected
Red: Mismatch detected

Summary - iOptics

From the test menu, tap **Results**, and the **Summary** tab.

Start Time indicates the date and time the test was started. The date and time reset every time the test is restarted.

Calibrating: When necessary for power consumption monitoring, the **Calibrating** progress message is displayed. If at any point during this process or during a sub-test execution an unexpected condition is detected, an abort message is displayed as follows:

Test Status	Description
Aborted, <reason>	Sub-test sequence has been aborted and a reason is displayed: **Missing Device Under Test**, **Invalid Device Under Test**, **Link Down**, **Laser Off**, **LOS**, **Device under Test Ovrld** (overload), **Device Pulled**, **Failed**, or **User Stopped**.

Sub-Test Sequence

The progress status and pass/fail verdict are displayed for each sub-test sequence as follows:

Test Status	Description
"--"	Sub-test is not running or results are not available.
Running <details>	Sub-test is running and progress details are displayed.
Completed, Pass/Fail	Sub-test is completed with Pass or Fail verdict.
Aborted, Fail	Sub-test sequence has been aborted with a fail verdict.

- **I/O Interface Quick Check**
  - Validates the operation of the MDIO/I2C interface by sending specific commands to the transceiver.
  - Validates the information provided by a status pin and stimulates a control pin of the transceiver when the **Control Pin Check** check box is selected.

- **Optical TX Power Test (dBm)** reports the minimum and maximum optical TX power values; in-range values are displayed in green while out-of-range are in red. Not available with an **AOC**.
- **Optical RX Power Test** (dBm) reports the minimum and maximum optical RX power values; in-range values are displayed in green while out-of-range are in red.
- **Bit Error Test** reports the bit error count; a count value smaller or equal to the BER threshold is displayed in green while a bigger value is in red.
- **Excessive Skew Test** reports the highest skew value monitored during the sub-test; a value smaller than the threshold is displayed in green while a value crossing the threshold is in red. Only available for parallel interfaces with the exception of transceivers using RS-FEC (100GBASE-SR4, 100GBASE-SR4 AOC, 100GE-CWDM4, 100GE-CLR4).

Monitoring

- **Power Consumption** graphically displays a meter representing the transceiver power consumption in Watt.

  The **Current (A)** and **Power (W)** values (**Actual** and **Maximum**) for 3.3V source are displayed.

- **Temperature** graphically displays a meter representing the transceiver temperature in ^{o}C.

  The current (**Actual**) and maximum temperature values are also displayed.

Note: *The green region is delimited from 0 to the Threshold corresponding to a **PASS** verdict. The red region beyond the threshold corresponds to a **FAIL** verdict.*

Summary - Link OAM

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

Alarms

- **Link OAM** indicates that no OAM Information PDUs were received for 5 seconds.
- **Critical Event**: Indicates that the OAM link partner has sent a critical event notification (bit 2 of the Flags field is set to 1).

- **Dying Gasp**: Indicates that the OAM link partner has sent an unrecoverable local failure notification (bit 1 of the Flags field is set to 1).
- **Link Fault**: Indicates that the OAM link partner has sent a link fault notification (bit 0 of the Flags field is set to 1).

Loopback

- **Local** indicates the **Status** of the local loopback (**Enabled** or **Disabled**) and allows enabling or disabling it.
- **Remote**[1] indicates the **Status** of the remote loopback (**Enabled** or **Disabled**), the number of **Successful** remote loopback requests, the number of **Fail** remote loopback requests, and allows enabling or disabling it.

OAMPDU Frame Count

- Indicates the number of transmitted and received OAMPDU frames of the following types:
  - **Information**
  - **Loopback Control**
  - **Event Notification** (received only)
- **Total** indicates the total number of transmitted and received OAMPDU frames.

1. Statistics are influenced by both the protocol (Parser Action is set to “01”) and physical loopback. The Fail and Successful counters will be affected by successive enable/disable loopback requests when sending a loopback request to a remote module running Link OAM test since it does not provide physical loopback.

Summary - NI/CSU Emulation

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled. The Pass/Fail verdict is based on the following criteria: The worst pair's **Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.

Auto-Response/Manual Loopback Status

Indicates the status of the loopback:

- **Loopback Active**
- **No Loopback**.

Interface

See *Interface* on page 512 for more information on Interface alarms/errors.

DS1

See *DS1* on page 510 for more information on DS1 alarms/errors.

Summary - RFC 2544

From the **Test** menu, tap **Results**, and the **Summary** tab.

➤ **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset. For **Dual Test Set**, this is the only information available on the remote unit.

➤ **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.

➤ **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

➤ **Remote unit in Dual Test Set Mode** indicates that this unit is set as remote but the DTS Connection is not established.

➤ **Remote unit in use and locked for Dual Test Set** indicates that this unit is used for **Dual Test Set** as the remote unit.

Throughput, Back-to-Back, Frame Loss, and Latency Subtests

- **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency**

  For each subtest, its status (**--** (Idle), **In Progress**, **Completed**, or **Aborted -** (reason)) and duration are displayed.

- **TX Frames**[1] and **RX Frames**[1] display the transmitted and received frame counts of the subtest in progress. For **Dual Test Set**, frame counts are available for both local (**L**) and remote (**R**) directions. For Dual Port topology, frame counts are available for both port directions.

- **Trial #**[1] displays the current trial iteration of the subtest in progress when applicable.

- **Val. #**[1] displays the current validation iteration of the subtest in progress when applicable.

- **Step**[1] displays the current step of the subtest in progress when applicable.

- **Displayed Results**: Select the displayed result mode: **Current**, **Minimum** (default), **Maximum**, or **Average**.

- **Throughput**/**Back-to-Back**/**Frame Loss**/**Latency** table.

  Each frame size used for the test is displayed with its subtest statistics. Statistics values are displayed based on the **Displayed Results** setting.

  "**--**" indicates that the result is not available because the test has not run yet. While testing, one of the following messages is displayed for each frame size: **Initializing**, **Learning**, **Testing**, **Waiting**, **Not measurable**, **Aborted**, **Link is Down**, or **MAC not resolved**.

  Dir. (Direction), available with **Dual Test Set** or **Dual Port** topology, indicates respectively results for both local (**L**) and remote (**R**) directions, or for both port directions.

1. Only displayed once the test is started.

- **Unit**: Select the subtest result unit:

  For Throughput: **Mbit/s**, **Gbit/s**, **frame/s**, and **%**.
  For Back-to-Back: **Mbit/s**, **Gbit/s**, **frame/burst**, and **%**.
  Frame Loss: **%**.
  Latency: **ms** and **μs**.

- **Layer**: For Throughput and Back-to-Back subtests, select the subtest layers used to calculate the throughput.

  All (default): Layer 1,2,3 contains the Idle, Preamble, Start of Frame Delimiter, MAC address, IP address, and data.

  Ethernet: Layer 2,3 contains the MAC layer, IP layer, and data.

  IP: Layer 3 contains the IP layer, and data.

- **Step**: For Frame Loss subtest, selects the step (%) of the testing rate to be displayed.

- **Mode**: For Latency subtest, selects the propagation time mode.

  Cut Through (default) allows the calculation of the propagation time of a bit (Bit Latency).

  S. & F. (Store and Forward) allows the calculation of the propagation time of a frame (Frame Latency).

Summary - RFC 6349

From the test menu, tap **Results**, and the **Summary** tab.

Note: *For* ***Dual Test Set*** *on the remote unit only the following are available:* ***Test Status****,* ***Start Time****,* ***Test Recovery****,* ***Remote unit in Dual Test Set Mode****, and* ***Remote unit in use and locked for Dual Test Set****.*

Note: *For* ***iPerf Compatible Server*** *operation mode only the following are available:* ***Test Status****,* ***Start Time****,* ***Test Recovery****,* ***Active Connections****, and* ***Connection Details****.*

- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or any abort condition.
  - **--**: Idle state, the test is not running or results are not available.

  For **RFC 6349 DTS** and **TCP Throughput DTS**:

  - **In Progress**: The test is running.
  - **Completed**: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

For **RFC 6349 DTS** and **TCP Throughput DTS** (local unit):

- **Data Transfer**: The test is running but no traffic is being transmitted because the local and remote units are exchanging data.
- **Aborted**: The test is interrupted; stopped before the set timer. An abort condition is reported: **Link Down Alarm**, **LOS Alarm**, **DTS Connection failed**, **No Communication with Remote**, **Remote is busy**, **Unexpected response from Remote**, **Timeout during execution**, **Invalid Configuration**, **Unresolved addresses, Invalid MTU**, **User stopped**, **TCP Timeout**, **TCP Connection failed**, **NAT detection failed**

For **iPerf Compatible Server**:

- **Listening**: The test is running but the server does not have any active connections.
- **Connected**: The test is running and the server has at least one active connection.
- **Completed**: The test is manually stopped.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset. This is the only information available on the remote unit.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.
- **Remote unit in Dual Test Set Mode** indicates that this unit is set as remote but the DTS Connection is not established.
- **Remote unit in use and locked for Dual Test Set** indicates that this unit is used for **Dual Test Set** as the remote unit.

- **MTU (bytes)** indicates the validated Maximum Transfer Unit.
- **Minimum RTT (ms)** indicates the minimum time between the first bit of a segment sent and the last bit of the corresponding acknowledge.
- **Active Connections**, available with iPerf Compatible Server, displays the number of active TCP connections reported by the iPerf compatible server.
- **Connection Details**, available for iPerf Compatible Server, displays the list of each client IP address and their number of TCP connections.

Window Sweep (RFC 6349 DTS)

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
- **Actual L4** indicates for each step the average TCP throughput metric. **Boost** appearing next to the **BDP** step label indicates that **Window Boost** factor is applied.

TCP Throughput

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.

For **RFC 6349 DTS**:

- **Window** indicates the total maximum send window in KiB (1 KiB = 1024 bytes) followed by the number of connections and KiB per connection in parenthesis as follows: (n conn. @ n KiB). **Boost** appearing next to the **Window** label indicates that **Window Boost** factor is applied.
- **Ideal L4** indicates the ideal TCP throughput metric.
- **Actual L4** indicates the average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to the this metric when enabled. A value greater or equal to the defined **Threshold (% of ideal)** gives a pass verdict.

- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.
- **Buffer Delay (%)** indicates the Buffer Delay percentage metric which represents the increase in RTT during a TCP Throughput test versus the **Minimum RTT**.
- **Recommended Window Boost** suggests the window boost factor value(s) to apply per direction when the **Actual L4** metric fails. The recommendation is provided when:
  - **Buffer Delay** percentage value is positive.
  - **Window Boost - Enable** check box is cleared (refer to page 178).
  - **TCP Efficiency** is acceptable.

  Apply and Start applies the recommended window boost factor for direction(s) that failed and start the test. A boost factor of 1 is applied for a direction that didn't fail. The window boost factor values and the **Window Boost - Enable** check box are updated accordingly in test setup (refer to page 178).
- **Threshold (% of ideal)** allows entering the TCP Throughput as a percentage of the defined CIR that will be used to declare the pass/fail verdict for both directions: **0** to **100** %; default is **95 %**. The calculated throughput based on the selected threshold is displayed for both directions. Available when the **Pass/Fail Verdict** check box is selected.

For **TCP Throughput DTS**:

- Current L4 meters indicate the current TCP Throughput metric for both directions.
- **Current CWND** indicates the sum of the current average congestion window of each connection.
- **Current RTT** indicates the current average Round-Trip Time; the time elapsed between the transmission of a Segment and the reception of the corresponding ACK.

- **Ideal L4** indicates the ideal TCP throughput metric. Available when the **Pass/Fail Verdict** is enabled; the pass/fail verdict icon is displayed next to this metric; a value greater or equal to the defined CIR threshold gives a pass verdict.
- **Actual L4** indicates the maximum average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to this metric when enabled. A value greater or equal to the defined **Threshold (% of ideal)** gives a pass verdict.
- **Threshold (% of ideal)** allows entering the TCP Throughput as a percentage of the defined CIR that will be used to declare the pass/fail verdict for both directions: **0** to **100** %; default is **95 %**. The calculated throughput based on the selected threshold is displayed for both directions. Available when the **Pass/Fail Verdict** check box is selected.
- **Max CWND** indicates the sum of the maximum average congestion window for each connection. Only reported at the end of the test.
- **Min RTT** indicates the minimum Round-Trip Time; the time elapsed between the transmission of a Segment and the reception of the corresponding ACK. Only reported at the end of the test.
- **Max RTT** indicates the maximum Round-Trip Time; the time elapsed between the transmission of a Segment and the reception of the corresponding ACK. Only reported at the end of the test.
- **Average RTT** indicates the average Round-Trip Time; the time elapsed between the transmission of a Segment and the reception of the corresponding ACK. Only reported at the end of the test.
- **Nb of Connections** indicates the total number of TCP connections initiated during the test.
- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.

Summary - Smart Loopback

From the **Test** menu, tap **Results**, and the **Summary** tab.

➤ **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.

➤ **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.

➤ **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.

➤ **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

Traffic

Note: *See* Traffic - Ethernet *on page 326 for more information.*

Summary - S-OAM and MPLS-TP OAM

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

Continuity Check (Peer MEP)

➤ **Status** displays the status of the continuity check with the peer MEP.

Status	Description
Loss Continuity	Loss of Continuity alarm is active.
Mismerge	Mismerge alarm is active.
Unexpected MEG Level	Unexpected MEG Level alarm is active.
Unexpected MEP	Unexpected MEP alarm is active.
Unexpected Period	Unexpected Period alarm is active.
Unexpected MD Level	Unexpected MD Level alarm is active.
Receiving CCMs	CCM frames from the peer MEP are received without alarms.

➤ **TX CCM** indicates the count of transmitted CCM frames.

➤ **RX CCM** indicates the count of valid CCM frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to 505); and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

- **CCM** indicates the content of the last received CCM frame including **MEG ID** (Y.1731 and G.8113.1), **Domain ID** (802.1ag and MEF), **MA Name** (802.1ag and MEF), **MEG Level** (Y.1731, MEF, and G.8113.1), **MD Level** (802.1ag), **MEP ID**, and **Period**.

  For unsupported **Domain ID**, **MA Name**, and **MEG ID**, the **Unexpected Format** message is displayed.

	Supported Format
Domain ID	**1** (No Maintenance Domain Name present) **4** (Character String)
MA Name	**2** (Character String)
MEG ID	**32** (ICC based format) **33** (CC and ICC based format)

Loopback / Test / Frame Delay / Frame Loss / Synthetic Loss

Note: *Either **Loopback**, **Test**, **Frame Delay**, **Frame Loss**, or **Synthetic Loss** (available with Ethernet OAM) statistics are displayed according with the selected test function (refer to* Test Function *on page 186).*

- **Status** displays the status of the test function.

  For **Loopback**, **Frame Delay**, **Frame Loss**, and **Synthetic Loss** (available with Ethernet OAM) functions:

Status	Description
Idle	No Results (function did not run yet).
In Progress	Test is in progress. Frames are being transmitted and monitored.
Completed	Test is completed: The test with continuous transmission is manually stopped and replies have been received or timed out. The test with continuous transmission is automatically stopped by a test timer and replies have been received or timed out. All frames of the test with non-continuous transmission have been transmitted and replies have been received or timed out.
Aborted	Test is aborted. The test with non-continuous transmission is stopped before all the frames are transmitted.

For **Test** function:

Status	Description
Idle	No Results (function did not run yet).
In Progress	Test is in progress. RX TST frames are being monitored.
Completed	Test is completed. The test is stopped or function is disabled after being In Progress state.

- **RX Line Utilization** meter and value, available with **Loopback** function, indicate the line rate utilization percentage (only LBR frames are considered) received in the last second.
- **TST RX Rate** meter and value, available with **Test** function, indicate the quantity of TST frames received in the last second.
- **Frame Delay** meter and value, available with **Frame Delay** function, indicate the average of the measured frame delays in the last second.
- **Frame Loss Ratio** meter, available with **Frame Loss** function, indicates for both Near-End and Far-End the last measured frame loss ratio in the last second.
- **Synthetic Loss Ratio** meter, available with **Synthetic Loss** function which is available with Ethernet OAM, indicates for both Near-End and Far-End the last measured Synthetic Loss ratio in the last second.

Note: *Refer to* S-OAM and MPLS-TP OAM *on page 268 for more alarms/errors/statistics information.*

Summary

Refer to *S-OAM and MPLS-TP OAM* on page 268 for more information on alarms.

Thresholds

Refer to *Thresholds* on page 182 for more information.

Summary - Through Mode

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.

- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

Traffic / Traffic Ethernet

Note: *See* Traffic - Ethernet *on page 326 for more information.*

RX Frequency

Note: *RX Frequency is available on both ports for rates up to 10G LAN. Not available for a port using an active copper SFP.*

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

Note: *For both **Frequency** and **Offset** the following background colors are used.*

Background color	Description
Green	The frequency is in range.
Red	The frequency is out-of-range or LOC Lane. **LOC** is also displayed.
Gray	Pending state.

Summary - Traffic Gen & Mon

From the **Test** menu, tap **Results**, and the **Summary** tab.

- <Port #>, available with **Dual Port** topology, allows selecting the port to be displayed.
- **Test Status** displays the current status of the test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled.

  --: Idle state, the test is not running or results are not available.

  In Progress: The test is running.

  Completed: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

  Aborted: The test is interrupted; stopped before the set timer.
- **Start Time** indicates the date and time the test was started. The date and time reset every time the test is restarted or reset.
- **Test Recovery**, when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test Recovery** field. Refer to *Power Failure Recovery* on page 441.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 255.

Stream

- **Stream** indicates the stream number and provides stream detailed statistics when tapping on its button (see *Summary - Stream - Traffic Gen & Mon* on page 320).

The following statistics are available for each stream.

- **Current Throughput**: See *Streams - Throughput* on page 280.
- **Frame Loss Rate**: See *Streams - Frame Loss / Out-of-Sequence* on page 278.
- **Jitter**: See *Streams - Jitter* on page 278.
- **Latency**: See *Streams - Latency* on page 279.
- **Out-of-Sequence**: See *Streams - Frame Loss / Out-of-Sequence* on page 278.

Summary - Stream - Traffic Gen & Mon

Note: *Available from* Summary - Traffic Gen & Mon - Stream*. For **Test Status**, **Start Time**, **Test Recovery**, and **Logger Full** see* Summary - Traffic Gen & Mon *on page 318 .*

- **Latency Unit** allows selecting either **ms** (default) or **μs** as the reference unit for **Latency** and **Jitter**.
- Stream Selection: Select a stream by either using the left/right arrow or by tapping over the stream numbers area then tapping on a specific stream number. An orange background indicates the selected stream.
- **Throughput**, **Jitter**, and **Latency** meters display respectively the measured Throughput, Jitter, and Latency for the selected stream.

Note: *The green region defined by the configured threshold corresponds to a **PASS** verdict while the red regions corresponds to a **FAIL** verdict. The verdict is only displayed when enabled (see* QoS Metrics *on page 225).*

- **Jitter**: See *Streams - Jitter* on page 278.
- **Latency**: See *Streams - Latency* on page 279.
- **RX Rate**: See *Streams - Throughput* on page 280.
- **RX Frame Count** indicates the number of frame received matching the selected stream.
- **TX Rate**: See *Streams - Throughput* on page 280.
- **TX Frame Count** indicates the number of transmitted frames matching the selected stream.
- **Frame Loss** and **Out-of-Sequence**: See *Streams - Frame Loss / Out-of-Sequence* on page 278.

TCP Throughput

Dynamically displays the graph of throughput as a function of time. The dynamic view is a 2h sliding window. Available with **TCP Throughput DTS** operation mode.

From the **Test** menu, tap **Results**, and the **TCP Throughput** tab.

Traces - OTN

From the test menu, tap **Results**, **Traces**, and if available the **OTN** sub-tab.

Note: *Configuration is coupled with settings from* Traces - OTN *on page 231*.

OTUx, ODUx, and TCMx Buttons

Tap on either OTUx or ODUx button. For ODUx when TCM is enabled (see Modify TCM on page 211), tap on a TCMx button to select a TCM level.

SM TTI Traces / PM TTI Traces / ODUx TCM TTI Traces

Note: *The TTI Traces are available for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; see* **Config TCM** *on page 211).*

➤ **SAPI** (Source Access Point Identifier) indicates the received SAPI message (TTI bytes 0 to 15). The expected SAPI message is available when the **SAPI OTU-TIM** / **SAPI ODU-TIM** check box is selected.
A maximum of 16 characters is allowed.

TTI Traces	Default Message[a]
SM	EXFO OTU SAPI
PM	EXFO ODU SAPI
TCM	EXFO TCMi SAPI

a. The default message contains a NULL (all 0's) character preceding it. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined.

- **DAPI** (Destination Access point Identifier) indicates the received DAPI message (TTI bytes 16 to 31). The expected DAPI message is available when the **DAPI OTU-TIM** / **DAPI ODU-TIM** check box is selected.
  A maximum of 16 characters is allowed.

TTI Traces	Default Message[a]
SM	EXFO OTU DAPI
PM	EXFO ODU DAPI
TCM	EXFO TCMi DAPI

a. The default message contains a NULL (all 0's) character preceding it. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined.

- **Operator Specific** indicates the received Operator Specific message (TTI bytes 32 to 63).
- **SAPI OTU-TIM / SAPI ODU-TIM** / **SAPI TCM-TIM** check box, when selected (cleared by default), allows editing the expected Source Access Point Identifier and also enables OTU/ODU/TCM-TIM alarm monitoring.
- **DAPI OTU-TIM / DAPI ODU-TIM** / **DAPI TCM-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier and also enables the OTU/ODU-TIM alarm monitoring.
- **Copy RX** allows using the received SAPI/DAPI message as the expected one.

Traces - SONET/SDH

From the test menu, tap **Results**, **Traces**, and if available the **SONET/SDH** sub-tab.

Note: *Selecting a Trace byte to be generated will automatically update the corresponding OH byte. Refer to* OH - SONET/SDH *on page 370 for more information. Configuration is coupled with settings from* Traces - SONET/SDH *on page 234*.

Traces

- **Section (J0) / RS (J0)**, **STS Path (J1) / AU Path (J1) / TU-3 Path (J1)**, **VT Path (J2) / TU Path (J2)** displays the received J0/J1/J2 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.
- **TIM-S / RS-TIM**, **TIM-P / HP-TIM**, **TIM-V / LP-TIM** check box when selected (cleared by default) enables the corresponding Trace Identifier Mismatch for the expected message defined.

  Format allows the selection of the expected format:
  16 Bytes (default), or **64 Bytes**.

  Expected allows entering the expected J0 trace message.

  Copy RX allows using the received SAPI/DAPI message as the expected one.

TCM Access Point Identifier

Note: *Available when **TCM** is enabled (refer to page 212).*

➤ **STS Path (N1) / AU Path (N1)**, and **VT Path (Z6) / TU-Path (N2) / TU-Path (N1)** for (TU-3) displays the received N1/N2/Z6 value/message.

➤ **TC-TIM-P / HPTC-TIM** / **TC-TIM-V / LPTC-TIM** check box when selected (cleared by default) enables the corresponding TCM Access Point Identifier and allows the configuration of the expected message.

  Copy RX allows using the received SAPI/DAPI message as the expected one.

Traffic - Ethernet

From the test menu, tap **Results**, **Traffic**, and when applicable the **Ethernet** tab.

Note: *For **Through Mode** test application, the traffic statistics are displayed for both port directions.*

- <Port #>, available with **Dual Port** topology, allows selecting the port to be displayed.

Traffic

- **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
- **Ethernet BW (Mbit/s)** indicates the current transmitting/receiving data rate expressed in Mbit/s.
- **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including bad frames, Broadcast frames and Multicast frames) in frame per second.
- **Frame Count** indicates the total number of transmitted/received valid and invalid frames.

Frame Type

Displays the TX and RX count of the following frame types.

- **Multicast** indicates the number of multicast frames transmitted/received without FCS errors. Broadcast frames are not counted as multicast frames.
- **Broadcast** indicates the number of broadcast frames transmitted/received without FCS errors.
- **Unicast** indicates the number of unicast frames transmitted/received without FCS errors.

- **Non-Unicast** indicates the number of multicast and broadcast frames transmitted/received without FCS errors.
- **Total** indicates the total number of all frames transmitted/received without FCS error.

Frame Size

Displays the RX count of each received frame size (valid and invalid), and the percentage (%) ratio of each received frame size based on the total count of frames. The percentage (%) ratio is not available for Through Mode test application.

- **< 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 (no VLAN), 1522 (1 VLAN tag), 1526 (2 VLAN tags), or 1530 (3 VLAN tags) bytes.
- **> 1518**: frames with more than 1518 (no VLAN), 1522 (1 VLAN tag), 1526 (2 VLAN tags), or 1530 (3 VLAN tags) bytes.
- **Total** indicates the total count of all received frames (valid and invalid).

Traffic - Flow Control

From the test menu, tap **Results**, **Traffic**, and the **Flow Control** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

Frame Count - RX

- **Pause Frames** indicates the number of received valid flow-control frames. Frames that have a type/length field equal to 0x8808 will be counted as a pause frame.
- **Abort Frame** indicates the number of received pause frames with a Quanta equal to zero; cancelling the pause frames.
- **Total Frame** indicates the total number of pause time received from the link partner.

Pause Time

Indicates respectively the total, last, maximum, and minimum pause time received from the link partner in **Quanta** (default) or **Microsecond** (μs).

Pause Injection

Note: *Pause injection is only available for Traffic Gen & Mon test application.*

➤ **Packet Pause Time**: Enter the pause time value to be transmitted in **Quanta** or **Microsecond** (default is **100** Quanta).

Interface	Range	
	Quanta	µs
10 Mbit/s	**0** to **65535**	**0** to **3355392**
100 Mbit/s	**0** to **65535**	**0** to **335539.2**
1000 Mbit/s	**0** to **65535**	**0** to **33553.92**
10 Gbit/s	**0** to **65535**	**0** to **3355.392**
40 Gbit/s	**0** to **65535**	**0** to **838.848**
100 Gbit/s	**0** to **65535**	**0** to **335.5392**

Note: *When entering a value in µs it will be rounded to the closest multiple of 0.0512 µs for 10 Mbit/s, 5.12 µs for 100 Mbit/s, 0.512µs for 1000 Mbit/s, 0.0512 µs for 10 Gbit/s, 0.0128 µs for 40 Gbit/s, and 0.00512 µs for 100 Gbit/s.*

➤ **Inject** button allows generating the defined packet pause time.

➤ **Destination MAC Address** check box, when selected (cleared by default), enables and allows setting the destination MAC address. The default destination MAC address is the control protocol multicast address: **01:80:C2:00:00:01**.

Traffic - Graph

From the test menu, tap **Results**, **Traffic**, and the **Graph** tab.

Note: *For Dual Port topology select the port to be displayed.*

The graph displays the received line utilization. The X axis shows the time in seconds while the Y axis shows the percentage utilization.

Traffic - OAM, S-OAM, and MPLS-TP OAM

From th test menu, tap **Results**, **Traffic**, and the **OAM**, **S-OAM**, or **MPLS-TP OAM** tab.

Traffic Monitoring

Note: *Only available with **Carrier Ethernet OAM** test application.*

- In TX, reports counts of CCM, LBM, LTM, DMM, LMM, SLM, TST, AIS, LCK, and CSF frames transmitted. LTM and SLM are only available with Ethernet OAM. Total count is reported as well as unicast and/or multicast frame counts when applicable.
- In RX, reports counts of CCM, LBR, LTR, DMR, LMR, SLR, TST AIS, LCK, and CSF frames (LTR and SLR are only available with Ethernet OAM) received regardless of the sender as long as the following criteria are met:
  - **S-OAM**: The destination MAC address matches either the local MEP Unicast MAC address or a Multicast class 1 or class 2 address; and the VLANs matches the unit port VLANs. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 505 for more information.
  - **MPLS-TP OAM**: The destination MAC address matches either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; the VLANs matches the unit port VLANs; and MPL Labels matches the local MPLS Label Stack configuration. For AIS, LCK, and CSF, valid messages must also have the MEG Level matching the Local MEG Level.

  Total count is reported as well as unicast and/or multicast frame counts when applicable.

Responder

Note: *Available when the S-**OAM Responder** or **MPLS-TP OAM Responder** check box is selected (refer to* S-OAM and MPLS-TP OAM Responder *on page 181).*

For **Carrier Ethernet OAM** test application:

- In TX, reports counts of LBR, LTR, DMR, LMR, and SLR total frames transmitted. LTR and SLR are only available with Ethernet OAM.
- In RX, reports counts of valid LBM, LTM, DMM, LMM, and SLM unicast, multicast, and total frames received. LTM and SLM are only available with Ethernet OAM. A valid messages must have its:

  S-OAM: source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address; VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 505 for more information.

  MPLS-TP OAM: destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

For **Smart Loopback** test application:

- In TX, reports counts of LBR, LTR, DMR, LMR, and SLR total frames transmitted.
- In RX, reports counts of valid LBM, LTM, DMM, LMM, and SLM total frames received. A valid messages must have its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 505 for more information.

Window Sweep

Note: *Only available for RFC 6349 with operation modes* ***Dual Test Set*** *(local unit).*

Displays the graph showing the Ideal L4 and Actual L TCP Throughput measured for each Window Sweep step. The number of connections and KiB per connection is also displayed in parenthesis as follows:
(n conn.@ n KiB)

From the test menu, tap **Results**, and the **Window Sweep** tab.

WIS

From the **Test** menu, tap **Results**, and the **WIS** tab.

Traces/Label

- **J0 Trace** displays the **J0 Trace** value in 16-bytes format.
- **J1 Trace** displays the **J1 Trace** value in 16-bytes format.
- **Path Signal Label (C2)** displays the content of the STS SPE including the status of the mapped payload.

10 Test Functions

The Test Functions menu offers the following structure:

Transport

Test Application	Page, Sub-Page, or Pop Up	Page
DSn/PDH BERT	FDL - Bit-Oriented Message	349
	FDL - Performance Report Message	353
	FEAC	356
	RTD	405
	Signaling Bits	410
	Spare Bits	412
NI/CSU Emulation	FDL - Bit-Oriented Message	349
	FDL - Performance Report Message	353
OTN BERT	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	OH BERT	362
	OH - OTN	365
	RTD	405
SONET/SDH BERT	APS	344
	OH	370
	Pointer Adjustment	395
	RTD	405
SONET/SDH - DSn/PDH BERT	APS	344
	OH	370
	Pointer Adjustment	395
	RTD	405
	Signaling Bits	410
	Spare Bits	412

Ethernet

Test Application	Page, Sub-Page, or Pop Up	Page
Cable Test	Ping & Trace Route	390
Carrier Ethernet OAM	Filters	360
	Packet Capture	384
	Ping & Trace Route	390
	S-OAM Link Trace	408
EtherBERT	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Filters	360
	Packet Capture	384
	Ping & Trace Route	390
EtherSAM (Y.1564)	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Ping & Trace Route	390
RFC 2544	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Ping & Trace Route	390
RFC 6349	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Ping & Trace Route	390
Smart Loopback	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Ping & Trace Route	390
Through Mode	Filters	360
	Packet Capture	384

Test Application	Page, Sub-Page, or Pop Up	Page
Traffic Gen & Mon	<*rate*> Advanced - <*transceiver*> Control	338
	<*rate*> Advanced - Lanes Mapping & Skew	340
	Filters	360
	Packet Capture	384
	Ping & Trace Route	390
	Traffic Scan	414

<rate> Advanced - <transceiver> Control

Note: *Where <rate>, when displayed, is the rate selected for the test and <transceiver> is the selected connector.*

From the **Test** menu, tap **Functions**, <rate> **Advanced**, and the <transceiver> **Control** tab.

- <transceiver> **Power Class** indicates the power class of the inserted transceiver module. Not available with SFP transceivers.

<transceiver> Control Pins

Allows the following transceiver control pin settings. Refer to the MSA standards for more information. Not available with SFP transceivers.

Note: *To apply any control, first select its check box then clear it; the control is applied only when the selected check box is cleared.*

- **Module Low Power Mode** check box (cleared by default).
- **Module Reset** check box (cleared by default).
- **Module Power Shutdown** check box (cleared by default).

<transceiver> Status Pins

Gives the following transceiver's pin status (refer to the MSA standards for more information). Not available with SFP transceivers.

Transceiver	Pin status
QSFP28	**Module Absent**

<transceiver> I2C Access Interface

Available with I2C transceivers.

- **I2C - Bulk Read**
  - **Page Select** allows selecting the I2C address page: **0x00** (default) to **0xFF**. Not available when the **Device Address** selection is **0xA0**.
  - **I2C Start Address** allows selecting the I2C start address: **0x0000** (default) to **0xFFFF** (MDIO) / **0x00FF** (I2C).
  - **I2C End Address** allows selecting the **I2C** end address: **0x0000** to **0xFFFF**; default is **0x00FF**.
  - **Bulk Read** button (refer to *Bulk Read* on page 547)
- **I2C - Bulk Write** button (refer to *Bulk Write* on page 547)
- **I2C - Read/Write**
  - **I2C Address** allows selecting the I2C address: **0x0000** (default) to **0x00FF**.
  - **I2C Data** allows either selecting (write) or reading the I2C data: **0x0000** (default) to **0x00FF**.

    Read button reads the data of the specified **I2C Address**.

    Write button writes the specified **I2C DATA** value to the specified **I2C Address**.

<rate> Advanced - Lanes Mapping & Skew

Note: *Where <rate>, when displayed, is the rate selected for the test. Only available with parallel interfaces. Not availablewhen the **RS-FEC** check box is selected.*

From the test menu, tap **Functions**, **40/100G Advanced**, and the **Lanes Mapping & Skew** tab.

TX

➤ **PCS/Logical Lane**, for Ethernet test applications, indicates the PCS (Ethernet test applications) or Logical (Transport Test applications) lane markers. To change the PCS/Logical lane order, see *Default/Random/Manual Mapping* on page 342.

➤ **Skew (Bits)** indicates the TX relative delay in bit time for each PCS/Logical lane. To change the skew values, see *Reset / Manual Skew* on page 343.

Lane / Physical Lane

Indicates the lane numbers as follows:

Rate	Lane Number
100GE (4 Lanes)	CAUI-4
OTU4 (4 Lanes)	OTL4.4

RX

- **Skew (bits)** indicates the delay in bit time between the earliest PCS/Logical lane and the current lane for the one to zero transition of the alignment marker sync bits. The received skew accuracy is ±100 bits.
- **PCS/Logical Lane** indicates received PCS/Logical Lane markers.

Note: *If a PCS/Logical Lane marker is detected more than once, a red background is used to highlight all occurrences of this PCS/Logical Lane marker.* ***Duplicate*** *is also displayed on a red background.*

PCS/Logical Lane

Allows ordering the PCS/Logical Lane markers in either **Ascending** (1,2,3...) or **Coupled to RX**.

Alarms

For a description of each alarm, refer to **OTL on page 513** for Transport and *Ethernet - PCS Lanes* on page 512 for Ethernet.

Errors

For a description of each error, refer to **OTL on page 513** for Transport and *Ethernet - PCS Lanes* on page 512 for Ethernet.

The error values are displayed in seconds by default. Tapping on the unit allows selecting either **Seconds**, **Count**, or **Rate**.

Total indicates the total of all lanes when **Count** or **Rate** unit is selected.

Default/Random/Manual Mapping

Allows changing the lane mapping that will be used for the test.

- **Default Mapping** sets the TX mapping to the default numerical order value which corresponds to the ascending lane order.
- **Random Mapping** sets the TX mapping in a random order. Each time the button is tapped, random alignment markers are assigned to each lane.
- **Manual Mapping** allows setting the TX mapping manually.
  - **Lane Marker** and **Assigned Status**:

    The **Lane Marker** buttons allow assigning the corresponding lane marker to the selected PCS/Logical or CAUI/XLAUI/Physical Lane mapping (the one pointed by the arrow). Lane marker buttons are numbered from **0** to **19** for OTU4/100G, and **0** to **3** for OTU3/40G.

    The **Assigned Status** column displays a check mark when the lane marker is assigned.
  - **PCS/Logical Lane** and **CAUI/XLAUI/Physical Lane** columns indicate the target PCS/Logical to CAUI/XLAUI/Physical mapping.
  - **Clear All** clears the lane assignments.
  - **OK** accepts the new lane mapping. The **OK** button is only available when all target PCS/Logical Lane fields are assigned including duplicates.

Note: *A lane marker can be assigned more than once. If this is the case, a red background is used to highlight all occurrences of this lane marker.*

Reset / Manual Skew

Allows the selection of a relative delay in bit time that will be introduced for each PCS/Logical lane.

- **Reset Skew** sets all TX skew values to 0 bit time.
- **Manual Skew** allows setting the skew value for each PCS/Logical lane manually. Refer to *Manual Skew (PCS/Logical Lane)* on page 558.

Laser ON/OFF

Allows activating the laser control per optical lane or for all lanes. Refer to *Laser ON/OFF* on page 557.

Skew Alarm Threshold (bits)

Allows setting the threshold value that will be used to declare the **Exc. Skew** alarm (refer to *Ethernet - PCS Lanes* on page 512).

Default button restores the default alarm threshold value.

APS

From the **Test** menu, tap **Functions**, and the **APS** tab.

TX/RX

- **Switching Mode**, available for both TX and RX, selects the switching mode: **Linear** (default) or **Ring**.
- K1

  Request: Bits 1 through 4 of the K1 byte.

Bits 1 to 4	Request	
	Linear mode	Ring mode
0000	No Request[a]	No Request (default)[a]
0001	Do Not Revert	Reverse Request - Ring
0010	Reverse Request	Reverse Request - Span
0011	Unused	Exerciser - Ring
0100	Exerciser	Exerciser - Span
0101	Unused	Wait-to-Restore
0110	Wait-to-Restore	Manual Switch - Ring
0111	Unused	Manual Switch - Span
1000	Manual Switch	Signal Degrade - Ring
1001	Unused	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

a. Default value.

Channel (**Linear** switching mode) or
Destination Node ID (**Ring** switching mode):
Bits 5 through 8 of the K1 byte.

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

a. Default value.

➤ K2

Protected Channel (**Linear** switching mode) or
Source Node ID (**Ring** switching mode):
Bits 1 through 4 of the K2 byte.

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

a. Default value.

Architecture (**Linear** switching mode) or
Bridge Request (**Ring** switching mode):
Bit 5 of the K2 byte. 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[a]	Short Path[a]
1	1:n	Long Path

a. Default value.

Operation Mode: Bits 6 through 8 of the K2 byte.

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

a. Default value.
b. Operation mode for SONET.
c. Operation mode for SDH.

BFD (Bidirectional Forwarding Detection)

Note: *Only available with IPv4 Network Layer (refer to* IP *on page* 163) *in single port topology.*

From the **Test** menu, tap **Functions**, and the **BFD** tab.

Bidirectional Forwarding Detection

- **Local IP Address** displays the configured interface **Source IP Address** (refer to IP on page 163).
- **Remote IP Address** allows configuring the destination IP Address.
- **IP TOS/DS** allows entering the type of service: **00** (default) to **FF**.
- **Desired Min TX Interval** defines the minimum interval the local unit would like to use when transmitting BFD control packets: **100** ms (default) to **1** s.
- **Required Min RX Interval** defines the minimum interval between received BFD control packets the local unit requires: **100** ms (default) to **1** s.
- **Detect Multiplier** is a value that is multiplied by the negotiated transmit interval giving the detection time for the receiving system. Choices are **1** to **255** (**3** by default).
- **Session State** indicates the local session state: **Down**, **Init**, **Up**.
- **Diagnostic** indicates the reason of the last local session state change.
- **Connect** starts/stops the BFD process.

Statistics

- **Packets Transmitted** indicates the number of sent BFD control packets.
- **Packets Received** indicates the number of received BFD control packets.

Neighbor Status

- **Session State** reports the remote session state: **Admin Down**, **Down**, **Init**, or **Up**.
- **Diagnostic** reports the reason of the remote last session state change.
- **Desired Min TX Interval** reports the remote desired minimum TX interval.
- **Required Min RX Interval** reports the remote required minimum RX interval.
- **Detect Multiplier** reports the remote **Detect Multiplier** value.

FDL - Bit-Oriented Message

Allows setting and configuring the Bit-Oriented Messages (BOM) of the Extended Super-Frame (ESF).

Note: *FDL is only available for DS1 interface with ESF framing. For Dual RX test, FDL is only available for the DS1 TX/RX port 1.*

From the **Test** menu, tap **Functions**, **FDL**, and the **Bit-Oriented Message** tab.

Generated Messages

➤ **Priority**

Codeword: The Bit-Oriented Message codewords 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.

Codeword	Pattern
RAI	00000000 11111111
Loopback Retention and Acknowledge	00101010 11111111
RAI-CI	00111110 11111111

Injects generates the selected codeword priority message.

➤ **Command/Response**

Amount allows the selection of the number of message to be generated. Choices are **1** to **15**. The default value is **10**.

Inject manually generates the selected amount of messages.

Codeword

Command/Response Codeword	Pattern	Command/Response Codeword	Pattern
Line Loopback Activate	00001110 11111111	Protection Switch Line 22	01101100 11111111
Line Loopback Deactivate	00111000 11111111	Protection Switch Line 23	01101110 11111111
Payload Loopback Activate	00010100 11111111	Protection Switch Line 24	01110000 11111111
Payload Loopback Deactivate	00110010 11111111	Protection Switch Line 25	01110010 11111111
Reserved for Network Use	00010010 11111111[a]	Protection Switch Line 26	01110100 11111111
Universal Loopback (Deactivate)	00100100 11111111	Protection Switch Line 27	01110110 11111111
ISDN Line Loopback (NT2)	00101110 11111111	Protection Switch Acknowledge	00011000 11111111
CI/CSU Line Loopback (NT1)	00100000 11111111	Protection Switch Release	00100110 11111111
For network use	00011100 11111111[b]	Do Not use for Synchronization	00110000 11111111
Protection Switch Line 1 b	01000010 11111111	Stratum 2 Traceable	00001100 11111111
Protection Switch Line 2	01000100 11111111	SONET Minimum Clock Traceable	00100010 11111111
Protection Switch Line 3	01000110 11111111	Stratum 4 Traceable	00101000 11111111
Protection Switch Line 4	01001000 11111111	Stratum 1 Traceable	00000100 11111111
Protection Switch Line 5	01001010 11111111	Synchronization Traceability Unknown	00001000 11111111
Protection Switch Line 6	01001100 11111111	Stratum 3 Traceable	00010000 11111111
Protection Switch Line 7	01001110 11111111	Reserved for Network Synchronization	01000000 11111111
Protection Switch Line 8	01010000 11111111	Transmit Node Clock (TNC)	01111000 11111111
Protection Switch Line 9	01010010 11111111	Stratum 3E Traceable	01111100 11111111
Protection Switch Line 10	01010100 11111111	Under study for maintenance	00101100 11111111
Protection Switch Line 11	01010110 11111111	Under study for maintenance	00110100 11111111
Protection Switch Line 12	01011000 11111111	Reserved for network use	00010110 11111111
Protection Switch Line 13	01011010 11111111	Reserved for network use	00011010 11111111
Protection Switch Line 14	01011100 11111111	Reserved for network use	00011110 11111111
Protection Switch Line 15	01011110 11111111	Reserved for network use	00111010 11111111
Protection Switch Line 16	01100000 11111111	Reserved for customer	00000110 11111111
Protection Switch Line 17	01100010 11111111	Reserved for customer	00001010 11111111
Protection Switch Line 18	01100100 11111111	Reserved for customer	00000010 11111111
Protection Switch Line 19	01100110 11111111	Reserved for customer	00110110 11111111
Protection Switch Line 20	01101000 11111111	Reserved for customer	00111100 11111111
Protection Switch Line 21	01101010 11111111	Reserved for customer	01111010 11111111

a. Loopback Activate.
b. Indication of NT1 power off.

Receive Messages

- **Link Activity** indicates the activity of the following parameters during the last second of measurement.
  - **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.
  - **C/R** (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.
- **Priority**: 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.

  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.

Note: *See **Priority on page 349** for the list of possible priority codeword messages.*

➤ **Command/Response**

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.

Note: *See **Command/Response on page 349** for the list of possible Command/Response codeword messages.*

FDL - Performance Report Message

Note: *FDL PRM is only available for DS1 interface with ESF framing. For* **Dual RX** *test, FDL is only available for the DS1 TX/RX port 1. For NI/CSU Emulation, only available in the RX direction.*

From the **Test** menu, tap **Results**, tap the **FDL**, and **Performance Report Message** tab.

Generated Messages

- **Circuit** allows the selection of the circuit type: **CI to Network** (default) or **Network to CI**.
- **ANSI T1-403** check box when selected allows the generation of a compliant ANSI T1.403 PRM Message.
- **Injection**

  Single sends the selected PRM Message(s) manually.

  Continuous generates the selected PRM Message(s) continuously.
- **Event Count** indicates the number of PRM messages sent.
- **PRM Bit Events** allows the activation of the following PRM bit events. All PRM bit events are disabled by default.

G1: CRC = 1 G2: 1 < CRC ≤ 5 G3: 5 < CRC ≤ 10 G4: 10 < CRC ≤ 100 G5: 100 < CRC ≤ 319 G6: CRC ≥ 320 SE: Severely errored framing ≥ 1	FE: Frame sync. bit error ≥ 1 LV: Line code violation event ≥ 1 LB: Payload loopback activated SL: Slip ≥ 1 R Bit (Reserved - Default value is 0) U1: Bit U2: Bit

Received Messages

- **Event Counts** lists received PRM bit event counts.See **PRM Bit Events** below.
- **Report Content** lists received performance information. See **Performance Information** below.
- **Circuit** indicates the selected circuit type: **CI to Network** or **Network to CI**.
- **Valid Event Count** indicates the number of valid PRM messages received.
- **Link Activity**, see page 351 for more information.
- **PRM Bit Events** table, available when the **Event Counts** button is selected, reports the count of the detected valid PRM bit events.

G1: CRC = 1 G2: 1 < CRC ≤ 5 G3: 5 < CRC ≤ 10 G4: 10 < CRC ≤ 100 G5: 100 < CRC ≤ 319 G6: CRC ≥ 320	SE: Severely errored framing ≥ 1 FE: Frame sync. bit error ≥ 1 LV: Line Code Violation ≥ 1 LB: Payload loopback activated SL: Slip ≥ 1

- **Performance Information** table, available when the **Report Content** button is selected, reports the time t0, t0-1, t0-2, and t0-3 for each PRM.

  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).

  PRM

  G3: $5 < \text{CRC Error Event} \leq 10$
  LV: Line Code Violation Event ≥ 1
  G4: $10 < \text{CRC Error Event} \leq 100$
  U1: Under study for synchronization
  U2: Under study for synchronization
  G5: $100 < \text{CRC Error Event} \leq 319$
  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: $1 < \text{CRC Error Event} \leq 5$
  Nm and **Nl**: One-second report modulo 4 counter.

FEAC

The Far-End Alarm and Control signal (FEAC) provides Communication Channel capability over a DS3 in a network applications using C-bit Parity configuration (see page 207).

From the test menu, tap **Functions**, and the **FEAC** tab.

Generated Messages

Allows configuring and sending alarms/status information and control signals (loopback commands) to other network elements.

- **Alarm/Status and Unassigned**
  - **Codeword** allows the selection of 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)	Single DS1 LOS (00111100)	User Defined (00100000)
DS3 Loss of Signal (LOS) (00011100)	DS1 Equipment Failure NSA (00000110)	User Defined (00100010)
DS3 Out-of-Frame (00000000)	User Defined (00000010)	User Defined (00101000)
DS3 AIS Received (00101100)	User Defined (00000100)	User Defined (00101110)
DS3 Idle Signal Received (00110100)	User Defined (00001000)	User Defined (00110000)
DS3 Equipment Failure NSA (00011110)	User Defined (00001100)	User Defined (00111110)
DS3 NUI Loop Up (00010010)	User Defined (00010000)	User Defined (01000000)
DS3 NUI Loop Down (00100100)	User Defined (00010100)	User Defined (01111010)
Common Equipment Failure NSA (00111010)	User Defined (00010110)	User Defined (01111100)
Multiple DS1 LOS (00101010)	User Defined (00011000)	User Defined (01111110)
DS1 Equipment Failure SA (00001010)	User Defined (00011010)	

  - **Mode** is the alarm/status injection mode: **Manual** or **Continuous**.

- **Amount** is the amount of codeword to be generated: **1** to**15** (default is **10**).
- **Inject** generates error(s) according to the Codeword and mode selected.

- **Loopback Commands**
  - **Control**

    Codeword is the loopack control codeword to be generated: **Line Loopback Activate (00001110) -** (Default) or **Line Loopback Deactivate (00111000)**.

    Amount is the number of **Control Codeword** to be generated: **1** to **15** (default is **10**).

  - **Channel**

    Codeword is the channel codeword to be generated.

Channel Codeword		
DS3 Line (00110110)	DS1 Line-No10 (01010100)	DS1 Line-No20 (01101000)
DS1 Line-No1 (01000010)	DS1 Line-No11 (01010110)	DS1 Line-No21 (01101010)
DS1 Line-No2 (01000100)	DS1 Line-No12 (01011000)	DS1 Line-No22 (01101100)
DS1 Line-No3 (01000110)	DS1 Line-No13 (01011010)	DS1 Line-No23 (01101110)
DS1 Line-No4 (01001000)	DS1 Line-No14 (01011100)	DS1 Line-No24 (01110000)
DS1 Line-No5 (01001010)	DS1 Line-No15 (01011110)	DS1 Line-No25 (01110010)
DS1 Line-No6 (01001100)	DS1 Line-No16 (01100000)	DS1 Line-No26 (01110100)
DS1 Line-No7 (01001110)	DS1 Line-No17 (01100010)	DS1 Line-No27 (01110110)
DS1 Line-No8 (01010000)	DS1 Line-No18 (01100100)	DS1 Line-No28 (01111000)
DS1 Line-No9 (01010010)	DS1 Line-No19 (01100110)	DS1 Line-All (00100110)

Amount is the number of Channel Codeword to be generated: **1** to **15** (Default is **10**).

- **Inject** generates the defined loopback command.

Received Messages

Displays current and previous alarms/status and loopback commands as well as the link activity for the received DS3 signal.

- **Link Activity**
  - **None (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 and Unassigned** 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**.
  - **Previous** displays the last valid message received excluding the actual **Current** message.

Filters

Filters allows gathering statistics according to the programmed filters. Filters provide the capability to analyze a specific stream's behavior in order to monitor a single protocol's behavior, perform SLA verification, or precisely troubleshoot unwanted behavior. Up to 4 for 860/860G/880 units or 10 for 890/890Q units filters having up to four operands each can be defined and enabled.

From the test menu, tap **Functions**, and the **Filters** tab.

➤ <Port #> button, when available, allows selecting the port to be displayed. For **Dual Port** topology both ports are available. For the **Through Mode** test application, filters apply only to the **Primary Port**.

➤ **Filter** allows the selection of the filter number (1 to 4 for 860/860G/880 units or 1 to 10 for 890/890Q units). The filter criteria, if defined, will be displayed. A filter used (enabled) for data capture will not be configurable and the message **Filter in use for data capture** is displayed.

➤ **Enable** check box when selected enables the currently selected filter. The filter has to be configured first before enabling it. If the filter configuration contains errors, it will not be possible to enable it. A filter can be enabled or disabled even when the test is running. It is not possible to modify or disable a filter that is already in use for capture until either another filter or **Interface** (see *Capture Source* on page 384) is assigned to capture.

➤ **Enabled Time** indicates the time during which the filter is enabled.

➤ **Assign to Capture** assigns the selected filter for packet capture (see *Packet Capture* on page 384).

Filter Configuration

The filter configuration section allows configuring the filter criteria for the selected filter. The configuration is only possible when the **Enable** check box is cleared. Refer to *Filter Configuration* on page 553.

Filter Statistics

Indicates throughput statistics of the frame matching the configured filter's criteria.

- **Line Utilization** indicates the percentage of line rate utilization.
- **Ethernet BW** (Bandwidth) indicates the receiving data rate expressed in Mbit/s.
- **Frame Rate** indicates the receiving number of frames (including bad frames) in frame/s.
- **Frame Count** indicates the number of frame matching the configured filter's criteria.
- **Error Count** indicates respectively the number of frames matching the configured filter's criteria having **IP Checksum**, **UDP Checksum**, **TCP Checksum**, **FCS**, **Jabber**, **Oversize**, **Runt**, or **Undersize** errors. Refer to *Ethernet* on page 511 and **IP/*UDP/TCP* on page 512** for more information on errors.

OH BERT

The OH BERT validates the integrity of some overhead bytes on the top layer of an OTN test signal. The OH bytes are bundled as group for test purposes.

From the **Test** menu, tap **Functions**, and the **OH BERT** tab.

Note: *Only supported with Coupled topology.*

OH BERT

The **OH BERT** check box when selected (cleared by default), enabled the OH BERT/SYNC generation and monitoring.

Mode

Allows selecting the test operating mode:

➤ **BERT** (default) is a typical BER test that is executed on the selected group of OH bytes, a PRBS15 test pattern is mapped in each individual OH group for BER evaluation.

➤ **SYNC** is a special test which validates that the content of each selected OH group is carried by the same OTUk frame throughout its transfer over the network.

Invert PRBS15 Pattern

Invert PRBS15 Pattern check box, when selected (cleared by default), inverts the test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011. Available with BERT mode only.

OTUx and ODUx

Overhead group check boxes:

Layer	Overhead Group	Number of Bytes	OH Bytes Coordinate	
			Row	Column
OTU	GCC0	2	1	11,12
	RES	2	1	13,14
ODU	GCC1	2	4	1, 2
	GCC2	2	4	3, 4
	APS/PCC	4	4	5-8
	PM&TCM	1	2	3
	TCM ACT	1	2	4
	FTFL[a]	1	2	14
	EXP	2	3	13, 14
	RES	8	2 4	1,2 9-14
	TCM1[b]	3	3	7, 8, 9
	TCM2[b]	3	3	4, 5, 6
	TCM3[b]	3	3	1, 2, 3
	TCM4[b]	3	2	11, 12, 13
	TCM5[b]	3	2	8, 9, 10
	TCM6[b]	3	2	5, 6, 7

a. Only configurable when the test is not running. Once enabled, the FTFL configuration and alarm generation and monitoring in the main test are not available for the top ODU layer.
b. Only configurable when not enabled in the test and when the test is not running.

The current and history status for enabled overhead group is as follows:

Status	Mode	
	BERT	SYNC
Green	No alarms/errors.	Overhead group bytes are synchronized.
Red	Alarms/errors condition detected.	Un-synchronized overhead group bytes condition detected.
Gray	Pending state	

BERT

- Overhead group selector: Allows selection of the overhead group on which Pattern Loss condition and the Bit error statistics will be reported. Only enabled overhead group from OTUx/ODUx are listed.
- **Pattern Loss** indicates that the PRBS15 sequence synchronization is lost.
- **Bit Error** indicates that bit errors are detected on the selected overhead group bytes.

Bit Error

- Overhead group selector: Allows selection of the overhead group on which bit error will be injected. Only enabled overhead group from OTUx/ODUx are listed; All selects all enabled overhead group.
- **Inject** generates bit errors on the selected overhead group bytes.

Reset

Clears all OTUx/ODUx status as well as **Pattern Loss** and **Bit Error** statistics.

OH - OTN

From the **Test** menu, tap **Functions**, and the **OH** tab.

TX and RX buttons

Allows respectively modifying (**TX** button) the overhead information to be transmitted or viewing (**RX** button) the overhead information received.

Default OTN OH

Returns all TX overhead bytes to their factory default values.

TX/RX

Overhead bytes are organized using rows and columns structure as per G.709 standard.

Row 1

- **OA1** and **OA2**, columns 1-6, OTU FAS: All the Frame Alignment Signal **OA1** bytes and **OA2** bytes are individually configurable from **00** to **FF**. The default values are **F6** for all **OA1** bytes and **28** for all **OA2** bytes.
- **MFAS**, column 7, OTU MFAS: The Multi-Frame Alignment Signal byte is not configurable.

- **SM**, columns 8-10, OTU OH: The Section Monitoring contains the following bytes.

  The first SM byte (column 8) contains the TTI multiframe byte that is only configurable from *Traces - OTN* on page 231.

  The second SM byte (column 9) contains the BIP-8 byte that is automatically generated for each frame. This byte is not configurable.

  The third SM byte (column 10) contains the following sub-fields. This byte is configurable from **00** (default) to **FF**.

Bit 1-4	Bit 5	Bit 6	Bit 7-8
BEI/BIAE	BDI	IAE	RES

- **GCC0**, columns 11-12, OTU OH: The two General Communication Channel-0 bytes are configurable from **00** (default) to **FF**. Not configurable when GCC0 check box is selected from *OH BERT* on page 362.
- **RES**, columns 13-14, OTU OH: The two Reserved (RES) bytes are configurable from **00** (default) to **FF**.
- **RES**, column 15, OPU OH: The Reserved (RES) byte is configurable from **00** (default) to **FF**.
- **JC**, column 16, OPU OH:
  Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

Row 2

- **RES**, columns 1-2, ODU OH: The two Reserved (RES) bytes are configurable from **00** (default for each byte) to **FF**.
- **PM & TCM**, column 3, ODU OH: The Path Monitoring and Tandem Connection Monitoring byte is configurable from **00** (default) to **FF**.
- **TCM ACT**, column 4, ODU OH: The Tandem Connection Monitoring Activation is configurable from **00** (default) to **FF**.
- **TCM6/TCM5/TCM4**, column 5-13, ODU OH: The Tandem Connection Monitoring overhead contains the following bytes.

  The first TCMi byte contains the TTI multiframe byte and is only configurable from *Traces - OTN* on page 231.

  The second TCMi byte contains the BIP-8 byte and is automatically generated for each frame. This byte is not configurable.

  The third TCMi byte contains the following sub-fields. This byte is configurable from **00** to **FF**. The default value is **00** when TCMi is disabled, and 01 when enabled.

Bit 1-4	Bit 5	Bit 6-8
BEI/BIAE	BDI	STAT

- **FTFL**, column 14, ODU OH: The Fault Type Fault Location multiframe byte is only configurable from *FTFL/PT* on page 141.
- **RES**, column 15, OPU OH: The Reserved (RES) byte is configurable from **00** (default) to **FF**.
- **JC**, column 16, OPU OH:
  Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

Row 3

- **TCM3/TCM2/TCM1**, columns 1-9, ODU OH: See *TCM6/TCM5/TCM4* on page 367 for more information.
- **PM**, column 10-12, ODU OH: The Path Monitoring overhead contains the following bytes.

  The first PM byte (column 10) contains the TTI byte that is not configurable.

  The second PM byte (column 11) contains the BIP-8 byte and is automatically generated for each frame. This byte is not configurable.

  The third PM byte (column 12) contains the following sub-fields. This byte is configurable from **00** to **FF**. The default value is **01**.

Bit 1-4	Bit 5	Bit 6-8
BEI	BDI	STAT

- **EXP**, column 13-14, ODU OH: The two Experimental overhead bytes are configurable form **00** (default for each byte) to **FF**.
- **RES**, column 15, ODU OH: The Reserved (RES) bytes are configurable from **00** (default) to **FF**.
- **JC**, column 16, OPU OH:
  Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

Row 4

- **GCC1**, column 1-2, ODU OH: The two General Communication Channel-1 bytes are configurable from **00** (default for each byte) to **FF**. Not configurable when GCC1 check box is selected from *OH BERT* on page 362.

- **GCC2**, column 3-4, ODU OH: The two General Communication Channel-2 bytes are configurable from **00** (default for each byte) to **FF**. Not configurable when GCC2 check box is selected from *OH BERT* on page 362.
- **APS/PCC**, column 5-8, ODU OH: The Automatic Protection Switching / Protection Communication Channel overhead bytes are defined in the ITU-T G.709 standard. These bytes are configurable from **00** (default) to **FF**.
- **RES**, column 9-14, ODU OH: The six Reserved (RES) bytes are configurable from **00** (default for each byte) to **FF**.
- **PSI**, column 15, OPU/ODU OH: Tap the PSI field to configure (TX) or display (RX) the Payload Structure Identifier.
  - TX: Select any TX byte from the list and its content is displayed below the list. Tap the **Edit** button to change its value.
  - RX: Select any RX byte from the list and its content is displayed below the list.

Note: *The following legend is used to represent the status of the MSI for each PSI#, either **MSI TX** (black), **Expected MSI RX** (green), or **MSI Mismatch** (red).*

- **NJO**, column 16, ODU OH: The Negative Justification Opportunity byte is not configurable.

RX

- **RX OH Byte Details** displays the content of the selected OH RX byte. Tap on any OH RX byte to see its content
- **Legend TX/RX** indicates the path level for all OH bytes.

OH - SONET/SDH

The SONET/SDH OH page allows modifying (TX) the overhead information to be transmitted and viewing (RX) the overhead information received.

From the **Test** menu, tap **Functions**, and the **OH** tab.

Tap on any overhead byte in TX to modify its value.

Tap on any overhead byte in RX to see its detailed content/value.

Note: *A byte in TX that has no value displayed or is grayed out, is not configurable from the OH tab.*

TX and RX Buttons (SDH)

Tap on the TX or RX button to respectively access the overhead bytes in transmission or receive mode.

STS-1 Timeslot/STM-1 Channel

Allows selecting the timeslot number for the Transport OH bytes. The STS/AU/TU-3 overhead bytes are always for the timeslot selected in the test configuration. Furthermore when modifying the Transport OH bytes H1 SS bits, the modification applies to all timeslots when the test topology is **Coupled**. Choices are **1** (default) to **192** (SONET) / **64** (SDH) depending on the OC-N/STM-N interface selected.

Transport OH - Section/RS

- **A1** and **A2**: Framing. The value should be hexadecimal **F6** for A1 and **28** for A2. They must appear in every STS-1/STM-1 frame of a composite signal.

  SONET: Provide frame alignment of each STS-1 frame within a composite signal (STS-1 to STS-n).

  SDH: Indicate the beginning of the STM-N frame.

- **J0/Z0**

  - **J0**: The J0 (Trace) byte is used to trace the origin of an STS-1/STM-1 frame as it travels across the SONET/SDH network. This byte is only defined for the first STS-1/STM-1 frame of a composite signal. Available when the Trace format is set to 1 Byte (refer to *Traces - SONET/SDH* on page 234).

  - **Z0**: Growth.

    SONET: The Z0 byte was used to uniquely identify the STS in question. This byte has to be defined in every STS-1 to STS-n frame of a composite signal. This byte is only defined for the STS-1 #2 to STS-1 #N of a OC-N signal.

    SDH: 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**: BIP-8 (Bit-Interleaved Parity) byte provides section error monitoring. This byte is only defined for the first STS-1/STM-1 frame of a composite signal. The byte is calculated by performing a routine even-parity check over all bits of the previous STS-N/STM-N frame of a composite signal.

- **E1**: Orderwire. Provides a 64 Kbit/s voice channel for communication between two STEs (Section Terminating Equipment). This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

- **F1**: User/User Channel. This byte is reserved for user purposes. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.
- **D1**, **D2**, and **D3**: Data Communications Channel (DCC). Provides a 192 Kbit/s data communication between two STEs for operation functions such as OAM&P. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

Transport OH - Line/MS

- **H1** and **H2**: Pointer.

  SONET: H1 and H2 bytes are combined to form a pointer indicating where the path overhead begins within each SPE.

  SDH: H1 and H2 bytes are combined to form a pointer indicating where the VC (Virtual Container) frame begins within each SPE.

  Bits 5 and 6 of the H1 byte represent the SS bits and are configurable as follows:

SS Bits	Description
00	SONET
01	Undefined
10	SDH
11	Undefined

- **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.

  SONET: This byte must be defined in every STS-1 to STS-n frame of a composite signal.

  SDH: 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**: BIP-8

  SONET: The BIP-8 (Bit-Interleaved Parity) byte provides line error monitoring. This byte is only defined for the first STS-1/STM-1 frame of a composite signal. 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.

  SDH: 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.

- **K1** and **K2**: Automatic Protection Switching (APS): The K1 and K2 bytes communicate APS between two LTE. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

- **D4** through **D12**: Data Communications Channel (DCC): The D4 through D12 bytes provide a 576 Kbit/s data communications channel between two LTEs for administration, monitoring and other communications. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

- **S1/Z1 (SONET)**

  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/STM-1 frame of a composite signal.

  Z1: 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).

- **S1** (SDH): Synchronization Status. 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 STS-1/STM-1 frame of a composite signal.

➤ **M0** or **M1/Z2 (SONET)**

M0: REI-L: The M1 byte is used for line Remote Error Indication (REI-L)

➤ For STS-1e and OC-1: The M0 byte located in the STS-1 indicates BIP violations.

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

➤ For OC-192: The M0 bytes located in the STS-1 #4 indicates BIP violations when combined with the M1 byte (see M1 byte below for more information).

M1: REI-L. The M1 byte is used for line Remote Error Indication (REI-L).

➤ For STS-3e and OC-3: The M1 byte located in the STS-1 #3 indicates BIP violations.

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

- For OC-12: The M1 byte located in the STS-1 #7 indicates BIP violations.

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

- For OC-48: The M1 byte located in the STS-1 #7 indicates BIP violations.

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

- For OC-192: Either the M1 byte located in the STS-1 #7, or the combination of the M0 and M1 bytes indicates BIP violations (refer to *REI-L Computation Method* on page 213).

  For **M1 Only** computation method:

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

For **M0 and M1** computation method:

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 0110	0000 0000	1536 BIP violations
0000 0110 to 1111 1111	0000 0001 to 1111 1111	0 BIP violation

Z2: Growth. Available with OC-3, OC-12, and OC-48 signal, this byte is located in 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.

➤ **M0** or **M1 (SDH)**

M0: MS-REI. STM-1 channel #1 of a STM-0e and STM-0 signal; channel #2 of an STM-64 signal.

M1:MS-REI. STM-1 channel #1 of a STM-1e and STM-1 signal; channel #3 of an STM-N signal (N>1).

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

➤ **E2**: Orderwire. Provides a 64 Kbit/s voice channel for communication between LTEs. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

STS/AU/TU-3

- **J1**: Trace. Available when the Trace format is set to 1 Byte (refer to *Traces - SONET/SDH* on page 234).

  SONET: The J1 Trace byte provides a 16 or 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

  SDH: The higher-order (AU)/low-order (TU) VC-N path trace byte provides a 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

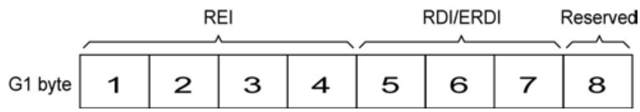
- **B3**: BIP-8. The BIP-8 (Bit-Interleaved Parity) byte provides path error monitoring. The byte is calculated by performing a even-parity check over all bits of the previous SPE.

➤ **C2**: Signal Label. Entering a C2 byte value will automatically update the Path Signal Label (C2) selection and vice versa. Refer to *STS/AU Path (C2)* on page 151 for more information.

C2 (Hex.)	Description	
	SONET	**SDH**
00[a]	Unequipped	UNEQ or supervisory-UNEQ
01	Equipped - Non-Specific	RES (Equipped - Non-Specific)
02	Floating VT Mode (Default)	TUG Structure
03	Locked VT Mode	Locked TU-n
04	Async Mapping for DS3	Async Mapping of 34M/45M in C-3
05	Mapping under development	Experimental Mapping
12	Async Mapping for 140M (DS4NA)	Async Mapping of 140M in C-4
13	Mapping for ATM	ATM Mapping
14	Mapping for DQDB	MAN DQDB
15	Async Mapping for FDDI	FDDI [3]-[11] Mapping
16	Mapping of HDLC over SONET	Mapping of HDLC/PPP
17	SDL with self-sync scrambler	RES (SDL self-synch scrambler)
18	Mapping of HDLC/LAPS	Mapping of HDLC/LAPS
19	SDL with a set-reset scrambler	RES (SDL set-reset scrambler)
1A	10 Gbit/s Ethernet (IEEE 802.3)	10 Gbit/s Ethernet (IEEE 802.3)
1B	GFP	GFP
1C	Not supported	Mapping 10 Gbit/s FC
20	Not supported	Async Mapping of ODUk
CF	RES (Obsolete HDLC/PPP framed)	RES (obsolete HDLC/PPP framed)
E1[a] to FC[a]	STS-1 w/1 VTx PD, STS-1 w/2 VTx PD, ... STS-1 w/28 VTx or STS-n/nc PD	Not supported
FE	Test Signal, ITU-T 0.181	Test Signal, ITU-T 0.181
FF[a]	STS SPE AIS (TCM)	VC-AIS (TCM)

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

➤ **G1**: Path Status. The G1 byte provides a method to communicate the far-end path status back to the path originating equipment.



REI:

Bits 1 to 4 of G1	Description
0000	No error
0001	1 error
0010	2 errors
:	:
1000	8 errors
1001 to 1111	No error

RDI/ERDI:

Bits 5, 6, 7 of G1	Description
000, 001, 011	No defect
100, 111	RDI
010	ERDI-PD
101	ERDI-SD
110	ERDI-CD

➤ **F2**: User Channel. The User Channel provides a 64 Kbit/s channel for communication between two PTEs. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

➤ **H4**: Multiframe Indicator. The H4 byte provides a multiframe phase indication of a VT/TU payload.

- **Z3** and **Z4**:

  SONET only: Growth.

- **F3**:

  SDH only: User Channel. The Path User Channel provides a channel for communication purposes between path elements and is payload dependent.

- **K3**:

  SDH only: Automatic Protection Switching (APS). Bits 1 to 4 of the K3 byte are used for APS signaling. K3 bits 5 to 8 are reserved for future use.

- **N1**:

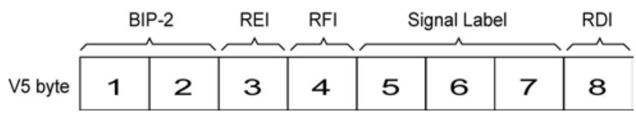
  SONET: The N1 byte (formerly referred to as the Z5 byte) is allocated for Tandem Connection Maintenance (TCM) and the Path Data Channel.

  SDH: (Network operator byte) The N1 byte is allocated to provide a Higher-Order Tandem Connection Monitoring (HO-TCM) function.

VT/TU

➤ **V5** VT/TU Path Overhead

The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads. It provides the same functions for VT/VC paths that the B3, C2, and G1 bytes provide for STS/STM paths.



➤ **BIP-2** is not configurable.

➤ **REI**, **RFI**, and **RDI**: Choices are **0** (disabled), and **1** (enabled).

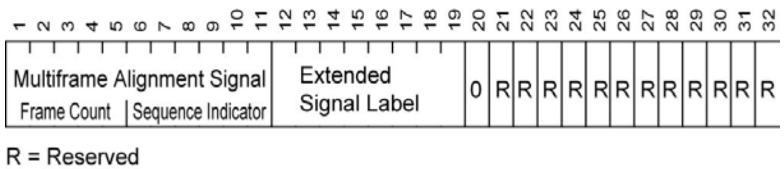
➤ Signal Label

Bits 5, 6, 7 of V5	Description	
	SONET	SDH
000[a]	Unequipped	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]	VT SPE AIS (TCM)	VC-AIS (TCM)

a. These bytes cannot be selected in receive mode.

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 multiframe as shown below. See Z7/K4 Structure shown below.

Z7/K4 Structure



➤ **J2** Trace. Available when the Trace format is set to 1 Byte (refer to *Traces - SONET/SDH* on page 234).

SONET: VT Path Trace: The J2 Trace byte provides a 16 or 64 bytes fixed string allowing the receiving VT PTE to verify its continued connection to the intended transmitting VT PTE.

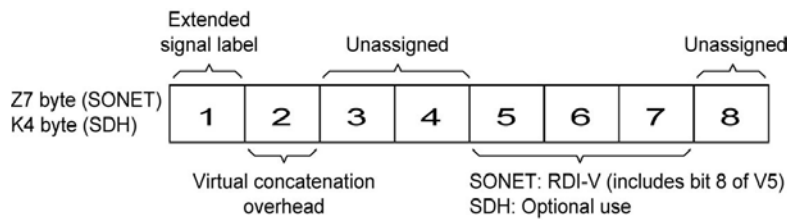
SDH: Path Trace: The J2 byte is used to repetitively transmit a Lower-Order Access Path Identifier so that a path receiving terminal can verify its continued connection to the intended transmitter.

➤ **Z6/N2**

Z6 (SONET): VT Tandem Connection Monitoring or VT Path Growth. The Z6 byte is allocated for future growth.

N2 (SDH): (Network operator byte) Tandem Connection Monitoring for the VC2, VC-12, and VC-11 level.

➤ **Z7 /K4** : Extended signal label



Bits	Description	
	Z7 (SONET)	K4 (SDH)
1	Extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see **Z7/K4 Structure on page 382**) contain the extended signal label.	
2	Virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see **Z7/K4 Structure on page 382**) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator.	
3 - 4	unassigned and reserved for APS signaling for protection at the lower order path level.	
5 - 7	These bits in combination with bit 8 of V5 are allocated for RDI -V/ERDI-V signal	Optional use.
8	unassigned and reserved for a lower order path data link.	

Default all OH

Returns all TX overhead bytes to their factory default values.

Packet Capture

Capture is used to analyze all or filtered data traffic and save complete or truncated frames into a buffer. It allows observing network truncated data precisely, or understanding errors and unwanted behavior.

From the test menu, tap **Functions**, and the **Packet Capture** tab.

➤ <Port #> button, when available, allows selecting the port to be displayed. For **Dual Port** topology both ports are available. For the **Through Mode** test application, packet capture applies only to the **Primary Port**.

Capture Source

Specifies what kind of data to be captured.

➤ **Interface** captures all received frames and saves them in the capture buffer.

➤ **Filter #** captures only frames that match the selected filter and saves them in the capture buffer. Select the filter number from the list. Only enabled filters are available, see *Filters* on page 360. The selected filter will be reserved for data capture and will not be available for filter configuration.

Frame Length

Specifies the length of the frame that will be saved in the capture buffer.

- **Complete** captures the entire frames.
- **Truncated** captures only the first specified number of bytes per frame. Use either the Bytes field to manually enter the number of bytes per frame or tap on the **Truncation Calculator** button for automatic bytes per frame calculation.

  Bytes allows the selection of the number of bytes that will be saved in the capture buffer for each frame captured: 14 (default) to 1536 bytes.

  Truncation Calculator allows determining easily at what byte to truncate the frame captured by selecting the desired frame header components.

  - **Header Layer** specifies the header layer level: **Layer 2 (Ethernet)**, **Layer 3 (IP)**, or **Layer 4 (TCP/UDP)**.
  - **IP Version** specifies the IP version: **IPv4** or **IPv6**.
  - **Encapsulation** parameters are optional and not selected by default.

    VLAN check box when selected enables VLAN and allows selecting the number of VLANs: 1, 2, or 3.

    MPLS check box when selected enables MPLS and allows selecting the number of labels: 1 or 2.

  - **Additional Payload (bytes)** allows selecting optionally the number of additional payload bytes (1 to 1400 bytes).
  - **Total Number of Bytes** indicates the number of bytes for the selected frame parameters. This value will be used as the truncated frame length (**Truncated** field).

Trigger

- **Trigger Type** defines the trigger source criterion that will be used to automatically start/stop the capture when a received frame matches the filter and trigger criteria.
  - **Manual** automatically starts the frame capture when the Capture button is on (green LED) and the test is started (refer to *Start/Stop|TX Button* on page 440).
  - **On Error** starts the frame capture when the selected error occurs.
    FCS
    Jabber
    Oversize (available when **Oversize Monitoriing** is enabled)
    Runt
    Undersize
    IP Checksum
    UDP Checksum
    TCP Checksum
    Any Type (any of the above errors).
  - **Field Match** starts the frame capture when the configured field match is encountered. Use the **Configuration** button to select the field match criteria (see **Filter Configuration** from the **Filters** tab).

    Cfg. Status indicates the status of the configured field match configuration: **Valid** or **Invalid**. A valid status is required to be able to start the capture.

- **Trigger Position** selects the triggered frame position within the buffer.
  - **Post-Trigger** for a trigger frame located at the beginning of the buffer. The buffer will contain the triggered frame with the following frames.
  - **Mid-Trigger** for a trigger frame located at the middle of the buffer. The buffer will contain the triggered frame with the preceding and following frames.
  - **Pre-Trigger** for a trigger frame located at the end of the buffer. The buffer will contain the triggered frame with the preceding frames.

Status and Controls

- **Capture Status** indicates the status of the data capture:

  "**--**" indicates that the capture is not started and has not run yet.

  Armed... indicates the the capture is started but waiting for the trigger event.

  Capturing... indicates that the capture is in progress. For Post-Trigger and Mid-Trigger mode, the trigger event has been captured and the buffer is filling up.

  Completed indicates that the capture is completed.

- **Frame Count** indicates the number of frames captured that matches the selected filter criteria. However, for Mid-trigger and Pre-Trigger, the frame counter will only be available when the capture is completed.
- **Buffer Usage** indicates the percentage of the buffer capacity used.
- **Triggered Error** is available when trigger on error is selected and indicates the error that activated the trigger.
- **Triggered Frame - Details** gives details on the triggered frame. Refer to *Triggered Frame Details* on page 573.

- **Capture** button allows starting/stopping the data capture. The test must be running (refer to *Start/Stop|TX Button* on page 440) in order to start capturing and recording data into the buffer. The Capture button is not available when the trigger on field match is selected while its trigger parameters are not valid.

  No data will be recorded in the buffer if no frame matches the filter and the trigger criteria during the data capture.

  The data capture stops automatically once the buffer is full. The maximum buffer capacity is 64 KBytes or a maximum of 2078 frames for rates up to 10GE and 512 KBytes or a maximum of 8192 frames for rate 100GE.

  When the capture stops or is manually stopped, the following message is displayed: **Capture completed. Press Export to save captured data (the test must be stopped)**. To avoid losing the captured data, the data must be exported and saved into a file before restarting the test or creating a new test.

- **Export**, available when the test application is stopped, allows exporting the data captured into a .pcap file format and viewing the file using Wireshark.

  - **Save In** allows selecting the folder to save the capture file (by default: Users\<User>\Documents\800-MaxTester\CaptureData).

  - **View File After Generation** check box when selected (cleared by default) allows displaying the report once it is generated using the Wireshark application.

- **Generate & Save** allows generating and saving the capture data. The name of the captured file is automatically selected and contains the date and time of the capture. Capture file bigger than 100Mbytes will be split into multiple files. Tapping on the **Cancel** button stops the capture generation. The captured data already processed will be saved.

Note: *The export process may take several minutes.*

Once generated, the capture file will be automatically opened in Wireshark when the **View File After Generation** check box is selected. The capture file report may also be manually opened within Wireshark typically using Windows Explorer.

Ping & Trace Route

From the **Test** menu, tap **Functions**, and the **Ping & Trace Route** tab.

Note: *For **Dual Port** topology select the port to be displayed.*

Source IP Address

Displays or allows the selection of either the interface source IP address or a stream IP address depending on the test and its configuration. Refer to *Network* on page 163, *MAC/IP/UDP* on page 154, or *Smart Loopback* on page 216.

Destination IP Address

Enter the **Destination IP Address** of the network device to be detected. The destination IP address is configurable only with **IPv4 Network Layer** (refer to *Modify Structure* on page 76). The accepted range for IPv4 is **0.0.0.0** (default) to **255.255.255.255**.

The default setting for IPv6 is **2001:0000:0000:0000:0000:0000:0000:0000** or is set automatically to the IP address of the target unit from the Remote Loopback mode. The destination IP address is configured only when **Ethernet/IPv6/UDP** is selected. The **IPv6 Address** can either be the **Link-Local IPv6 Address** or the **Global IPv6 Address**. The acceptable range for IPv6 is from **000:0000:0000:0000:0000:0000:0000:0001** to **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF**.

Stream

Stream, available with EtherSAM and Traffic Gen & Mon, allows selecting a stream/service to use its source and destination IP addresses for the Ping and Trace Route tests.

Use Stream

Use Stream, available with test application using stream/services, allows using the source and destination IP of the defined or selected stream/services.

Ping

- **Data Size (Bytes)**: Enter the data size that will be sent to the network device to be detected. Choices are **0** to **1452 bytes**; **32 bytes** by default.
- **TTL** for IPv4 and **Hop Limit (TTL)** for IPv6: Enter the maximum number of hops the packet can go through. Choices are **1** to **255**; **128** by default.
- **IP TOS/DS** for IPv4 and **Traffic Class (TOS/DS)** for IPv6: Enter the type of service. Choices are **00** (default) to **FF**.
- **Flow Label** (IPv6) value acceptable range is from **0** (default) to **1048575**.
- **Timeout (ms)**: Enter the maximum time allowed between an ICMP echo and response. Choices are **200 ms** to **10000 s**; **4000 ms** by default.
- **Delay (ms)**: Enter the delay between each attempt (PING). Choices are **100** to **10000 ms**; **1000 ms** by default.
- **Attempts**: Select **n-Attempts** to specify the number of ping requests to send following a ping activation or select **Continuous** to ping continuously until manually stopped. If **n-Attempts** is selected, enter the number of ping attempts from **1** to **1000.** The default setting is **n-Attempts** with **4** attempts.
- **Ping** button starts the ping tool with the specified settings.

Trace Route

- **Max Hop Count**: Enter the maximum network device the packet is allowed to go through. Choices are **1** to **255**; **128** by default.
- **Timeout (ms)**: Enter the maximum time allowed between an ICMP echo and response at each hop. Choices are **200 ms** to **10000 ms**; **4000 ms** by default.
- **Trace Route** button starts the trace route tool with the specified settings.

Results

To succeed, a ping command shall be acknowledged by the network device within a given delay (**Timeout**). Typically a ping command can fail for the following reasons:

- The IP address is unavailable or unknown.
- The time allowed to perform the ping command is too short.
- The remote device is not supporting ICMP messaging.

To succeed, a trace route command shall be acknowledged by the network device within a given delay (Timeout). Typically a trace route command can fail for the following reasons:

- The IP address is unavailable or unknown.
- The time allowed to perform the trace route command is too short.
- The remote device is not supporting ICMP messaging.

The ping and trace route results are displayed with the following columns:

- **No.**: Indicates the attempt number.

➤ **Status**: Indicates the status of the attempt as follows:

Status	Description
Successful	Valid ICMP echo reply received.
User Aborted	When a user has manually stopped the ping/trace route function before the end of attempts.
Time Out	When an ICMP echo reply was not received within the defined timeout.
Destination Invalid	With reserved IP addresses: For IPv4: 0.0.0.0, 127.0.0.0, and all addresses above 240.0.0.0 (Class E and above). For IPv6: 0::/8 (reserved/unspecified), 0::1/128 (Loopback), FF00::/8 (Multicast).
TTL Expired (ping test)	When the number of TTL was insufficient to reach the destination host.
Hop Reached (trace route test)	When a Time Exceeded message is received from a host while executing the trace route function.
Destination Unreachable	For IPv4: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or an ICMP Unreachable message is received). For IPv6: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or address resolution failed or an ICMP Destination Unreachable message is received).
Data Corrupted	Parameter problem message is received or data corruption is found for IPv4.
Discarded	Congestion has been detected and the request cannot be transmitted.
Packet Too Big	Packet Too Big message is received in response to a packet that the router cannot forward because the packet is larger than the MTU of the outgoing link. It is only applicable for the **IPv6 version**.
Undefined	For any other errors in ping/trace route that do not fall into one of the above description.

- **Replied Details**

  For ping, indicates the IP address of the replier, the buffer size of the ICMP echo response, the time of response in milliseconds, and the TTL of the ICMP echo response.

  For trace route, indicates the IP address of the replier, and the time of response in milliseconds.

Statistics

- **Packets Transmitted** indicates the number of sent packets.
- **Packets Received** indicates the number of received packets.

The following statistics are only available for the ping test.

- **Percentage Lost (%)** indicates the percentage of packets lost.
- **Min Round Trip Time (ms)** indicates the minimum time recorded for a ping request to be answered.
- **Max Round Trip Time (ms)** indicates the maximum time recorded for a ping request to be answered.
- **Avg. Round Trip Time (ms)** indicates the average time required for a ping request to be answered.

Pointer Adjustment

From the **Test** menu, tap **Functions**, and the **Pointer Adjustment** tab.

TX Pointer Adjustment

Note: *Only available in **Coupled** topology.*

The pointer adjustment supports two modes of operation: **Manual** and **Sequence**. Both modes offer the generation of pointer events even when the test is not started.

TX Pointer Adjustment - Manual Button

Step

➤ **Value**

For STS/AU: Select the number of positive (Increment) or negative (Decrement) pointer adjustments to include into the STS-n (SONET) or AU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 frames.

For VT/TU: Select the number of positive (Increment) or negative (Decrement) pointer adjustment to include into the VTn (SONET) or TU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 multiframes.

➤ **Increment** button sends the positive pointer adjustment defined.

➤ **Decrement** button sends the negative pointer adjustment defined.

➤ **Pointer Value** indicates the current pointer value.

Jump

➤ **New Pointer** allows selecting a new pointer value:

For STS/AU: **0** (default) to **782**

For VT/TU:

Path	Range
VT1.5	0 to 103
VT2	0 to 139
TU-3	0 to 764
TU-11	0 to 103
TU-12	0 to 139

➤ **Inject** button sends the new pointer value.

➤ **New Data Flag** (NDF) check box when selected inserts a New Data Flag with the pointer adjustment when the Inject button is tapped.

For STS/AU: 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 VT/TU: 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.

TX Pointer Adjustment - Sequence Button

Note: *The pointer sequence is only supported on one test layer; either on VT/TU layer or on STS/AU when the test doesn't contain VT/TU mapping. The field next to the* **Sequence** *operation mode button indicates the path level used for the sequence pointer adjustment.*

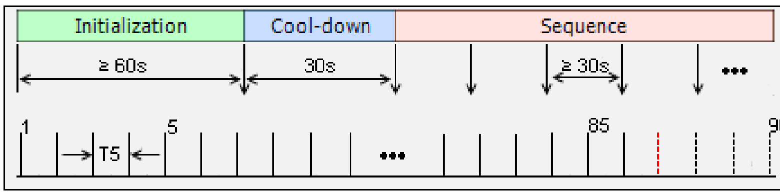
➤ **Sequence: T.105-03/GR-253** allows the selection of the pointer sequence pattern based on the **T.105-03/GR-253** standard.

Pointer Sequence Pattern	Available with
Single pointers of opposite polarity	AU-x, TU-3, TU-11, TU-12
Regular pointers plus one double pointer	AU-x, TU-3, TU-11, TU-12
Regular pointers with one missing pointer	AU-x, TU-3, TU-11, TU-12
Double pointers of opposite polarity	AU-x, TU-3, TU-11, TU-12
Single pointer adjustment	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Burst pointer adjustment	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Phase transient	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Periodic pointer adjustment 87-3 pattern	STS-x, AU-x, TU-3
Periodic 87-3 with Add	STS-x, AU-x, TU-3
Periodic 87-3 with Cancel	STS-x, AU-x, TU-3
Periodic pointer adjustment continuous	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Periodic pointer adjustment continuous with Add	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Periodic pointer adjustment continuous with Cancel	STS-x, VT1.5, VT2, AU-x, TU-3, TU-11, TU-12
Periodic pointer adjustment 26-1 pattern	VT1.5, TU-11
Periodic 26-1 with Add	VT1.5, TU-11
Periodic 26-1 with Cancel	VT1.5, TU-11

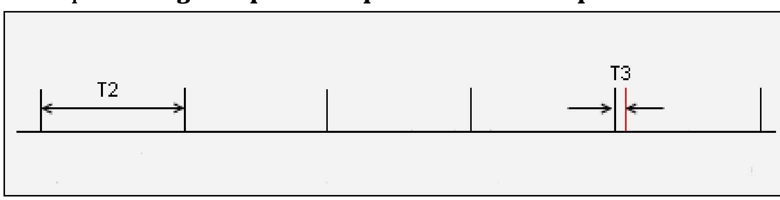
➤ Initialization / Cool Down / Sequence

The following time line examples show the initialization, cool down, and the pointer sequence according to the selected sequence and parameters.

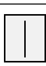
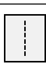
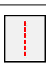
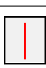
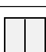
Example 1: **Periodic 87-3 with Cancel**



Example 2: **Regular pointers plus one double pointer**



Legend:

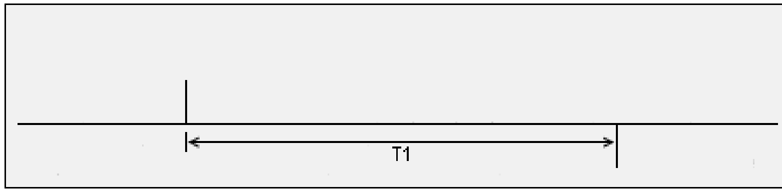
	Description
•••	When located at the end (right) of the sequence, indicates a continuous repetition of the pointer sequence. When located within the sequence, indicates a repetition of pointers.
	Regular pointer event or sequence.
	Cancel event.
	Special event like an extra cancel event (for example in **Periodic 87-3 with Cancel**) or a missing event from the **Regular pointers with one missing pointer** sequence.
	Special event like add, double pointer, etc.
	Indicates that the sequence is periodic with special event.

➤ **T1** to **T6** are configurable duration parameters. The range of the duration parameters as well as their availability versus pointer sequence are described in the following table.

Pointer Sequence Pattern	Parameter	Duration range
Single pointers of opposite polarity	T1	10 to 30 s (default 10 s)
Regular pointers plus one double pointer	T2	AU/TU-3: 7.5 ms to 30 s (default 0.333 s) TU-11/12: 0.2 s to 30 s (default 0.75 s)
	T3	AU/TU-3: 0.5 ms TU-11/12: 2 ms
Regular pointers with one missing pointer	T2	AU/TU-3: 7.5 ms to 30 s (default 0.333 s) TU-11/12: 0.2 s to 30 s (default 0.75 s)
Double pointers of opposite polarity	T1	10 to 30 s (default 10 s)
	T3	STS-x/AU-x/TU-3: 0.5 ms to 1 s (default 0.5 ms) VT-x/TU-11/12: 2 ms to 1 s (default 2 ms)
Single pointer adjustment	T6	30 to 60 s (default 30 s)
Burst pointer adjustment	T4	STS-x/AU-x/TU-3: 0.5 ms VT-x/TU-11/12: 2ms
	T6	30 to 60 s (default 30 s)
Phase transient	T6	30 to 60 s (default 30 s)
Periodic pointer adjustment 87-3 pattern	T5	7.5 ms to 10 s (default 0.333 s)
Periodic 87-3 with Add	T4	0.5 ms
	T5	7.5 ms to 10 s (default 0.333 s)
Periodic 87-3 with Cancel	T5	7.5 ms to 10 s (default 0.333 s)
Periodic pointer adjustment continuous	T5	STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s) VT-x/TU-11/12: 0.2 s to 10s (default 1 s)
Periodic pointer adjustment continuous with Add	T4	STS-x/AU-x/TU-3: 0.5 ms VT-x/TU-11/12: 2 ms
	T5	STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s) VT-x/TU-11/12: 0.2 s to 10 s (default 1 s)
Periodic pointer adjustment continuous with Cancel	T5	STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s) VT-x/TU-11/12: 0.2 s to 10 s (default 1 s)
Periodic pointer adjustment 26-1 pattern	T5	0.2 s to 10 s (default 1 s)
Periodic 26-1 with Add	T4	2 ms
	T5	0.2 s to 10 s (default 1 s)
Periodic 26-1 with Cancel	T5	0.2 s to 10 s (default 1 s)

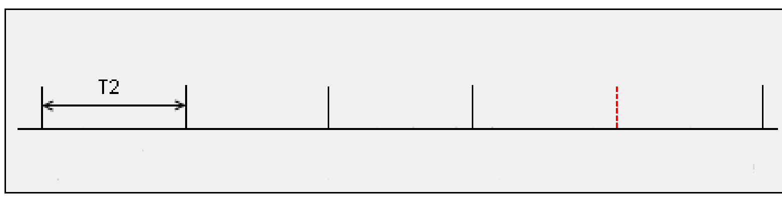
➤ **T1 (s)** represents the interval between two pointer events.

Example of **Single pointer of opposite polarity** sequence.



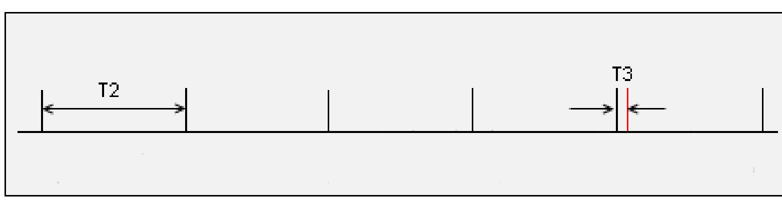
➤ **T2 (s)** represents the interval between successions of pointer events.

Example of **Regular pointers with one missing pointer** sequence.



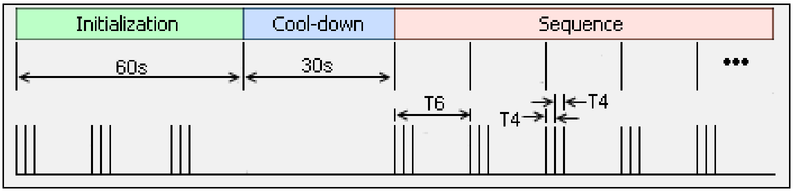
➤ **T3 (ms)** represents the interval between back to back pointer events.

Example of **Regular pointers plus one double pointer** sequence.



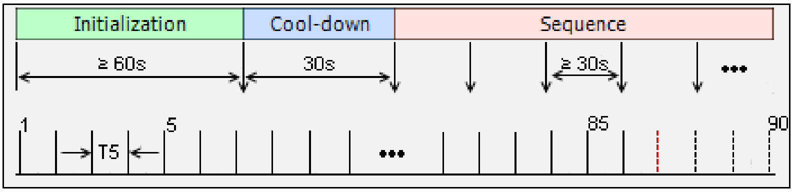
- **T4 (ms)** represents the interval between back to back pointer events in periodic pointer sequence.

  Example of **Burst pointer adjustment** sequence.



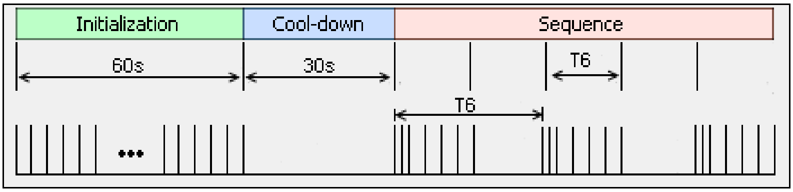
- **T5 (s)** represents the interval between successions of pointer events in a Periodic pointer sequence.

  Example of **Periodic 87-3 with Cancel** sequence.



- **T6 (s)** represents the interval between successions of pointer events.

  Example of **Phase transient** sequence.



- **Increment/Decrement** allows determining if the pointer sequence will increment (positive) or decrement (negative) the pointer values.
- **Periodic** check box when selected, generates the pointer sequence continuously. The pointer sequence is generated only once when the **Periodic** check box is cleared. The capability to clear the **Periodic** check box is only available for the following pointer sequences:
  - Single pointers of opposite polarity
  - Regular pointers plus one double pointer
  - Regular pointers with one missing pointer
  - Double pointers of opposite polarity
- **Init-Cool** check box when selected, generates pointer action with three phases: initialization, Cool-down, and pointer sequence. Only the pointer sequence is generated when the **Init-Cool** check box is cleared.
- **Status** indicates the pointer event activity status.
  - **Initialization** indicates that the pointer sequence test is started and is running the initialization phase.
  - **Cool-down** indicates that the pointer sequence test is started and is running the cool down phase.
  - **Sequence** indicates that the pointer sequence test is started and is running the sequence phase; this phase runs until the Sequence is turn off.
  - **Static pointer** indicates that the pointer sequence is not started. The signal generator transmits a fix pointer value.
- **Pointer Value** indicates the current pointer value. Available even if the test is not started or if the sequence is not enabled.

➤ **Sequence** button when enabled, generates pointer events on a regular basis. The initialization and cool down sequence are described below for each pointer sequence pattern.

Pointer Sequence Pattern	Initialization	Cool down
Single pointers of opposite polarity	Basic sequence[a,b] Duration ≥ 60 sec	Basic sequence[a,b] Duration = 30 sec
Regular pointers plus one double pointer	Add sequence Duration ≥ 60 sec	Add sequence Duration = 30 sec
Regular pointers with one missing pointer	Cancel sequence Duration ≥ 60 sec	Cancel sequence Duration = 30 sec
Double pointers of opposite polarity	Basic sequence[a,b] Duration ≥ 60 sec	Basic sequence[a,b] Duration = 30 sec
Single pointer adjustment	One pointer event per second Duration = 60 sec	No pointer event Duration = 30 sec
Burst pointer adjustment		
Phase transient		
Periodic pointer adjustment 87-3 pattern	Basic sequence[a] Duration ≥ 60 sec	Basic sequence[a] Duration = 30 sec
Periodic 87-3 with Add		Add sequence Duration = 30 sec
Periodic 87-3 with Cancel		Cancel sequence Duration = 30 sec
Periodic pointer adjustment continuous	Basic sequence[a] Duration = 60 sec	Basic sequence[a] Duration = 30 sec
Periodic pointer adjustment continuous with Add		Add sequence Duration = 30 sec
Periodic pointer adjustment continuous with Cancel		Cancel sequence Duration = 30 sec
Periodic pointer adjustment 26-1 pattern	Basic sequence[a] Duration ≥ 60 sec	Basic sequence[a] Duration = 30 sec
Periodic 26-1 with Add		Add sequence Duration = 30 sec
Periodic 26-1 with Cancel		Cancel sequence Duration = 30 sec

a. The basic sequence corresponds to the pointer event pattern defined in the standard without any Add or extra Cancel event.
b. Only available when the **Periodic** check box is selected.

RX Pointer Adjustment

- **Pointer Value**

  For STS/AU: 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 VT/TU: 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**.

- **Ptr. Incr.** (Pointer Increment) gives statistics on positive pointer adjustment detected.

- **Ptr. Decr.** (Pointer Decrement) gives statistics on negative pointer adjustment detected.

- **NDF** (New Data Flag) gives statistics on pointer jumps containing a New Data Flag.

  For STS/AU: Bits 1 to 4 of the pointer word (H1 and H2) detected are **1001**.

  For VT/TU: 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 STS/AU: Bit 1 to 4 of the pointer word (H1 and H2) detected are **0110**.

  For VT/TU: Bit 1 to 4 of the pointer word (V1 and V2) detected are **0110**.

RTD

Note: *Not available in Decoupled, or Through mode.*

Round Trip Delay (RTD) measurements are needed to quantify the time it takes for a signal to cross the network and come back. 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.

From the **Test** menu, tap **Functions**, and the **RTD** tab.

Note: *To do a 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 provide reliable results. Therefore, RTD results could be affected by error injection or error introduced by the network.*

Mode

Allows the selection of the round trip delay test mode. Choices are **Single** (default) and **Continuous**.

➤ **Single** allows testing the round trip delay once.

➤ **Continuous** allows testing the round trip delay continuously in a repetitive manner (one RTD measurement every 2 seconds).

Measure Delay Button

Allows enabling the round trip delay measurement.

For **Single** mode, the test is performed once and stops (the **Measure Delay** button turns off by itself). The **Measure Delay** 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 **Measure Delay** 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 measurement while the test is running or when starting the test while the* **Measure Delay** *button is enabled. 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.
  - Presence of high number of bit errors.

  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 that the RTD measurement is not ready.

Reset

Resets the RTD results and measurement counts.

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** (default) and **μs**.

Count

Indicates the total number of successful and failed measurements.

Successful: A measurement is declared successful when the RTD is smaller or equal to 2 seconds.

Failed: A measurement is declared failed when the RTD is > 2 seconds.

S-OAM Link Trace

From the **Test** menu, tap **Functions**, and the **S-OAM Link Trace** tab.

Link Trace

- **Priority**[1] allows selecting the VLAN user priority: **0** (default) to **7**. Refer to *VLAN* on page 164 for more information.
- **Drop Eligible**[1] is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **TTL** sets the Time To Live value: **1** to **255** (default is **128**).
- **Link Trace** button when ON (OFF by default) starts the link trace process. The **Link Trace** button turn OFF automatically once the link trace process is completed.

Result

The table reports the following information for each valid LTR frames received in response to the last LTM frame sent: **TTL**, **MEP/MIP MAC Address**, **Forward**, and **Term MEP**.

- **Last Link Trace Status** displays the last link trace status.

Status	Description
Pending	No Results
Successful	Last Link Trace was successful
Failed – LTR Timeout	Last Link Trace failed due to a LTR Timeout
Failed – Invalid LTR	Last Link Trace failed due to an Invalid LTR

- **TX LTM** indicates the count of transmitted LTM frames.

1. Available when VLAN is enabled (see *VLAN* on page 164).

- **RX LTR** indicates the count of received LTR frames having their destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs.
- **LTR Timeout** indicates the count of LTR Timeout event which occurs if a reply (LTR) from the Peer MEP is not received within 5 seconds.
- **Invalid LTR** indicates the count of LTR frames received with incorrect MEG/MD Level or Transaction ID.

Signaling Bits

Allows generation and monitoring of the signaling bits. Only available for DSn/PDH BERT framed test with DS0/E0 enabled.

From the **Test** menu, tap **Functions** and the **Signaling Bits** tab.

Note: *Two signaling bits (**AB**) are available for SF or SLC-96 framing while four signaling bits (**ABCD**) are available for ESF.*

TX Signaling

Note: *Only available when **TX Signaling** is enabled (refer to **TX Signaling check box when selected (cleared by default) allows generation of the signaling bits for either the 24 - DS0 channels or 30 - E0 channels (PCM-30 and PCM30 CRC-4). Only available when the DS0/E0 check box is selected.*** **on page 207***). For E0 the TX signaling always displays the ABCD bits.*

➤ **Signaling Mode**, available with DS0, is configurable to **2/4/16 States** for ESF or **2/4 States** for SF/ SLC-96; default is **4 States**.

Signaling Mode	2-States		4-States		16-States
Framing	SF/SLC-96	ESF	SF/SLC-96	ESF	ESF
Signaling Bits	00 11[a]	0000 1111[a]	00 to 11[a]	0000 0101 1010 1111[a]	0000 to 1111[a]

a. Default value.

- **Channel/AB/ABCD** table: Allows the configuration of signaling bits of either the 24 - DS0 channels or 30 - E0 channels.

Note: *Channel numbers for E0 refer to telephone channel numbers. Timeslots 1 to 15 and 17 to 31 are assigned to telephone channels numbered from 1 to 30 as per G.704.*

RX Signaling

Channel/AB/ABCD table: The monitoring of signaling bits of either the 24 - DS0 channels or 30 - E0 channels is performed when the test is running.

Spare Bits

Note: ***Spare Bits*** *are not available when the framing is set to* ***Unframed****.*

From the **Test** menu, tap **Functions**, tap the **Spare Bits** tab.

TX

Tap a spare bits field to set its value.

Note: *All spare bits are reserved for national use and should be set to 1 when not used.*

- E4

  G.751 Bit 14, 15, 16: Choices are **000** to **111** (default).

- E3

  G.751 Bit 12: Choices are **0** and **1** (default).

- E1

  - $\mathbf{S_{i0}}$ is located in the bit 1 of the frame containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
  - $\mathbf{S_{i1}}$ is located in the bit 1 of the frame not containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
  - $\mathbf{S}_{a4}$ 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. Choices are **0** and **1** (default) or **0000** to **1111** (default) 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. Choices are **000** to **111** (default).

RX

- E4

  G.751 Bit 14, 15, 16 are reserved for national use.

- E3

  G.751 Bit 12 is reserved for national use.

- E2

  G.742 Bit 12 represents Bit 12 from Timeslot 1, 2, 3, and 4 respectively.

- E1

  - $\mathbf{S_{i0}}$ is located in the bit 1 of the frame containing the frame alignment signal (FAS).

  - $\mathbf{S_{i1}}$ is located in the bit 1 of the frame not containing the frame alignment signal (FAS).

  - $\mathbf{S}_{a4}$ 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 either **0** and **1** or **0000** to **1111** depending on the 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.

Traffic Scan

The traffic scan tool provides the capability to discover and monitor VLAN traffic flows on the network.

Note: *Only available on 890/890Q. Not available with dual port test and when* ***Provider Encapsulation*** *is used.*

From the **Test** menu, tap **Functions**, and the **Traffic Scan** tab.

Level

Allows the selection of the criteria that will be used to filter the incoming VLAN traffic flows. The default setting is **All**. Choices are:

Level	Description
All	Monitors untagged frames and up to 3 levels of stacked VLAN frames
Untagged	Monitors untagged frames only (no VLAN)
C-VLAN	Discovers/monitors only frames where the outer VLAN is a C-VLAN (TPID of 0x8100)
S-VLAN	Discovers/monitors only frames where the outer VLAN is a S-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300)
E-VLAN	Discovers/monitors only frames where the outer VLAN is a E-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300)

Rate Layer

Allows the selection of the rate unit used for **Link Rate** and **Rate** statistics.

- **Line Utilization** is used to express the real line rate including the Preamble, SFD, and IFG.
- **Ethernet BW** (Bandwidth) is used to express the Ethernet bandwidth rate excluding the Preamble, SFD, and IFG.

Discovered

Indicates the number of different traffic flows monitored based on the scan criteria.

Link Rate (Mbit/s)

Indicates the network link rate based on the received frames with a valid FCS regardless if the frame matches or not the traffic flows, and regardless if the traffic flow was ignored due to the limit reached (see *Limit Reached*). The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** depending on the **Rate Layer** selected.

Limit Reached

Up to 128 different traffic flows can be monitored, the **Limit Reached** text appears with a red background next to the **Discovered** field when the limit is reached.

Scan

Starts/stops the traffic scan test.

Monitored Frames Table

Statistics are gathered for each different traffic flow matching the scan criteria. Each different monitored traffic flow creates a separate entry in the scan table. When the limit is reached, new traffic flows are not considered in the table but the existing traffic flows are still monitored.

The level of VLAN (untagged, E-VLAN, S-VLAN, C-VLAN), and values of VLAN ID, Priority, and TPID are used to identify a traffic flow. Any difference in one of these values will create a separated entry in the table. PBB-TE frames are ignored.

Note: *Scan statistics are cleared when restarting the scan.*

- **E-VLAN / S-VLAN / C-VLAN**
  - **ID** indicates the VLAN ID of the received traffic flow.
  - **Priority** indicates the VLAN Priority of the received traffic flow.

Note: *The TPID indicating the Tag Protocol Identifier of the received traffic flow is reported in the test report.*

- **Statistics**
  - **Frame Count** indicates for each traffic flow, the number of frames matching the selected scan criteria.

    Total indicates the total number of frames matching the selected scan criteria.
  - **Rate (Mbit/s)** indicates for each traffic flow, the rate of frames matching the selected scan criteria. The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** (see *Rate Layer*).

    Total indicates the total rate of frames matching the selected scan criteria.

11 Test Control

This chapter describes the test control buttons available on the right navigation bar of the application.

Button	For more information, see:
Discover Remote	Discover Remote *on page 418*
Inject	Inject Button *on page 423*
Laser	Laser Button *on page 423*
Lpbk Tool	Lpbk Tool Button (Loopback Tool) *on page 424*
Report	Report Button *on page 430*
Reset	Reset Button *on page 435*
Save/Load	Save/Load Button *on page 436*
Start/Stop|TX	Start/Stop|TX Button *on page 440*

More/Less Button

The **More**/**Less** button appears when there is not enough room to display all available test control buttons. The **More** button expands the control buttons area to display all control buttons while the **Less** button closes the expanded area. The pin button can be used to keep open the expanded area.

Discover Remote

The Discover Remote function allows performing Ethernet tests in conjunction with a second test set (unit) by either scanning and connecting to any available EXFO Datacom remote unit or connecting to a third party remote device in loopback mode. The remote unit is used to loop back the traffic; for an EXFO unit it could be via Smart Loopback or **Dual Test Set** (DTS) for simultaneous bidirectional RFC 2544, RFC 6349, or EtherSAM results.

Note: *Only available with single-port* ***EtherSAM****,* ***EtherBERT****,* ***RFC 2544****,* ***RFC 6349****, and* ***Traffic Gen & Mon*** *test applications.*

Remote Module Type

Allows selecting the loopback type for EtherSAM, EtherBERT, RFC 2544, and Traffic Gen & Mon test applications. For other test applications, this setting is forced to **EXFO**.

- **EXFO** (default), see *Remote Modules Discovery (EXFO)*
- **Third-Party Loopback**, see *Remote Modules Discovery (3rd Party Loopback)* on page 421

Remote Modules Discovery (EXFO)

- **Target** defines how to perform the scan to discover remote units.
  - **Subnet** indicates to perform the scan based on the current subnet.
  - **Specific IP** indicates to perform the scan for a specific remote unit IP address. Enter the IP address of the target unit.

    Quick Ping tests if the destination IP address can be reached. A message displays if the ping attempt is **Successful** or **Failed**.
- **Scan** button scans the subnet or a specific IP (see **Target**) to discover remote EXFO compatible unit(s).

The discovered units are listed in the table with their **IP Address**, **Remote ID**, **Capabilities**, and **Status** information. **Remote ID**, **Capabilities**, and **Status** are only available for remote MAX-800 Series, FTB-700G/800 Series, FTB-800v2 Series, and 88000 Series units.

- **Capabilities** indicates the loopback capabilities of the remote unit using the following test application icons[1]: Smart Loopback, RFC 2544, and/or EtherSAM.
- **Status** indicates the status of the remote unit.

Status	Description
Idle-<test application>[a]	The specified test application is selected but not running.
Busy-<test application>[b]	The specified test application is running.
Not Responding	No response from the specified IP address (only possible when **Target** is set to **Specific IP**).

a. Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, Smart Loopback, Through Mode, or Cable Test.
b. Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, or Smart Loopback.

1. A yellow exclamation symbol on the application icon indicates that there is a software incompatibility between the local and remote units. In this case the connection with the remote is not possible, a software upgrade is required on the remote unit to fix the incompatibility.

- **Loop Up** and **Loop Down** buttons (Not available with RFC 6349 test application)
  - **Loop Up** establishes the connection with the selected remote unit and sets the remote unit into **Smart Loopback** test application.

    If a remote unit is in any busy status, a user confirmation is required to proceed with the Loop Up command.

    Following a successful loop up, the IP address of the remote unit will be used as the destination IP address for the test.

    Once the connection is established with the remote unit, the local unit can be set for EtherSAM, RFC 2544, EtherBERT, or Traffic Gen & Mon testing.
  - **Loop Down** ends the connection between the local and the remote units.
- **Connect** and **Disconnect** buttons are only available with RFC 2544, RFC 6349, and EtherSAM test applications.
  - **Connect** establishes the connection with the selected remote unit and sets the remote unit into either RFC 2544 DTS, RFC 6349 DTS / TCP Throughput DTS, or EtherSAM DTS test application, depending on the active test on the local unit.

    If a remote unit is in any busy status, a user confirmation is required to proceed with the Loop Up command.

    If a remote unit is incompatible, indicated by a yellow exclamation symbol on the application icon, the connection is not established and a message is displayed indicating that a software upgrade is required on the remote unit.

    Following a successful connection, the IP address of the remote unit will be used as the destination IP address for the test.
  - **Disconnect** ends the connection between the local and the remote units.

Remote Modules Discovery (3rd Party Loopback)

- **Use Stream Destination from Test Application** check box when selected (default), it uses the stream destination configuration parameters from the test application to communicate with the third-party loopback unit. Only available with single-stream test applications.
- **Loop Layer** allows selecting the layer of loop messages: **L2: Ethernet**, **L3: IP**, or **L4: UDP/TCP**.
- **Destination MAC Address** (L2) allows specifying the stream destination MAC address. Not configurable when the **Use Stream Destination from Test Application** check box is selected.
- **Destination IP Address** (L3/L4), allows specifying the stream destination IP address. Not configurable when the **Use Stream Destination from Test Application** check box is selected.
- **Quick Ping** tests if the destination IP address can be reached. A message displays if the ping attempt is **Successful** or **Failed**.
- **Destination Port** (L4) allows selecting the stream destination UDP port. Not configurable when the **Use Stream Destination from Test Application** check box is selected.
- **Remote Module ID** indicates the unit ID of the remote unit.
- **Remote Status** indicates the status of the remote unit.

➤ **Loop Up** / **Loop Down**

➤ **Loop Up** establishes the connection with the selected remote unit and the loopback mode is set and initiated on the remote unit.

The interface IP address is used as the source address for the test and the stream/service address has to be coupled with the interface (refer to **Couple with Interface** on page 154). For Layer 4, the UDP source port is using the one configured on the first stream/service. For EtherSAM, since the VLAN is not coupled, make sure to use the same VLAN configuration for the interface and all enabled services.

Following a successful loop up, the MAC and IP addresses of the remote unit will be used as the destination addresses for the test.

When the connection is established with the remote unit, the test should be started locally. A message is displayed if the remote unit cannot be reached.

➤ **Loop Down** ends the connection between the local and the remote units.

Local Module Identification

Module ID is used to easily identify this unit in case another unit is performing a discovery scan. Up to 16 alpha-numeric characters are allowed.

Inject Button

Injects alarms/errors based on settings from the *Inject Button* on page 245.

Laser Button

The **Laser** button enables or disables the laser for optical interfaces. For **Dual Port** topology, enables or disables the laser for both optical interfaces (ports). However, when an active copper SFP is used on a port, the laser is always on for this port.

Laser Button	Border Color	Description
	Black	Laser is off.
	Red	Laser is on.

Note: *For SFP+ power level 2, a delay of up to 90 seconds may be required before generating/transmitting (TX) the laser signal as defined in the Specifications for Enhanced Small Form Factor Pluggable Module (SFF-8431).*

Lpbk Tool Button (Loopback Tool)

The Loopback Tool provides the capability of looping back the Ethernet frames/packets that are received on the loopback tool port.

Pressing the **Lpbk Tool** button opens the Loopback Tool pop-up and powers up the port unused by the main test application (it does not start looping back the frames yet). The Loopback Tool starts looping back the Ethernet frames/packets that are received when pressing on the **Loopback** button from the **Loopback Tool** tab.

Note: *The **Lpbk Tool** button is available when the main test application is any single port Ethernet test application (up to 10G rate) with the exception of Through mode.*

Note: *The Loopback Tool is independent from the main test **Start**/**Stop**, **Reset** and **Test Timer**.*

Note: *Enabling/disabling the Laser control affects both the main test application and the Loopback Tool when applicable (if both test and tool are using an optical port).*

Loopback Tool tab

The **Loopback Tool** tab allows the configuration of the loopback parameters and displays the traffic statistics.

Press the **Lpbk Tool** button and select the **Loopback Tool** tab.

- **Status**: The status field displays the current status of the Loopback test.
  - **-- (Idle):** Loopback Tool is not looping back frames and results are not available.
  - **In Progress**: Loopback Tool is looping back frames.
  - **Completed**: Loopback Tool is not looping back frames but results are available. The test **Status** indicates **Completed** when the loopback tool has been stopped.
- **Start Time:** The time when the Loopback Tool was started.
- **Transparent (Pseudo-Physical**) check box when selected (cleared by default), determines that the Loopback tool operates as a physical loopback by transmitting all received frames unaltered and without discrimination.

  In transparent mode, the Network tab is not available.

Note: *The **Transparent** mode is intended to be used for point-to-point topology, not for switched or routed networks. Use the **Transparent** mode with caution because all received frames are looped back without discrimination.*

- **Loopback Mode** determines at which layer the address/port swapping is limited.
  - **Ethernet** swaps the MAC addresses of received packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **Ethernet (All Unicast)** swaps the MAC addresses of received packets having Unicast **Destination MAC** address.

  - **IP**, for Ethernet Layer 3 and 4, swaps the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **UDP/TCP** (default), for Ethernet Layer 4, swaps the UDP or TCP ports and the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 3, swaps the MAC and IP addresses for packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
- **Traffic**
  - **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
  - **Ethernet BW (Mbit/s)** indicates the current transmitting/receiving data rate expressed in Mbit/s.
  - **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including bad frames, Broadcast frames and Multicast frames) in frame per second.
  - **Frame Count** indicates the total number of transmitted/received valid and invalid frames.
- **Loopback** button starts/stops looping back the frames/packets that are received. The default value is disabled.

Interface Tab

Physical Interface

- **Interface/Rate** allows the selection of the loopback tool interface rate: **10/100/1000M Electrical** (default), **100M Optical**, **1GE Optical**, or **10GE LAN**.
- **Connector** displays the unused unit's port (on the same transceiver port type for 890/890Q) for the selected interface/rate. Ethernet 10/100/1000M electrical is supported on optical connector when using an active copper SFP.
- **Clock Mode**: Displays the clock mode
- **Internal**: Internal clock of the unit (STRATUM 3).
- **Recovered**: Line clock from the input port signal involved in the tool.
- **Wavelength (nm)** indicates, when supported, the detected wavelength.
- **RX Power (dBm)** indicates the current received power level of the optical laser in dBm.

  Green: Power level in range.
  Yellow: Power level out-of-range.
  Red: Loss of signal or power level is close to damage.
  Gray: Invalid operational range value or not available/supplied by the transceiver.
- **Power Range (dBm)** indicates, when supported, the received power level range of the optical laser in dBm.
- **RX Frequency (MHz/GHz)** indicates the frequency of the input signal. When no frequency reading is possible, "**--**" is displayed. Not available when using an active copper SFP.

LINK

- **Auto-Negotiation** check box when selected, enables the link auto-negotiation and allows setting the port **Speed**, **Duplex**, **Flow Control**, and **Local Clock** parameters. Those settings are not applied immediately to the port, they are used only when the negotiation process is started and take effect only when the auto-negotiation succeeds. However current settings are applied immediately to the port when the **Auto-Negotiation** check box is cleared. The **Auto-Negotiation** check box is automatically selected for 1GE Electrical interface and is not configurable. Available with **10/100/1000M Electrical** interface.
- **Speed**, available with **10/100/1000M Electrical** interface, allows the selection of the interface rate: **10M**, **100M**, **1GE**, or **Auto**[1]. The negotiated speed will be displayed next to the **Speed** field selection.
- **Duplex** choices for **10M** and **100M** electrical interfaces are **Full Duplex** (default), **Half Duplex**, and **Auto**[1]. For other rates the Duplex is set to **Full Duplex**. The negotiated duplex will be displayed next to the **Duplex** field selection.
- **Flow Control** choices are **TX**, **RX**, **RX and TX**, **None** (default), and **Auto**[1]. When the **Flow Control** is set to **None**, pause frames received are ignored.
- **Cable Mode** is available with **10/100/1000M Electrical** interface.
- **Manual** mode is selected when the **Auto-Negotiation** check box is cleared and allows selecting the type of cable: **MDI** (default) for straight through cable or **MDIX** for crossover cable.

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

- **Automatic** mode is selected when the **Auto-Negotiation** check box is selected and allows detecting automatically the MDI or MDIX cable type.
- **Local Clock** is only available with 1GE electrical interface and allows setting the provenance of the clock: **Master** (default), or **Slave**, or **Auto**[1].

Network tab

Refer to *Network* on page 163 for more information.

SFP/SFP+ tab

Refer to *QSFP/SFP* on page 117 for more information.

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

Report Button

The report contains all information about the current test including its setup and results.

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

The **Report** button is available when the test is running or stopped, but the report generation is only possible when the test is stopped. It is possible to save, open, import, export, and delete test report(s).

File Location

- **Public Documents**:
  Users\Public\Documents\800-MaxTester\Reports
- **My Documents**:
  Users\<User>\Documents\800-MaxTester\Reports
- **Others**, use **Browse** to select a specific file location that will be displayed under **Others**.
- **Removable Drives** is only available when there is a removable disk/key connected to the MAX-800 Series USB port.

Config/Save Tab

The **Config/Save** tab allows configuring the report parameters and generating/saving the report.

Tap the **Report** button and the **Config/Save** tab.

- **Job Information** parameters, not mandatory, are used to identify the source of the report. Enter the following job information if required: **Job ID**, **Contractor Name**, **Customer Name**, **Operator Name**, **Circuit ID**, and **Comment**. Up to 30 characters are allowed for each parameter at the exception of **Comment** for which 256 characters are allowed.

  Restore Default reverts all **Job Information** parameters back to the default values.

- **Report Headlines and Content** parameters are used to identify the report and are not mandatory. Up to 30 characters are allowed for each parameter.

  - **Report Header** could be the company name.
  - **Report Title** could be the name of the product, name of test, test number, etc.
  - **Optional Content** allows choosing the optional content that can be part of the report:

    All (default) includes all optional content to the report.

    None excluded all optional content from the report.

    Custom allows selecting the optional content to be part of the report.

  - **Choose Content**, available when the **Optional Content** is set to **Custom**, allows selecting what will be part of the custom content.

- **Save Report**

  - **Auto-Generate Report** check box, when selected (cleared by default), automatically generates the report once the test ends or is manually stopped. When enabled, the report is also automatically generated when controlling the unit remotely using SCPI commands but the module application (GUI) must be running on the platform in order to work.

➤ **Auto-Generate File Name** check box, when selected (default), automatically generates the report file name which contains the name of the test, the date (YY.MM.DD), and time (HH.MM.SS). Clear the **Auto-Generate File Name** check box to enter a specific file name.

  File Name is the name of the report to be generated.

➤ **Save To** is the file location where the report file will be saved (see *File Location* on page 430).

➤ **Display Report after Saving** check box when selected (default) automatically displays the report once it is generated.

Note: *Once generated, the report can be opened from the* Open Tab *on page 433.*

➤ **Turn on Report Generation Prompt** check box when selected (default) displays a pop-up every time a test case is stopped or completed to ask if a report generation is desired.

➤ **Format** is the file format for the report: **PDF** (default), **HTML** and **JSON** (available with iOptics and EtherBERT).

➤ **Logo** check box when selected (default) allows including a logo to the report. Select the logo picture that will be displayed on the report. Not supported with JSON report format.

  To select another logo, first add a new logo by either copying the logo picture file to the following folder or by using the Import/Export (see page 433) then select the new logo from the list.
  Documents\800-MaxTester\Reports\Images

  Supported picture file formats are jpg, gif, bmp, and png.

- **Save Report** button generates and saves the report on the selected media (**Save to**).

Open Tab

Report files can be opened from this page.

Tap the **Report** button and the **Open** tab.

To open a saved report:

1. Select the file location (see *File Location* on page 430).
2. Select the report file from the list.
3. Tap the **Open** button.

Import/Export Tab

Allows transferring and deleting report files from an external USB media. Also allows importing images that can used as the Logo for reports.

Tap the **Report** button and select the **Import/Export** tab.

To import/export a report or image:

1. Select either **Report** or **Image** as **File Type**.
2. Select the file location (see *File Location* on page 430).
3. From the **Copy To** drop list, select where the file(s) will be copied.
4. Select the file(s) to be copied by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
5. Tap the **Copy** button.
6. A confirmation is displayed, tap **OK**.

To delete a report or image:

1. Select either **Report** or **Image** as **File Type**.
2. Select the file location (see *File Location* on page 430).

3. Select the file(s) to be deleted by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files.
4. Tap the **Delete** button.
5. Tap **YES** to confirm the deletion.

Reset Button

Tap the **Reset** button to clear results, statistics, and logger content. The **Reset** button is only available when the test is running.

Note: *The **Reset** button is not available for EtherSAM, RFC 2544, Cable Test, and Smart Loopback test applications.*

Save/Load Button

The **Save/Load** button allows saving, loading, importing, exporting, and deleting configuration file(s).

Note: *Save/Load is only possible when the test is stopped.*

File location

- **My Documents** offers two file locations: use **Favorites** for most commonly used configuration files or **Configurations** for others.

  Users\<User>\Documents\800-MaxTester\Configuration
  Users\<User>\Documents\800-MaxTester\Configuration\Favorites

- **Public Documents** offers two file locations: use **Favorites** for most commonly used configuration files or **Configurations** for others.

  Users\Public\Documents\800-MaxTester\Configuration
  Users\Public\Documents\800-MaxTester\Configuration\Favorites

- **Others** offers two file locations: use **Factory Defined** for factory defined configuration files or select **Browse** to create a user defined file location.

- **Removable Drives** is only available when there is a removable disk/key connected to the MAX-800 Series USB port.

Save/Load Tab

Tap the **Save/Load** button and the **Save/Load** tab.

The save function stores the configuration of the unit including all test settings to a file.

To save a configuration:

1. Select the file location (see *File location* on page 436).
2. Tap on the **Save** button.
3. Type the name of the configuration file to be saved and a description (**Config Summary**) if needed.
4. Select the **Add to Favorites** check box to save the configuration file in the **Favorites** list.
5. Tap **OK**.

The load function opens and applies the test configuration from a previously saved configuration file.

To load a configuration:

1. Select the file location (see *File location* on page 436).
2. Select the file from the list.
3. Select or clear the **Overwrite report settings** check box as required. The **Overwrite report settings** check box when selected (default) replaces the current report settings by those from the configuration that is loaded.
4. Tap the **Load** button.

Note: *Configuration file has a limited backward compatibility. (Typically the backward compatibility period is one year or three software releases.)*

To rename a configuration file:

1. Select the file location (see *File location* on page 436).
2. Select the file from the list.
3. Tap the **Rename** button.
4. Change the name of the configuration file.
5. Select the **Add to Favorites** check box to save the configuration file in the **Favorites** list.
6. Tap **OK**.

To delete a configuration file:

1. Select the file location (see *File location* on page 436).
2. Select the file from the list.
3. Tap the **Delete** button.
4. Tap **Yes** to confirm the deletion.

To add a configuration file to the Favorites list:

1. Select **Configuration** from either **My Documents** or **Public Documents**.
2. Select the file from the list.
3. Tap the **Add to Favorites** button. The file will be moved into the **Configurations** folder of its corresponding location (either **My Documents** or **Public Documents**).

To remove a configuration file from the Favorites list:

1. Select **Favorites** from either **My Documents** or **Public Documents**.
2. Select the file from the list.
3. Tap the **Remove from Favorites** button. The file will be moved into the **Configurations** folder of its corresponding location (either **My Documents** or **Public Documents**).

Import/Export Tab

Configuration files can be transferred to and from an external USB media as well as deleted.

Tap the **Save/Load** button and the **Import/Export** tab.

To import/export a test configuration:

1. Select the source file location (see *File location* on page 436).
2. From the **Copy To** drop list, select a destination file location.
3. Select the file(s) to be copied by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
4. Tap the **Copy** button.
5. A confirmation is displayed, tap **OK**.

To delete a test configuration:

1. Select the file location (see *File location* on page 436).
2. Select the file(s) to be deleted by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
3. Tap the **Delete** button.
4. Tap **YES** to confirm the deletion.

Start/Stop|TX Button

The **Start/Stop|TX** button allows starting or stopping manually any test as well as enabling traffic generation.

To start the test:

Tap the **Start** button to start the test. **Start** is available when the test is not running.

To stop the test:

Tap the **Stop** button to stop the test; the traffic generation also stops if it was enabled (TX button). **Stop** is available when the test is running.

By default, a message is displayed when the test stops asking to generate a report. To disable this feature, see *Turn on Report Generation* on page 433. Nothing prevents the configuration and alarm/error injection setup while the test has been stopped; thus, if a report is required, it should be saved before changing any test parameters to avoid discrepancy between the configuration and results. See *Report Button* on page 430 to generate and save a report.

To enable traffic generation:

Tap the **TX** button to enable traffic generation; the test is also started if it was not running.

Test Application	Descripton
Traffic Gen & Mon	Enables traffic generation for all enabled streams. Some conditions, such as ARP not resolved, link down, etc., may prevent the stream to be transmitted.

Note: *While the test is running the **TX** button is available to enable/disable traffic generation.*

12 Power Failure Recovery

The automatic power failure recovery is used to select, configure, and restart[1] the test that was running before the power failure; a test that was not running will be selected and configured but not started. To provide this level of protection, the configuration of the current test is automatically saved; the logger, injections, and configuration are periodically saved.

A power failure occurs when the AC power is down while the unit's battery has not sufficient power to keep the unit running. Pressing the MAX-800 Series power button for 5 seconds performs a power down reset and is also considered as a power failure condition. The Windows **Hibernate** or **Sleep** mode is also considered as a power failure condition.

When the power returns, the automatic power failure recovery restarts the MAX-800 Series, the unit application, then selects, configures, and starts the test if it was running before the power failure.

Note: *If the automatic power failure recovery is not used, restarting the unit after a power failure automatically selects, configures, and starts the test if it was running before the power failure.*

1. Not applicable for EtherSAM, RFC 2544, and Cable Test applications; these tests must be started manually.

Enabling Power Failure Recovery

To enable the automatic power failure recovery:

1. Enable launching the application when starting the MAX-800 Series (refer to the MAX-800 Series user guide for more information):

   From Mini ToolBox, tap on the **System Settings** button, the **Startup Applications** button, and select the model's check box.

2. Enable the MAX-800 Series automatic power on feature (refer to the MAX-800 Series user guide for more information):

   2a. From Mini ToolBox, tap on the **System Settings** button, and the **Startup Applications** button.

   2b. Select the **Power on the unit when AC outlet is connected or after power outage** check box.

3. Make sure that Windows does not require a user name and password. The MAX-800 Series is set to require user name and password by default. To disable Windows user name and password:

   3a. From Mini ToolBox, tap on the **System Settings** button and the **Automatic Logon** button.

   3b. Clear the **User must enter a user name and password to use this computer** check box and enter the password to confirm.

Note: *The power failure recovery is not used when the application closes normally.*

When Using the Test Timer

Refer to *Timer* on page 229 for more information on test timer.

The test that was running will be re-created and started after a power failure if conditions described above are met in addition with the following test time conditions:

- The start time has not expired during the power failure.
- The stop time or the duration has not expired during the power failure.

13 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, disconnect from any external power source, remove the batteries and let the unit dry completely.

WARNING

The use of controls, adjustments and procedures, namely for operation and maintenance, other than those specified herein may result in hazardous radiation exposure or impair the protection provided by this unit.

Cleaning LC Connectors

Under normal circumstances the cleaning of the LC connector is not required. However if the connector shows signs of debris or contamination, cleaning may be required.

To clean a LC connector

1. Use a clean dry air (CDA) or a air gun to blow out the dust or contamination.
2. Re-inspect the connector.
3. If the connector is still not clean, use a commercial cleaner recommended by the transceiver manufacturer.

Note: *Refer to the transceiver manufacturer for more detailed cleaning recommendations and instructions.*

Recalibrating the Unit

EXFO manufacturing and service center calibrations are based on the ISO/IEC 17025 standard (*General Requirements for the Competence of Testing and Calibration Laboratories*). This standard states that calibration documents must not contain a calibration interval and that the user is responsible for determining the re-calibration date according to the actual use of the instrument.

The 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, as well as the specific requirements for your application. All of these elements must be taken into consideration when determining the appropriate calibration interval of this particular EXFO unit.

Under normal use, the recommended interval for your unit is: 2 years.

For newly delivered units, EXFO has determined that the storage of this product for up to six months between calibration and shipment does not affect its performance (EXFO Policy PL-03).

To help you with calibration follow-up, EXFO provides a special calibration label that complies with the ISO/IEC 17025 standard and indicates the unit calibration date and provides space to indicate the due date. Unless you have already established a specific calibration interval based on your own empirical data and requirements, EXFO would recommend that the next calibration date be established according to the following equation:

Next calibration date = Date of first usage (if less than six months after the calibration date) + Recommended calibration period (2 years)

To ensure that your unit conforms to the published specifications, calibration may be carried out at an EXFO service center or, depending on the product, at one of EXFO's certified service centers. Calibrations at EXFO are performed using standards traceable to national metrology institutes.

Note: *You may have purchased a FlexCare plan that covers calibrations. See the Service and Repairs section of this user documentation for more information on how to contact the service centers and to see if your plan qualifies.*

Recycling and Disposal

This symbol on the product means that you should 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.

For complete recycling/disposal information, visit the EXFO Web site at www.exfo.com/recycle.

14 Troubleshooting

Solving Common Problems

Before calling EXFO's technical support, please read the following common problems that can occur and their respective solution.

Problem	Possible Cause	Solution
Optical Laser LED is off and the connector is not generating the signal.	The **Laser On** option is disabled.	Ensure that the **Laser** button is enabled (On).
	There is a configuration mismatch between the inserted transceiver and the rate selected for the test case.	Ensure that the transceiver is supporting the rate used for the test case.
	The transceiver is not compatible with the unit.	Ensure to use a compatible transceiver. Refer to *Modify Structure* on page 76 and *Specifications* on page 457.
Unable to connect to a remote module in Dual Test Set with RFC 6349, there is a yellow exclamation symbol on the RFC 6349 application icon.	The local and remote units have incompatible software versions.	Upgrade the remote unit. Note that with the new software version, the **EXFO|Worx Interop** operation mode is no longer supported.

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).

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

For detailed information about technical support, and for a list of other worldwide locations, visit the EXFO Web site at www.exfo.com.

If you have comments or suggestions about this user documentation, you can send them to customer.feedback.manual@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.

15 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.

Gray Market and Gray Market Products

Gray market is a market where products are traded through distribution channels that are legal but remain unofficial, unauthorized, or unintended by the original manufacturer. Intermediaries using such channels to distribute products are considered to be part of the gray market (hereafter unauthorized intermediary).

EXFO considers that a product originates from the gray market (hereafter gray market product) in the following situations:

- A product is sold by an unauthorized intermediary.
- A product is designed and destined for a particular market and sold on a second market.
- A product is resold, despite being reported lost or stolen.

When products are purchased on the gray market, rather than through an authorized EXFO distribution channel, EXFO is unable to guarantee the source and quality of those products nor the local safety regulations and certifications (CE, UL, etc.).

EXFO will not honor warranty, install, maintain, repair, calibrate, provide technical support nor make any support contracts available for gray market products.

For complete information, refer to EXFO's policy regarding gray market products at
www.exfo.com/en/how-to-buy/sales-terms-conditions/gray-market/

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

In the case of products equipped with optical connectors, EXFO will charge a fee for replacing 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 455). 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 455).

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
support@exfo.com

EXFO Europe Service Center
Winchester House, School Lane
Chandlers Ford, Hampshire S053 4DG
ENGLAND

Tel.: +44 2380 246800
Fax: +44 2380 246801
support.europe@exfo.com

EXFO Telecom Equipment (Shenzhen) Ltd.
3rd Floor, Building C,
FuNing Hi-Tech Industrial Park, No. 71-3,
Xintian Avenue,
Fuhai, Bao'An District,
Shenzhen, China, 518103

Tel: +86 (755) 2955 3100
Fax: +86 (755) 2955 3101
support.asia@exfo.com

To view EXFO's network of partner-operated Certified Service Centers nearest you, please consult EXFO's corporate website for the complete list of service partners:
http://www.exfo.com/support/services/instrument-services/exfo-service-centers.

A Specifications

IMPORTANT

The following technical specifications can change without notice. The information presented in this section is provided as a reference only. To obtain this product's most recent technical specifications, visit the EXFO Web site at *www.exfo.com*.

CAUTION

The operation and storage temperatures, as well as the altitude, and humidity of some models may differ from those specified for your MAX-800 Series unit. In this case, always ensure that you comply with the most restrictive conditions (either from this section or in the MAX-800 Series user guide).

General Specifications

Specification	860	860G	880	890	890Q
Temperature	Operating: 0 °C to 50 °C (32 °F to 122 °F)[a] Storing: -40 °C to 70 °C (-40 °F to 158 °F)				
Relative humidity	0 % to 95 %, non-condensing				
Maximum operation altitude	5000 m (16000 ft)				
Pollution degree	3				
Measurement category	Not rated for measurement categories II, III, or IV				

a. When testing 4 x 100GE EtherBERT Layer 2 on MAX-890Q, the maximum operation temperature is 35°C (95°F).

B Glossary

Acronym List

10B_ERR	10B_Error
?	Help

A

AC	Alternating Current
ACH	Associated Channel Header
ACT	Activity
AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
APS	Automatic Protection Switching
ATM	Asynchronous Transfer Mode
AU-n	Administrative Unit-n
AUI	Attachment Unit Interface

B

B8ZS	Bipolar with 8 Zero Substitution
BB	Buffer to Buffer
BBE	Background Block Error
BBER	Background Block Error Ratio
BDI	Backward Defect Indication
BDP	Bandwidth Delay Product
BEI	Backward Error Indication
BER	Bit Error Rate
BERT	Bit Error Rate Test
BIAE	Backward Incoming Alignment Error

BIP	Bit-Interleaved Parity
bit/s	Bit per second
BSD	Backward Signal Degrade
BSF	Backward Signal Fail
BTS	Base Station (Base Transceiver Station)

C

C	Current
C-DCI	Client - Defect Clear Indication
C-FDI	Client - Forward Defect Indication
C-LOS	Client - Loss Of Signal
C-RDI	Client - Remote Defect Indication
C-VLAN	Client/Customer Virtual Local Area Network
C&M	Control & Management
CAUI	100 Gbit/s Attachment Unit Interface
CAGE	Commerce And Government Entities
CBR	Constant Bit Rate
CBS	Committed Burst Size
CC	Continuity Check
CCM	Continuity Check Message
CE	Congestion Encountered
CD	Connectivity Defect
CDF	Client Data Frames
CE	European Conformity
cHEC	core Header Error Check
CID	Channel IDentifier
CIR	Committed Information Rate
CLK	Clock

CMF	Client Management Frames
CORR	Correctable
COS	Class Of Service
CPRI	Common Public Radio Interface
CRC	Cyclic Redundancy Check
CRC-x	Cyclic Redundancy Check on x bits
CRITIC	Critical
CSF	Client Signal Fail
CSV	Comma Separated Value
CV	Code Violation
CW	Code Word

D

DA	Destination MAC Address
DAPI	Destination Access Point Identifier
DAS	Distributed Antenna Systems
dBm	Decibel - milliwatts
DCC	Data Communications Channel
DCI	Defect Clear Indication
DM	Degraded Minutes
DMM	Delay Measurement Message
DMR	Delay Measurement Reply
DS0	Digital Signal-level 0 (64 Kbit/s)
DS1	Digital Signal-level 1 (1.544 Mbit/s)
DS3	Digital Signal-level 3 (44.736 Mbit/s)
DSn	Digital Signal-level n
DST	Destination
DTE	Data Terminal Equipment

DUS	Don’t Use for Synchronization
DUT	Device Under Test

E

E-VLAN	Extended Virtual Local Area Network
E0	European standard for digital transmission-level 0 (64 Kbit/s).
E1	European standard for digital transmission-level 1 (2.048 Mbit/s).
E2	European standard for digital transmission-level 2 (8.448 Mbit/s).
E3	European standard for digital transmission-level 3 (34.368 Mbit/s).
E4	European standard for digital transmission-level 4 (139.264 Mbit/s).
EB	Errored Block
EBS	Excess Burst Size
EC	Error Count
ECN	Explicit Congestion Notification
ECT	ECN Capable Transport
EEC	Ethernet Equipment Clock
EFS	Error Free Second
eHEC	extension Header Error Check
EIR	Excess Information Rate
EoOTN	Ethernet over OTN
ERDI	Enhanced RDI
ES	Errored Second
ESMC	Ethernet Synchronization Message Channel
ESF	Extended Superframe
ESR	Errored Second Ratio
EUI	EXFO Universal Interfaces
EXI	Extension Header Identifier

EXM	Extension Header Mismatch
EXT CLK	External Clock

F

FAS	Frame Alignment Signal
FC	Fibre Channel
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FD	Frame Delay
FDI	Forward Defect Indication
FEC	Forward Error Correction
FLOGI	Fabric Login
FLR	Frame Loss Ratio
fps	Frame Per Second
FSD	Forward Signal Degrade
FSF	Forward Signal Fail

G

GAL	Generic Associated Channel Label
GE	Gigabit Ethernet
Gbit/s	Gigabit per second
GCC	General Communication Channel
GFP	Generic Framing Procedure
GFP-F	GFP - Framed
GFP-T	GFP - Transparent
GHz	Giga Hertz
GM	Grand Master

GMP	Generic Mapping Procedure
GMP OOS	GMP Out of Synchronization
GUA	Global IPv6 Address
GUI	Graphical User Interface

H

H	History
HDB3	High Density Bipolar 3 Code
HDLC	High-level Data Link Control
HDMI	High Definition Multimedia Interface
HDTV	High Definition Television
Hi-BER	High-Bit Error Ratio
Hi-BER1027B	High-Bit Error Ratio 1027 Blocks
HP-	High Order Path -
Hz	Hertz

I

IAE	Incoming Alignment Error
IAIS	Incoming Alarm Indication Signal
ID	Identification
IEC	International Electrotechnical Commission
IEC	Incoming Error Count
IEEE	Institute of Electrical & Electronics Engineers
IFDV	Inter-Frame Delay Variation
IN	Input
IP	Internet Protocol
IPDV	Inter Packet Delay Variation

IPTV	Internet Protocol Television
IPG	Interframe Gap
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IQ Data	In-Phase and Quadrature modulation data (digital baseband signal)
ISDN	Integrated Services Digital Network
ISM	In-Service Monitoring

J

JC	Justification Control

K

KiB	Kibibyte (1024 Bytes)

L

-L	Line
L1	CPRI Layer 1
L2	CPRI Layer 2
LAN	Local Area Network
LBM	Loopback Message
LBR	Loopback Reply
LCD	Loss of Code-Group Delineation
LCK	Locked
LED	Light-Emitting Diode
LER	Label Edge Router
lb	Pound
LBO	Line Build Out

LFD	Loss of Frame Delineation
LLA	Link-Local IPv6 Address
LLC	Logical Link Control
LLM	Logical Lane Marker
LMM	Loss Measurement Message
LMR	Loss Measurement Reply
LOA	Loss Of Alignment
LOAML	Loss of Alignment Marker Lock
LOAML1027B	Loss of Alignment Marker Lock 1027 Blocks
LOBL	Loss of Block Lock
LOBL1027B	Loss of Block Lock 1027 Blocks
LOC	Loss Of Clock
LOC Lane	Loss Of Clock Lane
LOCS CSF	Loss of Client Signal - Client Signal Fail
LOCCS CSF	Loss of Client Character Synchronization - Client Signal Fail
LOF	Loss Of Frame
LOL	Loss of Lane Alignment
LOM	Loss Of Multiframe
LOP	Loss Of Pointer
LOPPS-L	Loss Of Pulse Per Second - Local
LOPPS-R	Loss Of Pulse Per Second - Remote
LOR	Loss Of Recovery
LOS	Loss Of Signal
LSB	Least-Significant Bit
LSP	Label Switch Path
LSR	Label Switching Router
LSS	Loss of Sequence Synchronization
LTC	Loss of Tandem Connection

LTM	Link Trace Message
LTR	Link Trace Reply

M

m	Minute
m	Meter
MA	Maintenance Association
MAC	Media Access Control
MAID	Maintenance Association Identification
Mbit/s	Megabit per second
MD	Maintenance Domain
MDI	Media Dependant Interface (straight through Ethernet cable)
MDIO	Management Data Input/Output
MDIX	Media Dependant Interface Crossover (crossover Ethernet cable)
ME	Maintenance Entity
MEG	ME Group
MEG ID	MEG Identification
MEP	MEG End Point
MFAS	Multiframe Alignment Signal
MHz	Megahertz
MNO	Mobile Network Operator
MIP	MEG Intermediate Point
MPD	Mean Path Delay
MPLS	Multiprotocol Label Switching
MS	Multiplex Section
MSA	Multisource Agreement
MSB	Most-Significant Bit
MSEQV	Marker Sequence Violation

msg/s	Message per second
MTIE	Maximum Time Interval Error
MTU	Maximum Transfer Unit

N

NATO	North Atlantic Treaty Organization
nAUI	CAUI, or XLAUI
NDF	New Data Flag
NE	Network Element
NID	Network Interface Device
NJO	Negative Justification Opportunity
nm	Nanometer

O

OAM	Operation, Administration, and Maintenance
OBSAI	Open Base Station Architecture Initiative
OC-	Optical Carrier-
OCI	Open Connection Indication
ODI	Outgoing Defect Indication
ODU	Optical Data Unit
OEI	Outgoing Error Indication
OH	Overhead
OOF	Out-Of-Frame
OOM	Out-Of-Multiframe
OOR	Out-Of-Recovery
OOS	Generic Mapping Procedure Out Of Synchronization
OOS	Out-Of-Sequence

OOSM	Out-Of-Service Monitoring
OPU	Optical Payload Unit
ORI	Open Radio equipment Interface
OTL	Optical channel Transport Lane
OTN	Optical Transport Network
OTU	Optical Transport Unit
OUI	Organizationally Unique Identifier
OUT	OUTput

P

-P	Path
PC	Personal Computer
PCD	Path Connectivity Defect
PCS	Physical Coding Sublayer
PD	Payload Defect
PD	Powered Device
PDI	Payload Defect Indication
PDU	Protocol Data Unit
PE	Provider Edge
pFCS	payload Frame Check Sequence
PFI	Payload Frame Check Sequence Identifier
PHY	Physical Layer Device
PLI	Payload Length Indicator
PLM	Payload Label Mismatch
PLOGI	Port Login
PM	Performance Monitoring
PNO	Provisionable by the Network Operator
POS	Position Field

POSV	Position Field Violation
PPD	Path Payload Defect
ppm or PPM	parts per million
PRBS	Pseudo Random Bit Sequence
PRS	Primary Reference Source/Clock
PRC	Primary Reference Source/Clock
PSD	Path Server Defect
PSI	Payload Structure Identifier
PTI	Payload Type Identifier
PTP	Precision Time Protocol
Ptr. Incr.	Pointer Increment
Ptr. Decr.	Pointer Decrement
PTSF	Packet Timing Signal Fail
PW	Pseudo-Wire

Q

QL	Quality Level
QoS	Quality of Service
QSFP	Quad Small Form Factor Pluggable

R

R-LOF	Remote - Loss Of Frame
R-LOS	Remote - Loss Of Signal
RAI	Remote Alarm Indication
RDI	Reverse Defect Indication
RDI	Remote Defect Indication
RE	Radio Equipment

REC	Radio Equipment Control
REI	Remote Error Indicator
RES	Reserved
RFI	Remote Failure Indication
RMA	Return Merchandise Authorization
RRH	Remote Radio Head
RS-	Regenerator Section
RTD	Round Trip Delay
RTT	Round Trip Time
RX	Receive

S

s	second
-S	Section
S-OAM	Service - OAM
S-VLAN	Service Virtual Local Area Network
SA	Source MAC Address
SAPI	Source Access Point Identifier
SB	Superblock
SD	Server Defect
SDH	Synchronous Digital Hierarchy
SDI	Service Access Point Defect Indication
SDT	Service Disruption Time
SDTV	Standard Digital Television
SEF	Severely Errored Framing
SEP	Severely Errored Period
SEQV	Sequence Violation
SES	Severely Errored Second

SESR	Severely Errored Second Ratio
SF	Superframe
SFP	Small Form Factor Pluggable
SI	International System
SLA	Service-Level Agreement
SLM	Synthetic Loss Message
SLR	Synthetic Loss Reply
SM	Section Monitoring
SMA	Sub-Miniature A Connector
SMC	SONET Minimum Clock Traceable
SNAP	Sub Network Access Point
SOF	Start Of Frame
SONET	Synchronous Transport Signal
SP	Service Provider
SPE	Synchronous Payload Envelope
SR4	Short Reach (4 Lanes)
SRC	Source
SSM	Synchronization Status Messaging
ST1	Stratum 1 Traceable
ST2	Stratum 2 Traceable
ST3	Stratum 3 Traceable
ST3E	Stratum 3E Traceable
STM	Synchronous Transport Module
STS	Synchronous Transport Signal
STU	Synchronized - Traceability Unknown
SYMB	Symbol
SW	Software

T

TC	Traffic Class
TCM	Tandem Connection Monitoring
TCP	Transport Control Protocol
tHEC	type Header Error Check
THz	Terahertz
TIM	Trace Identifier Mismatch
TLV	Type, Length, and Value
TNC	Transit Node Clock Traceable
TOS	Type Of Service
TST	Test PDU
TTI	Trail Trace Identifier
TTL	Time To Live
TU	Tributary Unit
TUG	Tributary Unit Group
TX	Transmit

U

UAS	Unavailable Second
UE	end-User Equipment
UDP	User Data Protocol
UNCORR	Uncorrectable
UNEQ	Unequipped
UPI	User Payload Identifier
UPM	User Payload Mismatch
μs	microsecond
USA	United States of America
UTP	Unshielded Twisted Pairs

V

V	VT
VC	Virtual Container
VIOL	Violation
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VT	Virtual Tributary
VTG	VT Group

W

WAN	Wide Area Network
WIS	WAN Interface Sublayer
WWN	World Wide Name

X

XLAUI	40 Gbit/s Attachment Unit Interface

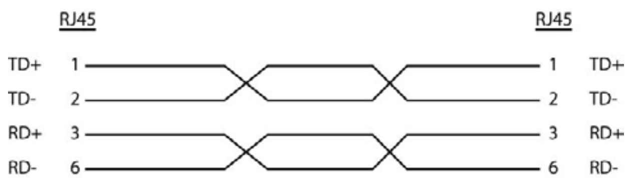
Ethernet Cables

Minimum Category 3 cable is required for 10Base-T connection while Category 5 cable is required for 100Base-TX and 1000Base-T connections.

Maximum cable length (between two nodes) for 10Base-T, 100Base-TX, or 1000Base-T connection is 328 feet (100 meters).

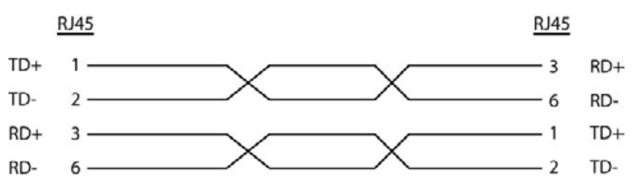
➤ Straight Through Cable (10/100 Mbit/s)

An Unshielded Twisted Pair (UTP) straight through cable is required to connect a 10Base-T/100Base-TX unit port to a layer 1 or 2 device (ex: HUB, switch).

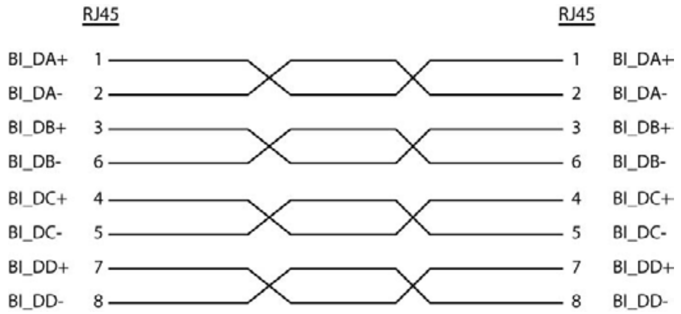


➤ Crossover Cable (10/100 Mbit/s)

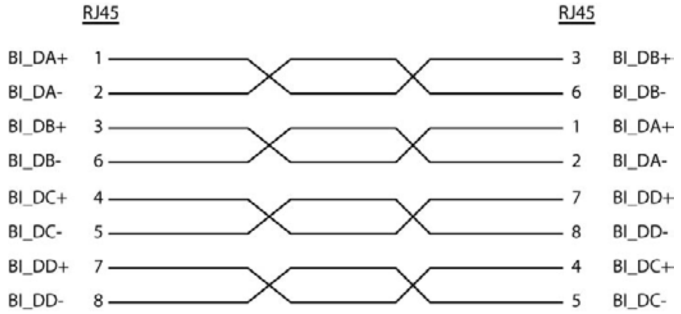
An Unshielded Twisted Pair (UTP) crossover cable is required to connect the 10Base-T/100Base-TX unit port to a layer 3 device (ex: router).



➤ Straight Through Cable (1000 Mbit/s)



➤ Crossover Cable (1000 Mbit/s)



G.709 Optical Transport Network (OTN)

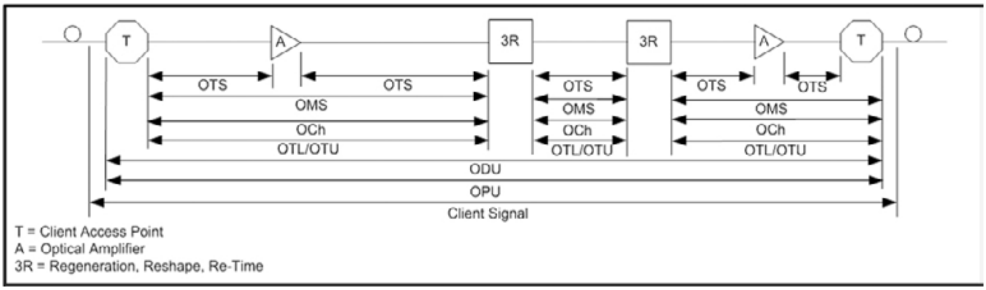
Overview

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 channel Transport Lane (OTL)
- 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 the following line rates:

- OTU1 (255/238 x 2.488 320 Gbit/s ≈ 2.666057143 Gbit/s) also referred to as 2.7 Gbit/s
- OTU2 (255/237 x 9.953280 Gbit/s ≈ 10.709225316 Gbit/s) also referred to as 10.7 Gbit/s
- OTU3 (255/236 x 39.813120 Gbit/s ≈ 43.018413559 Gbit/s) also referred as to 43 Gbit/s
- OTU4 (255/227 x 99. 532 800 Gbit/s ≈ 111.809973568 Gbit/s) also referred to as 112 Gbit/s.

The following non standard rates are also defined:

- OTU1e (255/238 × 10.3125 Gbit/s ≈ 11.0491071429 Gbit/s)
- OTU2e (255/237 × 10.3125 Gbit/s ≈ 11.0957278481 Gbit/s)
- OTU3e1 (255/236 x 4 x 10.3125 Gbit/s ≈ 44.570974576 Gbit/s)
- OTU3e2 (243/217 x 16 x 2.488320 Gbit/s ≈ 44.583355576 Gbit/s)

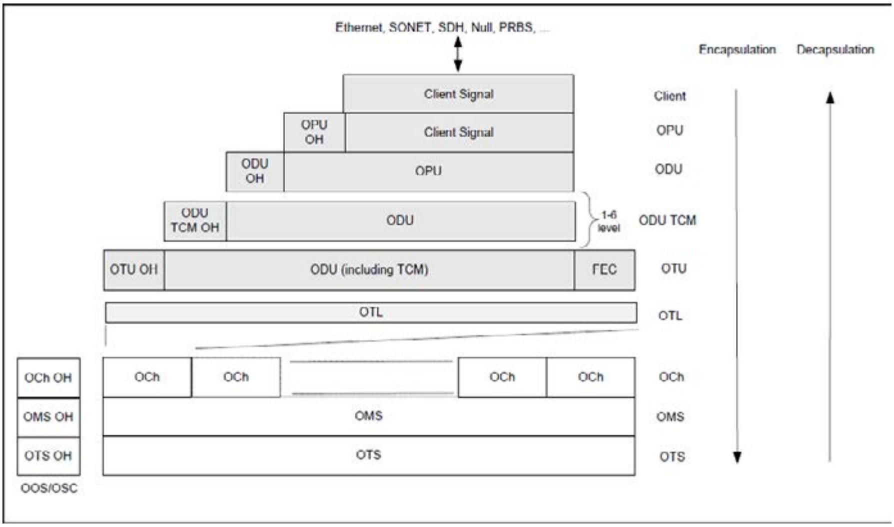
The following non standard rates are not covered by the ITU standard but they are the equivalent function associated to Fiber Channel rates:

- OTU1f (255/238 × 10.51875 Gbit/s ≈ 11.2700892857143 Gbit/s)
- OTU2f (255/237 × 10.51875 Gbit/s ≈ 11.3176424050633 Gbit/s)

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, 1e, 2e, 1f, 2f, 3, 3e1, 3e2, 4)
- PRBS31 is transported via OTUk (k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2, 4)

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 480, 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.

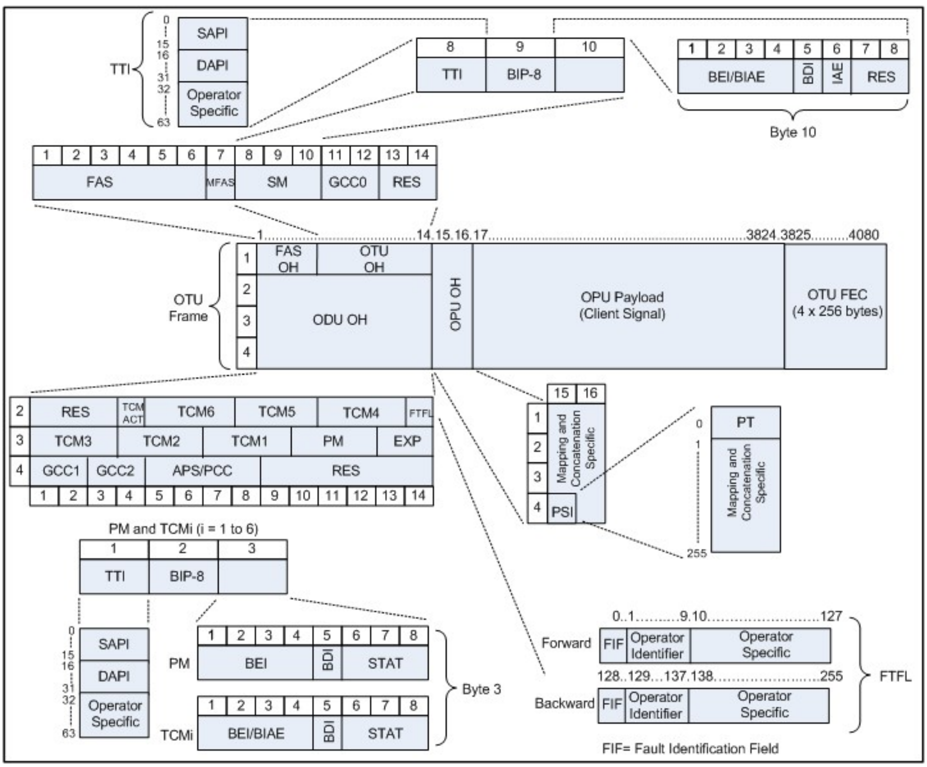
OTU Frame Structure and Overhead

As shown in the figure below, the OTU frame is broken down into the following components:

➤ Framing

➤ OTL, 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 482, and are briefly described below. Further details can be found about these overhead fields in the ITU G.709 standard.

  - Optical channel Transport Lane (OTL)

    The Optical channel Transport Lane (OTL) is an adaptation layer whose purpose is to re-use the modules developed for Ethernet 40GBASE-R and 100GBASE-LR4. These modules have a four-lane WDM interface to and from a transmit/receive pair of G.652 optical fibers, and connect to the host board via a 4-lane (OTL3.4) or 10-lane (OTL4.10) electrical interface.

    The OTL layer is responsible for mapping the serial OTU signal onto a parallel path designated lanes. In the case of OTU4 the signal is distributed over 20 logical lanes and for OTU3 the signal is distributed over 4 logical lanes.

- 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.

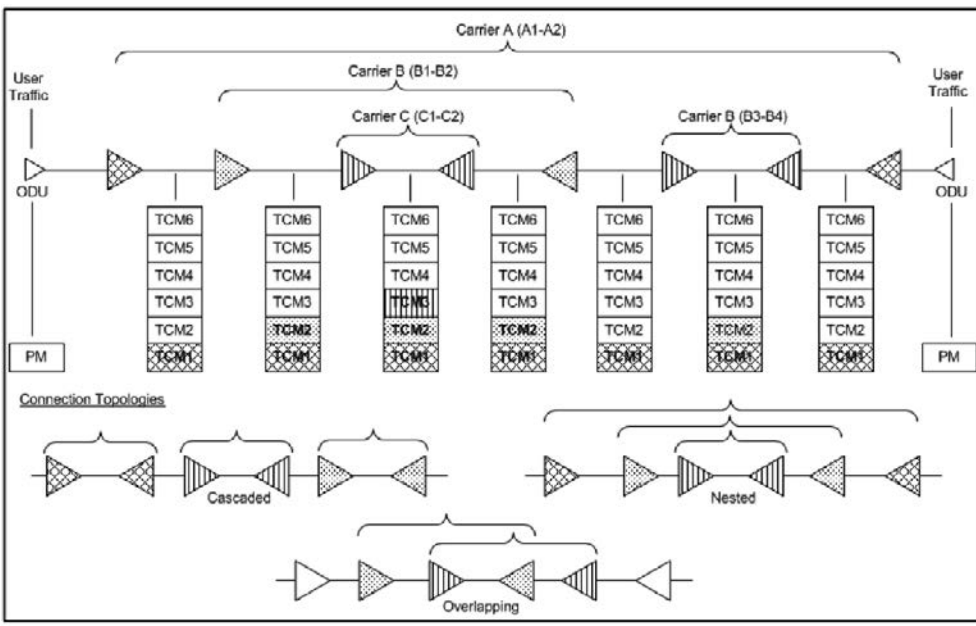
➤ Optical Payload Unit (OPU)

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 487, 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.

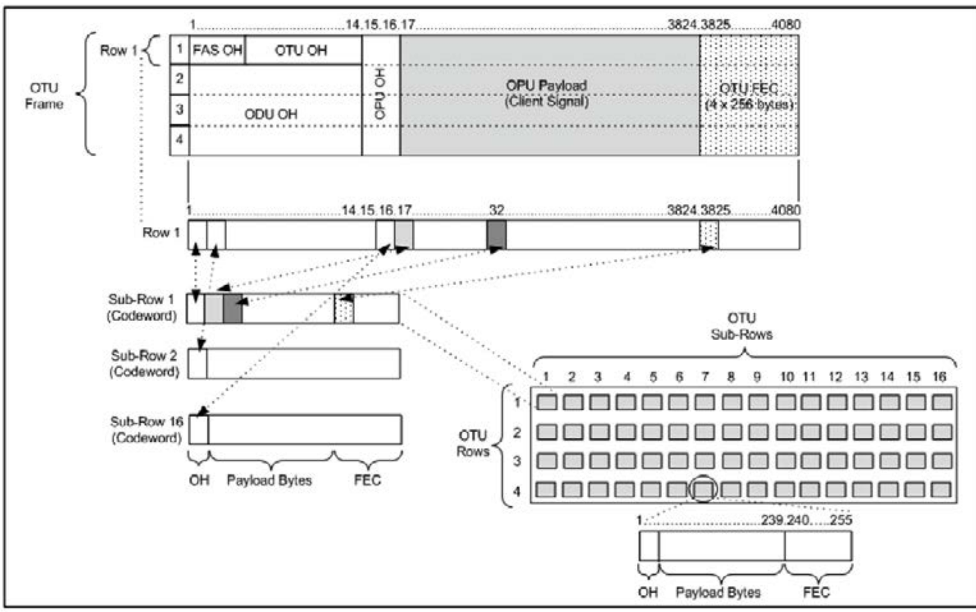
In addition to monitoring maintenance signals, using the STAT field associated with each TCM level, the TCM connection also monitors the BIP-8 and BEI errors for each connection level. Maintenance signals are used to advertise upstream maintenance conditions affecting the traffic and errors provide an 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 489. 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

ODU Multiplexing

The ODU multiplexer is a function that allows the multiplexing of ODU tributary signals into higher OTN signal rates. The G.709 standard supports 2 types of ODU multiplexer which can be classified as follows:

- Legacy architecture is based on multi-stage architecture to bring an ODUk client to a higher OTN interface rate. This multiplexer is identified by Payload Type 20 (PT 20).
- New architecture uses a single stage architecture to bring an ODUk client to any higher OTN interface rate. This method supports the ODUflex client signal. The multiplexer is identified by Payload Type 21 (PT 21).

Note: *Refer to the OTN BERT* on page 35 *for the ODU multiplexing capabilities.*

The multiplexing strategy is based on the concept of tributary slots, which is similar in concept to the SONET timeslot. The multiplexing of 4 ODU1 in one ODU2 is made by distributing the ODU1 structure in a repetitive sequence of 4 ODU2 Tributary slots, a similar strategy is used for ODU3 multiplexing where the repetitive sequence is made of 16 ODU3 tributary slots, refer to G.709 standard for detailed information.

The main attributes of the ODU multiplexer functionality are as follows:

- The Asynchronous Mapping Procedure (AMP) is used for multiplexing the tributary signals; this method uses a modified Justification Control mechanism which has 2 positive Justification Control bytes and one negative Justification Control byte.
- The new multiplex method also supports the Generic Mapping Procedure as the Justification Control mechanism is still using the OPU OH JC bytes.
- The Multiplex Structure Identifier (MSI) provides information that is specific to each type of multiplexer provided.
- Can handle multiplex signals with frequency offset of +/- 20 ppm on every layer for the legacy architecture while the new architecture (using GMP) can handle frequency offset of +/-100 ppm.

ODUflex

ODUflex provides the capability to carry client payload of variable size with a container size of 1.244 Gbit/s granularity. An ODUflex (L) signal can be transported once multiplexed in an ODUk (H) signal, the multiplexer in this case handles tributary slots of 1.244 Gbit/s and has a Payload Type 21. The ODUflex function can be used to transport 2 signal categories mapped in ODTUk.ts using GMP:

- Ethernet in ODUflex over GFP-F signal

  The Ethernet packets are mapped in GFP-F as specified in G.7041, the packets are processed as follows:

  - The Start of Frame Delineation bytes are terminated
  - Inter Frame Gaps bytes are terminated
  - PCS coding is terminated
  - GFP overhead bytes added

  Since the PCS coding is terminated, it is not possible to transport the Ethernet Link status transparently but it is accommodated by the Forward Defect Indication (FDI) and Remote Defect Indication (RDI) alarms over GFP. The RDI is used to carry the Remote Fault alarm while the FDI is used to carry the Local Fault.

  GFP-F provides rate adaptation between the incoming Ethernet signal and the outgoing OPUflex transport signal. This brings the fact that GMP is operated at a fixed Cm value close to the maximum server capacity.

- CBR over ODUflex signal

  ODUflex can transport Constant Bit Rate signal (bulk filled Test pattern) as Client of the ODUflex CBR function. This CBR function needs a Pattern generator that can operate at a data rate specified by the user, the range of the available data rates is qualified by the Bandwidth management function.

OTN Signal Rates

Rate	Signal
2.666057143 Gbit/s	OTU1
10.709225316 Gbit/s	OTU2
11.0491 Gbit/s	OTU1e
11.0957 Gbit/s	OTU2e
11.2701 Gbit/s	OTU1f
11.3176 Gbit/s	OTU2f
43.018413559 Gbit/s	OTU3
111.81	OTU4

MPLS Labels

The MPLS labels are listed in the following table.

Label	Description
0	IPv4 explicit null
1	Router alert
2	IPv6 explicit null
3	Implicit null
14	OAM alert
4 to 13, and 15	Unassigned
16 to 1048575	Label ID

SONET/DSn/SDH/PDH

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 unit.

Software option	Nomenclature
SONET only	International
SDH only	European
SONET and SDH	International

Signal Rates

Rate	SONET/DSn	SDH/PDH	
		International	European
1.544 Mbit/s	DS1	-	1.5M
2.048 Mbit/s	-	E1	2M
8.448 Mbit/s	-	E2	8M
34.368 Mbit/s	-	E3	34M
44.736 Mbit/s	DS3	-	45M
51.84 Mbit/s	STS-1e / OC-1	STM-0e / STM-0	52M
139.264 Mbit/s	-	E4	140M
155.52 Mbit/s	STS-3e / OC-3	STM-1e / STM-1	155M / STM-1
622.08 Mbit/s	OC-12	STM-4	STM-4
2.48832 Gbit/s	OC-48	STM-16	STM-16
9.95328 Gbit/s	OC-192	STM-64	STM-64

SONET/SDH High and Low Order 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-3	-

SONET/SDH Alarms and Errors Nomenclature

Layer	SONET	SDH
Physical	BPV/CV	CV
Section / Regenerator Section	LOF-S	RS-LOF
	SEF	RS-OOF
	TIM-S	RS-TIM
	FAS-S	RS-FAS
	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
	H4-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

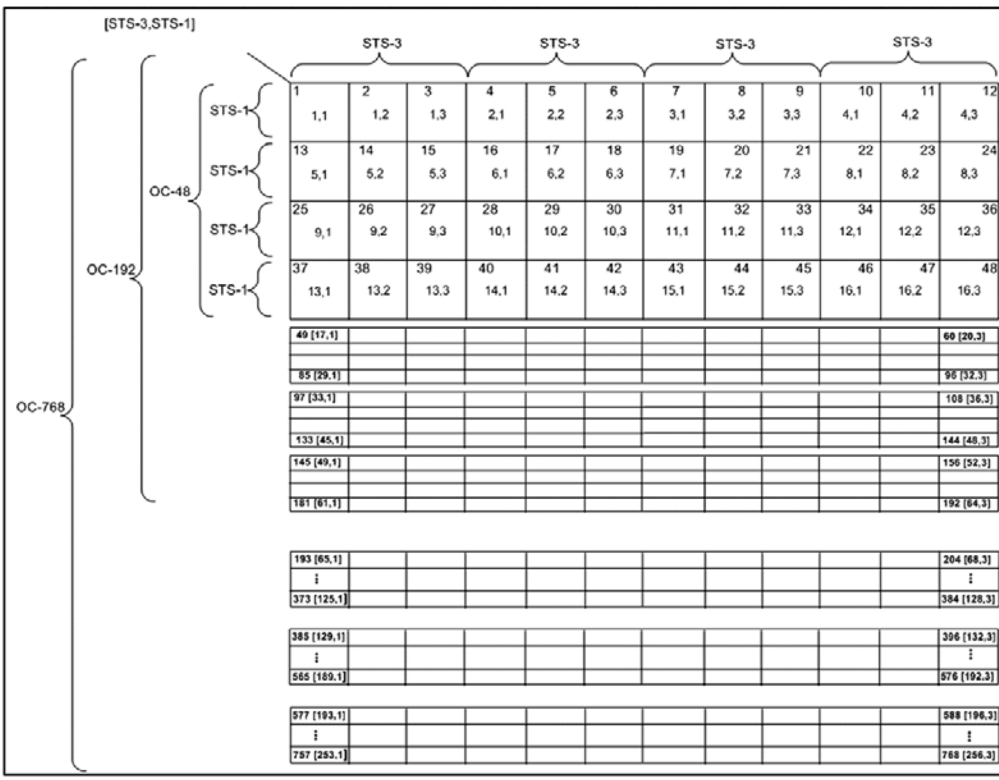
Layer	SONET	SDH
Low Order Path	AIS-V	TU-AIS
	LOP-V	TU-LOP
	RDI-V	LP-RDI
	ERDI-VCD	ERDI-CD
	ERDI-VPD	ERDI-PD
	ERDI-VSD	ERDI-SD
	RFI-V	LP-RFI
	UNEQ-V	LP-UNEQ
	TIM-V	LP-TIM
	PLM-V	LP-PLM
	BIP-2	BIP-2
	REI-V	LP-REI

SONET Numbering Convention

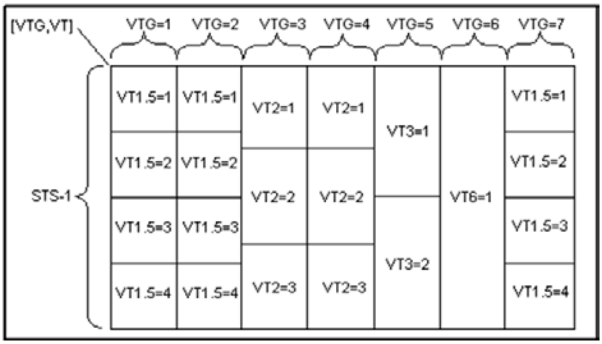
The unit supports the Timeslot (default) and hierarchical two-level numbering conventions as per GR-253.

Hierarchical Notation:

The unit 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 unit 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 unit 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.*

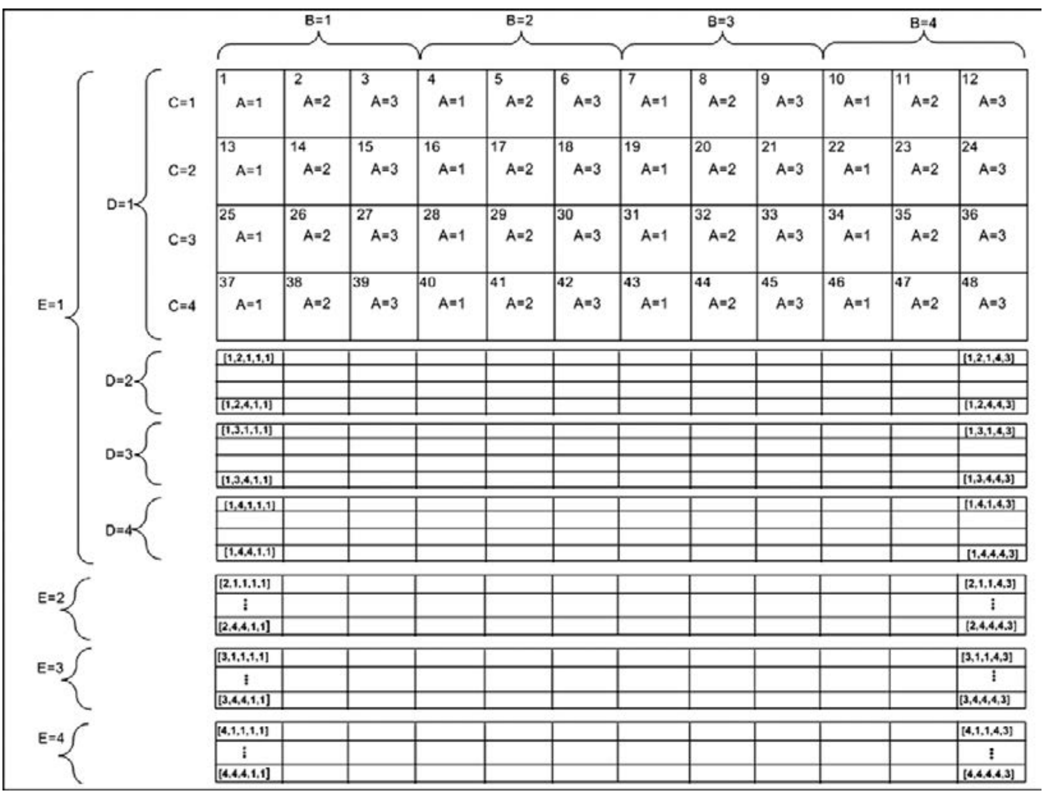
SDH Numbering Convention

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

Naming is as follows for each of the following rates:

- [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

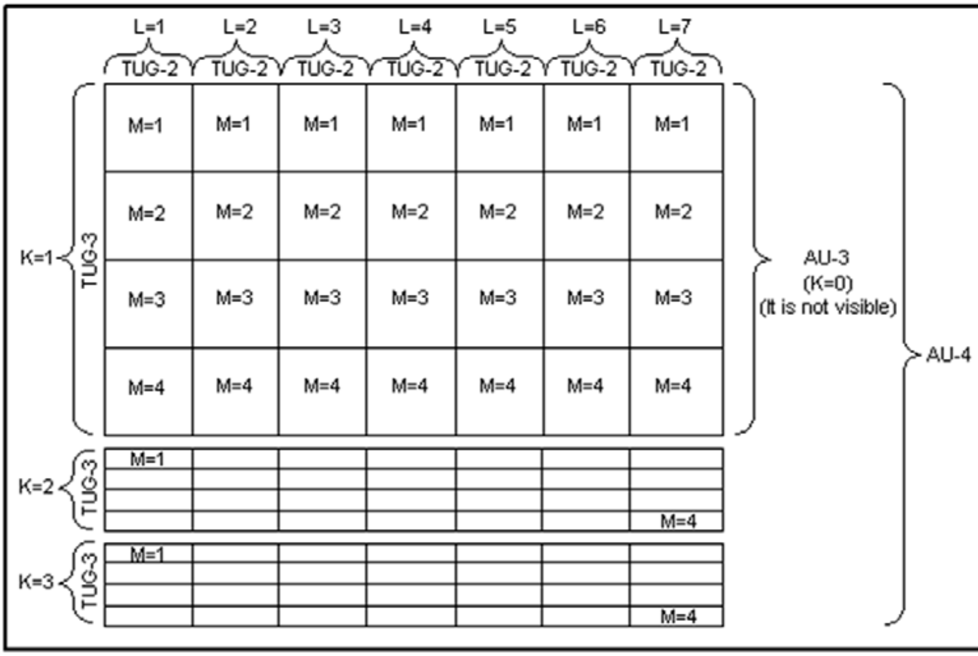
Examples for AU-4 (3 level convention)

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.

Unicast/Multicast Addresses for Ethernet OAM

Unicast or multicast address can be used for most of S-OAM functions.

- ➤ Unicast addresses a unique destination address of the MEP.
- ➤ Multicast Class 1 addresses all MEPs in the MEG. The address value is 01-80-C2-00-00-3x, where x represents the MEG/MD Level.
- ➤ Multicast Class 2 addresses all MIPs and MEPs in the MEG. The address value is 01-80-C2-00-00-3y, where y represents the MEG/MD Level + 8.

The following table specifies which address type is used for each frame type.

Frame Type	Unicast	Multicast		Frame Type	Unicast	Multicast	
		Class 1	Class 2			Class 1	Class 2
CCM	X	X		LMM	X	X	
LBM	X	X		LMR	X		
LBR	X			SLM	X	X	
LTM			X	SLR	X		
LTR	X			AIS	X	X	
TST	X	X		CSF	X	X	
DMM	X	X		LCK	X	X	
DMR	X						

C Alarms/Errors

Note: *For a complete list of alarms/errors per layer and their TX/RX availability see* TX/RX Alarms/Errors per Layer *on page 510.*

Quick Access to Alarms/Errors per Layer

BER

Clock

DS1 | *DS3*

E1 | *E2/E3/E4* |*Ethernet* | *Ethernet - PCS Lanes*

FEC Lanes

Interface | **IP/*UDP/TCP***

MPLS-TP OAM

ODUx | *ODUx-TCM* | *OPUx* | *OTL* | *OTUx*

QoS Metrics

RS-FEC (Ethernet)

S-OAM | *Section/Line / RS/MS* | *STS-x/AU-x*

TCM (SONET/SDH)

VT/TU

WIS

Alarms/Errors Layer per Test Application

The following table lists the alarm/error layers availability per test application and interface/rate.

➤ **Transport**

Test Application	Interface	Alarms/Errors Layer
OTN BERT	All	***BER* | *Clock* | *Ethernet* | *Interface* | *ODUx* | *ODUx-TCM* | *OPUx* | *OTUx***
	OTU3	***OTL***
	OTU4	***OTL***
SONET/SDH BERT	All	***BER* | *Clock* | *Interface* | *Section/Line / RS/MS* | *STS-x/AU-x* | *TCM (SONET/SDH)* | *VT/TU***
DSn/PDH BERT	All	***BER* | *DS1* | *DS3* | *E1* | *E2/E3/E4* | *Interface***
SONET/SDH - DSn/PDH BERT	All	***BER* | *DS1* | *DS3* | *E1* | *E2/E3/E4* | *Interface* | *Section/Line / RS/MS* | *STS-x/AU-x* | *TCM (SONET/SDH)* | *VT/TU***
NI/CSU Emulation	DS1	***Interface* | *DS1* | *DS3***

➤ **Ethernet**

Test Application	Interface	Alarms/Errors Layer
Carrier Ethernet OAM	All	***Clock* | *Ethernet* | *Interface* | *MPLS-TP OAM* | *S-OAM***
	10GE WAN	***WIS***
EtherBERT	All	***BER* | *Clock* | *Ethernet* | *Interface*** | **IP/*UDP/TCP***
	10GE WAN	***WIS***
		RS-FEC (Ethernet)
	100GE	***Ethernet - PCS Lanes* | *FEC Lanes* | *RS-FEC (Ethernet)***
EtherSAM (Y.1564)	All	***Clock* | *Ethernet* | *Interface*** | **IP/*UDP/TCP***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes* | *FEC Lanes* | *RS-FEC (Ethernet)***

Test Application	Interface	Alarms/Errors Layer
RFC 2544	All	***Clock*** | ***Ethernet*** | ***Interface*** | **IP/*UDP*/*TCP***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes*** | ***FEC Lanes*** | ***RS-FEC (Ethernet)***
RFC 6349	All	***Clock*** | ***Ethernet*** | ***Interface*** | **IP/*UDP*/*TCP***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes*** | ***FEC Lanes*** | ***RS-FEC (Ethernet)***
Smart Loopback	All	***Clock*** | ***Ethernet*** | ***Interface*** | **IP/*UDP*/*TCP***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes*** | ***FEC Lanes*** | ***RS-FEC (Ethernet)***
Through Mode	All	***Clock*** | ***Ethernet*** | ***Interface*** | **IP/*UDP*/*TCP***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes*** | ***FEC Lanes*** | ***RS-FEC (Ethernet)***
Traffic Gen & Mon	All	***Clock*** | ***Ethernet*** | ***Interface*** | **IP/*UDP*/*TCP*** | ***QoS Metrics***
	10GE WAN	***WIS***
	100GE	***Ethernet - PCS Lanes***| ***FEC Lanes*** | ***RS-FEC (Ethernet)***

TX/RX Alarms/Errors per Layer

The following table lists the Injection (TX) and Reception (RX) alarms/errors availability per layer.

Layer	Alarms/Errors (A/E)		TX/RX	Comments	Page
BER	A	No Traffic	RX		528
		Pattern Loss	TX/RX		529
	E	Bit Error	TX/RX		538
		Mismatch '0'	RX		542
		Mismatch '1'	RX		542
		Pattern Error	TX/RX		543
Clock	A	LOC	TX[a]		526
		LOPPS-L and LOPPS-R	RX		527
DS1	A	AIS	TX/RX		518
		OOF	TX/RX		529
		RAI	TX/RX		530
	E	CRC-6	TX/RX		539
		Framing Bit	TX/RX		542
DS3	A	AIS	TX/RX		518
		Idle	TX/RX		525
		OOF	TX/RX		529
		RDI	TX/RX		530
	E	CP-Bit	TX/RX		539
		F-Bit	TX/RX		540
		FEBE	TX/RX		540
		P-Bit	TX/RX		543

Layer	Alarms/Errors (A/E)		TX/RX	Comments	Page
E1	**A**	AIS	TX/RX		518
		LOF	TX/RX	Not available with **Unframed**.	526
		LOMF	TX/RX	Not available with **Unframed**.	527
		RAI	TX/RX		530
		RAI MF	TX/RX		530
		TS16 AIS	TX/RX		534
	E	CRC-4	RX		539
		E-Bit	RX		539
		FAS	TX/RX		540
E2/E3/E4	**A**	AIS	TX/RX		518
		LOF	TX/RX	Not available with **Unframed**.	526
		RAI	TX/RX		530
	E	FAS	TX/RX		540
Ethernet	**A**	Hi-BER	RX	25/40/50/100GE and EoOTN 100 GbE client	524
		Link Down	TX/RX		525
		Local Fault Det	RX		526
		Local Fault Rcd	RX		526
		Remote Fault	TX/RX		531
	E	Alignment	RX	10/100 Mbit/s electrical	536
		Block	TX/RX	10G LAN/WAN	538
		Collision	RX	10/100 Mbit/s electrical in **Half Duplex**	539
		Exc. Coll.	RX		539
		False Carrier	RX	100/1000 Mbit/s	540
		FCS	TX/RX		540
		Idle	RX	10/100 Mbit/s electrical in **Half Duplex**	542
		Jabber	RX		542
		Late Coll.	RX	10/100 Mbit/s electrical in **Half Duplex**	542
		Oversize	RX		543
		Runt	RX		544
		Symbol	TX/RX	100/1000 Mbit/s	544
		Undersize	RX		545

Layer		Alarms/Errors (A/E)	TX/RX	Comments	Page
Ethernet - PCS Lanes For Ethernet parallel interfaces (under the PCS sub tab for Through Mode test providing alarms/errors for both ports)	**A**	Exc. Skew	RX	Not available with 100GE (1 Lane)/ 100GE (2 Lanes) interface.	522
		Inv. Mapping	RX	40/100GE	525
		LOA	RX	40/100GE	525
		LOAML	RX		526
		LOBL	RX	40/100GE	526
	E	Block	TX/RX	Ethernet interfaces and 100 GbE over OTU4	539
		Inv. Marker	TX/RX		542
		PCS BIP-8	TX/RX		543
FEC Lanes	**A**	FEC-LOAML	RX		523
	E	Pre-FEC-SYMB	RX		543
Interface	**A**	Frequency	RX		523
		LOC Lane	RX		526
		LOS	TX/RX		528
		BPV	TX/RX	For DS1/DS3/STS-1e	539
		CV	TX/RX	For E1/E3/E4/STM-0e/STM-1e/STS-3e	539
		EXZ	TX/RX	For DS1 and DS3	539
IP/UDP/TCP	**E**	IP Chksum	RX		542
		TCP Chksum	RX		545
		UDP Chksum	RX		545
MPLS-TP OAM	**A**	AIS	TX/RX		518
		C-DCI	TX		520
		C-FDI	TX/RX		520
		C-LOS	TX/RX		520
		C-RDI	TX/RX		521
		LCK	TX/RX		525
		Loss Continuity	RX	Available when **CC Function** is enabled	528
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		RDI	TX/RX		530
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		Unexp MEP	RX		534
		Unexp Period	RX		535

Layer		Alarms/Errors (A/E)	TX/RX	Comments	Page
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		BDI	TX/RX		519
		BSD	TX/RX		520
		BSF	TX/RX		520
		FSD	TX/RX		524
		FSF	TX/RX		524
		LCK	TX/RX		525
		OCI	TX/RX		528
		TIM	RX		533
	E	BEI	TX/RX		537
		BIP-8	TX/RX		538
ODUx-TCM	A	BDI	TX/RX		519
		BIAE	TX/RX		520
		IAE	TX/RX		524
		LTC	TX/RX		528
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		BIP-8	TX/RX		538
OPUx (displayed under ODUx group)	A	AIS	TX/RX		518
		CSF	TX/RX		521
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		LOF	TX/RX		526
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		OOF	TX/RX		529
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	E	FAS	TX/RX		540
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Layer		Alarms/Errors (A/E)	TX/RX	Comments	Page
OTUx	**A**	AIS	TX/RX		518
		BDI	TX/RX		519
		BIAE	TX/RX		520
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		OOF	TX/RX		529
		OOM	TX/RX		529
		TIM	RX		533
	E	BEI	TX/RX		538
		BIP-8	TX/RX		538
		FAS	TX/RX		540
		FEC-CORR	RX	Any of FEC-CORR-BIT, FEC-CORR-CW, or FEC-CORR-SYM error	541
		FEC-CORR-BIT	TX/RX		541
		FEC-CORR-CW	TX/RX		541
		FEC-CORR-SYM	TX/RX		541
		FEC-STRESS	TX		541
		FEC-UNCORR or FEC-UNCORR-CW	TX/RX		542
		MFAS	TX/RX		542
QoS Metrics	**E**	Frame Loss	RX	For Traffic Gen & Mon	523
		Out-of-Seq.	RX		529
RS-FEC (Ethernet)	**A**	FEC-LOA	RX		523
		FEC-LOAML	RX		523
	E	FEC-COR-BITS	RX	For 100GE (1 Lane)	540
		FEC-COR-CW	RX	For 100GE (4 Lanes)	540
		FEC-UNCOR-CW	RX	For 100GE	541

Layer		Alarms/Errors (A/E)	TX/RX	Comments	Page
S-OAM	**A**	AIS	TX/RX	Available with G.8113.1, Y.1731 and MEF modes	518
		C-DCI	TX		520
		C-FDI	TX/RX		520
		C-LOS	TX/RX		520
		C-RDI	TX/RX		521
		LCK	TX/RX		525
		Loss Continuity	RX	Available when **CC Function** is enabled	528
		Mismerge	RX		528
		RDI	TX/RX		530
		Unexp MEG/MD Lvl	RX		534
		Unexp MEP	RX		534
		Unexp Period	RX		535
Section/Line / RS/MS	**A**	AIS-L / MS-AIS	TX/RX		519
		LOF-S / RS-LOF	TX/RX		527
		RDI-L / MS-RDI	TX/RX		531
		SEF / RS-OOF	TX/RX		532
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		B2	TX/RX		536
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		ERDI-PCD / ERDI-CD	TX/RX		521
		ERDI-PPD / ERDI-PD	TX/RX		521
		ERDI-PSD / ERDI-SD	TX/RX		521
		H4-LOM	TX/RX		524
		LOP-P / AU-LOP	TX/RX		527
		PDI-P	TX/RX		529
		PLM-P / HP-PLM	RX		530
		RDI-P / HP-RDI	TX/RX		531
		TIM-P / HP-TIM	RX		533
		UNEQ-P / HP-UNEQ	TX/RX		534
	E	B3	TX/RX		536
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Layer		Alarms/Errors (A/E)	TX/RX	Comments	Page
TCM (SONET/SDH) For rates up to OC-192 / STM-64; STS-x/AU-x or VT/TU tab; TCM must be enabled	**A**	TC-IAIS-P / HPTC-IAIS	TX/RX		532
		TC-IAIS-V / LPTC-IAIS	TX/RX		532
		TC-LTC-P / TC-LTC-V / HPTC-LTC / LPTC-LTC	TX/RX		532
		TC-ODI-P / TC-ODI-V / HPTC-ODI / LPTC-ODI	TX/RX		532
		TC-RDI-P / TC-RDI-V / HPTC-RDI / LPTC-RDI	TX/RX		532
		TC-TIM-P / TC-TIM-V / HPTC-TIM / LPTC-TIM	RX		532
		TC-UNEQ-P / HPTC-UNEQ	TX/RX		532
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	E	TC-IEC-P / HPTC-IEC	TX/RX		544
		TC-OEI-P / TC-OEI-V / HPTC-OEI / LPTC-OEI	TX/RX		544
		TC-REI-P / TC-REI-V / HPTC-REI / LPTC-REI	TX/RX		545
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VT/TU	**A**	AIS-V / TU-AIS	TX/RX		519
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		ERDI-VSD / LP-ERDI-SD	TX/RX		522
		LOP-V / TU-LOP	TX/RX		527
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		UNEQ-V / LP-UNEQ	TX/RX		534
	E	BIP-2	RX		538
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Layer	Alarms/Errors (A/E)		TX/RX	Comments	Page
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		AIS-P	RX		519
		ERDI-PCD	RX		521
		ERDI-PPD	RX		521
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		UNEQ-P	RX		534
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	E	B1	RX		536
		B2	RX		536
		B3	RX		536
		REI-L	RX		543
		REI-P	RX		543

a. TX alarm, no injection.

Alarms

- **AIS** (Alarm Indication Signal) for DS1/E2/E3/E4, indicates that an unframed all-ones signal is received.
- **AIS** (Alarm Indication Signal) for DS3, indicates that 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.
- **AIS** (Alarm Indication Signal) for E1, indicates that two or less ZEROs are received in each of two consecutive double frame periods (512 bits).
- **AIS** (Alarm Indication Signal) for OAM with G.8113.1/Y.1731/MEF mode, indicates that a valid AIS frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 505), VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the AIS transmission period indicated in the last received AIS frame, no AIS frames are received.
- **AIS** (Alarm Indication Signal) for ODU, indicates that the STAT information in the PM byte 3, bits 6 to 8 is “111” for at least 3 consecutive frames. In TX, 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.
- **AIS** (Alarm Indication Signal) for OPU, indicates that a PRBS11 pattern is received causing a failure of the client signal. In TX, generates a PRBS11 pattern.
- **AIS** (Alarm Indication Signal), for OTU serial interfaces, indicates that polynomial number 11 (PN-11) is over all OTU frame bits including FAS and MFAS for at least 3 consecutive 8192 bit-interval. In TX, generates polynomial number 11 (PN-11) over all OTU frame bits including FAS and MFAS continuously.

- **AIS-L** / **MS-AIS** (Alarm Indication Signal) for SONET/SDH, indicates that bits 6, 7 and 8 of the K2 byte contain the “111” pattern in five consecutive frames. In TX, generates a SONET/SDH signal that contains a valid Section Overhead (SOH) / Regenerator Section Overthead (RSOH) and an all-ones pattern on the SPE.
- **AIS-L** (Alarm Indication Signal - Line) for WIS, indicates that bits 6, 7 and 8 of the K2 byte contain the “111" pattern in five consecutive frames.
- **AIS-P** / **AU-AIS** (Alarm Indication Signal) for SONET/SDH, indicates that the H1 and H2 bytes contain an all-ones pattern in three consecutive frames or more. In TX, generates an all-ones pattern over H1, H2, H3, and SPE.
- **AIS-P** (Alarm Indication Signal - Path) for WIS, indicates that the H1 and H2 bytes for a STS path contain an all-ones pattern in three consecutive frames or more.
- **AIS-V** / **TU-AIS** (Alarm Indication Signal) for SONET/SDH, indicates that V1 and V2 bytes for the VT/TU path contain an all-ones pattern in three (SONET) / five (SDH) consecutive superframes. In TX, generates an all-ones pattern for the V1 and V2 bytes of the VT/TU path and payload.
- **BDI** (Backward Defect indication) for ODU, indicates that the BDI bit in the PM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive frames. In TX, generates a “1” in the BDI (byte 3, bit 5) of the PM overhead field continuously.
- **BDI** (Backward Defect Indication) for ODU-TCM, indicates that the BDI bit in the TCM overhead field Byte 3, bit 5 is “1” for at least 5 consecutive frames. In TX, generates a "1" in the BDI bit of the TCM overhead field (byte 3, bit 5) continuously.
- **BDI** (Backward Defect Indication) for OTU, indicates that the BDI bit in the SM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive OTU frames. In TX, generates “1” for the BDI bit in the SM overhead field (byte 3, bit 5) continuously.

- **BIAE** (Backward Incoming Alignment Error) for ODU-TCM, indicates that the BEI/BIAE bits in the TCM overhead field Byte 3, bits 1 to 4 are “1011” for at least 3 consecutive frames. In TX, generates "1011" in the BEI/BIAE bits of the TCM overhead (byte 3, bits 1 to 4) continuously.
- **BIAE** (Backward Incoming Alignment Error) for OTU, indicates that the BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) are “1011” for at least 3 consecutive frames. In TX, generates “1011” for the BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) continuously.
- **BSD** (Backward Signal Degrade) for ODU, indicates that the FTFL byte 128 is “00000010”. In TX, generates a “00000010” pattern in the FTFL Byte 128 continuously.
- **BSF** (Backward Signal Fail) for ODU, indicates that the FTFL byte 128 is “00000001”. In TX, generates a “00000001” pattern in the FTFL Byte 128 continuously.
- **C-DCI** (Client Signal Fail - Defect Clear Indication) for OAM with G.8113.1/Y.1731/MEF mode, generates a CSF frame with CSF type equal to **011**.
- **C-FDI** (Client Signal Fail - Forward Defect Indication) for OAM with G.8113.1/Y.1731/MEF mode, indicates that a CSF frame is received with CSF type equal to **001**.The alarm is cleared when no CSF (C-FDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-FDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).
- **C-LOS** (Client Signal Fail - Loss Of Signal) for OAM with G.8113.1/Y.1731/MEF mode, indicates that a CSF frame is received with CSF type equal to **000**. The alarm is cleared when no CSF (C-LOS) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-LOS) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

- **C-RDI** (Client Signal Fail - Remote Defect Indication) for OAM with G.8113.1/Y.1731/MEF mode, indicates that a CSF frame is received with CSF type equal to **010**. The alarm is cleared when no CSF (C-RDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-RDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).
- **CSF** (Client Signal Fail) for OPU, indicates that Bit 1 of the OPUk PSI[2] byte is set to "1" causing a failure of the client signal mapped into the OPUk of the OTN signal. In TX, sets the bit 1 of the OPUk PSI[2] byte to "1".
- **ERDI-PCD** / **ERDI-CD** (ERDI - Connectivity Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the G1 byte contain the "110" pattern in five consecutive frames. In TX, generates a "110" pattern for bits 5, 6, and 7 of the G1 byte.
- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect) for WIS, indicates that bits 5, 6 and 7 of the G1 byte contain the "110" pattern in five to ten consecutive frames.
- **ERDI-PPD** / **ERDI-PD** (ERDI - Payload Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the G1 byte contain the "010" pattern in five consecutive frames. In TX, generates a "010" pattern for bits 5, 6, and 7 of the G1 byte.
- **ERDI-PPD** (Enhanced RDI - Path Payload Defect) for WIS, indicates that bits 5, 6 and 7 of the G1 byte contain the "010" pattern in five to ten consecutive frames.
- **ERDI-PSD** / **ERDI-SD** (ERDI - Server Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the G1 byte contain the "101" pattern in five consecutive frames. In TX, generates a "101" pattern for bits 5, 6, and 7 of the G1 byte.
- **ERDI-PSD** (Enhanced RDI - Path Server Defect) for WIS, indicates that bits 5, 6 and 7 of the G1 byte contain the "101" pattern in five to ten consecutive frames.

➤ **ERDI-VCD** (Enhanced Remote Defect Indication - Connectivity Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “110” pattern, and bit 8 of the V5 byte contain “1”, in five consecutive VT/LP superframes. In TX, generates a “110” pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and “1” for bit 8 of the V5 byte.

➤ **ERDI-VPD** / **LP-ERDI-PD** (Enhanced Remote Defect Indication - Payload Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “010” pattern, and bit 8 of the V5 byte contain “0”, in five consecutive VT/LP superframes. In TX, generates a “010” pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and “0” for bit 8 of the V5 byte.

➤ **ERDI-VSD** / **LP-ERDI-SD** (ERDI - Server Defect) for SONET/SDH, indicates that bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “101” pattern, and bit 8 of the V5 byte contain “1”, in five consecutive VT/LP superframes. In TX, generates a “101” pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and “1” for bit 8 of the V5 byte.

➤ **Exc. Skew** (Excessive Skew) indicates that the skew exceeds the defined threshold.

Skew Alarm Threshold (bits) for Ethernet test applications, allows setting the threshold value that will be used to declare a skew alarm. Not available at 100G when the RS-FEC check box is selected. **Default** restores the default skew alarm threshold value.

Rate	Range	Default Value
100GE	0 to 2047	928
40GE	0 to 4095	1856

- **FEC-LOA** (FEC-Loss Of Alignment) for Ethernet, indicates that the deskew process is not complete meaning that not all lanes are synchronized (Alignment Marker locked) and aligned. Not available with 100GE (1 Lane)/100GE (2 Lanes) interface.
- **FEC-LOAML** (FEC-Loss Of Alignment Marker Lock) for Ethernet, indicates that the location of the alignment marker payload sequence for a given lane on the PMA service interface is not detected. Not available with 100GE (1 Lane)/100GE (2 Lanes) interface.
- **Frame Loss** for Traffic Gen & Mon, indicates that a sequence number is missing in the received frames.
- **Frequency** indicates that the received signal frequency meets the standard specifications (green) or not (red). Not available when using an active copper SFP.

  For Ethernet **100/1000M Electrical**, **100M Optical**, **1GE Optical**, **10GE LAN/WAN** interface/rate, the frequency range is ± 100 ppm. Not supported for 10M electrical.

  For parallel interfaces (available for each Physical Lane):

Rate	Physical Lane	Frequency
40GE	XLAUI	10.3125 GHz ± 100 ppm
100GE	CAUI-4	25.78125 GHz ± 100 ppm
OTU3	4x10G	10.7546 GHz ± 20 ppm
OTU4	4x25G	27.952 GHz ± 20 ppm

  For serial interfaces:

Interface	Standard Rate Specification
DS1	1544000 ±36.6 ppm
E1	2048000 ±54.6 ppm
E3	34368000 ±24.6 ppm
DS3	44736000 ±24.6 ppm
STS-1e/STM-0e, OC-1/STM-0	51840000 ±20 ppm
E4	139264000 ±19.6 ppm
STS-3e/STM-1e, OC-3/STM-1	155520000 ±20 ppm

Interface	Standard Rate Specification
OC-12/STM-4	622080000 ±20 ppm
OC-48/STM-16	2488320000 ±20 ppm
OTU1	2666057143 ±20 ppm
OC-192/STM-64	9953280000 ±20 ppm
OTU2	10709225316 ±20 ppm
OTU1e	11049107143 ±100 ppm
OTU2e	11095727848 ±100 ppm
OTU1f	11270089286 ±100 ppm
OTU2f	11317642405 ±100 ppm

- **FSD** (Forward Signal Degrade) for ODU, indicates that the FTFL byte 0 is “00000010”. In TX, generates a “00000010” pattern in the FTFL Byte 0 continuously.
- **FSF** (Forward Signal Fail) for ODU, indicates that the FTFL byte 0 is “00000001”. In TX, generates a “00000001” pattern in the FTFL Byte 0 continuously.
- **H4-LOM** (H4 - Loss Of Multiframe) for SONET/SDH - VT/TU structured optical frames, indicates that the system loss track of the H4 byte multiframe indicator sequence. In TX, generates a wrong H4 byte multiframe indicator sequence.
- **Hi-BER** (High-Bit Error Ratio) for Ethernet 40/100GE, indicates that the bit error ratio is > 10^{-4} on a fixed time period; 1250 μs for 40GE, and 500 μs for 100GE.
- **IAE** (Incoming Alignment Error) for ODU-TCM, indicates that the STAT information in the TCM is “010” for at least 3 consecutive frames. In TX, generates "1" in the IAE bit of the TCM overhead (byte 3, bit 6) continuously.
- **IAE** (Incoming Alignment Error) for OTU, indicates that the IAE bit in the SM overhead field (byte 3, bit 6) is “1” for at least 5 consecutive OTU frames. In TX, generates “1” for the IAE bit in the SM overhead field (byte 3, bit 6) continuously.

- **Idle** (DS3 Idle) for DS3, indicates that 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.
- **Inv. Mapping** (Invalid Mapping) for Ethernet 40/100GE, indicates errors in the mapping attributed to either a mapping value appearing more than once or a non valid mapping value (out of range).
- **LCD-P** (Loss of Code-Group Delineation - Path) for WIS, indicates that the signal synchronization has been lost and the valid code-groups are no longer being delineated from the received payload stream being passed to the PCS.
- **LCK** (Locked) for OAM with G.8113.1/Y.1731/MEF mode, indicates that a valid LCK frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 505), VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the LCK transmission period indicated in the last received LCK frame, no LCK frames are received.
- **LCK** (Lock) for ODU, indicates that the STAT information in the PM byte 3, bits 6 to 8 is “101” for at least 3 consecutive frames. In TX, generates a repeating "01010101" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).
- **Link Down** for Ethernet, indicates for 10/40GE that there is a local or a remote fault condition; for 100/1000 Mbit/s that there is no bits/clock sync (PMA/PMD Link down), including LOS; for 10 Mbit/s that no data or no Normal Link Pulse (NLP) are received.
- **LOA** (Loss Of Alignment) for Ethernet parallel interfaces, indicates that two or more logical lanes have the same logical lane marker value, or one or more logical lane marker recovery processes are in the OOR state, or if the differential delay between two logical lanes exceeds the configured alarm threshold compensable delay.

- **LOAML** (Loss of Alignment Marker Lock) for Ethernet, indicates that in lock mode, four consecutive marker values are received that do not match the alignment marker that the lane is currently locked to. The LOAML alarm is cleared when the PCS Lane is declared Lock and two valid alignment markers 16384 blocks (66b) apart are received.
- **LOBL** (Loss of Block Lock) for Ethernet 40/100GE, indicates that in lock mode, 65 invalid sync fields (00 or 11) within a 1024 sync window are received. A PCS Lane Lock alarm is cleared when receiving 64 consecutive valid 66b sync field (01 or 10) in a row.
- **LOC** (Loss Of Clock) indicates that the unit is unable to synchronize with the selected **Clock Mode**. No valid clock is generated/extracted to/from the EXT CLK port.
- **LOC Lane** (Loss Of Clock Lane) for Interface (for each Lane for parallel interfaces), indicates that the unit is unable to lock on the Physical / CAUI-4 / XLAUI link interface.
- **Local Fault Det** (Local Fault Detected) for Ethernet, indicates that at least one of the following events is detected: Loss of bit synchronization, Loss of Block synchronization, WIS Link down, or High BER. Available with 10/40/100 GE.
- **Local Fault Rcd** (Local Fault Received) for Ethernet, indicates that the received data path contains the **Local Fault** signal. Available with Ethernet 10/40/100 GE.
- **LOF** (Loss Of Frame) for E1, indicates that three consecutive incorrect frame alignment signals is received.
- **LOF** (Loss Of Frame) for E2/E3/E4, indicates that four consecutive incorrect frame alignment signals is received.
- **LOF** (Loss of Frame) for OTL, indicates that OOF is present for at least 3 ms.
- **LOF** (Loss of Frame) for OTU, indicates that OOF is present for at least 3 ms. In TX, generates error in all FAS bits continuously.

- **LOF** (Loss Of Frame) for WIS, indicates that a Severely Error Framing (SEF) defect on the incoming SONET signal persists for at least 3 milliseconds.
- **LOF-S** / **RS-LOF** (Loss Of Frame) for SONET/SDH, indicates that an SEF (SONET)/RS-OOF (SDH) defect on the incoming optical signal persists for at least 3 milliseconds. In TX, generates non-valid framing bytes (A1 and A2).
- **LOL** (Loss of Lane Alignment) for OTL, indicates that the multilane alignment process is in the out-of-alignment (OLA) state for 3 ms.
- **LOM** (Loss Of Multiframe) for OTU, indicates that OOM is present for at least 3 ms. In TX, generates error in MFAS bits continuously.
- **LOMF** (Loss Of MultiFrame) for E1, indicates that two consecutive multiframes alignment signals (bits 1 through 4 of TS16 of frame 0) is received with an error.
- **LOP-P** / **AU-LOP** (Loss Of Pointer) for SONET/SDH, 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). In TX, generates a non-valid pointer.
- **LOP-P** (Loss Of Pointer - Path), for WIS with non-concatenated payloads, indicates that a valid pointer is not found in N consecutive frames (where $8 = N = 10$), or N consecutive NDFs ("1001" pattern) are detected.
- **LOP-V** / **TU-LOP** (Loss Of Pointer) for SONET/SDH, 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). In TX, generates a non-valid pointer.
- **LOPPS-L** and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) indicates that either no pulse is received or no pulse is received within 1 second $\pm$ 6.6 μs after the previous pulse. **LOPPS-R** is only monitored once the DTS connection is established. Available in **One-Way Latency** measurement mode for .

- **LOR** (Loss Of Recovery) for OTL, indicates that OOR persists at least 3 ms.
- **LOS** (Loss Of Signal) for Interface (for each Optical Lane for parallel interfaces), indicates absence of an input signal or an all-zeros pattern is received.
- **Loss Continuity** for OAM with **CC Function** enabled, indicates that no CCM frames with same or lower MEG/MD Level were received from the peer MEP within an interval equal to 3.5 times the configured CCM transmission period. The alarm is cleared when at least 3 CCM frames with same or lower MEG/MD Level from the peer MEP are received within an interval equal to 3.5 times the configured CCM transmission period.
- **LTC** (Loss of Tandem Connection) for ODU-TCM, indicates that the STAT information in the TCM Byte 3, bits 6, 7, and 8 are “000” for at least 3 consecutive frames. In TX, generates "000" in the STAT field of TCM overhead (byte 3, bits 6 to 8) continuously.
- **Mismerge** for OAM with **CC Function** enabled, indicates that a CCM frame was received from the peer MEP with same MEG/MD Level but with incorrect MEG ID/MAID value or format. The MAID, composed of a Domain ID and a Short MA Name strings, is incorrect if one or both strings are not as expected. The alarm is cleared when no CCM frames with same MEG/MD Level but with incorrect MEG ID/MAID value or format are received within an interval equal to 3.5 times the configured CCM transmission period.
- **No Traffic** for EtherBERT, indicates that no pattern traffic has been received in the last second. Not available when **Disruption Monitoring** is enabled.
- **OCI** (Open Connection Indication) for ODU, indicates that STAT information in the PM byte 3, bits 6 to 8 is “110” for at least 3 consecutive frames. In TX, generates a repeating "01100110" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).

- **OOF** (Out-OF-Frame) for DS1/DS3, indicates that four consecutive frame bit errors are detected.
- **OOF** (Out-Of-Frame) for OTL, indicates that any byte of the FAS (bytes 3, 4, and 5) is in error for at least 5 consecutive frames.
- **OOF** (Out-Of-Frame) for OTU, indicates that FAS (bytes 3, 4, and 5) are in error for at least 5 consecutive OTU frames. In TX, generates error in all FAS bits for 5 consecutive OTU frames.
- **OOM** (Out-Of-Multiframe) for OTU, indicates that MFAS are in error for at least 5 consecutive OTU frames. In TX, generates error in multiframe number for 5 consecutive OTU frames.
- **OOR** (Out-Of-Recovery) for OTL, indicates that while in In-recovery (IR) state, in five consecutive 16320 byte periods each of the received logical lane marker (LLM) is different from the accepted LLM value.
- **Out-of-Seq.** (Out-of-Sequence) for Traffic Gen & Mon, indicates that the received frame sequence number is either smaller than the expected frame sequence number or is a duplicate number.
- **Pattern Loss** indicates that more than 20 percent of bit errors are received or the reference sequence can be unambiguously identified as out of phase. However, for OTU4 **- 4 Unframed Physical Lanes** and 100GE **- 4 Unframed CAUI-4**, bit error rate is greater than $2.5x10^{-3}$.
- **PDI-P** (Payload Defect Indication) for SONET - VT-structured STS-1 SPE, indicates that there is a 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, the C2 byte contains the hexadecimal FC code. In TX, 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, inserts the hexadecimal FC code in the C2 byte.
- **PLM** (Payload Mismatch) for OPU, indicates that the Payload Structure Identifier (PSI) field does not match the expected PT for at least 3 consecutive frames. Available when OPU-PLM check box is selected.

- **PLM-P** / **HP-PLM** (Payload Label Mismatch) for SONET/SDH, indicates that five consecutive frames have mismatched STS/VC signal labels (C2 byte). Only available when PLM-P/UNEQ-P / HP-PLM/HP-UNEQ is enabled (refer to *Labels* on page 151).
- **PLM-P** (Payload Label Mismatch - Path) for WIS, indicates that five consecutive frames have mismatched STS signal labels.
- **PLM-P/UNEQ-P** (Payload Label Mismatch - Path / Unequipped - Path) check box when selected (cleared by default) enables the Signal Label Mismatch for the expected message defined as well as **UNEQ-P** monitoring.
- **PLM-V** / **LP-PLM** (Payload Label Mismatch) for SONET/SDH, indicates that five consecutive superframes with mismatched VT/LP Signal (bits 5 through 7 of the V5 byte are “000”, “001” or “111”). Only available when the **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box is selected (refer to page *Labels* on page 151).
- **RAI** (Yellow) (Remote Alarm Indication) for DS1 ESF framing, indicates that eight “ones” followed by eight “zeros” pattern is received continuously in the data link (FDL).
- **RAI** (Yellow) (Remote Alarm Indication) for DS1 SF framing, indicates that bit 2 in each timeslot contains “0”.
- **RAI** (Yellow) (Remote Alarm Indication) for E1, indicates that bit 3 in timeslot 0 is set to “1”.
- **RAI** (Remote Alarm Indication) for E2/E3/E4, indicates that bit 11 of a framed E2 is set to “1”.
- **RAI MF** (Remote Alarm Indication Multi-Frame) for E1, indicates that bit 6 of timeslot 16 of frame 0 is set to “1”.
- **RDI** (Remote Defect Indicator) for DS3, indicates that both X-bits of the M-Frame are set to “0”.
- **RDI** (Remote Defect Indication) for OAM with **CC Function** enabled, indicates that the RDI flag bit of a valid CCM frames is set to 1. A valid CCM frame has its source MAC address matching the Peer MEP MAC

address, the destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 505), and VLANs matching the unit port VLANs.

- **RDI-L** / **MS-RDI** (Remote Defect Indication) for SONET/SDH, indicates that bits 6, 7, and 8 of the K2 byte contain the “110” pattern in five consecutive frames. In TX, generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.
- **RDI-L** (Remote Defect Indication - Line) for WIS, indicates that bits 6, 7, and 8 of the K2 byte contain the “110" pattern in five consecutive frames.
- **RDI-P** / **HP-RDI** (Remote Defect Indication) for SONET/SDH, indicates that bits 5, 6, and 7 of the G1 byte contain the “100” or “111” pattern in five consecutive frames. In TX, generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.
- **RDI-P** (Remote Defect Indication - Path) for WIS, indicates that bits 5, 6 and 7 of the G1 byte contain the “100" or “111" pattern in ten consecutive frames.
- **RDI-V** / **LP-RDI** (Remote Defect Indication) for SONET/SDH, indicates that bit 8 of the V5 byte contains “1” in five consecutive VT/TU superframes while bits 6 and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “00” or “11” pattern. In TX, generates “1” for the bit 8 of the V5 byte and a “00” pattern for bits 6 and 7 of the Z7 (SONET) / K4 (SDH) byte.
- **Remote Fault** for Ethernet, indicates that the received data path contains the **Remote Fault** status. Available with Ethernet 10/40/100 GE.
- **RFI-V** / **LP-RFI** (Remote Failure Indication) for SONET/SDH, indicates that bit 4 of the V5 byte contains “1” in five consecutive superframes. In TX, generates “1” for the bit 4 of the V5 byte. Available with VC-11 only. Available with VC-11 only.

- **SEF** / **RS-OOF** (Severely Errored Framing / Out-Of-Frame) for SONET/SDH, indicates that a minimum of four consecutive errored framing patterns are received. In TX, generates four consecutive errored framing patterns.
- **SEF** (Severely Errored Framing) for WIS, indicates a minimum of four consecutive errored framing patterns.
- **TC-IAIS-P** / **HPTC-IAIS** (Incoming Alarm Indication Signal) for SONET/SDH with TCM enabled, indicates that bits 1 through 4 of the N1 byte are set to “1110”.
- **TC-IAIS-V** / **LPTC-IAIS** (Incoming Alarm Indication Signal) for SONET/SDH with TCM enabled, indicates that bit 4 of the Z6/N2 byte is set to “1”.
- **TC-LTC-P / TC-LTC-V** / **HPTC-LTC / LPTC-LTC** (Loss of Tandem Connection) for SONET/SDH with TCM enabled, indicates that a wrong FAS multiframe is received/generated.
- **TC-ODI-P / TC-ODI-V** / **HPTC-ODI / LPTC-ODI** (Outgoing Defect Indication) for SONET/SDH with TCM enabled: For SONET indicates that bit 7 of the N1/Z6 byte frame 74 is set to “1”; for SDH indicates that bit 7 of the N1/N2 byte multiframe 74 is set to “1”.
- **TC-RDI-P / TC-RDI-V** / **HPTC-RDI / LPTC-RDI** (Remote Defect Indication) for SONET/SDH with TCM enabled: For SOENT indicates that bit 8 of the N1/Z6 byte frame 73 is set to “1”; for SDH indicates that bit 8 of the N1/N2 byte multiframe 73 is set to “1”.
- **TC-TIM-P** / **TC-TIM-V** / **HPTC-TIM / LPTC-TIM** (Trace Identifier Mismatch) for SONET/SDH with TCM enabled, indicates that 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-P** / **HPTC-UNEQ (**Unequipped) for SONET/SDH with TCM enabled, indicates that an all “0”s pattern is received/generated 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).

- **TC-UNEQ-V** / **LPTC-UNEQ** (Unequipped / LPTC - Unequipped) for SONET/SDH with TCM enabled, indicates that an all “0”s pattern is received/generated 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).
- **TIM** (Trace Identification Mismatch) for ODU, indicates that the received SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the **SAPI ODU-TIM** and/or **DAPI ODU-TIM** check boxes are selected from *PT* on page 142.
- **TIM** (Trace Identification Mismatch) for ODU-TCM, indicates that the SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the **SAPI TCM-TIM** and/or **DAPI TCM-TIM** check boxes are selected from *PT* on page 142.
- **TIM** (Trace Identifier Mismatch) for OTU, indicates that the 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 **SAPI OTU-TIM** and/or **DAPI OTU-TIM** check boxes are selected.
- **TIM-P** / **HP-TIM** (Trace Identifier Mismatch) for SONET/SDH, indicates that J1 Trace doesn’t match the expected message value. Only available when TIM-P/HP-TIM is enabled (refer to *Traces - SONET/SDH* on page 234).
- **TIM-S** / **RS-TIM** (Trace Identifier Mismatch) for SONET/SDH, indicates that the received J0 Trace doesn’t match the expected message value. Only available when Enable TIM-S/RS-TIM check box is selected (refer to *Traces - SONET/SDH* on page 234).
- **TIM-V** / **LP-TIM** (Trace Identifier Mismatch) for SONET/SDH: For SONET indicates that the J2 Trace doesn’t match the expected message value; for SDH indicates that tone of the sampled LP trace strings match the expected message value. Only available when the **TIM-V/LP-TIM** check box is selected (refer to page *Traces - SONET/SDH* on page 234).

- **TS16 AIS** (TimeSlot 16 Alarm Indication Signal) for E1, indicates that three or less ZEROs are received in each Timeslot 16 of two consecutive multiframes.
- **UNEQ-P** / **HP-UNEQ** (Unequipped) for SONET/SDH, indicates that the C2 byte contains “00 H” in five consecutive frames. Only available when PLM-P/UNEQ-P / HP-PLM/HP-UNEQ is enabled (refer to *Labels* on page 151). In TX, generates an all-zeros pattern over POH and SPE.
- **UNEQ-P** (Unequipped - Path) for WIS, indicates that the C2 byte contains “00 H" in five consecutive frames.
- **UNEQ-V** / **LP-UNEQ** (Unequipped) for SONET/SDH, indicates that bit 5 through 7 of the V5 byte contain “000” for five consecutive superframes. Only available when the **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box is selected (refer to page *Labels* on page 151). In TX, generates samples of unequipped VT/LP signal label (bits 5 through 7 of V5 byte are set to “000”).
- **Unexp MEG/MD Lvl** (Unexpected MEG/MD Level) for OAM with **CC Function** enabled, indicates that a CCM frame was received from the peer MEP with lower MEG/MD Level. The alarm is cleared when no CCM frames with lower MEG/MD Level are received within an interval equal to 3.5 times the configured CCM transmission period.
- **Unexp MEP** (Unexpected MEP) for OAM with **CC Function** enabled, indicates that a CCM frame was received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct source MAC Address (corresponds to the peer MEP) but with unexpected MEP ID. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, correct source MAC Address (corresponds to the peer MEP) but with an unexpected MEP ID are received within an interval equal to 3.5 times the configured CCM transmission period.

- **Unexp Period** (Unexpected Period) for OAM with **CC Function** enabled, indicates that a CCM frame is received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with a period field value different than the one configured. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with incorrect period field value are received within an interval equal to 3.5 times the configured CCM transmission period.
- **WIS Link Down** for WIS, indicates that at least one of the following errors is present: AIS-P, LOF, PLM-P, SEF, LOP, or AIS-L.

Errors

- **Alignment** for Ethernet 10/100 Mbit/s interface, indicates that frames without an integral number of octets in length are received.
- **B1** (BIP-8, Bit-Interleave Parity - 8 bits) for SONET/SDH, indicates a Section (SONET) / Regeneration Section (SDH) parity error by performing a routine even-parity check over all frames of the previous STS-n/STM-n signal (located in the first STS-1/STM-1 of an STS-n/STM-n signal).
- **B1** (BIP-8, Bit-Interleave Parity - 8 bits) for WIS, indicates a Section parity error by performing a routine even-parity check over all Section bits of the previous frame of a composite signal (located in the first STS-1 of an STS-n signal).
- **B2** (BIP-8, Bit-Interleave Parity - 8 bits) for SONET/SDH: For SONET 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). For SDH 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.
- **B2** (BIP-1536, Bit-Interleave Parity - 1536 bits) for WIS, indicates a Line parity error by performing a routine even-parity check over all Line bits of the LOH and STS-1 frame capacity of the previous frame of a composite signal (located in every STS-1 of an STS-n signal).
- **B3** (BIP-8, Bit-Interleave Parity - 8 bits) for SONET/SDH, indicates a high order path parity error by performing an even-parity check over all bits of the previous SPE (SONET) / VC-N (SDH).
- **B3** (BIP-8, Bit-Interleave Parity - 8 bits) for WIS, indicates a Path parity error by performing a routine even-parity check over all Path bits of the previous SPE excluding the LOH and SOH.

➤ **BEI** (Backward Error Indication) for ODU, indicates that there is 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

➤ **BEI** (Backward Error Indication) for ODU-TCM, indicates that there is interleaved block in error detected by the corresponding ODU tandem connection monitoring sink using the BIP-8 code.

ODU TCM 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

- **BEI** (Backward Error Indication) for OTU, indicates that there is a SM BIP-8 mismatch between the received value and locally computed 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

- **BIP-2** (Bit-Interleave Parity - 2 bits) for SONET/SDH: For SONET, 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); for SDH, indicates a Low Order Path parity error by performing a routine even-parity check over all bytes of the previous VC frame.
- **BIP-8** (Bit Interleave Parity-8) for ODU, indicates that there is a PM BIP-8 mismatch between the received value and locally computed value (0 to 8).
- **BIP-8** (Bit Interleave Parity-8) for ODU-TCM, indicates that there is a TCM BIP-8 mismatch between the received value and locally computed value (0 to 8).
- **BIP-8** (Bit Interleave Parity-8) for OTU, indicates that SM BEI errors are received from the DUT (value 0 to 8).
- **Bit Error** indicates that there are logic errors in the bit stream (i.e., zeros that should be ones and vice versa).
- **Block** for Ethernet 10G LAN/WAN interface, indicates that error block is received in frames.

- **Block** for parallel Ethernet interfaces, indicates that invalid 64b/66b block code are received. An invalid 64b/66b block is declared when the synchronization field has a value of 00 or 11. Injection is not available at 100GE when RS-FEC is enabled.
- **BPV (**Bipolar Violation) for Interface DS1/DS3/STS-1e, indicates that pulses of the same consecutive polarity were detected, in violation with the bipolar signal format. Available with DS1, DS3, and STS-1e.
- **Collision** for Ethernet 10/100 Mbit/s electrical interface in **Half Duplex** mode, indicates the number of collisions on the link.
- **CP-Bit** (Control-Bit) for DS3, indicates that the three C-bits reserved to control bit stuffing are different of "111" and "000".
- **CRC-4** (Cyclical Redundancy Check) for E1, indicates that one or more bit errors are detected in a block of data through cyclical redundancy check.
- **CRC-6** (Cyclical Redundancy Check) for DS1 ESF framing, indicates that one or more bit errors have been detected in a block of data through cyclical redundancy check.
- **CV** (Code Violation) for E1/E3/E4/STM-0e/STM-1e/STS-3e, indicates that pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.
- **E-Bit** (CRC-4 Error Signal) for DS1 **PCM30 CRC-4** or **PCM31 CRC-4** framing, indicates that bit 1 of sub-multiframe (SMF) II in frame 13 and/or 15 is set to 0 indicating a sub-multiframe error.
- **Exc. Coll.** for Ethernet 10/100 Mbit/s electrical interface in **Half Duplex** mode, indicates the number of frames that were sent 16 times unsuccessfully due to consecutive collisions.
- **EXZ** (Excessive Zeros) for **DS1** with **AMI Line Coding**, indicates that more than 15 consecutive bit periods with no pulses have been received.

- **EXZ** (Excessive Zeros) for **DS1** with **B8ZS Line Coding**, indicates that more than 7 consecutive bit periods with no pulses have been received.
- **EXZ** (Excessive Zeros) for **DS3**, indicates that more than 2 consecutive bit periods with no pulses have been received.
- **F-Bit** (Framing-Bit) for DS3, indicates that the frame alignment pattern received is different of “1001”.
- **False Carrier** for Ethernet 100/1000 Mbit/s interface, indicates that data is being received with invalid start of frame.
- **FAS** (Frame Alignment Signal) for E1 **PCM30 CRC-4** or **PCM31 CRC-4** framing, indicates that bits 2 to 8 of the frame containing the FAS differ from 0011011.
- **FAS** (Frame Alignment Signal) for E2/E3/E4, indicates that bits 1 to 10 of the first frame differ from 1111010000.
- **FAS** (Frame Alignment Signal) for OTL, indicates that FAS bits are in error.
- **FAS** (Frame Alignment Signal) for OTU, indicates that the FAS bits are in error.
- **FAS-S** / **RS-FAS** (Frame Alignment Signal) for SONET/SDH, indicates that at least one A1 or A2 byte of the FAS word is in error.
- **FCS** (Frame Check Sequence) for Ethernet, indicates that frames with an invalid FCS are received.
- **FEBE** (Far-End Block Error) for DS3, indicates that the three FEBE bits reserved for framing or parity error detection contain the “000” pattern.
- **FEC-COR-BITS** (FEC Correctable Bits) for Ethernet 100GE (1 Lane), indicates that FEC Bits containing errors were corrected.
- **FEC-COR-CW** (FEC Correctable Codeword) for Ethernet, indicates that FEC Codeword containing errors were corrected.

- **FEC-CORR-BIT** (FEC Correctable Bit) for OTN, indicates FEC Bit containing errors that were corrected.
- **FEC-CORR-BIT** (FEC - Correctable - Bit) for OTU, indicates that statistics on bits (BIT) are corrected by the FEC. In TX, generates 1 symbol (byte) containing 1 bit in error.
- **FEC-CORR-CW** (FEC Correctable Codeword) for OTN, indicates FEC Codeword containing errors that were corrected.
- **FEC-CORR-CW** (FEC - Correctable - Codeword) for OTU, indicates that statistics on codewords (CW) are corrected by the FEC. In TX, generates 8 symbols (bytes) containing 8 bits in error each, in each codeword.
- **FEC-CORR-SYM** (FEC Correctable Symbol) for OTN, indicates FEC Symbol containing errors that were corrected.
- **FEC-CORR-SYM** (FEC - Correctable - Symbol) for OTU, indicates that statistics on symbols (SYMB) are corrected by the FEC. In TX, generates 1 symbol (byte) containing 8 bits in error.
- **FEC-STRESS** (Forward Error Correction - Stress) for OTU, 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.
- **FEC-SYMB** (FEC Symbol) for Ethernet 100GE (4 Lanes), indicates that FEC symbol errors are corrected and counted once for each 10-bit symbol.
- **FEC-UNCOR-CW** (FEC Uncorrectable Codeword) for Ethernet, indicates that FEC Codeword containing errors and were not corrected.
- **FEC-UNCORR-CW** (FEC Uncorrectable Codeword) for OTN, indicates FEC Codeword containing errors that were not corrected.

- **FEC-UNCORR-CW** (FEC - Uncorrectable - Codeword) for OTU, indicates statistics on the detected codewords (CW) having uncorrectable errors. In TX, generates 16 symbol (bytes) containing 8 bits in error each, in each codeword.
- **Framing Bit** for DS1, indicates that an incorrect value appeared in a bit position reserved for framing.
- **Idle** for Ethernet 100/1000 Mbit/s interface, indicates that an error is detected between the end of a frame and the beginning of the next frame.
- **Inv. Marker** (Invalid Marker) for parallel Ethernet interfaces, indicates that there are errors in the 66-bit block alignment marker. Injection is not available when RS-FEC is enabled.
- **Inv. Marker** (Invalid Marker) for OTL, indicates that errors are detected in the 66-bit block alignment marker.
- **IP Chksum** (IP Checksum) indicates that received IP datagrams have invalid IP header checksum. Only available for IPv4.
- **Jabber** for Ethernet, indicates that frames larger than 1518 bytes with an invalid FCS are received (add 4 bytes for each VLAN layer enabled).
- **Late Coll.** for Ethernet 10/100 Mbit/s electrical interface in **Half Duplex** mode, indicates the number of collisions that have occurred after a 64 bytes transmission.
- **MFAS** (Multiframe Alignment Signal) for OTU, indicates that the MFAS bits are in error.
- **Mismatch ’0’** indicates that there is a bit error on a binary ‘0’ (for example ones that should be zeros) found in the test pattern only. Available with EtherBERT
- **Mismatch ’1’** indicates that there is a bit error on a binary ‘1’ (for example zeros that should be ones) found in the test pattern only. Available with EtherBERT

- **Oversize** for Ethernet, indicates frames larger than: 1518 bytes with a valid FCS (add 4 bytes for each VLAN layer enabled). Available when the **Oversize Monitoring** check box is selected.

  Oversize Monitoring check box when selected (cleared by default) allows monitoring the **Oversize** frame errors.

- **P-Bit** (Parity-Bit) for DS3, 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.

- **Pattern Error**, available with **Seed A** or **Seed B** pattern, indicates a block mismatch.

- **PCS BIP-8** for Ethernet, indicates that there are PCS lane bit-interleave parity errors. A routine even-parity check is performed over all bits of a PCS lane, from and including the previous alignment marker, but not including the current alignment marker.

- **Pre-FEC-SYMB** (Pre-FEC Symbol) for Ethernet, indicates that FEC symbol errors are corrected and counted once for each 10-bit symbol.

- **REI-L** / **MS-REI** (Remote Error Indicator) for SONET/SDH, indicates that the M0, M1, or the combination of both M0 and M1 bytes indicate that one or more BIP violations have been detected. Refer to **M0** ***or M1/Z2 (SONET)*** **on page 374** for more information. For OC-192, also refer to *REI-L Computation Method* on page 213.

- **REI-L** (Remote Error Indicator - Line) for WIS, indicates that bits 5 through 8 of the M0 byte contain one pattern from the following binary range: “0001" through “1000" (1 to 8) (located in the first STS-1 of an STS-n signal).

- **REI-P** (Remote Error Indicator - Path) for WIS, indicates that 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).

- **REI-P** / **HP-REI** (Remote Error Indicator) for SONET/SDH, indicates that 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/STM-1 of an STS-n/STM-n signal.
- **REI-V** / **LP-REI** (Remote Error Indicator) for SONET/SDH, is declared when bit 3 of the V5 byte is set to “1”.
- **Runt** for Ethernet, indicates frames smaller than 64 bytes with an invalid FCS.
- **Symbol** for Ethernet 100/1000 Mbit/s interface, indicates that an invalid code-group is detected in the code.
- **TC-IEC-P** / **HPTC-IEC** (Incoming Error Count) for SONET/SDH with TCM enabled, 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).

Number of BIP-8 violations	Bit				Number of BIP-8 violations	Bit			
	1	2	3	4		1	2	3	4
0	0	0	0	0	8	1	0	0	0
1	0	0	0	1	0	1	0	0	1
2	0	0	1	0	0	1	0	1	0
3	0	0	1	1	0	1	0	1	1
4	0	1	0	0	0	1	1	0	0
5	0	1	0	1	0	1	1	0	1
6	0	1	1	0	0 (IAIS)	1	1	1	0
7	0	1	1	1	0	1	1	1	1

- **TC-OEI-P / TC-OEI-V** / **HPTC-OEI / LPTC-OEI** (Outgoing Error Indication) for SONET/SDH with TCM enabled, indicates errored blocks of the outgoing VTn/VC-n (bit 6 of the N1 or Z6/N2 byte). In TX, bit 6 of the N1 or Z6/N2 byte is set to 1.

- **TC-REI-P / TC-REI-V** / **HPTC-REI / LPTC-REI** (Remote Error Indication) for SONET/SDH with TCM enabled, indicates errored blocks caused within the Tandem Connection (bit 5 of the N1 or Z6/N2 byte). In TX, bit 5 of N1 or Z6/N2 byte is set to 1.
- **TC-VIOL-P** / **HPTC-VIOL** (Violations) for SONET/SDH with TCM enabled, indicates the number of B3 parity violation within the tandem connection for STS-1 SPE/VC-3 and above.
- **TC-VIOL-V** / **LPTC-VIOL** (Violations) for SONET/SDH with TCM enabled, indicates the number of violation within the tandem connection for VT6 SPE/VC-2 and below.
- **TCP Chksum** (TCP Checksum) indicates that received TCP segments have invalid TCP checksum.
- **UDP Chksum** (UDP Checksum) indicates that received UDP segments have invalid UDP checksum.
- **Undersize** for Ethernet, indicates frames smaller than 64 bytes with a valid FCS.

D Pop-Up

Bulk Read

Bulk Read button reads and displays the data based on the specified MDIO range (I2C Start Address to I2C End Address).

Save to CSV button allows saving the read I2C's addresses and data to a CSV file.

Note: *The bulk read size is limited to 1024 addresses.*

Bulk Write

Bulk Write allows configuring and writing I2C data values for up to 20 addresses.

➤ **Page Select** allows selecting the I2C address page: **0x00** (default) to **0xFF**.

➤ **Address** and **Data** allows defining up to 20 I2C addresses and their data values: 0x00 (default) to 0xFF.

➤ **Bulk Write** button writes the I2C data values for each I2C address defined.

➤ **Default** button resets the I2C page select, addresses, and data values to their default values.

Config TCM

Config TCM allows enabling each TCM level (1 to 6) individually. All ODUx of a mapped signal are also available. All TCM check boxes are cleared by default (disabled). Refer to *Traces - OTN* on page 231 for more information.

Configure Per Frame Size

Config. per Frame Size is available when the **Copy From Throughput** check box is cleared and allows setting the **Max. Rate** for each frame size. For **Dual Test Set** the **Max. Rate** is configurable for both local (**L**) and remote (**R**) directions. For **Dual Port** topology, **Max. Rate** is configurable for both port directions.

All Frames check box when selected (cleared by default) allows entering the maximum rate that will be applied to all frame sizes.

Copy Service

- **Copy Service** allow selecting the services number from which the configuration will be copied from.
- **To the following Services** allows selecting all services that will inherit the configuration from the selected service. An orange background represents a selected service. A service that is already enabled cannot be selected for copy.
- **Copy** allows confirming the service configuration copy for all selected services.

Copy Stream

Select the stream number the configuration will be copied from.

From **To the following Streams**, select all streams that will inherit the configuration from the selected stream. An orange background represents a selected stream. A stream that is already enabled (Enable TX) cannot be selected for copy.

Tap **Copy** to confirm the stream configuration for all selected streams.

DS1 Loopback

The Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

➤ **Loop Code** allows selecting the type of loopback that will be used to overwrite the traffic that will be generated. Choices are listed in the following table in addition with 10 predefined Loop Codes (see **Modify Loop Codes** on page 550).

Loopback Type	Command	
	Loop-Up	Loop-Down
CSU (10000/100)	10000 (default)	100
NIU FAC1 (1100/1110)	1100	1110
NIU FAC2 (11000/11100)	11000	11100
NIU FAC3 (100000/100)	100000	100

➤ **Loop-Up** injects the selected loop up 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. The text box next to the **Loop-Up** button indicates the selected loop up code.

- **Loop-Down** injects the selected loop down 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. The text box next to the **Loop-Down** button indicates the selected loop down code.
- **Modify Loop Codes** allows the configuration of 10 DS1 loop code pairs. Configure each loop code **Name**, **Loop-Up** and **Loop-Down** values. The name field allows up to 16 characters. **Loop-Up** and **Loop-Down** range is from 3 to 16 bits (**000** to **1111111111111111**). The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up=**10000**, and Loop-Down=**100**).

EMIX

- **Quantity** allows selecting 2 to 8 frame size values.
- **EMIX Frame Sizes** allows setting the EMIX frame sizes: 48[1] to 16000[2].

  The following table lists each component, when supported by the test application, that may affect the minimum frame size value.

Component	Description
VLAN	4 bytes per VLAN
MPLS	4 bytes per label (up to two labels)
LLC and SNAP Headers	8 bytes
UDP	8 bytes
TCP	20 bytes
Ethernet Header	14 bytes
IPv4	20 bytes
IPv6	40 bytes
Latency	8 bytes
Using DTS	4 bytes

- **Restore Default** button reverts the quantity and EMIX frame sizes to their default values.

1. The minimum value is adjusted according to the frame structure and components selected as shown in the following table. The minimum of 48 bytes is only available for rates up to 10GE, for higher rates the minimum frame size is 64 bytes. For EtherSAM the minimum frame size is 64 bytes.

2. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

Export Capture

Export, available when the test application is stopped, allows exporting the data captured into a .pcap file format and viewing the file using Wireshark.

- **Save In** allows selecting the folder to save the capture file (by default: Users\<User>\Documents\800-MaxTester\CaptureData).
- **View File After Generation** check box when selected (cleared by default) allows displaying the report once it is generated using the Wireshark application.
- **Generate & Save** allows generating and saving the capture data. The name of the captured file is automatically selected and contains the date and time of the capture. Capture file bigger than 100Mbytes will be split into multiple files. Tapping on the **Cancel** button stops the capture generation. The captured data already processed will be saved.

Note: *The export process may take several minutes.*

Once generated, the capture file will be automatically opened in Wireshark when the **View File After Generation** check box is selected. The capture file report may also be manually opened within Wireshark typically using Windows Explorer.

Filter Configuration

- "**(**" and "**)**", the open and close parenthesis controls the precedence of operands when more than two operands are used. Only one level of parenthesis is supported. When no parenthesis are used, a logical AND has precedence over a logical OR.
- **Not** check box when selected, adds the logical negation (not equal) operator for the operand filter defined at its right.
- **Filter** specifies the filter to be used (**None** by default).

Category	Filter
Ethernet	MAC Destination Address, MAC Source Address, EtherType[a], C-VLAN ID, S-VLAN ID, E-VLAN ID, C-VLAN Priority, S-VLAN Priority, E-VLAN Priority, Frame Format
IPv4	IPv4 Destination Address, IPv4 Source Address, IPv4 TOS, IPv4 Precedence, IPv4 Protocol, IPv4 DiffServ
IPv6	IPv6 Destination Address, IPv6 Source Address, IPv6 Flow Label, IPv6 Next Header[b], IPv6 Traffic Class, IPv6 Precedence, IPv6 DiffServ
Higher Layer	TCP Destination Port[c], TCP Source Port, UDP Destination Port, UDP Source Port
MPLS[d]	MPLS Label 1, MPLS Label 2, MPLS COS 1, MPLS COS 2

a. Applies only to the last EtherType occurrence when VLAN is used.
b. Applies only to the last next header occurrence when extension headers are used.
c. Available with 10M to 10G interface rates only.
d. Available when the corresponding software option is enabled.

- **Value** is the value associated to the selected filter.

- **Mask** allows masking the defined filter value. A bit mask of 1 indicates that the corresponding bit in the value is compared for the match. A bit mask of 0 indicates that the corresponding bit in the value is ignored.

  For binary values, enter the mask value in binary format.
  For decimal and MAC address values, enter the mask value in hexadecimal format.
  For IP address field, enter the mask in decimal format.

- **Oper.** specifies the logical operator (AND or OR) used between two operands.

IPv6 Address Configuration

IP

- **Link-Local IPv6 Address** (LLA) is used for local communication between on-link neighbors and for Neighbor Discovery process.

  - **Mode**

    Stateless Auto (default) allows automatic generation of the IPv6 address based on the MAC address.

    Static allows entering the IP Address.

  - **Address**, available with **Static** mode, allows selecting the Link-Local IPv6 Address. The accepted range is from **FE80:0000:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF.** The default address is **FE80::[Interface ID]**, where [**Interface ID**] is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing the selection of a previously configured IP address.

- **Global IPv6 Address** (GUA) is used to communicate with on-link neighbors and for global communication with hosts outside the subnet.

  - **Mode**

    None disables the **Global IPv6 Address** and **Default Gateway**.

    Stateless Auto (default) allows automatic generation of the IPv6 address based on the Link-Local address interface ID and the prefix obtained from the router advertisements. If no Interface ID has been obtained for the **Link-Local IPv6 Address**, the global address will not be generated.

    Static allows entering the IP address.

- **Address**, available with **Static** mode, allows selecting the **Global IPv6 Address**. The accepted range is from **0000:0000:0000:0000::[Interface ID]** to **FFFF:FFFF:FFFF:FFFF::[Interface ID]**. The default address is **2001:0000:0000:0000::[Interface ID]**, where [**Interface ID**] is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing the selection of a previously configured IP address.

- **Interface ID Coupled**, available when the **Source Global IPv6 Address** mode is **Static**, allows coupling the interface ID of the Global address to the Link-Local source address.

  Enabled (default): Only the 64 bit (MSB) prefix ID in the IPv6 address is configurable, and the 64 bit (LSB) Interface ID is not configurable (read-only).

  Disabled: The 64 bit (MSB) Prefix ID and 64 bit (LSB) Interface ID in the IPv6 address are configurable.

- **Prefix Mask**, available with **Static** mode, allows specifying a prefix that defines the subnet. The accepted range is **0000:0000:0000:0000:0000:0000:0000:0000** to **FFFF:FFFF:FFFF:FFFF:0000:0000:0000:0000**.

  For example:
  Global IPv6 Address: 2001:0DB8:0001:0002:02AA:00FF:FE11:1111
  Prefix Mask: FFFF:FFFF:FFFF:0000:0000:0000:0000:0000
  Corresponding Prefix: 2001:0DB8:0001.

- **Default Gateway** allows the configuration of the default gateway address to forward packets outside the subnet.
  - **Mode**

    Automatic (default) allows automatic selection of the default gateway.

    Static allows entering the default gateway IP address.
  - **Address**, available with **Static** mode, allows entering the IP address of the Default Gateway. The accepted range is from **0000:0000:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80:0000:0000:0000:0000:0000:0000:0000**.

Laser ON/OFF

Laser ON/OFF button, available with parallel interfaces, is used to activate the laser control per optical lane or for all lanes. Select the **Laser** check box to enable/disable the laser for each lane individually or select the **All Lanes** check box to enable/disable all optical lanes at once.

Manual Skew (PCS/Logical Lane)

- **All Lanes**, when selected, applies the change(s) to all PCS/Logical Lane at once.
- **Skew Inc/Dec Size (bits)** allows setting the increment/decrement value that will be used when changing the TX Skew (bits) values using the "+" and "-" buttons. Range is from **0** to **2047** for 100G/OTU4 and **0** to **4095** for 40G/OTU3.
- **PCS/Logical Lane** indicates the PCS/Logical Lane numbers and **All** which represents the value for all PCS/Logical Lane when the **All Lanes** check box is selected.
- **Skew (bits)** allows setting the skew value for each lane. Enter directly the skew value in the field or use the "+" and "-" buttons to respectively increment or decrement the skew value using the defined **Skew Inc/Dec Size** value. Tapping and holding the "+" or "-" button allows reaching the desired value faster using the defined **Skew Inc/Dec Size** value. Range is from **0** to **2047** for 100G/OTU4 and **0** to **4095** for 40G/OTU3.

Default/Random/Manual Mapping

Allows changing the lane mapping that will be used for the test.

- **Default Mapping** sets the TX mapping to the default numerical order value which corresponds to the ascending lane order.
- **Random Mapping** sets the TX mapping in a random order. Each time the button is tapped, random alignment markers are assigned to each lane.
- **Manual Mapping** allows setting the TX mapping manually.
  - **Lane Marker** and **Assigned Status**:

    The **Lane Marker** buttons allow assigning the corresponding lane marker to the selected PCS/Logical or CAUI/XLAUI/Physical Lane mapping (the one pointed by the arrow). Lane marker buttons are numbered from **0** to **19** for OTU4/100G, and **0** to **3** for OTU3/40G.

    The **Assigned Status** column displays a check mark when the lane marker is assigned.
  - **PCS/Logical Lane** and **CAUI/XLAUI/Physical Lane** columns indicate the target PCS/Logical to CAUI/XLAUI/Physical mapping.
  - **Clear All** clears the lane assignments.
  - **OK** accepts the new lane mapping. The **OK** button is only available when all target PCS/Logical Lane fields are assigned including duplicates.

Note: *A lane marker can be assigned more than once. If this is the case, a red background is used to highlight all occurrences of this lane marker.*

Modify DS0/E0

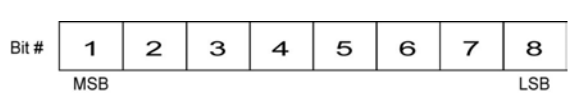
Note: *For DS0, the framing structure has 24 timeslots. For E0, the framing structures PCM-30 and PCM30 CRC-4 have 30 channel timeslots (1 to 15 and 17 to 31) while PCM-31 and PCM-31 CRC-4 have 31 channel timeslots (1 to 31).*

- **DS0/E0 Size** sets the channel timeslot data rate for the pattern payload content to either **56K** or **64K** (default); forced to respectively **56K** for DS0 and **64K** for E0 when **TX Signaling** is enabled. A timeslot data rate of 56 Kbit/s uses 7 bits while 64 Kbit/s 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:

ZCS	Description	Availability
None[a]	No Zero Code Suppression	DS0 and E0
Jammed Bit 8	Every 8th (LSB) bit is forced to **1**.	DS0 and E0
GTE	Bit 8 of an all zero channel byte is replaced by **1**, except in signaling frames where bit 7 is forced to **1**.	DS0
Bell	Bit 7 of an all zero channel byte is replaced by **1**.	DS0

a. Default value.

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



- **Payload Content** allows the selection of the payload content that will be applied to all TX timeslots when tapping the **Set All** button: **Pattern**, **Idle**, or **Tone**.

  Set All applies the selected payload content to all TX timeslots.

- **TX**

  - **Pattern/Idle/Tone** button: Tap once or several times on each timeslot until the desired payload content appears: **Pattern** (default), **Idle**, or **Tone**. For E0, timeslots 0 and 16 (PCM30 and PCM30 CRC4) are not configurable; timeslot 0 generates the FAS/NFAS framing; timeslot 16 generates a static MFAS frame when TX Signaling is disabled and generates a frame with Signaling capability when TX Signaling is enabled.

    Pattern: The pattern used is the one selected from *Pattern* on page 109.

  - **Tone (Hz)** 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** (default). The selected tone applies to all timeslots set to **Tone**.

  - **Idle** uses the Idle code byte from the Idle field: **00** to **FF** (default is **7F**). The selected Idle code applies to all timeslots set to Idle.

    Binary check box allows either displaying the **Idle** code value in binary (when selected) or in hexadecimal (default).

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

- **RX**
  - **Apply Channel TX to RX**, available for decoupled test, allows applying the RX payload content based on the TX settings. **None** will be used when TX is set to either **Idle** or **Tone**. For E0 the timeslots 0 and 16 (PCM30 and PCM30 CRC4) are not configurable. Timeslot 0 processes the FAS/NFAS while timeslot 16 processes the Signaling frame.

Note: *The RX timeslot selection is only configurable in a **Decoupled** topology when the **Apply Channel TX to RX** check box is cleared. A warning is displayed when the number of Pattern timeslot does not match between TX and RX. This is to ensure pattern continuity between the TX and RX interface in a MUX/DEMUX test even if used through a cross-connect device.*

  - **Pattern**/**None** button: Select the payload content by tapping once or several times on each timeslot until the desired content appears: **Pattern** or **None**.

    Pattern (default) uses the pattern from the received signal.

    None does not use the pattern.

Modify Frame Structure

Allows modifying the structure of the frame.

Global Options

- **S-OAM** check box when selected, available with EtherSAM for rates up to 10G WAN, enables EtherSAM over service OAM at Layer 2 on all services. The EtherSAM uses LBM and LBR messages of the S-OAM protocol to perform the test. A device having the capability to loopback LBM messages (via LBR) is required at the remote. Not available in Dual Test Set and Dual Port topology. Only supported on 890/890Q unit.
- **Layer Mode** sets the frame layer mode for all services (available with EtherSAM when the **S-OAM** check box is cleared):

  Mixed (default) allows configuring the frame layer per service: L2, L3, or L4.

  L2 Only configures all services to Layer 2 only (no IP, no MPLS).
- **IP Version** allows selecting **IPv4** (default) or **IPv6**. For EtherSAM and Traffic Gen & Mon, the IP version applies to both the interface and all streams/services.

Framing

Note: *The framing for EtherSAM in a NAT environment is limited to Ethernet II, IPv4, and UDP.*

- **Frame Format** (layer 2) allows selecting **Ethernet II** (default) or **802.3 SNAP** as the frame format.
- **Network Layer** (layer 3) sets the network traffic type: **IPv4**/**IPv6** (default), or **None**. Not available with EtherSAM when the **Layer Mode** is set to **L2 Only**.Not configurable and set to **None** for: 40GE/100GE dual port topology.

➤ **Transport Layer** allows the selection of the transport layer; disabled when the **Network Layer** is set to **None**. Not available with EtherSAM when the **Layer Mode** is set to **L2 Only**.Not configurable and set to **None** for: 40GE/100GE dual port topology.

Test Application	Transport Layer
EtherSAM	**None**, **UDP** (default), **TCP**[a]
RFC 2544	**UDP**
EtherBERT	**UDP** (default), **TCP**[a]
Traffic Gen & Mon	**None, UDP** (default), **TCP**[a]

a. Only available for 10M to 10G.

VLAN

VLAN Tag check box when selected (cleared by default) enables up to 3 stacked VLAN. *See VLAN* on page 157 *for additional VLAN settings.*

MPLS

MPLS Label check box when selected (cleared by default) enables 1 or 2 MPLS labels allowing management and test frames to be transmitted and received. Only available with EtherSAM and Traffic Gen & Mon test applications. Not available with EtherSAM when **Layer Mode** is set to **L2 Only**.

Modify Wavelength (SFP)

Modify Wavelength, available with tunable transceivers, is used to configure the transceiver wavelength.

- **Wavelength** (nm) indicates the actual wavelength value selected. Use the scroll box and/or the -/+ buttons to select the wavelength. The minimum and maximum wavelength values are displayed.
- **Channel Number** indicates the actual ITU channel number based on ITU Grid.
- **Frequency** (THz) indicates the actual Frequency based on ITU Grid
- **Channel Spacing** (GHz) indicates the difference in frequency between two adjacent channel detected from the transceiver device.
- **Restore Previous** restores the current value present in the transceiver device.

Profile (Stream)

Allows the selection and configuration of either **Voice**, **Video**, or **Data** (default) emulation profile.

Voice

- **Voice Codec** allows the selection of the codec used by the voice profile: **VoIP G.711** (default), **VoIP G.723.1**, or **VoIP G.729**.
- **Number of Calls** allows the selection of the number of calls that will be generated for the selected stream. The minimum (default value) is **1** for 10M to 1G, **5** for 10G, and **10** for 40G/100G.
- **Rate** indicates the rate corresponding to the selected codec and the number of calls.

Video

- **Video Codec** allows the selection of the codec used by the video profile: **SDTV (MPEG-2) -** (default), **HDTV (MPEG-2)**, or **HDTV (MPEG-4)**.
- **Number of Channels** allows the selection of the number of channels (**1** by default) that will be generated for the selected stream.
- **Rate** indicates the rate corresponding to the selected coded and the number of channels.

Profile (Services)

Allows the selection and configuration of either **Voice**, **Video**, or **Data** (default) emulation profile.

Voice

- **Voice Codec** choices are **VoIP G.711** (default), **VoIP G.723.1**, and **VoIP G.729**.
- **Number of Calls** allows the selection of the equivalent number of calls that will be generated for the selected stream (default is **1**).
- **CIR** indicates the committed information rate in Mbps based on the number of calls selected.

Video

- **Video Codec** choices are **SDTV (MPEG-2) -** (default), **HDTV (MPEG-2)**, and **HDTV (MPEG-4)**. Only **SDTV (MPEG-2)** is available with the 10 Mbps interface.
- **Number of Channels** is the equivalent number of channels that will be generated for the selected service (default is **1**).
- **CIR** indicates the committed information rate in Mbps based on the number of channels selected.

Note: *The **CIR** value will be calculated on the basis of the selected service profile and the value entered in the **Number of Calls** or **Number of Channels** field.*

Remote Interface Discovery

Note: *Available with Traffic Gen & Mon for rates up to 10GE WAN.*

Discover

The **Discover** button activates, disabled by default, the interface discovery process. The discovery process automatically stops when the test is started or when the maximum of 16 signatures is reached.

Remote Interfaces

Lists every unique signature having good FCS and valid IP checksum. Any difference in either MAC source address, VLAN parameters, or IP source address is considered as a unique signature. Up to 16 signatures can be discovered.

➤ **Signature**

Number indicates the identification number given to the discovered signature.

The check box of a signature, when selected, indicates the signature's parameters that will be use for the current stream when clicking on the **Apply To Stream** button. Only one signature can be selected. Signatures having a different IP version than the test configuration will not be available for selection.

➤ **Layer 2** indicates the Layer 2 parameters if applicable: **MAC Address**, **E-VLAN**, **S-VLAN**, **C-VLAN**.

➤ **Layer 3** indicates the Layer 3 parameter if applicable: **IP Address**.

➤ **Signature Advanced Details** (**...** button) opens a pop-up displaying the details of the current signature: **Number**, **Source MAC Address**, **Source IP Address**, **E-VLAN ID**, **S-VLAN ID**, **C-VLAN ID**, **Priority**, **Type**.

Apply To Stream

Applies the selected signature parameters to the current stream and updates the stream configuration accordingly.

Shaping

For Burst and n-Burst TX modes.

- **Burst Duty Cycle (%)** represents the burst duration within the burst period: **1** to **100** percent (default is **50** percent).
- **Period** represents the burst pattern duration: **1** to **8000** milliseconds (default is **1000** ms).
  Unit choices are **ms** (default) and **s**.
- **Burst Count**, available with n-Burst TX Mode, represents the number of times the burst will be repeated: **1** (default) to **255**.

For Ramp and n-Ramp TX modes.

- **Ramp Nb. of Steps** represents the number of steps within the ramp: **2** to **100** (default is **10**).
- **Step Time** represents the duration of each step: **100** to **8000** milliseconds (default is **1000** ms).
  Unit choices are **ms** (default) and **s**.
- **Ramp Cycle Count**, available with n-Ramp TX mode only, represents the number of times the ramp will be repeated: **1** (default) to **255**.

Thresholds - RFC 2544

Note: *For **Dual Test Set**, thresholds are configurable for **Local to Remote** and **Remote to Local** directions at the exception of **Round-Trip Latency Threshold** for which the value is unique. For **Dual Port** topology, thresholds are configurable for both port directions.*

➤ **Throughput Threshold** sets the threshold value used to declare a pass/fail verdict for all frame sizes when applicable. The verdict is PASS when the received/measured value is greater or equal to the threshold value. The range is as follows:

Interface Speed	Threshold[a]		
	%	Mbit/s	Gbit/s
10 Mbit/s	0.0 to 100.0[b]	0.0 - 10.0[b]	Not Applicable
100 Mbit/s	0.0 to 100.0[b]	0.0 - 100.0[b]	Not Applicable
1000 Mbit/s	0.0 to 100.0[b]	0.0 - 1000.0[b]	0.0 - 1.0[b]
10G LAN	0.0 to 100.0[b]	0.0 - 10000.0[b]	0.0 - 10.0[b]
10G WAN[c]	0.0 to 92.857[b]	0.0 - 9285.7[b]	0.0 - 9.2857[b]
40G	0.0 to 100.0[b]	0.0 - 40000.0[b]	0.0 - 40.0[b]
100G	0.0 to 100.0[b]	0.0 - 100000.0[b]	0.0 - 100.0[b]

a. The maximum threshold value is adjusted with the Throughput **Max. Rate** selected.
b. Defalut value.
c. The maximum value for 10G WAN may be lower depending on the frame size. The maximum value will be adjusted for each frame size.

➤ **Back-to-Back Threshold** sets the threshold value in percentage of frames per burst to declare a pass/fail verdict for all frames sizes when applicable. The verdict is PASS when the received/measured value is greater or equal to the threshold value.

➤ **Frame Loss Threshold (%)** sets the threshold value of frame loss for all frame sizes when applicable. The verdict is PASS when the received/measured value is lower or equal to the threshold value.

- **Latency Threshold**, available when **Dual Test Set** is not enabled, sets the threshold value as the maximum delay for all frame sizes when applicable.
- **Round-Trip Latency Threshold**, available with **Dual Test Set** in **Round-Trip** measurement mode (see *Latency* on page 174), sets the threshold value as the maximum delay for all frame sizes when applicable.
- **One-Way Latency Threshold**, available with **Dual Test Set** in **One-Way** measurement mode (**o**nly available on MAX-880 model, see *Latency* on page 174), sets the maximum one-way latency value allowed for all frame sizes.
- **Latency Unit** allows selecting either **ms** (default) or **μs** as the reference unit for **Latency**.

Thresholds (S-OAM)

Available with G.8113.1, Y.1731 and MEF OAM Modes when Pass/Fail verdict is enabled. The verdict is PASS when the measured value is lower or equal to the threshold value.

- **Frame Delay Threshold (ms)** allows setting the threshold value of frame delay: **0.001** to **8000** ms (default is **50** ms).
- **Frame Loss Threshold (%)** allows setting the threshold value of frame loss: **0.001** to **100** % (default is **10** %).
- **Synthetic Loss Threshold (%**), available with Ethernet OAM (Y.1731 and MEF), allows setting the threshold value of Synthetic Loss: **0.001** to **100** % (default is **10** %).

TOS/DS Config

TOS/DS

- **TOS/DS** allows selecting either Type Of Service (TOS) or Differentiated Services (DS).
- **Binary/Hex** allows displaying, once this pop-up is closed, the IP TOS/DOS value either in binary or hexadecimal.

Type Of Service (TOS)

- **Precedence:**

  000 (Routine) (Default)
  001 (Priority)
  010 (Immediate)
  011 (Flash)
  100 (Flash Override)
  101 (CRITIC/ECP)
  110 (Internet Control)
  111 (Network Control)
- **Delay** allows the selection of the delay level: **Normal** (default) or **Low**.
- **Throughput** allows the selection of the throughput level: **Normal** (default) or **High**.
- **Reliability** allows the selection of the reliability level: **Normal** (default) or **High**.
- **Monetary Cost** allows the selection of the monetary cost level: **Normal** (default) or **Low**.
- **Reserved Bit** allows the selection of the reserved bit value: **0** (default) or **1**.

Differentiated Services (DS)

- **DSCP Codepoints**:

  000000 (CS0) (default), **001000 (CS1)**, **010000 (CS2)**, **011000 (CS3)**, **100000 (CS4)**, **101000 (CS5)**, **110000 (CS6)**, **111000 (CS7)**, **001010 (AF11)**, **001100 (AF12)**, **001110 (AF13)**, **010010 (AF21)**, **010100 (AF22)**, **010110 (AF23)**, **011010 (AF31)**, **011100 (AF32)**, **011110 (AF33)**, **100010 (AF41)**, **100100 (AF42)**, **100110 (AF43)**, **101100 (VOICE-ADMIT)**, **101110 (EF)**, **110011 (51)**, **110110 (54)**, or **User Defined**.

  User Defined Codes, available when **User Defined** is selected from the **DSCP Codepoints**, allows entering a user defined code from hexadecimal **00** (default) to **3F** once the **TOS/DS Config** pop-up is closed.

- **ECN** allows the selection of the Explicit Congestion Notification code: **00 (Not-ECT)** (default), **01 (ECT-1)**, **10 (ECT 0)**, or **11 (CE)**.

Triggered Frame Details

The triggered frame corresponds to the first received frame that matches the filter and the trigger settings.

- **Frame Number** indicates the triggered frame position in the buffer.
- The table displays the framing MAC/IP/UDP/TCP source and destination addresses.

Truncation Calculator

Truncation Calculator allows determining easily at what byte to truncate the frame captured by selecting the desired frame header components.

- **Header Layer** specifies the header layer level: **Layer 2 (Ethernet)**, **Layer 3 (IP)**, or **Layer 4 (TCP/UDP)**.
- **IP Version** specifies the IP version: **IPv4** or **IPv6**.
- **Encapsulation** parameters are optional and not selected by default.

  VLAN check box when selected enables VLAN and allows selecting the number of VLANs: 1, 2, or 3.

  MPLS check box when selected enables MPLS and allows selecting the number of labels: 1 or 2.
- **Additional Payload (bytes)** allows selecting optionally the number of additional payload bytes (1 to 1400 bytes).
- **Total Number of Bytes** indicates the number of bytes for the selected frame parameters. This value will be used as the truncated frame length (**Truncated** field).

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CHINESE REGULATION ON RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)
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及含量

Part Name 部件名称	Lead 铅（Pb）	Mercury 汞（Hg）	Cadmium 镉（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 电子和电气组件	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

Note:
注：
This table is prepared in accordance with the provisions of SJ/T 11364.
本表依据 SJ/T 11364 的规定编制。
O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.
O：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 标准规定的限量要求以下。
X: indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572. Due to the limitations in current technologies, parts with the “X” mark cannot eliminate hazardous substances.
X：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 标准规定的限量要求。
标记“X”的部件，皆因全球技术发展水平限制而无法实现有害物质的替代。
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	5	

a. If applicable.
如果适用。

P/N: 18.0.0.1

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