User Guide

ETHERNET AND TRANSPORT TESTER

MaxTester Application

MAX-800 Series

www.EXFO.com
Telecom Test and Measurement

EXPERTISE REACHING OUT

EXFO's Commerce And Government Entities (CAGE) code under the North Atlantic Treaty Organization (NATO) is 0L8C3.

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Trademarks

EXFO's trademarks have been identified as such. However, the presence or absence of such identification does not affect the legal status of any trademark.

Units of Measurement

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

Patents

Dual Test Set/Bi-Directional testing is protected by US patent 9,432,206 and equivalents in other countries.

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Contents

Certification Information

North America Regulatory Statement

This unit was certified by an agency approved in both Canada and the United States of America. It has been evaluated according to applicable North American approved standards for product safety for use in Canada and the United States.

Electronic test and measurement equipment is exempt from FCC part 15, subpart B compliance in the United States of America and from ICES-003 compliance in Canada. 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 guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

European Community Declaration of Conformity

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.

The full text of the EU declaration of conformity is available at the following Internet address: *www.exfo.com/library*.

Laser

Your instrument is a Class 1 laser product in compliance with standards IEC 60825-1: 2007 and 21 CFR 1040.10, except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

1 Introducing the Ethernet and Transport Tester

ALL-IN-ONE solution for field technicians installing, testing and troubleshooting Ethernet, DSn/PDH, SONET/SDH, and OTN network services up to 10G.

Features

Features		Model		
		860	860G	880
Transport	OTN BERT	-	-	X
	SONET/SDH BERT	-	-	X
	DSn/PDH BERT	-	-	X
	SONET/SDH - DSn/PDH BERT	-	-	X
	NI/CSU Emulation	-	-	X
Ethernet	EtherSAM (Y.1564)	X	X	X
	RFC 2544	X	X	X
	EtherBERT	X	X	X
	Traffic Gen & Mon	X	X	X
	Smart Loopback	X	X	X
	Through Mode	X	X	X
	Cable Test	X	X	X

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.

IMPORTANT

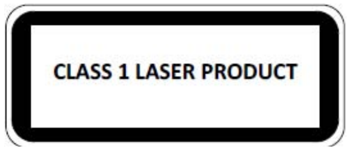
When you see the following symbol on your unit , make sure that you refer to the instructions provided in your user documentation. Ensure that you understand and meet the required conditions before using your product.

IMPORTANT

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.

Additional Laser Safety Information

This product employs Class 1 Laser transceivers.



WARNING

When the LASER LED is on or flashing, the MAX-800 Series is transmitting an optical signal on the SFP/SFP+transceiver ports.

Note: *Refer to the MAX-800 Series's 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 MaxTester.
- before inserting or removing **SFP/SFP+** transceiver to/from the MaxTester.

3 Getting Started

The MaxTester has been shipped with the latest software version.

Turning On the Unit

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

Starting the MaxTester Application

The MAX-800 Series can be configured and controlled by starting the MaxTester application.

To start the MaxTester application:

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

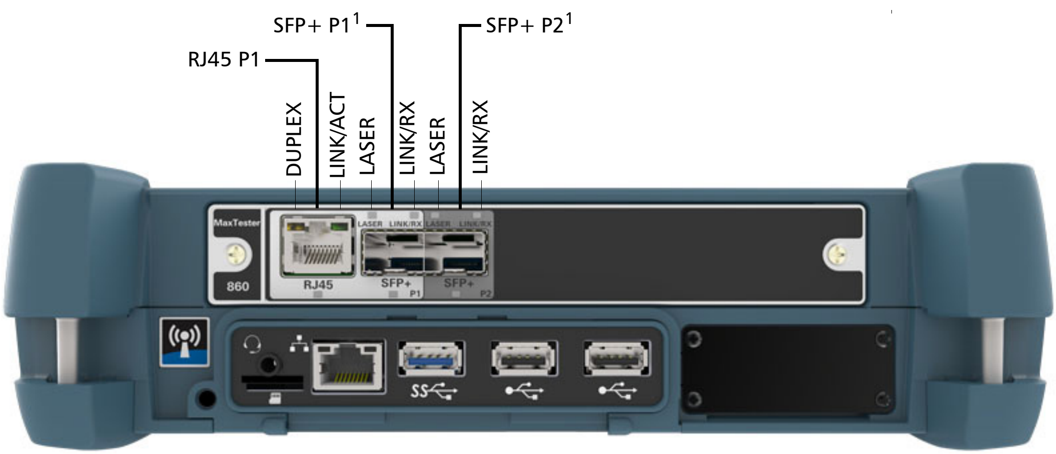
4 Physical Interfaces and LEDs

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

CAUTION

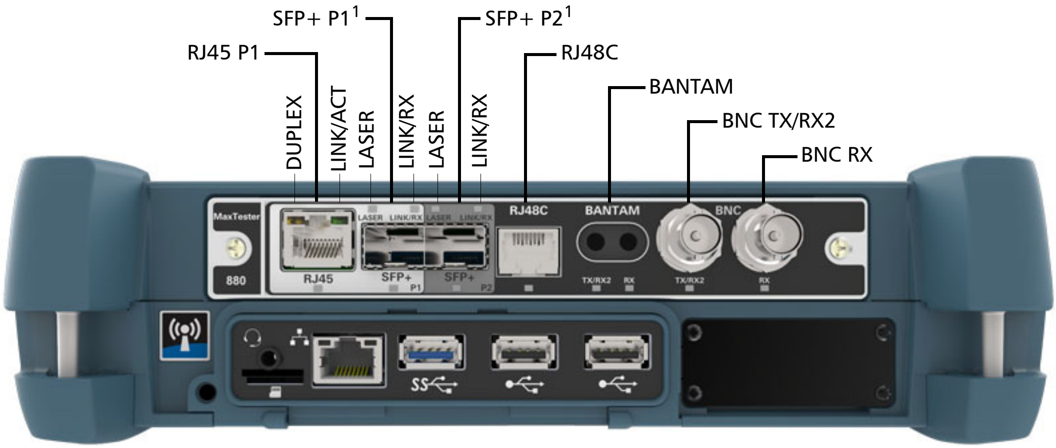
To prevent exceeding the maximum input/output power level, please refer to this product's technical specifications at *www.exfo.com*.

MAX-860 and 860G Models



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

MAX-880 Model



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

Port Availability on the MAX-800 Series

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	Model 860G	Model 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, 2MHz			
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
	SFP+ P1	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.

SFP+ (P1/P2)

These ports can be used for the following test applications and rates:

Application	Rates	PORT	
		1	2
Transport	OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OTU1, OC-192/STM-64[a], OTU2	X	
Ethernet	100 Mbit/s, 1000 Mbit/s, 10 Gbit/s LAN/WAN	X	X
	10/100/1000 Mbit/s electrical (using active copper SFP)	-	X[b]

a. Port 2 is used with OC-192/STM-64 in **Decoupled (TX≠RX)** mode.
b. Available as a second port when the test application requires two ports.

Plug the SFP/SFP+ transceiver into the P1/P2 slot.

WARNING

Use only EXFO supported transceivers. Refer to this product's technical specifications at *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 SFP/SFP+ while the test is running to avoid distorting statistics. First stop the test case, replace the SFP/SFP+ and then restart the test.*

RJ45

This port can be used for electrical Ethernet test applications.

Supported electrical rates are 10Mbits/s, 100 Mbit/s, and 1000 Mbit/s. Plug the 10/100/1000 electrical interface or the cable to be tested to the connector. The electrical ports is RJ45 for category 5 unshielded twisted pair (UTP). Refer to *Ethernet Cables* on page 401 for cable specifications.

BNC (TX/RX2 and RX)

This port can be used for electrical Transport test applications, DS1/DS3 dual RX, or clock synchronization.

Supported electrical signal are E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, and STS-3e/STM-1e/155M for TX/RX test application; DS1/DS3 for dual RX test application; DS1/1.5M, E1/2M, 2MHz for clock output; DS1/1.5M, E1/2M, 2MHz, 1PPS[1] for clock input. Plug the signal to be tested to the BNC or TX/RX2 and RX ports; RX2 is used as the second input port for DS1/DS3 dual RX test. Connector type is BNC for coaxial 75-ohm cable connection.

BNC (EXT CLK)

This port can be used for external input clock synchronization: DS1 (1.5M), E1 (2M), 2MHz, or 1PPS signal. Connector type is BNC for coaxial 75-ohm cable connection. An adapter cable (BNC to Bantam) is required for Bantam connection (not supplied).

1. 1PPS is available for Dual Test Set in One-Way Latency measurement mode.

RJ48C

This port can be used for electrical Transport test applications or for clock IN/OUT synchronization.

Supported electrical signal are DS1/1.5M and E1/2M for TX/RX test application; DS1/1.5M, E1/2M, 2MHz for clock IN/OUT. Plug the signal to be tested to RJ48C port.

BANTAM

This port can be used for electrical Transport test application or for clock IN/OUT synchronization.

Supported signal are DS1/1.5M and E1/2M for TX/RX test application and DS1/1.5M, E1/2M, 2MHz for clock synchronization. Plug the signal to be tested to the BANTAM IN and OUT TX and RX ports.

Fibre Cables Connection

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

CAUTION

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

LEDs

- **LASER** red LED is on when the MAX-800 Series 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 and/or 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

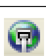
The following main application window is displayed when the MaxTester application is started.

Main Window

The main window allows 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 number (Port 1 or Port 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, OTU1, OTU2, etc.	All
LINK	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. Yellow: Power level out-of-range. Red with “LOS”: Loss of signal. 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. 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 351.	All
	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

Icon and/or text	Description	Test Application
	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 clock. The clock icon is followed by the clock mode: **INT** for Internal, **EXT** for External, or **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

The following status are also displayed:

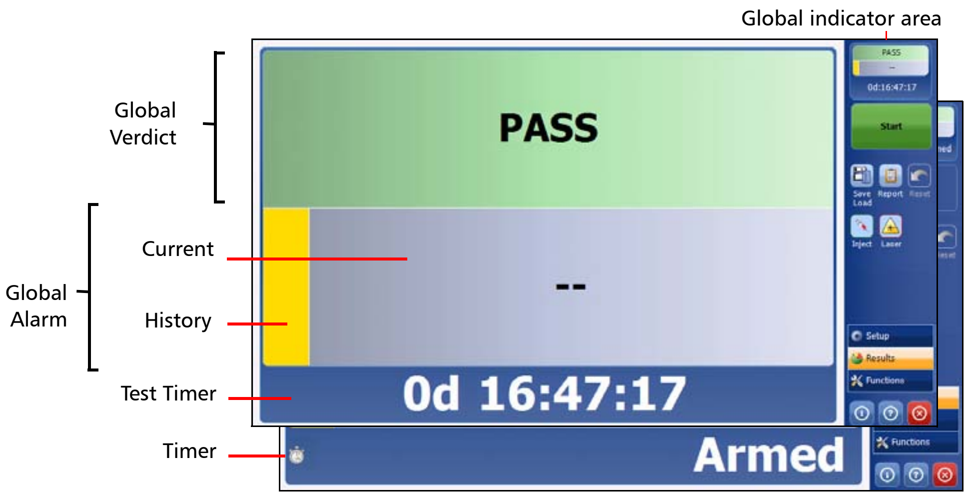
- Battery/AC icons indicate the battery level and if the MAX-800 Series is connected to an AC power source. Refer to the MAX-800 Series user guide for more information.
- Date and Time indicate the current date and time.

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 347 for more information.*

Test Menu

The test menu displays the following buttons:

- **Setup** allows to configure the selected test. Refer to *Test Setup - Test Configurator, Timer, and System* on page 57 for more information.
- **Results** allows to view test results. Refer to *Test Results* on page 189 for more information.
- **Functions** allows to configure additional test functions (refer to *Test Functions* on page 287).

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.

  Module Details button displays the MaxTester details such as its ID, Serial Number, Software Product Version, etc.

  View Licence Agreement button displays the details of the product licence agreement.

  Software Options button displays the list of software options.

Note: *For information on how to install and activate software options, refer to the MAX-800 Series User Guide. The MaxTester application must be restarted once a new software option is installed in order to activate it.*

Software Option	Description
DSn	Digital Signal
DS1-FDL	DS1/1.5M Facility Data Link
DS3-FEAC	DS3/45M Far-End Alarm and Control
DUALRX	Dual RX
DS3-G747	ITU-T Recommendation G.747
PDH	Plesiochronous Digital Hierarchy
NI-CSU	NI/CSU Emulation
SONET	Synchronous Optical Network
SDH	Synchronous Digital Hierarchy
TCM	Tandem Connection Monitoring
OTU2	Optical Transport Unit-2 (10.7 Gbit/s)
OTU1	Optical Transport Unit-1 (2.7 Gbit/s)
52M	52 Mbit/s

Software Option	Description
155M	155 Mbit/s
622M	622 Mbit/s
2488M	2.488 Gbit/s
9953M	9.953 Gbit/s
100optical	100 Mbit/s optical interfaces.
GigE _Optical	1000Base-T and GigE optical interfaces.
GigE_ Electrical	1000Base-T electrical Interfaces.
10G_LAN	10G LAN optical interface.
10G_WAN	10G WAN optical interface.
IPV6	IPV6 testing
MPLS	MPLS Encapsulation
Cable_Test	Cable Test application
GCC-BERT	GCC BERT
ETH-THRU	Through Mode test application.
DUAL-PORT	Dual Port Test

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.

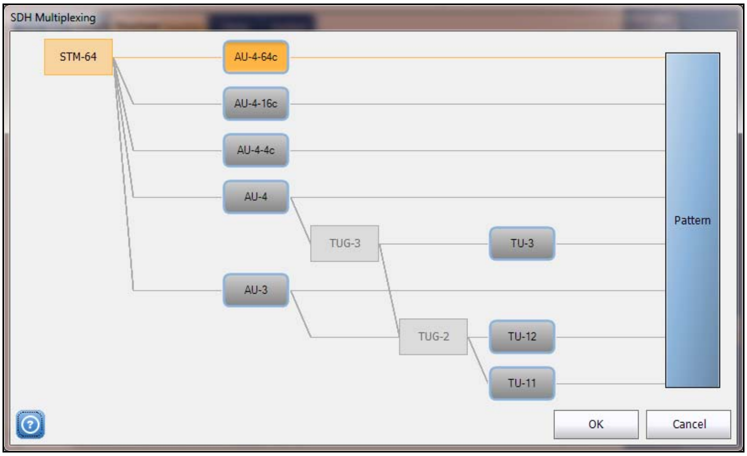
Note: *For certain text fields, the GUI pops up or uses the unit's on-screen keyboard. Refer to the MAX-800 Series user guide for more information on how to use it.*

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

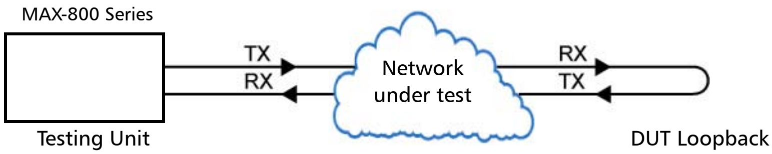
The MaxTester offers the following test applications.

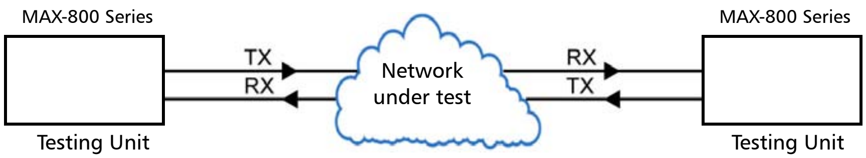
Type	Application	Available on MAX-...		Page
		860 860G	880	
Transport	*OTN BERT*	-	X	30
	SONET/SDH BERT	-	X	31
	DSn/PDH BERT	-	X	34
	SONET/SDH - DSn/PDH BERT	-	X	36
	NI/CSU Emulation	-	X	39
Ethernet	*EtherSAM (Y.1564)*	X	X	40
	RFC 2544	X	X	42
	EtherBERT	X	X	44
	Traffic Gen & Mon	X	X	46
	Smart Loopback	X	X	48
	Through Mode	X	X	50
	Cable Test	X	X	51

OTN BERT

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

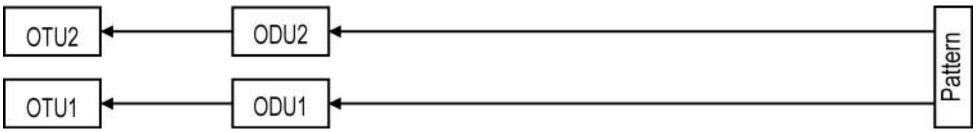
➤ Typical OTN BERT test applications:





➤ Path/Mapping

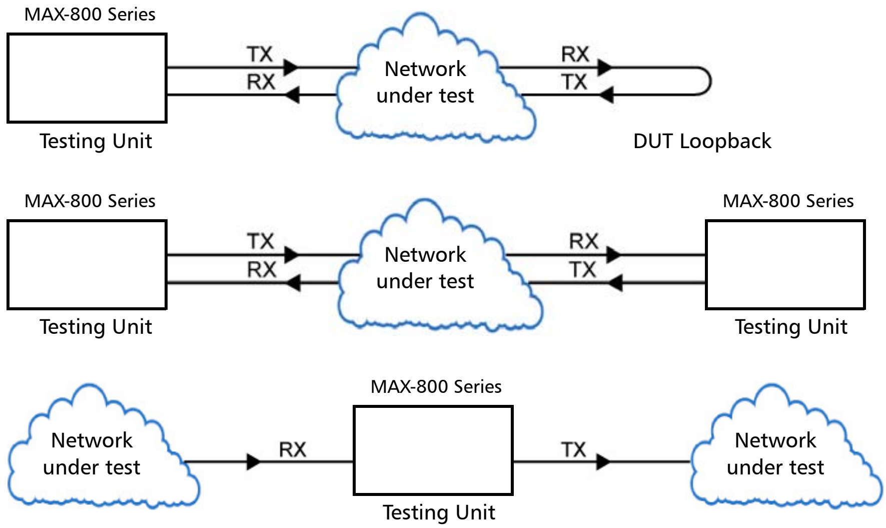
The **OTN BERT** test application offers the following path/mapping structures depending on the inserted transceiver and enabled options.



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.

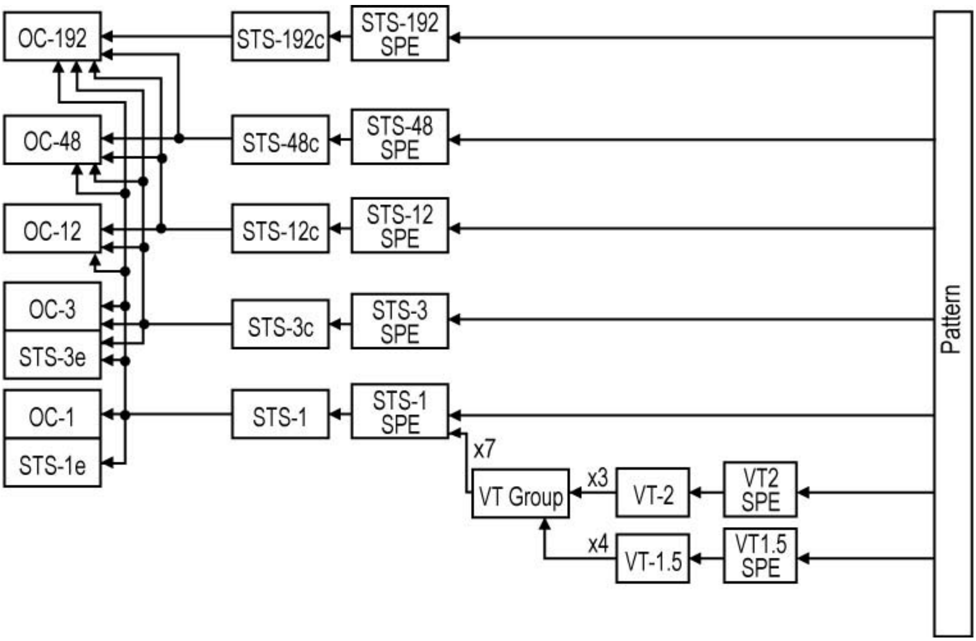
➤ Typical SONET/SDH BERT test applications:



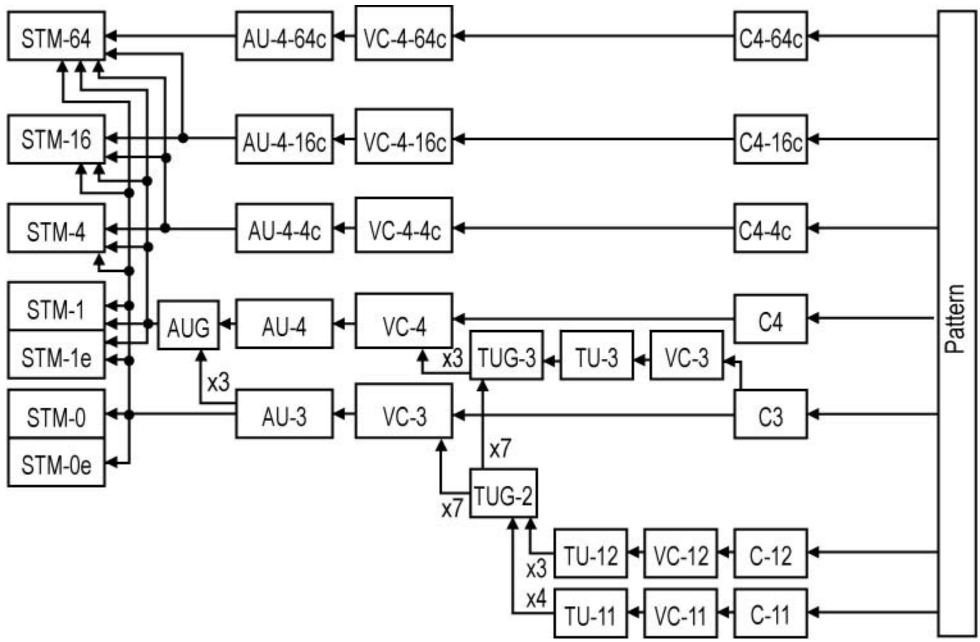
➤ Path/Mapping

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

For SONET BERT



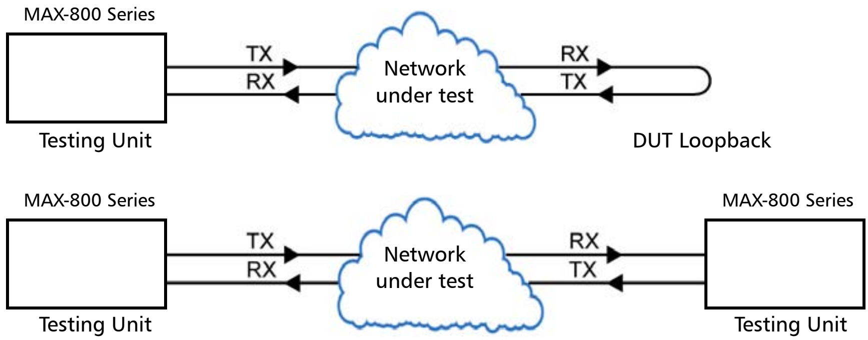
For SDH BERT


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

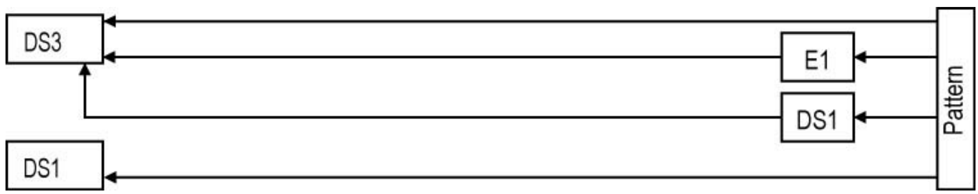
➤ Typical DSn/PDH BERT test applications:



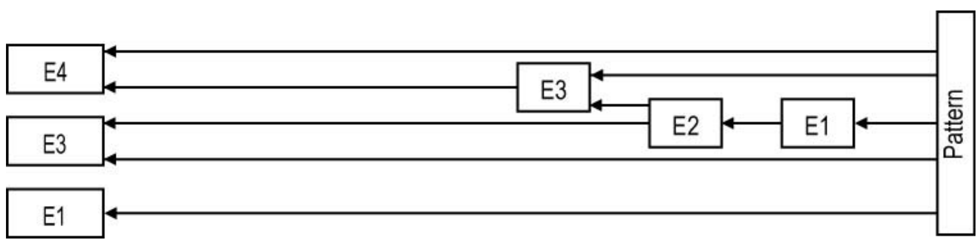
➤ Path/Mapping

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

For DSn:



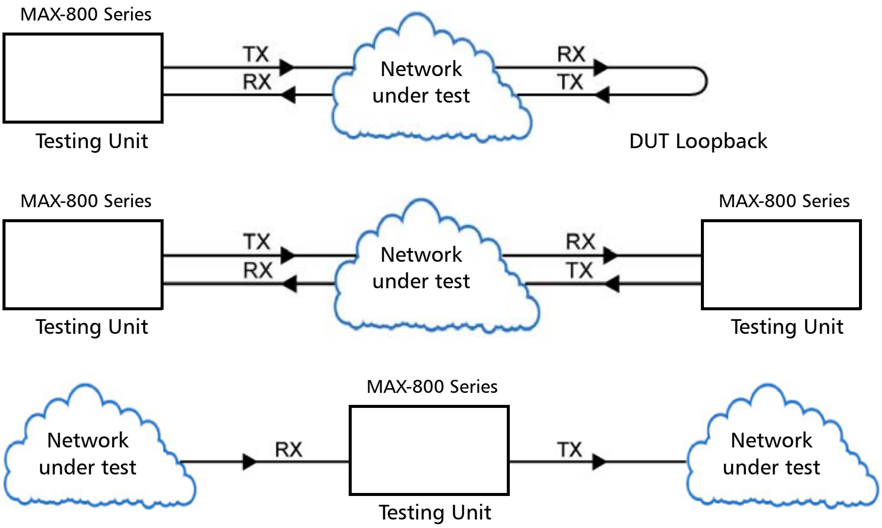
For PDH:



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.

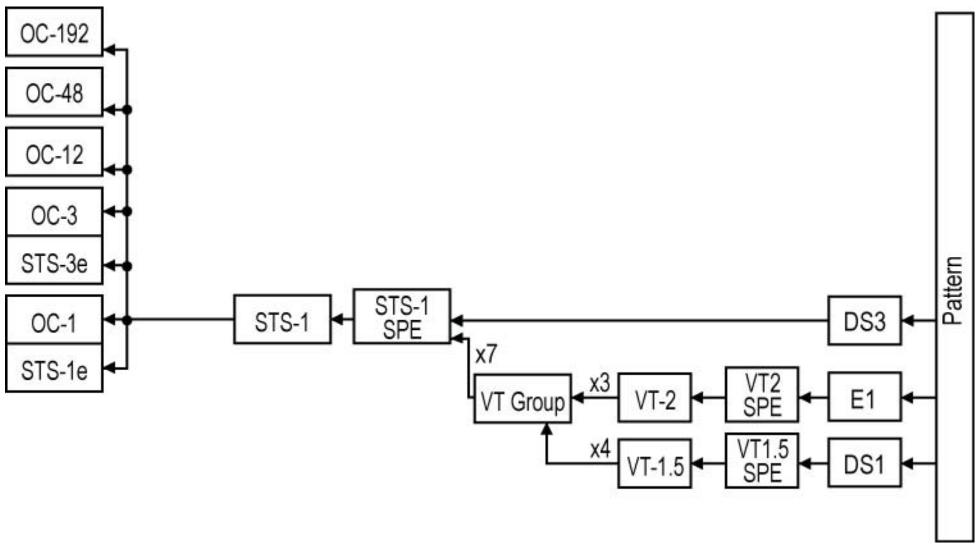
➤ Typical SONET/SDH - DSn/PDH BERT test applications:



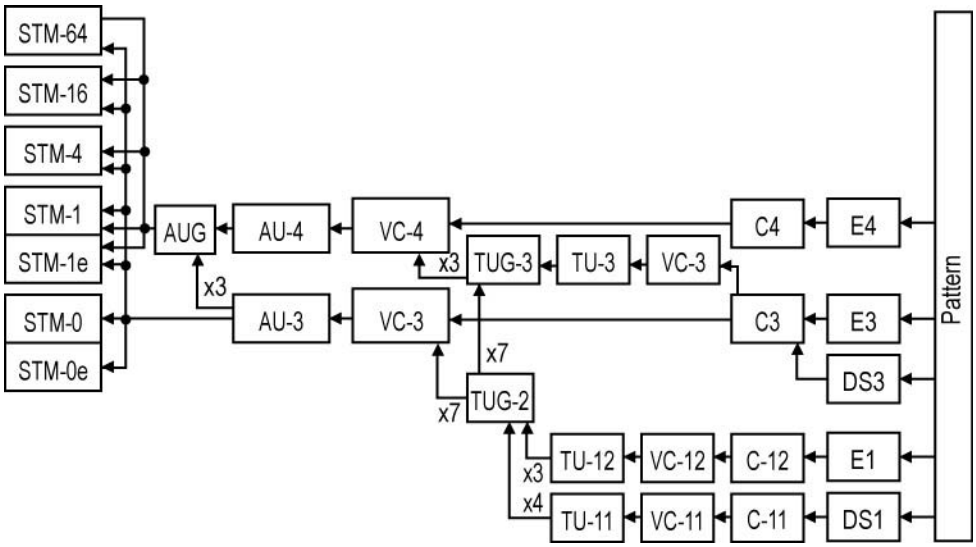
➤ Path/Mapping

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

For SONET:



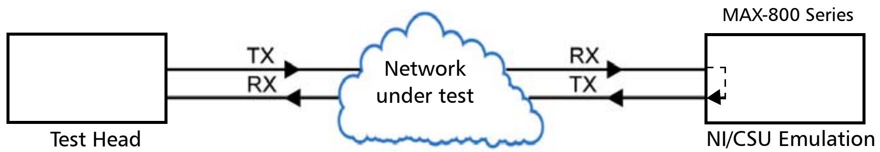
For SDH:

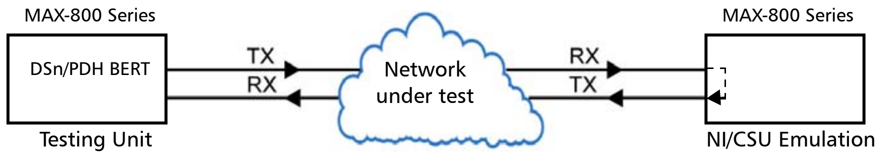

STM-64
STM-16
STM-4
STM-1
STM-1e
STM-0
STM-0e
AUG
AU-4
AU-3
VC-4
VC-3
x3
TUG-3
TU-3
VC-3
C4
E4
C3
E3
DS3
x7
TUG-2
x7
TU-12
VC-12
C-12
E1
x3
x4
TU-11
VC-11
C-11
DS1
Pattern

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)

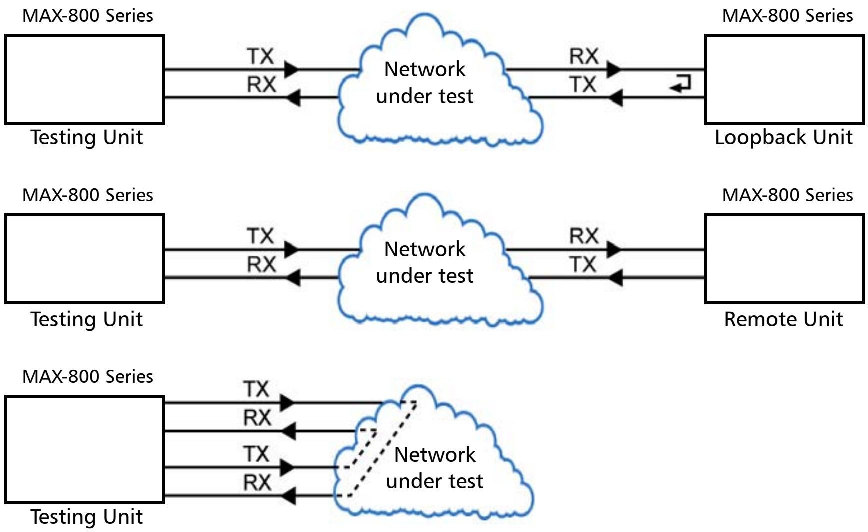
EtherSAM can simulate all types of services that will run on the network and simultaneously qualify all key SLA parameters for each of these services. Moreover, it validates the QoS mechanisms provisioned in the network to prioritize the different service types, resulting in more accurate validation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

The **EtherSAM (Y.1564)** test, in single port configuration, has to be executed in conjunction with a remote module. The remote module 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 test between two compatible modules 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:



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

RFC 2544

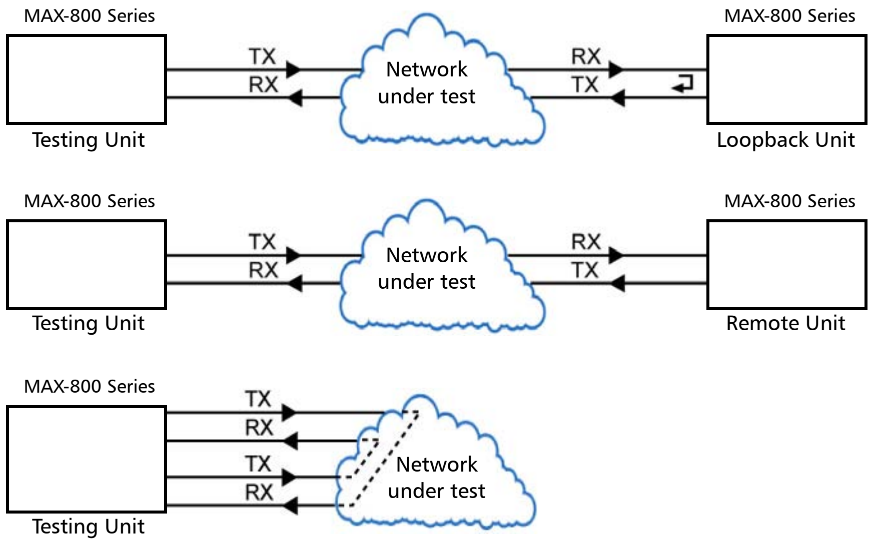
RFC 2544 allows Ethernet Throughput, Back-to-Back, Frame Loss, and Latency performance testing in accordance with RFC 2544 specifications.

The **RFC 2544** test, in single port configuration, has to be executed in conjunction with a remote module. The remote module 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 test between two compatible modules 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:

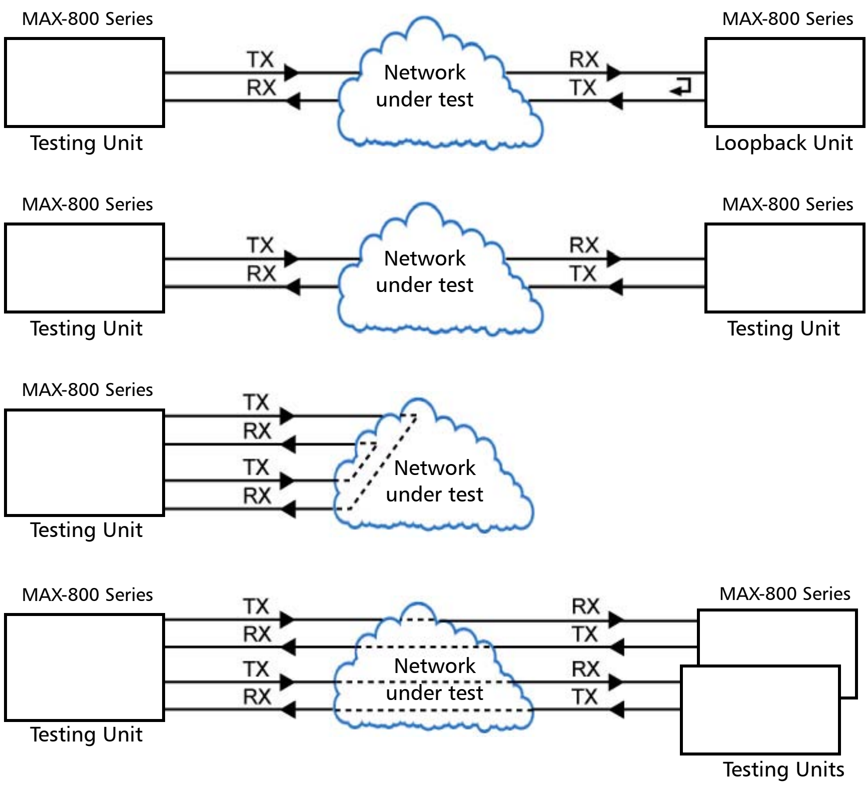


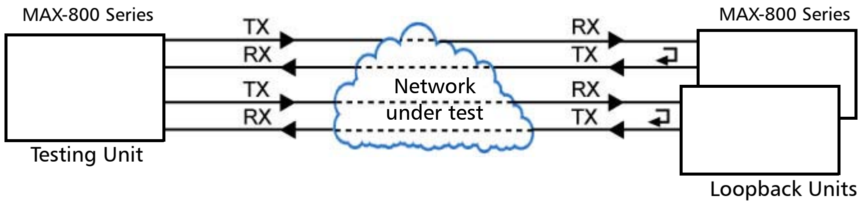
➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

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:



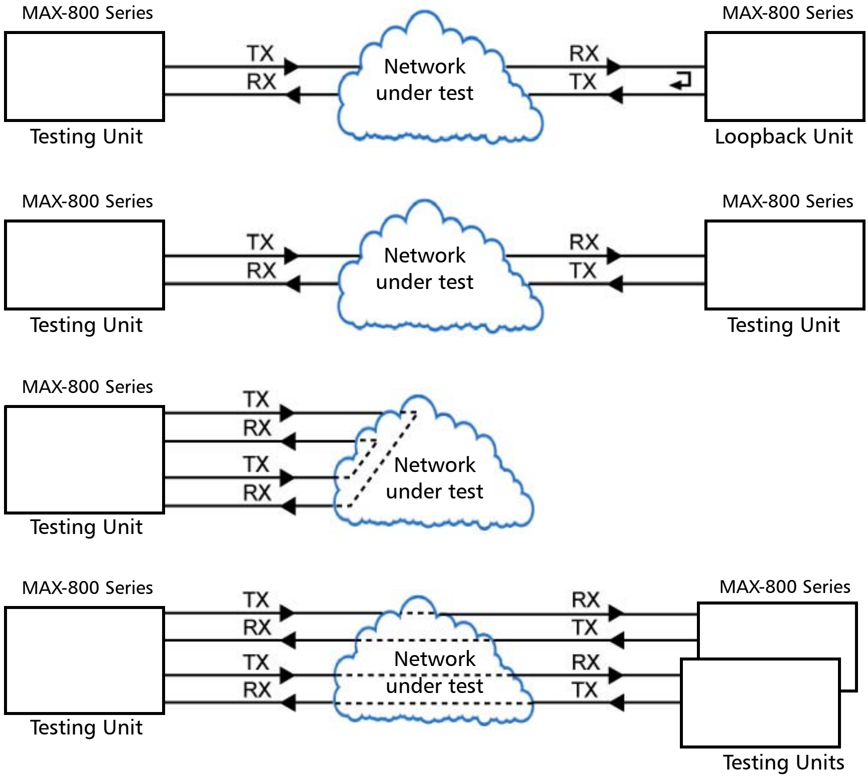


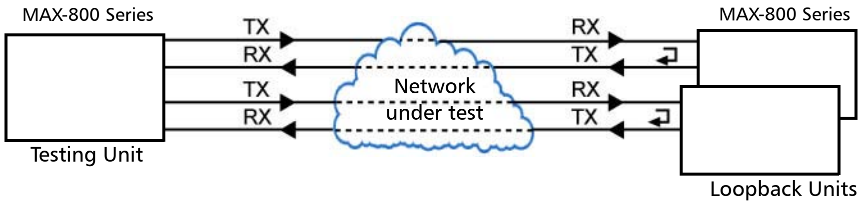
➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

Traffic Gen & Mon

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

➤ Typical Traffic Gen & Mon test applications:





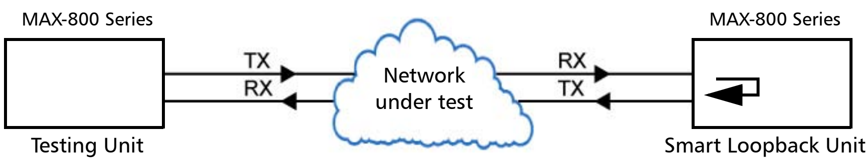
➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

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 55) or remotely using an EXFO unit (refer to *Discover Remote Button* on page 348) or a Third-Party device (see *Third-Party Remote Loopback* on page 49).

➤ Typical Smart Loopback test application:



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

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 level 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

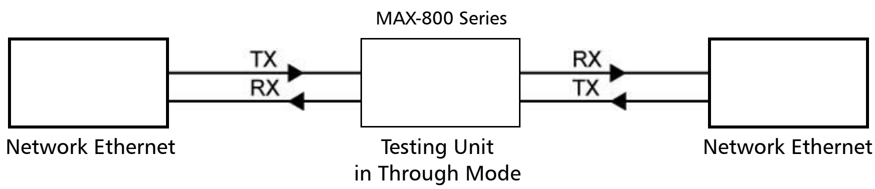
➤ Layer 4: UDP/TCP

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

Through Mode

The Through Mode test application allows traffic to pass through the MAX-800 Series 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:



➤ Supported Interfaces/Rates: 10M to 1GE; 10/100/1000M electrical is supported when using an active copper SFP and the RJ45 port.

Cable Test

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

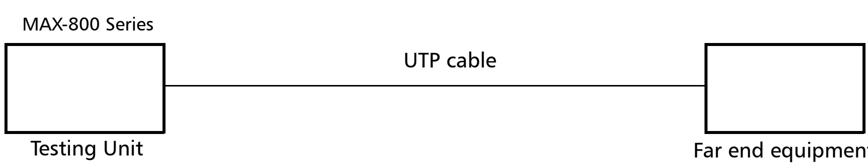
Cable test can be performed everywhere in the network where an electrical 10/100/1000 Mbit/s Ethernet interface is available for testing. Only the pairs used by the Ethernet signal will be tested. For 10 Base-T, and 100 Base-TX, pair 2 and 3 will be tested; for 1000 Base-T, all pairs will be tested.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

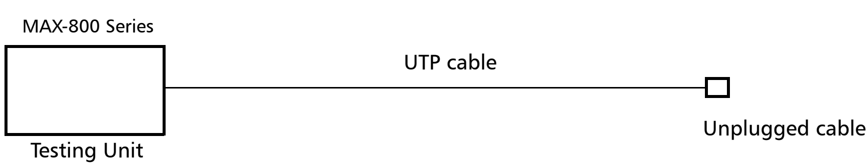
Even if a link up is not required when testing with a far end equipment, it is preferable to have the far end equipment powered up to maximize the cable test results.

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:





➤ Supported Interfaces/Rates: 10M to 1000M Electrical.

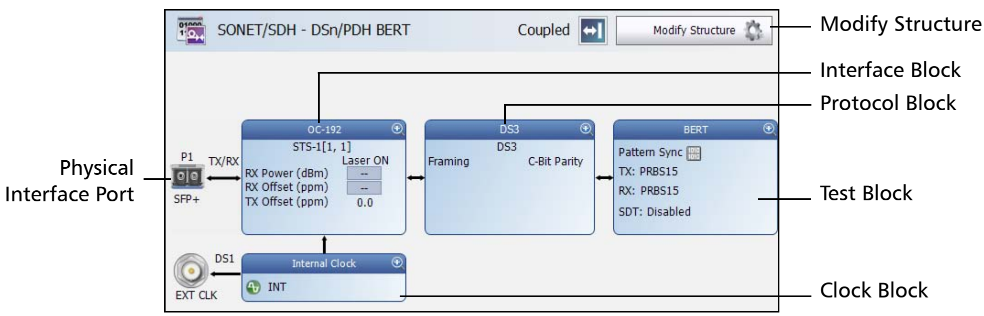
7 Selecting and Starting a Test

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 364 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 to *Modify Structure Button* on page 63).

3b. Tap the interface block to configure the signal parameters (refer to page 57).

3c. For an embedded signal, tap the protocol block to configure the signal (refer to page 57).

- **3d.** Tap the test block to configure the specific test settings (refer to page 57). Not available with **NI/CSU Emulation** test application.
- **3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 81).

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 182).
5. For additional test configurations refer to *Test Functions* on page 287.
6. Tap the **Start** button from the right navigation bar to start the test. (refer to *Start/Stop|TX Button* on page 368). 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 189.
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 358).

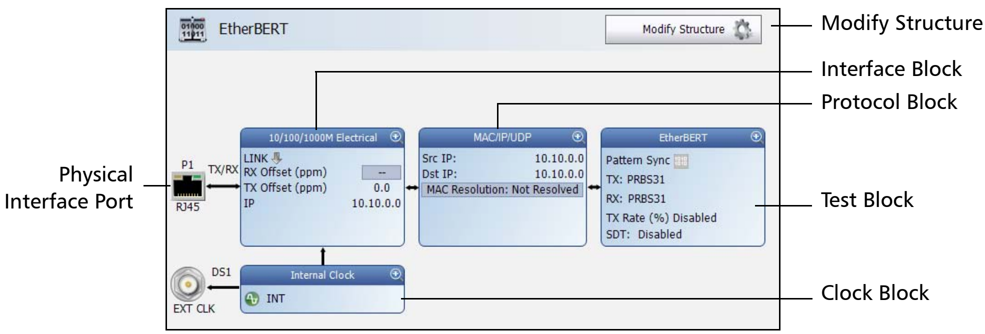
Ethernet Test Applications

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 to *Modify Structure Button* on page 63).

3b. Tap the interface block to configure the interface parameters (refer to page 57). 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 18).

3c. Tap the protocol block[1] to configure the frame structure and its parameters (refer to page 58). For RFC 2544, EtherBERT, and Traffic Gen & Mon in Dual Port topology, there is a protocol block for each port.

3d. Tap the test block[2] to configure the specific test settings (refer to page 58).

3e. Tap the clock block[3] to configure the clock synchronization (refer to *Clock* on page 81).

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 182).

5. For additional test configurations refer to *Test Functions* on page 287.

6. Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop|TX Button* on page 368). 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 189.

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 358 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 in **Dual Port** topology and when using an active copper SFP. However the clock is either set to **Internal** or **Auto** (1GE electrical).

8 Test Setup - Test Configurator, Timer, and System

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

➤ **Test Configurator** for **Transport** test applications.

Block	Subtab or Pop Up	Test Application					Page
		a	b	c	d	e	
Button	Modify Structure	X	X	X	X	X	63
	Signal Auto-Detect	-	-	X	-	X	73
Interface	FTFL/PT	X	-	-	-	-	98
	Labels	-	X	-	X	-	107
	SFP+	X	X	-	X	-	148
	Signal	X	X	X	X	X	149
	Traces	184	187	-	187	-	<---
Protocol	Signal	-	-	-	X	-	155
Test	BERT	X	X	X	X	-	74
Clock	Clock	X	X	X	X	X	81

a. OTN BERT
b. SONET/SDH BERT
c. DSn/PDH BERT
d. SONET/SDH - DSn/PDH BERT
e. NI/CSU Emulation

➤ **Test Configurator** for **Ethernet** test applications.

Block	Subtab or Pop Up	Test Application a	b	c	d	e	f	g	Page
Button	Modify Structure	X	X	X	X	X	X	X	63
Interface	Interface	X	X	X	X	X	X	X	101
	Network	X	X	X	X	X	X	X	120
	SFP/SFP+	X	X	X	X	X	X	-	148
Protocol	MAC/IP/UDP	X	X	X	X	-	-	-	108
	Services - Global	X	-	-	-	-	-	-	138
	Services - Profile	X	-	-	-	-	-	-	141
	Streams - Global	-	-	-	X	-	-	-	171
	Streams - Profile	-	-	-	X	-	-	-	173
Test	Cable Test	-	-	-	-	-	-	X	79
	EtherBERT and Unframed BERT	-	-	X	-	-	-	-	85
	EtherSAM - Burst	X	-	-	-	-	-	-	90
	EtherSAM - Global	X	-	-	-	-	-	-	92
	EtherSAM - Ramp	X	-	-	-	-	-	-	96
	RFC 2544 - Global	-	X	-	-	-	-	-	126
	RFC 2544 - Subtests	-	X	-	-	-	-	-	129
	Smart Loopback	-	-	-	-	X	-	-	170
Clock	Clock	X	X	X	X	X	-	-	81

a. EtherSAM
b. RFC 2544
c. EtherBERT
d. Traffic Gen & Mon
e. Smart Loopback
f. Through Mode
g. Cable Test

➤ **Timer**, see page 182.

➤ **System**, see page 181.

Test Configurator Overview

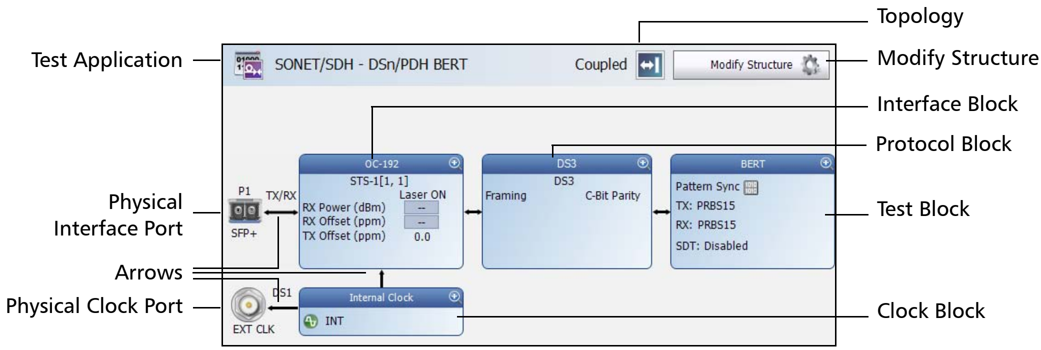
The **Test Configurator** tab displays the interconnected blocks composing the test structure. Each block of the test structure gives an overview of its configuration/status. Availability of each block depends on the selected test application and its structure. Arrows are used to indicate the interconnection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

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

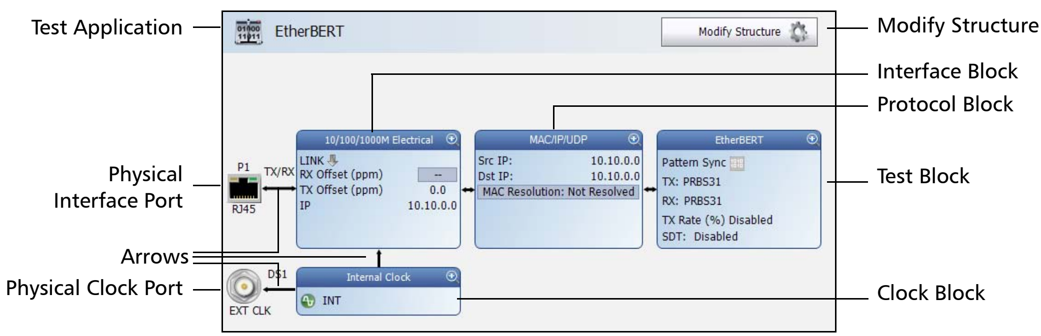
The block arrangement represents the network under test. From any block, either select the basic parameters or click on **More** for all settings.

- **Local** block displays and allows to change basic interface settings. Tap on the **More** button to access all settings.
- **Network** block displays and allows to change basic test settings. Tap on the **More** button to access all settings.
- Remote operation mode allows to select the remote operation mode. Tap on the button to change the remote operation mode.
- **Remote** block displays and allows to change basic remote settings. Tap on the **More** button to access all 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.

➤ Physical Interface Port indicates the physical interface port. For **Dual Port** topology, there is a physical interface for each port.

- 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. 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 Button

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

For Transport Test Applications

TX/RX allows the configuration of the following parameters for either TX/RX, RX and RX2, TX, or RX depending on the selected topology.

➤ **Interface/Rate**: Select the desired interface rate. Choices depend on the selected test and the rates available on the MaxTester.

Test	Interface/Rate
OTN	**OTU2 [10.709 Gbit/s]** **OTU1 [2.666 Gbit/s]**
SONET	**OC-192 [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]** **STS-3e [155.520 Mbit/s]** **STS-1e [51.840 Mbit/s]**
SDH	**STM-64 [9.953 Gbit/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]** **STM-1e [155.520 Mbit/s]** **STM-0e [51.840 Mbit/s]**
DSn	**DS1 [1.544 Mbit/s]** **DS3 [44.736 Mbit/s]**
PDH	**E1 [2.048 Mbit/s]** **E3 [34.368 Mbit/s]** **E4 [139.264 Mbit/s]**
NI/CSU Emulation	**DS1**

➤ **Connector** allows the selection of the MaxTester's port.

Interface/Rate	Connector
OTU2 [10.709 Gbit/s] OTU1 [2.666 Gbit/s] OC-192 [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-64 [9.953 Gbit/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
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

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

➤ **Framing**: For OTN BERT, and SONET/SDH BERT test applications, the framing is set to **Framed**.

- **OTN Multiplexing - Config Mux** button, only 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

- **SONET/SDH Multiplexing - Config Mux** button allows the selection of SONET/SDH multiplexing. Only available with SONET/SDH BERT test application.

Embedded SONET/SDH	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

➤ **DSn/PDH Multiplexing**, available with **SONET/SDH - DSn/PDH BERT** and **DSn/PDH** test application applications, allows the selection of the DSn/PDH multiplexing.

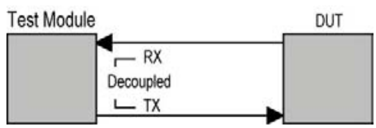
Interface/Rate	DSn/PDH Multiplexing
DS3	**None (default), DS1, E1**
DS1	**None**
E4	**None (default), E3, E3/E2/E1**
E3	**None (default), E2/E1**
E1	**None**

➤ **Client** is set to **Pattern**.

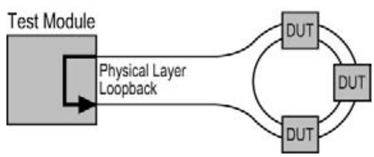
➤ **Topology** allows the selection of the network test topology.

➤ **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.

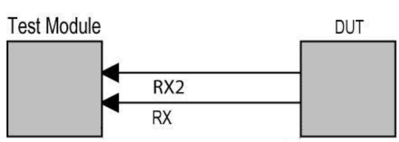
➤ **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled. **Decoupled** is not supported with **OTN BERT** test application.



➤ **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.



For Ethernet Test Applications

- **Port 1** and **Port 2** are only displayed when **Dual Port** topology is selected and allows to configure each port individually.
- **Interface/Rate** choices depend on the selected test and the rates available on the MaxTester.

Test	Interface/Rate
EtherSAM RFC 2544 EtherBERT Traffic Gen & Mon Smart Loopback	10GE WAN 10GE LAN 1GE Optical 100M Optical 10/100/1000M Electrical[a]
Through Mode	10GE LAN 1GE Optical 100M Optical 10/100/1000M Electrical[b]
Cable Test	10/100/1000M Electrical

a. Also available as a second port when the test application requires two ports; Ethernet 10/100/1000 Mbit/s electrical is supported when using an active copper SFP.

b. Ethernet 10/100/1000 Mbit/s electrical is supported when using an active copper SFP and the RJ45 port.

- **Primary Port** / **Secondary Port**, available with Through Mode test application, allows to select the MaxTester's ports that are respectively used as primary (Port 1) and secondary (Port 2) port. The configuration of the network configuration parameters will be available on the Primary Port only.

➤ **Connector** allows the selection of the MaxTester's port.

Interface/Rate	Connector
10GE WAN 10GE LAN 1GE Optical 100M Optical	Port 1 - SFP+ Port 2 - SFP+
10/100/1000M Electrical	Port 1 - RJ45 Port 2 - SFP+ (RJ45)[a]

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

➤ **Framing**, available for EtherBERT test application, allows the selection of the test framing type; otherwise the framing is set to Framed Layer 2. See *Network* on page 120 for more information on frame format.

➤ **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[1] bytes without network layer (**None**) that complies with IEEE 802a Ethernet II standard.

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

➤ **Framed Layer 3/4** (default): Frames of x[1] bytes with UDP (default) or TCP network layer that complies with IEEE 802a Ethernet II standard.

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

1. To set the frame length, see Frame Size on page 89 for EtherBERT, and page 128 for RFC 2544.

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

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

For **PRBS31 Unscrambled**, only available for 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)

➤ **Loopback Mode**

Note: *Only available for Smart Loopback Ethernet test application.*

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 170.

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.*

➤ **Topology** allows the selection of the network test topology: **Single Port** (default) or **Dual Port**. **Dual Port** is only available with EtherSAM, RFC 2544, EtherBERT, and Traffic Gen & Mon.

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.*

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

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

Pattern

The icon next to the **Pattern** label indicates the status of the received pattern signal. Refer to *Status Bar* on page 18 for more information.

➤ **Coupled RX to TX** check box is always selected and allows coupling both the TX and RX signal with the same test pattern.

➤ **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** sets respectively the TX and RX test pattern.

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	-	-	-	-
PRBS9	X	X	X	X	X	X
PRBS11	X[a]	X	X	X	X	
PRBS15	-	X	X[a]	X	X[b]	X
PRBS20 User Pattern	X	X	X	X	X	X
PRBS23	-	X	X	X[a]	X[c]	X

Pattern	DS0, E0	DS1	DS3, E1	E3, E4	SONET/SDH	OTN
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.

For Multi-Pattern, see *Multi-Pattern Configuration* on page 77.

When **User Pattern** is selected, enter the payload pattern hexadecimal value.

➤ **Invert** 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. Not available when pattern is Multi-Pattern.

Bit Error

➤ **Pass/Fail Verdict** allows to enable bit-error-rate pass/fail verdict by selecting either **Bit Error Count** or **Bit Error Rate**. The default value is **Disabled**.

➤ **BER Threshold** allows to enter the threshold **Count** or **Rate** value that will be used to declare the pass/fail verdict. The **BER Threshold** applies to individual pattern for **Multi-Pattern**.

For **Count**, enter the maximum bit error count allowed before declaring a fail verdict: **0** (default) to **999999**.

For **Rate**, enter the maximum bit error rate allowed before declaring a fail verdict: **1.0E-14** to **1.9E-01**. The default value is **1.0E-12**.

Service Disruption

The Service Disruption Time (SDT) corresponds to the duration associated to a defect that occurred in the network. For example a disruption that occurs during a network switching from the active channels to the backup channels or vice versa.

Note: *The service disruption measurements are cleared when changing the criteria. Service Disruption is not available for* ***Multi-Pattern****.*

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

Layer	Signal	Defect
Interface	OTN/SONET/SDH	**LOS**
	DSn	**LOS, BPV, EXZ**
	PDH	**LOS, CV**
OTUk	OTN	**AIS, BDI, BEI, BIAE, BIP-8, FAS, IAE, LOF, LOM, MFAS, OOF, OOM**
ODUk	OTN	**AIS, OCI, LCK, BDI, BIP-8, BEI, FSF, BSF, FSD, BSD**
OPUk	OTN	**AIS, CSF**
Section/RS	SONET/SDH	**LOF-S/ RS-LOF, B1**
Line/MS	SONET/SDH	**AIS-L/MS-AIS, RDI-L/MS-RDI, REI-L/MS-REI, B2**
STS/AU Path	SONET/SDH	**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	SONET/SDH	**AIS-V/TU-AIS, LOP-V/TU-LOP, RDI-V/TU-RDI, REI-V/LP-REI, BIP-2, UNEQ-V/LP-UNEQ**
DS1	DSn	**AIS, OOF, RAI, Framing Bit, CRC-6**
DS3	DSn	**AIS, OOF, Idle, RDI, F-Bit, C-Bit, P-Bit, FEBE**
E1	PDH	**AIS, CRC-4, E-Bit, LOMF, TS16 AIS, LOF, FAS, RAI, RAI MF**
E4, E3, E2	PDH	AIS, LOF, FAS, RAI
BER	OTN, SONET/SDH, DSn/PDH	**Pattern Loss, Bit Error**

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)** represents 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.

Note: *Clearing the **Disruption Monitoring** check box will stop the measurement without clearing the results. The disruption monitoring is automatically stopped without clearing results when the test is stopped. However, starting the test again while the **Disruption Monitoring** check box is selected will reset the results before restarting.*

- **Pass/Fail Verdict** check box when selected (cleared by default) enables service disruption pass/fail verdict and allows to set the threshold value.
- **SDT Threshold (ms)** allows to enter the SDT threshold value that will be used to declare the pass/fail verdict: **0.001** to **299999.999 ms** (default is **50** ms). For EtherBERT, the minimum value is adjusted with respect to the **No Traffic Time**.

Multi-Pattern Configuration

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

This 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** 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

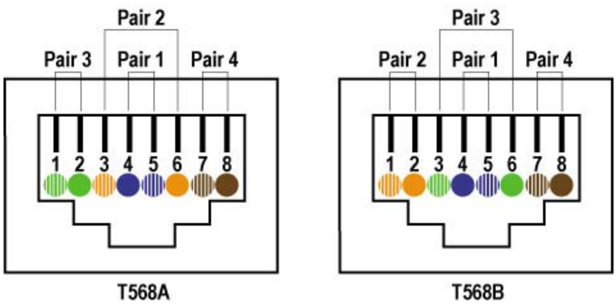
Reverts the current test application to its default factory settings.

Cable Test

From the **Test** menu, tap **Setup**, **Test Configurator**, and the 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 to set 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 1000 Base-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 configured parameters to their default values.

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 to select the source clock that will be used for transmission (TX). The clock mode is forced to **Recovered** for 1GE electrical interface using **Slave** local clock (see **Local Clock** on page 102).

- **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 and Ethernet applications using 10G WAN.
- **External**: Clock signal from the EXT CLK port. Only available on MAX-880 model.

Ext Clock In

Note: *Available on MAX-880 model only and when the **Clock Mode** is set to **External**.*

Allows to set the external clock for test synchronization.

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

  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.

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

- **Termination** mode specifies how the MaxTester 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 to set 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 that the BNC connector type is 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**, available with DS1 and E1, 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**.

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. The **Coupled RX to TX** check box is selected and not configurable for **Seed A**, **Seed B**, and **PRBS31 Unscrambled** patterns.

- **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. See *BER* on page 196 for more information.

- **TX Pattern/RX Pattern**: Select the test pattern from the list for each direction (TX and RX) if required. Choices are **PRBS9**, **PRBS11**, **PRBS15**, **PRBS20**, **PRBS23**, **PRBS31** (default), **Seed A**[1], **Seed B**[1], **PRBS31 Unscrambled**[1], **CSPAT**[2], **CJTPAT**[2], **CRPAT**[2], **Short CRTPAT**[2], **Long CRTPAT**[2], and **User Pattern**.

  When **User Pattern** is selected, enter the payload pattern hexadecimal value.

- **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.

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1. Only available for 10G LAN with **Unframed (Interop)** (see Framing on page 70).
2. Only available for 1G optical with **Framed Layer 1** (see Framing on page 70).

Bit/Pattern Error

The configuration of **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** allows to enable and configure 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/Pattern Error Count**or **Bit/Pattern Error Rate** (default is **Disabled**).

➤ **BER Threshold** allows to enter the threshold **Count** or **Rate** value that will be used to declare the pass/fail verdict.

For **Count**, enter the maximum bit/pattern error count allowed before declaring a fail verdict: **0** (default) to **999999**.

For **Rate**, enter the maximum bit/pattern error rate allowed before declaring a fail verdict: **1.0E-14** to **1.9E-01**. The default value is **1.0E-12**.

Service Disruption

- **No Traffic Time** (ms) represents the time between two Ethernet Frames that is acceptable without raising an alarm including a Service Disruption event: **0.005 ms** to **1000 ms** in step of 0.005 ms (default is **50 ms**). Only available with EtherBERT.
- **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.

Note: *Clearing the **Disruption Monitoring** check box will stop the measurement without clearing the results. The disruption monitoring is automatically stopped without clearing results when the test is stopped. However, starting the test again while the **Disruption Monitoring** check box is selected will reset the results before restarting.*

- **Pass/Fail Verdict** allows to enable and configure the SDT Threshold.
- **SDT Threshold** allows to configure the amount of time with no traffic that is accepted before failing the test: **0.005** to **299999.995** ms in step of 0.005 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; automatically cleared when the test stops. The **Enable TX** check box may also be selected or cleared while the test is running.

Ethernet Frame

Frame Size (Bytes) allows to enter the frame size for Ethernet test applications. The range is from **64**[1] to **16000**[2].

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

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

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

1. 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 92).*

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 from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).
- **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 EtherSAM **Dual Test Set**. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit. Not available in **Dual Port** topology.

Note: *Alternatively it is possible to use the Discover Remote button to connect to a remote module and automatically enable the Dual Test Set. For more details, refer to* Discover Remote Button *on page 348.*

  ➤ **Disconnected** indicates that there is no connection established with a remote module.

  ➤ **Connected** indicates that the connection is established with a remote module.

➤ **Discover Remote** button allows to discover remote modules supporting **Remote Loopback** and/or **Dual Test Set**. For more details, see *Discover Remote Button* on page 348.

Subtests

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

  - **Seconds per Service** indicates the **Service Configuration Test** duration in seconds based on the configured Services, Ramp, and Burst settings.

  - **Ramp Test** check box when selected (default):

    In the first stage of the test, when **CIR** check box is selected (see *SLA Parameters* on page 146), 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 146), 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 145), 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 generated 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 146), 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 146), 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 generated for each enabled service.

- **Service Performance Test** check box when selected (default) verifies that the **SLA** parameters (see *SLA Parameters* on page 146) 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 to set the duration time, in HH:MM:SS format, for the **Service Performance Test** (default is 10 minutes).

- **Global Test Duration Estimate** 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 (P1 to P2 and P2 to P1) 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.

Note: *For **Dual Test Set** the **Per Direction Configuration** is only available when the communication with the remote module 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**, and **Service performance** (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** for rates from 10M to 10GE, allows the selection of the latency measurement mode: **Round-Trip** (default) or **One-Way**. **One-Way** is only available on MAX-880 model.

  Synchronization with an external 1PPS clock 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 ± 6.6 μs after the previous pulse. LOPPS-R is only monitored once the DTS connection is established.

Restore EtherSAM Defaults

Reverts the current 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 92).*

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

The graphic displays the percentage of each CIR level step in time.

Step Time

The step time is the test duration for each ramp step: **5** (default) to **60** seconds.

Ramp Duration

The ramp duration indicates the total time required to perform all the ramp steps for each service.

Add Step

Allows to add 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 to delete 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.

FTFL/PT

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

FTFL

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

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

Fault Indication	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 **Fault Indication 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). By default no Operator Identifier is defined.

➤ **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). By default no Operator Specific is defined.

PT

Note: *Changing the payload type (PT) does not alter the signal structure; it only modifies the OH value that is generated.*

➤ **Payload Type** and **Code**

Generated: Allows to select the payload signal type to be generated either by selecting the payload type from the list or by entering its code in hexadecimal (**00** to **FF**).

Expected: Allows to select the expected payload signal type.

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
Bit Stream with Octet Timing mapping	10	0001	0000
Bit Stream Without Octet Timing mapping	11	0001	0001

Payload type	Hex Code	MSB 1234	LSB 5678
IB SDR mapping into ODUflex	12	0001	0010
IB DDR mapping into ODUflex	13	0001	0011
IB QDR mapping into ODUflex	14	0001	0100
ODU Multiplex with ODTUjk	20	0010	0000
ODU Multiplex with ODTUk.ts/ODTUjk	21	0010	0001
Not Available[b]	55	0101	0101
Reserved Codes for Proprietary Use[c]	80	1000	0000
NULL Test Signal 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**, when selected, enables the OPU-PLM alarm analysis.

Interface (Ethernet)

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

LINK

An arrow is used to indicate the status of the test link.

- A green arrow indicates that the link is up.
- A red arrow indicates alarms, the link is down.
- A gray arrow indicates awaiting incoming data to provide a status.

For Ethernet test application:

- **Auto-Negotiation** check box is available with **10/100/1000M Electrical** and **1GE Optical** interfaces. When the **Auto-Negotiation** check box is selected the test application indicates to the remote port which parameters to use. The **Auto-Negotiation** check box is automatically selected (not configurable) for 1GE Electrical interface and when using an active copper SFP.

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**[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**. Availability of choices depend on the test applications. Half Duplex is not available with an active copper SFP. 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. Availability of choices depend on test applications.
- **Cable Mode** is available with **10/100/1000M Electrical** interface. Availability of choices depend on the test application.

  Manual mode is selected when the **Auto-Negotiation** check box is cleared and allows to select 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 MAX-800 Series to automatically detect the MDI or MDIX cable type.
- **Local Clock** is only available with 1GE interface and allows to set the source of the clock: **Master** (default), or **Slave**, or **Auto**[1].

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

WIS Button

Note: *__WIS__ is only available for __10GE WAN__ interface.*

➤ **J0 Trace** allows to set the **J0 Trace** value in 16 bytes format (default is **EXFO 10GigE**).

➤ **J1 Trace** allows to set the **J1 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: *J0 and J1 values should be 7-bit T.50 suitable characters. The __Padding__ drop list from the message keyboard allows to select __Null__ or __Space__ to fill up the __J0 Trace__ and __J1 Trace__ up to15 byte value. The __Control Characters__ button in the __J0 Trace__ and __J1 Trace__ message keyboard, allows to select the required character. For more details on __Control Characters__, see page 28.*

➤ **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

- **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 in dBm.
- **Wavelength (nm)** indicates the detected wavelength when supported by the transceiver.
- **RX Power (dBm)** indicates, when supported, 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.

- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser in dBm.
- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser in dBm.
- **Lasers OFF at Start-Up** check box when selected automatically turns OFF the laser when starting the MaxTester or when switching from one test application to another. However the laser remains ON, on a remote module receiving a request for a DTS connection or a loopback command. This check box is cleared by default.
- **Power Range (dBm**) indicates the transceiver operational RX power range.

TX Frequency

Note: *Not available when using an active copper SFP*

- **TX Frequency (GHz)** indicates the frequency (actual frequency + Frequency offset) used for transmission.
- **Offset (ppm)** check box, when selected (cleared by default), allows to set the frequency offset that will be generated: ±120 ppm. 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 to set 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: *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. **LOC** is also displayed.
Gray	Pending state.

- **Max Offset (ppm)**

  Negative indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.

  Positive 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.

Note: *Selecting a Label byte to be generated will automatically update the corresponding OH byte. Refer to* OH - SONET/SDH *on page 311 for more information.*

Labels

- **STS/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: Select the C2 byte from the list. Selecting a C2 byte value will automatically update the OH C2 selection and vice versa. Refer to *C2* on page 319 for more information.

- **PLM-P/UNEQ-P** / **HP-PLM/HP-UNEQ**: Enables the Payload Mismatch and STS/AU UNEQ monitoring. This setting is coupled with the configuration of *Traces - SONET/SDH* on page 280.

  Expected: Select the expected C2 byte from the list. Refer to *C2* on page 319 for more information.

- **VT/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**: Select the V5 byte from the list. Selecting a V5 byte value will automatically update the OH V5 selection and vice versa. Refer to V5 on page 322 for more information.
- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ**: Enables the Payload Mismatch and VT/TU UNEQ monitoring. This setting is coupled with the configuration on the *Labels* on page 241.
- **Expected**: Select the expected V5 byte from the list. Refer to V5 on page 322 for more information.

MAC/IP/UDP

Note: *Only available with Framed Layer 2 (see* ***Framing*** *from the* Modify Frame Structure*). For Traffic Gen & Mon all parameters are configurable per stream. For EtherSAM all parameters are configured per service.*

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 (Traffic Gen & Mon)

The Traffic Gen & Mon test application supports the configuration of up to 16 different streams. 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.

Service Selection (EtherSAM)

The EtherSAM test application supports the configuration of up to 10 different services. 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.

Couple with Interface

The **Frame Format**, **Network Layer**, and all **IP** and **VLAN** settings are coupled with the interface (see *Network* on page 120) when the **Couple with Interface** check box is selected (default). The **Source MAC Address** is always coupled.

Modify Frame Structure

Allows to modify the structure of the frame.

- **Global Option**

  IP Version allows to select **IPv4** (default) or **IPv6** that will be used for both the interface and all streams/services.

- **Framing**

  - **Frame Format** (layer 2) allows to select **Ethernet II** (default) or **802.3 SNAP** as the frame format.
  - **Network Layer** (layer 3) sets the network traffic type: **IPv4** (default)/**IPv6**, or **None**.
  - **Transport Layer** is disabled when the **Network Layer** is **None**.

Test Application	Transport Layer
EtherSAM	**None**, **UDP** (default), **TCP**
RFC 2544	**UDP**
EtherBERT	**UDP** (default), **TCP**
Traffic Gen & Mon	**None**, **UDP** (default), **TCP**

- **MPLS**: The **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.

- **VLAN**: The **VLAN Tag** check box when selected (cleared by default), enables up to 3 stacked VLAN.

  See *VLAN* on page 111 for additional VLAN settings.

Preamble/SFD

Indicates that the frame structure contains the Preamble and SFD.

MAC

- **Source MAC Address** indicates the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **Destination MAC Address**: Enter 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* on page 113. This check box is not available when the **Network Layer** is set to **None** (refer to *Modify Frame Structure* on page 109).
- **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.
- **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 to enter the **OUI** value: **0x000000** (default) to **0xFFFFFF**.

Note: ***Source/Destination Flooding*** *and* ***Flood Range*** *are only available with Traffic Gen & Mon when the Network Layer is set to None (see page 109).*

- **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.
- **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).

VLAN

Note: *VLAN is only available when the VLAN Tag is enabled; refer to* Modify Frame Structure *on page 109.*

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

- **VLAN ID** choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 431 for more information.
- **Priority**, VLAN user priority, choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 431 for more information.
- **Type**, VLAN Ethernet Type, choices are **8100** (default for C-VLAN), **88A8** (default for S-VLAN), **9100** (default for E-VLAN), **9200**, and **9300**.
- **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 8100. This parameter is set to **No** by default.

MPLS

Note: *MPLS is only available when the MPLS Label is enabled; refer to* Modify Frame Structure *on page 109.*

➤ **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 the selection of the **Time to Live** value: **0 to 255** (default is **128**).

IP

For **IPv4** the following configuration parameters are available.

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

➤ **Source IP Address** allows to enter 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 to enter the destination IP address for the stream. The default setting is the source IP address.

For **IPv6** the following configuration parameters are displayed: **Source Link-Local IPv6 Address**, and **Source Global IPv6 Address**. Tap on the **IPv6 Config** button to access all settings.

➤ **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 to enter the IP Address.

  ➤ **Address**, available with **Static** mode, allows to select 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 to select 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 the **Default Gateway Address**.

    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 Address,** the global address will not be generated.

    Static allows to enter the IP address.

  - **Address**, available with **Static** mode, allows to select 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 to select a previously configured IP address.

  - **Interface ID Coupled**, available when the **Source Global IPv6 Address** mode is **Static**, allows to couple 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 to specify 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 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 to enter 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**.

- **IPv6 Destination Address** allows to select 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 to select a previously configured IP address.

The following configuration parameters are available for both **IPv4** and **IPv6** unless otherwise specified.

- **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 325 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 110. The Resolve MAC address status is displayed. Possible status are:

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**.
- **Subnet Mask** (IPv4) allows to enter the Subnet Mask for the stream. The default setting is **255.255.0.0**. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Default Gateway** (IPv4) check box, when selected (cleared by default), allows to enter a default Gateway IP address. When the **Default Gateway** check box is selected, its default address is **0.0.0.0**. The **Default Gateway** address is not configurable when the **Automatic IP (DHCP)** check box is selected.

➤ **TTL** (IPv4) or **HOP Limit TTL** (IPv6) sets the Time To Live value: **1** to **255** (default is **128**).

➤ **Flow Label** (IPv6) is a number used to identify a series of related packets from a source to a destination: **0** (default) to **1048575**.

➤ **IP TOS/DS** (IPv4) or **Traffic Class (TOS/DS) -** (IPv6) allows to enter 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.

TOS/DS

➤ **TOS/DS** allows to select either Type Of Service (TOS) or Differentiated Services (DS).

➤ **Binary/Hex** allows to display, once this pop-up is closed, the IP TOS/DOS value either in binary or hexadecimal.

Type Of Service (available when **TOS** is selected).

➤ **Precedence** value:
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 (available when **DS** is selected).

- **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)**, **101110 (EF)**, **110011 (51)**, **110110 (54)**, or **User Defined**.
- **User Defined Codes**, available when **User Defined** has been selected from the **DSCP codepoints**, allows to enter 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)**.

UDP

Allows the selection of the source and destination UDP port number.

➤ **Source Port** is configurable from **0** to **65535**; the default is **49184**.

➤ **Destination Port** is configurable from **0** to **65535**; the default is **7 (echo)**.

TCP

Allows the selection of the source and destination TCP port number.

➤ **Source Port** is configurable from **0** to **65535**; the default is **49184**.

➤ **Destination Port** is configurable from **0** to **65535**; the 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 to define a 16-byte header.

➤ **Pattern** allows the selection of a pattern: **00** to **FF** (default is **CC**).

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 to change, 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 to select **Ethernet II** (default) or **802.3 SNAP** as the frame format.

IP

IP Version allows the selection of either **IPv4** (default) or **IPv6**.

For **IPv4** the following configuration parameters are available.

- **Automatic IP (DHCP)** check box, when selected (cleared by default), allows to dynamically obtain an IP address from a DHCP (Dynamic Host Configuration Protocol) server.
- **IP Address**[1]: Enter the IP address of the port. 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.
- **Subnet Mask**[1]: Enter the Subnet Mask. The default setting is **255.255.000.000**.
- **Default Gateway**[1] check box, when selected (cleared by default), allows to enter a default Gateway IP address. When the **Default Gateway** check box is selected, its default address is **0.0.0.0**.

1. Not configurable when the **Automatic IP (DHCP)** check box is selected.

For **IPv6** the following configuration parameters are displayed: **Link-Local IPv6 Address**, **Global IPv6 Address**, and **Default Gateway**. Tap on the **Config** button to access all settings.

➤ **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 to enter the IP Address.

➤ **Address**, available with **Static** mode, allows to select 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 to select 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 the **Default Gateway Address**.

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 Address,** the global address will not be generated.

Static allows to enter the IP address.

➤ **Address**, available with **Static** mode, allows to select 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 to select a previously configured IP address.

➤ **Interface ID Coupled**, available when the **Source Global IPv6 Address** mode is **Static**, allows to couple 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 to specify 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 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 to enter 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**.

VLAN

VLAN Tag check box, when selected (cleared by default), enables and allows to set up to 3 stacked VLANs.

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

- **VLAN ID** choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 431 for more information.
- **Priority**, VLAN user priority, choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 431 for more information.
- **Type**, VLAN Ethernet Type, choices are **0x8100** (default for C-VLAN), **0x88A8** (default for S-VLAN), **0x9100** (default for E-VLAN), **0x9200**, and **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 8100. This setting is set to **No** by default.

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 RFC 2544 **Dual Test Set**. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit. Not available in **Dual Port** topology.

Note: *Alternatively it is possible to use the Discover Remote button to connect to a remote module and automatically enable the* ***Dual Test Set****. For more details, refer to* Discover Remote Button *on page 348.*

  - **Disconnected** indicates that there is no connection established with a remote module.
  - **Connected** indicates that the connection is established with a remote module.

- **Discover Remote** button allows to discover remote modules supporting **Remote Loopback** and/or **Dual Test Set**. For more details, refer to *Discover Remote Button* on page 348.

Global Options

- **Flow Direction** allows the selection of the traffic direction as follows:
  - **TX to RX** for **Single Port** topology.
  - **Port #1 to Port P2**, **Port #2 to Port #1**, and **Bidirectional** for **Dual Port** topology.
  - **Local to Remote**, **Remote to Local**, and **Bidirectional** for **Dual Test Set**.
- **Rate Unit** determines the unit used to display the rate values: **%**, **Mbit/s**, or **Gbit/s**.
- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict.

Subtests and Estimated Time

- **Subtests** allows to individually enable the **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** subtests.
- **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 to select either **RFC 2544** (default) or **User Defined** distribution.
- **Quantity** is only available when **User Defined** is selected and allows to select the number of frames, from **1** to **7** (default), in the distribution.
- **Frame Size (Bytes):** For **RFC 2544** distribution, gives predefined frame size distribution values. For **User Defined** distribution, enter up to seven frame size values.

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)
IPv4	20 bytes
IPv6	40 bytes
Using DTS	4 bytes

Restore RFC 2544 Defaults

Reverts the configured parameters to their default values.

RFC 2544 - Subtests

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

Allows the configuration of each enabled subtest.

Throughput

The objective of this 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 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 to remote (**L->R**) and remote to local (**R->L**) directions. For **Dual Port** topology, Max. Rate is configurable for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**) 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]

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 throughput 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. The accepted values are as follows:

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

➤ **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 this 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** represents the number of times the Back-to-Back test will be generated: **1** (default) to **100** 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 Configuration

The objective of this 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 130. For **Dual Test Set**, **Max. Rate** is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions. For **Dual Port** topology, Max. Rate is configurable for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**) directions.

➤ **Trial Duration** represents the time value for each trial in minutes:seconds: **1** second to **30** minutes (default is **00:01**).

➤ **Trials** represents 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 Configuration

The objective of the 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** represents the time value for each trial in “minutes:seconds”: **1** second (default) to **2** minutes.

➤ **Trials** represents 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** for rates from 10M to 10GE, allows the selection of the latency measurement mode: **Round-Trip** (default) or **One-Way**. **One-Way** is only available on MAX-880 model.

  Synchronization with an external 1PPS clock 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 to set the **Max. Rate** for each frame size. For **Dual Test Set** the **Max. Rate** is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions. *For **Dual Port** topology, Max Rate is configurable for P1 to P2 (P1->P2) and P2 to P1 (P2->P1) directions.*

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

Thresholds Button

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 P1 to P2 (P1->P2) and P2 to P1 (P2->P1) directions.*

➤ **Throughput Threshold** sets the threshold[1] value used to declare a pass/fail verdict and it applies to all frame sizes when applicable. The range is as follows:

Interface Speed	Max. Rate		
	%	Mbit/s	Gbit/s
10 Mbit/s	0.000 to 100.000[a]	0.000 - 10.000[a]	Not Applicable
100 Mbit/s	0.000 to 100.000[a]	0.000 - 100.000[a]	Not Applicable
1000 Mbit/s	0.000 to 100.000[a]	0.000 - 1000.000[a]	0.000 - 1.000[a]
10G LAN	0.000 to 100.000[a]	0.000 - 10000.000[a]	0.000 - 10.000[a]
10G WAN[b]	0.000 to 92.8571[a]	0.000 - 9230.769[a]	0.000 - 9.230[a]

a. Defalut 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.

➤ **Back-to-Back Threshold** sets the threshold[1] value in percentage of frames per burst to declare a pass/fail verdict. The range is from **0.0** to **100.0** (default) percent and it applies to all frames sizes when applicable.

➤ **Frame Loss Threshold (%)** sets the threshold[2] value of frame loss. The range is from **0.000** to **100.000** (default is **0.100**) and it applies to all frame sizes when applicable.

1. The verdict is PASS when the received/measured value is greater or equal to the threshold value.
2. The verdict is PASS when the received/measured value is lower or equal to the threshold value.

- **Latency Threshold** / **Round-Trip Latency Threshold** sets the threshold value as the maximum delay in **ms** or **μs**. The range is from **0.5** to **8000.0 ms** (default is **125.0** ms) and it applies to all frame sizes when applicable. For **Dual Test Set**, only available with **Round-Trip Latency Measurement Mode** (**o**nly available on MAX-880 model, see *Latency Configuration* on page 134).
- **One-Way Latency Threshold**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Latency Configuration* on page 134), sets the maximum one-way latency value in millisecond, allowed for all frame sizes: **0.005** to **500 ms** (default is **125 ms**).
- **Latency Unit** allows to either select **ms** or **μs** as the reference unit for the **Latency Threshold**.

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 to sequentially enable service(s) within the limit of the link capacity when the **Service Performance Test** is enabled or enable all services when the **Service Performance Test** is disabled.
  - The check boxes next to the service numbers allow to enable 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 141 for more information.
- **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

- **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 108).
- **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 108).
- **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 108).

  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 138 for more information on check boxes, **Direction**, and **Service Name**.

See *SLA Parameters* on page 146 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 92). 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 choices are **%** (default), **Mbit/s**, and **Gbit/s**.

Copy Service Button

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

➤ **Copy Service** allow to select the services number from which the configuration will be copied from.

➤ **To the following Services** allows to select 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 to confirm 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 92).*

Indicates the total transmit rate of all services enabled for transmission. Unit selection is available from the *SLA Parameters* on page 146.

Profile

➤ **Profile** button allows to select the emulation profile. The selected service profile icon, name, and configuration (when applicable) is displayed next to the **Profile** button.

Select the emulation profile: **Voice**, **Video**, or **Data** (default).

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.*

➤ **Frame Size (Bytes)** indicates the frame size for **Voice** and **Video** profiles and allows to change the frame size for **Data** profile:

Fixed (default)

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 type is selected. The EMIX frame sequence is repeated until the test ends.

Quantity allows to select from 2 to 8 frames size values (default is **5**).

EMIX Frame Sizes allows to set the EMIX frame sizes (default are **64**, **128**, **512**, **1024**, and **1518**). The minimum frame size value is adjusted according to the frame structure and components selected as shown in the above table.

Restore Default button reverts the quantity and EMIX frame sizes to their default values.

Test Parameters

Note: *Unit selection is available from the* SLA Parameters *on page 146.*

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

For **Dual Port** topology, parameters are configurable for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

- **Traffic Policing** check box when selected (default) allows to stress the rate limiting of the network by sending traffic at higher rate than committed by the SLA.
- **Burst Max Rate** allows to set 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 92).

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 to remote (**L->R**) and remote to local (**R->L**) directions at the exception of Max Round-Trip Latency for which the value is unique.

For **Dual Port** topology, parameters are configurable for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

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 92).

- 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 (ms)** allows to set the maximum jitter value in millisecond, allowed for the service: **0.015** to **8000 ms** (default is **2 ms**).
- **Max Round-Trip Latency (ms)** allows to set the maximum round-trip latency value in millisecond allowed for the service: **0.015** to **8000 ms** (default is **15 ms**). For **Dual Test Set**, only available with **Round-Trip Latency Measurement Mode** (only available on MAX-880 model, see *Global Options* on page 95). Not available in **Dual Port** topology.
- **Max Latency**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Global Options* on page 95) and Dual Port topology, allows to set the maximum one-way latency value in millisecond, allowed for the service: **0.015** to **500 ms** (default is **15 ms**).
- **Frame Loss Rate** allows to set the maximum rate of Frame Loss allowed for the service: **0.0E00** to **5.0E-02**, default is **1.0E-03**.

Note: *For Dual Test Set, the Frame Loss Rate is changed to percentage when the remote module does not support exponential notation. In this case a Frame Loss Rate Threshold lower than 1.0E-06 (0.0001 %) is considered as 0 %; the configurable range is **0** to **5** percent.*

SFP/SFP+

The SFP/SFP+ tab gives hardware information related to the inserted SFP/SFP+ module.

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

Signal (Transport)

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

Physical Interface

Note: *For electrical interface, see* Physical Interface - Electrical *on page 150.*

- **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 in dBm.
- **Wavelength (nm)** indicates, when supported, the detected laser wavelength.
- **RX Power (dBm)** indicates, when supported, 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.
- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser in dBm.
- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser in dBm.

- **Lasers OFF at Start-Up** check box when selected automatically turns OFF the laser when starting the Power Blazer or when switching from one test application to another. However the laser remains ON, on a remote module receiving a request for a DTS connection or a loopback command. This check box is cleared by default.
- **Power Range (dBm)** indicates the transceiver operational RX power range.

Physical Interface - Electrical

Note: *The following settings are available with electrical signal and their availability depend on the signal itself and its mapping. For optical interface, see* Physical Interface *on page 149.*

- **LBO** (Line Build Out): The **LBO** allows to meet 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

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

➤ **Offset (ppm)** check box, when selected (cleared by default), allows to set 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
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

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 to set 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

- **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. **LOC** is also displayed.
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 208 for more information on standard rate specifications.*

Signal Configuration

- For OTN, refer to *Signal - Signal Configuration (OTN)* on page 164 for more information.
- For SONET/SDH, refer to *Signal - Signal Configuration (SONET/SDH)* on page 166 for more information.
- For DSn/PDH, refer to *Signal - Signal Configuration (DSn/PDH)* on page 155 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.

Framing

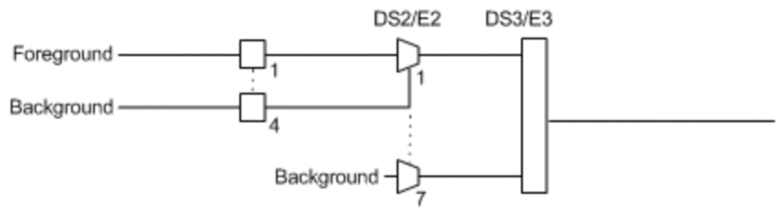
Framing allows the selection of the framing that will be used for transmission.

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 case, allows the selection of the default timeslot background traffic: **AIS** (default) or **All Zeros**.



The diagram above shows a test case defined with DSn/PDH traffic where the background traffic is also inserted for the unused timeslots in a test case data path. The insertion is similar to the low order path SONET/SDH terminated signal where the background traffic format inserted uses the same rate as the one defined in the test case data path.

Channel

Channel, for multiplex text case, allows the selection of the channel number of the mapped signal.

DS0/E0

The **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

The **TX Signaling** check box when selected (cleared by default) allows generation of the signaling bits for the 24 - DS0 channels. Only available when the **DS0** check box is selected.

Modify DS0/E0

Modify DS0/E0 button is only available when the **DS0/E0** check box is selected.

Note: *For DS0, the framing structure have 24 timeslots. For E0, the framing structure PCM-30 and PCM30 CRC-4 have 30 channel timeslots while PCM-31 and PCM-31 CRC-4 have 31 channel timeslots.*

- **DS0/E0 Size** sets the channel timeslot data rate for the pattern payload content to either **56K** or **64K** (default); forced to **56K** 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	Available with
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).*

Bit #	1	2	3	4	5	6	7	8
	MSB							LSB

➤ **Payload Content** and **Set All**

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**.

➤ **TX**

Select the payload content by tapping once or several times on each timeslot until the desired content appears: **Pattern** (default), **Idle**, or **Tone**.

Note: *For Pattern, the pattern that will be used is the one selected from* Pattern *on page 74.*

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. Choices are **00** to **FF**. The selected Idle code applies to all timeslots set to Idle. The default setting is **7F**.

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

Binary allows either displaying the Idle code values in binary (when selected) or in hexadecimal (default).

➤ **RX**

Apply Channel TX to RX, available for decoupled test, allows to apply the RX payload content based on the TX settings. **None** will be used when TX is set to either **Idle** or **Tone**.

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.*

Select the payload content by tapping once or several times on each timeslot until the desired content appears.

Pattern (default) uses the pattern from the received signal.

None does not use the pattern.

Loopback button

The Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

Select 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 button* on page 161).

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** button

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 long. 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**).

DS1 Loopback - for NI/CSU Emulation Test

The 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**: Select the Type of loopback code that will be applied; **Line**, or **Payload**. Payload is not available when the framing is **Unframed**.

  For **Auto-Response**: Select the Type of loopback code on which the MaxTester 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 selection (Type).

- **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 button* on page 161.	

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 / Activate / Release**
  - **Force Release** button, available with **Auto-Response** mode, allows to release a loopback condition initiated from the network. Only available when a loopback is active.
  - **Activate** button, available with **Manual** mode when no loopback is active, allows to send a loopback condition.
  - **Release** button, available with **Manual** mode when a loopback is active, allows to release the loopback condition.
- **Loop-Up** indicates the selected loop up code.
- **Loop-Down** indicates the selected loop down code.
- **Modify Loop Codes** button: See *Modify Loop Codes button* on page 161 for more information.

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.

➤ **OTU2** or **OTU1**

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 to detect, report, and correct up to 8 symbol errors (Correctable) per codeword. If there are over 8 symbol errors detected, they are reported as uncorrectable errors.

➤ **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 which may cause alarms/errors. This configuration can be used for special analysis in a lab environment.*

- **ODU2**, or **ODU1.**
  - **OPU Tributary Port**, available for each OPU level of a mapped signal, indicates the OPU tributary port used for the test. Tap the **Modify Trib Slots/Port** button to change the OPU tributary port.
  - **OPU Tributary Slots**, available for each OPU level of a mapped signal, indicates the OPU tributary slots used for the test. Tap the **Modify Trib Slots/Port** button to change the OPU tributary slots.
  - **TCM** indicates each Tandem Connection enabled; **No TCM** indicates that no TCM is enabled. To enable TCM, tap the **Config TCM** button.
- **Config TCM**

  Allows to enable 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 184 for more information.

Signal - Signal Configuration (SONET/SDH)

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

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/MS-REI Computation Method** (OC-192/STM-64 only): Allows to select the default method used to calculate the REI-L/MS-REI error for OC-192 and STM-64 signals. Choices are **M1 Only** and both **M0 and M1**. The default setting is M1 only.

- **STS/AU and VT/TU Mappings Timeslot/Number**

  Timeslot (SONET) allows the selection of the STS timeslot number. Refer to *SONET Numbering Convention* on page 425 for more information.

  Number (SDH) allows the selection of the AU channel number. Refer to *SDH Numbering Convention* on page 426 for more information.

- **TCM** check box when selected (cleared by default) allows Tandem Connection Monitoring (TCM).

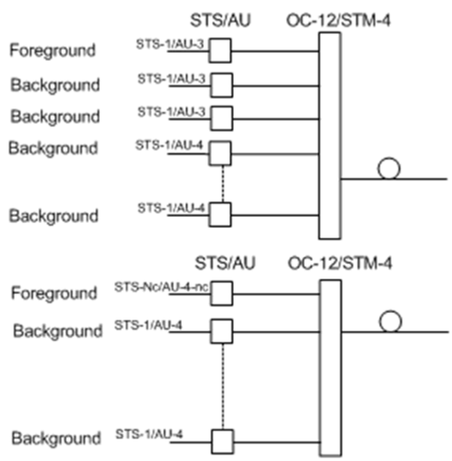
- **TC-UNEQ-P** / **TC-UNEQ-V** / **HPTC-UNEQ** / **LPTC-UNEQ** check boxes when selected (cleared by default) allows the monitoring of the corresponding Tandem Connection - Unequipped alarm. Only available when the **TCM** check box is selected.

- **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* on page 74.

- **Background Traffic** allows the selection of the high order path background traffic: **AIS**, **Equipped** (PRBS23) - (default), or **Unequipped**.

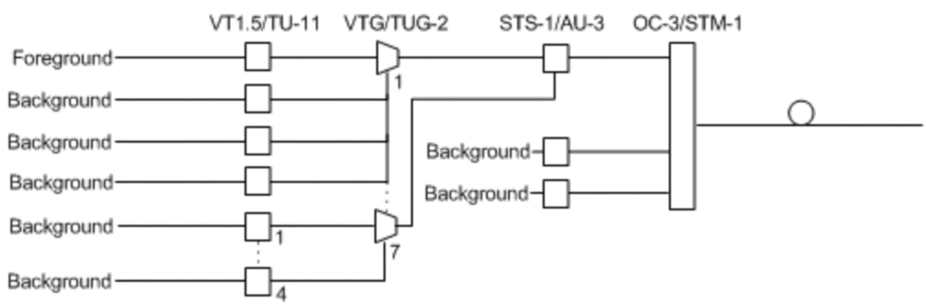
STS/AU Path (SONET/SDH HOP):

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 72).*

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 to sequentially enable stream(s) within the limit of the link capacity.

  The check boxes next to the stream numbers allow to enable 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 177).
- **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 108).
- **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).

1. See the Profile tab for more information.

- **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).

  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** choices are **%** (default), **Mbit/s**, **Gbit/s**, **frame/s**, and **IFG**.
  - **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 to copy 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.

  Voice when selected allows the configuration of the following parameters.

  - **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 and default value is **1** for 10M to 1G interface, and **5** for 10G interfaces.
  - **Rate** indicates the rate corresponding to the selected codec and the number of calls.

  Video when selected allows the configuration of the following parameters.

  - **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.

- **Frame Size (Bytes)** for Data profile is selectable: **Fixed** (default), **Random**, or **Sweep**. The Frame Size is forced to **Fixed** for Voice and Video profiles.
  - For **Fixed** type, the frame size is as follow.

Profile	Codec	Frame Size	
		IPv4	IPv6
Voice	VoIP G.711	**138**	**158**
	VoIP G.723.1	**82**	**102**
	VoIP G.729	**78**	**98**
Video	All codec	**1374**	**1394**
Data	-	Programmable from **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 frame size value.

  - For **Random** type, the frame size range is from 64 to 1518 bytes. However, 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 frame size value. The maximum frame size value is also adjusted for VLAN (+4 bytes per VLAN).

➤ For **Sweep** type, 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. The frame size range is from 64 to either 10000 bytes for electrical interfaces or 16000 bytes for optical interfaces; default is 1518 bytes. However, 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 frame size value.

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

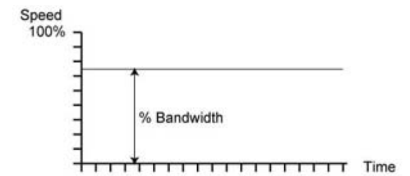
Component	Description
VLAN	4 bytes per VLAN (up to 2 VLAN)
MPLS	4 bytes per label (up to two labels)
UDP	8 bytes
Ethernet Header	14 bytes
IPv4	20 bytes
IPv6	40 bytes

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.

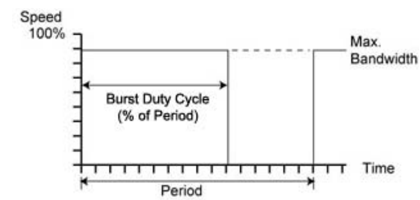
Continuous (default) transfers the selected frame continuously according to the selected percentage of bandwidth.

n-Frame transfers the selected number of frames.



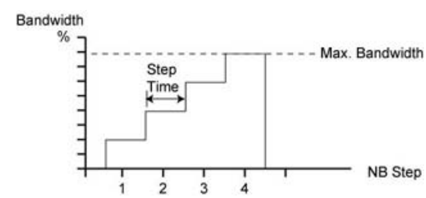
Burst transfers the selected frame at maximum bandwidth for the selected **Burst Duty Cycle** over the **Period**.

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 to enter 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

  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**.

- **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 to select if the verdict is based on the **Current Throughput** (default) or **Average Throughput**.
  - **Frame Loss** allows to select if the verdict is based on a frame loss **Count** (default) or **Rate**.
  - **Out-of-Sequence** allows to select 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 to set the minimum and maximum threshold values.

➤ **Frame Loss Count/Rate** check box when selected enables the Frame Loss pass/fail verdict and allows to set 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 to set 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 (ms)** check box when selected enables the Jitter verdict and allows to set the maximum Jitter in ms before declaring a fail verdict.

➤ **Latency (ms)** check box when selected enables the Latency verdict and allows to set the maximum Latency in ms 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.

Timer

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

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

Timer

Note: *For RFC 2544, 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 20 for more information.*

Traces (OTN)

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the signal block, and on the **Traces** tab.

OTUx, ODUx, and TCM Buttons

Tap on either OTUx or ODUx button. For ODUx when TCM is enabled (see Modify TCM on page 165), tap on a TCMx button to select a TCM level.

SM/PM/TCM TTI Traces

Note: *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; see* **Modify TCM** *on page 165).*

➤ **Generated Message**

Allows editing the SAPI, DAPI and Operator Specific messages to be generated.

➤ **Expected Message**

Allows editing the expected SAPI, and DAPI messages. The expected message settings are coupled with the **Expected Message** from *Traces - OTN* on page 278.

➤ **SAPI** (Source Access Point Identifier) corresponds to the TTI bytes 0 to 15. A maximum of 16 characters is allowed. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined. The expected SAPI message is available when the **SAPI OTU/ODU-TIM** check box is selected.

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) corresponds to the TTI bytes 16 to 31. A maximum of 16 characters is allowed. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined. The expected DAPI message is available when the **DAPI OTU/ODU-TIM** check box is selected.

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** corresponds to the TTI bytes 32 to 63. A maximum of 32 characters are allowed. NULL (all 0's) characters are automatically appended to the message for bytes that are not defined.

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/ODU/TCM-TIM** check box, when selected (cleared by default), allows editing the expected Source Access Point Identifier (SAPI) and also enables OTU/ODU/TCM-TIM alarm monitoring.

➤ **DAPI OTU/ODU/TCM-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier (SAPI) and also enables the OTU/ODU/TCM-TIM alarm monitoring.

Traces (SONET/SDH)

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

Note: *Selecting a Trace byte to be generated will automatically update the corresponding OH byte. Refer to* OH - SONET/SDH *on page 311 for more information.*

Traces

➤ **Section/RS (J0)**, **STS/AU/TU-3 Path (J1)**, and **VT/TU Path (J2)**

Format: Allows the selections of the J0/J1/J2 format: **1 Byte** (default), **16 Bytes**, or **64 Bytes** format.

Generated: When the 16 bytes or 64 bytes format is selected, enter the J0/J1/J2 trace value/message to be generated.

Default values/messages

Format (bytes)	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 311 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 28.*

- **TIM-S/RS-TIM**, **TIM-P/HP-TIM**, **TIM-V/LP-TIM**: Enables the corresponding Trace Identifier Mismatch for the expected message defined. These settings are coupled with the *Result - Traces/Labels* configuration (refer to *Traces - SONET/SDH* on page 280).

  Format: Allows the selection of the expected format: **16 Bytes** (default), or **64 Bytes**.

  Expected: Allows entering the expected J0 trace message for TIM-S/RS-TIM, J1 for TIM-P/HP-TIM, and J2 for TIM-V/LP-TIM. See *Default values/messages* on page 187.

TCM Access Point Identifier

Note: *Available when TCM is enabled from the* Signal - Signal Configuration (SONET/SDH) *on page 166.*

- **STS/AU Path (N1)**, and **VT/TU Path (Z6 or N1 (TU-3))**

  Enter the N1/Z6 value/message to be generated.

- **TC-TIM-P/HPTC-TIM/TC-TIM-V/LPTC-TIM**: Enables the corresponding TCM Access Point Identifier for the expected message defined. These settings are coupled with the Traces configuration from *Traces - SONET/SDH* on page 280.

9 Test Results

The Test Results menu offers the following structure:

Transport test applications

Tab	Available with					Page
	a	b	c	d	e	
Alarms/Errors	X	X	X	X	-	193
Alarms/Errors Logger	-	-	-	-	-	242
FTFL/PT	X	-	-	-	-	238
Labels	-	X	-	X	-	241
Logger	X	X	X	X	X	242
Performance Monitoring	X	X	X	X	-	245
Summary	260	260	260	260	272	<---
Traces	278	280	-	280	-	<---

a. OTN BERT
b. SONET/SDH BERT
c. DSn/PDH BERT
d. SONET/SDH - DSn/PDH BERT
e. NI/CSU Emulation

Ethernet test applications

Tab - Subtab	Test Application							Page
	a	b	c	d	e	f	g	
Alarms/Errors	X	X	X	X	X	X	-	193
Graph	-	X	-	-	-	-	-	240
Logger	X	X	X	X	-	X	-	242
Service Configuration - Burst	X	-	-	-	-	-	-	252
Service Configuration - Ramp	X	-	-	-	-	-	-	253
Service Performance	X	-	-	-	-	-	-	255
Streams - Frame Loss / Out-of-Sequence	-	-	-	X	-	-	-	257
Streams - Jitter	-	-	-	X	-	-	-	257
Streams - Latency	-	-	-	X	-	-	-	258
Streams - MPLS	-	-	-	X	-	-	-	244
Streams - Throughput	-	-	-	X	-	-	-	259
Summary	269	273	260	276	260	260	265	<---
Traffic - Ethernet	X	X	X	X	X	X	-	281
Traffic - Flow Control	-	X	-	X	-	X	-	283
Traffic - Graph	-	-	-	X	-	X	-	285
Traffic - MPLS	-	-	-	-	-	X	-	244
WIS	X	X	X	X	X	-	-	286

a. EtherSAM
b. RFC 2544
c. EtherBERT
d. Traffic Gen & Mon
e. Smart Loopback
f. Through Mode
g. Cable Test

Alarms/Errors Overview

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.
	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.

- **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: *Some Alarms/errors groups display a magnifying icon allowing to see more information on alarm/error like Second, Count, and Rate information.*

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.

P1 and P2 Buttons

The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display the alarms/errors for port #1 (**P1**) or port #2 (**P2**).

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.

Alarms/errors blocks containing the magnifier (+) icon in its title**,** opens a zoomed view giving more details like 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**.

The following table lists the availability of alarms/errors per layer for TX and RX.

Layer	Alarms/Errors		Page
	TX/RX	RX only	
BER	Pattern Loss	No Traffic	196
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a. Available in TX only.

BER

Alarms

- **No Traffic** (Available with EtherBERT)

  RX: No pattern traffic has been received in the last second.

- **Pattern Loss**

  RX: More than 20 percent of bit errors are received or the reference sequence can be unambiguously identified as out of phase.

Errors

- **Bit Error**

  RX: There are logic errors in the bit stream (i.e., zeros that should be ones and vice versa).

- **Pattern Error**

  RX: Indicates a block mismatch. Only available with **Seed A** or **Seed B** pattern.

- **Mismatch '0'** (Available with EtherBERT)

  RX: There is a bit error on a binary '0' (for example ones that should be zeros) found in the test pattern only.

- **Mismatch '1'** (Available with EtherBERT)

  RX: There is a bit error on a binary '1' (for example zeros that should be ones) found in the test pattern only.

Clock

- **LOC** (Loss Of Clock)

  RX: The MaxTester is unable to synchronize with the selected **Clock Mode**. No valid clock is generated/extracted to/from the EXT CLK port.

- **LOPPS-L** and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) is only available with **Dual Test Set** in **One-Way Latency** measurement mode.

  RX: 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.

DS1

Alarms

- **AIS** (Alarm Indication Signal)

  RX: An unframed all-ones signal is received.

- **OOF** (Out-OF-Frame)

  RX: Four consecutive frame bit errors are detected.

- **RAI** (Yellow) (Remote Alarm Indication)

  RX:

  SF framing: Bit 2 in each timeslot contains “0”.

  ESF framing: Eight “ones” followed by eight “zeros” pattern is received continuously in the data link (FDL).

Errors

- **Framing Bit**

  RX: An incorrect value appeared in a bit position reserved for framing.

- **CRC-6** (Cyclical Redundancy Check) is only available with ESF framing.

  RX: One or more bit errors have been detected in a block of data through cyclical redundancy check.

DS3

Alarms

- **AIS** (Alarm Indication Signal)

  RX: The M-frame contains zeros (0) for C-bits, ones (1) for X-bits, 1010... repeating sequence with a one (1) immediately following any of the control bit positions for the information bits.

- **Idle** (DS3 Idle)

  RX: 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.

- **OOF** (Out-OF-Frame)

  RX: Four consecutive frame bit errors are detected.

- **RDI** (Remote Defect Indicator)

  RX: Both X-bits of the M-Frame are set to “0”.

Errors

- **CP-Bit** (Control-Bit)

  RX: The three C-bits reserved to control bit stuffing are different of “111” and “000”.

- **F-Bit** (Framing-Bit)

  RX: The frame alignment pattern received is different of “1001”.

- **P-Bit** (Parity-Bit)

  RX: The P-Bits does not match the parity of all the information bits following the first X-Bit of the previous DS3 frame.

- **FEBE** (Far-End Block Error)

  RX: The three FEBE bits reserved for framing or parity error detection contain the “000” pattern.

E1

Alarms

Note: *Only AIS is available when the framing is set to* ***Unframed****.*

➤ **AIS** (Alarm Indication Signal)

RX: An unframed all-ones signal is received.

➤ **LOF** (Loss Of Frame)

RX: Three consecutive incorrect frame alignment signals is received.

➤ **RAI** (Yellow) (Remote Alarm Indication)

RX: Bit 3 in timeslot 0 is set to “1”.

➤ **TS16 AIS** (TimeSlot 16 Alarm Indication Signal)

RX: Timeslot 16 is received as all-ones for all frames of two consecutive multiframes.

➤ **LOMF** (Loss Of MultiFrame)

RX: Two consecutive multiframes alignment signals (bits 1 through 4 of TS16 of frame 0) is received with an error.

➤ **RAI MF** (Remote Alarm Indication Multi-Frame)

RX: Bit 6 of timeslot 16 of frame 0 is set to “1”.

Errors

- **FAS** (Frame Alignment Signal) is only available with **PCM30 CRC-4** or **PCM31 CRC-4** framing.

  RX: Bits 2 to 8 of the frame containing the FAS differ from 0011011.

- **CRC-4** (Cyclical Redundancy Check)

  RX: One or more bit errors are detected in a block of data through cyclical redundancy check.

- **E-Bit** (CRC-4 Error Signal) is only available with **PCM30 CRC-4** or **PCM31 CRC-4** framing.

  RX: Bit 1 of sub-multiframe (SMF) II in frame 13 and/or 15 is set to 0 indicating a sub-multiframe error.

E2

Alarms

Note: *Only AIS is available when the framing is set to Unframed.*

- **AIS** (Alarm Indication Signal)

  RX: An unframed all-ones signal is received.

- **LOF** (Loss Of Frame)

  RX: Four consecutive incorrect frame alignment signals is received.

- **RAI** (Remote Alarm Indication)

  RX: Bit 11 of a framed E2 is set to “1”.

Errors

- **FAS** (Frame Alignment Signal)

  RX: Bits 1 to 10 of the first frame differ from 1111010000.

E3

Alarms

Note: *Only AIS is available when the framing is set to Unframed.*

➤ **AIS** (Alarm Indication Signal)

RX: An unframed all-ones signal is received.

➤ **LOF** (Loss Of Frame)

RX: Four consecutive incorrect frame alignment signals is received.

➤ **RAI** (Remote Alarm Indication)

RX: Bit 11 of a framed E3 is set to “1”.

Errors

➤ **FAS** (Frame Alignment Signal)

RX: Bits 1 to 10 of the first frame differ from 1111010000.

E4

Alarms

Note: *Only AIS is available when the framing is set to Unframed.*

➤ **AIS** (Alarm Indication Signal)

RX: An unframed all-ones signal is received.

➤ **LOF** (Loss Of Frame)

RX: Four consecutive incorrect frame alignment signals is received.

➤ **RAI** (Remote Alarm Indication)

RX: Bit 13 of a framed E4 is set to “1”.

Errors

➤ **FAS** (Frame Alignment Signal)

RX: Bits 1 to 12 of the first frame differ from 111110100000.

Ethernet

Alarms

- **Link Down**

  RX: The Ethernet connection is down meaning that there is a local or a remote fault condition.

- **Local Fault Det.**[1] (Local Fault Detected)

  RX: At least one of the following events is detected: Loss of bit synchronization, Loss of Block synchronization, WIS Link down, or High BER.

- **Local Fault Rcd.**[1] (Local Fault Received)

  RX: The received data path contains the **Local Fault** signal.

- **Remote Fault**[1]

  RX: The received data path contains the **Remote Fault** status.

1. Available with Ethernet 10 Gbit/s interface.

Errors

- **Symbol**[1]

  RX/TX: Invalid code-group is detected/generated in the code.

- **Idle**[1]

  RX: An error is detected between the end of a frame and the beginning of the next frame.

- **False Carrier**[1]

  RX: Data is being received with invalid start of frame.

- **Block** (available with Ethernet 10G LAN/WAN interface)

  RX: Error block received in frames.

- **Alignment** (available with 10/100 Mbit/s interface)

  RX: Frames without an integral number of octets in length are received.

- **FCS** (Frame Check Sequence)

  RX: Frames with an invalid FCS are received.

- **Jabber**

  RX: Frames larger than 1518 bytes[2] with an invalid FCS are received.

- **Oversize** (available when the **Oversize Monitoring** check box is selected.)

  RX: Frames larger than 1518 bytes[2] with a valid FCS.

- **Runt**

  RX: Frames smaller than 64 bytes with an invalid FCS.

---

1. Available with Ethernet 100/1000 Mbit/s interface.
2. Add 4 bytes to this value for each VLAN layer enabled.

- **Undersize**

  RX: Frames smaller than 64 bytes with a valid FCS.

- **Oversize Monitoring** check box, when selected (cleared by default), allows monitoring the **Oversize** frame errors.

The following errors are only available with **Half Duplex** mode (only for electrical interface at speeds of 10 Mbit/s and 100 Mbit/s).

- **Collision**

  RX: Indicates the number of collisions on the link.

- **Late Coll.**

  RX: Indicates the number of collisions that have occurred after a 64 bytes transmission.

- **Exc. Coll.**

  RX: Indicates the number of frames that were sent 16 times unsuccessfully due to consecutive collisions.

Interface

Alarms

- **LOS** (Loss Of Signal)

  RX: Absence of an input signal or an all-zeros pattern is received.

- **Frequency:** Not available when using an active copper SFP.

  RX: The received signal frequency meets the standard specifications (green) or not (red).

  For Ethernet **10/100/1000M Electrical**, **100M Optical**, **1GE Optical**, **10GE LAN/WAN** interface/rate, the frequency range is ± 100 ppm.

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
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

Error

- **BPV (**Bipolar Violation), available with DS1 and DS3, pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.
- **BPV/CV** (Bipolar Violation/Code Violation), available with STS-1e and STS-3e, pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.
- **CV** (Code Violation)

  For E1, E3, E4, STM-0e, and STM-1e: Pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.
- **EXZ** (Excessive Zeros):

  For **DS1** with **AMI Line Coding**, more than 15 consecutive bit periods with no pulses have been received.

  For **DS1** with **B8ZS Line Coding**, more than 7 consecutive bit periods with no pulses have been received.

  For **DS3**, more than 2 consecutive bit periods with no pulses have been received.

IP/UDP/TCP

Errors

➤ **IP Chksum** (IP Checksum)

RX: The IP datagrams received have invalid IP header checksum. Only available for IPv4.

➤ **UDP Chksum** (UDP Checksum)

RX: The UDP segments received have invalid UDP checksum.

➤ **TCP Chksum** (TCP Checksum)

RX: The TCP segments received have invalid TCP checksum.

ODUx

Note: *For OPUx alarms see page 216.*

Alarms

- **AIS** (Alarm Indication Signal)

  RX: The STAT information in the PM byte 3, bits 6 to 8 is “111” for at least 3 consecutive frames.

  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.

- **BDI** (Backward Defect indication)

  RX: The BDI bit in the PM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive frames.

  TX: Generates a “1” in the BDI (byte 3, bit 5) of the PM overhead field continuously.

- **BSD** (Backward Signal Degrade)

  RX: The FTFL byte 128 is “00000010”.

  TX: Generates a “00000010” pattern in the FTFL Byte 128 continuously.

- **BSF** (Backward Signal Fail)

  RX: The FTFL byte 128 is “00000001”.

  TX: Generates a “00000001” pattern in the FTFL Byte 128 continuously.

- **FSD** (Forward Signal Degrade)

  RX: The FTFL byte 0 is “00000010”

  TX: Generates a “00000010” pattern in the FTFL Byte 0 continuously.

- **FSF** (Forward Signal Fail)

  RX: The FTFL byte 0 is “00000001”.

  TX: Generates a “00000001” pattern in the FTFL Byte 0 continuously.

- **LCK** (Lock)

  RX: STAT information in the PM byte 3, bits 6 to 8 is “101” for at least 3 consecutive frames.

  TX: Generates a repeating "01010101" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).

- **OCI** (Open Connection Indication)

  RX: STAT information in the PM byte 3, bits 6 to 8 is “110” for at least 3 consecutive frames.

  TX: Generates a repeating "01100110" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).

- **TIM** (Trace Identification Mismatch)

  RX: 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 99.

Errors

➤ **BIP-8** (Bit Interleave Parity-8)

RX: There is a PM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **BEI** (Backward Error Indication)

RX: 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

ODUx-TCM

Alarms

- **BDI** (Backward Defect Indication)

  RX: The BDI bit in the TCM overhead field Byte 3, bit 5 is “1” for at least 5 consecutive frames.

  TX: Generates a "1" in the BDI bit of the TCM overhead field (byte 3, bit 5) continuously.

- **BIAE** (Backward Incoming Alignment Error)

  RX: The BEI/BIAE bits in the TCM overhead field Byte 3, bits 1 to 4 are “1011” for at least 3 consecutive frames.

  TX: Generates "1011" in the BEI/BIAE bits of the TCM overhead (byte 3, bits 1 to 4) continuously.

- **IAE** (Incoming Alignment Error)

  RX: The STAT information in the TCM is “010” for at least 3 consecutive frames.

  TX: Generates "1" in the IAE bit of the TCM overhead (byte 3, bit 6) continuously.

- **LTC** (Loss of Tandem Connection)

  RX: The STAT information in the TCM Byte 3, bits 6, 7, and 8 are “000” for at least 3 consecutive frames.

  TX: Generates "000" in the STAT field of TCM overhead (byte 3, bits 6 to 8) continuously.

- **TIM** (Trace Identification Mismatch)

  RX: The SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the Enable TIM SAPI and/or DAPI check boxes are selected from *PT* on page 99.

Errors

➤ **BIP-8** (Bit Interleave Parity-8)

RX: There is a TCM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **BEI** (Backward Error Indication)

RX: 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

OPUx

Note: *OPUx is displayed under ODUx alarms/errors group.*

Alarms

➤ **AIS** (Alarm Indication Signal)

RX: A PRBS11 pattern is received indicating a failure of the client signal.

TX: Generates a PRBS11 pattern.

➤ **CSF** (Client Signal Fail)

RX: Bit 1 of the OPUk PSI[2] byte is set to "1" indicating a failure of the client signal mapped into the OPUk of the OTN signal.

TX: Sets the bit 1 of the OPUk PSI[2] byte to "1".

➤ **PLM** (Payload Mismatch) is available when OPU-PLM check box is selected.

RX: The Payload Structure Identifier (PSI) field does not match the expected PT for at least 3 consecutive frames.

OTUx

Note: *Available for OTU2 and OTU1.*

Alarms

➤ **AIS** (Alarm Indication Signal)

RX: Polynomial number 11 (PN-11) is over all OTU frame bits including FAS and MFAS for at least 3 consecutive 8192 bit-interval.

TX: Generates polynomial number 11 (PN-11) over all OTU frame bits including FAS and MFAS continuously.

➤ **BDI** (Backward Defect Indication)

RX: The BDI bit in the SM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive OTU frames.

TX: Generates “1” for the BDI bit in the SM overhead field (byte 3, bit 5) continuously.

➤ **BIAE** (Backward Incoming Alignment Error)

RX: The BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) are “1011” for at least 3 consecutive frames.

TX: Generates “1011” for the BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) continuously.

➤ **IAE** (Incoming Alignment Error)

RX: The IAE bit in the SM overhead field (byte 3, bit 6) is “1” for at least 5 consecutive OTU frames.

TX: Generates “1” for the IAE bit in the SM overhead field (byte 3, bit 6) continuously.

- **LOF** (Loss of Frame)

  RX: OOF is present for at least 3 ms.

  TX: Generates error in all FAS bits continuously.

- **LOM** (Loss Of Multiframe)

  RX: OOM is present for at least 3 ms

  TX: Generates error in MFAS bits continuously.

- **OOF** (Out-Of-Frame)

  RX: FAS (bytes 3, 4, and 5) are in error for at least 5 consecutive OTU frames.

  TX: Generates error in all FAS bits for 5 consecutive OTU frames.

- **OOM** (Out-Of-Multiframe)

  RX: MFAS are in error for at least 5 consecutive OTU frames.

  TX: Generates error in multiframe number for 5 consecutive OTU frames.

- **TIM** (Trace Identifier Mismatch)

  RX: Expected SM SAPI and/or SM DAPI do not match the received SM SAPI and/or DAPI for at least 3 consecutive TTI. This alarm is only available when the Enable TIM SAPI OTU-TIM and/or DAPI OTU-TIM check boxes are selected from page 188.

Errors

➤ **BEI** (Backward Error Indication)

RX: SM BEI errors are received from the DUT (value 0 to 8).

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

➤ **BIP-8** (Bit Interleave Parity-8)

RX: There is a SM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **FAS** (Frame Alignment Signal)

RX: The FAS bits are in error.

➤ **FEC-CORR** (Forward Error Correction - Correctable)

RX: Statistics on codewords (CW; default), symbols (SYMB), or bits (BIT) corrected by the FEC.

TX:

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

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

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

- **FEC-UNCORR** (FEC - Uncorrectable)

  RX: Statistics on the detected codewords (CW) having uncorrectable errors.

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

- **FEC-STRESS** (Forward Error Correction - Stress)

  TX: 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.

- **MFAS** (Multiframe Alignment Signal)

  RX: The MFAS bits are in error.

QoS Metrics

Note: *Only available with Traffic Gen & Mon test application.*

Errors

- **Frame Loss**

  RX: A sequence number is missing in the received frames.

- **Out-of-Seq.** (Out-of-Sequence)

  RX: The received frame sequence number is either smaller than the expected frame sequence number or is a duplicate number.

Section/Line / RS/MS

Alarms

- **LOF-S** (Loss Of Frame - Section) - SONET
  RS-LOF (Regeneration Section - Loss Of Frame) - SDH

  RX: A SEF (SONET)/RS-OOF (SDH) defect on the incoming optical signal persists for at least 3 milliseconds.

  TX: Generates non-valid framing bytes (A1 and A2).

- **SEF** (Severely Errored Framing) - SONET.
  RS-OOF (Regeneration Section - Out-Of-Frame) - SDH.

  RX: A minimum of four consecutive errored framing patterns are received.

  TX: Generates four consecutive errored framing patterns.

- **TIM-S** (Trace Identifier Mismatch - Section) - SONET
  RS-TIM (Regeneration Section - Trace Identifier Mismatch) - SDH

  RX: 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 187).

- **AIS-L** (Alarm Indication Signal - Line) - SONET
  MS-AIS (Multiplex Section - Alarm Indication Signal) - SDH

  RX: Bits 6, 7 and 8 of the K2 byte contain the "111" pattern in five consecutive frames.

  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.

- **RDI-L** (Remote Defect Indication - Line) - SONET
  MS-RDI (Multiplex Section - Remote Defect Indication) - SDH

  RX: Bits 6, 7, and 8 of the K2 byte contain the “110” pattern in five consecutive frames.

  TX: Generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.

Errors

- **FAS-S** (Frame Alignment Signal - Section) - SONET
  RS-FAS (Regeneration Section - Frame Alignment Signal) - SDH

  RX: At least one A1 or A2 byte of the FAS word is in error.

- **B1** (BIP-8, Bit-Interleave Parity - 8 bits)

  RX: 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).

- **B2** (BIP-8, Bit-Interleave Parity - 8 bits)

  RX:

  - 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).

  - 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.

- **REI-L** (Remote Error Indicator - Line) - SONET
  MS-REI (Multiplex Section - Remote Error Indicator) - SDH

  RX: 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 315 for more information. For OC-192, also refer to *REI-L Computation Method* on page 167.

STS-x/AU-x

Alarms

- **AIS-P** (Alarm Indication Signal - Path) - SONET
  AU-AIS (Administrative Unit - Alarm Indication Signal) - SDH

  RX: The H1 and H2 bytes contain an all-ones pattern in three consecutive frames or more.

  TX: Generates an all-ones pattern over H1, H2, H3, and SPE.

- **LOP-P** (Loss Of Pointer - Path) - SONET
  AU-LOP (Administrative Unit - Loss Of Pointer) - SDH

  RX: 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).

  TX: Generates a non-valid pointer.

- **UNEQ-P** (Unequipped - Path) - SONET
  HP-UNEQ (HP - Unequipped) - SDH

  RX: 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 107).

  TX: Generates an all-zeros pattern over POH and SPE.

- **H4-LOM** (H4 - Loss Of Multiframe)

  RX: For VT/TU structured optical frames, the system loss track of the H4 byte multiframe indicator sequence.

  TX: Generates a wrong H4 byte multiframe indicator sequence.

- **TIM-P** (Trace Identifier Mismatch - Path) - SONET
  HP-TIM (HP - Trace Identifier Mismatch) - SDH

  RX: 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 187).

- **PLM-P** (Payload Label Mismatch - Path) - SONET
  HP-PLM (HP - Payload Label Mismatch) - SDH

  RX: 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 107).

- **PDI-P** (Payload Defect Indication - Path) - SONET

  RX: For VT-structured STS-1 SPE, 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.

  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.

- **RDI-P** (Remote Defect Indication - Path) - SONET
  HP-RDI (High Order Path - Remote Defect Indication) - SDH

  RX: Bits 5, 6, and 7 of the G1 byte contain the “100” or “111” pattern in five consecutive frames.

  TX: Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.

- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect) - SONET
  ERDI-CD (Enhanced RDI - Path Connectivity Defect) - SDH

  RX: Bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five consecutive frames.

  TX: Generates a “110” pattern for bits 5, 6 and 7 of the G1 byte.

- **ERDI-PPD** (Enhanced RDI - Path Payload Defect) - SONET
  ERDI-PD (Enhanced RDI - Payload Defect) - SDH

  RX: Bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five consecutive frames.

  TX: Generates a “010” pattern for bits 5, 6 and 7 of the G1 byte.

➤ **ERDI-PSD** (Enhanced RDI - Path Server Defect) - SONET
ERDI-SD (Enhanced RDI - Server Defect) - SDH

RX: Bits 5, 6 and 7 of the G1 byte contain the "101" pattern in five consecutive frames.

TX: Generates a "101" pattern for bits 5, 6 and 7 of the G1 byte.

Errors

➤ **B3** (BIP-8, Bit-Interleave Parity - 8 bits)

RX: Indicates a high order path parity error by performing an even-parity check over all bits of the previous SPE (SONET) / VC-N (SDH).

➤ **REI-P** (Remote Error Indicator - Path) - SONET
HP-REI (HP - Remote Error Indicator) - SDH

RX: 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.

TCM (SONET/SDH)

Note: *TCM is displayed for rates up to OC-192/STM-64 under the STS-x/AU-x or VT/TU alarms/errors group when TCM is enabled.*

Alarms

- **TC-UNEQ-P** / **HPTC-UNEQ (**Unequipped)

  RX/TX: 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)

  RX/TX: 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).

- **TC-LTC-P / TC-LTC-V** / **HPTC-LTC / LPTC-LTC** (Loss of Tandem Connection)

  RX/TX: A wrong FAS multiframe is received/generated.

- **TC-IAIS-P** / **HPTC-IAIS** (Incoming Alarm Indication Signal)

  RX/TX: Bits 1 through 4 of the N1 byte are set to "1110".

- **TC-IAIS-V** / **LPTC-IAIS** (Incoming Alarm Indication Signal)

  RX/TX: Bit 4 of the Z6/N2 byte is set to "1".

- **TC-ODI-P / TC-ODI-V** / **HPTC-ODI / LPTC-ODI** (Outgoing Defect Indication)

  RX/TX:

  - SONET: Bit 7 of the N1/Z6 byte frame 74 is set to "1".
  - SDH: Bit 7 of the N1/N2 byte multiframe 74 is set to "1".

- **TC-TIM-P** / **TC-TIM-V** / **HPTC-TIM** / **LPTC-TIM** (Trace Identifier Mismatch)

  RX: 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-RDI-P** / **TC-RDI-V** / **HPTC-RDI** / **LPTC-RDI** (Remote Defect Indication)

  RX/TX:

  - SONET: The TC-RDI is declared when bit 8 of the N1/Z6 byte frame 73 is set to “1”.
  - SDH: The TC-RDI is declared when bit 8 of the N1/N2 byte multiframe 73 is set to “1”.

Errors

- **TC-VIOL-P** / **HPTC-VIOL** (Violations)

  RX: TC-VIOL 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)

  RX: TC-VIOL indicates the number of violation within the tandem connection for VT6 SPE/VC-2 and below.

➤ **TC-IEC-P** / **HPTC-IEC** (Incoming Error Count)

RX: The TC-IEC indicates the number of B3 parity violations detected at the TC Source for STS-1 SPE/VC-3 and above (bits 1 to 4 of the N1 byte).

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)

RX: Indicates errored blocks of the outgoing VTn/VC-n (bit 6 of the N1 or Z6/N2 byte).

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)

RX: Indicates errored blocks caused within the Tandem Connection (bit 5 of the N1 or Z6/N2 byte).

TX: Bit 5 of N1 or Z6/N2 byte is set to 1.

VT/TU

Alarms

➤ **AIS-V** (Alarm Indication Signal - VT) - SONET
TU-AIS (Tributary Unit - Alarm Indication Signal) - SDH

RX: V1 and V2 bytes for the VT/TU path contain an all-ones pattern in three (SONET) / five (SDH) consecutive superframes.

TX: Generates an all-ones pattern for the V1 and V2 bytes of the VT/TU path and payload.

➤ **LOP-V** (Loss Of Pointer - VT) - SONET
TU-LOP (Tributary Unit - Loss Of Pointer) - SDH

RX: A valid pointer is not found in N consecutive superframes (where $8 \leq N \leq 10$), or if N consecutive NDFs (“1001” pattern).

TX: Generates a non-valid pointer.

➤ **RDI-V** (Remote Defect Indication - VT) - SONET
LP-RDI (Tributary Unit - Remote Defect Indication) - SDH

RX: 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.

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.

➤ **RFI-V** (Remote Failure Indication - VT) - SONET
LP-RFI (LOP - Remote Failure Indication) - SDH, available with VC-11 only.

RX: Bit 4 of the V5 byte contains “1” in five consecutive superframes.

TX: Generates “1” for the bit 4 of the V5 byte.

- **TIM-V** (Trace Identifier Mismatch - VT) - SONET
  LP-TIM (LOP - Trace Identifier Mismatch) - SDH

  RX:

  - SONET: The J2 Trace doesn't match the expected message value. Only available when the **TIM-V** check box is selected (refer to page *Traces (SONET/SDH)* on page 187).
  - SDH: None of the sampled LP trace strings match the expected message value. Only available when the **LP-TIM** check box is selected (refer to page *Traces (SONET/SDH)* on page 187).

- **PLM-V** (Payload Label Mismatch - VT) - SONET
  LP-PLM (LOP - Payload Label Mismatch) - SDH

  RX: 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 107).

- **UNEQ-V** (Unequipped - VT) - SONET
  LP-UNEQ (LOP - Unequipped) - SDH

  RX: 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 107).

  TX: Generates samples of unequipped VT/LP signal label (bits 5 through 7 of V5 byte are set to "000").

- **ERDI-VSD** (Enhanced RDI - VT Server Defect) - SONET
  LP-ERDI-SD (LOP - Enhanced RDI - Server Defect) - SDH

  RX: 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.

  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.

- **ERDI-VCD** (Enhanced RDI - VT Connectivity Defect) - SONET
  LP-ERDI-CD (LOP - Enhanced RDI - Connectivity Defect) - SDH

  RX: 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.

  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** (Enhanced RDI - VT Path Payload Defect) - SONET
  LP-ERDI-PD (LOP - Enhanced RDI - Path Payload Defect) - SDH

  RX: 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.

  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.

Errors

- **BIP-2** (Bit-Interleave Parity - 2 bits)

  RX:

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

  SDH: The BIP-2 error indicates a Low Order Path parity error by performing a routine even-parity check over all bytes of the previous VC frame.

- **REI-V** (Remote Error Indicator - VT) - SONET
  LP-REI (Low Order Path - Remote Error Indicator) - SDH

  RX: REI is declared when bit 3 of the V5 byte is set to “1”.

WIS

Note: *Available under the WIS sub tab for 10G WAN interface only.*

Alarms

- **WIS Link Down**

  RX: At least one of the following errors is present: AIS-P, LOF, PLM-P, SEF, LOP, or AIS-L.

- **SEF** (Severely Errored Framing)

  RX: A minimum of four consecutive errored framing patterns.

  TX: Generates more than four consecutive errored framing patterns.

- **LOF** (Loss Of Frame)

  RX: A Severely Error Framing (SEF) defect on the incoming SONET signal persists for at least 3 milliseconds.

  TX: Generates a non-valid framing pattern.

- **AIS-L** (Alarm Indication Signal - Line)

  RX: Bits 6, 7 and 8 of the K2 byte contain the “111" pattern in five consecutive frames.

  TX: Generates a “111” pattern for the bits 6, 7 and 8 of the K2 byte.

- **RDI-L** (Remote Defect Indication - Line)

  RX: Bits 6, 7, and 8 of the K2 byte contain the “110" pattern in five consecutive frames.

  TX: Generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.

- **AIS-P** (Alarm Indication Signal - Path)

  RX: The H1 and H2 bytes for a STS path contain an all-ones pattern in three consecutive frames or more.

  TX: Generates an all-ones pattern for H1 and H2 bytes.

- **RDI-P** (Remote Defect Indication - Path)

  RX: Bits 5, 6 and 7 of the G1 byte contain the “100" or “111" pattern in ten consecutive frames.

  TX: Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.

- **LCD-P** (Loss of Code-Group Delineation - Path)

  RX: 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.

  TX: Generates a PCS link down.

- **LOP-P** (Loss Of Pointer - Path)

  RX: For non-concatenated payloads, a valid pointer is not found in N consecutive frames (where 8 = N = 10), or N consecutive NDFs ("1001" pattern) are detected.

  TX: Generates a non-valid pointer.

- **PLM-P** (Payload Label Mismatch - Path)

  RX: Five consecutive frames have mismatched STS signal labels.

- **UNEQ-P** (Unequipped - Path)

  RX: The C2 byte contains “00 H" in five consecutive frames.

  TX: Generates samples of unequipped STS signal labels (C2 is set to “00 H”).

- **ERDI-PSD** (Enhanced RDI - Path Server Defect)

  RX: Bits 5, 6 and 7 of the G1 byte contain the “101” pattern in five to ten consecutive frames.

  TX: Generates a “101” pattern for bits 5, 6 and 7 of the G1 byte.

- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect)

  RX: Bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five to ten consecutive frames.

  TX: Generates a “110” pattern for bits 5, 6 and 7 of the G1 byte.

- **ERDI-PPD** (Enhanced RDI - Path Payload Defect)

  RX: Bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five to ten consecutive frames.

  TX: Generates a “010” pattern for bits 5, 6 and 7 of the G1 byte.

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.

Errors

- **B1** (BIP-8, Bit-Interleave Parity - 8 bits)

  RX: 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-1536, Bit-Interleave Parity - 1536 bits)

  RX: 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)

  RX: 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.

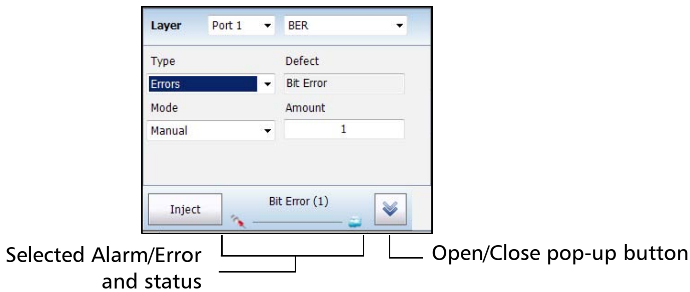
➤ **REI-L** (Remote Error Indicator - Line)

RX: 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)

RX: 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).

Inject Button



- **Layer**: Allows to select on which layer is the alarm/error to be generated. Choices depend on the test application and its interface.

  Port 1 or **Port 2** selection, available with **Dual Port** topology, allows to select the port used for alarm/error injection.

- **Type**: Allows to select the type of injection, either **Alarms** or **Errors**.

- **Defect**: Allows the selection of the alarm/error defect to be generated. Choices depend on the selected **Layer** and **Type**. Refer to *Alarms/Errors* on page 193 for more information.

- **Mode** and **Rate/Amount**

  - **Manual** allows to enter the amount of manual error to be generated: **1** (default) through **50** or **100** (depends on the selected error).

  - **Rate** allows the selection of the injection rate for the selected error. The rate must be within the minimum and maximum values specified.

  - **Max Rate** generates the selected error to its theoretical maximum rate.

- **Inject button**

  For **Manual** mode: Manually generates the selected errors according to the defect and the amount selected.

  For **Rate** and **Max Rate**: Generates respectively the selected error at the rate specified or at its theoretical maximum rate.

Note: *The selected alarm/error as well as its injection mode and status are displayed next to the* ***Inject*** *button.*

- The open/close pop-up button allows to respectively expand (up arrow) or collapse (down arrow) a pop-up allowing to set the alarm/error injection parameters.

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** 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)

➤ **Payload Type** and **Code**

Received displays the received payload signal type and its code in hexadecimal format.

Expected allows to select the expected payload signal type either by selecting the payload from the list or by typing its hexadecimal code.

Note: *Refer to* PT *on page 99 for the list.*

➤ **OPU-PLM**, 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 from P1 to P2 (P1->P2) and P2 to P1 (P2->P1) using distinctive colors.

From the **Test** menu, tap **Results**, and the **Graphs** tab.

➤ **All** button allows to view the graphs of all subtests simultaneously.

➤ **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** buttons allow to view an enlarged graph view of the selected subtest.

➤ **Displayed Results** allows to select the displayed results mode, either **Minimum**, **Maximum** (default), **Average**, or **Current**.

➤ **Step**, available with Frame Loss, allows to select 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 to select either **Frame Size** (default) or **Step** as the X axis criterion.

Labels

From the **Test** menu, tap **Results**, and **Labels**.

Note: *Selecting a Label byte to be generated will automatically update the corresponding OH byte. Refer to* OH - SONET/SDH *on page 311 for more information.*

Labels

- **STS/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 319 for more information.

- **PLM-P/UNEQ-P** / **HP-PLM/HP-UNEQ**: Enables the Payload Mismatch and STS/AU UNEQ monitoring. This setting is coupled with the configuration of *Labels* on page 107.

  Expected: Select the expected C2 byte from the list. Refer to *C2* on page 319 for more information.

- **VT/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 322 for more information.

- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ**: Enables the Payload Mismatch and VT/TU UNEQ monitoring. This setting is coupled with the configuration of *Labels* on page 107.

  Expected: Select the expected V5 byte from the list. Refer to *V5* on page 322 for more information.

Logger

The Logger page displays color-coded events and pass/fail verdict.

From the **Test** menu, tap **Results**, and the **Logger** tab.

Sort By

Select the sorting order of the event logger entries:

- **ID/Time** (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 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 date and time the event occurred. 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>.

Table

The logger table provides the following event logger information.

- **ID**: Indicates the event identification number. The events are sequentially numbered.
- **Time**: Indicates when the event has been detected.
- **Event**: Provides the event type and threshold crossing information.
- **Duration**: Indicates the number of seconds within which the event occurred. Test events like **Test Started** and **Test Stopped** will have no duration.

- **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
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 is 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

From the **Test** menu, tap **Results**, and...

- for **Traffic Gen and Mon**, the **Streams**, and the **MPLS** tab.
- for **Though Mode**, the **Traffic**, and the **MPLS** tab.

Note: *For **Dual Port** topology, the P1 and P2 buttons allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).*

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.

Performance Monitoring

Note: *This tab is only available with Transport test applications with Pattern client.*

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 (refer to page 74).*

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 ≥ 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.

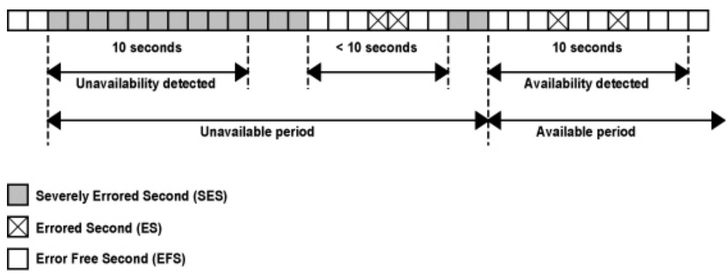
	OC-1 STS-1e STM-0 STM-0e	OC-3 STS-3e STM-1 STM-1e	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30 %	30 %	30 %	30 %	30 %
Line/MS	15 %	15 %	25 %	30 %	30 %
Section/RS	10 %	30 %	30 %	30 %	30 %

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.

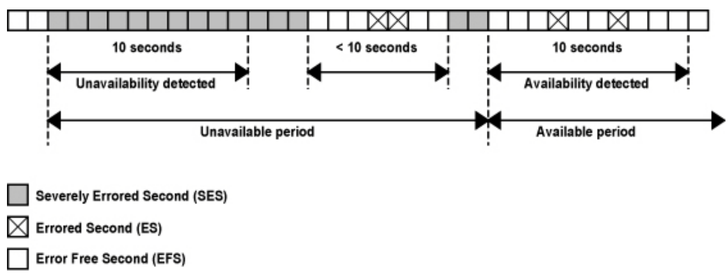
	OC-1 STS-1e STM-0 STM-0e	OC-3 STS-3e STM-1 STM-1e	OC-12 STM-4	OC-48 STM-16	OC-192 STM-64
Path	30 %	30 %	30 %	30 %	30 %
Line/MS	15 %	15 %	25 %	30 %	30 %
Section/RS	10 %	30 %	30 %	30 %	30 %

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.

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 from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).
- **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 269 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 269 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 from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).
- **TX Rate** indicates the transmission rate for each step.
- **SLA Verified** indicates the committed SLA parameters that are used to declare the pass/fail verdict. See *Summary (EtherSAM)* on page 269 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 269 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 141 for more information. For **Dual Test Set** or **Dual Port** topology, parameters are displayed respectively for both local to remote (**L->R**), remote to local (**R->L**) directions, or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

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 from local to remote (**L->R**) and remote to local (**R->L**), P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**), and Round-Trip for Latencywhen in Round-Trip Latency Measurement Mode (see *Global Options* on page 95). 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 (ms)** indicates the measured delay variation.
- **Latency (ms)** 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: *Delay variation measurements smaller than 15 μs will be discarded, not used for the sampling process, and **< 0.015** is displayed as the minimum value. 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 to remote (**L->R**) and remote to local (**R->L**). For **Dual Port** topology, errors are reported for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

➤ **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 to remote (**L->R**) and remote to local (**R->L**). For **Dual Port** topology, the count is reported for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

Streams - Frame Loss / Out-of-Sequence

From the **Test** menu, tap **Results**, **Streams**, and the **Frame Loss / Out-Of-Sequence** tab.

- ➤ The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).
- ➤ **Stream**: Indicates the stream identification number.
- ➤ **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 179).
- ➤ **Frame Loss**: See *QoS Metrics* on page 220.
- ➤ **Out-Of-Sequence**: See *QoS Metrics* on page 220.

Streams - Jitter

From the **Test** menu, tap **Results**, **Streams**, and the **Jitter** tab.

- ➤ The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).
- ➤ **Stream**: Indicates the stream identification number.
- ➤ **Jitter (ms)** 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: *Delay variation measurements smaller than 15 μs will be discarded, not used for the sampling process, and "< 0.015" will be displayed as the minimum value. For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- ➤ **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 179).

Streams - Latency

From the **Test** menu, tap **Results**, **Streams**, and the **Latency** tab.

- The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).
- **Stream**: Indicates the stream identification number.
- **Latency (ms)** 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: *Delay measurements smaller than 15 µs will be discarded, not used for the sampling process, and **< 0.015** will be displayed. For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 179).

Streams - Throughput

From the **Test** menu, tap **Results**, **Streams**, and the **Throughput** tab.

➤ The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).

➤ **Stream** indicates the stream identification number.

➤ **TX Rate** indicates the transmitted throughput 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. Refer to *Unit* on page 172 for unit selection.

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 to set the pass/fail thresholds (refer to *QoS Metrics* on page 179).

Summary

Note: *Available with Transport, and Ethernet (EtherBERT, Through Mode, and Smart Loopback) test applications. For other test applications see the corresponding test summary page.*

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Global** (default), **P1**, and **P2** buttons, available with **Dual Port** topology, allow to respectively display a brief test summary for both ports or a full summary for either port #1 (**P1**) or port #2 (**P2**).
- **Status** indicates the actual test status as follows.
  - "--": 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 is 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 369.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 242.

BERT and Multi-Pattern BER

Note: *See* BER *on page 196 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* on page 74 or *EtherBERT and Unframed BERT* on page 85.

- **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 236. For Transport test applications, not available in Through modes or with Multi-Pattern.

Service Disruption

Note: *Service Disruption results are only available with Transport and EtherBERT test applications when **Disruption Monitoring** is enabled (refer to* BERT *on page 74 or* EtherBERT and Unframed BERT *on page 85). 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.

➤ **Disruption Time**

Longest (ms): Indicates the longest measured disruption time.

Shortest (ms) indicates the shortest measured disruption time.

Last (ms) indicates the length of the last measured disruption time.

Average (ms) indicates the average duration of all measured disruption times.

Total (ms) indicates the total duration of all measured disruption times.

➤ **Defect**, available with Transport test applications, indicates on which layer and defect the service disruption time test is performed.

➤ **Disruption Count**: Indicates the number of disruption events detected since the beginning of the SDT test.

Note: *When a disruption event is equal 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 to enter the SDT threshold value that will be used to declare the pass/fail verdict: 0.005 to 299999.995 ms in step of 0.005 ms (default is **50** ms). This setting is only accessible when Pass/Fail Verdict is enabled and is coupled with the SDT Threshold set from the test setup (refer to page 77).

Traffic / Traffic Ethernet

Note: *The **Traffic** statistics are available for Smart Loopback and Through Mode test applications. See* Traffic - Ethernet *on page 281 for more information.*

RX Frequency

Note: *RX Frequency is available for Through Mode test application on both ports (**Port 1** and **Port 2**). 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. **LOC** is also displayed.
Gray	Pending state.

Summary (Cable Test)

From the **Test** menu, tap **Results**, and the **Summary** tab.

Test Status

Test Status indicates the progress of the cable test as follows:

- **Idle** (test has not started)
- **In Progress**
- **Completed**

The Pass/Fail verdict is displayed next to the **Test Status** field, when enabled, based on the following criteria: The worst pair's **Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

Start Time

Indicates the date and time the test was started. The date and time is 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 1000 Base-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 MAX-800 Series 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 MAX-800 Series and the far end equipment. For example, two crossed pair cables end to end used between the MAX-800 Series 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 401 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 (EtherSAM)

From the **Test** menu, tap **Results**, and the **Summary** tab.

Note: *For **Dual Test Set**, only Start Time is displayed on the remote module.*

➤ **Service Configuration/Performance Test Status** 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**

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 is reset every time the test is restarted.

➤ **Remote unit in use and locked for Dual Test Set** indicates that this module is used for **Dual Test Set** as the remote module.

- **Remote unit in Dual Test Set Mode** indicates that this module is set as remote but the DTS Connection is not established.
- **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 module.
  - **Direction**, available with **Dual Test Set** or **Dual Port** topology, indicates respectively results from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).
  - **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 module does not support exponential notation.
- **Max. Jitter (ms)** indicates the maximum measured delay variation.
- **Max Latency (ms)** 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 95).
- **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 occurred during any step of a Ramp or Burst tests as follows:

Grey: Undefined
Green: No Mismatch detected
Red: Mismatch detected

Summary (NI/CSU Emulation)

From the **Test** menu, tap **Results**, and the **Summary** tab.

Status

Status indicates the progress of the cable test as follows:

- **Idle** (test has not started)
- **In Progress**
- **Completed**

The Pass/Fail verdict is displayed next to the **Test Status** field, when enabled, based on the following criteria: The worst pair's **Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

Start Time

Indicates the date and time the test was started. The date and time is 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 208 for more information on Interface alarms/errors.

DS1

See *DS1* on page 198 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 is reset every time the test is restarted or reset. For **Dual Test Set**, this is the only information available on the remote module.
- **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 369.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 242.
- **Remote unit in use and locked for Dual Test Set** indicates that this module is used for **Dual Test Set** as the remote module.
- **Remote unit in Dual Test Set Mode** indicates that this module is set as remote but the DTS Connection is not established.

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 directions: from local to remote (**L->R**) and remote to local (**R->L**). For Dual Port topology, frame counts are available for both P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

➤ **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 from local to remote (**L->R**) and remote to local (**R->L**), or P1 to P2 (**P1->P2**) and P2 to P1 (**P2->P1**).

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 (Traffic Gen & Mon)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display the test summary for port #1 (**P1**) or port #2 (**P2**).
- **Test Status** indicates the actual test status as follows. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see *QoS Metrics* on page 179).
  - "--": 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 is 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 369.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger* on page 242.

Stream

The following statistics are available for each stream.

- **Current Throughput**: See *Streams - Throughput* on page 259.
- **Frame Loss Rate**: See *Streams - Frame Loss / Out-of-Sequence* on page 257.
- **Jitter**: See *Streams - Jitter* on page 257.
- **Latency**: See *Streams - Latency* on page 258.

- **Out-of-Sequence**: See *Streams - Frame Loss / Out-of-Sequence* on page 257.
- **Stream** indicates the stream number and provides stream detailed statistics when tapping on its button.

  The following statistics are displayed for the selected stream.

  - 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 is delimited from 0 to the Threshold corresponding to a **PASS** verdict. The red regions beyond the threshold corresponds to a **FAIL** verdict. The Pass/Fail verdict is only displayed when enabled (see* QoS Metrics *on page 179).*

  - **Jitter**: See *Streams - Jitter* on page 257.
  - **Latency**: See *Streams - Latency* on page 258.
  - **RX Rate**: See *Streams - Throughput* on page 259.
  - **RX Frame Count** indicates the number of frame received matching the selected stream.
  - **TX Rate**: See *Streams - Throughput* on page 259.
  - **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 257.

Traces - OTN

From the **Test** menu, tap **Results**, **Traces**, and the **OTN** sub-tab.

OTUx, ODUx, and TCM Buttons

Tap on either OTUx, or an ODUx button. For ODUx when TCM is enabled (see Modify TCM on page 165), tap on a TCMx button to select a TCM level.

SM/PM TTI Traces

Received Message

- **SAPI** indicates the received TTI (Trail Trace Identifier) Source Access Point Identifier.
- **DAPI** indicates the received TTI Destination Access Point Identifier.
- **Operator Specific** indicates the received TTI Operator Identifier.

Expected Message

Note: *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; refer to* Modify TCM *on page 165). The following settings are coupled with the Expected Message from* Traces (OTN) *on page 184.*

- **SAPI** allows editing the expected Source Access point Identifier (TTI bytes 0 to 15). Available when the SAPI OTU/ODU-TIM check box is selected.
- **DAPI** allows editing the expected Destination Access point Identifier (TTI bytes 16 to 31). Available when the DAPI OTU/ODU-TIM check box is selected.
- **SAPI OTU/ODU-TIM** check box, when selected (cleared by default), allows editing the expected Source Access Point Identifier (SAPI) and also enables OTU/ODU-TIM alarm monitoring.

- **DAPI OTU/ODU-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier (SAPI) and also enables the OTU/ODU/TCM-TIM alarm monitoring.
- **Copy RX** uses the received SAPI/DAPI message as the expected SAPI/DAPI.

Traces - SONET/SDH

From the **Test** menu, tap **Results**, **Traces**, and 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 311 for more information.*

Traces

- **Section/RS (J0)**, and **STS/AU/TU-3 Path (J1)**, and **VT/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**: Enables the corresponding Trace Identifier Mismatch for the expected message defined. These settings are coupled with the Traces configuration from *Traces (SONET/SDH)* on page 187.

  Copy RX allows to use the received TIM message as the expected one.

TCM Access Point Identifier

Note: *Available when TCM is enabled (refer to page 166).*

- **STS/AU Path (N1)**, and **VT/TU Path (Z6 or N1 (TU-3))**

  Displays the received N1/Z6 value.

- **TC-TIM-P/HPTC-TIM/TC-TIM-V/LPTC-TIM**: Enables the corresponding TCM Access Point Identifier for the expected message defined. These settings are coupled with the Traces configuration from *Traces (SONET/SDH)* on page 187.

  Copy RX allows to use the received TIM 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 (P1->P2 and P2->P1).*

P1 and P2 Buttons

The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).

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.

P1 and P2 Buttons

The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).

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**

Note: *When entering a value in µs it will be rounded to the closest multiple of 0.0512 for 10 Gbit/s, 5.12 µs for 100 Mbit/s, 0.512µs for 1000 Mbit/s, and 0.0512µs for 10 Mbit/s.*

- **Inject** button allows to generate the defined packet pause time.
- **Destination MAC Address** check box, when selected (cleared by default), enables and allows to set 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.

P1 and P2 Buttons

The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display results for port #1 (**P1**) or port #2 (**P2**).

The graph displays the received line utilization. The X axis shows the time in seconds while the Y axis shows the percentage utilization.

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 Applications

Tab	Available with					Page
	a	b	c	d	e	
APS	-	X	-	X	-	289
FDL - Bit-Oriented Message	-	-	X	X	X	292
FDL - Performance Report Message	-	-	X	X	X	296
FEAC	-	-	X	X	-	299
GCC BERT	X	-	-	-	-	303
OH (OTN)	X	-	-	-	-	305
OH (SONET/SDH)	-	X	-	X	-	311
Pointer Adjustment	-	X	-	X	-	330
RTD	X	X	X	X	-	340
Signaling Bits	-	-	X	-	-	343
Spare Bits	-	-	X	X	-	344

a. OTN BERT
b. SONET/SDH BERT
c. DSn/PDH BERT
d. SONET/SDH - DSn/PDH BERT
e. NI/CSU Emulation

Ethernet Test Applications

Tab - Sub Tab	Test Application							Page
	a	b	c	d	e	f	g	
Ping & Trace Route	X	X	X	X	X	-	X	325

a. EtherSAM
b. RFC 2544
c. EtherBERT
d. Traffic Gen & Mon
e. Smart Loopback
f. Through Mode
g. Cable Test

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.

FDL - Bit-Oriented Message

Allows to set and configure 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 292 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 292 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	FE: Frame sync. bit error ≥ 1
G2: 1 < CRC ≤ 5	LV: Line code violation event ≥ 1
G3: 5 < CRC ≤ 10	LB: Payload loopback activated
G4: 10 < CRC ≤ 100	SL: Slip ≥ 1
G5: 100 < CRC ≤ 319	R Bit (Reserved - Default value is 0)
G6: CRC ≥ 320	U1: Bit
SE: Severely errored framing ≥ 1	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 294 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 < CRC Error Event ≤ 10
  LV: Line Code Violation Event ≥ 1
  G4: 10 < CRC Error Event ≤ 100
  U1: Under study for synchronization
  U2: Under study for synchronization
  G5: 100 < CRC Error Event ≤ 319
  SL: Controlled Slip Event ≥ 1
  G6: CRC Error Event ≥ 320
  FE: Frame Sync. Bit Error Event ≥ 1
  SE: Severely-Errored Framing Event ≥ 1
  LB: Payload Loopback Activated
  G1: CRC Error Event = 1
  R: Reserved
  G2: 1 < CRC Error Event ≤ 5
  Nm and **Nl**: One-second report modulo 4 counter.

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 155).

From the test menu, tap **Functions**, and the **FEAC** tab.

Generated Messages

Allows to configure and send 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.

GCC BERT

Note: *Only supported with Coupled topology.*

From the **Test** menu, tap **Functions**, and the **GCC BERT** tab.

GCC Channels

GCC0, **GCC1**, and **GCC2** check boxes allow to respectively enable OTU GCC0, ODU GCC1, and ODU GCC2 generation and monitoring using a PRBS15 pattern. GCC1 and GCC2 are only available on the higher ODU layer of a multiplexed test. The status of the received pattern signal (per channel) is displayed in green for synchronized, red for loss of pattern, or gray for pending state.

PRBS15 Invert Pattern

PRBS15 Invert 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.

BERT

- **Pattern Loss** indicates that the sequence synchronization is lost.
- **Bit Error** indicates that bit errors are detected on the received GCC Pattern.

Bit Error

Allows selection of the GCC channel on which bit error will be injected. Only enabled GCC channels are listed; **All** selects all enabled GCC channels.

Inject generates bit errors on the selected GCC channel(s).

Reset

Resets GCC BERT statistics: **Pattern Loss** and **Bit Error**.

OH - OTN

From the **Test** menu, tap **Functions**, and the **OH** tab.

TX and RX buttons

Allows to respectively modify (**TX** button) the overhead information to be transmitted or to view (**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 184.

  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 *GCC BERT* on page 303.
- **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 184.

  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 98.
- **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 307 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 *GCC BERT* on page 303.
- **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 *GCC BERT* on page 303.
- **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.
- **NJO**, column 16, ODU OH: The Negative Justification Opportunity byte is not configurable. Available either for non-concatenated signal or on the LO of a concatenated signal.

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 to modify (TX) the overhead information to be transmitted and to view (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 to select 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 187).
  - **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 167).

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.

  M1:MS-REI. STM-1 channel #1 of a 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 187).

  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.

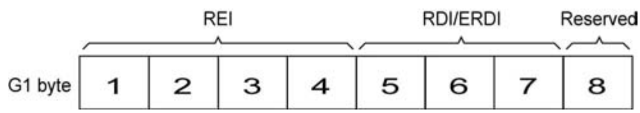
- **B3**: BIP-8. The BIP-8 (Bit-Interleaved Parity) byte provides path error monitoring. The byte is calculated by performing a even-parity check over all bits of the previous SPE.

➤ **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 107 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**:

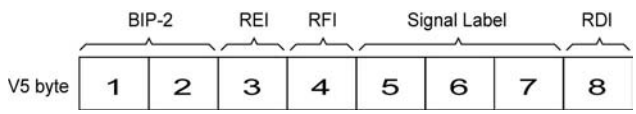
  SONET: The N1 byte (formerly referred to as the Z5 byte) is allocated for Tandem Connection Maintenance (TCM) and the Path Data Channel.

  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).

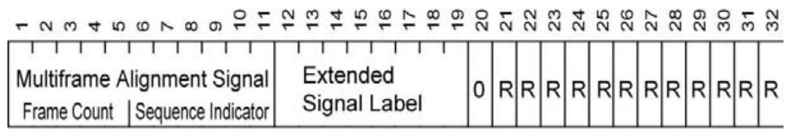
➤ Signal Label

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



R = Reserved

- **J2** Trace. Available when the Trace format is set to 1 Byte (refer to *Traces (SONET/SDH)* on page 187).

  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.

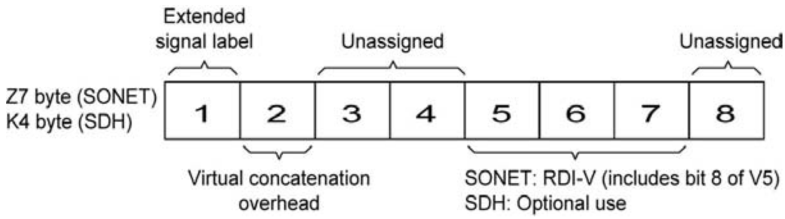
  SDH: Path Trace: The J2 byte is used to repetitively transmit a Lower-Order Access Path Identifier so that a path receiving terminal can verify its continued connection to the intended transmitter.

- **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



<table>
<tr><th rowspan="2">Bits</th><th colspan="2">Description</th></tr>
<tr><th>Z7 (SONET)</th><th>K4 (SDH)</th></tr>
<tr><td>1</td><td colspan="2">Extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see Z7/K4 Structure on page 323) contain the extended signal label.</td></tr>
<tr><td>2</td><td colspan="2">Virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see Z7/K4 Structure on page 323) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator.</td></tr>
<tr><td>3 - 4</td><td colspan="2">unassigned and reserved for APS signaling for protection at the lower order path level.</td></tr>
<tr><td>5 - 7</td><td>These bits in combination with bit 8 of V5 are allocated for RDI -V/ERDI-V signal</td><td>Optional use.</td></tr>
<tr><td>8</td><td colspan="2">unassigned and reserved for a lower order path data link.</td></tr>
</table>

Default all OH

Returns all TX overhead bytes to their factory default values.

Ping & Trace Route

From the **Test** menu, tap **Functions**, and the **Ping & Trace Route** tab.

P1 and P2 Buttons

The **P1** and **P2** buttons, available with **Dual Port** topology, allow to respectively display the alarms/errors for port #1 (**P1**) or port #2 (**P2**).

Source IP Address

Displays the configured **Source IP Address**. Refer to *MAC/IP/UDP* on page 108 for RFC 2544 and EtherBERT tests, and to *Smart Loopback* on page 170 for Smart Loopback test.

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 Button* on page 63). 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 module 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 is available with EtherSAM and Traffic Gen & Mon and allows to select a stream/service to use its source and destination IP addresses for the Ping and Trace Route tests.

Use Stream

Use Stream is available with test application using stream/services and allows to use 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 **100.** 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**

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 to select 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.*

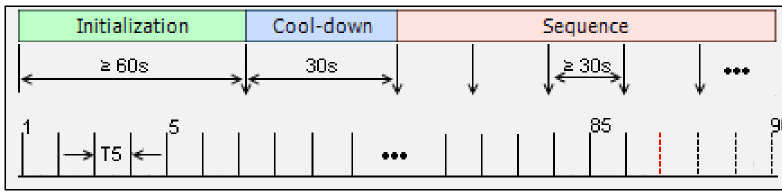
➤ **Sequence: T.105-03/GR-253** allows the selection of the pointer sequence pattern based on the **T.105-03/GR-253** standard.

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

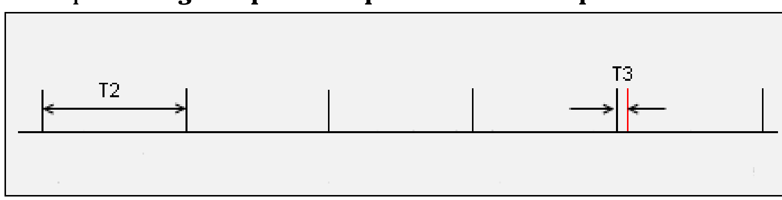
➤ Initialization / Cool Down / Sequence

The following time line examples show the initialization, cool down, and the pointer sequence according to the selected sequence and parameters.

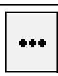
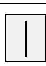
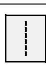
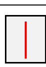
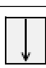
Example 1: **Periodic 87-3 with Cancel**



Example 2: **Regular pointers plus one double pointer**



Legend:

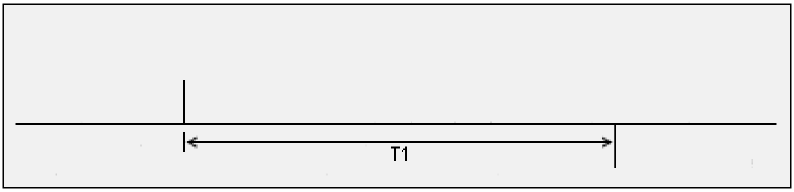
	Description
	When located at the end (right) of the sequence, indicates a continuous repetition of the pointer sequence. When located within the sequence, indicates a repetition of pointers.
	Regular pointer event or sequence.
	Cancel event.
	Special event like an extra cancel event (for example in **Periodic 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)

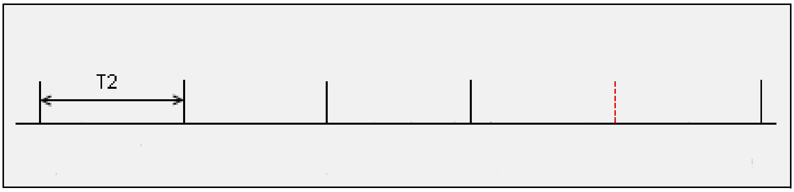
➤ **T1 (s)** represents the interval between two pointer events.

Example of **Single pointer of opposite polarity** sequence.



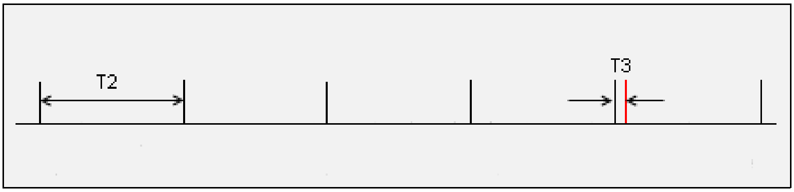
➤ **T2 (s)** represents the interval between successions of pointer events.

Example of **Regular pointers with one missing pointer** sequence.



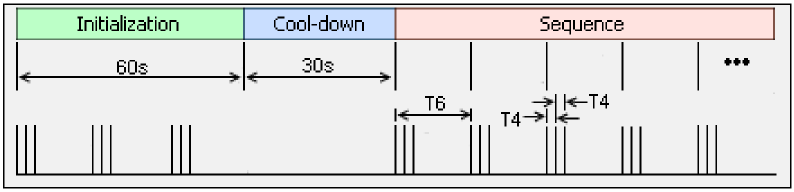
➤ **T3 (ms)** represents the interval between back to back pointer events.

Example of **Regular pointers plus one double pointer** sequence.



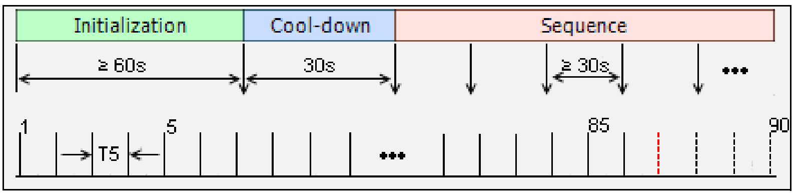
- **T4 (ms)** represents the interval between back to back pointer events in periodic pointer sequence.

  Example of **Burst pointer adjustment** sequence.



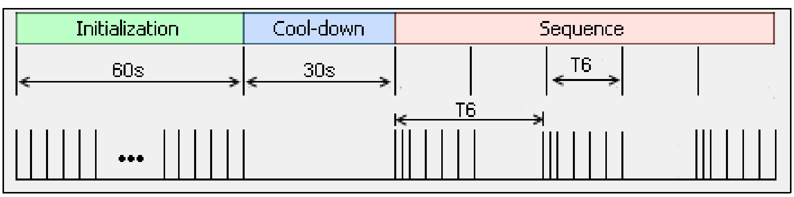
- **T5 (s)** represents the interval between successions of pointer events in a Periodic pointer sequence.

  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 to determine 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 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.

Signaling Bits

Allows generation and monitoring of the signaling bits. Only available for **DSn/PDH BERT** framed test with DS0 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* on page 156*).*

➤ **Signaling Mode** 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 the 24 - DS0 channels.

RX Signaling

Channel/AB/ABCD table: The monitoring of signaling bits of the 24 - DS0 channels is performed when 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.

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 Button *on page 348*
Inject	Inject Button *on page 351*
Laser	Laser Button *on page 351*
Lpbk Tool	Lpbk Tool Button (Loopback Tool) *on page 352*
Report	Report Button *on page 358*
Reset	Reset Button *on page 363*
Save/Load	Save/Load Button *on page 364*
Start/Stop|TX	Start/Stop|TX Button *on page 368*

Discover Remote Button

The Discover Remote function allows to perform Ethernet tests in conjunction with a second test set (module) by scanning and connecting to any available EXFO Datacom remote module. The remote module is used to loop back the traffic via Smart Loopback or **Dual Test Set** (DTS) for simultaneous bidirectional RFC 2544, or EtherSAM results.

Note: *Only available with **EtherSAM**, **EtherBERT**, **RFC 2544**, and **Traffic Gen & Mon** test applications.*

Remote Modules Discovery

- **Target** defines how to perform the scan to discover remote modules.
  - **Subnet** indicates to perform the scan based on the current subnet.
  - **Specific IP** indicates to perform the scan for a specific remote module IP address. Enter the IP address of the target module.

    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 module(s).

  The discovered modules 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 modules.
  - **Capabilities** indicates the loopback capabilities of the remote module using the following test application icons:
    Smart Loopback, RFC 2544, and/or EtherSAM.

- **Status** indicates the status of the remote module.

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, EtherBERT, Traffic Gen & Mon, Smart Loopback, Through Mode, or Cable Test.
b. Possible test applications: EtherSAM, RFC 2544, EtherBERT, Traffic Gen & Mon, or Smart Loopback.

- **Loop Up** and **Loop Down** buttons
  - **Loop Up** establishes the connection with the selected remote module and sets the remote module into **Smart Loopback** test application.

    If a remote module 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 module will be used as the destination IP address for the test.

    Once the connection is established with the remote module, the local module can be set for EtherSAM, RFC 2544, EtherBERT, or Traffic Gen & Mon testing.
  - **Loop Down** ends the connection between the local and the remote modules.

- **Connect** and **Disconnect** buttons are only available with RFC 2544, and EtherSAM test applications.
  - **Connect** establishes the connection with the selected remote module and sets the remote module into either DTS RFC 2544, or DTS EtherSAM test application, depending on the active test on the local module.

    If a remote module is in any busy status a user confirmation is required to proceed with the Loop Up command.

    Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.
  - **Disconnect** ends the connection between the local and the remote modules.

Local Module Identification

Module ID is used to easily identify this module in case another MaxTester 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 236.

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 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**. **10GE LAN** is only available when the loopback tool runs on Port #1.

➤ **Connector** displays the MaxTester's port for the selected interface/rate.

Interface/Rate	Connector	
	When using Port 1	When using Port 2
10GE LAN	Port 1 - SFP+	
1GE Optical 100M Optical	Port 1 - SFP+	Port 2 - SFP+
10/100/1000M Electrical	Port 1 - RJ45	Port 2 - SFP+ (RJ45)[a]

a. Ethernet 10/100/1000M electrical is supported 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.

➤ **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 supported by the optical 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 to set 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.

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

- **Cable Mode** is available with **10/100/1000M Electrical** interface.

  Manual mode is selected when the **Auto-Negotiation** check box is cleared and allows to select 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 to automatically detect the MDI or MDIX cable type.

- **Local Clock** is only available with 1GE electrical interface and allows to set the provenance of the clock: **Master** (default), or **Slave**, or **Auto**[1].

Network tab

Refer to *Network* on page 120 for more information.

SFP/SFP+ tab

Refer to *SFP/SFP+* on page 148 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 to configure the report parameters and generate/save the report.

Tap the **Report** button and the **Config/Save** tab.

➤ **Job Information** parameters are used to identify the source of the report and are not mandatory. 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 to choose 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 to select the optional content to be part of the report.

  ➤ **Choose Content**, available when the **Optional Content** is set to **Custom**, allows to select what will be part of the custom content.

- **Save Report**
  - **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 358).
  - **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 361.*

  - **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) and **Text**.
  - **Logo** check box when selected (default) allows to include a logo to the report. Only available with the PDF file format. Select the logo picture that will be displayed on the report.
  - 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 362) 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 358).
2. Select the report file from the list.
3. Tap the **Open** button.

Import/Export Tab

Allows to transfer and delete report files from an external USB media. Also allows to import 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 358).
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 358).
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 to save, load, import, export, and delete 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 MaxTester including all test settings to a file.

To save a configuration:

1. Select the file location (see *File location* on page 364).
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 364).
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 364).
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 364).
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 364).
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 364).
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 to manually start or stop any test as well as to enable traffic generation (Traffic Gen & Mon).

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 (Traffic Gen & Mon) 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 360. 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 358 to generate and save a report file.

To enable traffic generation (available with Traffic Gen & Mon):

Tap the **TX** button to enable traffic generation for all enabled streams; the test is also started if it was not running. While the test is running the **TX** button is available to enable/disable traffic generation. Some conditions, such as ARP not resolved, link down, etc., may prevent the stream to be transmitted.

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 MaxTester, 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 MaxTester 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 MaxTester'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 182 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/SC/MPO-24 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 SFP/SFP+ 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 MaxTester 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 (Applies to European Union Only)

For complete recycling/disposal information as per European Directive WEEE 2012/19/UE, 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 SFP and the rate selected for the test case.	Ensure that the SFP is supporting the rate used for the test case.
	The SFP is not compatible with the MAX-800 Series.	Ensure to use a compatible SFP. Refer to *Modify Structure Button* on page 63 and *Specifications* on page 383.

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.

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 382). 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 382).

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, Fuyong, Bao'An District, Shenzhen, China, 518103	Tel: +86 (755) 2955 3100 Fax: +86 (755) 2955 3101 support.asia@exfo.com

A Specifications

IMPORTANT

The following general 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, humidity and IP rating of some modules may differ from those specified for your MAX-800 Series. In this case, always ensure that you comply with the most restrictive conditions (either module or MAX-800 Series).

General Specifications

Specification	860	860G	880
Size (H x W x D)	210 mm x 254 mm x 66 mm (8 1/4 in x 10 in x 2 5/8 in)		
Weight (without transceiver)	2.1 kg (4.6 lb)	2.5 kg (5.6 lb)	2.6 kg (5.7 lb)
Temperature	Operating: 0 °C to 50 °C (32 °F to 122 °F) 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		

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
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-4	Cyclic Redundancy Check on 4 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

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	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
LOCS CSF	Loss of Client Signal - Client Signal Fail
LOCCS CSF	Loss of Client Character Synchronization - Client Signal Fail
LOF	Loss Of Frame
LOM	Loss Of Multiframe
LOPPS-L	Loss Of Pulse Per Second - Local
LOPPS-R	Loss Of Pulse Per Second - Remote
LOP	Loss Of Pointer
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
MSIM	Multiplex Structure Identifier Mismatch
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
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
QoE	Quality of Experience
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
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

T

TC	Traffic Class
TCM	Tandem Connection Monitoring
TCP	Transport Control Protocol
tHEC	type Header Error Check
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

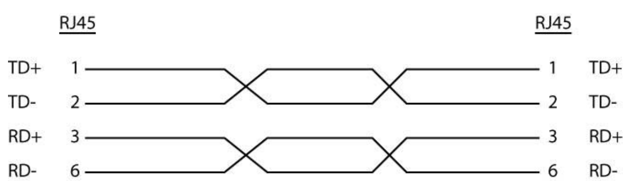
Ethernet Cables

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).

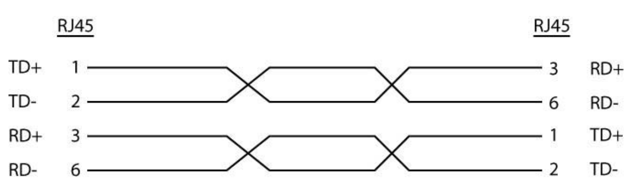
➤ Straight Through Cable (10/100 Mbit/s)

An Unshielded Twisted Pair (UTP) straight through cable is required to connect a 10Base-T/100Base-TX MaxTester port to a layer 1 or 2 device (ex: HUB, switch).

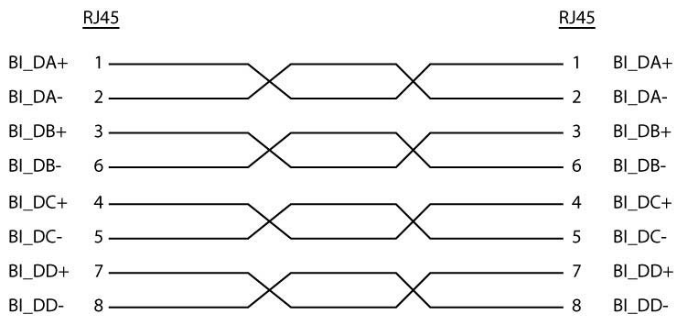


➤ Crossover Cable (10/100 Mbit/s)

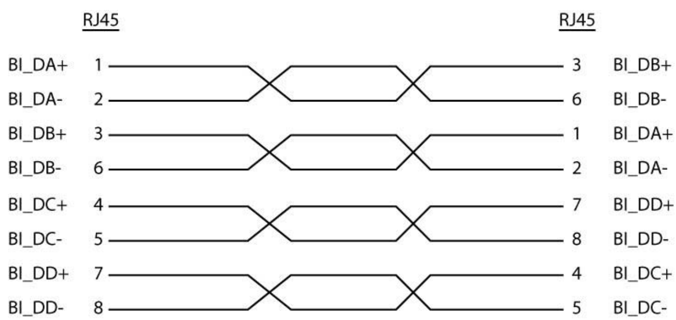
An Unshielded Twisted Pair (UTP) crossover cable is required to connect the 10Base-T/100Base-TX MaxTester port to a layer 3 device (ex: router).



➤ Straight Through Cable (1000 Mbit/s)



➤ Crossover Cable (1000 Mbit/s)



G.709 Optical Transport Network (OTN)

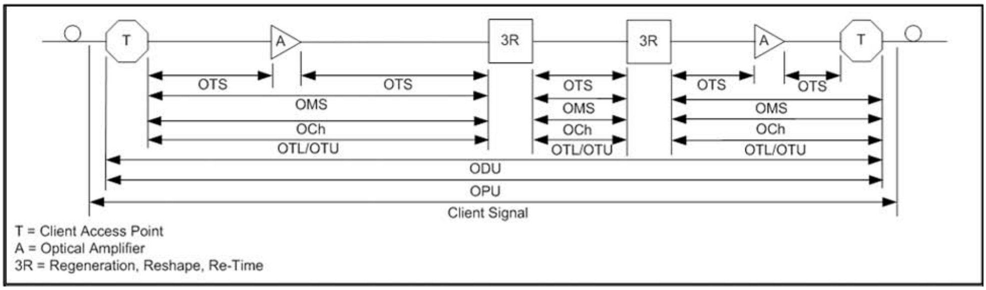
Overview

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)

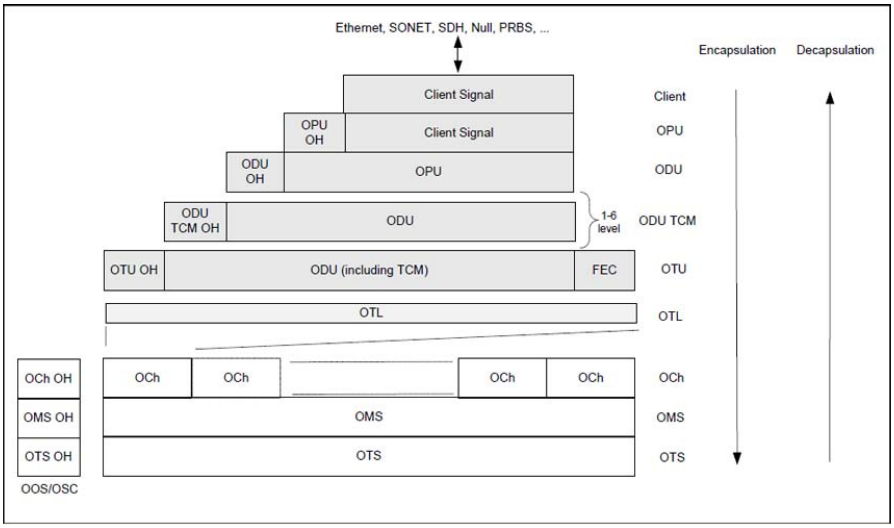
The following non standard rates are not covered by the ITU standard but they are the equivalent function associated to Fiber Channel rates:

- 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)
- PRBS31 is transported via OTUk (k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2)

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.

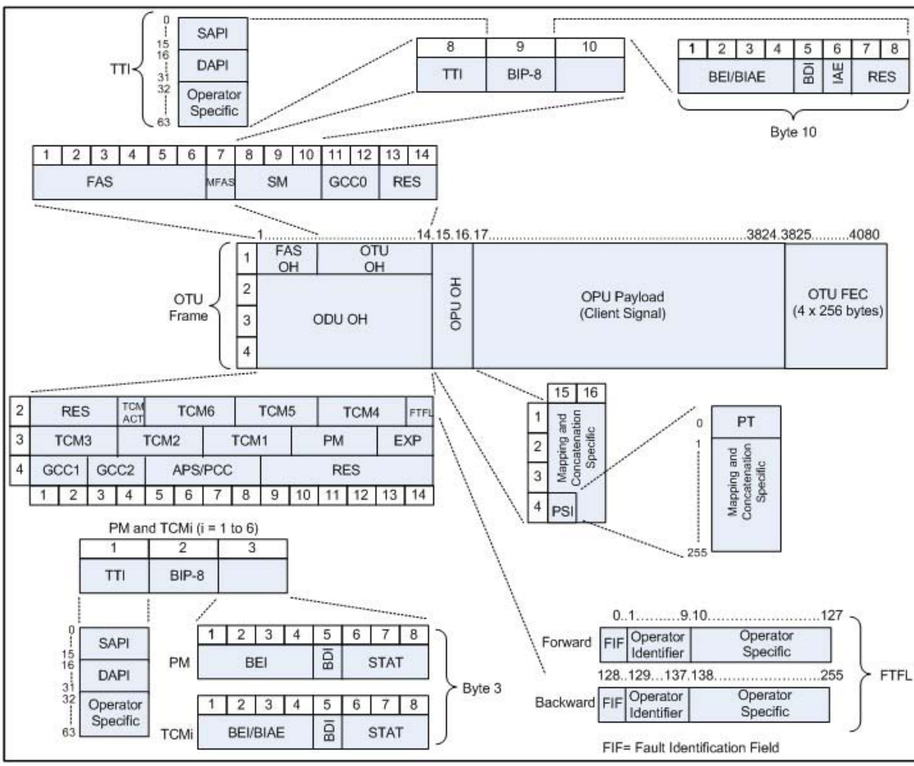
Following the OTN structure presented in figure *Basic OTN Transport Structure* on page 406, OTUks (k = 1, 2, 3) are transported using the OCh; each unit is assigned a specific wavelength of the ITU grid. Several channels can be mapped into the OMS and then transported via the OTS layer. The OCh, OMS 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 408, 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. 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) electrical interface.

    The OTL layer is responsible for mapping the serial OTU signal onto a parallel path designated lanes. In the case of 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.

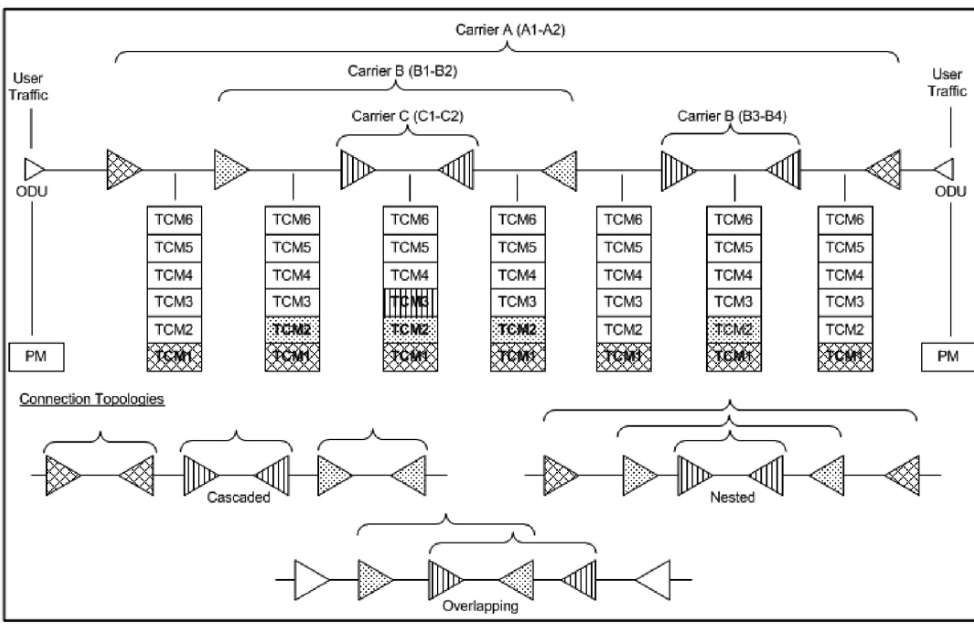
➤ Optical Payload Unit (OPU)

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 413, 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.

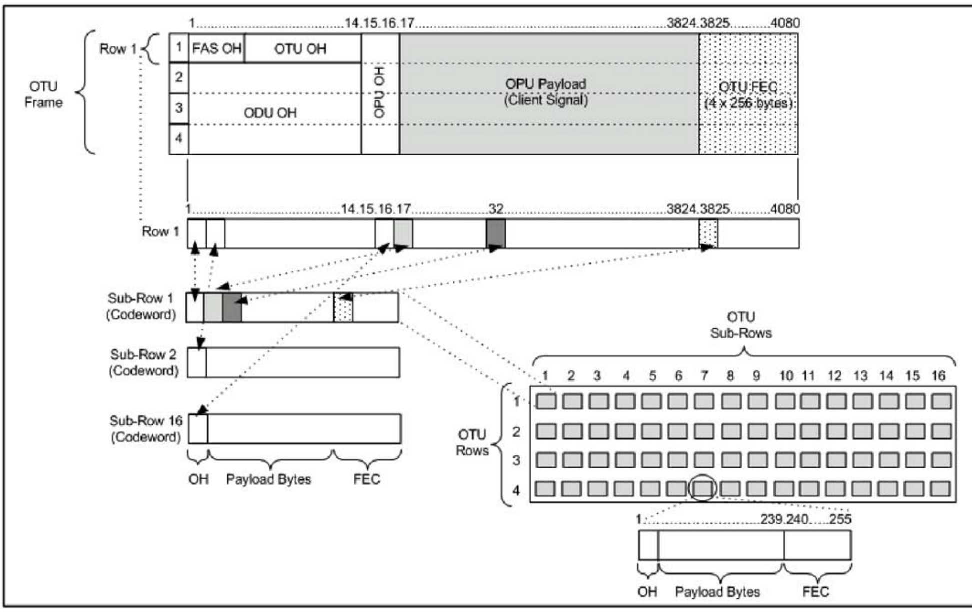
In addition to monitoring maintenance signals, using the STAT field associated with each TCM level, the TCM connection also monitors the BIP-8 and BEI errors for each connection level. Maintenance signals are used to advertise upstream maintenance conditions affecting the traffic and errors provide an 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 415. 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 30 *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

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/SDH Nomenclature

The GUI will used the International or European nomenclature based on the SONET and SDH software options installed on the MAX-800 Series.

Software option	Nomenclature
SONET only	International
SDH only	European
SONET and SDH	International

Signal Rates

Rate	SONET/DSn	SDH/PDH	
		International	European
1.544 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

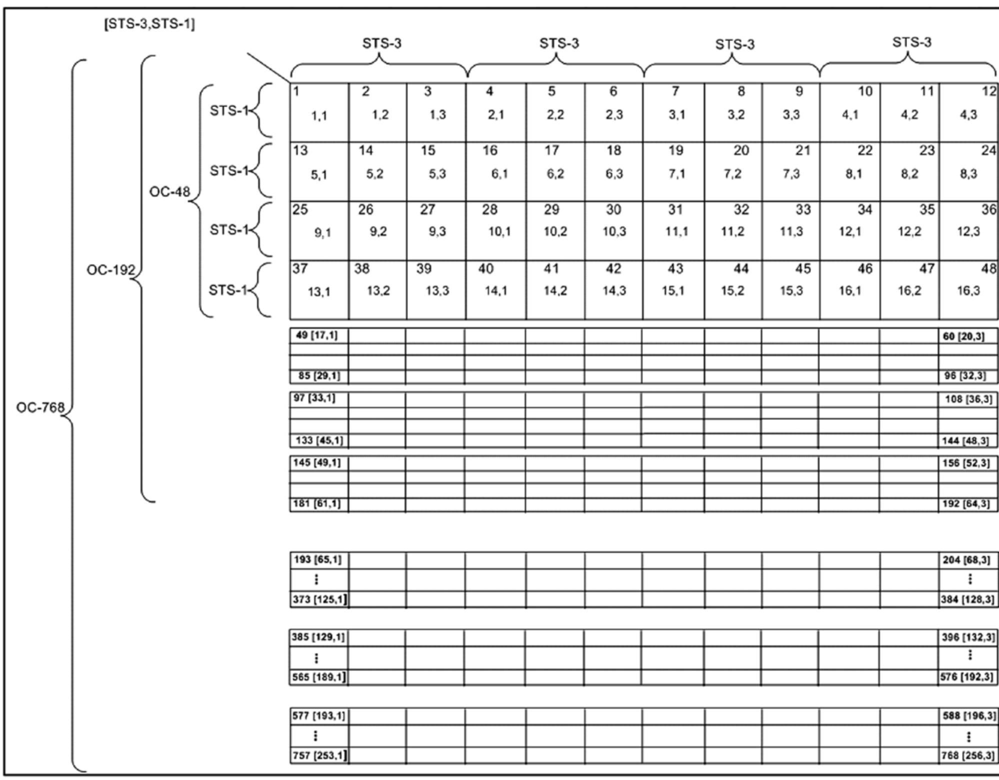
Layer	SONET	SDH
Low Order Path	AIS-V	TU-AIS
	LOP-V	TU-LOP
	RDI-V	LP-RDI
	ERDI-VCD	ERDI-CD
	ERDI-VPD	ERDI-PD
	ERDI-VSD	ERDI-SD
	RFI-V	LP-RFI
	UNEQ-V	LP-UNEQ
	TIM-V	LP-TIM
	PLM-V	LP-PLM
	BIP-2	BIP-2
	REI-V	LP-REI

SONET Numbering Convention

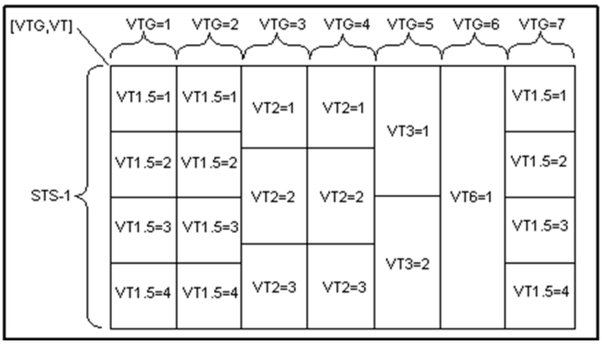
The MAX-800 Series supports the Timeslot (default) and hierarchical two-level numbering conventions as per GR-253.

Hierarchical Notation:

The MAX-800 Series supports numbering SONET high order path STS-1s and STS-3c using the two-level “STS-3#,STS-1#”convention in an OC-N. For example: STS-1 [2,3].



The MAX-800 Series supports numbering SONET low order path using the two-level “VTGroup#,VT#” convention for numbering VTs within an STS-1. For example: VT1.5 [1,3], VT2 [3,2], VT6 [6,1].



The MAX-800 Series supports numbering SONET high order path STS-nc within an OC-N using the two-level “STS-3#,STS-1#”. For example: STS-12c [5,1].

Note: *For STS-1e the numbering is limited to the A value as only one STS-1 exits.*

SDH Numbering Convention

As per ITU G.707, the high order paths are defined using a 2 to 5 level convention E,D,C,B,A depending on the rate of the STM-n used.

➤ E: the AUG-64 are numbered 1 to 4

➤ D: the AUG-16 are numbered 1 to 4

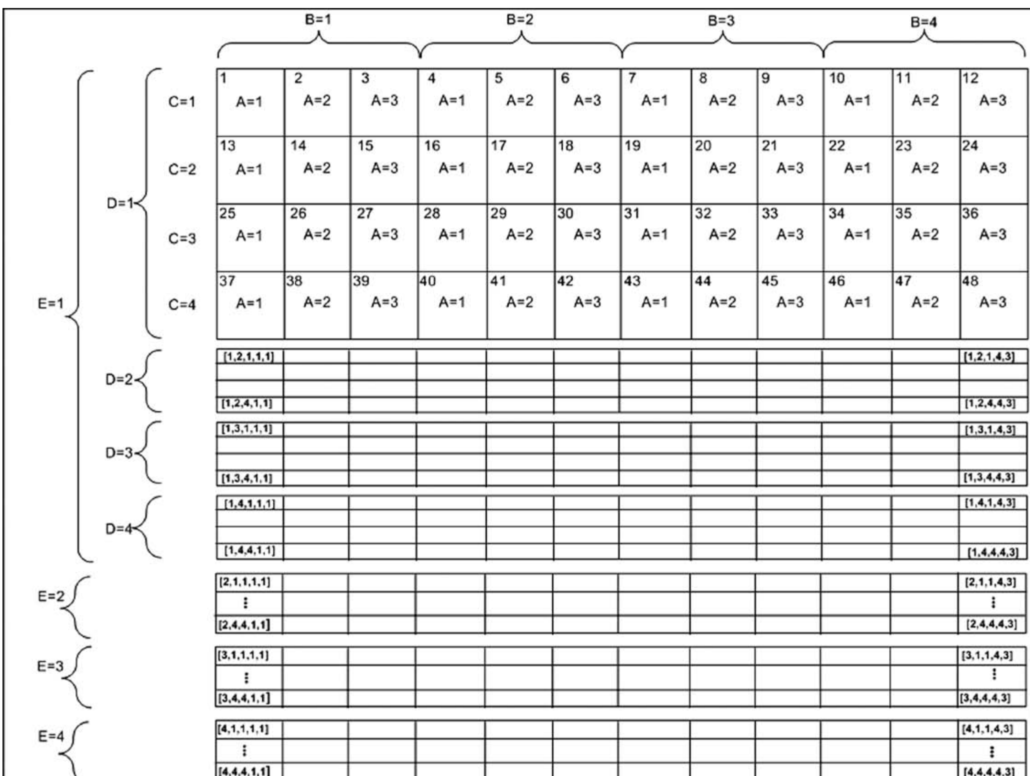
➤ C: the AUG-4 are numbered 1 to 4

➤ B: the AUG-1 are numbered 1 to 4

➤ A: the AU-3 are numbered 1 to 3

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

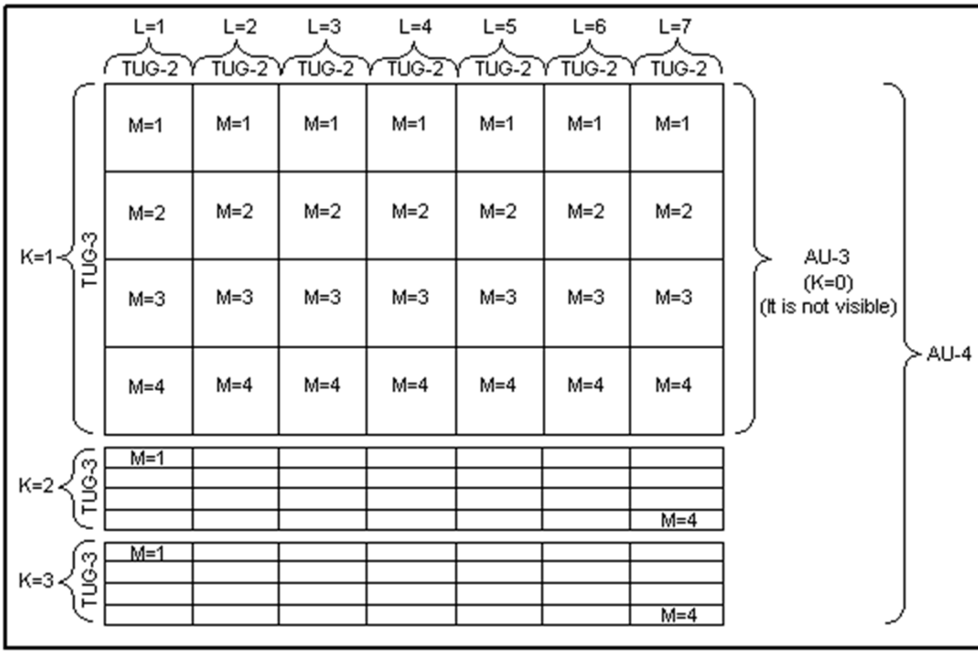
Examples for AU-4 (3 level convention)

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.

VLAN ID and Priority

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.

VLAN Priority

0	000 - Low Priority	4	100 - High Priority
1	001 - Low Priority	5	101 - High Priority
2	010 - Low Priority	6	110 - High Priority
3	011 - Low Priority	7	111 - High Priority

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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:1070982

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