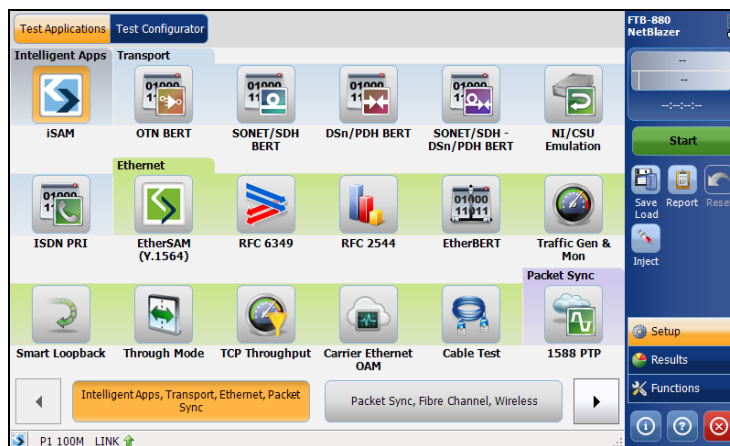


ETHERNET AND MULTISERVICE TESTER

FTB-700G/800 Series

FTB-700G/800 Series



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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 patent appl. US 2012/0307666 A1 and equivalents in other countries.

October 20, 2015

Document version: 6.0.0.3

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.

An electronic version of the declaration of conformity for your product is available on our website at **www.exfo.com**. Refer to the product's page on the Web site for details.

For continued compliance to the requirements of the EMC Directive:

For the BNC port(s) use double-shielded coaxial cable, type 734A or equivalent.

Laser



This product complies with 21 CFR 1040.10 as per Laser Notice No. 42, dated December 18, 1989 and with IEC/EN 60825-1.

Contents

Certification Information	iii
1 Introducing the Ethernet and Multiservice Tester	1
Features	1
Conventions	2
2 Safety Information	3
Additional Laser Safety Information	4
Installation Instruction Warnings	5
3 Getting Started	7
Turning On the Unit	7
Starting the Module Application	7
4 Physical Interfaces and LEDs	9
FTB-810 and FTB-810G Modules	9
FTB-860, FTB-720G, and FTB-730G Modules	10
FTB-860G Module	11
FTB-860GL Module	11
FTB-870, FTB-720G ⁺ , and FTB-730G ⁺ Modules	12
FTB-880 Module	13
Port Availability on the NetBlazer Modules	14
100M-4.25G (PORT #1/#2)	16
8.5G-11.3G (PORT #1)	17
155M-2.5G (PORT #1)	18
10G (PORT #1)	19
ETHERNET 10G (PORT #1)	20
ETHERNET 100/1000M (PORT #1/#2)	21
ETHERNET 10/100/1000M	22
2M-155M (PORT #1)	22
2M-52M (PORT #2)	22
1.5M/2M (PORT #1/#2)	22
EXT CLK	23
Headset/Microphone Port (FTB-1)	23
AUX Connection	24
Fibre Cables Connection	24
LEDs	24

5	Graphical User Interface Overview	25
	Main Application Window	25
	Main Window	25
	Navigation Buttons	25
	Status Bar	26
	Title Bar	28
	Global Indicator	29
	Test Control	31
	Test Menu	31
	Application Buttons	32
	Zoomed-In/Zoomed-Out Views	35
	Arrow Buttons	35
	Keyboard Usage	36
6	Test Setup - Test Applications	39
	iSAM	40
	OTN BERT	41
	SONET/SDH BERT	43
	DSn/PDH BERT	46
	SONET/SDH - DSn/PDH BERT	48
	NI/CSU Emulation	51
	ISDN PRI	52
	EtherSAM (Y.1564)	53
	RFC 6349	54
	RFC 2544	55
	EtherBERT	56
	Traffic Gen & Mon	57
	Smart Loopback	58
	Through Mode	60
	TCP Throughput	61
	Carrier Ethernet OAM	62
	Cable Test	64
	1588 PTP	65
	SyncE	66
	FC BERT	67
	CPRI/OBSAI BERT	68

7	Selecting and Starting a Test	71
	Intelligent Apps	71
	Transport Test Applications	74
	Ethernet Test Applications	76
	Packet Sync Test Applications	78
	Fibre Channel Test Application	80
	Wireless Test Application	82
8	Test Setup - Test Configurator, Timer, and System	85
	Test Configurator Overview	90
	Modify Structure Button	95
	Signal Auto-Detect	109
	1588 PTP	110
	BERT	115
	Cable Test	121
	Clock	123
	EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT	126
	EtherSAM - Burst	132
	EtherSAM - Global	134
	EtherSAM - Ramp	138
	Fibre Channel	140
	FTFL/PT	143
	Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)	146
	Interface (iSAM)	155
	ISDN PRI - Call Management	159
	ISDN PRI - ISDN Settings	164
	Labels	166
	Link OAM	168
	MAC/IP/UDP	170
	Network	182
	Network Details (iSAM)	188
	Remote Details (iSAM)	199
	RFC 2544 - Global	203
	RFC 2544 - Subtests	206
	RFC 6349	215
	S-OAM and MPLS-TP OAM	218
	Services - Global	228
	Services - Profile	231
	SFP/SFP+	238
	Signal (Transport)	239
	Signal - Signal Configuration (DSn/PDH)	245
	Signal - Signal Configuration (OTN)	254

Signal - Signal Configuration (SONET/SDH)	256
Smart Loopback	260
Streams - Global	262
Streams - Profile	264
SyncE	272
System	274
TCP Throughput	275
Timer	277
Traces (OTN)	279
Traces (SONET/SDH)	282
9 Test Results	285
Alarms/Errors Overview	288
Alarms/Errors	290
FTFL/PT	347
Graph (RFC 2544)	349
ISDN Logger	350
Labels	355
Link OAM	356
Logger and Alarms/Errors Logger	360
MPLS	362
Performance Monitoring	363
PTP Stats	370
Quality Level (1588 PTP)	372
Quality Level (SyncE)	374
S-OAM and MPLS-TP OAM	377
Service Configuration - Burst	382
Service Configuration - Ramp	383
Service Performance	385
Streams - Frame Loss / Out-of-Sequence	387
Streams - Jitter	387
Streams - Latency	388
Streams - Throughput	389
Summary	390
Summary (1588 PTP)	396
Summary (Cable Test)	400
Summary (EtherSAM)	404
Summary (FC BERT)	407
Summary (iSAM)	410
Summary (ISDN PRI)	414
Summary (Link OAM)	420
Summary (NI/CSU Emulation)	422

Summary (RFC 2544)	423
Summary (RFC 6349)	426
Summary (S-OAM and MPLS-TP OAM)	429
Summary (SyncE)	434
Summary (TCP Throughput)	437
Summary (Traffic Gen & Mon)	440
Traces - OTN	442
Traces - SONET/SDH	444
Traffic - Ethernet	445
Traffic - Flow Control	447
Traffic - Graph	449
Traffic - OAM, S-OAM, and MPLS-TP OAM	450
Window Sweep	452
WIS	453
10 Test Functions	455
APS	457
FDL - Bit-Oriented Message	460
FDL - Performance Report Message	464
FEAC	467
Filters	471
Packet Capture	475
OH - OTN	481
OH - SONET/SDH	487
Ping & Trace Route	501
Pointer Adjustment	506
RTD	516
RTD (CPRI Framed L2)	519
S-OAM Link Trace	521
Signaling Bits	523
Spare Bits	524
Traffic Scan	526

11 Test Control	529
More/Less Button	529
Discover Remote Button	530
Headset/DTMF Button	533
Inject Button	535
Laser Button	535
Lpbk Tool Button (Loopback Tool)	536
Phone Book Button	543
Report Button	547
Reset Button	551
Save/Load Button	552
Start/Stop TX Button	556
12 Power Failure Recovery	557
When Using the Test Timer	559
13 Suspend and Resume	561
Suspend Mode	561
Resume Operation	562
14 Maintenance	563
Cleaning LC Connectors	564
Recalibrating the Unit	565
Recycling and Disposal (Applies to European Union Only)	566
15 Troubleshooting	567
Solving Common Problems	567
Contacting the Technical Support Group	568
Transportation	568
16 Warranty	569
General Information	569
Liability	570
Exclusions	570
Certification	570
Service and Repairs	571
EXFO Service Centers Worldwide	572

A Specifications	573
General Specifications	573
SFP SONET/SDH and OTN Optical Interfaces	574
SFP+ 10G SONET/SDH and OTN Optical Interfaces	575
DSn/PDH and SONET/SDH Electrical Interfaces	576
SFP/SFP+ CPRI/OBSAI Optical Interface	577
SFP Ethernet Optical Interfaces	578
SFP+ Ethernet Optical Interfaces	579
Ethernet Electrical Interfaces	580
SFP Fibre Channel Interfaces	581
SFP+ Fibre Channel Interfaces	581
Synchronization Interface	582
B Glossary	583
Acronym List	583
10G Ethernet Client	601
1588 PTP	604
CPRI	609
Ethernet Cables	614
G.709 Optical Transport Network (OTN)	616
MPLS Labels	633
SONET/DSn/SDH/PDH	634
SyncE	644
Unicast/Multicast Addresses for Ethernet OAM	646
VLAN ID and Priority	647
Index	649

1 ***Introducing the Ethernet and Multiservice Tester***

ALL-IN-ONE Ethernet/optical solution for field technicians installing, testing and troubleshooting FTTx, fronthaul, backhaul, small-cell, DAS, remote radio head and data center networks, in addition to OTN, SONET/SDH, Fibre Channel, GigE and 10 GigE, CPRI/OBSAI and SyncE/1588 PTP services, with the added support of OTDR and iOLM capabilities.

Features

Features	Modules						
	860GL	860 860G	720G 730G	730G+ 730G+	810 810G	870	880
Intelligent Apps.	X	X	X	X		X	X
Ethernet	X	X	X	X		X	X
Packet Sync		X	X	X		X	X
Fibre Channel		X	X	X		X	X
Wireless		X	X	X		X	X
OTN				X		X	X
SONET/SDH				X	X	X	X
DSn/PDH					X		X
ISDN PRI and NI/CSU					X		X
OTDR and iOLM			X	X			

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.

Safety Information

Additional Laser Safety Information

Additional Laser Safety Information

This product employs Class 1 Laser SFP/SFP+.



WARNING

When the LASER LED is on or flashing, the FTB-700G/800 Series is transmitting an optical signal on the SFP/SFP+ transceiver ports.

Note: *Refer to the OTDR, iOLM, and FTB-1 user guides 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.

Safety Information

Installation Instruction Warnings



CAUTION

Electrostatic Discharge (ESD) Sensitive Equipment:

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

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

3 **Getting Started**

If the FTB-700G/800 Series has been purchased at the same time as the FTB-1, the FTB-700G/800 Series module is pre-installed with the appropriate software version. If the NetBlazer is not already installed, refer to the FTB-1 User Guide for more information on how to install the module.

Turning On the Unit

Turn on the FTB-1. Refer to the FTB-1 platform user guide for more information.

Starting the Module Application

The module can be configured and controlled by starting the NetBlazer or OTDR application; only one application can run at once.

To start the NetBlazer application:

1. For FTB-800 Series, from **Mini ToolBox** tap the NetBlazer application button.
2. For FTB-700G Series, from **Mini ToolBox** select the **FTB-7xx Ethernet & Multi-Service** module then tap NetBlazer application button.

Note: *To start the OTDR application, refer to the OTDR or iOLM user guide for more information.*

4 *Physical Interfaces and LEDs*

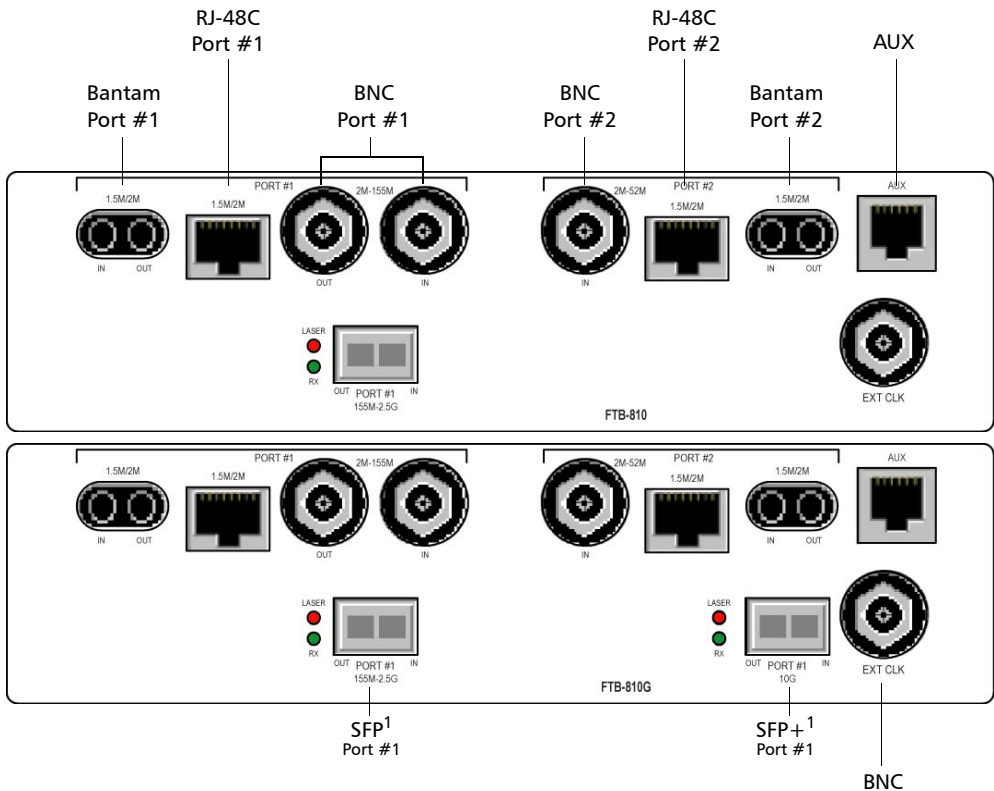
This section describes all connectors (ports) and LEDs available on the FTB-700G/800 Series module.



CAUTION

To prevent exceeding the maximum input/output power level, please refer to the *Specifications* on page 573.

FTB-810 and FTB-810G Modules

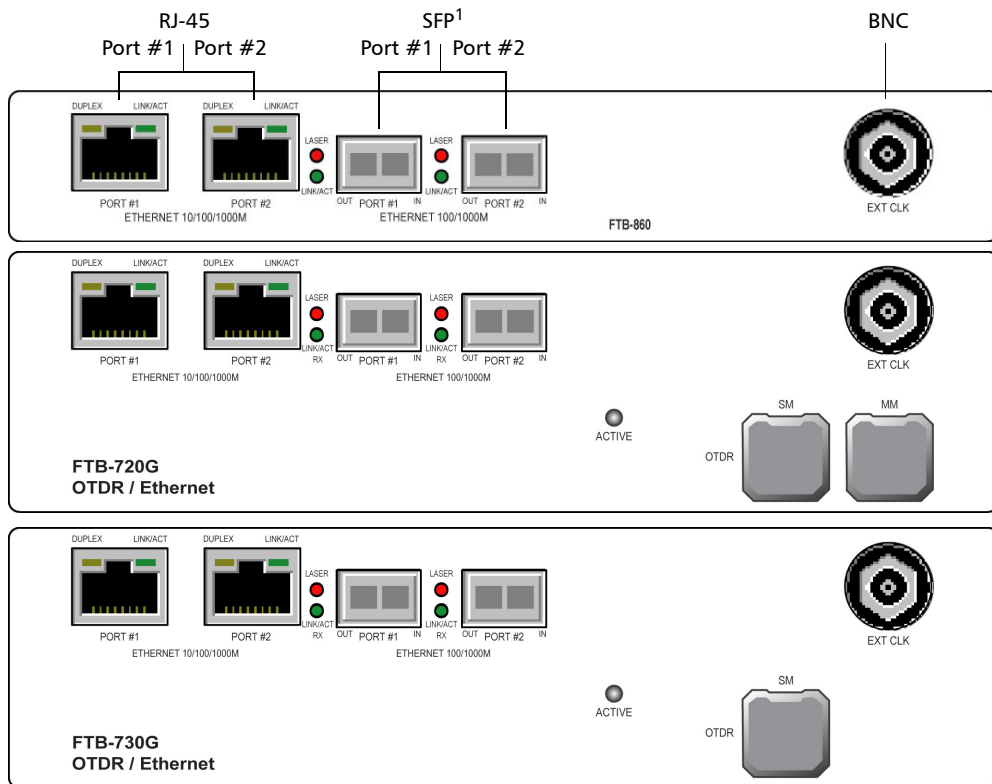


1. Laser radiation emitted from this port when LASER LED is on.

Physical Interfaces and LEDs

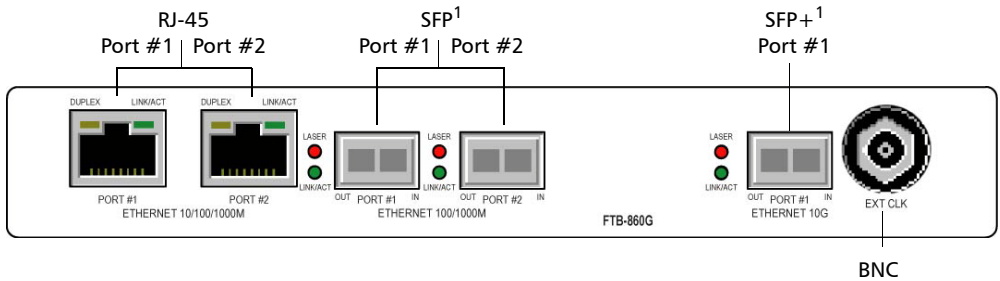
FTB-860, FTB-720G, and FTB-730G Modules

FTB-860, FTB-720G, and FTB-730G Modules



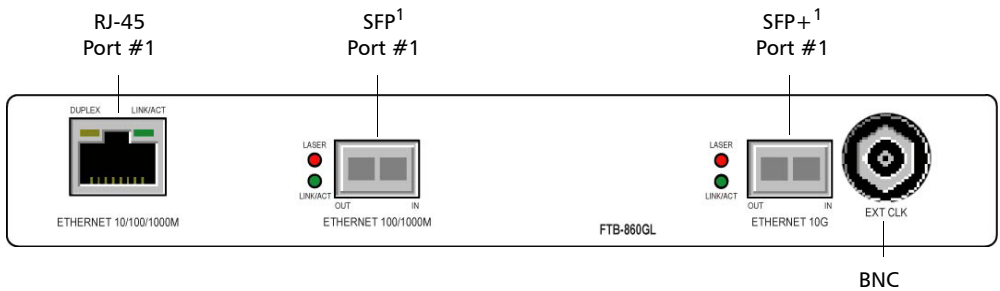
1. Laser radiation emitted from this port when LASER LED is on.

FTB-860G Module



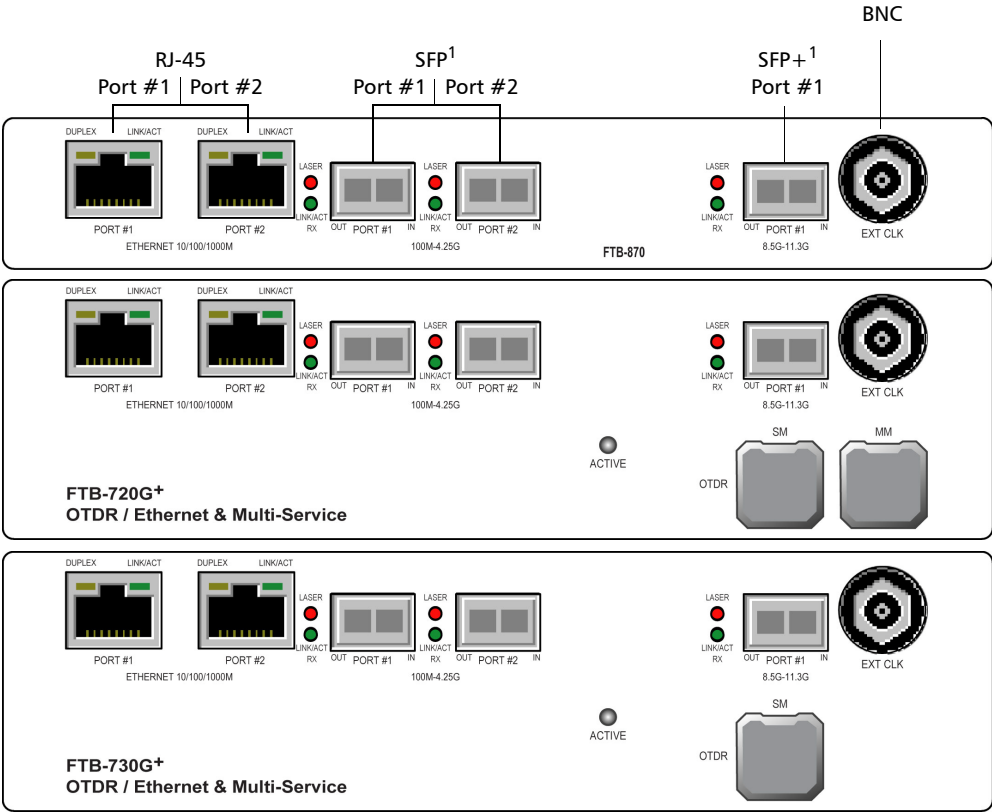
1. Laser radiation emitted from this port when LASER LED is on.

FTB-860GL Module



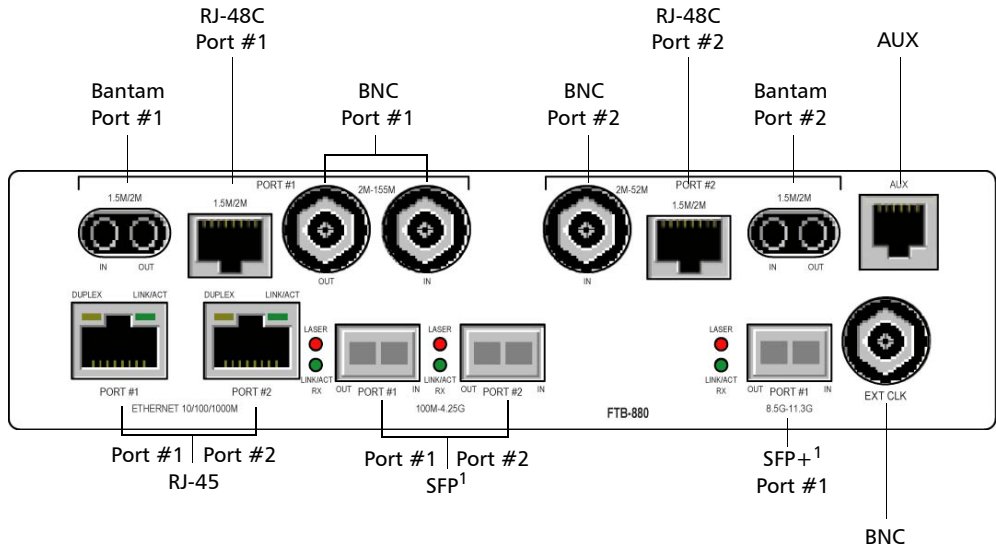
1. Laser radiation emitted from this port when LASER LED is on.

FTB-870, FTB-720G⁺, and FTB-730G⁺ Modules



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

FTB-880 Module



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

Physical Interfaces and LEDs

Port Availability on the NetBlazer Modules

Port Availability on the NetBlazer Modules

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

Connector	Labelled	Description and Supported signal(s)	Module
Bantam	1.5M/2M PORT #1	DS1/1.5M, E1/2M	FTB-810/810G/880
	1.5M/2M PORT #2	DS1/1.5M (IN port)	FTB-810/810G/880
BNC	2M-155M PORT #1	E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M	FTB-810/810G/880
	2M/52M PORT #2	DS3/45M (IN port)	FTB-810/810G/880
	EXT CLK	External clock synchronization: DS1/1.5M, E1/2M, 2MHz, 1PPS	All
AUX	AUX	Future use	FTB-810/ 810G/880
RJ-45	ETHERNET 10/100/1000M PORT #1 and PORT #2	Ethernet 10/100/1000 Mbit/s electrical	FTB-720G/ 720G ⁺ / 730G/ 730G ⁺ / 860/ 860G/860GL ^a
RJ-48C	1.5M/2M PORT #1	DS1/1.5M, E1/2M	FTB-810/810G/880
	1.5M/2M PORT #2	DS1/1.5M (IN port)	FTB-810/810G/880
SFP	ETHERNET 100/1000M PORT #1 and PORT #2	Ethernet 100 Mbit/s, 1000 Mbit/s optical CPRI 1.2288, 2.4576, 3.072, 4.9152, 6.1440 Gbit/s ^b OBSAI 3.072 Gbit/s ^b Fibre Channel 1X/2X/4X	FTB-720G/ 730G/ 860/ 860G/860GL ^a
	100M-4.25 PORT #1 and PORT #2 ^b	Ethernet 100 Mbit/s, 1000 Mbit/s optical CPRI 1.2, 2.4, 3.1, 4.9, 6.1 Gbit/s OBSAI 3.1 Gbit/s Fibre Channel 1X/2X/4X OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OTU1	FTB-720G ⁺ /730G ⁺ / 870/880
	155M-2.5G (PORT #1)	OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16	FTB-810/810G

Physical Interfaces and LEDs

Port Availability on the NetBlazer Modules

Connector	Labelled	Description and Supported signal(s)	Module
SFP+	ETHERNET 10G PORT #1	Ethernet 10 Gbit/s CPRI 9.8304 Gbit/s Fibre Channel 8X/10X	FTB-860G/ 860GL ^a
	8.5G-11.3G PORT #1	Ethernet 10 Gbit/s CPRI 9.8304 Gbit/s Fibre Channel 8X/10X OC-192/STM-64, OTU2, OTU1e, OTU2e, OTU1f, OTU2f	FTB-720G ⁺ /730G ⁺ +/ 870/880
	10G PORT #1	OC-192/STM-64	FTB-810G

- a. Only one port is available on the FTB-860GL module. The FTB-860GL module does not support Fibre Channel and CPRI/OBSAI test applications.
- b. OC-x/STM-x/OTU1 and CPRI/OBSAI are only available on PORT #1.

Physical Interfaces and LEDs

100M-4.25G (PORT #1/#2)

100M-4.25G (PORT #1/#2)

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	X	
Intelligent Apps Ethernet	100Mbit/s, 1000 Mbit/s	X	X
Packet Sync	100Mbit/s, 1000 Mbit/s	X	X
Fibre Channel	1X, 2X, 4X	X	X
Wireless	CPRI 1.2, 2.4, 3.1, 4.9, 6.1 Gbit/s; OBSAI 3.1 Gbit/s.	X	X

Plug the SFP module into the PORT #1 or PORT #2 slot.



WARNING

Use only EXFO supported transceivers. Refer to the Specifications on page 573 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

Note: Do not replace a 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.

8.5G-11.3G (PORT #1)

The 8.5G-11.3G PORT #1 can be used for the following test application and optical rates:

Application	Rates
Transport	OC-192/STM-64, OTU2, OTU1e, OTU2e, OTU1f, and OTU2f
Ethernet	10Gbit/s LAN and 10Gbit/s WAN
Packet Sync	10Gbit/s LAN
Fibre Channel	8X and 10X
Wireless	CPRI: 9.8304 Gbit/s

Plug the SFP+ module into the **8.5G-11.3G** PORT #1 slot on the module.



WARNING

Use only EXFO supported transceivers. Refer to the *SFP+ 10G SONET/SDH and OTN Optical Interfaces* on page 575 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

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

Physical Interfaces and LEDs

155M-2.5G (PORT #1)

155M-2.5G (PORT #1)

The 155M-2.5G PORT #1 can be used for optical Transport test applications.

Supported rates:

OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16.

Plug the SFP module into the **155M-2.5M** PORT #1 slot on the module.



WARNING

Use only EXFO supported transceivers. Refer to the *SFP SONET/SDH and OTN Optical Interfaces* on page 574 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

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

10G (PORT #1)

The 10G PORT #1 can be used for optical Transport test applications.

Supported rates:

OC-192/STM-64.

Plug the SFP+ module into the **10G** PORT #1 slot on the module.



WARNING

Use only EXFO supported transceivers. Refer to the *SFP+ 10G SONET/SDH and OTN Optical Interfaces* on page 575 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

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

ETHERNET 10G (PORT #1)

The ETHERNET 10G PORT #1 can be used for the following test application and optical rates:

Application	Rates
Ethernet	10Gbit/s LAN and 10Gbit/s WAN
Packet Sync	10Gbit/s LAN
Fibre Channel	8X and 10X
Wireless	CPRI: 9.8304 Gbit/s

Plug the SFP+ module into the **ETHERNET 10G** PORT #1 slot on the module.



WARNING

Use only EXFO supported transceivers. Refer to the *SFP+ Ethernet Optical Interfaces* on page 579 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

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

ETHERNET 100/1000M (PORT #1/#2)

The ETHERNET 100/1000M PORT #1 can be used for the following test application and optical rates:

Application	Rates	PORT	
		#1	#2
Ethernet	100Mbit/s, 1000 Mbit/s	X	X
Packet Sync	100Mbit/s, 1000 Mbit/s	X	X
Fibre Channel	1X, 2X, 4X	X	X
Wireless	CPRI 1.2288, 2.4576, 3.072, 4.9152, 6.1440 Gbit/s; OBSAI 3.072 Gbit/s.	X	X

Plug the SFP module into the **ETHERNET 100/1000M** PORT #1 or PORT #2 slot on the module.



WARNING

Use only EXFO supported transceivers. Refer to the *SFP Ethernet Optical Interfaces* on page 578 for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

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

ETHERNET 10/100/1000M

This port can be used for electrical Intelligent Apps, Ethernet, or Packet Sync test applications.

Supported electrical rates are 10Mbits/s, 100Mbit/s, and 1000Mbit/s. 10Mbits/s is not supported for SyncE. Plug the 10/100/1000 electrical interface or the cable to be tested to the ETHERNET 10/100/1000M (PORT #1 or PORT #2) connector on the module. The electrical ports is RJ45 for category 5 unshielded twisted pair (UTP). Refer to *Ethernet Cables* on page 614 for cable specifications.

2M-155M (PORT #1)

This port can be used for electrical Transport test applications.

Supported electrical signal are E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, and STS-3e/STM-1e/155M. Plug the signal to be tested to the BNC IN and OUT ports. Connector type is BNC for coaxial 75-ohm cable connection.

2M-52M (PORT #2)

This port can be used for electrical DS3 dual RX Transport test application.

Supported electrical signal are DS1 or DS3 for Dual RX testing capability. Plug the signal to be tested to the BNC IN port. Connector type is BNC for coaxial 75-ohm cable connection.

1.5M/2M (PORT #1/#2)

This port can be used for electrical Transport test applications.

Supported electrical signal are DS1/1.5M and E1/2M. Plug the signal to be tested to either Bantam or RJ48C port.

EXT CLK

The FTB-700G/800 Series provides one connector, labeled **EXT CLK** that can be used either for input/output external clock DS1 (1.5M), E1 (2M), 2MHz, or 1PPS synchronization signal. 1PPS is available for **Dual Test Set** in **One-Way Latency** measurement mode. The connector type is BNC SMB for coaxial 75-ohm cable connection. An adapter cable (BNC to Bantam) is required for Bantam connection (not supplied).

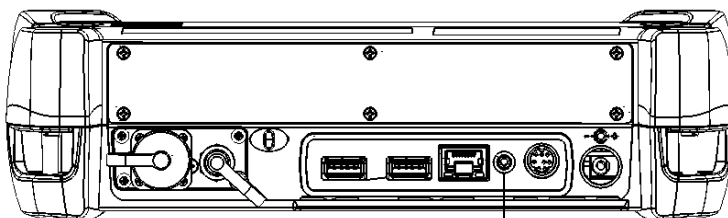
Headset/Microphone Port (FTB-1)



CAUTION

When using speech over ISDN (ISDN PRI test application), use only the headset supplied by EXFO to ensure adequate protection.

The headset port can be used with the ISDN PRI test application to connect a headset allowing to talk and listen when calls are made and received.



Headset/microphone port

Note: Refer to *FTB-1 User Guide* for instructions on configuring the *Headset/Microphone settings*.

AUX Connection

The **AUX** port is reserved for future use to attach a buttset or telephone to talk and listen over an ISDN PRI line.

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

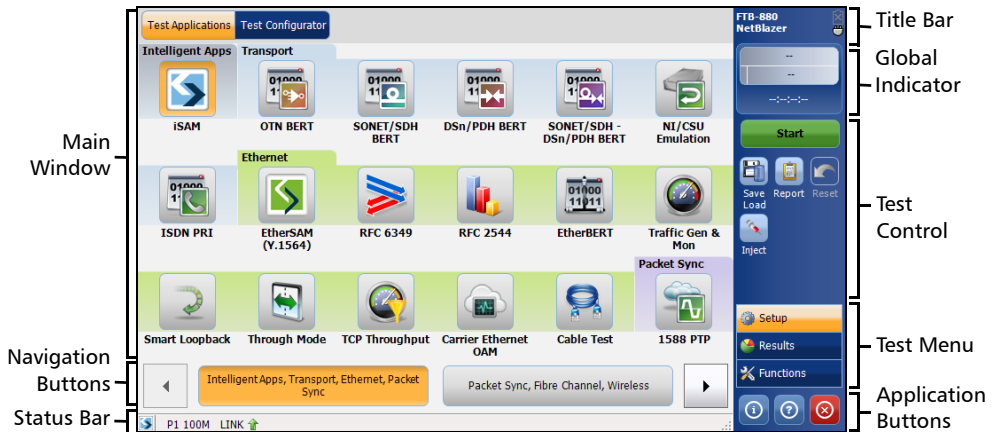
- **LASER** red LED is on when the FTB-700G/800 Series is emitting an optical laser signal.
- **LINK** green LED is on when the link is up, off when the link is down, and flashing when frames are transmitted and/or received.
- **DUPLEX** green LED is on for Full Duplex mode, off for Half Duplex mode, and flashing when collisions are detected.

5 Graphical User Interface Overview

This chapter describes the FTB-700G/800 Series graphical user interface.

Main Application Window

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



Main Window

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

Navigation Buttons

Navigation buttons appear when there is not enough room on one page to display all available test applications. The left and right arrow buttons allow to respectively access the previous or next window. The buttons in between the left and right arrow buttons allow to directly select the window for the type of test application listed.

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
(BTS) or (RRH)	BTS: Emulation mode is Base Station RRH: Emulation mode is Remote Radio Head	CPRI/OBSAI BERT
LINK	Green arrow: Link up. Red arrow: Link down. Gray arrow: Awaiting incoming data to provide a status.	Transport Ethernet Fibre Channel CPRI/OBSAI BERT
PTP	Green arrow: Signaling requests granted. Red arrow: Request denied, session canceled, or no reply. Gray arrow: Pending or inactive. Refer to <i>Negotiation Status</i> on page 397 for more information.	1588 PTP
ESMC	Green arrow: ESMC valid information frame received. Red arrow: No ESMC valid information frames received. Gray arrow: Pending state. Refer to <i>ESMC Monitoring</i> on page 272 for more information.	SyncE
D-Channel	The channel used as the D-channel to transmit signalling information. Green arrow: Link up Red arrow: Link down.	ISDN PRI
 7	B-Channel #x is configured as a Speech or 3.1 kHz channel	ISDN PRI

Icon and/or text	Description	Test Application
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 for 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 <i>Laser Button</i> on page 535.	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 Fibre Channel
	A connection is established between two testing units either in Dual Test Set (DTS) or in Loop Up mode. Not available with Intelligent Apps .	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 Fibre Channel
	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

Graphical User Interface Overview

Title Bar

Icon and/or text	Description	Test Application
	Alarm/error is currently injected. Not displayed when there is no alarm/error injection.	Transport, EtherBERT, Carrier Ethernet OAM, Fibre Channel, Wireless

The following status are available at the platform level.

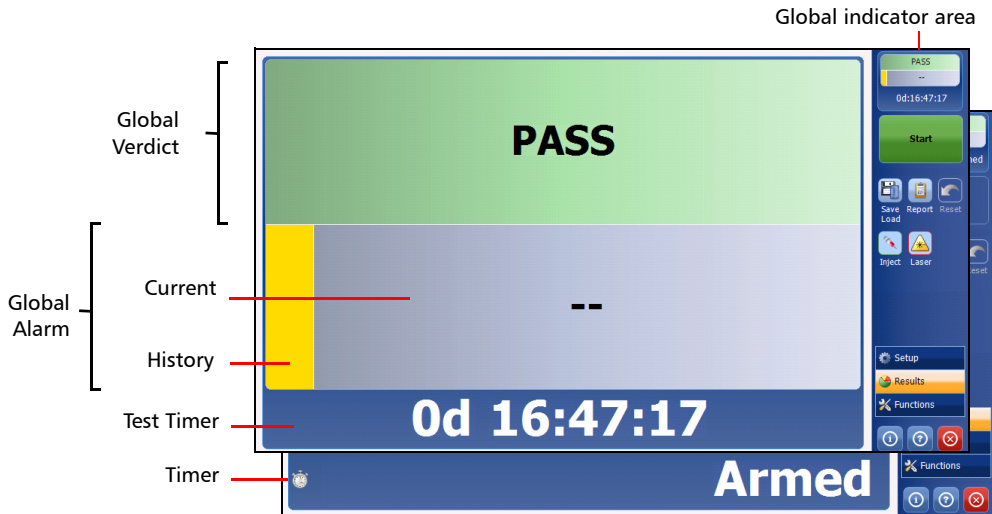
- Battery/AC icons indicate the battery level and if the FTB-1 is connected to an AC power source. Refer to the FTB-1 user guide for more information.
- Date and Time indicate the current date and time.

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 529 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 85 for more information.
- **Results** allows to view test results. Refer to *Test Results* on page 285 for more information.
- **Functions** allows to configure additional test functions (refer to *Test Functions* on page 455).

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 module 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 *FTB-1 User Guide*. The module 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
ISDN-PRI	Primary Rate North American and/or European ISDN
SONET	Synchronous Optical Network
SDH	Synchronous Digital Hierarchy
TCM	Tandem Connection Monitoring
OTU2-1f-2f	Optical Transport Unit-2 Overclocked (11.270/11.317 Gbit/s)
OTU2-1e-2e	Optical Transport Unit-2 Overclocked (11.049/11.096 Gbit/s)
OTU2	Optical Transport Unit-2 (10.7 Gbit/s)
OTU1	Optical Transport Unit-1 (2.7 Gbit/s)
52M	52 Mbit/s
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.
FC-1X	Fibre Channel 1X
FC-2X	Fibre Channel 2X
FC-4X	Fibre Channel 4X

Graphical User Interface Overview

Application Buttons

Software Option	Description
FC-8X	Fibre Channel 8X
FC-10X	Fibre Channel 10X
IPV6	IPV6 testing.
MPLS	MPLS Encapsulation
TRAFFIC_GEN	Traffic Gen & Mon test application
iSAM	Intelligent Service Activation Methodology
Cable_Test	Cable Test application
TCP-THPUT	TCP Throughput Test Application
CPRI-1.2G	CPRI 1.2288 Gbit/s
CPRI	CPRI 2.4576 Gbit/s and 3.072 Gbit/s
CPRI-4.9G	CPRI 4.9152 Gbit/s
CPRI-6.1G	CPRI 6.144 Gbit/s
CPRI-9.8G	CPRI 9.8304 Gbit/s
OBSAI	OBSAI 3.072 Gbit/s
1588PTP	1588 Precision Time Protocol Test Application
SyncE	Synchronous Ethernet Test Application
ETH-THRU	Through Mode test application.
ETH-OAM	Carrier Ethernet OAM test application
TRAFFIC-SCAN	Traffic Scan
LINK-OAM	Link OAM
RFC6349	RFC 6349 test application (10GE and less)
ETH-CAPTURE	Ethernet Frame Capture
ADV-FILTERS	Advanced filtering

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.

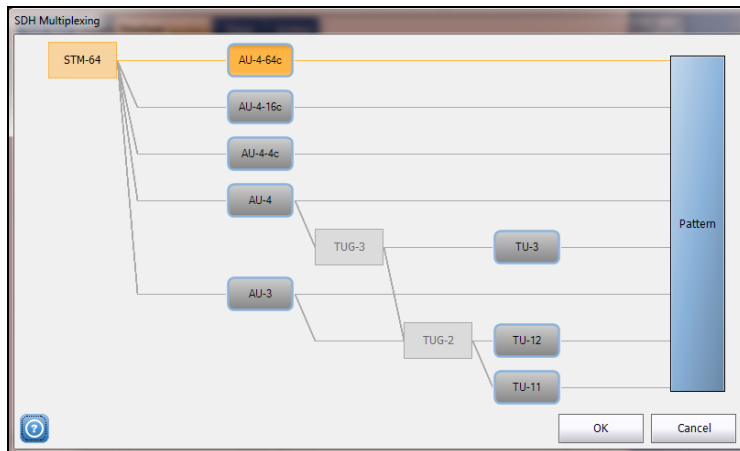
Note: *For certain text fields, the GUI pops up or uses the platform's on-screen keyboard. Refer to the platform user guide for more information on how to use it.*

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.



Graphical User Interface Overview

Keyboard Usage

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 NetBlazer offers the following test applications.

Type	Application	Available on FTB-...					Page
		720G, 730G, 860, 860G	810, 810G	860GL	720G+, 730G+, 870	880	
Intelligent Apps	iSAM	X	-	-	X	X	40
Transport	OTN BERT	-	-	-	X	X	41
	SONET/SDH BERT	-	X	-	X	X	43
	DSn/PDH BERT	-	X	-	-	X	46
	SONET/SDH - DSn/PDH BERT	-	X	-	-	X	48
	NI/CSU Emulation	-	X	-	-	X	51
	ISDN PRI	-	X	-		X	52
Ethernet	EtherSAM (Y.1564)	X	-	-	X	X	53
	RFC 6349	X	-	-	X	X	54
	RFC 2544	X	-	-	X	X	55
	EtherBERT	X	-	-	X	X	56
	Traffic Gen & Mon	X	-	-	X	X	57
	Smart Loopback	X	-	X	X	X	58
	Through Mode	X	-	-	X	X	60
	TCP Throughput	X	-	-	X	X	61
	Carrier Ethernet OAM	X	-	-	X	X	62
	Cable Test	X	-	X	X	X	64
Packet Sync	1588 PTP	X	-	-	X	X	65
	SyncE	X	-	-	X	X	66
Fibre Channel	FC BERT	X	-	-	X	X	67
Wireless	CPRI/OBSAI BERT	X	-	-	X	X	68

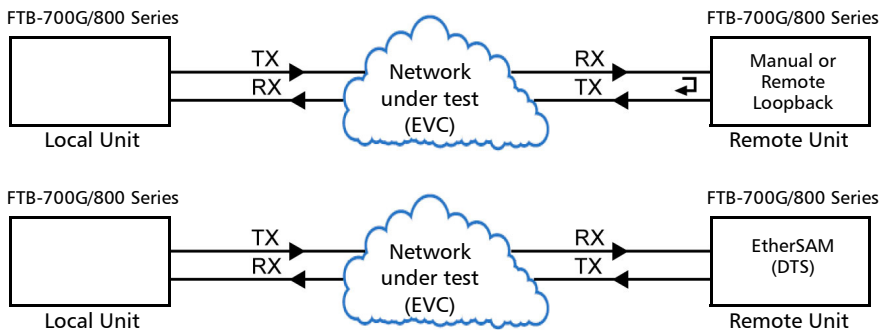
iSAM

iSAM is a simplified version of EtherSAM that is centered around addressing turn-up of E-Line circuits (EVC). The objective of the test is to validate Carrier Ethernet-based services key performance indicators defined in MEF: Frame Delay (FD), Inter-Frame Delay Variation (IFDV), and Frame Loss Ratio (FLR). In addition the RFC 6349 subtest can be enabled to validate that the Ethernet service is able to properly carry TCP traffic.

The **iSAM** test 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.

➤ Typical iSAM test applications:

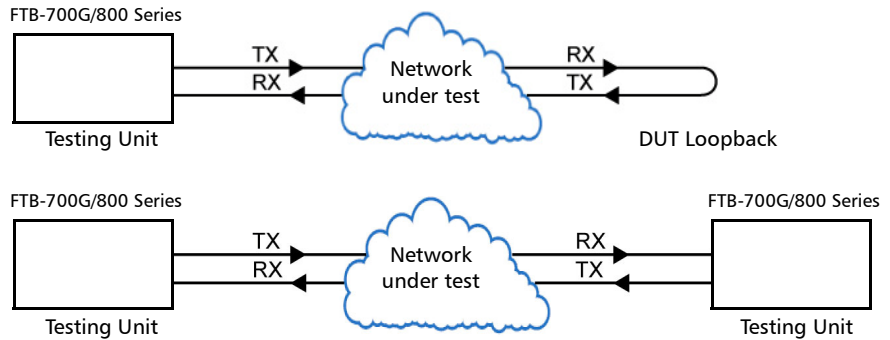


➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

OTN BERT

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

➤ Typical OTN BERT test applications:

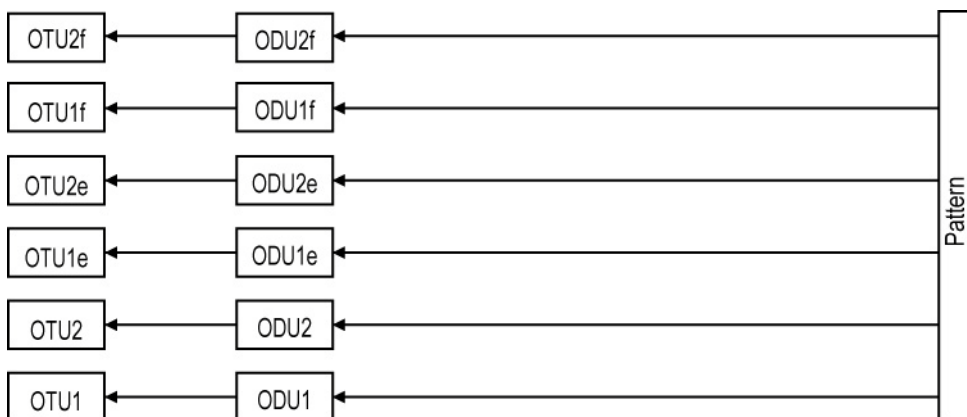


Test Setup - Test Applications

OTN BERT

➤ Path/Mapping

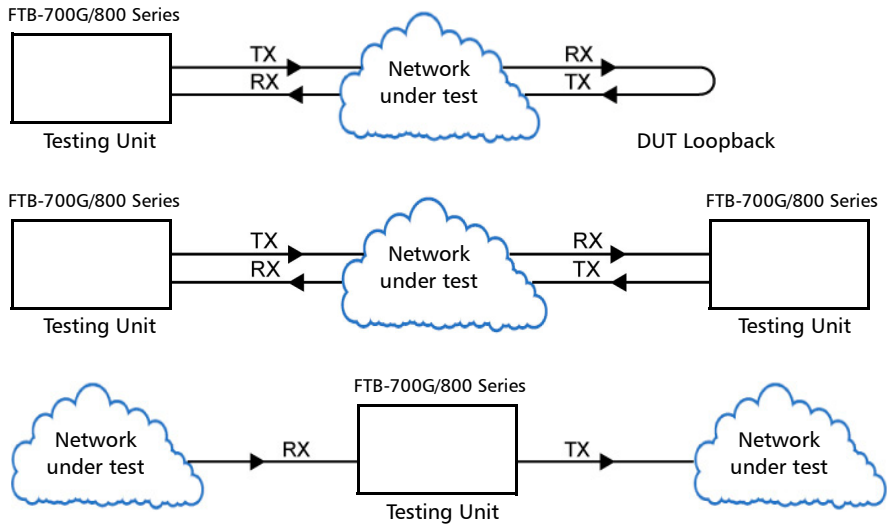
The **OTN BERT** test application offers the following path/mapping structures depending on the inserted SFP/SFP+ transceiver, and enabled options.



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:



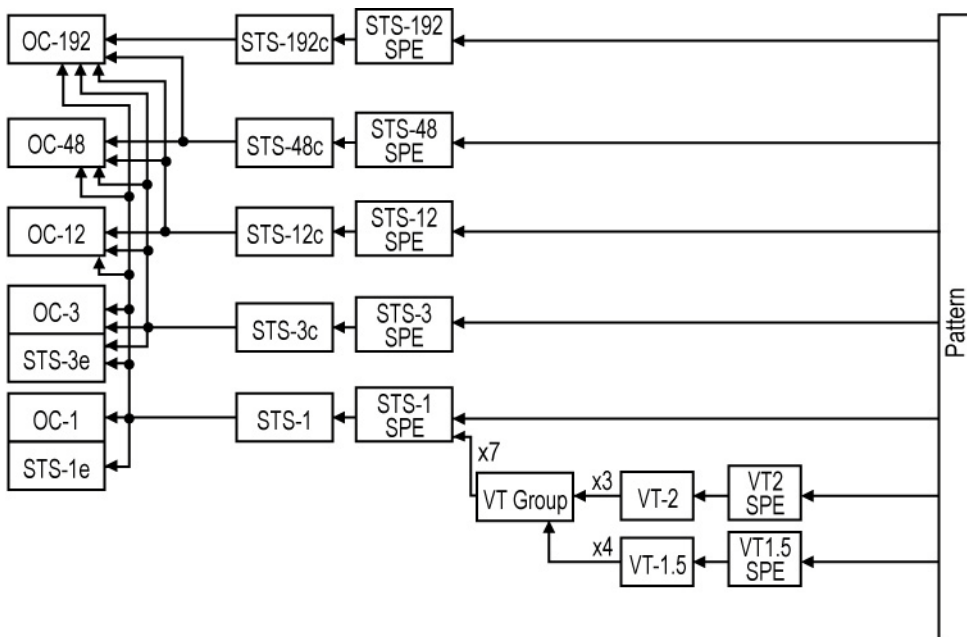
Test Setup - Test Applications

SONET/SDH BERT

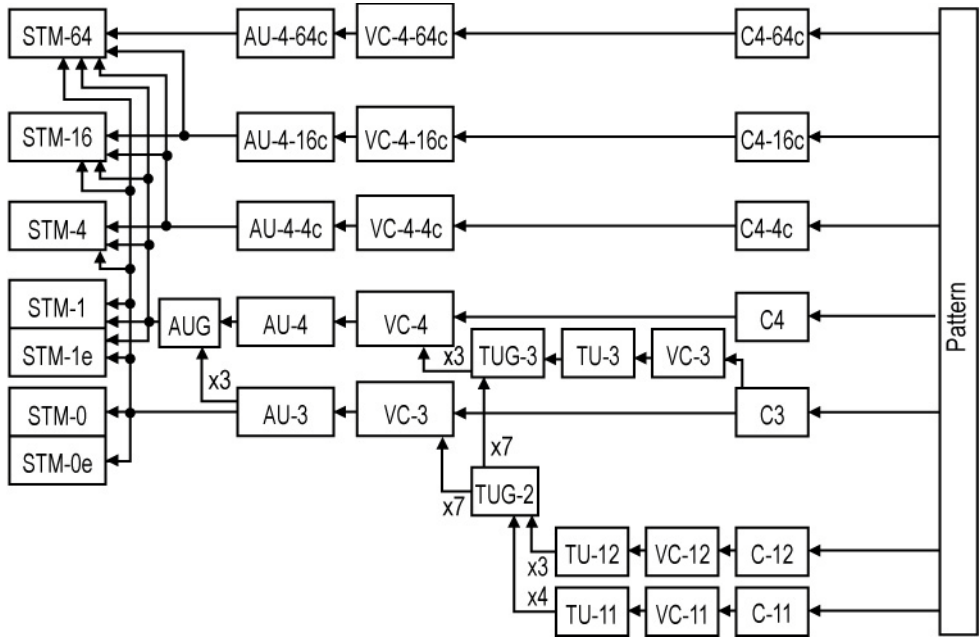
➤ Path/Mapping

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

For SONET BERT



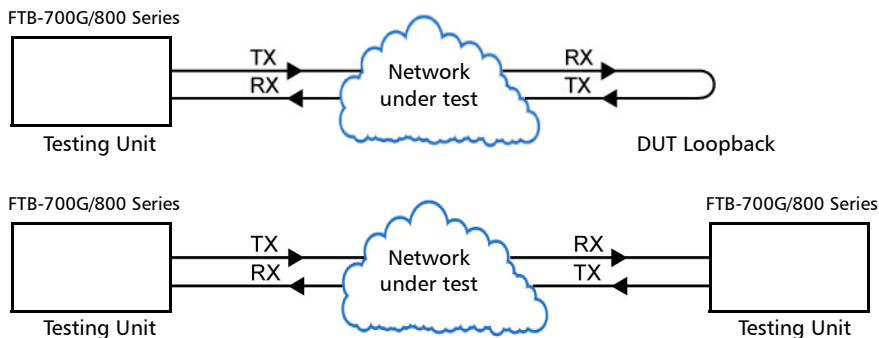
For SDH BERT



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.

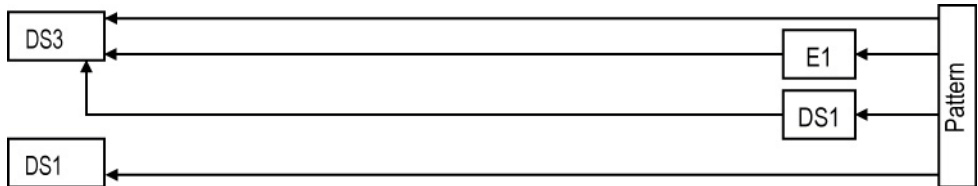
- Typical DSn/PDH BERT test applications:



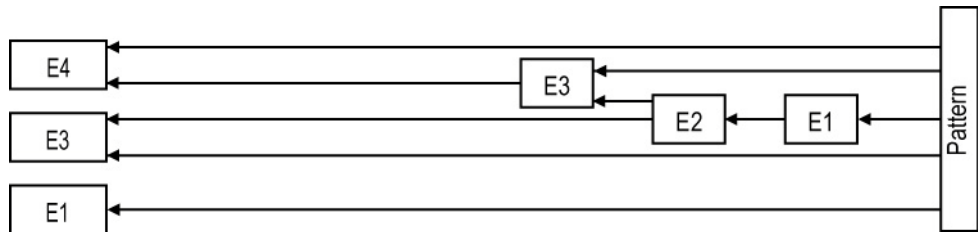
➤ Path/Mapping

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

For DSn:



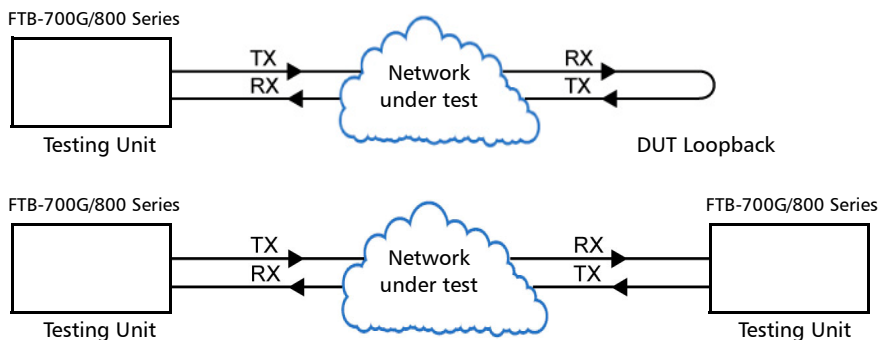
For PDH:



SONET/SDH - DS_n/PDH BERT

Allows validation of the DS_n 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.

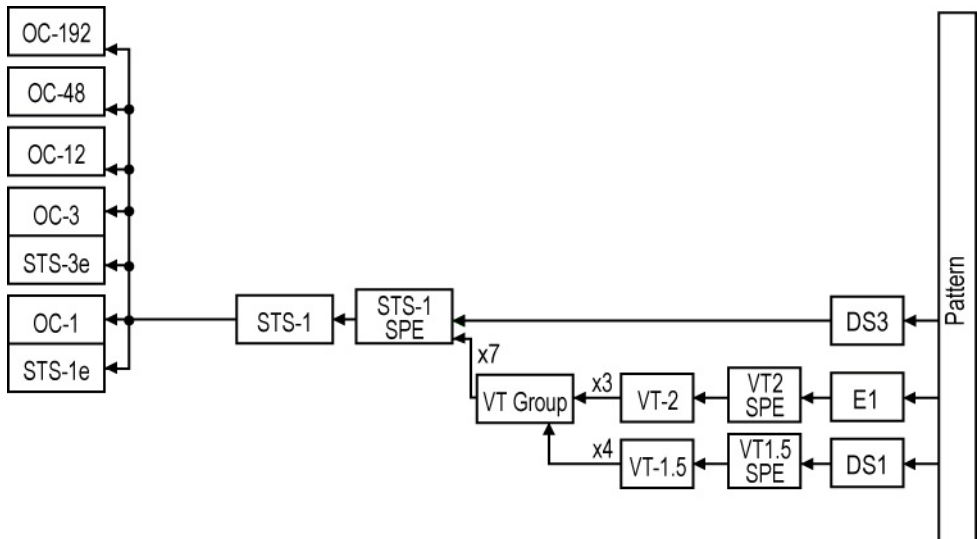
- Typical SONET/SDH - DS_n/PDH BERT test applications:



➤ Path/Mapping

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

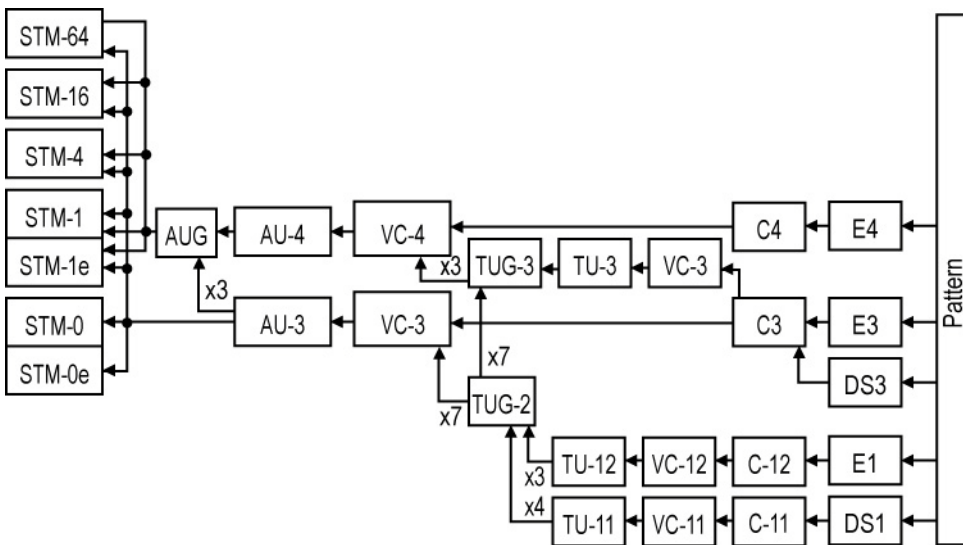
For SONET:



Test Setup - Test Applications

SONET/SDH - DSn/PDH BERT

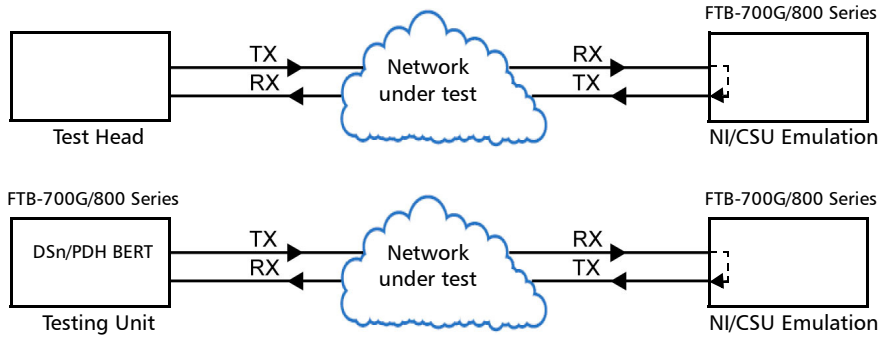
For SDH:



NI/CSU Emulation

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

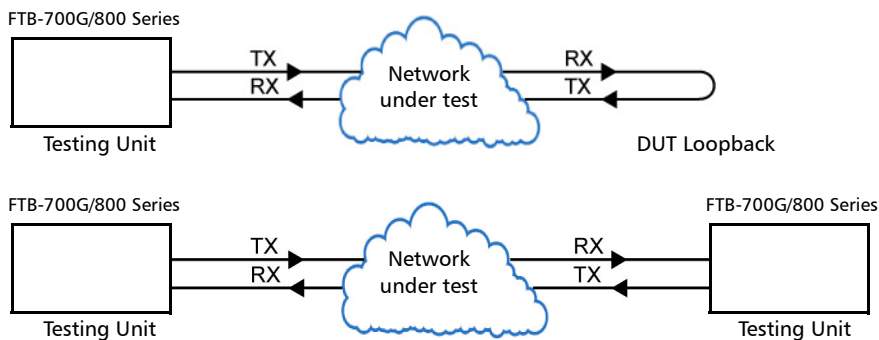
Typical NI/CSU Emulation test applications:



ISDN PRI

Allows to test and troubleshoot North American or European ISDN PRI configurations by calling one or all 23 DS1 or 30 E1 PRI channels. Once connected, the user can perform a channel-by-channel BERT, or talk and listen via a headset.

Typical ISDN PRI test applications:



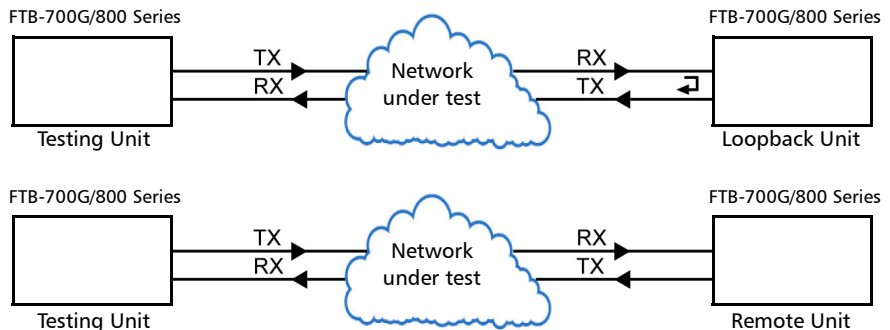
EtherSAM (Y.1564)

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 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.

➤ Typical EtherSAM (Y.1564) test applications:



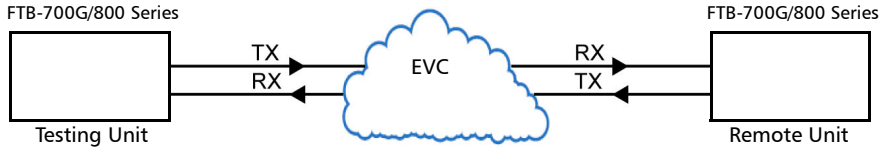
➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

RFC 6349

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

The **RFC 6349** test has to be executed in conjunction with a remote compatible module in RFC 6349 **Dual Test Set** mode allowing bidirectional testing. The **Dual Test Set** test provides independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

- Typical RFC 6349 test application:



- Supported Interfaces/Rates: 10M to 10G LAN.

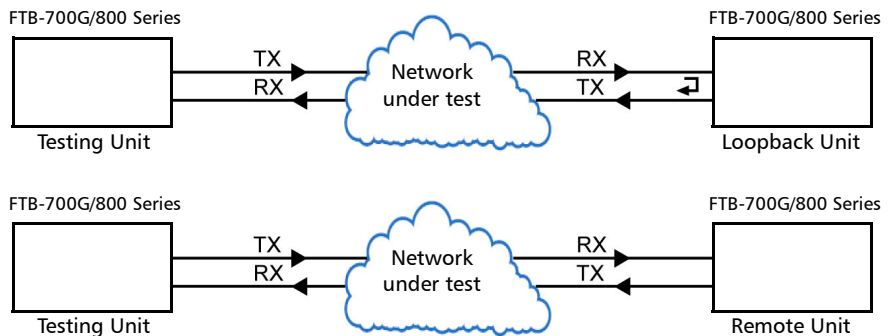
RFC 2544

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

The **RFC 2544** test 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.

➤ Typical RFC 2544 test applications:

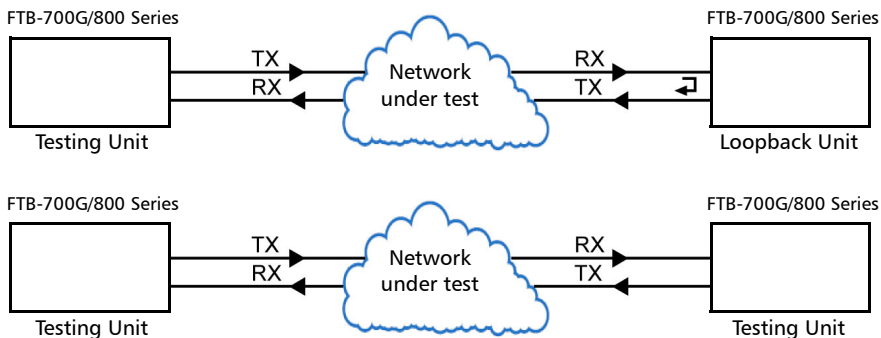


➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

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:

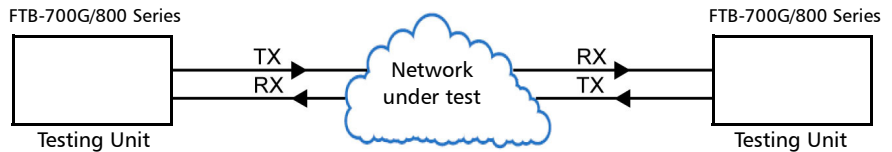
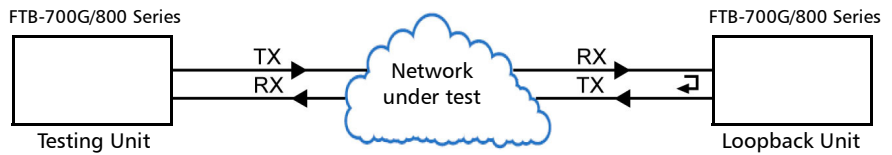


- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

Traffic Gen & Mon

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

- Typical Traffic Gen & Mon test applications:



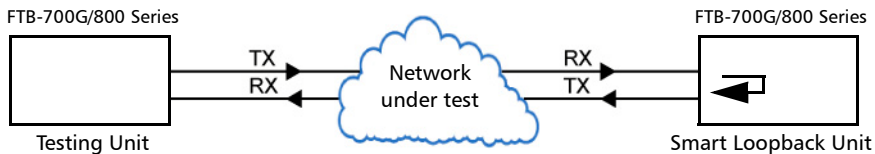
- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

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 76) or remotely using an EXFO unit (refer to *Discover Remote Button* on page 530) or a Third-Party device (see *Third-Party Remote Loopback* on page 59).

- 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:

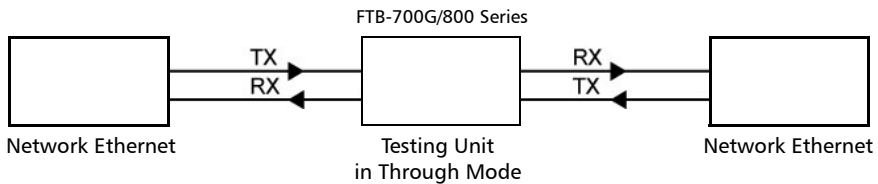
- Layer 2: Ethernet
- Layer 3: IP
- Layer 4: UDP/TCP

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 FTB-700G/800 Series unit using either 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:



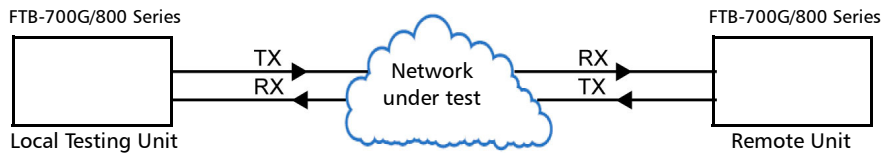
- Supported Interfaces/Rates: 10M to 1G.

TCP Throughput

The objective of this test is to find the TCP throughput based on the successfully transported bytes over the test time. Two units running a TCP Throughput test are required. One unit will act as the source (Local) and the other one as the destination (Remote).

The local unit starts sending TCP segments using the Initial Window Size defined. The window size is adjusted following the TCP algorithm. The window size is incremented until the Maximum Window Size or congestion is reached. However, the window size will be reduced when congestion occurs, then incremented again as described above when the congestion is cleared. TCP Throughput and windows size statistics will be gathered throughout the test.

- Typical TCP Throughput test application:



- Supported Interfaces/Rates: 10M to 1G.

Carrier Ethernet OAM

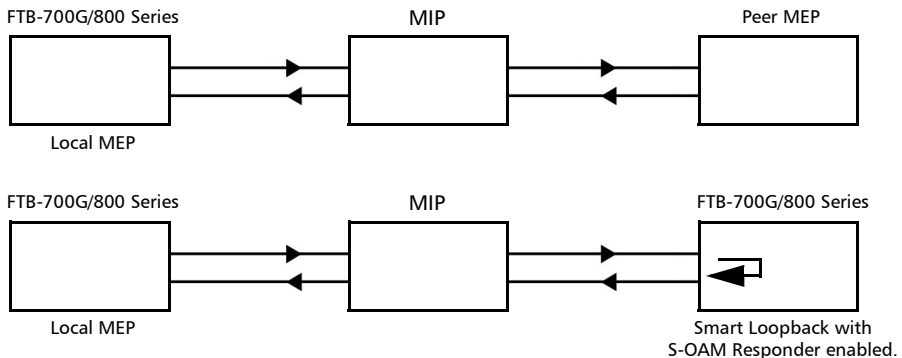
The Carrier Ethernet OAM test application supports the following tests:

Ethernet OAM (S-OAM), MPLS-TP OAM, and Link OAM.

Ethernet OAM and MPLS TP OAM

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

- Performance Monitoring measures parameters such as frame delay, frame loss, and synthetic loss (Y.1731/MEF).
 - Connectivity Fault Management provides the capability for detecting, verifying, and isolating connectivity failure (Y.1731/802.1ag/MEF).
- Typical Ethernet OAM and MPLS TP OAM test applications:

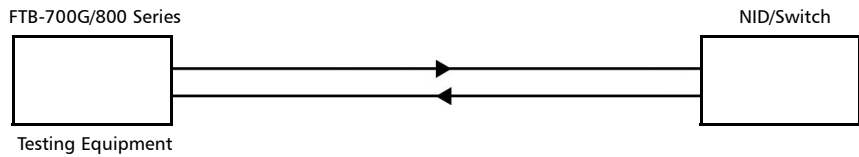


- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

Link OAM

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

- Typical Link OAM test application:



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

Cable Test

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

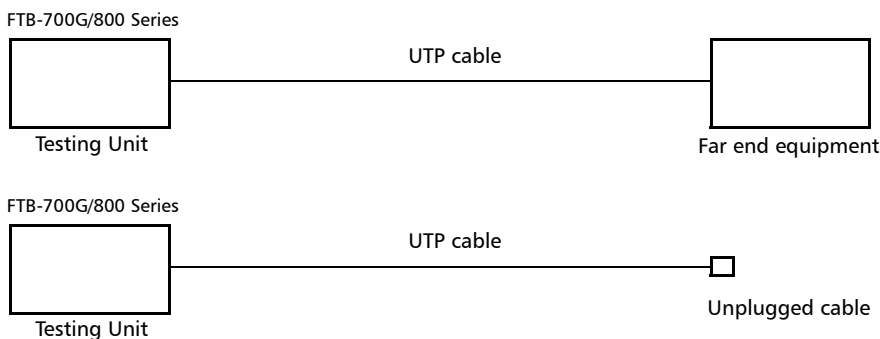
Cable test can be performed everywhere in the network where an electrical 10/100/1000 Mbit/s Ethernet interface is available for testing. Only the pairs used by the Ethernet signal will be tested. For 10 Base-T, and 100 Base-TX, pair 2 and 3 will be tested; for 1000 Base-T, all pairs will be tested.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

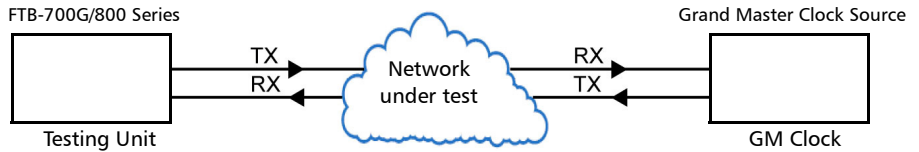


➤ Supported Interfaces/Rates: 10M to 1000M Electrical.

1588 PTP

The 1588 PTP (Precision Time Protocol) test application handles the 1588 PTP communication with the Grand Master (GM) clock, collects statistics related to packets, and monitors the clock Quality Level.

- Typical 1588 PTP test application:

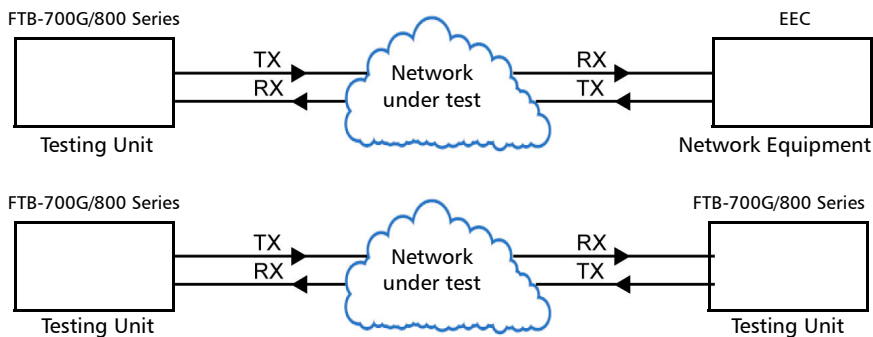


- Supported Interfaces/Rates: 10M to 10G LAN.

SyncE

The Synchronous Ethernet (SyncE) test application provides elementary test primitives to interactively validate the clock management functions of a SyncE capable network equipment.

- Typical SyncE test applications:

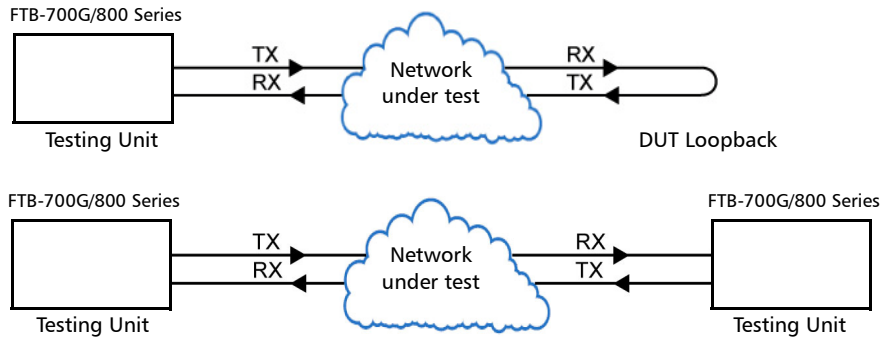


- Supported Interfaces/Rates: 100M to 10G LAN.

FC BERT

The FC BERT (Fibre Channel BERT) application provides full wire-speed traffic generation at the FC-2 layer allowing BER testing for link integrity measurements, latency, buffer-to-buffer credit measurements for optimization as well as login capabilities.

- Typical Fibre Channel BERT test applications:



- Supported Interfaces/Rates: 1X, 2X, 4X, 8X, 10X.

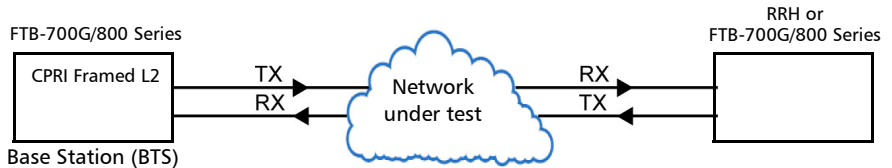
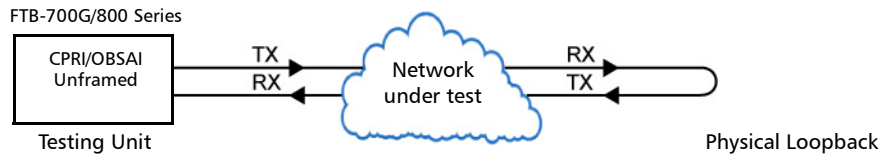
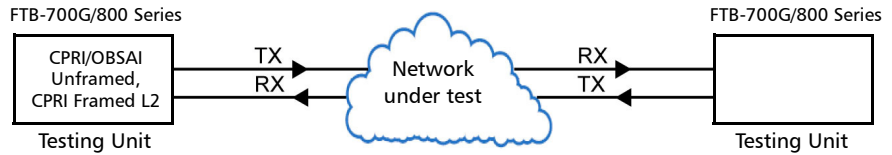
CPRI/OBSAI BERT

The CPRI/OBSAI BERT test application offers the capability to test the fronthaul and dark fiber for CPRI/OBSAI and in addition supports detailed CPRI L2 protocol testing, round trip delay, and Service Disruption Time measurements.

The Common Public Radio Interface (CPRI) is an industry cooperation aimed at defining a publicly available specification for the key internal interface of radio base stations between the Radio Equipment Control (REC) and the Radio Equipment (RE). In the industry the CPRI REC and RE are mainly known as Base Station (BTS) and Remote Radio Head (RRH) respectively.

The Open Base Station Architecture Initiative (OBSAI) is a standard that defines the internal modular structure and interface for base stations.

➤ Typical CPRI/OBSAI BERT test applications:



➤ Supported Interfaces/Rates:

CPRI: 1.2, 2.4, 3.1, 4.9, 6.1, and 9.8 Gbit/s

OBSAI: 3.1 Gbit/s.

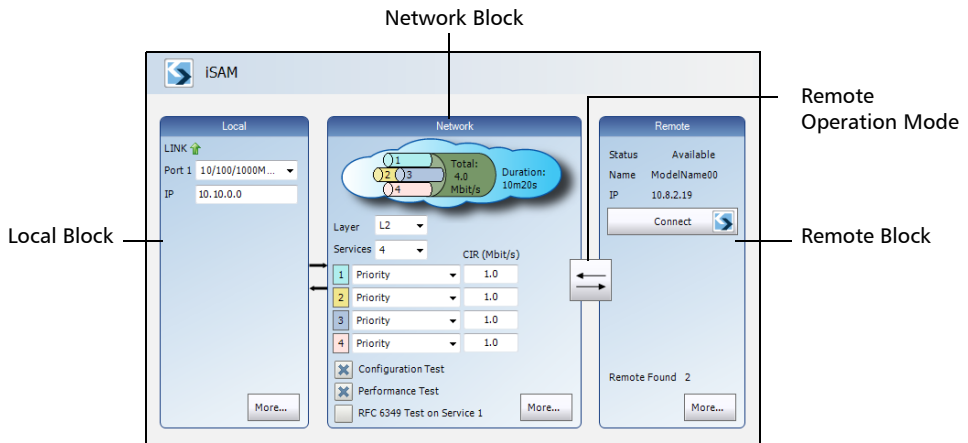
7 *Selecting and Starting a Test*

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 552 for more information).

Intelligent Apps

To select, configure, and start an Intelligent Application:

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



- 3a. From the **Local** block, either select the basic port parameters or click on **More** for all settings (refer to *Interface (iSAM)* on page 155). Ensure that the link is up and the power level for optical interface (when supported) is adequate in the status bar before proceeding to the next step (refer to *Status Bar* on page 26).

Selecting and Starting a Test

Intelligent Apps

- 3b.** From the **Network** block, either select the basic test parameters or click on **More** for all settings (refer to *Network Details (iSAM)* on page 188). The total bandwidth and the estimated test duration are displayed.
- 3c.** Select the remote operation mode; DTS is automatically selected when the **RFC 6349 Test** is enabled:

	DTS (Dual Test Set) The remote device is automatically set in EtherSAM when the connection/overtake is successfully established.
	Remote Loopback The remote device is automatically set in Smart Loopback when the connection/overtake is successfully established.
	Manual Loopback The remote device is a physical loopback or has to be manually set in loopback.

- 3d.** From the **Remote** block, either select the basic remote parameters or click on **More** for all settings (refer to *Remote Details (iSAM)* on page 199).

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

4. Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 556). If the connection with the remote module is not established with either **DTS** or **Remote Loopback** mode, the automatic remote connection process is performed before starting the test. 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 285.
5. When the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).

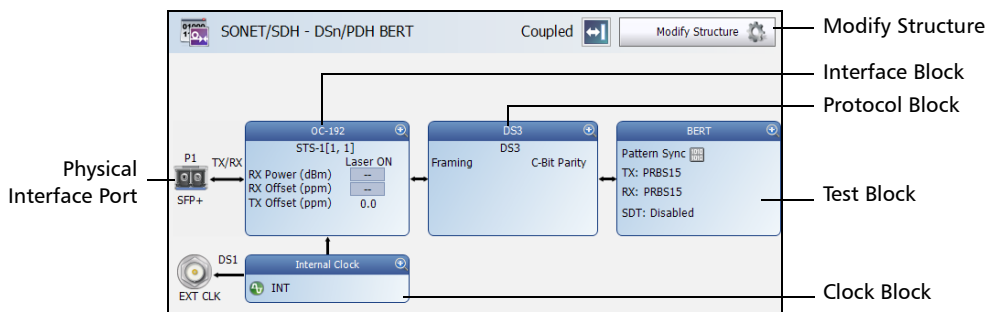
Selecting and Starting a Test

Transport Test Applications

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 95).
- 3b. Tap the interface block to configure the signal parameters (refer to page 85).
- 3c. For an embedded signal, tap the protocol block to configure the signal (refer to page 85).

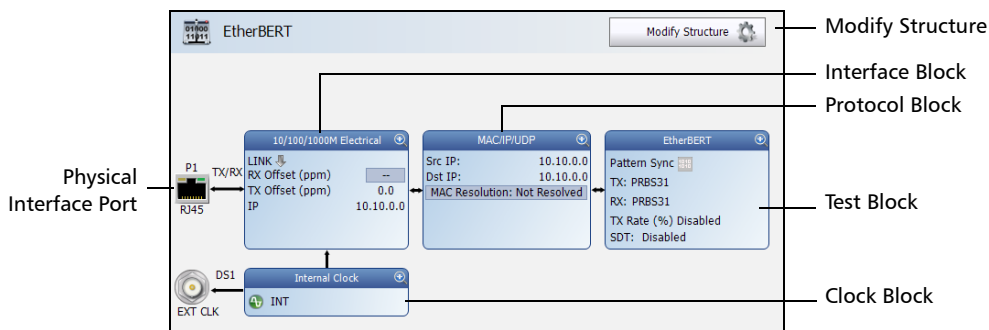
- 3d.** Tap the test block to configure the specific test settings (refer to page 85). Not available with **NI/CSU Emulation** test application.
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 123).
- 4.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 277).
- 5.** For additional test configurations refer to *Test Functions* on page 455.
- 6.** Tap the **Start** button from the right navigation bar to start the test. (refer to *Start/Stop | TX Button* on page 556). 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 285.
- 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 547).

Selecting and Starting a Test

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 95).
- 3b. Tap the interface block to configure the interface parameters (refer to page 85). 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 26).

- 3c.** Tap the protocol block¹ to configure the frame structure and its parameters (refer to page 87).
- 3d.** Tap the test block² to configure the specific test settings (refer to page 87).
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 123).
- 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 277).
- 5.** For additional test configurations refer to *Test Functions* on page 455.
- 6.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 556). 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 285.
- 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 547 for more information).

1. Not available with Smart Loopback, Through Mode, TCP Throughput, Carrier Ethernet OAM, and Cable Test.

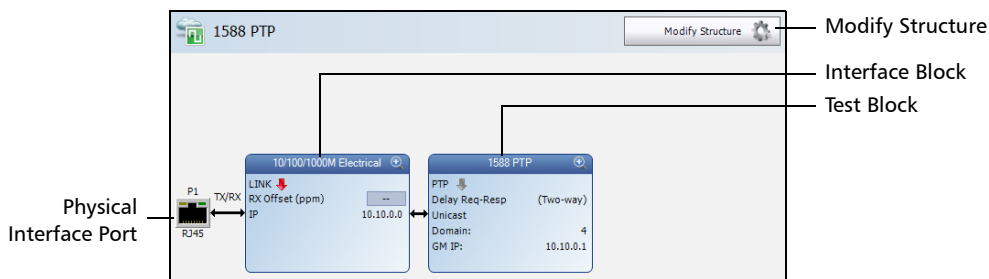
2. Not available with Traffic Gen & Mon and Through Mode.

Selecting and Starting a Test

Packet Sync Test Applications

To select, configure, and start a Packet Sync test:

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Packet Sync**, 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 95).
- 3b. Tap the interface block to configure the interface parameters (refer to page 85). 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 26).
- 3c. Tap the test block to configure the specific test settings (refer to page 88).

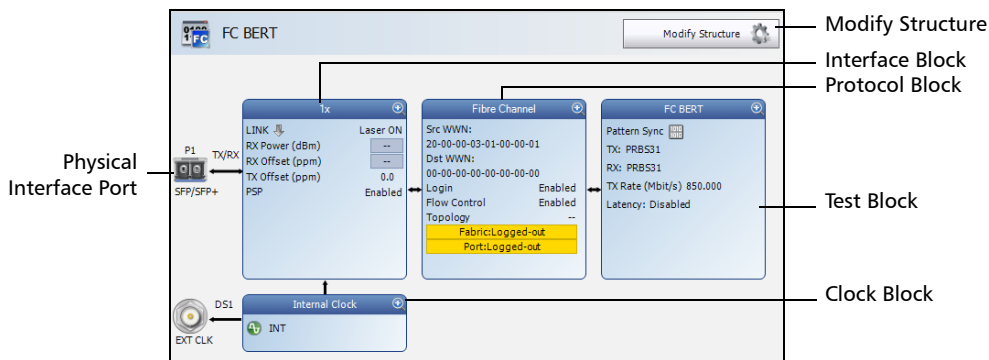
4. Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 277).
5. For additional test configurations refer to *Test Functions* on page 455.
6. Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 556). 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 285.
7. Depending on the test, when the test ends automatically or 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 547 for more information).

Selecting and Starting a Test

Fibre Channel Test Application

To select, configure, and start a Fibre Channel test:

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Fibre Channel**, tap the **FC BERT** 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 and connector. (refer to *Modify Structure Button* on page 95).
- 3b. Tap the interface block to configure the interface parameters (refer to page 146). 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 26).
- 3c. Tap the protocol block to configure the frame structure and its parameters (refer to page 140).

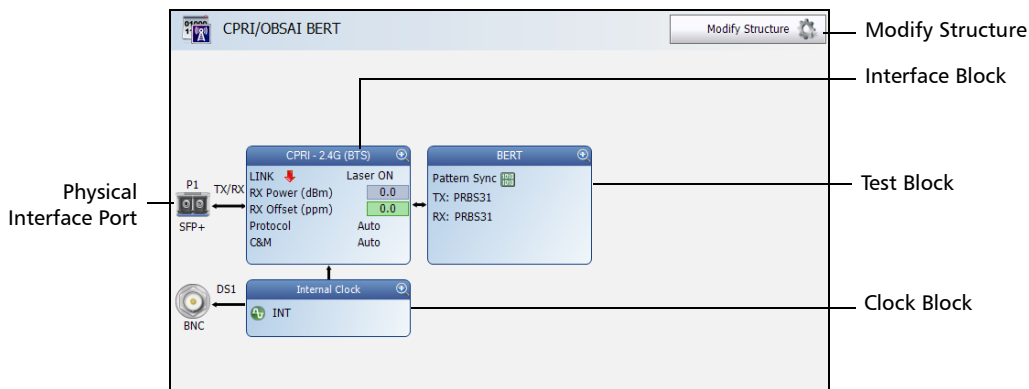
- 3d.** Tap the test block to configure the specific test settings (refer to page 126).
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 123).
- 4.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 277).
- 5.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 556). 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 285.
- 6.** 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 547 for more information).

Selecting and Starting a Test

Wireless Test Application

To select, configure, and start a Wireless test:

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Wireless**, tap the **CPRI/OBSAI BERT** 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 95).
- 3b. Tap the interface block to configure the interface parameters (refer to page 146). Ensure that the power level is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 26).

- 3c.** Tap the test block to configure the specific test settings (refer to page 126).
- 3d.** For **Framed L2** in **Base Station** emulation mode, tap the clock block to configure the clock synchronization (refer to *Clock* on page 123). The clock is fixed to **Recovered** for **Remote Radio Head** emulation mode.

Note: For *Unframed*, the clock is set to **Internal**.

- 4.** Refer to *Test Functions* on page 455 for additional test configurations.
- 5.** 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 277).
- 6.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 556). 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 285.
- 7.** 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 547 for more information).

8 ***Test Setup - Test Configurator, Timer, and System***

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

- **Test Configurator** for **Intelligent Apps** test application.

Block	Subtab or Pop Up	Test Application iSAM	Page
Local	Interface	X	155
	SFP/SFP+	X	238
Network	Network Details	X	188
Remote	Remote Details	X	199

Test Setup - Test Configurator, Timer, and System

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

Block	Subtab or Pop Up	Test Application						Page
		a	b	c	d	e	f	
Button	Modify Structure	X	X	X	X	X	X	95
	Signal Auto-Detect	-	-	X	-	X	X	109
Interface	FTFL/PT	X	-	-	-	-	-	143
	Labels	-	X	-	X	-	-	166
	SFP/SFP+	X	X	-	X	-	-	238
	Signal	X	X	X	X	X	X	239
	Traces	279	282	-	282	-	-	<---
Protocol	Signal	-	-	-	X	-	-	245
Test	BERT	X	X	X	X	-	-	115
	ISDN PRI - Call Management	-	-	-	-	-	X	159
	ISDN PRI - ISDN Settings	-	-	-	-	-	X	164
Clock	Clock	X	X	X	X	X	X	123

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS_n/PDH BERT
- d. SONET/SDH - DS_n/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

► Test Configurator for Ethernet test applications.

Block	Subtab or Pop Up	Test Application										Page
		a	b	c	d	e	f	g	h	i	j	
Button	Modify Structure	X	X	X	X	X	X	X	X	X	X	95
Interface	Interface	X	X	X	X	X	X	X	X	X	X	146
	Network	X	X	X	X	X	X	X	X	X	X	182
	SFP/SFP+	X	X	X	X	X	X	X	X	X	-	238
Protocol	MAC/IP/UDP	X	-	X	X	X	-	-	-	-	-	170
	Services - Global	X	-	-	-	-	-	-	-	-	-	228
	Services - Profile	X	-	-	-	-	-	-	-	-	-	231
	Streams - Global	-	-	-	-	X	-	-	-	-	-	262
	Streams - Profile	-	-	-	-	X	-	-	-	-	-	264
Test	Cable Test	-	-	-	-	-	-	-	-	-	X	121
	EtherBERT and Unframed BERT	-	-	-	X	-	-	-	-	-	-	126
	EtherSAM - Burst	X	-	-	-	-	-	-	-	-	-	132
	EtherSAM - Global	X	-	-	-	-	-	-	-	-	-	134
	EtherSAM - Ramp	X	-	-	-	-	-	-	-	-	-	138
	Link OAM	-	-	-	-	-	-	-	-	X	-	168
	RFC 2544 - Global	-	-	X	-	-	-	-	-	-	-	203
	RFC 2544 - Subtests	-	-	X	-	-	-	-	-	-	-	206
	RFC 6349	-	X	-	-	-	-	-	-	-	-	215
	S-OAM / MPLS-TP OAM	-	-	-	-	-	-	-	-	X	-	218
	Smart Loopback	-	-	-	-	-	X	-	-	-	-	260
	TCP Throughput	-	-	-	-	-	-	-	X	-	-	275
Clock	Clock	X	-	X	X	X	X	-	X	X	-	123

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

Test Setup - Test Configurator, Timer, and System

➤ Test Configurator for Packet Sync test applications.

Block	Subtab or Pop Up	Test Application		Page
		1588 PTP	SyncE	
Button	Modify Structure	X	X	95
Interface	Interface	X	X	146
	Network	X	X	182
	SFP/SFP+	X	X	238
Test	1588 PTP	X	-	110
	SyncE	-	X	272

➤ Test Configurator for Fibre Channel test application.

Block	Subtab or Pop Up	Test Application FC BERT	Page
Button	Modify Structure	X	95
Interface	Interface	X	146
	SFP/SFP+	X	238
Protocol	Fibre Channel	X	140
Test	FC BERT	X	126

- **Test Configurator** for **Wireless** test application.

Block	Subtab or Pop Up	Test Application CPRI/OBSAI BERT	Page
Button	Modify Structure	X	95
Interface	Interface	X	146
	SFP/SFP+	X	238
Test	BERT and Unframed BERT	X	126

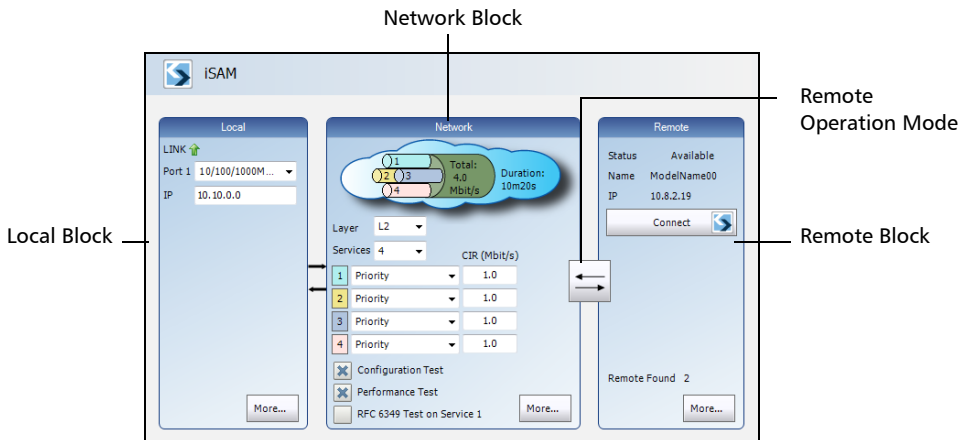
- **Timer**, see page 277.
- **System**, see page 274.

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.

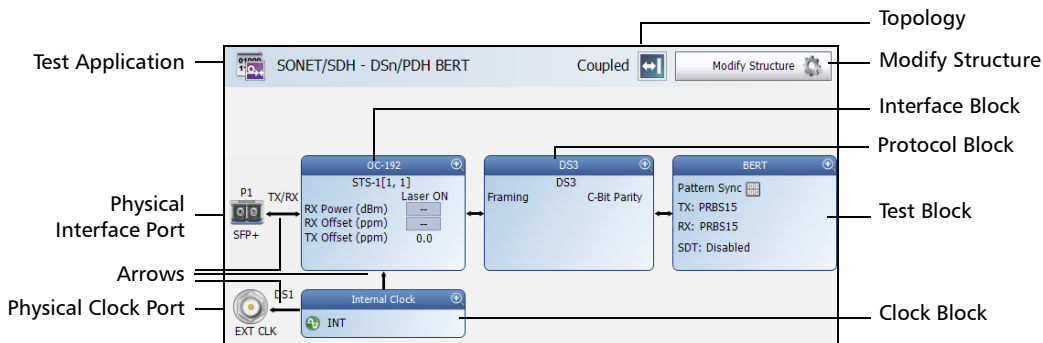
- Intelligent Apps:



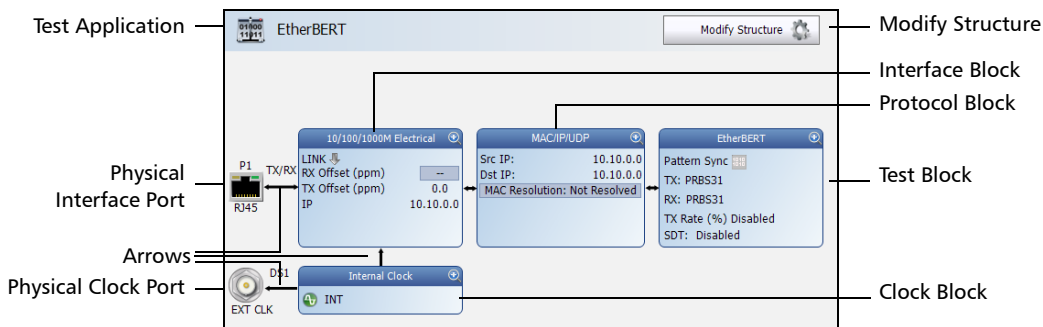
The block arrangement represents the network under test. From any block, either select the basic parameters or click on **More** for all settings.

- **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:



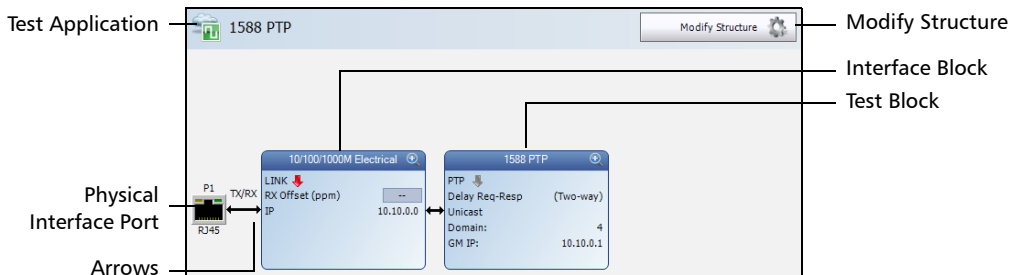
- Ethernet Test Applications:



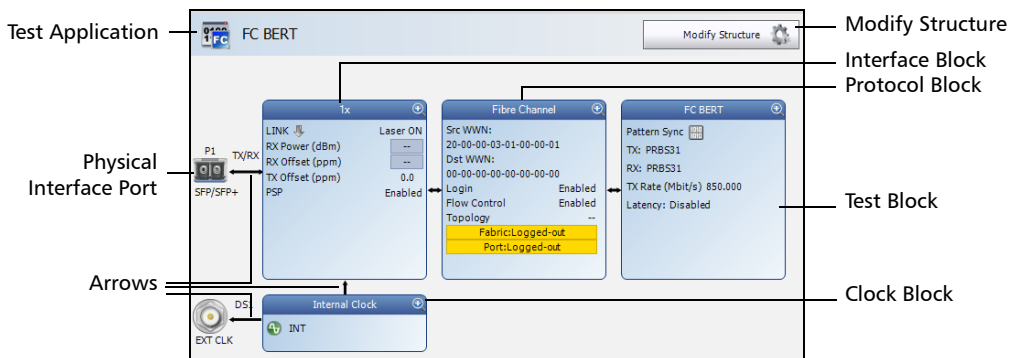
Test Setup - Test Configurator, Timer, and System

Test Configurator Overview

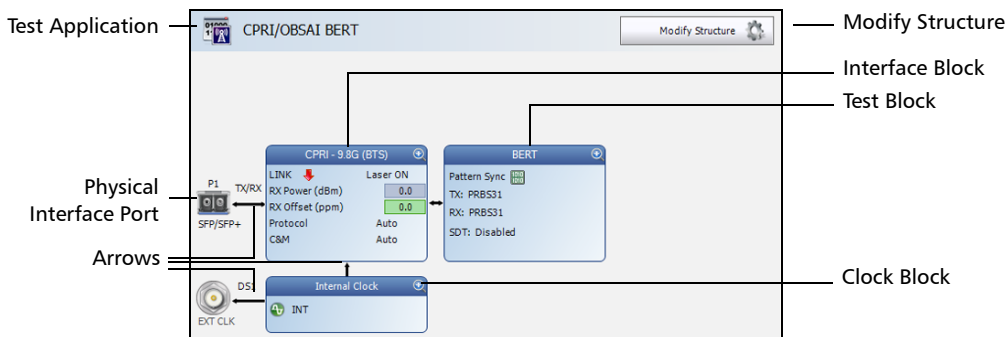
➤ Packet Sync Test Applications:



➤ Fibre Channel Test Application:



➤ Wireless Test Application:



- 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.
 - 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.
- 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.

Test Setup - Test Configurator, Timer, and System

Test Configurator Overview

- 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. Tap on the clock area to change the settings and to see detailed status.

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, TX1/RX1 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 module.

Test	Interface/Rate
OTN	OTU2 [10.709 Gbit/s] OTU1e [11.049 Gbit/s] OTU2e [11.096 Gbit/s] OTU1f [11.270 Gbit/s] OTU2f [11.318 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]

Test Setup - Test Configurator, Timer, and System

Modify Structure Button

Test	Interface/Rate
NI/CSU Emulation	DS1
ISDN PRI	DS1 [1.544 Mbit/s] E1 [2.048 Mbit/s]

- **Connector** allows the selection of the module's port.

Interface/Rate	Connector
OTU2 [10.709 Gbit/s] OTU1e [11.049 Gbit/s] OTU2e [11.096 Gbit/s] OTU1f [11.270 Gbit/s] OTU2f [11.318 Gbit/s] OC-192 [9.953 Gbit/s] STM-64 [9.953 Gbit/s]	Port 1 - SFP+
OTU1 [2.666 Gbit/s] OC-48 [2.488 Gbit/s] OC-12 [622.08 Mbit/s] OC-3 [155.520 Mbit/s] OC-1 [51.840 Mbit/s] STM-16 [2.488 Gbit/s] STM-4 [622.080 Mbit/s] STM-1 [155.520 Mbit/s] STM-0 [51.840 Mbit/s]	Port 1 - SFP
STS-3e [155.520 Mbit/s] STS-1e [51.840 Mbit/s] STM-1e [155.520 Mbit/s] STM-0e [51.840 Mbit/s]	Port 1 - BNC
DS1 [1.544 Mbit/s]	Port 1 - Bantam Port 1 - RJ48C
E1 [2.048 Mbit/s]	Port 1 - Bantam Port 1 - BNC Port 1 - RJ48C
DS3 [44.736 Mbit/s] E3 [34.368 Mbit/s] E4 [139.264 Mbit/s]	Port 1 - BNC

- **Framing:** For OTN BERT, and SONET/SDH BERT test applications, the framing is set to **Framed**.
- **OTN Multiplexing**, 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
OTU1e [11.049 Gbit/s]	ODU1e
OTU2e [11.096 Gbit/s]	ODU2e
OTU1f [11.270 Gbit/s]	ODU1f
OTU2f [11.318 Gbit/s]	ODU2f

Test Setup - Test Configurator, Timer, and System

Modify Structure Button

- **SONET/SDH Multiplexing** 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

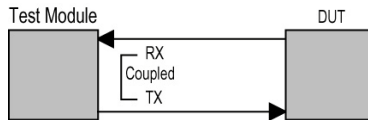
- **Client** is set to **Pattern**.
- **Switch Type**¹ allows the selection of the **Switch Type** for ISDN DS1 and E1 rates. The switch type in brackets indicates the switch type in abbreviated format.
 - **DS1: National ISDN (NI-4)** - (default), **National ISDN (NI-3)**, **National ISDN (NI-2)**, **National ISDN (NI-1)**, **AT&T 4ESS**, **AT&T 5ESS**, and **Nortel DMS-100/250**.
 - **E1: Euro ISDN** (default), **Euro Q.SIG**, and **Euro VN6**.
- **Emulation Mode**¹: **TE** (Terminal Equipment) - (default), and **NT** (Network Termination).

1. Only available with ISDN PRI test application.

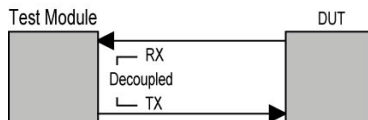
Test Setup - Test Configurator, Timer, and System

Modify Structure Button

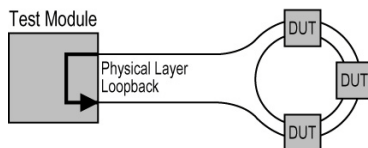
- **Topology** allows the selection of the network test topology.
- **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



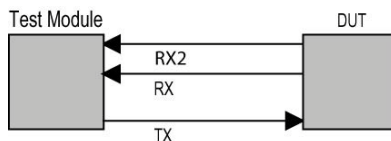
- **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled. **Decoupled** is not supported with **OTN BERT** test application.



- **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

- **Interface/Rate** choices depend on the selected test and the rates available on the module.

Test	Interface/Rate
EtherSAM RFC 2544 RFC 6349 EtherBERT Traffic Gen & Mon Smart Loopback Carrier Ethernet OAM	10GE WAN ^a 10GE LAN 1GE Optical 100M Optical 10/100/1000M Electrical
Through Mode	1GE Optical 100M Optical
TCP Throughput	1GE Optical 100M Optical 10/100/1000M Electrical
Cable Test	10/100/1000M Electrical

- a. Not available with RFC 6349 test application.

Test Setup - Test Configurator, Timer, and System

Modify Structure Button

- **Primary Port / Secondary Port**, available with Through Mode test application, allows to select the module'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 module's port.

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

- **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 182 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 x¹ 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 x¹ 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 131 for EtherBERT, and page 205 for RFC 2544.

Test Setup - Test Configurator, Timer, and System

Modify Structure Button

- **Unframed (Interop)¹:**
For **Seed A²** and **Seed B²**: Pattern generated by the PCS scrambler from a specific seed. The pattern is not encoded.

For **PRBS31 Unscrambled²**: Pattern 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)

- **Unframed¹:**
Encoded pattern generated by the PCS scrambler.

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

- **Unframed with Sync¹:** 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)

1. Only available with optical interface up to 10G LAN.
2. These patterns are only available for 10G LAN.

➤ 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 260.

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.*

➤ OAM Type

Note: *Only available for Carrier Ethernet OAM test application.*

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

For Packet Sync Test Applications

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

Test	Interface/Rate
1588 PTP SyncE	10GE LAN 1GE Optical 100M Optical 10/100/1000M Electrical ^a

- a. The 10M rate is not available for SyncE test application.

- **Connector:** Allows the selection of the module's port available for the selected interface/rate.

Interface/Rate	Connector
10GE LAN	Port 1 - SFP+
1GE Optical 100M Optical	Port 1 - SFP Port 2 - SFP
10/100/1000M Electrical	Port 1 - RJ45 Port 2 - RJ45

For Fibre Channel Test Application

- **Interface/Rate:** Select the desired interface rate. Choices depend on the rates available on the module.

Interface/Rate	Module
1X 2X 4X	FTB-860, FTB-860G, FTB-720G, FTB-720G+, FTB-730G, FTB-730G+, FTB-870, FTB-880
8X 10X	FTB-860G, FTB-720G+, FTB-730G+, FTB-870, FTB-880

- **Connector:** Allows the selection of the module's port available for the selected interface/rate.

Interface/Rate	Connector
1X 2X 4X	Port 1 - SFP Port 2 - SFP
8X 10X	Port 1 - SFP+

For Wireless Test Application

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

Interface Rate	Connector
CPRI - 1.2G	Port 1 - SFP, Port 2 - SFP
CPRI - 2.4G	
CPRI - 3.1G	
OBSAI - 3.1G	
CPRI - 4.9G	
CPRI - 6.1G	
CPRI - 9.8G	Port 1 - SFP+

- **Connector** is the module's port available for the selected interface/rate (see table above).
- **Framing**
 - **Framed L2** (default) is mainly used to validate connectivity with the base station (REC) or remote radio head (RE) over the fiber interface.
 - **Unframed** is mainly used to validate the continuity of the dark fiber at CPRI or OBSAI rate.
- **Emulation Mode**, available with **Framed L2**, determine the CPRI Start-Up Sequence operation and synchronization operation.
 - **Base Station** (default) is used to validate the connectivity with the RRH. It initiates the start-up sequence and provides synchronization to the RRH.
 - **Remote Radio Head** is used to validate the communication with a base station. It begins its start-up sequence when it detects a valid signal from the base station.

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 and ISDN PRI test applications.*

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

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

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

1588 PTP

From the **Test** menu, tap **Setup, Test Configurator**, and the 1588 PTP test block.

PTP

- **Profile** is not configurable and is set to **ITU G.8265.1**, also called Telecom Profile, which is for frequency synchronization.
- **Mode** is not configurable and is set to **Unicast** which implies a dedicated communication link between the master and the slave clock.
- **Framing** is not selectable and is set to **UDP/IPv4**.
- **Domain** is the PTP domain parameter used by the 1588 PTP function to communicate with the Grand Master clock: **4** (default) to **23**.
- **GM IP Address** is the IP address of the Grand Master Clock used by the 1588 PTP function to communicate with it.
- **Quick Ping** button allows to test if the Grand Master IP address can be reached. A message is returned indicating if the ping attempt was **Successful** or **Failed**.
- **IP TOS/DS** allows to enter the Type of Service: **0x00** (default) to **0xFF**.
- **Mechanism** is not selectable and is set to **Delay Req-Resp** (Delay Request-Response) which specifies the mechanism used by the 1588 PTP function to communicate with the Grand Master clock. Refer to *Delay Request-Response* on page 604 for more information.
- **Delay Mode** is not selectable and is set to **Two-way** which uses Sync/Follow Up, Delay Request, and Delay Response messages.
- **Connect** button is used to initiate the Grand Master Connection process. This process is also automatically initiated when starting the test if not already initiated. The process automatically ends when stopping the test.

- **Negotiation Status** is displayed during the Unicast negotiation process which is initiated when either the test is started or the **Connect** button is activated. See *Negotiation Status* on page 397 for more information.
- **Message Rate**
 - **Announce** determines the transmission interval of the Announce messages: **1 message/2s** (default), **1 message/s**, or **8 message/s**.
 - **Sync** determines the transmission interval of the Sync messages: **32** (default), **64**, or **128 message/s**.
 - **Delay-Request** determines the transmission interval of the Delay Request messages: **1, 2, 4, 8, 16, 32** (default), **64**, or **128 message/s**. The **Delay-Request** message rate is limited by the Sync rate selection; the Delay-Request message rate is automatically updated to be smaller than or equal to the **Sync** message rate.
- **Service Duration**
 - **Lease Duration** is not configurable and is set to **300** seconds which determines the Lease Duration used between the 1588 PTP function and the Grand Master clock.
 - **Renewal Interval** is not configurable and is set to **150** seconds which determines the interval used by the 1588 PTP function to initiate the renewal of its lease with the Grand Master clock.

➤ GM Info

Note: Only available when Grand Master clock information is available.

The Grand Master Information window displays the decoded clock information.

- **Identity** report the 8-byte identification code of the Grand Master Clock.
- **Clock Class** reports the description and code of the Grand Master Clock Class.

Code	Description
0-5, 8-12, 15-51, 53-57, 59-67, 123-132, 171-186, 188-192, 194-215, 233-247, 249-254	Reserved
6	Sync to primary reference
7, 14	Holdover
13	Sync to application-specific reference
52, 58, 187, 193	Degraded
68 to 79, 81-109 (odd values), 11-122, 133-170, 216-232	Alternate PTP profiles
80-110 (even values) ^a	Quality Level (QL-xxx ^a)
248	Default
255	Slave only

a. Refer to QL table on page 372 for the list of Quality Level values that will be used as the description.

- **Clock Mode** reports the description of the Grand Master Clock Mode: **Two-step** or **One-step**.

PTSF Alarm Timeout/Threshold

Note: *The following parameters are also used to declared the Pass/Fail verdict.*

- **Receipt Timeout** defines the threshold used to declare a **Loss Announce** or **Loss Sync** message alarm: **2** to **255** messages (default is **3** messages). A message is considered lost if not received within its expected arrival time and a loss alarm is declared when the number of consecutive lost messages is greater than or equal to the defined **Receipt Timeout**.
- **IPDV Threshold** defines the inter packet delay variation threshold used to raise the **Unusable** message alarm. The alarm is raised when IPDV is not within the configured **IPDV Threshold: 0.001** to **1000ms** (default is **2ms**). The minimum value of 0.001 is adjusted when the **Sync** or **Delay Req** is set to 4 messages/s or less.

Quality Level

The quality level characterizes the clock quality in terms of network synchronization.

- **QL Mismatch Monitoring** when selected (default) enables the Quality Level mismatch monitoring.
- **Expected QL** allows, when **QL Mismatch Monitoring** check box is selected, the selection of the Expected Quality Level value: **QL-PRS** by default. Refer to page 372 for more information.

Pass/Fail Verdict

Pass/Fail Verdict check box when selected (default) enables the use of the pass/fail verdict. The global pass/fail verdict is based on the following criteria: alarms (**Link Down**, **Loss Sync**, **Loss Announce**, **Unusable**, and/or **QL Mismatch** (when **QL Mismatch Monitoring** is enabled)), or the test is automatically aborted (service request denied, session canceled, or no reply).

Restore 1588 PTP Defaults

Reverts the 1588 PTP test application to its default factory settings.

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 26 for more information.

- **Coupled RX to TX** check box, when selected (default), allows coupling both the TX and RX signal with the same test pattern.

For a framed test, the **Coupled RX to TX** check box is selected and cannot be cleared.

- **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.

Test Setup - Test Configurator, Timer, and System

BERT

- **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
PRBS31	-	X	X	X	X ^d	X ^a
QRSS	-	X ^a	-	-	-	-
Null Client	-	-	-	-	-	X

- Default value.
- Default value for VT1.5/TU-11/TU-12.
- 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.
- Default value for STS-192c/AU-4-64c.

For Multi-Pattern, see *Multi-Pattern Configuration* on page 120.

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, IAE, LOF, LOM
ODUk	OTN	AIS, OCI, LCK, BDI, BIP-8, BEI
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
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 a 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: *Multi-Pattern Configuration is 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

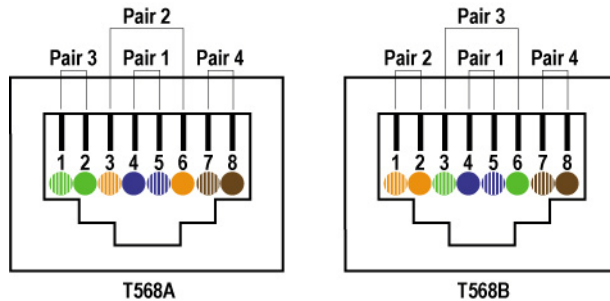
Reverts the current test application to its default factory settings.

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.

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).

- **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 or 1GE electrical using **Slave** local clock.
- **External:** Clock signal from the EXT CLK port.

Ext Clock In

Note: Available 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 on the **EXT CLK** port.

LOS on a red background indicates that the clock is not valid on the **EXT CLK** port.

- **Termination** mode specifies how the module 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 $\pm$ 8 bit/s ($\pm$ 4.6 ppm)
E1	2048000 $\pm$ 10 bit/s ($\pm$ 4.6 ppm)
2MHz	2048000 $\pm$ 10 bit/s ($\pm$ 4.6 ppm)

Ext Clock Out

Note: Available 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 **EXT CLK** port.

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

- **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, FC BERT, BERT (CPRI), and Unframed BERT

From the **Test** menu, tap **Setup, Test Configurator**, and tap on the **EtherBERT, FC BERT, BERT**, 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 as well as for Wireless CPRI/OBSAI BERT test.
- **No Pattern Analysis (Live)** check box when cleared (default; selected by default for framed CPRI), 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. Even if this check box is not available for FC BERT, the received traffic pattern and Round-Trip Latency are monitored. See *BER* on page 294 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.

1. Only available for 10G LAN with **Unframed without Sync** (see Framing on page 103).

2. Only available for 1G optical with **Framed Layer 1** (see Framing on page 103).

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**.

CPRI

Note: *Available with CPRI/OBSAI BERT test application with CPRI Framed L2.*

- **Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict. A pass verdict is given when the link status is up and no CPRI alarm and/or error are recorded for the duration of the test.

Restore CPRI/OBSAI Defaults

Note: *Available with CPRI/OBSAI BERT test application.*

Reverts the current test application to its default factory settings.

Service Disruption

Note: *Not available for FC BERT.*

- **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.
- **No Defect Time (ms)** represents the period without any defects before stopping SDT measurement: **0.005 ms** to **2000 ms** (default is **300 ms**). Only available with CPRI/OBSAI.
- **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.

FC Frame

Note: *Only available with FC BERT.*

Frame Size (Bytes) allows to enter the frame size (in step of 4 bytes) for FC BERT test application: **40** to **2148** bytes (default). However the minimum frame size is 64 bytes when the **Latency Tag** check box is selected.

Latency Tag Insertion

Note: *Available with FC BERT test application.*

Round trip latency measures the average round trip latency (delay) between the time the data was transmitted and received.

- **Latency Tag** check box when selected, enables latency measurements.
- **Pass/Fail Verdict** check box when selected, enables the pass/fail verdict and allows to set the **Round-Trip Latency Threshold**.
- **Round-Trip Latency Threshold (ms)** allows the selection of the round trip latency: **0.015** (default) to **8000 ms**.

Test Setup - Test Configurator, Timer, and System

EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT

Shaping

- **TX Rate** allows the selection of the transmission rate in percentage of utilization (100% by default), Mbit/s, Gbit/s, Frame/s, or IFG for Ethernet; Mbit/s, Gbit/s, MB/s, or % for Fibre Channel. For Ethernet, the maximum percentage is 105% 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. Not available for FC BERT.

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 134).

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

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

Burst Sequence

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

- **Refill Delay** represents the pre-burst recuperation time in percentage that is equal to the remaining percentage not used by the post-burst time (**Refill Delay Ratio**).
- **Burst Frames** represents the burst frame ratio in percentage that is equal to the subtraction 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%** (**50%** 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%** (**90%** 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**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **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.

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 530.*

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 530.

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 236), 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 236), 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 235), 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.

Test Setup - Test Configurator, Timer, and System

EtherSAM - Global

- **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 236), 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 236), 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 is 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 236) 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**. When the **Per Direction Configuration** check box is cleared the configuration will be coupled and the values apply to both directions.

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**.

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 $\pm 6.6 \mu s$ after the previous pulse. LOPP-S-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 134).

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

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

Dynamic Ramp

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.

Fibre Channel

From the **Test** menu, tap **Setup, Test Configurator**, and the **Fibre Channel** block.

World Wide Name (WWN)

The following WWN settings are only available when the **Login - Enable** check box is selected (see page 141).

- **Source** allows to set the 64-bit WWN address of the local fibre channel port: **00-00-00-00-00-00-00-00** to **FF-FF-FF-FF-FF-FF-FF-FF** (default is **20-00-00-03-01** [IEEE-MAC lsb (bits 23..0)]).
- **Destination** allows to set the 64-bit WWN address of the remote fibre channel port: **00-00-00-00-00-00-00-00** (default) to **FF-FF-FF-FF-FF-FF-FF-FF**. The destination WWN address is displayed and grayed-out for Point-to-Point topology after a successful login.

Buffer to Buffer Flow Control

Buffer to Buffer (BB) Flow Control, also called Flow Control Management, manages the control of data traffic between the local and remote fibre channel ports based on the network, distance, and traffic congestion.

Each remote port advertises the buffer size (**BB_Credit**) during the login.

- **Enable** check box when selected allows to set or use buffers to receive frames. The **Enable** check box is force selected when the **Login - Enable** check box is selected (see page 141).
- **Available BB_Credit** is the number of frame buffers that the remote port has available to receive frames from the local port: **1 to 65535** (default is **10**). The **Available BB_Credit** is not editable when the **Login - Enable** check box is selected but its value received from the remote interface through the login process is displayed. If the login fails, the **Available BB_Credit** displays “-”.

Login

After a link is established, it is possible to login to the Fibre Channel Network to send and receive data between a local and remote fibre channel port.

- **Enable** check box when selected (default) allows to press the **Login** button to start the login process.
- **Advertised BB_Credit** is the number of frame buffers the local port has available to receive frames from the remote port: **1** to **65535** (default is **10**). **Advertised BB_Credit** is advertised to the remote port through the **Login** process. Changing the **Advertised BB_Credit** requires to manually re-send a login using the **Login** button.
- **Login/Re-Login** button allows the initiation of the Login process with the selected **Advertised BB_Credit**. Available when the **Login - Enable** check box is selected. The **Login** button initiates a log-in when not logged-in while the **Re-Login** re-initiates a log-in after changing the **BB_Credit** and/or **WWN** when already logged-in. The capability to login is available only with Framed Layer 2 (FC-2) when a successful link has been established. There are two Login processes supported by Fibre Channel: **Port Login** (PLOGI) and **Fabric Login** (FLOGI).

It is possible to skip the **Login** procedure and use the **BB_Credit** value. This is called **Implicit Login** and is only applicable for **Point-to-Point** topology. For **Point-to-Point** topology using implicit login, you must manually configure the **Available BB_Credit** value for the remote port.

- **Discovered Topology** indicates the discovered topology.

Fabric: Ports are interconnected to a fabric switching network.

A **Fabric** and **Port** login are required, and the **BB_Credit** value is set based on the buffer capacity of the fabric switch.

Point To Point: Direct link between two ports.

Test Setup - Test Configurator, Timer, and System

Fibre Channel

- **Fabric Status** indicates the status of the Fabric switching network. The status is not available when the discovered topology is Point-to-Point.
 - **Logged-in** indicates that the login process has completed successfully.
 - **Failed** indicates that the login process is not completed successfully or an error has been detected.
 - **In Progress** indicates that the login process is running (not completed yet).
 - **Logged-out** (default) indicates that the system has not logged in yet or has received a valid Logout command from the remote port.
- **Port Status** indicates the state of the port login process.
 - **Logged-in** indicates that the login process has completed successfully.
 - **Failed** indicates that the login process is not completed successfully or an error has been detected.
 - **In Progress** indicates that the login process is running (not completed yet).
 - **Logged-out** (default) indicates that the system has not logged in yet, has received a valid Logout command from the remote port, or the Fabric status is either Failed, In Progress, or Logged-out.

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

Payload type	Hex Code	MSB 1234	LSB 5678
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
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

- 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.
- Selecting **Not Available** will use the hexadecimal code 55 but, 66 and FF are also Not Available payload types.
- 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, Packet Sync, Fibre Channel, and Wireless)

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 and Packet Sync test applications:

- **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 for 1GE Electrical interface and is not configurable.

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. The **10M** speed is not available with SyncE test application.
- **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. 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 FTB-700G/800 Series to automatically detect the MDI or MDIX cable type.

- **Local Clock** is only available with 1GE interface and allows to set the provenance of the clock: **Master** (default), or **Slave**, or **Auto**^{1, 2}.

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

2. Not available with SyncE test application.

Test Setup - Test Configurator, Timer, and System

Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

For Fibre Channel test application:

- **PSP (Link Protocol)** (Primitive Sequence Protocol) check box when selected (default) allows link management by activating the port.

For CPRI **Unframed** test application:

- **Scrambling** check box when selected (default) enables the scrambler. Only available with **Unframed** CPRI rates 4.9152 Gbit/s and higher.

For CPRI **Framed L2** test application:

- **Sequence** indicates the last Startup Sequence State: **Standby (A)**, **L1 Sync (B)**, **Protocol (C)**, **L2 C&M (D)**, **Vendor (E)**, **Operation (F)**, or **Passive (G)**.
- **Protocol** defines how the CPRI Startup Sequence negotiates the protocol version.
 - **Auto** can use protocol **Version 1** and **Version 2** during the negotiation.
 - **Version 1** negotiates the protocol with Scrambling disabled. Available with all supported CPRI rates.
 - **Version 2** negotiates the protocol with Scrambling enabled. Available with CPRI rates: 4.9, 6.1, and 9.8 Gbit/s.

Protocol table indicates either the last received (**Version 1** or **Version 2**) or negotiated (**Auto**) protocol version. A light-red background indicates a Protocol version mismatch between the received value and the expected generated value.

- **C&M Channel** defines the kind of channel that will be used by the startup sequence for negotiation.
 - **Auto** (default): Overhead byte #Z.66.0 can use any of the HDLC rates and Overhead byte #Z.194.0 can use any of the Ethernet Subchannel in the negotiation process.
 - **HDLC**: Only overhead byte #Z.66.0 is used with the configured HDLC Rate during the negotiation process. Ethernet #Z.194.0 byte is set to rr00 0000 as it is disabled.
 - **Ethernet**: Only overhead byte #Z.194.0 is used with the configured Ethernet Subchannel during the negotiation process. HDLC #Z.66.0 byte is set to rrrr r000 as it is disabled.
 - **Disabled**: Both HDLC Rates and Ethernet Subchannel are disabled to simulate a Passive Link. Ethernet #Z.194.0 byte is set to rr00 0000 and HDLC #Z.66.0 byte is set to rrrr r000. Only available with **Base Station** emulation mode.

C&M table indicates either the received (HDLC or Ethernet) or negotiated (Auto) C&M for Ethernet subchannel and HDLC rates in Mbit/s. A red background indicates either a C&M type mismatch or HDLC Rate/Ethernet subchannel mismatch compared to the generated C&M channel. An arrow is displayed indicating which C&M Channel should normally be selected as per the standard rules.

- **Subchannel** selects the Ethernet Subchannel number: **20** to **63** where 63 is the lowest bit rate and 20 the highest.

Test Setup - Test Configurator, Timer, and System

Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

- **Rate (Mbit/s)** is available with **HDLC** and **Ethernet C&M Channel**.

For **HDLC**: Allows the selection of the HDLC bit rate. Choices depend on the selected CPRI interface rate. HDLC **Proprietary** is used to exercise a case where the Base Station is aware in advance of the HDLC rate to use. The proprietary rate are not described in the standard. If an HDLC Proprietary is received during the negotiation process while the **C&M Channel** is set to **Auto**, the negotiation completes but no actual bit rate is reported as it is unknown. Similarly, if an equipment vendor uses an invalid rate (as per the CPRI Standard) during the negotiation process, this rate is reported as **Unspecified (Code)** where **Code** is a decimal value representing an invalid rate based on the configured interface rate.

CPRI Rate (Gbit/s)	HDLC Rate (Mbit/s)
1.2	0.240, 0.480, 0.960 (default), Proprietary
2.4	0.240, 0.480, 0.960, 1.920 (default), Proprietary
3.1	0.240, 0.480, 0.960, 1.920, 2.400 (default), Proprietary
4.9	0.240, 0.480, 0.960, 1.920, 2.400, 3.840 (default), Proprietary
6.1	0.240, 0.480, 0.960, 1.920, 2.400, 4.800 (default), Proprietary
9.8	0.240, 0.480, 0.960, 1.920, 2.400, 7.680 (default), Proprietary

For **Ethernet**: Indicates the bit rate corresponding to the selected **Subchannel**.

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 to 15 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 38.*

- **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** allows to automatically turn off all lasers when starting the module or when switching from one test application of the same group (Ethernet or Transport) to another. This check box is cleared by default.
- **Power Range (dBm)** indicates the SFP/SFP+ operational RX power range.

TX Frequency

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

Note: *Frequency offset is not available with Wireless or RFC 6349 test application.*

- **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.

Test Setup - Test Configurator, Timer, and System

Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

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 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.

Interface (iSAM)

From the **Test** menu, tap **Setup**, **Test Configurator**, and the **More** button from the **Local** block.

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 that the link is down.
- A gray arrow indicates awaiting incoming data to provide a status.
- **Interface/Rate** or **Port** choices depend on the rates available on the module.

Interface/Rate
10GE WAN
10GE LAN
1GE Optical
100M Optical
10/100/1000M Electrical

For 10GE WAN, the test uses the WIS default values for J0, J1, and C2 as defined in *WIS Button* on page 151.

Test Setup - Test Configurator, Timer, and System

Interface (iSAM)

- **Connector** allows the selection of the module's port.

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

- **Auto-Negotiation** check box when selected (default), indicates to the remote port which parameters to use. Only available with **10/100/1000M Electrical** and **1GE Optical** interfaces. For 1GE Electrical interface, the **Auto-Negotiation** check box is automatically selected and is not configurable.

Note: When the **Auto-Negotiation** check box is selected, the port **Speed** can be set. This settings is not applied immediately to the port, it is used only when the negotiation process is started and take effect only when the auto-negotiation succeeds. However current setting is 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.

Note: **Full Duplex** is used and there is no **Flow Control** (pause frames received are ignored).

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

- **Lasers OFF at Start-Up** allows to automatically turn off all lasers when starting the module or when switching from one test application of the same group (Ethernet or Transport) to another. This check box is cleared by default.

MAC

- **Address** indicates the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **VLAN ID/Priority** check box when selected, cleared by default, enables C-VLAN with VLAN Ethernet type of 8100 and allows to set both VLAN ID and priority.

VLAN ID choices are **0** through **4095**; default is **2**; refer to *VLAN ID and Priority* on page 647 for more information.

Priority choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 647 for more information.

Test Setup - Test Configurator, Timer, and System

Interface (iSAM)

IP

- **IP Version** is set to **IPv4**.
- **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 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.
- **Subnet Mask**¹ allows to enter the Subnet Mask for the stream. The default setting is **255.255.0.0**.
- **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**.

Remote Discovery ID

Remote Discovery ID is used to easily identify this module in case another module is performing a discovery scan. Up to 16 alpha-numeric characters are allowed.

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

ISDN PRI - Call Management

From the **Test** menu, tap **Setup, Test Configurator**, the test block, and the **Call Management** tab.

Call Origination Settings

➤ Channel Identification

- The channel buttons allow the selection of a channel for call origination configuration. The selected channel has its button highlighted with a blue border. **D-Ch** indicates the channel configured as D-Channel and is not selectable.

A warning icon is displayed on each channel button for which either the originator and/or destination number is not defined.

- **Call All at Start** check box when selected, initiates calls for all configured channels when the test is started.
- **Calling Party** and **Called Party** defines respectively the originator and destination call information.
- **Numbering Plan** choices are **Unknown**, **ISDN/Telephony** (default), or **Private**.
- **Numbering Type** choices depend on the **Numbering Plan** and **DS1/E1 Switch Type** selected.

Test Setup - Test Configurator, Timer, and System

ISDN PRI - Call Management

Interface/ Rate	Switch Type	Numbering Types for ... Numbering Plan		
		Unknown	ISDN Telephony	Private
DS1	National ISDN	Unknown	International, National, Local	Subscriber
	Nortel DMS-100/250 and AT&T 4ESS/5ESS	Unknown	International, National, Subscriber	Subscriber
E1	Euro VN6 and Euro ISDN	Unknown	Unknown, International, National, Subscriber	Unknown, Network Specific, Subscriber
	Euro Q.SIG	Unknown	Unknown, International, National, Subscriber	Unknown, Level 2 Regional, Level 1 Regional, PISN Specific, Level 0 Regional

- **Number** allows to enter respectively the originator and destination numbers. A maximum of 30 digits is permitted.

If the originator and/or destination number field is empty for any channel, a warning icon with the following message is displayed at the bottom of the pop-up:

Call origination settings incomplete. Missing Calling or Called Party Number.

- **Call at Start** check box when selected, initiates calls for the selected channel when the test is started. Alternatively the **Call All at Start** check box can be used to initiates calls for all configured channels when the test is started.

- **Call**
 - **Type** selects the service type: **3.1 kHz**, **Speech**, or **Data** (default).
 - **Rate** is only configurable for **Data** type: **56K** or **64K** (default). The rate is set **64K** for **3.1 kHz** and **Speech** types as well as for **Euro Q.SIG** switch type.
- **Network**
 - **Transit Net Code** (Transit Network Code) selects a specific network on which the call is placed and is only applicable in **TE - Emulation Mode**. The range is from **0** to **9999**. By default this field is blank meaning that no Transit Network Selection code is transmitted. Not supported with **Euro Q.SIG** switch type.
 - **Operator Sys Access** (Operator System Access) determines whether or not an operator is used: **Disabled** (default), **Principal**, and **Alternate**. Only applies to **National ISDN** switch type, **Speech** and **3.1 kHz** call type, and in **TE - Emulation Mode**.

Answer Mode

Allows the selection of the call answering mode.

- **Auto-Answer** (default) answers all incoming calls automatically.
- **Auto-Reject** rejects all incoming calls automatically.
- **Prompt**: asks to answer or reject a call. A call answered or rejected is removed from the table in the **Answer Prompt** window. All incoming calls are listed in the received order.

Calls can be answered or rejected individually (**Answer/Reject**) or collectively (**Answer All/Reject All**).

The **Close** button is available once all calls are answered or rejected.

Call Establishment/Termination Pass/Fail Verdict

- **Call Establishment/Termination Pass/Fail Verdict** check box when selected (cleared by default) enables call establishment and termination pass/fail verdict for each channel and globally for the test. No verdict is provided on the D-Channel.

A pass verdict indicates that there was no call processing error during call establishment or call termination.

A fail verdict indicates that one of the following events occurs.

- **Call Establishment:** An incoming or outgoing call is unexpectedly cleared before it reaches the connected state at the exception of rejected incoming calls.
- **Call Termination:** A connected call is unexpectedly cleared.

The global pass/fail verdict is reported as fail when any channel has a fail verdict or when a LOS, LOF, or AIS error occurs.

Call Control

The channel buttons allow the selection of a channel to see its information or to initiate/terminate calls. The selected channel has its button highlighted with a blue border. Each channel button presents the following information.

Information (location on the button)	Description
Channel number (Top-left corner)	Indicates the channel's number. There are 24 channels for DS1 and 31 for E1.
Pattern sync. (Top-right corner)	Available with data call. The pattern sync icon indicates if the data call pattern is properly synchronized (green icon) or not (red icon).
Call State or D-Channel (Bottom-centered)	Indicates either the call state or D-Ch for the channel configured as D-Channel.

Call/Hang-Up and **Hang-Up All** buttons are available depending on the status of the call.

- **Call** initiates a call on the selected channel.
- **Hang-Up** terminates a call on the selected channel.
- **Hang-Up All** terminates all calls.

The information for the selected channel is displayed at the right of the channel's buttons. See *Call Origination Settings* on page 159 for more information.

Phone Book Name indicates the name associated to the call number when present in the phone book (refer to *Phone Book Button* on page 543).

The following message is displayed when either the originator and/or destination number field is empty for the selected channel:

Call origination settings incomplete. Missing Calling or Called Party Number.

ISDN PRI - ISDN Settings

From the **Test** menu, tap **Setup, Test Configurator**, the test block, and the **ISDN Settings** tab.

D-Channel

- **Channel** indicates the channel selected to establish the ISDN signalling path. The default D-Channel for DS1 is **24** and for E1 is **16**.
- **Rate** represents the rate at which data is exchanged. Depending on the network, the options available are **56K** and **64K** (default).
- **HDLC Mode** represents the bit inversion of the signal: **Normal** (default) or **Inverted**.
- **D-Channel** indicates the status of the D-Channel. A green arrow pointing up indicates that the link is up (**L2 - Multiple frame established**) and a red arrow pointing down indicates that the link is down.

B-Channel

Note: *The following B-Channel settings apply to all data calls.*

- **Data Call Pattern** allows to select the pattern: **PRBS9**, **PRBS11** (default), **PRBS20**, **1111**, **1100**, **1010**, **0000**, **1in8**, **1in16**, **2in8**, and **3in24**.
- **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.
- **RX Pattern Analysis** check box when selected enables the monitoring of the test pattern for all data calls.
- **BER Pass/Fail Verdict** allows to enable bit error pass/fail verdict by selecting either **Bit Error Count** or **Bit Error Rate** (default) or **Disabled**.

- **Threshold** allows to enter the threshold value that will be used to declare the pass/fail verdict.

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** (default is **1.0E-12**).

- **Idle Code** allows the generation of idle code when a B-Channel is in idle state or active with a Speech or 3.1 kHz call without the headset connected. Choices are **00** to **FF** (default is **7F**). Idle code is not present on a channel connected to the headset.
- **Binary** check box when selected allows to enter Idle Code in Binary format else it is in Hex format.

Restore ISDN PRI Defaults

Reverts the current test application to its default factory settings.

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 487 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 495 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 444.

Expected: Select the expected C2 byte from the list. Refer to C2 on page 495 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 498 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 355.
- **Expected:** Select the expected V5 byte from the list. Refer to V5 on page 498 for more information.

Link OAM

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

OAM Mode

Allows the selection of the OAM mode:

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

OAMPDU Destination MAC Address

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

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

00:00:00:00:00:00 to **FF:FF:FF:FF:FF:FF**.

Pass/Fail Verdict

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

- **Remote Alarms** check box when selected (default) considers the following alarms to declare the pass/fail verdict: **Critical Event**, **Dying Gasp**, and **Link Fault**.
- **Remote Loopback** check box when selected (default) considers successful/unsuccessful remote loopback request to declare the pass/fail verdict.

OAM Discovery Status

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

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

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

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

Loopback

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

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 182) 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 Option¹

IP Version allows to select **IPv4** (default) or **IPv6** that will be used for both the interface and 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**¹ - 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.
- **VLAN** - The **VLAN Tag** check box when selected (cleared by default), enables up to 3 stacked VLAN.

See *VLAN* on page 173 for additional VLAN settings.

1. Only available with EtherSAM and Traffic Gen & Mon test applications.

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 174. This check box is not available when the **Network Layer** is set to **None** (refer to *Modify Frame Structure* on page 171).
- **EtherType** is not configurable and set to the following value:
 - 0x0000** when **Network Layer** is set to **None** without MPLS Label.
 - 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 **0xFFFFF**.

- **Source Flooding** and **Destination Flooding**¹ 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**¹ 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 171.*

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

- **VLAN ID:** Enter the VLAN ID. Choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 647 for more information.
- **Priority:** Select the VLAN user priority. Choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 647 for more information.
- **Type:** Allows the selection of the 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.

1. Only available with **Traffic Gen & Mon** when the Network Layer is set to **None** (see page 171).

MPLS

Note: *MPLS is only available when the MPLS Label is enabled; refer to Modify Frame Structure on page 171.*

- **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** 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** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80:0000:0000:0000:0000:0000:0000**.
- **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** 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 501 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 172. 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 Multiplier** 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**. Only IPv4 is supported for TCP Throughput test application.

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:** 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. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Subnet Mask:** Enter the Subnet Mask. The default setting is **255.255.000.000**. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Default Gateway** 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.

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** 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** 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** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80:0000:0000:0000:0000:0000:0000**.

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**: Enter the VLAN ID. Choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 647 for more information.
- **Priority**: Select the VLAN user priority. Choices are **0** to **7**; default is **0** (**000 - Low Priority**). Refer to *VLAN ID and Priority* on page 647 for more information.

- **Type:** Allows the selection of the 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.

Network Details (iSAM)

Either select the Layer parameter, the number of services, for each service the profile and CIR settings, or click on **More** for all settings. The total bandwidth (when the **Performance Test** is enabled) and the estimated test duration are also displayed.

From the **Test** menu, tap **Setup**, **Test Configurator**, and the **More** button from the **Network** block.

iSAM

- **Layer** is the layer used for all services. The layer is fixed to **L3/L4** when the **RFC 6349 Test** is enabled.
 - **L2** (default) for Ethernet II.
 - **L3/L4** for Ethernet II, IP (IPv4), and respectively UDP for the Configuration and Performance subtests, and TCP for RFC-6349 subtest.
- **Classification** defines the traffic classification used in the provider network: **VLAN ID**, **VLAN Priority**, or **DSCP** (available with layer L3/L4).

Note: *At least one check box (**Configuration Test**, or **Performance Test**, or **RFC 6349 Test**) has to be selected.*

- **Configuration Test** check box when selected (default) verifies if the network configuration is correct for each service before starting a long term test (Performance Test).

Set the **Configuration Test** duration in seconds per step enabled (CIR and CIR+EIR): 5 seconds (default) to 60 seconds.

- **Performance Test** check box when selected (default) verifies that the SLA parameters (FD, IFDV, and FLR) are met over time by running multiple services simultaneously. Results are measured and compared to the configured thresholds to declare the pass/fail verdicts. The **Performance Test** is only performed for services that have their **CIR** check box selected.

Set the **Performance Test** duration in hh:mm format: 1 minute to 24 hours (default is 10 minutes).

- **RFC 6349 Test on Service 1** check box when selected (cleared by default) verifies that the Ethernet service is able to properly carry TCP traffic; **Service 1** is used to performed the RFC 6349 test. Enabling the **RFC 6349 Test on Service 1** automatically set the operation mode to DTS and the layer to **L3/L4**; direction is bidirectional, max MTU is 1500 bytes, multiple connections as well as Path MTU Discovery are enabled.

Duration: The field next to the **RFC 6349 Test on Service 1** check box is used to set the duration of the TCP Throughput phase per direction in hh:mm format: 1 minute (default) to 24 hours.

Threshold (% of ideal) allows to enter the TCP Throughput as a percentage of the Ideal L4 Throughput that will be used to declare the pass/fail verdict for both directions: **0** to **100%**; default is **95%**.

Services

Allows the selection of the number of services: **1** (default) to **4**.

The following parameters are configurable individually for each service:

➤ Profile

Two profiles are defined by default as well as **User Profile**. Profiles are user definable and up to 25 profiles can be predefined (see *Customizable Profiles* on page 195).

Profile	Parameter				
	Frame Type	Frame Sizes	VLAN Priority	DSCP	Performance Criteria
Priority	EMIX	64, 128, 512, 1024, and 1518 ^a	7	CS7 ^b	MEF Metro High
Best Effort			0	CS0 ^b	MEF Metro Low

- a. The minimum frame size value is adjusted according to the frame structure and components selected as shown in the table of *Frame Size* on page 192.
- b. ECN is not present and not configurable but is set to 00 (Not-ECT).

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.*

Note: *For Dual Test Set, the CIR and CIR+EIR values are the same (Symmetric) for both **L->R** and **R->L** directions.*

- **CIR** (Mbit/s) (Committed Information Rate) check box when selected (default) sets the service rate guaranteed by the SLA (default is **1 Mbit/s**).
- **CIR+EIR** (Mbit/s) 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 (default is 1.5 Mbit/s). The threshold value is configurable from the defined CIR value for this service to the line rate minus the total CIR from all services.
- **Frame Type** allows the selection of the frame type and frame size(s).
 - **Frame types** choices are: **Fixed** and **EMIX**.

Fixed allows to set a single frame size.

EMIX allows to set up to 8 EMIX frame sizes. The EMIX frame sequence is repeated until the test ends. Default are **64**, **128**, **512**, **1024**, and **1518**.

Quantity, available with **EMIX**, allows to select the number of EMIX frame sizes: 2 to 8 frames (default is **5**).

Test Setup - Test Configurator, Timer, and System

Network Details (iSAM)

➤ Frame Size

Type	Frame Size (bytes)
Fixed (default)	64 ^a (default) to 16000 ^b
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.

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

Component	Description
C-VLAN	4 bytes
UDP	8 bytes
Ethernet Header	14 bytes
IPv4	20 bytes
Using DTS	4 bytes

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

► Classification

Allows the selection of the value for the selected classification:

Classification	Value
VLAN ID	0 through 4095 (default is 2). Refer to <i>VLAN ID and Priority</i> on page 647.
VLAN Priority	0 (default) to 7 . Refer to <i>VLAN ID and Priority</i> on page 647.
DSCP	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) .

Test Setup - Test Configurator, Timer, and System

Network Details (iSAM)

► Performance Criteria

The following performance criteria are available by default:

Name	≤ FD (ms)	≤ IFDV (ms)	≤ FLR (%)
MEF Metro High	10	3	0.01
MEF Metro Med	20	8	0.01
MEF Metro Low	37	Disabled	0.1
MEF Regional High	25	8	0.01
MEF Regional Med	75	40	0.01
MEF Regional Low	125	Disabled	0.1
MEF Continental High	77	10	0.025
MEF Continental Med	115	40	0.025
MEF Continental Low	230	Disabled	0.1
MEF Global High	230	32	0.05
MEF Global Med	250	40	0.05
MEF Global Low	390	Disabled	0.1

User Performance allows the configuration of the following values per service:

- **FD (Latency): 0.015 to 8000 ms** (default is **15 ms**).
- **IFDV (Jitter): 0.015 to 8000 ms** (default is **2 ms**).
- **FLR (Frame Loss): 0 to 5%** (default is **0.1%**).

Note: The **Performance Criteria** list is user definable and up to 25 Performance criteria can be created (see Customizable Performance Criteria on page 197).

Customizable Profiles

As mentioned above, 2 profiles are available by default and up to 25 profiles can be predefined by editing the profile's text file (iSAMProfilesTemplate.ini) using a word processor like **Notepad**. The file is located under

Documents and Settings\All Users\Application Data\EXFO\ProtocolProducts\.

Example of profile's text file:

```
[Priority]
Frame Type = EMIX
Frame Size = 64, 128, 512, 1024, 1518
VLAN Priority = 7
DSCP = CS7
Performance Criteria = MEF Metro High

[Best Effort]
Frame Type = EMIX
Frame Size = 64, 128, 512, 1024, 1518
VLAN Priority = 0
DSCP = CS0
Performance Criteria = MEF Metro Low
```

Test Setup - Test Configurator, Timer, and System

Network Details (iSAM)

Each profile entry has the following parameters.

- **Profile Name:** 1 to 16 characters. All ASCII characters from 32 to 126 decimal are supported.
- **Frame Type:** Enter **Fixed** or **EMIX**. When the frame type is missing from a profile, **EMIX** is used.
- **Frame Size** (see *Frame Size* on page 192 for possible values); when the frame size is missing from a profile, default value(s) is used:
For **Fixed**: Enter a unique frame size.
For **EMIX**: Enter 2 to 8 frame sizes with a comma between each entry.
- **VLAN Priority**¹ (optional): Enter the priority number.
- **DSCP**¹ (optional): Enter either the DSCP name or its binary value.
- **Performance Criteria**¹: Enter the name of the performance criteria. When the **Performance Criteria** is missing from a profile or is not available from the user profile file, the **User Performance** criteria is used.

When a parameter is missing from a profile, the default value of the missing parameter is used.

The value of a parameter is validated to ensure it is within the supported range; otherwise the profile entry is unsupported.

If the profile file contain more than 25 profiles, only the first 25 valid profiles are retained.

1. See *Classification* on page 193 for possible values.

Customizable Performance Criteria

As mentioned above, factory performance criteria are available and up to 25 performance criteria can be defined by editing the performance criteria text file (iSAMPerformanceCriteriaTemplate.ini) using a word processor application like **Notepad**. The file is located under

Documents and Settings\All Users\Application Data\EXFO\ProtocolProducts\.

Example of performance criteria's text file:

```
[MEF Metro High]
FD = 10
IFDV = 3
FLR = 0.01

[MEF Metro Med]
FD = 20
IFDV = 8
FLR = 0.01

[MEF Metro Low]
FD = 37
IFDV =
FLR = 0.1
```

Each profile entry has the following parameters:

- Performance Criteria Name: 1 to 16 characters. All ASCII characters from 32 to 126 decimal are supported.
- Frame Delay (FD) Threshold: 0.015 ms to 8000 ms.
- Inter-Frame Delay (IFDV) Threshold: 0.015 ms to 8000 ms.
- Frame Loss Ratio (FLR) Threshold: 0% to 5%.

Test Setup - Test Configurator, Timer, and System

Network Details (iSAM)

If the threshold value for a parameter is not defined, it is considered as disabled (as in the example above for IFDV =).

The value of a parameter is validated to ensure it is within the supported range; otherwise the performance criteria entry is unsupported.

Remote Details (iSAM)

The remote block automatically scan the remote modules for **DTS** and **Remote Loopback** modes and allows the selection of the remote module that is used to loop back the traffic via **Smart Loopback** or EtherSAM in **Dual Test Set** (DTS) mode for simultaneous bidirectional results. The number module available for remote connection is displayed. If the connection with the remote module is not manually established, the remote connection process is automatically performed when starting the test.

From the **Test** menu, tap **Setup, Test Configurator**, and the **More** button from the **Remote** block.

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

For both DTS and Remote Loopback Operation Modes

➤ Discovered Remotes

The modules are discovered dynamically and listed with their **Name**, **IP** address, **Status**, **Connection**, and **Preferred** information. **Name** and **Status** are only available for remote FTB-700G/800 Series, FTB-800v2 Series, and FTB-88000 Series, modules. Only modules from the same subnet are automatically discovered. To access a module from a different subnet, use the **Add** button.

Test Setup - Test Configurator, Timer, and System

Remote Details (iSAM)

- **Preferred** check box when selected indicates that this module is part of the preferred module's list. Preferred remote modules will be considered first during the automatic connection process as follows:

Priority	Preferred or not	Status
1	Preferred	Available
2		Taken
3		Test in Progress
4	Non Preferred	Available
5		Taken
6		Test in Progress

- **Status**

Background Color	Status	Description
Green	Ready	Connected with the local unit
	Running	
Yellow	Taken	Connected with another unit
Red	Test in Progress	Test in progress with another unit
No color	Unreachable	Preferred remote does not reply
	Available	Not connected

- **Connection** indicates **Connected** when the local unit is connected to a remote module.
- **Add** button is used to add a preferred remote module to the preferred list. Enter the IP address of the remote module and tap **OK**. This is useful to access a module from a different subnet.

For Remote Loopback Operation Mode

- **Loop-Up** button establishes the connection with the selected remote module and sets the remote module into **Smart Loopback** test application.

Following a successful loop-up, the IP address of the remote module will be used as the destination IP address for the test.

- **Overtake** button manually establishes the connection with the remote module and set the remote module into Smart Loopback test application. Available when the status is **Taken** or **Test in Progress** with another unit. A confirmation is required to overtake a module.
- **Loop-Down** button ends the connection between the local and the remote modules.

For DTS Operation Mode

- **Connect** button manually establishes the connection with the selected remote module and sets the remote module into DTS EtherSAM test application.

Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.

- **Overtake** button manually establishes the connection with the remote module and set the remote module into DTS EtherSAM test application. Available when the status is **Taken** or **Test in Progress** with another unit. A confirmation is required to overtake a module.

Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.

- **Disconnect** button, available once the connection with the remote module is established, terminates the connection with the remote module. Available when the status is **Ready**.

For Manual Loopback Operation Mode

- **MAC**, available with layer L2, allows to enter the destination MAC address of the remote.
- **IP**, available with L3/L4, allows to enter the destination IP address of the remote.
- Resolved MAC address status, available with L3/L4, indicates:
 - **Resolving** when the ARP process is resolving.
 - **Resolved** when the ARP process is resolved.
 - **Failed** when the ARP process failed.
- **Quick Ping**, available with layer L3/L4, tests if the destination IP address can be reached. A message displays if the ping attempt is **Successful** or **Failed**.

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.

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 530.*

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 530.

Global Options

- **Flow Direction** allows the selection of the traffic direction as follows:
 - **TX to RX** for **Single 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 ^b

- The minimum frame size will be adjusted according to the frame structure and components selected.
- The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

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

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

Restore RFC 2544 Defaults

Reverts the 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 throughput measurement is validated the number of times specified (**Validations**) for the predefined duration (**Trial Duration**). The **Accuracy** setting specifies 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.

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.

Test Setup - Test Configurator, Timer, and System

RFC 2544 - Subtests

- **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)

- **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** setting specifies how precise that result must be. The test is performed for each defined frame size.

- **Burst Time** is expressed in seconds: **1** to **5** seconds. The default setting is **2** 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.

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 10 %, then the test is repeated again until there are two successive trials in which no frames are lost. 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 207. For **Dual Test Set**, **Max. Rate** is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions.
- **Trial Duration** represents the time value for each trial in minutes:seconds: **1** second to **30** minutes (default is **00:01**).

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%**.

- **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**.

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 $\pm 6.6 \mu s$ 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.

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.

- **Throughput Threshold** sets the threshold¹ 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. 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.

- **Back-to-Back Threshold** sets the threshold¹ value in percentage of frames per burst to declare a pass/fail verdict. The range is from **0.0** to **100.0%** (default) and it applies to all frames sizes when applicable.
- **Frame Loss Threshold (%)** sets the threshold² 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** (see *Latency Configuration* on page 211).
- **One-Way Latency Threshold**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Latency Configuration* on page 211), 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**.

RFC 6349

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

Connection

- **Operation Mode** indicates the test operation mode: **Dual Test Set** (DTS). It is possible to select a remote unit by clicking on the **Discover Remote** button.

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 **Dual Test Set**. For more details, refer to *Discover Remote Button* on page 530.
- **Direction** allows the selection of the traffic direction: **Local to Remote**, **Remote to Local**, and **Bidirectional** (default).

Parameters

- **Multiple Connections** check box when selected (default) indicates that the applicable TCP Throughput phases are performed with multiple connections; otherwise TCP Throughput phases are performed within a single connection.
- **TCP Server Port**

Local TCP Server Port is the port used by the server located at the local side: **1** to **65535** (excluding **62819** that is used for DTS connection), default is **50201**.

Remote TCP Server Port is the port used by the server located at the remote side: range is **1** to **65535** (excluding **62819** that is used for DTS connection), default is **50201**.

➤ CIR

The Local-to-Remote CIR and Remote-to-Local CIR represent the Committed Information Rate of the Ethernet Service under test: **1.0 Mbit/s** to Line Rate. The CIR is not used to actually transmit frames at this rate but to calculate a Bandwidth Delay Product (BDP) which in turn is used to set the Max Window Size of the TCP connections.

Rate Unit determines the unit used to display the rate values: **Mbit/s** (default) or **Gbit/s**.

- **TOS/DS** (IPv4) allows to enter an hexadecimal value, **00** (default) to **FF**. Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.

MTU

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

Window Sweep

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

TCP Throughput

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

Restore RFC 6349 Defaults

- Reverts the configured parameters to their default values.

S-OAM and MPLS-TP OAM

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

OAM Mode

Allows the selection of the OAM mode.

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

S-OAM and MPLS-TP OAM Responder

S-OAM Responder or **MPLS-TP OAM Responder** check box when selected (default) allows to respond to LBM, LTM¹, DMM, LMM, and SLM¹ valid messages (test running or not). Traffic statistics are also monitored (refer to *Responder* on page 451).

For S-OAM: A valid message must have its source MAC address matching the Peer MEP MAC address, destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address², VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level.

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

Respond to... message	Respond with... message
LBM	LBR
LTM ¹	LTR
DMM	DMR
LMM	LMR
SLM ¹	SLR

1. Only available with Ethernet OAM.

2. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Pass/Fail Verdict

Pass/Fail Verdict check box when selected (default) enables the use of the pass/fail verdict. A global fail verdict is declared when any of the following condition is met: **Link Down** alarm, **Loss Continuity** alarm, or any fail verdict for **Frame Delay**, **Frame Loss**, **Synthetic Loss**¹, **Frame Delay Failure**, **Frame Loss Failure**, **Synthetic Loss Failure**¹, **Loopback Failure**, or **Test Failure**.

Thresholds

Available with G.8113.1, Y.1731 and MEF OAM Modes when Pass/Fail verdict is enabled.

- **Frame Delay Threshold (ms)** allows to set the threshold² value of frame delay: **0.001** to **8000** ms (default is **50** ms).
- **Frame Loss Threshold (%)** allows to set the threshold² value of frame loss: **0.001** to **100%** (default is **10%**).
- **Synthetic Loss Threshold (%)**³ allows to set the threshold² value of Synthetic Loss: **0.001** to **100%** (default is **10%**).

1. Only applicable to Ethernet OAM.

2. The verdict is PASS when the measured value is lower or equal to the threshold value.

3. Available with Ethernet OAM (Y.1731 and MEF).

Next HOP Router (G.8113.1)

- **MAC Address**, available when **Resolve MAC** check box is cleared, allows to enter the Next HOP Router MAC address: 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF, default is 01:00:5E:90:00:00¹. The MAC Address field is not accessible when the **Resolve MAC** check box is selected.
- **Resolve MAC** check box, when selected (cleared by default), sends a request to the network to retrieve the MAC address corresponding to the selected IP address.
- **IP Address**, available when **Resolve MAC** check box is selected, allows to enter the Next HOP Router IP address: 0.0.0.0 to 255.255.255.255 for IPv4; default is the source IP address; ::1 to FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF for IPv6, default is 2001::.

Local Parameters

- **MEG ID** (Y.1731 and G.8113.1) is the Maintenance Entity Group Level identification allowing to enter a 13-bytes MEG ID value/message to be generated (default value is **EXFO MEG ID**). Values should be ASCII suitable characters including the *ITU T.50 Characters* on page 38.

Padding allows the selection of the character (**Null** or **Space**) to used for remaining byte values.

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

1. The MAC Address 01:00:5E:90:00:00 is reserved for point-to-point link and can be used when the unicast address is unknown (as per RFC-7213).

Test Setup - Test Configurator, Timer, and System

S-OAM and MPLS-TP OAM

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

Peer MEP Parameters

- **MAC Address**¹ allows to enter the unique Media Access Control (MAC) address of the peer MEP (default is **00:00:00:00:00:00**).
- **MEP ID** is the Maintenance Entity Group End Point Identification configurable from **0x0001** (default) to **0x1FFF**.
- **OAM Quick Ping** verifies the bidirectional connectivity with the peer MEP. The **Successful** message is reported when at least one of three attempts has been successful otherwise **Failed** is reported.

Continuity Check

- **CC Function** check box when selected (default) allows to transmit and monitor CCM frames.

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

- **Address Type**¹ defines the destination address type of the CCM frames: **Unicast** or **Multicast** (default).
- **Priority**¹² allows to select the VLAN user priority: **0** to **7** (default). Refer to *VLAN ID and Priority* on page 647 for more information.

1. Available with S-OAM Mode.

2. Available when VLAN is enabled (see *VLAN* on page 186).

- **Drop Eligible**¹² is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **Period** determines the transmission period of the CCM frame: **3.33 ms**, **10 ms**, **100 ms** (default), **1 s**, **10 s**, **1 min**, or **10 min**.

MPLS-TP Label Stack (G.8113.1)

- **MPLS-TP Mode**

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

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

Section is a segment between two adjacent LER/LSR.

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

1. Available with S-OAM Mode.

2. Available when VLAN is enabled (see *VLAN* on page 186).

Test Function

Note: *Test Function parameters are not configurable when the **TX Enable** check box is selected.*

- **Function** allows the selection of the test function to be performed.
 - **Loopback** (default) function is used to verify the bidirectional connectivity to a peer MEP (**Continuous** check box cleared) and to verify its capability to sustain close to line rate traffic (diagnostic test; **Continuous** check box selected).
 - **Test** function is used to generate a test signal and/or verify the integrity of received test signal from the peer MEP.
 - **Frame Delay** function is used to measure the round trip delay with the peer MEP.
 - **Frame Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point.
 - **Synthetic Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point using synthetic frames.
- **TX Enable** check box when selected (cleared by default) allows transmission of frames. However the transmission will only begin when the test is started or if the test is already running. When the **Continuous** check box is cleared, the **TX Enable** check box is automatically cleared once all frames have been transmitted.
- **Address Type**¹ defines the destination address type of the frame: **Unicast** (default) or **Multicast**. Availability of address types depend on selected **S-OAM Mode** and **Test Function**.
- **Continuous** check box when selected (default) specifies that the frame generation is continuous. The **Continuous** check box is cleared for Multicast address type.

1. Available with S-OAM Mode.

- **Requesting MEP ID TLV** (G.8113.1) check box when selected (default) determines if the Requesting MEP ID TLV is present in the LBM frame. The **Requesting MEP ID TLV** check box is cleared and not selectable when the **Continuous** check box is selected.
- **Priority**¹² allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 647 for more information.
- **Drop Eligible**¹², when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is only configurable with **Unicast** address type, otherwise is set to **No** (Default). Drop Eligible is set to **No** for **Frame Delay**, **Frame Loss**, and **Synthetic Loss** functions.
- **Period** determines the transmission period of frames which is set to **100 ms**. **Period** is not applicable for Multicast address type or when the **Continuous** check box is selected.
- **TX Rate (%)** is the transmission rate of the LBM frame: **0.0001** to **95%** for 10M, **99.5%** for 100M, **99.95%** for 1G, **99.995%** for 10G LAN, and **92.8521%** for 10G WAN. Only available with Loopback test function when the **Continuous** check box is selected.

1. Available with S-OAM Mode.

2. Available when VLAN is enabled.(see *VLAN* on page 186)

Test Setup - Test Configurator, Timer, and System

S-OAM and MPLS-TP OAM

- **Frame Size** allows to enter the frame size. The frame size range for Ethernet II frame format is as follows:
 - S-OAM Mode: 64¹² to 1518³.
 - MPLS-TP OAM Mode: Minimum¹ and maximum values are as follows:

Test Function	MPLS-TP Mode		
	PW	LSP	Section
Loopback	68 ^a to 16000 ³	72 to 16000 ³	68 to 16000 ³
Test	68 to 1522	68 to 1522	64 to 1518
Frame Delay	68 ^{ab} to 1522	72 ^b to 1522	68 ^b to 1518
Frame Loss ²	68	68	64

- a. Add 4 bytes when the **GAL** check box is selected.
- b. Add 2 bytes when **Test ID** is selected as **TLV Type**.

The following table lists each parameter that may affect the minimum and maximum³ frame size value.

Parameter	Number of bytes to be added	Apply to
802.3 SNAP	8 bytes	Y.1731, MEF, G.8113.1
VLAN	4 bytes per VLAN (up to 3 VLAN)	
Label 2	4 bytes	G.8113.1
Continuous	18 bytes for Data TLV Type 21 bytes for Test TLV Type	
Requesting MEP ID TLV	56 bytes	

1. The minimum frame size is adjusted according to the frame structure and parameters selected.

2. For **Frame Loss** function, the frame size is not configurable and set to the minimum value.

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

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

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

Restore Carrier Ethernet OAM Defaults

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

Services - Global

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

General Button

The following parameters are displayed and configurable per service.

➤ Check boxes:

- The first check box (top-left) allows 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**¹ indicates the name of each service. Tap on the **Service Name** button to modify the name of each service.
- **Direction**, available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).

1. See *Services - Profile* on page 231 for more information.

- **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** (see **Modify Frame Structure** from the *MAC/IP/UDP* on page 170).
- **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 170).
- **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 170).

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

See *SLA Parameters* on page 236 for more information on **CIR**, **CIR+EIR**, **CBS**, **EBS**, **Max Jitter**, **Max Latency**, and **Frame Loss**.

Total TX Rate

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

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

Global Options

Rate Unit 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 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 134).

Indicates the total transmit rate of all services enabled for transmission. Unit selection is available from the *SLA Parameters* on page 236.

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	158
		82	102
		78	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	

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

Test Setup - Test Configurator, Timer, and System

Services - Profile

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 236.*

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

- **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 134).

Note: *Changing a criteria value (CIR, CIR+EIR, Ramp Traffic Policing, or Burst Max Rate) may affect the other criteria values in order to comply to the following rules:*

$CIR \leq CIR+EIR \leq \text{Ramp Traffic Policing Rate} \leq \text{Line Rate}$

$CIR \leq CIR+EIR \leq \text{Burst Max Rate} \leq \text{Line Rate}$

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:

$CIR < CIR+EIR < \text{Burst Max Rate} \leq \text{Line Rate}$

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.

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%** (default is **50%**). 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%** (default is **75%**).

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

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

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

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

Performance Criteria

- **Max Jitter (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** (see *Global Options* on page 137).
- **Max Latency**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Global Options* on page 137), 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** allows to set the maximum percentage value of Frame Loss allowed for the service: **0** to **5%** (default is **0.1%**).

SFP/SFP+

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

For iSAM: From the **Test** menu, tap **Setup, Test Configurator**, tap on the **Local** block, and on the SFP/SFP+ tab.

For all other tests: 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 - Optical

Note: For electrical interface, see Physical Interface - Electrical on page 240.

- **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** allows to automatically turn off the laser when starting the module or when switching from one test application of the same group (Transport, Ethernet, Packet Sync, Fibre Channel, or Wireless) to another.
- **Power Range (dBm)** indicates the SFP/SFP+ 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 - Optical on page 239.

- **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 DS_n or dBm for PDH and SONET/SDH.
- **Amplitude** indicates the received signal amplitude as well as its MIN, and MAX received values.

TX Frequency

Note: Frequency offset is not available when **Through** mode is selected.

- **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
OTU1e	± 120 ppm	11049107143 bit/s
OTU2e		11095727848 bit/s
OTU1f		11270089286 bit/s
OTU2f		11317642405 bit/s

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

- **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 309 for more information on standard rate specifications.

Signal Configuration

- For OTN, refer to *Signal - Signal Configuration (OTN)* on page 254 for more information.
- For SONET/SDH, refer to *Signal - Signal Configuration (SONET/SDH)* on page 256 for more information.
- For DS_n/PDH, refer to *Signal - Signal Configuration (DS_n/PDH)* on page 245 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

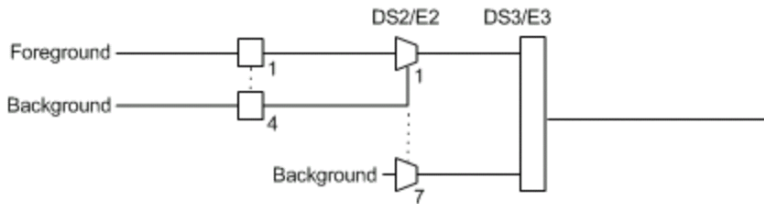
a. Default value

Test Setup - Test Configurator, Timer, and System

Signal - Signal Configuration (DSn/PDH)

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

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.

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 23 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). 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.

Test Setup - Test Configurator, Timer, and System

Signal - Signal Configuration (DSn/PDH)

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 115.*

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 251).

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 module 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 <i>Modify Loop Codes</i> button on page 251.	

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 251 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, OTU2f, OTU1f, OTU2e, OTU1e, 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.

- **ODU2, ODU2f, ODU1f, ODU2e, ODU1e, 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 279 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 638 for more information.

Number (SDH) allows the selection of the AU channel number. Refer to *SDH Numbering Convention* on page 639 for more information.

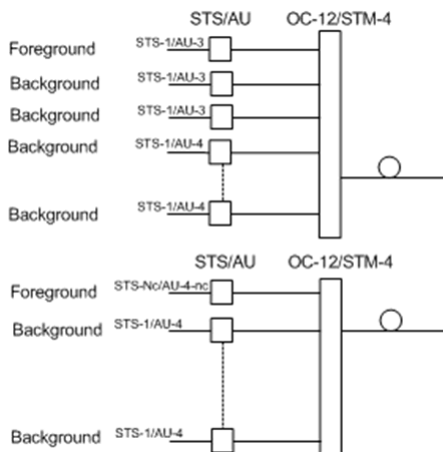
- **TCM** check box when selected (cleared by default) allows Tandem Connection Monitoring (TCM).
- **TC-UNEQ-P / TC-UNEQ-V / HPTC-UNEQ / LPTC-UNEQ** check boxes when selected (cleared by default) allows the monitoring of the corresponding Tandem Connection - Unequipped alarm. Only available when the **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 115.
- **Background Traffic** allows the selection of the high order path background traffic: **AIS**, **Equipped** (PRBS23) - (default), or **Unequipped**.

Test Setup - Test Configurator, Timer, and System

Signal - Signal Configuration (SONET/SDH)

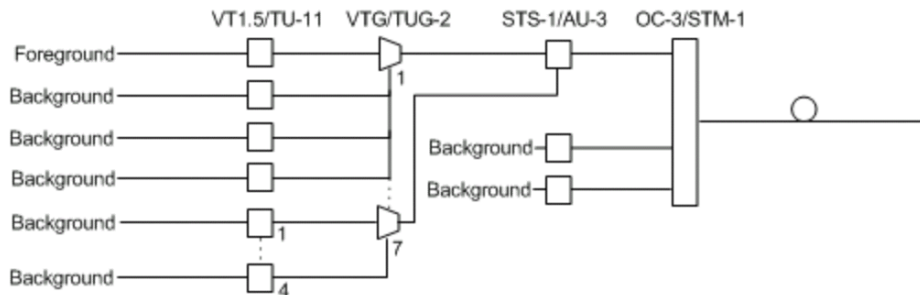
STS/AU Path (SONET/SDH HOP):

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 105).

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.

S-OAM Responder

The S-OAM Responder check box when selected (default) allows to respond to LBM, LTM, DMM, LMM, and SLM valid messages (test running or not). Traffic statistics are also monitored (refer to *Responder* on page 451).

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

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 269).
- **Framing** indicates the framing of each stream. Tap on the **Framing** button to modify the Network Layer, Transport Layer and VLAN (see **Modify Frame Structure** from the **MAC/IP/UDP** tab).
- **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** indicates the source and destination IP addresses for each stream. Tap on the **Addressing** button to modify the 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 will be 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 copy 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 coded 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.

Test Setup - Test Configurator, Timer, and System

Streams - Profile

- **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 ^b	

- 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 is limited to 10000 for 10/100/1000Mbps electrical interface.
- 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.

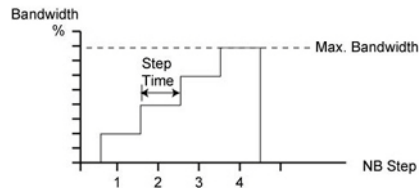
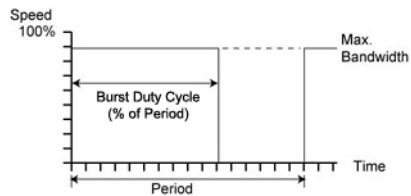
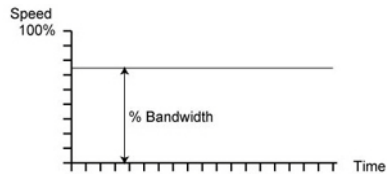
n-Frame transfers the selected number of frames.

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% for all interfaces at the exception of 10Gig-E WAN which is 92.8571% (depending on the frame format).

Unit choices are % (default), **Mbit/s**, **Gbit/s**, **frame/s**, and **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%** (default is **50%**).
- **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**.

Test Setup - Test Configurator, Timer, and System

Streams - Profile

- **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.

SyncE

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

ESMC Monitoring

- **ESMC** (Ethernet Synchronization Message Channel) is a live value monitored even when the test is not started.

An arrow next to the ESMC label indicates that ESMC valid information frames are received or not.

- A green arrow indicates that at least one ESMC valid information frame, containing a valid FCS, was received within a second in the last 5-second interval.
- A red arrow indicates that no ESMC valid information frames were received for more than 5 seconds.
- A gray arrow indicates awaiting incoming data to provide a status.
- **Received QL** indicates the last Quality Level received. The **Received QL** is a live value monitored even when the test is not started.
- **QL Mismatch Monitoring** check box when selected (default) enables the Quality Level mismatch monitoring. The quality level characterizes the clock quality in terms of network synchronization.
- **Expected QL** available when the **QL Mismatch Monitoring** check box is selected, allows the selection of the Expected Quality Level value. See page 374 for more information.

- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict. The global pass/fail verdict is based on the following criteria: **ESMC Rate Threshold** (when enabled), **QL Mismatch Monitoring** (when enabled), **ESMC Loss**, or **Link Down**.
- **ESMC Rate Threshold** check box when selected (default) enables the ESMC rate threshold monitoring which will declare a Fail verdict when the ESMC frame rate is outside the range of 0.8 to 10.2 frames/s.

ESMC Generation

- **Generated QL**

The **Generated QL** check box when selected (default) enables the generation of the selected QL message.

The **Generated QL** field allows the selection of the QL message that will be generated. See page 374 for the list of QL message (default is **QL-EEC2/ST3**).

Note: *For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Generated QL** is not configurable and is set to **QL-DNU/DUS** with its check box selected.*

- **QL Rate (frame/s)** defines the frame rate at which the ESMC transmit the QL message value: **1** (default), **5**, or **10** frames per second. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **QL Rate** is not configurable and is set to **1** frame/s.

Restore SyncE Defaults

Reverts the SyncE test application to its default factory settings.

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.

TCP Throughput

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

TCP Mode

Since two units are required to perform a TCP Throughput test, one unit must be the source (**Local**) unit and the other one the destination (**Remote**). Set the TCP Mode on both units: **Local** (default) or **Remote**.

TCP Connection Configuration

- **Remote IP Address**, available with **Local** TCP mode, allows to enter the IP address of the remote unit.
- **Quick Ping** button automatically starts the quick Ping utility for the remote 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 501 for more options.
- **Accept Connection from IP**, available with **Remote** TCP mode, allows to enter the IP address of the local unit. The IP address **0.0.0.0** (default) listens to any TCP stream.
- **IP TOS/DS**, available with **Local** TCP mode, is configurable from **0x00** (default) to **0xFF**.
- **TCP Port**, available with **Local** and **Remote** TCP modes, allows the selection of the TCP port number: **0** to **65535** (default is **50201**). For the local unit, the specified TCP port will be used for the TCP initialization algorithm with the remote unit. The following TCP segments sent by the local unit will use the TCP port number replied by the remote unit.

TCP Throughput Configuration

Note: *TCP Throughput Configuration is only available on the local unit.*

- **Initial Window Size**¹ is the window size that is used when the test is started: **1024** Bytes to **65536** KBytes (default is **2** KBytes). The Initial Window Size value must be between the **Minimum Window Size** and the **Maximum Window Size** values.
- **Minimum Window Size**¹ is the minimum window size used for the test: **1024** Bytes to **65536** KBytes (default is **1** KBytes).
- **Maximum Window Size**¹ is the maximum window size used for the test: **1024** Bytes to **65536** KBytes (default is **64** MBytes).
- **Rate Unit** allows to select the unit that will be used to set the Throughput Pass/Fail Verdict Threshold and throughput results: % (default) or **MBit/s**.
- **Throughput Pass/Fail Verdict** check box when selected (default) enables the throughput verdict.
- **Threshold** allows to set the pass/fail verdict threshold value: **0** to **100%** (default).

Restore TCP Throughput Defaults

Reverts the TCP Throughput test application to its default factory settings.

1. The entered value will be rounded to the closest multiple of 1024 Bytes. Unit choices are Bytes, KBytes (default), and MBytes.

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 and RFC 6349, only **Start Time** and the **ARM** button are available.*

- **Duration:** Selects the test duration based on the test start time. The test start time can be either the time the user starts the test or the time the test is automatically started when the start time is enabled. The **Duration** check box has to be selected to be included in the test timer. Choices are **15 minutes** (default), **1, 2, 4, 6, 12, 24, 72 hours, 7 days**, and **User Defined**.

When **User Defined** is selected, the field next to it becomes available to enter the test duration using the format: dd:hh:mm:ss.

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

- **Start Time** selects the time the test will automatically start. The **Start Time** check box has to be selected to be included in the test timer.

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

Test Setup - Test Configurator, Timer, and System

Timer

- **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 29 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 255), 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 255).*

➤ **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 442.

Test Setup - Test Configurator, Timer, and System

Traces (OTN)

- **SAPI** (Source Access Point Identifier) corresponds to the TTI bytes 1 to 15. A maximum of 15 characters are allowed. The TTI byte 0 is set to NULL (all 0's). The expected SAPI message is available when the **SAPI OTU/ODU-TIM** check box is selected.

TTI Traces	Default Message
SM	EXFO OTU SAPI
PM	EXFO ODU SAPI
TCM	EXFO TCMi SAPI

- **DAPI** (Destination Access point Identifier) corresponds to the TTI bytes 17 to 31. A maximum of 15 characters are allowed. The TTI byte 16 is set to NULL (all 0's). The expected DAPI message is available when the **DAPI OTU/ODU-TIM** check box is selected.

TTI Traces	Default Message
SM	EXFO OTU DAPI
PM	EXFO ODU DAPI
TCM	EXFO TCMi DAPI

- **Operator Specific** corresponds to the TTI bytes 32 to 63. A maximum of 32 characters are allowed.

TTI Traces	Default Message
SM	EXFO OTU OPERATOR SPECIFIC
PM	EXFO ODU OPERATOR SPECIFIC
TCM	EXFO TCMi OPERATOR SPECIFIC

- **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 487 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 487 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 ($\langle C_R \rangle$ and $\langle L_F \rangle$ 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 38.

- **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 444).

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 282.

TCM Access Point Identifier

Note: Available when TCM is enabled from the Signal - Signal Configuration (SONET/SDH) on page 256.

- **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 282.

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

9 Test Results

The Test Results menu offers the following structure:

Intelligent Apps test application

Tab	Test Application iSAM	Page
Logger	X	360
Summary	X	410

Transport test applications

Tab	Available with						Page
	a	b	c	d	e	f	
Alarms/Errors	X	X	X	X	-	X	290
Alarms/Errors Logger	-	-	-	-	-	X	360
FTFL/PT	X	-	-	-	-	-	347
ISDN Logger	-	-	-	-	-	X	350
Labels	-	X	-	X	-	-	355
Logger	X	X	X	X	X	-	360
Performance Monitoring	X	X	X	X	-	-	363
Summary	390	390	390	390	422	414	<---
Traces	442	444	-	444	-	-	<---

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS_n/PDH BERT
- d. SONET/SDH - DS_n/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

Test Results

Ethernet test applications

Tab - Subtab	Test Application										Page
	a	b	c	d	e	f	g	h	i	j	
Alarms/Errors	X	X	X	X	X	X	X	X	X	-	290
Graph	-	-	X	-	-	-	-	-	-	-	349
Link OAM	-	-	-	-	-	-	-	-	X	-	356
Logger	X	X	X	X	X	-	X	X	X	-	360
S-OAM / MPLS-TP OAM	-	-	-	-	-	-	-	-	X	-	377
Service Configuration - Burst	X	-	-	-	-	-	-	-	-	-	382
Service Configuration - Ramp	X	-	-	-	-	-	-	-	-	-	383
Service Performance	X	-	-	-	-	-	-	-	-	-	385
Streams - Frame Loss / Out-of-Sequence	-	-	-	-	X	-	-	-	-	-	387
Streams - Jitter	-	-	-	-	X	-	-	-	-	-	387
Streams - Latency	-	-	-	-	X	-	-	-	-	-	388
Streams - MPLS	-	-	-	-	X	-	-	-	-	-	362
Streams - Throughput	-	-	-	-	X	-	-	-	-	-	389
Summary	404	426	423	390	440	390	390	437	420 429	400	<---
Traffic - Ethernet	X	X	X	X	X	X	X	X	-	-	445
Traffic - Flow Control	-	X	X	-	X	-	X	X	-	-	447
Traffic - Graph	-	-	-	-	X	-	X	-	-	-	449
Traffic - MPLS	-	-	-	-	-	-	X	-	-	-	362
Traffic - S-OAM / MPLS-TP OAM	-	-	-	-	-	X	-	-	X	-	450
Window Sweep	-	X	-	-	-	-	-	-	-	-	452
WIS	X	-	X	X	X	X	-	-	X	-	453

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

Packet Sync test applications

Tab	Test Application		Page
	1588 PTP	SyncE	
Alarms/Errors	X	X	290
Logger	X	X	360
PTP Stats	X	-	370
Quality Level (1588 PTP)	X	-	372
Quality Level (SyncE)	-	X	374
Summary	396	434	<---
Traffic - Ethernet	X	X	445

Fibre Channel test application

Tab	Test Application Fibre Channel BERT	Page
Alarms/Errors	X	290
Logger	X	360
Summary	X	407

Wireless Test Application

Tab	Test Application CPRI/OBSAI BERT	Page
Alarms/Errors	X ^a	290
Logger	X	360
Summary	X	390

a. Only available for Framed L2.

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.

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	294
	Bit Error, Pattern Error	Mismatch '0', Mismatch '1', Frame Loss, Out-of-Seq.	
CLOCK	-	LOC, LOPPS-L, LOPPS-R	296
CPRI	LOF, R-LOS, R-LOF, RAI, SDI	Link Down	297
	FAS		
DS1	AIS, OOF, RAI	-	298
	CRC-6, Framing Bit	-	
DS3	AIS, Idle, OOF, RDI	-	299
	CP-BIT, FEBE, F-Bit, P-Bit	-	
E1	AIS, LOF, RAI, LOMF, RAI MF, TS16 AIS	-	300
	FAS	CRC-4, E-Bit	
E2	AIS, LOF, RAI	-	301
E3	FAS	-	302
E4			303
Ethernet	Link Down, Remote Fault, Local Fault ^a	Hi-BER, Local Fault Det., Local Fault Rcd.	304
	FCS	Jabber, Oversize, Runt, Undersize	
FEC	CORR-BIT, CORR-CW, CORR-SYM, STRESS, UNCORR-CW	CORR, UNCORR	318
Fibre Channel	-	Link Down, Local Fault Detected, Local Fault Received, Remote Fault	307
	-	Symbol, Block, FCS, Oversize, Undersize	
Interface	LOS, CV, K30.7	Frequency, LOC	309
IP/UDP/TCP	-	IP Chksum, UDP Chksum, TCP Chksum	311
ISDN	-	D-CH Down, D-Ch FCS	311
MPLS-TP OAM	RDI, AIS, LCK, C-LOS, C-FDI, C-RDI, C-DCI ^a	Loss Continuity, Mismerge, Unexp MEG Lvl, Unexp MEP, Unexp Period	324

Test Results

Alarms/Errors

Layer	Alarms/Errors		Page
	TX/RX	RX only	
ODU _x	LOFLOM, AIS, OCI, LCK, BDI, FSF, BSF, FSD, BSD	TIM	312
	BEI, BIP-8	-	
ODU _x -TCM	BDI, BIAE, IAE, LTC	TIM	315
	BEI, BIP-8	-	
OPU _x	AIS, MSIM, CSF	PLM	317
OTU _x	AIS, BDI, BIAE, IAE, LOF, LOM, OOF, OOM	TIM	318
	FAS, MFAS, BIP-8, BEI	-	
PTP	-	Loss Sync, Loss Announce, Unusable, QL Mismatch	322
QoS Metrics	-	Frame Loss, Out-of-Seq.	323
S-OAM	RDI, AIS, LCK, C-LOS, C-FDI, C-RDI, C-DCI ^a	Loss Continuity, Mismerge, Unexp MEG Lvl, Unexp MEP, Unexp Period	324
Section/Line / RS/MS	LOF-S/RS-LOF, SEF/RS-OOF, AIS-L/MS-AIS, RDI-L/MS-RDI	TIM-S/RS-TIM	328
	FAS-S/RS-FAS, B1, B2, REI-L/MS-REI	-	
STS-x / AU-x	AIS-P/AU-AIS, LOP-P/AU-LOP, UNEQ-P/HP-UNEQ, PDI-P, RDI-P/HP-RDI, ERDI-PCD/ERDI-CD, ERDI-PPD/ERDI-PD, ERDI-PSD/ERDI-SD	TIM-P/HP-TIM, PLM-P/HP-PLM	330
	B3, REI-P/HP-REI	-	
SyncE	-	ESMC, QL Mismatch	333
TCM (SONET/SDH)	TC-UNEQ-P/HPTC-UNEQ, TC-LTC-P/HPTC-LTC, TC-IAIS-P/HPTC-IAIS, TC-ODI-P/HPTC-ODI, TC-RDI-P/HPTC-RDI, TC-UNEQ-V/LPTC-UNEQ, TC-LTC-V/LPTC-LTC, TC-IAIS-V/LPTC-IAIS, TC-ODI-V/LPTC-ODI, TC-RDI-V/LPTC-RDI	TC-TIM-P/HPTC-TIM, TC-TIM-V/LPTC-TIM	334
	TC-IEC-P/HPTC-IEC, TC-OEI-P/HPTC-OEI, TC-REI-P/HPTC-REI, TC-OEI-V/LPTC-OEI, TC-REI-V/LPTC-REI	TC-VIOL-P/HPTC-VIOL, TC-VIOL-V/LPTC-VIOL	
VT/TU	AIS-V/TU-AIS, LOP-V/TU-LOP, RDI-V/LP-RDI, RFI-V/LP-RFI, UNEQ-V/LP-UNEQ, ERDI-VSD/LP-ERDI-SD, ERDI-VCD/LP-ERDI-CD, ERDI-VPD/LP-ERDI-PD	TIM-V/LP-TIM, PLM-V/LP-PLM	337
	-	BIP-2, REI-V/LP-REI	

Layer	Alarms/Errors		Page
	TX/RX	RX only	
WIS	SEF, LOP, AIS-L, RDI-L, AIS-P, RDI-P, LCD-P, LOP-P, UNEQ-P, ERDI-PSD, ERDI-PCD, ERDI-PPD	WIS Link Down, PLM-P	340

a. Available in TX only.

Test Results

Alarms/Errors

BER

Alarms

➤ No Traffic¹

RX:

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

Fibre Channel: No traffic is being transmitted when Login Management fails; a pop up displays **No Data is being transmitted on Port(s) <port number>. The Login process has failed.**

➤ Pattern Loss

RX:

Ethernet: More that 20% of bit errors are received or the reference sequence can be unambiguously identified as out of phase.

Fibre Channel: bit error is detected on four consecutive words.

1. Available with EtherBERT.

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 ‘0’¹

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

➤ Mismatch ‘1’¹

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

1. Available with EtherBERT.

Clock

➤ **LOC** (Loss Of Clock)

RX: The module 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 $\pm 6.6 \mu s$ after the previous pulse. **LOPPS-R** is only monitored once the DTS connection is established.

CPRI

Note: CPRI alarms/errors are only available for Framed L2.

Alarms

➤ **Link Down**

RX: Indicates that the start-up sequence is not in F (Operation) or G (Passive) link state.

➤ **LOF** (Loss Of Frame)

RX: The hyperframe alignment cannot be achieved or is lost.

➤ **R-LOS** (Remote - Loss Of Signal)

RX: Bit 3 of the Z.130.0 byte is set to 1.

➤ **R-LOF** (Remote - Loss Of Frame)

RX: Bit 4 of the Z.130.0 byte is set to 1.

➤ **RAI** (Remote Alarm Indication)

RX: Bit 1 of the Z.130.0 byte is set to 1.

➤ **SDI** (Service Access Point Defect Indication)

RX: Bit 2 of the Z.130.0 byte is set to 1.

Errors

➤ **FAS** (Frame Alignment Signal)

RX: Error detected in the start of hyperframe (byte different of K28.5 while not in LOF).

Test Results

Alarms/Errors

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.

Test Results

Alarms/Errors

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.

Test Results

Alarms/Errors

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.

Test Results

Alarms/Errors

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 10Gbit/s interface.

Errors

➤ **Symbol¹**

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

➤ **Idle¹**

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

➤ **False Carrier¹**

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 10/100Mbit/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 bytes² with an invalid FCS are received.

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

RX: Frames larger than 1518² bytes with a valid FCS.

➤ **Runt**

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

1. Available with Ethernet 100/100Mbit/s interface.

2. 1518 bytes for no VLAN tag, 1522 for one VLAN tag, 1526 for two VLAN tags, or 1530 for 3 VLAN tags.

Test Results

Alarms/Errors

➤ **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.

Fibre Channel

Alarms

➤ **Link Down**

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

➤ **Local Fault Detected (FC 10X)**

RX: Indicates that at least one of the following events is detected: **LOS**, **Loss of bit synchronization**, **Loss of Block synchronization**, **Link down**, or **High BER** (High BER is true when the bit error ratio $> 10^{-4}$ on a fixed 125 μs time period).

➤ **Local Fault Received (FC 10X)**

RX: Indicates that the received data path contains the Local Fault signal.

➤ **Remote Fault (FC 10X)**

RX: Indicates that a Remote Fault event is detected.

Test Results

Alarms/Errors

Error

➤ **Symbol** (FC 1X/2X/4X/8X)

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

➤ **Block** (FC 10X)

RX: The number of frames received with an errored block condition.

➤ **FCS** (Frame Check Sequence)

RX: Frames with an invalid FCS are received.

➤ **Oversize**

RX: The number of received FL-2 frames larger than 2148 bytes with a valid FCS.

➤ **Undersize**

RX: FL-2 frames smaller than 36 bytes with a valid FCS.

Interface

Alarms

► LOS (Loss Of Signal)

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

For CPRI Framed L2: Absence of an input signal or at least 16 8B/10B code violations occur in one hyperframe.

► Frequency

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**, or Fibre Channel **1X/2X/4X/8X/10X** 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
OTU1e	11049107143 ± 100 ppm
OTU2e	11095727848 ± 100 ppm
OTU1f	11270089286 ± 100 ppm
OTU2f	11317642405 ± 100 ppm

Test Results

Alarms/Errors

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.

For CPRI Framed L2: Invalid 10B code word received.

- **K30.7**, for CPRI Framed L2, code word /V/ with Error_Propagation ordered_set received.

- **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.

ISDN

Alarms

➤ **D-Ch Down** (D-Channel Down)

RX: The Data Link Layer is not in the multiple-frame established state.

Errors

➤ **D-Ch FCS** (D-Channel FCS)

RX: D-Channel Frames have an invalid FCS.

ODUx

Note: For OPUx alarms see page 317.

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 144.

Test Results

Alarms/Errors

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 144.

Test Results

Alarms/Errors

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, OTU2f, OTU1f, OTU2e, OTU1e, 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 TTl. This alarm is only available when the Enable TIM SAPI OTU-TIM and/or DAPI OTU-TIM check boxes are selected from page 283.

Test Results

Alarms/Errors

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 1 bit 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.

PTP

Alarms

➤ Loss Sync

RX: The Slave Clock does not receive packet timing signal messages (Sync, Follow Up, Delay Resp) within their expected arrival time for a duration exceeding the configured **Receipt Timeout** (refer to *PTSF Alarm Timeout/Threshold* on page 113).

➤ Loss Announce

RX: The Slave Clock does not receive Announce messages within their expected arrival time for a duration exceeding the configured **Receipt Timeout** (refer to *PTSF Alarm Timeout/Threshold* on page 113).

➤ Unusable

RX: Either the maximum Sync IPDV value or the maximum Delay Req IPDV value in the last second exceeds the configured **IPDV Threshold** (refer to *PTSF Alarm Timeout/Threshold* on page 113).

➤ QL Mismatch

RX: The received QL value does not match the Expected QL (refer to page 113 or page 372). The **QL Mismatch** alarm is only reported when at least one Announce message has already been received (**Last QL Received**) and that the **QL Mismatch Monitoring** check box is selected.

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.

S-OAM and MPLS-TP OAM

Alarms

Note: The following alarms are available when the **CC Function** check box is selected (refer to page 222).

➤ **Loss Continuity**

RX: No CCM frames with same or lower MEG/MD Level were received from the peer MEP within an interval equal to 3.5 times the configured CCM transmission period. The alarm is cleared when at least 3 CCM frames with same or lower MEG/MD Level from the peer MEP are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Mismerge**

RX: A CCM frame was received from the peer MEP with same MEG/MD Level but with incorrect MEG ID/MAID¹ value or format. The alarm is cleared when no CCM frames with same MEG/MD Level but with incorrect MEG ID/MAID¹ value or format are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Unexp MEG/MD Lvl** (Unexpected MEG/MD Level)

RX: A CCM frames was received from the peer MEP with lower MEG/MD Level. The alarm is cleared when no CCM frames with lower MEG/MD Level are received within an interval equal to 3.5 times the configured CCM transmission period.

1. The MAID, composed of a Domain ID and a Short MA Name strings, is incorrect if one or both strings are not as expected.

➤ **Unexp MEP** (Unexpected MEP)

RX: A CCM frame was received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct source MAC Address (corresponds to the peer MEP) but with unexpected MEP ID. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, correct source MAC Address (corresponds to the peer MEP) but with an unexpected MEP ID are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Unexp Period** (Unexpected Period)

RX: A CCM frame is received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with a period field value different than the one configured. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with incorrect period field value are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **RDI** (Remote Defect Indication)

RX: The RDI flag bit of a valid CCM frames is set to 1. A valid CCM frame has its source MAC address matching the Peer MEP MAC address, the destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹, and VLANs matching the unit port VLANs.

TX: The RDI flag bit of transmitted CCM frames is set to 1.

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Test Results

Alarms/Errors

Note: The following alarms are available with G.8113.1, Y.1731 and MEF modes.

➤ **AIS** (Alarm Indication Signal)

RX: A valid AIS frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹, VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the AIS transmission period indicated in the last received AIS frame, no AIS frames are received.

➤ **LCK** (Locked)

RX: An valid LCK frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹, VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the LCK transmission period indicated in the last received LCK frame, no LCK frames are received.

➤ **C-LOS** (Client Signal Fail - Loss Of Signal)

RX: A CSF frame is received with CSF type equal to **000**. The alarm is cleared when no CSF (C-LOS) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-LOS) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

TX: Generates a CSF frame with CSF type equal to **000**.

➤ **C-FDI** (Client Signal Fail - Forward Defect Indication)

RX: A CSF frame is received with CSF type equal to **001**. The alarm is cleared when no CSF (C-FDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-FDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

TX: Generates a CSF frame with CSF type equal to **001**.

➤ **C-RDI** (Client Signal Fail - Remote Defect Indication)

RX: A CSF frame is received with CSF type equal to **010**. The alarm is cleared when no CSF (C-RDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-RDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

TX: Generates a CSF frame with CSF type equal to **010**.

➤ **C-DCI** (Client Signal Fail - Defect Clear Indication)

TX: Generates a CSF frame with CSF type equal to **011**.

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 282).
- **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 Overhead (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 491 for more information. For OC-192, also refer to *REI-L Computation Method* on page 257.

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 166).

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 282).

- **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 166).
- **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.

Test Results

Alarms/Errors

- **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).

SyncE

Alarms

➤ **ESMC Loss**

RX: No ESMC valid information frames were received for more than 5 seconds.

➤ **QL Mismatch** (available when the **QL Mismatch Monitoring** check box is selected)

RX: The received QL value does not match the Expected QL (refer to page 272 or page 374).

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.

Test Results

Alarms/Errors

➤ **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.

Test Results

Alarms/Errors

- **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 282).
- 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 282).

- **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 166).

- **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 166).

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 $8 \leq N \leq 10$), 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.

Test Results

Alarms/Errors

➤ **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: BER

Type: Errors

Defect: Bit Error

Mode: Manual

Amount: 1

Inject Bit Error (1)

Selected Alarm/Error and status

Open/Close pop-up button

- **Layer:** Allows to select on which layer is the alarm/error to be generated. Choices depend on the test application and its interface.
- **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 290 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.

The following settings are only available with Carrier Ethernet OAM test application.

- **Address Type** defines the destination address type of the frame: **Unicast** or **Multicast** (default).
- **Priority**¹ allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 647 for more information.
- **Drop Eligible**¹ is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **MEG Level** (Y.1731 and MEF) is the Maintenance Entity Group Level configurable from **0** to **7** (default).
- **Period** determines the transmission period of frames: **1 s** (default) and **1 min**. Not available with C-DCI.
- **Amount**, only available with C-DCI alarm, is set to **1**.

Note: *The RDI alarm is available when the **CC Function** is enabled and is using the parameters from the CC Function (refer to page 222 for more information).*

1. Available when VLAN is enabled.(see *VLAN* on page 186)

Test Results

Alarms/Errors

➤ **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 144 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.

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% 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.

ISDN Logger

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

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

- **Sort By** selects the event sorting order: **ID/Time** (default), **Message Type**, **Dir.**, **Call Ref.**, **Ch#**, or **Call Type**.
- **Filter** selects the filtering criterion: **All** (default), **Layer 2**, or **Layer 3**.
- **Time Mode** selects the time representation mode. The **Time Mode** for the **ISDN Logger** and the **Alarms/Errors Logger** is coupled.
 - **Relative** displays the time relative to the beginning of the test or the last reset. The time format is Dd HH:MM:SS.
 - **Absolute** (default) displays the date and time the test has started. The time format depends upon the platform time which will be either **MM/DD HH:MM:SS** for 24 hours time format or **MM/DD HH:MM:SS <AM/PM>** for 12 hours time format.
- **Clear Logger** button clears the logger entries.
- **Message Type** column indicates the type of message which are classified into Layer 2 and Layer 3 messages as follows.

Layer 2 messages

- **SABME** (Set Asynchronous Balanced Mode Extended) command is used to place the addressed user side or network side into a modulo 128 multiple frame acknowledged operation.
- **UA** (Unnumbered Acknowledgment) response is used by a data link layer to acknowledge the receipt and acceptance of the mode-setting commands (SABME or DISC).
- **I** (Information) command is used to transfer, across a data link connection, sequentially numbered frames containing information fields provided by Layer 3. Used while multiple frame operation is in effect on point-to-point data link.

- **UI** (Unnumbered Information) command is used to send information.
- **DISC** (Disconnect) command is used to terminate the multiple frame operation.
- **DM** (Disconnect Mode) response is used to report that the data link layer is in a state such that multiple frame operation cannot be performed.
- **FRMR** (Frame Reject) response is used to report an error condition that is not recoverable by a retransmission.
- **XID** (Exchange Identification) command/response is used for connection management to exchange information.
- **RNR** (Receive Not Ready) command/response is supervisory frame used by a data link layer entity to indicate a busy condition or to ask the status of its peer data link layer entity.
- **REJ** (Reject) command/response supervisory frame is used by a data link layer entity to request retransmission or to ask the status of its peer data link layer entity.
- **RR** (Receive ready) supervisory frame is used by a data link layer entity to indicate it is ready to receive an I frame. Besides this, it is used to acknowledge previously received I frames numbered up to and including $N(R)-1$ and clear a busy condition that was indicated by the earlier transmission of an RNR frame by the same data. In addition to indicating the status of a data link layer entity, the RR command with the P bit set to 1 may be used by the data link layer entity to ask for the status of its peer data link layer entity.

Note: *The RR message is not included in the logger as it would fill the logger in a short period since this message is used to keep alive.*

Layer 3 messages

- **SETUP** message is sent by the calling user to the network and by the network to the called user to initiate call establishment.
- **CALL PROCEEDING** message is sent by the called user to the network or by the network to the calling user to indicate that requested call establishment has been initiated and no more call establishment information will be accepted.
- **ALERTING** message is sent by the called user to the network and by the network to the calling user to indicate that called user alerting has been initiated.
- **CONNECT** message is sent by the called user to the network and by the network to the calling user, to indicate call acceptance by the called user.
- **CONNECT ACK** message is sent by the network to the called user to indicate the user has been awarded the call.
- **DISCONNECT** message is sent by the user to request the network to clear an end-to-end connection or is sent by the network to indicate that the end-to-end connection is cleared.
- **RELEASE** message is sent by the user or the network to indicate that the equipment sending the message has disconnected the channel (if any) and intends to release the channel and the call reference. Thus the receiving equipment should release the channel and prepare to release the call reference after sending a RELEASE COMPLETE.
- **RELEASE COMPLETE** message is sent by the user or the network to indicate that the equipment sending the message has released the channel (if any) and call reference, the channel is available for reuse, and the receiving equipment shall release the call reference.

- **STATUS ENQUIRY** message is sent by the user or the network at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory.
- **STATUS** message sent is by the user or the network in response to a STATUS ENQUIRY message or at any time during a call to report certain error conditions.
- **PROGRESS** message is sent by the user or the network to indicate the progress of a call in the event of interworking or in relation with the provision of in-band information/patterns.
- **RESTART** message is sent by the user or network to request the recipient to restart (return to an idle condition) the indicated channel(s) or interface.
- **RESTART ACK** message is sent to acknowledge the receipt of the RESTART message and to indicate that the requested restart is complete.
- **Event XXX - Additional Information** displays additional information on the selected event having the icon . Additional information is available for six message types.

Message Type	Additional information
DISCONNECT	Cause Value, Cause Definition, Location
RELEASE	
RELEASE COMPLETE	
PROGRESS	Progress Desc. No., Progress Description, Location
SETUP	Calling number, Called number
STATUS	Cause Value, Cause Definition, Location, Call State

Test Results

ISDN Logger

- **Cause Value** reports the reason why a call has been terminated, or a problem with a received message. (7 bits).
Supported Cause Value range: 1 to 127.
- **Cause Definition** is associated with each Cause Value but the Cause Definition is not received or transmitted with a message.
Longest Cause Definition: 86 characters.
- **Location** reports from where the action is initiated. (4 bits)
Longest **Location** definition: 45 characters.
- **Progress Desc. No.** indicates the number associated to the Progress Description.
- **Progress Description** indicates the progress of a call in the event of inter-working or in relation with the provision of in-band information/patterns.
- **Calling Number** indicates the number of the calling party.
- **Called Number** indicates the number of the called party.
- **Call State** indicates the state of the actual call.

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 487 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 495 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 166.

Expected: Select the expected C2 byte from the list. Refer to C2 on page 495 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 498 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 166.

Expected: Select the expected V5 byte from the list. Refer to V5 on page 498 for more information.

Link OAM

From the **Test** menu, tap **Results**, and the **Link OAM** tab.

Remote MAC Address

Indicates the remote OAM link partner MAC address.

Remote OAM Information

- **OAM Version** indicates the protocol version supported by the DTE.
- **Revision** indicates the revision of the Information TLV.
- **Multiplexer Action** reports the Multiplexer Action:
 - Forward** indicates that the device is forwarding non-OAMPDUs to the lower sublayer.
 - Discard** indicates that the device is discarding non-OAMPDUs.
- **Parser Action** reports the Parser Action:
 - Forward** indicates that the device is forwarding non-OAMPDUs to the higher sublayer.
 - Loopback** indicates that the device is looping back non-OAMPDUs to the lower sublayer.
 - Discard** indicates that the device is discarding non-OAMPDUs.
- **OAM Mode** reports the OAM mode:
 - Active** indicates that the DTE is configured in **Active** mode.
 - Passive** indicates that the DTE is configured in **Passive** mode.
- **OUI** reports the 24-bit IEEE Organizationally Unique Identifier field identifying the vendor.
- **Maximum OAMPDU Size** reports the maximum OAMPDU size in bytes, supported by the DTE.

- **Vendor Specific Information** reports the 32-bit **Vendor Specific Information** field identifying the vendor's product model and version.
- **Unidirectional** reports unidirectional support capability:
 - Supported** indicates that the DTE is capable of sending OAMPDUs when the receive path is non-operational.
 - Unsupported** indicates that the DTE is not capable of sending OAMPDUs when the receive path is non-operational.
- **Remote Loopback** reports OAM remote loopback support capability:
 - Supported** indicates that the DTE is capable of OAM remote loopback mode.
 - Unsupported** indicates that the DTE is not capable of OAM remote loopback mode.
- **Variable Retrieval** reports variable retrieval capability:
 - Supported** indicates that the DTE supports sending Variable Response OAMPDUs.
 - Unsupported** indicates that the DTE does not support sending Variable Response OAMPDUs.
- **Link Events** reports link event capability:
 - Supported** indicates that the DTE supports interpreting Link Events.
 - Unsupported** indicates that the DTE does not support interpreting Link Events.

Remote Error Event Statistics

- **Date Stamp**¹ indicates the date the last Event Notification OAMPDU frame was received.
- **Time Stamp**¹ indicates the time the last Event Notification OAMPDU event was received by the test equipment.
- **Window**

Symbol Period	Errored symbol Window in second
Frame	Errored frame event Window in second
Frame Period	Errored frame period Window - duration period in number of 64 bytes frames
Frame Seconds	Errored frame seconds summary Window

- **Threshold**

Symbol Period	Errored symbol threshold in second
Frame	Errored frame event threshold in second
Frame Period	Errored frame period threshold in second
Frame Seconds	Errored frame seconds summary threshold in second

- **Error Count**

Symbol Period	The number of symbol errors in Window
Frame	The number of frame event errors in Window
Frame Period	The number of frame period errors in Window
Frame Seconds	The number of frame seconds summary errors in Window

1. **Date Stamp** and **Time Stamp** parameters differ from the 802.3 standard definitions.

➤ **Error Running Total**

Symbol Period	The number of symbol errors since the last reset
Frame	The number of frame event errors since the last reset
Frame Period	The number of frame period errors since the last reset
Frame Seconds	The number of frame seconds summary errors since the last reset

➤ **Event Running Total**

Symbol Period	The number of symbol events since the last reset
Frame	The number of frame events since the last reset
Frame Period	The number of frame period events since the last reset
Frame Seconds	The number of frame seconds events since the last reset

Inject Errored Frames

Generates 5 consecutive packets with FCS errors within a 1 second period.

Logger and Alarms/Errors Logger

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

From the **Test** menu, tap **Results**, and the **Logger** or **Alarms/Errors Logger** tab.

Sort By

- **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 platform time settings.

When the platform is configured in 24 hours time format, the time format is MM/DD HH:MM:SS.

When the platform is configured in 12 hours time format, the time format is MM/DD HH:MM:SS <AM or PM>.

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 **Through Mode**, the **Traffic**, and the **MPLS** tab.

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 **RX Pattern Analysis** check box is selected (refer to BERT on page 115).

Near-End

- **EFS** (Error Free Second) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the number of seconds within which no error occurred.
- **EC** (Error Count) (**G.821** only): Gives the number of bit errors.
- **EB** (Errored Block) (**G.826**, **G.828**, and **G.829**): Gives the count of blocks in which one or more bits are in error.
- **ES** (Errored Second)

For **G.821**, and **M.2100 OOSM**: Gives the number of seconds within which one or more bit error occurred, or during which Loss Of Signal (LOS) or AIS is detected.

For **G.826**, **G.828**, **G.829**, **M.2100 ISM**, and **M.2101**: Gives the number of seconds within which one or more anomalies (FAS (DSn/PDH), EB, etc.) occurred, or at least one defect occurred.

- **SES** (Severely Errored Second)

For **G.821**, and **M.2100 OOSM**: Gives the number of seconds within which a bit error ratio is $\geq 10^{-3}$, or during which one defect (LOS/AIS) is detected.

For **G.826**, **G.828**, **G.829** and **M.2101**: Gives the number of seconds within which anomalies (FAS (DSn/PDH), EB, etc.) are $\geq X\%$ or at least one defect occurred. $X = 30\%$ 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 $\geq Y$ or at least one defect occurred. Y depends on the type of DS_n/PDH signal as described in the following table.

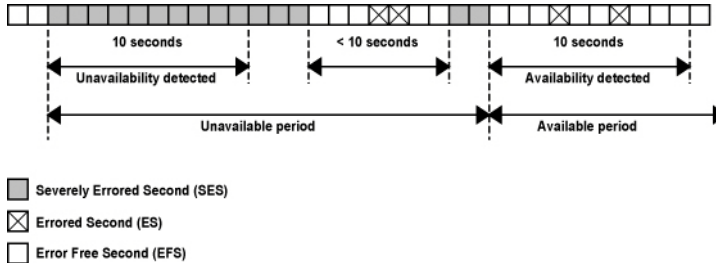
Signal	SES Threshold
DS1 (SF)	8 frame bit errors (Near-End)
DS1 (ESF)	320 CRC-6 block errors (Near-End) 320 CRC-6 block errors (Far-End, if FDL enabled)
E1 (Framed without CRC-4)	28 frame bit errors (Near-End)
E1 (Framed with CRC-4)	805 CRC-4 block errors (Near-End) 805 E-bit errors (Far-End)
DS3 (M13)	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.

Test Results

Performance Monitoring

- **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.

$$\text{ESR} = \text{ES} \div \text{AS}$$

- **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.

$$\text{SESR} = \text{SES} \div \text{AS}$$

- **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 $\geq X\%$ or at least one defect occurred. $X = 30\%$ 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%

Test Results

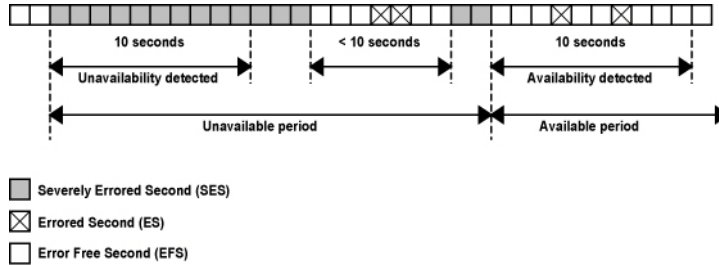
Performance Monitoring

For M.2100 ISM: Gives the count of the seconds within which anomalies (frame bit errors, CRC block errors, etc.) are $\geq Y$ or at least one defect occurred. Y depends on the type of DS_n/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.

$$\text{ESR} = \text{ES} \div \text{AS}$$

- **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.

$$\text{SESR} = \text{SES} \div \text{AS}$$

- **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.

PTP Stats

From the **Test** menu, tap **Results**, and the **PTP Stats** tab.

TX/RX PTP Message Count/Rate

Gives the transmitted/received count and average rate for each PTP message, and the total count for all messages.

TX	RX
Signaling Announce Req ^a	Signaling Announce Grant ^a
Signaling Sync Req ^a	Signaling Sync Grant ^a
Signaling Delay Resp Req ^a	Signaling Delay Resp Grant ^a
Delay Req	Delay Resp
	Sync
	Follow Up
	Announce

- a. The rate value corresponds to an average rate because these messages are only transmitted/received when negotiating or renewing the lease with the Grand Master clock. If the connection with the Grand Master Clock was already established when the test is started, the 0 value is displayed. However, the value becomes available with the next lease renewal which happens every 150 seconds.

Note: *In the case where messages are lost while the Receipt Timeout is set to a large value (slow communication), the last valid recorded rate value will be preceded with “<” to indicate that the reception rate is not stable. This applies to **Delay Resp**, **Announce**, **Sync**, and **Follow UP**.*

Note: *When the rate is above 150 message/s, “> 150” is displayed.*

IPDV

Inter Packet Delay Variation (IPDV) is available for **Sync** and **Delay Req** messages and is measured for all valid in-sequence messages (see *Delay Measurement* on page 399). **Current**, **Average**, **Minimum**, **Maximum**, and **Standard Deviation** measurement values are displayed. The **Standard Deviation** is the measure of the dispersion of messages from its mean. When a value is below 1μ second, “< **1 μ s**” is displayed. The pass/fail verdict is also displayed beside the maximum value when enabled.

Test Results

Quality Level (1588 PTP)

The quality level characterizes the clock quality in terms of network synchronization.

From the **Test** menu, tap **Results**, and the **Quality Level** tab.

- **Last QL Received** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.
- **Last Change** indicates the date and time of the Last QL has changed.
- **QL Mismatch Monitoring** when selected (default) enables the Quality Level mismatch monitoring.
- **Expected QL** allows the selection of the Expected Quality Level value. Available when the **QL Mismatch Monitoring** check box is selected.

Quality Level value	PTP Clock Class	Description
QL-PRS (default)	80	Primary Reference Source Traceable (G.811)
QL-STU/UNK	82	Synchronized - Traceability Unknown
QL-PRC	84	Primary Reference Clock Traceable (G.811)
QL-ST2	86	Traceable to Stratum 2 (G.812 Type II)
QL-INV3	88	Quality Level Invalid 3
QL-SSU-A/TNC	90	Type I or V slave clock (G.812) Traceable to Transit Node Clock (G.812 Type V)
QL-INV5	92	Quality Level Invalid 5
QL-INV6	94	Quality Level Invalid 6
QL-SSU-B	96	Type VI slave clock (G.812)
QL-INV9	98	Quality Level Invalid 9
QL-ST3E	100	Traceable to Stratum 3E (G.812 Type III)
QL-EEC2/ST3	102	Ethernet Equipment Clock Option 2 Traceable to Stratum 3 (G.812 Type IV)

Quality Level value	PTP Clock Class	Description
QL-EEC1/SEC	104	Ethernet Equipment Clock Option 1 Synchronous Equipment Clock (G.813 or G.8262, Option 1)
QL-SMC	106	Traceable to SONET Minimum Clock (G.813 or G.8262, Option 2)
QL-PROV	108	Provisionable by the Network Operator (PNO)
QL-DNU/DUS	110	Do Not Use Do Not Use for Synchronization

- **Count** gives the count for each QL code (PTP Clock Class) included in the announce message received.
- **Other** includes all clock class codes (0 to 255) included in the announce message received other than the QL codes (see table above). Refer to page 398 for the complete list.
- **Total** indicates the total count of all QL code messages received.

Quality Level (SyncE)

The quality level characterizes the clock quality in terms of network synchronization.

From the **Test** menu, tap **Results**, and the **Quality Level** tab.

- **Generated QL** indicates the Quality Level value that is generated.
Last Change indicates the date and time of the Generated Quality Level value has changed. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Last Change** is not available.
- **Last QL Received** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.
Last Change indicates the date and time of the Last QL Received has changed.
- **QL Mismatch Monitoring** when selected (default), enables the Quality Level mismatch monitoring.
- **Expected QL** allows the selection of the Expected Quality Level value. Available when the **QL Mismatch Monitoring** check box is selected.

Quality Level value	SSM	Description
QL-STU/UNK	0	Synchronized - Traceability Unknown
QL-PRS	1	Primary Reference Source Traceable (G.811)
QL-PRC	2	Primary Reference Clock Traceable (G.811)
QL-INV3	3	Quality Level Invalid 3
QL-SSU-A/TNC	4	Type I or V slave clock (G.812) Traceable to Transit Node Clock (G.812 Type V)
QL-INV5	5	Quality Level Invalid 5
QL-INV6	6	Quality Level Invalid 6
QL-ST2	7	Traceable to Stratum 2 (G.812 Type II)

Quality Level value	SSM	Description
QL-SSU-B	8	Type VI slave clock (G.812)
QL-INV9	9	Quality Level Invalid 9
QL-EEC2/ST3 (default)	10	Ethernet Equipment Clock Option 2 Traceable to Stratum 3 (G.812 Type IV)
QL-EEC1/SEC	11	Ethernet Equipment Clock Option 1 Synchronous Equipment Clock (G.813 or G.8262, Option 1)
QL-SMC	12	Traceable to SONET Minimum Clock (G.813 or G.8262, Option 2)
QL-ST3E	13	Traceable to Stratum 3E (G.812 Type III)
QL-PROV	14	Provisionable by the Network Operator (PNO)
QL-DNU/DUS	15	Do Not Use Do Not Use for Synchronization

- **QL Mismatch Frame Count** gives the total count of information and/or event frames received not matching the expected Quality Level. Only available when the **QL Mismatch Monitoring** check box is selected.

Test Results

Quality Level (SyncE)

➤ TX

- **Information** gives the count of information frames generated for each Quality Level as well as the total of all Quality Level values. For 1GE Electrical interface using **Slave** as **Master-Slave Clock**, only the count for **QL-DNU/DUS** is reported.
- **Event** gives the count of event frames generated for each Quality Level as well as the total of all Quality Level values. Not available with 1GE Electrical using **Slave** as **Master-Slave Clock**.

➤ RX

- **Information** gives the count of information frames received for each Quality Level as well as the total of all Quality Level values.
- **Event** gives the count of event frames received for each Quality Level as well as the total of all Quality Level values.

S-OAM and MPLS-TP OAM

From the **Test** menu, tap **Results**, and the **S-OAM** or **MPLS-TP OAM** tab.

Loopback

- **Status** displays the status of the test function (refer to page 432).
- **TX LBM** indicates the count of transmitted LBM frames.
- **RX LBR** indicates the count of valid LBR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address, destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.

- **LBR Timeout**

For connectivity verification (Continuous check box cleared), indicates the count of LBR Timeout event which occurs if a reply (LBR frame with matching Transaction ID) to a transmitted LBM frame is not received within 5 seconds.

For diagnostic test (Continuous check box selected), indicates the difference between the transmitted LBM frames and the received LBR frames.

- **Invalid LBR**

For connectivity verification (Continuous check box cleared), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level or with an unexpected Transaction ID.

For diagnostic test (Continuous check box is selected), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level.

Test Results

S-OAM and MPLS-TP OAM

- **Invalid Payload** indicates the count of received LBR frames having either a TLV type different than the one transmitted, Bit error or wrong data value detected in the data payload of a Data TLV, Bit error, Pattern Loss, or Pattern Type mismatch of a Test TLV, or CRC32 error.
- **Successful** indicates the count of received LBR frames having no errors.
- **Failed** indicates the count of LBR frames declared as invalid.

Test

- **Status** displays the status of the test function (refer to page 432).
- **TX TST** indicates the count of transmitted TST frames.
- **RX TST** indicates the count of valid TST frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid TST** indicates the count of TST frames received from the peer MEP with incorrect MEG/MD level.
- **Invalid Payload** indicates the count of received TST frames having either an unsupported pattern type, or bit error / pattern loss detected in the payload.
- **Successful** indicates the count of received TST frames having no errors.
- **Failed** indicates the count of TST frames declared as invalid.

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Frame Delay

- **Status** displays the status of the test function (refer to page 432).
- **TX DMM** indicates the count of transmitted DMM frames.
- **RX DMR** indicates the count of valid DMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration..
- **Invalid DMR** indicates the count of received DMR frames from the peer MEP having an incorrect MEG/MD Level, an incorrect Test ID (when applicable), or with a valid MEG/MD Level and valid Test ID (when applicable) but with a Frame Delay outside the 0.001 to 8000.000 ms range.
- **Delay (ms): Current** indicates the average of frame delay measured in the last second. **Minimum**, **Maximum**, and **Average** indicates respectively the minimum, maximum, and average frame delays measured since the beginning of the test.
- **Successful** indicates the count of received DMR frames having no errors.
- **Failed** indicates the count of DMR frames declared as invalid.

Test Results

S-OAM and MPLS-TP OAM

Frame Loss

- **Status** displays the status of the test function (refer to page 432).
- **TX LMM** indicates the count of transmitted LMM frames.
- **RX LMR** indicates the count of valid LMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid LMR** indicates the count of LMR frames received from the peer MEP with incorrect MEG/MD level.
- **Frame Loss** is calculated (count and %) for both Near-End and Far-End over all valid LMR frames received.
- **Successful** indicates the count of received LMR frames having no errors.
- **Failed** indicates the count of LMR frames declared as invalid.

Synthetic Loss¹

- **Status** displays the status of the test function (refer to page 432).
- **TX SLM** indicates the count of transmitted SLM frames.
- **RX SLR** indicates the count of valid SLR frames received. A valid frame has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs.
- **Invalid SLR** indicates the count of SLR frames received from the peer MEP with incorrect MEG/MD level, incorrect source MEP ID, or incorrect Test ID.
- **Synthetic Loss** is calculated (count and %) for both Near-End and Far-End over all frames received and is updated after each Synthetic Loss measurement period (after receiving the defined **Frame Count**, refer to page 227).
- **Successful** indicates the count of received SLR frames having no errors.
- **Failed** indicates the count of SLR frames declared as invalid.

1. Available with Ethernet OAM.

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**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **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 404 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 404 for more information on **Frame Loss**, **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**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **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 404 for more information on **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, and **Max RX Rate**.

Test Results

Service Configuration - Ramp

- **Informational** parameters are for information purpose only, they are not included in the test pass/fail verdict. See *Summary (EtherSAM)* on page 404 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** and **Max Latency/Max Round-Trip Latency** SLA parameters are displayed. Refer to *Services - Profile* on page 231 for more information. For **Dual Test Set**, parameters are displayed for both local to remote (**L->R**), remote to local (**R->L**) directions.

Metrics

Current, **Average**, **Minimum**, **Maximum**, and **Estimate (Jitter)** measured values for each metric are reported. **Direction**, available with **Dual Test Set** indicates results from local to remote (**L->R**) and remote to local (**R->L**), and Round-Trip for Latency when in Round-Trip Latency Measurement Mode (see *Global Options* on page 137). For **Dual Test Set**, results for remote to local are obtained at the end of each step.

- **RX Rate** indicates the measured utilization throughput.
- **Jitter (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.

Test Results

Service Performance

Note: *Delay variation measurements smaller than 15 μ s 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**).

- **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**).

Streams - Frame Loss / Out-of-Sequence

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

- **Stream:** Indicates the stream identification number.
- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 270).
- **Frame Loss:** See *QoS Metrics* on page 323.
- **Out-Of-Sequence:** See *QoS Metrics* on page 323.

Streams - Jitter

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

- **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 μ s 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 270).

Streams - Latency

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

- **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 μ s 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 270).

Streams - Throughput

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

- **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 263 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 270).

Summary

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

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

- **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 has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Interface

Note: Only available with CPRI/OBSAI Unframed test application.

➤ **Alarms**

LOS indicates that there is no input signal.

➤ **Errors**

CV (Code Violation) indicates that invalid 10B code word are received.

BER and Multi-Pattern BER

Note: See BER on page 294 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 enabled¹.
- **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 115 or *EtherBERT* and *EtherBERT*, *FC BERT*, *BERT (CPRI)*, and *Unframed BERT* on page 126.

Test Results

Summary

- **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 selection¹.

When the verdict is enabled¹, 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 enabled¹.

- **Bit/Pattern Error, Amount/Rate, and Inject:** The bit/pattern error injection and settings are coupled with the *Inject Button* on page 344. For Transport test applications, not available in Through modes or with Multi-Pattern.

Service Disruption

Note: *Service Disruption results are only available with Transport, CPRI, and EtherBERT test applications when **Disruption Monitoring** is enabled (refer to BERT on page 115 or EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT on page 126). 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 119).

Traffic / Traffic Ethernet

Note: The **Traffic** statistics are available for Smart Loopback and Through Mode test applications. See Traffic - Ethernet on page 445 for more information.

CPRI

Note: Available with CPRI Framed L2.

- **Sequence** indicates the last Sequence State parameter: **Standby (A)**, **L1 Sync (B)**, **Protocol (C)**, **L2 C&M (D)**, **Vendor (E)**, **Operation (F)**, and **Passive (G)**. The pass/fail verdict is also displayed when enabled.
- **Frame Sync** indicates that the startup sequence synchronization status as per L1 Sync Status parameter: active (green) or inactive (red).
- **Protocol** indicates either the last received (**Version 1** or **Version 2**) or negotiated (**Auto**) protocol version. A red background indicates a Protocol version mismatch.
- **C&M** indicates either the received (HDLC or Ethernet) or negotiated (Auto) C&M for Ethernet subchannel and HDLC rates in Mbit/s. A red background indicates either a C&M type mismatch or HDLC Rate/Ethernet subchannel mismatch. An arrow is displayed indicating which C&M Channel, Ethernet or HDLC, is selected following the negotiation process.
- **Code Word (CW)** indicates the transmitted and received Code Word count.
- **Hyperframe** indicates the transmitted and received hyperframe count.
- **L1 Reset**, available when **Remote Radio Head** emulation mode is selected, indicates the number of times a request to reset the RRH interface was received.

RX Frequency

Note: *RX Frequency is available for Through Mode test application on both ports (**Port 1** and **Port 2**).*

- **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.

Test Results

Summary (1588 PTP)

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

- **Test Status** displays the current status of the 1588 PTP test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled (see *Pass/Fail Verdict* on page 114).

Test Status	Description
--	Idle state, the test is not running or results are not available.
In Progress	The test is running.
Completed	The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
Aborted	The test is interrupted; stopped before the set timer. [Message type] Request Denied , Session Canceled , or No Reply is displayed next to Aborted when applicable.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

➤ **Negotiation Status**

The status of the PTP Negotiation is displayed while in Unicast negotiation.

Negotiation Status	Description	Background Color ^a
Request Granted	All the Signaling request types have been granted.	Green
[Message type] Request Denied	The Signaling grant message has not been granted.	Red
Session Canceled	The Grand Master has canceled the Unicast session.	Red
No Reply	No message is received from the Grand Master following transmission of 3 Signaling requests for a message type. Make sure that both IP address and Domain (refer to <i>1588 PTP</i> on page 110) of the Grand Master Clock are valid as well as the IP address of the unit's port used to connect on the network (refer to <i>Network</i> on page 182).	Red
Pending	Unicast negotiation has started and no message has been received from the Grand Master.	Gray
Inactive	The Unicast negotiation is not active.	Gray

- a. The gray background color is also used for a Link Down.

Test Results

Summary (1588 PTP)

➤ GM Info

Note: Only available when Grand Master clock information is available.

The Grand Master Information window displays the decoded clock information.

- **Identity** report the 8-byte identification code of the Grand Master Clock.
- **Clock Class** reports the description and code of the Grand Master Clock Class.

Code	Description
0-5, 8-12, 15-51, 53-57, 59-67, 123-132, 171-186, 188-192, 194-215, 233-247, 249-254	Reserved
6	Sync to primary reference
7, 14	Holdover
13	Sync to application-specific reference
52, 58, 187, 193	Degraded
68 to 79, 81-109 (odd values), 11-122, 133-170, 216-232	Alternate PTP profiles
80-110 (even values) ^a	Quality Level (QL-xxx ^a)
248	Default
255	Slave only

a. Refer to QL table on page 372 for the list of Quality Level values that will be used as the description.

- **Clock Mode** reports the description of the Grand Master Clock Mode: **Two-step** or **One-step**.

- **Start Time** indicates the time the test was started.

Delay Measurement

- **Sync IPDV** meter displays the average of the inter packet delay variation of consecutive Sync messages in the last second. The value and the pass/fail verdict is also displayed when enabled.
- **Delay Req IPDV** meter displays the average of the inter packet delay variation of consecutive Delay Req messages in the last second. The value and the pass/fail verdict is also displayed when enabled.

Note: When a value is below 1 μ second, “< 1 μ s” is displayed.

Note: When the Pass/Fail verdict is enabled, the green region is delimited from 0 to the IPDV Threshold (refer to PTSF Alarm Timeout/Threshold on page 113) corresponding to a **PASS** verdict. The red region beyond the threshold corresponds to a **FAIL** verdict. There is neither green nor red region when the Pass/Fail verdict is disabled.

Quality Level

- **Last QL Received** indicates the last Quality Level received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.
- **Last Change** indicates the date and time of the Last QL change.

Total PTP Messages

Gives respectively the total count of transmitted (TX) and received (RX) PTP messages.

Test Results

Summary (Cable Test)

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 has been 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

Test Results

Summary (Cable Test)

- **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 FTB-700G/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 FTB-700G/800 Series and the far end equipment. For example, two crossed pair cables end to end used between the FTB-700G/800 Series and a far end equipment may give a straight pair (MDI) wire map result.

MDI	Straight pair.
MDIX	Crossed pair.
MDI (-)	For 1Gbit/s, straight pair with swapped wires within pair.
MDIX (-)	For 1Gbit/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 1Gbit/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 614 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 has been 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**, 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**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
 - **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.

Test Results

Summary (EtherSAM)

Committed

- **Frame Loss** indicates the percentage of frames that are lost. The reported value is the maximum percentage of Frame Loss from all burst sequences and ramp steps excluding the **CIR+EIR**, **EBS**, and **Traffic Policing** steps.
- **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 137).
- **Avg RX Rate**, for **Service Performance Test**, indicates the measured average utilization throughput.

Excess

- Max RX Rate**, for **Service Configuration Test**, indicates the measured maximum utilization throughput.
- **VLAN Preservation** indicates if any VLAN mismatch occurred during any step of a Ramp or Burst tests as follows:
 - Grey: Undefined
 - Green: No Mismatch detected
 - Red: Mismatch detected

Summary (FC BERT)

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

- **Test 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.

Once the test is stopped, the test pass/fail verdict is displayed next to the **Status** field when enabled. The verdict is Pass when all verdicts are Pass, the verdict is Fail as soon as one of the verdict is Fail. Refer to *Bit/Pattern Error* on page 127 and *Latency Tag Insertion* on page 129 for more information.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Test Results

Summary (FC BERT)

BER

Note: See BER on page 294 for a description of each alarm/error.

- **BER Threshold** is available when **Pass/Fail Verdict** is enabled (refer to page 127).
- **Bit Error Rate/Count** graphically displays a meter representing either the bit error rate or the bit error count depending on the Pass/Fail Verdict selection (refer to page 127).

When the verdict is enabled, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit error rate is displayed in blue.

The arrow pointer indicates the current received bit error rate/count.

The Pass/Fail verdict is displayed just on top of the meter when enabled.

- **Bit Error and Rate/Amount**
 - **Manual** allows to enter the amount of manual error to be generated: **1** (default) through **50**.
 - **Rate** allows the selection of the injection rate for the selected error.
 - **Max Rate** generates the selected error to its theoretical maximum rate.
- **Inject** generates, if the test is running, the amount of bit error configured.

Round-Trip Latency

- **Round Trip Latency (ms)** is measured for each local and remote port.
Current, **Average**, **Minimum**, and **Maximum** indicates respectively the current, average, minimum, and the maximum round trip latency from the local to the remote port in the last one second. The pass/fail verdict is also displayed for the maximum round trip latency.
Samples indicates the number of samples used for the round trip latency.
- **Estimated BB_Credit** indicates the estimated number of packets that can be transmitted on the optical line at the same time.
- **Round-Trip Latency Threshold (ms)** sets the round trip latency threshold: **0.015** to **8000 ms** (default is **15**). This setting is only available when both **Latency Tags** and **Pass/Fail Verdict** check boxes are selected (refer to *Latency Tag Insertion* on page 129).

Traffic

- **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
- **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including frame with error and aborted frames) in frame per second.
- **Byte Count** indicates the total number of transmitted/received bytes including the frame delimiters.
- **Frame Count** indicates the total number of transmitted/received frames including link service control frames.

Test Results

Summary (iSAM)

Summary (iSAM)

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

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted.
- **Configuration/Performance Tests** and **RFC 6349 Test** buttons are used to respectively display summary results for **Service Configuration Test** and **Service Performance Test**, or **RFC 6349 Test** when results don't fit on one page.

Service Configuration Test and Service Performance Test

- The actual test status is displayed 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), Unresolved addresses, Stopped

For **Dual Test Set** the following values are reported for both local to remote (**L->R**) and remote to local (**R->L**).

- **Service** indicates the service's number and name.
The pass/fail verdict icon is displayed next to the service name indicating if the service complies to the configured SLA parameters.
- **TX CIR** (Mbit/s) indicates the transmitted Committed Information Rate.
- **FD (ms) (RTT¹) (Latency)** indicates the maximum measured round-trip latency (Frame Delay). The pass/fail verdict is also displayed.
- **IFDV (ms) (Jitter)** indicates the maximum measured Inter Frame Delay Variation. The pass/fail verdict is also displayed.
- **FLR (%) (Frame Loss)** indicates the maximum percentage of frames that are lost (Frame Loss Ratio) from the CIR step. The pass/fail verdict is also displayed.
- **RX Rate (Mbit/s)** indicates either the measured maximum utilization throughput for **Service Configuration Test** or the measured average utilization throughput for **Service Performance Test**. The pass/fail verdict is also displayed.
- **Total RX Rate**, available for **Service Performance Test**, indicates the average utilization throughput for all services (both directions are displayed for **Dual Test Set**).

1. RTT is only displayed for Dual Test Set.

Test Results

Summary (iSAM)

RFC 6349 Test

- **Test Status** indicates the actual test status as follows.

Test Status	Description
"--"	Test has not started.
In Progress	The test is running.
Completed, <Verdict>	Test has completed and the test pass/fail verdict is displayed when enabled. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU).
Aborted, <reason>	Test has been aborted either manually (Stop) or automatically from an alarm and the reason is displayed as follows: Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Invalid Configuration, Unresolved addresses, Invalid MTU, User Stopped

- **MTU (bytes)** is the validated Maximum Transfer Unit.
- **Minimum RTT (ms)** is the minimum time between the first bit of a segment sent and the last bit of the corresponding acknowledge.
- **TCP Throughput**
 - **Service** indicates the service's number and name. The pass/fail verdict icon is displayed next to the service name. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU).
 - **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
 - **Window** indicates the total Max Window (1 KiB = 1024 bytes) followed by the number of connections and KiB per connection in parenthesis as follows: (n conn.@ n KiB).

- **Ideal L4** indicates the ideal TCP throughput metric.
- **Actual L4** indicates the average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to the this metric. A value greater or equal to the defined threshold gives a pass verdict.
- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.
- **Buffer Delay (%)** indicates the Buffer Delay percentage metric which represents the increase in RTT during a TCP Throughput test versus the **Minimum RTT**.

Summary (ISDN PRI)

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

- **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.

The Pass/Fail verdict is displayed next to the **Status** field when enabled (see ***Call Establishment/Termination Pass/Fail Verdict*** on page 162).

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Channel Buttons

The channel buttons allow the selection of a channel for which the information is displayed. The selected channel has its button highlighted with a blue border.

The top left corner of each button indicates the channel number on a background color as follows. The color coding remains when the test is stopped or when the call ends.

Channel Number Background Color	Description
Yellow	At least one alarm/error occurred during a data call.
Red	An alarm/error occurred in the last second of a data call.
Green	No alarm/error has occurred during a data call.

The channel buttons also used background colors as follows:

Button	Description
Red	An alarm/error occurred in the last second of a data call. The Status Bit Error or Pattern is displayed.
Green	No alarm/error has occurred in the last second of a data call. The status No Alarm is displayed.
Blue	Either a Speech or 3.1 kHz call is established, any call type is terminated, or the test is stopped.
(Greyed Out) Disabled	When a channel button is disabled, it implies that no call was established on the channel after the test started.

Test Results

Summary (ISDN PRI)

The Pass/Fail verdict icon is displayed on the top right corner of a channel button as follows.

Verdict	Call	Description
Pass	Data	BER result value meets the configured threshold criterion and the call establishment/termination succeeded.
	Speech or 3.1 kHz	The call establishment/termination succeeded.
Fail	Data	BER result value does not meet the configured threshold criterion and/or the call establishment/termination failed.
	Speech or 3.1 kHz	The call establishment/termination failed.

Channel

This section at the right of the channel buttons, displays information on the selected channel.

- **Call Reference** is a unique value assigned to an established call.
- The icon next to **Call Reference** indicates whether the call is incoming or outgoing followed by the duration of the call. An incoming call has an arrow pointing towards the receiver whereas, for an outgoing call the arrow points outwards.
- The Call Timer next to the incoming/outgoing call icon displays the duration of a call.
- **Calling Number** indicates the number of the calling party.
- **Called Number** indicates the number of the called party.
- **BERT**
 - **Alarms**, see *BER* on page 294 for more information.
 - **Errors**, see *BER* on page 294 for more information.

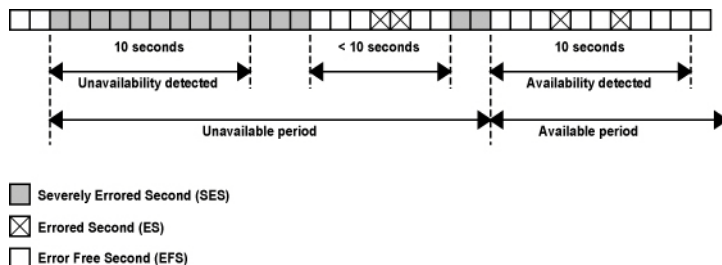
► **Performance**

EFS (Error Free Second) gives the number of seconds within which no error occurred.

ES (Errored Second) gives the number of seconds in which one or more bits are in error.

SES (Severely Errored Second) gives the number of seconds in which bit error ratio is $\geq 1 \times 10^{-3}$.

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.



► **Bit Error Rate/Count** graphically displays a meter representing either the bit error rate or the bit error count depending on the Pass/Fail Verdict selection (refer to *ISDN PRI - ISDN Settings* on page 164).

When the verdict is enabled, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit error rate is displayed in blue.

Test Results

Summary (ISDN PRI)

Statistics

- **Active Call** column displays the quantity of active calls.

Active Call	Description
Data	Number of active Data calls
Speech	Number of active Speech calls
3.1 kHz	Number of active 3.1 kHz calls
Total	Total number of active calls

- **Total Calls Count** column displays statistics of **Connected**, **Cleared**, **Failed/Rej.**, and **Placed** calls.

Total Calls Count	Description
Connected	Number of calls that have been connected.
Cleared	Number of calls that have been cleared.
Failed/Rej.	Number of calls that failed or have been remotely rejected.
Placed	Number of outgoing calls.

- **Frequency** column displays the following information:

RX (MHz) indicates the monitored frequency of the input signal. The following table lists the supported frequency monitoring range:

Interface	Standard Rate Specification
DS1	1544000 ± 140 ppm
E1	2048000 ± 100 ppm

Offset (ppm) indicates the offset between the standard rate specification and the rate of the input signal.

Max (+) Offset (ppm) indicates the offset between the standard rate specification and the largest rate recorded from the received signal.

Max (-) Offset (ppm) indicates the offset between the standard rate specification and the smallest rate recorded from the received signal.

Note: *Values inside the standard range are presented on a green background while the value outside are presented on a red background.*

Test Results

Summary (Link OAM)

Summary (Link OAM)

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

- **Test Status** displays the current status of the Link OAM test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 273).

Test Status	Description
--	The test is not running or results are not available.
In Progress	The test is running.
Completed	The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
Aborted	The test is interrupted; stopped before the set timer.

- **Start Time** Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Alarms

- **Link OAM** indicates that no OAM Information PDUs were received for 5 seconds.
- **Critical Event**: Indicates that the OAM link partner has sent a critical event notification (bit 2 of the Flags field is set to 1).

- **Dying Gasp:** Indicates that the OAM link partner has sent an unrecoverable local failure notification (bit 1 of the Flags field is set to 1).
- **Link Fault:** Indicates that the OAM link partner has sent a link fault notification (bit 0 of the Flags field is set to 1).

Loopback

- **Local** indicates the **Status** of the local loopback (**Enabled** or **Disabled**) and allows to **Enable** or **Disable** it.
- **Remote**¹ indicates the **Status** of the remote loopback (**Enabled** or **Disabled**), the number of **Successful** remote loopback requests, the number of **Fail** remote loopback requests, and allows to **Enable** or **Disable** it.

OAMPDU Frame Count

- Indicates the number of transmitted and received OAMPDU frames of the following types:
 - **Information**
 - **Loopback Control**
 - **Event Notification** (received only)
- **Total** indicates the total number of transmitted and received OAMPDU frames.

1. Statistics are influenced by both the protocol (Parser Action is set to "01") and physical loopback. The Fail and Successful counters will be affected by successive enable/disable loopback requests when sending loopback request to a remote FTB-700G/800 Series module running Link OAM test since it does not provide physical loopback.

Test Results

Summary (NI/CSU Emulation)

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 has been 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 309 for more information on Interface alarms/errors.

DS1

See *DS1* on page 298 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 has been 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.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.
- **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 Frames¹** and **RX Frames¹** 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**).

➤ **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.

➤ **Step¹** 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**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).

1. Only displayed once the test is started.

- **Unit:** Select the subtest result unit:

For Throughput: **Mbit/s**, **Gbit/s**, **frame/s**, and %.

For Back-to-Back: **Mbit/s**, **Gbit/s**, **frame/burst**, and %.

Frame Loss: %.

Latency: **ms**, and **μs**.

- **Layer:** For Throughput and Back-to-Back subtests, select the subtest layers used to calculate the throughput.

All (default): Layer 1,2,3 contains the Idle, Preamble, Start of Frame Delimiter, MAC address, IP address, and data.

Ethernet: Layer 2,3 contains the MAC layer, IP layer, and data.

IP: Layer 3 contains the IP layer, and data.

- **Step:** For Frame Loss subtest, selects the step (%) of the testing rate to be displayed.

- **Mode:** For Latency subtest, selects the propagation time mode.

Cut Through (default) allows the calculation of the propagation time of a bit (Bit Latency).

S. & F. (Store and Forward) allows the calculation of the propagation time of a frame (Frame Latency).

Summary (RFC 6349)

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

- **Status** indicates the actual test status as follows.

Test Status	Description
"--"	Test has not started.
In Progress	The test is running.
Completed, <Verdict>	Test has completed and the test pass/fail verdict is displayed when enabled. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU).
Aborted, <reason>	Test has been aborted either manually (Stop) or automatically from an alarm and the reason is displayed as follows: Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Invalid Configuration, Unresolved addresses, Invalid MTU, User Stopped

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset. This is the only information available on the remote module.
- **Test/Power 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/Power Recovery** field. Refer to *Power Failure Recovery* on page 557.

- **Logger Full**¹, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.
- **Remote unit in use and locked for Dual Test Set**² indicates that this module is used for **Dual Test Set** as the remote module.
- **Remote unit in Dual Test Set Mode**² indicates that this module is set as remote but the DTS Connection is not established.

MTU (bytes) is the validated Maximum Transfer Unit.

Minimum RTT (ms) is the minimum time between the first bit of a segment sent and the last bit of the corresponding acknowledge.

Window Sweep

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
- **Actual L4** indicates for each step the average TCP throughput metric.

TCP Throughput

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
- **Window (KiB)** indicates the total Max Window (1 KiB = 1024 bytes) followed by the number of connections and KiB per connection in parenthesis as follows: (n conn.@ n KiB).
- **Ideal L4** indicates the ideal TCP throughput metric.
- **Actual L4** indicates the average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to the this metric when enabled. A value greater or equal to the defined threshold gives a pass verdict.
- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.

1. Displayed on local module only.

2. Displayed on Remote module only.

Test Results

Summary (RFC 6349)

- **Buffer Delay (%)** indicates the Buffer Delay percentage metric which represents the increase in RTT during a TCP Throughput test versus the **Minimum RTT**.
- **TCP Throughput Threshold (% of ideal)** allows to enter the TCP Throughput as a percentage of the defined CIR that will be used to declare the pass/fail verdict for both directions: **0** to **100%**; default is **95%**. The calculated throughput based on the selected threshold is displayed for both directions.

Summary (S-OAM and MPLS-TP OAM)

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

- **Test Status** displays the current status of the S-OAM / MPLS-TP OAM test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 273).

Test Status	Description
--	The test is not running or results are not available.
In Progress	The test is running.
Completed	The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
Aborted	The test is interrupted; stopped before the set timer.

- **Start Time** Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Test Results

Summary (S-OAM and MPLS-TP OAM)

Continuity Check (Peer MEP)

- **Status** displays the status of the continuity check with the peer MEP.

Status	Description
Loss Continuity	Loss of Continuity alarm is active.
Mismerge	Mismerge alarm is active.
Unexpected MEG Level	Unexpected MEG Level alarm is active.
Unexpected MEP	Unexpected MEP alarm is active.
Unexpected Period	Unexpected Period alarm is active.
Unexpected MD Level	Unexpected MD Level alarm is active.
Receiving CCMs	CCM frames from the peer MEP are received without alarms.

- **TX CCM** indicates the count of transmitted CCM frames.
- **RX CCM** indicates the count of valid CCM frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

- **CCM** indicates the content of the last received CCM frame including **MEG ID** (Y.1731 and G.8113.1), **Domain ID** (802.1ag and MEF), **MA Name** (802.1ag and MEF), **MEG Level** (Y.1731, MEF, and G.8113.1), **MD Level** (802.1ag), **MEP ID**, and **Period**.

For unsupported **Domain ID**, **MA Name**, and **MEG ID**, the **Unexpected Format** message is displayed.

	Supported Format
Domain ID	1 (No Maintenance Domain Name present) 4 (Character String)
MA Name	2 (Character String)
MEG ID	32 (ICC based format) 33 (CC and ICC based format)

Test Results

Summary (S-OAM and MPLS-TP OAM)

Loopback / Test / Frame Delay / Frame Loss / Synthetic Loss

Note: *Either Loopback, Test, Frame Delay, Frame Loss, or Synthetic Loss¹ statistics are displayed according with the selected test function (refer to Test Function on page 224).*

➤ **Status** displays the status of the test function.

For **Loopback, Frame Delay, Frame Loss, and Synthetic Loss¹** functions:

Status	Description
Idle	No Results (function did not run yet).
In Progress	Test is in progress. Frames are being transmitted and monitored.
Completed	Test is completed: The test with continuous transmission is manually stopped and replies have been received or timed out. The test with continuous transmission is automatically stopped by a test timer and replies have been received or timed out. All frames of the test with non-continuous transmission have been transmitted and replies have been received or timed out.
Aborted	Test is aborted. The test with non-continuous transmission is stopped before all the frames are transmitted.

For **Test** function:

Status	Description
Idle	No Results (function did not run yet).
In Progress	Test is in progress. RX TST frames are being monitored.
Completed	Test is completed. The test is stopped or function is disabled after being In Progress state.

1. Available with Ethernet OAM.

- **RX Line Utilization** meter and value, available with **Loopback** function, indicate the line rate utilization percentage (only LBR frames are considered) received in the last second.
- **TST RX Rate** meter and value, available with **Test** function, indicate the quantity of TST frames received in the last second.
- **Frame Delay** meter and value, available with **Frame Delay** function, indicate the average of the measured frame delays in the last second.
- **Frame Loss Ratio** meter, available with **Frame Loss** function, indicates for both Near-End and Far-End the last measured frame loss ratio in the last second.
- **Synthetic Loss Ratio**¹ meter, available with **Synthetic Loss**¹ function, indicates for both Near-End and Far-End the last measured Synthetic Loss ratio in the last second.

Note: *Refer to S-OAM and MPLS-TP OAM on page 377 for more alarms/errors/statistics information.*

Summary

Refer to *S-OAM and MPLS-TP OAM* on page 377 for more information on alarms.

Thresholds

Refer to *Thresholds* on page 220 for more information.

1. Available with Ethernet OAM.

Summary (SyncE)

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

- **Test Status** displays the current status of the SyncE test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 273).

Test Status	Description
--	The test is not running or results are not available.
In Progress	The test is running.
Completed	The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
Aborted	The test is interrupted; stopped before the set timer.

- **Start Time** indicates the time the test was started.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

ESMC

Indicates the current (meter and value), average, minimum, and maximum ESMC frame rate (including information and event frames) received in frame/s. A fail verdict is also displayed beside the minimum and/or maximum values when the ESMC frame rate is outside the range while the Pass/Fail Verdict is enabled.

ESMC RX Rate meter displays the current ESMC frame rate (including information and event frames) in frame/s averaged over the last 11 frames received. The pass/fail verdict is also displayed when enabled.

Note: *When the **Pass/Fail Verdict** and **ESMC Rate Threshold** check boxes are selected (see page 273), the green region is delimited from 0.8 to 10.2 frames/s corresponding to a **PASS** verdict. The red regions above and beyond the threshold correspond to a **FAIL** verdict. There is neither green nor red region when the Pass/Fail verdict is disabled.*

Test Results

Summary (SyncE)

RX

- **Last QL Message** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.

Last Change indicates the date and time of the Last QL Message has changed.

- **Information/Event Count** gives respectively the count of information and event frames generated for all Quality Level values.
- **QL Mismatch Frame Count** gives the total count of information and/or event frames received not matching the expected Quality Level. Only available when the **QL Mismatch Monitoring** check box is selected.
- **Frequency/Offset** indicates respectively the frequency and the offset between the standard rate specification and the rate of the input signal.
- **Max. (-/+) Offset (ppm)** indicates respectively the minium and maximum offset between the standard rate specification and the largest/smallest rate recorded from the received signal.

TX

- **QL Message** indicates the Quality Level value that is generated.

Last Change indicates the date and time of the QL Message value has changed. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Last Change** is not available.

- **Information/Event Count** gives respectively the count of information and event frames generated for all Quality Level values. **Event Count** is not available with 1GE Electrical interface using remote local clock.

Summary (TCP Throughput)

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

- **Test Status** indicates the actual test status as follows.

Test Status	Description
"_"	The test is not running or results are not available.
In Progress	The test is running.
Completed	The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
Aborted - <Reason>	The test is interrupted; stopped before the set timer. Possible <Reason> are: TCP Session Closed or Remote IP Not Found .

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

TCP Throughput

- **TCP Connection Status** indicates the actual TCP connection status.

Test Status	Description
"_"	The test is not running or results are not available.
In Progress	The TCP initialization algorithm is in progress.
Waiting	Indicates on the remote unit that the test is started but the TCP initialization algorithm is not initiated by the local unit.
Established	The TCP session has been successfully established between the local and remote units.

Test Results

Summary (TCP Throughput)

Test Status	Description
Closed	The session is closed. Either no TCP initialization algorithm has been received, the remote unit has received and completed the request to close the TCP session, or no data has been received at the remote unit for 30 seconds.
Closing	The TCP protocol is closing down the connection.
Remote IP not found	The local unit didn't received an answer to the ARP request sent to the IP address of the remote unit.

- **Transmitted Frames** indicates the total of frames transmitted by the local unit excluding the re-transmitted frames.
- **Re-transmitted Frames** indicates the total of frames that have been re-transmitted by the local unit.
- **Efficiency (%)** indicates the percentage of bytes that were not retransmitted.
- **Window Size Unit** allows to select the unit used for **Window Size**: **Bytes**, **KBytes**, or **MBytes** (default).
- **Throughput Threshold** allows to set the pass/fail verdict threshold value: **0** to **100%** (default). This setting is available when the **Throughput Pass/Fail Verdict** check box is selected (refer to *TCP Throughput* on page 275).
- **Throughput** meter displays the last second TCP Throughput measurement.
- **TCP Throughput** displays respectively the last, minimum, maximum, and average TCP Throughput measurement.

- **Window Size** displays respectively the last, minimum, and maximum TCP window size.
- **Round Trip Latency (ms)** displays respectively the last, minimum, maximum, and average round trip time gathered from the TCP Throughput test.

Ethernet Traffic

Note: See Traffic - Ethernet on page 445 for more information.

Test Results

Summary (Traffic Gen & Mon)

Summary (Traffic Gen & Mon)

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

- **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 270).
 - “--”: 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 has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 557.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 360.

Stream

The following statistics are available for each stream.

- **Current Throughput**: See *Streams - Throughput* on page 389.
- **Frame Loss Rate**: See *Streams - Frame Loss / Out-of-Sequence* on page 387.
- **Jitter**: See *Streams - Jitter* on page 387.
- **Latency**: See *Streams - Latency* on page 388.

- **Out-of-Sequence:** See *Streams - Frame Loss / Out-of-Sequence* on page 387.
- **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 270).*

- **Jitter:** See *Streams - Jitter* on page 387.
- **Latency:** See *Streams - Latency* on page 388.
- **RX Rate:** See *Streams - Throughput* on page 389.
- **RX Frame Count** indicates the number of frame received matching the selected stream.
- **TX Rate:** See *Streams - Throughput* on page 389.
- **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 387.

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 255), tap on a TCMx button to select a TCM level.

SM/PM TTI Traces

Note: *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; refer to Modify TCM on page 255).*

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 following settings are coupled with the Expected Message from Traces - OTN on page 442.*

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

- **SAPI OTU/ODU-TIM** check boxes, 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 message.

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 487 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 282.

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 256).*

➤ **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 282.

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).*

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.

Test Results

Traffic - Ethernet

- **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 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, or 1522 (1 VLAN tag), 1526 (2 VLAN tags), or 1530 (3 VLAN tags) bytes.
- **> 1518**: frames with more than 1518, or 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.

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).

Test Results

Traffic - Flow Control

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	μ s
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 μ s it will be rounded to the closest multiple of 0.0512 for 10 Gbit/s, 5.12 μ s for 100 Mbit/s, 0.512 μ s for 1000 Mbit/s, and 0.0512 μ s 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.

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

Test Results

Traffic - OAM, S-OAM, and MPLS-TP OAM

Traffic - OAM, S-OAM, and MPLS-TP OAM

From the **Test** menu, tap **Results**, **Traffic**, and the **OAM, S-OAM**, or **MPLS-TP OAM** tab.

Traffic Monitoring

Note: Only available with *Carrier Ethernet OAM* test application.

- In TX, reports counts of CCM, LBM, LTM¹, DMM, LMM, SLM¹, TST, AIS, LCK, and CSF frames transmitted. Total count is reported as well as unicast and/or multicast frame counts when applicable.
- In RX, reports counts of CCM, LBR, LTR¹, DMR, LMR, SLR¹, TST AIS, LCK, and CSF frames received regardless of the sender as long as the following criteria are met:
 - **S-OAM:** The destination MAC address matches either the local MEP Unicast MAC address or a Multicast class 1 or class 2 address²; and the VLANs matches the unit port VLANs.
 - **MPLS-TP OAM:** The destination MAC address matches either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; the VLANs matches the unit port VLANs; and MPL Labels matches the local MPLS Label Stack configuration. For AIS, LCK, and CSF, valid messages must also have the MEG Level matching the Local MEG Level.

Total count is reported as well as unicast and/or multicast frame counts when applicable.

1. Only available with Ethernet OAM.

2. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Responder

Note: Available when the **S-OAM Responder** or **MPLS-TP OAM Responder** check box is selected (refer to S-OAM and MPLS-TP OAM Responder on page 219).

For **Carrier Ethernet OAM** test application:

- In TX, reports counts of LBR, LTR¹, DMR, LMR, and SLR¹ total frames transmitted.
- In RX, reports counts of valid LBM, LTM¹, DMM, LMM, and SLM¹ unicast, multicast, and total frames received. A valid messages must have its:

S-OAM: source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address²; VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level.

MPLS-TP OAM: destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

For **Smart Loopback** test application:

- In TX, reports counts of LBR, LTR, DMR, LMR, and SLR total frames transmitted.
- In RX, reports counts of valid LBM, LTM, DMM, LMM, and SLM total frames received. A valid messages must have its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address².

1. Only available with Ethernet OAM.

2. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Test Results

Window Sweep

Window Sweep

Displays the graph showing the Ideal L4 and Actual L TCP Throughput measured for each Window Sweep step. The number of connections and KiB per connection is also displayed in parenthesis as follows:
(n conn.@ n KiB)

From the **Test** menu, tap **Results**, and the **Window Sweep** tab.

WIS

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

Traces/Label

- **J0 Trace** displays the **J0 Trace** value in 16-bytes format.
- **J1 Trace** displays the **J1 Trace** value in 16-bytes format.
- **Path Signal Label (C2)** displays the content of the STS SPE including the status of the mapped payload.

Test Results

WIS

10 Test Functions

The Test Functions menu offers the following structure:

Transport Test Applications

Tab	Available with						Page
	a	b	c	d	e	f	
APS	-	X	-	X	-	-	457
FDL - Bit-Oriented Message	-	-	X	X	X	-	460
FDL - Performance Report Message	-	-	X	X	X	-	464
FEAC	-	-	X	X	-	-	481
OH - OTN	X	-	-	-	-	-	481
OH - SONET/SDH	-	X	-	X	-	-	487
Pointer Adjustment	-	X	-	X	-	-	506
RTD	X	X	X	X	-	-	516
Signaling Bits	-	-	X	-	-	-	523
Spare Bits	-	-	X	X	-	X	524

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS_n/PDH BERT
- d. SONET/SDH - DS_n/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

Test Functions

Ethernet Test Applications

Tab - Sub Tab	Test Application										Page
	a	b	c	d	e	f	g	h	i	j	
Filters	-	-	-	-	X	-	X	-	X	-	471
Packet Capture	-	-	-	-	X	-	X	-	X	-	475
Ping & Trace Route	X	X	X	X	X	X		X	X	X	501
S-OAM Link Trace	-	-	-	-	-	-	-	-	X	-	521

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

Packet Sync Test Applications

Tab	Test Application		Page
	1588 PTP	SyncE	
Filters	X	X	471
Packet Capture	X	X	475
Ping & Trace Route	X	X	501

Wireless Test Application

Tab	Test Application CPRI/OBSAI BERT	Framing	Page
RTD	X	Unframed	516
	X	Framed L2	519

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.

Test Functions

APS

**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 at 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 460 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 460 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: $1 < \text{CRC} \leq 5$	LV: Line code violation event ≥ 1
G3: $5 < \text{CRC} \leq 10$	LB: Payload loopback activated
G4: $10 < \text{CRC} \leq 100$	SL: Slip ≥ 1
G5: $100 < \text{CRC} \leq 319$	R Bit (Reserved - Default value is 0)
G6: $\text{CRC} \geq 320$	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 462 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	SE: Severely errored framing ≥ 1
G2: $1 < \text{CRC} \leq 5$	FE: Frame sync. bit error ≥ 1
G3: $5 < \text{CRC} \leq 10$	LV: Line Code Violation ≥ 1
G4: $10 < \text{CRC} \leq 100$	LB: Payload loopback activated
G5: $100 < \text{CRC} \leq 319$	SL: Slip ≥ 1
G6: CRC ≥ 320	

Test Functions

FDL - Performance Report Message

- **Performance Information** table, available when the **Report Content** button is selected, reports the time t0, t0-1, t0-2, and t0-3 for each PRM.

Time

- **T0** represents the valid PRM message received in the last second of measurement (bytes 5 and 6).
- **T0-1** represents the message one PRM ago (bytes 7 and 8).
- **T0-2** represents the message two PRM ago (bytes 9 and 10).
- **T0-3** represents the message three PRM ago (bytes 11 and 12).

PRM

G3: $5 < \text{CRC Error Event} \leq 10$

LV: Line Code Violation Event ≥ 1

G4: $10 < \text{CRC Error Event} \leq 100$

U1: Under study for synchronization

U2: Under study for synchronization

G5: $100 < \text{CRC Error Event} \leq 319$

SL: Controlled Slip Event ≥ 1

G6: CRC Error Event ≥ 320

FE: Frame Sync. Bit Error Event ≥ 1

SE: Severely-Errored Framing Event ≥ 1

LB: Payload Loopback Activated

G1: CRC Error Event = 1

R: Reserved

G2: $1 < \text{CRC Error Event} \leq 5$

Nm and **Nl:** One-second report modulo 4 counter.

FEAC

The Far-End Alarm and Control signal (FEAC) provides Communication Channel capability over a DS3 in a network applications using C-bit Parity configuration (see page 245).

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 1111111) 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**.

Test Functions

FEAC

- **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 loopback 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 measurement.
 - **Previous** indicates the message, if any, that was received just before the current measurement.

Test Functions

FEAC

➤ Loopback Commands

- **Current** displays the valid message received in the last second of measurement. A valid message is detected only when receiving 10 consecutive occurrences of a specific **Loopback Command** immediately followed by 10 occurrences of a specific **Channel Codeword**.
- **Previous** displays the last valid message received excluding the actual **Current** message.

Filters

Allows gathering statistics according to the programmed filters. Filters provide the capability to analyze a specific stream's behavior in order to monitor a single protocol's behavior, perform SLA verification, or precisely troubleshoot unwanted behavior. Up to 4 filters having up to four operands each can be defined and enabled.

From the **Test** menu, tap **Functions**, and the **Filters** tab.

Filters

Allows the selection of the filter number (1 to 4). The filter criteria, if defined, will be displayed. A filter used (enabled) for data capture will not be configurable and the message **Filter in use for data capture** is displayed.

Enable

Once the filter is configured, select the **Enable** check box to enable the current filter. However, if the filter configuration contains errors, it will not be possible to enable it. A filter can be enabled or disabled even when the test is running. It is not possible to modify or disable a filter that is already in use for capture until either another filter or **Interface** (see *Capture Source* on page 475) is assigned to capture.

Enabled Time

Indicates the time during which the filter is enabled.

Assign to Capture

Note: *Only available when the ETH-CAPTURE software option is enabled. Refer to Software Option on page 33 for more information.*

Assigns the selected filter for packet capture. See *Packet Capture* on page 475.

Filter Configuration

Note: *Multiple filter criteria is only available when the ADV-FILTERS option is enabled; otherwise only one criterion is possible. Refer to Software Option on page 33 for more information.*

The filter configuration section allows to configure the filter criteria for the selected filter. The configuration is only possible when the **Enable** check box is cleared.

- “(“ and “)“, the open and close parenthesis controls the precedence of operands when more than two operands are used. Only one level of parenthesis is supported. When no parenthesis are used, a logical AND has precedence over a logical OR.
- **Not** check box when selected, adds the logical negation (not equal) operator for the operand filter defined at its right.

- **Filter** specifies the filter to be used (**None** by default).

Category	Filter
Ethernet	MAC Destination Address, MAC Source Address, EtherType ^a , C-VLAN ID, S-VLAN ID, E-VLAN ID, C-VLAN Priority, S-VLAN Priority, E-VLAN Priority
IPv4	IPv4 Destination Address, IPv4 Source Address, IPv4 TOS, IPv4 Precedence, IPv4 Protocol, IPv4 DiffServ
IPv6 ^b	IPv6 Destination Address, IPv6 Source Address, IPv6 Flow Label, IPv6 Next Header ^c , IPv6 Traffic Class, IPv6 Precedence, IPv6 DiffServ
Higher Layer	TCP Destination Port, TCP Source Port, UDP Destination Port, UDP Source Port
MPLS ^b	MPLS Label 1, MPLS Label 2, MPLS COS 1, MPLS COS 2

- Applies only to the last EtherType occurrence when VLAN is used.
- Available when the corresponding software option is enabled (refer to page 33).
- Applies only to the last next header occurrence when extension headers are used.

- **Value** is the value associated to the selected filter.

Test Functions

Filters

- **Mask** allows masking the defined filter value. A bit mask of 1 indicates that the corresponding bit in the value is compared for the match. A bit mask of 0 indicates that the corresponding bit in the value is ignored.

For binary values, enter the mask value in binary format.

For decimal values, enter the mask value in hexadecimal format.

For IP address field, enter the mask in decimal format.

For MAC address, enter the mask value in hexadecimal format.

- **Oper.** specifies the logical operator (AND or OR) used between two operands.

Filter Statistics

Indicates throughput statistics of frame matching the configured filter's criteria.

- **Line Utilization** gives the percentage of line rate utilization.
- **Ethernet BW** (Bandwidth) gives the receiving data rate expressed in Mbit/s.
- **Frame Rate** gives the receiving number of frames (including bad frames) in frame/s.
- **Frame Count** indicates the number of frame matching the configured filter's criteria.
- **Error Count** indicates respectively the number of frames matching the configured filter's criteria having **IP Checksum**, **UDP Checksum**, **TCP Checksum**, **FCS**, **Jabber**, **Oversize**, **Runt**, or **Undersize** errors. Refer to *Ethernet* on page 304 and *IP/UDP/TCP* on page 311 for more information on errors.

Packet Capture

Capture is used to analyze all or filtered data traffic and save complete or truncated frames into a buffer. It allows to precisely observe network truncated data, or to understand errors and unwanted behavior.

From the **Test** menu, tap **Functions**, and the **Packet Capture** tab.

Capture Source

Specifies what kind of data to be captured.

- **Interface** captures all received frames and saves them in the capture buffer.
- **Filter x** captures only frames that match the selected filter and saves them in the capture buffer. Select the filter number from the list. Only enabled filters are available, see *Filters* on page 471.

The selected filter will be reserved for data capture and will not be available for filter configuration.

Frame Length

Specifies the length of the frame that will be saved in the capture buffer.

- **Complete** captures the entire frames.
- **Truncated** captures only the first specified number of bytes per frame. Use either the Bytes field to manually enter the number of bytes per frame or tap on the **Truncation Calculator** button for automatic bytes per frame calculation.

Bytes allows the selection of the number of bytes that will be saved in the capture buffer for each frame captured. Choices are from 14 (default) to 1536 bytes.

Truncation Calculator allows to easily determine at what byte to truncate the frame captured by selecting the desired frame header components.

- **Header Layer** specifies the header layer level: **Layer 2 (Ethernet)**, **Layer 3 (IP)**, or **Layer 4 (TCP/UDP)**.
- **IP Version** specifies the IP version: **IPv4** or **IPv6**.
- **Encapsulation** parameters are optional and not selected by default.

VLAN check box, when selected, enables VLAN and allows to select the number of VLANs: 1, 2, or 3.

MPLS check box, when selected, enables MPLS and allows to select the number of labels: 1 or 2.

- **Additional Payload (bytes)** allows to optionally select the number of additional payload bytes (1 to 1400 bytes).
- **Total Number of Bytes** indicates the number of bytes for the selected frame parameters. This value will be used as the truncated frame length (**Truncated** field).

Trigger

- **Trigger Type** defines the trigger source criterion that will be used to automatically start/stop the capture when a received frame matches the filter and the trigger criteria.
- **Manual** automatically starts the frame capture when the Capture button is on (green LED) and the test is started (refer to *Start/Stop | TX Button* on page 556).
- **On Error** starts the frame capture when the selected error occurs.

FCS

Jabber

Oversize (Available when **Oversize Monitoring** is enabled)

Runt

Undersize

IP Checksum

UDP Checksum

TCP Checksum

Any Type (Any of the above errors).

- **Field Match** starts the frame capture when the configured field match is encountered. User the **Configuration** button to select the field match criteria (see **Filter Configuration** from the **Filters** tab).

Cfg. Status indicates the status of the configured field match configuration: **Valid** or **Invalid**. A valid status is required to be able to start the capture.

Test Functions

Packet Capture

- **Trigger Position** selects the triggered frame position within the buffer.
 - **Post-Trigger** for a trigger frame located at the beginning of the buffer. The buffer will contain the triggered frame with the following frames.
 - **Mid-Trigger** for a trigger frame located at the middle of the buffer. The buffer will contain the triggered frame with the preceding and following frames.
 - **Pre-Trigger** for a trigger frame located at the end of the buffer. The buffer will contain the triggered frame with the preceding frames.

Status and Controls

- **Capture Status** indicates the status of the data capture:
 - “--”: The capture is not started and has not run yet.
 - Armed...**: The capture is started but waiting for the trigger event.
 - Capturing...**: The capture is in progress. For Post-Trigger and Mid-Trigger mode, the trigger event has been captured and the buffer is filling up.
 - Completed**: The capture is completed.
- **Frame Count** indicates the number of frames captured that matches the selected filter criteria. However, for Mid-trigger and Pre-Trigger, the frame counter will only be available when the capture is completed.
- **Buffer Usage** indicates the percentage of the buffer capacity used.
- **Triggered Error** is available when trigger on error is selected and indicates the error that activated the trigger.

- **Triggered Frame - Details** gives details on the triggered frame.

The triggered frame corresponds to the first received frame that matches the filter and the trigger settings.

Frame Number indicates the triggered frame position in the buffer.

The framing MAC/IP/UDP/TCP source and destination addresses are displayed in a table.

- **Capture** button allows to start/stop the data capture. The test must be running (refer to *Start/Stop | TX Button* on page 556) in order to start capturing and recording data into the buffer. The Capture button is not available when the trigger on field match is selected while its trigger parameters are not valid.

No data will be recorded in the buffer if no frame matches the filter and the trigger criteria during the data capture.

The data capture stops automatically once the buffer is full. The maximum buffer capacity is 512 KBytes.

When the capture stops or is manually stopped, the following message is displayed: **Capture completed. Press Export to save captured data (the test must be stopped)**. To avoid losing the captured data, the data must be exported and saved into a file before restarting the test or creating a new test.

- **Export** button, available when the test application is stopped, allows to export the data captured into a .pcap file format and to view the file using Wireshark.

- **Save In:** Allows to select the folder to save the capture file.

The capture file is saved in the following folder by default:

d:\ToolBox\User Files\<Product Name>\Capture Data

d:\IQSManager\User Files\<Product Name>\Capture Data

- **View File After Generation:** Allows to display the report once it is generated using the Wireshark application. The **View File After Generation** check box is not selected by default.

Test Functions

Packet Capture

➤ **Generate & Save**

Allows to generate and save the capture data. The name of the captured file is automatically selected and contains the date and time of the capture. Capture file bigger than 100Mbytes will be split into multiple files.

Tapping on the **Cancel** button stops the capture generation. The captured data already processed will be saved.

Note: *The export process may take several minutes.*

Once generated, the capture file will be automatically opened in Wireshark when the **View File After Generation** check box is selected.

The capture file report may also be manually opened within Wireshark typically using Windows Explorer.

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 279.

The second SM byte (column 9) contains the BIP-8 byte that is automatically generated for each frame. This byte is not configurable.

Test Functions

OH - OTN

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**.
- **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 279.

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 143.
- **RES**, column 15, OPU OH: The Reserved (RES) byte is configurable from **00** (default) to **FF**.

Test Functions

OH - OTN

- **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 483 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 from **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**.
- **GCC2**, column 3-4, ODU OH: The two General Communication Channel-2 bytes are configurable from **00** (default for each byte) to **FF**.
- **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.

Test Functions

OH - OTN

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**¹: 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. Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 282).

- **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**¹: BIP-8 (Bit-Interleaved Parity) byte provides section error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the previous STS-N/STM-N frame of a composite signal.
- **E1**¹: Orderwire. Provides a 64 Kbit/s voice channel for communication between two STEs (Section Terminating Equipment).

1. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

- **F1¹**: User/User Channel. This byte is reserved for user purposes.
- **D1¹, D2¹, and D3¹**: Data Communications Channel (DCC). Provides a 192 Kbit/s data communication between two STEs for operation functions such as OAM&P.

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.

1. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

Test Functions

OH - SONET/SDH

➤ **B2¹**: BIP-8

SONET: The BIP-8 (Bit-Interleaved Parity) byte provides line error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the LOH and the STS-1 frame capacity of the previous frame of a composite signal (STS-1 to STS-n). Note that the SOH is not used to calculate the parity check.

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.

➤ **K1¹** and **K2¹**: Automatic Protection Switching (APS): The K1 and K2 bytes communicate APS between two LTE.

➤ **D4¹** through **D12¹**: 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.

➤ **S1/Z1 (SONET)**

S1¹: Synchronization Status: The S1 byte is used to carry the synchronization status of the SONET device.

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)¹**: Synchronization Status. Bits 5 to 8 of the S1 byte are used to carry the synchronization messages of the SDH device.

1. 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

Test Functions

OH - SONET/SDH

- 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 257).

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.

Test Functions

OH - SONET/SDH

➤ **M0 or M1 (SDH)**

M0: MS-REL. STM-1 channel #1 of a STM-0e and STM-0 signal.

M1: MS-REL. STM-1 channel #1 of a STM-1e and STM-1 signal;
channel #3 of an STM-N signal (N>1).

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

➤ **E2¹**: Orderwire. Provides a 64 Kbit/s voice channel for communication between LTEs.

STS/AU/TU-3

➤ **J1**: Trace. Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 282).

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.

1. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

- **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 166 for more information.

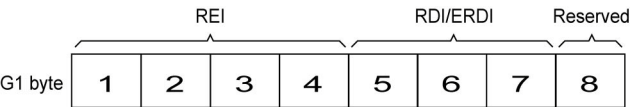
C2 (Hex.)	Description	
	SONET	SDH
00 ^a	Unequipped	UNEQ or supervisory-UNEQ
01	Equipped - Non-Specific	RES (Equipped - Non-Specific)
02	Floating VT Mode (Default)	TUG Structure
03	Locked VT Mode	Locked TU-n
04	Async Mapping for DS3	Async Mapping of 34M/45M in C-3
05	Mapping under development	Experimental 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.

Test Functions

OH - SONET/SDH

- **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.

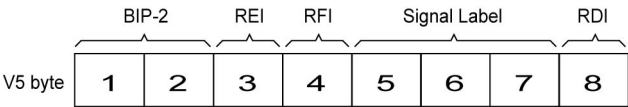
- **Z3 and Z4:**
SONET only: Growth.
- **F3:**
SDH only: User Channel. The Path User Channel provides a channel for communication purposes between path elements and is payload dependent.
- **K3:**
SDH only: Automatic Protection Switching (APS). Bits 1 to 4 of the K3 byte are used for APS signaling. K3 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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Multiframe Alignment Signal											Extended Signal Label								0	R	R	R	R	R	R	R	R	R	R	R	
Frame Count					Sequence Indicator																										

R = Reserved

- **J2 Trace.** Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 282).

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**

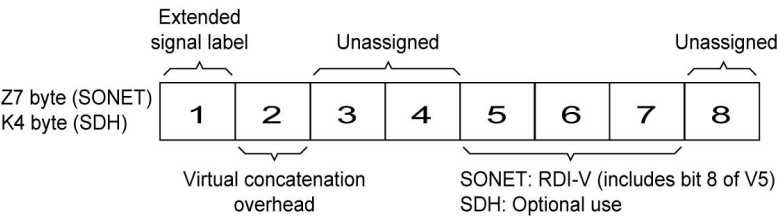
Z6 (SONET): VT Tandem Connection Monitoring or VT Path Growth. The Z6 byte is allocated for future growth.

N2 (SDH): (Network operator byte) Tandem Connection Monitoring for the VC2, VC-12, and VC-11 level.

Test Functions

OH - SONET/SDH

➤ Z7 /K4 : Extended signal label



Bits	Description	
	Z7 (SONET)	K4 (SDH)
1	Extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see Z7/K4 Structure on page 499) contain the extended signal label.	
2	Virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see Z7/K4 Structure on page 499) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator.	
3 - 4	unassigned and reserved for APS signaling for protection at the lower order path level.	
5 - 7	These bits in combination with bit 8 of V5 are allocated for RDI -V/ERDI-V signal	Optional use.
8	unassigned and reserved for a lower order path data link.	

Default all OH

Returns all TX overhead bytes to their factory default values.

Ping & Trace Route

From the **Test** menu, tap **Functions**, and the **Ping & Trace Route** tab.

Source IP Address

Displays the configured **Source IP Address**. Refer to *MAC/IP/UDP* on page 170 for RFC 2544 and EtherBERT tests, and to *Smart Loopback* on page 260 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 95). 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** 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.

Test Functions

Ping & Trace Route

➤ **Status:** Indicates the status of the attempt as follows:

Status	Description
Successful	Valid ICMP echo reply received.
User Aborted	When a user has manually stopped the ping/trace route function before the end of attempts.
Time Out	When an ICMP echo reply was not received within the defined timeout.
Destination Invalid	With reserved IP addresses: For IPv4: 0.0.0.0, 127.0.0.0, and all addresses above 240.0.0.0 (Class E and above). For IPv6: 0::/8 (reserved/unspecified), 0::1/128 (Loopback), FF00::/8 (Multicast).
TTL Expired (ping test)	When the number of TTL was insufficient to reach the destination host.
Hop Reached (trace route test)	When a Time Exceeded message is received from a host while executing the trace route function.
Destination Unreachable	For IPv4: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or an ICMP Unreachable message is received). For IPv6: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or address resolution failed or an ICMP Destination Unreachable message is received).
Data Corrupted	Parameter problem message is received or data corruption is found for IPv4.
Discarded	Congestion has been detected and the request cannot be transmitted.
Packet Too Big	Packet Too Big message is received in response to a packet that the router cannot forward because the packet is larger than the MTU of the outgoing link. It is only applicable for the IPv6 version .
Undefined	For any other errors in ping/trace route that do not fall into one of the above description.

➤ **Replied Details**

For ping, indicates the IP address of the replier, the buffer size of the ICMP echo response, the time of response in milliseconds, and the TTL of the ICMP echo response.

For trace route, indicates the IP address of the replier, and the time of response in milliseconds.

Statistics

➤ **Packets Transmitted** indicates the number of sent packets.

➤ **Packets Received** indicates the number of received packets.

The following statistics are only available for the ping test.

➤ **Percentage Lost (%)** indicates the percentage of packets lost.

➤ **Min Round Trip Time (ms)** indicates the minimum time recorded for a ping request to be answered.

➤ **Max Round Trip Time (ms)** indicates the maximum time recorded for a ping request to be answered.

➤ **Avg. Round Trip Time (ms)** indicates the average time required for a ping request to be answered.

Pointer Adjustment

From the **Test** menu, tap **Functions**, and the **Pointer Adjustment** tab.

TX Pointer Adjustment

Note: *Only available in **Coupled** topology.*

The pointer adjustment supports two modes of operation: **Manual** and **Sequence**. Both modes offer the generation of pointer events even when the test is not started.

TX Pointer Adjustment - Manual Button

Step

➤ Value

For STS/AU: Select the number of positive (Increment) or negative (Decrement) pointer adjustments to include into the STS-n (SONET) or AU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 frames.

For VT/TU: Select the number of positive (Increment) or negative (Decrement) pointer adjustment to include into the VTn (SONET) or TU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 multiframes.

- **Increment** button sends the positive pointer adjustment defined.
- **Decrement** button sends the negative pointer adjustment defined.
- **Pointer Value** indicates the current pointer value.

Jump

- **New Pointer** allows 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.

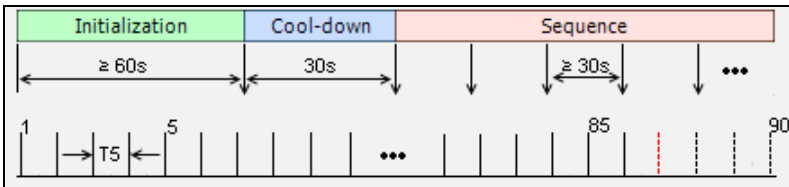
- **Sequence: T.105-03/GR-253** allows the selection of the pointer sequence pattern based on the **T.105-03/GR-253** standard.

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.

Test Functions

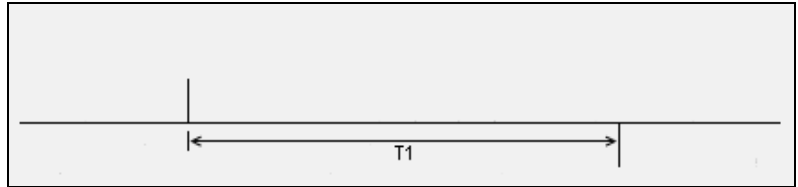
Pointer Adjustment

- **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.



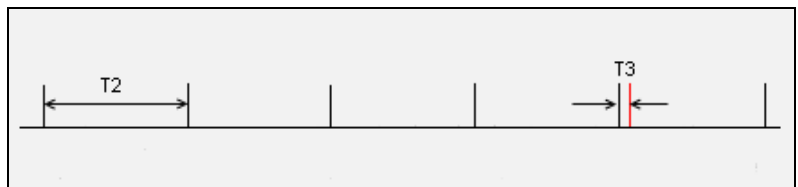
- **T2 (s)** represents the interval between successions of pointer events.

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.

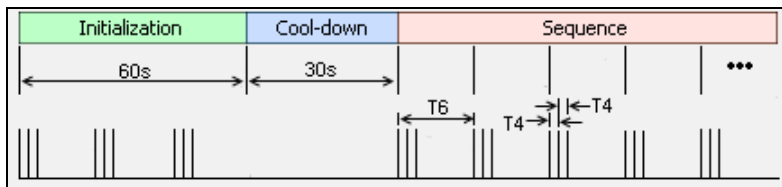


Test Functions

Pointer Adjustment

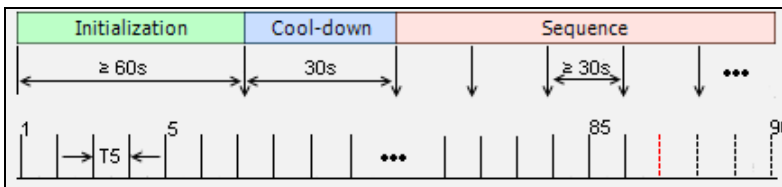
- **T4 (ms)** represents the interval between back to back pointer events in periodic pointer sequence.

Example of **Burst pointer adjustment** sequence.



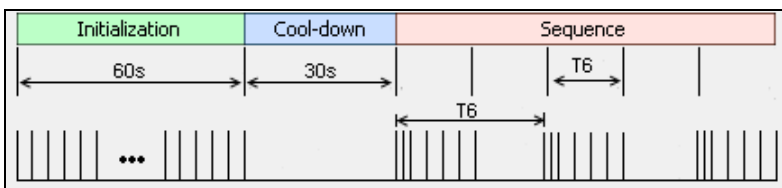
- **T5 (s)** represents the interval between successions of pointer events in a Periodic pointer sequence.

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.

Test Functions

Pointer Adjustment

- **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 ^{ab} Duration ≥ 60 sec	Basic sequence ^{ab} 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 ^{ab} Duration ≥ 60 sec	Basic sequence ^{ab} 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

- The basic sequence corresponds to the pointer event pattern defined in the standard without any Add or extra Cancel event.
- 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**. For CPRI/OBSAI test application, RTD operates in **Single** mode only.

- **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.

Test Functions

RTD

- **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.

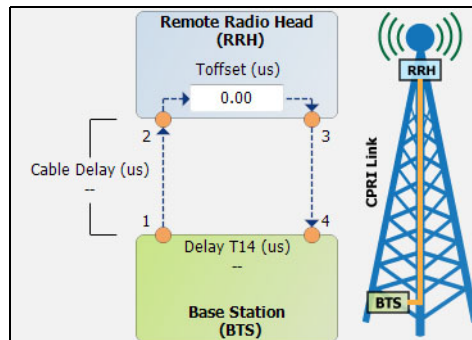
RTD (CPRI Framed L2)

Note: Only available with CPRI Framed L2 in **Base Station** emulation mode.

Round Trip Delay (RTD) measurements are needed to quantify the time it takes for a signal to cross the remote radio head and come back.

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.

From the **Test** menu, tap **Functions**, and the **RTD** tab.



Round Trip Delay

Indicates the time required for a bit to travel from one point to another.

- **Delay T14** indicates the round trip delay measurement from the Base Station going through the Remote Radio Head (including **Toffset**) and back to the Base Station. The **Delay T14** appearing on the diagram corresponds to the average value.

Test Functions

RTD (CPRI Framed L2)

- **Cable Delay** indicates the cable delay measured from the Base Station to the Remote Radio Head (RRH) or vice-versa assuming that the cabling in both directions are the same. The **Cable Delay** appearing on the diagram corresponds to the average value.
- **Last** indicates the result of the last delay measurement.
- **Minimum** indicates the minimum delay recorded.
- **Maximum** indicates the maximum delay recorded.
- **Average** indicates the average delay value.
- **Unit** measurement selections are **μs** (default) and **ns**.
- **Toffset** allows the configuration of the internal delay introduced by the electronic components in the Radio Equipment (RE): 0 μs (default) to 66.67 μs.

Note: *A warning icon appears next to the **Toffset** value when this value is larger than the **Delay T14** value measured indicating that the **Toffset** configured value maybe invalid thus corrupting the **Cable Delay** values reported.*

S-OAM Link Trace

From the **Test** menu, tap **Functions**, and the **S-OAM Link Trace** tab.

Link Trace

- **Priority**¹ allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 647 for more information.
- **Drop Eligible**¹ is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **TTL** sets the Time To Live value: **1** to **255** (default is **128**).
- **Link Trace** button when ON (OFF by default) starts the link trace process. The **Link Trace** button turn OFF automatically once the link trace process is completed.

Result

The table reports the following information for each valid LTR frames received in response to the last LTM frame sent: **TTL**, **MEP/MIP MAC Address**, **Forward**, and **Term MEP**.

- **Last Link Trace Status** displays the last link trace status.

Status	Description
Pending	No Results
Successful	Last Link Trace was successful
Failed – LTR Timeout	Last Link Trace failed due to a LTR Timeout
Failed – Invalid LTR	Last Link Trace failed due to an Invalid LTR

- **TX LTM** indicates the count of transmitted LTM frames.

1. Available when VLAN is enabled.(see *VLAN* on page 186)

Test Functions

S-OAM Link Trace

- **RX LTR** indicates the count of received LTR frames having their destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs.
- **LTR Timeout** indicates the count of LTR Timeout event which occurs if a reply (LTR) from the Peer MEP is not received within 5 seconds.
- **Invalid LTR** indicates the count of LTR frames received with incorrect MEG/MD Level or Transaction ID.

Signaling Bits

Signaling Bits is only available for **DSn/PDH BERT** test with DS1 interface, DS0 enabled, and SF, ESF, or SLC-96 framing.

From the **Test** menu, tap **Functions** and the **Signaling Bits** tab.

The monitoring of signaling bits of the 24 - DS0 channels is performed when test is running. Two signaling bits (**AB**) are monitored for SF or SLC-96 framing while four signaling bits (**ABCD**) are monitored for ESF.

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

- **S_{i0}** is located in the bit 1 of the frame containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
- **S_{i1}** is located in the bit 1 of the frame not containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
- **S_{a4}** to **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

➤ **S_{i0}** is located in the bit 1 of the frame containing the frame alignment signal (FAS).

➤ **S_{i1}** is located in the bit 1 of the frame not containing the frame alignment signal (FAS).

➤ **S_{a4} to S_{a8}** are located in bit 4 to 8 of frame number 1, 3, 5, and 7 of sub-multiframe 1 and 2. Possible values are either **0** and **1** or **0000** to **1111** depending on the framing.

➤ **TS16 Frame 0 Bit 5, 7, 8** are located in bit 5, 7, and 8 from Timeslot 16 of frame 0 of a E1 signal.

Traffic Scan

The traffic scan tool provides the capability to discover and monitor VLAN traffic flows on the network.

Not available with Framed Layer 1. From the **Test** menu, tap **Functions**, and the **Traffic Scan** tab.

Level

Allows the selection of the criteria that will be used to filter the incoming VLAN traffic flows. The default setting is **All**. Choices are:

Level	Description
All	Monitors untagged frames and up to 3 levels of stacked VLAN frames
Untagged	Monitors untagged frames only (no VLAN)
C-VLAN	Discovers/monitors only frames where the outer VLAN is a C-VLAN (TPID of 0x8100)
S-VLAN	Discovers/monitors only frames where the outer VLAN is a S-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300)
E-VLAN	Discovers/monitors only frames where the outer VLAN is a E-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300)

Rate Layer

Allows the selection of the rate unit used for **Link Rate** and **Rate** statistics.

- **Line Utilization** is used to express the real line rate including the Preamble, SFD, and IFG.
- **Ethernet BW** (Bandwidth) is used to express the Ethernet bandwidth rate excluding the Preamble, SFD, and IFG.

Discovered

Indicates the number of different traffic flows monitored based on the scan criteria.

Link Rate (Mbit/s)

Indicates the network link rate based on the received frames with a valid FCS regardless if the frame matches or not the traffic flows, and regardless if the traffic flow was ignored due to the limit reached (see *Limit Reached*). The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** depending on the **Rate Layer** selected.

Limit Reached

Up to 128 different traffic flows can be monitored, the **Limit Reached** text appears with a red background next to the **Discovered** field when the limit is reached.

Scan

Starts/stops the traffic scan test.

Monitored Frames Table

Statistics are gathered for each different traffic flow matching the scan criteria. Each different monitored traffic flow creates a separate entry in the scan table. When the limit is reached, new traffic flows are not considered in the table but the existing traffic flows are still monitored.

The level of VLAN (untagged, E-VLAN, S-VLAN, C-VLAN), and values of VLAN ID, Priority, and TPID are used to identify a traffic flow. Any difference in one of these values will create a separated entry in the table. PBB-TE frames are ignored.

Note: *Scan statistics are cleared when restarting the scan.*

➤ E-VLAN / S-VLAN / C-VLAN

- **ID** indicates the VLAN ID of the received traffic flow.
- **Priority** indicates the VLAN Priority of the received traffic flow.

Note: *The TPID indicating the Tag Protocol Identifier of the received traffic flow is reported in the test report.*

➤ Statistics

- **Frame Count** indicates for each traffic flow, the number of frames matching the selected scan criteria.

Total indicates the total number of frames matching the selected scan criteria.

- **Rate (Mbit/s)** indicates for each traffic flow, the rate of frames matching the selected scan criteria. The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** (see *Rate Layer*).

Total indicates the total rate of frames matching the selected scan criteria.

11 Test Control

This chapter describes the test control buttons available on the right navigation bar of the application.

Button	For more information, see:
Discover Remote	Discover Remote Button <i>on page 530</i>
Headset DTMF	Headset/DTMF Button <i>on page 533</i>
Inject	Inject Button <i>on page 535</i>
Laser	Laser Button <i>on page 535</i>
Lpbk Tool	Lpbk Tool Button (Loopback Tool) <i>on page 536</i>
Phone Book	Phone Book Button <i>on page 543</i>
Report	Report Button <i>on page 547</i>
Reset	Reset Button <i>on page 551</i>
Save/Load	Save/Load Button <i>on page 552</i>
Start/Stop TX	Start/Stop TX Button <i>on page 556</i>

More/Less Button

The **More/Less** button appears when there is not enough room to display all available test control buttons. The **More** button expands the control buttons area to display all control buttons while the **Less** button closes the expanded area. The pin button can be used to keep open the expanded area.

Discover Remote 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, RFC 6349, or EtherSAM results.

Note: Only available with *EtherSAM, EtherBERT, RFC 2544, RFC 6349, 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 FTB-700G/800 Series, FTB-800v2 Series, and FTB-88000 Series modules.

- **Capabilities** indicates the loopback capabilities of the remote module using the following test application icons:
Smart Loopback, RFC 2544, RFC 6349, 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).

- Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, Smart Loopback, Through Mode, TCP Throughput, Carrier Ethernet OAM, Cable Test, 1588 PTP, or SyncE.
- Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, Smart Loopback, TCP Throughput, Carrier Ethernet OAM, 1588 PTP, or SyncE.

- **Loop Up** and **Loop Down** buttons (Not available with RFC 6349 test application)

- **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.

Test Control

Discover Remote Button

- **Connect** and **Disconnect** buttons are only available with RFC 2544, RFC 6349, and EtherSAM test applications.
- **Connect** establishes the connection with the selected remote module and sets the remote module into either DTS RFC 2544, DTS RFC 6349, 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 module is performing a discovery scan. Up to 16 alpha-numeric characters are allowed.

Headset/DTMF Button

Note: Only available with **ISDN PRI** test application.

The **Headset/DTMF** allows to connect a B-Channel (Speech or 3.1 kHz) to the headset and DTMF tones can be generated using the keyboard.

Enable/Disable Headset and DTMF

- **Enable Headset and DTMF** button is used to enable the Headset and DTMF on the selected channel. The button is only available when one or more **Speech** or **3.1 kHz** calls are active, otherwise the button is grayed out.
- **Disable Headset and DTMF** button indicates that the Headset and DTMF is enabled on the selected channel. Tapping on the **Disable Headset and DTMF** button disables the Headset and DTMF from the selected channel.

Channel

Allows to select the channel used to connect the Headset and DTMF. Only active **Speech** and **3.1 kHz** channels are displayed. Other channels including the D-Channel will not be available.

Headset

Note: *The settings here and on the platform are independent but platform settings may limit level control. For more information, refer to Adjusting Microphone and Speaker Volume from the platform user guide.*

- **Speaker Volume:** The slide bar and +/- buttons are used to increase or decrease the volume of the speaker.
- **MIC Volume:** The slide bar and +/- buttons are used to increase or decrease the volume of the microphone.

DTMF

The DTMF phone-style button grid is used to enter the standard DTMF tone (0-9, *, #). Alternatively the hard keyboard of the FTB-1 platform can be used.

Inject Button

Injects alarms/errors based on settings from the *Inject Button* on page 344.

Laser Button

The **Laser** button enables or disables the laser for optical interfaces.

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 Ethernet test application at 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 as well as the S-OAM Responder 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 and the S-OAM Responder statistics 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.*

Test Control

Lpbk Tool Button (Loopback Tool)

- **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.

- **S-OAM Responder** check box when selected (default) allows to respond to LBM, LTM, DMM, LMM, and SLM valid messages (**Lpbk Tool** must be started, see **Loopback** button below). Traffic statistics are also monitored (refer to *Responder* on page 451).

Responds to... message	Responds with... message
LBM	LBR
LTM	LTR
DMM	DMR
LMM	LMR
SLM	SLR

Responder - TX Count reports respectively the count of LBR, LTR, DMR, LMR, SLR, and the total of frames transmitted.

Responder - RX Count reports counts of valid LBM, LTM, DMM, LMM, SLM, and the total of frames received. A valid messages must have its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address¹.

- **Loopback** button starts/stops looping back the frames/packets that are received. The default value is disabled.

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 646 for more information.

Test Control

Lpbk Tool Button (Loopback Tool)

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 module'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 - RJ45

- **Clock Mode:** Displays the clock mode
Internal: Internal clock of the unit (STRATUM 3).
- **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.

➤ **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.

Test Control

Lpbk Tool Button (Loopback Tool)

- **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 182 for more information.

SFP/SFP+ tab

Refer to *CFP/CFP2/XFP/SFP/SFP+* on page 134 for more information.

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

Phone Book Button

Note: Only available with *ISDN PRI* test application.

The **Phone Book** is used to configure, save, load, import, and export phone numbers and phone books.

Configure tab

The **Configure** tab allows to save a phone number and associate a name to it.

To save an entry to the Phone Book:

1. From the **Configure** tab, tap the **Create New Entry** button.
2. Enter a name associated to the phone number in the **Name** field. A maximum of 20 characters is allowed.
3. Enter the phone number in the **Number** field. A maximum of 30 digits is permitted.

A phone book can contain up to 100 entries. The list of phones is presented in alphabetical order.

To delete an entry from the Phone Book:

1. Select the check box of each entry to be deleted. Alternatively, tap the **(Un)Select All** button to select or un-select all entries in a phone book.
2. Tap the **Delete** button.
3. Tap **Yes** to confirm.

To edit an entry in the Phone Book:

1. Highlight the entry to be edited.
2. Enter the new name and/or phone number.

Save/Load tab

The save function stores the phone book.

To save a phone book:

1. From the **Save/Load** tab, select the media where the file will be saved: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
2. Tap on the **Save** button.
3. Type the name of the phone book file to be saved.
4. Tap **OK**.

The load function opens a previously saved phone book.

To load a phone book:

1. From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
2. Select the file from the list.
3. Tap the **Load** button.
4. Tap **OK**.

1. **Internal Storage** specifies that the file is saved in Documents\810-880-NetBlazer\PhoneBook.

To rename a phone book file:

- 1.** From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
- 2.** Select the file from the list.
- 3.** Tap the **Rename** button.
- 4.** Change the name of the phone book file.
- 5.** Tap **OK**.

To delete a phone book file:

- 1.** From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
- 2.** Select the file from the list.
- 3.** Tap the **Delete** button.
- 4.** Tap **Yes** to confirm the deletion.

1. **Internal Storage** specifies that the file is saved in Documents\810-880-NetBlazer\PhoneBook.

Import/Export tab

The import/export function allows to copy multiple files from a **Removable Drives to Internal Storage** (Import) or from **Internal Storage to Removable Drives** (Export).

To import/export phone book file(s):

1. From the **Import/Export** tab, select the media from where the files are located: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
2. Select the check box of each phone book file to be imported/exported. Alternatively, tap the **(Un)Select All** button to select or un-select all phone book files.
3. Select the destination where the file will be copied (**Copy To**).
4. Tap the **Copy** button.
5. Tap **Yes**.

To delete phone book file(s):

1. From the **Import/Export** tab, select the media from where the files are located: **Internal Storage**¹ or **Removable Drives** (USB media for example) if present.
2. Select the check box of each phone book file to be deleted. alternatively, tap the **(Un)Select All** button to select or un-select all phone book files.
3. Tap the **Delete** button.
4. Tap **Yes** to confirm.

1. **Internal Storage** specifies that the file is saved in Documents\810-880-NetBlazer\PhoneBook.

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).

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.

Test Control

Report Button

- **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 media where the report file will be saved: **Internal Storage** (default), or **Removable Disk**. **Removable Disk** is available only when there is a removable disk/key connected to the FTB-1 USB port. **Internal Storage** specifies to save the report in **Documents\810-880-NetBlazer\Reports**.
 - **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 549.

- **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 550) then select the new logo from the list.
Documents\810-880-NetBlazer\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 media containing the file to open: **Internal Storage**, or a removable drive (USB key for example) if present. **Internal Storage** lists reports from **Documents\810-880-NetBlazer\Reports**.
2. Select the report file to open 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 be 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 media from where the file(s) will be copied:
Internal Storage¹, or a removable drive (USB media for example) if present.
3. From the **Copy To** drop list, select where the file(s) will be copied:
Internal Storage or **Removable Drives**.
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 media from where the file(s) will be deleted;
Internal Storage¹, or a removable drive (USB media for example) if present.
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.

1. **Internal Storage** lists files from **Documents\810-880-NetBlazer\Reports** for reports or **Documents\810-880-NetBlazer\Reports\Images** for images.

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, RFC 6349, 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.*

Save/Load Tab

Tap the **Save/Load** button and the **Save/Load** tab.

The save function stores the configuration of the module including all test settings to a file.

To save a configuration:

1. Select the media where the file will be saved: **Favorites**, **Others**, or a removable drive (USB media for example) if present.

Favorites specifies that the configuration file is saved in **Documents\810-880-NetBlazer\Configuration\Favorites**.

Others specifies that the configuration is saved in **Documents\810-880-NetBlazer\Configuration**.

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 media from where the file will be loaded; **Favorites**¹, **Factory Defined**², **Others**³, or a removable drive (USB key for example) if present.
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 media where the file is located: **Favorites**¹, **Others**³, or a removable drive (USB key for example) if present.
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**.

1. **Favorites** lists configuration files from: **Documents\810-880-NetBlazer\Configuration\Favorites**.

2. **Factory Defined** lists the factory configuration files.

3. **Others** lists configuration files from: **Documents\810-880-NetBlazer\Configuration**.

Test Control

Save/Load Button

To delete a configuration file:

1. Select the media where the file is located: **Favorites**¹, **Others**², or a removable drive (USB key for example) if present.
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 the media where the file is located: **Others**², or a removable drive (USB key for example) if present.
2. Select the file from the list.
3. Tap the **Add to Favorites** button.

To remove a configuration file from the Favorites list:

1. Select the **Favorites** internal storage. The configuration files from the following folder are listed:
Documents\810-880-NetBlazer\Configuration\Favorites.
2. Select the file from the list.
3. Tap the **Remove from Favorites** button. The file will be moved into the **Others** internal storage corresponding to the following folder:
Documents\810-880-NetBlazer\Configuration.

1. **Favorites** lists configuration files from **Documents\810-880-NetBlazer\Configuration\Favorites.**

2. **Others** lists configuration files from **Documents\810-880-NetBlazer\Configuration.**

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 media from where the test configuration file(s) will be copied: **Favorites**¹, **Others**², or a removable drive (USB media for example) if present.
2. From the **Copy To** drop list, select either **Favorites**¹, **Others**², or a **Removable Drives** as the destination location where the file(s) will be copied.
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 media from where the file(s) will be deleted: **Favorites**¹, **Others**², or a removable drive (USB media for example) if present.
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.

1. **Favorites** lists configuration files from **Documents\810-880-NetBlazer\Configuration\Favorites**.

2. **Others** lists configuration files from **Documents\810-880-NetBlazer\Configuration**.

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 549. 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 547 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 restart¹ 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 platform power button for 5 seconds performs a power down reset and is also considered as a power failure condition.

When the power returns, the automatic power failure recovery restarts the platform, the module, 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 module 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, TCP Throughput, and Cable Test applications; these tests must be started manually.

To enable the automatic power failure recovery:

- 1.** Enable launching the application when starting the platform¹:
From Mini ToolBox, tap on the **System Settings** button, the **Startup Applications** button, and select the module's check box.
- 2.** Enable the platform automatic power on feature¹:
 - 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 platform 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.*

1. Refer to the platform user guide for more information.

When Using the Test Timer

Refer to *Timer* on page 277 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 *Suspend and Resume*

Suspend and Resume allow respectively the FTB-1 and its running applications to stop (Suspend) and to be quickly re-initialized (Resume) when the unit is turned back on.

Suspend Mode

To enter the suspend mode, refer to the FTB-1 user guide. . In Suspend Mode, the NetBlazer module is directly turned off and its configuration and injection information are kept. The Suspend Mode remains active as long as battery power or AC power is available. If the battery is drained the information is lost and the Resume operation is no more possible.

The following conditions prevent the activation of the Suspend Mode:

- A firmware download is in-progress
- Resume operation is in-progress.

Note: *The test will be stopped when entering the suspend mode meaning that the test logger content will be lost.*

Suspend and Resume

Resume Operation

Resume Operation

To enter the resume operation, turn on the FTB-1 by pressing the power button. During the resume operation, the module is re-initialized.

Note: *In the event a manual shutdown of the FTB-1 occurs, while the resume operation is in-progress, the resume operation is terminated and all the test configuration information is lost.*

The following conditions prevent the resume operation:

- The module status has changed (mismatch in serial number or module is missing).
- A module failure is detected.

14 *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 FTB-700G/800 Series 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).

Maintenance

Recycling and Disposal (Applies to European Union Only)

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.

15 *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 FTB-700G/800 Series.	Ensure to use a compatible SFP. Refer to <i>Modify Structure Button</i> on page 95.

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.

16 **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.

Warranty

Liability

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 572). 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 572).

Warranty

EXFO Service Centers Worldwide

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 10,
Yu Sheng Industrial Park (Gu Shu
Crossing), No. 467,
National Highway 107,
Xixiang, Bao An District,
Shenzhen, China, 518126

Tel: +86 (755) 2955 3100
Fax: +86 (755) 2955 3101
support.asia@exfo.com

A Specifications



IMPORTANT

The following technical specifications can change without notice. The information presented in this section is provided as a reference only. To obtain this product's most recent technical specifications, visit the EXFO Web site at www.exfo.com.



CAUTION

The operation and storage temperatures, as well as the altitude, humidity and IP rating of some modules may differ from those specified for your platform. In this case, always ensure that you comply with the most restrictive conditions (either module or platform).

Note: Refer to *FTB-700 Series user guide* for specifications on OTDR instrument.

General Specifications

Size (H x W x D) - 860/860G/860GL/870:	130 mm x 252 mm x 36 mm (5 1/8 in x 9 15/16 in x 1 7/16 in)
- 810/880/720G/720G+/ 730G/730G+:	130 mm x 252 mm x 56 mm (5 1/8 in x 9 15/16 in x 2 3/16 in)
Weight (without transceiver) - 860/860G/860GL/870:	0.58 kg (1.3 lb)
- 810/880:	0.97 kg (2.1 lb)
- 720G/720G+ /730G/730G+:	1.02 kg (2.25 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 93%, non-condensing
Maximum operation altitude	3000 m (9843 ft)
Pollution degree	3
Measurement category	Not rated for measurement categories II, III, or IV

Specifications

SFP SONET/SDH and OTN Optical Interfaces

SFP SONET/SDH and OTN Optical Interfaces

SFP SONET/SDH AND OTN OPTICAL INTERFACES												
Transceiver type	OC-3/STM-1				OC-12/STM-4				OC-48/STM-16/OTU1			
Reach and wavelength	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm
Model	FTB-8190	FTB-8191	FTB-8193	FTB-8192	FTB-8190	FTB-8191	FTB-8193	FTB-8192	FTB-8190	FTB-8191	FTB-8193	FTB-8192
Tx level (dBm)	-5 to 0	-2 to 3	-5 to 0	-2 to 3	-5 to 0	-2 to 3	-5 to 0	-2 to 3	-5 to 0	-2 to 3	-5 to 0	-2 to 3
Rx operating range (dBm)	-23 to -10	-30 to -15	-23 to -10	-30 to -15	-22 to 0	-27 to -9	-22 to 0	-29 to -9	-18 to 0	-27 to -9	-18 to 0	-28 to -9
Transmit bit rate	155.52 Mbit/s ± 4.6 ppm				622.08 Mbit/s ± 4.6 ppm				2.48832 Gbit/s ± 4.6 ppm 2.66606 Gbit/s ± 4.6 ppm			
Frequency offset generation (ppm)	±50				±50				±50			
Receive bit rate	155.52 Mbit/s ± 100 ppm				622.08 Mbit/s ± 100 ppm				2.48832 Gbit/s ± 100 ppm 2.66606 Gbit/s ± 100 ppm (OTU1)			
Operational wavelength range (nm)	1261 to 1360	1263 to 1360	1430 to 1580	1480 to 1580	1270 to 1360	1280 to 1335	1430 to 1580	1480 to 1580	1260 to 1360	1280 to 1335	1430 to 1580	1500 to 1580
Spectral width	1 nm (-20 dB)				1 nm (-20 dB)				1 nm (-20 dB)			
Measurement accuracy (uncertainty)												
Frequency (ppm)	±4.6				±4.6				±4.6			
Optical power (dB)	±2				±2				±2			
Maximum Rx before damage (dBm) *	3				3				3			
Jitter compliance	GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH) G.8251 (OTN)			
Line coding	NRZ				NRZ				NRZ			
Laser product	Class 1				Class 1				Class 1			
Connector*	LC				LC				LC			

- To avoid exceeding the maximum receiver power level before damage, an attenuator must be used.
- External adaptors can be used for other types of connectors.
- SFP+ compliance: The FTB-700G/800 Series selected SFP+ shall meet the requirements stated in the SFP-8431 "Enhanced Small Form-Factor Pluggable Module SFP+" Transceiver Multisource Agreement (MSA)." The FTB-700G/800 Series selected SFP+ shall meet the requirements stated in the "Specification for Diagnostic Monitoring Interface for Optical Xcvrs."

SFP+ 10G SONET/SDH and OTN Optical Interfaces

SFP+ ^c 10G SONET/SDH AND OTN OPTICAL INTERFACES			
Transceiver type	OC-192/STM-64/OTU2	OC-192/STM-64/OTU2	OC-192/STM-64/OTU2
Wavelength (nm)	1310	1550	1550
Model	FTB-8693	FTB-8694	FTB-8695
Tx level (dBm)	-6 to -1	-1 to 2	0 to 4
Rx level sensitivity (dBm)	-11 to 0.5	-14 to -1	-24 to -7
Maximum reach	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	9.9532 ± 4.6 ppm 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)	9.9532 ± 4.6 ppm 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)	9.9532 ± 4.6 ppm 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Reception bit rate (Gbit/s)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)
Tx operational wavelength range (nm)	1260 to 1355	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty)			
Frequency (ppm)	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2
Maximum Rx before damage (dBm) ^a	5	5	3
Jitter compliance	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)
Laser product	Class 1	Class 1	Class 1
Connector ^b	LC	LC	LC

Notes

- a. To avoid exceeding the maximum receiver power level before damage, an attenuator must be used.
- b. External adaptors can be used for other types of connectors.
- c. SFP+ compliance: The FTB-700G Series selected SFP+ shall meet the requirements stated in the SFP-8431 "Enhanced Small Form-Factor Pluggable Module SFP+" Transceiver Multisource Agreement (MSA).¹ The FTB-700G Series selected SFP+ shall meet the requirements stated in the "Specification for Diagnostic Monitoring Interface for Optical Xcvrs."

Specifications

DSn/PDH and SONET/SDH Electrical Interfaces

DSn/PDH and SONET/SDH Electrical Interfaces

DSn/PDH AND SONET/SDH ELECTRICAL INTERFACES								
Transceiver type	DS1	E1/2M		E3/34M	DS3/45M		E4/140M	STS-3e/STM-1e/155M
Tx pulse amplitude	2.4 to 3.6 V	3.0 V	2.37 V	1.0 ±0.1 V	0.36 to 0.85 V		1.0 ±0.1 Vpp	0.5 V
Tx pulse mask	GR-499 Figure 9.5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 17	DS-3 GR-499 Figure 9-8	45M G.703 Figure 14	GR-253 Figure 4-10/4-11	STS-3e GR-253 Figure 4-12, 4-13, 4-14
Tx LBO preamplification	0-133 ft 133-266 ft 266-399 ft 399-533 ft 533-655 ft				0 to 225 ft 225 to 450 ft		0 to 225 ft 225 to 450 ft	0 to 225 ft
Cable simulation	-22.5 dB -15.0 dB -7.5 dB 0 dB				450 to 900 (927) ft		450 to 900 (927) ft	
Rx level sensitivity	For 772 kHz: TERM: ≤26 dB (cable loss only) at 0 dBdsx Tx DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	For 1024 kHz: TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	For 1024 kHz: TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	For 17,184 MHz: TERM: ≤12 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	For 22,368 MHz: TERM: ≤10 dB (cable loss only) DSX-MON: ≤26.5 dB (21.5 dB resistive loss + cable loss ≤ 5 dB)	For 25,92 MHz: TERM: ≤10 dB (cable loss only) MON: ≤25 dB (20 dB resistive loss + cable loss ≤ 5 dB)	For 70 MHz: TERM: ≤12.7 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	For 78 MHz: TERM: ≤12.7 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB)
Transmit bit rate	1.544 Mbit/s ±4.6 ppm	2.048 Mbit/s ±4.6 ppm	2.048 Mbit/s ±4.6 ppm	34.368 Mbit/s ±4.6 ppm	44.736 Mbit/s ±4.6 ppm	51.84 Mbit/s ±4.6 ppm	139.264 Mbit/s ±4.6 ppm	155.52 Mbit/s ±4.6 ppm
Frequency offset generation	1.544 Mbit/s ±140 ppm	2.048 Mbit/s ±70 ppm	2.048 Mbit/s ±70 ppm	34.368 Mbit/s ±50 ppm	44.736 Mbit/s ±50 ppm	51.84 Mbit/s ±50 ppm	139.264 Mbit/s ±50 ppm	155.52 Mbit/s ±50 ppm
Receive bit rate	1.544 Mbit/s ±140 ppm	2.048 Mbit/s ±100 ppm	2.048 Mbit/s ±100 ppm	34.368 Mbit/s ±100 ppm	44.736 Mbit/s ±100 ppm	51.84 Mbit/s ±100 ppm	139.264 Mbit/s ±100 ppm	155.52 Mbit/s ±100 ppm
Measurement accuracy (uncertainty)								
Frequency (ppm)	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6
Electrical power (dB)	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5
Peak-to-peak voltage	±10 % down to 500 mVpp	±10 % down to 500 mVpp	±10 % down to 500 mVpp	±10 % down to 500 mVpp	±10 % down to 200 mVpp	±10 % down to 200 mVpp	±10 % down to 200 mVpp	±10 % down to 200 mVpp
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1 G.751 section 2.3	GR-499 section 7.3 (categories I and II)	GR-253 section 5.6.2.2 (category II)	G.823 section 5.1	G.825 section 5.1 GR-253 section 5.6.2.2
Input jitter tolerance	AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	GR-499 section 7.3 (categories I and II)	GR-253 section 5.6.2.2 (category II)	G.823 section 7.1 G.751 section 3.3	G.825 section 5.2 GR-253 section 5.6.2.3
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	HDB3	B3ZS	B3ZS	CM1	CM1
Input impedance (resistive termination)	100 ohms ±5 %, balanced	120 ohms ±5 %, balanced	75 ohms ±5 %, unbalanced	75 ohms ±5 %, unbalanced	75 ohms ±5 %, unbalanced	75 ohms ±5 %, unbalanced	75 ohms ±10 %, unbalanced	75 ohms ±5 %, unbalanced
Connector type	BANTAM and RJ-48C	BANTAM and RJ-48C	BNC	BNC	BNC	BNC	BNC	BNC

SFP/SFP+ CPRI/OBSAI Optical Interface

SFP/SFP+ FTTA INTERFACES					
CPRI/OBSAI					
Wavelength (nm)	850	1310	1310	1310	1550
EXFO product number	FTB-8590	FTB-8190	FTB-8191	SFP-8600	FTB-8192
Tx level (dBm)	-9 to -3	-5 to 0	-2 to 3	-8.2 to 0.5	-2 to 3
Rx level sensitivity (dBm)	-18 to 0	-18 to 0	-27 to -9	0.5 (max)	-28 to -9
Maximum reach	300 m on OM3 MMF	15 km	40 km	1.4 km (SMF)	80 km
Transmission bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288-9.8304	2.4576/3.072
Reception bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288-9.8304	2.4576/3.072
Tx operational wavelength range (nm)	830-860	1270-1360	1280 to 1355	1260 to 1355	1500 to 1580
Measurement accuracy (uncertainty) Optical power (dB)	±2	±2	±2	±2	±2
Max Rx before damage (dBm)	+5	+5	+3	+5	+3
Jitter compliance	IEEE 802.3	GR-253 (SONET) G-958 (SDH)	GR-253 (SONET) G-958 (SDH)	802.3ae	GR-253 (SONET) G-958 (SDH)
Laser type	VCSEL	DFB	DFB	FP/PIN	CML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC
Transceiver type	SFP	SFP	SFP	SFP+	SFP

SFP Ethernet Optical Interfaces

SFP ETHERNET OPTICAL INTERFACES							
	Two ports: 100M and GigE						
Available wavelengths (nm)	850, 1310 and 1550						
Model	FTB-85910	FTB-85911	FTB-8590	FTB-8190	FTB-8192	FTB-8596	FTB-8597
Transceiver type	100 Base-FX	100 Base-LX	1000 Base-SX	1000 Base-LX	1000 Base-ZX	1000 Base-BX10-D	1000 Base-BX10-U
Wavelength (nm)	1310	1310	850	1310	1550	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490
Tx level (dBm)	-20 to -15	-15 to -8	-9 to -3	-9.5 to -3	0 to 5	-9.5 to -3	-9.5 to -3
Rx level sensitivity (dBm)	-31	-28	-20	-22	-22	-20	-20
Maximum reach	2 km	15 km	550 m	10 km	80 km	10 km	10 km
Transmission bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Reception bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Tx operational wavelength range (nm)	1280 to 1380	1261 to 1360	830 to 860	1270 to 1360	1540 to 1570	1480 to 1500	1260 to 1360
Measurement accuracy (uncertainty)							
Frequency (ppm)	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2	±2	±2	±2	±2
Maximum Rx before damage (dBm) ^a	3	3	6	6	6	6	6
Jitter compliance	ANSI x3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Ethernet classification	ANSI x3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Laser type	LED	FP	VCSEL	FP	DFB	DFB	FP
Laser product	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector ^b	LC	LC	LC	LC	LC	LC	LC

SFP+ Ethernet Optical Interfaces

SFP+ ETHERNET OPTICAL INTERFACES			
Transceiver type	10G Base-SR/SW	10G Base-LR/LW	10G Base-ER/EW
Wavelength (nm)	850	1310	1550
Model	FTB-8690	FTB-8691	FTB-8692
Tx level (dBm)	-5 to -1	-8 to 0.5	-4.7 to 4.0
Rx level sensitivity (dBm)	-11.1	-12.6	-14.1
Maximum reach	300 m	10 km	40 km
Tx bit rate (Gbit/s)	9.95 to 10.3	9.95 to 10.3	9.95 to 10.3
Rx bit rate (Gbit/s)	9.95 to 10.3	9.95 to 10.3	9.95 to 10.3
Tx operational wavelength range (nm)	840 to 860	1260 to 1355	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm)	±4.6	±4.6	±4.6
Maximum Rx before damage (dBm) ^a	6	5	5
Jitter compliance	IEEE 802.3ae	IEEE 802.3ae	IEEE 802.3ae
Laser type	VCSEL	DFB	CML
Laser product	Class 1	Class 1	Class 1
Connector ^b	LC	LC	LC

Specifications

Ethernet Electrical Interfaces

Ethernet Electrical Interfaces

ELECTRICAL ETHERNET INTERFACES			
	Two ports: 10/100Base-T half/full duplex, 1000Base-T full duplex Automatic or manual detection of straight/crossover cable		
Transceiver type	10Base-T	100Base-TX	1000Base-T
Tx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s
Tx accuracy (uncertainty) (ppm)	±4.6	±4.6	±4.6
Rx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s
Rx measurement accuracy (uncertainty) (ppm)		±4.6	±4.6
Duplex mode	Half and full duplex	Half and full duplex	Full duplex
Jitter compliance	IEEE 802.3	IEEE 802.3	IEEE 802.3
Connector	RJ-45	RJ-45	RJ-45
Maximum reach (m)	100	100	100

SFP Fibre Channel Interfaces

SFP FIBRE CHANNEL INTERFACES					
FC-1x/2x/4x					
Wavelength (nm)	850	1310	1310	1550	
Model	FTB-85912	FTB-85913	FTB-85914	FTB-85915	
Tx level (dBm)	-9 to -2.5	-8.4 to -3	0 to 5	1 to 5	
Rx level sensitivity (dBm)	-15 at FC-4 -18 at FC-2 -20 at FC-1	-18 at FC-4 -21 at FC-2 -22 at FC-1	-18 at FC-4 -21 at FC-2 -22 at FC-1	-16.5 at FC-4 -20.5 at FC-2 -22 at FC-1	
Maximum reach (FC-1)	500 m on 50/125 µm MMF 300 m on 62.5/125 µm MMF	4 km	30 km	40 km	
Transmission bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	
Reception bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	
Tx operational wavelength range (nm)	830 to 860	1260 to 1350	1285 to 1345	1544.5 to 1557.5	
Measurement accuracy (uncertainty)					
Frequency (ppm)	±4.6	±4.6	±4.6	±4.6	
Optical power (dB)	±2	±2	±2	±2	
Max Rx before damage (dBm)	3	3	3	3	
Jitter compliance	ANSI FC-P1-2	ANSI FC-P1-2	ANSI FC-P1-2	ANSI FC-P1-2	
FC classification	ANSI FC-P1-2	ANSI FC-P1-2	ANSI FC-P1-2	ANSI FC-P1-2	
Laser type	VCSEL	Fabry-Perot	DFB	DFB	
Laser product	Class 1	Class 1	Class 1	Class 1	
Connector	LC	LC	LC	LC	

SFP+ Fibre Channel Interfaces

SFP+ FIBRE CHANNEL INTERFACES					
FC-8x/10x					
Wavelength (nm)	850	850	1310	1550	1550
Model	FTB-8696	FTB-8690	FTB-8693	FTB-8694	FTB-8695
Tx level (dBm)	-8.2 to -2	-5 to -1	-6 to -1	-1 to 2	0 to 4
Rx level sensitivity (dBm)	-11.1 to 0	-11.1 to 0.5	-14.4 to 0.5	-14 to -1	-24 to -7
Maximum reach	150 m on OM3 MMF	300 m on OM3 MMF	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Reception bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Tx operational wavelength range (nm)	840 to 860	840 to 860	1260 to 1355	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty)					
Frequency (ppm)	±4.6	±4.6	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2	±2	±2
Max Rx before damage (dBm)	+5	+5	+5	+5	+3
Jitter compliance	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3
FC classification	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3	ANSI FC-P1-3
Laser type	VCSEL	VCSEL	DFB	CML	EML
Laser product	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC

Specifications

Synchronization Interface

Synchronization Interface

SYNCHRONIZATION INTERFACES				
	External Clock DS1/1.5M	External Clock E1/2M	External Clock E1/2M	Trigger 2 MHz
Tx pulse amplitude (V)	2.4 to 3.6	3.0	2.37	0.75 to 1.5
Tx pulse mask	GR-499 Figure 9.5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 20
Tx LBO preamplification	Typical power dBdsx +0.6 dBdsx (0–133 ft) +1.2 dBdsx (133–266 ft) +1.8 dBdsx (266–399 ft) +2.4 dBdsx (399–533 ft) +3.0 dBdsx (533–655 ft)			
Rx level sensitivity	TERM: ≤6 dB (cable loss only) (at 772 kHz for T1) DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	TERM: ≤6 dB (cable loss only) MON: ≤26 dB (resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only)	≤6 dB (cable loss only)
Transmission bit rate	1.544 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	
Reception bit rate	1.544 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 6.1	G.823 section 6.1	G.703 table 11
Input jitter tolerance	AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.2 G.813	G.823 section 7.2 G.813	G.823 section 7.1 G.751 section 3.3
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	
Input impedance (resistive termination)	75 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced
Connector type	BNC*	BNC*	BNC	BNC
Note a. Adaptation cable required for BANTAM.				

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

Glossary

Acronym List

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&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

Glossary

Acronym List

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

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
FCC	Federal Communications Commission
FD	Frame Delay
FDI	Forward Defect Indication
FEC	Forward Error Correction
FLOGI	Fabric Login
FLR	Frame Loss Ratio
fps	Frame Per Second

Glossary

Acronym List

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

Glossary

Acronym List

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
LOFLOM	Loss of Frame Loss Of Multiframe
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

Glossary

Acronym List

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
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

Glossary

Acronym List

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
PDI	Payload Defect Indication
PDU	Protocol Data Unit
PE	Provider Edge
pFCS	payload Frame Check Sequence
PFI	Payload Frame Check Sequence Identifier
PHY	Physical Layer Device
PLI	Payload Length Indicator
PLM	Payload Label Mismatch
PLOGI	Port Login
PM	Performance Monitoring
PNO	Provisionable by the Network Operator
POS	Position Field
POSV	Position Field Violation

PPD	Path Payload Defect
ppm or PPM	parts per million
PRBS	Pseudo Random Bit Sequence
PRS	Primary Reference Source/Clock
PRC	Primary Reference Source/Clock
PSD	Path Server Defect
PSI	Payload Structure Identifier
PTI	Payload Type Identifier
PTP	Precision Time Protocol
Ptr. Incr.	Pointer Increment
Ptr. Decr.	Pointer Decrement
PTSF	Packet Timing Signal Fail
PW	Pseudo-Wire

Q

QL	Quality Level
QoS	Quality of Service
QSFP	Quad Small Form Factor Pluggable

R

R-LOF	Remote - Loss Of Frame
R-LOS	Remote - Loss Of Signal
RAI	Remote Alarm Indication
RDI	Reverse Defect Indication
RDI	Remote Defect Indication

Glossary

Acronym List

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
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

Glossary

Acronym List

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

Glossary

Acronym List

W

WAN	Wide Area Network
WIS	WAN Interface Sublayer
WWN	World Wide Name

10G Ethernet Client

The OTN Overclocked technology provides the capability to transparently transport 10G base-R Ethernet signals into OPU2 as specified in ITU-T. Two optical rates are provided:

- 11.0957 Gbits/s, +/- 100 ppm, designated OTU2e
- 11.0491 Gbits/s, +/- 100 ppm, designated OTU1e

The OTU2e uses the mapping scheme of CBR10G into OPU2 as defined in G.709. The client signal, 10GE LAN and the OPU fixed stuff bytes are accommodated into an OPU-like signal designated OPU2e. This signal is then wrapped in an ODU2e and then in an OTU2e signal.

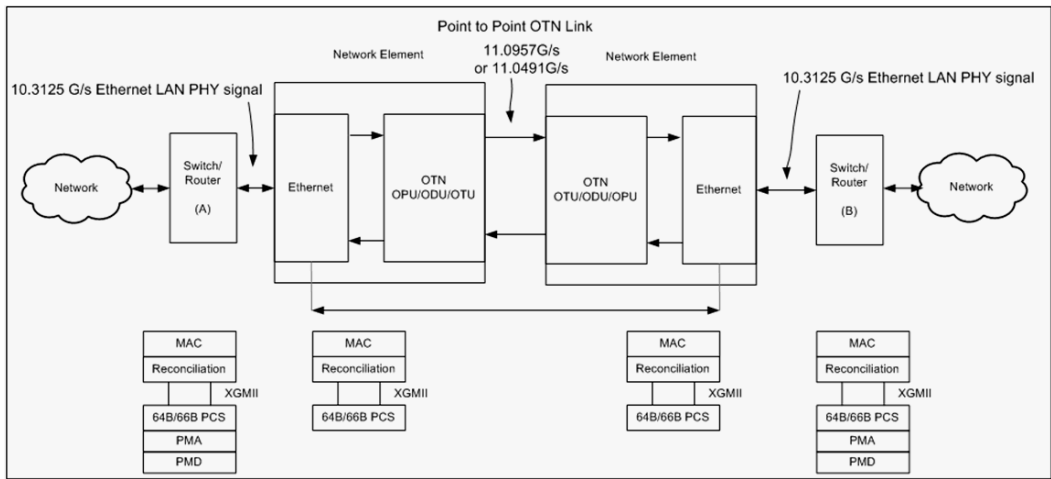
The OTU1e uses the mapping scheme of CBR2G5 into OPU1 as defined in G.709. The client signal, 10GE LAN is accommodated into an OPU-like signal designated OPU1e (note that the fixed stuff bytes are not left free) this is why the 10GE signal can be transported at a lower rate than OTU2e. This signal is then wrapped in an ODU1e and then in an OTU1e signal.

The transparent transport of the 10G base-R means that the full 10G Ethernet data rate i.e. 10.3125 Gbit/s is transported over OTN. This means that the following information is transported:

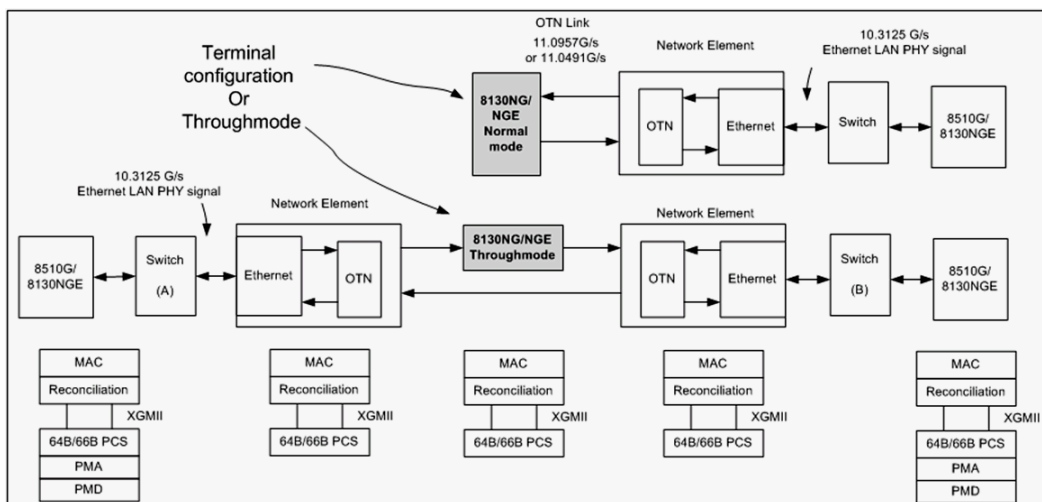
- PCS 64B/66B coded information
- IPG (inter-frame filler), MAC FCS, Preamble and SFD (start of frame delimiter) and Ordered Sets (Remote Fault indication)

The OTN clocking is derived from the Ethernet client signal which is +/- 100 ppm, this is outside the clock tolerance allocated by the G.709 standard which translates in unspecified jitter performance thus limiting the application to Point to Point data path.

The following figure presents a typical network application.



The following figure presents a typical test application.



The Ethernet layer provides the equivalent functionality of the BERT Framed Layer 2 Test application supported on EXFO's Datacom product family with the particularity that there is no Ethernet Physical port as such. The Ethernet frame has its Ethertype field set to 0x88B7.

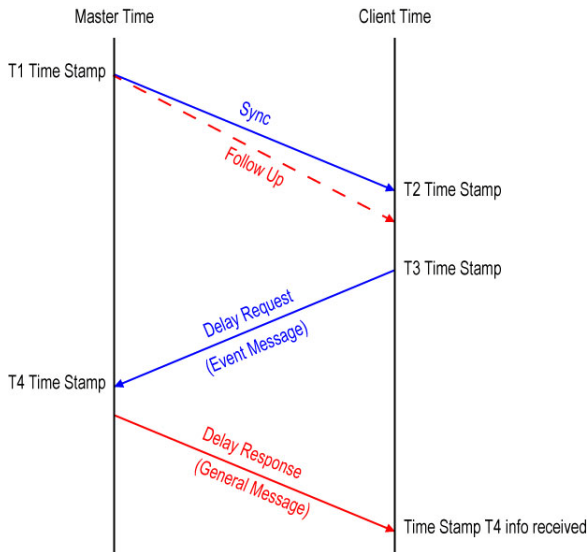
1588 PTP

The goal of the IEEE 1588 Precision Time Protocol (PTP) is to provide Network Synchronization using a packet based distribution mechanism.

Depending on the system application the Network Synchronization may require phase and frequency synchronization. 1588 PTP has the capability to deliver both by allowing a Client clock to track a Master clock in phase (time of day) and in frequency.

The protocol is based on exchange of time stamps between the Master clock and the Client clock. Two methods have been defined in the 1588 PTP standard:

- **Delay Request-Response** mechanism uses message Sync, Delay Request, Delay Response, and Follow Up (if required).



- **Peer Delay** mechanism uses message Pdelay Request, Pdelay Response, and if required Pdelay Response Follow Up. This mechanism is restricted to topologies where each peer-to-peer port communicates PTP messages with, at most, one other such port. Peer Delay is not supported by the Telecom Profile.

In order to minimize traffic on the network, PTP can operate in different modes:

- **Two-way** operation uses Sync/Follow Up, Delay Request, and Delay Response messages.
- **One-way** operation uses only the Sync/Follow Up messages. This mode of operation is used to synchronize a Client clock in frequency only. The Master clock and Client clock phases are not aligned.
- **Two-step** clock mode uses the optional Follow Up message to carry the T1 time stamp.
- **One-step** clock mode uses the Sync message to carry the T1 time stamp; no Follow Up message is transmitted by the Master clock, therefore less traffic on the network.

Client clock synchronization is achieved with a 2-part process:

- Part 1: Path delay measurement using bidirectional messages
$$\text{Mean path delay measurement (MPD)} = ((T2-T1) + (T4-T3)) / 2$$
- Part 2: Clock phase offset correction
$$\text{Offset} = (T2-T1) - \text{MPD}$$

The offset information is used by the Client clock to adjust the frequency of its oscillator in order to keep the phase offset close to zero.

The 1588 PTP supports the following Master/Client communication; however **Unicast** is used for the Telecom Profile.

- **Multicast:** A Master clock sends its Sync/Follow Up and Delay Response in a multicast mode. A Client can collect information from many Master clocks and select the Master clock that is best suited for its application.
- **Unicast:** A dedicated communication link is established between the Master and the Client clock. This mode of operation requires a negotiation which is initiated by the Client clock.

The 1588 PTP messages can be mapped on the following protocols; however UDP IPv4 is used for the Telecom Profile.

- UDP/IPv4
- UDP/IPv6
- Ethernet

1588 PTP Profiles

The purpose of a PTP profile is to allow organizations to specify particular selections of attribute values and optional features of PTP that, when using the same transport protocol, inter-work and achieve a performance that meets the requirements of a given application. The following describes the Telecom Profile.

The Telecom Profile G.8265.1 is designed for frequency synchronization in Telecom network applications. The main attributes of this profile are:

- Unicast communication with the Grand Master
- UDP/IPv4 network layer

With the Telecom Profile, the Client Clock initiates the communication to the Master Clock by making a request for service that consists of sending Signaling messages containing a REQUEST UNICAST TRANSMISSION TLV to the IP address of the Master Clock.

If the Master Clock has sufficient capacity to handle the Client Clock request, it responds with a signaling message containing a GRANT UNICAST TRANSMISSION TLV.

The REQUEST UNICAST TRANSMISSION TLV contains several parameters:

- **messageType** is the type of service being requested: Announce, Sync, or Delay Response.
- **durationField** is the duration of the requested service: 300 seconds by default and configurable from 60 to 1000 seconds.
- **logInterMessagePeriod**: transmission rate of the requested messages.

If the Master Clock denies the request, e.g. because it has no remaining capacity, it will send back a GRANT UNICAST TRANSMISSION TLV with the durationField set to zero.

In the event of being denied service by a Master Clock, or receiving no response to the service request, a Client Clock should wait a minimum of one second before issuing a new Unicast request to that Master Clock.

As Unicast service is only granted for a limited time, the Client Clock must re-request service periodically, before the expiration of the current grant. The Client Clock should reissue the request sufficiently far in advance of the expiration to allow the request to be repeated at least twice if no grant is received. This parameter is called Unicast renewal interval.

```

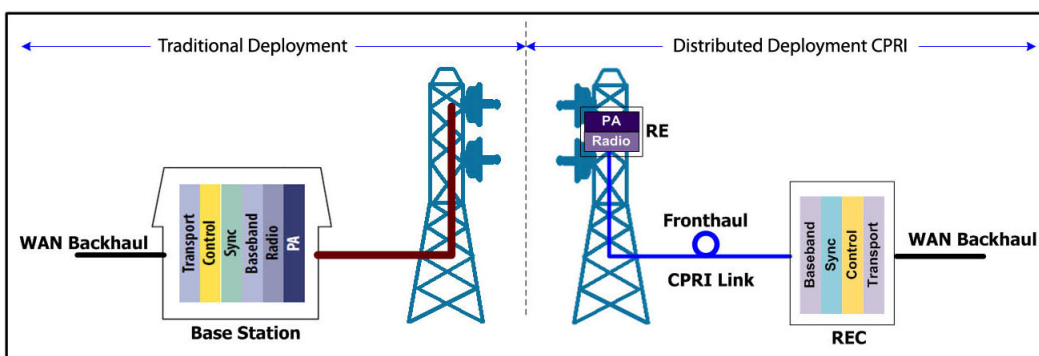
sequenceDiagram
    participant PC as Packet Client
    participant PM as Packet Master

    Note over PC, PM: Unicast renewal interval
    Note over PC, PM: Announce duration interval
    PC->>PM: Signaling (Announce-request)
    PM-->>PC: Signaling (Announce-grant)
    PC-.->>PM: Announce
    Note over PC, PM: Sync duration interval
    PC->>PM: Signaling (Sync-request)
    PM-->>PC: Signaling (Sync-grant)
    PC-.->>PM: Sync
    PC-.->>PM: Sync
    PC-.->>PM: Announce
    PC->>PM: Signaling (Announce-request)
    PM-->>PC: Signaling (Announce-grant)
    PC-.->>PM: Announce
    PC->>PM: Signaling (Sync-request)
    PM-->>PC: Signaling (Sync-grant)
    
```


CPRI

Overview

Traditional mobile installations are bulky (use thick coaxial cables) and require a lot of power to operate (there is a huge power loss in the coaxial cabling which often requires the use of Tower Mounted Amplifiers) as outlined in the following figure.



Pressures on the Mobile Network Operators (MNO) to reduce their capital, operational cost, and increase coverage are at the heart of a revolution in the mobile network. To address the situation, a concept of decomposition of the radio base station has been developed where the radio basic functions and its ability to transmit and receive radio modulated signals are separated. In such a distributed environment a protocol is required to maintain synchronization and management capabilities as well as transporting the user traffic between the simplified base station and its Remote Radio Head (RRH).

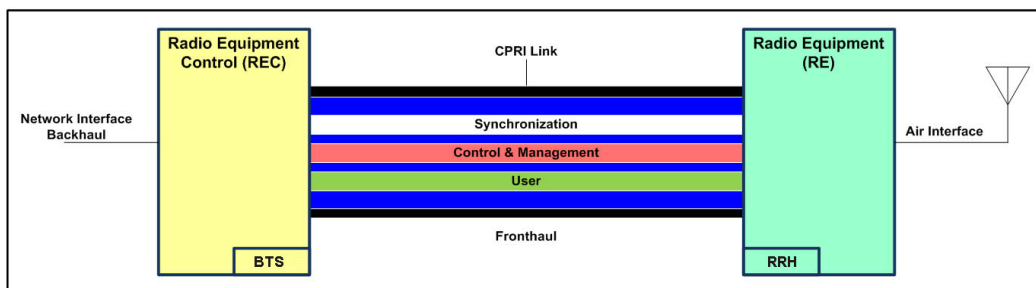
This protocol called Common Public Radio Interface (CPRI) separates a traditional radio base station configuration into two separate elements: Radio Equipment Control (REC) and the Radio Equipment (RE). The REC processes the baseband radio digital information and performs the control of the Radio Equipment. The RE converts the digital radio information into radio frequency signals transported over the air interface (antenna). The REC and RE are interconnected by a point-to-point link. This link carries the CPRI protocol and is known in the industry as the fronthaul as opposed to the backhaul that is the WAN bringing the network traffic to the base station.

The CPRI link can be extended over several kilometers as it uses fiber optics, in fact it can be deployed up to 40 km although most field installations at the moment of this writing are below 10 km.

The CPRI standard covers the physical and data link layers only. This specific focus provides additional development freedom to the various vendors to implement proprietary functions at upper layers.

Functional Description

As mentioned earlier, CPRI remotely locates the RE from the REC. This means that the RE must be controlled, managed and synchronized from the REC in addition to transporting the User information (Voice and user application data) and all that on the same digital link. As such, CPRI is composed of 3 communication flows multiplexed into a single serial signal transmitted in the same optical fiber as illustrated in the following figure.

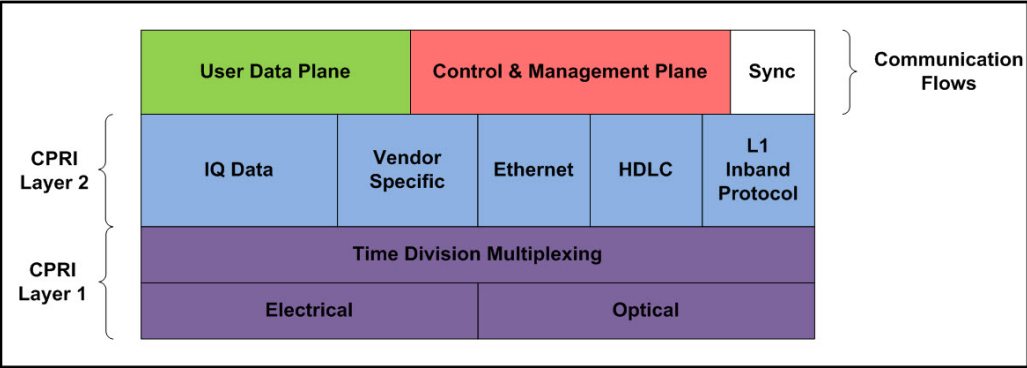


An electrical link is also available from CPRI but it is typically used for base station shelf interconnection. Since a state machine drives the link parameters (rates, protocol, and C&M channel) alignment, a BTS (defined as Master in the standard) and RRH (defined as Slave in the standard) interfaces are defined where the Master initiates the negotiation procedure necessary to achieve this alignment.

- **Synchronization:** Provides precise frequency and frame timing alignment from BTS to RRH to ensure accurate frequency and timing of the RF signal transmission and reception on the Air Interface. In essence, it provides the reference frequency for the RE.
- **Control & Management (C&M):** Management of the link between the REC and RE as well as control over radio functions such as alarms and power.
- **User:** Also known as IQ Data, represents the voice and data information that is exchanged by end-User Equipment (UE)

CPRI Model

The CPRI Model revolves around the 3 communication flows described above. CPRI defines only the Layer 1 and Layer 2 associated to these communication flows as outlined in the following figure.



The User Data Plane contains mostly voice/data traffic in the form of IQ Data samples. IQ Data digitally encodes the change in amplitude/phase of a user device modulated signal sampled at the RE antenna.

The Control & Management Plane maintains the CPRI link itself and provides the facility to manage the operation of the RE radio functions. It is done through the L1 Inband Protocol which provides a bit oriented channel defined to support link specific alarms (R-LOS, R-LOF, ...). Also, the Ethernet/HDLC channel offer two OAM&P channel alternatives which are respectively high and low bandwidth with rates configurable based on the CPRI line interface rate. These carry proprietary information between the REC and RE. Some Vendor Specific overhead is also available.

Finally, the Synchronization flow ensures frequency stability and offers the overhead necessary for frame alignment between the REC and RE to ensure hitless channel or frequency hopping. All these flows are time division multiplexed onto one optical fiber for CPRI field deployments such as Distributed Antenna Systems (DAS).

Physical Interface

CPRI offers 8 options in terms of interface rates. Rates below 10G uses 8B/10B line coding as per CPRI V6.0 while rates above 10G use 64B/66B coding. Depending on the rates used, scrambling is optional. Depending on the CPRI signal structure (Framed or Unframed) the scrambling is either manually configured or negotiated.

Option	Rate	Line Coding	Protocol Version (Scrambling)
1	614.4 Mbit/s ^a	8B/10B	Version 1: No scrambling
2	1.2288 Gbit/s		
3	2.4576 Gbit/s		
4	3.0720 Gbit/s		
5	4.9152 Gbit/s		Version 1: No scrambling Version 2: Scrambling (Scrambling is optional)
6	6.1444 Gbit/s		
7	9.8304 Gbit/s		
8	10.1376 Gbit/s ^a	64B/66B	Version 2: Scrambling

- a. Not supported as presently not used in the field.

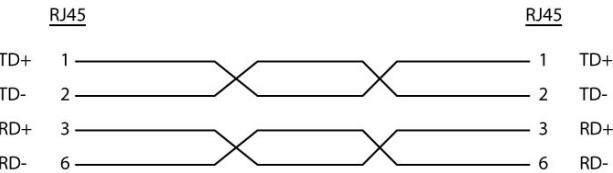
Ethernet Cables

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).

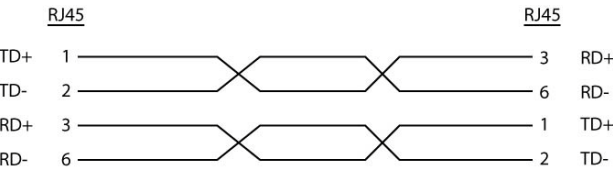
➤ **Straight Through Cable (10/100 Mbit/s)**

An Unshielded Twisted Pair (UTP) straight through cable is required to connect a 10Base-T/100Base-TX NetBlazer port to a layer 1 or 2 device (ex: HUB, switch).

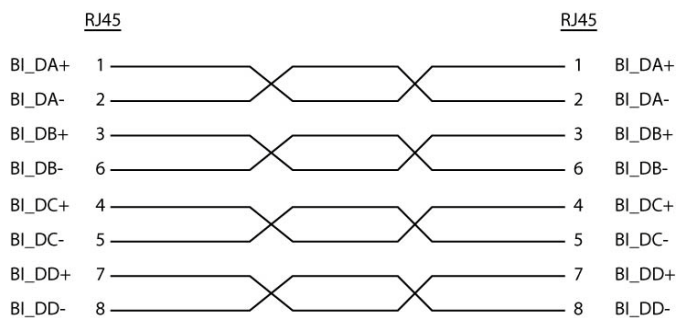


➤ **Crossover Cable (10/100 Mbit/s)**

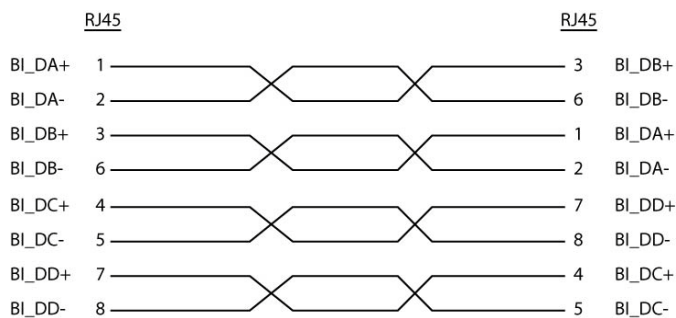
An Unshielded Twisted Pair (UTP) crossover cable is required to connect the 10Base-T/100Base-TX NetBlazer port to a layer 3 device (ex: router).



➤ **Straight Through Cable (1000 Mbit/s)**



➤ **Crossover Cable (1000 Mbit/s)**



G.709 Optical Transport Network (OTN)

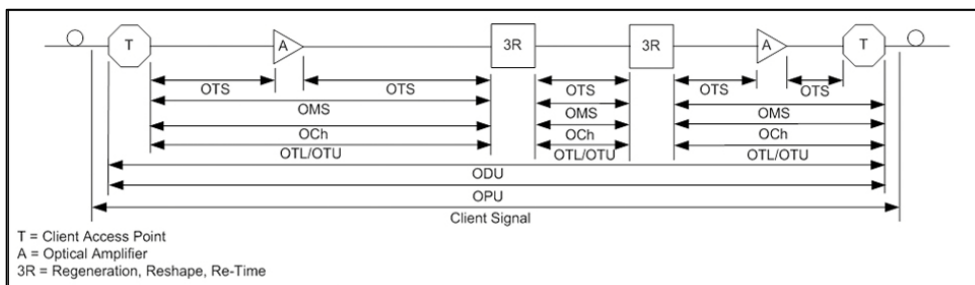
Overview

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.

Glossary

G.709 Optical Transport Network (OTN)

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 ($255/238 \times 2.488\,320\text{ Gbit/s} \approx 2.666057143\text{ Gbit/s}$) also referred to as 2.7 Gbit/s
- OTU2 ($255/237 \times 9.953280\text{ Gbit/s} \approx 10.709225316\text{ Gbit/s}$) also referred to as 10.7 Gbit/s
- OTU3 ($255/236 \times 39.813120\text{ Gbit/s} \approx 43.018413559\text{ Gbit/s}$) also referred to as 43 Gbit/s
- OTU4 ($255/227 \times 99.532\,800\text{ Gbit/s} \approx 111.809973568\text{ Gbit/s}$) also referred to as 112 Gbit/s.

The following non standard rates are also defined:

- OTU1e ($255/238 \times 10.3125\text{ Gbit/s} \approx 11.0491071429\text{ Gbit/s}$)
- OTU2e ($255/237 \times 10.3125\text{ Gbit/s} \approx 11.0957278481\text{ Gbit/s}$)
- OTU3e1 ($255/236 \times 4 \times 10.3125\text{ Gbit/s} \approx 44.570974576\text{ Gbit/s}$)
- OTU3e2 ($243/217 \times 16 \times 2.488320\text{ Gbit/s} \approx 44.583355576\text{ Gbit/s}$)

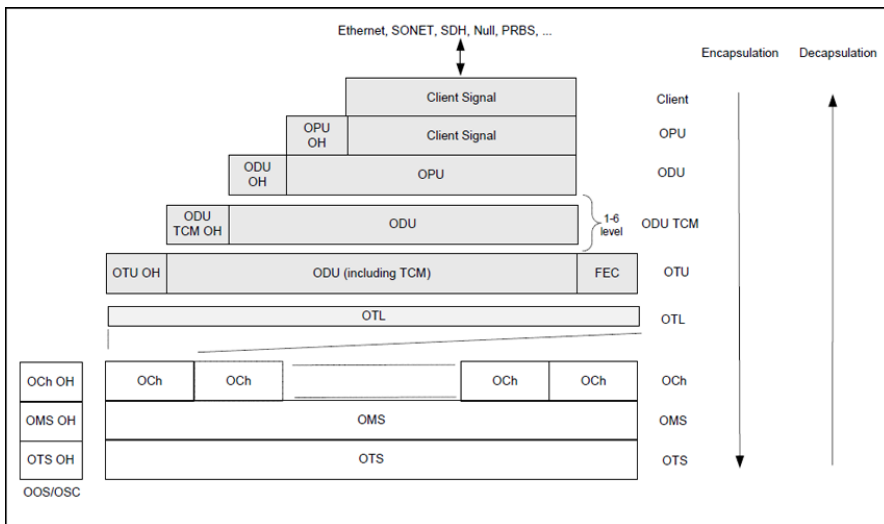
The following non standard rates are not covered by the ITU standard but they are the equivalent function associated to Fiber Channel rates:

- OTU1f ($255/238 \times 10.51875\text{ Gbit/s} \approx 11.2700892857143\text{ Gbit/s}$)
- OTU2f ($255/237 \times 10.51875\text{ Gbit/s} \approx 11.3176424050633\text{ Gbit/s}$)

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 OTU_k ($k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2$)
- PRBS31 is transported via OTU_k ($k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2$)

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

Glossary

G.709 Optical Transport Network (OTN)

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.

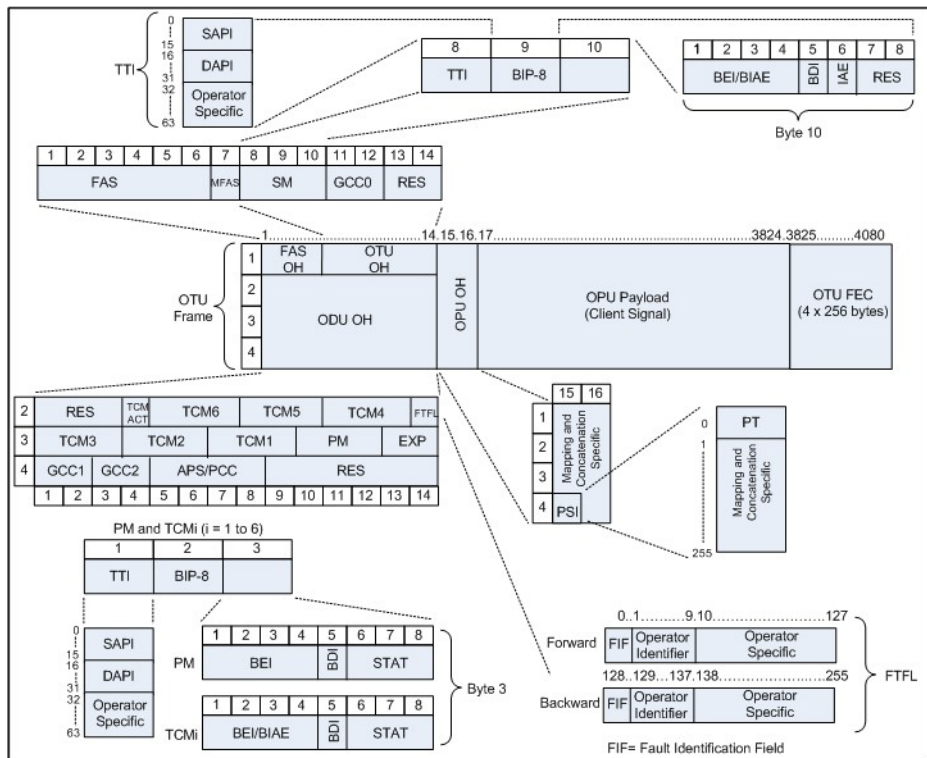
Following the OTN structure presented in figure *Basic OTN Transport Structure* on page 619, OTUks ($k = 1, 2, 3$) are transported using the OCh; each unit is assigned a specific wavelength of the ITU grid. Several channels can be mapped into the OMS and then transported via the OTS layer. The OCh, OMS 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 621, 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.

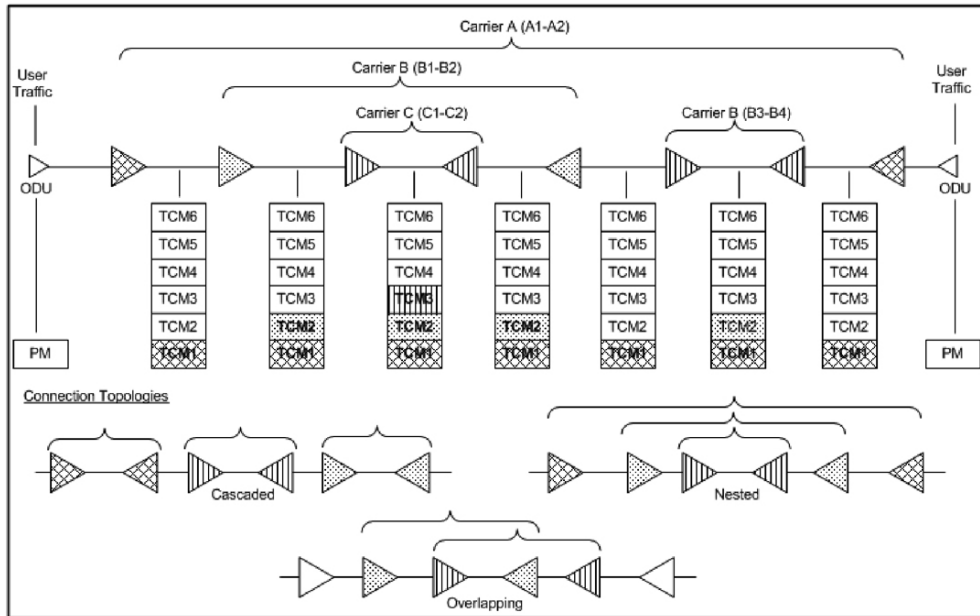
➤ **Optical Payload Unit (OPU)**

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 626, 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)

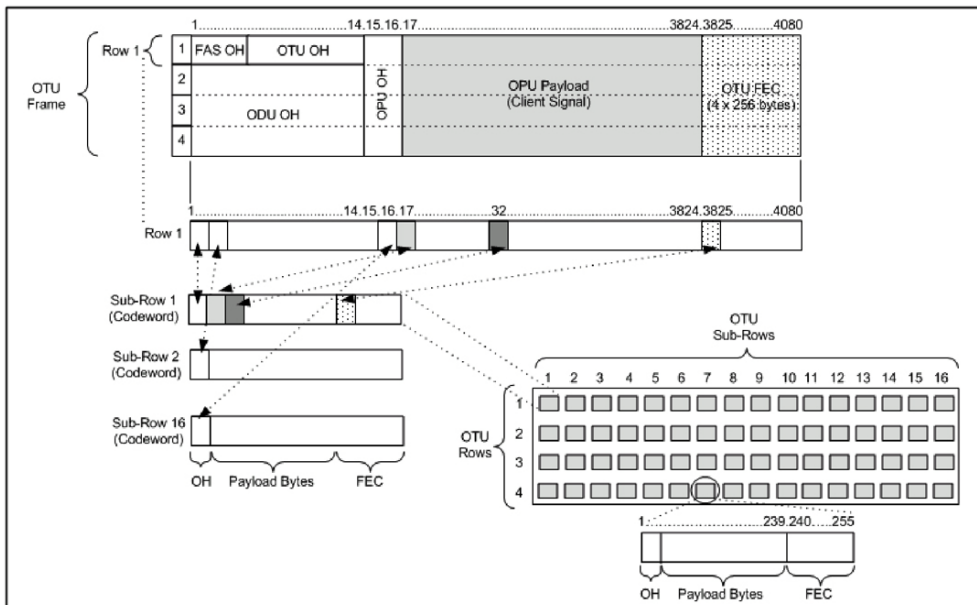
The ITU G.709 standard supports forward error correction (FEC) in the OTU frame and is the last part added to the frame before the frame is scrambled. FEC provides a method to significantly reduce the number of transmitted errors due to noise, as well as other optical phenomena that occur at high transmission 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 628. 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.

Glossary

G.709 Optical Transport Network (OTN)

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 41 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.

Glossary

G.709 Optical Transport Network (OTN)

The main attributes of the ODU multiplexer functionality are as follows:

- The Asynchronous Mapping Procedure (AMP) is used for multiplexing the tributary signals; this method uses a modified Justification Control mechanism which has 2 positive Justification Control bytes and one negative Justification Control byte.
- The new multiplex method also supports the Generic Mapping Procedure as the Justification Control mechanism is still using the OPU OH JC bytes.
- The Multiplex Structure Identifier (MSI) provides information that is specific to each type of multiplexer provided.
- Can handle multiplex signals with frequency offset of +/- 20 ppm on every layer for the legacy architecture while the new architecture (using GMP) can handle frequency offset of +/-100 ppm.

ODUflex

ODUflex provides the capability to carry client payload of variable size with a container size of 1.244 Gbit/s granularity. An ODUflex (L) signal can be transported once multiplexed in an ODUk (H) signal, the multiplexer in this case handles tributary slots of 1.244 Gbit/s and has a Payload Type 21. The ODUflex function can be used to transport 2 signal categories mapped in ODTUk.ts using GMP:

➤ Ethernet in ODUflex over GFP-F signal

The Ethernet packets are mapped in GFP-F as specified in G.7041, the packets are processed as follows:

- The Start of Frame Delineation bytes are terminated
- Inter Frame Gaps bytes are terminated
- PCS coding is terminated
- GFP overhead bytes added

Since the PCS coding is terminated, it is not possible to transport the Ethernet Link status transparently but it is accommodated by the Forward Defect Indication (FDI) and Remote Defect Indication (RDI) alarms over GFP. The RDI is used to carry the Remote Fault alarm while the FDI is used to carry the Local Fault.

GFP-F provides rate adaptation between the incoming Ethernet signal and the outgoing OPUflex transport signal. This brings the fact that GMP is operated at a fixed Cm value close to the maximum server capacity.

➤ CBR over ODUflex signal

ODUflex can transport Constant Bit Rate signal (bulk filled Test pattern) as Client of the ODUflex CBR function. This CBR function needs a Pattern generator that can operate at a data rate specified by the user, the range of the available data rates is qualified by the Bandwidth management function.

OTN Signal Rates

Rate	Signal
2.666057143 Gbit/s	OTU1
10.709225316 Gbit/s	OTU2
11.0491 Gbit/s	OTU1e
11.0957 Gbit/s	OTU2e
11.2701 Gbit/s	OTU1f
11.3176 Gbit/s	OTU2f

MPLS Labels

The MPLS labels are listed in the following table.

Label	Description
0	IPv4 explicit null
1	Router alert
2	IPv6 explicit null
3	Implicit null
14	OAM alert
4 to 13, and 15	Unassigned
16 to 1048575	Label ID

SONET/DSn/SDH/PDH

SONET/DSn/SDH/PDH Nomenclature

The GUI will use the International or European nomenclature based on the SONET and SDH software options installed on the FTB-700G/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

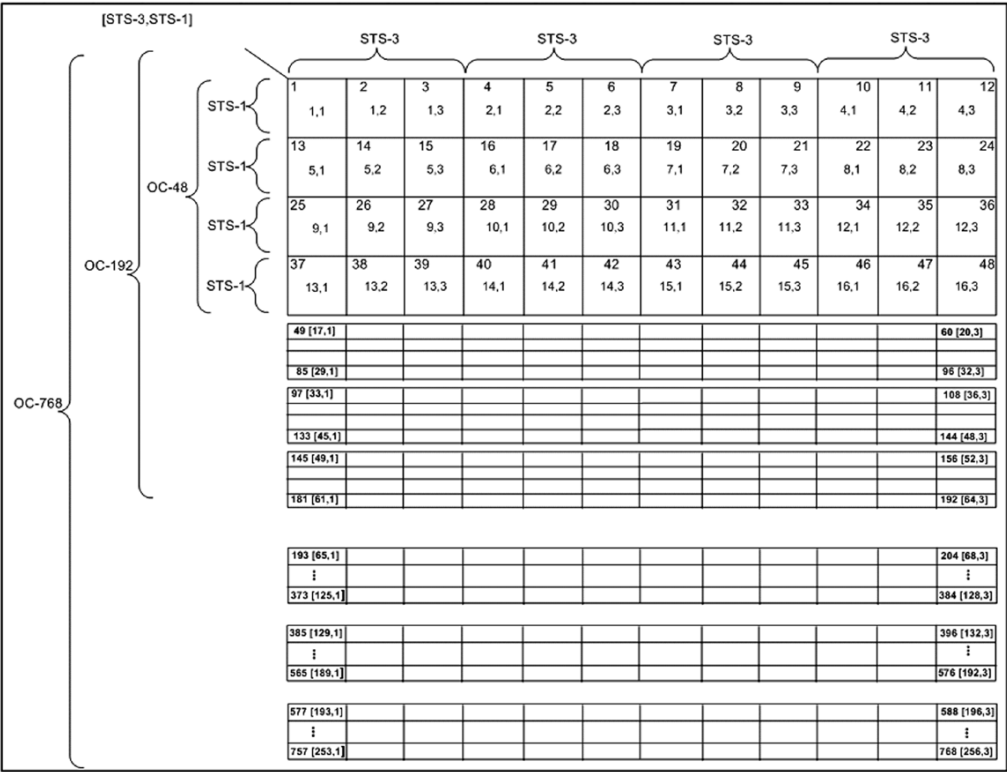
Layer	SONET	SDH
Low Order Path	AIS-V	TU-AIS
	LOP-V	TU-LOP
	RDI-V	LP-RDI
	ERDI-VCD	ERDI-CD
	ERDI-VPD	ERDI-PD
	ERDI-VSD	ERDI-SD
	RFI-V	LP-RFI
	UNEQ-V	LP-UNEQ
	TIM-V	LP-TIM
	PLM-V	LP-PLM
	BIP-2	BIP-2
	REI-V	LP-REI

SONET Numbering Convention

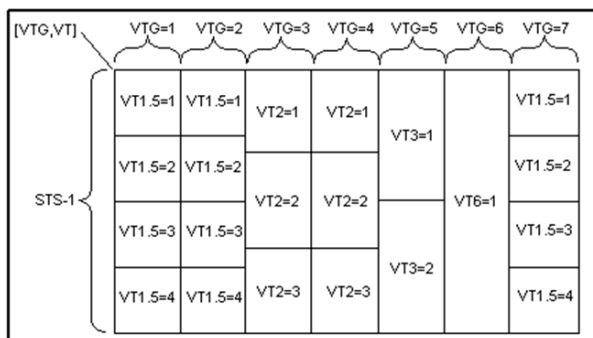
The FTB-700G/800 Series supports the Timeslot (default) and hierarchical two-level numbering conventions as per GR-253.

Hierarchical Notation:

The FTB-700G/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 FTB-700G/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 FTB-700G/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 exists.

SDH Numbering Convention

As per ITU G.707, the high order paths are defined using a 2 to 5 level convention E,D,C,B,A depending on the rate of the STM-n used.

- E: the AUG-64 are numbered 1 to 4
- D: the AUG-16 are numbered 1 to 4
- C: the AUG-4 are numbered 1 to 4
- B: the AUG-1 are numbered 1 to 4
- A: the AU-3 are numbered 1 to 3

So for the naming is as follows for each of the following rate:

- [E,D,C,B,A] for STM-256

Glossary

SONET/DSn/SDH/PDH

- [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.

B=1				B=2				B=3				B=4														
E=1	D=1	C=1	1	A=1	2	A=2	3	A=3	4	A=1	5	A=2	6	A=3	7	A=1	8	A=2	9	A=3	10	A=1	11	A=2	12	A=3
		C=2	13	A=1	14	A=2	15	A=3	16	A=1	17	A=2	18	A=3	19	A=1	20	A=2	21	A=3	22	A=1	23	A=2	24	A=3
		C=3	25	A=1	26	A=2	27	A=3	28	A=1	29	A=2	30	A=3	31	A=1	32	A=2	33	A=3	34	A=1	35	A=2	36	A=3
		C=4	37	A=1	38	A=2	39	A=3	40	A=1	41	A=2	42	A=3	43	A=1	44	A=2	45	A=3	46	A=1	47	A=2	48	A=3
	D=2	[1,2,1,1,1]																								[1,2,1,4,3]
		[1,2,4,1,1]																								[1,2,4,4,3]
		[1,3,1,1,1]																								[1,3,1,4,3]
		[1,3,4,1,1]																								[1,3,4,4,3]
	D=4	[1,4,1,1,1]																								[1,4,1,4,3]
		[1,4,4,1,1]																								[1,4,4,4,3]
E=2	[2,1,1,1,1]																								[2,1,1,4,3]	
	⋮																								⋮	
	[2,4,4,1,1]																								[2,4,4,4,3]	
E=3	[3,1,1,1,1]																								[3,1,1,4,3]	
	⋮																								⋮	
	[3,4,4,1,1]																								[3,4,4,4,3]	
E=4	[4,1,1,1,1]																								[4,1,1,4,3]	
	⋮																								⋮	
	[4,4,4,1,1]																								[4,4,4,4,3]	

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]

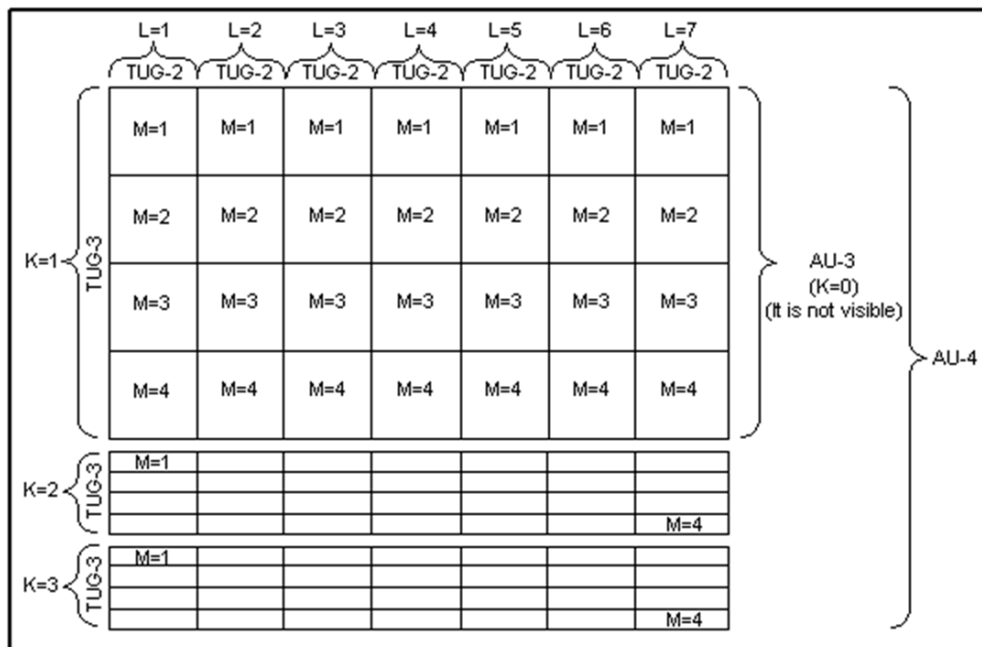
TU-12: [L,M] M is numbered 1 to 3

TU-11: [L,M] M is numbered 1 to 4

Glossary

SONET/DSn/SDH/PDH

The GUI Grid indicates the TUG-2 [x] and TUG-3 [x] values.



DSn/PDH Numbering Convention

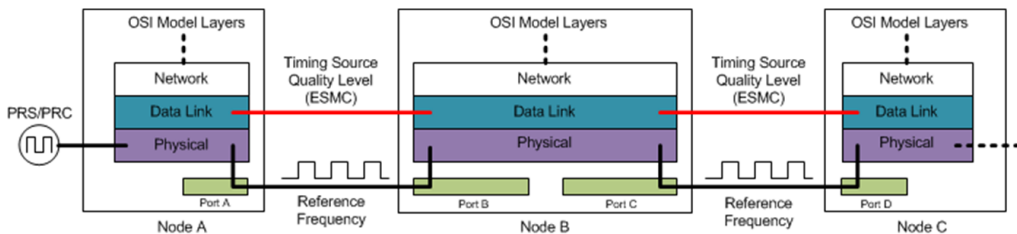
The DS1 numbering in DS3 shall be numbered with respect to the DS2 muxing [DS2,DS1]. For example a DS3 has 7 DS2 and a DS2 has 4 DS1, so an example would be for a DS1 number [3,2]. The DS3 shall have a single number to represent its position. That is [1] all the time whether it is used in an STS-1 or 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.

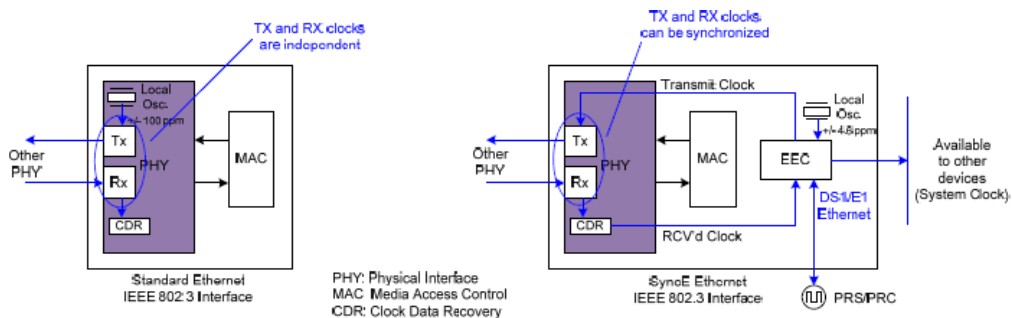
SyncE

Synchronous Ethernet or SyncE enables a traceable network timing reference frequency to be distributed node-by-node across a chain of Ethernet devices (SyncE compliant devices only). The network timing reference is typically hierarchically traceable to a Primary Reference Source/Clock (PRS/PRC) in a unidirectional flow. Any node in the chain not compliant to SyncE automatically terminates the synchronization propagation but this does not impact the flow of traffic.



The Physical Layer carries the clock frequency and the Data Link layer carries the Quality Level (QL) associated to the transported frequency via Synchronization Status Messaging (SSM) embedded in the Ethernet Synchronization Message Channel (ESMC). The QL is transported via Information and Event PDUs typically transmitted at a rate of 1 frame per second but this rate can vary between 1 to 10 messages per second to respect the slow protocol rules. The Information PDU is used as heart-beat for the channel while one Event PDU is transmitted asynchronously to the Information PDU upon change of the QL value. Following this change, the Information PDU is also adjusted to match the new QL.

In order for an Ethernet interface to be considered Synchronous Ethernet compliant it needs to be upgraded as shown in the following diagram. In addition to supporting the ESMC channel, this upgrade consists in allowing the recovered clock from the CDR to be propagated to a function called the Ethernet Equipment Clock (EEC).



The EEC is present in a network element (NE) to determine which port should be used to distribute the frequency to other port(s) in the NE as well as what QL value to transmit over the ESMC to other network element in the network synchronization chain. The actual selection decision is based on the QL value received from the various port(s) in the NE. If none are valid the EEC is equipped with a better oscillator than a standard Ethernet interface to provide synchronization (Holdover mode). Typically the highest QL value is selected among the nominated sources within the network element.

Unicast/Multicast Addresses for Ethernet OAM

Unicast or multicast address can be used for most of S-OAM functions.

- Unicast addresses a unique destination address of the MEP.
- Multicast Class 1 addresses all MEPs in the MEG. The address value is 01-80-C2-00-00-3x, where x represents the MEG/MD Level.
- Multicast Class 2 addresses all MIPs and MEPs in the MEG. The address value is 01-80-C2-00-00-3y, where y represents the MEG/MD Level + 8.

The following table specifies which address type is used for each frame type.

Frame Type	Unicast	Multicast		Frame Type	Unicast	Multicast	
		Class 1	Class 2			Class 1	Class 2
CCM	X	X		LMM	X	X	
LBM	X	X		LMR	X		
LBR	X			SLM	X	X	
LTM			X	SLR	X		
LTR	X			AIS	X	X	
TST	X	X		CSF	X	X	
DMM	X	X		LCK	X	X	
DMR	X						

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

Index

1.5M/2M	22
10G	19
155M-2.5G	18
1588 PTP	65, 110
2M-155M	22
2M-52M	22
802.1ag	218

A

A1	488
A2	488
Abort Frame	447
About button	32
Absolute	350, 360
Accept Connection from IP	275
Accuracy	208
Accuracy (Frames)	209
Acronym	583
Activate	253
Active Call	418
Actual L4	413, 427
Add Step	138
Additional Payload	476
Address	157, 175, 176, 177, 184, 185, 186
Address Type	222, 224, 345
Addressing	229
Advertised BB_Credit	141
after-sales service	568
AIS	298, 299, 300, 301, 302, 303, 312, 317, 318, 326, 450
AIS-L	328, 340
AIS-P	330, 340
AIS-V	337
Alarm/Status	469
Alarms background color	288
Alarms/Errors Logger	360
Alarms/Status and Unassigned	467

ALERTING	352
Alignment	305
All	349
Amount	345, 468
Announce	111
ANSI TI-403	464
Answer Mode	161
Application buttons	32
Apply Channel TX to RX	249
APS	457
APS/PCC	485
Architecture	459
ARM	278
Arrow buttons	35
Arrows	93
Assign to Capture	472
Attempts	502
AU Path (C2)	166, 355
AU Path (J1)	444
AU Path (N1)	283, 444
AU-AIS	330
AU-LOP	330
Auto	148, 149
Auto-Answer	161
Automatic	147, 177, 186
Automatic IP (DHCP)	158, 174, 183
Auto-Negotiation	146, 156, 541
Auto-Reject	161
Auto-Response Loopback Status	422
AUX	24
AU-x	330
Available	230
Available BB_Credit	140
Average	289
Average RX Rate	382
Average TX Rate	384
Avg RX Rate	406
Avg. Round Trip Time	505

Index

B

B1..... 329, 342, 488
B2..... 329, 342, 490
B3..... 332, 342, 494
Background..... 246
Background Traffic..... 257
Back-to-Back..... 209, 424
Back-to-Back button..... 349
Base Station..... 108
Batch button..... 229, 263
Battery/AC Icons..... 28
BBE..... 365, 368
BBER..... 366, 369
B-Channel..... 164
BDI..... 312, 315, 318
BEI..... 314, 316, 320
Bell..... 247
BER..... 294
BER Pass/Fail Verdict..... 164
BER Threshold..... 117, 127, 408
BERT..... 115, 126
BIAE..... 315, 318
Bidirectional..... 204
Binary..... 165, 248
Binary/Hex..... 179
BIP-2..... 339
BIP-8..... 314, 316, 320
Bit Error..... 117, 127, 295, 392, 408
Bit Error Count..... 392, 417
Bit Error Rate..... 392, 417
Bit-Oriented Message..... 460
Block..... 305
BNC..... iv
BPV..... 310
BPV/CV..... 310
BRIDGE..... 124
Bridge Request..... 459
Broadcast..... 445
BSD..... 312
BSF..... 312
Buffer Delay..... 413, 428

Buffer to Buffer Flow Control..... 140
Buffer Usage..... 478
Burst..... 268, 382
Burst Count..... 269
Burst Duty Cycle..... 269
Burst Frames..... 132
Burst Max Rate..... 235
Burst Sequence..... 132
Burst Size..... 236, 382
Burst Test..... 136
Burst Time..... 209
Burst/IR Frame Ratio..... 133
Burt..... 132

C

C/R..... 462
C&M..... 149, 394
C&M Channel..... 149
C2..... 166, 495
cable..... 614
Cable Delay..... 520
Cable Mode..... 147, 542
Cable Test..... 64, 121
Calibration Failed..... 517
Call..... 161, 163
Call All at Start..... 159
Call at Start..... 160
Call Control..... 162
Call Establishment/Termination..... 162
Call Management..... 159
Call Origination Settings..... 159
CALL PROCEEDING..... 352
Call Reference..... 416
Call State..... 354
Called Number..... 354, 416
Calling Number..... 354, 416
Calling Party..... 159
Cancelled..... 517
Capture button..... 479
Capture Source..... 475
Capture Status..... 478

Carrier Ethernet OAM.....	62	Config/Save	547
Cause Definition.....	354	Configuration/Performance Tests.....	410
Cause Value.....	354	CONNECT.....	352
caution		Connect.....	110, 201, 532
of personal hazard.....	2	CONNECT ACK.....	352
of product hazard.....	2	Connected	134, 203, 215
CBS.....	136, 237	Connection	215
CBS Test Time.....	133	Connector....	96, 102, 106, 107, 108, 156, 540
CC Function.....	222	Continuity Check	222
C-CDI.....	327	Continuity Check (Peer MEP)	430
CCM	431, 450	Continuous	224, 268, 516
certification information	iii	Control	468
C-FDI	326	conventions, safety.....	2
Cfg. Status	477	Copy	230
Channel.....	164, 246, 416, 458, 468, 533	Copy From Throughput	211
Channel buttons.....	415	Copy RX.....	283, 348, 444
CIR.....	191, 216, 232, 236	Copy Service	230
CIR or CIR+EIR Frames	132	Copy Services button.....	230
CIR+EIR.....	191, 236	Copy Stream button	263
Circuit.....	464, 465	Count	288, 518
Classification	188, 193	Couple with Interface	170
cleaning		Coupled	100
front panel.....	563	Coupled RX to TX	115, 126
Cleaning Optical Connectors	564	CP-bit	299
Clear Logger.....	350	CPRI.....	127, 297, 394, 609
Client.....	99	CPRI/OBSAI BERT.....	68
Clock	123, 296	CRC-4	301
Clock block.....	94	CRC-6	298
Clock Class	112, 398	C-RDI	327
Clock Mode	112, 123, 398, 540	Critical Event	420
Clock Synchronization	123	CSF	317, 450
C-LOS	326	Cumulative Offset.....	515
Code.....	348	Current	289
Code Word	394	Current Throughput	440
Codeword	460, 467, 468	customer service.....	571
Collision	306	Cut Through	425
Command/Response.....	463	CV.....	310, 391
Committed	230		
Committed - Burst Test	382		
Committed Steps.....	383		
Complete.....	476		
Config TCM	255		

D

D1	489
D2	489

Index

D3 489
D4 through D12 490
DAPI 280, 442
DAPI ODU-TIM 281, 443
DAPI OTU-TIM 281, 443
DAPI TCM-TIM 281
Data Call Pattern 164
Data Size 502
Date and Time 28
Date Stamp 358
D-Ch Down 311
D-Ch FCS 311
D-Channel 164
Decoupled 100
Default all OH 500
Default Gateway 158, 177, 178, 183, 186
Default OTN OH 481
Defaults 139
Defect 118, 344
Delay 179, 502, 518
Delay (ms) 379
Delay Measurement 399
Delay Mode 110
Delay Req IPDV 399
Delay Skew 401
Delay Skew Threshold 121
Delay T14 519
Delay-Request 111
Delete Step 139
Destination 140
Destination Flooding 173
Destination IP Address 174, 501
Destination MAC Address 172, 448
Destination Node ID 458
Destination Port 181
Details 361
Differentiated Services 180
Direction .. 133, 215, 228, 382, 383, 405, 412,
424, 427
Disabled 149, 518
DISC 351
DISCONNECT 352

Disconnect 201, 532
Disconnected 134, 203, 215
Discover Remote 134, 203, 215
Discovered Topology 141
Displayed Results 349, 424
Disruption Count 393
Disruption Monitoring 119, 128
Disruption Time 393
Distance To Fault 403
DM 351, 366
DMM 450, 451, 539
DMR 451, 539
Domain 110
Domain ID 221
Drop Eligible 173, 187, 223, 225, 345, 521
DS0 check box 246
DS0/E0 Size 247
DS1 298, 422
DS3 299
DSCP Codepoints 180
DSn/PDH BERT 46
DSn/PDH Multiplexing 99
DSX-MON 124
Dual RX 100
Dual Test Set 134, 203
Duplex 147
Duration 217, 277, 360
Dying Gasp 421
Dynamic Ramp 138

E

E0 check box 246
E1 300, 488
E2 301, 494
E3 302
E4 303
EB 364, 367
E-bit 301
EBS 136, 237
EBS Test Time 133
EC 364, 367

ECN	180	Ethernet BW	362, 445, 474, 538
Efficiency	438	Ethernet Frame	131
EFS	367, 417	Ethernet OAM	105
EMIX	191, 234	Ethernet Traffic.....	439
EMIX Frame Sizes	234	EtherSAM	53
Emulation Mode.....	108	EtherType	172
Enable	231, 264, 471	Event	360, 376
Enable TX	130	Event Count.....	436, 464
Enabled Time.....	471	Event Counts	465
Encapsulation.....	476	Event Running Total	359
equipment returns	571	Event XXX - Additional Information.....	353
ERDI-CD	331	Exc. Coll.....	306
ERDI-PCD	331, 342	Excess - Burst Test.....	382
ERDI-PD	331	Excess Steps.....	383
ERDI-PPD	331, 342	Exit button	32
ERDI-PSD	332, 341	EXP	484
ERDI-SD	332	Expected	144, 283, 348
ERDI-VCD	339	Expected Message	279
ERDI-VPD	339	Expected QL.....	113, 272, 372, 374
ERDI-VSD	338	EXT CLK	23
Error Count	358, 474	Ext Clock In.....	123
Error Running Total	359	External	123
Errors background color.....	288	EXZ	310
ES	364, 367, 417		
ESD	6		
ESF	364	F	
ESMC.....	272, 435	F1	489
ESMC Generation	273	F2	496
ESMC Loss	333	F3	497
ESMC Monitoring.....	272	Fabric.....	141
ESMC Rate Threshold	273	Fabric Status.....	142
ESMC RX Rate	435	Factory Default	182, 274
ESR.....	366, 369	FAIL	30, 289
Estimated BB_Credit.....	409	False Carrier	305
Estimated Time.....	204	Far-End	367
EtherBERT	56, 126	FAS	297, 301, 302, 303, 320
Ethernet	149, 260, 304, 538	FAS-S	329
Traffic	445	Fault Indication.....	143, 347
Ethernet (All Unicast)	260, 538	Fault Indication Code.....	143
ETHERNET 10/100/1000M.....	22	F-bit.....	299
ETHERNET 100/1000M.....	21	FC BERT	67, 126
ETHERNET 10G	20	FC Frame	129

F

F1	489
F2	496
F3	497
Fabric.....	141
Fabric Status	142
Factory Default	182, 274
FAIL	30, 289
False Carrier	305
Far-End	367
FAS	297, 301, 302, 303, 320
FAS-S	329
Fault Indication.....	143, 347
Fault Indication Code.....	143
F-bit	299
FC BERT	67, 126
FC Frame	129

Index

FCS	181, 305, 308	Frame Loss Configuration	210
FD	194, 411	Frame Loss Rate	440
FEAC	467	Frame Loss Ratio	433
FEBE	299	Frame Loss Threshold	220
FEC	254, 627	Frame Number	479
FEC-CORR	320	Frame Rate	362, 409, 445, 474, 538
FEC-CORR-BIT	320	Frame Size 129, 131, 192, 205, 226, 229, 233, 262, 266, 349, 446	
FEC-CORR-CW	320	Frame Sync	394
FEC-CORR-SYMB	320	Frame Type	191, 445
FEC-STRESS-CW	321	Framed L2	108
FEC-UNCORR	321	Framed Layer 1	103
FEC-UNCORR-CW	321	Framed Layer 2	103
Fibre Channel	140, 307	Framing 97, 103, 108, 110, 124, 125, 229, 245, 262	
Field Match	477	Framing Bit	298
Filter	350, 473	Frequency	124, 154, 243, 309, 395, 419
Mask	474	Frequency/Offset	436
Operator	474	FRMR	351
Value	473	front panel, cleaning	563
Filter Configuration	472	FSD	312
Filter x	475	FSF	313
Filters	471	FTFL	143, 483
Fixed	191, 266	FTFL/PT	347
Flood Range	173	Function	224
Flow Control	147, 541	Functions	31
Traffic	447		
Flow Direction	204		
Flow Label	179		
FLR	194, 411		
Force Release	253		
Format	282, 283		
Frame Count 227, 269, 362, 409, 445, 474, 478, 538			
Frame Count - RX	447		
Frame Delay	224, 379, 433		
Frame Delay Threshold	220		
Frame Distribution	205		
Frame Format	171, 182		
Frame Loss 194, 224, 237, 270, 271, 323, 380, 386, 387, 406, 411, 424			
Frame Loss / Out-of-Sequence			
Stream	387		
Frame Loss button	349		

G

G.709 OTN	616
G.742 Bit 12	525
G.751 Bit 12	524, 525
G.751 Bit 14, 15, 16	524, 525
G.8113.1	218
G1	496
GAL	223
GCC0	482
GCC1	485
GCC2	485
Generate & Save	480
Generated	166, 282
Generated Message	279

Generated Messages	460, 464, 467
Generated QL	273, 374
Global	
EtherSAM	134
RFC 2544	203, 204
Services	228
Streams	262
Global alarm	30
Global indicator	29
Global IPv6 Address	176, 185
Global Options	137, 204, 230, 263
Global Pass/Fail Verdict	270
Global Test Duration Estimate	136
Global Thresholds Type	270
Global Verdict	30
GM Info	112, 398
GM IP Address	110
Graph	
RFC 2544	349
Traffic	449
GTE	247

H

H1	489
H2	489
H3	489
H4	496
H4-LOM	330
Hang-Up	163
Hang-UP All	163
HDLC	149
HDLC Mode	164
Header Layer	476
Headset	23
Help button	32
HOP Limit TTL	179
HP-PLM	331
HP-PLM/HP-UNEQ	355
HP-RDI	331
HP-REI	332
HPTC-IAIS	334

HPTC-IEC	336
HPTC-LTC	334
HPTC-ODI	334
HPTC-OEI	336
HPTC-RDI	335
HPTC-REI	336
HPTC-TIM	335, 444
HPTC-UNEQ	257, 334
HPTC-VIOL	335
HP-TIM	283, 330, 444
HP-UNEQ	330
Hyperframe	394

I

I (Information)	350
IAE	315, 318
ID	360
Ideal L4	413, 427
Identification label	568
Identity	112, 398
Idle	248, 299, 305, 462
Idle Code	165
IFDV	194, 411
Import/Export tab	555
Information	376
Information Count	436
Information Rate	236
Informational	382, 384
Initial Window Size	276
Inject	408, 448, 460, 468, 507
Inject button	344, 346
Injection	464
Injects	460
Interface	146, 155, 309, 422, 475
Interface block	93
Interface ID Coupled	176, 185
Interface Type	123, 125
Interface/Rate95, 101, 106, 107, 108, 155, 540	
Internal	123, 540
Invalid DMR	379
Invalid LBR	377

Index

Invalid LMR 380
Invalid LTR 522
Invalid Payload 378
Invalid SLR 381
Invalid TST 378
Invert 117, 126, 164
IP 174, 202, 260, 538
IP Address 158, 183, 221
IP Checksum 311
IP TOS/DS 110, 179, 275, 502
IP Version 158, 171, 183
IP/UDP/TCP 311
IPDV 371
IPDV Threshold 113
IPv4 174, 183
IPv6 175, 184
IPv6 Destination Address 177
iSAM 40
ISDN 311
ISDN Logger 350
ISDN PRI 52
ISDN Settings 164

J

J0 488
J0 Trace 151, 453
J1 494
J1 Trace 151, 453
J2 499
Jabber 305
jammed bit 8 247
JC 482, 484, 485
Jitter 194, 271, 385, 387, 411, 440
 Streams 387
Job Information 547

K

K1 457, 490
K2 458, 490
K3 497

K4 500
Keyboard usage 36

L

L1 Reset 394
L2 188
L3/L4 188
Label 223, 453
Label 1 223, 362
Label 2 223, 362
label, identification 568
Labels 166, 355
LASER 24
Laser 152, 239
Laser OFF at Start-Up 152, 157, 239
Laser On 567
Last 289
Last Change 372, 399, 436
Last Link Trace Status 521
Last QL Message 436
Last QL Received 372, 374, 399
Late Coll. 306
Latency 194, 271, 385, 388, 411, 424, 440
 Streams 388
Latency button 349
Latency Configuration 211
Latency Measurement Mode 137
Latency Tag 129
Latency Tag Insertion 129
Layer 188, 344, 425
Layer 2 messages 350
Layer 3 messages 352
LBM 450, 451, 539
LBO 125, 240
LBR 451, 539
LBR Timeout 377
LCD-P 341
LCK 313, 326, 450
Lease Duration 111
LED 24
Legend TX/RX 486

Length.....	401, 403	Loop UP.....	531
Length Threshold	121	Loopback.....	224, 250, 260, 377, 469, 539
Length Unit	121	Loopback Commands	468, 470
Line	328	Loopback Mode.....	105, 538
Line Coding	124, 125, 241	Loop-Down.....	201, 250, 253
Line Utilization	362, 409, 445, 474, 538	Loop-Up	201, 250, 253
LINK.....	146, 155	LOP-P	330, 341
Link Activity.....	462, 465, 469	LOPPS-L	137, 296
Link Capacity	263	LOPPS-R	137, 296
Link Down	297, 304, 307	LOP-V	337
Link Events	357	LOS.....	309, 391
Link Fault.....	421	Loss Announce	322
Link OAM	168, 420	Loss Continuity.....	324
Link Trace	521	Loss Sync	322
LINK/RX	24	LP-ERDI-CD	339
Link-Local IPv6 Address	175, 184	LP-ERDI-PD.....	339
LMM.....	450, 451, 539	LP-ERDI-SD.....	338
LMR.....	451, 539	LP-PLM.....	167, 338
LOC	296	LP-PLM/LP-UNEQ.....	355
Local.....	215	LP-RDI	337
Local block	90	LP-REI	339
Local Clock	147, 542	LP-RFI	337
Local Fault Det.	304	LPTC-	336
Local Fault Detected	307	LPTC-IAIS	334
Local Fault Rcd.	304	LPTC-LTC	334
Local Fault Received	307	LPTC-ODI	334
Local Module Identification.....	532	LPTC-OEI	336
Local Parameters	221	LPTC-RDI	335
Local to Remote	204	LPTC-TIM	283, 335, 444
Location	354	LPTC-UNEQ	257, 334
LOF.....	297, 300, 301, 302, 303, 319, 340	LPTC-VIOL	335
LOF-S	328	LP-TIM	283, 338, 444
Logger.....	360	LP-UNEQ	167, 338
Alarms/Errors Logger	360	LSP.....	223
ISDN	350	LTC	315
Logger Full 390, 396, 407, 414, 420, 423, 427, 429, 434, 437, 440		LTM	450, 451, 539
Login	141	LTR	451, 539
Logo	549	LTR Timeout.....	522
LOM	319		
LOMF.....	300		
Loop Down	531		

M

M0	491, 494
M1	491, 494
MA Name	221
MAC	202
MAC Address	182, 221, 222
MAC/IP/UDP	170
MAID	221
maintenance	
front panel	563
general information	563
Manual	147, 344, 408, 477
Manual Loopback Status	422
Margin	211
Mask	
Filter	474
Matching & Swapping	260
Max Hop Count	503
Max Jitter	237
Max Latency	237, 406
Max Offset	419
Max Rate	344, 408
Max Round Trip Time	505
Max Round-Trip Latency	237
Max RX Power	152, 239
Max RX Rate	406
Max TX Rate	269
Max. (-/+) Offset	436
Max. Jitter	406
Max. Negative Offset	243
Max. Offset	154
Max. Positive Offset	243
Max. Rate	207, 210
Maximum	289
Maximum OAMPDU Size	356
Maximum Window Size	276
MD Level	222
Measure Delay button	517
Mechanism	110
MEF	218
MEG ID	221
MEG Level	222, 345
MEP ID	222
Message Rate	111
Message Type	350
Metrics	385
MFAS	321, 481
Mid-Trigger	478
Min Round Trip Time	505
Min RX Power	152, 239
Minimum	289
Minimum RTT	412, 427
Minimum Window Size	276
Mismatch '0'	295
Mismatch '1'	295
Mismerge	324
Mode	110, 260, 344, 467, 516
Modify DS0	247
Modify E0	247
Modify Frame Structure	171
Modify Loop Codes	251, 253
Modify Structure	93
Ethernet Test Applications	101
Packet Sync Test Applications	106, 107
Transport Test Applications	95
Wireless Test Applications	108
Modify Structure button	95
MON	124
Monetary Cost	180
MPLS	174, 362
MPLS Label	171
MPLS-TP Label Stack	223
MPLS-TP Mode	223
MPLS-TP OAM	105, 218, 324, 356, 377
Traffic	450
MPLS-TP OAM Responder	219
MS	328
MS-AIS	328
MS-RDI	329
MS-REI	329
MS-REI Computation Method	257
MTU	412, 427
Multicast	445

Multiplexer Action.....	356
Multiple Connections	215

N

N1	497
N2	499
n-Burst	268
NDF	515
Near-End	364
Negative	154
Negotiation Status	111, 397
Network	161, 182
Network block	90
Network Details.....	188, 199
Network Layer	171
New Data Flag	507
New Pointer	507
Next HOP Router	221
n-Frame.....	268
NI/CSU Emulation	51
NJO	485
No Defect Time	119, 128
No NDF.....	515
No Pattern Analysis (Live)	115, 126
No Traffic	294
No Traffic Time	128
None	247, 249
None (All 1's)	469
Non-Unicast	446
n-Ramp	268
Number	160, 257
Number of Burst Sequence.....	133
Number of Calls	232, 265
Number of Channels	232, 265
Numbering Plan	159
Numbering Type.....	159

O

OA1	481
OA2	481
OAM Mode	168, 218, 356

OAM Quick Ping	222
OAM Type.....	105
OAM Version	356
OCI	313
ODU.....	624
ODU Multiplexing	629
ODU1.....	255
ODU1f	255
ODU2.....	255
ODU2e.....	255
ODU2f	255
ODUflex.....	631
ODUx	312
ODUx-TCM.....	315
Offset	124, 153, 154, 242, 243, 395, 419
On Error.....	477
One-step.....	112, 398
One-Way Latency Threshold	214
OOF	298, 299, 319
OOM.....	319
Operation Mode	215, 459
Operator	
Filter.....	474
Operator Identifier.....	143, 347
Operator Specific.....	143, 280, 347, 442
Operator Sys Access.....	161
OPU	625
OPU Tributary Port.....	255
OPU Tributary Slots.....	255
OPU-PLM	145, 348
OPUx	317
OTL	622
OTN	481
OTN BERT	41
OTN Multiplexing.....	97
OTU	623
OTU frame structure	621
OTU overhead.....	621
OTU1	254
OTU1e	254
OTU1f.....	254
OTU2	254

Index

OTU2e	254
OTU2f	254
OTUx	318
OUI	172, 356
Out-of-Seq.	323
Out-of-Sequence	270, 271, 386, 387, 441
Oversize	305, 308
Oversize Monitoring	306
Overtake	201
Overwrite Fixed Stuff	257

P

Packet Capture	475
Packet Pause Time	448
Packets Received	505
Packets Transmitted	505
Pair	401
Parameters	133, 215
Parser Action	356
PASS	30, 289
Pass/Fail Verdict 114, 117, 119, 121, 127, 128, 129, 137, 204, 217, 220, 273	
FAIL	289
PASS	289
Path Signal Label (C2)	151, 453
Path/Mapping	
DSn/PDH BERT	47
OTN BERT	42
SONET/SDH - DSn/PDH BERT	49
SONET/SDH BERT	44
Pattern	115, 126, 249
Pattern Error	127, 295, 392
Pattern Error Count	392
Pattern Error Rate	392
Pattern Loss	294
Pause Frames	447
Payload	181, 227
Payload Content	248
Payload Type	144, 348
P-bit	299
PD	194
PDI-P	331
Peer MEP Parameters	222
Per Direction Configuration	137
Percentage Lost	505
Performance	417
Performance Criteria	194, 237
Performance Information	466
Performance Monitoring	363
Performance Report Message	464
Performance Test	189
Period	223, 225, 269, 345
Phone Book Name	163
Physical clock port	93
Physical Interface	
Electrical	240
Optical	239
Physical interface port	93
Ping & Trace Route	501
Ping button	502
Pins	401
PLM	317
PLM-P	331, 341
PLM-P/UNEQ-P	342, 355
PLM-V	167, 338
PLM-V/UNEQ-V	355
PM	484
PM & TCM	483
PM TTI Traces	279, 442
Point To Point	141
Pointer Adjustment	506
Pointer Value	506, 515
Port Status	142
Positive	154
Post-Trigger	478
Power Range	152, 239, 540
Power Recovery 390, 396, 407, 414, 420, 423, 426, 429, 434, 437, 440	
Preamble/SFD	172
Precedence	179
Prefix Mask	177, 186
Pre-Trigger	478
Primary Port / Secondary Port	102

Priority 157, 173, 186, 222, 225, 345, 460, 462, 521

PRM 462, 466

PRM Bit Events 464, 465

product

- identification label 568
- specifications 573

Profile 110, 190, 232

- Services 231
- Streams 264

Profile button 265

PROGRESS 353

Progress Desc. No 354

Progress Description 354

Prompt 161

Prop. Delay 400, 403

Prop. Delay Threshold 121

Protected Channel 458

Protocol 148, 394

Protocol block 93

PSI 485

PSP (Link Protocol) 148

PTP 322

PTP Alarm Timeout/Threshold 113

PTP Message 370

PTP Stats 370

Ptr. Decr. 515

Ptr. Incr. 515

PW 223

Q

QL Message 436

QL Mismatch 322, 333

QL Mismatch Frame Count 375, 436

QL Mismatch Monitoring .. 113, 272, 372, 374

QL Rate 273

QoS Metrics 270, 323

QoS Metrics Tags Insertion 263

Quality Level 113, 372, 374, 399

Quantity 205

Quick Ping 110, 178, 275

R

RAI 297, 298, 300, 301, 302, 303

RAI MF 300

Ramp 268

- EtherSAM 138
- Service Configuration 383

Ramp Cycle Count 269

Ramp Duration 138

Ramp Nb. of Steps 269

Ramp Test 135

Random 266

Rate 150, 161, 164, 265, 288, 344, 408

Rate Unit 204, 216, 230, 263, 276

rates 632, 634

RDI 299, 325

RDI-L 329, 340

RDI-P 331, 341

RDI-V 337

Ready 517

Receipt Timeout 113

Receive Messages 462, 469

Received 348

Received QL 272

Receiving Live Traffic 391

Refill 132

Refill Delay 132

Refill Delay Ratio 133

REI-L 329, 343

REI-L Computation Method 257

REI-P 332, 343

REI-V 339

REJ 351

Relative 350, 360

RELEASE 352

Release 253

RELEASE COMPLETE 352

Reliability 180

Re-Login 141

Remote 215

Remote block 91

Remote Fault 304, 307

Index

Remote IP Address	275	RFC 6349	54, 215
Remote Loopback	357	RFC 6349 Test	410
Remote Radio Head	108	RFC 6349 Test on Service 1	189
Remote to Local	204	RFI-V	337
Remote unit in DTS Mode	405, 423, 427	R-LOF	297
Remote unit in use and locked for DTS	404, 423, 427	R-LOS	297
Remove Modules Discovery	530	RNR	351
Renewal Interval	111	Round Trip Delay	519
Replied Details	505	Round Trip Latency	439
Report Content	465	Round-Trip Latency	409
Request	457	Round-Trip Latency Threshold	129, 409
Requesting MEP ID TLV	225	RR	351
RES	482, 483, 484, 485	RS	328
Reserved Bit	180	RS (J0)	444
Reset	518	RS-FAS	329
Reset button	551	RS-LOF	328
Resolve MAC	221	RS-OOF	328
Resolve MAC Address	172, 178, 202	RS-TIM	283, 328, 444
Responder	451	RTD	516, 519
RESTART	353	RTT	411
RESTART ACK	353	Running	517
Restore 1588 PTP Defaults	114	Runt	305
Restore Cable Test Defaults	122	RX button	487
Restore Carrier Ethernet OAM Defaults	227	RX CCM	430
Restore CPRI/OBSAI Defaults	127	RX DMR	379
Restore Default	234, 274	RX Frame Count	386
Restore Default at Start-Up	274	RX Frames	424
Restore EtherSAM Defaults	137	RX Frequency	154, 243, 395
Restore ISDN PRI Defaults	165	RX LBR	377
Restore RFC 2544 Defaults	205	RX Line Utilization	433
Restore RFC 6349 Defaults	217	RX LMR	380
Restore SyncE Defaults	273	RX LTR	522
Restore TCP Throughput Defaults	276	RX OH Byte Details	486
Restore Test Application Defaults	120	RX Pattern	116
Results	31, 503	RX Pattern Analysis	164
resume operation	562	RX Pointer Adjustment	515
Re-transmitted Frames	438	RX Power	152, 239, 540
return merchandise authorization (RMA) ..	571	RX Rate	385, 389, 411
Revision	356	RX SLR	381
RFC 2544	55	RX Termination	241
Global	204	RX TST	378

S

- S. & F..... 425
- S1..... 256, 490
- Sa4..... 524, 525
- Sa5..... 524, 525
- Sa6..... 524, 525
- Sa7..... 524, 525
- Sa8..... 524, 525
- SABME 350
- safety
 - caution 2
 - conventions 2
 - warning 2
- SAPI..... 280, 442
- SAPI ODU-TIM 281, 443
- SAPI OTU-TIM 281, 443
- SAPI TCM-TIM..... 281
- SATUS ENQUIRY 353
- Save/Load button 552
- Save/Load tab..... 552
- Scrambler 254
- Scrambling 148
- SDI 297
- SDT Threshold 119, 128, 393
- Secondary Port 102
- Seconds..... 288
- Seconds per Service..... 135
- Section 223, 328
- Section (J0)..... 444
- SEF 328, 340
- SEP 367
- SEPI 367
- Sequence..... 148, 394
- Service..... 231, 405, 411, 412
- service and repairs..... 571
- service centers..... 572
- Service Configuration
 - Ramp 383
- Service Configuration Test..... 135, 188, 405
- Service Configuration Test button 405
- Service Configuration Test Status 404, 410
- Service Disruption..... 118, 393
- Service Duration 111
- Service Name..... 133, 228
- Service Name and Selection..... 382, 383, 385
- Service No..... 133
- Service Performance 385
- Service Performance Test 136, 405
- Service Performance Test button 405
- Service Performance Test Status 404, 410
- Service Selection 170
- Services..... 190
- SES 364, 367, 417
- SESR 366, 369
- Set All 248
- SETUP 352
- Setup 31
- SFP..... 238, 567
- SFP+ 238
- Shaping 268
- Shaping button 269
- shipping to EXFO..... 571
- Si0 524, 525
- Si1 524, 525
- Signal 239
- Signal Auto-Detect 109
- Signal Configuration..... 244
 - DSn/PDH 245
 - OTN..... 254
 - SONET/SDH 256
- signal rates 632, 634
- Signaling Bits..... 523
- Single 516
- SLA button 229
- SLA Parameters..... 236, 385
- SLA Verified 382, 383
- SLM 450, 451, 539
- SLR 451, 539
- SM 481
- SM TTI Traces..... 279, 442
- Smart Loopback..... 58, 260
- S-OAM..... 218, 324, 356, 377
 - Traffic 450

Index

S-OAM Link Trace	521	Loopback mode	27
S-OAM Responder	219, 261, 539	OH	27
Software options	33	P1, P2	26
SONET/SDH	487	Pattern	27
SONET/SDH - DS _n /PDH BERT	48	Power level	27
SONET/SDH BERT	43	PTP	26
SONET/SDH Multiplexing	98	Test icon	26
Sort By	350, 360	TX/RX, TX, RX	26
Source	140	Step	349, 424, 425, 506
Source Flooding	173	Step Size	243
Source IP Address	174, 501	Step Size	153
Source IP Multiplier	178	Step Time	138, 269
Source MAC Address	172	STM-1 Channel	487
Source Node ID	458	Stop button	556
Source Port	181	Stop Time	278
Spare Bits	524	storage requirements	563
Special VID values	647	Stream	264, 387, 388, 389, 441, 501
Specific IP	530	Stream Name	262
specifications, product	573	Stream Selection	170
Speed	147, 156, 541	Stream Selection and Activation	264
Start button	556	STS Path (C2)	166, 355
Start Time. 277, 390, 396, 398, 400, 404, 407, 410, 414, 420, 422, 423, 426, 429, 434, 437, 440, 537		STS Path (J1)	444
Stateless Auto	175, 176, 184, 185	STS Path (N1)	283, 444
Static	175, 177, 184, 186	STS-1 Timeslot	487
Statistics	418	STS-x	330
STATUS	353	Subchannel	149
Status390, 414, 422, 426, 430, 432, 504, 517, 537		Subnet	530
Status Bar	26	Subnet Mask	158, 178, 183
Alarm/Error Injection	28	Subtest Duration	136
Amplitude	27	Subtests	135, 204
B-Channel	26	RFC 2544	206
Clock synchronization	27	Subtests EtherSAM	
Connection with another unit	27	Service Configuration Test	188
D-Channel	26	Summary	390
ESMC	26	1588 PTP	396
Interface/Signal	26	Cable Test	400
Laser	27	EtherSAM	404
LINK	26	FC BERT	407
Loopback	27	iSAM	410
		ISDN PRI	414
		MPLS-TP OAM	420, 429
		NI/CSU Emulation	422

RFC 2544	423	TCM5	483
RFC 6349	426	TCM6	483
S-OAM	420, 429	TC-ODI-P	334
SyncE	434	TC-ODI-V	334
TCP Throughput	437	TC-OEI-P	336
Traffic Gen & Mon	440	TC-OEI-V	336
suspend mode	561	TCP	181
Sweep	267	TCP Checksum	311
Switching Mode	457	TCP Connection Configuration	275
Symbol	305, 308	TCP Connection Status	437
symbols, safety	2	TCP Efficiency	413, 427
Sync	111	TCP Mode	275
Sync IPDV	399	TCP Port	275
SyncE	66, 272, 333	TCP Server Port	215
Synchronization interface	582	TCP Throughput	61, 275, 438
Synchronization Status Message (S1)	256	TCP Throughput Configuration	276
Synthetic Loss	224, 381	TCP Throughput Threshold (% of ideal)	428
Synthetic Loss Ratio	433	TC-RDI-P	335
Synthetic Loss Threshold	220	TC-RDI-V	335
System	85, 274	TC-REI-P	336
		TC-REI-V	336
		TC-TIM	283
		TC-TIM-P	335, 444
		TC-TIM-V	335, 444
		TC-UNEQ-P	257, 334
		TC-UNEQ-V	257, 334
		TC-VIOL-P	335
		TC-VIOL-V	335
		technical specifications	573
		technical support	568
		temperature for storage	563
		TERM	124
		Termination	123
		Test	224, 378
		Test Applications	39
		Test Block	94
		Test Configurator	85
		Ethernet Test Applications	91
		Fibre Channel Test Application	92
		Intelligent Apps	90
		Overview	90
		Packet Sync Test Applications	92

T

T0	466
T0-1	466
T0-2	466
T0-3	466
Target	530
TC	223
TC-IAIS-P	334
TC-IAIS-V	334
TC-IEC-P	336
TC-LTC-P	334
TC-LTC-V	334
TCM	255, 257, 334, 626
TCM Access Point Identifier	283
TCM ACT	483
TCM TTI Traces	279
TCM1	484
TCM2	484
TCM3	484
TCM4	483

Index

Transport Test Applications	91	Total Calls Count	418
Wireless Test Applications.....	92	Total Frame	447
Test Control.....	31	Total Number of Bytes.....	476
Test Function.....	224	Total PTP Messages.....	399
Test ID	227	Total TX Rate	230, 232, 263, 270
Test Menu	31	Total TX/RX MPLS	362
Test Parameters	235	Trace Route	503
Test Pattern	227	Traces	453
Test Recovery.....	396, 407, 420, 426, 429, 434, 437	OTN	279, 442
Test Setup	39	SONET/SDH	282, 444
Test Status	396, 400, 407, 412, 420, 429, 434, 437, 440	Traffic	409, 445
Test Timer.....	31	Traffic Class (TOS/DS).....	179
Threshold	165, 276, 358	Traffic Ethernet.....	394
Threshold (% of ideal)	189, 217	Traffic Gen & Mon	57
Thresholds.....	220, 387, 388, 389	Traffic Monitoring	450
Through	100	Traffic Policing	235
Through Mode	60	Traffic Scan.....	526
Throughput.....	179, 206, 270, 424	Transit Net Code.....	161
Streams	389	Transmitted Frames	438
Throughput button	349	Transparent	105, 537
Throughput meter.....	438	Transparent (Pseudo-Physical)	105, 537
Throughput Pass/Fail Verdict	276	Transport Layer.....	171
Throughput Threshold.....	438	transportation requirements	563, 568
TIM.....	313, 315, 319	Trial	424
Time	360, 466	Trial Duration	207, 210, 211
Time Mode.....	350, 360	Trials.....	209, 211
Time Stamp.....	358	Trigger Position	478
Timeout.....	502, 503	Trigger Type	477
Timer	31, 85, 277	Triggered Error	478
Timeslot	257	Triggered Frame - Details.....	479
TIM-P.....	283, 330, 444	Truncated	476
TIM-S.....	283, 328, 444	Truncation Calculator	476
TIM-V	283, 338, 444	TS16 AIS	300
Title Bar	28	TS16 Frame 0 Bit 5, 7, 8	524, 525
TLV Type.....	227	TST	450
To the following Services	230	TST RX Rate	433
Tone	248	TTI Traces	
Topology	93, 100	DAPI ODU-TIM	281
TOS/DS	179, 216	DAPI OTU-TIM	281
TOS/DS Config.....	179	DAPI TCM-TIM.....	281
Total Burst Test Time	133	PM	279
		SAPI ODU-TIM	281

SAPI OTU-TIM	281
SAPI TCM-TIM	281
SM	279
TCM	279
TTL	179, 223, 502, 521
TU	337
TU Path	259
TU Path (N1)	283
TU Path (V5)	166, 355
TU Path (Z6 or N1 (TU-3))	283, 444
TU-AIS	337
TU-LOP	337
Two-step	112, 398
TX button	487, 556
TX CCM	430
TX CIR	411
TX DMM	379
TX Enable	224
TX Frames	424
TX Frequency	153, 242
TX LBM	377
TX LMM	380
TX LTM	521
TX Mode	268
TX Pattern	116
TX Pattern/RX Pattern	126
TX Poniter Adjustment	506
TX Power	152, 239
TX Rate	130, 225, 262, 269, 383, 389
TX SLM	381
TX to RX	204
TX TST	378
Type	161, 173, 187, 344
Type Of Service	179

U

UA	350
UAS	366, 369, 417
UDP	181, 260
UDP Checksum	311
UDP/TCP	538

UI	351
Unassigned	462, 469
Undersize	306, 308
UNEQ-P	330, 341
UNEQ-V	167, 338
Unexp MEP	325
Unexp Period	325
Unexp. MD Lvl	324
Unexp. MEG Lvl	324
Unframed	104, 108
Unframed (Interop)	104
Unframed BERT	115, 126
Unframed with Sync	104
Unicast	446
Unidirectional	357
Unit	425
Unusable	322
Use Stream	501
User Defined Codes	180
User Performance	194

V

V5	498
Val.	424
Valid Event Count	465
Validations	208
Value	506
Filter	473
Variable Retrieval	357
Vendor Specific Information	357
Verdict	30
--	30
FAIL	30, 289
PASS	30, 289
Version 1	148
Version 2	148
VID	647
Video	265
Video Codec	232, 265
View File After Generation	479
VLAN	173, 262

Index

VLAN (ID/Priority) 229

VLAN ID..... 157, 173, 186

VLAN ID/Priority..... 157

VLAN Priority..... 647

VLAN Tag 171, 186

Voice 265

Voice Codec 232, 265

VT..... 337

VT Path..... 259

VT Path (V5) 166, 355

VT Path (Z6) 283, 444

W

warranty

 certification 570

 exclusions 570

 general 569

 liability..... 570

 null and void..... 569

Wavelength..... 152, 239

Window 358

Window (KiB) 412, 427

Window Size 439

Window Sweep 427, 452

Windows Size Unit 438

Wire Map 400

Wire Map Test Result..... 402

Wiring Standard..... 121

WIS 340, 453

WIS button..... 151

WIS Link Down 340

World Wide Name..... 140

X

XID 351

Y

Y.1731..... 218

Z

Z0 488

Z1 490

Z2 493

Z3 497

Z4 497

Z5 497

Z6 499

Z7 500

Zero Code Suppression 247

NOTICE

通告

CHINESE REGULATION ON RESTRICTION OF HAZARDOUS SUBSTANCES

中国关于危害物质限制的规定

NAMES AND CONTENTS OF THE TOXIC OR HAZARDOUS SUBSTANCES OR ELEMENTS
CONTAINED IN THIS EXFO PRODUCT

包含在本 **EXFO** 产品中的有毒有害物质或元素的名称和含量

O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下。
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11363-2006 标准规定的限量要求。

Part Name 部件名称	Toxic or hazardous Substances and Elements 有毒有害物质和元素					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 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 电子和电子组件	X	O	X	O	X	X
Optical sub-assembly ^a 光学组件 ^a	X	O	O	O	O	O
Mechanical sub-assembly ^a 机械组件 ^a	O	O	O	O	O	O

a. If applicable.
如果适用。

MARKING REQUIREMENTS
标注要求

Product 产品	Environmental protection use period (years) 环境保护使用期限 (年)	Logo 标志
This EXFO product 本 EXFO 产品	10	
Battery ^a 电池 ^a	5	

a. If applicable.
如果适用。

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