

# **USER MANUAL**



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# 1.0 General Information

This user manual is suitable for novice, intermediate, and experienced users and is intended to help use the features and capabilities of VeEX products successfully. It is assumed that the user has basic computer experience and skills, and is familiar with telecommunication and other concepts related to VeEX product usage, terminology, and safety.

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# **1.1 Customer Support**

For more technical resources, visit <u>www.veexinc.com</u>.

For assistance or questions related to the use of this product, call or e-mail our customer care department for customer support. Before contacting our customer care department, have the product model, serial number, and software version ready. Please locate the serial number on the back of the chassis. Please provide this number when contacting VeEX, Inc. customer care.

Support hours may vary depending on the product.

#### **Product Technical Support**

Support is generally available 8:00 AM to 8:00 PM, Eastern Standard Time, Monday to Friday. **Phone:** +1 510 651 0500 **E-mail:** <u>customercare@veexinc.com</u>

#### **MPA Product Technical Support**

Support is generally available 8:30 AM to 5:30 PM, Eastern Standard Time, Monday to Friday. **Phone:** +1 877 929 4357 **International:** +1 727 475 1206 **E-mail:** serviceandsupport@veexinc.com

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# 1.2 Warranty

For warranty information on VeEX products, go to https://www.veexinc.com/Support/Warranty.

To activate the warranty, please register your product at https://www.veexinc.com/Support/ProductRegistration.

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# 1.3 Patent Information

VeEX product hardware and software may be protected by one or more patents on file with the United States Patent Office.

# **1.4 Documentation Conventions**

Icons used in this manual:

	Marks a helpful tip (action or method), which can save time and improve usability of the product.
1	Provides important information needed to use this product and avoid missteps.
	Cautions against and action or inactivity, which can hinder productivity.
	Strongly warns against a condition, an action, or inactivity which can lead to a health hazard, injury, equipment damage, data loss, and/or financial losses.
	Stop and read before continuing.

# 2.0 Safety Information

	VEEX INCORPORATED					
	SAFETY MARKINGS AND					
	INSTRUCTIONS.					
/ • \l	IF IN DOUBT, CONTACT					
	VEEX CUSTOMER SERVICE					



Safety precautions should be observed during all phases of operation of this instrument. The instrument has been designed to ensure safe operation however please observe all safety markings and instructions. Do not operate the instrument in the presence of flammable gases or fumes or any other combustible environment. VeEX Inc. assumes no liability for the customer's failure to comply with safety precautions and requirements.

# **Optical Connectors**

The test sets display a laser warning icon when the laser source is active to alert the user about a potentially dangerous situation. It is recommended to:

- 1. Deactivate the laser before connecting or disconnecting optical cables or patchcords.
- Never look directly into an optical patchcord or an optical connector interface (SFP+) while the laser is enabled. Even though
  optical transceivers are typically fitted with Class 1 lasers, which are considered eye safe, optical radiation for an extended
  period can cause irreparable damage to the eyes.
- 3. Never use a fiber microscope to check the optical connectors when the laser source is active.

### **Lithium-ion Battery Precautions**

Lithium-ion (Li-ion) battery packs are compact and offer high capacity and autonomy, which make them ideal for demanding applications, like providing long lasting power to portable test equipment. For safety reasons, due to their high energy concentration, these batteries packs and products containing them must be used, charged, handled, and stored properly, according to the manufacturer's recommendations.

Li-ion battery packs contain individual Li-ion cells as well as battery monitoring and protection circuitry, sealed in its plastic container that shall not be disassembled or serviced.

The test set unit's battery pack is also fitted with a safety connector to prevent accidental short circuits and reverse polarity.

- Always charge the unit's battery pack inside the test platform battery bay using the AC/DC adapter supplied by VeEX.
- Do not charge or use the battery pack if any mechanical damage is suspected (shock, impact, puncture, crack, etc).
- Do not continue charging the battery if it does not recharge within the expected charging time
- Storage: For long term storage, the battery pack should be stored at 20°C/68°F (room temperature), charged to about 30 to 50% of its capacity. Spare battery packs should be charged and used at least once a year to prevent over-discharge (rotate them regularly).
- It is recommended to charge and use battery packs at least every three months. Battery packs shall not go without recharging (reconditioning) for more than six months.
- After extended storage, battery packs may reach a deep discharge state or enter into sleep mode. For safety reasons, Li-ion batteries in deep discharge state may limit the initial charging current (pre-recharge) before starting their regular fast charging cycle. The pre-charging state may take several hours.
- Air transportation of Li-ion batteries is regulated by United Nations' International Air Transportation Association (IATA) Dangerous Goods Regulations and by country-specific regulations. Please check local regulations and with common carriers before shipping Li-ion battery packs or products containing relatively large Li-ion battery packs.

# **Electrical Connectors**

Telephone lines may carry dangerous voltages. Always connect the electrical test ports to known test interfaces which carry low level signals.

# ESD: Electrostatic Discharge Sensitive Equipment

Test modules could be affected by electrostatic discharge. To minimize the risk of damage when replacing or handling test modules, make sure to follow proper ESD procedures and dissipate any electrostatic charge from your body and tools and the use proper grounding gear.

- Perform all work at a workplace that is protected against electrostatic build-up and discharging.
- Never touch any exposed contacts, printed circuit boards or electronic components.
- Always store test modules in ESD protected packaging.
- Wear ESD protection and grounding gear when:
  - Inserting, extracting, or handling test modules.
  - Inserting or removing SFPs, XFPs, QSFPs from the platform.
  - Connecting or disconnecting cables from modules or platform.



# 3.0 Introduction

# 3.1 TX300s-100GX Overview

The TX300s-100G, with the latest technology in pluggable physical interfaces, is a perfect complement to the TX300s Platform, extending its testing range to 100 Gbps. Compatibility with the companion TX340s option offers a complete 64k to 100G test solution in a compact portable package.

Installation, commissioning, monitoring and maintenance of Ethernet, OTN and SDH/SONET networks is simplified thanks to a combination of intuitive features and powerful test functions. Fast troubleshooting and comprehensive analysis of transmission problems can be performed using its common graphical user interface. Novice users benefit from the easy-to-use GUI, while experienced users will appreciate an array of advanced features such as OTL/PCS, CAUI-4/XLAUI Lane BERT, Service Disruption, overhead monitor/control, Tandem Connection Monitoring, Protocol Capture/Decode, BERT, Throughput test, and much more.

# 3.2 Key Features

# General

- QSFP28/QSFP+, SFP28/SFP+ and RJ45 test ports
- 10 Mbps to 100GE testing in one module
- Can be combined with a TX340s<sup>1</sup> module
- Soft LED indicators
- GPS timing and location
- Atomic clock<sup>2</sup>

# Ethernet

- 10Gbps and 100 Gbps, Ethernet testing
- Supports IEEE 802.3bj Clause 91 RS-FEC<sup>3</sup>
- Optical Lane BERT and CAUI-4/XLAUI Lane BERT<sup>3</sup>
- PCS Layer Testing with Skew generation/monitoring<sup>3</sup>
- Multi-stream testing up to 32 independent streams<sup>3</sup>
- IEEE 802.3ah, ITU-T Y.1731, IEEE 802.1ag, MPLS-TP OAM support
- Q in Q (VLAN stacking), MPLS, MPLS-TP, PBB, EoE support<sup>3</sup>
- MAC flooding
- RFC2544 and V-SAM (Y.1564) testing
- V-PERF (stateful TCP performance testing) from 1GE to 100GE<sup>3</sup>
- V-Test (Internet speed testing) and V-FTP (FTP Performance testing<sup>3</sup>
- Service Disruption Measurements
- IPv4 and IPv6 traffic generation
- BERT and Throughput testing at Layer 2 and Layer 3
- Smart Loopback mode for Layer 2 and Layer 3
- One-Way-Delay latency measurement (GPS assisted)
- Line rate packet capture with Wireshark<sup>™</sup> decode
- Error and Alarm Injection<sup>3</sup>

# Fibre Channel

- 1G to 32G Layer FC-1 and FC-2 Throughput Testing
- RFC2544
- Fabric port login: FLOGI/PLOGI

# **OTN Testing**

- OTN testing for OTU3 and OTU4
- Complete multi-stage Mapping/Multiplexing
- Ethernet over OTN
- Service Disruption measurements
- Tandem Connection Monitoring

- Overhead monitoring and byte decoding
- Terminate, Payload Through and Line Through test modes
- Per-lane optical power and frequency measurements
- External clock reference interface
- Histogram Analysis

# **QSFP28 Support**

- Optical lane BERT
- PCS layer testing with skew generation/monitoring
- Transmit and receive optical power measurement
- Module status display

### **Test Interfaces**

•		
	TX300s-100GX (Single Module)	TX340s-100GX (with TX340Sm)
Test Ports		
QSFP28/QSFP+	1	1
SFP28/SFP+	1	1
RJ-45	1	No*
Applications		
100GE	Yes	Yes
40GE	Yes	Yes
25GE	Yes	Yes
OTU4	Yes	Yes
32G FC	Yes	Yes
10GBASE-X	Yes	No*
100FX/1000BASE-X	Yes	No*
10/100/1000BASE-T	Yes	No*
1G to 16G FC	Yes	No*

\*Supported by the TX340sm module

- 1. Reference the TX340s module spec sheet for details
- 2. Configuration dependent
- 3. Data rate dependent

# 3.3 Connector Panels & Test Ports

# TX300s with 100GX blade



100GX Blade

### TX340s with 100GX blade



TX340s with 100GX Blade

Test Mode Selection for TX300s with 100GX and TX340s with 100GX blade



Test Port Selection for TX300s with 100GX







**Test Mode Selection Port 2** 



Test Port Selection for TX340s-100GX



**Test Mode Selection Port 1** 



**Test Mode Selection Port 2** 



**TX340s Test Mode Selection Port 1** 



**Test Mode Selection Release** 

For TX340s-100GX there are only 2 test cards present: Module 2 Port 1 and Module 2 Port 2 (on 100GX module). If application is loaded on a port, and the user tries to load the application on a second port, a notification pops up, asking to release the app on another port first.

# 4.0 Basic Operations

Refer to the **TX300s, MTTplus, RXT-1200, or UX400 platform manuals** for information about Basic Operations, Home menu, Launching Test Applications etc.

# 4.1 Utilities

Refer to the TX300s, MTTplus, RXT-1200, or UX400 platform manuals for information about all Utilities and Tools available.

# 5.0 Ethernet Test Application

(This chapter applies to 1G, 10G, 25G, 40G and 100G)

Refer to the RXT-1200, TX300s, or UX400 platform manuals for information on launching test applications and assigning test modules (UX400 only).

When first starting the test application, the soft LEDs might be red. Soft LEDs that are steady green indicate that the module is ready to perform different tests. This may require turning the **LASER On** button for optical interfaces or tapping the **History** tab to clear blinking LED reminders of past Errors and Alarms (test results are not affected).

Available test configurations will vary based on the test platform and installed module.



#### **Ethernet Home Menu**

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# 5.1 Setup

#### 5.1.1 Port Setup

Port setup configuration is accessed from the **Setup** menu located on the Ethernet home menu. The available configuration settings depend on the interface selected in the Test Mode selection.

Select the operation mode and the interfaces that will be used to carry out tests. Once the operating mode and interfaces are selected, independently configure the auto-negotiation, speed, duplex, and flow control settings for each port (where applicable).

After configuring settings, tap Apply to save changes. Tap Discard to revert to previous selections.

LEDs	Port	Measurement	
	100G port profile	Default 🛛 🗸 🔻	
😑 Signal	Network Type	LAN 🔻	
	Flow Control	Enable 🛛 🔻	
🜔 Frame	Clock Source	▼	
Pattern	Clock Offset (ppm)	0.0	
	Link Fault Response	Disable 🛛 🔻	LASER On/Off
ALM/ERR	Optical Module CDR Setting	Optical Module Default 🛛 🔻 🔻	MX Discover
History	Apply	Discard	CDR Access

TX300s-100GX Ethernet Test App Setup

#### 100G Port, TX300s-100GX:

- 100G port profile: Lock, Delete, Save, Save as..., Default, Last configuration
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal
- Clock Offset (ppm): Can be configured; range is +/- 150ppm
- Link Fault Response: Disable or Enable (also enables Local link and failure, remote, failure)
- Eye Clk (100G only)

#### Status

The **Status** tab lists current port settings. Please note that the Status tab is only available if a fiber port option is selected from the **Test Port Selection** menu.



Test units shipped before January 2012 support up to +/- 50 ppm offset only. Units shipped from 2012 onwards, support up to +/- 150 ppm offset. This applies to both 10GE WAN and 10GE LAN modes.

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#### 5.1.2 Measurement Setup

The measurement and event log settings are configured on this screen.

- Profile: Delete, Save, Save as..., Default.
- Mode: Manual, Timed
  - Manual mode: Starts and stops the measurements manually.
  - Timed mode: Defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- TX Start: Separated and Coupled. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - Separated: Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on -- the user must start the transmitter manually.
  - Coupled: Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.
- Clock (ToD) Synchronization Device: Disable, GPS. Select the device to be used to synchronize the clock to perform the One Way Delay measurement.

When a device is selected the following fields can be seen on the screen:

- External Clock Input: 1pps (SMA Port). The SMA Port must be used for the 1pps signal.
- UTC ToD: Displays the Coordinated Universal Time (UTC) Time of Day once it is acquired.
- Clock Sync Time: Time field to configure the UTC ToD that both test sets, carrying out a one-way delay test between each other, will be synchronizing their internal time stamping at.
   Note: Both test sets must be configured to the same Clock Sync Time.

Clock Synchronization is not supported on all the test set models. Check with customer care for availability.

- Gratuitous ARP: ON or OFF. If set to ON, a gratuitous ARP is performed. When the test port has an IP connection, an ARP request will be transmitted at regular intervals to keep the router/gateway ARP table aware of the test set's IP address. This setting is useful for long-term L3 routed testing.
- Results Auto Save: ON or OFF. If set to ON, results will be saved automatically

LEDs	Port	Measurement	
	100G port profile	Last configuration 🛛 🔍 🔻	
😑 Signal	Network Type	LAN 🗸	
	Flow Control	Enable 🛛 🔻	
😝 Frame	Clock Source	▼	
Pattern	Clock Offset (ppm)	0.0	
	Link Fault Response	Disable 🗸 🔻	LASER On/Off
ALM/ERR	Optical Module CDR Setting	Optical Module Default 🛛 🔻 🔻	MX Discover
History	Apply	Discard	CDR Access

#### **Measurement Setup**

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#### 5.1.3 MX Discover and Control

Before proceeding with MX Discover or Control, be sure to assign an IP address to each test port. To assign an IP address, proceed to the home menu and select the IP icon.

If using OAM Discover, it is unnecessary to assign an IP address to the local or remote unit.

### **Using MX Discover**

MX Discover enables the test set to discover other VeEX VePal test sets and devices with an assigned IP address on the same subnet. To discover other devices using **MX Discover**:

- 1. Tap on the **MX Discover** button and then press **Discover**.
- 2. A list of discovered devices on the same IP subnet will appear. Select a unit to connect to from the list of devices.
- 3. Tap on **Close** to exit the window.



**MX Discovery Tool** 

### **Loop Control**

The **Loop Control** button becomes available on the right side menu when any Ethernet application (V-SAM, RFC 2544, Throughput, BERT) is selected. Press the **Loop Control** button to configure loop up and loop down commands necessary to control a far-end unit. The loop up command contains information about the test layer. Looping back test traffic is possible as follows:

- Layer 1: All incoming traffic is looped back unchanged
- Layer 2: All incoming unicast traffic is looped back with the MAC source and destination addresses swapped
- Layers 3 & 4: All incoming unicast traffic is looped back with MAC/IP source and destination addresses swapped

To configure loopback control on the unit, select from the following options under Partner Address:

- MX Discovered: Lists MX discovered devices. Select from the list of discovered devices to loop up/down
- User Defined: Input the destination IP address of the far-end device
- OAM Discover: Lists OAM discovered devices. Select from the list of discovered devices to loop up/down
- **X-Loop:** Loops non-VeEX networking equipment.
- VL2-Loop: Input the Mac address or VLAN ID and Pri of the far-end device



**Remote Partner Control** 

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#### **OAM Discover**

Like MX Discover, OAM Discover can also be used to discover far-end test units without manually configuring the local or remote unit's destination address. If OAM is enabled on the test set, any link partner that supports the IEEE 802.3ah protocol will be

discovered automatically and displayed under the OAM Discover tab. To access OAM Discover:

- Go to Throughput > OAM > Link OAM and tap on the 802.3ah check box to activate Link OAM. Select Active from the OAM Mode drop-down menu (only Active mode can send loop commands).
- Tap OAM Loopback Loop Control button and select the OAM Discover tab to see a list of discovered OAM devices. You can also see a list of OAM devices by tapping the Loop Control button and selecting OAM Discover tab. Select an OAM device and press Loop Up to send a loop up command to the selected remote unit.

For detailed descriptions of Discovery Capabilities, Link Events, and Notification Settings, refer to Ethernet OAM Testing.

	LEDs		Setup			Results		Start
		Header	Traffic	Error Inj.	General	Summary	OAM	
$\left  \times \right $	Tools		Link OAM		Se	ervice Level O	AM	
	Utilities	802.3ah OAN	A: ⊠	OAM Mo	de: Active	•		
	E11	Vendor OUI	00-18-6	3	Max PDU I	_ength 15	18	
	Files	Vendor SPI	63-00-1	B-93	PDU Rate	10	00	
		Discovery C	apability					
			Remote	Loopback		Link Events	⊻	
			MIB Re	trieval	≤	Unidirection	⊻	
		Link Events	Notification	Settings				MX Discover
			Link Fa	ult				
			Dvina 0	Even: iasp				Control
					_			

### Activating 802.3ah Link OAM

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#### 5.1.4 ViPAG/V-Route Test

ViPAG/V-Route can be accessed from the Test Mode menu. Refer to the TX300s, UX400, or RXT-1200 platform manual for information on launching test applications from the Test Mode menu.

The following selections are available on the unit:

- Router Wrap Test: "On local unit" testing on a single unit
- End to End Test: (VeEX to VeEX)
- End to Loopback Test:

Router Wrap Test is the default selection for test sets.

ViPAG/V-Route is not available so far on 100GX module. It is only available on TX340s module.

#### ViPAG/V-Route Setup

LEDs	Quick Test	Setup	Results	
P1 P2	Welcome to V-R	oute		
😑 😋 Frame	<ul> <li>Router Wrap</li> </ul>	Test		
Pattern	End to End T	est(VeEX to VeEX)		
O Alm/Err	C End to Loopi	back lest		
History				NEXT
P1:1000-XFULL				
P2:1000-XFULL				

Quick Test Setup Welcome Page

Quick Test menu options may vary depending on the unit you are using.

#### **Quick Test Setup**

Fill out each screen and press **NEXT** to proceed to the next page or **Previous** to go back to the previous screen.

- Select the test type: Router Wrap Test
- Step 1: Select the router test interface. "Local unit" denotes a router wrap test while "end-to-end" conducts an end-to-end test. For End-to-End testing, select whether this unit will be a *Controller* or *Responder*. For End to Loopback testing, select whether this unit will be Generating Traffic or in Loopback Mode. The frame size for each option listed below is 256 bytes.
- Step 2 (Router Wrap only): Layer 2 is selected by default.
- Step 3: Configure port settings for port 1. Refer to Port Setup for detailed instructions.
- Step 4: Configure port settings for port 2.
- Step 5: Enable up to 3 VLAN tags. Configure ID, Priority, Type, and Drop Eligible.
- Step 6: Enter the frame size. The default frame size for each option is 256 bytes.
- Step 7: Review the settings for both ports. Press Start to begin testing. Pressing Reconfigure will restart the Quick Test Setup and return the screen to Step 1.

LEDs	Quick Test	Setup			Re	sults		
P1 P2	Router Wrap Te	st				Step	8	
🚫 🔘 Signal	Frame Size	256	bytes					
OOFrame	1GE P1 Configuration - I	Fiber 1310 nm						
			#1	ID	N/A	Priority	N/A	
🔵 🔵 Pattern	MAC Address 00-18-63-0	2-D1-BA VL	AN #2	ID	N/A	Priority	N/A	
			#3	ID	N/A	Priority	N/A	
Alm/Err	1GE P2 Configuration - I	Fiber 1310 nm		_				Previous
			#1	ID	N/A	Priority	N/A	
History	MAC Address00-18-63-0	2-D1-BB VL/	AN #2	ID	N/A	Priority	N/A	Start
			#3	ID	N/A	Priority	N/A	Pesonfiguro
P1:1000-XFULL	Please review configura	tion.						Reconingure
P2:1000-XFULL								

**Router Wrap Test Configuration Summary** 

#### **Quick Test View**

After starting the test, the Error Injection button for each port (P1->P2 Error and P2->P1 Error) becomes available and the screen displays Quick Test view and the following results for both ports:

- Link Up/Down status
- Optical Power
- Transmitted Rate
- Received Rate
- Throughput Pass/Fail status

LEDs	Quick Test	Setup	Results	
P1 P2	V-Route		Testing	1G P1>P2 Err
😑 🕒 Signal	1G-1G Test	Running	2020-12-17 16:51:35	1G P2>P1 Err
OOErama		1G P1: Fiber 1310 nm	1G P2 Fiber 1310 nm	
	Link	Up	Up	LASER Off
O OPattern	Optical Power	-5.61 dBm	-6.38 dBm	
		1G P1 to 1G P2	1G P2 to 1G P1	
Alm/Err	Throughput	PASS	PASS	
	Transmitted Rate	1.000G	1.000G	
History	Received Rate	1.000G	1.000G	Stop & Save
P1:1000-XFULL				Stop Details
P2:1000-XFULL				

Quick Test Results Summary

Stop & Save stops the test and enables naming of saved test results. Details brings up the Results screen.

In case of link or IP related test failure, V-Route will indicate the possible failure in red text and give instructions on what to check for.

LEDs	Quick Test	Setup	Results	
P1 P2	V-Route			
😑 🔘 Signal	1G-1G Test	Stopped	2020-12-17 16:53:47	
OOFrame		1G P1: Fiber 1310 nm	1G P2 Fiber 1310 nm	
	Link	Up	Up	LASER Off
🔵 🔵 Pattern	Optical Power	-5.51 dBm	-6.42 dBm	
		1G P1 to 1G P2	1G P2 to 1G P1	
Alm/Err	Throughput	PASS	PASS	Restart
	Transmitted Rate	1.000G	1.000G	
History	Received Rate	1.000G	1.000G	Save
P1:1000-XFULL				Reconfigure
P2:1000-XFULL	Errors Detected	CRC E	rrors	

**Test Failure** 

#### Setup

Test sets come preconfigured. To customize settings for both ports, go to the **Setup** tab. For configuration instructions, please refer to <u>BERT</u>.





#### Results

LEDs	Quick Test		Set	tup		Results	
	Summary		Results	1GE P1	R	esults 1GE P2	
P1 P2	1G-1G Test	Test	Stopped	16:53:47		17-12-2020	
	Throughput 1G-10	G	PASS		1.000	G	
🜔 🜔 Frame	Throughput 1G-10	G	PASS		1.000	G	
Pattern							LASER OT
● ●Alm/Err							Restart
History							Save
P1:1000-XFULL							Reconfigure
P2:1000-XFULL							

**Results Summary** 

The Summary tab lists the Pass/Fail status of the Throughput test for each port along with test measurements.

The **Results** tabs for each port lists statistical results similar to those featured in the BERT Results section. Please see <u>BERT</u> <u>Results</u> for more information.





### 5.2 IP

### 5.2.1 IP Connection

Port setup and IP connection are required prior to performing the following Ethernet applications: Ping, Trace Route, Web/FTP, ARP Wiz, VoIP, IPTV testing, and 688v2 (except Layer 2).

Tap on IP from the Ethernet home menu to access Port and IP settings.

### 5.2.1.1 Setup

Select PPoE, IPv4, or IPv6 from the Mode menu.

#### Point-to-Point Protocol over Ethernet (PPoE)

- Authentication: PAP, CHAP, or CHAP & PAP.
- VLAN: Off or 1 Tag.
- ID: VLAN ID. Enter value 0 to 4095.
- **Pri:** VLAN priority 0 to 7.
- **DNS:** Selecting Manual DNS opens another menu. Select from Off, Primary, or Primary & Secondary. Enter the Primary and/or Secondary DNS if required.

LEDs	Trace	Route	ARPWiz			VoIP	
	Se	tup	Sta	tus Ping		Ping	
😑 Signal		Network			Port	:	Connect
🔴 Frame	Mode	lode		IPv4 🗸			
	Profile			Last configuration 🛛 🔻 🔻		•	
Pattern	IP Address			Static 🗸 🗸 🗸			
	Local IP			192.168.0.101			
ALM/ERR	Subnet			255.255.255.0			
History	Gateway an	d DNS		Enable		•	
	Gateway	On	▼	192.168.0.1			
	DNS	Primary	▼	192.168.0.1			
		٩	Page	1 of 2 🕨			PCAP Start

- IP Type: IPv4 or IPv6
- IP Address: Static, DHCP (IPv4 only) or AUTO (IPv6 only)
- Static: The user is required to enter a Local IP, Gateway address, and Subnet. All Static fields can be filled by tapping on the section to access an alphanumeric keyboard
  - Local IP: IPv4/IPv6 address of the test set
  - Gateway: IPv4/IPv6 address of the network gateway
  - CIDR (IPv6 only): The user can enter a Classless Inter -domain Routing Network
  - Subnet (IPv4 only): The user can enter a subnet mask
- **DNS:** Off, Manual, or Auto. If Manual is selected, a DNS IP is required in order to use the URL as a destination. Enter the IP address of the Domain Name System (DNS) Server providing domain name translation to IP addresses.
- VLAN: Off, 1 Tag, 2 Tags. For each VLAN tag, enter the following:
  - ID: VLAN ID. Enter value 0 to 4095.
  - Pri: VLAN priority 0 to 7.

#### 5.2.1.2 Status

Ensure the Status is PASS before continuing with any IP tests. If the connection fails, go back to the setup screen to verify that the parameters are entered correctly. Verify that the Ethernet cable is properly connected on the management port on the left hand side of the unit.

LEDs	Trace Route	ARF	Wiz	VoIP	
	Setup	Sta	itus	Ping	
😑 Signal	DHCP server		192.168.0.2:67	Disconnect	
O 5	DHCP Lease Time		1 days 12 hou		
o Frame	Local IP		192.168.0.170		
Pattern	Subnet Mask		255.255.255.0		
Ŭ	Gateway		192.168.0.1		
ALM/ERR	DNS IP	3.8.8.8	Second DNS	8.8.2.2	
History	DHCP:		PASS		
	IP:		PASS		
	Gateway:		PASS		
	DNS:		DNS1(PASS)		
					PCAP Start

#### **Pass Status**

- DHCP: PASS indicates that an IP address has successfully been assigned.
- IP: PASS indicates that the IP address assigned has been verified to be unique in the network.
- Gateway: PASS indicates that the gateway IP address is valid.
- DNS: PASS indicates that the DNS IP address is valid.

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### 5.2.2 Trace Route

Trace Route is a common method used to find the route to the destination IP address or URL. Refer to **Trace Route** in the **TX300s**, **MTTplus**, **RXT-1200**, or **UX400** platform manuals for more information on this feature including setup and results.

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#### 5.2.3 ARP Wiz

ARP Wiz uses the Address Resolution Protocol (ARP) to verify the status of each IP address in a user-selectable IP range. It is the standard method for finding a host's hardware address when only its network layer address is known. Refer to **ARP Wiz** in the **TX300s**, **MTTplus**, **RXT-1200**, **or UX400 platform manuals** for more information on this feature including setup and results.

#### 5.2.4 Ping

Ping is a popular computer network tool used to test whether a particular host is reachable across an IP network. A ping is performed by sending an echo request or ICMP (Internet Control Message Protocol) to the echo response replies. Refer to **Ping** in the**TX300s**, **MTTplus**, **RXT-1200**, or **UX400** platform manuals for more information on this feature including setup and results.

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### 5.3 PCS

#### 5.3.1 Setup

#### 5.3.1.1 Tx Lane Mapping and Skew

- PCS to CAUI lanes configurable mapping:
  - Defines the alignment markers ID that will be assigned to each lane
  - Default, random or manual setting
  - Receivers must be able to reorder and reassemble any mapping of PCS lanes into single stream
- Lane Skew generation (up to 16000 bits time)
  - Enter relative delay that will be introduced for the PCS lane pair (CAUI lane)
  - Stresses the de-skew function on the receiver side
- Skew alarm threshold value: User configurable threshold for Skew alarm



PCS Setup - Tx Lane Mapping and SkewGo

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#### 5.3.1.2 Alarm/ Error Injection

- Error Injection per PCS lane:
  - Invalid Sync header: first 2 bits of the 64/66 block header
  - Invalid alignment marker: inserted every 16383 block on each virtual lane it contains the Virtual lane identifier
  - **BIP:** generates bit interleave parity error
- Alarm Generation:
  - LOBL: Loss of block lock
  - LOA: Loss of Alignment marker
  - HI-BER: high bit error rate of sync header

LEDs		Stop					
	PCS	S Lane	Selection		Error		
😑 Signal	VL ID	Sel.	VL ID	Sel.	Layer	PCS 🔻	Restart
	0	<ul><li>✓</li></ul>	10		Туре	ізн 🔻	
😑 Frame	1		11		Behavior	Single 🔻 🔻	
	2		12				PCS Err Ini.
Pattern	3		13				
	4		14		Alarm G	PCS Alarm Inj.	
ALM/ERR	5		15		Layer	PCS 🔻	
	6		16		Туре	LOBL 🗸 🔻	LASER On/Off
History	7		17		Behavior	Continuous 🔻	
	8		18				MX Discover
	9		19				
	Select All	Clea	ar All				

PCS Setup - Alarm/ Error Injection

# 5.3.2 Results

### 5.3.2.1 Summary

LEDs		Setup							Results									Stop				
	Summ	n <b>ary</b> Rx La				Rx Lane Skew				Alarms/Errors				Events				;				
😑 Signal	ST:2017-12	2-8	16:	36:0	)9	E				E	ET:00:03:06							Restart				
	CAUI ID	0			0 1				2				3									
🜔 Frame	PCS ID	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
O Detterm	LOBL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	PCS Err Inj.
<b>Ο</b> Pattern	ISH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	LOAML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	PCS Alarm Inj.
	IAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
History	BIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LASER ON/OF
	Hi Skew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	MX Discover
	VLID	1	2	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Hi-BER	0	LC	A		(	0															
																						Setup Injection

PCS Results - Summary



PCS Results - Rx Lane Skew

# 5.3.2.3 Alarms/Errors

LEDs	Set	tup		Resi	Stop	
	Summary	Rx L	.ane Skew	Alarms/Errors	Events	
😑 Signal	ST:2017-12-8 16:30	6:09		ET:00:04:31	Restart	
O Erama	64/66B Alarms	5	Seconds			
	HI-BER		0			
Pattern			Aggr	egate		PCS Err Inj.
Ť	PCS Lane Alarms		Seconds	PCS Lane Errors	Count	PCS Alarm Ini.
ALM/ERR	LOA		21	Invalid Sync Heade	er 3577	
	LOBL		21	Invalid Align Marke	er O	LASER On/Off
History				BIP-8 Block Error	7	
	P	MX Discover				
	0 1	2	3 🗖 4	5 6 7	7 🖪 8 📄 9	
	<b>10 11 1</b>	12 📄	13 💼 14	15	7 👩 18 💼 19	
			View PCS L	ane Details		Setup Injection

PCS Results - Alarms/Errors

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5.3.2.4 Events

LEDs	Set	up		Res	ults	Stop
	Summary	Rx Lane Skew	Alarm	s/Errors	Events	
😑 Signal	Time	Event Type		# of Events	5 Test	Restart
O Frame	2017-12-8 16:36:31	LOA Ended			PCS	
	2017-12-8 16:36:31	LOBL Ended PCS	\$#3		PCS	
Pattern	2017-12-8 16:36:31	LOAML Ended PO	CS#3		PCS	PCS Err Inj.
	2017-12-8 16:36:31	LOBL Ended PCS	5#2		PCS	PCS Alarm Inj.
ALM/ERR	2017-12-8 16:36:31	LOAML Ended PO	CS#2		PCS	
History	2017-12-8 16:36:31	LOBL Ended PCS	\$#1		PCS	LASER On/Off
	2017-12-8 16:36:31	LOAML Ended PO	CS#1		PCS	MX Discover
		🕙 Pag	e 1 of 5	●		
						Setup Injection

**PCS Results - Events** 

### 5.3.3 Saving PCS Results

Once the test has been stopped the results can be saved by pressing the Save key on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved.



**PCS Results Save** 

Once the results are saved, they can be viewed or renamed by going to **Tools / System Settings screen> Files**. Refer to the **File Manager** section in the RXT1200, TX300s or UX400 Platform manual for more information on managing saved test results.

# **5.4 BERT**

# 5.4.1 BERT Setup

Tap on Advanced Tools (Home Menu) > BERT icon to access BER testing features.

#### **Overview:**

BER testing at Layer 2 and 3 is supported. The BERT can be configured to use either regular PRBS test patterns, stress patterns (specifically for 10Gigabit Ethernet) or user defined test patterns to simulate various conditions. The test layer, frame header, traffic profile, error injection, and control settings of the far-end device (if applicable) must be configured prior to testing.

- Layer 2:
  - Framed BERT: Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame
- Layer 3: Framed BERT
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame
  - **IP Address:** A default or user configured IP address is added to the frame



**BERT Setup - Header (Layer 3)** 

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#### 5.4.1.1 Header Settings

- BERT Profile: Load a previously configured test profile or create a new profile from existing settings. Currently its set to "Default". Please see the Profiles section in the ReVeal MTX300 manual for more details on how to create new profiles using ReVeal software.
- Encapsulation Type: None, MPLS-TP, Provider Backbone Bridge (PBB-TE), or EoE (Ethernet over Ethernet). Tap on the encapsulation type block to configure the settings. All encapsulation type fields are configurable:

Tap on the encapsulation type block (PBB-TE, MPLS-TP,) to configure the settings: All encapsulation type fields are configurable:

- MAC Source
- MAC Destination
- Ethernet Type
- I-SID (PBB-TE only)
- LSP, PW (MPLS-TP only)
- TTL (EoE only)
- VLAN ID, Priority, Type
- Test: Select the test layer to perform the BERT
  - Options are Layer 2 and Layer 3
- Frame Type:
  - Layer 2: 802.3 Raw (IEEE 802.3 frame without LLC) and Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is

the most common frame type today)

• Layer 3: Ethernet II (DIX)

- MAC/IP: Tap the MAC and IP blocks on the Frame image to access the setup menus
  - Set the Source and Destination MAC address for Layer 2
  - Set the Source and Destination MAC and IP addresses for Layer 3
  - VLAN: Off, 1 tag, 2 tags, 3 tags
    - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications) **Note:** VLAN stacking is an option
- MPLS: (For Layer 3 only) Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 MPLS tags
    - PMPLS tag configuration is only available when the MPLS option is purchased



### The most common Ethernet Frame format, Type IIGo

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### MAC, VLAN, MPLS, IP, and Test Pattern Configurations:

To configure the MAC addresses, IP addresses, VLAN tag(s), MPLS tag(s), and test pattern, tap on the frame image displayed on the screen. This brings up the configuration screens for all the header fields.

- MAC Header Tab:
  - MAC Source: Use the default source address of the test set or configure a new or different address.
  - MAC Destination: Configure the destination MAC address of the far-end partner test set or use the ARP or ARP GW keys to determine the MAC address of the destination IP address (ARP) or the Gateway (ARP GW). Note that a valid IP connection needs to be up to use these functions. Refer to <u>IP Connection</u> for instructions on establishing IP connection.
  - Ethernet Type: For Layer 3 testing, the Ethertype is set to 0800-IP. For Layer 2, it can be typed in.
  - Source (SRC) and Destination (Dest) flooding: Enable or Disable.
  - Flood Range: Specifies the number of MAC source and/or destination addresses. Enter a number from 0-4095. The source and/or destination MAC addresses will be incremented by 1 until it reaches the number of times entered in the flood range.

Tap on Mac Source, ARP, and ARP Gateway buttons to populate the fields with default test port settings.

LEDs	MPLS-TP	MAC	VLAN	MPLS		Р	DATA	RX Filter	Start				
	MAC Sourc	00	-18-63-	01-24-									
🕒 Signal	MAC Destin	nation		00	-1E-90-	A0-57-							
	Ethernet T	ype		88	47-MPL	.S uni							
🜔 Frame	Source Flo	oding		D	sable		▼						
Pattern	Source Flood Range						0						
Ŭ	Destination	n Flooding	J	D	sable								
ALM/ERR	Destination	n Flood Ra	ange	0									
History									LASER On/Off				
History									MX Discover				
									Control				
	MAC	Source		NDP			NDP Ga	ateWay					

BERT Setup MAC Layer 3

- VLAN Tab: In the VLAN tab the following parameters are configured:
  - VLAN ID: Configurable in the range 1 to 4094.
    - VLAN ID is the identification of the VLAN, which is basically used by the standard 802.1Q.
    - It has 12 bits which allows the identification of 4096 (2<sup>12</sup>) VLANs.
    - Of the 4096 possible VIDs, a VID of 0 is used to identify priority frames and value 4095 (FFF) is reserved.
    - Maximum possible VLAN configurations are therefore set to 4094.
  - VLAN Priority: Configurable in the range 0 to 6
    - Set by the Priority Code Point (PCP), a 3-bit field which refers to the IEEE 802.1p priority.
    - It indicates the frame priority level from 0 (lowest) to 7 (highest), which can be used to prioritize different classes of traffic (voice, video, data, etc.).
  - Type: The following selections are possible:
    - 8100 (IEEE 802.1Q tagged frame)
      - 88a8 (IEEE 802.1ad Provider Bridging)
      - User Defined
  - Drop Eligible: If enabled, drop eligibility flag will be set.



IEEE 802.1Q VLAN Tag in an Ethernet Frame



BERT Setup - VLAN Tag configuration (Layer 2 & 3)

- MPLS Tab (Only for Layer 3): In the MPLS tab the following parameters are configured:
  - **MPLS label:** Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved).
    - Composed of 20 bits which allows for the creation of over one million labels.
  - **CoS:** Configurable in the range 0 to 6.
This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS).
S-bit: Configurable 0 or 1.

The S field is one bit in length and is used for stacking labels. This is important as it is used to indicate the last label in the label stack.

• TTL: Configurable in the range 0 to 255. The default setting is 128 hops.

Used to decrement the time-to-live counter.

	LEDs	MAC	VLAN	MPLS	IP	D	ATA	RX Filter	Start
		MPLS #1	Label=	0	S=	0			
0	Signal		CoS=	0	TTL=	128			
0	Frame	MPLS #2	Label=	0	S=	1			
-	- Funite	î	CoS=	0	TTL=	128			
0	Pattern								
~									
0	ALM/ERR								
F	History								LASER UNION
-									

BERT Setup - MPLS configuration (Layer 3)

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- **IP Tab:** In the IP tab the user must configure the destination IP address and source address. The user may also configure the following IP header fields:
  - IP Type: IPv4, IPv6
  - **IP Source and IP Destination:**For IP Src, if the IP connection is up, refer to to <u>IP Connection</u>. The source address is fixed to the IP address from the IP setup menu.
  - IP TOS (for Quality of Service testing): Legacy TOS or DSCP
    - Legacy TOS : The first three bits of the IP TOS field can be edited:
      - Precedence:
        - 000 Routine
        - 001 Priority
        - 010 Immediate
        - 011 Flash
        - 100 Flash Override
        - 101 Critical
        - 110 Internetwork Control
        - 111 Network Control
      - TOS Values:
        - 1000 Minimize Delay
        - 0100 Maximize Throughput
        - 0010 Maximize Reliability
        - 001 Minimize Monetary Cost
        - 0000 Normal Service
    - DSCP (Differentiated Services Code Point): The first six bits of the IP TOS can be edited to provide more granular service classification.
    - Time To Live (TTL): Configurable in the range 0 to 255.
    - Fragment offset byte: Configurable in the range 0 to 65.528.

The fragment offset field, measured in units of eight-byte blocks, is 13 bits long and specifies the offset of a particular fragment relative to the beginning of the original unfragmented IP datagram.

• **Protocol field:** UDP (0x11), TCP (0x06), User Defined.

LEDs	MAC	VLAN	IP	DATA	RX Filter	Start
	IP Type		IPv	4	V	$ \longrightarrow $
😑 Signal	Source IP Add	ress	192	.168.0.10		
	Destination IP	Address	192	.168.2.200		
O Frame	IP TOS		Le	jacy TOS		
Pattern	Precedence		011	-Flash		
0	TOS Values		001	0-Maximize Relia		
ALM/ERR	TTL		128			
	Do Not Fragme	ent Flag	0		LASER On/Off	
History	Protocol		Us	er Defined 🔻 Fi	F	

BERT Setup - IP Address Setting Layer 3 (IPv4 Legacy TOS)

### IPv6:

- Source IP Address
- Destination IP Address
- Traffic Class
- Flow Label
- Next Header
- Hop Limit

LEDs	MAC	VLAN	IP	DATA	RX Filter	Start
	IP Type		IPv	;	V	
🕒 Signal	Source IP Add	ress	200	1:d11:c0a8:a:218:	53ff:fe00:2	
	Destination IP	Address	555	5:11:c0a8:a::8552		
🜔 Frame	Traffic Class		0			
Pattern	Flow Label		0			
0.1	Next Header		255			
ALM/ERR	Hop Limit		0			
History						LASER On/Off

BERT Setup - IP Address Setting Layer 3 (IPv6)

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- **Data Tab:** User selects a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). For both Layer 2 and 3 the following pattern is available:
  - PRBS:
    - 2^31 -1
    - 2^23 -1
    - 2^15 -1
    - 2^11 -1
    - 2^9 -1
  - Fixed: All 0s or All 1s
  - User Defined pattern: Length depends on size of frame
  - Inversion: Normal or inverted
  - RX Live

LEDs	MPLS-TP	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
🜔 Signal	• PRE	3S 2E31-1		😑 invert				
🜔 Frame	PRE	3S 2E23-1		📄 Rx Liv	'e			
-	PRE	3S 2E20-1						
Pattern	PRE	3S 2E15-1						
ALM/ERR		3S 2E9-1						
History		's 'e						LASER On/Off
History	© Use	r Defined		00				MX Discover
								Control

**BERT Setup - Data selection** 

- **RX Filter Tab:** Allows the user to filter incoming streams. When checked, the incoming traffic flows not matching these criteria will not be considered for these results.
  - MAC Destination address
  - MAC Source address
  - VLAN
  - VLAN Priority
  - VLAN Eligible
  - Frame Type
  - Traffic Class (for Layer 3)
  - Flow Label (for Layer 3)
  - Next Header (for Layer 3)

LEDs	MPLS-TP	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	📄 MPL	S-TP MAG	C Destinati	ion 📃 l	P Destinati	ion [192.1	68.0.101]	
🔘 Signal	😑 MPL	S-TP MAG	C Source	😑 I	P Source	[192.1	168.2.200]	
	📄 MPL	S-TP LSP	Label					
🜔 Frame	😑 MAC	Destinat	ion [00-18	-63-01-24-0	DF]			
Pattern	😑 MAC	Source	[00-18	E-90-A0-57-	-3C]			
	📄 VLA	N						
ALM/ERR		N Priority						
	😑 VLA	N Eligible						LASER On/Off
History	📄 Ethe	ernet Type	•					
		P						Mix Discover
	📄 Prot	ocol Type						Control

**BERT Setup RX Filter (Layer 3)** 

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### 5.4.1.2 Traffic Settings

The user configures the traffic profile for the stream, including traffic flow, frame size, frame type, and transmit rate.

- Traffic Flow: Select from the following traffic flows:
  - Constant: The selected frame is transmitted continuously according to the selected bandwidth %.
  - Ramp: The selected frame is transmitted at maximum bandwidth according to the selected duty cycle and burst period.
  - Burst: The selected frame is transmitted in a staircase profile according to user selectable step time, number of steps,

and maximum bandwidth.

- **Single Burst:** Configure the number of frames to be transmitted in the burst along with the bandwidth. For example, if 100000 frames are transmitted at 12.5% of bandwidth, on a 1Gbps line, 100000 frames will transmit at a rate of 125Mbps and then the burst will stop.
- Frame Size Type: Fixed or Uniform min and max frame length values. Uniform traffic is traffic generated with a uniform distribution of frame lengths.
- Frame Size (bytes):
  - Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 10000 bytes
- BW (Transmit Bandwidth): Configure the transmit rate for the test
  - When traffic flow is equal to Burst, two burst bandwidths are configured with burst time
  - When traffic flow is equal to Ramp, starting and an ending bandwidth are configured along with the bandwidth step size and duration

LEDs	Se	tup	Res	sults	Start
	Header	Traffic	Error Inj.	Alarm Inj.	
🔘 Signal	Traffic Flow		Ramp	▼	
C Frame	Frame Size (bytes)	)	1518		
	Start BW		5.000	% 🔻	
Pattern	Stop BW		10.000	% ▼	
	Step BW		5.000	% 🔻	
ALM/ERR	Ramp Time		1	sec 🔻 🔻	
History	Repetitions		1	CONTINUE 🔻	LASER On/Off

BERT Setup - Ramp TrafficGo

# Go back to top Go back to TOC

# 5.4.1.3 Error Injection

Error injection can be performed during testing. The error type and injection rate are configured in the **Setup Injection** tab, which appears after pressing **Start**. Once the test is running, error injection can be performed by pressing the **Err Inj.** button on the right side of the screen.

- Layer: Ethernet or PCS
  - **Error type:** Select from CRC, IP Checksum, Pause, Bit, and Runt. With Pause selected, the unit will transmit a pause frame when **Error Injection** icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- PCS
  - **Type**: ISH, IAM, and BIP. Use the checkbox to select the PCS Lanes for error injection.
- Behavior: The error injection flow determines how the selected errors will be injected.
  - Select a single, single burst, or rate error injection.
- Count: Configures the error count via a numeric keypad for single burst injection.
- Error Rate: Configure the error injection rate for rate error injection.

LEDs			Setup Ala	arm an	d Error Injection		Stop
	PCS	S Lane	Selection		Error l	njection	
😑 Signal	VL ID	Sel.	VL ID	Sel.	Layer	PCS 🔻	Restart
-	0		10		Туре	ISH 🔻	TV Star
😑 Frame	1		11		Behavior	Single 🛛 🔻	TX Stop
	2		12				PCS Err Ini.
😑 Pattern	3		13				
	4		14		Alarm G	eneration	Eth. Alarm Inj.
ALM/ERR	5		15		Layer	ETHERNET 🔻	
	6		16		Туре	Optical LOS 🛛 🔻	LASER On/Off
History	7		17		Behavior	Continuous 🔻 🔻	
	8		18		Optical LOS I	_ane Selection	MX Discover
	9		19		L1: 📄 L2: 📄	L3: 🚍 L4: 🚍	Control
	Select All	Clea	ar All				

**BERT Setup - Error Injection** 

### 5.4.1.4 Alarm Injection Settings

Alarm injection can be performed during testing. The type of alarms and alarm injection are configured in the Setup Injection tab. Once the test is running, alarm injection can be performed by pressing the **Alarm Inj.** button on the right side of the screen.

- Layer: Select from Ethernet or PCS
- Ethernet
  - Type: Local Fault, Remote Fault, Optical LOS. Four optical LOS lanes are available for selection.
- Alarm Flow: The alarm flow determines how the selected alarms will be injected. Single burst or continuous can be selected.
- Duration: Duration for single burst flow; 1s, 10s, or 100s.

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### 5.4.1.5 Starting/Stopping a BERT

Once all configurations have been made, the user can start the BERT test (press the **Start** icon on the top right section of the screen). The following are three scenarios of how to prepare and start the unit for BERT testing.

If testing on the fiber ports, make sure the LASER is turned on before starting the test.

- End-to-End Testing
  - Connect the UX400 to another unit that supports BERT testing.
  - After configuring test settings on both units, start the tests.

# • Far-End Unit in Manual Loopback Mode

- If the far-end unit is already in a manual loopback mode, do not send a loop up command since it is not necessary.
- Once the correct control settings are configured, the user can start the test.

The selected tests will run automatically. When all the tests are complete the test will stop automatically. If the BERT test suite needs to be stopped before they are done, then simply press the **Stop** button, located in the actions drop-down menu. The status of each selected test can be seen in the Results tab.

# Far-End Unit Controlled with Loop Up/Down Commands

- If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unit before the BERT test suite can be started.
- To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings mode to manual.
- Enter the MAC and/or IP address of the far-end unit.
- Send the loop up command by pressing Loop Up.

Once the far-end unit has been looped back, start the test by pressing the **Start** button. When all of the selected test are completed, the BERT test suite will stop automatically. Once all tests have been completed and there is no need to test again, go back to the

Control tab, and press the **Loop Down** button. This will send a loop down command to the far-end unit to remove the loopback that is in place.

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### 5.4.2 BERT Results

#### 5.4.2.1 Summary

Summary tab: The following results including the Start (ST) and Elapsed (ET) times are displayed:

- Line Rate (Mbps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- Utilization: % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or 100Mbps) of the total link capacity (or Line Rate).
- Utilization (bps)
- Framed Rate: (Payload + MAC/IP Header + VLAN Tag + Type/Length + CRC) / (Payload + Total Overhead) \* Line Rate % (in Mbps).
- Data Rate: Payload / (Payload + Total Overhead) \* Line Rate %.
- Number of bytes
- Pause Frames: Total number of transmitted and received ethernet pause flow-control frames.

LEDs		Setup					Res	ults			Stop	
	Events	Tra	ffic	De	lay		Rates		PCS			
😑 Signal	Summary		Signa	al	E	Errors			Alarms		Restart	)
O Frame	ST:2017-12-11	12:17:25	5		ET:00:0	)1:22	22				TX Stop	
		T)			тх							
😑 Pattern	Line Rate (bps	ine Rate (bps) 10			100.000G			100.000G			PCS Err Inj.	)
-	Utilization (%)	Utilization (%)			32.950%			32.950%			Eth. Alarm Inj	
ALM/ERR	Utilization (bps	;)	32.950G				32.950G					
	Framed Rate (b	ops)	30.562G			30.563G				LASER On/Of		
History	Data Rate (bps	)	22.444	G			22.444G					
	#ofBytes		522861	761792			522861760000			MX Discover	)	
	Pause Frames		0				0				Control	
											Setup Injectio	D

**BERT Results - Summary** 

### Go back to top Go back to TOC

#### 5.4.2.2 Signal

#### Signal (Page 1-2)

The Signal tab (fiber ports only) displays the receiving (RX) and transmitting (TX) optical level measured by the QSFP28, or QSFP+ (40G), depending on the 100G module in use.

Loss of Signal (LOS) and the Saturation level for optical signals are shown graphically including the level measurement in dBm for each lane.

LEDs	S	Setup				Res	sults		Stop
	Events	Traffi	ic	Dela	ıy	Rates		PCS	
😑 Signal	Summary		Signal		E	rrors		Alarms	Restart
O Eromo				Level	[Rx]			TX Stop	
	Rx Optio	al Powe	er[dBm	]	LOS			SAT	
Pattern		Cur. N						+12	PCS Err Inj.
	TOTAL	6.09	6.07	6.13	16			+e	Eth Alarm Ini
ALM/ERR	#1 1295.60nm	-0.91	-0.97	-0.70	- 10			•	
	#2 1300.10nm	1.13	1.08	1.16				•	LASER On/Off
History	#3 1304.60nm	0.66	0.59	0.68				+	
	#4 1309.10nm	-0.98	-1.04	-0.91	]	-8.6	5	+4.5	MX Discover
									Control
		٩		Page 1	of 5				Setup Injection

**BERT Results - Signal (Page 1)** 



**BERT Results - Signal (Page 2)** 

# Signal (Page 3)

The received signal frequency and offset is measured and performed on the optical interface. The latest test sets and software versions may display signal measurements for each lane, depending on supported versions.

- Frequency: Indicates the frequency of the input signal.
- Offset: Indicates the difference between the standard rate and the rate of the input signal.
- Min (ppm): Indicates the difference between the standard rate and the minimum deviation detected in the input signal.
- Max (ppm): Indicates the difference between the standard rate and the maximum deviation detected in the input signal.

LEDs	:	Setup			Res	ults	Stop
	Events	Traffic	De	lay	Rates	PCS	Restart
😑 Signal	Summary	Signa	al	E	rrors	Alarms	
O Frame			Freq	uency			
•	Frequency			103125	000KHz		
🜔 Pattern	Offset [ppm]			0.0			LASER On/Off
-	Min [ppm]			-0.0			
ALM/ERR	Max [ppm]			0.0			MX Discover
History							Control
							CDR Access
							I2C Access
			Page	3 of 5	۲		Setup Injection

BERT Results - Signal (Page 3)

# Signal (Page 4-5)

Page 4-5 displays the Optical module information and status.

LEDs		Setup			Resi	ults		Stop
	Events	Traffic	De	lay	Rates	PC	s	Restart
😑 Signal	Summary	Sign	al	E	rrors	Alarms	5	
Frame		QSFP Op	tical Mo	odule In	formation			TX Stop
<b>U</b> 114	Power Class		Pov	ver Clas	s 6 Module	(4.5 W max)		
🜔 Pattern	Vendor		Ocl	aro Inc.			LASER On/Off	
_	Part Number		TRO	25E20F	NF-LF000			
O ALM/ERR	Serial Number		T17	D57299			MX Discover	
History	Bit Rate (Gbps	)	25.5	;			Control	
	Wavelength (n	m)	131	0.0				
	Wavelength To	olerance(nm)	1.0					CDR Access
	Tranceiver Co	mpliance (Hex	) 80 0	0 00 00	00 00 00 00	Dec	ode	I2C Access
			Page	4 of 5	۲			Setup Injection

BERT Results - Signal (Page 4)

LEDs		Setup			Res	ults		Stop		
	Events	Traffic	De	lay	Rates		PCS	Restart		
🔘 Signal	Summary	Signa	al	Errors		Alarms			2	
O Frame		QSFP	QSFP Optical Modu			odule Status				
•		RXLC	RX LOS		TX Electrical LOS		FAULT	Alm 🖊 E		
🜔 Pattern	Channel 1	Norm	Normal		Normal		ormal	LASER On/C		
_	Channel 2	Norm	Normal		Normal		ormal			
ALM/ERR	Channel 3	Norm	Normal		Normal		ormal	MX Discove		
History	Channel 4	Norm	Normal		Normal		ormal	Control		
	Temperature			43.2 C				CDR Acces	5	
	Voltage			3231 m	V			I2C Access		
		٩	Page	5 of 5	۲			Setup Injecti	•••	

BERT Results - Signal (Page 5)

### 5.4.2.3 Errors

Errors tab: The following errors (Current and Total) are displayed:

- Bits: Indicates errors related to test pattern (Bit Error or LSS [Pattern Loss])
- BER: Bit Error Ratio
- Symbol: Declared when an invalid code-group in the transmission code is detected
- FCS/CRC: Number of received frames with an invalid FCS
- IP Checksum (Layer 3 only)
- Jabber frames: Number of received frames larger than 1518 bytes containing an invalid FCS
- Runt frames: Number of received frames smaller than 64 bytes containing an invalid FCS



**BERT Results - Errors** 

### Go back to top Go back to TOC

#### 5.4.2.4 Alarms

Alarms tab: The following Alarms (Current and Total) are displayed:

- LOS: Loss of Signal
- LOS Sync: Loss synchronization
- Pattern Loss: Indicates errors related to test pattern
  - Service disruption associated with loss of signal:
    - Current: Duration of the current service disruption
    - **Total:** Total accumulated duration of the service disruptions
    - Last:
    - Min/Max: Minimum and maximum duration of the service disruption events
    - No. of Occurrences: Counter of service disruption events
    - Local Fault
    - Remote Fault

••	LEDs		Setup			Resu	Stop	
_		Events	Traffic	Dela	ay	Rates	PCS	
🔘 Si	ignal	Summary	Signa	al	Errors		Alarms	Restart
	rame		Current			Total		TX Stop
	ane	LOS (us)	0			0		
		Link Down (us)	0			0		PCS Err Inj.
	attern	Pattern Loss	0			0		
		Local Fault	0	0 R		Fault 0		Eth. Alarm Inj.
		Service Disrup	tion (us)					
His	tory	Current	0	Т	Total			(LASER On/Off)
-		Last		0	)			MX Discover
		Min/Max	0			0		MIX DISCOVED
		No. of Occurre	nces	0				Control
								Setup Injection

**BERT Results - Alarms** 

### 5.4.2.5 Events

Events tab: A time stamped record or log of anomalies, alarms, test status (start/stop) and test application are displayed.

LEDs	Se	tup			Res	ults	Stop
	Summary	Signa	Signal		rrors	Alarms	
🔘 Signal	Events	Traffic	Traffic De		Rates	PCS	Restart
Frame	Time	Event Typ	e		# of Event	s Test	TX Stop
<b>U</b>	2017-12-8 17:42:24	Test Start	ed			BERT	PCS Err Ini
😑 Pattern							
							Eth. Alarm Inj.
							LASER On/Off
History							
							MX Discover
		•	Pag	je 1 of 1			Control
							Setup Injection

**BERT Results - Events** 

### Go back to top Go back to TOC

### 5.4.2.6 Traffic

Traffic tab: The following Traffic statistics are displayed:

- Frame type: Test and non-test frames
- Traffic type: Layer 2 and Layer 3 Unicast, Broadcast, and Multicast frame percentage
- Frame size distribution

Tap on the graph for detailed screens.



**BERT Results - Traffic** 

Frames tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

### • Received (RX) frames:

- Total frames
- Test frames
- VLAN tagged frames
- Q-in-Q VLAN stacked frames
- Non-test frames

#### • Transmitted (TX) frames:

- Total frame Total # frames transmitted
- Pause frames: Total number of transmitted and received Ethernet pause flow-control frames

LEDs	Frames		Traffic Type		Frame Size	Stop
	RX Frames	#		%		
🕒 Signal	Total	81015	352283	10	)	Restart
	Test	81015	352283	100	0.00000	
🜔 Frame	SP-VLAN Frames	0		0.0	00000	TX Stop
Ť	MPLS LSP Frame	81015	352283	100	0.00000	
😑 Pattern	MPLS PW Frames	0			00000	PCS Err inj.
Ŭ	VLAN	81015	352282	100	0.00000	Eth Alarm Ini
ALM/ERR	VLAN Stack	81015	352282	100	0.00000	
Ĩ	MPLS	81015	352282	100	0.00000	LASER On/Of
History	MPLS Stack	0		0.0	00000	
	Non-Test	0		0.0	00000	MX Discover
	TX Frames	#				
	Total	81015352375				Control
	Pause Frames	тх		RX		
	Total	0		0		Setup Injection

#### **BERT Results - Frames**

#### Go back to top Go back to TOC

Traffic Type tab: The following Traffic distribution statistics are displayed in Count (#) and Percentage (%):

- Layer 2 Unicast frames: Number of Unicast frames received without FCS errors.
- Layer 2 Broadcast frames: Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF.
- Layer 2 Multicast frames: Number of Multicast frames received without FCS errors.

LEDs	Frames	Traffic Type	Frame Size	Stop
	Distribution	#	%	
🔘 Signal	L2 Unicast	85139876849	100.000000	Restart
<u> </u>	L2 Broadcast	0	0.00000	TX Stop
🕒 Frame	L2 Multicast	0	0.00000	
Pattern	L3 Unicast	85139876849	100.000000	PCS Err Inj.
Ŭ	L3 Broadcast	0	0.00000	Eth, Alarm Ini.
ALM/ERR	L3 Multicast	0	0.00000	
History				LASER On/Off
				MX Discover
				Control
				Setup Injection

**BERT Results - Traffic Type** 

Frame Size tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- 64 bytes frames
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames
- 1280-1518 byte frames
- > 1518 byte frames Jumbo frames

LEDs	Frames		Traffic Type		Frame Size	Stop
	Distribution	#		%		
😑 Signal	64B	0		0.0	00000	Restart
<u> </u>	65 - 127B	0		0.0	00000	TX Stop
🕒 Frame	128 - 255B	0		0.0	00000	
Pattern	256 - 511B	856380	065255	100	.000000	PCS Err Inj.
•	512 - 1023B	0		0.0	00000	Eth. Alarm Ini
ALM/ERR	1024 - 1279B	0		0.0	00000	
	1280 - 1518B	0		0.0	00000	LASER On/Off
History	> 1518B	0		0.0	00000	
						MX Discover
						Control
						Setup Injection

**BERT Results - Frame Size** 

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### 5.4.2.7 Delay

**Delay tab:** Delay measures the interpacket gap, start of the frame, and preamble duration. Frame arrival statistics are displayed in tabular format:

- Current
- Minimum
- Maximum
- Variation (Current) Interframe delay variation

LEDs	Se	tup	Res	Results					
	Summary	Signal	Errors	Alarms					
🕒 Signal	Events	Traffic De	lay Rates	PCS	Restart				
🕒 Frame	Frame Arrival Tim	e		TX Stop					
<b>U</b>	Current	6ns	Average	25ns	DOS Err Ini				
😑 Pattern	Minimum	3ns	Maximum	236ns	Pos En Ing.				
•	Frame Delay Varia	tion			Eth. Alarm Inj.				
O ALM/ERR	Average		3ns						
History					LASER ON/Off				
					MX Discover				
					Control				
					Setup Injection				

**BERT Results - Delay** 

#### 5.4.2.8 Rates

**Rates tab:** Rate statistics are displayed in a graph format. Tap on either gauge to see rate details in table form. The table shows transmitted (**Tx**) and received (**Rx**) current, minimum, maximum and average frame rates (**FPS**) and Data Rates (**Mbps**).

- Frame rate in Frames per second (FPS): Number of received frames (including bad frames, Broadcast frames and Multicast frames)
- Data rate in Mbps: Received data rate expressed in Mbps



**BERT Results - Rates** 

LEDs		Stop		
	Frames/sec	тх	RX	
😑 Signal	Current	10439298	10439212	Restart
	Minimum	10439296	10439212	TX Stop
🜔 Frame	Maximum	39379544	39379628	
Pattern	Average	24909420	24909420	PCS Err Inj.
•	Data Rate (Mb/s)	тх	RX	Eth Alarm Ini
ALM/ERR	Current	15.701G	15.701G	
	Minimum	15.701G	15.701G	LASER On/Of
History	Maximum	59.227G	59.227G	
	Average	37.464G	37.464G	MX Discover
				Control
				Setup Injection

### 5.4.2.9 PCS

- HI-BER: high bit error rate of sync header
- LOA: Loss of Alignment marker
- LOBL: Loss of block lock
- Invalid Sync header: first 2 bits of the 64/66 block header
- Invalid alignment marker: inserted every 16383 block on each virtual lane it contains the Virtual lane identifier
- BIP: generates Bit Interleave Parity Error

Tap on **View PCS Lane Details** to see additional details such as PCS # and VL ID for each alarm/error. The magnifying glass displays Count and Rate error details.

LEDs		Setup			Resu	ilts	
	Summary		Signal	Errors		Alarms	
😑 Signal	Events	Traffi	c De	elay	Rates	PCS	
Frame	64/66B Ala	rms	Seconds				
	HI-BER		0				
🔘 Pattern			Aggr	egate	gate		
-	PCS Lane Alarm	ıs	Seconds	PCS La	ne Errors	Count	
ALM/ERR	LOA		0	Invalid	Sync Heade	r 0	
History	LOBL		0	Invalid	Align Marke	r 0	
HISTORY				BIP-8 E	Block Error	0	
		PCS La	nes Alarms	and Erro	ors Summary		
	0 1	2	3 🗖 4	5	6 🗖 7	8 9	
	10	12	13 💼 14	15	16 17	7 📑 18 📑 19	
			View PCS I	ane De	tails		

**BERT Results - PCS** 

				PCS	Lane Details			Stop		
LEDS	La	ne	Ala	rms		$\oplus$	Stop			
Signal	PCS# VLID		LOBL	LOAML onds	ISH	ISH IAM BIP8 BIk Count				
Ŭ Ū	0	4	0	0	0	0	0			
Frame	2	0 1	0	0	0	0	0	TX Stop		
	3	2	0	0	Ō	Ō	0			
O D-#+	4	3	0	0	0	0	0	PCS Err Inj.		
<b>Ο</b> Pattern	6	6	0	0	0	0	0			
	7	7	0	0	Ō	Ō	Ō	Eth. Alarm Inj.		
ALM/ERR	8	8	0	0	0	0	0			
	9 10	9 14	0	0	0	0	0	LASER On/Off		
History	11	10	Ŏ	Ō	Ŭ Û	Ŏ	0			
	12	11	0	0	0	0	0	MX Discover		
	13	12	0	0	0	0	0			
	15	19	Ŏ	0	0	ŏ	Ő	Control		
	16	15	0	0	Ō	Ō	Ō			
	17	16	0	0	0	0	0			
	18 19	17 18	0	0	0	0	0	Setup Injection		

**BERT Results - PCS Lane Details** 

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### 5.4.3 Saving BERT Results

Once the test has been stopped the results can be saved by pressing the Save key on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved.

Signal	Save result as 20121026_144542									Start
O Frame	1	2	3	4 5	6	7	8	9	0	
Pattern	q	w	e	r t	У	u	I.	0	Р	
ALM/ERR	a	s	d	f	9	h	j	k	1	
History	Caps	z	×	c	ь	v	n	m	Shift	LASER ON/OF
		Symbo	ol De	@	•	Del	All	<-		
				SPACE				Ap	ply	

**BERT Results Save** 

Once the results are saved, they can be viewed or renamed by going to **Tools / System Settings screen> Files**. Refer to the **File Manager** section in the RXT1200, TX300s or UX400 Platform manual for more information on managing saved test results.

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# 5.5 RFC2544

### 5.5.1 Setup

### **Overview:**

RFC 2544 recommendations are well accepted in the test and measurement industry for network performance testing. The RFC 2544 test suite consists of and performs a set of four automated tests (throughput, latency, frame loss, and burst or back-to-back) to qualify the performance of a network link under test. The tests are especially popular for the verification of network links with certain service level agreements (SLA).

The following settings must be configured prior to RFC 2544 testing:

- Test layer (Layer 2 & 3)
- Frame header (MAC, VLAN, IP, UDP, and Data)
- Test frames selection
- Pass/fail thresholds (optional)
- Throughput
- Latency
- Frame loss
- Burst (back-to-back)



### RFC2544 Home

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### 5.5.1.1 Header Settings

Unless otherwise noted, Frame Header setup is identical to the setup described in the BERT Application. Refer to the <u>BERT</u> <u>application</u> for details.

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LEDs	MPLS-TP	MAC	VLA	N MP	LS	IP		DATA	A R	X Filter		Start	
	MPLS-TP I	MAC Sour	ce		00-18·	-63-1A	\-2B-	4E					
😑 Signal	MPLS-TP I	MAC Desti	nation		00-18·	00-18-63-1A-2B-3C							
<u> </u>	Ethernet T	88-47											
🕒 Frame	B MPLS-	TP VLAN	ID <sup>/</sup>	1082 Prie	ority	6	Ту	pe	88a	8			
Pattern	LSP		Label=	0	S=	1 0	CoS=	0 Т	TL=	128			
Ŭ	📄 PW		Label=	0	S=	1 0	CoS=	0 Τ	TL=	128			
ALM/ERR													
											LAS	ER On/Of	
History												Discourse	
												Discover	)
												Control	

RFC2544 Setup MPLS-TP



### 5.5.1.2 Frames Settings

The following can be configured under the Frames tab of the RFC2544 Setup:

- Preset Frames: Select from a list of recommended test frame sizes defined in RFC 2544:
  - Test frames are 64, 128, 256, 512, 1024, 1280, and 1518 bytes.
  - The default selected frame is 1518 bytes.
  - To select/deselect any of the recommended test frames, check the box to the right of the desired frame.
- Add frame: Two additional user configurable test frames of any size ranging from 64 bytes to 9000 bytes can be added.
  - To add additional test frames, tap the Add Frame button.
  - Enter the frame size using the numeric keypad and click apply.
  - Press the back button to return to the frames screen.

TX300s-100GX\_User\_Manual\_RevA00

• The new custom frame size is displayed (it can be enabled or disabled as needed).



#### **RFC2544 Frames Setup**

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#### 5.5.1.3 Threshold Settings

Threshold settings can be enabled or disabled for the throughput and latency tests.

When enabled, threshold settings can be configured for all of the test frames selected in the frame settings tab.

A Pass/Fail criteria will be applied when the threshold settings are enabled. For example, if the throughput threshold value for a 64 byte frame is configured for 80%, then a Pass criteria is assigned if the throughput rate is 80% or better.

The threshold values for Throughput and Latency can be customized per user requirements. Tap on the selected value to edit.

LEDs	Set	up	Re	Start	
	Throughput	Latency	Frame Loss	Burst	
😑 Signal	Header	Fra	mes	Thresholds	
O Frame	Enable	Throughput (%	) Late	ency (us)	
0.100	64 bytes	70.00	100	)	
Pattern	128 bytes	75.00	200	)	
	256 bytes	80.00	300	)	
ALM/ERR	512 bytes	85.00	400	)	
History	1024 bytes	90.00	500	)	LASER On/Off
	1280 bytes	95.00	600	)	
	1518 bytes		700	)	

### **RFC2544 Thresholds Setup**

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### 5.5.1.4 Throughput, Latency, Frame Loss and Burst Settings

The RFC 2544 test suite allows the user to run all four tests, one of the four tests, or a combination of any of the four tests. The user simply has to enable/disable which tests to perform by checking/unchecking a selection box in the respective tab for each test. By default all four tests are enabled. Throughput test can not be disabled.

The following parameters must be configured before running the RFC 2544 conformance test suite.

# Throughput:

- Max Rate: Up to 100% of the negotiated line rate. The default value is 100%.
  - This is the maximum transmit rate to perform the throughput test for each test frame size.
  - This rate may be configured as a % of the total line rate or in Mbps. For example the Max Rate is configured to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.
- **Resolution:** Input any value between 0.001% and 1%. The default value is 1%. Resolution refers to the resolution in searching for the throughput rate. If 1% is selected, the throughput rate will be searched with ±1% accuracy.
- Duration: 5 to 999 seconds. The default value is 20 seconds.
  - The duration is the amount of time the throughput test is run for, for each frame size at a given rate.

LEDs	Set			ults	Start		
	Header			mes		Thresholds	
😑 Signal	Throughput	L	atency	Frame Lo	oss	Burst	
Frame	MAX Rate		100.000		%	T	
• • • • • •	Resolution		1.00				
Pattern	Duration (s)		20				
ALM/ERR     History	Enable Test						LASER On/Off

# **RFC2544 Throughput Settings**

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Latency: The following parameters can be configured:

- Test Rate: Throughput Rate or Custom Rate. The default value is Throughput.
  - Throughput rate: Latency test will be performed at the Throughput rate found for each of the tested frame sizes.
    Custom rate: A custom rate in % or Mbps can be configured.
- Rate: Only available if Custom Rate is selected. Enter up to 100% of the negotiated line rate or enter the rate in Mbps.
- **Duration:** 5 to 999 seconds. The default value is 20 seconds. This is the amount of time that the latency test will be performed for each test frame size.
- Repetitions: 1 to 100. The default value is 1.

This is the amount of times that the latency test will be repeated for each test frame size.

LEDs	Setup			Res	ults	Start
	Header	Fra	mes		Thresholds	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
O Frame	Test Rate	Throughput	Rate		▼	
0	Duration (s)	20				
Pattern	Repetitions	1				
ALM/ERR     History	✔ Enable Test					LASER On/Off

Frame Loss: The following parameters can be configured:

- Max Rate: Up to 100% of the negotiated line rate. The default value is 100%. This is the maximum transmit rate to perform the frame loss test for each test frame size. The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.
- Step Size: 1 to 10%. The default value is 10%.

The step size is the rate % that the frame loss test will be reduced by in the event of any frame loss. For example if the Max Rate is 100Mbps (or 100%) and frames are lost at this rate, then the transmit rate will be reduced to 90Mbps (or 90%). The frame loss test will now be performed at the new rate until there is zero frame loss at two consecutive rate settings. This means that the test will have to be performed at 80% (assuming that there was zero frame loss at 90%).

• **Duration:** Selectable in the range 5 to 999 seconds. The default value is 20 seconds. The duration is the amount of time the throughput test is run for, for each frame size at a given rate.

LEDs	Setup		Res	Start		
	Header	Fra	mes		Thresholds	
😑 Signal	Throughput	Latency	Frame Lo	ss	Burst	
Frame	MAX Rate	100.000		%	▼	
0	Step Size	10.00				
Pattern	Duration (s)	20				
ALM/ERR History	<b>√</b> Enable Test					LASER On/Off

**RFC2544 Frame Loss Settings** 

### Go back to top Go back to TOC

Burst (Back-to-Back): The following parameters can be configured:

- Max Rate: The default value is 100%. In the burst test, frames are always transmitted at the maximum rate for a given minimum and maximum burst duration.
- Minimum Duration: Selectable in the range 2 to 999 seconds. Default value is 2 seconds. This is the duration of the first burst.
- **Maximum Duration:** Selectable up to 999 seconds. The default value is 20 seconds. This is the duration of the second burst, which must be greater than the minimum burst.
- **Repetitions:** Selectable in the range 1 to 100. The default value is 1. This is the amount of times that the burst test will be repeated for each test frame size.

LEDs	Setup		Re	Start	
	Header	Fra	umes	Thresholds	
O Signal	Throughput	Latency	Frame Loss	Burst	
O Frame	MAX Rate	100.000	%		7
<b>U</b> France	MIN Duration (s)	2			
Pattern	MAX Duration (s)	20			
	Repetitions	1			
ALM/ERR     History	☑ Enable Test				LASER On/Off

### **RFC2544 Burst Settings**

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#### 5.5.1.5 Starting/Stopping a RFC 2544 Measurement

Once all configurations have been made, tap the Start button on the right section of the screen to start the measurements.

Note: If testing on the fiber ports, make sure the LASER is turned On before starting the test.

The selected tests will run automatically. When all the tests are complete the test will stop automatically. If the RFC 2544 test suite needs to be stopped before they are done, then simply tap the **Stop** button. The status of each selected test can be seen in the Results tab.

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#### 5.5.2 Results

The progress and current result of the RFC 2544 can be viewed as the test is in progress.

Navigate the respective sub-tabs (throughput, latency, frame loss, or burst) to view the results for each test. For the burst test, the results can be viewed in summary table format or test log format.

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5.5.2.1	Status:	The status of	f each test is	displayed	including a	stamped log c	of each test.
---------	---------	---------------	----------------	-----------	-------------	---------------	---------------

LEDs		Setup			Resu	Stop	
	Throughput	Latency	Fram	e Loss	Burst	PCS	
🔘 Signal	Status	Summ	ary	S	ignal	Events	
Frame	ST:2017-12-11 ′	14:00:29		ET:00:0	)3:14		
	Throughput Te	st		Done		PCS Err Ini	
Pattern	Latency				ress		
<u> </u>	Frame Loss Te	Pendin	g		PCS Alarm Inj.		
ALM/ERR	Burstability Te	st		Pendin	g		
History							LASER ON/OT
							MX Discover
							Control
							Setup Injection

#### RFC2544 Results Status

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5.5.2.2 Summary: The following results including the Start (ST) and Elapsed (ET) times are displayed:

- Line Rate (bps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- Utilization: % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or 100Mbps) of the total link capacity (or Line Rate).
- Utilization (bps)
- Framed Rate: (Payload + MAC/IP Header + VLAN Tag + Type/Length + CRC) / (Payload + Total Overhead) \* Line Rate % (in Mbps).
- Data Rate: Payload / (Payload + Total Overhead) \* Line Rate %.
- Total Frames
- Bad Frames
- **Pause Frames:** Total number of transmitted and received ethernet pause flow-control frames.

LEDs		Setup		Res	Stop	
	Throughput	Latency	Frame Los	s Burst	PCS	
😑 Signal	Status	Status Summa		Signal	Events	
O Frame	ST:2012-10-23 1		ET:0	0:01:13		
U Preside		тх		RX		
Pattern	Line Rate (bps)	100.0	100.000G		0G	
-	Utilization (%)	100.0	00%	100.00	0%	
ALM/ERR	Utilization (bps)	) 100.0	00G	100.00	0G	and the second second
	Framed Rate (b	ps) 98.70	0G	98.700	G	LASER On/Off
History	Data Rate (bps)	97.52	9G	97.529	G	
	Total Frames	Total Frames 61688		6168890004		
	Bad Frames	0	0			
	Pause Frames	0	0			

**RFC 2544 Results Summary** 

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**5.5.2.3 Signal:** The Signal tab displays the optical level measured by the QSFP+ transceiver.

LEDs	s	etup				R	lesults		Start
	Throughput	Laten	cy	Frame	e Loss	Bur	rst	PCS	
😑 Signal	Status	s	umma	ıry	s	ignal		Events	
O Frame				Leve	l [Rx]				
	Rx Optio	al Powe	er[dBn	n]		OS		SAT	
Pattern		Cur.	Min.	Max	-16			+12	
<b>U</b>	TOTAL	6.09	6.07	6.11	46			÷e	
ALM/ERR	#1 1295.60nm	-0.93	-0.96	-0.8	- 16 - 16			+	
Ĩ	#2 1300.10nm	1.13	1.10	1.15	;			• •	LASER On/Off
History	#3 1304.60nm	0.62	0.61	0.67				•	
	#4 1309.10nm	-0.95	-1.02	-0.9	1		-8.6	+4.5	MX Discover
									Control
		٩		Page	1 of 5	●			

**RFC2544 Results Signal Page 1** 

LEDs	Setup				Resu	Stop	
	Events	Traffic	De	lay	Rates	PCS	
😑 Signal	Summary	Signa	al	E	rrors	Alarms	Restart
Frame			Frequ	uency			TX Stop
	Frequency			103124	998KHz		DCS Err Ini
🜔 Pattern	Offset [ppm]					PC3 Ell'III.	
-	Min [ppm]			-0.0			PCS Alarm Inj.
ALM/ERR	Max [ppm]			0.0			
History							LASER On/Off
							MX Discover
							Control
		٩	Page	3 of 5			Setup Injection

RFC2544 Results Signal Page 3

LEDs	Set		Resi		Start			
	Throughput	Latency	Fram	e Loss	Burst		PCS	
🔘 Signal	Status	Summ	ary	Signal			Events	
Frame		QSFP Op	tical M	lodule Information				
0.000	Power Class	Pov	ver Clas	s 6 Module				
🔵 Pattern	Vendor			aro Inc.			LASER On/Off	
	Part Number			Q5E20FI	NF-LF000			
ALM/ERR	Serial Number		T17	T17D57299				MX Discover
History	Bit Rate (Gbps)		25.5	25.5				Control
	Wavelength (nm)		131	1310.0				
	Wavelength Tolerance(nm)			1.0				CDR Access
	Tranceiver Compl	liance (Hex)	) 80 (	00 00 00	00 00 00 00		Decode	I2C Access
		٩	Page	4 of 5	۲			

**RFC2544 Results Signal Page 4** 

LEDs	S	Setup			Resu	Start		
	Throughput	Latency	Frame	e Loss	Burst		PCS	
🔘 Signal	Status	Summ	Summary		Signal		Events	
O Frame		Optical	Module	Status				
•		RXLC	s	TX Ele	ctrical LOS	Т	X FAULT	
🔵 Pattern	Channel 1	Norm	Normal		Normal		Normal	ASER On/Off
_	Channel 2	Norm	Normal		ormal		Normal	
ALM/ERR	Channel 3	Norm	Normal		Normal		Normal	MX Discover
History	Channel 4	Norm	al	Normal Norma			Normal	Control
	Temperature			43.7 C			CDR Access	
	Voltage			3252 mV				I2C Access
			Page	5 of 5	۲			

Signal (Page 5) Optical Module Status

5.5.2.4 Events: A time stamped log of each test is displayed.

LEDs	S	etup		Result	Start	
	Throughput	Latency	Frame Loss	Burst	PCS	
O Signal	Status	Sum	mary S	Signal	Events	
O Frame	Time	Event T	ype	# of Events	Test	
U Frame	2012-10-23 13:15	:24 Test Sta	irted		RFC 2544	
Pattern	2012-10-23 13:15	:25 Test Sta	irted		Throughput	
	2012-10-23 13:16	:08 Test Sto	pped		Throughput	
ALM/ERR	2012-10-23 13:16	:08 Test Sta	irted		Latency	
History	2012-10-23 13:16	:52 Test Sto	pped		Latency	LASER On/Off
	2012-10-23 13:16	:52 Test Sta	irted		Frame Loss	
	2012-10-23 13:18	:20 Test Sto	pped		Frame Loss	
		٩	Page 1 of:	2 🖸		

### **RFC 2544 Results Events**

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### 5.5.2.5 Throughput:

The Throughput tab displays the maximum throughput rate of the link under test. Results are displayed in graphical and table formats. Use the drop-down menu to change the display format.

- Graphical: Throughput results are displayed in a bar graph form
- Summary table and test log table display:
  - byte size
  - Tx(%): Percentage of test frames transmitted by the unit
  - Rx(%): Percentage of test frames received by the unit
  - P/F: Pass/Fail test status determined by test criteria set in the Threshold tab

LEDs	5	Setup				Resu	lts		Start
	Status		Summa	ny	Sig	nal	1	Events	
O Signal	Throughput	Later	ncy	Frame L	.055	Burst		PCS	
O Frame	Summary	<b>▼</b> T:	×(%)	V	Rx(%)	Ţ	Thre	sholds	
U France	64 bytes	10	000.00		100.000		Pass		
Pattern	1518 bytes	10	000.000		100.000		Pass		
ALM/ERR	-	_					-		
History									LASER On/Off
			٩	Page 1	of 1 🕑				

**RFC2544 Results Throughput Summary** 



**RFC2544 Results Throughput Tx Graphical** 

LEDs	S	ietup		Re	Start						
	Status	Summ	ary	Signal		Events					
O Signal	Throughput	Latency	Frame Los	ss Burst	:	PCS					
O Frame	Test Log	🔻 Tx(%)	R	Rx(%)		15					
•	64 bytes	100.000	10	100.000 100.000							
Pattern	1518 bytes	100.000	10								
ALM/ERR											
History							LASER On/Off				
	6 6										
		Page 1 of 1 •									

**RFC2544 Results Throughput Test Log** 

### 5.5.2.6 Latency and Jitter

•

Latency and frame jitter measurements results are displayed under the Latency tab in the following formats:

- Graphical: Latency results displayed in line graph form (Latency [us] vs Frame size [bytes]).
  - Summary and Test Log tables display:
    - byte size
      - Latency (us): Round trip delay latency.
      - Rate (%): Percentage of frames transmitted. Data rate used for latency test.
      - Pass/Fail test status.

Use the drop-down menu to select the Latency format.



**RFC2544 Latency Results Graphical** 



**RFC2544 Latency Results Summary** 



**RFC2544 Latency Results Test Log** 

LEDs	S	ietup		Result	Start	
	Status	Sumr	nary S	ignal	Events	
O Signal	Throughput	Latency	Frame Loss	Burst	PCS	
O Frame	Jit. Graphical Latency(ns)	V		22	Done	
Pattern	3	-				
ALM/ERR				·		
History						LASER On/Off
	0	64		1518		
			Frame Size			

**RFC2544 Jitter Results Graphical** 



**RFC2544 Jitter Results Summary** 

LEDs	S	ietup		R	Start		
	Status	Status Summary		Signal		Events	
O Signal	Throughput	Latency	Frame Los	ss Bur	st	PCS	
O Frame	Jit. Test Log	<b>V</b> Jitter	R	ate (%)	Stat	tus	
0.14	64 bytes		10	000.000	Pas	s	
Pattern	1518 bytes	2ns	10	100.000		s	
0 414/500	2						
O ALMJERK							
History							LASER ON/OF
					_		
	<u></u>	-					-
	5		e	~			
		9	Page 1 of	10			

**RFC2544 Jitter Results Test Log** 

### 5.5.2.7 Frame Loss

Frame loss displays the percentage of frames not received. Use the drop-down menu to select the Frame Loss format:

Summary and Test log tables display test frame length, byte size, **frame loss (%)** from received traffic, and **rate (%)** transmitted.

• Graphical: Frame Loss displayed in line graph form (Frame size [bytes] vs Rate [%]). Tap the Graphical button to see the legend.



RFC2544 Results - Frame Loss Graphical

LEDs	s	Setup			Resu	lts		Start
	Status	Summ	iary	Si	gnal	2	Events	
O Signal	Throughput	Latency	atency Frame		Loss Burst		PCS	
O Frame	Summary	🔻 Frame l	Loss (%)	Frame	Loss Cnt	Rat	e (%)	
0	64 bytes			0		100	.000	
Pattern	1518 bytes	0.000	0.000		0		.000	
ALM/ERR						╞		-
History								LASER On/Off
	19				-			
		•	Page 1	of 1 C	>			

RFC2544 Results - Frame Loss Summary

LEDs	S	ietup			Resu	Start		
	Status	Summ	iary	Si	gnal	E	Events	
Signal	Throughput	Latency	atency Frame L		Loss Burst		PCS	
O Frame	Test Log	<b>F</b> rame I	Loss (%)	Frame	Loss Cnt	Rate	(%)	
0	64 bytes	0.000		0		100.0	00	
Pattern	64 bytes	0.000	0.000		0		0	
	1518 bytes	0.000	0.000			100.0	00	
ALM/ERR	1518 bytes	0.000	0.000			90.00	0	
History								LASER On/Off
	e.	_		1				
								_
2					-			
		٠	Page 1	of 1				

RFC2544 Results - Frame Loss Test Log

### 5.5.2.8 Burst

Burstability (back-back) results are the number of frames successfully transmitted/received at the line rate. It is displayed in the following formats:

- Summary table: Displays Average Frame Count received for each test frame length
- Test log table: Displays Average Frame Count and Duration (seconds) for each test frame length



RFC2544 Results - Burst Summary

LEDs		Setup							Start
	Status S		Summary		Signal			Events	
O Signal	Throughput Latence			Frame Lo	e Loss Burst		PCS		
O Frame	Test Log 🛛 🔻			RX Frm. Count		Exp. Frm. Coun		uration (s)	
0	64 bytes	2976	19047	297	619047	2			
Pattern	64 bytes			2976190476		2976190476		)	
	1518 bytes	16254876		162	54876	2			
ALM/ERR	1518 bytes		162548764		162	548764	20	)	
History									LASER On/Off
	2								
				Page 1 o	f 1 🔍	>			

RFC2544 Results - Burst Test Log

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#### 5.5.2.9 PCS

- HI-BER: high bit error rate of sync header
- LOA: Loss of Alignment marker
- LOBL: Loss of block lock
- Invalid Sync header: first 2 bits of the 64/66 block header
- Invalid alignment marker: inserted every 16383 block on each virtual lane it contains the Virtual lane identifier
- BIP: generates bit interleave parity error

LEDs		Setup		Result	5	Start			
	Status	5	ummary	Signal	Events				
😑 Signal	Throughput	Laten	cy Fram	e Loss Burst	PCS				
O Frame	64/66B Ala	rms	Seconds			]			
0	HI-BER		0						
Pattern		Aggregate							
	PCS Lane Alarr	ns	Seconds	PCS Lane Errors	Count				
ALM/ERR	LOA		0	Invalid Sync Header	0				
History	LOBL		0	Invalid Align Marker	0	LASER On/Off			
HIStory	19-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-			BIP-8 Block Error	0				
	6	PCS L	anes Alarms	and Errors Summary					
	0001	02	3 0 4	050607	0809				
	● 10 ● 11	<ul><li>12</li></ul>	13 💿 14	15	18 19				

### **RFC2544 Results - PCS**

		Start						
LEDS	La	ne	Ala	rms		Errors	$\odot$	Juli
Signal	PCS#	VL ID	LOBL	LOAML	ISH	IAM Count	BIP8 BIk	
	0	2	0	0	0	0	0	
	1	3	0	0	0	0	0	
🔵 Frame	2	4	0	0	0	0	0	
	3	0	0	0	0	0	0	
_	4	1	0	0	0	0	0	
🔵 Pattern	5	8	0	0	0	0	0	
-	6	9	0	0	0	0	0	
_	7	5	0	0	0	0	0	
🔵 ALM/ERR	8	6	0	0	0	0	0	
-	9	7	0	0	0	0	0	
Llisters	10	10	0	0	0	0	0	LASER ON/OF
History	11	<u>    11    </u>	0	0	0	0	0	
	12	12	0	0	0	0	0	MX Discover
	13	13	0	0	0	0	0	INA BISCOVEL
	14	14	0	0	0	0	0	
	15	17	0	0	0	0	0	Control
	16	18	0	0	0	0	0	
	17	19	0	0	0	0	0	
	18	15	0	0	0	0	0	
	19	16	0	0	0	0	0	

### **RFC2544 Results - PCS Lane Details**

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### 5.5.3 Saving RFC 2544 Results

Once the test has been stopped the results can be saved by pressing the **Save** key on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved.

Signal	Save re	esult as	B		2	01210	026_	144	542	Start
O Frame	1	2	3	4 5	6	7	8	9	0	
Pattern	q	w	e	r t	У	u	1	•	p	
ALM/ERR	a	s	d	f	9	h j	k		1	
History	Caps	z	×	c	b	v n	"	1	Shift	CASER ONION
		Symb	ol De	. @	•	Del All	<.			
				SPACE				Appl	y	

# **RFC2544 Results Save**

Once the results are saved, they can be viewed, renamed, or exported to USB in the **Utilities > Files > Saved** section. Refer to the **File Manager** section in the RXT1200, TX300s, or UX400 Platform manual for more information on managing saved test results.

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# 5.6 V-SAM

- Overview
- <u>Setup</u>
  - <u>General</u>
  - CIR Test Configuration
  - Header Settings
  - Service Attributes Bandwidth Profile
  - Service Acceptance Parameters
  - MX Discover / Control Settings
- <u>Results</u>
  - Configuration Test
  - Performance Test
  - Event Log

### Overview

V-SAM (VeEX Service Activation Methodology) is an automated Ethernet service activation test feature conforming to the ITU-T Y.1564 standard, created to address and solve the deficiencies of RFC 2544:

• RFC 2544 was limited to test at the maximum throughput line rate for a single service. SAM is able to run multiple services on a single 10/100/1000 or 10G Ethernet line at a bandwidth ranging from 0 to the line rate, allowing for more realistic stream testing

• The Frame Delay Variation, also known as (packet) jitter was not included in RFC 2544. Jitter is a critical parameter for real time voice and video services. It is now part of the SAM test suite.

• RFC 2544 validates the service parameters like frame loss, throughput and latency, one after the other, while SAM allows testing all the service critical parameters simultaneously. This results in significant time saving compared to RFC 2544.

	RFC2544	Y.1564
Key Test Objective	Device performance	Network Service verification/activation
Service validation	One service at a time	Multiple services simultaneously
Throughput	Yes	Yes
Latency	Yes	Yes
Frame Loss	Yes	Yes
Burstability	Yes	Yes
Packet Jitter	No	Yes
Multiple Streams	No	Yes
Test Duration	Long (serialized test procedure)	Short (simultaneous test/service)
Test Result	Link performance limit	Related to SLA, fast, simple, Pass/Fail

Comparison of RFC 2544 and Y.1564

### **Test Methodology**

The purpose of the SAM test suite is to verify that the service is compliant to its Bandwidth Profile and Service Acceptance Criteria. The test is broken down into two phases:

- Phase 1: Service Configuration test: The services running on the same line are tested one by one to verify the correct service profile provisioning.
- Phase 2: Service Performance test: The services running on the same line are tested simultaneously over an extended period of time, to verify network robustness.



### Phase 1: Service Configuration Test

The service configuration test is broken down into three steps. The steps are tested individually for all the services delivered on the same line.

- Step 1: Committed Information Rate (CIR) Test: Traffic is transmitted at the CIR for a short period of time and the received traffic is evaluated against the Service Acceptance Criteria (FLR, FTD, FDV) measured simultaneously. The CIR test passes if the measurements on the received traffic stay below the performance objectives.
- Step 2: Excess Information Rate (EIR) Test: Traffic is transmitted at the CIR+EIR rate for a short period of time; the EIR test passes if the received traffic rate is between the CIR (minus the margin allowed by the FLR) and CIR+EIR.
- Step 3: Traffic Policing (Overshoot Test): The purpose of the Traffic Policing Test is to ensure that when transmitting at a rate higher than the allowed CIR+EIR, the excess traffic will be appropriately blocked to avoid interference with other services. For this test, traffic is transmitted at 25% higher than the CIR+EIR for a short period of time. The test passes if the received traffic rate is at least at the CIR (minus the margin allowed by the FLR) but does not exceed the allowed CIR+EIR.
- At this time the Committed Burst Size (CBS) and Excess Burst Size (EBS) tests are considered experimental and not an integral part of the standard.



# Service Bandwidth Profile

# Phase 2: Service Performance Test

Services running on the same line are tested simultaneously over an extended period of time, to verify network robustness. Service Acceptance Criteria (SAC) including Frame Transfer Delay (FTD), Frame Delay Variation (FDV), Frame Loss Ratio (FLR) and Availability (AVAIL) are verified for each service.

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### 5.6.1 V-SAM Setup

### General (Page 1 and 2)

- V-SAM Profile: Delete, Save, Save as..., Default, or Last Configuration.
- **# of Services:** Select the number of services to run. Up to 8 services can be chosen for a 1 GE interface and up to 10 services can be chosen for a 10 GE interface.
- Display: ULR or IR. See the <u>Service Attributes</u> section for more information.
- Service Configuration Test: Enable or Disable the configuration test.
- Service Performance Test: Enable or Disable the performance test.
- Service Configuration and Performance Tests can be enabled independently.
- CIR Test Config: Tap on the box to configure the Committed Information Rate Test on another screen.
- Duration: Select the Service Performance Test duration. Options are 15min, 30min, 1hr, 2hr, 24hr or user defined. If userdefined is selected, input a duration between 1-10000 min.



# **Enabling/Disabling Tests**

A check next to the Service number in the Service Summary table indicates that the test for the corresponding service is set to run. Tap on the box to remove the check and cancel the test for that service.

LEDs		Set	tup			Res		Start	
		Gen	eral			Serv	rices		
O Signal	V-SAM F	Profile			Last con	figuration	▼		
Signal	# of Ser	vices	8	▼	Display		ULR Mbp	os 🔻	
C Erame	⊠ Serv	ice Config	uratio	n Test	CIR Tes	t Config.			
	⊠ Serv	ice Perfor	mance	e Test	Duration	15min 🔻			
Pattern	Service	Servio	e	CIR	EIR	Traffic	CBS	EBS	
	#	Name		(Mbps)	(Mbps)	Policing	(KB)	(KB)	
0.00	⊠ 1	Service	e 1	101.318	0.000	-	-	-	
alm/Err	⊠ 2	Service	e 2	101.318	0.000	-	-	-	LASER Off
	⊠ 3	Service	e 3	101.318	0.000	-	-	-	
History	⊻ 4	Service	e 4	101.318	0.000	-	-	-	
	5	Service	e 5	101.318	0.000	-	-	-	MIX Discover
	<b>N</b>	Service	e 6	101.318	0.000	-	-	-	
	☑ 7	Service	e 7	101.318	0.000	-	-	-	Control
	⊠ 8	8 Service 8 101.318				-	-	-	
	Total IR	(CIR+EIR):	799.0	0Mbps(810.	54Mbps Ul	_R)		P2P Setup	
1000-XFULL				🕣 Pag	ge1/2 🤇				

V-SAM - Setup - General (Page 1)

LEDs	Setup					R	Start		
		Genera	al		Services				
O Signal	V-SAM F	Profile			Las	t configurati			
Signal	# of Services 8 🔻					play	ps 🔻		
Frame	Service Configuration Test					R Test Confi			
	Service Performance Test					ration 15min		-	
🔵 Pattern	Service	Service	Frame	FLE	R	FTD	IFDV	AVAIL	
	#	Name	Size	(%	)	(ms)	(ms)	(%)	
<b>O H</b>	☑ 1	Service 1	EMIX	0.10	00	10.000	-	-	
🔘 Alm/Err	⊠ 2	Service 2	1518	0.10	00	10.000	-	-	LASER Off
	☑ 3	Service 3	1518	0.10	00	10.000	-	-	
History	☑ 4	Service 4	1518	0.10	00	10.000	-	-	MAY DI
	⊡ 5	Service 5	1518	0.10	00	10.000	-	-	WIX Discover
	⊡ 6	Service 6	1518	0.100		10.000	-	-	
	☑ 7	Service 7	1518	0.100		10.000	-	-	Control
	⊠ 8	Service 8	1518	0.10	)0	10.000	-	-	
	Total IR	P2P Setup							
1000-XFULL			•	Page	2/:	2 🕞			

### CIR Test Configuration

- CIR Test Config.: Select Simple Test, Step Load Test, or Simple and Step.
  - Simple Test: Starts the tests at the CIR.
  - Step Load Test: Starts the test below the CIR and continues in steps until it reaches the CIR.
  - Simple and Step Load Test: Step Load Test performs only if the Simple Validation test fails.
- Tap on the **Test Duration** box to input a test duration (test duration must be less than 999 sec).
- Tap on the table to modify the CIR value percentage for each step.

LEDs		C	Start					
	Stop V-S	AM on T	est Failure	Enable				
	🔿 Simple	e Test	Step Load Test		🔿 Simpl	le and Step Load Te		
😑 Signal			Starts the test he	low the				
<mark>⊖</mark> Frame	Starts th at the CI	e tests R.	CIR and continues in steps until it reaches the		Step Load Test is only performed if the Simple Validation test fails.			
🔘 Pattern			011.					
_			Step Load Tes	t Config	uration			
Alm/Err	Test Duration			Step		p Value(% of CIR)		ASER Off
	10 seconds		s/test/service		1	25		
History					2	50	MX	Discover
					3	75	$\geq$	$\equiv$
					4	100		Control
				Tap on table to modify				
1000-XFULL								

# **CIR Test Config**

### Go back to top Go back to TOC

### 5.6.1.1 Header Settings

- Service #: Select a service to configure
- Service Name: Assign a name to the service if desired.
- Frame Size Type: Fixed or EMIX (1GE only). A fixed frame size is chosen as default
- Frame Size:
  - For Fixed Traffic Flow: Input a fixed frame size within the range of 64-10000 bytes by tapping the value box.
  - For EMIX (1GE only): The default value is abceg. Tap the zoom (magnifying glass) icon to define other values. Select the values from the drop down lists on the next screen.

# Any EMIX configuration of 5 frames is allowed.

• Encapsulation Type: None, Provider Backbone Bridge (PBB-TE), or Multiprotocol Label Switching (MPLS-TP). MPLS-TP is a simplified version of MPLS. Provider Backbone Bridge MAC-in-MAC (IEEE 802.1ah) encapsulation are configured trunks that add resiliency and configurable performance levels in the provider backbone network. Both options are available for 1GE Copper/Fiber and 10GE port for all Ethernet tests (Layer 2,3 and 4) - BERT, RFC2544, Throughput, V-SAM.

Tap the PBB or MPLS-TP block to configure the settings. All fields are configurable.

PBB:

- Backbone MAC Source
- Backbone MAC Destination
- Ethernet Type
- I-SID
- VLAN ID, Priority, Type

MPLS-TP:

• MPLS-TP MAC Source

- MPLS-TP MAC Destination
- Ethernet Type
- VLAN ID, Priority, Type
- LSP, PW, CW

After making changes, tap **Apply to All**, for MPLS-TP configuration.

Please see <u>RFC 2544 Setup</u> and follow the setup procedure to configure the remaining Header Settings for V-SAM.



V-SAM Setup - Services - Header Settings

LEDs		Start		
	Frame #	Size		
	1	a-98 🔻		
😑 Signal	2	b-128 🗸 🗸		
O Erama	3	c-256 🛛 🔻		
	4	d-512 🗸 🗸		
Pattern	5	e-1024 🛛 🔻		
-	6	f-1280 🔻		
🔘 Alm/Err	7	g-1518 🛛 🔻		
	8	h-2048 🛛 🔻		ENSEIVOI
History				MX Discover
				Control
			se	



LEDs	MPLS-TP	MAC	IP		UDP		DAT	A F	RX Filter	Start
	MPLS-TP MAC Source					63-1A	2B-4E			
😑 Signal	MPLS-TP MAC Destination				00-18-63-1A-2B-3C					
	Ethernet Type									
😝 Frame	MPLS-TP	VLAN I	) <mark>1082</mark>	Prio	rity	6	Туре	88	a8	
Pattern	LSP	L	abel= <mark>0</mark>		S=	1 C	oS= <mark>0</mark>	TTL=	128	
•	PW		Label= <mark>0</mark>		S= <mark>1</mark> Co		oS= <mark>0</mark>	TTL=	128	
ALM/ERR										
History										MX Discover
				Apply	/ to All					
#### 5.6.1.2 Service Attributes

#### **Bandwidth Profile Parameters**

The Bandwidth Profile specifies how much traffic the customer is authorized to transmit and how the frames are prioritized within the network. In the Bandwidth table, the user specifies the following bandwidth criteria:

- CIR: Committed Information Rate. This is the guaranteed maximum rate at which the customer can send frames that are assured to be forwarded through the network without being dropped. Tap on the box to enter a rate and choose between IR Mbps or ULR Mbps. Allowed values range from 0.01Mbps to the line bandwidth.
  - Information Rate (IR): Measures the average Ethernet frame rate starting at the MAC address field and ending at the CRC.
  - Utilized Line Rate (ULR): Measures the average Ethernet frame rate starting with the overhead and ending at the CRC.



V-SAM Services - Header

- Excess Information Rate (EIR): Maximum rate above the CIR at which the customer can send frames that will be forwarded on a best effort basis, but may be dropped in the event of congestion within the network. The combined CIR and EIR must not exceed the line bandwidth. Traffic beyond CIR + EIR will be dropped when it enters the carrier's network. Tap on the box to enter a rate. EIR is expressed in terms IR Mbps or ULR Mbps. Select a term to express EIR or select Disable to disable the test.
- **Traf. Policing:** Enable or Disable the traffic policing test. For this test, traffic is transmitted at 25% higher than the CIR+EIR. The Policing test fails if the higher traffic rate is allowed through the network.
- Color Aware: Enable, Disable. When Color Aware is enabled, the Drop Eligible parameter in the VLAN header configuration screen is not available for configuration. If no VLAN is configured for the service traffic, the Color Aware parameter is ignored.
- CBS and EBS: Committed Burst Size (CBS) and Excess Burst Size (EBS).
  - CBS can be enabled without enabling EBS
  - If EBS is enabled, then CBS is automatically enabled too
  - Values between 4 KBytes and 100 KBytes can be input for both CBS and EBS

LEDs		Setup			Results		Start
		General			Services		
😑 Signal	He	ader	Service A	Attributes	Sum	imary	
-	Service #			1			
⊖ Frame	Bandwidth	Profile Paran	neters	Service Acc	eptance Pa	rameters	
Pattern	⊠ CIR	101.32	ULR Mbp	🗹 FLR	0.100	%	
	🗹 EIR	0.00	ULR Mbp	🗹 FTD	10.000	ms 🔻	
🔵 Alm/Err	🗆 СВЅ	20.000	КВ		1.000	ms 🔻	
	EBS	20.000	кв	🗆 AVAIL	99.900	%	LASER OT
History	Color Awar	e Service		Disable		▼	MX Discover
	Traffic Poli	cing Test		Enable		▼	
	Traffic Poli	cing Rate		125 %			Control
			C C C	py			P2P Setup
1000-XFULL							

V-SAM Setup - Services - Service Attributes



### **Service Acceptance Parameters**

The user establishes Pass/Fail test criteria for the following Service Acceptance Criteria. Values define the minimum requirements to ensure that the service meets the Service Level Agreement (SLA):

- FLR: Maximum ratio of lost frames to the total transmitted frames allowed to still be compliant with the SLA. FLR is only guaranteed for traffic conforming to the CIR. Enter a percentage from 0-100.
- FTD: Maximum transfer time that the frames can take to travel from source to destination, and still be compliant with the SLA.
   FTD is only guaranteed for traffic conforming to the CIR. Values are measured in us, ms, or sec. Input a value within the digital range of .001-999 and 1 us-999sec. The user can also choose to **Disable** the FTD threshold evaluation. FTD will be measured anyway but the value will not contribute toward passing or failing the service.
- **IFDV:** Maximum frame jitter allowed to still be compliant with the SLA. FDV is only guaranteed for traffic conforming to the CIR. Values are measured in us, ms, or sec. Input a value within the digital range of .001-999 and 1 us-999sec. The user can also choose to **Disable** the IFDV threshold evaluation. IFDV will be measured anyway but the value will not contribute toward passing or failing the service.
- AVAIL: Minimum percentage of service availability allowed to still be compliant with the SLA. The service becomes unavailable if more than 50% of the frames are errored or missing in a one second interval. Availability is only guaranteed for traffic conforming to the CIR. Enter a percentage from 0-100. The user can also choose to **Disable** the AVAIL threshold evaluation. AVAIL will be measured anyway but the value will not contribute toward passing or failing the service.

LEDs		Copy Service Head	ler	Start
	Copy FROM	Сору ТО	Copy TO + Increment	
	Service1	Service1	MAC Source	
😑 Signal	O Service2	🗹 Service2	MAC Destination	
0.5	O Service3	🗹 Service3		
Frame	O Service4	🗹 Service4		
Pattern	O Service5	🗹 Service5		
Ŭ	Service6	🗹 Service6		
🔘 Alm/Err	O Service7	🗹 Service7		
History	Service8	☑ Service8		MX Discover
1000-XFULL	Apply		card	Control

**Copying Services** 



### **MX Discover and Control Settings**

For instructions on how to loop up/down the test set with another test set or device, please refer to MX Discover and Control.

The **Control** button offers additional loopback control settings including User Defined and OAM Discover. These features are described in **MX Discover and Control**.

### Peer-to-Peer Setup

Peer-to-Peer and asymmetric testing via the **P2P Setup** button is also available. Refer to Peer-to-Peer and Asymmetric Testing section for more information.

### Packet Capture

To capture packets, tap on **P1 Cap Start**. Stopping packet capture automatically names and saves results in pcap format. A message displays the name of the saved file located in **Files > Saved** section of the test set. The file and can be exported to a PC and analyzed using Wireshark. Refer to **Files > Viewing Saved Files and Results** section in **TX300s**, **MTTplus**, **RXT-1200**, or **UX400 platform manuals** for more information on retrieving and managing saved files.

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#### 5.6.2 Results



**Results - Config. Tests - Service 1** 

- To run the test, make sure that traffic is being looped back at the far-end of the network under test.

#### **Configuration Test**

The **Config. Tests** tab lists the Pass/Fail status of each service and test. Tapping on the table brings up a screen with **CIR**, **CIR/EIR** and **Policing Test** results for the chosen Service. **CIR**, **CIR/EIR Test**, and **Policing** tabs display min, mean, and max values for **IR Mbps**, **FTD**, **FDV**, **Frame Loss Count**, and **Frame Loss Ratio (%).** If Step Load was selected for the CIR Test, these values will be displayed for each step. If any measured values do not meet the service test parameters set in the Bandwidth and Threshold tabs, the test fails.

- IR Mbps: Information Rate. Measures the average Ethernet frame rate starting at the MAC address field and ending at the CRC.
- FTD: Measures the time that the frames can take to travel from source to destination.
- FDV: Measures the frame jitter.
- Frame Loss Count: Counts the number of lost frames.
- Frame Loss Ratio: Ratio of lost frames to the total transmitted frames.

LEDs	CIR Test	CIR/EIR Test	Policing Test	CBS Test	EBS Test	Stop
0.01		Ste	p1 Step2	Step3	Step4	
Signal	Pass/Fail	Pas	s Pass	Pass	Pass	
-						
🜔 Frame	ULR Min(Mbp	s) 25.3	03 50.633	75.973	101.298	
	ULR Mean(Mb	ps) 25.3	20 50.651	75.979	101.310	
🔘 Pattern	ULR Max(Mbp	s) 25.3	34 50.668	75.990	101.314	
Alm/Err	Frame Loss C	ount 0	0	0	0	
<b>~</b>	Frame Loss R	atio(%) 0.00	0.000	0.000	0.000	LASER Off
History	FTD Min(ms)	0.00	000 0.0000	0.00000	0.00000	
	FTD Mean(ms	) 0.00	062 0.0006	2 0.00062	0.00062	
	FTD Max(ms)	0.01	036 0.0103	6 0.01018	0.01016	
	FDV Min(ms)	0.00	000 0.0000	0.00000	0.00000	
	FDV Mean(ms	) 0.00	226 0.0044	7 0.00409	0.00469	
1000-XFULL	FDV Max(ms)	0.00	424 0.0156	0 0.01561	0.01562	

**CIR Test - Service 1** 

CIR test: The test passes if all measured values are below the thresholds configured If a threshold is disabled, it will not be

LEDs	CIR Test	CIR/EIR Test	Policing Test	CBS Test	EBS Test	Start
<b>A a</b>			Green(CIR)	Yellow(EIR)	Total	
Osignal	Pass/Fail				Pass	
🜔 Frame	ULR Min(Mbp	s)			151.302	
	ULR Mean(Mb	ops)			151.311	
🔘 Pattern	ULR Max(Mbp	s)			151.315	
-						
Alm/Err	Frame Loss C	ount			0	
<b>•</b>	Frame Loss R	atio(%)			0.000	LASER Off
History	FTD Min(ms)				0.00060	MX Discover
	FTD Mean(ms	)			0.00060	
	FTD Max(ms)				0.00064	Control
	FDV Min(ms)				0.00000	
	FDV Mean(ms	)			0.00001	
1000-XFULL	FDV Max(ms)				0.00002	

**CIR/EIR Test - Service 1** 

CIR/EIR test: The test passes if the received IR value is between the CIR (minus the margin allowed by the FLR) and CIR+EIR.

LEDs	CIR Test CIR/EIR Test	Policing Test	CBS Test	EBS Test	Start
	Serv				
0.00		Green(CIR)	Yellow(EIR)	Total	
Osignal	Pass/Fail			Failed	
-					
😑 Frame	ULR Min(Mbps)			163.803	
	ULR Mean(Mbps)			163.811	
🔘 Pattern	ULR Max(Mbps)			163.815	
-					
Alm/Err	Frame Loss Count			0	
•	Frame Loss Ratio(%)			0.000	LASER Off
$\frown$					
History	FTD Min(ms)			0.00062	MX Discover
	FTD Mean(ms)			0.00062	
	FTD Max(ms)			0.00064	Control
					Control
	FDV Min(ms)			0.00000	
	FDV Mean(ms)			0.00001	
1000-XFULL	FDV Max(ms)			0.00001	

Policing Test - Service 1

**Policing test**: The test passes if the received traffic rate is at least at the CIR (minus the margin allowed by the FLR) but does not exceed the allowed CIR+EIR.

LEDs		Set	tup			Res	ults		Start
	Confi	Config. Tests		Perf. Tests		gnal	Event Log		
😑 Signal	Ser	vice 5	rice 5 Service 6		Ser	vice 7	Se	ervice 8	
• Erame	Sumn	n <b>ary</b> S	ervice 1	Serv	rice 2	Service	3	Service 4	
				Fai	led				
🔘 Pattern	Serv #	CIR	CIR/EIF	₹ P	olicing	CBS	E	BS	
_	1	Pass	Pass	F	ailed	Disable	ed [	Disabled	
🔘 Alm/Err	2	Pending	Disable	d D	isabled	Disable	ed [	Disabled	
	3	Pending	Disable	d D	isabled	Disable	ed [	Disabled	LASER Off
	4	Pending	Disable	d D	isabled	Disable	ed [	Disabled	
History	5	Pending	Disable	d D	isabled	Disable	ed [	Disabled	(MX Discover)
	6	Pending	Disable	d D	isabled	Disable	ed [	Disabled	
	7	Pending	Disable	d D	isabled	Disable	ed [	Disabled	Control
	8	Pending	Disable	d D	isabled	Disable	ed [	Disabled	
									P2P Setup
1000-XFULL									

**Results - Config. Tests - Summary** 

Summary: The Summary tab displays the status of each service and test as Pass, Failed, Pending, or Disabled.

LEDs		Setup			Res	ults		Start
	Config. Test	s Perf	f. Tests	Signal		Event Log		
😑 Signal	Service 4	Service {	5 Serv	ice 6	Service	7	Service 8	
O Erama	Summary	Aggregat	e Serv	ice 1	Service	2	Service 3	
Orranie		Ser	/ice #	1:Pe	ending			
🔘 Pattern	ULR Min(Mbps	9		Frame	Loss Count			
🔵 Alm/Err	ULR Mean(Mb	ps)		Frame Out of	Loss Ratio	%) Count		
	ETD Min(ms)				in(ms)		1	
History	FTD Mean(ms)			FDV M	ean(ms)			MX Discover
	FTD Max(ms)			FDV M	ax(ms)			
	Availability(%)	T		Errore	d Frame Co	unt	1	Control
	Unavailability (	Count		Total F	X Frames	un		
1000-XFULL								P2P Setup

Perf. Test - Service 1

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#### Performance Test

The Service # tabs display min, mean, and max values for IR Mbps, FTD, FDV, Frame Loss Count, Frame Loss Ratio (%), Availability, and Errored Frame Count. Pass/Fail/Pending status of each test is displayed on the top of each table.

- IR Mbps, FTD, FDV, Frame Loss Count, Frame Loss Ratio (%) definitions are listed in the Configuration Test section.
- Availability: Minimum percentage of service availability allowed to still be compliant with the SLA. The service becomes unavailable if more than 50% of the frames are errored or missing in a one second interval. Availability is only guaranteed for traffic conforming to the CIR.
- Total RX Frames: Total number of frames received
- Errored Frame Count: Number of frames with CRC or IP Checksum errors

Measured values that do not meet the service test parameters set in the Bandwidth and Threshold tabs cause the test to fail.

The Summary tab displays the status of each service and test as Pass, Failed, Pending, or Disabled.

LEDs					Results					Start			
		Config. Test	s	s Perf. Tests		s	Signal		Event Log				
😑 Signal		Service 4	S	ervice 5		Serv	ice 6	Ser	vice 7	7	Service	8	
• Erame		Summary	A	ggregate	2	Serv	ice 1	Ser	vice 2	2	Service	3	
					P	en	ding						
🔵 Pattern		Pass/Fail	ULI	R(Mbps)	FLR(	%)	FTD(r	ns)	FDV(	ms)	AVAIL(%	5)	
	1	Pending											
🔘 Alm/Err	2	Pending											
	3	Pending											LASER OIL
History	4	Pending											
	5	Pending											MX Discover
	6	Pending											
	7	Pending											Control
	8	Pending											
													P2P Setup
1000-XFULL	То	tal ULR(Mb)	ps):										

Perf. Tests - Summary

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# Event Log

A time stamped record or log of test types and test statuses (start/stop).

LEDs	Se	tup		R	Results					
	Config. Tests	P	erf. Tests	Signal	Event Log					
Signal	Time		Event Type	# of Events	s Test					
Jorginar	2020-12-21 01:44	1:56	Test Started	I	V-SAM					
😑 Frame	2020-12-21 01:46	5:12	Test Stoppe	d	V-SAM					
🔵 Pattern										
🔵 Alm/Err										
History						MX Discover Control P2P Setup				
1000-XFULL										

Event Log

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# 5.7 Throughput Testing

## 5.7.1 Setup

#### **Overview:**

The Throughput application performs the following measurements: Throughput performance, Frame Loss analysis, Delay analysis, Frame/Packet arrival analysis, received Traffic Type analysis, and received Traffic Frame Size analysis. On the transmit side, the Throughput application currently allows only one stream with its MAC and IP address, VLAN tags (up to 3), bandwidth/rate, frame size, and L2 and/or L3 quality of service (QoS) parameters. On the receiver end the traffic is analyzed on a per stream basis as well as a global or aggregate measurement.

This application is very useful in verifying the transport of traffic with different prioritization settings across a network link. The test helps verify that the network can handle high priority traffic and low priority traffic accordingly.

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#### 5.7.1.1 Header Settings

Unless otherwise noted, Frame Header, MAC, VLAN, MPLS, and IP configuration procedures are identical to the setup described in RFC 2544 and BERT. Refer to the <u>BERT</u> application for details. The following parameters must be configured prior to performing a Throughput test:

LEDs	Set	up			Res	ults	Start
	Throughput	L	_atency	Frar	ne Loss	Burst	
😑 Signal	Header		F	rames		Thresholds	
Frame	Profile			Last co	onfiguration	י 🔻	
	Encapsulation Typ	e		MPLS-	ТР	▼	
Pattern	Test Layer			Layer 3	1		
	Frame Type			Ethern	et II(DIX)	•	
ALM/ERR	VLAN			1 tag			
History	MPLS			2 tags		LASER On/Off	
			<u> </u>		<u> </u>		MX Discover
	MPLS-TP MAC		M M	IP	Da	ta C	
		Ā	L L			c	Control
		N	S S				

#### **Throughput Header Settings**

- Number of streams (See General Settings below)
- Bandwidth per stream (See General Settings below)
- Test layer
- Frame Type
- VLAN tag(s)
- MPLS tag(s)
- Frame header per stream (if applicable)
- Traffic profile per stream (if applicable)
- Error injection per stream (if applicable)
- Control settings of the far-end device(s) (if applicable)

The IP header features additional **Ping** and **ARP** features which can be applied to selected streams or all streams by Gateway or IP Destination. Refer to the **UX400 40G/100G**, **TX300s-100G**, or **RXT-1200 platform manual** for information on setup and results for Ping and ARP.

LEDs	MPLS- Stream	RX Filter	Start
O Signal	IP Type IP Addı   Selected Stream   Gateway  Source	<b>V</b>	
<ul> <li>Prame</li> <li>Pattern</li> </ul>	Destin Subnet O All Streams IP Destination Gatew:		
<ul> <li>Alm/Err</li> <li>History</li> </ul>	IP TOS DSCP OK Cancel I128	● ▼	LASER Off MX Discover
	Do Not Fragment Flag 0	V	Control
1000-XFULL	Apply to All Apply Ping	ARP	

**Throughput Header - IP - Ping Settings** 

LEDs	MPLS-TR	P MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	Stream #		▼					
	IP Type			liD.v/			<b>• •</b>	
😑 Signal	IP Addı			PING			▼	
<u></u>	Source							
O Frame	Destin	Stream #1		In Pro	ogress			
🔵 Pattern	Subnet		_		~			
Ĩ	Gatewa			ок	)			
🔘 Alm/Err	IP TOS			ספטן	<b>r</b>			
	DSCP	User Define	ed <b>▼</b> 011	1001 ECT	0	CE	0 🔻	
History	TTL			128				MX Discover
	Do Not F	ragment Fla	g	0			▼	
								Control
				Page 1/2	€			
1000-XFULL	Apply	to All	Apply		Ping			

**Throughput Header Settings** 



## 5.7.1.2 Traffic Settings (Per Stream Configuration)

In the Traffic tab the user is able to configure the traffic profile per stream, including frame size selection, traffic type, and transmit rate.

- Stream #: Select a stream number to configure.
- Traffic Flow: Select from Constant, Ramp, Burst, or Single Burst traffic flow.
- Frame Size (Type): Fixed, increment, decrement, random
- Frame Size (bytes): If a fixed frame size is chosen, this option is enabled. Enter the frame size when a Layer 2 or 3 is selected. Frame sizes can be from 64bytes to 1518bytes, in addition to jumbo frames up to 9k bytes.

Bandwidth: Configure the transmit rate for the stream. The parameters depend on the Traffic Flow selected.

- Constant Traffic Flow: Constant Bandwidth
- Ramp: Start BW, Stop BW, Step BW, Ramp Time, Repetitions
- Burst: Burst 1 Bandwidth, Burst 1 Time, Burst 2 Bandwidth, Burst 2 Times
- Single Burst: Single Burst Bandwidth

The bandwidth allocation per stream is already configured in the **General Settings** tab, but can be modified in this screen as well.

LEDs		Setup	Re	sults	Stop
	Header	Traffic Gei	neral Summai	ry OAM	
😑 Signal	Stream #	1 of 1	Prev	Next	Restart
Frame	Traffic Flow		Constant	▼	TX Stop
	Frame Size Ty	oe	Fixed		
😑 Pattern	Frame Size (by	tes)	256	Etn. Err inj.	
_	Constant Band	width	100.000	% ▼	PCS Alarm Inj.
ALM/ERR					
History					LASER On/Off
					MX Discover
					Control
					Setup Injection

**Throughput Traffic Settings** 

## 5.7.1.3 General Throughput Settings (Global Configuration)

- # of Streams: Only 1 for now. 256 in the future.
- Stream #: Allocated Bandwidth per Stream: The total bandwidth for all streams cannot exceed 100%.
- Total (%): Sum of all stream rates in %.

LEDs	Setup				Results	5	Start
	Header	Traffic	Gen	eral	Summary	OAM	
😑 Signal	# of Streams		-	1			
O Frame	Stream #1 (%)			100.000			
	Total (%)			100.000			
Pattern							
							LASER On/Off
History							
							MX Discover
							Control
			Page	1 of 2			

### **Throughput General Setup**

Page 2 features Round Trip Delay (RTD) measurement and Service Disruption Test (SDT) measurement settings.

- Delay Measurement Mode: Enable/disable the round trip delay measurement. It should only be enabled when running the test to a remote loopback.
- RTD Unit Auto Scale: ON/OFF
- Histogram: Enable / Disable
- Sampling Period: 1sec, 10secs, 30secs, 1min, 10min, 30min, 1hr. Defines how often the RTD (round trip delay) measurement is evaluated against the RTD threshold.
- Threshold (Max RTD allowed): Input the value in us, ms or sec. Defines the maximum allowed round trip delay value. If the

RTD value exceeds the threshold, an event is logged with corresponding time stamp.

- Save Histogram: Enable/Disable
  - **SDT Measurement**: Enable/Disable. The Service Disruption Test is triggered based on user established thresholds.
    - SDT Violation Threshold (us): Triggers an SDT Violation event in the event log. This is helpful for historical purposes during any given test. If the measured SDT is equivalent or greater than the configured threshold an SDT Violation event is counted.
    - **SDT Measurement Trigger (>us)**: Any inter-frame gap that is equivalent or greater than the configured threshold will trigger the SDT measurement. This is useful if a known threshold is expected from a given network under test. For example, if the known switchover time is 50ms, the trigger can be set to a value slightly below 50ms to assure that the SDT is measured.

LEDs	Setup				Resu		Start	
	Header	Traffic	Gen	ieral	Summary		OAM	
😑 Signal	Stream TX Sta	rt		Couple	d		▼	
<b>• •</b>	Delay Measure	elay Measurement Mode					▼	
e rrame	RTD Unit Auto Scale			ON			•	
Pattern	Histogram			Enable			•	
Ŭ	Sampling Perio	d		1min		LASER On/Off		
ALM/ERR	Threshold (Ma	x RTD allowed	)	100.00	L	IS	▼	MX Discover
History								Control
	SDT Measurer	nent		Enable			•	CDR Access
	SDT Violation Threshold(us)			50000				
	SDT Measurer	nent Trigger(u	s)	50000				IZC Access
			Page	2 of 2	۲			

Throughput General Setup - Round Trip Delay (RTD), Service



### Go back to top Go back to TOC

## 5.7.1.4 Error Injection Settings (Per Stream Configuration)

LEDs	Se		Resu	ts	Stop	
	Global	Per Stream	PC	s	OAM	Restart
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarm	s Event	ts Traffic Delay	
🜔 Frame	ST:2020-12-21 02:2	28:53	ET:00:01:21		TX Stop	
		тх	F	₹X		Alm Frr
😑 Pattern	Line Rate (bps)	1	00.000			
	Utilization (%)	100.000%	1	00.000%	0	LASER ON/OIL
ALM/ERR	Utilization (bps)	100.000G	1	00.000	;	MX Discover
History	Framed Rate (bps	) 92.754G	92.754G			Control
HISTORY	Data Rate (bps)	68.116G	6	8.116G		Control
	Total Frames	tal Frames 3667851434			341	CDR Access
	Bad Frames	0	0			12C Access
	Pause Frames	0	0			LOACCESS
						Setup Injection

## **Setup Error Injection**

Error injection can be performed during test. The type of errors and error injection are configured in the Error Injection tab. Once the

test is running, error injection can be performed by pressing the Error Inject button on the right side of the screen.

- Stream #: Select the stream to configure.
- Error type: Select from CRC, Pause, or Bit. With Pause selected, the unit will transmit a pause frame when the Error Inj. icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- Injection Flow: The error injection flow determines how the selected errors will be injected. The user can select a single error or a specific count.
- Count: Set a count using the numeric keypad.



**Throughput Error Injection Setup** 

#### Go back to top Go back to TOC

#### 5.7.1.5 Alarm Injection Settings

Alarm injection can be performed during test. The type of alarms and alarm injection are configured in the Alarm Injection tab. Once the test is running, alarm injection can be performed by pressing the **Alarm Inj.** button on the right side of the screen.

- Alarm Type: Local Fault, Remote Fault, Laser 1 Off, Laser 2 Off, Laser 3 Off, Laser 3 Off, Laser 4 Off
- Alarm Flow: The alarm flow determines how the selected alarms will be injected. A specific Count or Conitnue (continuous) can be selected.
- Alarm Length: 1s, 10s, or 100s.

LEDs	Setup Alarm an	Stop		
		Erro	r Injection	
😑 Signal		Layer	ETHERNET 🔻	Restart
		Туре	CRC 🗸	TX Stop
😑 Frame		Behavior	Single 🔻	
😑 Pattern				LASER On/Off
		Alarm	Generation	
ALM/ERR		Layer	ETHERNET V	MX Discover
		Туре	Local Fault 🛛 🔻	
History		Behavior	Single Burst 🔻	Control
		Duration	1s 🔻	CDR Access
				LI2C Access

**Throughput Alarm Injection Setup** 

#### Go back to top Go back to TOC

## 5.7.1.6 Summary

The summary screen lists the MAC source, MAC destination and VLAN information of each stream. Tap on the appropriate box of each tab to reconfigure the source, destination, or VLAN information if desired.

LEDs		Setup		Result	s	Stop
	Header	Traffic	General	Summary	OAM	Restart
😑 Signal	MAC List	IP List	VLAN List	Mpls List	Gateway List	
😑 Frame	# of Streams	MAC	Source	MAC De	estination	TX Stop
Ŭ	Stream #1	00-18-63-02-De	5-A8	00-1E-90-A0-5	7-3C	Alm / Err
🜔 Pattern						LASER On/Off
ALM/ERR						MX Discover
History						Control
						CDR Access
						I2C Access
			Page 1 of 1	۲		Setup Injection

**Throughput Summary MAC List** 

LEDs		Setup			R	esults	5		Stop
	Header	Traffic	Gei	neral	Summ	ary	OAM		Restart
😑 Signal	MAC List	IP List	VLA	N List	Mpls L	ist	Gateway	List	
🜔 Frame	# of Streams	Source IP	D	estinati	on IP	Subi	net Mask		TX Stop
Ĩ	Stream #1	192.168.0.101	1	92.168.0	.102	255.2	255.255.0		
😑 Pattern									LASER On/Off
ALM/ERR									MX Discover
History									Control
									CDR Access
									I2C Access
	Src. to Dest.	Dest. to Src.		Swap		Pa	ige 1 of 1	$\bullet$	Setup Injection

**Throughput Summary IP List** 

LEDs		Setup				Result	s	Stop
	Header	Traffic	Gene	eral	Sum	mary	OAM	Restart
😑 Signal	MAC List	IP List	VLAN	List	Mpl	s List	Gateway List	
🜔 Frame	# of Streams		ID	Prio	rity	Туре		
	vlan #1 of strea	am 1	12	3		8100	V	Alm Frr
O Pattern								LASER On/Off
O ALM/ERR								MX Discover
History								Control
								CDR Access
								I2C Access
								Setup Injection

**Throughput Summary VLAN List** 

LEDs		Setup			Result	5	Stop
	Header	Traffic	Gen	eral	Summary	OAM	Restart
😑 Signal	MAC List	IP List	VLAN	l List	Mpls List	Gateway List	
🜔 Frame	Background		Label	s	Cos	TTL	
-	mpls #1 of stre	am 1	0	0	0	128	
😑 Pattern	mpls #2 of stre	am 1	0	1	0	128	LASER On/Off
ALM/ERR							MX Discover
History							Control
							CDR Access
							I2C Access
							Setup Injection

**Throughput Summary MPLS List** 

LEDs		Setup			Result	Stop	
	Header	Traffic	Ger	ieral	Summary	OAM	Restart
😑 Signal	MAC List	IP List	VLAN	l List	Mpls List	Gateway List	
🜔 Frame	# of Streams			Gatewa	ay		TX Stop
Ŭ	Stream #1			192.168	3.0.1		
😑 Pattern							LASER On/Off
O ALM/ERR							MX Discover
History							Control
							CDR Access
							I2C Access
			Page	1 of 1	۲		Setup Injection

**Throughput Summary Gateway List** 

### **OAM Discover**

Like MX Discover, OAM Discover can also be used to discover far-end test units without manually configuring the local or remote unit's destination address. If OAM is enabled on the test set, any link partner that supports the IEEE 802.3ah protocol will be discovered automatically and displayed under the OAM Discover tab.

### To Access OAM Discover:

- 1. Go to **Throughput > OAM > Link OAM** tab. Tap on the 802.3ah check box to activate Link OAM.
- 2. Select Active from the OAM Mode drop-down menu (only Active mode can send loop commands).
- Tap on the Loop Control button and select OAM Discover from the Partner Address drop-down window to see a list of discovered OAM devices.
- 4. Select an OAM device and press the Loop Up button to send a loop up command to the selected remote unit.

For detailed descriptions of Discovery Capabilities and Link Events Notification Settings, see the Link Level 802.3ah OAM Setup section.

For information on Service Level OAM setup, see the Service Level OAM section.

LEDs	Setup					Results		Stop	
	Header	Traffic	Gen	ieral	s	ummary	OA	м	Restart
😑 Signal	L	ink OAM		Service Level OAM					
😑 Frame	802.3ah OAM:	<b>a</b> (	ode: Active 🔻						
	Vendor OUI	00-18-63		Max PE	ն ն	.ength	1518		
O Pattern	Vendor SPI	63-00-1B-93		PDU Ra	ate		1000		LASER On/Off
	Discovery Cap	ability Remote Loo MIB Retriev	pback		2	Link Ever	its	<b>N</b>	MX Discover
History	Link Events N	otification Sett Link Fault Critical Ever Dving Gasp	ings 1t			onunecti	011	v	Control CDR Access
									Setup Injection

Activating 802.3ah Link OAM

## 5.7.1.7 FEC



**Test Mode Selection** 







### **FEC test in Progress**

LEDs		PCS	FE	C	Stop
	:	Setup	Res	ults	Restart
😑 Signal	Summary	Alarms/Errors/Skew	RX AM Seque	nce Events	
Frame	ST:2021- 1-15 02	:42:52	ET:00:24:55	1	
•					
O Dattarn	Alarms	Seconds	Alarms	Seconds	
Pattern	HiSER	HiSER 0		0	LASER On/Off
	LOA	0	FEC Lane Swap	0	
		WIX DISCOVER			
History	E	rrors	Count	Rate	
	u	CFEC	0	0.00E+00	
	(	CFEC	0	0.00E+00	CDR Access
	LOAN	1PS Event	0	0.00E+00	
	LO	AEvent	0	0.00E+00	12C Access
	Invalid Tra	nscoded Block	0	0.00E+00	Setup Injection
	1				

### Setup Alarm and Error Injection

For the FEC there are 3 types of errors that can be injected: CFEC - controlled Forward Error Correction UCFEC - uncontrolled Forward Error Correction Invalid Transcoded Block

LEDs	P	cs	FE	C	Start
	Se	tup	Res	ults	
😑 Signal	Summary A	larms/Errors/Skew	RX AM Seque	nce Events	
🙆 Frame	ST:				
A Pattern	Alarms	Seconds	Alarms	Seconds	
	HISER	0	LOAMPS	0	LASER On/Off
	LOA	0	FEC Lane Swap	0	MY Discours
•		WIX DISCOVED			
History	Eri	ors	Count	Rate	
	uCl	FEC	0	0.00E+00	
	CF	EC	0	0.00E+00	CDR Access
	LOAMP	S Event	0	0.00E+00	
	LOA Event		0	0.00E+00	12C Access
	Invalid Trans	scoded Block	0	0.00E+00	

## FEC Results Summary

LEDs		PCS				FEC		Start
		Se	tup			Results		
🔘 Signal	Summary Alarms/Errors/Skew				RXA	M Sequence	Events	
🙆 Frame	ST: ET:					:00		
•				L	ane			
Pattern	LANE	RX FEC	FEC RX Skew		LOAMPS	LOAMPS		
Fattern	ID IC	ID	bits	ps	Seconds	Count	Rate	LASER On/Off
ALM/ERR	0	3	0	0	0	0	0.00E+00	MX Discover
	1	2	260	10084	0		0.00E+00	
History	2	1	196	7602	0	0	0.00E+00	
	3	0	255	9890	0		0.00E+00	
								CDR Access
								I2C Access

## FEC Alarms/Error/Skew



FEC - Results RX AM Sequence

LEDs		PCS			FEC		Start
	Setup				Results		
🜔 Signal	Summary	Ala	arms/Errors/Skew	RX	AM Sequence	Events	
🜔 Frame	Time		Event Type		# of Events	Test	
•	2021- 1-14 07:2	26:24	INVTC Block TOT	AL	1	FEC	
🔘 Pattern							LASER On/Off
ALM/ERR		_					MX Discover
History							
							CDR Access
			🕚 Pagi	e 1 of 1			I2C Access

### FEC - Results/Events

## 5.7.1.8 Starting/Stopping a Throughput (Multiple Streams) Test

Once all configurations have been made, tap the Start button on the right section of the screen to start the measurements.

The following are three scenarios of how to prepare and start the unit for Throughput testing.

## • End-to-End Testing

- Connect the test set to another unit that supports BERT testing.
- After configuring test settings on both units, start the tests.

## • Far-End Unit in Manual Loopback Mode

- If the far-end unit (another MX) is already in a manual loopback mode, do not send a loop up command since it isnot necessary.
- Once the correct control settings are configured, the user can start the test.

The selected tests will run automatically. When all the tests are complete the test will stop automatically. If the Throughput test suite needs to be stopped before they are done, then simply tap the **Stop** button. The status of each selected test can be seen in the Results tab.

### • Far-End Unit Controlled with Loop Up/Down Commands

- If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unitbefore the Throughput test suite can be started.
- To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings mode to manual.
- Enter the MAC and/or IP address of the far-end unit.
- Send the loop up command by tapping on the Loop Control button and pressing Loop Up.

Once the far-end unit has been looped back, start the test by pressing the **Start** button. When the all of the selected test are completed, the Throughput test suite will stop automatically. Once all tests have been completed and there is no need to test again, go back to the Control tab, and press the **Loop Down** button. This will send a loop down command to the far-end unit to remove the loopback that is in place.

## Go back to top Go back to TOC

## 5.7.2 Throughput Results

When the test is first started, the screen automatically changes to the Global/Aggregate results screen.

### Go back to top Go back to TOC

### 5.7.2.1 Global/Aggregate Results

The Global results pages display measurements for all traffic streams as well as non test traffic.

### The Global Stream Summary screen displays:

- Stream number (#)
- % of bandwidth per stream
- Errors/alarms associated with the stream
- Quality of Service (QoS) performance verification associated with each stream

LEDs	Setup				Res		Stop		
	GI	obal	Pers	Stream	PCS		OAM		
😑 Signal	Stream	Summary	Aggrega	te Signal	Errors A	larms Eve	nts Tra	ffic Delay	Restart
🔵 Frame	No.	% of BW	No.	% of BW	No.	% of BW	No.	% of BW	TX Stop
Ť	#1	100.000	#9		#17		#25		Eth Err Ini
🜔 Pattern	#2		#10		#18		#26		Eun. Err ing.
	#3		#11		#19		#27		Eth. Alarm Inj.
ALM/ERR	#4		#12		#20		#28		
History	#5		#13		#21		#29		LASER On/Off
HIStory	#6		#14		#22		#30		
	#7		#15		#23		#31		Wix Discover
	#8		#16		#24		#32		Control
	Stream #	‡1	No Erroi	ſS					Setup Injection

**Throughput Results - Global Stream Summary** 

## QoS

QoS values are based on packet statistic thresholds for roundtrip delay, jitter, frame loss, and IP checksum from the ITU-T Y.1541 standard. Below is a list of IP network QoS class definitions and network performance objectives from Y.1541.

"U" denotes "unspecified" or "unbounded" and signifies that no objective was established for this parameter and default Y.1541 objectives do not apply. Parameters designated with "U" are occasionally inconsistent and poor.

IP Network QoS Class Definitions and Network Performance Objectives (Classes 0-3)									
Network	QoS Classes								
Performance Parameter	Class 0	Class 1	Class 2	Class 3					
IPTD		≤ 800 ms/2 (400	≤ 200 ms/2 (100	≤ 800 ms/2 (400					
	≤ 200 ms/2 (100	ms one-way)	ms one-way)	ms one-way)					
	ms one-way)	AND > 200		AND > 200					
		ms/2		ms/2					
IPDV	≤ 50ms	≤ 50ms	U	U					
IPLR	> 1/100,000	> 1/100,000	> 1/100,000	> 1/100,000					
	AND ≤ 1/1000	AND ≤ 1/1000	AND ≤ 1/1000	AND ≤ 1/1000					
IPER	> 1/1,000,000	> 1/1,000,000	> 1/1,000,000	> 1/1,000,000					
	AND ≤ 1/10,000	AND ≤ 1/10,000	AND ≤ 1/10,000	AND ≤ 1/10,000					

IP Network QoS Class Definitions and Network Performance Objectives (Classes 4-7)										
Network	QoS Classes									
Performance Parameter	Class 4	Class 5	Class 6	Class 7						
IPTD	≤ 2 s /2 (1 s one-way) AND > 800 ms/2	U	≤ 200 ms/2 (100 ms one-way)	≤ 800 ms/2 (400 ms one-way) AND > 200 ms/2						
IPDV	U	U	≤ 50ms	≤ 50ms						
IPLR	> 1/100,000 AND ≤ 1/1000	U	≤ 1/100,000	≤ 1/100,000						
IPER	> 1/1,000,000 AND ≤ 1/10,000	U	≤ 1/1,000,000	≤ 1/1,000,000						

## Go back to top Go back to TOC

The **Aggregate** screen displays these parameters:

- Line Rate (bps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- Utilization: % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or 100Mbps) of the total link capacity (or Line Rate).
- Utilization (bps)
- Framed Rate: (Payload + MAC/IP Header + VLAN Tag + Type/Length + CRC) / (Payload + Total Overhead) \* Line Rate % (in Mbps).
- Data Rate: Payload / (Payload + Total Overhead) \* Line Rate %.
- Total # of frames, bad frames, and pause frames.

LEDs	Setup		Res	ults	Stop	
	Global	Per Stream	PCS	;	OAM	
😑 Signal	Stream Summary Age	gregate Signal	Errors Alar	ms Eve	ents Traffic Delay	Restart
🔵 Frame	ST:2017-12-11 17:36:52		ET:00:01:21	1		TX Stop
Ŭ		тх		RX		Eth Err Ini
😑 Pattern	Line Rate (bps)	100.000G		100.00	0G	
	Utilization (%)	100.000%		100.00	0%	Eth. Alarm Inj.
ALM/ERR	Utilization (bps)	100.000G	100.000G			
History	Framed Rate (bps)	92.754G		92.754	G	LASER On/Off
HISTORY	Data Rate (bps)	69.565G		69.565G		
	Total Frames	3665949988		366594	9896	MX Discover
	Bad Frames	0		0		Control
	Pause Frames	0		0		
						Setup Injection

**Throughput Results - Global Aggregate** 

The **Global Signal** screen (fiber ports only) displays the optical level measured by the QSFP+ transceiver.

LEDs	S	etup				Res	ults	Stop
	Global	Pe	er Strea	ım	PCS		OAM	
😑 Signal	Stream Summary	Aggre	gate S	ignal E	rrors Alarn	ns Eve	nts Traffic Delay	Restart
Frame				Level	[Rx]			TX Stop
• • • • • •	Rx Optica	al Powe	er[dBm]		LOS		SAT	
O Pattern		Cur.	Min.	Max.	-16		+12	Eth. Err Inj.
	TOTAL	6.09	6.07	6.10				
					-16		+6	Eth. Alarm Inj.
O ALM/ERR	#1 1295.60nm	-0.92	-0.97	-0.90			+	
	#2 1300.10nm	1.13	1.11	1.16			+	LASER On/Off
History	#3 1304.60nm	0.65	0.61	0.68			+ -	
	#4 1309.10nm	-0.97	-1.01	-0.93			+	MX Discover
						·-8.6	+4.5	
								Control
		◀		Page 1	of 5			Setup Injection

**Throughput Results - Global Signal Page 1** 

LEDs	Se		Result	s	Stop	
	Global	Per Stream	PCS		OAM	Bestert
😑 Signal	Stream Summary	Aggregate <mark>Signal</mark>	Errors Alarms	Event	s Traffic Delay	Restart
😑 Frame		Freq	uency			TX Stop
-	Frequency		103124998KHz			Eth. Err Ini.
😑 Pattern	Offset [ppm]	-0.0				
	Min [ppm]		-0.0			PCS Alarm Inj.
	Max [ppm]		0.0			
History						LASER ON/OT
						MX Discover
						Control
		<ul> <li>Page</li> </ul>	3 of 5 💽			Setup Injection

**Throughput Results - Global Signal Page 3** 

LEDs	Setup			Re	sults	Stop
	Global	Per Stream		PCS	OAM	
😑 Signal	Stream Summary	Aggregate <mark>Sigr</mark>	nal Errors	Alarms Ev	ents Traffic Delay	Restart
😑 Frame		TX Stop				
Ŭ	Power Class			ss 4 Module	Eth Err Ini	
😑 Pattern	Vendor		Oclaro Inc.			
-	Part Number		TRB5E20F	NF-LF000		PCS Alarm Inj.
ALM/ERR	Serial Number		J14H54919			
History	MSA H/W Spec. re	v. (	0.0		LASER On/Off	
	MSA MIS rev. 2		2.2		MX Discover	
	Control 1 Reg.(IEEE)		100GE-LR4	4(SMF)		
	Extended Ability(II	EEE)	111.8Gbps	,103.125Gb	ps	Control
		age 4 of 5		Setup Injection		

**Throughput Results - Global Signal Page 4** 

The Global Errors screen displays the Current and Total error count of all streams:

- Sync Header Error
- Block Type Error
- FCS/CRC: Number of received frames with an invalid Frame Check Sequence (FCS)
- IP Checksum: Invalid IP Frame Check sequence
- TCP/UDP Checksum (Layer 4 only)
- Jabber frames: Number of received frames larger than 1518 bytes containing an invalid FCS
- Runt frames: Number of received frames smaller than 64 bytes containing an invalid FCS
- Giant frames (Advanced Monitoring Pass Through Results only): Number of received frames larger than 1518 bytes

LEDs	Se	tup	R	Results
	Global	Per Stream	PCS	OAM
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarms E	vents Traffic Delay
🔵 Frame		Current	1	- Fotal
Ŭ	Bits	0	C	)
😑 Pattern	BER	0.000000E+0	0 0	0.000000E+00
	FCS/CRC	0	C	)
	FCS/CRC Rate	0.000000E+0	0 0	0.000000E+00
History	IP Checksum	0	C	)
	IP Checksum Rate	0.000000E+0	0 0	0.000000E+00
	Jabber Frames	0	C	)
	Runt Frames	0	C	)

**Throughtput Results - Global Errors** 

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The Global Alarms screen displays the Current and Total alarm count of all streams:

- LOS (ms): Loss of Signal
- Link Down (ms)
  - Service disruption associated with loss of signal:
    - Current: Duration of the current service disruption
    - Total: Total accumulated duration of the service disruptions
    - Min/Max: Minimum and maximum duration of the service disruption events
    - No. of Occurrences: Counter of service disruption events

- Local/Remote Fault
- SDT alarm measurements

LEDs	Se		Res	ults	Stop				
	Global	Per Stream	P	cs	OAM				
😑 Signal	Stream Summary	Aggregate Signal	Errors <mark>Al</mark>	arms Eve	ents Traffic Delay	Restart			
Frame		Current		Total		TX Stop			
<b>•</b>	LOS (us)	0		0					
	Link Down (us)	0		0		Eth. Err Inj.			
😑 Pattern	Local Fault	0	Remote	Fault	0				
	Service Disruptio	n (us)				PCS Alarm Ini.			
ALM/ERR	Current	0	Total		0				
	Last		0						
History	Min/Max	0		0		LASER ON/ON			
	No. of Occurrence	es -	0						
	No. of SDT Violati	ons	0			MX Discover			
	IPG Trigger Even	ts	0						
	IPG Trigger Meas	urement(us)	0			Control			
		SDT Reset							

**Throughtput Results - Global Alarms** 

The Global Events screen displays the Time, Event Type, Number of Events, and Test Type.

LEDs	Set	up	Res	sults	Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary A	ggregate Signal I	Errors Alarms <mark>Eve</mark>	ents Traffic Delay	Restart
😑 Frame	Time	Event Type	# of Event	ts Test	TX Stop
-	2017-12-12 16:08:25	Test Started		Global	Eth. Err Inj.
😑 Pattern					
ALM/ERR					PCS Alarm Inj.
History					LASER On/Off
					MX Discover
		• Pag	e 1 of 1 🕨		Control
					Setup Injection

**Throughtput Results - Global Events** 

The Global Traffic screen displays:

- Frame Type of all streams
- Traffic Type of all streams
- Frame size of all streams



**Throughtput Results - Global Traffic** 

Tap on the bar graph for frame and traffic distribution statistics.

Frames tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- Received (RX) frames: Total frame
- Total/Test frames
- VLAN tagged frames
- Q-in-Q VLAN stacked frames
- Non-test frames
- Transmitted (TX) frames: Total frame Total # frames transmitted
- Pause frames: Total number of transmitted and received Ethernet pause flow-control frames

LEDs	Frames		Traffic Type		Frame Size	Start
	RX Frames	#		%		
😑 Signal	Total	11583:	3853222	100	)	
Ŭ	Test	11583:	3853222	100	0.000000	
😑 Frame	SP-VLAN Frames	0		0.0	00000	
Ť	MPLS LSP Frame	11583:	3853222	100	0.000000	
Pattern	MPLS PW Frames	0		0.000000		
Ť	VLAN	11583:	3853222	100	0.000000	
ALM/ERR	VLAN Stack	0		0.0	00000	
<u> </u>	MPLS	11583:	3853222	100.000000		LASER On/Off
History	MPLS Stack	0		0.0	00000	
	Non-Test	0		0.0	00000	MX Discover
	TX Frames	#				
	Total	11583:	3853222			Control
	Pause Frames	тх		RX		
	Total	0		0		

**Throughtput Results - Global Traffic Details** 

Traffic Type tab: The following Traffic distribution statistics are displayed in Count (#) and Percentage (%):

- Layer 2/3 Unicast frames: Number of Unicast frames received without FCS errors.
- Layer 2/3 Broadcast frames: Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF.
- Layer 2/3 Multicast frames: Number of Multicast frames received without FCS errors.

Frame Size tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- < 64 bytes frames</p>
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames

- 1280-1518 byte frames
- > 1518 byte frames Jumbo frames

The **Global Delay** tab: Delay measures the interpacket gap, start of the frame, and preamble duration. Frame arrival statistics are displayed in tabular format:

- Frame Arrival Time:
  - Current, minimum, average, and maximum frame arrival time
- Frame Delay Variation:
  - Average

LEDs	Setup		Res	Results		
	Global	Per Stream	PCS	OAM		
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarms Eve	ents Traffic <mark>Delay</mark>	Restart	
😑 Frame	Frame Arrival Tim	e	v.	_	TX Stop	
-	Current	6ns	Average	6ns	Eth Err Ini	
😑 Pattern	Minimum	3ns	Maximum	23ns		
<b>.</b>	Frame Delay Varia	tion			PCS Alarm Inj.	
ALM/ERR	Average		3ns			
History					LASER On/Off	
					MX Discover	
					Control	
					Setup Injection	

**Throughtput Results - Global Delay** 

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#### 5.7.2.2 Per Stream Results

The **Per Stream** tab displays the same type of statistics as seen in Global Results, but for each stream. For descriptions of the parameters in each tab, with the exception of **Rates**, please refer back to the corresponding section in <u>Global/Aggregate Results</u>.

- Summary: Framed rate, data rate, # of bytes, total # of frames associated with each stream.
- Errors: Errors associated with each stream.
- Service Disruption Test results for each stream.
- Events: Events associated with each stream.
- Traffic: Traffic statistics associated with each stream.
- Delay: Delay associated with each stream. Note: Round Trip Delay measurements are only available in the per-stream results screen. Round trip delay measurement requires a traffic loop at the far-end.
- Rates: Rate information associated with each stream.

LEDs	Setup		Res	ults		Stop	
	Global	Per Stream	PCS	;	0	AM	
😑 Signal	Summary Errors	SDT Ev	ents Tra	affic	Delay	Rates	Restart
😑 Frame	VLAN ID: N/A	Stream #	1 of 1	Pr	ev	Next	TX Stop
Ŭ	ST:2017-12-12 16:08:25	;	ET:00:24:03	3			Eth Err Ini
😑 Pattern		тх		RX			
	Utilization (%)	100.000%		100.000	%		PCS Alarm Inj.
ALM/ERR	Utilization (bps)	100.000G		100.000	G		
History	Framed Rate (bps)	92.754G		92.7540	3		LASER On/Off
	Data Rate (bps)	69.565G		69.5650	3		MX Discover
	# of Bytes	167292800320	00	1672928	8000870	4	Discover
	Total Frames	65348750125		653487	50034		Control
	Bad Frames	0		0			
							Setup Injection

The Per Stream Errors screen displays the Current and Total error count of each stream.

- Bit: Indicates errors related to test pattern (Bit Error or LSS [Pattern Loss])
- BER: Bit Error Ratio
- FCS/CRC: Number of received frames with an invalid Frame Check Sequence (FCS)
- IP Checksum: Invalid IP Frame Check sequence
- TCP/UDP Checksum (Layer 4 only)
- Jabber frames: Number of received frames larger than 1518 bytes containing an invalid FCS
- Runt frames: Number of received frames smaller than 64 bytes containing an invalid FCS
- Frame Loss
- Frame Loss %
- 00S
- Duplicate Sequence

LEDs	Setup			Results		Stop
	Global P	er Stream	PCS		OAM	
😑 Signal	Summary Errors	SDT Ev	ents Traffic	: Delay	Rates	Restart
🔵 Frame	VLAN ID: N/A	Stream #	1 of 1	Prev	Next	TX Stop
Ť		Current		Total		Eth Err Ini
😑 Pattern	FCS/CRC	0		0		
	FCS/CRC Rate	0.000000E+0	0	0.000000E	+00	PCS Alarm Inj.
ALM/ERR	IP Checksum	0		0		
History	IP Checksum Rate	0.000000E+0	0	0.00000E	+00	(LASER On/Off)
	Frame Loss	0		0		MX Discover
	Frame Loss %	0.00%		0.00%		
	oos	0		0		Control
	Dup. Sequence	0		0		Setup Injection
						Setup injection

**Throughtput Results - Per Stream Errors Page 1** 

### **Service Disruption Test**

- Total: Total cumulative service disruption for the duration of the test.
- Last: Last SDT measured during the test.
- Min/Max: Minimum and maximum SDT measured during the test.
- No. of Occurrences: Number of service disruption events (SDTs).
- No. of SDT Violations: Number of instances the SDT threshold was met or exceeded.

LEDs	Set	up	Res	ults	Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Summary Erro	ors SDT Ev	ents Traffic	Delay Rates	Restart
🙆 Frame	VLAN ID: N/A	Stream #	1 of 1 Pi	rev Next	TX Stop
	Service Disruption	(us)			
😑 Pattern	Current		0	Etn. Err inj.	
-	Total		0	PCS Alarm Inj.	
ALM/ERR	Last		0		
	Min/Max (	)	0		LASER On/Off
History	No. of Occurrence	s	0		
	No. of SDT Violatio	ns	0		MX Discover
	IPG Trigger Events	5	0		
	IPG Trigger Measu	rement(us)	0		Control
		SDT	Reset		Setup Injection

The **Per Stream Events** screen displays a Date and Time stamped record of bit errors, alarms and other anomalies pertaining to each stream.



**Throughtput Results - Per Stream Events** 

### Go back to top Go back to TOC

The Per Stream Traffic screen displays the frame type and frame size distribution pertaining to each stream.



**Throughtput Results - Per Stream Traffic** 

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The Per Stream Delay screen displays the frame delay information pertaining to each stream.

The Histogram shows the sampling points for the delay.

LEDs	Se	tup	Res	Results		
	Global	Per Stream	PCS	OAM		
😑 Signal	Summary Err	ors SDT Ev	ents Traffic	Delay Rates	Restart	
😑 Frame	VLAN ID: N/A	Stream #	1 of 1 P	rev Next	TX Stop	
Ŭ	Frame Arrival Tim	e			Eth Err Ini	
😑 Pattern	Current	3ns	Average	6ns		
<b>a</b>	Minimum	3ns	Maximum	23ns	PCS Alarm Inj.	
ALM/ERR	Frame Delay Varia	tion	_			
History	Average		3ns	LASER On/Off		
	Round Trip Delay	Histogra	am		MX Discover	
	Current	319ns	Average	310ns		
	Minimum	140ns	Maximum	360ns	Control	
					Setup Injection	

**Throughtput Results - Per Stream Delay** 



Throughtput Results - Per Stream Delay - Histogram

The **Per Stream Rates** screen displays the frame rate and data rate pertaining to each stream. Tap on either dial to see rate details.



**Throughtput Results - Per Stream Rates** 

LEDs		Stop		
	Frames/sec	тх	RX	
😑 Signal	Current	45289856	45289856	Restart
	Minimum	45289852	45289852	TX Stop
🜔 Frame	Maximum	45289860	45289860	
Pattern	Average	45289856	45289856	Eth. Err Inj.
	Data Rate (Mb/s)	тх	RX	PCS Alarm Ini
ALM/ERR	Current	69.565G	69.565G	
	Minimum	69.565G	69.565G	LASER On/Off
History	Maximum	69.565G	69.565G	
	Average	69.565G	69.565G	MX Discover
				Control
				Setup Injection

**Throughtput Results - Per Stream Rate Details** 

### 5.7.3 Saving Throughput Results

Once the test has been stopped the results can be saved by pressing the Save key on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved. For more information on retrieving saved test results, refer to **File Management** in the **TX300s**, **MTTplus**, **RXT-1200**, or **UX400** platform manuals for more information.

Signal	Save r	esult a	IS			2	012	1026	6_14	4542	Start
O Frame	1	2	3	4	5	6	7	8	9	0	
• Pattern	q	w	e	r	t	У	u	1	0	р	
ALM/ERR	а	s	d			9	h	j	k	1	
History	Caps	z	×	•	:	b	v	n	m	Shift	LASER ON/OF
		Sym	bol	Del	0	-	Del	All	<-		
				SPA	CE				Ap	ply	

**Throughput Results Save** 

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## 5.8 Ethernet OAM Testing



Ethernet OAM provides automatic defect detection, fault management and performance monitoring tools for network links and end-to-end Ethernet Virtual Circuits (EVC). The OAM service supports IEEE 802.3ah, IEEE 802.1ag, ITU-T Y.1731, and G.8113.1.

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#### 5.8.1 OAM Setup

#### 5.8.1.1 Link Level 802.3ah OAM Setup

802.3ah functions include:

- Discovery
- Link Performance Monitoring
- Remote loopback
- Fault detection



#### Link OAM Setup

#### • 802.3ah OAM

Tap on the check box to start 802.3ah protocol testing. Transmission of OAM PDUs starts as soon as the box is checked.

#### OAM Mode

Select Active or Passive mode from the drop-down menu. Active and passive mode determines the type of actions the test set will take. For more on acceptable Active/Passive mode combinations and actions, see section <u>802.3ah OAM Discovery</u>.

#### • Vendor OUI and SPI

Organization Unique identifier and Vendor specific information (similar to MAC address fields).

#### • Max PDU Length

Advertised Max OAM PDU size (64 to 1518). After Discovery, the lowest of the local and remote will be used.

#### PDU Rate

100 to 10000 ms between consecutive OAM PDUs.

#### • Discovery Capability

Enables OAM enabled devices to exchange their OAM capabilities, configuration, and identity to link partners. Check on the boxes to advertise selected capabilities during Discovery.

### Link Events Notification Settings

Enable Event Notifications for Link Fault, Critical Event, and Dying Gasp.

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#### 802.3ah OAM Discovery

Discovery is the first phase of the 802.3ah protocol. During Discovery, local and remote units exchange Information OAM PDUs indicating capabilities and configuration information (mode, PDU size, loopback support, etc.). After successful negotiation the OAM protocol is enabled on the link. If no OAM PDU is received after 5 seconds, Discovery is restarted. The device can be configured in Active or Passive mode combinations.

Action	Mode Passive	Mode Active		Local Active	Local Passive
Initiates OAM discovery	No	Yes	Remote	Yes	Yes
Responds to OAM discovery	Yes	Yes	Active		
Peer must be in active mode	Yes	Yes	Remote Passive	Yes	No
Sends Information OAM PDU	Yes	Yes	1 400110		
Sends Event Notification OAM PDU	Yes	Yes	OAM Mode -	Acceptable A	ctive/Passive
Sends Variable Request OAM PDU	No	Yes		Combinations	5
Sends Loopback Control	No	Yes			
Reacts to Loopback Control	Yes	Yes			

#### **OAM Mode Active/Passive Actions**

Notice that each device can be placed in any mode as long as the remote and local device are not both in passive mode.

Discovery Capabilities: Capabilities advertised during discovery process

- Remote Loopback
- Link Events: Supported, but no stateful
- MIB Retrieval: Can be advertised but is not supported in current release
- Unidirection

**Remote Loopback:** The user can transmit a loopback command to place the remote unit into loopback mode. Every frame received is transmitted back on the same port to ensure the quality of links during installation or troubleshooting and for fault isolation testing.

Link Events: Event OAMPDU is transmitted when the link error exceeds the threshold. Events may be sent once or multiple times. In the current software release, link events are only transmitted upon user request, not based on threshold crossing.

MIB Retrieval: Retrieves information on network devices and interfaces.

Unidirection: Checks for unidirectional transmission.

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#### 5.8.1.2 Service Level OAM: 802.1ag/Y.1731/G.8113.1 Setup

Under the Service Level OAM tab, the user has the option of starting the 802.1ag, Y.1731, or G.8113.1 test.

• Fill out the given parameters.

MD Name, MA Name, VLAN, and MD Level input values must match for both connected OAM devices in order for the test to work. The **Destination MEPID** and **Local MEP ID** must also be inverted for the tests to work.

• Tap the box next to 802.1ag, Y.1731, or G.8113.1 to start the selected test. The transmission of OAM PDUs become active as soon as the checkmark is added to the test.

LEDs	Set	up		Results		
	Header Tra	ffic Error In	j. General	Summary OAM	Restart	
😑 Signal	Link	DAM	Servi	ice Level OAM		
🕤 Frame	802.1ag: 🔳	Y.1731: 🔳	G.8113.	1 🗃	TX Stop	
-	MAC Source		00-18-63-00-0C-4	0	Err Inj.	
O Pattern	MD Format	String 🔻	MD Name	veex		
0.000	MA/MEG Format	String 🔻	MA/MEG Name	veexMA		
	Local MEP ID	15	MD Level	5		
History	Primary VLAN ID	35	VLAN Type	S-VLAN 🔻	MX Discover	
	Destination MEP II	151	Direction	Down		
					Loop Control	
	MAC Source					
				-		
		•	Page 1 of 2			

OAM - Service Level OAM (Page 1)

## Service Level OAM Configuration Parameters

- MAC Source: Enter the source address of the test set or tap the MAC Source button to assign a default MAC address.
- MD Format: Configure the format of the Maintenance Domain Name:
  - None: No Maintenance Domain name
  - MAC+2octet: User configurable MAC address + 2 octets
  - String: User configurable ASCII character string
- MD Name: Name of the Maintenance Domain (only for 802.1ag)
- MA/MEG Format: Configure the format of the Maintenance Association name:
  - VID: User configurable ASCII character string
  - String: User configurable ASCII character string
  - 2 octet: 2 octet integer
  - ICC-Based: User configurable ITU-T Y.1731 ITU Carrier Code (ICC) based
- MA/MEG Name: Enter the name of the 802.1ag MA or Y.1731 MG
- Local MEP ID: Local end point identifier along the path (1 to 8191)
- MD Level: Maintenance domain level (0 to 7)
- MEP ID: End point identifier (1 to 8191)
- Primary VLAN ID: VLAN ID associated with the MA or MEG
- VLAN Type: C-VLAN, S-VLAN, or None
- Destination MEP ID: MEP ID of the MEP end point
- Direction
  - Up: Inward facing MEP used for MA/MEG with a wider reach (i.e., end-to-end, beyond a single link)
  - Down: Outward facing MEP used for MA/MEG spanning a single link



## Differences between 802.1ag, Y.1731, and G.8113.1

Selecting **802.1ag** enables Continuity Check Messages (CCM), Loopback Message (LBM) and Link Trace Message (LTM). **ITU-T Y.1731** provides all of the 802.1ag functionality with additional performance monitoring capabilities including Frame Loss (LM), and Delay (DM). **ITU-T G.8113.1** provides further monitoring of MPLS-TP traffic.

## **IEEE 802.1ag Definitions**

**Maintenance Domain (MD) :** Management space on a network that is owned and operated by a single network provider. There is a maintenance level (from 0 to 7) to define the hierarchical relationship between domains. Maintenance domains can be nested but never intersect. MD is defined by Operational or Contractual Boundaries (e.g., Customer/Service Provider/Operator).

- Maintenance Association (MA): Association of Maintenance. Elements that comprise the Maintenance domain.
- Maintenance Elements can either be MEPs (End points) or MIPs (Intermediate Points)
  - MEPs are at the edge of the network. They can generate and respond to OAM messages. A point-to-point EVC has only 2 MEPs, a multi-point EVC has multiple MEPs.
  - MIPs are located between the MEPs and can be used to isolate network problems. MIPs cannot generate OAM messages but can respond.
- **Maintenance Level:** Identifies the network hierarchy. Higher Level = Largest network. Level information present in all OAM PDU frames.
  - Level 0,1,2 = Operator domain
  - Level 3,4 = Service Provider domain
  - Level 5,6,7 = Customer domain



Some terms differ between IEEE 802.1ag and ITU Y.1731 protocols. The chart below describes the differences.

IEEE 802.1ag	ITU Y.1731 / G.8113.1
Maintenance Domain (MD)	No equivalent
Maintenance Association	Maintenance Entity Group
(MA)	(MEG)
Maintenance End Point	Maintenance entity Group
(MEP)	End Point (MEP)
Maintenance Intermediate	Maintenance entity Group
Point (MIP)	Intermediate Point (MIP)

### **Definition Equivalencies**

Function	MEP	MIP
Initiates CCM messages	Yes	No
Initiates Loopback and Linktrace messages	Yes	No
Responds to Loopback and Linktrace messages	Yes	Yes
Y.1731 Performance Management messages (AIS,LCK, TST,LM, etc) initiates and responds	Yes	No
Forwards messages	Yes (upper maintenance layer) No (lower maintenance layer)	Yes (upper maintenance layer) No (lower maintenance layer)

### **Maintenance Point Roles**

#### **OAM Services Setup**

Under the same tab, OAM Services pertaining to 802.1ag, Y.1731, and/or G.8113.1 can be enabled. The tests listed include:

- Continuity Check (CCM)
- Loopback (LBM/LBR)
- Link Trace (LTM/LTR)
- Loss Measurement (LMM/LMR) (Y.1731 and G.8113.1)
- Delay Measurement (DMM/DMR) (Y.1731 and G.8113.1)
- Multi Protocol Label Switching Transport Profile (MPLS-TP) (G.8113.1 only)

#### **General Setup**

- To run any 802.1ag/Y.1731/G.8113.1 test, tap on the checkbox next to the corresponding test.
- To initiate testing for individual OAM services, press Start next to the desired service (NOT the green start button which initiates Throughput testing).
- **CCM** testing is initiated by selecting Enable from a drop-down menu.

Details on individual test parameters will be listed in the specified section.

LEDs Setup			F	Results		Start	
	Header Traff	c Error Inj.	Alarm Inj.	General	Summary	OAM	
😑 Signal	Link OAM			Service Level OAM			
😑 Frame							
	Loopback (LBM/L	BR)				Start	
Pattern	Destination Type	MEP	V Destinat	ion MAC	00-00-00-	00-00-00	
	Priority	7	# Messa	ges	5		CLASED OF
History	Link Trace (LTM/	.TR)				Start	MX Discover
	Destination Type	MEP	Destinat	ion MAC	00-00-00-	00-00-00	Toon Control
	Priority	7	TTL		60		Loop control
		٩	Page 3	of4 C	•		

Pressing Start next to Loopback (LBM/LBR) initiates testing for that OAM service

#### 802.1ag/Y.1731/G.8113.1 Connectivity Fault Management Functions

Connectivity Fault Management Functions supported by the test set are as listed:

- Fault Detection Continuity Check:
  - CCM "heartbeat" messages are transmitted at a configurable periodic interval by MEPs.
- Network/Path Discovery Link trace message:
  - Equivalent to a traceroute test. MIPs and MEPs along the path send a response.
- Fault verification and isolation Loopback:
  - Verify connectivity to a specific point in the message. Equivalent to ping test.

#### **Continuity Check Messages (CCM)**

CCM Messages are multicast messages sent from MEP to MEP at configurable intervals. Loss of continuity is detected after no CCM is received for 3.5 times the CCM interval.

There can be 4,094 VLANs per port and up to eight maintenance levels. This yields a worst case CCM transmission rate of 9.8 million CCMs per second if 3.3ms interval is used.



Continuity Check Message (CCM)

RDI Flags added in CCM Messages indicates loss of continuity in the remote direction.

MAC Dst= Multicast or Unicast (Y.1731 only)		MAC Src	VLAN Tag	OAM Type = 8902			
Management Level = 0 to 7	Vers=0	Opcode = 1	Flags (RDI, Transmission period)	TLV (Type Length Value) Offset			
	Seq N	umber	MEP ID	(2 bytes)			
	MAID/MEG ID (up to 48 bytes)						
Y.1731	End TLV						

#### **CCM Message Format**

#### **CCM Configuration Parameters**

- CCM: Enable/Disable sending Continuity Check messages.
- **Type:** Unicast/Multicast. If CCM is set to Enable, this field is ignored. In unicast mode you must enter the MAC address of the destination unit.
- **Priority:** 802.1p priority in the CCM VLAN Tag.
- **Tx Interval:** Choose from the supported CCM intervals: 1 s, 10 s, 1 min, 10 min.

The **CCM Result** button is a shortcut that brings the user directly to the CCM Results tab.

LEDs	Setup			Results		Stop	
	Header	Traffic	Error Inj.	General	Summary	OAM	Restart
😑 Signal	Link OAM			Service Level OAM			
😑 Frame							TX Stop
	MPLS-TP						Err Inj.
Pattern	LSP: 🔳 L	abel <mark>O</mark>	Co	os <mark>o</mark>	TTL	64	
	PW: 🔳 L	abel <mark>O</mark>	Co	os <mark>o</mark>	TTL	64	
	GAL: L	abel <mark>13</mark>	то	2	TTL	64	
History	ACH: V	ersion 0	CH	nannel Type	89-02		MX Discover
	CCM Dis	able 🔻					Loop Control
	Туре	Mult	icast 🔻				
	Priority	7	Тх	Interval	1 min	V	
				Page 2 of 4	• •	M Result	

MPLS-TP, CCM Settings - Service Level OAM (Page 2)

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#### G.8113.1 Performance Management Functions

MPLS-TP



MPLS-TP over Ethernet with PW Label

MPLS-TP is a Layer 2 technology that combines the benefits of MPLS and removes the complexity of IP networking. It uses the MPLS Label switching mechanism, but with static route provisioning (no Label Distribution Protocol LDP or RSVP-TE). MPLS-TP supports an advanced set of OAM functions and path protection mechanisms. In-band OAM traffic is on the same path as data traffic.

### Multi Protocol Label Switching Transport Profile (MPLS-TP) Configuration Parameters

- For the path and tunnel, select LSP (Label Switched Path) and PW (Pseudowire).
  - Label: Configure in the range of 16-1,048,575 (labels 0-15 are reserved).
    - Composed of 20 bits which allows for the creation of over one million labels.
  - CoS: Enter the Classes of Service.
  - **TTL**: Enter the Time to Live. It will be decremented by 1 each time it crosses a hop. Frame is not forwarded after TTL reaches 0.
- ACH : Enter the Generic Associate Label
  - $\stackrel{ extsf{red}}{ extsf{red}}$  For Pseudowires, the ACH used the first four bits of the PW control word.
- Version: Enter the G-Ach version. The default is set to 0.
- Channel Type: Enter the channel type (16-bit field).

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Link Trace and Loopback Messages

### Link Trace Messages (LTM/LTR)

LTM (Link Trace Message) Multicast messages are transmitted on demand to a destination MAC address. All MIPs and destination MEPs respond with LTR (Link Trace Reply) and forward the LTM on to its destination.



LTM Diagram (LTM/LTR)

MAC Dst= Unicast		MAC Src VLAN Tag		/LAN Tag	OAM Type = 8902		
Management Level = 0 to 7	Vers=0	Opcode = 5 (LTM) Flags		TLV Offset			
Transaction ID							
TTL Original MAC address Target MAC address					MAC address		
Optional TLV					End TLV		

#### Link Trace Message Format

MAC Dst= Ur	MAC Dst= Unicast MAC Src		VLAN Tag	OAM Type = 8902			
Management Level = 0 to 7	Vers=0	Opcode = 4 (LTR)	Flags	TLV Offset			
Transaction ID							
TTL Relay action (802.1ag)							
Optional TLV End TLV							

### Link Trace Response Format

#### Go back to top Go back to TOC

#### Loopback Message (LBM/LBR)

LBM (Loopback Message) are unicast messages transmitted on demand to a destination MAC address. A destination address responds with an LBR (Loopback Reply Message).



## LBM Diagram (LBM/LBR)

MAC Dst= Unicast or Multicast (Y.1731 only)		MAC Src VLAN Tag		OAM Type = 8902			
Management Level = 0 to 7		Opcode = 3 (LBM) Opcode = 2 (LBR)	Flags (0)	TLV (Type Length Value) Offset			
	Loopback transaction ID/Sequence #						
	End TLV						

### Loopback Message Format
LEDs	Set	up	F	Results	Start
	Header Traffic	Error Inj. Al:	arm Inj. General	Summary OAM	
😑 Signal	Link	DAM	Servic	e Level OAM	
😑 Frame					
	Loopback (LBM/LB	R)		Start	
Pattern	Destination Type	MEP 🔻	Destination MAC	00-00-00-00-00	
	Priority	7	# Messages	5	TASERON
History	Link Trace (LTM/L	rr)		Start	MX Discover
	Destination Type	MEP 🔻	Destination MAC	00-00-00-00-00	Loop Control
	Priority	7	TTL	60	
		٩	Page 3 of 4 🛛	>	

LBM/LBR, LTM/LTR Settings - Service Level OAM (Page 3)

# Link Trace (LTM/LTR) and Loopback Message (LBM/LBR) Config. Parameters

- Destination
  - MEP: Sends LTM/LBM to the destination MEP as configured on Page 1.
  - MAC: Sends LTM/LBM to a destination MAC address.
- Priority: 802.1p priority in the LTM/LBM VLAN Tag.
- Destination MAC: Configure the destination MAC address used for the LTM/LBM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- # Messages: Enter the number of Loopback messages to be sent (LBM test only).
- TTL: Enter the Time to Live field in the LTM message. TTL will be decremented each time it crosses a hop (MIP) (LTM test only).

#### Press Start to initiate testing.

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#### Y.1731/G.8113.1 Performance Management Functions

LEDs		Setup			Results		
	Header	Traffic	Error Inj.	General	Summary	OAM	
O Signal	L	ink OAM		Sei	Service Level OAM		
⊖ Frame	Loss Measuren	nent (LMN	VLMR)	11		Start	
O Pattern	Destination Typ	pe MEP	V Dest	nation MAC 00-00-00-00-00			
-	# Send	10	Rate	(ms) 500			
<b>ALMIERR</b>	Priority	7	0				
History	Delay Measure	ment (DM	M/DMR)			Start	
	Destination Typ	pe MEP	<b>V</b> Dest	ination MAC	00-00-00-00	0-00-00	
	# Send	10	Rate	(ms)	500		
	Priority	7					
			٩	Page 4 of 4	٠		

OAM - Service Level OAM (Page 4)

#### Loss (LMM/LMR) and Delay Measurement (DMM/DMR) Configuration Parameters

- Destination
  - **MEP**: Sends LMM/DMM to the destination MEP as configured on Page 1
  - MAC: Sends LMM/DMM to a destination MAC address
- Priority: 802.1p priority in the LMM/DMM VLAN Tag
- Destination MAC: Configure the destination MAC address used for the LMM/DMM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- # Send Configure the number of LMM/DMM frames to send up to 50

• Rate: Configure the LMM/DMM frame interface rate (min: 100 ms; max: 10 seconds)

Press Start to initiate testing.

#### Frame Loss Measurement

#### Two local counters for each peer MEP:

- TxFCf: Counter for in-profile data frames transmitted towards peer MEP
- RxFCf: Counter for in-profile data frames received from peer MEP

#### Single-ended ETH-LM:

- On demand OAM
- MEP sends LMM frame (Unicast DA or Multicast Class 1 DA) and receives LMR frame (Unicast DA) with counters

CCM frames contain frame counters.



#### Single Ended Frame Delay Measurement

LMM frames contain frame counters.

#### **Delay Measurement**

#### On demand OAM for measuring Frame Delay (FD) and Frame Delay Variation (FDV):

- TxTimeStampf = Timestamp transmission of DMM frame
- RxTimef = Reception time of the DMM frame
- RxTimeb = Reception of DMR frame

#### Two-way ETH-DM:

- DMM frame (Unicast DA or Multicast Class 1 DA for multipoint measurement) & DMR frame (Unicast DA)
- FD = RxTimeb TxTimeStampf



**Dual Ended Frame Delay Measurement** 

DMM and DMR frames contain timestamp info.

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#### 5.8.2 OAM Results

#### 5.8.2.1 Link OAM Results

TX300s-100GX\_User\_Manual\_RevA00

#### Link OAM Discovery

The discovery page lists Local (the current test unit) and Remote (far-end device) parameters.

LEDs	Setup			Resul	ts	Stop
	Global	Per Stream		PCS	OAM	Restart
😑 Signal	Li	nk		Servi	ce	
😑 Frame	Disco	overy		Statist	ics	TX Stop
-		Local		Remote		
😑 Pattern	Mode	active		active		LASER On/Off
	Unidirection	supported		supported		
	Link Events	supported		supporte	d	MIX Discover
History	Remote Loopback	supported		supported		Control
	MIB Retrieval	supported		supported		CDR Access
	MTU Size	1518		1518		
						I2C Access
		<b>•</b> F	Page 1	of 2 🕑		Setup Injection

OAM - Link - Discovery (Page 1)

- Mode: Lists Active or Passive mode configuration.
- Supported and unsupported capabilities advertised during Discovery are listed, including: Unidirection, Link Events, Remote Loopback, MIB Retrieval, and MTU Size.

LEDs	Se	tup	Resu	lts		
	Global	Per Stream	PCS	OAM		
😑 Signal	Li	nk	Servi	ce		
🜔 Frame	Disco	overy	Statist	Statistics		
-		Local	Remote			
😑 Pattern	Vendor SPI		63001B9	63001B93		
	Vendor OUI		001863			
	Discovery State	Send Any				
History	Parser State	Forward	Forward			
	Multiplexer State	Forward	Forward			
	Flags	0x0050	0x0050			
	Revision	1	1			
		٩	Page 2 of 2 🕟			

OAM - Link - Discovery (Page 2)

- Vendor SPI and OUI: Organization Unique identifier and Vendor specific information (similar to MAC address fields).
- Discovery State: Send Any indicates the device was successfully discovered.
- Parser/Multiplexer state: Forward indicates the device is forwarding regular traffic transmission. Loopback/drop indicates loopback is enabled.
- Flags: Flag decode is listed in the graphic below.
- Revision: Number of times the configuration has been modified since discovery.





LEDs	Setup					Resul	ts	Stop
	Global	Per	Stream		PCS		OAM	Restart
😑 Signal	Link			Service				
🜔 Frame	Discovery				Statistics			TX Stop
-			тх			RX		
😑 Pattern	Information		310	0		310		LASER On/Off
	Unique Event		0	0				
	Duplicate Event		0	0		0		MX Discover
History	Loopback Control		0	0			Control	
	Variable Request		0	) (		0		
	Variable Response 0		0	0			ODICALCESS	
	Organization Spe	cific	0			0		I2C Access
								Setup Injection



#### OAM PDU

Transmitted and received 802.3ah OAM PDU are displayed with other Link OAM statistics:

- Information: Information OAM PDU acts as a "heartbeat" message. Discovery must be restarted if no OAM PDU is received after 5 seconds.
- Unique and Duplicate Events are Threshold crossing events not supported in the current test set release.
- Number of Loopback Control frames.
- Variable Request and Response are MIB query messages not supported in the current test set release.

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#### 5.8.2.2 OAM Service Results

802.1ag/Y.1731/G.8113.1 Connectivity Fault Management Functions Results

LEDs	Setup			Results					Start	
	Head	er	Traffic	Gene	eral	S	ummary	0	DAM	
😑 Signal		Link OAM		Service Level OAM						
😑 Frame	ССМ/А	AIS .	LBM	LTI	M		DMM	L	.MM	
-	MPID	Rem	ote MAC	RDI	LOC	:	XCON	UNEXP	Alarm	
Pattern	16	00:18	3:63:02:46:62	l	I		]	I	I	LASER On/Off
										MY Discours
	тх			185						WIX DISCOVER
History	RX			181						Control
	AIS									CDB Assess
	TX Inacti			Inactiv	ictive				CDRAccess	
	RX Inactiv			re				I2C Access		
									050	

OAM - Service - CCM

#### OAM CCM Results

RDI, LOC, XCON, UNEXP, and Alarm will display an I or A status with I = Inactive, A = Active.

• MPID: MEP ID of the remote MEP.

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- Remote MAC: MAC address of the remote MEP.
- RDI: The CCM received contains the RDI flag set.
- LOC: The MEP detects loss of connectivity.
- XCON: Possible cross-connect, the CCM received could be from another MA.
- UNEXP: Unexpected MEP ID or non-matching CCM interval.
- Alarm: A fault alarm is triggered if a defect is present for a time period of 10s. The fault alarm is cleared if a defect condition is not present for a time period of 10s.

LEDs		Setup	Results				
	Header	Traffic	General	Summary	OAM		
😑 Signal	L	ink OAM		Service Level OAM			
🜔 Frame	CCM/AIS	LBM	LTM	DMM	LMM		
	LBM Status		Pass				
Pattern	To Be Sent		0				
	Response Col	int	1				
	In Order		1				
History	Out Of Order		0				
	No Match		0				
					Close		

OAM - Service - LBM

#### **OAM LBM Results**

- LBM Status
  - Pass: At least 1 Loopback response received
  - Fail: No Loopback responses received
- To be sent: Outstanding number of LBM to be sent
- Response Count
- In Order: Number of LBR received in order
- Out of Order: Number of LBR received out of order
- No Match: The loopback transaction ID between the LBM and LBR do not match

LEDs		Setup		Results			Start
	Header	Traffic	ffic General		Summary	OAM	
🜔 Signal	L	ink OAM			Service Lev	el OAM	
🜔 Frame	CCM/AIS	LBM	LTM		DMM	LMM	
-	Action		MAC		TTL	Flags	
Pattern	0x1 (RlyHit)	00:18:63	00:18:63:02:46:62		9	0x20	LASER On/Off
ALM/ERR							MX Discover
History							Control
Thistory							
				_			CDR Access
							12C Access
		٩	) 1o	f 1	$\bullet$		L'OACCESS
						Close	



#### OAM LTM Results

- Action: RlyHit indicates that the LTM has reached the destination MAC/MEP (i.e., final point)
- MAC: MAC address of the responder
- TTL: TTL field on the response, indicated how many hops have been traversed
- Flags: If set, indicates that only MAC addresses learned in a Bridge's Filtering Database, and not information saved in the MIP CCM Database, is to be used to determine the Egress Port

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#### Y.1731 and G.8113.1 Performance Management Functions Results

#### OAM LMM



OAM - Service - LMM

	Setu	p	Results	Start
		Loss Measurem	ient	
X Tool	Status: : Complete			
📑 Utilit		Near End	Far End	
	Current	0	0	
Files	Accumulation	0	0	
	Ratio	0	0	
				Discover
		Close	_	Control
		Page 3 of 3	3 🕑	

# OAM - LMM Message

Parameter	Near End	Far End
Current	Value of the current number frames lost in the receive direction	Value of the current number of frames lost in the transmit direction
Accumulation	Total number of frames lost in the receive direction	Total number of transmitted frames lost in the transmit direction
Ratio	Percentage of frames lost in the receive direction	Percentage of frames lost in the transmit direction

# **OAM LMM Parameters**

# Go back to top Go back to TOC

LEDs		Setup			5	Start	
	Header	Traffic	Ger	ieral	Summary	OAM	
🔘 Signal	L	ink OAM			Service Leve	el OAM	
🜔 Frame	CCM/AIS	LBM	LI	м рмм		LMM	
	DMM Status		Comp	lete			
Pattern	Delay Samples				LASER On/Off		
	Average Delay	136423	329 nSe				
	Average Variat	ion	12713	nSecs	MX Discover		
History	Last Delay		13680	300 nSe	Control		
	Last Variation		10803	) nSecs			CDR Access
							I2C Access
						Close	

OAM - Service - DMM

#### OAM DMM Parameters

- DMM Status: Lists status (In progress, Fail, or Complete)
- Delay Samples: Number of frames transmitted
- Average Delay: Average round trip delay over the number of delay samples
- Average Variation: Average round trip delay variation over the number of delay samples
- Last Delay: Last round trip delay value measured
- Last Variation: Last round trip delay variation value measured

# 5.9 Loopback

The Loopback application can be accessed from the main menu on the home screen. It allows the user to establish a manual loopback on the test set. The loopback function is used when an end-to-end test needs to be performed with one of the test partners in software loopback mode. The loopback function will loopback the incoming traffic to the test set back into the network under test.

The type of traffic that the loopback function loops back will depend on the type of test layer configured (Layer 2 or 3). Additional criteria can be set to allow only messages with specific criteria to be looped back. To specify loopback parameters, select the desired parameter and choose Enable from the drop-down menu. Tap on the box and input a value or select one of the drop-down menu choices.

# Layer 2 & 3:

- All incoming test traffic will be looped back.
- The loopback function will swap the MAC destination and MAC Source addresses (for Layer 2) or MAC and IP destination and source addresses (for Layer 3).
- All incoming frames with CRC errors will be dropped, similar to what an Ethernet switch does.
- All broadcast and multicast frames will be dropped including any incoming unicast frames that have the MAC Source address equal to the MAC Destination address.
- Loopback Parameters: The following parameters are available on Layer 2, 3 and 4. For more information on the parameters, please see <u>BERT Header Settings</u> in the BERT section. It is possible to enable any of these parameters to create a customer loopback filter. For example, enabling a filter with VLAN 64, Priority 7, will only loop back traffic corresponding to these values.
  - VLAN ID
  - VLAN Priority
  - MAC Source
  - MAC Destination
  - IP Source Address (Layer 3 only)
  - IP Destination (Layer 3 only)
  - TOS Values (Layer 3 only)

LEDs	Setup	Results	Start
	Profile	Default 🗸 🗸	
🕒 Signal	Test Layer	Layer 3 🗸 🗸 🗸	
	VLAN ID	Disable 🔻 🔻	1
O Frame	VLAN Priority	Disable 🗸 🔻	1
Pattern	MAC Source	Disable 🗸 🗸	1
0	MAC Destination	Disable 🗸 🔻	<u></u>
ALM/ERR	IP Source	Disable 🛛 🔻	
	IP Destination	Disable 🗸 🗸	LASER On/Off
History	TOS Values	Disable 🗸 🔻	

#### **Internal SD Card Format**

Press Start to begin loopback. indicates that loopback is in progress. The **Results** tab displays current test results. Per Stream results are available for Multi-stream setup. Results for each stream can be viewed in **Results** > **Per Stream** > **Summary** and selecting the **Stream** #. Please see <u>BERT Results</u> for information on the Results tabs.

# 5.10 Lane BERT

The Lane BERT test is used for validating the physical interface of the optical module (CFP, QSFP28, QSFP+). It helps verify the performance and integrity of the optical module by checking bit error and BER per optical lane and frequency offset measurements per lane. The rates supported are dependent on the optical module capabilities.

# 5.10.1 Setup

In newer test sets, the unit will be able to toggle between single frequency or per lane frequency measurements.

LEDs	Setup		Results		Start
😑 Signal	QSFP Type		100G (4X25)		
Frame	QSFP Test Rate		103.125G 🛛 🗸		TX Start
•	BERT Type		Lane	▼	
🔘 Pattern		LASER On/Off			
_		Pattern Co	nfiguration		
ALM/ERR	TX P	attern	RX Pattern		MX Discover
History	Pattern	PRBS 2E31-1 🔻	Pattern	PRBS 2E31-1 🔻	
	Invert	Disable 🛛 🔻	Invert	Disable 🛛 🔻	
					CDR Access
					I2C Access

Setup - General (All Lane)

- 1. Select the test rate and test pattern. The same test pattern can be configured for all lanes or a different test pattern can be configured per lane.
- 2. Press TX Start, then press Start.

The option to set PRBS patterns per lane or for all lanes is available in newer 40G/100G modules, depending on the test set and software version.

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#### 5.10.2 Results

Aggregate and per optical lane BER and bit error count are measured, as well as pattern loss in seconds.

#### 5.10.3 Signal

#### Signal (Page 1-2)

The Signal tab (fiber ports only) displays the receiving (RX) and transmitting (TX) optical level measured by the QSFP+ transceiver.

Loss of Signal (LOS) and the Saturation level for optical signals are shown graphically including the level measurement in dBm for each lane.

LEDs	s	Setup			Results		Stop	
	Signal	A	ggrega	te	Lane		Events	
🜔 Signal				Level	[Rx]			Restart
	Rx Optic	al Powe	er[dBm]	]	LOS		SAT	TX Start
🔘 Frame		Cur.	Min.	Max.	-16		+12	
	TOTAL	6.07	6.06	6.08				Bit Err Ini.
😑 Pattern					-16		+6	
	#1 1295.60nm	-0.95	-0.97	-0.91			+	Alarm Ini
ALM/ERR	#2 1300.10nm	1.11	1.10	1.13			+	
	#3 1304.60nm	0.61	0.61	0.64			+	
History	#4 1309.10nm	-1.00	-1.01	-0.95		00	+	LASER On/Off
History						'-0.0	74.0	MX Discover
		•		Page 1	of 5	D		Setup Injection

Signal (Page 1)

# Signal (Page 3)

The received signal frequency and offset is measured and performed on the optical interface.

- Current: Indicates the frequency of the input signal.
- Offset: Indicates the difference between the standard rate and the rate of the input signal.
- Min (ppm): Indicates the difference between the standard rate and the minimum deviation detected in the input signal.
- Max (ppm): Indicates the difference between the standard rate and the maximum deviation detected in the input signal.

LEDs	Setup		Results		Stop
	Signal	Aggregate	Lane	Events	
😑 Signal		Freq	uency		Restart
Erame	Frequency		111809973KHz		TX Start
	Offset [ppm]		-0.0		
😑 Pattern	Min [ppm]		-0.0		
•	Max [ppm]		-0.0		Alarm Inj.
ALM/ERR					
History					LASER ON/OT
					MX Discover
		<ul> <li>Page</li> </ul>	3 of 5 💿		Setup Injection

Signal (Page 3)

# Signal (Page 4-5)

Page 4-5 displays the Optical module information and status.

LEDs	Set	Setup		Results	
	Signal	Aggregate	Lane	Events	
🔘 Signal		QSFP Optical	Module Information		
Frame	Power Class	F	ower Class 6 Module	TX Start	
•	Vendor	C	Oclaro Inc.		
🔵 Pattern	Part Number		RQ5E20FNF-LF000	ASER On/Off	
	Serial Number		17D57299	EASER ON/ON	
ALM/ERR	Bit Rate (Gbps)		5.5	MX Discover	
History	Wavelength (nm)	1	310.0		
	Wavelength Toler:	ance(nm) 1	.0		
	Tranceiver Compliance (Hex)		80 00 00 00 00 00 00 00 Decode		CDR Access
					I2C Access
		Pa	ge 4 of 5 💿		

# Signal (Page 4)

LEDs	Setup		Res	Results	
	Signal	Aggregate	Lane	Events	
🔘 Signal		QSFP Optical	Module Status		
Frame		RX LOS	TX Electrical LOS	TX FAULT	TX Start
	Channel 1	Normal	Normal	Normal	
Pattern	Channel 2	Normal	Normal	Normal	
	Channel 3	Normal	Normal	Normal	LASER ON/OF
ALM/ERR	Channel 4	Normal	Normal	Normal	MX Discover
History					
	Temperature		44.0 C		
	Voltage		3250 mV		CDR Access
		I2C Access			
		Page	5 of 5 💿		

Signal (Page 5)

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# 5.10.4 Aggregate

The Aggregate tab displays errors related to the test pattern (Bit Error or Pattern Loss).

LEDs	Setup		Res	ults	Stop
	Signal	Aggregate	Lane	Events	
🔘 Signal	ST:2018- 1-16 15:34	:21	ET:00:00:30		Restart
Frame	Pattern Loss(Sec.)		30		TX Start
	BIT Error Count		0		Pit Err Ini
😑 Pattern	BIT Error Ratio		0.000E+00		
ALM/ERR					Alarm Inj.
History					LASER On/Off
History					MX Discover
					Setup Injection



## 5.10.5 Lane

The Lane tab displays Pattern Loss and Bit Errors for each lane.

LEDs		Se	tup		Re	sults
	Si	gnal	Aggreg	jate	Lane	Events
😑 Signal	Lane #	Pattern L	.oss(Sec.)	BIT Er	ror Count	BIT Error Ratio
Frame	0	35		0		0.000E+00
	1	35		0		0.000E+00
😑 Pattern	2	35		0		0.000E+00
	3	35		0		0.000E+00
ALM/ERR						
History						

PCS Results - Alarms/Errors

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#### 5.10.6 Events

A time stamped record or log of anomalies, alarms, test status (start/stop) and test application are displayed.

LEDs	Setup		Resu	Stop	
	Signal	Aggregate	Lane	Events	
😑 Signal	Time	Event Type	# of Events	Test	Restart
Erame	2018- 1-16 15:34:22	Pattern Loss L#3		Lane Bert	TX Start
0	2018- 1-16 15:34:22	Pattern Loss L#2		Lane Bert	
😑 Pattern	2018- 1-16 15:34:22	Pattern Loss L#1		Lane Bert	Bit Err inj.
	2018- 1-16 15:34:22	Pattern Loss L#0		Lane Bert	Alarm Inj.
ALM/ERR	2018- 1-16 15:34:21	Test Started		Lane Bert	
History					LASER On/Off
					MX Discover
		Pag	je 1 of 1 💽		
					Setup Injection

**PCS Results - Events** 

# 5.11 Packet Capture

# 5.11.1 Packet Capture Setup

The packet capture function can be used to capture packets to Ethernet test ports. The packet capture format is compatible with Wireshark and can be viewed on a PC.

Configure the following Capture Mode parameters:

- Profile: Drop-down selections are Default, Delete, Save, Save As...
- Mode: Automatic. Packet capture is automatically started when pressing the CAP ON function key.
- Buffer Size: Defines the size of the storage allocated to packet capture.
- Truncate: Captures the whole frame or first number of bytes of that frame.

LEDs	Se	Start	
	Capture Mode	Filter	
😑 Signal	Profile	Default 🛛 🗸 🗸	
Frame	Mode	Automatic 🛛 🔻 🔻	
0.11	Buffer Size	2М 🔻	
Pattern	Truncate	Whole 🔻	
ALM/ERR     History			

## Capture Mode Setup

LEDs	Setup					
	Ca	pture Mode	Filter			
😑 Signal	Profile	Packet	Conturo	▼		
Frame	Mode	Packer	Capture	▼		
•	Buffer Size	Packet Capture captu	iring	▼		
Pattern	Truncate					
		Packet Num: 10				
History						
		St	op			

**Packet Capture In Progress** 

LEDs		Setup						
	Ca	pture Mode	Filter					
😑 Signal	Profile	Packet	Capture	<b></b>				
🔵 Frame	Mode	Facker	capture	▼				
	Buffer Size	Packet Capture accor	nplished!	<b></b>				
Pattern	Truncate	Packet Num: 143/143						
ALM/ERR     History		Result Saved as:20170922_094123.pcap						
		ОК						

#### **Packet Capture Save**

Select from the following Filter options:

#### MAC and IP Mode

- Disable: All IP packets to and from the unit are captured
- MAC and IP: Only traffic frames matching the MAC and IP source and destination addresses are captured
- UDP and TCP: Only TCP, Only UDP or both TCP/UDP are captured

Press the green Start button to begin packet capture. A display message shows the number of packets being captured.

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#### 5.11.2 Packet Capture Results

To finish packet capture and manage packet capture results, press Stop.

To save result packets and view results, tap YES when asked to view results. Results are saved in PCAP format and are automatically named. Wire shark will launch afterwards and display the results.

The file is stored in the Files folder. It can be viewed on the test set or exported and analyzed on PC Wireshark. Refer to **File Management** in the **TX300s**, **RXT-1200**, or **UX400** platform manuals for instructions on viewing and exporting files.

The Packet Capture results screen is divided into three parts with all details of the capture. The size of each part can be manually adjusted.

☆					→ → Decode As
No. V	Time	Source	Destination	Protoco Lengt	Info
1	0.000000	192.168.0.147	255.255.255.255	DB-L 221	Dropbox LAN sync Discovery Proto
2	0.001671	192.168.0.147	192.168.0.255	DB-L 221	Dropbox LAN sync Discovery Proto
3	0.002120	192.168.0.147	255.255.255.255	DB-L 221	Dropbox LAN sync Discovery Proto
4	0.244207	00:90:a9:b8:07:f0	ff:ff:ff:ff:ff	Intel 68	Sequence: 758301, Sender ID 2, T
•					
⊕… Eth ⊕… Inte ⊕… Use ⊕… Dro	ernet II, Src: ac rnet Protocol V r Datagram Pro pbox LAN sync	::81:12:22:c3:2d (ac:81:12 ersion 4, Src: 192.168.0.14 tocol, Src Port: 17500 (175 Discovery Protocol	:22:c3:2d), Dst: ff:ff:ff:ff:ff:ff 7 (192.168.0.147), Dst: 25 00), Dst Port: 17500 (1750	(ff:ff:ff:ff:ff:ff) 5.255.255.255 0)	(255.255.255.255)
0080	3a 20 22 22 2	c 20 22 70 6f 72 74 22	3a 20 31 37 : "", "p	ort": 17	A 1
0090	35 30 30 2c 2	0 22 6e 61 6d 65 73 70	61 63 65 73 500, "na	mespaces	
00a0	22 3a 20 5b 3	7 33 34 31 37 33 37 39	32 2c 20 38 ": [7341	73792, 8	
00b0	36 32 34 38 3	5 38 35 2c 20 37 32 36	31 37 37 31 6248585,	7261771	
0000	31 36 2c 20 3	7 36 36 39 32 35 39 30	2c 20 35 36 16, 7669	2590, 56	
0000	39 38 39 35 3	1 39 31 20 /d 0D CI 3/	32 9895191]	}/5	
					•
20170	0922_094123.p	ocap Packets:	143 Displayed: 143 Marked	d: 0 Load time: 0	0:0.39

**Packet Capture Results on Wireshark** 

Top section:

Time

- Source
- Destination
- Protocol
- Length
- Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

# 5.12 Autoscripting/Ethernet Auto Profile Testing

Autoscripting is available from the Ethernet Test Mode Selection menu and from within the Advanced Tools menu.



Advanced Tools > Auto Scripting

Autoscripting runs BERT and Throughput test profiles in succession. Profiles are configured from the test application or ReVeal software.

LEDs	BERT			THROU			
	File Prefix		Autos	Script			
😑 Signal	If Alarm/Error	detected:			Continue	▼	
	Profile1	Default	▼ 30	Sec. 🔻	View Setup		
😑 Frame	Profile2	Default	▼ 30	Sec. 🔻	View Setup	0	
	Profile3	None	•				
Pattern	Profile4	None	•				
	Profile5	None	•				
	Profile6	None	▼				LASER Off
History	Profile7	None	▼				MX Discover
	Profile8	None	•				
	Profile9	None	•				
	Profile10	None	▼				
		C	Start	)			

Autoscripting - BERT Setup

# Autoscripting Setup

- File Prefix: Prefix added to name of test results. The default prefix is "Autoscript."
- If Alarm/Error detected: Choose to Continue or Exit testing if an alarm/error is detected.
- Profile: Select Default, Last Configuration, or None.
- Testing duration can be set for seconds, minutes, hours, or days.
- Tap on View Setup to view test setup parameters. Setup cannot be configured from this menu.

Tap on the green Start button to begin Autoscripting.

The soft LED light indicates the status of finished tests:

- Green: No error or alarm was detected.
- Red: An error or alarm was detected.

Starting the test brings up the BERT/Throughput Results tab. Test status is displayed in green on the bottom of the screen. When testing finishes, results are automatically saved. Refer to **File Management** in the **TX300s**, **MTTplus**, **RXT-1200**, **or UX400 platform manuals** for information on accessing saved results.

Events     Traffic     Delay     Rates       Signal     Summary     Signal     Errors     Alarms       ST: 2017-03-08 12:50:08     ET: 00/00:00:37     Image: Comparison of the		Constant,		Results			
Signal         Summary         Signal         Errors         Alarms           Frame         ST: 2017-03-08 12:50:08         ET: 00/00:00:037         Image: Constraint of the state		Events	Traffic	De	lay	Rates	
Frame         ST: 2017-03-08 12:50:08         ET: 00/00:00:37           Pattern         TX         RX           Line Rate (bps)         10.000G         10.000G           Utilization (%)         10.000%         0.000%           ALM/ERR         Utilization (bps)         1.000G         0           History         Framed Rate (bps)         986.993M         0           Data Rate (bps)         975.290M         0         0	😑 Signal	Summary Signal		Errors		Alarms	
TX         RX           Pattern         Line Rate (bps)         10.000G         10.000G           Utilization (%)         10.000%         0.000%           ALM/ERR         Utilization (bps)         1.000G         0           History         Framed Rate (bps)         986.993M         0           Data Rate (bps)         975.290M         0         0	O Frame	ST: 2017-03-08 12:50:08		ET: 00/00	ET: 00/00:00:37		
Pattern         Line Rate (bps)         10.000G         10.000G           Utilization (%)         10.000%         0.000%           ALM/ERR         Utilization (bps)         1.000G         0           History         Framed Rate (bps)         986.993M         0           Data Rate (bps)         975.290M         0	<b>O</b> Frame		тх		RX		
Utilization (%)         10.000%         0.000%           Itilization (bps)         1.000G         0           History         Framed Rate (bps)         986.993M         0           Data Rate (bps)         975.290M         0         0	Pattern	Line Rate (bps)	10.000G		10.000G		
O ALM/ERR     Utilization (bps)     1.000G     0       History     Framed Rate (bps)     986.993M     0       Data Rate (bps)     975.290M     0	Ű	Utilization (%)	10.000%		0.000%		
History Pramed Rate (bps) 986.993M 0 Data Rate (bps) 975.290M 0	ALM/ERR	Utilization (bps)	1.000G		0		
History Data Rate (bps) 975.290M 0		Framed Rate (bps)	986.993M		0		
	History	Data Rate (bps)	975.290M		0		
# of Bytes 4605470826 0		# of Bytes	4605470826	0			

# **Autoscripting - BERT Results**



# **Autoscripting - Saving Results**

Column Show All Advanced									
Name	16 Mode	¶₀ Test	T Module	Date	Туре	Lock			
autosave	CPRI	CPRI L2	CPRI	2017-03-03 13:07:37	Profile				
autosave	CPRI	CPRI L2	CPRI	2017-03-03 13:05:36	Profile	2			
autosave	CPRI	CPRIL1	CPRI	2017-03-02 11:43:09	Profile				
Profile1	OTN/SDH	SONET	OTN/SDH	2017-02-03 16:17:29	Profile				
p2	Ethernet	THRPT	Fiber	2017-03-03 12:56:39	Profile				
p1	Ethernet	THRPT	Fiber	2017-03-03 12:56:33	Profile	2			
AutoScript_p2_20170303_13043	Ethernet	THRPT	Fiber	2017-03-03 13:04:37	Result				
AutoScript_p2_20170303_12582	Ethernet	THRPT	Fiber	2017-03-03 12:58:28	Result	2			
Page 1 of 3									
View 🔂 Del < Rename	UL	PDF 🍃 F	rom USB	≽ то USB 🚺 ВТ					

File Manager - Saved Results

# 6.0 OTU3/OTU4 (Ethernet/Bulk)

Refer to the TX300s, UX400, or RXT-1200 platform manuals for instructions on assigning test modules or launching test applications.

For safety reasons the transmitter laser is OFF by default. After making all the right connections, tap the **Laser On/Off** button on the right side of the screen.

The Laser On/Off button will turn Red, and the yellow Laser ON warning icon should show on the top of the screen. The soft LEDs for Signal and Frame may start blinking, indicating the historical LOS condition.

Tap the **History** button displayed below the soft LEDs. The LEDs will now turn steady green and the test tab will also turn green, indicating the module is ready to perform different tests.

- Actual screens may differ depending on the installed TX, UX, or RXT series module.



#### **OTU4 Setup Home**

# Go back to top Go back to TOC

# 6.1 Setup

# 6.1.1 Signal

The following Signal parameters can be configured under the Setup tab on the OTU4 or OTU3 Home screen:

- Interface Informations
- Hierarchy & Clocks
- OTL Lane & Skew
- Mapping & Payload
- Pattern

The parameters for TX and RX settings are Coupled. TX and RX configurations are grouped as one block with identical configuration. Tap on a block to configure the parameters applicable to each of the layers.

LEDs	Signal	Measurement	Service Disruption	Start
	OTU4 port profile	Default	V	
🜔 Signal	Interface Informations	Optical Mo	dule-QSFP	
😑 Frame	Hierachy & Clocks	OTLIC	DTU4	
😑 Pattern	OTL Lane & Skew	OTL	OTL Alarm Ini	
	Mapping & Payload	OTU4-	BULK	LASER On/Off
History				CDR Access
	Pattern	RX:2^31-1	TX:2^31-1	
				Set Injection

# Signal Setup parameters

#### 6.1.1.1 Interface Informations

Interface Information displays the capabilities and details relevant to the selected pluggable optical module (QSFP+, QSFP28, etc.).

LEDs	Interf	face Informations	Start
	Power Class	Power Class 6 Module (4.5 W max)	
😑 Signal	Vendor	Oclaro Inc.	
	Part Number	TRQ5E20FNF-LF000	
😑 Frame	Serial Number	T17D57299	
O Pattern	Bit Rate (Gbps)	25.5	OTL Err Inj.
•	Wavelength (nm)	1310.0	OTL Alarm Ini
ALM/ERR	Wavelength Tolerance(nm)	1.0	
	Tranceiver Compliance (Hex)	80 00 00 00 00 00 00	LASER On/Off
History	Temperature	43.9 C	
	Voltage	3218 mV	CDR Access
			Set Injection

#### Interface Informations

#### 6.1.1.2 Hierarchy & Clocks

Hierarchy	Start
Network Type OTL/OTN	<b>_</b>
Signal Operation Mode NORMAL	T
Test Rate OTU4 (111.810 G	bit/s) 🔻
O Frame Scrambler ON	T
FEC ON	
Pattern Tx Clock Source Internal	
Clock Signal Type Quartz VCXO	OTL Alarm Inj.
ALM/ERR Tx Clock Offset(ppm) 0.0	
	LASER On/Off
History Meas Ref. Clock Internal	
Clock Signal Type Quartz VCXO	
Eye Clk Disable	V
Link Fault Response Disable	T
Optical Module CDR Setting Optical Module D	efault 🛛 💙 Set Injection

**OTU3/OTU4 Hierarchy & Clocks** 

Tap the **Hierarchy** tab to enter the configuration screen for the physical test interface. Configuration options for the OTN signal and network types include the bit rate and higher order mapping, if applicable.

From the Network Type parameter, select OTL/OTN. Menu options will vary depending on the selected Network Type.

- **Operation Mode** (OTL/OTN only):
  - **Normal:** The test set terminates the link. The test signal and its payload is internally generated by the test set and compared to the received signal.
  - **Payload Thru:** The test set acts as a repeater, regenerating the signal received by the RX port and retransmitting it on its TX port, keeping the payload undisturbed. This allows the test set monitor the overhead bytes, payload and to intrusively modify non-critical overhead bytes to introduce (simulate) error and alarms.
  - Line Thru: The test set acts as a transparent repeater, regenerating the signal received by the RX port and retransmitting it on its TX port. The test set can monitor the incoming signal, but no errors or alarms ca be injected, besides using the Laser button to turn it off and generate LOS.
- Test Rate: OTU4 (111.819 Gbits/s)
- Scrambler (OTL/OTN only): On
- FEC (OTL/OTN only): On/Off
- Tx Clock Source:
  - **Internal:** The clock for the transmitter is derived from the internal clock. The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
  - **Received:** The clock for the transmitter is derived from the received signal and the jitter of the incoming signal is suppressed.
  - External (BNC):
    - Clock Signal Type: 1PPS (BNC), 10MHz, 5MHz, 1544KHz, 2048KHz, 2048Kbit/s, 1544Kbit/s, 64 Kbit/s signals are present on the SMA connector.
    - Line code: HDB3, B8ZS, AMI
- Clock Signal Type: Quartz oscillator (Internal)
- Measurement Reference Clock: Internal
- Eye Clk: Disable, 1/8 of network lane rate
- Link Fault Response: Disable/enable

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# 6.1.1.3 OTL Lane & Skew

Advanced users can enter the OTL tab on the Setup screen to configure the OTL Tx Lane Mapping and Skew, as well as tolerance thresholds (to generate alarms).

- Lane ID: Manually edit and assign specific Lane IDs to Lane #. Use the **Random** button to assign them arbitrarily, the **Shift** button to slide the Lane IS vs Lane # correlation, or the **Default** button to realign them back.
- Skew (bits): Enter the desired skew values by tapping directly on the fields or use the + and buttons to increment/decrement them by the amount set in the Inc/Dec Size field.
- Alarm Threshold: Defines the maximum skew value allowed. If the system exceeds the set value, a flag (alarm) is raised by the test set to notify users.



#### 6.1.1.4 Mapping and Payload

The mapping and multiplex structure is displayed. It supports one-stage (direct mapping) to multi-stage mapping and multiplexing.

- Select the ODUk(L) button to add a test payload (client) or ODUk(H) to add another multiplexing level for lower rate clients.
- The payload can be Bulk (PRBS test sequence) or Ethernet. Ethernet payload selection is only available when compatible ODUk(L) containers are selected, such as ODU4, ODU3, ODU2e, or ODU0.
- If an Ethernet test payload is selected, users have the option to run a BERT or Throughput test within the payload; Throughput test is recommended. Make sure to press the **Apply** button to reconfigure the test signal structure.

LEDs		Маррі	ng / Mu	ıltiplex		Start
Signal	оти4	ODU4(L) ODU4(H)			Client	
😑 Frame						
😑 Pattern						OTL Err Inj.
😑 ALM/ERR						
History						LASER On/Off
						Set Injection
	Payload	BULK	▼	BULK Type	Full Rate 🛛 🔻	

Mapping & Payload - Single Stage Mapping



Mapping & Payload - Multi-stage Mapping/Multiplexing

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#### 6.1.1.5 OTN Channels and GFP-T Settings

The OTN Channel level (menu block) allows advanced users to modify individual tributary slots (T/S) or channels for the transmitted and received (expected) signal. This also allows users to set the physical port to which lower rate payloads may be mapped to when demultiplexed from the OTU4 test signal. In **Show Channels** mode, the test set offers a **CH# Detect** function that displaysthe channels available in the RX, in case they need to match the existing signal.

If ODU0 is selected as the Ethernet mapping level, the test set will add a GFP-T sublayer to the signal structure. Advanced users

can use this block if a different payload header type needs to be set (transmitted or expected).

# 6.1.1.6 Test Pattern (Test Sequence or PRBS)

Tap the Pattern tab to configure the Test Data Settings. The following parameters are available:

- Test Data Mode: In Services (Live), Out of Service
- **PRBS Pattern (TX and RX):** Pseudo Random Bit Sequences (PRBS) defined by ITU-T 0.150 and 0.151 standards, fixed words and 24-bit or 32 bit user defined patterns are available.
- Invert (Logic pattern inversion): On / Off



**OTU4 Setup - Test Data Settings** 

#### Go back to top Go back to TOC

#### 6.1.2 Measurement

LEDs	Signal	Measu	rement	Service Disruption	Start
	Profile		Default	▼	
😑 Signal	Mode		Manual	▼	
0.5	Results Auto Save		OFF	▼	
😑 Frame	Corrected FEC Indicatio	n	Disable	▼	
Pattern					OTL Err Inj.
-					OTL Alarm Inj.
😑 ALM/ERR					
History					LASER On/Off
					Set Injection

#### **Measurement Setup**

- Mode: Manual and Timed selections are available.
  - **Manual:** This is directly linked to the Start/Stop function on the drop-down menu. The test starts as soon as the **Start** button is pressed.
  - **Timed:** The test duration can be set by the user in seconds, minutes, hours or days. The test is activated by the Start/Stop function on the drop-down menu and stops automatically when the defined time has elapsed.
- Results Auto Save: Tap Auto Save and set it to ON to automatically save the results file.
- Corrected FEC Indication

#### 6.1.3 Service Disruption Test (SDT)

LEDs	Signal	Measurement	Service Disruption	Start
		Service Disruption Setur	þ	
😑 Signal	Meas <mark>ON 🔻</mark> Save E	vt. OFF 🔻 Separation (m	s) 300 Limit(ms) 50	
	a Ala	ırm Trigger	Error Trigger	
😑 Frame	😑 LOS	📄 ODU-LCK	😑 OTL-FAS	
	😑 OTL-LOF		😑 OTL-LLM	OTL Err Inj.
Pattern	📄 OTL-OOF	📄 ODU-AIS	📄 OTU-MFAS	
	📄 OTL-LOL	📄 PM-BDI	📄 SM-BIP	OTL Alarm Inj.
	📄 OTL-OOL		📄 SM-BEI	
History	📄 OTU-LOM		📄 PM-BIP	LASER On/Off
	📄 OTU-OOM		📄 PM-BEI	
	📄 SM-IAE		✓ Bit Errors/Pat Loss	
	📄 SM-BDI			Set Injection
	SM-BIAE			

#### **Service Disruption Setup**

A service disruption is triggered by any qualifying error or alarm determined by the user and continues to count until the error-free condition (Gate Time) is met. If SDT is enabled and alarm/error triggers are selected, the results will appear in the Results section under the SDT tab.

#### **Testing Process**

The test set measures how long the event remains present after it is first recognized and will continue to measure the total service disruption time in the event of multiple disruptions.

Before starting, ensure that no errors or alarms are present on the transmission system because this will impact the measurement.

In the past, Automatic Protection Switching (APS) was used to measure physical service cuts, especially in optical links. Service disruption measurements are meant to measure the total time the service is not available to customers, which isnot limited by the optical path cut. Therefore, it configures to include the time the whole system takes to recover.

Service Disruption can still be used to measure APS time, if the trigger selected is LOS only. This will just measure the physical protection switch time.

#### Setup

- 1. Set Measurement to ON to activate SDT testing during BER tests.
- 2. Set a limit time and separation time. Limit and Gate Time counters begin at the onset of the first valid event.
  - Limit Time: Specifies pass/fail criteria for SDT events. This represents the acceptable amount of time for the customer to experience a service disruption. Events greater than the limit time are considered a fail. Configurable from 20 to 1000 ms.
  - **Gate Time:** Specifies the length of error free signal time used to determine the number of service disruptions. Configurable from 20 to 10000 ms. The Gate Time is not included in the service disruption time calculation.

3. (Optional) Turn **Save Event** to ON when SDT Measurement is enabled to include the Events Table details in the test report (including individual events within each of the disruptions recorded). When Save Event is turned OFF, the saved test results will only display general results (Current, Last, longest event, shortest events, total number of events detected and a PASS/FAIL verdict).

- 4. Select the type of errors/alarms from the SONET, PDH, BERT, OTN tabs that will trigger the SDT test.
- 5. Press the **Start** button to begin testing.



Service Disruption Time diagram

In the simplified example above, two events occur with 150ms of error free time in between. A gate time of 300ms counts them as one service disruption because the error-free section is less that the gate time. Using a gate time of 100ms to evaluate the same situation would count two service disruptions, because the Gate Time condition is met within the error-free section.

# 6.2 Results

Test measurements can be accessed from the Results icon in the main menu.

## 6.2.1 Results Summary

The Results Summary screen displays a summary of all the test results with start time (ST) and elapsed time (ET), alarms, errors, or signal failure pertaining to OTL, OTN, or BERT signal and its payload.



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# 6.2.2 Signal

The signal tab displays the Signal Level, Frequency and related measurements.

# **RX/TX Optical Level (Page 1-2)**

- The optical level measurement for each available wavelength (channel) is displayed in dBm.
- Loss of Signal (LOS) and the Saturation levels is shown both graphically and in dBm.



Signal - RX Optical Power Level

# Frequency (Page 3)

- The received signal frequency and offset is measured and displayed. The Signal page may display frequency measurements per lane for newer 40G/100G modules, depending on the test set and software version.
- For OTN signals, the measurement is performed on the optical interfaces QSFP28, and QSFP+.
- Frequency: Indicates the frequency of the input signal
- Offset (ppm): Indicates the difference between the standard rate and the bit rate of the input signal
- Min (ppm): Indicates the difference between the standard rate and the minimum deviation detected in the input signal
- Max (ppm): Indicates the difference between the standard rate and the maximum deviation detected in the input signal

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
			Freq	uency			
😑 Signal	Frequency			111809973K	Hz		
	Offset [ppm]			-0.1			
🜔 Frame	Min [ppm]			-0.1			
🔘 Pattern	Max [ppm]			-0.1			Bit Err Inj.
Ŭ							OTN Alarm Inj.
e Alm/err							
History							LASER On/Off
							Set Injection
		•	Page	3 of 5			

Signal - Frequency (All Lanes)

# **QSFP** Optical Module Information (Page 4)

The information and capabilities of the QSFP in use are listed.

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Start
	QSFP Optica			odule Inform			
🜔 Signal	Power Class		Pov	ver Class 6 N	1odule (4.5 W	/ max)	
-	Vendor		Ocl	aro Inc.			
Frame Part Number			TR	Q5E20FNF-L			
O Pattern	Serial Number			D57299	OTL Err Inj.		
<b>U</b> i ancenti	Bit Rate (Gbps)			5	OTL Alarm Ini		
O ALM/ERR	Wavelength (nm)			0.0			
	Wavelength	Tolerance(r	1.0 nm)				LASER On/Off
History	Tranceiver (	Compliance	(Hex) 80 (	00 00 00 00 00	00 00	Decode	
							CDR Access
			Page	4 of 5 (			Set Injection

Signal (Page 4) - QSFP Optical Module Information

#### **QSFP Optical Module Status (Page 5)**

QSFP Optical Module Status displays the internal diagnostics status of the pluggable QSFP optics. Color-coded LEDs indicate status of alarms and errors.

LEDs	Summary S	ignal	OTL	ΟΤΝ	BE	RT	Analysis	Start
		Q	SFP Optical	Module State	us			
😑 Signal		F	X LOS	TX Electrica	ILOS	T)	K FAULT	
	Channel 1	1	Normal	Norma			Normal	
🜔 Frame	Channel 2	1	Normal	Normal			Normal	
O Pattern	Channel 3	1	Normal	Normal		Normal		OTL Err Inj.
	Channel 4	1	Normal	Normal		Normal		OTL Alarm Ini
😑 ALM/ERR								
	Temperature			45.1 C				LASER On/Off
History	Voltage 3217 mV							
		۲	Page	5 of 5 (				Set Injection

Signal (Page 5) - QSFP Optical Module Status

#### 6.2.3 OTL and STL Results

Depending on the test configuration, OTL measurements are displayed for OTU3/OTU4.

# Go back to top Go back to TOC

#### 6.2.3.1 Summary

Color-coded LEDs indicating alarm and error status for each individual lane are listed.

**Green:** No error or alarm is present.

**Red:** An error or alarm condition is detected and is currently present.

**Yellow:** Indicates a history condition. An error or alarm was detected during the measurement interval but it is no longer present or active.

LEDs	Summary Sigr			nal OTL			OTN BE				BEI	ERT Analysis				sis	;	Stop	
	Summ	ary	F	Rx La	ane	Skev	v	AI	arm	s/Er	rors	5		E	ver	nts			
ᆼ Signal	ST:2017-11	- 6 17:	58:5	8				ET:0	00:53	3:46									
	Lane ID	0 1	2	3 4	l 5	6	7	8 9	) 10	11	12	13	14	15 ′	16 1	17	8	19	
🕒 Frame	LOF	$\mathbf{O}$	0	00		$\mathbf{O}$	$\circ$	00		$\mathbf{O}$	0	0	0	$\mathbf{O}$	)(			0	
O D-#	OOF	00	0	00	00	0	0	00		0	0	0	0	0	0	C	D	0	Bit Err Inj.
O Pattern	FAS	00	0	00	00	0	$\circ$	00		0	0	0	0	0				0	
	LOR	00	0	00	00	$\mathbf{O}$	$\circ$			$\mathbf{O}$	0	0	0	$\mathbf{O}$				0	OTN Alarm Inj.
	OOLLM	00	0	00	0	$\mathbf{O}$	$\circ$			$\mathbf{O}$	0	0	0	$\mathbf{O}$				0	
History	OOMFAS	00	0	00		$\mathbf{O}$	$\circ$			$\circ$	0	0	0	$\circ$				0	LASER ON/OIL
	LLM	00	0	00	$\mathbf{O}$	$\mathbf{O}$	$\circ$			0	0	0	0	0				0	
	MFAS	00	0	00		0	0	00		0	0	0	0	0				0	
	Hi Skew	00	0	00	$\mathbf{O}$	0	0			0	0	0	0	0			D	0	Set Injection
	RxID	4 0	1	2 3	3 9	5	6	7 8	3 10	11	12	13	14	17 1	18 1	19	5 <sup>-</sup>	16	
	LOL	0	DL		0														



OTL Ala	OTL Alarm/Error Definitions per ITU-T G.709 and G.798										
LLM	Logical Lane Marker Error										
FAS	Logical Lane Frame Alignment Error										
MFAS	LL Multi-Frame Alignment Error										
LOL	Loss of logical Lane alignment • Two or more logical lanes with the same marker • Consecutive LLM errors for ≥ 5 frames										
OOL	Out of logical Lane alignment										
OOF	LL Out of Frame (FAS error for $\geq$ 5 frames)										
LOF	LL Loss of Frame (consecutive OOF for ≥ 3ms)										
OOR	Out of Recovery (wrong LLM value for $\geq$ 5 cycles)										
LOR	Loss of Recovery (consecutive OOR for ≥ 3ms)										
OOLLM	Out of Logical Lane Marker (LLM errors for $\geq$ 5 frames)										
OOMFAS	Out of LL MFAS (MFAS errors for $\geq$ 5 frames)										
High Skew	Skew for any of the lanes is greater than a threshold (limit) value set for the application										

#### 6.2.3.2 Rx Lane Skew

👻 Lane skew is only available on 100G test modules.

#### Lane Skew

In OTU4 and 100GE implementations, the transmit data stream is split into 10 electrical lanes and 20 logical lanes, which are scrambled to ensure sufficient transition density (pulses) for clock recovery. The OTL/PCS layer is responsible for inserting Lane Alignment Markers into each of the logical lanes in the transmit direction, so the original 100G data stream can be reconstructed at the far end. The receiver's OTL/PCS layer is responsible for detecting the lane alignment markers and aligning recovered data in the receive direction. The alignment process ensures properly formatted data. Skew accumulation occurs downstream from the OTL/PCS and it is the responsibility of the receiver's OTL/PCS layer to remove skew and re-align the receive data.

#### **Fixed Skew**

Fixed or static skew represents the constant difference in arrival time for two signals generated from the same source. It is generated by physical lane-to-lane differences in the time a signal reaches a destination relative to the data on any other lane. This usually related to implementation factors, such as differences in electrical trace lengths (0.5 UI/cm), fiber optics dispersion, and lane-dependent clock recovery circuits (CDR).

#### Dynamic (Variable) Skew

Lane-to-lane skew can change or wander over time due to many physical and environmental factors, including uneven temperature, data rate, and supply voltage fluctuations.

LEDs	Sun	ummary Signa		nal OTL		ΟΤΝ	BER1	Г	Analysis	Stop		
	\$	Summary R			Rx L	ane S	kew	Alarms/Er	rors		Events	
😑 Signal	Ch #	Т	x Skew B	lit	L#	TxID	RxID	Rx Skew(bits)	Rx Skew(	(ps)	Hi Skew(Sec.)	
🕒 Frame					0	0	4 0	3 4	536 715		0	
Ŭ	0	-	0	+	2	2	1 2	4	715 715		0	Bit Err Ini
😑 Pattern		H		╞	4 5	4	39	4 0	715		0	
	1	-	0	+	6	6	5 6	1	178 178		0	OTN Alarm Inj.
					8	8	7 8	1	178 178		0	LASER ON/Off
History					<u>10</u> 11	10	<u>10</u> 11	37 37	6618 6618		0	
	2	-	0	+	12	12	12 13	37 37	6618 6618		0	
					14	14	14	37	6618		0	
	2				16	15	18		7870		0	Set Injection
	3				18	17	15 15 16	44 45 45	8049		0	



#### 6.2.3.3 Alarms/Errors

Detailed aggregate Alarm and Error count, as well as per-lane counters. Select the desired lane to be highlighted and press the **View OTL** button. Lanes are color-coded to indicate alarms and errors status. Refer to **Summary** for a description of LED color statuses.

LEDs	Summary	Signal	OTL	OTN BER	Γ Analysis	Stop							
	Summar	y Rx	Lane Skew	Alarms/Errors	Events								
😑 Signal	ST:2017-11-6	6 17:58:58		ET:00:55:00									
🕥 Frame	Lane Alig LOL	gnment	Seconds 239	Lane Alignment OOL	Seconds 0								
· ·			Aggr	egate									
	OTL Lane	e Alarms	Seconds	OTL Lane Errors	Count	Bit Err Inj.							
😑 Pattern	LOF		239	FAS	6847								
	OOF		0	MFAS	957	OTN Alarm Ini							
	LOR		0	LLM	1264								
	OOR		0										
	OOLLM		0	]		LASER On/Off							
History	OOMFAS		0	Hi Skew	0Sec.								
		OTL Lanes Alarms and Errors Summary											
	○ 0 ○ 1	2	3 💿 4	<ul> <li>● 5</li> <li>● 6</li> <li>● 7</li> </ul>	0809	Set Injection							
	10 11	12	13 💿 14	15	18 19								

#### **OTL Alarms/Errors**

						OTLL	ane Detail	s				Stop
	ST	·2017	-11-7	14.17.	17		ET:00:1	3.55				
	Ľ.		OOF				DOMEAS	FAS	ПИ	MFAS		
O Signal	L#		001	2010	Secon	de		17.0	Count		ID	
U Signai	0	0	0		0	0	0	0	0	0	3	
		ň	ň	ň	Ő	ň	ň	ŏ	ŏ	ň	Ă	
<u> </u>	2	ŏ	0	ŏ	ŏ	Ő	ŏ	Ő	ŏ	Ő	ō	
🕒 Frame	3	0	Ň	0	0	0	Ŏ	Ő	0	Ő	Ť	
	Ă	0	0	Ő	Ő	0	Ő	0	0	0	2	
_	5	ŏ	Ő	Ő	ŏ	Ő	ŏ	Ő	ŏ	Ő	5	OTL Err Inj.
😑 Pattern	6	ő	Ő	Ő	ŏ	Ő	ŏ	Ő	ŏ	Ő	1 Å	
-	7	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	ŏ	Ő	7	
	8	Ő	Ő	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	8	OTL Alarm Inj.
ALM/ERR	9	Ő	Ő	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	9	
Ŭ	10	Ő	Ő	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	10	
	11	Ő	Ő	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	11	(LASER On/Off)
( History	12	Ő	Ő	Ő	Ő	Ő	ŏ	Ő	ŏ	Ő	12	
	13	ō	ō	ŏ	ŏ	Ő	ŏ	Ő	ŏ	Ő	13	
	14	ō	ō	ŏ	ŏ	Ő	ŏ	Ő	ŏ	Ő	14	
	15	ō	ō	ŏ	Ō	Ő	ŏ	25	20	35	19	
	16	ő	ŏ	ŏ	õ	Ő	ő	131	90	67	15	
	17	Ő	ŏ	ŏ	õ	0	ő	1253	115	79	16	Set Injection
	18	Ő	ŏ	ŏ	Ő	Ő	Ő	714	23	38	17	
	19	Ő	ŏ	ŏ	Ő	Ő	Ő	871	526	38	18	
	10		· ·			· ·	· · ·		020		10	

# 6.2.3.4 Events

The Events log tab lists Error and Alarm events recorded during the test. The events are presented in chronological sequence with start time and duration (alarms), event type, sequence number, ratio/count (errors), and test type.

••	LEDs	Summary	Sig	gnal	OTL	ΟΤΝ	BERT		Analysis	Stop
		Summar	Summary		.ane Skew	Alarms/E	rrors		Events	
0	Signal	Time	E	Event		# of Err	ors	Test		
0	Frame	11-06 18:54:0	6.0	FAS O	TL#19		3		OTL	
<u> </u>	i rume	11-06 18:54:0	6.0 I	L <mark>LM O</mark>	TL#16		1		OTL	
0	Pattern	11-06 18:54:0	6.0	FAS O	TL#16		1		OTL	Bit Err inj.
		11-06 18:54:0	6.0	FAS O	TL#15		2		OTL	OTN Alarm Inj.
Θ	ALM/ERR	11-06 18:54:0	5.0	FAS O	TL#19		2		OTL	
Г	listory	11-06 18:54:0	5.0	FAS O	TL#18		2		OTL	LASER On/Off
		11-06 18:54:0	5.0	L <mark>LM O</mark>	TL#15		1		OTL	
		11-06 18:54:0	5.0	FAS O	TL#15		2		OTL	
					🔹 Page	1 of 210	D			Set Injection

**OTL Events** 

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Depending on the test configuration, OTN measurements are displayed for OTU3/OTU4 and SDH measurements displayed for SDH/SONET STL256.4.

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# 6.2.4 Summary

The OTN Results Summary screen displays a summary of alarms/errors pertaining to OTU, ODU, and TCM. Tap on the alarm/error for count and duration details.

LEDs	Summary	Signal	0	TL	ΟΤΝ		BER	Т	A	nalysis	Stop
	Summary	οτυ		ODU/O	PU		тсм		E٧	ents	
😑 Signal	ΟΤυ	ODU 1	ГСМ1	TCM2	TCN	/13	TCM4	TCN	/15	TCM6	
😑 Frame		) AIS C ) OCI C	) AIS ) OCI			S ( CI (	) AIS ) OCI		S Cl		
Pattern		DICK C	)LCK )BDI			K (			K DI		Bit Err Inj.
		BIP	BIAE			C	DBIAE		C		OTN Alarm Inj.
	OMFAS C		) TIM ) BIP			M ( P (			M P		LASER On/Off
History		C	) BEI	OBEI	OB		BEI	OB	=1		
											Set injection
	LOM: A	Alarm Secor	nds	0							

#### **OTN Summary Results**

ΟΤυ	Error Definitions per ITU-T G.709 and G.798
FAS	<ul><li>Frame Alignment Signal Error (mismatch)</li><li>One or more framing bits in error</li></ul>
MFAS	Multi-Frame Alignment Signal error (mismatch) <ul> <li>MFAS indicator (0 to 255) is in error (out of sequence)</li> </ul>
TIM	Trail Trace Identifier Mismatch <ul> <li>Received and expected TTI are different</li> </ul>
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) • Received and calculated BIP are different
BEI	Backward Error Indication (BEI/BIAE bits) • 0 8 Number of BIP-8 violations detected • 9 A No BIP-8 error detected • B Refer to BIAE • C F No BIP-8 error detected
BIAE	Backward Incoming Alignment Error (BEI/BIAE bits) ● B (1011) ≥ 3 consecutive frames
cFEC	Corrected FEC errors (don't affect ODUk)
uFEC	Uncorrectable FEC errors (ODUk is affected)

ΟΤυ	OTU Alarm Definitions per ITU-T G.709 and G.798										
OOF	Out of Frame										
	<ul> <li>FAS errors ≥ 5 consecutive frames</li> </ul>										
LOF	Loss of Frame										
	<ul> <li>OOF condition for ≥ 3 ms</li> </ul>										
OOM	Out of Multiframe										
	<ul> <li>MFAS errors for ≥ 5 consecutive frames</li> </ul>										
LOM	Loss of Multiframe										
	<ul> <li>OOM condition for ≥ 3 ms</li> </ul>										
BDI	Backward Defect Indication										
	<ul> <li>Defect: Set to 1 for ≥ 5 consecutive frames</li> </ul>										
	<ul> <li>Normal: Set to 0 for ≥ 5 consecutive frames</li> </ul>										
IAE	Incoming (Frame) Alignment Error										
	<ul> <li>Defect: Set to 1 for ≥ 5 consecutive frames</li> </ul>										
	<ul> <li>Normal: Set to 0 for ≥ 5 consecutive frames</li> </ul>										
AIS	Alarm Indication Signal										
	• Repetitive PN-11 sequence (2 <sup>11</sup> -1) completely filling										
	OTUk frames										

ODU Ala	arm/Error Definitions per ITU-T G.709 and G.798
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) • Received and calculated BIP are different
BEI	<ul> <li>Backward Error Indication (BEI/BIAE bits)</li> <li>0 8 Number of BIP-8 violations detected</li> <li>9 F No BIP-8 error detected</li> </ul>
BDI	Backward Defect Indication • Defect: Set to 1 for ≥ 5 consecutive frames • Normal: Set to 0 for ≥ 5 consecutive frames
LCK	Locked • Defect: STAT = 101 for ≥ 3 consecutive frames • Normal: STAT = 001
OCI	Open Connection Indication • Defect: STAT = 110 for ≥ 3 consecutive frames • Normal: STAT = 001
AIS	Alarm Indication Signal • Defect: STAT = 111 for ≥ 3 consecutive frames • Normal: STAT = 001
PLM	Payload Mismatch <ul> <li>Declared if the accepted payload type is not equal to the expected payload type(s) as defined by the specific adaptation function</li> </ul>
TIM	Trail Trace Identifier Mismatch <ul> <li>Received and expected TTI are different</li> </ul>

# 6.2.4.1 OTU

OTU alarms/errors are displayed for OTU3/OTU4 test configuration.

Results are displayed in logical order that are associated with the signal under test. All errors are evaluated and stored. The Elapsed Time [ET] is shown in the right hand corner of the header.

LEDs	Summary Sigi	nal (	OTL OTN	BERT	Analysis	Stop
	Summary	οτυ	ODU/OPU	тсм	Events	
😑 Signal	ST:2017-11-6 17:58	:58	ET:00:55:25	j		
O Erama	OTU Alarms	Seconds	OTU Errors	Counts	Ratio	
	LOM	0	MFAS	0	0.00E+00	
🔘 Pattern	оом	0	SM-BIP	0	0.00E+00	Bit Err Inj.
Ŭ	SM-IAE	0	SM-BEI	0	0.00E+00	OTN Alarm Ini.
😑 ALM/ERR	SM-BDI	0	FEC Errors	Counts	Ratio	
	SM-BIAE	0	Corr. FEC	11833344	3.18E-08	LASER On/Off
History	SM-TIM	0	Uncorr. FEC	0	0.00E+00	
						Set Injection



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#### 6.2.4.2 ODU/OPU

ODU/OPU for OTU3/OTU4 test configuration displays errors and alarms in a logical order that are associated with the signal under test. All alarms are evaluated and stored.

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
	Summary	οτυ	ODU	IOPU	тсм	Events	
😑 Signal	ST:2017-11-6	17:58:58		ET:00:55:31	I		
0.5	ODU Alarm	s Seconds	s ODI	J Errors	Counts	Ratio	
😈 Frame	AIS	0	PM-BIP		0	0.00E+00	
Pattern	oci	0	PM-BEI		0	0.00E+00	Bit Err Inj.
Ŭ	LCK	0					OTN Alarm Ini
😑 ALM/ERR	PM-BDI	0					
	PM-TIM	0					LASER On/Off
History	OPU Alarm	s Seconds	5				
	OPU-PLM	0					
							Set Injection

**OTN Results - ODU / OPU** 

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#### 6.2.4.3 Tandem Connection Monitoring (TCM)

Results are available for up to six tandem connections. Use the page buttons to navigate through TCM1 to TCM6 results. Tandem connections and corresponding source and sink functions are defined in ITU-T G.707, G.709, and G.783.

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. 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.

Counts are measured in number of errored bits. Ratio measures the bit error ratio.

LEDs	Summary	Sigr	nal (	OTL	ΟΤΝ	BEF	RT	Analysis	Stop
	Summary		οτυ	ODU	IOPU	тсм	F	Events	
😑 Signal	ST:2017-11-6 17:58:58			ET:00:55:39					
🜔 Frame	TCM #1 Alarms		Seconds	TCM #1 Errors		Cou	Counts Ratio		
	AIS		**	BIP		**		**	
Pattern	осі		**	BEI		**		**	Bit Err Inj.
Ŭ	LCK		**						OTN Alarm Ini.
🔵 ALM/ERR	BDI		**						
	BIAE		**						LASER On/Off
History	LTC		**						
	тім		**						
									Set Injection
			•	Page	1 of 6	●			

**OTN Results - TCM** 

Tandem Connection Monitoring (TCM) Definitions per ITU-T G.707, G.709, and G.783					
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) • Received and calculated BIP are different				
BEI	<ul> <li>Backward Error Indication (BEI/BIAE bits)</li> <li>0 8 Number of BIP-8 violations detected</li> <li>9 F No BIP-8 error detected</li> </ul>				
BDI	Backward Defect Indication • Defect: Set to 1 for ≥ 5 consecutive frames • Normal: Set to 0 for ≥ 5 consecutive frames				
LCK	Locked • Defect: STAT = 101 for ≥ 3 consecutive frames • Normal: STAT = 001				
OCI	Open Connection Indication • Defect: STAT = 110 for ≥ 3 consecutive frames • Normal: STAT = 001				
AIS	Alarm Indication Signal • Defect: STAT = 111 for ≥ 3 consecutive frames • Normal: STAT = 001				
PLM	Payload Mismatch <ul> <li>Declared if the accepted payload type is not equal to the expected payload type(s) as defined by the specific adaptation function</li> </ul>				
ТІМ	Trail Trace Identifier Mismatch • Received and expected TTI are different				

#### 6.2.4.4 Events

The Events log tab lists Error and Alarm events recorded during the test. The events are presented in chronological sequence with start time and duration (alarms), event type, sequence number, ratio/count (errors), and test type.

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#### 6.2.5 BERT

BERT alarms/errors results and Events are displayed in their respective tabs. Refer to BERT > <u>Errors</u> for a description of BERT alarms/errors.

LEDs	Summary S	ignal	OTL	OTN	BERT	Analysis	Stop
	Alarm	s/Errors		Events			
😑 Signal	ST:2017-11-8 16:	18:55		ET:00:00:41	1		
O Frame	BERT Alarm	Seconds	BEF	RT Error	Counts	Ratio	
•	LOP	0	Bit		0	0.00E+00	
🜔 Pattern							
							OTL Alarm Inj.
History							LASER On/Off
							Set Injection

**BERT Results - Alarms/Errors** 

# 6.2.6 Analysis

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
😑 Signal	ST:2017-11-	7 16:24:30	ET:00 / 00:	02:16 Ma	anual Measure	ment	
😑 Frame			SD1		Start Ti	me	
O Dettern	Current (ms)		136000.000		2017-11-07 16:24:31.000000		OTL Err Inj.
Pattern	Last (ms)		0.000				
ALM/ERR	Minimum (ms)		136000.000	20	17-11-07 16:24:	31.000000	OTL Alarm Inj.
	Maximum (m	is)	136000.000	20	17-11-07 16:24:	31.000000	LASER On/Off
History	Events		1				
	Limit		Fail				
					Events	Detail	Set Injection



Displays Service Disruption Time (SDT) results and start time and duration for each:

- Current: Current SDT measurement
- Last: Last SDT measured during the test
- Min/Max: Minimum and maximum SDT measured during the test
- Events: Number of service disruption events (SDTs)
- Limit: Displays Pass/fail results based on established threshold criteria

Tap on **Events Detail** for additional details on measured SDT events.

The event type for each service disruption and start and duration information is listed.

LEDs		OTU4 Service D	Page 1 of 64	Λ	
		Events	Start Time	Duration (ms) Verdict	
	1	Service Disruption	2017-11-07 16:24:31.000000	***	
🕒 Signal	1.1	- Bit Error/Pat Loss	2017-11-07 16:24:31.000000	***	
	1.2	- OTU LOM	2017-11-07 16:24:31.000000	***	
🖲 Frame	1.3	- OTU OOM	2017-11-07 16:24:31.000000	***	
	1.4	- OTL LOF	2017-11-07 16:24:31.000000	***	
🔘 Pattern	1.5	- OTL OOF	2017-11-07 16:24:31.000000	***	
	1.6	- OTL LOL	2017-11-07 16:24:31.000000	***	
😑 ALM/ERR	1.7	- OTL OOL	2017-11-07 16:24:31.000000	***	
	1.8	- OTL FAS	2017-11-07 16:24:31.226299	0.024	
History	1.9	- OTL FAS	2017-11-07 16:24:31.693329	0.025	
	1.10	- OTL FAS	2017-11-07 16:24:31.763907	0.025	
	1.11	- OTL FAS	2017-11-07 16:24:31.831282	0.024	
	1.12	- OTL LLM	2017-11-07 16:24:31.979068	0.024	
	1.13	- OTL LLM	2017-11-07 16:24:32.027504	0.024	
	1.14	- OTL FAS	2017-11-07 16:24:32.232035	0.025	V

Analysis Details
## 6.3 Alarm / Error Injection

Alarms and Errors can be injected into different signals. At any time during the test process, tap the **Error Injection** or **Alarm Injection** buttons to inject errors or generate alarms.

To access the setup for the alarms and errors, tap the **Set Injection** button on the right side of the screen.

## **Alarm and Error Injection Setup**



## **OTL Alarm and Error Injection Setup**

OTL/STL Lane Selection: For OTL and STL layers only

## **Error Injection:**

- Layer: OTL, OTN, SDH, STL, BERT
- Type:
  - OTL: FAS, MFAS, LLM
  - OTN: MFAS, SM-BIP, SM-BEI, Corr. FEC, Uncorr. FEC, PM-BIP, PM-BEI, TCM1 to 6-BIP/BEI
  - BERT: Bit
  - STL: FAS, LLM
  - SDH: B1, B2, MS-REI, B3, HP-REI
- Behavior: Single, Single Burst, Cont. Burst, Rate

## Alarm Injection:

- Layer: Physical, OTN, OTL, STL, SDH. Selecting the physical layer will display four optical lanes, L1-L4 or L1 to L10. Use these check boxes to select which lanes would be affected by the error generation. Note that, if no optical lane is selected, then no errors would be injected.
- Type:
  - Physical: LOS
    - LOS Lane Selection
    - OTL: OTL-LOF, OTL-OOF, OOLLM, OOMFAS
      - Continuous, Single Burst, Cont. Burst.
    - OTN: OTU-LOM, OTU-OOM, SM-IAE, SM-BDI, SM-BIAE, SM-TIM, ODU-AIS, ODU-OCI, ODU-LCK, PM-BDI, PM-TIM, OPU-PLM, and TCM1 to 6 ACI / OCI / LCK / BDI / TIM / BIAE / LTC
    - STL: LOF, OOF, STL-AIS
    - SDH: MS-AIS, MS-RDI, RS-TIM, AU-AIS, AU-LOP, HP-UNEQ, HP-PLM, HP-RDI, HP-TIM
- Behavior: Continuous, Single Burst, Continuous Burst

Click <u>here</u> to refer to OTU Alarm and Error Definitions.

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## 7.0 Ethernet OAM Testing



Ethernet OAM provides automatic defect detection, fault management and performance monitoring tools for network links and end-to-end Ethernet Virtual Circuits (EVC). The OAM service supports IEEE 802.3ah, IEEE 802.1ag, ITU-T Y.1731, and G.8113.1.

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#### 7.1 OAM Setup

#### 7.1.1 Link Level 802.3ah OAM Setup

802.3ah functions include:

- Discovery
- Link Performance Monitoring
- Remote loopback
- Fault detection



#### Link OAM Setup

#### • 802.3ah OAM

Tap on the check box to start 802.3ah protocol testing. Transmission of OAM PDUs starts as soon as the box is checked.

#### OAM Mode

Select Active or Passive mode from the drop-down menu. Active and passive mode determines the type of actions the test set will take. For more on acceptable Active/Passive mode combinations and actions, see section <u>802.3ah OAM Discovery</u>.

#### Vendor OUI and SPI

Organization Unique identifier and Vendor specific information (similar to MAC address fields).

#### Max PDU Length

Advertised Max OAM PDU size (64 to 1518). After Discovery, the lowest of the local and remote will be used.

PDU Rate

100 to 10000 ms between consecutive OAM PDUs.

• Discovery Capability

Enables OAM enabled devices to exchange their OAM capabilities, configuration, and identity to link partners. Check on the boxes to advertise selected capabilities during Discovery.

Link Events Notification Settings
 Enable Event Notifications for Link Fault, Critical Event, and Dying Gasp.

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#### 802.3ah OAM Discovery

Discovery is the first phase of the 802.3ah protocol. During Discovery, local and remote units exchange Information OAM PDUs indicating capabilities and configuration information (mode, PDU size, loopback support, etc.). After successful negotiation the OAM protocol is enabled on the link. If no OAM PDU is received after 5 seconds, Discovery is restarted. The device can be configured in Active or Passive mode combinations.

Action	Mode Passive	Mode Active		Local Active	Local Passive
Initiates OAM discovery	No	Yes	Remote	Yes	Yes
Responds to OAM discovery	Yes	Yes	Active		
Peer must be in active mode	Yes	Yes	Remote	Yes	No
Sends Information OAM PDU	Yes	Yes	1 455170		
Sends Event Notification OAM PDU	Yes	Yes	OAM Mode - Acceptable Active/Pas		ctive/Passive
Sends Variable Request OAM PDU	No	Yes	Combinations		
Sends Loopback Control	No	Yes			
Reacts to Loopback Control	Yes	Yes			

#### **OAM Mode Active/Passive Actions**

Notice that each device can be placed in any mode as long as the remote and local device are not both in passive mode.

Discovery Capabilities: Capabilities advertised during discovery process

- Remote Loopback
- Link Events: Supported, but no stateful
- MIB Retrieval: Can be advertised but is not supported in current release
- Unidirection

**Remote Loopback:** The user can transmit a loopback command to place the remote unit into loopback mode. Every frame received is transmitted back on the same port to ensure the quality of links during installation or troubleshooting and for fault isolation testing.

Link Events: Event OAMPDU is transmitted when the link error exceeds the threshold. Events may be sent once or multiple times. In the current software release, link events are only transmitted upon user request, not based on threshold crossing.

MIB Retrieval: Retrieves information on network devices and interfaces.

Unidirection: Checks for unidirectional transmission.

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#### 7.1.2 Service Level OAM: 802.1ag/Y.1731/G.8113.1 Setup

Under the Service Level OAM tab, the user has the option of starting the 802.1ag, Y.1731, or G.8113.1 test.

• Fill out the given parameters.

**MD** Name, MA Name, VLAN, and MD Level input values must match for both connected OAM devices in order for the test to work. The **Destination MEPID** and **Local MEP ID** must also be inverted for the tests to work.

• Tap the box next to 802.1ag, Y.1731, or G.8113.1 to start the selected test. The transmission of OAM PDUs become active as soon as the checkmark is added to the test.



OAM - Service Level OAM (Page 1)

#### Service Level OAM Configuration Parameters

- MAC Source: Enter the source address of the test set or tap the MAC Source button to assign a default MAC address.
  - **MD Format:** Configure the format of the Maintenance Domain Name:
    - None: No Maintenance Domain name
      - MAC+2octet: User configurable MAC address + 2 octets
      - String: User configurable ASCII character string
- MD Name: Name of the Maintenance Domain (only for 802.1ag)
- MA/MEG Format: Configure the format of the Maintenance Association name:
  - VID: User configurable ASCII character string
  - String: User configurable ASCII character string
  - 2 octet: 2 octet integer
  - ICC-Based: User configurable ITU-T Y.1731 ITU Carrier Code (ICC) based
- MA/MEG Name: Enter the name of the 802.1ag MA or Y.1731 MG
- Local MEP ID: Local end point identifier along the path (1 to 8191)
- MD Level: Maintenance domain level (0 to 7)
- MEP ID: End point identifier (1 to 8191)
- Primary VLAN ID: VLAN ID associated with the MA or MEG
- VLAN Type: C-VLAN, S-VLAN, or None
- Destination MEP ID: MEP ID of the MEP end point
- Direction
  - Up: Inward facing MEP used for MA/MEG with a wider reach (i.e., end-to-end, beyond a single link)
  - Down: Outward facing MEP used for MA/MEG spanning a single link



## Differences between 802.1ag, Y.1731, and G.8113.1

Selecting **802.1ag** enables Continuity Check Messages (CCM), Loopback Message (LBM) and Link Trace Message (LTM). **ITU-T Y.1731** provides all of the 802.1ag functionality with additional performance monitoring capabilities including Frame Loss (LM), and Delay (DM). **ITU-T G.8113.1** provides further monitoring of MPLS-TP traffic.

## **IEEE 802.1ag Definitions**

- Maintenance Domain (MD) : Management space on a network that is owned and operated by a single network provider. There is a maintenance level (from 0 to 7) to define the hierarchical relationship between domains. Maintenance domains can be nested but never intersect. MD is defined by Operational or Contractual Boundaries (e.g., Customer/Service Provider/Operator).
  - Maintenance Association (MA): Association of Maintenance. Elements that comprise the Maintenance domain.
- Maintenance Elements can either be MEPs (End points) or MIPs (Intermediate Points)
  - MEPs are at the edge of the network. They can generate and respond to OAM messages. A point-to-point EVC has only 2 MEPs, a multi-point EVC has multiple MEPs.
  - MIPs are located between the MEPs and can be used to isolate network problems. MIPs cannot generate OAM messages but can respond.
- **Maintenance Level:** Identifies the network hierarchy. Higher Level = Largest network. Level information present in all OAM PDU frames.
  - Level 0,1,2 = Operator domain
  - Level 3,4 = Service Provider domain
  - Level 5,6,7 = Customer domain



Some terms differ between IEEE 802.1ag and ITU Y.1731 protocols.The chart below describes the differences.

IEEE 802.1ag	ITU Y.1731 / G.8113.1
Maintenance Domain (MD)	No equivalent
Maintenance Association	Maintenance Entity Group
(MA)	(MEG)
Maintenance End Point	Maintenance entity Group
(MEP)	End Point (MEP)
Maintenance Intermediate	Maintenance entity Group
Point (MIP)	Intermediate Point (MIP)

#### **Definition Equivalencies**

Function	MEP	MIP
Initiates CCM messages	Yes	No
Initiates Loopback and Linktrace messages	Yes	No
Responds to Loopback and Linktrace messages	Yes	Yes
Y.1731 Performance Management messages (AIS,LCK, TST,LM, etc) initiates and responds	Yes	No
Forwards messages	Yes (upper maintenance layer) No (lower maintenance layer)	Yes (upper maintenance layer) No (lower maintenance layer)

#### **Maintenance Point Roles**

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#### **OAM Services Setup**

Under the same tab, OAM Services pertaining to 802.1ag, Y.1731, and/or G.8113.1 can be enabled. The tests listed include:

- Continuity Check (CCM)
- Loopback (LBM/LBR)
- Link Trace (LTM/LTR)
- Loss Measurement (LMM/LMR) (Y.1731 and G.8113.1)
- Delay Measurement (DMM/DMR) (Y.1731 and G.8113.1)
- Multi Protocol Label Switching Transport Profile (MPLS-TP) (G.8113.1 only)

#### **General Setup**

- To run any 802.1ag/Y.1731/G.8113.1 test, tap on the checkbox next to the corresponding test.
- To initiate testing for individual OAM services, press Start next to the desired service (NOT the green start button which initiates Throughput testing).
- CCM testing is initiated by selecting Enable from a drop-down menu.

Details on individual test parameters will be listed in the specified section.

LEDs	Set	up	F	Results	Start
-	Header Traffic	Error Inj. Ala	ırm inj. General	Summary OAM	
😑 Signal	Link	OAM	Servic	e Level OAM	
😑 Frame					
	Loopback (LBM/LE	IR)		Start	
Pattern	Destination Type	MEP 🔻	Destination MAC	00-00-00-00-00	
	Priority	7	# Messages	5	
History	Link Trace (LTM/L	TR)		Start	MX Discover
	Destination Type	MEP V	Destination MAC	00-00-00-00-00	
	Priority	7	TTL	60	Loop Control
		٩	Page 3 of 4 💽	•	

Pressing Start next to Loopback (LBM/LBR) initiates testing for that OAM service

#### 802.1ag/Y.1731/G.8113.1 Connectivity Fault Management Functions

Connectivity Fault Management Functions supported by the test set are as listed:

- Fault Detection Continuity Check:
  - CCM "heartbeat" messages are transmitted at a configurable periodic interval by MEPs.
- Network/Path Discovery Link trace message:
  - Equivalent to a traceroute test. MIPs and MEPs along the path send a response.
- Fault verification and isolation Loopback:

• Verify connectivity to a specific point in the message. Equivalent to ping test.

#### **Continuity Check Messages (CCM)**

CCM Messages are multicast messages sent from MEP to MEP at configurable intervals. Loss of continuity is detected after no CCM is received for 3.5 times the CCM interval.

There can be 4,094 VLANs per port and up to eight maintenance levels. This yields a worst case CCM transmission rate of 9.8 million CCMs per second if 3.3ms interval is used.



**Continuity Check Message (CCM)** 

RDI Flags added in CCM Messages indicates loss of continuity in the remote direction.

MAC Dst= Multicast or Unicast (Y.1731 only) MAC Src		VLAN Tag	OAM Type = 8902		
Management Level = 0 to 7	Vers=0	Opcode = 1	Flags (RDI, Transmission period)	TLV (Type Length Value) Offset	
Seq Number			MEP ID (2 bytes)		
	MAID/MEG ID (up to 48 bytes)				
Y.1731 Counters used to support performance monitoring(TxFCf, TxFCb, RxFCb)				End TLV	

#### **CCM Message Format**

#### **CCM Configuration Parameters**

- CCM: Enable/Disable sending Continuity Check messages.
- Type: Unicast/Multicast. If CCM is set to Enable, this field is ignored. In unicast mode you must enter the MAC address of the destination unit.
- Priority: 802.1p priority in the CCM VLAN Tag.
- Tx Interval: Choose from the supported CCM intervals: 1 s, 10 s, 1 min, 10 min.

The CCM Result button is a shortcut that brings the user directly to the CCM Results tab.



MPLS-TP, CCM Settings - Service Level OAM (Page 2)

## G.8113.1 Performance Management Functions

## MPLS-TP



#### MPLS-TP over Ethernet with PW Label

MPLS-TP is a Layer 2 technology that combines the benefits of MPLS and removes the complexity of IP networking. It uses the MPLS Label switching mechanism, but with static route provisioning (no Label Distribution Protocol LDP or RSVP-TE). MPLS-TP supports an advanced set of OAM functions and path protection mechanisms. In-band OAM traffic is on the same path as data traffic.

## Multi Protocol Label Switching Transport Profile (MPLS-TP) Configuration Parameters

- For the path and tunnel, select LSP (Label Switched Path) and PW (Pseudowire).
  - Label: Configure in the range of 16-1,048,575 (labels 0-15 are reserved).
    - Note: Composed of 20 bits which allows for the creation of over one million labels.
  - CoS: Enter the Classes of Service.
  - **TTL**: Enter the Time to Live. It will be decremented by 1 each time it crosses a hop. Frame is not forwarded after TTL reaches 0.
- ACH : Enter the Generic Associate Label
  - Note: For Pseudowires, the ACH used the first four bits of the PW control word.
- Version: Enter the G-Ach version. The default is set to 0.
- Channel Type: Enter the channel type (16-bit field).

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Link Trace and Loopback Messages

#### Link Trace Messages (LTM/LTR)

LTM (Link Trace Message) Multicast messages are transmitted on demand to a destination MAC address. All MIPs and destination MEPs respond with LTR (Link Trace Reply) and forward the LTM on to its destination.



LTM Diagram (LTM/LTR)

MAC Dst= Unicast		MAC Src VLAN Tag		OAM Type = 8902		
Management Level = 0 to 7	Vers=0	rs=0 Opcode = 5 (LTM) Flags		TLV Offset		
	Transaction ID					
TTL Original MAC address Target MAC address				MAC address		
	End TLV					

Link Trace Message Format

MAC Dst= Unicast MAC Src		MAC Src	VLAN Tag	OAM Type = 8902	
Management Level = 0 to 7	Vers=0	Opcode = 4 (LTR)	Flags	TLV Offset	
	Transaction ID				
TTL	TTL Relay action (802.1ag)				
Optional TLV				End TLV	

Link Trace Response Format

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Loopback Message (LBM/LBR)

LBM (Loopback Message) are unicast messages transmitted on demand to a destination MAC address. A destination address responds with an LBR (Loopback Reply Message).



LBM Diagram (LBM/LBR)

MAC Dst= Unicast or Multicast (Y.1731 only)		MAC Src	VLAN Tag	OAM Type = 8902		
Management Level = 0 to 7 Vers=0 Opcode = 3 (LBM) Opcode = 2 (LBR)		Flags (0)	TLV (Type Length Value) Offset			
	Loopback transaction ID/Sequence #					
Optional TLV				End TLV		

Loopback Message Format



LBM/LBR, LTM/LTR Settings - Service Level OAM (Page 3)

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Link Trace (LTM/LTR) and Loopback Message (LBM/LBR) Config. Parameters

- Destination
  - MEP: Sends LTM/LBM to the destination MEP as configured on Page 1.
  - MAC: Sends LTM/LBM to a destination MAC address.
- Priority: 802.1p priority in the LTM/LBM VLAN Tag.
- **Destination MAC:** Configure the destination MAC address used for the LTM/LBM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- # Messages: Enter the number of Loopback messages to be sent (LBM test only).
- TTL: Enter the Time to Live field in the LTM message. TTL will be decremented each time it crosses a hop (MIP) (LTM test only).

Press Start to initiate testing.

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## Y.1731/G.8113.1 Performance Management Functions

LEDs		Setup			Results		Stop
	Header	Traffic	Error Inj.	General	Summary	OAM	Barth
O Signal	L	Link OAM		Ser	vice Level O	AM	Kestar
😑 Frame	Loss Measure	ment (LMN	NLMR)			Start	Err Inj
O Pattern	Destination Ty	pe MEP	V Dest	ination MAC	0-00-00-00	0-00-00	
0.4141500	# Send	10	Rate	(ms)	500		
O ALMIERR	Priority	7					
History	Delay Measure	ement (DM	M/DMR)			Start	MX Disco
	Destination Ty	vpe MEP	💙 Dest	ination MAC	00-00-00-00	0-00-00	Loop Con
	# Send	10	Rate	(ms)	500		
	Priority	7	0				
				Page 4 of 4	۲		

## Loss (LMM/LMR) and Delay Measurement (DMM/DMR) Configuration Parameters

- Destination
  - MEP: Sends LMM/DMM to the destination MEP as configured on Page 1
  - MAC: Sends LMM/DMM to a destination MAC address
- Priority: 802.1p priority in the LMM/DMM VLAN Tag
- Destination MAC: Configure the destination MAC address used for the LMM/DMM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- # Send Configure the number of LMM/DMM frames to send up to 50
- Rate : Configure the LMM/DMM frame interface rate (min: 100 ms; max: 10 seconds)

Press Start to initiate testing.

#### Frame Loss Measurement

#### Two local counters for each peer MEP:

- TxFCf: Counter for in-profile data frames transmitted towards peer MEP
- RxFCf: Counter for in-profile data frames received from peer MEP

## Single-ended ETH-LM:

- On demand OAM
- MEP sends LMM frame (Unicast DA or Multicast Class 1 DA) and receives LMR frame (Unicast DA) with counters

CCM frames contain frame counters.



## Single Ended Frame Delay Measurement

LMM frames contain frame counters.

#### **Delay Measurement**

On demand OAM for measuring Frame Delay (FD) and Frame Delay Variation (FDV):

- TxTimeStampf = Timestamp transmission of DMM frame
- RxTimef = Reception time of the DMM frame
- RxTimeb = Reception of DMR frame

#### Two-way ETH-DM:

- DMM frame (Unicast DA or Multicast Class 1 DA for multipoint measurement) & DMR frame (Unicast DA)
- FD = RxTimeb TxTimeStampf



**Dual Ended Frame Delay Measurement** 

DMM and DMR frames contain timestamp info.

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## 7.1.3 Layer 4+ Applications

Stateful TCP testing refers to the validation of TCP connections used for the TCP/IP Protocol Stack. A V-PERF test will validate that the TCP parameters in the network were set up correctly. The optional V-PROBE is used as remote server to establish TCP connections and validate that the network is configured correctly for seamless passing of TCP traffic. It will also verify the maximum throughput for TCP traffic. Typically in the field, after running layer 2 & layer 3 tests successfully, a customer may still complain that their connection is slow to deliver their applications. Running a stateful TCP test will help verify maximum throughput rates in the download and upload direction. If throughput performance is poor, the test can help identify what the issue could be.

## TCP Protocol and Overview

Fundamental TCP parameters are the ideal TCP Window Size and Throughput. The complete list of relevant measurements include

- TCP Window Size
- TCP Throughput
- Number of Connections Established
- Download Time
- File Transfer Size
- Retransmits





Transmission Control protocol is the most widely used transport layer protocol. TCP is used by most application protocols: HTTP, FTP, Telnet. It provides the following services:

- End-to-end connection
- · Multiplexing/Demultiplexing of separate sessions
- Flow control



TCP is a connection oriented protocol. A Connection is established prior to data transmission between the two end devices (client and server). A 3-way handshake procedure is used to establish connection.

When a connection is established, the data transfer can start. TCP uses sequence numbers to reassemble data and verify that no data has been lost.

TCP uses Window mechanism for Flow Control:

- 1. The Sender indicates in the Window size the data it is prepared to receive
- 2. The Window size is the amount of outstanding data that can be sent before acknowledgement is received
- 3. If data is lost, the window size is decreased and less data is sent prior to acknowledgement



- Step 1: Client sends a SYN message with SYN flag set in the TCP header. The Sequence number specifies the number assigned to the first segment.
- Step 2: Server receives SYN packet and sends SYN + ACK packet SYN flag set, ACK flag set Sequence number specifies the server's starting sequence number. Acknowledgment number means that the server has received X and expects X+1.
- Step 3: Client receives SYN + ACK and send ACK back. ACK number means that server has received Y and expects Y+1.

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#### **RFC 6349 Testing Methodology**

RFC 6349 is a practical testing methodology consisting of 4 different steps for measuring end to end TCP Throughput and Performance in a managed IP network.

• Step 1 Max MTU Search:

Search for the maximum packet length that can be sent through the network without segmentation. The Path MTU search follows RFC4821 (Packetization Layer Path MTU Discovery).

• Step 2 Round Trip Time (RTT) Search:

Measure of the roundtrip time between the TCP segment sent and the acknowledgement received, the test has to be done in a network that is not congested to obtain the real round trip delay (not accounting for network buffer delay).

• Step 3 Bottleneck Bandwidth (BB) Search:

For this step, a Layer2/3 test can be done (RFC2544 or Y.1564) to determine the maximum throughput rate supported by the network.

• Step 4 Bandwidth Delay Product Calculation:

Based on RTT and BB results, the BDP is computed to estimate the optimal window size that should be used for testing (Auto mode). User can also specify fixed window size.

Key Metrics:

- TCP Bandwidth Delay Product
- Transfer Time Ratio
- TCP Efficiency
- Buffer Delay

TCP Bandwidth Delay Product is the theoretical maximum of data that can be transmitted based on network delay and throughput rate.

## BDP (Bytes) = Link Bandwidth (bps) x RTT (s)/ 8

 $^\prime$  To completely occupy the available bandwidth the Window size must be set to the BDP value.

The ideal TCP transfer time is based on the Maximum achievable TCP transfer rate, calculated based on the Bottleneck Bandwidth (BB) and the layer 1-2-3-4 overheads associated with the network path. The actual TCP transfer time measures the time it takes to transfer data.

## Transfer Time Ratio = Actual TCP Transfer Time / Ideal TCP Transfer Time

Link Speed	MAX Achievable TCP Throughput	ldeal TCP Transfer Time (rounded)
100Mbps Ethernet	94.9 Mbps	9 s
1G Ethernet	949.2 Mbps	1 s
10G Ethernet	9492.2 Mbps	0.1 s

## Example of an ideal TCP transfer time based on a 1500 Bytes size MTU and 100MB file download:

TCP retransmission is done when TCP segments are lost during transmission or an acknowledgement is missing. Segments can be retransmitted more than once.

There is no direct correlation between the number of Ethernet frames lost at the physical layer and the number of TCP retransmission, since a single lost acknowledgement could trigger many retransmission.

TCP Efficiency = Transmitted Bytes + Retransmitted Bytes/ Transmitted Bytes x 100

The Buffer Delay represents the increase (or decrease) in Round Trip Time (RTT) during a TCP throughput test compared to the baseline RTT.

A large RTT Buffer delay indicates that the network is experiencing congestion and that segments are being delayed.

Buffer Delay = Average RTT – Baseline RTT/ Average RTT x 100

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## Layer 4+ Applications Configuration

Before launching V-PERF, it's necessary establish an IP connection. For V-PERF testing, repeat these steps for both the far end and near

#### end test sets.

1. Launch the desired Ethernet Test Application from the Main Menu.

Test Ports	Module 2, Port 1	Test Mode Selection TX3005-1006
1 QSFP28	Ethernet	100G Ethernet Testing
1 R.145	OTN/SONET/DSn >	100GE RS-FEC(IEEE803.3bj) Testing
		😑 40G Ethernet Testing
		🗹 100GE Layer4 Testing
		100GE RS-FEC(IEEE803.3bj) Layer4 Testing
	Release	OK Cancel

2. For testing on SFP/XFP ports, turn the **Laser On**. Tap the **IP** button. Configure a static IP address for testing. If you are in an environment that supports DHCP, select DHCP from the IP Address menu, then tap **Connect**.



- 3. Once the proper IP information is entered, press Connect. An IP: PASS status indicates proper connection.
- 4. Go to Layer 4+ Applications. The test application will load.



Test results can be saved to the File Server using the Folder hardkey 🔍. Results can be retrieved via USB drive or remotely using the Web UI. Refer to File Management in the TX300s, MTTplus, RXT-1200, or UX400 platform manuals for more information on saving files.

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#### 7.1.3.1 V-PERF

The V-PERF test suite consists of the full TCP Throughput test Compliant with RFC6349 (Test Set to Test Set only) and also the original stateful TCP testing to iPerf/iPerf3 server or to our V-Probe.

- Stateful TCP Test up to 1GE/10GE/100GE line rate
- TCP Client/Server and Bi-Directional modes
- Compatible with iPerf Client/Server
- MTU search per RFC4821
- Round Trip Time Measurement •
- Configurable TCP Window •
- Multi-Window size tests
- Measurements: TCP Throughput rate (min, max, average), Transfer file size and duration, Transfer time ratio, TCP Efficiency %, • Buffer Delay %.



**TCP** Throughput Test Diagram

## Server/Client - Unidirectional Configuration and Results

1. After loading the Layer 4+ Application, set one test set as a Server from TCP Mode. Press Start.

LEDs	V-P		
	Setup	Results	Start
🌔 Signal	Profile	Default 🛛 🔻	Start
<u> </u>	V-PERF Mode	Server 🗸 🗸 🗸	
🜔 Frame	Compatibility	lperf3 🛛 🔻 🔻	
0.0.00	Server Port	5201	
Pattern			
ALM/ERR			
History			
QSFP28: 4X25G RS-FEC: OFF			

Test Set #1 - V-PERF Setup - Server

LEDs					
	Se	tup	Res	ults	Stop
🚫 Signal	Status	Summary	Per Stream	Event	
🚫 Frame	ST:2020-12-18 07:3	31:17	ET:00:00:11		
-	Current Event:				
🔘 Pattern	IP: 192.168.0.101				
	Waiting for Client	to connect			
History					
QSFP28: 4X25G					
RS-FEC: OFF					

Test Set #1 After Pressing Start

2. Set the other test set as a Client. Tap on Page 2 to configure the Throughput Test Mode type. <u>MTU Search, Round Trip Time</u> <u>Search, Bottleneck Bandwidth</u>, and <u>Window Size and Threshold Monitoring</u> options are also on Page 2.

	LEDs	V-P		
		Setup	Results	Start
0	Signal	Profile	Default 🛛 🗸 🗸	Start
~	_	V-PERF Mode	Client 🗸 🗸	
0	Frame	Compatibility	lperf3 🛛 🔻 🔻	
~	Dattawa	Transfer Direction	Serial 🛛 🔻	
0	Pattern	Protocol	тср 🗸 🗸	
		Parallel Streams	Manual 🛛 🔽 1	
0		Server IP	192.168.0.101	
н	istory	Server Port	5201	
		MTU Search	Enabled 🛛 🗸 🔻	
		Round Trip Time Search	Enabled 🛛 🔻 🔻	
QSF RS-F	P28: 4X25G FEC : OFF	Page	1 of 3 💽	

Test Set #2 - V-PERF Setup - Client

	LEDs	V-P	ERF		
		Setup	Res	ults	Start
Θ	Signal	Profile	Default	•	Start
~		Bottleneck Bandwidth/CIR	100000.000	Mbps 🔻	
•	Frame	TCP Window Size	Auto	▼	
~	<b>D</b>	Throughput Test Mode	Duration	▼	
0	Pattern	Duration(s)	10		
0		Save Data to USB	Disabled	▼	
0	ALIVIZER	Threshold Monitoring	Enabled		
$\frown$	listory	Throughput Threshold	Enabled 🛛 🔻	Settings	
-		RTT Threshold	Enabled 🛛 🔻	Settings	
-					
QSF	P28: 4X25G				
RS-	FEC : OFF	Image Page	2 of 3 🕟		

Test Set #2 - V-PERF Setup - Client - Page 2



## **Throughput Threshold Configuration**



**RTT Threshold Configuration** 

3. Connect the two test sets to the Near End (NE). Press Start on the Client unit.

LEDs	V-PERF						
		Setup			Results		Star
🔘 Signal		Global			Per Stream		Stop
🜔 Frame	Status	Summary	Graphs	MTU	RTT	Event	
-	ST:2020-12-	17 18:36:16		ET:00:00:17			
Pattern	MTU Searcl	h		Test Done			
	Round Trip Time Search			Test Done			
	TCP Test			In Progress			
History							
QSFP28: 4X25G							
RS-FEC : OFF							

Test Set #2 - Client - Results - Status

The Summary tab displays the following RFC 6349 metrics: TCP Efficiency, Buffer Delay & Retransmits.

LEDs	V-PERF						
		Setup			Results		Start
🔘 Signal		Global			Per Stream		Start
🜔 Frame	Status	Summary	Graphs	мти	RTT	Event	
	Win. Size	Efficiency	Buffer	DIy TXF	rm. Re	eTran Frm.	-
Pattern	Auto	100.000%	0.000%	1241	2156 0		
-							
ALM/ERR							
History							
QSFP28: 4X25G RS-FEC : OFF		٩	Pag	e 3 of 4	►		

Test Set #2 - Client - Results - Summary



Test Set #2 - Client - Results - MTU

LEDs		V-PERF					
		Setup			Results		Ctart
🜔 Signal		Global			Per Stream		Start
🜔 Frame	Status	Summary	Graphs	MTU	RTT	Event	
-	Time			Events			
🔵 Pattern	2020-12-17 1	18:36:16		Connecting	Server		
	2020-12-17 1	8:36:16		MTU Search	Start		
	2020-12-17 1	8:36:16		MTU Search	Done		
History	2020-12-17 1	8:36:16		RTT Search	Start		
	2020-12-17 1	8:36:27		RTT Search	Done		
	2020-12-17 1	8:36:27		Throughput	Start		
QSFP28: 4X25G RS-FEC : OFF	2020-12-17 1	18:36:38		Throughput	Done		

Test Set #2 - Client - Results - Event

LEDs		V-PERF				
		Setup		Res	sults	Start
😑 Signal		Global		Per S	Per Stream	
🜔 Frame	т	CP Status	;	тср о	Graphs	
	Stream #	1	of 1	Prev	Next	)
Pattern	TCP Window S	ize	2602 KB	▼	• •	
ALM/ERR	100.0(Gpbs)		Expected TC Actual TCP U	P Upload Rate pload Rate		
QSFP28: 4X25G RS-FEC: OFF	0.0		5		10	

Test Set #2 - Client - Results - Per Stream TCP Graphs

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#### Bi-Directional Configuration and Results (VeEX Enhanced Testing Methodology Implementation)

The Bi-Directional TCP testing methodology is unique as it allows two separate tests to run simultaneously on the same link in different directions. Both Test Sets are actually configured as Client & Server at the same time, saving the time of having to run each direction separately.

To simplify the configuration for this example, one test set is configured as a Client and the other as a Server. In reality however, as mentioned previously, both tests will be running simultaneously.

1. Select Bi-Directional from the V-PERF Mode drop-down menu on both test sets. Select the Bi-Directional Mode as Client on the Local End and Server on the Remote end.

	LEDs	V-P		
		Setup	Results	C Store
0	Signal	Profile	Default 🛛 🗸 🗸	Start
_		V-PERF Mode	Bi-directional 🛛 🗸 🔻	
0	Frame	Bi-directional Mode	Client 🗸 🗸 🗸	
~	<b>.</b>	Compatibility	lperf3	
0	Pattern	Protocol	тср 🔻	
~		Parallel Streams	Manual 🛛 🔽 1	
0	ALIVI/ERR	Server IP	192.168.0.101	
	listory	Server Port	5201	
-		MTU Search	Enabled 🛛 🗸 🔻	
		Round Trip Time Search	Enabled 🛛 🗸 🔻	
QSF RS-	FP28: 4X25G FEC : OFF	Page	1 of 3 🕒	

Local End Tester - Client - Bi-Directional Setup

LEDs	V-P		
	Setup	Results	Start
😑 Signal	Profile	Default 🛛 🔻	Start
0.5	V-PERF Mode	Bi-directional 🛛 🔻 🔻	
🔘 Frame	Bi-directional Mode	Server 🛛 🔻	
O Dottorn	Compatibility	lperf3 🛛 🔻	
	Server Port	5201	
ALM/ERR			
History			
QSFP28: 4X25G RS-FEC : OFF			

**Remote End Tester - Server - Bi-Directional Setup** 

Press Start test at the Near End. The entire test flow is automated. Results will show up as the tests run - a total of 4 sessions.

- Current test progress is shown in Event.
- Summary (Page 1) provides information on the current session running and the RFC-6349 key performance indicators. Tap on Client Results to verify the metrics.
- Final results of the completed test will show under Status.



**Bi-Directional - Server Results - Summary** 

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# 8.0 Fibre Channel

## **Fibre Channel Applications**

## Introduction

Enterprises worldwide rely on complex IT infrastructures to store and maintain critical data and applications. Storage Area Networks (SANs) have evolved to improve availability, resiliency, performance, modularity and geographical distribution of data storage systems and Fiber Channel is an important technology for linking SANs together.

#### Fiber Channel over IP

Often, IP-centric networks are used to connect SAN islands over Local Area Networks (LAN), Metropolitan Area Networks (MAN), or Wide Area Networks (WAN). An operational IP backbone (Layer 2 or Layer 3 topology) capable of delivering the required bandwidth for Fiber Channel applications is an absolute prerequisite. The test set equipped with Ethernet and Fiber Channel features is able to verify FCIP connections in a variety of network configurations.



## Fiber Channel over SDH/SONET

Service providers have made huge investments in SDH/SONET infrastructure over many decades, hence storage over SONET/SDH networks are considered an essential part of any operator's SAN extension solution. DWDM networks are perfect for transporting high-density, high-bandwidth SAN applications over short distances while SDH/SONET/OTN networks are often used for longer distance applications. The test set is equipped with a strong set of features needed to verify the strategic components and network interconnects.

## **Key Test Applications**

**Transport layer** - Most customers or providers transporting Fibre Channel are not necessarily trained or concerned with testing the higher protocol layers -- instead the transport groups tasked with transporting this data across a point-to-point or ring type DWDM network are more likely to ask: Did data arrive error free or were any bit errors encountered? Was the CRC corrupted or were any code violations experienced? Testing the transport layer is crucial and normally includes the FC-0 Layer, FC-1 Layer, and parts of the FC-2 Layer where:

- FC-0 addresses the physical layer: the optical fiber, connectors, and associated optical signal parameters.
- FC-1 addresses the transmission protocol encoding/decoding, and special characters used for protocol management.
- FC-2 addresses the signaling protocol layer, which comprises the framing protocol and the flow control process.

The Fibre Channel option addresses all the transport layers by measuring the optical power level and supporting the generation/analysis of bit errors, order sets, frame delimiters, frame transmission, and the generation of primitive sequences. User defined bytes, fixed test patterns or industry-standard PRBS patterns can be selected and inserted into the payload field depending on the test layer. Bit error, CRC error and Code violation insertion are useful features to verify Mux/Demux equipment for error monitoring and detection.



**Internal SD Card Format** 

**Buffer-to-Buffer Credit Estimation** - To avoid loss of frames during transmission, the Fibre Channel protocol uses a buffer-to-buffer flow control mechanism between link partners. During the login process, the remote node informs the local nodes as to the number of receive buffers it has available. For each frame received, the remote port returns a R\_RDY frame to indicate that one of the receive buffers is now free - the local port in turn increments its available credit counter by one for each R\_RDY acknowledgement frame it receives. However, as the distance between nodes or link partners increases, so does the time it takes for the transmitting node to receive the R\_RDY frame because of signal propagation delay. The standard practice for a 1Gbps Fibre Channel link is to allow 1 buffer credit for each 2km of distance.

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## 8.1 Setup



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## 8.1.1 Test Applications

After selecting the Fiber Channel test mode, the Fiber Channel main menu appears.

If using the UX400-Combo module, refer to the UX400 Platform manual for more details on how to assign a test module. Depending on the test platform and installed module, availability of test applications and features may vary.



**Fiber Channel Main Menu** 

The Fiber Channel Main Menu provides shortcut application buttons for FC BERT, FC RFC 2544, FC Throughput, FC Loopback, and IP testing.

Some test capabilities or test rates may be specific to the product configuration or may require the purchase of a software option in order to be displayed or be enabled.

To configure ports and measurements, press **Setup** on the main menu.

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#### 8.1.2 Port Configuration

LEDs	Port	Measurement	
	Speed	2G 🗸 🗸	
😑 Signal	Link Protocol(PSP)	Enable 🛛 🔻	
	Topology	P-to-P 🛛 🔻	
Frame	Link Management	Enable 🛛 🔻	
Pattern	B-to-B(TX)	1000	
Ŭ			
ALM/ERR			
History			LASER On

**Fiber Channel - Port Setup** 

On the **Port** tab, select from the following options to configure your FC port:

- Speed: Selectable test rates via drop-down menu:
  - 1G (1.0625 Gbps)
  - 2G (2.125 Gbps)
  - 4G (4.25 Gbps)
  - 8G (8.50 Gbps)
  - 10G (10.52 Gbps)
  - 16G (14.025 Gbps)
  - 32G (28.05 Gbps)
- Link Protocol: Enables or Disables the PSP
  - Enabling the Primitive Sequence Protocol (PSP) allows link management
  - o Disabling the Primitive Sequence Protocol (PSP) forces the port into an Active state with no link management
    - PSP is an Ordered Set transmitted repeatedly which is used to establish and maintain a link.
    - PSP also when this setting is enabled
    - When a Primitive Sequence is received and recognized, a corresponding Primitive Sequence or Idle is transmitted in response. Recognition of a Primitive Sequence requires consecutive detection of 3 instances of the same Ordered

Set.

- The Primitive Sequences supported by the standard are:
  - Offline (OLS)
  - Not Operational (NOS)
  - Link Reset (LR)
  - Link Reset Response (LRR)
- Topology: Point-to-Point (P-to-P) mode is supported.
  - In Point-to-Point mode, only two ports are used, connected by a fiber optic link. The transmitter of each port is connected directly to the receiver of the opposite port. There is no ambiguity in addressing, and there is no question of availability.
  - Note: Fibre Channel defines three topologies: 1) Point-to-Point, 2) Arbitrated Loop, and 3) Fabric; however, Point-to-Point topology is the least complex.
- Link Management: Enable or Disable
  - Only available when PSP is enabled
  - Initializes the Fibre Channel link and manages various states, including link failure, loss of synchronization, loss of signal, or protocol violations
- B-to-B (Tx): Buffer to Buffer: Valid settings are in the range from 1 to 65535.
  - Number of local port frame buffers are available to receive frames from another port
  - Determines how many frames can be sent before receiving R\_RDY acknowledgements.
  - o "Credits", or the number of frames, are negotiated between the n\_ports and f\_ports at the time of login
  - Both ports on the link exchange values of how many frames they are willing to receive at a time from the other port. This value becomes the other port's BB\_Credit value and remains constant as long as the ports are logged in.
  - Each port also keeps track of BB\_Credit\_CNT.
    - Transmitter: For each frame transmitted, BB\_Credit\_CNT is incremented by 1.
    - **Receiver**: The value is decremented by 1 for each R\_RDY Primitive Signal received from the other port.

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LEDs	Port	Measurement	
	Mode	Manual 🛛 🗸 🔻	
😑 Signal	Event Log	Circular 🛛 🔻 🔻	
0.5	TX Start	Coupled 🛛 🔻	
Frame	Results Auto Save	OFF 🛛 🔻	
Pattern			
ALM/ERR			
History			LASER On

Fiber Channel - Measurement Setup

On the **Measurement** tab, select from the following options to setup your FC measurements:

- Mode: Manual or Timed
  - Manual: Measurement is started (by the User) by pressing the Start button and ended when pressing the Stop button.
  - Timed: Measurement duration can be programmed in seconds, minutes, hours or days.
- Event Log: Circular or Blocked. When set to Circular, log events may be overwritten with the latest events if the circular buffer fills up. The oldest event will be deleted so that the new event can be added. When set to Blocked, the log will not be overwritten when buffer is full and the latest events will not be logged.
- TX Start: Separated or Coupled. Configures how the measurements are started when in BERT and Multiple Streams test modes.
  - **Separate:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on -- the user must start the transmitter manually.
  - **Coupled:** Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.

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## 8.2 BERT/Throughput

## 8.2.1 Overview

The test set complies with ANSI NCITS FC-FS recommendations and has the ability to test 1,2,4,8,10,16 and 32 Gigabit Fibre Channel.

- 1/2/4/8G Fiber Channel: The unit verifies the 8B/10B PCS Layer with a basic primitive set at FC-1 or FC-2 lower layers.
  - 10/16/32G Fiber Channel: The unit verifies the 64B/66B PCS Layer with a basic primitive set at FC-1 or FC-2 lower layers.
    - FC-1 Layer addresses the transmission protocol encoding, decoding, and special characters used for protocol management
    - FC-2 is the signaling protocol layer, which is made up of a framing protocol and a flow control process

The unit supports the generation and monitoring of: bit errors, order sets, frame delimiters, frame transmission, and generation of primitive sequences. BERT diagnostics perform a bit-by-bit comparison to find bit errors in the received data pattern. Error Count and Error Rate for the latest sample are displayed and maintained, as well as totals for all samples from the test start.

The user can use a default frame header or define a custom frame header - the unit takes care of the frame/header setup, creates the user defined SOF and EOF delimiters and calculates the CRC error checking bytes, which are placed within the frame. User defined bytes, fixed patterns or industry standard PRBS patterns can be selected from drop-down menus and radio buttons and inserted into the payload field.

Testing is supplemented with the capability to perform Bit and CRC error insertion. These tests allow users to test their own Mux demux equipment for error monitoring and detection. The test set displays the BERT test results continuously and any anomaly is recorded in an event log which is date and time stamped. All results can be saved and exported into ReVeal MX for analysis or customer test report generation.

## **Fiber Channel Layers**

The Open Systems Interconnect (OSI) model breaks communications into seven layers namely, Physical, Data Link, Network, Transport, Session, Presentation, and Application. Fibre Channel does not follow the ISO model - instead, the protocol has been broken into five layers: FC-0, FC-1, FC-2, FC-3, and FC-4.



**OSI layers versus FC layers** 

- **FC-0** defines the physical portions of Fibre Channel, including the media types, connectors, and the electrical and optical characteristics needed to connect ports. This level is in the FC-PH standard.
  - Signaling
  - Media specifications
  - Receiver/Transmitter specifications
- FC-1 defines the transmission protocol, encoding, order of word transmission, and error detection. This level is in the FC-PH standard.
  - 8B/10B character encoding (1/2/4/8G FC) or 64/66B character encoding (10/16/32G)
  - Link maintenance
- FC-2 defines the signaling and framing protocol, including frame layout, frame header content, and rules for use. It also contains

independent protocols such as login. This is the bulk of the FC-PH standard.

- Frame format
- Sequence management
- Exchange management
- Flow Control
- Classes of Service
- Login/Logout
- Topologies
- Segmentation and Reassembly

OSI Model	Fiber Channel	Description
Layer 2: Data link	FC-2	Similar to the MAC functionality – Fiber Channel frames are defined, addressed and CRC are added
Layer 1:	FC-1	Similar to the physical layer of the OSI model – Fiber Channel
Physical	FC-0	adds basic flow control functionality and ordered sets

## Fiber Channel layers and functionality

- FC-3 defines common services that may be available across multiple ports in a node. This level has no standard now.
   Services for multiple ports on one node
- FC-4 defines the mapping between the lower levels of Fibre Channel, and the command sets that use Fibre Channel.
  - Upper Layer Protocol (ULP) mapping
    - Small Computer System Interface (SCSI)
    - Internet Protocol (IP)
    - High Performance Parallel Interface (HIPPI)
    - Asynchronous Transfer Mode Adaption Layer 5 (ATM-AAL5)
    - Intelligent Peripheral Interface 3 (IPI-3) (disk and tape)
    - Single Byte Command Code Sets (SBCCS)

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## 8.2.2 Setup



#### FC-1 BERT - Test Frame Setup

**Profile:** User Defined Profile or Default setting can be used for testing. **Test layer:** FC-1 or FC-2 only. Testing at other layers is not supported.

- FC-1: Information is transmitted using an adaptive code (8B/10B or 64/66B) depending on test rate and the encoding process results in the generation of transmission characters.
  - The two types of Transmission Characters defined are data and special. Certain combinations of Transmission Characters, referred to as Ordered Sets, are designated by this standard to have special meaning.
  - Ordered Sets are used to identify frame boundaries, transmit primitive function requests, and maintain proper link transmission characteristics during periods of inactivity.

SOF	Payload	EOF
(4 bytes)	(0 to 2140 bytes)	(4 bytes)

FC-1 Frame Structure



FC-2 BERT - Header Setup

- FC-2: Only FC-2 frames have a header, so these fields are not available for FC-1 frames.
  - Defines the framing rules and mechanisms for controlling the different service classes. The following building blocks are defined by the standard:
    - Ordered Set
    - Frame
    - Sequence
    - Exchange
    - Protocol



## FC-2 Frame Structure



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## Understanding the Basic Test Channel Frame Structure

The Fibre Channel standard defines a variable frame length consisting of 36 bytes of overhead and up to 2112 bytes of payload for a total maximum size of 2148 bytes.

- SOF and EOF
  - A Start of Frame (SOF) delimiter and End of Frame (EOF) delimiter mark the beginning and end of each Fibre Channel frame
  - Available for both FC-1 and FC-2 frame formats
- Frame Header
  - o Is the first field of the frame content and immediately follows the SOF delimiter and is transmitted on a word boundary

Is used to control link operations and device protocol transfers as well as detect missing or out of order frames

- Available in FC-2 frame format only
- CRC The Cyclic Redundancy Check (CRC)
  - Is a four byte field that follows the Data Field and is used to verify the data integrity of the Frame Header and Data Field.
  - SOF and EOF delimiters are not included in the CRC verification
  - The CRC field is calculated on the Frame Header and Data Field prior to encoding for transmission and after decoding upon reception

## **Frame Delimiters**

A frame delimiter is an **Ordered Set** that immediately precedes or follows the contents of a frame. Separate and distinct delimiters shall identify the start of a frame and the end of a frame and shall be recognized when a single Ordered Set is detected. An Ordered set is described below.

## **Ordered Set**

An Ordered Set is a four-character combination of data and special Transmission Characters. Ordered Sets provide the ability to obtain bit and word synchronization that also establishes word boundary alignment. The three types of Ordered Sets are:

## • Frame Delimiters

- (SOF) Start-of-Frame
- (EOF) End-of-Frame

## • Primitive Signals

A Primitive Signal is an Ordered Set designated to have special meaning. All FC\_Ports shall at a minimum recognize R\_RDY and IDLE Primitive Signals. All Primitive Signals not recognized by the FC\_Port shall be treated as an IDLE.

- Idle: Idle is a Primitive Signal transmitted on the link to indicate that link initialization is complete and to maintain link synchronization
- (R\_RDY) Receiver Ready

## • Primitive Sequence

- (OLS) Off-line
- (NOS) Not Operational
- (LR) Link Reset
- (LRR) Link Reset Response

## Start of Frame (SOF) and End of Frame (EOF) Delimiter setup

The Start-of-Frame (SOF) delimiter is an Ordered Set that immediately precedes the frame content. There are multiple SOF delimiters defined for Sequence control. SOF indicates that a Frame will immediately follow and indicates which class of service the Frame will use.

The value of the SOF field determines the class of service associated with the FC frame. Several Classes of service are specified in Fiber Channel but only Classes 1,2,3 & 4 are described below. Classes 1, 2, and 3 are topology independent, however, Classes 4 and 6 require a Fabric. If the Fabric is not present, the service is provided as a special case of point-to-point. FC\_Ports are not required to support all classes of service.

- Class 1: Dedicated physical connection with delivery confirmation. This class of service has three phases:
  - Setting up the connection
  - Transferring the information
  - Closing down the connection
- Class 2: Frame multiplexed service with delivery confirmation. No dedicated connection between the two communication parties is established. This class of service allows a stream of frames to be sent to different destinations quickly. Class 2 also requires frame confirmations by the recipient.
- Class 3: Is sometimes called "datagram". It is "connectionless" service with the Fabric multiplexing frames at frame boundaries, if a Fabric is present. If a Fabric is not present, this service becomes a special case of point-to point.
- Class 4: Is a service that uses a virtual circuit established within a Fabric and between two communicating Nx\_Ports to transmit frames to each other using a fabric-managed fractional bandwidth allocation protocol. This service requires a Fabric.

The following SOF Service Class selections are available:

• SOF Initiate (SOFix)

A Sequence shall be initiated and identified by using SOFi1, SOFi2, SOFi3, or SOFi4 in the first frame. SOFix is used to represent these four SOF delimiters.

• **SOF\_i3:** Contains a code value of 0x2E indicating SOF Initiate Class 3. A SOFi3 should be used on the first frame of a Sequence for Class 3 Service.

## SOF Normal (SOFnx)

The following delimiters identify the start of all frames other than the first frame of a Sequence based on class of service. SOFnx is used to indicate SOFn1, SOFn2, SOFn3 and SOFn4.

• **SOF\_n3:** Contains a code value of 0x36 indicating SOF Normal Class 3. The SOFn3 shall be used for all frames except the first frame of a Sequence for Class 3 Service.

## • SOF Fabric (SOFf)

 SOF\_f: Contains a code value of 0x28 indicating SOF Fabric. If an Nx\_Port or Fx\_Port receives a Class F frame, indicated by an SOFf delimiter, it shall be discarded by the Nx\_Port or Fx\_Port. The receiving Nx\_Port or Fx\_Port may send an R\_RDY

LEDs	Payload ● SOF_i ● SOF_r	EOF 3 13	SOF	Header	Start
😑 Signal	o SOF_f	,			
• Frame					
Pattern     Alm/Err					
History					LASER On
Offline					

FC-2 BERT - SOF Setup

## End of Frame (EOF)

The End-of-Frame (EOF) delimiter is an Ordered Set that immediately follows the CRC and is transmitted on a word boundary. The EOF delimiter designates the end of the frame content and is followed by Idles. There are three categories of EOF delimiters found in the Fiber Channel standard, however the test set only supports the first category that indicates that the frame is valid from the sender's perspective and potentially valid from the receiver's perspective.

The following selections are available:

- **EOF\_t:** Contains a code value of 0x42 indicating EOF Terminate. The EOFt indicates that the Sequence associated with this SEQ\_ID is complete. EOFt is used to properly close a Sequence without error.
- EOF\_n: Contains a code value of 0x41 indicating EOF Normal. The EOFn identifies the end of frame when one of the other EOF delimiters indicating valid frame content is not required.

LEDs	Payload	EOF	SOF	Header	Start
	⊖ EOF_t				
😑 Signal	● EOF_r	1			
🔵 Frame					
Pattern					
🔵 Alm/Err					
History					LASER On
Offline					

FC-2 BERT - EOF Setup

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#### Payload

The test set implements and observes "Methodologies for Jitter and Signal Quality Specification (MJSQ)". A major goal of MJSQ is to

improve the relationship between measurements on signals and receiver performance in terms of bit errors. The unit transmits a "compliant pattern" which consists of a valid Fiber Channel protocol frame (SOF, payload, CRC, EOF) containing a test pattern as the payload. Different payload selections are available depending on the Fiber Channel layer to be tested. The payload consists of 0 to 2112 bytes, and is sent in 4 byte increments, otherwise it is considered to be a misaligned frame.

## FC-1 Payload (test pattern)

Layer 1 test patterns are formatted using the 8B/10B symbol format and include the PCS layer as part of the BER pattern.

CRPAT, CSPAT, and CJTPAT test patterns according to NCITS-TR-25-1999 and MJSQ, are designed to evaluate frequency fluctuations, transceiver noise and phase jumps caused by jitter and other anomalies. These test patterns are described briefly as follows:

- CSPAT: Compliant Supply Noise Pattern
  - Represents worst case power supply noise
  - **CRPAT:** Compliant Random Pattern
    - Provides broad spectral content and minimal peaking for the measurement of jitter at component or system level
- CJTPAT: Compliant Jitter Test Pattern
  - Jitter Tolerance Pattern that stresses a receiver by exposing it to extreme phase jumps thereby stressing the clock data recovery (CDR) circuitry
  - The pattern alternates between repeating low transition density patterns and repeating high transition density patterns



FC-1 BERT - Payload Setup



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#### FC-2 Payload (test patterns)

Layer 2 "Compliant" test patterns are modified to resemble a true Fiber Channel frame - the pattern's format is similar to a basic frame which includes a Start of Frame Delimiter (SFD), End of Frame Delimiter (EFD), and Cyclic Redundancy Check (CRC).

**Pseudo Random Bit Sequences (PRBS)** are commonly used to test the signal integrity of high-speed links and are defined in ITU-T 0.150 & 0.151 Recommendations – These legacy SONET/SDH/PDH test sequences may appear random but they have specific properties that can be used to measure the quality of a link. PRBS patterns can be normal or can be inverted.

- 2E31-1: 147 483 647-bit pattern used for special measurement tasks, (e.g., delay measurements at higher bit rates)
- 2E23-1: 8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps
- 2E15-1: 32 767 bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736 kbps
- 2E11-1: 2047 bit pattern primarily intended for error and jitter measurements on circuits operating at bit rates of 64 kbps and N x 64 kbps

LEDs	Payload	EOF	SOF	Header	Start
	PRBS	2E31-1			
_	O PRBS	2E23-1			
😑 Signal	O PRBS	2E15-1			
0.5	O PRBS	2E11-1			
Trame	🔿 User [	Defined			
🔵 Pattern	🗖 Inver	t			
Alm/Err					
History					
					LASER OIL
Offline					

FC-2 BERT - Payload Setup

BERT Testing Tips A BERT samples every incoming bit and looks for something that doesn't occur often. This traditional method tunically used in SONET/SDH measurements, can be were take a very long time. For
example, in a 1Gbps Fiber Channel system, errors occur on average once every 1000 s (about 17 Min) for 1x10 <sup>-12</sup> BER, so you would need to detect at least 10 to 100 errors before you can have confidence in your measurement. Bear in mind that for a quick measurement, you need a test pattern that repeats frequently. A PRBS-11 sequence (2047 bits) repeats many times a second at a 1-Gbps rate, however a PRBS-31 pattern, with 2 billion bits, repeats only every 2 s at 1 Gbps.
A general rule of thumb is to choose a PRBS that is closest to the nature of the data you will be passing through your network. Patterns between $2^{11}$ –1 and $2^{31}$ –1 (such as $2^{15}$ –1 and $2^{23}$ –1) offer good gradual steps in difficulty that allow you to see where networks fail, or how much margin you have beyond pass/fail thresholds.
Bit errors can affect the data frames - these frames will be re-transmitted at the request of the upper- layer protocols. If the FC link suffers a lot of bit errors, you may experience a slight performance loss. These bit errors can also affect the Receiver Ready (R_RDY) messages. A R_RDY is never repeated, so the buffer credit is one BB_Credit short until the link is reset.
The Fiber Channel standard allows a 1 x 10E-12 maximum error rate.

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## Header Setup (FC-2 only)

The FC-2 Frame Header is subdivided into the fields as shown in the diagram below.

(	SOF (4 byt	: es)	Frame (24 b)	Header ytes)		Payloa (0 to 2112 l	id bytes)	CRC ( 4 bytes)	EOF (4 bytes)
					·····	***************	*****		
v	Bits Nord	3	1 - 24	23 - 1	6	16 - 08			
	0	R	CTL			D_ID			
	1	CS P	S_CTL / riority			S_ID			
	2		Туре			F_CTL			
	3	s	EQ_ID	DF_C	TL	SEQ			
	4		ox	ID RX_ID					
	5				Para	meter			

**FC-2 Header Format** 

The Frame Header is the first field of the frame content and immediately follows the SOF delimiter. The Frame Header is used to control link operations and device protocol transfers as well as detect missing or out of order frames. The values of each field can be edited depending on network setup and test scenario. A brief description of each parameters is provided below.

LEDs	Payload	EOF	SOF	Header	Start
	R_CTL	00	D_ID	00-00-00	
	CS_CTL	00	S_ID	00-00-00	
😑 Signal	Туре	00	F_CTL	00-00-00	
Erama	SEQ_ID	00	DF_CL	00	
Frame	SEQ_CN	00-00			
🔵 Pattern	OX_ID	00-00	RX_ID	00-00	
-	Parameter	00-00-00-00			
🔘 Alm/Err					
History					LASER On
Offline					



## • Routing Control (R\_CTL):

- The R\_CTL field is a one-byte field in Word 0 Bits 31-24 that contains routing bits and information bits to categorize the frame function.
- When used in combination with the TYPE field (Word 2, bits 31-24), it provides an FC\_Port with assistance in frame routing, data routing, or addressing.
- The R\_CTL field is further subdivided into the ROUTING field (bits 31-28) and the INFORMATION field (bits 27-24).

## • D\_ID Address Identifier:

- Destination Identifier is a three-byte field (Word 0, Bits 23-0) that contains the address identifier of the destination Nx\_Port.
- Each Nx\_Port has a native N\_Port\_ID that is unique within the address domain of a Fabric. It may also represent hunt groups, domain controllers, and other servers.

## • Class Specific Control (CS\_CTL)/Priority:

- When bit 17 of F\_CTL is set to zero, Word 1, bits 31-24 of the Frame\_Header is defined as the CS\_CTL field.
- Contains management information for the class of service identified by the SOF. The meaning of the CS\_CTL field is dependent on the class of service.
- When supported by FC\_Ports, the Priority field shall be used to resolve resource contention or to determine the order to deliver frames. The definition and use of the Priority field is class dependent.

## • S\_ID Address Identifier:

• The S\_ID is a three-byte field (Word 1, Bits 23-0) that contains the address identifier of the source Nx\_Port.

## • Type (Data Structure Type):

• The data structure type (TYPE) is a one-byte field (Word 2, Bits 31-24) that identifies the protocol of the frame content for Data frames.

## • Frame Control (F\_CTL):

 The Frame Control (F\_CTL) field (Word 2, Bits 23-0) is a three-byte field that contains control information relating to the frame content such as exchange, retransmission, or sequence control. It is also used to identify the function of the CS\_CTL/P field.

#### • Sequence Identifier (SEQ\_ID):

- The SEQ\_ID is a one-byte field (Word 3, Bits 31-24) assigned by the Sequence Initiator that is unique for a specific D\_ID and S\_ID pair while the Sequence is open.
- Both the Sequence Initiator and the Sequence Recipient track the status of frames within the Sequence using fields within the Sequence\_Qualifier.

#### • Data Field Control (DF\_CTL):

- Data Field Control (DF\_CTL) is a one-byte field (Word 3, Bits 23-16) that specifies the presence of optional headers at the beginning of the Data\_Field for Device\_Data or Video\_Data frames.
- DF\_CTL bits are not meaningful on Link\_Control or Basic Link Service frames.

#### • Sequence count (SEQ\_CNT):

• The sequence count (SEQ\_CNT) is a two-byte field (Word 3, Bits 15-0) that indicates the sequential order of Data frame transmission within a single Sequence or multiple consecutive Sequences for the same Exchange.

#### • Originator Exchange\_ID (OX\_ID):

- The Originator Exchange\_ID is a two-byte field (Word 4, Bits 31-16) that identifies the Exchange\_ID assigned by the Originator of the Exchange.
- Each Exchange is assigned an identifier unique to the Originator or Originator Responder pair.

#### • Responder Exchange\_ID (RX\_ID):

 The Responder Exchange\_ID is a two byte field (Word 4, Bits 15-0) assigned by the Responder that provides a unique, locally meaningful identifier at the Responder for an Exchange established by an Originator and identified by an OX ID.

#### • Parameter:

- The Parameter field (Word 5, Bits 31-0) has meanings based on frame type.
- For Link Control frames, the Parameter field is used to carry information specific to the individual Link Control frame.
- For Data frames with the relative offset present bit set to 1, the Parameter field specifies relative offset, a four-byte field that contains the relative displacement of the first byte of the Payload of the frame from the base address as specified by the ULP.

For detailed information, please visit <u>http://www.incits.org/</u> and download the Fiber Channel FRAMING AND SIGNALING-2 (FC-FS-2) standard.

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#### 8.2.3 Traffic Generation and Error Injection

#### Traffic Setup

- Traffic Flow: Select from Constant, Ramp, or Burst traffic flow available selections depend on FC-1 or FC-2
  - Constant: Continuous traffic (no traffic shaping)
  - Burst: Two burst bandwidths are configured with variable burst time in seconds
  - Ramp: Start and stop bandwidths are configured along with the bandwidth step size and duration
- Frame Size: Set the frame size in bytes.
  - Available in FC-2 mode only
  - Valid settings are 56 bytes to 2148 bytes.
  - The frame length includes the SOF and EOF overhead bytes.
- Constant Bandwidth: Configure the transmit rate or bandwidth in %
  - Valid settings are 1% to 100% in 0.01% increments

LEDs	Setup			Results	Start
	Header	Tra	ffic	Error Inj.	
🖨 Signal	Traffic Flow		Constant	▼	
•••••	Frame Size		2000		
🔘 Frame	Constant Bandwidth		100.000		
Pattern					
🔵 Alm/Err					
History					LASER On
Offline					

FC-BERT/FC-Throughput Traffic Setup

#### Go back to top Go back to TOC

#### Error Injection Setup

Error injection can be performed during a test. The type of errors and error injection rate or flow are configured in the Error Injection tab.

- Error type: Select from Bit and CRC.
- Injection Flow: Determines how the selected errors will be injected. The user can select a single error injection, a specific count, or error rate.
- Count: When Count is selected, configure the error count via the numeric pop-up keypad.

LEDs	Setup			Results	Start
	Header	Tra	ffic	Error Inj.	
A Signal	Error Type		CRC	▼	
0.9	Injection Flow		Single	▼	
🔵 Frame					
🔵 Pattern					
🔵 Alm/Err					
History					LASER On
Offline					

FC-BERT/FC-Throughput Error Injection Setup

Once the test is running, error injection can be enabled by selecting the **Error Injection** button from the action drop-down menu at the top of the screen. Press the **Error Inject** button to start injecting errors.

LEDs	Setup		Res	Start	
	Header	Traffic	Error Inj.	General	
😑 Signal	RTD Measuremen	t	Disable	▼	
Frame	SDT Measuremen	t Trigger(>us)	10000		
•	SDT Violation Thr	eshold(us)	50000		
O Pattern					
					LASER Off
History					

## General tab (Throughput only)

- RTD Measurement: Enable or Disable Round Trip Delay Measurement
- SDT Measurement Trigger (>µs): Any inter-frame gap that is equivalent or greater than the configured threshold will trigger the SDT measurement. This is useful if a known threshold is expected from a given network under test. For example, if the known switchover time is 50ms, the trigger can be set to a value slightly below 50ms to assure that the SDT is measured.
- **SDT Violation Threshold (µs)**: Triggers an SDT Violation event in the event log. This is helpful for historical purposes during any given test. If the measured SDT is equivalent or greater than the configured threshold an SDT Violation event is counted.

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#### 8.2.4 Starting Measurements

- Start button: Click to start the measurement.
- Laser button: Can be turned On or Off to make adjustments to the fiber patch cord, etc.
- **TX Start** button: Activate the Transmitter to initiate the BER measurement.

LEDs		Setup			Res	Start		
	Traffic	Delay	Ra	tes	Signal		FEC	
Signal	Summary	Erro	rs	A	arms		Events	
ŬŬ	ST:2020-12-22 01:06:01			ET:00:00:08				
😑 Frame		ТΧ			RX			
Pattern	Line Rate (bps	i) 28050.000	28050.000M			0M		
<b>U</b> r accorn	Framed Rate (	bps 0.000M	0.000M		0.000M			
🔵 Alm/Err	Data Rate (bps	s) 0.000M	.000M 0.000		0.000M	0.000M		
	Utilization (%)	0.000%		0.000%				
History	# of Bytes	0		0				
	BB Credits Us	ed O						LASER Off
Active								

FC-1/2 BERT - Prior to Starting

#### Go back to top Go back to TOC

#### 8.2.5 Results

#### Summary

- Line Rate: Indicates the transmitted and received bit rate
  - 1.0625 Gbps, 2.125 Gbps, 4.25 Gbps, 8.50Gbps, 10.52Gbps, 14.025Gbps, 28.05Gbps
- Framed Rate: Total number of frames including overhead of any type per second (Mbytes)
- Data rate: Total count of frames with payload data per second (Mbytes)
- Utilization: Bandwidth utilization in %
- # of Bytes: Number of bytes transmitted versus bytes received.
- **BB Credits Used:** Number of Buffer Credits used.

## Summary (Throughput only)

- Total Frames: Total number of frames transmitted versus frames received
- Bad Frames: Number of frames transmitted but not received.
| LEDs      | Setup           |               |    |             | Res                   | Stop   |           |
|-----------|-----------------|---------------|----|-------------|-----------------------|--------|-----------|
|           | Traffic         | Delay         | Ra | tes         | Signal                | FEC    |           |
| O Signal  | Summary         | Erro          | rs | A           | larms                 | Events | Restart   |
| 0.0       | ST:2020-12-22   | 01:07:49      |    | ET:00:00:17 |                       |        | TX Stop   |
| 😑 Frame   |                 | ТΧ            |    |             | RX                    |        |           |
| O Pottorn | Line Rate (bps) | ) 28050.0001  | М  |             | 28050.000             | )M     | Err Inj.  |
| Oractern  | Framed Rate (b  | ops 26886.738 | М  |             | 26886.754             | IM     |           |
| 🔘 Alm/Err | Data Rate (bps  | ) 26730.115   | М  |             | 26730.13 <sup>,</sup> |        |           |
|           | Utilization (%) | 100.000%      |    | 100.000%    |                       |        |           |
| History   | # of Bytes      | 578906679     | 60 | 57890830700 |                       |        |           |
|           | BB Credits Use  | ed 4          |    |             |                       |        | LASER Off |
|           |                 |               |    |             |                       |        |           |
|           |                 |               |    |             |                       |        |           |
| Active    |                 |               |    |             |                       |        |           |
|           |                 |               |    |             |                       |        |           |

# FC - BERT - Summary

LEDs	Setup			Results			Stop
	Traffic	Delay	Rates		Signal	FEC	
Signal	Summary	Errors	Alaı	ms	SDT	Events	Restart
	ST:2020-12-22	01:09:17		ET:00:0	0:12	TX Stop	
😑 Frame		тх			RX		
O Dettern	Line Rate (bps	) 28050.000	Л		28050.000M		Err Inj.
Pattern	Framed Rate (	bps <mark>26878.738</mark> 1	Л		26878.734M		
🔘 Alm/Err	Data Rate (bps	s) 26396.848N	Л		26396.844M		
	Utilization (%)	100.000%			100.000%		
History	Total Frames	20408985			20409070		
	Bad Frames	0			0		
	BB Credits Us	ed 4					
Active							

FC - Throughput - Summary

# Go back to top Go back to TOC

#### Errors

Current and Total values for:

- Bits: Number of bits received
- BER: Bit error ratio based on PRBS received or ratio of payload bit errors to total received payload bits
- Symbol: Symbol error or Code Violation is a bit error or disparity error occurring in a primitive sequence or Ordered Set
- FCS/CRC: Number of frames with either a bad or missing CRC or Frame Check Sequence
- Oversize: Number of Oversize frames received (> 2112 bytes)
- Undersize: Number of Undersize frames received (< 28 bytes)

# Errors (Throughput only)

- Frame Loss: Number of frames lost
- Frame Loss (%): Percentage of frames lost
- OOS: Number of out-of-sequence frames received

LEDs	Setup			Res	Stop	
	Traffic	Delay	Rates		Signal	
🙆 Signal	Summary	Errors	Alaı	rms	Events	Restart
		Current		Total		TX Stop
😑 Frame	Bits	0		0		
O Dottorn	BER	0.000000E+00		0.000000E+00		Err Inj.
Pattern	Symbol	0		0		
🔵 Alm/Err	FCS/CRC	0	0			
	Oversize	0	0			
History	Undersize	0	0			
Active-2G						LASER Off



LEDs	Setup			Results			Stop
	Events	Traffic	Delay		Rates	Signal	
Signal	Summary	Error	s	AI	arms	SDT	Restart
0		Current			Total		TX Stop
😑 Frame	Bits	0			0		
O Battorn	BER	0.000000E-	+00		0.000000E+00		Err Inj.
Pattern	Symbol	0			0		
🔵 Alm/Err	FCS/CRC	0			0		
	Frame Loss	0		0			
History	Frame Loss %	0.000%			0.000%		
	oos	0			0		LASER Off
	Oversize	0			0		
	Undersize	0			0		
Active-2G							

Throughput - Errors (Page 1)

#### Alarms

Current and Total values for:

- LOS: Number of times the Link has transitioned to a Loss of Signal state in the measurement interval. Generally loss of optical signal.
- LOSync: Number of times the Link has transitioned to a Loss of Sync state in the measurement period
- Pattern Loss: Number of times test pattern or test sequence was lost
- Service Disruption
  - Current: Current disruption in ms
  - Total: Total measurement period
  - Last: Last disruption measurement time
  - Min/Max: Minimum and Maximum disruption time
  - No. of Occurrences: A count of the disruption events over the measurement period

LEDs	Setup			Resul	ts	Stop	
	Traffic	Delay	Rates	Signal	FEC		
🕒 Signal	Summary	Errors	Alarms	SDT	Events	Restart	
ŬŬ		Current		Total	TX Stop		
😑 Frame	LOS (ms)	0		0			
O Dettern	LOSync	0		0		Err Inj.	
Pattern	Pattern Loss 0			0	0		
🔵 Alm/Err	Service Disrup	otion					
	Current		0ms	i			
History	Total		0ms	i			
	Last		0ms	-			
	Min/Max	0ms		0ms			
	No. of Occurrences 0						
Active							

FC-BERT/FC-Throughput - Alarms

# Service Disruption Test (SDT) (Throughput only)

- Total: Total cumulative service disruption for the duration of the test.
- Last: Last SDT measured during the test.
- Min/Max: Minimum and maximum SDT measured during the test.
- No. of Occurrences: Number of service disruption events (SDTs).
- No. of SDT Violations: Number of instances the SDT threshold was met or exceeded.

LEDs	Setup				Resu	lts	Stop
	Events	Traffic	De	lay	Rates	Signal	
Signal	Summary	Erro	rs	A	arms	SDT	Restart
<b>°</b>	Service Disrup	tion					TX Stop
😑 Frame	Total			0.00us			
O Pattern	Last	Last				Err Inj.	
0	Min/Max	0.00us		0.00us			
🔵 Alm/Err	No. of Occurrences			0			
	No. of SDT Vio	lations		0			
History							
							LASER Off
Active-2G			SDT	Reset	)		

FC-Throughput Results - SDT

## Go back to top Go back to TOC

#### Events

Time stamped event table:

- Time: Indicates when the test was started, an anomaly occurred or a test was stopped
- Event/Event Type: Indicates type of anomaly
- # of Events: Indicates the number of times the event occurred
- Test: Indicates the test mode

LEDs	Se	tup	Res	Results		
	Traffic	Delay	Rates	Signal		
🔵 Signal	Summary	Errors	Alarms	Events	Restart	
	Time	Event Type	# of Events	Test	TX Stop	
C Frame	2021-01-05 08:39:44	Test Started		BERT	Err Inj.	
O Pattern	2021-01-05 08:39:55		1	BERT		
	2021-01-05 08:40:00		1	BERT		
Active-2G					LASER Off	



LEDs	Se	etup	Res	Results			
	Summary	Errors	Alarms	SDT			
🙆 Signal	Events	Traffic D	elay Rates	Signal	Restart		
	Time	Event Type	# of Events	Test	TX Stop		
⊖ Frame	2021-01-05 08:42:43	Test Started		Per Stream	Err Inj.		
O Pattern	2021-01-05 08:42:54	SDT Violation	1598us	Per Stream			
History Active-2G					LASER OFF		

**Throughput - Events** 

# **Traffic Distribution Overview**

Graphical representation of:

- Frame type: Test frames in BER mode
- Traffic type: Class of service set by the SOF delimiter
- Frame size:
  - FC-1 mode the frame size is determined by the test sequence being used
  - FC-2 mode the frame size corresponds to the frame size configured in the traffic menu



FC-BERT/FC-Throughput - Traffic Summary

#### **Traffic Distribution Details - Frames**

- RX (Received) Frames
  - Total: Total number of frames received
  - Test: Number of test frames received
  - Non-Test: Number of non-test frames received
- TX (Transmitted) Frames
  - Total: Number of test frames transmitted
- Flow Control: Flow control is the FC-2 control process to pace the flow of frames between Nx\_Ports, an Nx\_Port and the Fabric and within the Fabric to prevent overrun at the receiver.
  - Flow control is managed between Nx\_Ports (end-to-end) and between FC\_Ports (buffer-to-buffer). Flow control
  - management has variations dependent upon the service class, however Class 3 uses only buffer-to-buffer flow control.
- **RR-RDY:** For Class 3 frames transmitted and received, a R\_RDY is issued when a receive buffer is available.

Memory or "buffers" to temporarily store frames as they arrive and until they are assembled in sequence, and delivered to the upper layer protocol. Buffer Credits are the number of frames a port can store. To track the number of frames transmitted for which R RDY responses are outstanding, the transmitting FC Port uses the BB Credit CNT.

- BB Credits Used: The number of unacknowledged or outstanding frames awaiting R\_RDY responses from the directly attached FC Port.
- BB Credits Available: The number of frames transmitted and received R\_RDY responses from the directly attached FC\_Port.

LEDs	Frames	Traffic Type	Frame Size	Stop
	RX Frames	#	%	
	Total	15502668	100	Restart
😑 Signal	Test	15502668	100.000000	
○ Eromo	Non-Test	0	0.000000	TX Stop
OFfame	TX Frames	#		
😑 Pattern	Total	15502668		Err inj.
	Flow Control	тх	RX	
🔘 Alm/Err	RR_RDY	15502668	15502666	
	BB Credits Used	3		
History	BB Credits Availa	997		
				LASER Off
Active-2G				

FC-BERT/FC-Throughput - Frame Distribution

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#### **Traffic Distribution - Traffic Type**

Fibre Channel supports three classes of services, and a fourth which is a combination of classes 1 and 2.

Similar to ATM, different classes allow Fibre Channel to support a variety of communication needs.

- Class 1: Provides a circuit-emulation service for time-sensitive applications such as video teleconferencing.
  - Designed for dedicated, non-bursty links between supercomputers. Class 1 traffic is circuit-switched.
- Class 2: Provides guaranteed delivery for connectionless traffic.
  - Class 2 traffic is switched on each frame rather than on a connection. An acknowledgment from the destination provides an end-to-end guarantee of delivery.
- **Class 3:** Offers a best-effort connectionless service.
  - Class 3 is similar to Class 2, except that no guarantee is given for delivery.

LEDs	Frames	Traffic Type	Frame Size	Stop
	Distribution	#	%	
	Class 1	0	0	Restart
🚫 Signal	Class 2	0	0	
○ Erame	Class 3	19372009	100	TX Stop
Orianie	Class F	0	0	
🔵 Pattern				
🖲 Alm/Err				
History				
				LASER Off
Active-2G				

FC-BERT/FC-Throughput - Traffic Type Distribution

# Frame Size Distribution

Indicates the number and percentage of different frame sizes received during the test period.

LEDs	Frames		Traffic Type		Frame Size	Stop
	Distribution	#		%		
	=28B	0		0		Restart
😑 Signal	28 - 64B	0		0		
O Erame	68 - 124B	0		0		TX Stop
Urraile	128 - 252B	0		0		Errini
😑 Pattern	256 - 508B	0		0		Err inj.
	512 - 1020B	0		0		
Alm/Err	1024 - 2140B	25019	154	100	)	
	>2140	0		0		
History Active-2G						LASER Off

FC-BERT/FC-Throughput - Frame Size Distribution

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#### Delay

Frame Arrival Delay or Latency is the round-trip delay experienced by a frame as it traverses the fiber link or network. The difference between the transmitted time and received time is the measured delay.

Indicates the Current, Minimum, Maximum, and Average frame arrival delay during the test period.

#### Delay (Throughput only)

Current, Minimum, Maximum, and Average Round-Trip Delay during the test period is also displayed.

LEDs	Set	tup	Res	ults	Stop
	Summary	Errors	Alarms	Events	
🕒 Signal	Traffic	Delay Ra	tes Signal	FEC	Restart
	Frame Arrival		Delay		TX Stop
😑 Frame	Current		0.00us		
O Pattern	Minimum		0.00us	Err Inj.	
	Maximum		0.00us		
🔘 Alm/Err	Average		0.00us		
History					LASER Off

# FC - BERT - Delay

LEDs	Setup		Results		Stop		
	Summary	Erro	rs	A	larms	SDT	
O Signal	Events	Traffic	De	lay	Rates	Signal	Restart
0.13	Frame Arrival		-	Delay		÷	TX Stop
🜔 Frame	Current			0.13us			
O Pattern	Minimum			0.13us			Err Inj.
Oraccenti	Maximum			1.59800005s			
🔵 Alm/Err	Average		0.18us				
	Round Trip			Delay			
History	Current		N/A				
	Minimum		N/A			LASER Off	
	Maximum		N/A				
	Average			N/A			
Active-2G							

FC - Throughput - Delay

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# Frame Rate Summary

Graphical representation of the Frame rates and Data rates.



FC-BERT/FC-Throughput - Frame Rate Summary

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#### Frame Rate Details

Tabular representation of the Transmitted and Received frames and the corresponding Data Rates in Mbps.

LEDs	Rate Details			Stop
	Frames/sec	тх	RX	
	Current	104570	104570	Restart
🜔 Signal	Minimum	0	0	
OFrama	Maximum	104580	104580	TX Stop
Frame	Average	104149	104149	
😑 Pattern	Data Rate (Mb/s)	тх	RX	Err inj.
	Current	1649.696	1649.806	
🔵 Alm/Err	Minimum	0.000	0.000	
	Maximum	1649.854	1649.806	
History	Average	1643.054	1643.054	
Active-2G				LASER Off

FC-BERT/FC-Throughput - Frame Rate Details

#### Signal

# Level (Page 1)

The Signal tab displays the Level and Frequency screen. Page 1 displays the level measurement Loss of Signal (LOS), and the Saturation level for optical signals is shown graphically, including the level measurement in dBm.



FC-BERT/FC-Throughput Signal - Level (Page 1)

# **Optical Information (Page 2)**

Page 2 displays the Optical module XFP information which includes Vendor name, Part number, and Optical Wavelength.

LEDs	Setup		Results		Stop
	Summary	Errors	Alarms	Events	
O Signal	Traffic	Delay	Rates	Signal	Restart
	SFP Optical Module Information			TX Stop	
🔵 Frame 👘	Vendor		FINISAR CORP.		
O Pottorn	Part Number		FTLF1432P3BCV		Err Inj.
Fattern	Wavelength (nm)		1310.00		
🔵 Alm/Err					
History Active-2G					LASER OFF

FC-BERT/FC-Throughput Signal - Optical Information (Page 2)

# 8.3 RFC 2544

The RFC 2544 Ethernet test suite is adapted to Fiber Channel circuits to verify 1Gbps, 2Gbps, 4Gbps, 8Gbps, 10Gbps ,16Gbps and 32Gbps SAN networks. The automated RFC 2544 test routine/analysis ensures repeatable installations:

- Check buffer parameters needed to achieve desired Service Level Agreement (SLA)
- Determine optimum buffer size Capacity versus link speed
- Determine minimum buffer credits for selected throughput for each frame length
- Measuring throughput at various buffer credit sizes to check link quality



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# 8.4 Loopback

The Loopback function can be found on the Fiber Channel Home menu.

LEDs	Setup			Start
	Test Layer	FC-1	<b></b>	
😑 Signal				
<mark>⊖</mark> Frame				
🔵 Pattern				
🔵 Alm/Err				
History			•	ASER Off
Active				

FC-1/2 Manual Loopback Setup

Modes of operation: Manual and Responder (future)

**Mode (FC layer):** FC-1 or FC-2 Layer loopbacks are supported. In FC-2 mode, the destination and source IDs (D\_ID and S\_ID) are swapped including any other relevant Header fields (e.g., OX\_ID, RX\_ID, etc.).

LEDs		Stop	
	Test Layer	FC-1	
😑 Signal			
😑 Frame			
🔵 Pattern			
O Alm/Err			
History			
			LASER Off
Active			

FC-1/2 Manual Loopback Active

To enable the loopback, press **Start** from the drop-down menu. Once the loopback is enabled, a message appears indicating that the loopback is active.

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# 8.5 Packet Capture

The packet capture function can be used to capture packets to Fiber Channel test ports. The packet capture format is compatible with Wireshark and can be viewed on a PC.

The following packet capture options are available in the Capture Mode tab:

- Profile: Drop-down selections are Default, Delete, Save, Save As...
- Mode: Automatic. Packet capture is automatically started when pressing the CAP ON function key.
- Buffer Size: Defines the size of the storage allocated to packet capture.
- Truncate: Captures the whole frame or first number of bytes of that frame.

Tap on the **Filter** tab to select frame header parameters to filter for. Refer to <u>Header Setup (FC-2 only</u>) for a brief description of each parameter.

Press the green Start button to begin packet capture. To store these results packets:

- 1. Press Stop, then press Save as.
- 2. Enter a name for the results file, and then press **Apply** to save the file. The file is saved under the Files folder on the unit in pcap format. The file can be later exported to a PC and analyzed using Wireshark.

LEDs	Se	Start	
	Mode	Filter	
😑 Signal	Packet Capture Profile	Default 🗸 🔻	
O Frame	Mode	Automatic 🛛 🔻 🔻	
<b>U</b> Traine	Buffer Size	512K 🛛 🔻	
Pattern			
- ····			View
ALM/ERR			
History			

#### Capture Mode







**Capture Save** 

# 9.0 Certifications and Declarations



Declaration of Conformity

# What is CE?

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.

Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.

# **RoHS Compliance**

# VeEX QUALITY AND ENVIRONMENTAL POLICY

Our quality and environmental policy is to limit and progressively eliminate the use of hazardous substances and chemicals in the design and manufacture of our products.

VeEX products are classified as Monitoring and Control Instruments under Article 2, Section (1), Category 9 of the WEEE 2002/96/EC Directive.

#### **RoHS and WEEE Position Statement**

The Council of the European Union and the European Parliament adopted Directive 2002/95/EC (January 27, 2003), to Reduce the use of certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment, and Directive 2002/96/EC on Waste Electrical and Electronics Equipment (WEEE), with the purpose of reducing the environmental impact of waste electrical and electronic equipment. Both were later recast by Directives 2011/65/EU and 2012/19/EU respectively. All VeEX products being placed on the EU market conform with these directives.

Additional RoHS substance restrictions for the Monitoring and Control Instruments were adopted by EU Directive 2015/863 (March 31, 2015). These new restrictions will take effect from July 22, 2021. VeEX has established a program to ensure that from July 22, 2021, all its products to be sold and shipped into the EU market will conform with (EU) 2015/863.

VeEX Inc. is committed to comply with RoHS and WEEE Directives to minimize the environmental impact of our products.

For more information about RoHS as it relates to VeEX Inc, go to the VeEX web site at <u>www.veexinc.com/RoHS</u>



**ROHS Statement** 

# 10.0 About VeEX

VeEX Inc., a customer-oriented communications test and measurement company, develops innovative test and monitoring solutions for next generation telecommunication networks and services. With a blend of advanced technologies and vast technical expertise, VeEX products address all stages of network deployment, maintenance, field service turn-up, and integrate service verification features across copper, fiber optics, CATV/DOCSIS, mobile 4G/5G backhaul and fronthaul, next generation transport network, Fibre Channel, carrier & metro Ethernet technologies, WLAN and synchronization.

Visit us online at <u>www.veexinc.com</u> for the latest updates and additional documentation.

VeEX Incorporated 2827 Lakeview Court Fremont, CA 94538 USA Tel: +1 510 651 0500 Fax: +1 510 651 0505

# **Customer Care**

Tel: + 1 510 651 0500 Email: <u>customercare@veexinc.com</u>

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