

**USER MANUAL** 



400G Module for RXT-1200 Platform

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# 1.0 About This User Manual

This user manual is suitable for novice, intermediate, and experienced users and is intended to help you successfully use the features and capabilities of the test platform. It is assumed that you have basic computer experience and skills, and are familiar with IP and telecommunication concepts, terminology, and safety.

Every effort was made to ensure that the information contained in this manual is accurate. However, information is subject to change without notice. We accept no responsibility for any errors or omissions. In case of discrepancy, the web version takes precedence over any printed literature.

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For more technical resources, visit the VeEX Inc. web site at <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 serial number and software version ready. Please go to the Basic Operations section for details on locating the unit serial number in the menus or locate the serial number on the back of the chassis. Please provide this number when contacting VeEX customer service.

#### **Customer Care:**

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Website:www.veexinc.com

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# 2.0 Safety Information

# VEEX INCORPORATED PLEASE OBSERVE ALL SAFETY MARKINGS AND INSTRUCTIONS, 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 platform displays 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 interface (e.g. CFP, CFP2, CFP4, QSFP+, SFP+, SFP, OTDR, LS, VFL) 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.

#### **Electrical Connectors**

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

#### Safe Module Handling

While replacing test modules, all work on the open panel must be performed only by suitably qualified personnel who are familiar with the dangers both to people and to the instrument itself.

- Modules are not hot swappable. The platform must be turned off and unplugged from VAC mains when removing or inserting test modules.
- For safety and EMC (Electromagnetic Compatibility), empty module slots must be properly covered with blank panel covers.
- Prevent foreign objects from entering the TX300s, before, during and after module exchange or re-configuration process. They could create short circuits or damage internal fans.
- Always store test modules by themselves in individual ESD protected packaging (with no loose elements, like screws or tools).

#### **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 battery 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 their plastic container that must 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 must 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

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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 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, or CFPs from the platform.
  - Connecting or disconnecting cables from modules or platform.

# 3.0 Introduction

The RXT-6400 is the first truly portable 400G test set offering native PAM4, QSFP-DD and OSPF support. Equipped to support all common transceiver form-factors, this module is a perfect complement to the RXT Platform, extending its testing range to 400 Gbps and offering a future upgrade path for all-in-one 10M-to-400GE testing. Evaluation, Interop, Installation, verification, commissioning, monitoring, troubleshooting, and maintenance tasks are simplified thanks to a combination of intuitive user interface and powerful test functions. Novice users benefit from the easy-to-use GUI, while experienced users will appreciate an array of advanced layer 1-4 features, such as FEC codeword Error distribution analysis, PAM4 pre-emphasis, skew, I2C/MDIO Read/Write, transceiver check and stress, Lane BERT, Throughput test, IPv4/IPv6 and much more.

### **Platform Highlights**

- Native PAM4 QSFP-DD and OSFP hardware for best-in-class signal integrity (no adapters required)
- 400G Ethernet testing per IEEE 802.3bs specification with KP4 Forward Error Correction (FEC)
- Provides all the necessary features to test QSFP-DD and OSFP transceivers, networking equipment and 400GE links
- Advanced and flexible state-of-the-art FPGA-based design, with native PAM4 transceivers, provides future-proof hardware support for 400GE evolution, emerging standards, test functions, requirements and applications
- Wide range of supported 400GE interfaces, including 400GBASE-SR8, FR8, LR8, DR4, and FR4
- MDIO/I2C registers Read and Write
- Per-lane PAM4 pre-emphasis settings
- KP4 FEC codeword symbol errors distribution and Skew
- Ethernet Throughput performance test
- Hardware supports QSFP56, QSFP28, QSFP+, SFP28, SFP+, SFP, RJ45 (via SFP transceivers) interfaces for lower rate applications
- Battery backup for efficient operation and mobility within large equipment rooms and data centers (no need for constant rebooting)

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# 3.1 Connector Panels & Test Ports





# 4.0 RXT Operations

### 4.1 Basic Operations

For information on Basic Operations, Home menu, Launching Test Applications, and other features specific to the RXT-6400 Host Chassis, refer to the RXT-1200 Platform Manual.

### 4.2 Utilities

Refer to the <u>RXT-1200 Platform Manual</u> for information about all Utilities and Tools available.

#### 4.3 Setup

Accessing Setup: Please see the <u>RXT-1200 Platform Manual</u> Getting Started section to launch Test Applications.

# 5.0 Ethernet

Test mode, test port(s), and network settings are required prior to performing any measurements or applications

## 5.1 Ethernet Setup

### 5.1.1 Test Port Selection

Test mode, test port(s), and network settings are required prior to performing any measurements or applications.

Ethernet test modes are accessed by selecting the Test Application button at the top of the screen **Level**. Tap on a technology group then select a test interface. Depending on interface options purchased, the following selections are possible:

#### Single/dual port combinations present on RXT-6400:

- Single port 400GE (OSFP)
- Single port 400GE (QSFP-DD)
- Single port 100GE (QSFP28)
- Single port 40G, 50G (QSFP+)
- Single port 25GE (SFP28)
- Single port 10GE, 1GE (QSF+)

- Dual port, OTN and other protocols are planned for upcoming software releases, please keep the test set software up to date.

Test Ports		Test Mode Selection
OSFP	Ethernet	400G Ethernet Testing
	Other Functions >	
QSFP-DD		
QSFP28 QSFP+		
SFP56 SFP28 SFP+		
	Release	OK Cancel
192.168.0.92	Remote/CLI	2019-10-29 03:14:25 🛛 💦 😡

### **Test Mode Selection RXT-6400**

After selecting the test interface click OK.

The configuration parameters (header, bandwidth, etc. for each application (on each of the ports) are completely independent from one another. All test feature combinations are allowed and completely independent (Loopback, BERT, Throughput, RFC2544,VSAM) in dual port operation. However, some advanced tools, such as IPTV, VLAN scan, Packet Capture, etc. are available in single port testing mode only. The user interface will provide an error message when a feature is not available in dual port operation.

When the soft LEDs are steady green, this indicates 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).

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#### 5.1.2 Port Setup

Port setup or test interface configurations are accessed via the Setup menu located on the Home page. 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.



#### Ethernet Home Menu

#### 1 GE Fiber Port

- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxCLK, GPS1PPS

	10 GE	Setup	
(C) 1 10GE		<u> 8</u>	
LEDs	Port	Measurement	
	10G port profile	Last configuration 🛛 🔻 🔻	
🔘 Signal	Network Type	LAN 🔻	
	Flow Control	Enable 🛛 🔻	
Frame	Clock Source	Internal 🛛 🗸 🔻	
Pattern	Clock Offset (ppm)	0.0	
Ŭ	Link Fault Response	Disable 🛛 🔻	
ALM/ERR			MX Discover
History			
SFP+: 10G	Арріу	Discard	

### 10 GE Port

- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxCLK, GPS1PPS
- Clock Offset (pmm): 0.0
- Link Fault Response: Enable/Disable

#### 40 GE Setup

	LEDs	Port	Measurement	
		40G port profile	Default 🛛 🔻	
0	Signal	Network Type	LAN 🔻	
_		Flow Control	Enable 🛛 🔻	
0	Frame	Clock Source	Internal 🛛 🗸 🔻	
0	Pattern	Clock Offset (ppm)	0.0	
Ŭ	i accern	Link Fault Response	Disable 🛛 🔻	
0	ALM/ERR			
	History	Арріу	Discard	MX Discover

#### 40 GE Port

- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxFCf, GPS1PPS
- Clock Offset (ppm): 0.0
- Link Fault Response: Enable/Disable



100 GE Port

- 100G port profile: Default
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxFCf, GPS1PPS
- Clock Offset (ppm): 0.0
- Link Fault Response: Disable/Enable

	400 GE	E Setup	
		<u> </u>	
LEDs	Port	Measurement	
	400G port profile	Last configuration	
🔘 Signal	Network Type	LAN 🔻	
<u> </u>	Flow Control	Enable 🛛 🔻	
Frame	Clock Source	Internal 🛛 🗸 🔻	
Pattern	Clock Offset (ppm)	0.0	
Ŭ	Link Fault Response	Disable 🗸 🔻	
ALM/ERR			
History			
OSFP RS-FEC : ON	Apply	Discard	

400 GE Port

- 400G port profile: Default
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxCLK, GPS1PPS
- Clock Offset (ppm): 0.0
- Link Fault Response: Disable/Enable

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#### 5.1.3 Measurement Settings

### 1GE/10GE/100 GE Measurement Setup

1 100GE			😵 🕞
LEDs	Port	Measurement	
	Profile	Default 🛛 🔻	
🜔 Signal	Mode	Manual 🛛 🗸 🔻	
	TX Start	Coupled 🛛 🔻	
🜔 Frame	ToD Synchronization Source	Disable 🛛 🔻	
Pattern	Results Auto Save	OFF 🛛 🔻	
0	Maximum Number of Saved Events	128 🔻	LASER On/Off
ALM/ERR			MX Discover
History			
QSFP28 RS-FEC : OFF			I2C Access
P 192.168.33.170	Remote/CLI	2020-03-30 04:50:25	

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

- Profile: Last configuration, Lock, Delete, Save, Save as..., Default.
- Mode: Manual or timed
  - Manual mode: User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start:** Tx & Rx, or Tx Separate. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - **Tx & Rx:** 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.
  - **Tx 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.
  - **Tx 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.
- ToD Synchronization Source: Disable, GPS 1PPS
- Results Auto Save: Off/On
- Maximum Number of Saved Events: 128/256/512/1024

		<u> </u>	
LEDs	Port	Measurement	
	Profile	Last configuration 🛛 🔍	
🔘 Signal	Mode	Manual 🛛 🗸 🔻	
~ -	TX Start	Coupled 🛛 🔻	
Frame	Results Auto Save	ON 🔻	
Pattern	Results Save Interval (min)	60	
Ŭ,			
ALM/ERR	FEC Bypass Indication	Enable 🗸 🔻	
	FEC Hi SER Detection	Enable 🗸 🔻	
History	Maximum Number of Saved Events	128 🗸 🗸	
	OSFP High Temperatue Power Off	82 C	
	OSFP High Temperatue Warning(C)	65	
OSFP			
RS-FEC : ON			
(P) 192.168.0.92	Remote/CLI	2019-10-29 03:19:16	

#### 400 GE Measurement Setup

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

- Profile: Last configuration, Lock, Delete, Save, Save as..., Default.
- Mode: Manual or timed
  - Manual mode: User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start:** Tx & Rx, or Tx Separate. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - **Tx & Rx:** 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.
  - **Tx 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.
  - **Tx 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.
- Results Auto Save: Off/On
- FEC Bypass Indication: Enable/Disable
- FEC HI SER Detection: Enable/Disable
- Maximum Number of Saved Events: 128/256/512/1024
- High Temperature Power OFF: The SFP will power off at this temperature
- High Temperature Warning: User defines the value at which temperature warnings is displayed

#### 5.1.4 CDR Access

### (100GE Only)



### Enables TX and RX CDR to be turned on

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#### 5.1.5 I2C Access



**I2CAccess** 

## Transceiver I2C (MDIO) Register Read/Write

- Module information, settings, status and control
- Reconfigure the PHY and monitor status

### 5.1.6 Pre-emphasis

							(	Ê								0	3	🛞 🖻
LEDs								I2C	Acce	ss								
	Pag	e	(	)	Upp	e 🔻	Ad	dres	s	128		Rea	d [	Writ	:e	0 x 0	00	
😑 Signal																		
								Re	fres	h								
😑 Frame		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Pattern	128	80	49	01	4E	4F	4C	49	47	48	54	20	20	20	20	20	20	
• I allern	144	20	44	7C	7F	54	2D	44	50	34	43	4E	48	2D	4E	30	30	LASER On/Off
ALM/ERR	160	20	20	20	20	31	41	49	4E	49	42	4A	38	31	34	31	30	
	176	32	32	20	20	20	20	32	30	31	38	30	39	30	35	00	00	
History	192	00	00	00	00	00	00	00	00	A0	30	00	00	00	00	00	00	
	208	00	00	00	00	06	00	00	00	00	00	00	00	00	00	AA	00	
	224	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
QSFP-DD	240	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
RS-FEC : ON																		
P 192.168.33.170	R Re	emote	/CLI										2020	03-30	04:	59:59		<b>No No</b>

#### • Per-lane PAM4 Pre-emphasis Settings

- Advanced user can configure PAM4 signal conditioning circuits for each lane, on the host side, to match a transceiver for the best performance
- Per-lane Pre-taps (1,2,3), Post-tap and Attenuation
- Can be used to verify/stress transceiver tolerances

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### 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, ARPWiz, VoIP, IPTV testing, and 1588v2 (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.

#### IP Setup-IPv4

1 100GE			Ø			<b>(3)</b>	
LEDs	Setup	Status	Pi	ng	Trace Rout	e ARPWiz	
		Network			Por	t	
😑 Signal	Mode			IPv4		▼	Connect
Frame	Profile			Defaul	:	▼	
	IP Address			Static		•	
🔵 Pattern	Local IP			192.168	3.0.101		
-	Subnet			255.25	5.255.0		
ALM/ERR	Gateway and	DNS		Enable		•	
History	Gateway	On	<b>V</b>	192.168	3.0.1		
	DNS	Primary	▼	192.168	3.0.1		
QSFP28 RS-FEC : OFF	Descento //1	Q	Page	1 of 2	D	02 20 0F-04/26	

#### IPv4 or IPv6

- IP Type: PPPoE, IPv4 or IPv6
- Profile: Delete, Save, Save as ..., Default
- 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.

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## 5.2.1.2 Status

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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.

#### IP Setup-IPv4

Setup         Status         Ping         Trace Route         ARPWiz           Local IP         192.168.0.101	
Local IP 192.168.0.101	
Signal Subnet Mask 255.255.0 Disconn	lect
Gateway 192.168.0.1	
DNS IP 192.168.0.1	
Pattern IP: PASS	
Gateway: N/A	
O ALM/ERR DNS: DNS1(N/A)	
History	
QSFP28 RS-FEC : OFF	

- 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.

## 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.

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## 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 TX300S, MTTplus, RXT-1200, or UX400 platform manuals** for more information on this feature including setup and results.

# **5.3 BERT**

#### 5.3.1 BERT Setup

Tap on Advanced Tools (Home Menu) > BERT icon to access BER testing features. (Only Layer 2&3 available)

#### Overview:

BER testing at Layer 1, 2, 3, and 4 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 1: Unframed mode (fiber ports only) or Framed mode
  - Unframed mode: Test traffic consists of a bit stream of the selected test pattern
  - Framed mode: Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field
- Layer 2: Framed BERT (same as Layer 1 Framed)
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame
- Layer 3: Framed BERT (same as Layer 1 & 2 Framed)
  - 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
- Layer 4: Framed BERT (same as Layer 1, 2, & 3 Framed)
  - 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
  - UDP Address: A user defined source and destination port address is added to the frame

	LEDs	Se	tup	Res	Results				
		Header	Traffic	Error Inj.	Alarm Inj.				
	Tools	BERT Profile		Last configuration	י 🔻				
	Utilities	Encapsulation Typ	e .	РВВ-ТЕ	V				
	oundes	Test Layer		Layer 4	▼				
	Files	VLAN		1 tag					
_		MPLS		Off					
		PROTOCOL		UDP	▼				
		PBB		P UDP Dat	a CRC	MX Discover Control			

#### **BERT Setup - Header (Layer 4)**

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#### 5.3.1.1 Header Settings

- **BERT Profile:** Load a previously configured test profile or create a new profile from existing settings. Please see **6.0 Profiles** in the **ReVeal MTX300 manual** for more details on how to create new profiles using ReVeal software.
- Encapsulation Type: None, MPLS-TP, or Provider Backbone Bridge (PBB-TE). 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. Available for 1GE Copper/Fiber and 10GE port. PBB encapsulation is available for all Ethernet tests (Layer 2, 3, and 4) BERT, RFC2544, Throughput, V-SAM.

Tap the **PBB** block to configure the settings. All PBB fields are configurable.

- Backbone MAC Source
- Backbone MAC Destination

- Ethernet Type
- I-SID
- Backbone VLAN ID, Priority, Type

FBD										
	EDs	PBB-TE	MAC	IP	UD	P	DATA	RX Filter	Start	
_		Backbone N	IAC Source	2	00-18-	63-1A-	2B-4E			
😑 Sign	al	Backbone N	IAC Destin	ation	00-18-	63-1A-	2B-3C			
		Ethernet Ty	pe		88-E7					
🖲 Fram	ie	I-SID								
Patte	ern	VLAN ID	1	082 F	Priority	6	Туре	88a8		
O ALM	/ERR								LASER On MX Discover Control	

----

- Test: Select the test layer to perform the BERT
  - Options are Layer 1 Unframed, Layer 1 Framed, Layer 2, Layer 3, and Layer 4
- Frame Type: Select the Ethernet frame type for Layer 2 or Layer 3
  - 802.3 Raw (IEEE 802.3 frame without LLC) Not available when Layer 3 is selected
  - 802.3 LLC (IEEE 802.3 frame with LLC header)
  - 802.3 SNAP (IEEE 802.3 frame with SNAP header)
  - Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)
- 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 and Layer 4
- 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)

VLAN stacking is an option

- MPLS: Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 MPLS tags

MPLS tag configuration is only available when the MPLS option is purchased

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



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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).

A valid IP connection needs to be up to use these functions. Refer to <u>RXT-1200 Platform Manual</u>Chapter 7\_Tools>IP Tools.

- Ethernet Type: For Layer 3 testing, the user can also configure the Ethertype:
  - 0800-IP (Internet Protocol Version 4, IPv4)
  - 0600-Xerox
  - 0801-X.75 (X.75 Internet)
  - 0805-X.25 (X.25 Level 3)
  - 0806-ARP (Address Resolution Protocol [ARP])
  - 8035-RARP (Reverse Address Resolution Protocol [RARP])
  - 8137-IPX (Novell IPX)
  - 814C-SNMP
  - 8847-MPLS unicast
  - 8848-MPLS multicast
  - 86DD (Internet Protocol, Version 6 [IPv6]) Future Release

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

	LED'S	MAC	IP	DATA	RX Filter	Start
		MAC Source		00-18-63-00-0C-40		
$\left  \mathbf{X} \right $	Tools	MAC Destination		00-1E-90-A0-57-3C		
		Ethernet Type		0800-IP	V	
	Utilities					
	Files					
						LASER On/Off
						MX Discover
						Control
		MAC Source	Al	RP /	ARP Gateway	

### BERT Setup - MAC address settings (Layer 3)

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- 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>1</sup>2) 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)
  - Drop Eligible: If enabled, drop eligibility flag will be set.
  - VLAN Flooding: Enable/Disable.
  - VLAN Flooding Range: Specifies the number of VLAN IDs. Enter a number from 0-4096. The VLAN IDs will be incremented by 1 until it reaches the number of times entered in the flood range.

#### IEEE 802.1Q VLAN Tag in an Ethernet Frame



#### BERT Setup - VLAN Tag configuration (Layer 3)

	LED'S	N	1AC	VLAN	MPL	s	IP	DATA	RX Filter	Start
		VLAN	#1(CE-VL	AN ID)						
$\left  \mathbf{X} \right $	Tools	ID	0	Priority	0	Туре	810	• •	r i i i i i i i i i i i i i i i i i i i	
	Utilities	VLAN	I #2(SP-VL	AN ID)						
	Files	ID	0	Priority	0	Туре	810	• •	'	
			Drop Eligik	le						
		VLAN	#3(SP-VL	AN ID)						
		ID	0	Priority	0	Туре	810	• •	r	LASER UNION
			Drop Eligik	le						MX Discover
										Centrel

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

- MPLS Tab: 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).*

#### **BERT Setup - MPLS label configuration**

LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	MPLS #1	Labe⊨	0	S= 0			
Tools		CoS=	0	TTL= 0			
Utilities	MPLS #2	Labe⊫	0	S= 0			
		CoS=	0	TTL= 0			
Files	MPLS #3	Labe⊨	0	S= 1			
		CoS=	0	TTL= 0			
							ASER On Off
							MX Discover
							Control

- **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
  - IP Src and IP Dest: For IP Src, if the IP connection is up, refer to <u>RXT-1200 Platform Manual</u> Chapter 7\_Tools> IP Tools. The source address is fixed to the IP address from the IP setup menu.
  - IP TOS (for Quality of Service testing):
    - Legacy TOS (Precedence): The first three bits of the IP TOS field can be edited:
      - 000 Best Effort
      - 001 Bulk Data
      - 010 Transactional
      - 011 Call Signaling
      - 100 Streaming Video
      - 101 Voice
      - 110 Routing
      - 111 Reserve
    - DSCP (Differentiated Services Code Point): The first six bits of the IP TOS can be edited to provide more granular service classification.

For more information on the definition of DSCP field in IPv4 and IPv6 headers, refer to RFC 2472.

- **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.

	LED'S	MAC	VLAN	I MPLS	IP	DAT/	A RX Filter	Start
		Source IP A	ddress		192.168.0.	10		
$\left  \mathbf{X} \right $	Tools	Destination	IP Addre	55	192.168.2.	200		
		IP TOS			DSCP			7
	Utilities	DSCP	01	1001	ECT 0	) <b>T</b>	E 0 1	7
	Files	TTL			128			
		Fragment O	ffset		0			
		Protocol			UDP - 0x1	1		<b>7</b>
								LASER On/Off
								MX Discover
								Control

### BERT Setup - IP Address settings (Layer 3)

- **Data Tab:** User selects a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). Depending on the test layer, different test pattern options are available.
  - Layer 1 Framed Test Patterns
    - 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 is a 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.
    - CSPAT: Compliant Supply Noise Pattern. Represents worst case power supply noise.



#### BERT Setup - Data selection (Layer 1 Framed)

BERT Setup - Data selection - (Layer 1 Unframed)

LEDs	Header Configuration	Start
X Tools	• HFPAT	
Utilities	● LFPAT	
	MFPAT	
Files	C RDPAT	
	<ul> <li>JTPAT</li> </ul>	
	• SNPAT	LASER Onfoff MX Discover Control

#### • Layer 1 Unframed Test Patterns

- HFPAT (High Frequency Pattern): This test pattern is to test random jitter (RJ) at a BER of 10-12, and also to test the asymmetry of transition times. This high frequency test pattern generates a one, or light on, for a duration of 1 bit time, followed by a zero, or light off, for a duration of 1 bit time. This pattern can be generated by the repeated transmission of the D21.5 code-group. Disparity rules are followed.
- LFPAT (Low Frequency Pattern): The intent of this test pattern is to test low frequency RJ and also to test PLL tracking error. This low frequency test pattern generates a one, or light on, for a duration of 5 bit times, followed by a zero, or light off, for a duration of 5 bit times. This pattern can be generated by the repeated transmission of the K28.7 code-group. Disparity rules are followed.
- MFPAT (Mixed Frequency Pattern): The intent of this test pattern is to test the combination of RJ and deterministic jitter (DJ). This mixed frequency test pattern generates a one, or light on, for a duration of 5 bit times, followed by a zero, or light off, for a duration of 1 bit times, followed by a one for 1 bit time followed by a one for 2 bit times followed by a zero for 5 bit times followed by a one for 1 bit time followed by a one for 1 bit time followed by a one for 1 bit time followed by a zero for 5 bit times. This pattern can be generated by the repeated transmission of the K28.5 code-group. Disparity rules are followed.

- RDPAT (Random Data Pattern): Designed to provide energy across the entire frequency spectrum providing good simple BER testing.
- JTPAT (Jitter Tolerance Pattern): Designed to verify jitter tolerance on the receivers by exposing a receiver's CDR to large instantaneous phase jumps. The pattern alternates repeating low transition density patterns with repeating high transition density patterns.
- SNPAT (Supply Noise Pattern): Designed to simulate the worst case power supply noise that could be introduced by a transceiver.

### • Layer 2, 3, & 4 test patterns

- PRBS:
  - 2<sup>31</sup> -1 (147 483 647-bit pattern used for special measurement tasks, [e.g., delay measurements at higher bit rates])
  - 2<sup>2</sup>3 -1 (8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps)
  - 2^15 -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)
  - 2<sup>11</sup> -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)
- Fixed: All 0s or All 1s
- User Defined pattern: Length depends on size of frame
- Inversion: Normal or inverted

4 LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
🔀 Tools	PRBS	6 2E31-1	<b>•</b> Ir	ivert			
Utilities	<ul> <li>PRBS</li> <li>PRBS</li> </ul>	5 2E23-1 5 2E15-1					
Files	PRB	5 2E11-1					
	<ul> <li>All 1's</li> </ul>	;	-				LASER On/Off
	User	Defined	00-00-00	0-00			MX Discover
			Pa	ae 1 of 2 🛈	>		Control

#### BERT Setup - Data selection - PRBS Patterns (Page 1)

• Auto (Special Patterns): For special patterns, the most significant bit of the test pattern is populated first into the payload frame, as opposed to non-special patterns, in which the least significant bit is populated first.

#### BERT Setup - Data selection - Special Patterns (Page 2)

LEDs	MAC	MPLS	DATA	RX Filter	Start
		Auto			
Tools	PRBS 2E31	I-SPEC 📃 Ir	nvert		
Utilities	PRBS 2E23	-SPEC			
	PRBS 2E16	S-SPEC			
Files	PRBS 2E11	I-SPEC			
					MX Discover
		🔹 Ра	ge 2 of 2 💿		Control

- **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
  - Type of Service
  - Protocol Type
  - IP Destination address
  - IP Source address

LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
Tools Utilities	MAC MAC VLAN	Destination Source Priority					
Files	Fram Type Proto	e Type of service col Type stination urce					LASER OnfOff MX Discover
							Control

**BERT Setup - RX Filter selection** 

• UDP/TCP: Input Source Port and Destination Port.



#### **BERT Setup - RX Filter selection**

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#### 5.3.1.2 Traffic Settings

#### Traffic tab:

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): Enter the frame size when a Layer 2, 3, or 4 BERT is selected
  - Frame size configuration is not available for Layer 1 BERT
  - 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	Setup		Results		Start	
		Header	Tra	ffic	Error inj.		
$\left  X \right $	Tools	Traffic Flow		Constant		▼	
_	Utilities	Frame Size Type	rame Size Type			▼	
	Culler S	Frame Size (bytes)		1516			
	Files	Constant Bandwidth		10.000	%	▼	
-							
							MX Discover
							Control

### **BERT Setup - Constant Traffic**



## **Frame Size Limitations**

Layer 1 framed mode - Frame size configuration is not available. Layer 1 unframed mode - Traffic profile is constant at 100% bandwidth.

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#### 5.3.1.3 Error Injection

Error injection can be performed during testing. The error type and injection rate are configured in the Error Injection tab.

- Error type: Select from Bit, CRC, IP Checksum (Layer 3, 4 only), Pause, TCP/UDP Checksum (Layer 4 only). 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.
- Injection Flow: The error injection flow determines how the selected errors will be injected.
  - Select a single error injection or specific count.

Count: Configures the error count via a numeric keypad.

#### **BERT Setup - Error Injection** Error Inj. Function Stop Setup Results Start LEDs Traffic Restart Error Inj. Tools Error Type Error Type CRO TX Stop Injection Flow V Utilities CRC IP Checksun Err Inj Files **TCP/UDP Checksum** Pause Bit MX Discover Control MX Discover Control

## Error Injection

After pressing **Start**, error injection can be enabled by pressing the **Error Inj.** button on the right side of the screen.

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### 5.3.1.4 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 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 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 the 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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#### 5.3.2 BERT Results

#### 5.3.2.1 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.
- 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 %.
- 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).
- Number of bytes
- Pause Frames: Total number of transmitted and received Ethernet pause flow-control frames.

		0					-		
eo LEDs		Setu	<b>,</b>			R	esults		
	Summary	Errors	Alarms	Events	Traff	ic 🛛	Delay	Rates	
😑 Signal	ST:2012-2	- 8 01:40:4	2	ET	:00:00:07	, i			
<u></u>			тх			RX			
Frame	Line Rate	(bps)	1000.000	м		1000	.000M		
O Pattern	Utilization	(%)	10.001%	10.001%			10.001%		
0	Utilization	(bps)	100.010	100.010M			100.010M		
ALM/ERR	Framed Ra	ite (bps)	98.706M	98.706M			98.706M		
Ŭ	Data Rate	(bps)	97.536M			97.53	36M		
Tools	# of Bytes		8578521	6		8578	6734		
	Pause Fra	mes	0			0			
📑 Utilities									
Files									

#### **BERT Results - Summary**

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#### 5.3.2.2 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**

LEDs	Se	tup		1	Stop		
	Summary Error	s Alarms	Events	Traffic	Delay	Rates	
😑 Signal		Current		Total			Restart
Frame	Bits	0		0			TX Stop
	BER	0.000000E+00	0.000000E+00				E
😑 Pattern	Symbol	N/A	N/A				
-	FCS/CRC	0		0			
ALM/ERR	Jabber Frames	0		0			
	Runt Frames	0		O			
Tools							MX Discover
Utilities							Control
Files							

#### 5.3.2.3 Events

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

LEDs		Setu	ą	F	Stop		
	Summary E	Irrors	Alarms Eve	nts Traffic	Delay	Rates	
😑 Signal	Time		Event Type	# of Events	Test		Restart
Frame	2012-2-8 01:4	41:06	Test Started		BERT		TX Stop
Ŭ					_		Err Ini.
😑 Pattern					_		
ALM/ERR							
Ŭ							
X Tools							MX Discover
			Pag	e1of1 💽			
Utilities							Control
Files							

#### **BERT Results - Events**

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### 5.3.2.4 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
- Pause frames

Tap on the **graph** for detailed screens.

## **BERT Results - Traffic Distribution**



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

DERT Rosalis - Frances												
	LEDs	Frames		Traffic Type		Frame Size	Stop					
		RX Frames	#		%							
🔵 Sig	Inal	Total	1503288		100		Restart					
		Test	1503288		100	.000000	TX Stop					
🔵 Fra	ume	VLAN	Û		0.00	0000						
O Pat	Hom	VLAN Stack	0		0.00	0000	Err Inj.					
<b>U</b>		Non-Test	0		0.00	0000						
🔵 ALI	M/ERR	TX Frames	#									
Ŭ		Total	1503278									
4	Tools	Pause Frames	тх		RX							
		Total	0		0		MX Discover					
	Utilities						Control					
	Files											

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

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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.

## **BERT Results - Traffic Type**

LEDs	Frames	Traffic Type		Frame Size	Stop
	Distribution	#	%		
😑 Signal	L2 Unicast	1820260	100	.000000	Restart
0	L2 Broadcast	0	0.000000		TX Stop
🕒 Frame	L2 Multicast	0	0.0	00000	
😑 Pattern					Err Inj.
ALM/ERR					
X Tools					MX Discover
Utilities					Control
Files					

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

#### **BERT Results - Frame Size**

LEDs	Frames		Traffic Type		Frame Size	Stop
	Distribution	#		%		
😑 Signal	< 64B	0		0.0	00000	Restart
0.5	64 - 127B	0		0.0	00000	TX Stop
🕒 Frame	128 - 255B	0		0.0	00000	
Pattern	256 - 511B	0		0.000000		Err Inj.
<b>U</b>	512 - 1023B	0		0.0	00000	
ALM/ERR	1024 - 1279B	0		0.000000		
-	1280 - 1518B	1974683		100	.000000	
X Tools	> 1518B	0		0.0	00000	
						MADISCOVER
Utilities						Control
Files						

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#### 5.3.2.5 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



#### 5.3.2.6 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

#### **BERT Results - Delay**

LEDs	Se	tup	Res	Stop	
	Summary Errors	s Alarms Eve	ents Traffic	elay Rates	
😑 Signal	Frame Arrival Tim	Restart			
😑 Frame	Current	110.912us	Average	110.914us	TX Stop
	Minimum	110.912us	Maximum	110.928us	Exc lat
😑 Pattern	Frame Delay Varia				
	Current		0.002us		
64 Tests					
1 ools					MX Discover
Utilities					Control
Files					

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#### 5.3.2.7 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
    - Min/Max: Minimum and maximum duration of the service disruption events
    - No. of Occurrences: Counter of service disruption events

#### **BERT Results - Alarms**

LEDs	Setup			Res	Stop		
	Summary Errors	s <mark>Alarms</mark> Eve	nts Traffic Delay Rates				
😑 Signal		Current		Total			Restart
Frame	LOS (ms)	0		0			TX Stop
	LOSync	0		0			
😑 Pattern	Pattern Loss	0		0			
	Service Disruption	Service Disruption (ms)					
ALM/ERR	Current	0	Total		0		
	Last			0			
X Tools	Min/Max	0		0			MX Discover
	No. of Occurrence	:5	0				
Utilities							Control
Files							

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#### 5.3.2.8 Signal

The Signal tab (fiber ports only) displays the Tx (and Rx) optical levels measured by the transceiver. Page 1 displays the level measurement in dBm for the optical signals.

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



#### **BERT Results - Signal**

#### Signal (Page 2)

Page 2 displays the Optical module (transceivers) information which includes Vendor name, Part Number and Optical Wavelength. Tap on the **Decode** button to view additional information on SFP optics.

### **BERT Results - Signal (Page 2)**
LEDs	EDs		Re	sults	Stop
	Events	Traffic	Delay	Rates	Partart
😑 Signal	Summary	Signal	Errors	Alarms	restart
O Frame			TX Stop		
U France	Vendor		FINISAR CORP.	(e	Err Inj.
O Pattern	Part Number		FTLX1472M3BCL		
	Wavelength (nm)		1310.00		Alarm inj.
O ALM/ERR	Temperature(°C)		45.992	(	LASER OF
History 10GE LAN	۲	Page 2 al	. 0		

## Signal (Page 3)

## **BERT Results - Signal (Page 3)**

LEDs	Set	up	Re	Results		
	Events	Traffic	Delay	Rates		
O Signal	Summary	Signal	Errors	Alarms		
O Frame	1					
	Current [bps]		1250000000			
Pattern	Offset [ppm] Min [ppm]		0.0			
			0.0			
ALM/ERR	Max (ppm)		0.0	LASER Off		
History		• р	ae 3 of 3 💿		MX Discover	

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

- 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.

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# 5.4 RFC 2544 Conformance Testing

- <u>Overview</u>
- Setup Standard Mode
  - Header Settings
  - Frames Settings
  - Threshold Settings
  - Throughput Settings
  - Latency Settings
  - Frame Loss Settings
  - Burst Settings
- <u>Starting / Stopping a RFC2544 Measurement</u>
  - <u>Results Standard Mode</u>
    - Status
    - Summary
    - Signal
    - Events
    - Latency / Jitter
    - Frame Loss
    - Burst
- Saving Results

## **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, & 4)
- Frame header (PBB, MAC, VLAN, IP, UDP, and Data)
- Test frames selection
- Pass/fail thresholds (optional)
- Far-end unit loop control
- Throughput
- Latency
- Frame loss
- Burst (back-to-back)

	LEDs	Set	up	-		Resu	ilts	Start
		Throughput	Latency		Frame Loss		Burst	
$\left  \right\rangle$	Tools	Header		Fra	mes		Thresholds	
	Utilities	Profile			Last configu	ıration	▼	
	Encapsulation Type			PBB-TE				
	Files	Test Layer			Layer 2 🗸 🔻			
		Frame Type			Ethernet II(	DIX)	SLA Mode	
		VLAN			1 tag 🛛 🔻 🔻			
		PBB	MAC	VLAN	Da	ta	CRC	MX Discover Control

## RFC 2544 Setup - Layer 2 parameters

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## 5.4.1 Setup - Standard Mode

Unless otherwise noted, the Frame Header and related setups are identical to the setups described in the BERT Application.

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## 5.4.1.1 Header Settings

With the exception of the Data tab, RFC 2544 Header setup options are identical to the setups described in the BERT application. Refer to the <u>Header Settings</u> section of the BERT application for more information.

RFC 2544 setup options are listed below:

- Profile
- Encapsulation Type
- Test
- Frame Type
- MAC/IP
- VLAN
- MPLS:
- MAC, VLAN, MPLS, IP, and Test Pattern Configurations:
- MAC Header Tab
- Data Tab: No payload selection is possible.
   The payload area is populated with a VeEX signature field and other proprietary data.
- RX Filter Tab
- VLAN Tab
- MPLS Tab
- IP Tab

# MAC DATA RX Filter Start Image: Start Image:

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#### 5.4.1.2 Frame Settings

Frames tab: User configures the following:

- Preset Frames: User selects 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 frames are 64 and 1518 bytes.
  - To select/deselect any of the recommended test frames, check the box to the right of the desired frame.

When VLAN tagging or MPLS tagging is enabled, the value in parentheses reflects the actual frame size transmitted. For example one VLAN tag adds 4 bytes to the frame size, therefore a 64B frame becomes a 68 byte frame.

• Add frame: The user can add two additional user configurable test frames of any size ranging from 64 bytes to 10000 bytes.

## RFC 2544 Data tab

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

LEDs	Setup		Res	ults	Stop
	Throughput	Latency	Frame Loss	Burst	
😑 Signal	Header	Fra	mes	Thresholds	
Frame	64 (68) bytes				
	128 (132) bytes		•		
Pattern	256 (260) bytes		<ul><li>✓</li></ul>		
-	512 (516) bytes		<b>v</b>		SLA Mode
ALM/ERR	1024 (1028) bytes		<ul><li>✓</li></ul>		
	1280 (1284) bytes		•		
X Tools	1518 (1522) bytes		🗹 🛛 🛛 Add Fra	me	MX Discover
📑 Utilities					Control
Files					

## **RFC 2544 Setup - Frame Settings**

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## 5.4.1.3 Threshold Settings

#### Threshold tab:

- User enables or disables threshold settings 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. Select a **rate type** from the drop-down menu that will be used to determine pass/fail criteria. Options are % of Max Rate, % of Line Rate, Utlized Line Rate (Mbps).
  - 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	Setup			Res	Start		
	Throughput	Latency		Frame Lo	rame Loss Burst		
😑 Signal	Header		Fra	Frames		Thresholds	
C Erama	🗹 Enable	% 0	of Max Rate		Late	ncy (us)	
- Frame	68 bytes	70.0	000		1000	)	
Pattern	128 bytes	75.0	75.000		2000	)	
Ŭ.	256 bytes	80.000			3000		SLA Mode
ALM/ERR	512 bytes	85.0	000		4000		LASER On
	1024 bytes	90.0	000		5000		
History	1280 bytes	95.0	000		6000		MX Discover
	1518 bytes	100	.000		7000		Loop Control
							P2P Setup
							P2P Setup

## **RFC 2544 Setup - Threshold Settings**



## 5.4.1.4 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.

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

## Throughput tab:

- 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.
  - 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.
- **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.
- Frame Loss Limit (%): Configures the frame loss tolerance used in the throughput rate search algorithm. If the frame loss count stays below the configured Frame Loss limit, the throughput rate search will stop, otherwise the throughput rate search will continue to the next step.

## **RFC 2544 Setup - Throughput Settings**

(1) 400GE					<b>(3)</b>	
LEDs	Setup			Res		
	Header	Frames		Thresholds		
Signal	Throughput I	_atency	Frame Lo	oss	Burst	
Frame	MAX Rate	100.000		%	▼	
Ŭ.	Resolution	1.00				
Pattern	Duration (s)	20				
ALM/ERR	🗹 Enable Test					
History						
OSFP						
RS-FEC : ON						
P 192.168.0.92	Remote/CLI			20'	19-10-29 05:45:46	

Latency tab: User configures the following:

- Test: 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: User configures a custom rate in % or Mbps.
  - Custom Rate per frame size: The user can configure a custom rate in % or Mbps for each test frame. Tap on Rate Table Config. to configure rates for each frame. After making edits tap Apply to confirm edits or Apply to All to apply rates to all tests.
- 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.

	LED'S	Setup	Setup			ts	Start	
		Header	Header Fran			hresholds		
$\boldsymbol{\times}$	Tools	Throughput I	atency	Frame Lo	55	Burst		
-	Utilities	Test Rate	lest Rate Throughput Rate 🗸 🗸					
_	o till de s	Duration (s)	10					
	Files	Repetitions	1					
		✔ Enable Test					SLA Mode LASER On/Off MX Discover Control	

## **RFC 2544 Setup - Latency Settings**

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## Frame Loss tab:

• 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.

	LED'S	Setup			Result	5	Start
		Header	Fra	mes	T	nresholds	
$\left  \times \right $	Tools	Throughput I	Latency	Frame Lo	55	Burst	
	Utilities	MAX Rate	80.000		%	V	
		Step Size (%)	10.00				
	Files	Duration (s)	10				
		✔ Enable Test					SLA Mode LASER On/Off MX Discover

## RFC 2544 Setup - Frame Loss Settings

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

## Burst (Back-to-Back) tab:

- Max Rate: Up to 100% of the negotiated line rate. The default value is 1000 ULR (Mbps). In the burst test, frames are always transmitted at the maximum rate for a given minimum and maximum burst duration. 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.
- **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.

## RFC 2544 Setup - Burst Settings

	LED'S	Setup			Resul	ts	Start
		Header	Fra	ames	т	hresholds	
$\left  \boldsymbol{X} \right $	Tools	Throughput	Latency	Frame Lo	55	Burst	
Utilities		MAX Rate	80.000		%	▼	
		MIN Duration (s)	2				
	Files	MAX Duration (s)	10				
_		Repetitions	1				SLA Mode
		✓ Enable Test					LASER On/Off MX Discover Control

## 5.4.1.5 Starting/Stopping a RFC 2544 Measurement

Once all configurations have been made, the user can start the RFC 2544 test (press the **Start** icon on the top right section of the screen). The following are two scenarios of how to prepare and start the unit for RFC 2544 testing.

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

## • 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 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 RFC 2544 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 RFC 2544 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 the all of the selected test are completed, the RFC 2544 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.

✓ If the unit is in Advanced SLA mode, the RFC 2544 test runs simultaneously with the background.

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## 5.4.2 Results - Standard Mode

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

## **Results tab:**

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.

Status tab: The status of each test is displayed including a stamped log of each test.

LEDs	Set	чр	Resu	Results		
_	Throughput	Latency	Frame Loss	Burst		
😑 Signal	Status	Summary	Signal	Events		
O Frame	ST: 2017-02-16 13:25:45		ET: 00/00:00:28	ET: 00/00:00:28		
<b>U</b> Traine	Throughput Test		In progress		]	
Pattern	Latency		Pending	SI A Mode		
	Frame Loss Test		Pending		SEAMORE	
ALM/ERR	Burstability Test		Pending	LASER Off		
History					MX Discover	
					Loop Control	
					P2P Setup	

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.
- 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 %.
- 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).
- Total Frames
- Bad Frames
- Pause Frames: Total number of transmitted and received Ethernet pause flow-control frames.

LEDs	Setup		Results			Stop	
	Throughput	L	_atency	Frame L	oss	Burst	
😑 Signal	Status		Sum	imary		Events	
O Frame	ST: 2017-08-21 11:5	54:00		ET: 00/00:00:31			
	ТХ		х		RX		
Pattern	Line Rate (bps)		1.000G 1		1.000G		SI A Mada
	Utilization (%)	10	10.007%		1.058%		SLA WIOde
ALM/ERR	Utilization (bps)	10	100.070M		10.580M		
History	Framed Rate (bps)	98	98.767M		8.061M		MX Discover
	Data Rate (bps)	9	5.774M	5.794M		l	Mix Discover
	Total Frames	24	241852		468275		Control
	Bad Frames	0			0		DOD Satur
1000-TFULL	Pause Frames	e Frames 0		467980			P2P Setup
							P1 CAP Start

## **RFC 2544 Results - Summary**

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**Signal tab:** The Signal tab (fiber ports only) displays the optical level measured by the transceivers. The RFC 2544 Signal tab is identical to the Signal tab for the BERT application. Refer to <u>Signal</u> from the BERT section for more information.

## RFC 2544 Results - Signal (Page 1)



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

	LEDs	Setu	qt	Results			Start
		Throughput	Latency	Frame	Loss	Burst	
$\left  \times \right $	Tools	Status	Summary	Signal		Events	
_	Utilities	Time Events		Test			
	otinities	20-2-2012 17:05:31	Test Started		RFC 2544		
	Files	20-2-2012 17:05:31	Test Started		Through	nput	
		20-2-2012 17:06:03	Test Stopped		Throughput		
		20-2-2012 17:06:03	Test Started		Latency		
		20-2-2012 17:06:05	Test Stopped		Latency		LASER On/Off
		20-2-2012 17:06:05	Test Started		Frame L	.055	
		20-2-2012 17:06:26	Test Stopped		Frame L	oss	
		•	Page 1 of	2 0	>		Control
							Profiles

## RFC 2544 Results - Events

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#### Throughput tab

•

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
    - Thresholds: Pass/Fail test status determined by test criteria set in the Threshold tab

## RFC 2544 Results - Throughput (Tx Graphical)



## RFC 2544 Results - Throughput (Summary Table)

LEDs	Setup			Resu	lts	Start
_	Status	Sum	mary		Events	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
Frame	Summary 🛛 🔻	Tx(%)	<b>F</b> x(%)	T	Thresholds	
0	128 (132) bytes	80.00	80.00		Pass	
Pattern	256 (260) bytes	80.00	80.00		Pass	
	512 (516) bytes	80.00	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	80.00	80.00		Pass	
	1518 (1522) bytes	80.00	60.00		Failed	
X Tools						MX Discover
Otilities						Control
Files						

## RFC 2544 Results - Throughput (Test Log Table)

LEDs	Setup			Res	ults	Start
	Status	Sun	mary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Test Log 🛛 🔻	Tx(%)	Rx(%)		Status	
<b>U</b>	128 (132) bytes	80.00	80.00		Pass	
Pattern	256 (260) bytes	80.00	80.00		Pass	
č	512 (516) bytes	80.00	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	80.00	80.00		Pass	
	1518 (1522) bytes	80.00	80.00		Pass	
X Tools						MX Discover
Utilities						Control
Files						

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Latency and frame jitter measurements results are displayed in the following formats. Use the drop-down menu to select the Latency format:

- 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.

LEDs	Setup	Setup		Resu	ilts	Start
	Status	Sum	nmary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Summary 🔻	Latency	Rate (%)		Thresholds	
	128 (132) bytes	5.90us	60.00		Pass	
Pattern	256 (260) bytes (	5.94us	00.08		Pass	
-	512 (516) bytes	9.00us	60.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	13.10us	80.00		Pass	
	1518 (1522) bytes	17.04us	80.00		Pass	
Tools						MX Discover
📑 Utilities						Control
Files		Page	1 of 1 🕑			

## RFC 2544 Results - Latency (Summary)

RFC 2544 Results - Latency (Graphical)



## RFC 2544 Results - Latency (Test Log)

LEDs	Setup		Res	alts	Start	
	Status	Sun	nmary		Events	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
Frame	Test Log 🛛 🔻	Latency	Rate (%)		Status	
<b>U</b>	128 (132) bytes	5.90us	60.00		Pass	
Pattern	256 (260) bytes	6.94us	80.00		Pass	
	512 (516) bytes	9.00us	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	13.10us	80.00		Pass	
	1518 (1522) bytes	17.04us	80.00		Pass	
X Tools						MX Discover
Utilities						Control
Files	Page 1 of 1 •					

RFC 2544 Results - Latency (Jitter Graphical)



## RFC 2544 Results - Latency (Jitter Summary)

LEDs	Setup			Res	ults	Start
	Status	Sum	mary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Jit. Summary 🛛 🔻	Jitter	Rate (%)		Thresholds	
<b>U</b>	128 (132) bytes	0.00us	80.00		Pass	
Pattern	256 (260) bytes	0.00us	80.00		Pass	
-	512 (516) bytes	0.00us	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	0.00us	80.00		Pass	
	1518 (1522) bytes	5.00us	80.00		Pass	
X Tools						MX Discover
Utilities						Control
Files						

## RFC 2544 Results - Latency (Jitter Test log)

LEDs	Setup	Setup			ults	Start
	Status	Sun	mary		Events	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
Frame	Jit. Test Log 🛛 🔻	Jitter	Rate (%)		Status	
	128 (132) bytes (	).00us	80.00		Pass	
Pattern	256 (260) bytes (	0.00us	80.00		Pass	
-	512 (516) bytes (	).00us	60.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes 🛛 (	0.00us	80.00		Pass	
	1518 (1522) bytes	5.00us	60.00		Pass	
X Tools						MX Discover
Utilities						Control
Files						

## Go back to top Go back to TOC

**Frame Loss tab:** 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 on the magnifying glass to see the legend.

LEDs	Setup			Rest	Start			
	Status	Summ	iary		Events			
😑 Signal	Throughput	Latency	Frame Loss		Burst			
Frame	Summary 🛛 🔻	Frame Loss (%)	Frame Los	s Cnt	Rate (%)			
	128 (132) bytes	0.000000	0		100.000000			
Pattern	256 (260) bytes	0.000000	0		100.000000			
	512 (516) bytes	0.000000	0		100.000000	SLA Mode		
ALM/ERR	1024 (1028) bytes	0.000000	0		100.000000			
	1518 (1522) bytes	0.000000	0		100.000000			
X Tools						MX Discover		
Utilities						Control		
Files		• Page 1 of 1 •						

## RFC 2544 Results - Frame Loss (Summary)





## RFC 2544 Results - Frame Loss (Test log)

LEDs	Setup			Resu	Start	
	Status	Sum	mary		Events	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
Frame	Test Log 🛛 🔻	rame Loss (%)	Frame Los	is Cnt	Rate (%)	
0	126 (132) bytes 0	.000000	0		100.000000	
Pattern	128 (132) bytes 🛛 🕻	.000000	0 5		90.00000	
	256 (260) bytes 0	.000000	0		100.000000	SLA Mode
ALM/ERR	256 (260) bytes 🛛 🗘	.000000	0		90.000000	
	512 (516) bytes 0	.000000	0		100.000000	
X Tools	512 (516) bytes 0	.000000	0		90.000000	MX Discover
	1024 (1028) bytes 0	.000000	0		100.000000	
Utilities	1024 (1028) bytes 0	.000000	0		90.000000	Control
Files		Page	1 of 2 🕑			

## Go back to top Go back to TOC

**Burst tab:** 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

	Setup			Resu	Start	
LEDS	Status	Sum	mary		Events	Jan
😑 Signal	Throughput	Latency	Frame Lo	955	Burst	
A Frame	Summary	🔻 Avg. Frame	Count	Status	•	
	128 (132) bytes	8223684		Pass		
Pattern	256 (260) bytes	4464285		Pass		
-	512 (516) bytes	2332089		Pass		SLA Mode
ALM/ERR	1024 (1028) bytes	1192748		Pass		
	1518 (1522) bytes	810635		Pass		
X Tools						MX Discover
Utilities						Control
Files		Page	1 of 1 💽			

## RFC 2544 Results - Burstability (Summary)



LEDs	Setup		Resu	lts	Start	
	Status	Sumr	nmary		Events	
😑 Signal	Throughput l	Latency	Frame Lo	55	Burst	
Frame	Test Log 🛛 🔻	RX Frm. Cou	int Exp. Fri	n. Coun	d Duration (s)	
	128 (132) bytes	822368	822368		2	
Pattern	128 (132) bytes	8223684	8223684		20	
č	256 (260) bytes	446428	446428		2	SLA Mode
ALM/ERR	256 (260) bytes	4464285	4464285		20	
	512 (516) bytes	233208	233208		2	
X Tools	512 (516) bytes	2332089	2332089		20	MX Discover
	1024 (1028) bytes	119274	119274		2	
Utilities	1024 (1028) bytes	1192748	1192748		20	Control
Files		Page '	1 of 2 💽			

## FEC tab:

# RFC 2544 Results - FEC Summary

	_								
LEDs	s	etup			Re	sults		Stop	
	Status	Summ	Summary		Signal		Events		
🕒 Signal	Throughput	Latency	Fram	e Loss	Burst		FEC		
🕒 Frame	Summar	y	Aları	ms/Error	s		Skew		
Ŭ	Alarms	Seco	nds						
Pattern	HiSER	0							
	LOA	0							
ALM/ERR	E	rrors		c	ount		Rate		
	uCFEC				0		0.00E+00		
History	CFEC CW			14	44169		1.07E-03	Pre-emphasis	
	CFEC Symbol			14	50908		1.97E-06		
	CFEC Bit			14	52140		1.98E-07	I2C Access	
	CFEC Ones			12	70758		1.73E-07	Setup Injection	
QSFP-DD	CFEC Zero			18	31382		2.47E-08		
RS-FEC : ON	Invalid Transco	ded Block			0		0.00E+00		
192.168.0.92	Remote/CLI				20	19-10	-29 06:45:52		

RFC 2544 Results - FEC Alarms/Errors

		🔶 🙆 🔇						
LEDs		Setup			Resul	ts	Stop	
	Status	Summ	ary	S	ignal	Events		
🜔 Signal	Throughput	Latency	Frame	Loss	Burst	FEC		
🕒 Frame	Summa	ry	Alarms/Errors			Skew		
Ŭ		Channe	nel A Error		Chanı	nel B Error	VAIm VErr	
Pattern		Count	Ra	ıte	Count	Rate		
<u> </u>	uCFEC	0	0.00	E+00	0	0.00E+00		
ALM/ERR	CFEC CW	2526164	1.18	E-03	2471159	1.15E-03		
History	CFEC Symbol	2537805	2.17	E-06	2482756	2.13E-06	Pre-emphasis	
	CFEC Bit	2539869	2.18	E-07	2484971	2.13E-07		
	CFEC Ones	2216677	1.90	E-07	2167442	1.86E-07	12C Access	
	CFEC Zero	313481	2.77	E-08	311407	2.72E-08	Setup Injection	
RS-FEC : ON	[	Lane Detai	ls	C	orr. Symbol	Details		
(P) 192.168.0.92	Remote/CLI				2019	10-29 06:46:29		



1 400GE	-	-	_		_			
			LOAMPS		Symbol	CFE	C Bit	Stop
LEDs		FECID	Seconds	Count	Rate	Count	Rate	Stop
	0	1	0	402968	1.73E-07	403051	1.73E-07	
😑 Signal	1	0	0	142302	6.11E-08	142326	6.11E-08	
	2	3	0	1152062	4.95E-07	1152846	4.95E-07	
🜔 Frame	3	2	0	206968	8.89E-08	207031	8.89E-08	
	4	5	0	15488	6.65E-09	15488	6.65E-09	MAlm MErr
Pattern	5	4	0	295198	1.27E-07	295223	1.27E-07	
Ŭ	6	7	0	3144442	1.35E-06	3148066	1.35E-06	
	7	6	0	2076930	8.92E-07	2079092	8.92E-07	
	8	9	0	20231	8.69E-09	20231	8.69E-09	
History	9	8	0	32786	1.41E-08	32787	1.41E-08	Pre-emphasis
	10	11	0	406791	1.75E-07	406833	1.75E-07	
	11	10	0	109662	4.71E-08	109666	4.71E-08	I2C Access
	12	12	0	56606	2.43E-08	56606	2.43E-08	
	13	13	0	23871	1.02E-08	23871	1.02E-08	Setup Injection
QSFP-DD	14	14	0	56375	2.42E-08	56375	2.42E-08	
RS-FEC : ON	15	15	0	31038	1.33E-08	31038	1.33E-08	
(P) 192 168 0 92	Remo	ote/CLL				2019-10-29	06:47:03	

RFC 2544 Results - FEC Alarms/Errors Corr. Symbol Details

1 400GE		_		🔞 🕞
LEDs	FEC Correctable Symbol Breakdown	Count	Percentage	Stop
	FEC Corr. Sym 1 Count	12559489	99.53475	
😑 Signal	FEC Corr. Sym 2 Count	57553	0.45611	
	FEC Corr. Sym 3 Count	1094	0.00867	
😑 Frame	FEC Corr. Sym 4 Count	52	0.00041	
	FEC Corr. Sym 5 Count	5	0.00004	Alm Frr
🔘 Pattern	FEC Corr. Sym 6 Count	1	0.00001	
	FEC Corr. Sym 7 Count	1	0.00001	
ALM/ERR	FEC Corr. Sym 8 Count	0	0.00000	
	FEC Corr. Sym 9 Count	0	0.00000	
History	FEC Corr. Sym 10 Count	0	0.00000	Pre-emphasis
	FEC Corr. Sym 11 Count	0	0.00000	12C Access
	FEC Corr. Sym 12 Count	0	0.00000	IZO ACCESS
	FEC Corr. Sym 13 Count	0	0.00000	Setup Injection
QSFP-DD	FEC Corr. Sym 14 Count	0	0.00000	
RS-FEC : ON	FEC Corr. Sym 15 Count	0	0.00000	
(P) 192.168.0.92	R Remote/CLI	2019-	10-29 06:47:49	

The FEC Correctable Symbol Breakdown page shows the Symbol Errors per FEC Codeword distribution, which is important to

benchmark the quality of the transceiver and/or PAM4 signal. KP4 FEC can only correct up to 15 symbol errors per codeword, so rows 1 to 15 show the amount of correctable errors, based on how many bad symbols found in the received codeword. The closer the numbers are to the top, the better the quality and performance of the link. Any codeword with more that 15 symbol error becomes an uncorrectable FEC error and will affect the payload (Ethernet traffic), hence not counted on this screen.

			3 😣								
LEDs	Setup							Resu		Stop	
		Status Summary			ary	Signal				Events	
😑 Signal	Thre	oughpu	t Laten	cy	Frame	e Loss Burst		Burst		FEC	
Frame		Sumi	nary		Alarr	ns/Err	ors			Skew	
Ŭ	. #		RX S	Skew					RX S	Skew	
Pattern			bits		ps			bit	s	ps	
_	0	1	114	4	291	8	9	160	)	6023	
ALM/ERR	1	0	113	4	254	9	8	159	9	5985	
History	2	3	1		37	10	11	174	1	6550	Pre-emphasis
	3	2	0		0	11	10	17;	3	6512	
	4	5	142	5	345	12	12	60		2258	I2C Access
	5	4	141	5	308	13	13	60		2258	Setup Injection
QSFP-DD	6	7	78	2	936	14	14	172	2	6475	
RS-FEC : ON	7	6	77	2	898	15	15	172	2	6475	
192.168.0.92	RR	emote/CL	I					2019	-10-29	06:48:19	

#### **RFC 2544 Results - FEC Skew**

## Go back to top Go back to TOC

## 5.4.3 Saving RFC 2544 Results

Once the test has been stopped the results can be saved by pressing the **Save** key on the VePAL's keypad. The results will be saved and named automatically. Once the results are saved, the user may view or rename the results file by going to **Utilities** > **Files** > **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.

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## 5.5 V-SAM

## (100G only)

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

## Overview



V-SAM is not supported for 400G as yet.

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.



## **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.

## 5.5.1 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.
- 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.

## V-SAM - Setup - General (Page 1)

LEDs		Setup				Results		Stop
		Genera	ıl					
😑 Signal	V-SAM P	rofile		La	ast configu	ration		
🜔 Frame	# of Servic ✓Servic ✓Servic	/ices 3 e Configurative Performan	tion Test	:	CIR Test C			
Pattern	Service #	Service Name	CIR (Mbps)	EIR (Mbps)	Traffic Policing	CBS (KB)	EBS (KB)	
	✓ 1	Service 1 Service 2	101.093	20.000	Yes		· ·	
•		Service 3	100.000	0.000	Tes	-		
X Tools								MX Discover
Utilities								Control
Files	Total IR(0	CIR+EIR):121	.093МБр •	s(121.362 Page 1 of	12 DLR	)		

V-SAM - Setup - General (Page 2)

LEDs		Setup				Results		Start
	General							
😑 Signal	V-SAM Pr	ofile		La	ist configu	ration	T	
😑 Frame	# of Servic VServic VServic	vices 3 e Configurat e Performan	▼ tion Test ice Test	Di	CIR Test O Iration	<mark>Config.</mark> 15min ▼		
O Pattern	Service #	Service Name	Frame Size	FLR (%)	FTD (ms)	IFDV (ms)	AVAIL (%)	
ALM/ERR	✓ 2 ✓ 3	Service 2 Service 3	1518 1518	0.1	10.000	-	-	
X Tools								MX Discover
Utilities								Control
Files	Total IR((	CIR+EIR):301	.093Mbp	s(303.953 Page 2 of	Mbps ULR	4)		

## **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.

## **CIR Test Config**



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## 5.5.1.1 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 RFC 2544 Setup and follow the setup procedure to configure the remaining Header Settings for V-SAM.



V-SAM Setup - Services - Header Settings



••	LEDs			EMIX Configuration	
幺	Tools	Frame #	Size		
		1	a-64	▼	
	Utilities	2	b-128	▼	
	Files	3	c-256	▼	
		4	e-1024	▼	
		5	g-1518	▼	
				Close	

LEDs	MPLS-TP	MAC		IP	UD	P	DAT	A I	RX Filter	Start
	MPLS-TP M	MPLS-TP MAC Source					-2B-4E			
😑 Signal	MPLS-TP M	AC Destir	natior	ı	00-18-6	53-1A	-2B-3C			
0.5	Ethernet Typ	e .			88-47					
😝 Frame	MPLS-TR	VLAN	ID	1082 Prio	ority	6	Туре	88	a8	
Pattern	LSP		Labe	⊫ <mark>0</mark>	S=	1 0	CoS= <mark>0</mark>	TTL=	128	
<b>U</b>	😑 PW		Labe	<b>l=</b> 0	S=	1 0	CoS= <mark>0</mark>	TTL-	128	
ALM/ERR										
History										MX Discover
				Appl	y to All					

## 5.5.1.2 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		
$\left  X \right $	Tools	He	ader	Service	Attributes	Sun		
-	Utilities	Service #	1 Drofile Doros	•	Comilao Ac			
		CIR	98.08	IR Mbps 🔻	ZFLR	0.100	%	
	Files	CBS	0.00	IR Mbps ▼ KB	FTD	10.000	ms ▼ ms ▼	
		✓EBS	20.000	КВ	AVAIL	99.900	%	
		Color Awar	e Service		Enable 🔻	1		
		Traffic Poli	cing Test		Enable 🔻	]		
		Traffic Poli	cing Rate		125 %			MX Discover
								Control
				- <b>-</b> •	ору			

## V-SAM Setup - Services - Service Attributes



# **Enabling/Disabling Tests**

A check next to the parameters in the Service Attributes 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.

## Go back to top Go back to TOC

## **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 have errors or are 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.

## **Copying Services**

LED5	(	Copy Service Header	Start
	Copy FROM	Сору ТО	
Signal	Service1	Service1	
Ŭ	Service2	Service2	
😑 Frame	Service3	✓ Service3	
Pattern			
ALM/ERR			
Tools			MX Discover
Utilities	Apply	Discard	Control
Files			



# **Copying Services**

Tap on the **Copy** button on the bottom of the **Header** or **Service Attributes** tabs to copy frame parameters specific to that tab to other services. For example, pressing Copy on the Header tab will only transfer header parameters to other services.

## Go back to top Go back to TOC

## 5.5.2 Results

	LEDs		Setup			Results	Start					
		Config	. Tests	Perf.	Tests	Ever	it Log					
0	Signal	Service	1 s	ervice 2 Service		3 Summary						
0	rame		Service #1:Failed									
0			Pass/Fail	IR(Mbps)	FLR(%)	FTD(ms)	FDV(ms)					
~		CIR Test		Dura	ation 40 Sec	onds						
	Pattern	Step1	Pass	25.265	0.0	0.077	0.000					
$\sim$		Step2	Pass	50.539	0.0	0.077	0.000					
$\sim$		Step3	Pass	75.814	0.0	0.077	0.000					
$\mathbf{O}$	ALMVERR	Step4	Pass	101.079	0.0	0.077	0.000					
		CIR/EIR										
		Total IR	Pass	121.095	0.0	0.077	0.000					
$\mathbf{x}$	Tools	Policing	Duration	10 Seconds	, Transmitte	d Rate 146.3	69 Mbps	ANY DISCOURSE				
~		Total IR	Failed	146.360	0.0	0.077	0.000	MA Discover				
		Tap a	anywhere on	the table fo	r detailed re	sults of each	test.					
	Utilities							Control				
	Files											

## Results - Config. Tests - Service 1

arsigma 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/EI	R Test	Policin	ıg Test	Start
Signal		Step1	Step2	Step3	Step4	
<b>U</b>	Pass/Fail	Pass	Pass	Pass	Pass	
A 5						
U Frame	IR Min(Mbps)	25.211	50.494	75.778	101.061	
-	IR Mean(Mbps)	25.265	50.539	75.814	101.079	
Pattern	IR Max(Mbps)	25.283	50.566	75.850	101.133	
Ŭ						
	Frame Loss Count	0	0	0	0	
0	Frame Loss Ratio(%)	0.0	0.0	0.0	0.0	
Tools	FTD Min(ms)	0.077	0.077	0.077	0.077	
	FTD Mean(ms)	0.077	0.077	0.077	0.077	(MX Discover)
	FTD Max(ms)	0.077	0.077	0.077	0.077	
Utilities	1	Control				
_	FDV Min(ms)	0.000	0.000	0.000	0.000	
Files	FDV Mean	0.000	0.000	0.000	0.000	
	FDV Max(ms)	0.000	0.001	0.001	0.001	

## **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 evaluated towards pass/fail criteria.

<b>CIR/EIR</b>	Test -	Service	1
----------------	--------	---------	---

LEDs	CIR Test	CIR/EIR Test	Poli	cing Test	Start
	Ser				
Signal		Green(CIR)	3reen(CIR) Yellow(EIR)		
<b>U</b>	Pass/Fail			Pass	
C Erama					
- rame	IR Min(Mbps)			121.086	
	IR Mean(Mbps)	-		121.095	
Pattern	IR Max(Mbps)	-		121.158	
Ŭ					
	Frame Loss Count	-		0	
	Frame Loss Ratio(%)			0.0	
Tools	FTD Min(ms)			0.077	
	FTD Mean(ms)	-		0.077	(MX Discover)
	FTD Max(ms)			0.077	
Utilities					Control
	FDV Min(ms)			0.000	
Files	FDV Mean(ms)	-		0.000	
	FDV Max(ms)			0.001	

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.

## Policing Test - Service 1

LEDs	CIR Test	CIR/EIR Test	Poli	cing Test	Start
	Serv				
Signal		Green(CIR)	Yellow(EIR)	Total	
<b>U</b>	Pass/Fail			Failed	
O 5					
- Frame	IR Min(Mbps)			146.297	
	IR Mean(Mbps)			146.360	
🔵 Pattern	IR Max(Mbps)			146.369	
Ŭ	]				
	Frame Loss Count			0	
	Frame Loss Ratio(%)			0.0	
4 Tools	FTD Min(ms)	-		0.077	
	FTD Mean(ms)	-		0.077	(MX Discover)
	FTD Max(ms)	-		0.077	
Utilities					Control
	FDV Min(ms)			0.000	
Files	FDV Mean(ms)			0.000	
	FDV Max(ms)			0.001	

**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		Results	Start
	Config. Tests	Perf	Tests	Event Log	
😑 Signal	Service 1	Service 2	Service	3 Summary	
C Frame		Fa	iled		
0	Service	CIR	CIR/EI	R Traffic Policing	
~	1	Pass	Pass	Failed	
Pattern	2	Pending	Disable	d Pending	
-	3	Pending	Disable	d Pending	
1					
Tools					MX Discover
Utilities					Control
					Control
Files					

## **Results - Config. Tests - Summary**

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

LEDS	Setup		Results	Start					
_	Config. Tests	Perf.	Tests	Ever	nt Log				
🔵 Signal	Service 1 S	ervice 2	Service	3 S	ummary				
😑 Frame	Sei	rvice #1:	Pendin:	g					
č	IR Min(Mbps)		Frame Loss	Count	1				
Pattern	IR Mean(Mbps)								
	In max(mops)		Out of Sequ						
	FTD Min(ms) FTD Mean(ms)		FDV Min(ms) FDV Mean(m	) IS)					
Tools	FTD Max(ms)		FDV Max(ms	)					
	Availability(%)		Errored Fra	ne Count		MX Discover			
Utilities	Unavailability Count		Total RX Fra	mes		Control			
Files									

## 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		Setup			F		Start	
	Cont	lg. Tests		Perf. Tests	s 📃	Event	Log	
😑 Signal	Service 1 Service			2 5	Service 3	mmary		
Frame			Pe	ending				
<b>U</b>	4	Pass/Fail	IR(Mbps)	FLR(%)	FTD(ms)	FDV(ms)	AVAIL(%)	
Pattern	2	Disabled			-			
-	3	Disabled			-			
ALM/ERR								
X Tools								MX Discover
Utilities								Control
Files								

## Perf. Tests - Summary

## Go back to top Go back to TOC

#### **Event Log**

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

Event Log								
LEDs	Set	up	Results				Start	
	Config. Tests	P	Perf. Tests		[	Event Log		
🔵 Signal	Time	Event Type		# of Ever	nts	Test		
Frame	2011-11-10 07:35:46	Test Started	t Started		V-SAM			
0	2011-11-10 07:36:56	Test Stoppe	Stopped			V-SAM		
Pattern								
ALM/ERR								
× Tools							MX Discover	
Utilities	Page 1 of 1 🔍						Control	
Files								

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# 5.6 Throughput Testing (Multiple Streams)

- <u>Setup</u>
  - General Settings
  - Per Stream Configurations
  - Traffic Settings
  - Error Injection Settings
  - Alarm Injection Settings
  - Summary
  - Starting/ Stopping a Throughput Test
- <u>Results</u>
  - Viewing Throughput (Multiple Streams) Test Results
  - Global Aggregate Results
  - Per Stream Results
  - Saving Throughput (Multiple Streams) Results

## **Overview:**

The throughput application (or the multiple streams 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 allows for the configuration of up to 8 traffic streams with their own MAC and IP addresses, VLAN tags (up to 3 per stream), 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 (up to 8 streams) 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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## 5.6.1 Setup

Unless otherwise noted, the Frame Header and related setups are the same as the ones described in the <u>BERT</u> section. The following parameters must be configured prior to performing a Throughput test:

- 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)

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## 5.6.1.1 General Throughput Settings (Global Configuration)

## Page 1:

- # of Streams: From 1 to 10 streams.
- Stream #: Allocated Bandwidth per Stream: The total bandwidth for all streams cannot exceed 100%.
- Total (%): Sum of all stream rates in %.

## **Throughput Setup - General Settings**

eo LEDs	Setup	Results	Start
	Header Traffic Error Inj. Alar	n Inj. General Summary OAM	
Tools	# of Streams	1	1
Litilities	Stream #1 (%)	10.000	
Candes	Total (%)	10.000	
Files			
			LASER ONOH
			MX Discover
			Control
6	• Page	1 of 2 💿	

## Page 2:

• **#of Streams:** From 1 to 10 streams.

 $igsymbol{\neg}$  # of Streams can be specified either on Page 1 or Page 2. It will be reflected on both pages.

- Delay Measurement Mode: Disable, Round Trip Delay. Local One way delay measurement, Atomic one way delay, or GPS one way delay are also available depending on the Clock Synchronization device selected in the Setup (home menu) > Measurement menu. Refer to Measurement Settings for more information. Round Trip Delay should only be enabled when running the test to a remote loopback.
- 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.
- SDT Measurement: Enable/Disable. The Service Disruption Test is triggered based on user established thresholds.
  - **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.
  - **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.
- Traffic Loss Trigger: If the receiver does not detect incoming traffic within the configured threshold time, a traffic loss trigger is recorded in the event log.
- RTD Unit Auto Scale: On/OFF

LEDs	Setup				Results		Start			
	Header	Traffic	Error Inj.	General	Summary	OAM				
😑 Signal	# of Streams	5		1						
A Frame										
	Delay Meası	urement Moo	de	Round Trip Delay 🛛 🔻 🔻						
Pattern	Histogram			Enable 🛛 🔻						
0	Sampling Period			1sec 🗸 🗸 🗸						
ALM/ERR	Threshold (I	Max RTD all	owed)	100.00	us	▼				
	SDT Measu	rement		Enable 🗸 🗸						
HISTORY	SDT Measu	rement Trigg	jer(>us)	10000			MX Discover			
	SDT Violatio	on Threshold	l(us)	50000			Control			
	Traffic Loss	Trigger(>m	5)	Enable 🔻 100						
		Page 2 of 2								

## **Throughput Setup - General Settings (Page 2)**



# **Multiple Streams**

All streams are configured for the same test layer - if Layer 2 is selected, all streams will be Layer 2 traffic.

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## 5.6.1.2 Per Stream Configurations

## **MAC Setup**

MAC configuration in the Throughput section features MAC flooding for buffering verification and performance testing of Ethernet switches.

- 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.

For information on header configuration please see <u>BERT Header Settings</u> in the BERT section.



## **Throughput Setup - Header Settings per Stream**



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# 5.6.1.3 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 or Uniform. If uniform is chosen, the user will have to input a minimum and maximum frame size.
- 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 10k bytes.
- BW (Transmit Bandwidth): Configure the transmit rate for the stream.

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

For more information on Traffic Settings, please see **<u>BERT Traffic Settings</u>**.



## Throughput Setup - Traffic Setup - Constant Traffic Flow

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## 5.6.1.4 Error Injection Settings (Per Stream Configuration)

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, IP Checksum (Layer 3, 4 only), TCP/UDP Checksum (Layer 4 only), Sync Header Error, Block Type Error, Pause, or Bit. With Pause selected, the unit will transmit a pause frame when the 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.
- Injection Flow: The error injection flow determines how the selected errors will be injected. The user can select a single error, a specific count, or rate.
- Count and Rate: The user will be able to configure the error count via numeric keypad.

LEDs	Setup	Results	Start
	Header Traffic Error Inj. Alar	m Inj. General Summary OAM	
😑 Signal	Stream #	1 🔻	
Frame	Error Type	CRC 🗸	
•	Injection Flow	Rate 🔻	
Pattern	Rate	1.00E-03	
ALM/ERR			LASER On MX Discover Loop Control

## **Throughput Test - Error Injection Settings per Stream**

## 5.6.1.5 Alarm Injection Settings

Alarm injection can be performed during the 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 Inject** button on the right side of the screen.

Alarm Injection is available only with 10GE Port Tests.

- Alarm Type: Local Fault, Remote Fault, PCS-HI-BER, PCS-LOBL
- Alarm Flow: The alarm flow determines how the selected alarms will be injected. A specific Count or Continue (continuous) can be selected.
- Alarm Length: 1s, 10s, or 100s.

	LEDs		Setu	P	Results		Start
		Header	Traffic	Error Inj. Alarn	<mark>n Inj.</mark> General Summary	OAM	
$\left  \times \right $	Tools	Alarm Type	•		Local Fault	V	
	Utilities	Alarm Flow	v		COUNT	▼	
		Alarm Len	gth		1s	<b>•</b>	
	Files						
							LASER ONIOR
							CHOIL OIL OIL
							MX Discover
							Control

## **Throughput Alarm Injection Setup**

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#### 5.6.1.6 Summary

The summary screen lists the source, 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		Results				Start
		Header Tr	raffic Err	ror Inj. Alarn	n Inj. Ger	neral <mark>Su</mark>	mmary	OAM	
$\left  \right\rangle$	Tools	MAC List	IP Lis	t VLAN	l List	Port List	:	MpIs List	]
	Utilities	# of Streams		MAC Source	•	MAC	Destin	ation	
		Stream #1		00-18-63-00	0C-40	00-1E	-90-A0	-57-3C	
	Files	Stream #2		00-18-63-00-	-0C-40 00-1E-90-A0-57-3C		-57-3C		
		Stream #3		00-18-63-00	0C-40	00-1E	-90-A0	-57-3C	
									LASER On/Off
									MX Discover
									Control

**Throughput Test - Summary (MAC List)** 

e LED	5	Setup				Resul		Start	
	_	Header	Traffic	Error Inj.	General	Summa	ary	OAM	
X Tool	5	MAC Lis	st	IP List	VLAN LI	st	P	ort List	
Utilit	ties	# of Streams	5	Source IP A	ddress	Destina	tion	IP Address	
	_	Stream #1		192.168.1.10	1	192.168.2.200			
Files	-	Stream #2		192.168.1.10	192.168.2.200				
	_	Stream #3		192.168.1.10	1	192.168.	.2.20	0	
									MX Discover
									Control

# Throughput Test - Summary (VLAN List)

	EDs		Setup			Start		
		Header	Traffic Erro	or Inj. Alam	n Inj. Gener	al Summary	OAM	
×  「	ools	MAC Lis	t IP List	VLA	N List Po	ort List I	MpIs List	
<b>D</b> U	tilities	# of Stream	ns	ID	Priority	Туре		]
		vian #1 of :	stream 1	12	3	8100 🔻		
E F	iles	vian #1 of	stream 2	12	3	8100 🔻		
		vlan #1 of	stream 3	12	3	8100 🔻		
								LASER On/Off
								MADISCOVER
								Control

Throughput Test - Summary (Port List)

	LEDs		Setup				Start		
		Header	Traffic	Error Inj.	Alarm Inj.	General	Summary	OAM	
$\left  \times \right $	Tools	MAC Lit	it IP	List	VLAN List	Port	List	Mpls List	
	Utilities	Backgrour	ıd	Source	e Port	D	estination I	Port	
		Stream #1		0		0			
	Files	Stream #2		0		0			
		Stream #3		0		0			
									LASER On/Off MX Discover Control

Throughput Test - Summary (MPLS List)

	Setup	)			Resul	Start	
Header	Traffic	Error Inj	j. Alarm	lnj.	General Sum	mary OAM	
MAC Lit	st IP	List	VLAN	Lis	t Port List	Mpls List	
Backgrour	nd	Label		s	Cos	TTL	
mpls #1 of	stream 1	0		1	0	128	
							LASER On
							MX Discover
							Loop Control
	Header MAC Lis Backgrour mpls #1 of	Setur Header Traffic MAC List IP Background mpls #1 of stream 1	Setup       Header     Traffic     Error Inj       MAC List     IP List       Background     Label       mpls #1 of stream 1     0	Setup         Header       Traffic       Error Inj.       Alarm         MAC List       IP List       VLAN         Background       Label       mpls #1 of stream 1       0	Setup       Header     Traffic     Error Inj.     Alarm Inj.       MAC List     IP List     VLAN List       Background     Label     S       mpls #1 of stream 1     0     1	Setup     Result       Header     Traffic     Error Inj.     Alarm Inj.     General     Sum       MAC List     IP List     VLAN List     Port List       Background     Label     S     Cos       mpls #1 of stream 1     0     1     0	Setup       Results         Header       Traffic       Error Inj.       Alarm Inj.       General       Summary       OAM         MAC List       IP List       VLAN List       Port List       Mpls List         Background       Label       S       Cos       TTL         mpls #1 of stream 1       0       1       0       128

## 5.6.1.7 FEC

# Throughput Test - FEC Summary

1 400GE	_				<u> ()</u>	
LEDs	Se	tup		R	esults	Stop
	Global		Per	Stream	FEC	Restart
😑 Signal	Summary		Alarn	ns/Errors	Skew	
Frame	Alarms	S	Seconds			TX Stop
•	HiSER		0			Alm Frr
Pattern	LOA		0			
<b>U</b>	Err	ors		Count	Rate	
	uCFEC			0	0.00E+00	
	CFEC CW			4994206	4.22E-04	
History	CFEC Symbol			5005042	7.78E-07	Pre-emphasis
	CFEC Bit			5007728	7.79E-08	
	CFEC Ones			4408353	6.86E-08	I2C Access
	CFEC Zero			599375	9.32E-09	
OSFP-DD	Invalid Transcode	d Blo	ck	0	0.00E+00	Setup Injection
RS-FEC : ON						
(P) 192.168.0.92	Remote/CLI			2	019-10-29 06:41:10	

Throughput Test - FEC Alarm/Errors

6 1 400GE			-			(	<u> </u>	🔞 🖻
LEDs		Setup			R	esults		Stop
	Global		Per	Stream		FEC		Restart
😑 Signal	Summa	ry	Aları	ms/Error	'S		Skew	
🔘 Frame		Ch	annel A Erro	or	CI	hanne	B Error	TX Stop
Ŭ		Coun	t R	ate	Cou	nt	Rate	MAIm MErr
😑 Pattern	uCFEC	0	0.00	E+00	0		0.00E+00	
<u> </u>	CFEC CW	436333	38 5.69	9E-04	4230950		5.52E-04	
ALM/ERR	CFEC Symbol	437465	57 1.05	5E-06	4242292		1.02E-06	
History	CFEC Bit	437955	59 1.05	5E-07	42472	262	1.02E-07	Pre-emphasis
	CFEC Ones	339160	08 8.13	3E-08	33984	133	8.15E-08	
	CFEC Zero	Zero 987951		7E-08	8488	29	2.04E-08	I2C Access
QSFP-DD RS-FEC : ON		Lane [	Details	C	orr. Sym	bol De	tails	Setup Injection
I92.168.0.92	Remote/CLI				1	2019-10	-29 06:41:54	

Throughput Test - FEC Alarm/Errors Lane Details

1 400GE							😵 🕞	
		EEC ID	LOAMPS	CFEC	Symbol	CFE	C Bit	Stop
LEDs			Seconds	Count	Rate	Count	Rate	Stop
	0	1	0	2605134	4.39E-07	2615677	4.41E-07	Restart
😑 Signal	1	0	0	136819	2.31E-08	136847	2.31E-08	
	2	3	0	1490082	2.51E-07	1490784	2.51E-07	TX Stop
🜔 Frame	3	2	0	246636	4.16E-08	246705	4.16E-08	
	4	5	0	8080	1.36E-09	8080	1.36E-09	MAlm MErr
Pattern	5	4	0	231414	3.90E-08	231420	3.90E-08	
Ŭ	6	7	0	3251532	5.48E-07	3253730	5.49E-07	
	7	6	0	2122789	3.58E-07	2124004	3.58E-07	
	8	9	0	12466	2.11E-09	12466	2.11E-09	
History	9	8	0	23677	4.01E-09	23677	4.01E-09	Pre-emphasis
	10	11	0	552156	9.35E-08	552194	9.35E-08	
	11	10	0	164257	2.78E-08	164259	2.78E-08	I2C Access
	12	12	0	44817	7.59E-09	44817	7.59E-09	
	13	13	0	22819	3.86E-09	22819	3.86E-09	Setup Injection
QSFP-DD	14	14	0	103966	1.76E-08	103966	1.76E-08	
RS-FEC : ON	15	15	0	64647	1.10E-08	64648	1.10E-08	
(P) 192.168.0.92	R Rem	ote/CLI				2019-10-29	06:42:21	



				😵 🕞
LEDs	FEC Correctable Symbol Breakdown	Count	Percentage	Stop
	FEC Corr. Sym 1 Count	13910364	99.70631	Restart
😑 Signal	FEC Corr. Sym 2 Count	40372	0.28938	
	FEC Corr. Sym 3 Count	567	0.00406	TX Stop
😑 Frame	FEC Corr. Sym 4 Count	30	0.00022	
	FEC Corr. Sym 5 Count	4	0.00003	Alm Err
😑 Pattern	FEC Corr. Sym 6 Count	0	0.00000	
	FEC Corr. Sym 7 Count	0	0.00000	
ALM/ERR	FEC Corr. Sym 8 Count	0	0.00000	
	FEC Corr. Sym 9 Count	0	0.00000	
History	FEC Corr. Sym 10 Count	0	0.00000	Pre-emphasis
	FEC Corr. Sym 11 Count	0	0.00000	12C Access
	FEC Corr. Sym 12 Count	0	0.00000	
	FEC Corr. Sym 13 Count	0	0.00000	Setup Injection
QSFP-DD	FEC Corr. Sym 14 Count	0	0.00000	
RS-FEC : ON	FEC Corr. Sym 15 Count	0	0.00000	
102 168 0 02	Remote/CLL	2019	10 29 06:43:06	

## **Throughput Test - Skew**

		🛞 🕞							
LEDs			Setup				Results		Stop
		Glo	bal	Per Stream				FEC	Restart
😑 Signal		Sum	mary	Alarms/Errors				Skew	
🕒 Frame	1#	BX ID	RX	Skew	1#	BXID	RX	Skew	TX Stop
Ŭ	L#		bits	ps	L#		bits	ps	Alm /Err
😑 Pattern	0	1	114	4291	8	9	160	6023	
	1	0	113	4254	9	8	159	5985	
ALM/ERR	2	3	1	37	10	11	174	6550	
History	3	2	0	0	11	10	173	6512	Pro omphacic
Thistory	4	5	142	5345	12	12	60	2258	Pre-empirasis
	5	4	141	5308	13	13	60	2258	I2C Access
	6	7	78	2936	14	14	172	6475	Setup Injection
QSFP-DD	7	6	77	2898	15	15	172	6475	Setup injection
RS-FEC : ON									
I92.168.0.92	RR	emote/CL	1				2019-10-2	9 06:43:38	

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

Once all configurations have been made, the user can start the Throughput 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 Throughput testing.

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

#### • 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 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 Throughput 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 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.

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#### 5.6.2 Throughput Results

#### 5.6.2.1 Viewing Throughput (Multiple Streams) Test Results

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

#### 5.6.2.2 Global/Aggregate Results

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

The Global Stream Summary screen displays:

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

#### **Throughput Results - Global Stream Summary**

LEDs	Se	tup		Res	ults	Stop
	Global	Per	Stream		OAM	
🜔 Signal	Stream Summary	Aggregate Er	rors Alarms	Event	s Traffic Delay	Kestar
Frame	Stream #	% of BW	Errors		QoS	TX Stop
•	Stream #1	0.00	None		0	
Pattern	Stream #2	30.00	None		0	
$\sim$	Stream #3	49.94	None		0	
ALM/ERR						
Tools						MX Discover
Utilities						Control
Files						

#### 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.

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

#### IP Network QoS Class Definitions and Network Performance Objectives (Classes 0-3)

# IP Network QoS Class Definitions and Network Performance Objectives (Classes 4-7)

Network		QoS C	lasses	
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	≤ 50 ms	≤ 50 ms
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

The Aggregate screen displays these parameters:

- 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).
- 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				Result	ts		Stop
_	Global		Per Stre	am		OAM		
😑 Signal	Stream Summary Ag	gregate	Errors	Alarms	Events	Traffic	Delay	Restart
Frame	ST:2012- 1- 5 19:41:54		ET	:00:00:37				TX Stop
0		тх			RX			
😑 Pattern	Line Rate (bps)	1000.000	М		1000.0001	М		
Ŭ	Utilization (%)	79.943%			79.942%			
ALM/ERR	Utilization (bps)	799.430N	1		799.420M	1		
	Framed Rate (bps)	789.042N	1		769.033M	1		
X Tools	Data Rate (bps)	764.377N	1		764.368M			MY Disasure
	Total Frames	2407503			2407500			MADISCOVER
Utilities	Bad Frames	0			0			Control
	Pause Frames	0			0			
Files								

#### **Throughput Results - Global Aggregate**

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The **Global Signal** screen (fiber ports only) displays the optical level measured by the transceivers. Page 1 displays the level measurement in dBm for the optical signal.

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



#### **Throughput Results - Global Signal (Page 1)**

#### Signal (Page 2)

Page 2 displays the Optical module (transceivers) information which includes Vendor name, Part Number and Optical Wavelength. Tap on the **Decode** button to view additional information on SFP optics.

#### Signal (Page 3)

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

- 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.

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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

#### **Throughput Results - Global Errors**

LEDs	Set	up				Res	ults		Stop
	Global			Per Stre	am		OAM		Restart
Signal	Stream Summary	Aggr	egate	Signal	Errors	Alarms	Events	Traffic	
Frame			Curre	nt	ie er er til Ve	Total	i.	÷	TX Stop
-	Sync Header Error		0			0			Err Inj.
Pattern	Block Type Error		0			0			Alarm Ini
	FCS/CRC		0			0			
ALM/ERR	IP Checksum		0			0			LASER Off
History	TCP/UDP Checksu	IM	0			0			MX Discover
	Jabber Frames		0			0			
	Runt Frames		0			0			Loop Control

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

- LOS: Loss of Signal
- LOSync: Loss synchronization
- 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
- PCS-HI-BER: PCS High BER
- PCS-LOBL: PCS Loss of Block Lock

#### **Throughput Results - Global Alarms**

LEDs	Se	tup				Res	ults		Stop
	Global			Per Stre	eam		OAM		Restart
O Signal	Stream Summary	Aggr	egate	Signal	Errors	Alarms	Events	Traffic	
Frame	1	Curre	nt			Total			TX Stop
-	LOS(us)	0.000				0.000			Err Inj.
Pattern	LOSync(us)	0.000				0.000			Alarmini
-	Service Disruptio	n							
ALM/ERR	Current	Ous		T	otal		Ous		LASER Off
History	Last			01	us				MX Discove
	Min/Max	Ous				Ous			
	No. of Occurrence	es		0					Loop Contro
	Local Fault	0		R	emote i	Fault	0		]
		۲		Page	1 of 2	۲			

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

#### **Throughput Results - Global Events**

LEDs	Set	up				Re	sults	Stop
	Global		P	er Strea	am		OAM	
😑 Signal	Stream Summary	Aggre	gate	Errors	Alarms	Even	ts Traffic Delay	Restart
Frame	Time	Event	:Type		# of Eve	nts	Test	TX Stop
U	2012- 1- 5 19:41:54	Test \$	Started				Global	Errini
😑 Pattern								
ALM/ERR								
X Tools								MX Discover
Utilities			•	Page 1	of1 🔍	>		Control
Files								

The **Global Traffic** screen displays:

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



#### **Throughput Results - Global Traffic Summary**

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 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

### **Throughput Results - Frames Type**

LEDs	Frames		Traffic Type	-	Frame Size	Stop
	RX Frames	#		%		Paulant
😑 Signal	Total	0		100		Kestar
0.0	Test	0		0		TX Stop
O Frame	VLAN	0		0		Err Ini.
Pattern	VLAN Stack	0		0		
0	MPLS	0		0		Alarm Inj.
e ALM/ERR	MPLS Stack	0		0		LASER Off
	Non-Test	0		0		
History	TX Frames	#				MX Discover
	Total	979874				Loop Control
	Pause Frames	тх		RX		
	Total	0		0		

**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

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#### 5.6.2.3 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 <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.

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.

#### Throughput Results - Summary per Stream

LEDs	Setup				Results	Stop	
	Glo	bal	Per S	tream	04	ъM	
😑 Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restart
Frame	VLAN ID: N#	4	Stream #		2	•	TX Stop
U	ST:2012-1-	5 19:41:54		ET:00:06:43			Errini
😑 Pattern		T	X		RX		
	Utilization (%	%) 30	0.000%		30.000%		
ALM/ERR	Utilization (k	ops) 30	M000.00		300.000M		
	Framed Rate	e(bps) 29	96.108M		296.108M		
X Tools	Data Rate (b	ops) 28	96.381M		286.381M		MX Discover
	# of Bytes	14	4913065870		14913064348		
Utilities	Total Frame	s 97	798335		9798334		Control
	Bad Frames	0			0		
Files							

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

				•				
LEDs	Se	tup				Results		Stop
_	Global		Per Si	tream		Ó/	AM	
😑 Signal	Summary Err	ors	Events	Traffi	6	Delay	Rates	Restart
Frame	VLAN ID: N/A		Stream #			2	▼	TX Stop
<b>U</b>		Currer	nt		Tot	al		
😑 Pattern	Bits	N/A			N/A			
	BER	N/A			N/A			
ALM/ERR	FOSICRC	0			0			
	IP Checksum	0			0			
X Tools	TCP/UDP Checks	0			0			MX Discover
	Jabber Frames	0			0			
Utilities	Runt Frames	0			0			Control
Files		٩	Pag	e 1 of 2		•		

#### **Throughput Results - Errors per Stream**

Throughput Results - Errors per Stream (page 2)

LEDs	s	etup				Results		Stop
	Global		Per S	tream		ÓA	M	
😑 Signal	Summary E	rors	Events	Traffic	;	Delay	Rates	Restart
😑 Frame	VLAN ID: N/A		Stream #			2	▼	TX Stop
Ŭ		Curre	nt		Tot	al		Errini
O Pattern	Frame Loss	0			0			
	Frame Loss %	0.00%			0.00	0%		
U ALM/ERK	oos	0			0			
Tools								
								MX Discover
Utilities								Control
Files		٩	Pag	e 2 of 2		۲		

#### Service Disruption Test (SDT)

- 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	1	Setup				Results		
	Global Per Stream OAM							
Signal	Summary	Errors	SDT	Events	Traffic	Delay	Rates	
ame	VLAN ID: N/	A	Stre	am #	1		V	
	Service Dis	ruption						
attern	Total			Ous				
	Last			Ous				
M/ERR	Min/Max	0u	s	24 	Ous			
ory	No. of Occu	rrences		0				
	No. of SDT	Violations		0				
			(	SDT Res				

#### **SDT Per Stream Results**

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

#### **Throughput Results - Events per Stream**

LEDs		Setup	þ		F	Results		Stop
	G	ilobal		Per Stream	n	0	AM	Restart
😑 Signal	Summary	Errors	SDT	Events	Traffic	Delay	Rates	
Frame	VLAN ID: N	I/A	Stre	am#	1			TX Stop
	Time		Event T	ype	# of Ever	nts Te	st	Err Inj.
O Pattern	2017-02-22	14:34:16	Lost Fra	ames	1	Pe	r Stream	
ALM/ERR						_		-
History								MX Discover
								Loop Control
			٩	Page	1 of 1 🕑			

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



Throughput Results - Traffic per Stream

The **Per Stream Delay** screen displays the frame delay information pertaining to each stream. The Histogram shows the sampling points for the delay.

#### **Round Trip Delay Results and Histogram**

LEDs	-	Setup	1		Res	ults		Stop
	Glo	bal	Pers	Stream		0/	AM	
Signal	Summary	Errors	Events	Traffic	De	lay	Rates	Restart
C Frame	VLAN ID: N/A		Stream #		1		V	TX Stop
<b>U</b>	Frame Arriva	l Time						Errini
Pattern	Current	N/A		Average		N/A		
0	Minimum	N/A	î	Maximum		N/A		
O ALMVERR	Frame Delay	Variation		-				
	Current			0.00us				
Tools	Round Trip [	Delay	Histogr	am				MX Discover
Litilities	Current	0.00u	s	Average		0.00u	5	
Cundes	Minimum	0.00u	5	Maximum		0.00u	5	Control
Files	<u>j</u>							

#### **Throughput Results - Delay per Stream**



#### **Throughput Results - Round Trip Delay Histogram**

One Way Delay Results and Histogram (Table and Graph)

LEDs		Setup			Res	ults		Stop
	Glo	bal	Per	Stream		OA	M	
Signal	Summary	Errors	Events	Traffic	De	lay	Rates	Restart
C Frame	VLAN ID: N/A		Stream #	3	1		v	TX Stop
•	Frame Arriva	l Time						Errini
Pattern	Current	110.90	)us	Average		110.90	lus	
0	Minimum	110.88	Bus	Maximum		110.91	lus	
	Frame Delay	Variation						<u> </u>
	Current			0.00us				
Tools	One-Way Del	ay	Histog	ram				MX Discover
Linitation	Current	13.26	us	Average		13.24	IS	
Cuindes	Minimum	12.32	us	Maximum		17.80u	IS	Control
Files								

#### Throughput Results - Delay per Stream (One Way Delay)

**Throughput Results - One Way Delay Histogram Graph** 



Throughput Results - One Way Delay Histogram Table

LEDs		Setup			Results		Stop
	Glo	bal	Per S	tream	0.	AM	
🜔 Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restart
C Frame	VLAN ID: N/A	iê	Stream #		1	V	TX Stop
Ŭ	Gra	h			Close		Errini
O Pattern	Sample#		Time		One-Way Del	lay	$\square$
	1		2013-7-17 2	1:50:00	13.24us		
ALMVERR	2		2013-7-17 2	1:50:01	13.44us		
	3		2013-7-17 2	1:50:02	13.36us		
Tools	4		2013-7-17 2	1:50:03	13.32us		MY Discover
	5		2013-7-17 2	1:50:04	13.10us		
Utilities	6		2013-7-17 2	21:50:05	13.20us		Control
	7		2013-7-17 2	1:50:06	13.46us		
Files			-		<b>&gt;</b> >>		

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



#### **Throughput Results - Rates per Stream**

#### Throughput Results - Rates per Stream (Rate Details)

LEDs		Rate Details		Stop
	Frames/sec	тх	RX	
😑 Signal	Current	24319	24319	Restart
0.5	Minimum	22071	22069	TX Stop
🕒 Frame	Maximum	24320	24320	
Pattern	Average	24315	24315	Err Inj.
0	Data Rate (Mb/s)	тх	RX	
ALM/ERR	Current	286.381M	286.381M	
-	Minimum	259.908M	259.885M	
X Tools	Maximum	286.392M	286.392M	
	Average	286.337M	286.337 M	MADISCOVER
Utilities				Control
Files				

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#### 5.6.2.4 Saving Throughput (Multiple Streams) Results

Once the test has been stopped the results can be saved by pressing the **Save** key on the VePAL's keypad. The results will be RXT-6400\_Module\_Manual Page 8

saved and named automatically. Once the results are saved, the user may view or rename the results file by going to **Utilities** > **Files** > **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.

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### 5.7 Autoscripting

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

LEDs	BE	RT		THROUG	SHPUT	
	File Prefix		AutoScrip	ot		
😑 Signal	If Alarm/Error dete	cted:			Continue 🛛 🔻	<u>i</u>
	Profile1	Default 🛛 🔻	30	Sec. 🔻	View Setup 🧲	•
😑 Frame	Profile2	Default 🛛 🔻	30	Sec. 🔻	View Setup	b
	Profile3	None 🛛 🔻				
Pattern	Profile4	None 🛛 🔻				
	Profile5	None 🛛 🔻				
ALMIERK	Profile6	None 🛛 🔻				LASER OF
History	Profile7	None 🛛 🔻				MX Discover
	Profile8	None 🛛 🔻				
	Profile9	None 🛛 🔻				
	Profile10	None 🛛 🔻				
		S	art			

#### **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.

LEDs	Setu	P		Results		
	Events	Traffic	D	elay	Rates	
😑 Signal	Summary	Signal	Er	rors	Alarms	
O Frame	ST: 2017-03-08 12:50	:08	ET: 00/0	ET: 00/00:00:37		
<b>O</b> Frame		тх		RX		
Pattern	Line Rate (bps)	10.000G		10.000G		
-	Utilization (%)	10.000%		0.000%		
😑 ALM/ERR	Utilization (bps)	1.000G	0			
	Framed Rate (bps)	986.993M		0		
History	Data Rate (bps)	975.290M		0		
	# of Bytes	4605470826	6	0		

#### **Autoscripting - BERT Results**

**Autoscripting - Saving Results** 

LEDs	Se	tup	Res	ults	
	Events	Traffic	Delay	Rates	
O Signal		Saving r	esults		
🕤 Frame	ST::				
Pattern	Line Utili:	Sav	ed!		
ALM/ERR	Utili:				LASER Off
History	Data				MX Discover
	# of	Car	icel		Loop Control
					Restart Script

### File Manager - Saved Results

				olumn Show All	Adva	inced
Name	16 Mode	¶₀Test	<b>T</b> Module	Date	<b>Т₀</b> Туре	Lock
autosave	CPRI	CPRI L2	CPRI	2017-03-03 13:07:37	Profile	2
autosave	CPRI	CPRIL2	CPRI	2017-03-03 13:05:36	Profile	2
autosave	CPRI	CPRIL1	CPRI	2017-03-02 11:43:09	Profile	2
Profile1	OTN/SDH	SONET	OTN/SDH	2017-02-03 16:17:29	Profile	2
p2	Ethernet	THRPT	Fiber	2017-03-03 12:56:39	Profile	2
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	2
AutoScript_p2_20170303_12582	Ethernet	THRPT	Fiber	2017-03-03 12:58:28	Result	2
		Page	1 of 3 🕟			
View 🔀 Del < Rename	) UL 1	S PDF 🍃 F	rom USB	🔈 то USB 🔹 ВТ		

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### 5.8 Packet Capture

#### 5.8.1 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	tup	Start
	Capture Mode	Filter	
😑 Signal	Profile	Default 🗸 🗸	
Frame	Mode	Automatic 🛛 🗸 🔻	
	Buffer Size	2М 🔻	
Pattern	Truncate	Whole 🔻	
ALM/ERR     History			
1000-TFULL			

#### **Capture Mode Setup**

#### Packet Capture In Progress

LEDs		Setup				
_		Ca	pture Mode		Filter	
😑 Signal		Profile	Dooket	Conture		▼
Frame		Mode	Packet	Capture		▼
		Buffer Size	Packet Capture captu	uring		<b></b>
Pattern		Truncate		-		▼
<u> </u>			Packet Num: 10			
	2					
History						
			St	op		
1000-TFULL	•					

**Packet Capture Save** 

LEDs		Set	tup			
	Ca	pture Mode	Filter			
😑 Signal	Profile	Packet	Capture	▼		
🔵 Frame	Mode	Facket	capture	▼		
	Buffer Size	Packet Capture accomplished!				
Pattern	Truncate	Packet Num: 143/143				
ALM/ERR     History		Result Saved as:2017	0922_094123.pcap			
		ок				
1000-TFULL						

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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#### 5.8.2 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**, **MTTplus**, **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.

#### **Packet Capture Results on Wireshark**

☆																							÷	•	Deco	de A	.s
No.	Tim	ne		Sou	rce						De	stin	atio	on					Protoco	Le	engt	Info					
1	0.0	0000		192	.168	8.0.1	47				25			255	.25				DB-L	22	21	Dropbox LAN s	ync [	Disco	very	Prot	0
2	0.0	0167	1	192	.168	8.0.1	47				19	2.1	68.	0.25	55				DB-L	22	21	Dropbox LAN s	ync [	Disco	very	Prot	0
3	0.0	0212	0	192	.168	8.0.1	47				25	5.2	55.	255	.25	5			DB-L	22	21	Dropbox LAN s	ync [	Disco	very	Prot	0
4	0.2	4420	7	00:9	0:a	9:b8	3:07	:f0			ff:f	f:ff:	ff:ff	ff					Intel	68	В	Sequence: 758	301,	Sen	der I	D 2,	
•																											
⊕ Eth ⊕ Into ⊕ Use ⊕ Dro	<ul> <li>→ Frame 1: 221 bytes on wire (1/88 bits), 221 bytes captured (1768 bits)</li> <li>→ Ethernet II, Src: ac:81:12:22:c3:2d (ac:81:12:22:c3:2d), Dst: ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff</li></ul>																										
0080	3a 20	22 2	22 2c	20	22	70	6f	72	74	22	3a	20	31	37		: ""	, "I	p (	ort": 1	7							
0090	35 30	30 2	2c 20	22	6e	61	6d	65	73	70	61	63	65	73		500,	"na	a r	nespace	s							
00a0	22 38	20 3	50 37	33	34	31	37	33	37	39	32	2C	20	38		": [	/34.	1	/3/92,	8							
0000	36 32	34 3	38 35	38	35	2C	20	37	32	36	31	37	37	31		6248	585	ζ.	/261//	1							::::
0000	31 30	20 20 20 20 20 20 20 20 20 20 20 20 20 2	20 37	30	30	39	32	35	39	30	20	20	35	30		10,	1005		2590, 5	в							***
0000	39 30	593	22 21	39	21	20	70	00	C1	57	30				1	9895	191	J .	}/5								
																											◄
2017	0922	0941	23.p	cap				Р	ack	ets:	14	3 D	ispl	ave	d: 1	431	Mark		1·0102	4 ti	me <sup>,</sup> (	0.0.30					٦

Top section:

TimeSource

- Destination
- Protocol
- Length
- Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

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### 6.0 Lane BERT

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

#### 6.1 Lane BERT Setup

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



#### Lane BERT Setup Per Lane

1 400GE			(	+					🔞 🖻
LEDs		Se	tup			Re	sults		Stop
				Ger	neral				Restart
😑 Signal	QSFP Typ	e	400G (4X100)	)	Test	Rate	425G	▼	
<u> </u>			Patte	rn Co	nfigu	ration			TX Stop
Frame	Lane #	тх	Pattern	Inv	/ert	RX Patt	ern	Invert	
O D-#	All	PRBS3	1Q 🔻			PRBS31Q	▼		
<b>Θ</b> Pattern	BER Thr	eshold	2.400E-04						LASER On/Off
ALM/ERR									
History									Pre-emphasis
									I2C Access
QSFP-DD									Setup Injection
RS-FEC : ON				Perl	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 options to set PRBS patterns per lane or for all lanes is available in newer 40G/100G/400G modules, depending on the test set and software version.

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#### 6.1.1 Lane BERT Results

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

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#### 6.1.2 Lane BERT Signal

#### Signal (Page 1-2)

The Signal tab (fiber ports only) displays the receiving (RX) and transmitting (TX) optical level measured by the QSFP28, QSFP-DD, QSFP+ or OSFP transceiver.

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

1 400GE			¢			(	3 😣	
LEDs	S	etup				Results		Stop
	Signal	A	ggregat	te	Lane		Events	Restart
😑 Signal				Level	[Rx]			
<u> </u>	Rx Optica	al Powe	er[dBm]	1	LOS		SAT	TX Stop
Frame		Cur.	Min.	Max.	-13	_	+16	
• • • • • • • •	TOTAL	5.61	5.60	5.64	42			
<b>β</b> Pattern	#1 1310.00nm	-0.33	-0.35	-0.31	-13		+6	LASER On/Off
	#2 1310.00nm	0.10	0.09	0.19			•	
	#3 1310.00nm	-1.32	-1.32	-1.30		+		
History	#4 1310.00nm	-0.22	-0.24	-0.20		-4.4	+4.2	Pre-emphasis
								I2C Access
								Setup Injection
QSFP-DD								
RS-FEC : ON				Page 1	of 5 💽 🕑			

#### Signal (Page 1)

Signal (Page 2)



Signal (Page 3)

The received signal frequency and offset is measured and preformed 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.

1 400GE		_		)	-	<b>()</b>	😵 🕞
LEDs		Setup			Resul	ts	Stop
	Si	gnal	Aggregate	l	Lane	Events	Restart
😑 Signal			Frequ	ency			
	Lane	Freq. (kHz)	Offset (ppn	1) I	Min. (ppm)	Max. (ppm)	TX Stop
Frame	1	5312500	00	0.0	-2.3	0.0	
Ŭ	2	5312500	00	0.0	-2.9	0.0	Alm /Err
O Detterm	3	5312500	00	0.0	-2.9	0.0	
<b>O</b> Pattern	4	5312500	00	0.0	-2.9	0.0	LASER On/Off
	5	5312500	00	0.0	-2.8	0.0	
ALM/ERR	6	5312500	00	0.0	-2.8	0.0	
	7	5312500	00	0.0	-2.7	0.0	
History	8	5312500	00	0.0	-2.4	0.0	Pre-emphasis
	Total	42500000	00	0.0	-2.7	0.0	
QSFP-DD							Setup Injection
RS-FEC : ON		•	Page	3 of 5			

#### Signal (Page 3)

#### Signal (Page 4-5)

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

1 400GE					🔞 🕞
LEDs	Se	tup	Re	sults	Stop
	Signal	Aggregate	Lane	Events	Restart
🜔 Signal		QSFP Optical M	odule Information		Restart
0.5	Vendor	N/A	Part Number	T-DP4CNH-N00	TX Stop
Frame	Serial Number	INIBJ8141022	ldentifier	[80h] Unallocated	
O D-#***	oui	7F7C44	CLEI	N/A	
<b>β</b> Pattern	Date Code	20180905	Lot Code	05	LASER On/Off
	H/W Version	33-41	F/W Version	FF-FF	
ALM/ERR	Wavelength (nm)	1310.0	Tolerance (nm)	10.0	
History	Host Lane	8	Media Lane	4	Pre-emphasis
	Power Class		Power Class 6 Mo	dule (12.0 W max)	
	Module Type		[02h] Optical Inter	rfaces: SMF	I2C Access
	Host Electrical Int	erface Code	[11h] 400GAUI-8 C	2M (PAM4)	
QSFP-DD	Module Media Int	erface Code	[1Ch] 400GBASE-	Setup Injection	
RS-FEC : ON		Page	4 of 5 💿		

#### Signal (Page 4)

LEDs	Se	tup	Re	sults	Stop
	Signal	Aggregate	Lane	Events	Restart
😑 Signal		QSFP Optical	Module Status		
Frame	Temperature (Mo	dule/Cage)	51.5 C	48.0 C	TX Stop
<b>U</b> Praine	Voltage		3394 mV	Alm /Err	
🕒 Pattern	Power Consumpti	on	11.15 W		LASER On/Off
0 414555					
	Implemente	d Monitors 1	Implemente	d Monitors 2	
History	Temperature impl	emented	Tx Bias implemer	ited	Pre-emphasis
	Internal 3.3V imple	mented	Tx Opt. Power im	plemented	12C Access
			Rx Opt. Power im	plemented	ZO Access
OSEP-DD					Setup Injection
RS-FEC : ON		Page	5 of 5 💿		

#### 6.1.3 Aggregate

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

#### Aggregate



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#### 6.1.4 Lane

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

#### **PCS Results - Alarms/Errors**

					<b>)</b>	<b>()</b>	😢 🕞
LEDs		Setu			Re	sults	Stop
	Si	gnal	Aggreg	jate	Lane	Events	Restart
😑 Signal	Lane #	Pattern L	.oss(Sec.)	BIT Er	ror Count	BIT Error Ratio	
0.5	0	5		363649	)	1.353E-08	TX Stop
Frame	1	5		264652	:0	9.847E-08	
Pattern	2	5		562597	,	2.093E-08	
•	3	5		736728	;	2.741E-08	(LASER On/Off)
ALM/ERR	4	5		291109	)	1.083E-08	
	5	5		11302		4.205E-10	
History	6	5		93178		3.467E-09	Pre-emphasis
	7	5		246644	ļ	9.177E-09	I2C Access
QSFP-DD RS-FEC : ON							Setup Injection

#### 6.1.5 Events

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

#### **PCS Results - Events**



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### 7.0 FEC

(400G Only)

### 7.1 FEC Codeword Symbol Error Distribution

Count GOOD		1=					×		) 🕞
665057 261505	•• LEDs	FEC Correctable Sy	/mbol Breakdov	vn Co	unt	Perc	entage	-	Stop
199052		FEC Corr. Sym 1 Cou	Int	2240	882	99	9.99		
158574	🔘 Signal	FEC Corr. Sym 2 Cou	Int	14	10	0	.01		estart
112272		FEC Corr. Sym 3 Cou	Int	(	)	0	.00		( Stop
70346	🔵 Frame	FEC Corr. Sym 4 Cou	int	(	)	0	.00		
39129		FEC Corr. Sym 5 Cou	int	(	)	0	.00	Aln	n PErr
19361	Pattern	FEC Corr. Sym 6 Cou	Int	(	)	0	.00		
8659		FEC Corr. Sym 7 Cou	int	(	)	0	.00		
3466	ALM/ERR	FEC Corr. Sym 8 Cou	int	(	)	0	.00	Pre-	emphasis
		FEC Corr. Sym 9 Cou	int	(	)	0	.00		$\equiv$
	History	FEC Corr. Sym 10 Co	unt	(	)	0	.00	120	Access
		FEC Corr. Sym 11 Co	unt	0	)	0	.00	Cotur	Injection
BÃD		FEC Corr. Sym 12 Co	unt	0	)	0	.00	Seruh	injection
18		FEC Corr. Sym 13 Co	unt	0	)	0	.00		
	QSPP-DD	FFC Corr. Sym 14 Co	unt	(	)	0	.00		
	RS-FEC: ON	FEC Corr. Sym 15 Co	unt	(	)	0	.00		
	Down	Remote/CLI			2018-	10-02 09:	.08:23		
100%									
90%				Channe	el A Error		Cha	annel B	Error
80%				Count	Ra	te	Count	:	Rate
70%			CFEC	448	3.258	-07	500		3.63E-07
60%		d	FEC CW	102902	6.86	-09	98328		6.55E-09
40%		ō	FEC Symbol	175134	2.33	E-08	16981	4	2.26E-08
30%			FEC B	207989	1.398	E-08	20191	5	1.35E-08
20%			CFEC Ones	139677	9.31	-09	13394	1	8.93E-09
10%			FEC Zero	68312	4.55	-09	67974		4.53E-09
0%	4 5 6 7 8 9	10 11 12 13 14 15			1				

#### **Monitor Mode Results**

- Verify/Monitor PAM4 Signal Integrity
  - Codeword Symbol Error distribution
- PAM4 always has pre-FEC Errors
  - Differentiate between Correctable and Uncorrectable Errors
  - Identify how hard FEC is working
  - Benchmark/Compare transceiver preformances
  - Beyond 15 Symbol Errors per Codeword, the errors become Uncorrectable and start affecting the payload
- Zero post-FEC Errors
  - Client/Test traffic payload must remain Error Free (no uncorrectable errors)

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### 7.1.1 FEC Set Up

Stress Test Setup: After configuring setup, tap Start.

										×	
LEDs	FEC										Start
			Setup				ł				
😑 Signal		TX Lane Mapping & Skew									
0.5	L#	FEC ID	T	(Skew I	Bit	L#	FEC ID	т	Skew	Bit	
😈 Frame	0	0	-	0	+	8	8	-	0	+	
Pattern	1	1	-	0	+	9	9	-	0	+	
Ŭ	2	2	-	0	+	10	10	-	0	+	LASER On/Off
ALM/ERR	3	3	-	0	+	11	11	-	0	+	
	4	4	-	0	+	12	12	-	0	+	
History	5	5	-	0	+	13	13	-	0	+	Pre-emphasis
	6	6	-	0	+	14	14	-	0	+	I2C Access
	7	7	-	0	+	15	15	-	0	+	
QSFP-DD											
RS-FEC : ON		FEC II	) Shift			Ske	w Bit In	c./Dec.	Size	1	

### 7.1.2 FEC Results Summary

Results Summary: Tap on the Results>Summary tab to view test results.

#### **FEC Results Summary**



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

#### 7.1.3 Alarms and Errors

**FEC Alarms/Errors** 

6 1 400GE			-			🔞 🖻
LEDs			FEC			Stop
		Setup		ults	Restart	
😑 Signal	Summa	ry	Alarms/Erro	rs	Skew	
🕒 Frame	ST:2020-3-30 0	02:50:48	ET:00:	05:12		
<b>U</b>		Channe	A Error	Cha	nnel B Error	
Pattern		Count	Rate	Count	Rate	LASER On/Off
-	uCFEC	0	0.00E+00	0	0.00E+00	
ALM/ERR	CFEC CW	1990055	1.63E-04	2037891	l 1.67E-04	
History	CFEC Symbol	1990482	3.00E-07	2038426	6 3.07E-07	Pre-emphasis
	CFEC Bit	1990491	3.00E-08	2038444	3.07E-08	
	CFEC Ones	656712	9.90E-09	657215	9.90E-09	I2C Access
	CFEC Zero	1333779	2.01E-08	1381229	9 2.08E-08	Setup Injection
QSFP-DD RS-FEC : ON		Lane Deta	ils	Corr. Symbo	l Details	

FEC Results Alarms/Errors Lane Details

(1) 400GE								🔞 🕞
			LOAMPS	CFEC	Symbol	CFE	C Bit	Stop
LEDS			Seconds	Count	Rate	Count	Rate	
	0	1	0	91271	1.54E-07	91276	1.54E-08	Restart
😑 Signal	1	0	0	117221	1.98E-07	117227	1.98E-08	
	2	3	0	360799	6.08E-07	360799	6.08E-08	
🜔 Frame	3	2	0	1046111	1.76E-06	1046115	1.76E-07	=
	4	4	0	279866	4.72E-07	279867	4.72E-08	Alm / Err
Pattern	5	5	0	67585	1.14E-07	67585	1.14E-08	
Ŭ	6	6	0	72760	1.23E-07	72761	1.23E-08	LASER On/Off
	7	7	0	137512	2.32E-07	137513	2.32E-08	
	8	9	0	76946	1.30E-07	76946	1.30E-08	
History	9	8	0	60423	1.02E-07	60423	1.02E-08	Pre-emphasis
	10	11	0	2350	3.96E-09	2350	3.96E-10	
	11	10	0	2958	4.99E-09	2958	4.99E-10	I2C Access
	12	13	0	46111	7.77E-08	46111	7.77E-09	
	13	12	0	23263	3.92E-08	23263	3.92E-09	Setup Injection
QSFP-DD	14	15	0	76258	1.29E-07	76258	1.29E-08	
RS-FEC : ON	15	14	0	63207	1.07E-07	63207	1.07E-08	

FEC Results Alarms/Errors Corr. Symbol Details

1 400GE	$\rightarrow$			🔞 🖻
LEDs	FEC Correctable Symbol Breakdown	Count	Percentage	Stop
	FEC Corr. Sym 1 Count	4890629	99.97636	Restart
😑 Signal	FEC Corr. Sym 2 Count	1150	0.02351	restart
	FEC Corr. Sym 3 Count	6	0.00012	
😑 Frame	FEC Corr. Sym 4 Count	0	0.00000	
	FEC Corr. Sym 5 Count	0	0.00000	
Pattern	FEC Corr. Sym 6 Count	0	0.00000	LASER On/Off
	FEC Corr. Sym 7 Count	0	0.00000	
ALM/ERR	FEC Corr. Sym 8 Count	0	0.00000	
	FEC Corr. Sym 9 Count	0	0.00000	
History	FEC Corr. Sym 10 Count	0	0.00000	Pre-emphasis
	FEC Corr. Sym 11 Count	0	0.00000	IDC Access
	FEC Corr. Sym 12 Count	0	0.00000	EC Access
	FEC Corr. Sym 13 Count	0	0.00000	Setup Injection
QSFP-DD	FEC Corr. Sym 14 Count	0	0.00000	
RS-FEC : ON	FEC Corr. Sym 15 Count	0	0.00000	

### 7.1.4 Skew

1 400GE			😵 🖻						
LEDs			Stop						
			Setup				Results	Restart	
🔘 Signal		Summary A				ors		Skew	
🕒 Frame	ST:20	)20-3-3	0 02:50:48		ET:00	:09:18			
Ŭ	1#	RX ID	RX S	Skew	1#	BX ID	RX S	Skew	
🔵 Pattern			bits	ps			bits	ps	ASER On/Off
	0	1	2489	93703	8	9	1	37	LASER ONION
ALM/ERR	1	0	2488	93665	9	8	0	0	
History	2	3	1149	43256	10	11	1816	68367	Pro omnhacio
ristory	3	2	1148	43218	11	10	1815	68329	Pre-empirasis
	4	4	1860	70023	12	13	2221	83614	I2C Access
	5	5	1860	70023	13	12	2220	83576	Setup Injection
QSFP-DD	6	6	2497	94004	14	15	2243	84442	Setup injection
RS-FEC : ON	7	7	2497	94004	15	14	2242	84404	

#### FEC Skew

### Go back to top Go back to TOC

### 8.0 PCS

#### (100G Port 1 Only)

#### 8.1 PCS Setup

#### 8.1.1 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

LEDs		PCS											
			Se	tup			Results	Restart					
😑 Signal	VL ID	Тх	Skewl	Bit	PCS#	XLAUI	Dool Marris						
Frame	0	-	0	+	0	0		Chift					
	1	-	0	+	1	1	Default	Snift					
Pattern	2	·	0	+	2	2	Skow Sottings		LASER On/Off				
	3	·	0	+	3	3	Skew Settings	1					
							Inc./Dec. Size		MX Discover				
History							Alarm Threshold(bits)	1000					
								Default	I2C Access				
QSFP+ : 4X10G							Reset Tx Skew Bits		Setup Injection				

#### PCS Set Up - TX Lane Mapping and Skew

#### 8.1.2 Tx 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

#### PCS Setup - Tx Alarm/ Error Injection

1 100GE		<u> </u>	🛞 🖻				
LEDs		Stop					
	PC	S Lane	Selection		Erro		
😑 Signal	VL ID	Sel.	VL ID	Sel.	Layer	PCS 🔻	Restart
-	0	<ul><li>✓</li></ul>	10		Туре	ISH 🔻	
🜔 Frame	1		11		Behavior	Single 🔻	
	2		12				Alm Frr
🔵 Pattern	3		13				ASER On/Off
	4		14		Alarm	Generation	
ALM/ERR	5		15		Layer	PCS 🔻	MX Discover
	6		16		Туре	LOBL 🗸	
History	7		17		Behavior	Continuous 🔻	
	8		18				I2C Access
	9		19				
QSFP28 RS-FEC : OFF	Select All	Clea	ar All	_			
I92.168.33.170	Remote/C	LI				2020-04-02 04:23:41	

### 8.2 Results

### 8.2.1 Summary

				oount	, oanna			
LEDs				PC	S			Stop
		Set	up			Res	ults	Restart
😑 Signal	Summ	ary	Rx Lane :	Skew	Alarms/Errors Events			
Frame	ST:2020-3	-30 04:02	2:57	E	ET:00:11:36	·		
	XLAUI ID	0	1	2	3			Alm /Err
Pattern	0	1	2	3				
Ŭ	LOBL	$\odot$	0	0	0			LASER On/Off
ALM/ERR	ISH	$\odot$	0	0	0			MX Discover
	LOAML	$\odot$	0	0	0			
History	IAM	$\odot$	0	$\bigcirc$	$\circ$			
	BIP	$\odot$	0	0	0			(120 Assess
	Hi Skew	$\odot$	$\bigcirc$	$\bigcirc$	$\bigcirc$			IZC Access
	VLID	0	1	2	3			Setup Injection
QSFP+:4X10G	Hi-BER	0	LOA	0				

#### PCS Results Summary

### Go back to top Go back to TOC

8.2.2 RX Lane Skew

PCS RX Lane Skew

LEDs		PCS										
	Setup							Resul	ts	Restart		
😑 Signal	Su	Summary F			Rx Lane	Skew	Alarms/Errors		Events			
🔵 Frame	VL ID	Т	x Skew B	it	PCS#	XLAUI	Rx VL ID	Rx Skew(bits	s) Rx Skew(ps)			
	0	·	0	+	0	0	0	4	387			
Pattern	1	·	0	÷	1	1	1	66	6400	LASER On/Off		
ALM/ERR	2	·	0	+	2	2	2	0	0	MX Discover		
	3	ŀ	0	+	3	3	3	38	3684	MIX DISCOVED		
History												
										I2C Access		
										Setup Injection		
QSFP+:4X10G										Cetap injection		

### 8.2.3 Alarms and Errors



#### **PCS Results Alarms and Errors**

### Go back to top Go back to TOC

8.2.4 Events

**PCS Results - Events** 

LEDs		PCS											
	Set	up	Res	Restart									
😑 Signal	Summary	Rx Lane Skew	Alarms/Errors	Events									
🜔 Frame	Time	Event Type	# of Event	s Test									
Ť	2020- 3-30 04:02:57	Test Started		PCS	Alm /Err								
Pattern					LASER On/Off								
O ALM/ERR					MX Discover								
History													
					I2C Access								
QSFP+ : 4X10G		Pag	ie 1 of 1 🕒		Setup Injection								

### 8.3 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	Res	sults -	Sav	е			
Signal	Save r	Start									
• Frame	1	2	3	4	5	6	7	8	9	0	
Pattern	q	w	e	r	t	У	u	1	•	р	
ALM/ERR	a	s	d			9	h	J	k	1	
History	Caps	z	x		:	b	v	n	m	Shift	LASER On/Off
		Symb	001 [	Del	0	•	Del	AJI	<-		
				SPA	CE				Арр	oly	

Once the results are saved, they can be viewed or renamed by going to Tools / System Settings screen> Files.

Go back to top Go back to TOC

# 9.0 Advanced Optical Transceiver Test & Stress Test

The **Transceiver Stress Test** and **Advanced Optical Transceiver Test** features perform a batch of PASS/FAIL tests to check the health and capabilities of high-speed transceivers. From checking optical signal power levels, Lane BERT (pre-FEC) performance, voltage and frequency swing tolerances, I2C/MDIO registers read/write, pre-emphasis manipulation, all the way to verifying error-free Ethernet Throughput.

## 9.1 Transceiver Stress Test

Stress Test Setup: After configuring setup, tap Start.

() 400GE		<	*			×	
	QSFP-I	OD Stress	Test		Stop		
Setup	Summary	Si	gnal	Pr	e-FEC BERT		
Vendor: I NOLIGHT	P/N: T-DC	4CNT-N0	0	S/N: IN	IBV8142049		
Type: QSFP-DD	Undefined	Rates	(Gbps)	425G			
Thresholds		Pre-F	EC Pattern		Per Lane		
Frequency(ppm)	5.000	Lane	TX Pattern	Invert	RX Pattern	Invert	
MAX Pre-FEC BER	2.400E-04	All	PRBS31Q		PRBS31Q 🔻		
BERT Duration(secs)	300						
Ranges							
TX Power(dBm)	3 (typical)						Pre-emphasis
RX Level(dBm)	Min. <mark>-3.0</mark> Max. <mark>4.</mark>	0					
Stress Tests Options							
Pre-FEC Clock Swe	eep						
Post-FEC Performa	ance Test						
(P) 192.168.0.92 (R	Remote/CLI			2	019-10-29 02:58	:50	

#### **Stress Test Setup**

Stress Test Summary: Tap on the Summary tab to view the test summary.

#### **Stress Test Summary**

				) 🚱 🕞						
	QSFP-DD Stress Test									
Setup	Summary	Signal	Pre-FEC BERT							
Vendor: I NOLIGHT	P/N: T-DQ4	CNT-N00	S/N: INIBV8142049							
Type: QSFP-DD	400G-FR4	Test Rate (Gbps)	425							
PAS Signal - Leve	<b>S</b> els uency	Pre-FEC    Pre-FEC	C Option1 disabled Option2 disabled Option3 disabled Option4 disabled Option5 disabled C disabled	Pre-emphasis						
(P) 192.168.0.92 R	Remote/CLI		2019-10-29 03:04:34							

			¢				<b>()</b>	😵 🖻
	G	SFP-D	D Stres	s Test				Start
Setup	Summary			Signal		Pre-FE	C BERT	
				Level	[Rx]			
	Rx Optic	al Powe	er[dBm]		LOS		SAT	
		Cur.	Min.	Max.	-16		+12	
o'	TOTAL	6.43	6.35	6.44				
Signal Levels		0.07	0.07	0.07	-16		+6	
PASS	#1 12/1.00nm	-0.07	-0.37	-0.07				
	#2 1291.00nm	0.27	0.16	0.30				
<b>F</b>	#3 1311.00nm	0.02	0.26	0.02				
Frequency	#4 1001.001111	0.02	-0.50	0.05	]	-8.6	+4.5	Pre-emphasis
PASS								
				Page 1	of 5			
P 192.168.0.92	Remote/CLI					2019-1	0-29 03:05:49	

#### Stress Test Signal (Page 1)

Stress Test Signal Tab (Page 2): Tap on the Signal tab to view Signal Level (TX)

#### Stress Test Signal (Page 2)

			(					
	c	SFP-D	D Stres	s Test				Stop
Setup	Summary		:	Signal		Pre-Fl	EC BERT	
		,		Level	[Tx]			
	Tx Optic	al Powe	er[dBm]		LO	S	SAT	
		Cur.	Min.	Max.	-16		+12	
	TOTAL	7.29	7.28	7.29				
Signal Levels					-16		+6	
PASS	#1 1271.00nm	1.32	1.30	1.35			+	
	#2 1291.00nm	1.01	1.00	1.02			• •	
_	#3 1311.00nm	2.14	2.09	2.16			+	
Frequency	#4 1331.00nm	0.42	0.41	0.45		-8.6	+4.5	Pre-emphasis
PASS								
		٩		Page 2	of 5			
I92.168.0.92	Remote/CLI					2019-	10-29 07:36:38	

Stress Test Signal Tab (Page 3): Tap on the Signal tab to view Signal Frequency

#### Stress Test Signal (Page 3)

					<b>(3)</b>	😵 🕞
		QSFP-DI	O Stress Test			Stop
Setup		Summary	Signal	Pre-Fl	EC BERT	
			Frequency	1		
	Lane	Freq. (kHz)	Offset (ppm)	Min. (ppm)	Max. (ppm)	
	1	53125000	0.0	-0.0	0.0	
	2	53125000	0.0	0.0	0.0	
Signal Levels	3	53125000	0.0	0.0	0.0	
DACC	4	53125000	0.0	0.0	0.0	
PASS	5	53125000	0.0	-0.0	0.0	
	6	53125000	0.0	-0.0	0.0	
Frequency	7	53125000	0.0	0.0	0.0	
Trequency	8	53125000	0.0	-0.0	0.0	Pre-emphasis
PASS	Total	425000000	0.0	-0.0	0.0	
		٩	Page 3 of 5	•		
P 192.168.0.92	Remo	ote/CLI		2019-	10-29 07:37:20	

Stress Test Signal Tab (Page 4): Tap on the Signal tab to view QSFP Optical Module Information

#### Stress Test Signal (Page 4)

				<b>()</b>	🛞 🕞		
	QSFP-DD Stress Test						
Setup	Summary	Signa	Pre-FEC BERT				
	Vendor	I NOLIGHT	Part Number	T-DQ4CNT-N00			
	Serial Number	INIBV8142049	ldentifier	[18h] QSFP-DD			
Signal Levels	OUI	7F7C44	CLEI	N/A			
DACC	Date Code	20190105	Lot Code	05			
PASS	H/W Version	32-41	F/W Version	FF-FF			
	Wavelength (nm)	1310.0	Tolerance (nm)	10.0			
Frequency	Host Lane	8	Media Lane	4	Pre-emphasis		
PASS	Power Class		Power Class 6 M				
	Module Type		[02h] Optical Inte				
	Host Electrical Int	erface Code	[11h] 400GAUI-8				
	Module Media Int	erface Code	[1Dh] 400G-FR4				
		Page	4 of 5 💿				
(P) 192.168.0.92	Remote/CLI		2	019-10-29 07:37:54			

Stress Test Signal Tab (Page 5): Tap on the Signal tab to view QSFP Optical Module Status

#### Stress Test Signal (Page 5)

		<del>R</del>			<b>(</b>	) 😵 🕞		
	QSFP-DD Stress Test							
Setup	Summary	Pre-FEC BERT						
	Q	SFP Optical	Module	Status				
	Temperature (Module/C	age)	) 58.1 C		47.0 C			
	Voltage		3274 mV					
Signal Levels	Power Consumption		10.41 W					
	Implemented Monitors 1 Implemented Monitors 2							
Frequency	Temperature implemented Tx Bias implemented				ted	Pre-emphasis		
PASS	Internal 3.3V implemente	d	Tx Opt	Tx Opt. Power implemented				
			Rx Opt	. Power im	plemented			
	•	Page	5 of 5					
192.168.0.92	Remote/CLI			20	19-10-29 07:56:43			

Pre-FEC BERT Aggregate Tab: Tap on the Pre-FEC BERT tab and tap Start. The test will show as running.

Stress Test Pre-FEC BERT Aggregate

				<u></u>	
	Stop				
Setup	Summary	Signa	l	Pre-FEC BERT	
BER	Aggregate			Lane	
Running	ST:2019-10-29 07:55:54		ET:00:0	1:36	
	Pattern Loss(Sec.)		0		
	BIT Error Count		715141	4	
	BIT Error Ratio		1.753E-	07	
					Pre-emphasis
I92.168.0.92	Remote/CLI			2019-10-29 07:57:32	

Pre-FEC BERT Aggregate Pass: Once the test has finished the screen will show as Pass

#### Stress Test Pre-FEC BERT Aggregate PASS

				<u></u>	<b>S</b>
	QSFP-DD	Stress Tes	t		Start
Setup	Summary Signa		Pre-FEC BERT		
BER	Aggregate			Lane	
PASS	ST:2019-10-29 07:55:54		ET:00:0	5:01	
	Pattern Loss(Sec.)		0		
	BIT Error Count		2290810	00	
	BIT Error Ratio		1.791E-	07	
					Pre-emphasis
I92.168.0.92	Remote/CLI			2019-10-29 08:03:43	

Pre-FEC BERT Lane Tab: Tap on the Pre-FEC BERT>Lane tab and tap Start. The test will show as running.

Stress Test Pre-FEC BERT Lane

400GE			<	*		<u> </u>	8
		QSFP-D	D Stress	s Test			Stop
Setup	s	Summary	s	ignal	Pro	e-FEC BERT	
BER		Aggregate			L	ane	
Running	Lane #	Pattern Loss(S	ec.) B	IT Error Co	unt	BIT Error Ratio	
	0	0	73	34235		8.747E-08	
	1	0	24	155047		2.925E-07	
	2	0	32	22679		3.844E-08	
	3	0	68	384586		8.202E-07	
	4	0	59	9198		7.053E-09	Pro omnhasio
	5	0	96	61861		1.146E-07	Pre-emphasis
	6	0	24	19893		2.977E-08	
	7	0	26	68491		3.199E-08	
A02 460 0 02	Domo	to/011			20	040 40 20 07/50/22	

Pre-FEC BERT Lane Pass: Once the test has finished the screen will show as Pass

Stress Test Pre-FEC BERT Lane Pass
6 1 400 GE						<u></u>	😵 🖻
	Start						
Setup	s	Summary		Signal		Pre-FEC BERT	
BER		Aggregate				Lane	
PASS	Lane #	Pattern Loss(S	Sec.)	BIT Error C	ount	BIT Error Ratio	
	0	0		1397008		8.736E-08	
	1 0		4690905			2.934E-07	
	2 0			607883	3.801E-08		
	3	0				8.314E-07	
	4	0		116352		7.276E-09	Pro omphasis
	5	0		1874400		1.172E-07	Pre-emphasis
	6	0		427289		2.672E-08	
	7	0		499670		3.125E-08	
<b>R</b> 402 469 0 02	Domo	to/CL1				2040 40 20 00:04:20	

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

## 9.2 Advanced Optical Transceiver Test

To access the advanced optical transceiver test select **OSFP** or **QSFP-DD** port buttons, select **Other Functions**, then **Advanced Optical Transceiver Testing**.

**Setup:** The left side of the screen contains all the configuration items. Tap on the different buttons to have access to general Setup, Voltage swing, Pre-FEC BERT, Frequency Offset, Pre-emphasys settings and I2C registers read/write access.

Use the check boxes to enable or disable the different sub tests.

**Results:** The right side of the screen shows the different results. The status indicators on top (Pre-BER, Frequency Offset, Temperature, TX Optical Power, RX Optical Power, Supply Voltage) not only show the current results, but provide access to the detailed results if you tap on them.



#### **Advanced Optical Transceiver Setup**

Module Tab: Tab on the module tab to view module information.

#### **Advanced Optical Transceiver Module**



Histogram Tab: Tap on the histogram tab, can be viewed in Table or Graph form.



#### Advanced Optical Transceiver Histogram Graph

Advanced Optical Transceiver Histogram Table

	$\Rightarrow$	😒 🕞				
Setup       Voltage       Pre-FEC BERT         Freq. Offset       Pre-Emphasis       I2C Read/Write         Auto Test       Manual Mode         HW Initialization       SW Initialization	Pre-FEC BER 1.776E-08 TX Power 7.85 dBm Freq. Offset -0.00 ppm RX Power 5.57 dBm None 3	Temperature 44.4 C Voltage 3399 mV Laser Off				
Initialization Wait Time (secs) 30	Graph Sample# Time	Volt.(mV) Temp.(C) BER				
<ul> <li>Voltage Sweep Non-Sweep(V) 3.300</li> <li>Frequency Offset Sweep</li> </ul>	1         2020- 3-26 03:36:29           2         2020- 3-26 03:36:30	3400         43.9         0.000E+00           3400         43.9         1.443E-08				
Ranges	3         2020- 3-26 03:36:31           4         2020- 3-26 03:36:32           5         2020- 3-26 03:36:33	3399         43.9         1.929E-08           3400         43.7         1.888E-08           2400         43.9         1.761E-08				
TX Power(dBm) 1 (typical) RX Level(dBm) Min. <mark>-4.4</mark> Max. <mark>4.2</mark>	3         2020-3-26 03:36:33           6         2020-3-26 03:36:34           7         2020-3-26 03:36:35	3400         43.9         1.781E-08           3400         43.7         1.692E-08           3400         43.9         1.644E-08				
P 192.168.33.170 R Remote/CLI	2020-03-2	6 03:38:29				

## Voltage Tab:

### Advanced Optical Transceiver Voltage

	<b>@</b>	Solution							
Setup     Voltage     Pre-FEC BERT       Freq. Offset     Pre-Emphasis     I2C Read/Write       Duration (seconds)     60       Minimum Voltage(mV)     3135       Center Voltage(mV)     3300	Pre-FEC BER     Freq. Offset       0.000E+00     0.00 ppm       TX Power     RX Power       N/A     LOS	TemperatureStart38.0 CModuleVoltageHistogram3424 mVLaser On							
Maximum Voltage(mV) 3465	None Stress								
	Aggregate	Lane							
QSFP-DD High Temperatue Power Off 82 C	ST:	ET:00:00:00							
QSFP-DD High Temperatue Warning(C) <mark>68</mark>	Pattern Loss(Sec.)	0							
	BIT Error Count	0							
	BIT Error Ratio	0.000E+00							

#### Pre-FEC BERT Tab:

## Advanced Optical Transceiver Pre-FEC BERT

	<b>~</b>	<b>()</b>			
Setup     Voltage     Pre-FEC BERT       Freq. Offset     Pre-Emphasis     I2C Read/Write       MAX Pre-FEC BER     2.400E-04       BERT Duration(secs)     300       Pre-FEC Pattern     Per Lane	Pre-FEC BER     Freq. Offset       0.000E+00     0.00 ppm       TX Power     RX Power       N/A     LOS       READY	TemperatureStart38.2 CModuleVoltageHistogram3423 mVLaser On			
Lane TX Pattern Invert RX Pattern Invert	None	Stress			
	Aggregate	Lane			
	ST:	ET:00:00:00			
	Pattern Loss(Sec.)	0			
	BIT Error Count	0			
	BIT Error Ratio	0.000E+00			
<u></u>					

### Freq. Offset Tab:

		_	<b>&amp;</b>	<b>S</b>							
Setup V Freq. Offset Pre- Duration(secs)	oltage Emphasis	Pre-FEC BERT I2C Read/Write 300	Pre-FEC BER     Freq. Offset       0.000E+00     0.00 ppm       TX Power     RX Power       N/A     LOS       READY	Temperature 38.2 C Voltage 3425 mV Laser On							
<ul> <li>Offset (ppm) #1</li> <li>Offset (ppm) #2</li> </ul>	✓ Offset (ppm) #1 ✓ Offset (ppm) #2 0.0		- None Stress								
🖌 Offset (ppm) #3		100.0	Aggregate	Lane							
🚍 Offset (ppm) #4		0.0	ST:	ET:00:00:00							
Offset (ppm) #5		0.0	Pattern Loss(Sec.)	0							
			BIT Error Count	0							
			BIT Error Ratio	0.000E+00							
(IP) 192 168 33 170	Remote		2020.03	26 03:27:10							

### Advanced Optical Transceiver Freq. Offset

**Pre-Emphasis Tab:** Tap on the **Pre-Emphasis** tab to view the **TX Pre-equalization** settings. To return to the previous screen tap on the red cross.

### Advanced Optical Transceiver Pre-Emphasis

		<b></b>		😣 🚱 🕞							
TX Pre-equalization Setting											
	Couple lanes										
L #	Pre-tap 1	Pre-tap 2	Post-tap 1	Drv. Swing							
0	[0]0.0dB 🛛 🔻 🔻	[0]0.0dB 🛛 🔻 🔻	[8]-3.2dB 🛛 💙	[22]800mV 🛛 🔻							
1	[0]0.0dB 🛛 🔻 🔻	[0]0.0dB 🛛 🔻 🔻	[8]-3.2dB 🛛 🔻	[22]800mV 🛛 🔻							
2	[0]0.0dB 🛛 🔻 🔻	[0]0.0dB 🛛 🔻 🔻	[8]-3.2dB 🛛 🔻	[22]800mV 🛛 🔻							
3	[0]0.0dB 🛛 🗸 🔻	[0]0.0dB 🛛 🔻 🔻	[8]-3.2dB 🛛 💙	[22]800mV 🛛 🔻							
4	[0]0.0dB	[0]0.0dB	[8]-3.2dB 🛛 🔻	[22]800mV 🛛 🔻							
5	[0]0.0dB	[0]0.0dB	[8]-3.2dB 🛛 🔻	[22]800mV 🛛 🔻							
6	[0]0.0dB 🛛 🔻	[0]0.0dB 🛛 🔻	[8]-3.2dB 🛛 🔻	[22]800mV 🛛 🔻							
7	[0]0.0dB 🛛 🗸 🔻	[0]0.0dB 🛛 🗸 🔻	[8]-3.2dB 🛛 💙	[22]800mV 🛛 🔻							
	102 169 33 170 🔊 Remota	Default	Apply	0-14 (A) (B)							

I2C Tab: Tap on the I2C tab to view the I2C Access. To return to the previous screen tap on the red cross.

Advanced Optical Transceiver I2C Read/Write

	FP	$\mathbf{O}$															0	3			
		I2C Access																			
Page	0	0 Upper ▼ Address 12									28 Read				Write 0x00						
	Refresh											Dump & Save									
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
	1	28	80	49	01	4E	4F	4C	49	47	48	54	20	20	20	20	20	20			
	1	44 :	20	44	7C	7F	54	2D	44	50	34	43	4E	48	2D	4E	30	30			
	1	60	20	20	20	20	31	41	49	4E	49	42	4A	38	31	34	31	30			
	1	76	32	32	20	20	20	20	32	30	31	38	30	39	30	35	00	00			
	1	92	00	00	00	00	00	00	00	00	A0	30	00	00	00	00	00	00			
	2	08	00	00	00	00	06	00	00	00	00	00	00	00	00	00	AA	00			
	2	24	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00			
	2	40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00			
I92.168.33.17	0 (R	Ren	note	/CLI										2020	.03-2(	6 03:3	31:51		8		

## 10.0 Warranty and Software

#### **VeEX Limited Warranty**

The following terms and conditions govern the Limited Warranty for hardware ("Hardware"), Firmware and software ("Software") products (collectively, "Products") provided by VeEX, Inc. or its affiliates ("VeEX") that is the contracting party. This Limited Warranty extends only to the original purchaser of a Product ("Customer") and is effective as of the date of purchase of such Product. For future purchases, please consult this page for current warranty information, as this Limited Warranty may be updated by VeEX from time to time. To insure you receive up-to-date information and notices, please register your Product with VeEX.

#### **Limited Warranty Start Date**

VeEX Products may come with a 90-day, 1-year, 2-year, or other limited hardware warranty (the "Warranty Period") based on product, configuration and customer contract. The Warranty Period for battery pack, LCD, LCD touch panel, LCD protective cover, and accessories (including but not limited to patch cords, AC adaptor, SFP, USB adaptors, carrying case, carrying pouch) is limited to one (1) year from the Start Date, as defined below.

"Start Date" as used in this policy means the date when the VeEX Product downloaded or is shipped from VeEX's facilities or from an authorized VeEX reseller to the Customer.

#### **Limited Hardware Warranty**

To determine the warranty that came with your Hardware product(s), or the warranty renewal or extension that you purchased, see your packing slip, invoice, receipt or other sales documentation. Any Software embedded in the VeEX hardware is subject to the Limited Software Warranty set forth below.

VeEX warrants that for the applicable Warranty Period, the VeEX Hardware purchased by Customer shall be free of defects in material and workmanship under normal authorized use consistent with the Product instructions. In the event that VeEX receives notice during the Warranty Period that any Hardware does not conform to this Limited Warranty, Customer's sole and exclusive remedy, and VeEX's sole and exclusive liability, shall be for VeEX, at its sole option, to: (1) repair the Hardware at no charge, using new or refurbished replacement parts in accordance with VeEX's Return Policy; (2) exchange the Hardware with new or refurbished Hardware; or (3) refund the purchase price of the Hardware, provided that Customer returns the Hardware with acceptable evidence of purchase within 30 days from the date of VeEX's request, freight prepaid. VeEX's obligations hereunder are conditioned upon Customer's return of the Hardware to VeEX in accordance with the terms of this Limited Warranty. VeEX will use commercially reasonable efforts to ship any replacement Hardware within thirty (30) working days after VeEX's receipt of the non-conforming Hardware. Actual delivery times may vary depending on Customer location.

#### This limited hardware warranty does not cover:

- Software, including, without limitation, third-party software
- Non VeEX products and accessories
- Repairs made by Customer or any other party without VeEX's prior written authorization
- Problems that result, directly or indirectly, from external causes such as accident, abuse, misuse or problems with electrical power
- Usage that is not in accordance with product instructions
- Failure to follow the product instructions or failure to perform preventive maintenance
- Using accessories, parts or components not supplied by VeEX
- Commercial hardware products that use, or in which have been installed, products or components that have not been provided by VeEX.
- Products with missing or altered service tags or serial numbers
- · Products for which VeEX has not received payment
- Normal wear and tear

Customer is solely responsible for assessing the suitability of the Product for use in particular applications and backing up its

programs and data to protect against loss or corruption. VeEX's warranty obligations do not include installation support. No one is authorized to make any statement or representation altering the terms of this Limited Warranty.

#### Limited Software Warranty

Subject to the terms of VeEX's End User License Agreement, VeEX warrants for a period of 90 days from the Start Date that: (i) the media on which the Software is delivered will be free of defects in material and workmanship under normal authorized use consistent with the Product instructions; and (ii) the Software will perform substantially in accordance with VeEX's standard specifications. VeEX does not warrant that the Software will operate uninterrupted or error-free. In the event that VeEX receives notice during the warranty period for (the "Error"), Customer's sole and exclusive remedy, and VeEX's sole and exclusive liability, shall be: (1) for VeEX to replace the defective media; or (2) to provide Customer with a replacement copy of the Software containing any correction or modification needed to remedy the Error; or (3), at its sole option, to use commercially reasonable efforts to correct any substantial nonconformity of the Software reported to VeEX's failure to correct the Error will be the refund of the purchase price of the Software, provided that the Software is returned to VeEX by the Customer along with proof of purchase within thirty (30) days of the request by the Customer, freight prepaid. VeEX shall not be obligated to remedy any Error which cannot be adequately reproduced by VeEX.

During the Warranty Period, VeEX will provide, without charge to the customer, all fixes, patches and enhancements to the purchased software, firmware and software options. VeEX does not warrant that all software or firmware defects will be corrected. New enhancements attached to a software option require the option to be purchased (at the time of order or the time of upgrade) in order to benefit from such enhancements.

VeEX's obligations hereunder are conditioned upon Customer's compliance with the terms of VeEX's End User License Agreement. For purposes of this Limited Warranty, "Software" means any VeEX software embedded in or installed on any Hardware when delivered to Customer, or any VeEX software identified in a Purchase Order, invoice or proof of entitlement issued by VeEX. With respect to any Software that is not shipped from VeEX's facilities or from an authorized VeEX reseller to the Customer, the "Start Date" shall mean the date when the Customer is granted access to the Software on the VeEX website.

The foregoing warranty shall not apply to any failure to conform by the Software that is caused by (a) the use or operation of the Software in an environment other than that intended or recommended by VeEX in the applicable Documentation, (b) modifications to the Software not made or authorized by VeEX, (c) third party hardware or software, provided by any third party and not authorized by VeEX for use with the Software, (d) used other than in its most current version (to the extent that any failure of the Software would have been avoided by the use of the most current version); or (e) damaged by improper environment, abuse, misuse, accident or negligence. In addition, the foregoing warranty shall not apply to any Software which has been used with any third party hardware or software.

#### **Hardware Replacement Process**

Any defective Hardware can only be replaced in accordance with VeEX's Return Policy. Transportation costs, if any, incurred in connection with the return of a defective Hardware to an VeEX repair center shall be borne by Customer. If VeEX determines, at its sole discretion, that the allegedly defective Hardware is not covered by VeEX's Limited Warranty, the cost of repair by VeEX, including all shipping expenses, shall be paid by Customer. Customer is responsible for backing up and saving any data, software, firmware or other information embedded in or saved on any returned Hardware, and VeEX will not restore, save or return any such data, software, firmware or other information with any repaired or replaced Hardware. This Limited Warranty only covers Hardware manufactured by an authorized VeEX manufacturer and sold by VeEX's distributors and resellers.

#### Disclaimer

EXCEPT AS EXPRESSLY PROVIDED IN THIS LIMITED WARRANTY, ALL EXPRESS OR IMPLIED REPRESENTATIONS AND WARRANTIES, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR MEETING CUSTOMER'S REQUIREMENTS, NONINFRINGEMENT OF ANY THIRD PARTY'S INTELLECTUAL PROPERTY RIGHTS, COMPATIBILITY OR INTEROPERABILITY WITH ANY HARDWARE, SOFTWARE, SYSTEMS OR DATA NOT PROVIDED BY VEEX, SATISFACTORY QUALITY, OR FREEDOM FROM INTERRUPTION OR ERROR, ARE HEREBY DISCLAIMED AND EXCLUDED TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW. VEEX DISCLAIMS ANY WARRANTY, REPRESENTATION OR ASSURANCE THAT THE PRODUCT WILL OPERATE WITHOUT ERROR OR INTERRUPTION, OR WILL BE FREE OF VULNERABILITY TO INTRUSION OR ATTACK. ANY PRODUCTS LICENSED OR PROVIDED UNDER AN EVALUATION LICENSE, ANY PRODUCTS PROVIDED WITHOUT CHARGING ANY FEE, ANY MODIFIED PRODUCTS AND ANY THIRD PARTY PRODUCTS ARE FURNISHED "AS IS," WITH ALL FAULTS AND WITHOUT WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED. CUSTOMER MAY NOT MAKE A WARRANTY CLAIM AFTER EXPIRATION OF THE WARRANTY PERIOD. TO THE EXTENT AN IMPLIED WARRANTY CANNOT BE EXCLUDED, SUCH WARRANTY IS LIMITED IN DURATION TO THE WARRANTY PERIOD OR OTHERWISE TO THE MAXIMUM EXTENT PERMITTED BY LAW. BECAUSE SOME STATES OR JURISDICTIONS DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, THE ABOVE LIMITATION MAY NOT APPLY TO CUSTOMER. THIS WARRANTY

GIVES CUSTOMER SPECIFIC LEGAL RIGHTS, AND CUSTOMER MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM JURISDICTION TO JURISDICTION.

#### Limitation of Liability

IN NO EVENT WILL VEEX OR ITS DIRECTORS, OFFICERS, EMPLOYEES, AFFILIATES, SUPPLIERS, MANUFACTURERS, RESELLERS, DISTRIBUTORS OR LICENSORS BE LIABLE FOR ANY LOST REVENUE OR PROFIT, LOSS OF DATA, LOSS OF USE, INTERRUPTION OF BUSINESS, COSTS OF PROCUREMENT OF SUBSTITUTE GOODS, OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF OR RELATED TO THIS LIMITED WARRANTY OR THE USE OF OR INABILITY TO USE ANY PRODUCT, EVEN IF VEEX OR ITS DIRECTORS, OFFICERS, EMPLOYEES, AFFILIATES, SUPPLIERS, MANUFACTURERS, RESELLERS, DISTRIBUTORS OR LICENSORS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL THE CUMULATIVE LIABILITY OF VEEX, ITS DIRECTORS, OFFICERS, EMPLOYEES, AFFILIATES, SUPPLIERS, SUPPLIERS, MANUFACTURERS, RESELLERS, DISTRIBUTORS OR LICENSORS TO CUSTOMER, WHETHER IN CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, EXCEED THE AMOUNTS ACTUALLY PAID TO VEEX BY CUSTOMER FOR THE PRODUCT THAT IS THE SUBJECT OF SUCH CLAIM. THE FOREGOING LIMITATIONS SHALL APPLY EVEN IF THE ABOVE-STATED LIMITED WARRANTY FAILS OF ITS ESSENTIAL PURPOSE. BECAUSE SOME STATES OR JURISDICTIONS DO NOT ALLOW LIMITATION OR EXCLUSION OF CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO CUSTOMER. IN SUCH A CASE THE FOREGOING LIMITATION WILL BE APPLIED TO THE GREATEST EXTENT PERMISSIBLE PURSUANT TO APPLICABLE LAW.

# **11.0 Certifications and Declarations**



## 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** 

# 12.0 About VeEX

VeEX Inc., the Verification EXperts, is an innovative designer and manufacturer of test and measurement solutions addressing numerous technologies. Global presence through a worldwide distribution channel provides uncompromised product support.

Visit us Online at <u>www.veexinc.com</u> for latest updates and additional documentation.

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## **Customer Care**

Tel: + 1 510 651 0500 Email: <u>customercare@veexinc.com</u>