

USER MANUAL





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1.0 About This User Manual

The purpose of this manual is to help users successfully use the features of VePAL UX400 test platform.

This manual is intended for novice, intermediate, and experienced users. It is assumed that users have basic computer experience and skills, and are familiar with basic telecommunication concepts, terminology, and safety. For more technical resources, visit VeEX Inc. website at <u>www.veexinc.com</u>.

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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If any assistance is needed or there are any 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 serial number ready. Please refer to the Basic Operations section of this manual for details on locating the unit serial number.

Customer Care:

Phone: +1 510 651 0500

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Website: www.veexinc.com

2.0 Introduction to 40G/100G Modules

40G and 100G test interfaces are available on the UX400 40G/100G, TX300s-100G, and RXT6000/e/+ test sets. Testing on each platform share a common user interface and similar feature set to ease the transitioning from one product or platform to another.

40G/100G Features

Refer to the latest specification sheet for a breakdown of available test modes for each platform and module. Available test modes vary depending on the test platform and module, but may include the following:

General

• CFP, CFP2, CFP4, QSFP28, QSFP+ ports compliant to MSA standards

ΟΤΝ

- OTN testing for OTU3 and OTU4
- Complete multi-step Mapping/Multiplexing with Ethernet, SDH, SONET, PDH, DSn payloads
- Ethernet over OTN, ODU0 and ODUflex
- Service Disruption measurements
- Tandem Connection Monitoring
- · Overhead monitoring and capture byte decoding
- · Payload and Line through monitor modes
- · Per-lane optical power and frequency measurements

Ethernet

- 100G and 40G Ethernet testing
- Optical Lane BERT and CAUI/XLAUI Lane BERT
- PCS Layer Testing with Skew generation/monitoring
- Service Disruption Measurements
- RFC2544 testing
- Multi-stream testing up to 32 independent streams
- IPv4 and IPv6 traffic generation
- Q-in-Q (VLAN stacking) and multiple MPLS tag support
- BER testing at Layer 2 and Layer 3
- Smart Loop mode for Layer 2 and Layer 3
- Coupled operation (two modules)
- 1-way latency measurement
- Line rate packet capture with Wireshark[™] decode

SDH/SONET

- STM-256, OC-768, STL256.4 with bulk, PDH and DSn payloads
- · Line Rate or as OTU3 payload

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2.1 Connector Panels and Test Ports



Left to right: CFP, CFP2, CFP4, QSFP28 pluggable optical modules

Pluggable optical module versions for each test platform are listed below:

UX400-100G



UX400-100G CFP connector panel



UX400-100G QSFP+ and CFP4 connector panel



UX400-100G QSFP+ and CFP2 connector panel

- UX400-100G: CFP
- UX400-100G: CFP2 (CFP4*), QSFP+
- UX400-100G: CFP4, QSFP+
- UX400-100G: QSFP28, QSFP+

TX300s-100G

- TX300s-100G: CFP4, QSFP+
- TX300s-100G: QSFP28, QSFP+

RXT-6000

- RXT-6000 100G: CFP2, QSFP+, SFP+, RJ45
- RXT-6000+ 100G: CFP2 (CFP4*), QSFP28, QSFP+, SFP+, RJ45
- RXT-6000e 100G: CFP2 (CFP4*), QSFP28/QSFP+, 2x SFP28, 2x RJ45 (optional PDH/DSn)
- RXT-6200 100G: CFP4, 2x QSFP28/QSFP+, 2x SFP28, 2x RJ45 (optional PDH/DSn)

* Using CFP2-to-CFP4 or CFP2-to-QSFP28 adapter

3.0 Safety Information

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

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

Safe Module Handling

While replacing test modules, all work on the open panel must be performed only by suitably qualified personnel who is 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 unit, 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 batteries packs and products containing them must be used, charged, handled, and stored properly, according to the manufacturer's recommendations.

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

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

- Always charge the unit's battery pack inside the test platform battery bay using the AC/DC adapter supplied by VeEX.
- Do not charge or use the battery pack if any mechanical damage is suspected (shock, impact, puncture, crack, etc).
- Do not continue charging the battery if it does not recharge within the expected charging time
- Storage: For long term storage, the battery pack should be stored at 20°C/68°F (room temperature), charged to about 30 to 50% of its capacity. Spare battery packs should be charged and used at least once a year to prevent over-discharge (rotate them regularly).
- It is recommended to charge and use battery packs at least every three months. Battery packs shall not go without recharging (reconditioning) for more than six months.

After extended storage, battery packs may reach a deep discharge state or enter into sleep mode. For safety reasons, Liion batteries in deep discharge state may limit the initial charging current (pre-recharge) before starting their regular fast charging cycle. The pre-charging state may take several hours.

 Air transportation of Li-ion batteries is regulated by United Nations' International Air Transportation Association (IATA) Dangerous Goods Regulations and by country-specific regulations. Please check local regulations and with common carriers before shipping Li-ion battery packs or products containing relatively large Li-ion battery packs.

Electrical Connectors

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

ESD: Electrostatic Discharge Sensitive Equipment

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

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



4.0 Basic Operations

Refer to the TX300S, UX400, and RXT-1200, platform manuals for information about Basic Operations, Home menu, Launching Test Applications etc.

5.0 Utilities

Refer to the TX300S, UX400, and RXT-1200, platform manuals for information about all Utilities and Tools available.

6.0 100G Ethernet Test Application

Refer to the RXT-1200, TX300, or UX400 platform manuals for information on launching test applications and assigning test modules (UX400 only).

When the dual port interfaces and software options are enabled, the test module can operate a combination of two ports at the same time.

Port selection buttons are available on the left side panel below the History tab.

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

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



Ethernet Home Menu

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6.1 Setup

6.1.1 Port Setup

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

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

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

UX400 100G Ethernet Test App Setup

LEDs	Port	Measurement	
	100G port profile	Last configuration	
😑 Signal	Network Type	LAN 🔻	
	Flow Control	Enable 🛛 🔻	
🜔 Frame	Clock Source	Internal 🛛 🔻 🔻	
Pattern	Clock Offset (ppm)	0.0	
0	Link Fault Response	Disable 🛛 🔻	
ALM/ERR	Eye Clk	Disable 🛛 🔻	
History	Арріу	Discard	MX Discover

40G and 100G Port, RXT-6000:

- 100G port profile: Lock, Delete, Save, Save as..., Default, Last configuration
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (various rates), RxCLK, GPS 1 PPS, Atomic 1PPS
- Clock Offset (ppm): Can be configured; range is +/- 150ppm
- Link Fault Response: Disable or Enable (also enables Local link and failure, remote, failure)
- Eye Clk (100G only)

Status

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

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

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6.1.2 Measurement Setup

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

- Profile: Delete, Save, Save as..., Default.
- Mode: Manual, Timed
 - Manual mode: Starts and stops the measurements manually.
 - Timed mode: Defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start**: Separated and Coupled. Configure how the measurements are started when in BERT and Multiple Streams test modes.
 - Separated: Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on -- the user must start the transmitter manually.
 - Coupled: Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.
- Clock (ToD) Synchronization Device: Disable, GPS, 1PPS, Local, Atomic 1PPS. Select the device to be used to synchronize the clock to perform the One Way Delay measurement.

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

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

Note: Both test sets must be configured to the same Clock Sync Time.

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

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

LEDs	Port	Measurement	
	Profile	Last configuration 🛛 🗸 🔻	
😑 Signal	Mode	Manual 🛛 🗸 🔻	
	TX Start	Coupled 🛛 🔻	
😑 Frame	ToD Synchronization Source	Disable 🛛 🔻	
Pattern	Results Auto Save	OFF 🛛 🔻	
Ŭ,			
ALM/ERR			
			LASER On/Off
History			MX Discover
			MIX DISCOVER

Measurement Setup

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6.1.3 MX Discover and Control

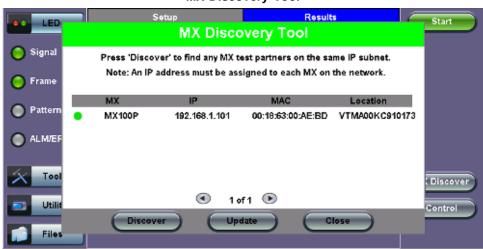
Before proceeding with MX Discover or Control, be sure to assign an IP address to each test port. To assign an IP address, proceed to the home menu and select the IP icon.

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

Using MX Discover

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

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



MX Discovery Tool

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

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

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

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



Remote Partner Control

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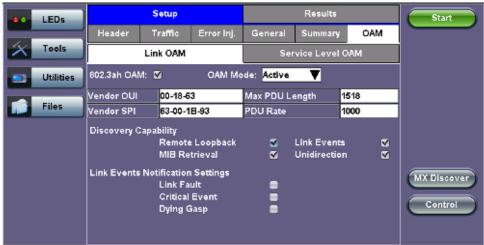
OAM Discover

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

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

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

Activating 802.3ah Link OAM



6.1.4 ViPAG/V-Route Test

ViPAG/V-Route can be accessed from the Test Mode menu. Refer to the TX300S, UX400, or RXT-1200 platform manual for information on launching test applications from the Test Mode menu.

The following selections are available on the unit:

· SILO/Router Wrap Test: "On local unit" testing on a single unit

SILO/Router Wrap Test is the default selection for 40/100G test sets.

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ViPAG/V-Route Setup

LEDs	Quick Test	Setup	Results	
😑 🕒 Signal				
○○Frame	 SILO/Router \ 	Nran Test		
Pattern	S SILON OULER	map rest		LASER On/Off
O O ALM/ERR				
History				NEXT

Quick Test Setup Welcome Page

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

Quick Test Setup

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

- Select the test type: SILO/Router Wrap Test
- Step 1: Select the router test interface. "Local unit" denotes a router wrap test while "end-to-end" conducts an end-to-end test. For End-to-End testing, select whether this unit will be a *Controller* or *Responder*. For End to Loopback testing, select whether this unit will be Generating Traffic or in Loopback Mode. The frame size for each option listed below is 256 bytes. 100G to 10G is the default test option.
- Step 2 (SILO/Router Wrap only): Layer 2 is selected by default.
- Step 3: Configure port settings for port 1. Refer to Port Setup for detailed instructions.
- Step 4: Configure port settings for port 2.
- Step 5: Enable up to 3 VLAN tags. Configure ID, Priority, Type, and Drop Eligible.
- Step 6: Enter the frame size. The default frame size for each option is 256 bytes.
- Step 7: Review the settings for both ports. Press Start to begin testing. Pressing Reconfigure will restart the Quick Test Setup and return the screen to Step 1.

SILO/Router Wrap Test Configuration Summary

LEDs	Quick Test	Setup	Results	
	SILO/Router W	rap Test	Step 7	
OO Signal	Frame Size	256 bytes		
OO Frame	100GE LAN C			
● ● Pattern	MAC Ac	ldress 00-18-63-01-24-0F		LASER On/Off
ALM/ERR	10GE LAN Co MAC Ac	onfiguration Idress 00-18-63-01-24-10		Previous
	Please revie	w configuration.		Reconfigure

Quick Test View

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

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

Quick Test Results Summary

LEDs	Quick Test	Set	up:	Results	
	VIPAG			Testing	
Signal	100G-10G Test	Running	20	18- 1-25 13:27:33	P1 → P2 Err
• Frame		100GE: 10	0G P1	10GE: 10G P2	P2 -> P1 Err
	Link	Up		Up	LASER On/Off
OO Pattern	Transmitted Rate	10.000)G	10.000G	LASER ON/OT
	Received Rate	10.000)G	10.000G	
O O ALM/ERR		100G P1 to	10G P2	10G P2 to 100G P1	
History	Throughput	PAS	s	PASS	
Thatory					Stop & Save
					Stop
					Details

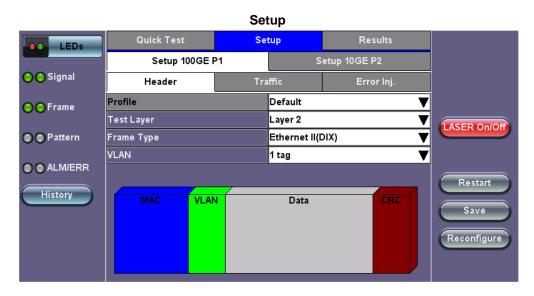
Stop & Save stops the test and enables naming of saved test results. **Details** brings up the **Results** screen. In case of link or IP related test failure, ViPAG will indicate the possible failure in red text and give instructions on what to check for.

Test Failure

LEDs	Quick Test	Set	tup	Results	
	ViPAG				
🔴 🔴 Signal	100G-10G Test	Stopped	20	18- 1-25 14:52:53	
Frame		100GE: 10	0G P1	10GE: 10G P2	
O F anie	Link	DOW	'N	Up	
Pattern	Transmitted Rate	10.000)G	10.000G	LASER On/Off
	Received Rate	10.000)G	0.000K	
e ALM/ERR		100G P1 to	10G P2	10G P2 to 100G P1	
History	Throughput	PAS	s	PASS	Restart
					Save
					Reconfigure
	Errors Detected	CRC Errors R	unt Frames	1	

Setup

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



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Results

			oouno	• annan,	,		
LEDs	Quick Test		Se	tup		Results	
	Summary		Results	100GE P1	R	esults 10GE P2	
Signal	100G-10G Test	Test S	topped	15:02:45		2018- 1-25	
• Frame	Thrpt. 100G P1 - 1	0G P2	P.	ASS		10.000G	
00	Thrpt. 10G P2 - 10	0G P1	P.	ASS		10.000G	LASER On/Off
• Pattern							
O O ALM/ERR							
History							Restart
							Save
							Reconfigure

Results - Summary

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

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

LEDs	Quick Tes	t		Setu	p		Results		
	Summary		Res	sults 10	0GE P1	Resu	ults 10G	E P2	
O Signal	Summary Sigr	nal Er	rors	Alarms	Events	Traffic	Delay	PCS	
○○ Frame				Level	Rx]				i
	Rx Optic	al Powe	er[dBm]		LOS			SAT	LASER On/Off
Pattern		Cur.	Min.	Max.	-16			+12	LASER ON/OT
00.	TOTAL	6.08	6.05	6.09					
0.0					-16			+6	
O O ALM/ERR	#1 1295.60nm	-0.93	-0.99	-0.91			+		
	#2 1300.10nm	1.14	1.10	1.16			+		Restart
History	#3 1304.60nm	0.63	0.58	0.65			+		
	#4 1309.10nm	-0.98	-1.07	-0.96		-8.6	+	+4.5	Save
						0.0		r4.0	
									Reconfigure
				Page 1	of 5	D			

Port Poculte Signal

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6.2 IP

6.2.1 IP Connection

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

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

6.2.1.1 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

	Trace	e Route	ARF	Wiz	VoIP	
	Se	etup	Sta	tus	Ping	
😑 Signal		Network			Port	Connect
😑 Frame	Mode			IPv4		V
	Profile			Last configu	ıration	V
Pattern	IP Address			Static		▼
	Local IP			192.168.0.10	1	
ALM/ERR	Subnet			255.255.255.	0	
History	Gateway ar	nd DNS		Enable		V
	Gateway	On	▼	192.168.0.1		
	DNS	Primary	▼	192.168.0.1		
		٩	Page	1 of 2 🕒		PCAP Start

IPv4 or IPV6

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

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6.2.1.2 Status

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

		E A	A33	Status			
LEDs	Trace Route		ARF	Wiz		VolP	
	Setup		Status			Ping	
😑 Signal	DHCP server			192.168.0.2:	67	Disconnect	
O F	DHCP Lease Time	•		1 days 12 ho	urs		
😑 Frame	Local IP			192.168.0.17	0		
Pattern	Subnet Mask			255.255.255.	0		
Ŭ	Gateway			192.168.0.1			
ALM/ERR	DNS IP	8.8.8.8		Second DN	.8.2.2		
History	DHCP:			PASS			
	IP:			PASS			
	Gateway:			PASS			
	DNS:			DNS1(PASS) DNS2((N/A)	
							PCAP Start

PASS Status

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

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6.2.2 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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6.2.3 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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6.2.4 Ping

Ping is a popular computer network tool used to test whether a particular host is reachable across an IP network. A ping is performed by sending an echo request or ICMP (Internet Control Message Protocol) to the echo response replies. Refer to **Ping** in the **TX300S**, **MTTplus**, **RXT-1200**, or **UX400** platform manuals for more information on this feature including setup and results.

6.3 PCS

PCS layer testing helps validate and test all aspects of the PCS layer, which plays a significant role in 100G traffic generation/reception. Lane mapping and skew generation allows for the realignment of the virtual lanes and the injection of skew bits into each physical lane in order to stress and validate the PCS receiver.

6.3.1 Setup

6.3.1.1 Tx Lane Mapping and Skew

- PCS to CAUI lanes configurable mapping:
 - The Default, Random, and Shift buttons define the alignment markers ID that will be assigned to each lane
 - Receivers must be able to reorder and reassemble any mapping of PCS lanes into single stream
- Skew Settings (up to 16000 bits time)
 - Enter relative delay that will be introduced for the PCS lane pair (CAUI lane)
 - Default Alarm Threshold is 1000 bits
 - Stresses the de-skew function on the receiver side
- Skew alarm threshold value: User configurable threshold for Skew alarm



PCS Setup - Tx Lane Mapping and Skew

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6.3.1.2 TX Alarm/Error Injection

To setup errors and alarms tap on the **Setup Injection** button, which appears after the test has started. Errors and alarms are assigned to the **PCS Err. Inj.** and **PCS Alarm Inj.** buttons and can be injected during testing.

- Error Injection per PCS lane:
 - Invalid Sync header (ISH): first 2 bits of the 64/66 block header
 - Invalid alignment marker (IAM): inserted every 16383 block on each virtual lane it contains the Virtual lane identifier
 - BIP: generates bit interleave parity error
 - Behavior: Single, Single Burst, or a user-defined Rate of error injection
- Alarm Generation:
 - LOBL: Loss of block lock
 - LOA: Loss of Alignment marker
 - HI-BER: high bit error rate of sync header
 - Behavior: Continuous error injection is chosen by default

PCS Setup - Alarm/ Error Injection

LEDs			Setup Al	arm an	d Error Injection			Stop
	PC	S Lane	Selection		Error	Injection		
😑 Signal	VL ID	Sel.	VL ID	Sel.	Layer	PCS	▼	Restart
	0	✓	10		Туре	ISH	▼	
😑 Frame	1		11		Behavior	Single	▼	
	2		12					PCS Err Inj.
Pattern	3		13					
	4		14		Alarm C	Generation		PCS Alarm Inj.
ALM/ERR	5		15		Layer	PCS	▼	
	6		16		Туре	LOBL	▼	LASER On/Off
History	7		17		Behavior	Continuous	▼	
	8		18					MX Discover
	9		19					
	Select All	Clea	ır All					

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6.3.2 Results

6.3.2.1 Summary

LEDs	Setup												Res	ults	;				Stop
	Summ	ary	y Rx Lane					w	Alarms/Errors			s	Events			nts			
🜔 Signal	ST:2017-12	2-8´	16:3	36:09					ET:	00	:03:0	6							Restart
-	CAUI ID			0				1				2				;	3		
🜔 Frame	PCS ID	0	1	2 3	3 4	5	6	7	8	9	10 1	1 12	13	14	15	16 1	7 1	8 19	
0.0.0	LOBL	0	0	00		0	0	0	0	D	00		0	0	0	0			PCS Err Inj.
Pattern	ISH	0	0	00		0	0	0	\circ	C	00		0	0	0	0			
ALM/ERR	LOAML	0	0	00		0	0	0	\circ	C	00		0	0	0	0			PCS Alarm Inj.
	IAM	\circ	0	00		0	0	0	0	C	00		0	0	0	\circ			
History	BIP	\circ	0	00		\circ	0	0	\circ	0	00		0	0	0	\circ			LASER On/Off
	Hi Skew	$oldsymbol{\circ}$	0	00		\circ	0	0	\circ	0	00		0	0	0	\circ			MX Discover
	VLID	1	2	3 4	0	0	0	0	0	0	0 0	0	0	0	0	0	0 0) 0	
	Hi-BER	\mathbf{O}	LO	A		\circ													
																			Setup Injection

PCS Results - Summary

Summary gives a quick view of all the PCS errors and alarms of all 20 virtual lanes and their corresponding mapped CAUI lanes. For details on any virtual lane go to the Alarms/Errors tab.

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6.3.2.2 Rx Lane Skew

PCS Results - Rx Lane Skew

LEDs	Setup					Res	Stop				
	Su	mmai	ry	R	Rx Lane Skew		Alarms/Errors			Events	
😑 Signal	VL ID	Tx	Skew Bi	it	PCS#	CAUI#	Rx VL ID	Rx Skew(b	oits)	Rx Skew(ps)	Restart
🕒 Frame	0 1 2 3	-	0	+	0 1 2	0	1 2 3	0000		0	
Pattern	3 4 5 6				3 4 5 6		4 0 0	0 0 0		0 0 0	PCS Err Inj.
ALM/ERR	8 9	-	0	+	7 8 9	1	0 0 0 0	0 0 0		0	PCS Alarm Inj.
History	10 11 12	_	0	+	10 11 12	2	0 0 0	0 0 0		0 0 0	MX Discover
	13 14				13 14		0	0		0	WIX DISCOVER
	15 16 17	-	0	+	15 16 17	3	0 0 0	0 0 0		0 0 0	
	18 19				18 19		0	0		0 0	Setup Injection

RX skew measurements in bits and pico seconds are displayed for each received virtual lane. TX Skew can be injected at the same time that the PCS test is running to see the real time effects on the receive lanes.

The increment/decrement button will inject the number of skew bits configured in the Skew Settings Inc./Dec/Size field in the PCS Setup tab.

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6.3.2.3 Alarms/Errors

LEDs	Set	tup	Resu	Stop		
	Summary	Rx Lane Skew	Alarms/Errors	Events	Restart	
🜔 Signal	ST:2017-12-8 16:3	6:09	ET:00:04:31	ET:00:04:31		
🕒 Frame	64/66B Alarms	s Seconds				
	HI-BER	0	0			
Pattern		Agg	regate	PCS Err Inj.		
Ŭ	PCS Lane Alarms	Seconds	PCS Lane Errors	Count	PCS Alarm Inj.	
ALM/ERR	LOA	21	Invalid Sync Heade	r 3577		
	LOBL	21	Invalid Align Marke	r 0	LASER On/Off	
History			BIP-8 Block Error	7		
	Р	CS Lanes Alarms	and Errors Summary		MX Discover	
	0 1	2 🖸 3 🗖 4	5 6 7	89		
	10 11 	12 💼 13 💼 14	15 16 17	18 💼 19		
		View PCS	Lane Details		Setup Injection	

PCS Results - Alarms/Errors

Alarms/Errors displays aggregate (all lanes) measurements and per virtual lane measurements of PCS errors and alarms.

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6.3.2.4 Events

PCS Results - Events

LEDs	Set	up	Res	Results				
	Summary	Rx Lane Skew	Alarms/Errors	Events	Destant			
🔘 Signal	Time	Event Type	# of Event	s Test	Restart			
🕒 Frame	2017-12-8 16:36:31	LOA Ended		PCS	_			
	2017-12-8 16:36:31	LOBL Ended PCS	\$#3	PCS	PCS Err Inj.			
Pattern	2017-12-8 16:36:31	LOAML Ended P	CS#3	PCS	PCS Err inj.			
	2017-12-8 16:36:31	LOBL Ended PCS	\$#2	PCS	PCS Alarm Inj			
ALM/ERR	2017-12-8 16:36:31	LOAML Ended P	CS#2	PCS				
History	2017-12-8 16:36:31	LOBL Ended PCS	5#1	PCS	LASER On/Of			
	2017-12-8 16:36:31			PCS	MX Discover			
		🕙 Pag	e 1 of 5 🕑					
					Setup Injectio			
					Comp injectio			

The Events log tab lists Error and Alarm events recorded during the test. The events are presented in chronological sequence with start time, event type, number of events, and test type.

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6.3.3 Saving PCS Results

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

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



PCS Results Save

Once the results are saved, they can be viewed or renamed by going to **Tools / System Settings screen> Files**. For information on managing saved results from the **File Manager**

6.4 BERT

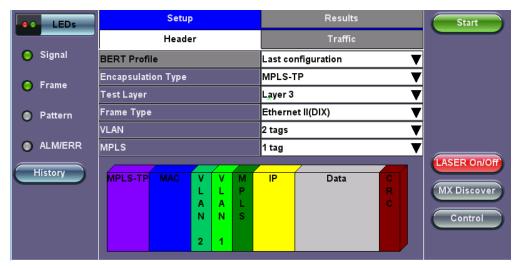
6.4.1 BERT Setup

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

Overview:

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

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



BERT Setup - Header (Layer 3)

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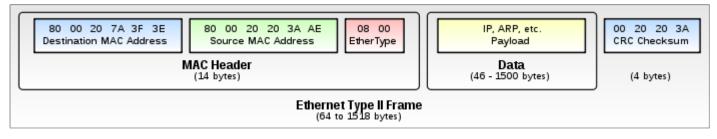
6.4.1.1 Header Settings

- **BERT Profile:** Load a previously configured test profile or create a new profile from existing settings. Currently its set to "Default". Please see the **Profiles** section in the **ReVeal MTX300 manual** for more details on how to create new profiles using ReVeal software.
- Encapsulation Type: None, MPLS-TP, Provider Backbone Bridge (PBB-TE), or EoE (Ethernet over Ethernet). Tap on the encapsulation type block to configure the settings. All encapsulation type fields are configurable:
 - MAC Source
 - MAC Destination
 - Ethernet Type
 - I-SID (PBB-TE only)
 - LSP, PW (MPLS-TP only)
 - TTL (EoE only)
 - VLAN ID, Priority, Type
 - Test: Select the test layer to perform the BERT
 - Options are Layer 2 and Layer 3
- Frame Type:
 - Layer 2: 802.3 Raw (IEEE 802.3 frame without LLC) and Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)
 - Layer 3: Ethernet II (DIX)
- MAC/IP: Tap the MAC and IP blocks on the Frame image to access the setup menus

- Set the Source and Destination MAC address for Layer 2
- Set the Source and Destination MAC and IP addresses for Layer 3
- VLAN: Off, 1 tag, 2 tags, 3 tags
 - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications) **Note:** VLAN stacking is an option
- MPLS: (For Layer 3 only) Off, 1 tag, 2 tags, 3 tags
 - The user is able to configure up to 3 MPLS tags

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

The most common Ethernet Frame format, Type II



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

To configure the EoE, 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.

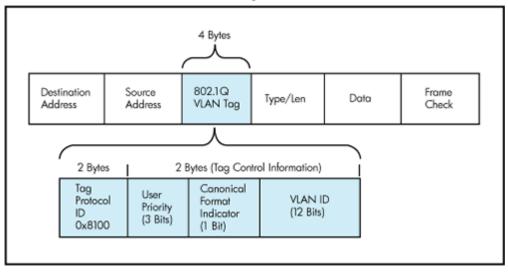
- EoE (Ethernet Over Ethernet): EoE is an alternative to PBB with its own MAC, VLAN, TTL (Time To Live), EID (Extended ID), and FCS (Frame Check Sequence). Note: EoE is only used in Japan as of the time of this publication.
- MAC Header Tab:
 - **MAC Source:** Use the default source address of the test set or configure a new or different address.
 - MAC Destination: Configure the destination MAC address of the far-end partner test set or use the ARP or ARP GW keys to determine the MAC address of the destination IP address (ARP) or the Gateway (ARP GW). Note that a valid IP connection needs to be up to use these functions. Refer to <u>IP Connection</u> for instructions on establishing IP connection.
 - Ethernet Type: For Layer 3 testing, the Ethertype is set to 0800-IP. For Layer 2, the default is 0700.
 - Source (SRC) and Destination (Dest) flooding: Enable or Disable.
 - Flood Range: Specifies the number of MAC source and/or destination addresses. Enter a number from 0-4095. The source and/or destination MAC addresses will be incremented by 1 until it reaches the number of times entered in the flood range.

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

LEDs	MPLS-TP	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	MAC Sourc	e		00-1	8-63-01-24	-0F		
🔘 Signal	MAC Destin	nation		00-1	E-90-A0-57	-3C		
	Ethernet T	ype		8847	'-MPLS uni	icast	▼	
🜔 Frame	Source Flo	oding		Disa	ble		▼	
Pattern	Source Flood Range			0				
	Destinatior	n Flooding	J	Disa	ble			
ALM/ERR	Destinatior	n Flood Ra	ange	0				
								LASER On/Off
History								MX Discover
								Control
	MAC	Source		NDP		NDP Ga	ateWay	

BERT Setup MAC Layer 3

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



IEEE 802.1Q VLAN Tag in an Ethernet Frame

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



- MPLS Tab (Only for Layer 3): In the MPLS tab the following parameters are configured:
 - **MPLS label:** Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved). **Note:** Composed of 20 bits which allows for the creation of over one million labels.
 - **CoS:** Configurable in the range 0 to 6.

Note: 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.
 Note: 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. *Note:* Used to decrement the time-to-live counter.

LEDs	MAC	VLAN	MPLS	IP		DATA	RX Filter	Start
	MPLS #1	Label=	0	S=	0			
O Signal		CoS=	0	TTL=	128			
• Frame	MPLS #2	Label=	0	S=	1			
0.11		CoS=	0	TTL=	128			
Pattern								
~								
ALM/ERR								LASER On/Off
History								LASER UNION

BERT Setup - MPLS configuration (Layer 3)

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

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

LEDs	MAC	VLAN	IP	DATA	RX Filter	Start
	IP Type		IP	'v4	▼	
😑 Signal	Source IP Add	ress	19	92.168.0.10		
0	Destination IP	Address	19	2.168.2.200		
😑 Frame	IP TOS		L	egacy TOS	▼	
Pattern	Precedence		01	11-Flash		
Ū I III	TOS Values		00	010-Maximize Reliat		
ALM/ERR	TTL		12	28		
History	Do Not Fragme	ent Flag	0		LASER On/Off	
Thistory	Protocol		U	ser Defined 🔻 FF		

IPv6:

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



LEDs	MAC	VLAN	IP	DATA	RX Filter	Start
	IP Type		IPv6		V	
😑 Signal	Source IP Add	ress	2001:d	11:c0a8:a:218:		
	Destination IP	Address	5555:1	1:c0a8:a::8552		
🕒 Frame	Traffic Class		0			
Pattern	Flow Label		0			
0.1	Next Header		255			
ALM/ERR	Hop Limit		0			
History						LASER On/Off

- **Data Tab:** User selects a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). For both Layer 2 and 3 the following pattern is available:
 - PRBS:
 - 2^31 -1
 - 2²3 -1
 - 2^15 -1
 - 2^11 -1
 - 2^9 -1
 - Fixed: All 0s or All 1s
 - User Defined pattern: Length depends on size of frame
 - Inversion: Normal or inverted
 - RX Live

LEDs	MPLS-TP MAC	VLAN MPLS	IP DATA F	RX Filter Start
Signal	PRBS 2E31-1	📄 invert		
	 PRBS 2E31-1 PRBS 2E23-1 	Rx Live		
🜔 Frame	PRBS 2E20-1			
Pattern	 PRBS 2E15-1 PRBS 2E9-1 			
ALM/ERR	 All 0's 			
History	◯ All 1's			LASER On/Off
	O User Defined	00		MX Discover
				Control

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

BERT Setup RX Filter (Layer 3)

LEDs	MPLS-TP	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	📄 MPL	S-TP MAG	C Destinati	ion 📃 l	P Destinat	ion [192.1	68.0.101]	
😑 Signal		S-TP MAG	Source		P Source	[192.	168.2.200]	
	😑 MPL	S-TP LSP	Label					
🜔 Frame		Destinat	on [00-18	-63-01-24-0)F]			
Pattern		Source	[00-18	E-90-A0-57-	3C]			
Ŭ	📄 VLA							
ALM/ERR	📄 VLA	N Priority						
History	📄 VLA	N Eligible						LASER On/Off
History	📄 Ethe	ernet Type	•					MX Discover
		P						WIX DISCOVER
	📄 Prot	ocol Type						Control

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6.4.1.2 Traffic Settings

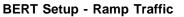
The user configures the traffic profile for the stream, including traffic flow, frame size, frame type, and transmit rate.

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

example, if 100000 frames are transmitted at 12.5% of bandwidth, on a 1Gbps line, 100000 frames will transmit at a rate of 125Mbps and then the burst will stop.

- Frame Size Type: Fixed or Uniform min and max frame length values. Uniform traffic is traffic generated with a uniform distribution of frame lengths.
- Frame Size (bytes): Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 10000 bytes
- BW (Transmit Bandwidth): Configure the transmit rate for the test
 - When traffic flow is equal to Burst, two burst bandwidths are configured with burst time
 - When traffic flow is equal to Ramp, starting and an ending bandwidth are configured along with the bandwidth step size and duration

LEDs	Set	up	Re	sults	Start		
	Header	Traffic	Error Inj.	Alarm Inj.			
Signal	Traffic Flow		Ramp	Ramp 🗸 🗸			
Frame	Frame Size (bytes)		1518				
0.000	Start BW		5.000	% ▼			
Pattern	Stop BW		10.000	% ▼			
	Step BW		5.000	% ▼			
ALM/ERR	Ramp Time		1	sec 🔻 🔻			
History	Repetitions		1	LASER On/Off			



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6.4.1.3 Error Injection

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

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

BERT Setup - Error Injection

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

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6.4.1.4 Alarm Injection Settings

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

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

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6.4.1.5 Starting/Stopping a BERT

Once all configurations have been made, the user can start the BERT test (press the **Start** icon on the top right section of the screen). The following are three scenarios of how to prepare and start the unit for BERT testing. *Note:* If testing on the fiber ports, make sure the LASER is turned on before starting the test.

• End-to-End Testing

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

• Far-End Unit in Manual Loopback Mode

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

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

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

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

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

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6.4.2 BERT Results

6.4.2.1 Summary

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

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

LEDs		Setup				Results		
	Events	Traffic	Dela	lay Rates		PCS		
😑 Signal	Summary	Sig	nal	Er	rors	Alarms		
🔵 Frame	ST:2017-12-11 1	12:17:25	ET:00:01:22					
		тх			RX			
😑 Pattern	Line Rate (bps)	100.0	100.000G			100.000G		
-	Utilization (%)	32.95	32.950%		32.950%			
ALM/ERR	Utilization (bps) 32.95	32.950G					
History	Framed Rate (b	ps) 30.56	30.562G			30.563G		
HIStory	Data Rate (bps)) 22.44	4G		22.444G			
	# of Bytes	52286	61761792		522861760000			
	Pause Frames	0			0			

BERT Results - Summary

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6.4.2.2 Signal

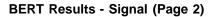
Signal (Page 1-2)

The Signal tab (fiber ports only) displays the receiving (RX) and transmitting (TX) optical level measured by the CFP, CFP2, CFP4, QSFP28, or QSFP+ (40G), depending on the 100G module in use.

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

BERT Results - Signal (Page 1)

LEDs	s	etup			Resul	ts	Stop
	Events	Traffic	Dela	y	Rates	PCS	
😑 Signal	Summary	Sign	al	E	rrors	Alarms	Restart
0.5			Level	[Rx]			TX Stop
🜔 Frame	Rx Optic	al Power[dB	m]		os	SAT	
		Cur. Min	. Max.	-16		+12	PCS Err Inj.
O Pattern	TOTAL	6.09 6.07	6.13				
				-16		+6	Eth. Alarm Inj.
ALM/ERR	#1 1295.60nm	-0.91 -0.9	7 -0.70			+	
	#2 1300.10nm	1.13 1.08	3 1.16			•	LASER On/Off
History	#3 1304.60nm	0.66 0.59	0.68			•	
	#4 1309.10nm	-0.98 -1.0	4 -0.91		-8.6	+4.5	MX Discover
				-	d.6-	+4.5	WIX DISCOVER
							Control
		٩	Page 1	of 5	۲		Setup Injection



LEDs	Setup					Re	Stop			
	Events	Traffi	ic	Dela	ay	Rates		PCS		
🜔 Signal	Summary		Signa		E	rrors		Alarms	Restart	
😑 Frame		Level [Tx]								
	Tx Optical Power[dBm]					os		SAT		
Pattern	TOTAL	Cur.	Min.	Max.	-16			+12	PCS Err Inj.	
•	TOTAL	6.19	6.18	6.19	-16			+6	Eth. Alarm Inj.	
ALM/ERR	#1 1295.60nm	-0.82	-0.83	-0.81				•		
	#2 1300.10nm		1.26	1.29				•	LASER On/Off	
History	#3 1304.60nm		0.84	0.86				+		
	#4 1309.10nm	-1.15	-1.16	-1.14		-8.6	3	+4.5	MX Discover	
									Control	
		٩		Page 2	of 5				Setup Injection	

Signal (Page 3)

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

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

BERT Results - Signal (Page 3)

		Setup Results									
LEDs			·					Stop			
	Eve	nts	Traffic	Del	ay	Rates	PCS				
😑 Signal	Sur	nmary	Sig	Signal		rrors	Alarms	Restart			
🙆 Frame				Frequ	ency			TX Stop			
Ŭ	Lane	Freq. (k	Hz) (Offset (ppm) [Vlin. (ppm)	Max. (ppm)				
😑 Pattern	1	257	81249	-	0.0	-0.0	0.0	Eth. Err Inj.			
	2	257	81249	-	0.0	-0.0	0.0	Eth. Alarm Inj.			
ALM/ERR	3	257	81250		0.0	-0.0	0.0				
History	4	257	81250		0.0	-0.0	0.0	LASER On/Off			
	Total	1031	25000		0.0	0.0	0.0	MX Discover			
								Control			
			◀	Page	of 5			Setup Injection			

Signal (Page 4-5)

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

LEDs		Setup			Res	Stop	
	Events	Traffic	De	elay Rates		PCS	
😑 Signal	Summary	Sign	al	Errors		Alarms	Restart
🕒 Frame		CFP Opt	ical Mo	dule Inf	ormation		TX Stop
	Power Class			er Clas	s 4 Module	(12 W)	PCS Err Inj.
😑 Pattern	Vendor		Ocla	aro Inc.		PCS Err Inj.	
	Part Number		TRE	35E20F1	Eth. Alarm Inj.		
ALM/ERR	Serial Number		J14I	454919			
History	MSA H/W Spec	. rev.	0.0		LASER On/Off		
	MSA MIS rev.		2.2		MX Discover		
	Control 1 Reg.((IEEE)	100	GE-LR4			
	Extended Abilit	y(IEEE)	111.	8Gbps,	Control		
		٩	Page	4 of 5	۲		Setup Injection

BERT Results - Signal (Page 4)

BERT Results - Signal (Page 5)

LEDs		Setup		Resul	ts				
	Events	Traffic	Delay	Rates	PCS				
😑 Signal	Summary	Signa	al	Errors	Alarms				
Frame		CFP C	ptical Module	Status					
•	Module Status		Ready						
😑 Pattern	Module Alarm S	Status	Normal	Normal					
	Temperature		49.1 C	49.1 C					
ALM/ERR	Voltage		3286 mV	3286 mV					
History	😑 CFP Un	plug	🕒 Ho:	😑 Host Lane Fault					
	O Network	(Lane Fault	🔘 Net	😑 Network Lane Alarm					
	😑 Module	Alarm	🔘 Mo	dule Fault					
	😑 General	Alarm							
		۲	Page 5 of 5	۲					

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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

LEDs		Setup			Res	ults	Stop
	Events	Traffi	ic Delay		Rates	PCS	
😑 Signal	Summary		Signal	E	rrors	Alarms	Restart
🔘 Frame			Current	_	Tot	al	TX Stop
	Bits		0				
😑 Pattern	BER		0.000000E+	00	0.00	0000E+00	Eth. Err Inj.
	FCS/CRC		0				Eth. Alarm Inj
ALM/ERR	FCS/CRC Rate		0.000000E+	00	2.55	4000E-10	
History	IP Checksum		0				LASER On/O
	IP Checksum F	late	0.000000E+	00	0.00	0000E+00	MX Discover
	Jabber Frames		0		0		
	Runt Frames		0		0		Control
							Setup Injectio

BERT Results - Errors

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6.4.2.3 Alarms

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

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

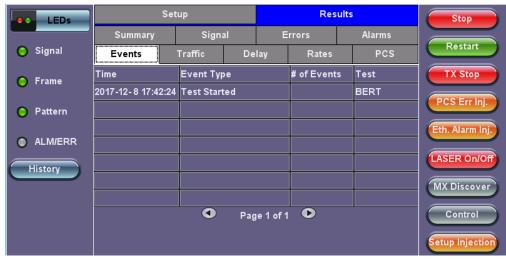
LEDs		Setup		Res	ults	Stop
	Events	Traffic	Delay	Rates	PCS	
😑 Signal	Summary	Signa	al	Errors	Alarms	Restart
🔵 Frame		Current		Total		TX Stop
	LOS (us)	0		0		
0.0.0	Link Down (us)	0		0	PCS Err Inj	
🜔 Pattern	Pattern Loss		0			
	Local Fault	0	Remo	te Fault	0	Eth. Alarm In
ALM/ERR	Service Disrup	tion (us)	<u>^</u>	ň		
History	Current	0	Total		0	LASER On/O
	Last		0			
	Min/Max	0		0		MX Discove
	No. of Occurre	nces	0		Control	
						Control
						Setup Injectio

BERT Results - Alarms

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6.4.2.5 Events

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



BERT Results - Events

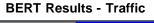
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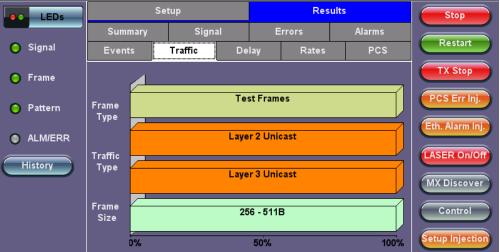
6.4.2.6 Traffic

Traffic tab: The following Traffic statistics are displayed:

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

Tap on the graph for detailed screens.





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

• Received (RX) frames:

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

- Non-test frames
- Transmitted (TX) frames:
 - Total frame Total # frames transmitted
- Pause frames: Total number of transmitted and received Ethernet pause flow-control frames

LEDs	Frames		Traffic Type		Frame Size	Stop
	RX Frames	#		%		
😑 Signal	Total	81015	352283	100		Restart
	Test	81015	352283	100	.000000	
🔵 Frame	SP-VLAN Frames	0		0.0	00000	TX Stop
-	MPLS LSP Frame	81015	352283	100	.000000	PCS Err Inj.
😑 Pattern	MPLS PW Frames	0		0.0	00000	PCS Err Inj.
-	VLAN	81015352282			.000000	Eth. Alarm Inj.
ALM/ERR	VLAN Stack	81015	352282	100	.000000	
	MPLS	81015	352282	100	.000000	LASER On/Off
History	MPLS Stack	0		0.0	00000	
	Non-Test	0		0.0	00000	MX Discover
	TX Frames	#				
	Total	81015	352375			Control
	Pause Frames	ТΧ		RX		
	Total	0		0		Setup Injection

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.

			ittooutto i)	
LEDs	Frames		Traffic Typ	е	Frame Size	Stop
	Distribution	#		%		
🕒 Signal	L2 Unicast	851398	76849	100.0	00000	Restart
	L2 Broadcast	0		0.000	000	TX Stop
🜔 Frame	L2 Multicast	0		0.000	000	
Pattern	L3 Unicast	851398	76849	100.0	00000	PCS Err Inj.
	L3 Broadcast	0		0.000000		Eth. Alarm Inj.
ALM/ERR	L3 Multicast	0		0.000	000	
History						LASER On/Off
						MX Discover
						Control
						Setup Injection

BERT Results - Traffic Type

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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

				inc.	OIZC	
LEDs	Frames		Traffic Type		Frame Size	Stop
	Distribution	#		%		
🕒 Signal	64B	0		0.00	00000	Restart
	65 - 127B	0		0.000000		TX Stop
🜔 Frame	128 - 255B	0		0.00	00000	
Pattern	256 - 511B	85638	065255	100	.000000	PCS Err Inj.
	512 - 1023B		0		00000	Eth. Alarm Inj.
ALM/ERR	1024 - 1279B	0		0.000000		
	1280 - 1518B	0		0.00000		LASER On/Off
History	> 1518B	0		0.00	00000	
						MX Discover
						Control
						Setup Injection

BERT Results - Frame Size

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6.4.2.7 Delay

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

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

		BERT Res	and Delay		
LEDs	Se	tup	Res	ults	Stop
	Summary	Signal	Errors	Alarms	
🕒 Signal	Events		ay Rates	PCS	Restart
🕒 Frame	Frame Arrival Tim	e			TX Stop
	Current	6ns	Average	25ns	PCS Err Inj.
🔘 Pattern	Minimum 3ns I		Maximum	236ns	PCS LIT IIJ.
	Frame Delay Varia	ation			Eth. Alarm Inj.
ALM/ERR	Average		3ns		
History					LASER On/Off
					MX Discover
					Control
					Setup Injection

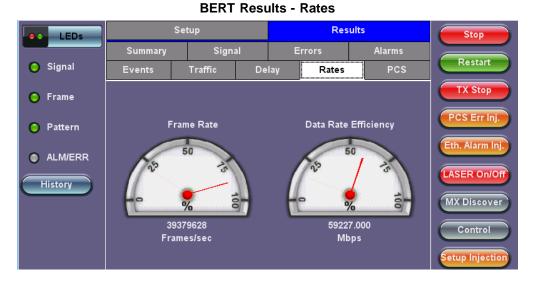
BERT Results - Delay

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6.4.2.8 Rates

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

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



BERT Results - Rate Details

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

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6.4.2.9 PCS

PCS layer testing helps validate and test all aspects of the PCS layer, which plays a significant role in 100G traffic generation/reception. Lane mapping and skew generation allows for the realignment of the virtual lanes and the injection of skew bits into each physical lane in order to stress and validate the PCS receiver.

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

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

BERT Results - PCS

LEDs	5			Resu	lts	Stop	
	Summary		Signal	E	rrors	Alarms	
😑 Signal	Events	Traffi	ic D	elay	Rates	PCS	Restart
Frame	64/66B Alar	Seconds			_	TX Stop	
	HI-BER	0					
O Pattern		PCS Err Inj.					
Ŭ	PCS Lane Alarm	Seconds	PCS La	ne Errors	Count	Eth. Alarm Inj.	
ALM/ERR	LOA		0	Invalid	Sync Heade	r 0	
	LOBL		0	Invalid Align Marker		r 0	LASER On/Off
History				BIP-8 E	lock Error	0	
		PCS La	anes Alarms	and Erro	ors Summary		MX Discover
	0 1	8 9	Control				
	10 11	12	13 📄 14	15	16 1 7	/ 📑 18 📑 19	
			View PCS	Lane De	tails		Setup Injection

BERT Results - PCS Lane Details

LEDs				PCS	Lane Details			Stop
LEDS	La	ne	Ala	rms		Errors	\odot	
Signal	PCS#	VL ID		LOAML onds	ISH	IAM Count	BIP8 BIk	Restart
Joighan	0	4	0	0	0	0	0	
	1	0	0	0	Ō	Ō	Ō	TX Stop
🔵 Frame	2	1	0	0	0	0	0	TA Stop
-	3	2	0	0	0	0	0	
_	4	3	0	0	0	0	0	PCS Err Inj.
🜔 Pattern	5	5	0	0	0	0	0	
	6	6	0	0	0	0	0	
			0	0	0	0	0	Eth. Alarm Inj.
ALM/ERR	8 9	8	0	0	0	0	0	
	10	9 14	0	0	0	0	0	LASER On/Off
History	11	14	0	0	0	0	0	
	12	11	0	0	0	0	0	
	13	12	0	0	0	ŏ	0	MX Discover
	14	13	0	0	0	ŏ	ŏ	
	15	19	0	0	Ō	Ő	Ŏ	Control
	16	15	0	0	0	0	0	Control
	17	16	0	0	0	0	0	
	18	17	0	0	0	0	0	Setup Injection
	19	18	0	0	0	0	0	

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6.4.3 Saving BERT Results

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

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

Signal	Save re	sult as	s			2012	102	6_14	<mark>4542</mark>	Start
• Frame	1	2	3	4 5	6	7	8	9	0	
Pattern	q	w	e	r t	У	u	1	•	р	
ALM/ERR	а	s	d	f	9	h	j	k	1	LASER On/Off
History	Caps	z	×	c	ь	v	n	m	Shift	LASER UNION
		Symb	ol De	. @	•1	De	IAI	<-		
				SPACE				Ap	ply	

BERT Results Save

Once the results are saved, they can be viewed, renamed, or exported to USB in the **Utilities > Files > Saved** section. Refer to the **File Manager** section in the RXT1200, TX300S, or UX400 Platform manual for more information on managing saved test results.

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6.5 RFC2544

6.5.1 Setup

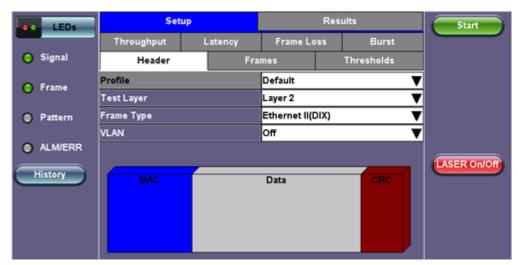
Overview:

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

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

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

RFC2544 Home



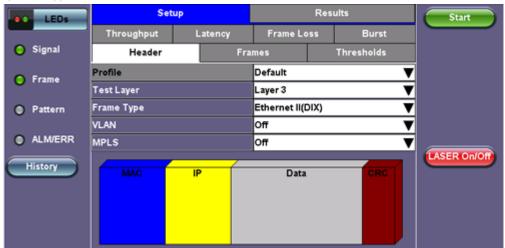
Go back to top Go back to TOC

6.5.1.1 Header Settings

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

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RFC2544 Setup Layer 3



RFC2544 Setup MPLS-TP

LEDs	MPLS-TP	MAC	VLA	N MP	PLS	IP	l	DATA	RX	Filter	Start
	MPLS-TP MAC Source					00-18-63-1A-2B-4E					
😑 Signal	MPLS-TP MAC Destination			00-18·	00-18-63-1A-2B-3C						
0.5	Ethernet T	ype			88-47						
😑 Frame	B MPLS-1	TP VLAN	ID	1082 Prie	ority	6	Туре	ε	38a8		
Pattern	LSP		Label	0	S=	1 C	o S= 0	TTL	.= 1	28	
Ŭ	📄 PW		Label	0	S=	1 C	o S= 0	TTL	_= 1	28	
ALM/ERR											
History											LASER On/Off
HISTOTY											MX Discover
											MIX DISCOVEL
											Control



RFC 2544 Header Setups

The MAC, VLAN, MPLS, and IP configuration procedures are the same as in BERT mode. Please refer to the <u>BERT Application</u> section for details.

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6.5.1.2 Frames Settings

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

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

- Press the back button to return to the frames screen.
- The new custom frame size is displayed (it can be enabled or disabled as needed).

LEDs	Setu	P		Res	Start	
	Throughput	Latency	Fra	me Loss	Burst	
Signal	Header	Fr	ames		Thresholds	
Frame	64 bytes	11-	•	10		
	128 bytes					
Pattern	256 bytes					
	512 bytes					
ALM/ERR	1024 bytes					
History	1280 bytes					LASER On/Off
	1518 bytes			Add Fra	me	

RFC2544 Frames Setup

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6.5.1.3 Threshold Settings

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

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

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

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

LEDs	Setup				Res	ults	Start
	Throughput	L	atency	Frame Loss		Burst	
😑 Signal	Header		Frames			Thresholds	
Frame	Enable		oughput (%)	Late	ncy (us)	
0.10	64 bytes	70.0	70.00			1	
Pattern	128 bytes	75.0	00		2000		
	256 bytes	80.0	00		3000		
ALM/ERR	512 bytes	85.0	00	400		1	
History	1024 bytes	90.0	00	500		1	LASER On/Off
	1280 bytes	95.0	00		6000	1	
	1518 bytes	100	.00		7000	1	

RFC2544 Thresholds Setup

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6.5.1.4 Throughput, Latency, Frame Loss, and Burst Settings

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

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

40G/100G Manual D07-00-123P Rev A00 Throughput:

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

LEDs	Setup			Res	Start	
	Header	Fra	mes		Thresholds	
🔘 Signal	Throughput	Latency	Frame Lo	ss	Burst	
Frame	MAX Rate	100.000		%	▼	
0.10	Resolution	1.00				
Pattern	Duration (s)	20				
ALM/ERR History	Enable Test					LASER On/Off

RFC2544 Throughput Settings

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Latency: The following parameters can be configured:

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

RFC2544 Latency Settings

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

Go back to top Go back to TOC

Frame Loss: The following parameters can be configured:

• Max Rate: Up to 100% of the negotiated line rate. The default value is 100%.

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

• Step Size: 1 to 10%. The default value is 10%.

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

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

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

RFC2544 Frame Loss Settings

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

- Max Rate: The default value is 100%.
 In the burst test, frames are always transmitted at the maximum rate for a given minimum and maximum burst duration.
- **Minimum Duration:** Selectable in the range 2 to 999 seconds. Default value is 2 seconds. This is the duration of the first burst.

Maximum Duration: Selectable up to 999 seconds. The default value is 20 seconds. This is the duration of the second burst, which must be greater than the minimum burst.

• **Repetitions:** Selectable in the range 1 to 100. The default value is 1. This is the amount of times that the burst test will be repeated for each test frame size.

LEDs	Setur	o	Re	sults	Start
	Header	Fra	ames	Thresholds	
O Signal	Throughput	Latency	Frame Loss	Burst	
Frame	MAX Rate	100.000	%		7
U Frame	MIN Duration (s)	2			
Pattern	MAX Duration (s)	20			
	Repetitions	1			
ALM/ERR History	✓ Enable Test				LASER On/off

RFC2544 Burst Settings

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6.5.1.5 Starting/Stopping a RFC 2544 Measurement

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

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

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

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6.5.2 Results

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

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

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

RFC2544 Results Status

	5	Setup			Resu	Stop	
	Throughput	Latency	Frame	e Loss	Burst	PCS	
😑 Signal	Status	Summ	ary	s	ignal	Events	
😑 Frame	ST:2017-12-11 1	4:00:29		ET:00:0	3:14		
Ŭ	Throughput Te	st		Done			PCS Err Inj.
Pattern	Latency		_	ln prog			
ALM/ERR	Frame Loss Tes			Pendin			PCS Alarm Inj.
Ě	Burstability Tes	t		Pendin	g		LASER On/Off
History							
							MX Discover
							Control
							Setup Injection

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

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

LEDs	s s	Setup			Result	Stop	
	Throughput	Latency	Fram	e Loss	Burst	PCS	
O Signal	Status	Sum	mary	Sig	Inal	Events	
O Frame	ST:2012-10-23 1	3:15:24		ET:00:01	:13		1
O Thank		тх			RX		
Pattern	Line Rate (bps)	100.0	000G		100.000G		
-	Utilization (%)	100.0	100.000%		100.000%		
ALM/ERR	Utilization (bps)	100.0	100.000G		100.000G		
History	Framed Rate (b)	ps) 98.7(98.700G		98.700G		LASER On/Off
HISTORY	Data Rate (bps)	97.5	29G		97.529G		
	Total Frames	6168	890017		61688900	04	
	Bad Frames	0.			0		
	Pause Frames	0			0		

RFC 2544 Results Summary

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6.5.2.3 Signal: The Signal tab displays the optical level measured by the CFP2 or QSFP+ transceiver.

RFC2544 Results Signal Page 1

LEDs	S	etup				Results	;	Start
	Throughput	Latency	Fra	ame Lo	ss	Burst	PCS	
😑 Signal	Status	Su	mmary		Sign	al	Events	
O Emana			L	evel [R	x]			
😑 Frame	Rx Optic	al Power	[dBm]		LOS		SAT	
Pattern				/lax.	-16		+12	
U l'attern	TOTAL	6.09	6.07 6	5.11				
ALM/ERR	#1 1295.60nm	-0.93 ·	-0.96 -	0.89	-16		+6	
	#2 1300.10nm			1.15			•	LASER On/Off
History	#3 1304.60nm).67			•	LASER OILOIT
	#4 1309.10nm	-0.95	-1.02 -	0.91		-8.6	+4.5	MX Discover
						0.0		
								Control
			Pa	ige 1 of	f 5	►		

RFC2544 Results Signal Page 3

LEDs		Setup			Resu	Stop	
	Events	Traffic	De	lay	Rates	PCS	
😑 Signal	Summary	Signa	al	E	rrors	Alarms	Restart
😑 Frame		_	Frequ	uency			TX Stop
	Frequency			103124	998KHz		PCS Err Inj.
😑 Pattern	Offset [ppm]			-0.0		PCS Err Inj.	
-	Min [ppm]			-0.0			PCS Alarm Inj.
ALM/ERR	Max [ppm]			0.0			
History							LASER On/Off
							MX Discover
							Control
		٩	Page	3 of 5	۲		Setup Injection

RFC2544 Results Signal Page 4

LEDs		Setup		Result	5	Start
	Throughput	Latency	Frame Loss	Burst	PCS	
O Signal	Status	Sumr	nary Si	gnal	Events	
O Frame	1	CFP Op	tical Module Info	ormation		
•	Power Class		Power Class	s 3 Module (<	:= 24 W max)	
Pattern	Vendor		NEOPHOTO	NICS		
121	Part Number		PD100-TXF	ND-0		
ALM/ERR	Serial Number		D6058			
History	MSA H/W Spec.	rev.	1.4		LASER On/Off	
	MSA MIS rev.		1.4			
	Control 1 Reg.(IEEE)	100GE SMF	2km, 10x10		
	Extended Ability	y(IEEE)	111.8Gbps,1	03.125Gbps		
		•	Page 4 of 4	۲		

Signal (Page 5) - CFP Optical Module Status

LEDs	\$		Res		Start			
	Throughput	Latency	Fram	e Loss	Burst		PCS	
😑 Signal	Status	Summ	ary	s	ignal		Events	
😑 Frame		CFP C	Optical	Module	Status			
	Module Status		Re	ady				
Pattern	Module Alarm S	tatus	No	rmal				
_	Temperature		47.	BC				
ALM/ERR	Voltage		328	6 mV				
History	😑 CFP Unp	lug		🔵 Host	: Lane Fault	LASER On/Off		
	😑 Network	Lane Fault		🔵 Netv	vork Lane A	ları	n	MX Discover
	😑 Module /	Alarm		🔵 Mod	ule Fault			
	ら General	Alarm						Control
		٩	Page	5 of 5	۲			

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

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

RFC 2544 Results Events

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6.5.2.5 Throughput:

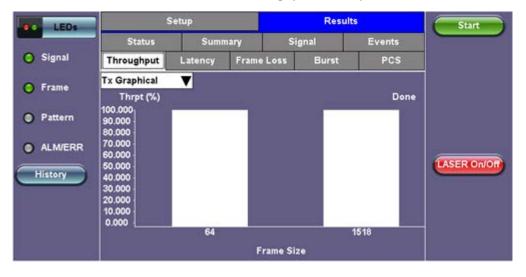
The Throughput tab displays the maximum throughput rate of the link under test. Results are displayed in graphical and table formats. Use the drop-down menu to change the display format.

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

RFC2544 Results Throughput Summary

LEDs	1 5	Setup			Resu	alts	Start
	Status	Summ	nary	Sig	nal	Events	
Signal	Throughput	Latency	Frame	Loss	Burst	PCS	
Frame	Summary	▼ Tx(%)	V	Rx(%)	V	Thresholds	
- France	64 bytes	100.000)	100.000		Pass	
Pattern	1518 bytes	100.000)	100.000		Pass	
ALM/ERR	1						
History	0						LASER On/O
		0	Page 1	of 1 💌			

RFC2544 Results Throughput Tx Graphical



RFC2544 Results Throughput Test Log

LEDs	s	ietup			Re	sults		Start
	Status	Summ	nary	Sig	Inal		Events	
O Signal	Throughput	Latency	Fram	e Loss	Burst		PCS	
Frame	Test Log	▼ Tx(%)	-	Rx(%)		Stat	tus	
U T T MITE	64 bytes	100.000)	100.000	0	Pas	5	
O Pattern	1518 bytes	100.000)	100.000	0	Pas	5	
ALM/ERR								-
History		1		Ŭ.		Ű		LASER On/Off
		_		_		-		-
	0 2					5		-
		0	Page	1 of 1 C	>			

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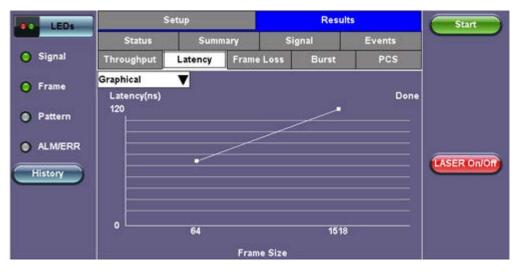
6.5.2.6 Latency and Jitter

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

- Graphical: Latency results displayed in line graph form (Latency [us] vs Frame size [bytes]).
- Summary and Test Log tables display:

- byte size
- Latency (us): Round trip delay latency.
- Rate (%): Percentage of frames transmitted. Data rate used for latency test.
- Pass/Fail test status.

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

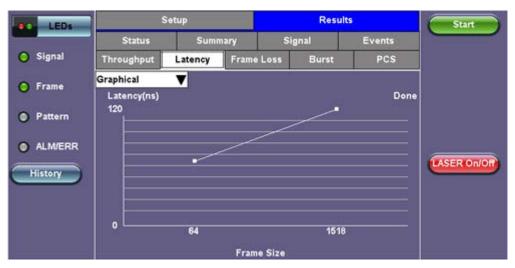


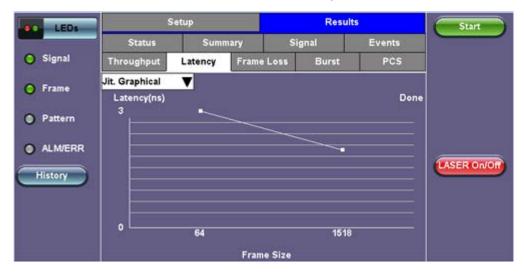
RFC2544 Latency Results Graphical

RFC2544 Latency Results Summary

LEDs	s	etup			Resu	ults		Start
	Status	Sum	mary	Sigr	nal	E	vents	
O Signal	Throughput	Latency	Frame	Loss	Burst		PCS	
O Frame	Summary	V Laten	cy	Rate (%)	Thres	holds	
U T T MINE	64 bytes	66ns		100.000		Pass		
O Pattern	1518 bytes	120ns		100.000		Pass		
ALM/ERR	22 22	-		-				
History	1					1		LASER On/Off
						-		
		٩	Page 1	1 of 1 👁				

RFC2544 Latency Results Test Log



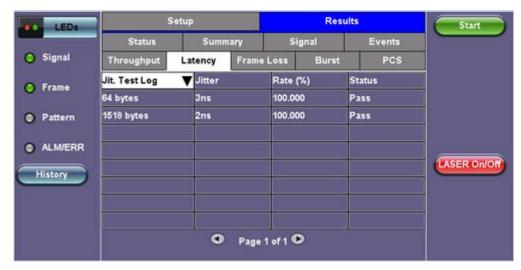


RFC2544 Jitter Results Graphical

RFC2544 Jitter Results Summary

LEDs	Setup			Re	sults	Start
	Status	Sum	nary	Signal	Events	
O Signal	Throughput	Latency	Frame Los	is Burs	t PCS	
O Frame	Jit. Summary	V Jitter	R	ate (%)	Thresholds	
	64 bytes	3ns	10	0.000	Pass	
Pattern	1518 bytes	2ns	10	0.000	Pass	
ALM/ERR						LASER On/Off
History						
		•	Page 1 of	1•		

RFC2544 Jitter Results Test Log

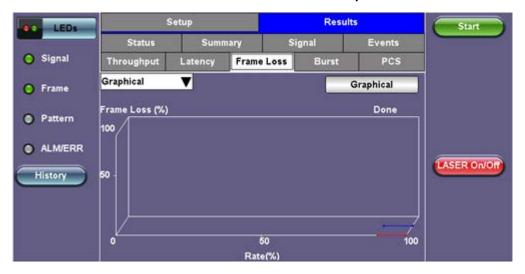


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6.5.2.7 Frame Loss

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

- Summary and Test log tables display test frame length, byte size, frame loss (%) from received traffic, and rate (%) transmitted.
- Graphical: Frame Loss displayed in line graph form (Frame size [bytes] vs Rate [%]). Tap the Graphical button to see the legend.



RFC2544 Results - Frame Loss Graphical

RFC2544 Results - Frame Loss Summary

LEDs	5	Setup	S.			Rest	ults		Start
	Status		Sum	nary	Si	gnal		Events	
O Signal	Throughput	Lat	tency	Frame	Loss	Burst		PCS	
O Frame	Summary	V	Frame	Loss (%)	Frame	Loss Cnt	Rate	» (%)	
U France	64 bytes		0.000		0		100.	000	
O Pattern	1518 bytes		0.000		0		100.	000	
ALM/ERR	-	_					╞		-
History	1				Ť.				LASER On/Off
HISTORY					ļ.				
	4								
						451 Š	Ļ		
			٩	Page 1	of 1 🗨				

RFC2544 Results - Frame Loss Test Log

LEDs		Setup			Res	ults	Start
	Status	Sum	nary	Sig	gnal	Event	s
O Signal	Throughput	Latency	Frame	Loss	Burst	PC	s
Frame	Test Log	V Frame	Loss (%)	Frame	Loss Cnt	Rate (%)	
O France	64 bytes	0.000		0		100.000	
O Pattern	64 bytes	0.000		0		90.000	
	1518 bytes	0.000		0		100.000	
ALM/ERR	1518 bytes	0.000		0		90.000	
History							LASER On/off
	0	-					
				1			
	-						
		٩	Page 1	of 1 🖸			

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6.5.2.8 Burst

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

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



RFC2544 Results - Burst Summary

RFC2544 Results - Burst Test Log

LEDs	5	Setup				Rest	ilts		Start
	Status	s	ummar	ν	Si	gnal		Events	
O Signal	Throughput	Laten	cy	Frame Lo	55	Burst		PCS	
O Frame	Test Log		RX Fr	m. Count	Exp	Frm. Cou	nt Du	ration (s)	
0	64 bytes		297619	9047	2976	19047	2		
O Pattern	64 bytes 21		2976190476		2976190476		20		
	1518 bytes		162548	876	1625	4876	2		
ALM/ERR	1518 bytes		162548	8764	1625	48764	20		
History									LASER On/Off
	2								
	10		1				+		-
			•	Page 1 of	r1 C	>			

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6.5.2.9 PCS

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

RFC2544 Results - PCS

LEDs		Setup					Result	5		Start
	Status		Sum	nary	S	Signal		Eve	nts	
O Signal	Throughput	Late	ency	Fram	e Loss	В	urst		PCS	
O Frame	64/66B Ala	urms	Sec	onds	1	in.		100		1
U Traine	HI-BER		0							
Pattern			10	Agg	regate			20		
	PCS Lane Alar	ms	Sec	onds	PCSL	ane Err	ors	Coun	t	
ALM/ERR	LOA		0		Invalid	Sync H	leader	0		
History	LOBL		0		Invalid	Align N	Marker	0		LASER On/Off
HISTORY	<u>è</u>				BIP-8	Block E	rror	0		
	The second second	PCS	Lanes	Alarms	and Err	ors Su	mmary	00		
	0001	0 2	0 3	0 4	0 5	6	07	08	0 9	
	○ 10 ○ 11	12	0 13	0 14	15	16	17	18	19	
			Vie	w PCS	Lane De	tails				

RFC2544 Results - PCS Lane Details

LEDs				PCS	Lane Details			Start
LEDS	La	ne	Ala	rms		Errors	\odot	Start
🔘 Signal	PCS#	VL ID		LOAML onds	ISH	IAM Count	BIP8 BIk	
- orginal	0	2	0	0	0	0	0	
	1	3	0	0	0	0	0	
📔 🜔 Frame	2	4	0	0	0	0	0	
-	3	0	0	0	0	0	0	
	4	1	0	0	0	0	0	
🔵 Pattern	5	8	0	0	0	0	0	
-	6	9	0	0	0	0	0	
	7	5	0	0	0	0	0	
ALM/ERR	8	6	0	0	0	0	0	
	9	7	0	0	0	0	0	LASER On/Off
History	10	10	0	0	0	0	0	LASER ON/ON
HISTORY	11	11	0	0	0	0	0	
	12	12	0	0	0	0	0	MX Discover
	13	13	0	0	0	0	0	
	14	14	0	0	0	0	0	
	15	17	0	0	0	0	0	Control
	16	18	0	0	0	0	0	
	17	19	0	0	0	0	0	
	18	15	0	0	0	0	0	
	19	16	0	0	0	0	0	

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6.5.3 Saving RFC 2544 Results

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

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

Signal	Save re	esult as .			2	0121	026	_14	<mark>4542</mark>	Start
• Frame	1	2 3	4	5	6	7	8	9	0	
Pattern	q	w e	r	t	У	u	4	•	р	
ALM/ERR	a	s	d	f	9	h	j	k	1	
History	Caps	z	x	c	ь	v	n	m	Shift	LASER On/Off
		Symbol	Del	@	•	Del A	JI -	<-		
			SP	ACE				Ар	ply	

RFC2544 Results Save

Once the results are saved, they can be viewed, renamed, or exported to USB in the **Utilities > Files > Saved** section. Refer to the **File Manager** section in the RXT1200, TX300S, or UX400 Platform manual for more information on managing saved test results.

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6.6 V-SAM

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

Overview

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

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

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

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

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

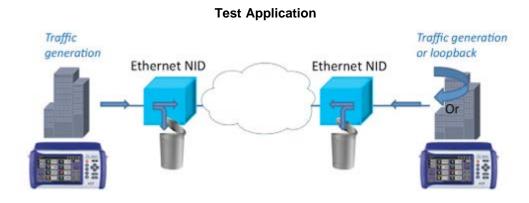
Comparison of RFC 2544 and Y.1564

Test Methodology

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

• Phase 1: Service Configuration test: The services running on the same line are tested one by one to verify the correct service profile provisioning.

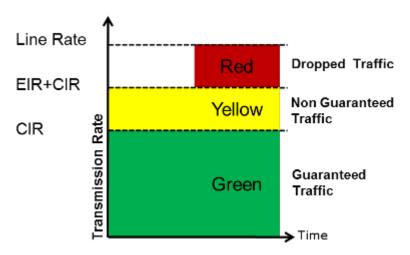
Phase 2: Service Performance test: The services running on the same line are tested simultaneously over an extended
period of time, to verify network robustness.



Phase 1: Service Configuration Test

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

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



Service Bandwidth Profile

Phase 2: Service Performance Test

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

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- V-SAM Profile: Delete, Save, Save as..., Default, or Last Configuration.
- **# of Services:** Select the number of services to run. Up to 8 services can be chosen for a 1 GE interface and up to 10 services can be chosen for a 10 GE interface.
- **Display:** ULR or IR. See the <u>Service Attributes</u> section for more information.
- Service Configuration Test: Enable or Disable the configuration test.
- Service Performance Test: Enable or Disable the performance test.
- Service Configuration and Performance Tests can be enabled independently.
- CIR Test Config: Tap on the box to configure the Committed Information Rate Test on another screen.
- Duration: Select the Service Performance Test duration. Options are 15min, 30min, 1hr, 2hr, 24hr or user defined. If user-defined 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	d			Services		
😑 Signal	V-SAM P	ofile		La	ist configu	ration		
😑 Frame		vices 3 e Configuration e Performan	tion Test	-	CIR Test C	<mark>onfig.</mark> 15min ▼		
O Pattern	Service #	Name		EIR (Mbps)	Traffic Policing	CBS (KB)	EBS (KB)	
ALM/ERR	✓ 1 2 3	Service 1 Service 2 Service 3		0.000	Yes Yes	-	· ·	
Tools								MX Discover
Utilities	Tatal ID(002546-	- (101 200		•		Control
Files	i ocal IR(t	CIR+EIR):121		S(121.362 Page 1 of		,		

V-SAM - Setup - General (Page 2)

LEDs		Setup				Results		Start
		Genera	d			Services		
😑 Signal	V-SAM P	rofile		La	ist configu	ration	▼	
😑 Frame		vices 3 e Configuration e Performan	tion Test		CIR Test O	<mark>onfig.</mark> 15min ▼		
O Pattern	Service # ⊽1	Service Name Service 1	Frame Size 9000	FLR (%) 0,1	FTD (ms) 10,000	IFDV (ms) 1.000	AVAIL (%) 99.9	
ALM/ERR	✓ 2 ✓ 3	Service 2 Service 3	1518 1518	0.1	10.000	-		
X Tools								MX Discover
Utilities	Total IR((CIR+EIR):301		s (303.953 Page 2 of		e)		Control

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CIR Test Configuration

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

LEDs	CIR Test	Configuration	Start
Signal	Simple Test Starts the tests at the CIR. and continues	if the Simple Validation test fails.	
😑 Frame	steps until it reaches the Cl	R.	
🔵 Pattern	Step Load Test	Configuration	
ALM/ERR	Test Duration 10 seconds/test/service	Step Value(% of CIR) 1 25 2 50	
Tools		3 75 4 100 Tap on table to modify	MX Discover
Utilities		Close	Control
Files			

CIR Test Config

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6.6.1.1 Header Settings

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

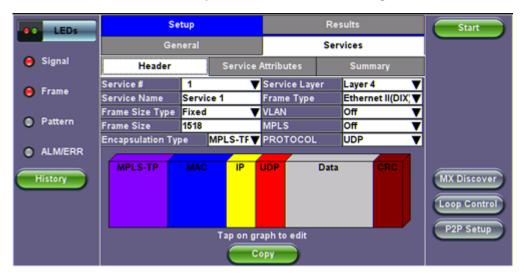
MPLS-TP:

• 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

V-SAM Setup - Services - EMIX Frame Size Settings

LEDs		EMI	(Configuration	
X Tools	Frame #	Size		
	1	a-64	V	
Utilities	2	b-128	V	
Files	3	c-256	▼	
	4	e-1024	▼	
	5	g-1518	▼	
		C	Close	

V-SAM Setup - Services - MPLS-TP Settings

LEDs	MPLS-TP	MAC	I	P	UD	P	DAT	A I	RX Filter	Start
	MPLS-TP MAC Source					3-1/	-2B-4E			
😑 Signal	MPLS-TP M	AC Destinat	ion		00-18-6	3-1/	-2B-3C			
O 5	Ethernet Typ	pe			88-47	_				
😑 Frame	MPLS-TR	VLAN ID	108	2 Pric	ority	6	Туре	88	3a8	
Pattern	LSP	La	bel= <mark>0</mark>		S=	1 (CoS= <mark>0</mark>	TTL	128	
Ũ	😑 PW	La	bel= <mark>0</mark>		S=	1 (CoS= <mark>0</mark>	TTL	128	
ALM/ERR										
History										MX Discover Loop Control
				Appl	y to All					

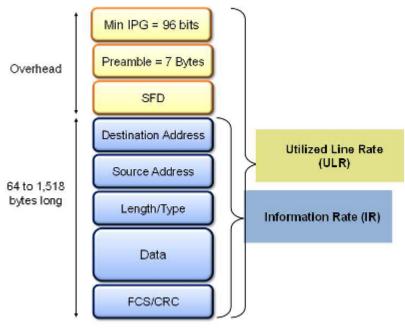
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6.6.1.2 Service Attributes

Bandwidth Profile Parameters

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

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

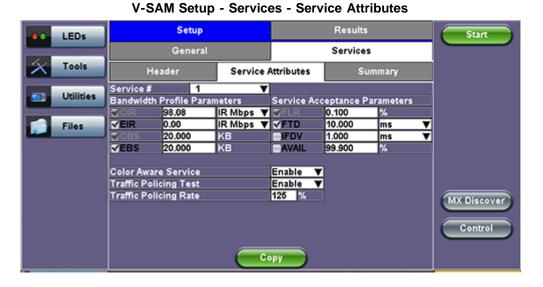


V-SAM Services - Header

- Excess Information Rate (EIR): Maximum rate above the CIR at which the customer can send frames that will be forwarded on a best effort basis, but may be dropped in the event of congestion within the network. The combined CIR and EIR must not exceed the line bandwidth. Traffic beyond CIR + EIR will be dropped when it enters the carrier's network. Tap on the box to enter a rate. EIR is expressed in terms IR Mbps or ULR Mbps. Select a term to express EIR or select Disable to disable the test.
- Traf. Policing: Enable or Disable the traffic policing test. For this test, traffic is transmitted at 25% higher than the

CIR+EIR. The Policing test fails if the higher traffic rate is allowed through the network.

- Color Aware: Enable, Disable. When Color Aware is enabled, the Drop Eligible parameter in the VLAN header configuration screen is not available for configuration. If no VLAN is configured for the service traffic, the Color Aware parameter is ignored.
- CBS and EBS: Committed Burst Size (CBS) and Excess Burst Size (EBS).
 - CBS can be enabled without enabling EBS
 - If EBS is enabled, then CBS is automatically enabled too
 - Values between 4 KBytes and 100 KBytes can be input for both CBS and EBS





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.

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Service Acceptance Parameters

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

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

\sim		C ~ **	1000
6.0	pying	Ser	vices
	PJ		

	•		
LEDs	Copy Service Header		Start
	Copy FROM	Сору ТО	
🙆 Signal	Service1	Service1	
\sim	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.

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MX Discover and Control Settings

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

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

Peer-to-Peer Setup

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

Packet Capture

To capture packets, tap on **P1 Cap Start**. Stopping packet capture automatically names and saves results in pcap format. A message displays the name of the saved file located in **Files** > **Saved** section of the test set. The file and can be exported to a PC and analyzed using Wireshark. Refer to **Files** > **Viewing Saved Files and Results** section in **TX300S**, **MTTplus**, **RXT-1200**, **or UX400 platform manuals** for more information on retrieving and managing saved files.

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6.6.2 Results

LEDs	Setup				Results		Start
	Config. Tests Perf.			Tests	Ever	nt Log	
😑 Signal	Service	1 s	ervice 2	Service	3 Summary		
Frame		\$	Service #	#1:Faile	d		
		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	
Ŭ	Step2	Pass	50.539	0.0	0.077	0.000	
ALM/ERR	Step3	Pass	75.814	0.0	0.077	0.000	
	Step4	Pass	101.079	0.0	0.077	0.000	
	CIR/EIR		Dura	ation 10 Sec			
	Total IR	Pass	121.095	0.0	0.077	0.000	
Tools	Policing	Duration	10 Seconds	s, Transmitte	d Rate 146.3	69 Mbps	MX Discover
	Total IR	Failed	146.360	0.0	0.077	0.000	
	Tapa	anywhere on	the table fo	r detailed re	sults of each	i test.	
Utilities							Control
Files							

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

Configuration Test

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

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

LEDs	CIR Test	CIR/EIR Test		Policir	ıg Test	Start				
		Service #1:Pass								
Signal		Step1	Step2	Step3	Step4					
U	Pass/Fail	Pass	Pass	Pass	Pass					
A 5										
😑 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										
ALM/ERR	Frame Loss Count	0	0	0	0					
0	Frame Loss Ratio(%)	0.0	0.0	0.0	0.0					
X 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						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.

LEDs	CIR Test	CIR/EIR Test	Poli	cing Test	Start
	Ser	vice #1:P	ass		
Signal		Green(CIR)	Yellow(EIR)	Total	
•	Pass/Fail			Pass	
Frame					
U Frame	IR Min(Mbps)	-		121.086	
	IR Mean(Mbps)	-		121.095	
Pattern	IR Max(Mbps)			121.158	
Ŭ					
ALM/ERR	Frame Loss Count	-		0	
	Frame Loss Ratio(%)			0.0	
X 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.

		5							
LEDs	CIR Test	CIR/EIR Test	Poli	cing Test	Start				
	Serv	Service #1:Failed							
Signal		Green(CIR)	Yellow(EIR)	Total					
	Pass/Fail			Failed					
O 5									
😑 Frame	IR Min(Mbps)			146.297					
	IR Mean(Mbps)			146.360					
🔵 Pattern	IR Max(Mbps)			146.369					
Ŭ									
ALM/ERR	Frame Loss Count			0					
	Frame Loss Ratio(%)			0.0					
X 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 - Service 1

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

		and coming					
LEDs	Se	tup		Resu	ults	Start	
	Config. Tests	Config. Tests Perf. T			Event Log		
😑 Signal	Service 1	Service 1 Service 2		3	Summary		
Frame		Failed					
	Service	CIR	CIR/EIF	२	Traffic Policing		
	1	Pass	Pass		Failed		
Pattern	2	Pending	Disable	d	Pending		
Ŭ	3	Pending	Disable	d	Pending		
ALM/ERR							
X Tools						MX Discover	
						MA Discover	
Utilities						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	h	ervice 2	Service		Summary	
😑 Frame	Sei					
Ŭ	IR Min(Mbps)		Frame Loss	Count	-	
Pattern	IR Mean(Mbps)		Frame Loss			
0	IR Max(Mbps)		Out of Sequ			
ALM/ERR	FTD Min(ms)		FDV Min(ms)			
	FTD Mean(ms)		FDV Mean(n			
	FTD Max(ms)		FDV Max(m:	i)		
Tools						MX Discover
	Availability(%)		Errored Fra			
Utilities	Unavailability Count		Total RX Fra	ames		Control
						Control
Files						

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				Re	sults		Start
	Cont	Config. Tests Perf. T			sts Event Log				
😑 Signal	Servi	vice 1 Service 2			Service 3 Su			nmary	
Frame			Pe	ending	J				
•			IR(Mbps)	FLR(%)	FTD(n	ns)	FDV(ms)	AVAIL(%)	
0.0	1	Pending							
Pattern	2	Disabled							
	3	Disabled							
ALM/ERR									
Tools									MX Discover
Utilities									
Utilities									Control
Files									

Perf. Tests - Summary

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Event Log

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

LEDs	Set	φ	Re	sults	Start
	Config. Tests	Perf. T	ests	Event Log	\square
🧿 Signal	Time	Event Type	# of Events	Test	
Frame	2011-11-10 07:35:46	Test Started		V-SAM	
U	2011-11-10 07:36:56	Test Stopped		V-SAM	
Pattern	<u> </u>		_		
X Tools		• Page	:1 of 1 🔍		MX Discover
Utilities		Control			
Files					

6.7 Throughput Testing

6.7.1 Setup

Overview:

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

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

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6.7.1.1 Header Settings

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

LEDs	Set	up	R	esults	Start	
	Throughput	Latency	Frame Loss	Burst		
😑 Signal	Header	Fra	imes	Thresholds		
😑 Frame	Profile		Last configurati	Last configuration		
			MPLS-TP			
Pattern	Test Layer		Layer 3			
	Frame Type		Ethernet II(DIX)			
O ALM/ERR	VLAN		1 tag			
History	MPLS		2 tags	LASER On/Off		
					MX Discover	
	MPLS-TP MAC	V M M	IP C	Data C		
				ĉ	Control	
		NSS				

Throughput Header Settings

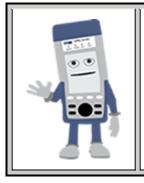
- Number of streams (See **General Settings** below)
- Bandwidth per stream (See General Settings below)
- Test layer
- Frame Type
- VLAN tag(s)
- MPLS tag(s)
- Frame header per stream (if applicable)
- Traffic profile per stream (if applicable)
- Error injection per stream (if applicable)
- Control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

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



Throughput Header Settings





•

Multiple Streams - MAC/IP Address Setup

If all of the streams are going to the same far-end unit, then the MAC/IP destination addresses must be the same on all of the streams.

If any of the traffic streams are going to more than one far-end unit then ensure the correct MAC/IP destination addresses are configured for the respective streams.

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6.7.1.2 Traffic Settings (Per Stream Configuration)

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

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

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

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

LEDs	Setup				Res	Stop	
	Header	Traffic		neral Summary) OAM	
😑 Signal	Stream #	1 of 1			Prev	Next	Restart
😑 Frame	Traffic Flow			Consta	ant	,	TX Stop
	Frame Size Type			Fixed			Eth. Err Inj.
😑 Pattern	Frame Size (bytes)			256			
	Constant Bandwidth			100.000 %			PCS Alarm Inj.
ALM/ERR History							LASER On/Off
							MX Discover
							Control
							Setup Injection

Throughput Traffic Settings

6.7.1.3 General Throughput Settings (Global Configuration)

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

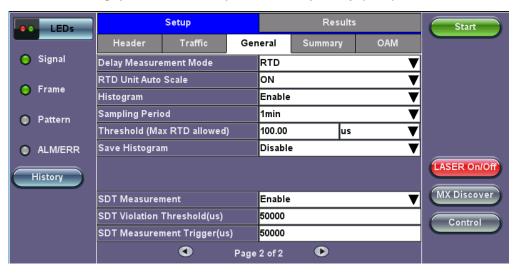
			-		-		
LEDs	Setup				Results	;	Start
	Header	Traffic	Genera	d	Summary	OAM	
😑 Signal	# of Streams		1				
O 5	Stream #1 (%)		100	0.000			
😑 Frame	Total (%)		100	0.000			
Pattern							
ALM/ERR							
History							LASER On/Off
							MX Discover
							Control
		•	Page 1 o	f 2	►		
			Pagello	12			

Throughput General Setup

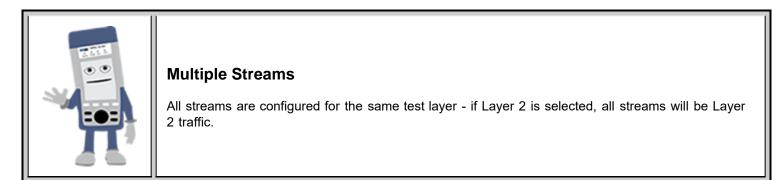
Page 2 features Round Trip Delay (RTD) measurement and Service Disruption Test (SDT) measurement settings.

- **Delay Measurement Mode:** Enable/disable the round trip delay measurement. It should only be enabled when running the test to a remote loopback.
- RTD Unit Auto Scale: ON/OFF
- Histogram: Enable / Disable
- Sampling Period: 1sec, 10secs, 30secs, 1min, 10min, 30min, 1hr. Defines how often the RTD (round trip delay) measurement is evaluated against the RTD threshold.
- Threshold (Max RTD allowed): Input the value in us, ms or sec. Defines the maximum allowed round trip delay value. If the RTD value exceeds the threshold, an event is logged with corresponding time stamp.
- Save Histogram: Enable/Disable
- SDT Measurement: Enable/Disable. The Service Disruption Test is triggered based on user established thresholds.

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



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



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6.7.1.4 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 of the screen.

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

Throughput Error Injection Setup



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6.7.1.5 Alarm Injection Settings

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

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

Throughput Alarm Injection Setup



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6.7.1.6 Summary

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

LEDs		Setup			Result	s	Start
	Header	Traffic	Gen	eral	Summary	OAM	
😑 Signal	MAC List	IP List	VLAN	l List	Mpls List	Gateway List	
😑 Frame	# of Streams	MAC Source			MAC De		
Ŭ	Stream #1	00-18-63-01-24	-0F		00-1E-90-A0-5		
Pattern							
ALM/ERR							
							LASER On/Off
History							
							MX Discover
							Control
		٩	Page	1 of 1	►		

Throughput Summary MAC List

Throughput Summary IP List

LEDs		Setup			R	esults	;		Start
	Header	Traffic	G	eneral	Summ	ary	OAM		
😑 Signal	MAC List	IP List	VL	AN List	MpIs L	ist	Gateway	List	
🔘 Frame	# of Streams	Source IP		Destinatio	on IP	Subi	net Mask		
Ŭ	Stream #1	192.168.0.10		192.168.2.	200	255.2	255.255.0		
Pattern									
ALM/ERR									
History									LASER On/Off
									MX Discover
									Control
	Src. to Dest.	Dest. to Src.		Swap		Pa	ge 1 of 1		

Throughput Summary VLAN List

	LEDs		Setup				Result	s	Start
		Header	Traffic	Gen	eral	Sum	mary	OAM	
0	Signal	MAC List	IP List	VLAN	l List	Mpl	s List	Gateway List	
0	Frame	# of Streams		ID	Prio	rity	Туре		
		vlan #1 of stre	am 1	12	3		8100	▼	
0	Pattern								
0	ALM/ERR								
	listory								LASER On/Off
	istory								MX Discover
									Control

Throughput Summary MPLS List

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

Throughput Summary Gateway List

•• LEDs		Setup			Result	s	Start
	Header	Traffic	Ger	neral	Summary	OAM	
😑 Signal	MAC List	IP List	VLAN	N List	Mpls List	Gateway List	
😑 Frame	# of Streams			Gatewa	ıy		
Ť	Stream #1			192.168	.0.1		
Pattern							
ALM/ERR							
History							LASER On/Off
							MX Discover
							Control
		٩	Page	1 of 1	►		

OAM Discover

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

To Access OAM Discover:

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

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

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

Activating 802.3ah Link OAM

LEDs		Setup			Result	:s		Start
	Header	Traffic	Gen	ieral	Summary	OAN		
😑 Signal	L	ink OAM		s	ervice Lev	el OAM		
😑 Frame	802.3ah OAM:	•	DAM Mo	de: <mark>Activ</mark>	e 🔻			
	Vendor OUI	00-18-63		Max PDU	Length	1518		
Pattern	Vendor SPI	63-00-1B-93		PDU Rate	÷	1000		
ALM/ERR	Discovery Cap	ability						
		Remote Loo		v	Link Eve		V	LASER On/Off
History		MIB Retriev	al	✓	Unidirec	tion	✓	LASER ON/OIL
	Link Events N	otification Sett	ings					MX Discover
		Link Fault						
		Critical Ever Dying Gasp	nt					Control
		Dying Gasp						

6.7.1.7 Starting/Stopping a Throughput (Multiple Streams) Test

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

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

Note: 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 isnot necessary.
- Once the correct control settings are configured, the user can start the test.

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

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

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

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

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6.7.2 Throughput Results

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

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6.7.2.1 Global/Aggregate Results

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

The Global Stream Summary screen displays:

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

Throughput Results - Global Stream Summary

LEDs		Se	tup			Res	ults		Stop
	Glo	obal	Pers	Per Stream		PCS		DAM	
😑 Signal	Stream S	Summary	Aggregat	te Signal	Errors A	larms Eve	nts Tra	ffic Delay	Restart
🕒 Frame	No.	% of BW	No.	% of BW	No.	% of BW	No.	% of BW	TX Stop
	#1	100.000	#9		#17		#25		Eth. Err Inj.
😑 Pattern	#2		#10		#18		#26		Etn. Err inj.
	#3		#11		#19		#27		Eth. Alarm Inj.
ALM/ERR	#4		#12		#20		#28		
History	#5		#13		#21		#29		LASER On/Off
	#6		#14		#22		#30		MX Discover
	#7		#15		#23		#31		
	#8		#16		#24		#32		Control
	Stream #	1	No Error	s					Setup Injection

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

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

IP Network	IP Network QoS Class Definitions and Network Performance Objectives (Classes 0-3)								
Network		QoS C	lasses						
Performance 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	≤ 50ms	≤ 50ms	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	IP Network QoS Class Definitions and Network Performance Objectives (Classes 4-7)								
Network		QoS C	lasses						
Performance Parameter	Class 4	Class 5	Class 6	Class 7					
IPTD	≤ 2 s /2 (1 s one-way) AND > 800 ms/2	U	≤ 200 ms/2 (100 ms one- way)	≤ 800 ms/2 (400 ms one- way) AND > 200 ms/2					
IPDV	U	U	≤ 50ms	≤ 50ms					
IPLR	> 1/100,000 AND ≤ 1/1000	U	≤ 1/100,000	≤ 1/100,000					
IPER	> 1/1,000,000 AND ≤ 1/10,000	U	≤ 1/1,000,000	≤ 1/1,000,000					

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The Aggregate screen displays these parameters:

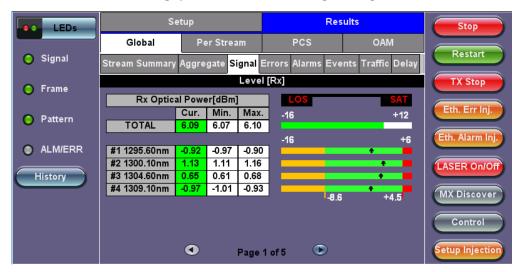
- Line Rate (bps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- Utilization: % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then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

Throughput Results - Global Aggregate

LEDs	Se		Resul	ts	Stop	
	Global	al Per Stream			OAM	
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarm	is Event	s Traffic Delay	Restart
😑 Frame	ST:2017-12-11 17:3	6:52	ET:00:01:21	TX Stop		
		тх	F	٦X		Eth. Err Inj.
🜔 Pattern	Line Rate (bps)	100.000G	1	100.000G		Eun. Err inj.
	Utilization (%)	100.000%	1	100.000%		Eth. Alarm Inj.
ALM/ERR	Utilization (bps)	100.000G	1	100.000G		
History	Framed Rate (bps)) 92.754G	9	92.754G		LASER On/Off
	Data Rate (bps)	69.565G	6	69.565G		MX Discover
	Total Frames	3665949988	3	36659498	96	Mix Discover
	Bad Frames	0	0	0		Control
	Pause Frames	0	0)		
						Setup Injection

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The Global Signal screen (fiber ports only) displays the optical level measured by the CFP2 or QSFP+ transceiver.



Throughput Results - Global Signal Page 1

Throughput Results - Global Signal Page 3

LEDs	Se	tup	Res	ults	Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary	Aggregate <mark>Signal</mark>	Errors Alarms Eve	nts Traffic Delay	Restart
🔵 Frame		Freq	uency		TX Stop
Ŭ	Frequency		103124998KHz		Eth. Err Inj.
😑 Pattern	Offset [ppm]		-0.0		
	Min [ppm]		-0.0		PCS Alarm Inj.
ALM/ERR	Max [ppm]		0.0		LASER On/Off
History					LASER ON/OF
					MX Discover
					Control
		 Page 	3 of 5 💿		Setup Injection

Throughput Results - Global Signal Page 4

LEDs	Se	tup		Result	s	Stop
	Global	Per Stream	PCS		OAM	
🔘 Signal	Stream Summary	Aggregate <mark>Sign</mark>	al Errors Alarms	Events	s Traffic Delay	Restart
🔘 Frame		CFP Optical M	/lodule Informati	on	<u> </u>	TX Stop
Ŭ	Power Class	P	ower Class 4 Mo	dule (1	2 W)	Eth. Err Inj.
😑 Pattern	Vendor	C	claro Inc.			
	Part Number	т	RB5E20FNF-LF0	00		PCS Alarm Inj.
ALM/ERR	Serial Number	J	14H54919			
History	MSA H/W Spec. re	ev. 0.	.0			LASER On/Off
	MSA MIS rev.	2	2			MX Discover
	Control 1 Reg.(IEI	EE) 1	00GE-LR4(SMF)			
	Extended Ability(I	EEE) 1	11.8Gbps,103.12	ōGbps		Control
		C Pa	ge 4 of 5 💽			Setup Injection

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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

Throughtput Results - Global Errors

LEDs	Se	tup		Results	Stop
_	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarms	Events Traffic Delay	Restart
🔵 Frame		Current		Total	TX Stop
Ŭ	Bits	0		0	Eth. Err Inj.
😑 Pattern	BER	0.000000E+0	0	0.000000E+00	
-	FCS/CRC	0		0	PCS Alarm Inj.
ALM/ERR	FCS/CRC Rate	0.000000E+0	0	0.000000E+00	
History	IP Checksum	0		0	LASER On/Of
	IP Checksum Rate	0.000000E+0	0	0.000000E+00	MX Discover
	Jabber Frames	0		0	
	Runt Frames	0		0	Control
					Setup Injection

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

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

- Local/Remote Fault
- SDT alarm measurements

		A		Deer		
e LEDs	56	tup		Res	uits	Stop
_	Global	Per Stream	PCS	;	OAM	
😑 Signal	Stream Summary	Aggregate Signal	Errors <mark>Alar</mark>	ms Evei	nts Traffic Delay	Restart
😑 Frame	LOS (us)	Current 0	T 0	otal		TX Stop
😑 Pattern	Link Down (us) Local Fault	0 0	0 Remote Fa	ult	0	Eth. Err Inj.
- -	Service Disruptio Current	n (us)	Total		0	PCS Alarm Inj
ALM/ERR	Last		0		U	LASER On/Of
History	Min/Max No. of Occurrence	0 es	0			
	No. of SDT Violati	ons	0			MX Discover
	IPG Trigger Even IPG Trigger Meas		0			Control
		SDT	Reset			Setup Injectio

Throughtput Results - Global Alarms

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

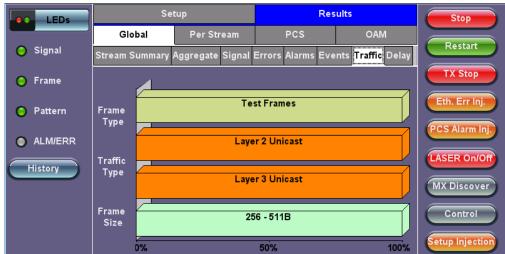
Throughtput Results - Global Events

LEDs	Set	tup	Res	ults	Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary /	Aggregate Signal	Errors Alarms <mark>Eve</mark>	ents Traffic Delay	Restart
😑 Frame	Time	Event Type	# of Event	ts Test	TX Stop
	2017-12-12 16:08:2	5 Test Started		Global	Eth. Err Inj.
O Pattern					
ALM/ERR					PCS Alarm Inj.
					LASER On/Off
History					MX Discover
		Pag	je 1 of 1 🕑		Control
					Setup Injection

The **Global Traffic** screen displays:

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

Throughtput Results - Global Traffic



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

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

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

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

Throughtput Results - Global Traffic Details

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

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

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

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

> 1518 byte frames - Jumbo frames

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

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

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

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6.7.2.2 Per Stream Results

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

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

Throughtput Results - Per Stream Summary

Throughtput Results - Global Delay

LEDs		Setup			Results			Stop
	Global		Per Stream	PCS	PCS		MAM	
😑 Signal	Summary	Errors	SDT E	vents Tr	affic	Delay	Rates	Restart
😑 Frame	VLAN ID: N/A		Stream #	1 of 1	P	rev	Next	TX Stop
	ST:2017-12-12	16:08:25		ET:00:24:0	3			Eth. Err Inj.
😑 Pattern			тх		RX			
	Utilization (%)		100.000%		100.000%			PCS Alarm Inj.
ALM/ERR	Utilization (bp	s)	100.000G		100.000G			
History	Framed Rate ((bps)	92.754G		92.754G			LASER On/Off
	Data Rate (bp	s)	69.565G	69.565G 69.56		69.565G		MX Discover
	# of Bytes 16729280		167292800320	16729:		16729280008704		
	Total Frames 65348750125		65348750034			Control		
	Bad Frames 0		0	0				
								Setup Injection

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

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

LEDs	Setu	qr	R	Stop	
	Global	Per Stream	PCS	OAM	
😑 Signal	Summary Erro		ents Traffic	Delay Rates	Restart
🜔 Frame	VLAN ID: N/A	Stream #	1 of 1	Prev Next	TX Stop
Ŭ		Current	٦	Total	Eth. Err Inj.
😑 Pattern	FCS/CRC	0	C)	
	FCS/CRC Rate	0.000000E+0	o c	0.000000E+00	PCS Alarm Inj.
ALM/ERR	IP Checksum	0	c)	
History	IP Checksum Rate	0.000000E+0	o c	0.000000E+00	LASER On/Off
	Frame Loss	0	C)	MX Discover
	Frame Loss %	0.00%	C).00%	
	oos	0	C)	Control
	Dup. Sequence	0	C)	Setup Injection
					Cetap injection

Throughtput Results - Per Stream Errors Page 1

Service Disruption Test

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

LEDs	Set	up	R	Stop	
	Global	Per Stream	PCS	OAM	
😑 Signal	Summary Erro	ors SDT Ev	ents Traffic	Delay Rates	Restart
🔵 Frame	VLAN ID: N/A	Stream #	1 of 1	Prev Next	TX Stop
Ť	Service Disruptior	ı(us)			
😑 Pattern	Current		0	Eth. Err Inj.	
	Total		0	PCS Alarm Inj.	
ALM/ERR	Last		0		
	Min/Max	0	0		LASER On/Off
History	No. of Occurrence	s	0		
	No. of SDT Violatic	ons	0	MX Discover	
	IPG Trigger Event	s	0		
	IPG Trigger Measu	irement(us)	0	Control	
		SDT	Reset		Setup Injection

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

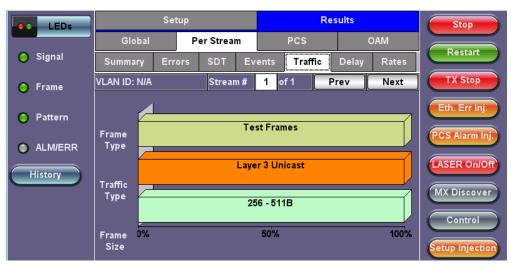


Throughtput Results - Per Stream Events

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

Throughtput Results - Per Stream Traffic



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

The Histogram shows the sampling points for the delay.

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

Throughtput Results - Per Stream Delay

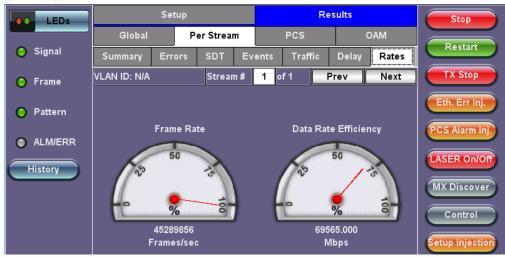
Throughtput Results - Per Stream Delay - Histogram



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

Throughtput Results - Per Stream Rates



Throughtput Results - Per Stream Rate Details

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

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6.7.3 Saving Throughput Results

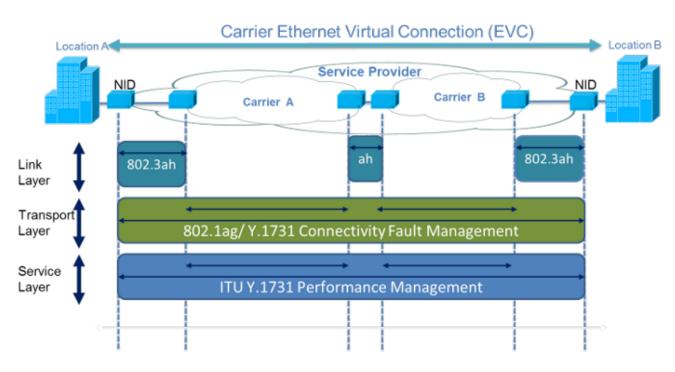
Once the test has been stopped the results can be saved by pressing the Save key on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved. For more information on retrieving saved test results, refer to **File Management** in the **TX300S**, **MTTplus**, **RXT-1200**, or **UX400** platform manuals for more information.

•• LEDs	Save re	sult as				20121	026_	144	542	Start
• Frame	1	2	3 4	5	6	7	8	9	0	
Pattern	q	w	, r	t	У	u	1	•	р	
ALM/ERR	a	s	d	f	9	h j	ŀ		1	LASER On/Off
History	Caps	z	×	c	ь	v r	n	1	Shift	
		Symbo	Del	@		Del Al				
			s	PACE				Appl	v	

Throughput Results Save

6.8 Ethernet OAM Testing



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

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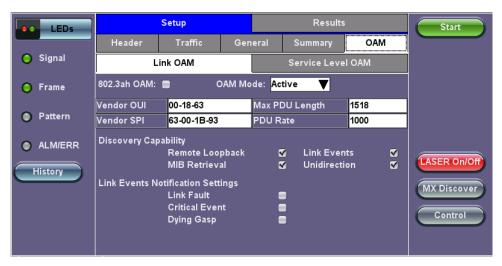
6.8.1 OAM Setup

6.8.1.1 Link Level 802.3ah OAM Setup

802.3ah functions include:

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

Link OAM Setup



802.3ah OAM

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

OAM Mode

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

• Vendor OUI and SPI

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

• Max PDU Length

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

• PDU Rate

100 to 10000 ms between consecutive OAM PDUs.

• Discovery Capability

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

Link Events Notification Settings

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

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802.3ah OAM Discovery

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

OAM Mode Active/Passive Actions

Action	Mode Passive	Mode Active
Initiates OAM discovery	No	Yes
Responds to OAM discovery	Yes	Yes
Peer must be in active mode	Yes	Yes
Sends Information OAM PDU	Yes	Yes
Sends Event Notification OAM PDU	Yes	Yes
Sends Variable Request OAM PDU	No	Yes
Sends Loopback Control	No	Yes
Reacts to Loopback Control	Yes	Yes

OAM Mode - Acceptable Active/Passive Combinations

	Local Active	Local Passive
Remote Active	Yes	Yes
Remote Passive	Yes	No

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

Discovery Capabilities: Capabilities advertised during discovery process

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

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

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

MIB Retrieval: Retrieves information on network devices and interfaces.

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

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

• Fill out the given parameters.

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

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

e LEDs	Setup				Results		Stop
	Header	Traffic	Error In	j. General	Summary	OAM	Restart
😑 Signal	Link OAM			Serv	rice Level OA	M	
🔿 Frame	802.1ag: 🔳	٢	′.1731: 🔳	G.8113	U1 🔳		TX Stop
	MAC Source			00-18-63-00-0C-	40		Err Inj.
Pattern	MD Format	Str	ing 🔻	MD Name	veex		
	MA/MEG Form:	it Str	ing 🔻	MA/MEG Name	veexMA		
ALM/ERR	Local MEP ID	15		MD Level	5		
History	Primary VLAN I	D 35		VLAN Type	S-VLAN	▼	MX Discover
	Destination ME	ID 151	1	Direction	Down		
							Loop Control
	MAC Source						
			٩	Page 1 of 2			

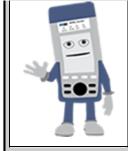
OAM - Service Level OAM (Page 1)

Service Level OAM Configuration Parameters

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

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

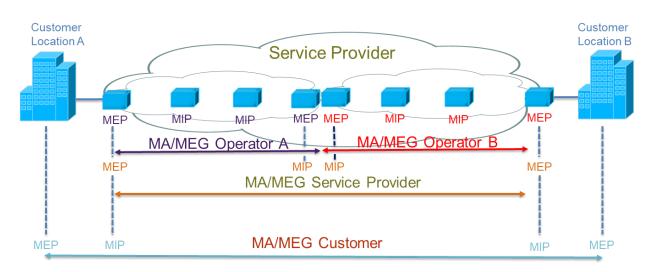
Selecting 802.1ag enables Continuity Check Messages (CCM), Loopback Message (LBM) and Link



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

IEEE 802.1ag Definitions

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



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

Definition Equivalencies

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

Maintenance Point Roles

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

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OAM Services Setup

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

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

General Setup

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

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

LEDs	Se		Results			Start	
	Header Traffi	c Error Inj.	Alarm Inj.	General	Summary	OAM	
😑 Signal	Link	OAM		Servio	e Level OA	м	
9 Frame	Loopback (LBM/LI	BR)	-20			Start	
Pattern	Destination Type	MEP	V Destina	tion MAC	00-00-00-	00-00-00	
ALM/ERR	Priority	7	# Mess	ages	5		LASER On
History	Link Trace (LTM/LTR)						MX Discover
	Destination Type	MEP	🔻 Destina	tion MAC	00-00-00-	00-00-00	Loop Control
	Priority	7	TTL		60		Coop Control

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

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

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

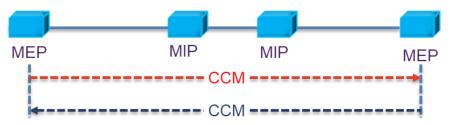
- Fault Detection Continuity Check:
 - CCM "heartbeat" messages are transmitted at a configurable periodic interval by MEPs.
- Network/Path Discovery Link trace message:
 - Equivalent to a traceroute test. MIPs and MEPs along the path send a response.
- Fault verification and isolation Loopback:
 - Verify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

Continuity Check Messages (CCM)

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

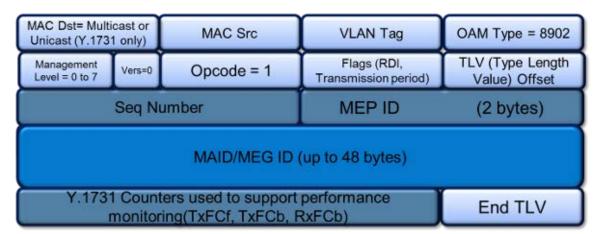
Note: There can be 4,094 VLANs per port and up to eight maintenance levels. This yields a worst case CCM transmission rate of 9.8 million CCMs per second if 3.3ms interval is used.

Continuity Check Message (CCM)



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

CCM Message Format



CCM Configuration Parameters

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

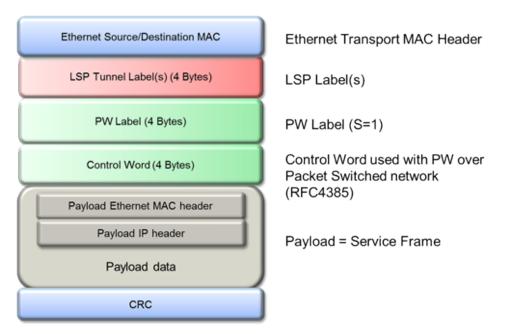
The CCM Result button is a shortcut that brings the user directly to the CCM Results tab.

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

LEDs	Setup				Results		Stop
	Header	Traffic	Error Inj.	General	Summary	OAM	Restart
😑 Signal		Link OAM		Ser	vice Level O		
• Frame	MPLS-TP						TX Stop Err Inj.
😑 Pattern		_abel 0	Co	os <mark>o</mark>	TTL	64	
	PW: 🔳 L	Label <mark>0</mark>	Co	oS <mark>0</mark>	TTL	64	
ALM/ERR	GAL: L	.abel <mark>13</mark>	то	2	TTL	64	
History	ACH: \	/ersion 0	CI	hannel Type	89-02		MX Discover
	ссм Di	sable 🔻					Loop Control
	Туре	Mult	icast 🔻				
	Priority	7	Tx	Interval	1 min	V	
			•	Page 2 of 4	• cc	M Result	

G.8113.1 Performance Management Functions

MPLS-TP



MPLS-TP over Ethernet with PW Label

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

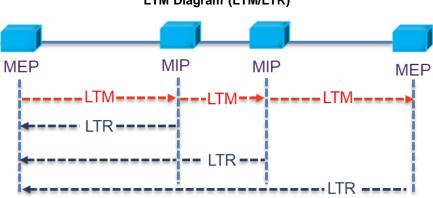
Multi Protocol Label Switching Transport Profile (MPLS-TP) Configuration Parameters

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

Link Trace and Loopback Messages

Link Trace Messages (LTM/LTR)

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



LTM Diagram (LTM/LTR)

Link Trace Message Format

MAC Dst= Ur	nicast	MAC Src	VLAN Tag	OAM Type = 8902			
Management Level = 0 to 7	Vers=0	Opcode = 5 (LTM)	Flags	TLV Offset			
	Transaction ID						
TTL	MAC address						
	Optional TLV						

Link Trace Response Format

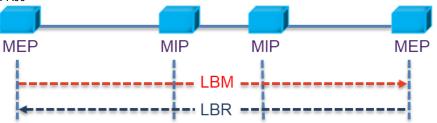
MAC Dst= Ur	nicast	MAC Src	VLAN Tag	OAM Type = 8902			
Management Level = 0 to 7	Vers=0	Opcode = 4 (LTR)	Flags	TLV Offset			
	Transaction ID						
TTL	TTL Relay action (802.1ag)						
	Optional TLV End TLV						

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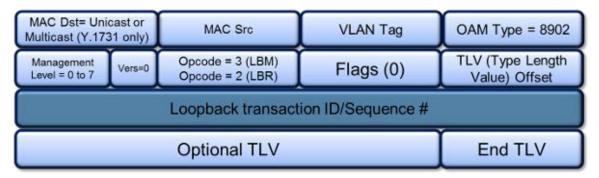
Loopback Message (LBM/LBR)

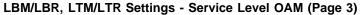
LBM (Loopback Message) are unicast messages transmitted on demand to a destination MAC address. A destination address responds with an LBR (Loopback Reply Message).

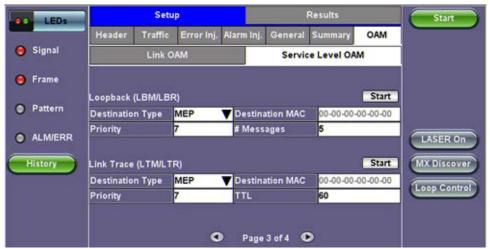
LBM Diagram (LBM/LBR)



Loopback Message Format







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

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

Press Start to initiate testing.

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Y.1731/G.8113.1 Performance Management Functions

e LEDs	Se			Results			
	Header Tr	affic	Erro	r Inj. General	Summary	OAM	Restart
O Signal	Link	OAM		Se	rvice Level O	AM	
😑 Frame							TX Stop Err Inj.
Pattern	Loss Measuremen	-				Start	
•	Destination Type	MEP		Destination MAC	00-00-00-00	0-00-00	
O	# Send	10		Rate (ms)	500		
ALM/ERR	Priority	7					
History	Delay Measureme	nt (DMI	M/DM	R)		Start	MX Discover
	Destination Type	MEP	V	Destination MAC	00-00-00-00	0-00-00	Loop Contro
	# Send	10		Rate (ms)	500		
	Priority	7					
			•	Page 4 of 4	۲		

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

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

Press Start to initiate testing.

Frame Loss Measurement

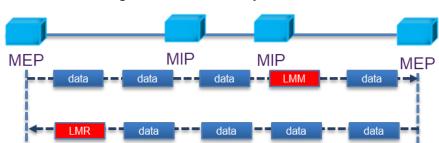
Two local counters for each peer MEP:

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

Single-ended ETH-LM:

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

CCM frames contain frame counters.



Single Ended Frame Delay Measurement

LMM frames contain frame counters.

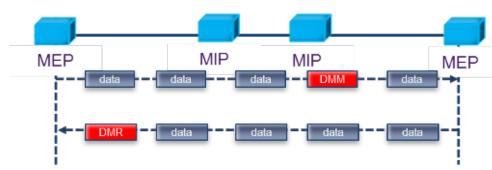
Delay Measurement

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

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

Two-way ETH-DM:

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



Dual Ended Frame Delay Measurement

DMM and DMR frames contain timestamp info.

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6.8.2 OAM Results

6.8.2.1 Link OAM Results

Link OAM Discovery

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

LEDs	Setup			Results	Start
	Global	Per S	tream	OAM	
X Tools	Link			Service	
Utilities	Discover	γ	Statistics		
		Local		Remote	
Files	Mode	active		active	
	Unidirection	supported		not supported	
	Link Events	supported	supported		
	Remote Loopback	supported		supported	
	MIB Retrieval	supported		supported	MX Discover
	MTU Size	1518		1518	
					Control
		٩	Page 1 of 2	2 🕑	

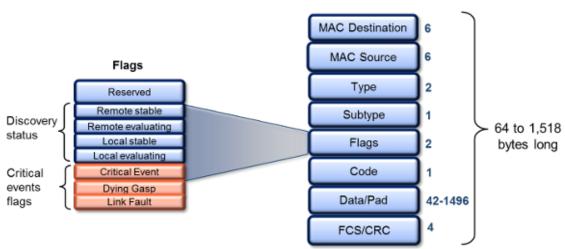
OAM - Link - Discovery (Page 1)

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

OAM - Link - Discovery (Page 2)

LEDs	Setup	•		Results	Start
	Giobal	Per S	tream	OAM	
X Tools	Link			Service	
Utiliti	es Discove	ery		Statistics	
		Local		Remote	
Files	Vendor SPI			AD00593F	
	Vendor OUI			0015AD	
	Discovery State	Send Any			
	Parser State	Forward	Forward		
	Multiplexer State	Forward		Forward	MX Discover
	Flags	0×0050		0x0050	
	Revision	1		1	Control
		•	Page 2 of 2	•	

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



Flag Decode

OAM PDU

LEDs	Setup		Results	Start
	Global	Per Stre	eam OAM	
😑 Signal	Link		Service]
Frame	Discovery		Statistics	
Ŭ		тх	RX	
Pattern	Information	775	833	
	Unique Event 0		0	
ALM/ERR	Duplicate Event	0	0	
	Loopback Control	1	0	
X Tools	Variable Request	0	0	MX Discover
Utilities	Variable Response	0	0	
Otilities	Organization Specific 0		0	Control
Files				

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

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

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6.8.2.2 OAM Service Results

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

		Setup			Res	Stop		
i.	Glob	al	tream		OAM		Restart	
		Link	Service					
co	M	LBM	LT	м	DMM	L	.MM	TX Stop
MPID	Rem	ote MAC	RDI	LOC	XCON	UNEXP	Alarm	Err Inj.
151	00:00	0:00:00:00:00:00	1	A	Î	Ĵ	A	
TX			2					
RX			0					MX Discover
								Loop Contro
	MPID 151 TX	CCM MPID Rem 151 00:00 TX	Global Link CCM LBM MPID Remote MAC 151 00:00:00:00:00:00	Global Per Si Link CCM LBM LT MPID Remote MAC RDI 151 00:00:00:00:00 I TX 2	Global Per Stream Link CCM LBM LTM MPID Remote MAC RDI LOC 151 00:00:00:00:00 I A TX 2	Global Per Stream Link Serv CCM LBM LTM DMM MPID Remote MAC RDI LOC XCON 151 00:00:00:00:00 I A I TX 2	Global Per Stream OAM Link Service CCM LBM LTM DMM L MPID Remote MAC RDI LOC XCON UNEXP 151 00:00:00:00:00:00 I A I I TX 2	OAM Global Per Stream OAM Link Service CCM LBM LTM DMM LMM MPID Remote MAC RDI LOC XCON UNEXP Alarm 151 00:00:00:00:00:00 I A I I A TX 2



OAM CCM Results

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

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

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OAM - Service - LBM

Global Per Stream OAM Cols Link Service Utilities CCM LBM LTM DMM LMM Files To Be Send 0 Common Service Common Service Files Out of Order 0 Common Service Common Service No Match 0 Common Service Common Service	tart
CCM LBM LTM DMM LMM Image: Barry local strain	
Utilities CCM LBM LTM DMM LMM LBM Status 0 To Be Send 0 To Be Send 0 Second Second Response Count 5 In Order 0 Out Of Order 0 Second Second	
To Be Send 0 Response Count 5 In Order 5 Out Of Order 0	
Response Count 5 In Order 5 Out Of Order 0	
In Order 5 Out Of Order 0	
Out Of Order 0	
No Match 0 MX DI	
	scover
	ntrol

OAM LBM Results

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

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LEDs	:	Setup			Results	Start	
	Global		Per St	ream		OAM	
😑 Signal		Link			Service	,	
😑 Frame	ссм	LBM	LT	м	DMM	LMM]
Ŭ	Action		MAC		TTL	Flags]
Pattern	0×0	00:0	00:00:00:00:00	0		0x0	
		+					
X Tools							MX Discover
Utilities							Control
Files			0	1 of 1	۲		

OAM - Service - LTM

OAM LTM Results

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

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Y.1731 and G.8113.1 Performance Management Functions Results

OAM LMM

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e o 🛛 Li	EDs		Setup			Start			
		Globa	ul I	Per S	Per Stream		OAM		
×	ools		Link			Serv	ice		
. U	ltilities	ссм	LBM	LI	м	DMM		LMM	
		LMM Status]
Fi Fi	iles	Current Near B	End	0					
		Current Far Er	ıd	0					
		Accum Near Ei	ndi	0					
		Accum Far End	i	0					
		Ratio Near En	ł	0					MX Discover
		Ratio Far End		0					
									Control

OAM - LMM Message

e LED	Setup		Results	Start
		Loss Measurem	ent	
X Tool				
	Status: : Complete			
Utilit		Near End	Far End	
	Current	0	0	
Files	Accumulation	0	0	
	Ratio	0	0	
				(Discover
				Control
		Close		Control
		Page 3 of 3	•	

OAM LMM Parameters

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

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OAM - Service - DMM

LEDs		Setup			Start		
	Globa	ı	Per S	tream	M		
😑 Signal		Link			Service		
Frame	ссм	LBM	LT	м	DMM	LMM	
	DMM Status						
Pattern	Delay Samples		0				
ALM/ERR	Average Delay		0 nSe	:5			
	Average Variat	ion	0 nSe	:5			
	Last Delay		0 nSe	s			
X Tools	Last Variation		0 nSe	:5			MX Discover
Utilities							Control
Files							

OAM - DMM Message

e LEDs	Setup Results Start
Tools	Delay Measurement
Utilities	
	Loss DMM Result : Complete art
Files	Dest Delay Samples : 4 # Se Average Delay : 319000 nSecs
	Prior Average Variation : 1333 nSecs Last Delay : 321000 nSecs
	Dela Last Variation : 3000 nSecs
	M Se OK Control
	Prioy
	Page 3 of 3 D

OAM DMM Parameters

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

6.9 Loopback

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

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

Layer 2 & 3:

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

Loopback Setup Layer 3

LEDs	Setup	Results	Start
	Profile	Default	
😑 Signal	Test Layer	Layer 3	
	VLAN ID	Disable	
😑 Frame	VLAN Priority	Disable	
Pattern	MAC Source	Disable	
0	MAC Destination	Disable	1
ALM/ERR	IP Source	Disable	
	IP Destination	Disable	LASER On/Off
History	TOS Values	Disable	,

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

6.10 Lane BERT

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

6.10.1 Setup

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

LEDs		Se	tup			Re		Start	
		General							
😑 Signal	СFР Туре		100G (4X25)		CFP	Test Rate	103.125	G 🔻	
Frame		1		ern Co	nfigu	ration			TX Start
Ŭ	Lane #		(Pattern	Inv	ert	RX Patt		Invert	
Pattern	All	PRBS 2	2E31-1			PRBS 2E31-	1 🔻		
ALM/ERR									
Ě									LASER On/Off
History									
									MX Discover
CFP4: 4X25G									
RS-FEC : OFF				Perl	ane				

Setup - General (All Lane)

Setup - General (Per Lane)

LEDs	Setup					Res	Start			
		General								
😑 Signal	СFР Туре		100G (4X	25)	CFP	Test Rate	103.125	G 🔻		
Frame			Р	atter	n Config	uration			TX Start	
0	Lane #	ТΧ	Pattern		Invert	RX Patt	ern	Invert		
Pattern	0	PRBS 2	E31-1	▼		PRBS 2E31-	1 🔻			
	1	PRBS 2	E31-1	▼		PRBS 2E31-	1 🔻			
ALM/ERR	2	PRBS 2	E31-1	▼		PRBS 2E31-	1 🔻			
History	3	PRBS 2	E31-1	▼		PRBS 2E31-	1 🔻		LASER On/Off	
									MX Discover	
CFP4: 4X25G RS-FEC: OFF					All Lane					
					An Lane					

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

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

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6.10.2 Results

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

6.10.2.1 Signal

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The Signal tab (fiber ports only) displays the receiving (RX) and transmitting (TX) optical level measured by the CFP2 or QSFP+ transceiver.

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

LEDs	Setup					Result	s	Stop
	Signal	A	ggregat	te	Lane	•	Events	
😑 Signal				Level	Rx]			Restart
	Rx Optic	al Powe	er[dBm]		LOS		SAT	TX Start
🔘 Frame		Cur.	Min.	Max.	-16		+12	
	TOTAL	6.07	6.06	6.08				Bit Err Inj.
😑 Pattern					-16		+6	
	#1 1295.60nm	-0.95	-0.97	-0.91			•	Alarm Inj.
ALM/ERR	#2 1300.10nm	1.11	1.10	1.13			•	
	#3 1304.60nm	0.61	0.61	0.64			+	
History	#4 1309.10nm	-1.00	-1.01	-0.95		-8.6	+4.5	LASER On/Off
History						-0.0	14.0	MX Discover
		٩		Page 1	of 5	▶		Setup Injection

Signal (Page 1)

Signal (Page 3)

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

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

•• LEDs	Setup				Resu	ilts	s	
	Si	gnal	Ag	ggregate		Lane	Events	
😑 Signal				Frequ	ienc	у		
Frame	Lane	Freq. (k	Hz)	Offset (ppr	n)	Min. (ppm)	Max. (ppm)	
	1	257	81250		0.0	-0.0	0.0	
😑 Pattern	2	257	81250		0.0	-0.0	0.0	Bit
	3	257	81249		-0.0	-0.0	0.0	Ala
ALM/ERR	4	257	81249		-0.0	-0.0	0.0	
History	Total	1031	25000		0.0	0.0	0.0	LASE
THISTORY								MXI
				Page	3 of	5 💽		Setup

Signal (Page 3)

Signal (Page 4-5)

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

LEDs	Setup		Res	ults	Stop
	Signal	Aggregate	Lane	Events	
😑 Signal		CFP Optical N	lodule Information		Restart
Frame	Power Class	P	ower Class 4 Module	(12 W)	TX Start
	Vendor	0	claro Inc.		
😑 Pattern	Part Number	т	RB5E20FNF-LF000		Bit Err Inj.
	Serial Number	J1	4H54919		Alarm Inj.
ALM/ERR	MSA H/W Spec. re	v. 0.0	0		
History	MSA MIS rev.	2.:	2		LASER On/Off
	Control 1 Reg.(IEE	E) 10	0GE-LR4(SMF)		MX Discover
	Extended Ability(IE	EE) 11	1.8Gbps,103.125Gbp	os	
		Pag	e 4 of 5 💿		Setup Injection

Signal (Page 5)

LEDs	Se	tup	Re	sults	Stop
	Signal	Aggregate	Lane	Events	
😑 Signal		CFP Optica	l Module Status		Restart
Frame	Module Status	R	eady		TX Start
	Module Alarm Stat	us N	ormal		Bit Err Inj.
ဓ Pattern	Temperature	49	.1 C		Bit Err Inj.
	Voltage	32	86 mV		Alarm Inj.
ALM/ERR	CFP Unplug	g	😑 Host Lane Fau	lt	
History	😑 Network La	ne Fault	😑 Network Lane	Alarm	LASER On/Off
	😑 Module Ala	rm	ᆼ Module Fault		MX Discover
	😑 General Ala	arm			In Discover)
		Pag	e 5 of 5 💿		Setup Injection

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6.10.2.2 Aggregate

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

e LEDs	Se	etup	Res	sults	Sto
	Signal	Aggregate	Lane	Events	
ᆼ Signal	ST:2018- 1-16 15:3	34:21	ET:00:00:30		Res
Frame	Pattern Loss(Sec	.)	30		ТХ Я
•	BIT Error Count		0		Bit E
😑 Pattern	BIT Error Ratio		0.000E+00		
ALM/ERR					Alar
					LASE
History					
					MX D
					Setup I

Aggregate

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

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

PCS Results - Alarms/Errors

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6.10.2.4 Events

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

LEDs	Setup		Resul	ts
	Signal	Aggregate	Lane	Events
Signal	Time	Event Type	# of Events	Test
Frame	2018- 1-16 15:34:22	Pattern Loss L#3		Lane Bert
Traine	2018- 1-16 15:34:22	Pattern Loss L#2		Lane Bert
Pattern	2018- 1-16 15:34:22	Pattern Loss L#1		Lane Bert
	2018- 1-16 15:34:22	Pattern Loss L#0		Lane Bert
) ALM/ERR	2018- 1-16 15:34:21	Test Started		Lane Bert
History				
		Pag	e 1 of 1 🕑	

PCS Results - Events

6.11 Packet Capture

6.11.1 Packet Capture Setup

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

Configure the following Capture Mode parameters:

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

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

Packet Capture In Progress

LEDs		Se	tup		
	Ca	pture Mode	F	ilter	
😑 Signal	Profile	Doeket	Conture		
😑 Frame	Mode	Packet	Capture	▼	
- rame	Buffer Size	Packet Capture capt	uring	V	
Pattern	Truncate		-	▼	
		Packet Num: 10			
ALM/ERR					
History					
		St	op		

Packet Capture Save

Capture Mode Setup

LEDs		Se	tup		
	Ca	pture Mode	Filter		
😑 Signal	Profile	Packet	Capture	▼	
😑 Frame	Mode	Гаскет	Capture		
O D-#	Buffer Size	Packet Capture acco	mplished!		
Pattern		Packet Num: 143/14	3	V	
ALM/ERR					
History		Result Saved as:201	70922_094123.pcap		
			ок		

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.

Go back to top Go back to TOC

6.11.2 Packet Capture Results

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

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

The file is stored in the Files folder. It can be viewed on the test set or exported and analyzed on PC Wireshark. Refer to **File Management** in the **TX300S**, **RXT-1200**, or **UX400** platform manuals for instructions on viewing and exporting files.

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

Packet Capture Results on Wireshark

☆					\rightarrow	Decode As
No. ∇	Time	Source	Destination	Protoco Lengt	Info	
1	0.000000	192.168.0.147	255.255.255.255	DB-L 221	Dropbox LAN sync D	iscovery Proto
2	0.001671	192.168.0.147	192.168.0.255	DB-L 221	Dropbox LAN sync D	iscovery Proto
3	0.002120	192.168.0.147	255.255.255.255	DB-L 221	Dropbox LAN sync D	iscovery Proto 🔺
4	0.244207	00:90:a9:b8:07:f0	ff:ff:ff:ff:ff	Intel 68	Sequence: 758301,	Sender ID 2, T🔻
•						••
⊞ - Ether ⊞ - Inter ⊞ - User	rnet II, Src: ac net Protocol V Datagram Pro	s on wire (1768 bits), 221 b :81:12:22:c3:2d (ac:81:12: ersion 4, Src: 192.168.0.14 tocol, Src Port: 17500 (175 Discovery Protocol	22:c3:2d), Dst: ff:ff:ff:ff:ff:ff 7 (192.168.0.147), Dst: 25	5.255.255.255	(255.255.255.255)	
0080 3	a 20 22 22 2	c 20 22 70 6f 72 74 22	3a 20 31 37 : "", "p	ort": 17		
	5 30 30 2c 2					
	2 3a 20 5b 3					
		5 38 35 2c 20 37 32 36				
		7 36 36 39 32 35 39 30				
	9 38 39 35 3					
20170	922 094123.p	cap Packets:	143 Displayed: 143 Marked	d: 0 Load time: (0:0.39	

Top section:

• Time

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- Source
- Destination
- Protocol
- Length
- Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

6.12 Autoscripting/Ethernet Auto Profile Testing

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



Advanced Tools > Auto Scripting

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

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

Autoscripting - BERT Setup

Autoscripting Setup

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

Tap on the green Start button to begin Autoscripting.

The soft LED light indicates the status of finished tests:

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

Starting the test brings up the BERT/Throughput Results tab. Test status is displayed in green on the bottom of the screen. When testing finishes, results are automatically saved. Refer to **File Management** in the **TX300S**, **MTTplus**, **RXT-1200**, or **UX400 platform manuals** for information on accessing saved results.

Autoscripting - BERT Results

O Signal Sum	ents mary -03-08 12:50	Traffic Signal	Del		Rates Alarms	_
ST: 2017		Signal	Err	ors	Alarms	
Frame ST: 2017	-03-08 12:50			1000		
		08	ET: 00/00	:00:37		TX Stop
		тх		RX		Err Inj.
Pattern Line Rat	e (bps)	10.000G		10.0000	•	
Utilizatio	n (%)	10.000%		0.000%		Alarm Inj.
ALM/ERR Utilizatio	n (bps)	1.000G		0		LASER Off
Framed	Rate (bps)	986.993M		0		
History Data Rat	e (bps)	975.290M		0		MX Discove
# of Byte	s	4605470826		0		Loop Contro

Autoscripting - Saving Results



File Manager - Saved Results

	Column Show All Advanced										
	Name	16 Mode	¶ Test	T Module	Date	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				
	Profile 1	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 8	8 PDF 🍃 F	rom USB	To USB BT						

7.0 OTU3/OTU4 (Ethernet/Bulk) and STL256.4 (Basic)

Refer to the TX300S, UX400, or RXT-1200 platform manuals for instructions on assigning test modules or launching test applications.

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

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

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

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



OTU4 Setup Home

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7.1 Setup

7.1.1 Signal

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

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

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

Signal Setup parameters

• •					
	LEDs	Signal	Measurement	Service Disruption	Start
		OTU4 port profile	Default	▼	
	🔵 Signal	Interface Informations	Optical M	odule-CFP	
	🜔 Frame	Hierachy & Clocks	OTL/	OTU4	OTL Err Inj.
	Pattern	OTL Lane & Skew	ΟΤΙ	. 4.4	OTL Alarm Inj.
		Mapping & Payload	OTU4	BULK	LASER On/Off
	History				
		Pattern	RX:2^31-1	TX:2^31-1	Set Injection

7.1.1.1 Interface Informations

Interface Information displays the capabilities and details relevant to the selected pluggable optical module (CFP, CFP2, CFP4, QSFP+, QSFP28, etc.).

LEDs	In	Start	
	СГР Туре	4x25 Gbits	
😑 Signal	Power Class	Power Class 4 Module (12 W max)	
	Vendor	Oclaro Inc.	
🜔 Frame	Part Number	TRB5E20FNF-LF000	
Pattern	Serial Number	J14H54919	OTL Err Inj.
	MSA H/W Spec. rev.	0.0	OTL Alarm Inj.
😑 ALM/ERR	MSA MIS rev.	2.2	
	Control 1 Reg.(IEEE)	100GE-LR4(SMF)	LASER On/Off
History	Extended Ability(IEEE)	111.8Gbps,103.125Gbps	
	Temperature	55.8 C	
	Voltage	3286 mV	Set Injection

Interface Informations

7.1.1.2 Hierarchy & Clocks

OTU3/OTU4 Hierarchy & Clocks

LEDs	Hier	Stop	
	Network Type	οτι/οτη 🗸 🗸	
😑 Signal	Operation Mode	NORMAL 🗸 🔻	
	Test Rate	OTU4 (111.810 Gbit/s) 🛛 🔻	
🜔 Frame	Scrambler	on 🔻	
Pattern	FEC	ON 🔻	Bit Err Inj.
	Tx Clock Source	Internal 🛛 🔻	OTN Alarm Inj.
😑 ALM/ERR	Clock Signal Type	Quartz VCXO 🛛 🔻	
	Tx Clock Offset(ppm)	0.0	LASER On/Off
History			
	Meas Ref. Clock	Internal 🛛 🔻	
	Clock Signal Type	Quartz VCXO 🛛 🔻	Set Injection
	Eye Clk	Disable 🛛 🔻	
	Link Fault Response	Disable 🛛 🔻	

STL/SDH/SONET Hierarchy & Clocks

LEDs	Hier	Start	
	Network Type	STL/SDH/SONET 🛛 🔻	
😑 Signal			
	Test Rate	SDH/SONET (39.8G)	
😑 Frame			
Pattern			STL Err Inj.
Ŭ	Tx Clock Source	Internal 🛛 🗸 🔻	STL Alarm Inj.
😑 ALM/ERR	Clock Signal Type	Quartz VCXO 🛛 🔻	
History	Tx Clock Offset(ppm)	0.0	LASER On/Off
History			
	Meas Ref. Clock	Internal 🛛 🔻	
	Clock Signal Type	Quartz VCXO 🛛 🔻	Set Injection
	Link Fault Response	Disable 🗸 🔻	

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

From the **Network Type** parameter, select OTL/OTN or STL/SDH/SONET (basic version). Menu options will vary depending on the selected Network Type.

- **Operation Mode** (OTL/OTN only):
 - **Normal:** The test set terminates the link. The test signal and its payload is internally generated by the test set and compared to the received signal.
 - **Payload Thru:** The test set acts as a repeater, regenerating the signal received by the RX port and retransmitting it on its TX port, keeping the payload undisturbed. This allows the test set monitor the overhead bytes, payload and to intrusively modify non-critical overhead bytes to introduce (simulate) error and alarms.
 - **Line Thru:** The test set acts as a transparent repeater, regenerating the signal received by the RX port and retransmitting it on its TX port. The test set can monitor the incoming signal, but no errors or alarms ca be injected, besides using the Laser button to turn it off and generate LOS.
- Test Rate: OTU4 (111.819 Gbits/s) or SDH/SONET (39.8 G)
- Scrambler (OTL/OTN only): On
- FEC (OTL/OTN only): On/Off
- Tx Clock Source:
 - **Internal:** The clock for the transmitter is derived from the internal clock. The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
 - **Received:** The clock for the transmitter is derived from the received signal and the jitter of the incoming signal is suppressed.
 - External (BNC):
 - Clock Signal Type: 1PPS (BNC), 10MHz, 5MHz, 1544KHz, 2048KHz, 2048Kbit/s, 1544Kbit/s, 64 Kbit/s signals are present on the SMA connector.
 - Line code: HDB3, B8ZS, AMI
- Clock Signal Type: Quartz oscillator (Internal)
- Measurement Reference Clock: Internal
- Eye Clk: Disable, 1/8 of network lane rate
- Link Fault Response: Disable/enable

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7.1.1.3 OTL Lane & Skew

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

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

LEDs		OTL Tx Lane Mapping and Skew						
	Lane ID	Skew (bi	ts)	Lane#	Ch.			
🜔 Signal	0		Γ	0	_	OTL Lane Mapping	Shift	
😑 Frame	2 3 4	- 0	+	2 3 4	0			
Pattern	5 6		Γ	5 6		Skew Settings		OTL Err Inj.
	7	- 0	+	7 8	1	Inc./Dec. Size	1	OTL Alarm Inj.
😑 ALM/ERR	9 10 11		┢	9 10 11		Alarm Threshold(bits)	1000	
History	12 13 14	- 0	+	12 13 14	2	Reset Skew Defaul	t Alarm	LASER On/Off
	15 16 17 18 19	- 0	+	15 16 17 18 19	3	RX MFAS Deskew En	nable	Set Injection
						-		

OTL Tx Lane Mapping and Skew

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7.1.1.4 Mapping and Payload

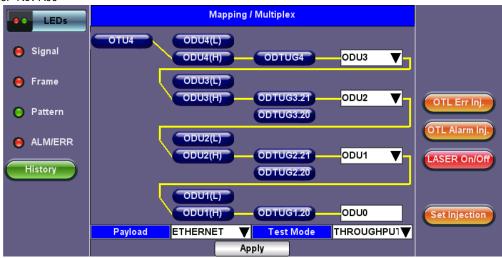
The mapping and multiplex structure is displayed. It supports one-stage (direct mapping) to multi-stage mapping and multiplexing.

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

ConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionConstructionC	ОТU4	Mapp ODU4(L) ODU4(H)	ping / N	lultiplex	Client]	Start
FramePattern							OTL Err Inj.
ALM/ERR History							OTL Alarm Inj.
	Payload	BULK	V	BULK Type	Full Rate	V	Set Injection

Mapping & Payload - Single Stage Mapping

Mapping & Payload - Multi-stage Mapping/Multiplexing



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7.1.1.5 OTN Channels and GFP-T Settings

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

If ODU0 is selected as the Ethernet mapping level, the test set will add a GFP-T sublayer to the signal structure. Advanced users can use this block if a different payload header type needs to be set (transmitted or expected).

7.1.1.6 Test Pattern (Test Sequence or PRBS)

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

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

LEDs		Start		
	Test Data Mode	Out of Service		
😑 Signal		тх	RX	
	PRBS Pattern	2^31-1	▼ 2^31-1	▼
🜔 Frame	Invert	OFF	OFF	▼
😑 Pattern				OTL Err Inj.
e Alm/err				OTL Alarm Inj.
History				LASER On/Off
				Set Injection

OTU4 Setup - Test Data Settings

Go back to top Go back to TOC

7.1.2 Measurement

LEDs	Signal Meas	urement	Service Disruption	Start
	Profile	Default	V	
😑 Signal	Mode	Manual	▼	
	Results Auto Save	OFF	▼	
😑 Frame	Corrected FEC Indication	Disable	▼	
Pattern				OTL Err Inj.
Ŭ				OTL Alarm Inj.
😑 ALM/ERR				
History				LASER On/Off
Thistory				
				Set Injection

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

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7.1.3 Service Disruption Test (SDT)

LEDs	Signal	Measurement	Service Disruption	Start
		Service Disruption Setu	p	
😑 Signal	Meas <mark>ON 🔻</mark> Save Evi	t. OFF 🔻 Separation (m	s) 300 Limit(ms) 50	
	Alar	m Trigger	Error Trigger	
😑 Frame	LOS	📄 ODU-LCK	OTL-FAS	
	📄 OTL-LOF	📄 ODU-OCI	📄 OTL-LLM	OTL Err Inj.
Pattern	📄 OTL-OOF	📄 ODU-AIS	📄 OTU-MFAS	
•	📄 OTL-LOL	📄 PM-BDI	📄 SM-BIP	OTL Alarm Inj.
😑 ALM/ERR	📄 OTL-OOL		📄 SM-BEI	
History	😑 OTU-LOM		📄 PM-BIP	LASER On/Off
	📄 оти-оом		📄 PM-BEI	
	SM-IAE		🗹 Bit Errors/Pat Loss	
	📄 SM-BDI			Set Injection
	SM-BIAE			

Service Disruption Setup

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

Testing Process

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

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

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

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

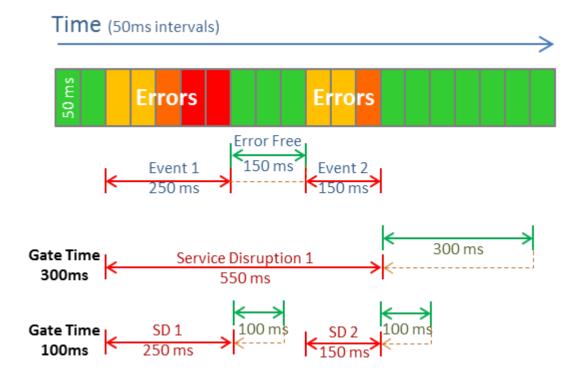
Setup

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

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

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

Service Disruption Time diagram



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

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7.2 Results

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

7.2.1 Results Summary

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



SDH/SONET STL256.4 Results (Summary)

OTU3/OTU4 Results (Summary)

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
	ST:2017-11-6 17:58:58			ET:00:44:24			
😑 Signal			LOS	No Alarm - OK			
-	Signal		Frequency	1	111809973KHz		
🜔 Frame		Rx	Total Power		6.09 dBm		
O Dattarn	OTL		Alarms	N	lo Alarms - O	К	Bit Err Inj.
O Pattern			Errors	Errors			
ALM/ERR	ΟΤΝ		Alarms	No Alarms - OK		OTN Alarm Inj.	
Č			Errors		Errors		LASER On/Off
History	BERT		Pattern	Pattern Sync - OK			
			Bit		No Error - Ol	۲	
							Set Injection

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7.2.2 Signal

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

RX/TX Optical Level (Page 1-2)

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

Signal - RX Optical Power Level

LEDs	Summary Si	gnal	OTL	ΟΤΝ	BERT	Analysis	Stop
			Leve	I [Rx]			
😑 Signal	Rx Optical Pov	wer[dBm]	LOS	5		SAT	
			-16			+12	
😑 Frame	TOTAL	6.08	-16			+6	
_	#1 1295.56nm	-1.02	- 10		+		Bit Err Inj.
😑 Pattern	#2 1300.05nm	1.14				•	
•	#3 1304.58nm #4 1309.14nm	0.64			•	•	OTN Alarm Inj.
😑 ALM/ERR	#4 1509.14111	-0.95		-8.6		+4.5	
History							LASER On/Off
							Set Injection
					_		
			Page	1 of 5	D		

Signal - Frequency (Per Lane)

LEDs	Summary Signal		STL	SDH	BERT	Analysis	Stop							
		Frequency												
😑 Signal	Lane	Freq. (kHz)	Offset (ppm)	Min. ((ppm)	Max. (ppm)								
0.5	1	9953280	-0	.0	-0.0	-0.0								
😑 Frame	2	9953280	-0	.0	-0.0	-0.0								
Pattern	3	9953280	-0	.0	-0.0	-0.0	STL Err Inj.							
U	4	9953280	-0	.0	-0.0	-0.0	STL Alarm Inj.							
😑 ALM/ERR	Total	39813120	-0	.0	-0.0	-0.0								
History							LASER On/Off							
							Set Injection							
		٩	Page 2	of 4										

Frequency (Page 3)

- The received signal frequency and offset is measured and displayed. The Signal page may display frequency measurements per lane for newer 40G/100G modules, depending on the test set and software version.
- For OTN signals, the measurement is performed on the optical interfaces CFP, CFP2, CFP4, QSFP28, and QSFP+.
- Frequency: Indicates the frequency of the input signal
- Offset (ppm): Indicates the difference between the standard rate and the bit rate of the input signal
- Min (ppm): Indicates the difference between the standard rate and the minimum deviation detected in the input signal
- Max (ppm): Indicates the difference between the standard rate and the maximum deviation detected in the input signal

Signal - Frequency (All Lanes)

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop						
		Frequency											
😑 Signal	Frequency			111809973K	Hz								
	Offset [ppm]			-0.1									
🜔 Frame	Min [ppm]			-0.1									
Pattern	Max [ppm]			-0.1			Bit Err Inj.						
							OTN Alarm Inj.						
😑 ALM/ERR													
							LASER On/Off						
History													
							Set Injection						
					-								
			Page	3 of 5 (D								

CFP Optical Module Information (Page 4)

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

LEDs	Summary	Signal OTL		ΟΤΝ	BERT	Analysis	Stop
		CFF	P Optical N	lodule Informa	tion		
😑 Signal	Power Class		P	wer Class 4 N	lodule (12 W	max)	
• -	Vendor		0	claro Inc.			
😑 Frame	Part Number		TI	RB5E20FNF-LI	=000		
Pattern	Serial Numb	er	J1	4H54919			Bit Err Inj.
	MSA H/W Sp	ec. rev.	0.)	OTN Alarm Inj.		
🖲 ALM/ERR	MSA MIS rev	<i>.</i>	2.	2			
	Control 1 Re	g.(IEEE)	10	0GE-LR4(SMF		LASER On/Off	
History	Extended Ab	ility(IEEE)	11	1.8Gbps,103.1			
							Set Injection

Signal (Page 4) - CFP Optical Module Information

CFP Optical Module Status (Page 5)

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

Signal (Page 5) - CFP Optical Module Status

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LEDs	Summary	Signal	OTL	. от	N	BERT	Analysis	Stop
		C	FP Opti	cal Module	Statu	IS		
😑 Signal	Module Statu	JS		Ready				
	Module Alarr	n Status		Normal				
🜔 Frame	Temperature	5		54.4 C				
Pattern	Voltage			3286 mV				Bit Err Inj.
	😑 CFP L	Jnplug		😑 Hos	t Lan	OTN Alarm Inj.		
😑 ALM/ERR	😑 Netwo	ork Lane Fa	ult	😑 Net	work	CTRATATION .		
	🔘 Modu	le Alarm		🔘 Moo	lule F		LASER On/Off	
History	😑 Gene	ral Alarm						
								Set Injection
		٩	P	age 5 of 5	(D		

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7.2.3 OTL and STL Results

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

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7.2.3.1 Summary

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

Green: No error or alarm is present.

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

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

LEDs	Summary Sign			gna	al		0	TL			0	ΤN			BE	RT		A	nal	ysi	s	Stop
	Summary			Rx Lane Skew			1	Alaı	rms	/Er	ror	s			Eve	ents	;					
😑 Signal	ST:2017-11	7:58:58					ET:00:53:46															
	Lane ID	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
😑 Frame	LOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
O D-#+++	OOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bit Err Inj.
😑 Pattern	FAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Θ	0	0	Θ	Θ	
ALM/ERR	LOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	OTN Alarm Inj.
	OOLLM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LASER On/Off
History	OOMFAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LASER ON/OT
	LLM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Θ	0	0	0	
	MFAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Hi Skew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Set Injection
	RxID	4	0	1	2	3	9	5	6	7	8	10	11	12	13	14	17	18	19	15	16	
	LOL					(2															

OTL Summary

Note: <u>SDH Alarm definitions</u> are listed in Results: SDH/SONET STL256.4 (Advanced).

	OTL Alarm/Error Definitions per ITU-T G.709 and G.798											
LLM		Logical Lane Marker Error										

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

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7.2.3.2 Rx Lane Skew

Note: Lane skew is only available on 100G test modules.

Lane Skew

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

Fixed Skew

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

Dynamic (Variable) Skew

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

OTL Rx Lane Skew

- `	1 1101 / 100												
	LEDs	Sun	nma	iry S	ign	al	01	Ľ	ΟΤΝ	BERT	Analysis	Stop	
		ļ	Sum	imary	6	Rx La	ane S	kew	Alarms/Eri	rors	Events		
	😑 Signal	Ch #	Т	x Skew B	it	L#	TxID	RxID	Rx Skew(bits)	Rx Skew(ps)	Hi Skew(Sec.)		
	🔵 Frame					0	0 1	4 0	3 4	536 715	0		
	Ŭ	0	-	0	+	2	2	12	4 4	715 715	0		
	🕒 Pattern					4	4	3	4	715	Ō	Bit Err Inj.	
	•					5	5 6	9 5	0	0 178	0		
	ALM/ERR	1	-	0	+	7	7	6	1	178	Ŏ	OTN Alarm Inj.	
						8	8	7 8	1	<u>178</u> 178	0		
	History		Ħ		╞	10	10	10	37	6618	0 O	LASER On/Off	
	Instory	2		0	+	11	11 12	11 12	<u> </u>	6618 6618	0		
		2		۰ I	T	13	13	13	37	6618	0		
						14	14	14	37	6618	0		
						15	15 16	17 18	44		0	Set Injection	
		3	-	0	+	17	17	19	44	7870	Ō		
						18 19	18 19	15 16	45 45	8049 8049	0		
		L			<u> </u>						· · · · ·		

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7.2.3.3 Alarms/Errors

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

LEDs	Summary Signal		OTL	ΟΤΝ	BERT	Analysis	Stop
	Summar	y RxI	Lane Skew	Alarms/Eri	rors	Events	
😑 Signal	ST:2017-11-0			ET:00:55:00			
🕒 Frame	Lane Ali LOL	gnment	Seconds 239	Lane Alig OOL	nment So 0	econds	
· •			Aaar	egate			
Pattern	OTL Land	e Alarms	Seconds	OTL Lane		ount	Bit Err Inj.
	LOF		239	FAS		347	
	OOF		0	MFAS	95	57	OTN Alarm Inj.
ALM/ERR	LOR		0	LLM	12	264	
	OOR		0				
	OOLLM		0				LASER On/Off
History	OOMFAS		0	Hi Skew	09	Sec.	
		OTL La	anes Alarms :	and Errors S	ummary		
	○ 0 ○ 1	02	3 🔵 4	 5 6 	070	8 💿 9	Set Injection
	10 11	12	13 💿 14	15 16	6 🛛 17 🕤	18 💿 19	
			View OTL L	ane Details.			

OTL Alarms/Errors

OTL Lane Details

						OTL	ane Detail	_				
e LEDs				Stop								
	ST	:2017										
-	1 #	LOF	OOF				OOMFAS	FAS	LLM	MFAS	ID	
😑 Signal					Secon				Count			
-	0	0	0	0	0	0	0	0	0	0	3	
	1	0	0	0	0	0	0	0	0	0	4	
🜔 Frame	<u>∠</u> 3		0	0	0	0	0	0	0	0	0	
-	4	0	0	0	0	0	0	0	0	0	2	
	5	0	0	0	0	0	0	0	0	0	5	OTL Err Inj.
😑 Pattern	Ğ	0	ŏ	0	0	0	0	0	0	0	Ğ	
	7	Ő	ŏ	ŏ	ŏ	Ő	0	0	0	Ő	7	
	8	Ŏ	ŏ	ŏ	ŏ	Ő	Ő	Ő	0	ŏ	8	OTL Alarm Inj.
🔵 ALM/ERR	9	Ō	Ō	Ō	Ō	0	Ō	Ō	0	Ō	9	
	10	0	0	0	0	0	0	0	0	0	10	
	11	0	0	0	0	0	0	0	0	0	11	LASER On/Off
History	12	0	0	0	0	0	0	0	0	0	12	
	13	0	0	0	0	0	0	0	0	0	13	
	14	0	0	0	0	0	0	0	0	0	14	
	15	0	0	0	0	0	0	25	20	35	19	
	16	0	0	0	0	0	0	131	90	67	15	Set Injection
	17	0	0	0	0	0	0	1253	115	79	16	Ceringeouon
	18	0	0	0	0	0	0	714	23	38	17	
	19	0	0	0	0	0	0	871	526	38	18	

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7.2.3.4 Events

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

OTL Events

LEDs	Summary	Sign	nal OT	L	ΟΤΝ	BER	Т	Analysis	Stop
	Summary	1	Rx Lane Sk	(ew	Alarms/E	rrors	Εv	'ents	
😑 Signal	Time	E١	vent Type			# of Erro	rs Te	st	
🙃 Frame	11-06 18:54:06	5.0 F <i>F</i>	AS OTL#19			3	01	ΓL	
	11-06 18:54:00	5.0 LL	_M OTL#16			1	0	٢L	
😑 Pattern	11-06 18:54:06	5.0 F <i>F</i>	AS OTL#16			1	01	ΓL	Bit Err Inj.
	11-06 18:54:06	5.0 F <i>F</i>	AS OTL#15			2	01	ΓL	OTN Alarm Inj.
🖲 ALM/ERR	11-06 18:54:05	5.0 FA	AS OTL#19			2	01	٢L	
History	11-06 18:54:05	5.0 F <i>A</i>	AS OTL#18			2	01	ΓL	LASER On/Off
matory	11-06 18:54:05	5.0 LL	M OTL#15			1	01	ΓL	
	11-06 18:54:05	5.0 FA	AS OTL#15			2	01	٢L	
			•	Page	1 of 210 (D			Set Injection

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7.2.4 OTN and SDH Results

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

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7.2.4.1 Summary

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

LEDs	Summary	Signal	OTL	ОТ	'N	BER.	T A	nalysis	Stop
	Summary	οτυ	0	DU/OPU	1	гсм	E١	/ents	
😑 Signal	ΟΤυ	ODU 1	ГСМ1 Т	СМ2 ТС	:M3	ТСМ4	TCM5	TCM6	
🜔 Frame					DCI Č		O AIS O OCI O L C K		
Pattern		BDI C		BDI OE BIAE OB	IAE) BDI) BIAE	O BDI OBIAE	O BDI OBIAE	Bit Err Inj.
e Alm/err		BEI C		LTC OL TIM OT BIP OE		TIM (OTN Alarm Inj.
History		¥	<u> </u>	BEI OE			O BEI	O BEI	LASER ON/OT
									Set Injection
	LOM: A	larm Secor	nds	0					

OTN Summary Results

SDH Summary Results

LEDs	Summary	Signal	STL	SDH	BERT	Analysis	Stop
	Summary	Alar	ms/Errors	Pointer		Events	
😑 Signal		RS/MS			High Patł	ı	
🕒 Frame	MS-AIS MS-RDI RS-TIM		B1 B2 MS-REI	AU-AIS AU-LOP HP-UNE	› Ŏ	B3 HP-REI TCM-OEI	
😑 Pattern				O HP-PLN O HP-TIN		TCM-REI TCM-IEC	STL Err Inj.
e Alm/err				O HP-RD O TCM-LC)F		
History				O TCM-RI			LASER On/Off
				О тсм-о			
							Set Injection
	B3:	Error Coun	nts	1400386			

Note: <u>SDH Alarm definitions</u> are listed in Results: SDH/SONET STL256.4 (Advanced).

ΟΤυ	OTU Error Definitions per ITU-T G.709 and G.798				
FAS	Frame Alignment Signal Error (mismatch) • One or more framing bits in error				
MFAS	Multi-Frame Alignment Signal error (mismatch) • MFAS indicator (0 to 255) is in error (out of sequence)				
ТІМ	Trail Trace Identifier Mismatch Received and expected TTI are different 				
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) Received and calculated BIP are different 				
BEI	 Backward Error Indication (BEI/BIAE bits) 08 Number of BIP-8 violations detected 9A No BIP-8 error detected B Refer to BIAE CF No BIP-8 error detected 				
BIAE	Backward Incoming Alignment Error (BEI/BIAE bits) • B (1011) ≥ 3 consecutive frames				
cFEC	Corrected FEC errors (don't affect ODUk)				
uFEC	Uncorrectable FEC errors (ODUk is affected)				

ΟΤυ	OTU Alarm Definitions per ITU-T G.709 and G.798				
OOF	Out of Frame • FAS errors ≥ 5 consecutive frames				
LOF	Loss of Frame • OOF condition for ≥ 3 ms				
ООМ	Out of Multiframe • MFAS errors for ≥ 5 consecutive frames				
LOM	Loss of Multiframe • OOM condition for ≥ 3 ms				
BDI	 Backward Defect Indication Defect: Set to 1 for ≥ 5 consecutive frames Normal: Set to 0 for ≥ 5 consecutive frames 				
IAE	Incoming (Frame) Alignment Error				

	Defect: Set to 1 for ≥ 5 consecutive frames • Normal: Set to 0 for ≥ 5 consecutive frames
AIS	Alarm Indication Signal • Repetitive PN-11 sequence (2 ¹¹ -1) completely filling OTUk frames

ODU Ala	rm/Error Definitions per ITU-T G.709 and G.798
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) • Received and calculated BIP are different
BEI	 Backward Error Indication (BEI/BIAE bits) 08 Number of BIP-8 violations detected 9F No BIP-8 error detected
BDI	 Backward Defect Indication Defect: Set to 1 for ≥ 5 consecutive frames Normal: Set to 0 for ≥ 5 consecutive frames
LCK	Locked • Defect: STAT = 101 for ≥ 3 consecutive frames • Normal: STAT = 001
OCI	Open Connection Indication • Defect: STAT = 110 for ≥ 3 consecutive frames • Normal: STAT = 001
AIS	 Alarm Indication Signal Defect: STAT = 111 for ≥ 3 consecutive frames Normal: STAT = 001
PLM	 Payload Mismatch Declared if the accepted payload type is not equal to the expected payload type(s) as defined by the specific adaptation function
ТІМ	Trail Trace Identifier Mismatch • Received and expected TTI are different

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7.2.4.2 OTU and SDH/SONET

OTU alarms/errors are displayed for OTU3/OTU4 test configuration, while SDH alarms/errors are displayed for SDH/SONET STL256.4.

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

OTN Results - OTU

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

SDH Results - STL256.4

LEDs	Summary	Signal	STL	SDH	BE	RT	Analysis	Stop
	Summary	Alarms/E	Errors	Pointe	er	E	vents	
🔘 Signal	ST:2018- 3-19 1	3:28:26		ET:00:26:28	;			
O Everne	RS/MS Alarm	<mark>s</mark> Seconds	RS/N	IS Errors	Cou	unts	Ratio	
🜔 Frame	MS-AIS	0	B1		145293	9	2.30E-08	
Pattern	MS-RDI	0	B2		181090	4	2.90E-08	STL Err Inj.
	RS-TIM	0	0 MS-RE		I 656		1.05E-11	STL Alarm Inj.
😑 ALM/ERR	HP Alarms	Seconds	HP	Errors	Cou	unts	Ratio	
	AU-AIS	0	B3		140481	0	2.30E-08	LASER On/Off
History	AU-LOP	1	HP-REI		0		0.00E+00	
	HP-UNEQ	0						
	HP-PLM	0						Set Injection
	HP-TIM	0						
	HP-RDI	0						

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7.2.4.3 ODU/OPU

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

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
	Summary	οτυ	ODU	/OPU	тсм	Events	
😑 Signal	ST:2017-11-6	17:58:58		ET:00:55:31			
😑 Frame	ODU Alarm	<mark>s</mark> Secon	ids ODU	J Errors	Counts	Ratio	
	AIS	0	PM-BIP		0	0.00E+00	
😑 Pattern	осі	0	PM-BEI		0	0.00E+00	Bit Err Inj.
Ŭ	LCK	0					OTN Alarm Inj.
😑 ALM/ERR	PM-BDI	0					
	РМ-ТІМ	0					LASER On/Off
History	OPU Alarm	<mark>s</mark> Secon	ıds				
	OPU-PLM	0					
							Set Injection

OTN Results - ODU / OPU

7.2.4.4 Tandem Connection Monitoring (TCM)

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

TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network. SONET/SDH allowed a single level of TCM to be configured, while ITU G.709 allows six levels of tandem connection monitoring to be configured. The assignment of monitored connections is currently a manual process that involves an understanding between the different parties. There are various types of monitored connection topologies: cascaded, nested, and overlapping.

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

LEDs	Summary	Signal	OTL	ΟΤΝ	BERT	Analysis	Stop
	Summary	οτυ	ODU	I/OPU	ТСМ	Events	
😑 Signal	ST:2017-11-6	17:58:58		ET:00:55:39			
🜔 Frame	TCM #1 Alar	<mark>ms</mark> Seco	nds TCM	#1 Errors	Counts	Ratio	
	AIS	**	BIP		**	**	
😑 Pattern	oci	**	BEI		**	**	Bit Err Inj.
Ŭ	LCK	**					OTN Alarm Inj.
🖲 ALM/ERR	BDI	**					
	BIAE	**					LASER On/Off
History	LTC	**					
	ТІМ	**					
							Set Injection
		◀	Page	1 of 6	D		

OTN Results - TCM

Tand	Tandem Connection Monitoring (TCM) Definitions per ITU-T G.707, G.709, and G.783					
BIP-8	Bit Interleaved Parity - level 8 code error (mismatch) • Received and calculated BIP are different					
BEI	 Backward Error Indication (BEI/BIAE bits) 08 Number of BIP-8 violations detected 9F No BIP-8 error detected 					
BDI	 Backward Defect Indication Defect: Set to 1 for ≥ 5 consecutive frames Normal: Set to 0 for ≥ 5 consecutive frames 					
LCK	Locked • Defect: STAT = 101 for ≥ 3 consecutive frames • Normal: STAT = 001					
осі	Open Connection Indication • Defect: STAT = 110 for ≥ 3 consecutive frames • Normal: STAT = 001					
AIS	Alarm Indication Signal • Defect: STAT = 111 for ≥ 3 consecutive frames • Normal: STAT = 001					
PLM	 Payload Mismatch Declared if the accepted payload type is not equal to the expected payload type(s) as defined by the specific adaptation function 					

Trail Trace Identifier Mismatch
 Received and expected TTI are different

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7.2.4.5 Pointer Analysis

Pointers keep SDH signals synchronous by compensating for timing differences without having to use stuffing bits. Pointers are allowed to move up or down every three frames however the actual rate should be slower. The Administrative Unit (AU) and theTributary Unit (TU) each has its own pointer and the unit has two tabs for displaying the values and measurements.

For AU pointers:

- SS bits Displays bits 5 and 6 of the H1 byte to indicate SDH [10], SONET [00], Unknown [01] and [11] signal type
- Pointer value Displays the H1 and H2 values (addresses) indicating the offset in bytes between the pointer andfirst byte
 of the AU-n
- LOP (Loss of Pointer)
- PJE and NJE
- NDF or New Data Flag. NDF is enabled when all bits match "1001" (or "0001", "1101", "1011" and "1000") and is disabled when all bits match "0110" (or "1110", "0010", "0100", "0111").
- Difference and Sum

For TU pointers:

- Pointer value
- LOP (Loss of Pointer)
- PJE and NJE
- NDF or New Data Flags
- Difference and Sum

OTN Results - TCM

LEDs	Summary	Signal	STL	SDH	BERT	Analysis	Stop
	Summary	Alar	ms/Errors	Pointer		Events	
😑 Signal	ST:2018-3-19	13:28:26		ET:00:26:33			
🔘 Frame	SS Bits					SDH [10]	
	Pointer Value					0	
O Pattern	LOP					1 s	STL Err Inj.
Ŭ	PJE		0 s			0	STL Alarm Inj.
🖲 ALM/ERR	NJE			0 s		0	
	NDF			0 s		0	LASER On/Off
History	Diff					0	
	Sum					0	
	Implied Offse	t (ppm)				0.00	Set Injection

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7.2.4.6 Events

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

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7.2.5 BERT

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

LEDs	Summary Sig	Inal	OTL	ΟΤΝ	BERT	Analysis	Stop
	Alarms	/Errors			Events		
😑 Signal	ST:2017-11- 8 16:1	8:55		ET:00:00:41	1		
🕒 Frame	BERT Alarm	Seconds	BEF	RT Error	Counts	Ratio	
	LOP	0	Bit	0		0.00E+00	
😑 Pattern							OTL Err Inj.
							OTL Alarm Inj.
😑 ALM/ERR							
History							LASER On/Off
							Set Injection

BERT Results - Alarms/Errors

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7.2.6 Analysis

Analysis

LEDs	Summary	Signal	OTL	ОТ	N	BERT	Analysis	Stop
😑 Signal	ST:2017-11-7	ET:00 / 00:0	02:16	Manual Measurement				
-								
😑 Frame			SDT			Start Ti	me	
O Dettern	Current (ms)	136000.000		2017-11-07 16:24:31.000000			OTL Err Inj.	
Pattern	Last (ms)		0.000					
ALM/ERR	R Minimum (ms)		136000.000		2017-11-07 16:24:31.000000			OTL Alarm Inj.
	Maximum (m	s)	136000.000		2017-11-07 16:24:31.000000			LASER On/Off
History	Events		1					
	Limit		Fail					
						Events	Detail	Set Injection

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

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

Tap on **Events Detail** for additional details on measured SDT events. The event type for each service disruption and start and duration information is listed.

Analysis Details

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

7.3 Alarm / Error Injection

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

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

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Alarm and Error Injection Setup

LEDs		Start							
		OTL	. Lane	Selec	tion		Error l		
🜔 Signal	Lane#	Tx ID	Sel.	Lane#	Tx ID	Sel.	Layer	OTL 🔻	
-	0	0	✓	10	10		Туре	FAS 🔻	
😑 Frame	1	1		11	11		Behavior	Single 🛛 🔻	
	2	2		12	12				OTL Err Inj.
😑 Pattern	3	3		13	13				
	4	4		14	14				Lane LOS Inj.
🖲 ALM/ERR	5	5		15	15		Alarm G	eneration	
	6	6		16	16		Layer	Physical 🛛 🔻	LASER On/Off
History	7	7		17	17		Туре	Optical LOS 🛛 🔻	
	8	8		18	18		Behavior	Continuous 🔻 🔻	
	9	9		19	19		Optical LOS I	ane Selection	
	Sele	ct All	Clea	ar All			L1: 🗖 L2: 🗖	L3: 🔲 L4: 🔲	
I92.168.0.180	R Re	mote/CL					20	17-11-20 17:12:51	

OTL Alarm and Error Injection Setup

STL Alarm and Error Injection Setup

LEDs			Stop					
		STL	. Lane Selecti	ion	Err			
🔘 Signal	Lane#	Tx ID	Sel.		Layer	STL	▼	
-	0	0	✓		Туре	FAS	▼	
😑 Frame	1	1			Behavior	Single	▼	
	2	2						STL Err Inj.
😑 Pattern	3	3						
								STL Alarm Inj.
🖲 ALM/ERR					Alarm	n Generation		
					Layer	STL	▼	LASER On/Off
History					Туре	LOF	▼	
					Behavior	Continuous	▼	
QSFP+:4X10G	Solo	ct All	Clear All					
	Jele	CC AII						

Menu options will vary depending on whether the network is set as OTU or SDH/SONET.

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

Error Injection:

- Layer: OTL, OTN, SDH, STL, BERT
- Type:
 - **OTL:** FAS, MFAS, LLM
 - OTN: MFAS, SM-BIP, SM-BEI, Corr. FEC, Uncorr. FEC, PM-BIP, PM-BEI, TCM1 to 6-BIP/BEI
 - BERT: Bit
 - STL: FAS, LLM

- SDH: B1, B2, MS-REI, B3, HP-REI
- Behavior: Single, Single Burst, Cont. Burst, Rate

Alarm Injection:

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

Note: Click here to refer to OTU Alarm and Error Definitions. SDH Alarm and Error Definitions can be found here.

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7.4 SDH/SONET Tools

For information on SDH/SONET Tools in the basic version of SDH/SONET STL256.4, refer to STL256.4 SDH/SONET (Basic).

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7.5 OTN Tools

Note: This section refers to OTN Tools for OTU3/OTU4 Testing, not OTN Tools for SDH/SONET mapping with PDH/DSn multiplexing.



OTN Tools Home Menu for OTU3/OTU4 Testing

7.5.1 Overhead Generation and Analysis

LEDs	Over	head	Gene	ration	Ov	Overhead Analysis OTU/ODU)U Tra	OU Trace T			см		
						ODUk								OPU		
🜔 Signal		FAS		AS			MF	SM		GCC0		RES		RES	JC1	
	OA1	OA1	OA1	OA2	OA2	OA2		TTI	BIP	BEI						
🜔 Frame	F6	F6	F6	28	28	28	XX	TI	XX	00	00	00	00	00	00	XX
	R	S	DM	тс		тсм6			тсм5			тсм4		FTFL	RES	JC2
😑 Pattern					TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI			
Ť	00	00	00	00	TI	XX	00	TI	XX	00	TI	XX	00	FTFL	00	XX
ALM/ERR	ТСМЗ				TCM2			тсм1			PM		E	KP	RES	JC3
•	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	RR	RR		
History	TI	XX	00	TI	XX	00	TI	XX	00	TI	XX	01	00	00	00	XX
	GC	:C1	GC	:C2		APS	PCC				R	ES			PSI	NJO
	00	00	00	00	00	00	00	00	00	00	00	00	00	00	PSI	XX

Overhead Application Menu

The Overhead Generator and Analysis tabs generate and analyze bytes, respectively. The Overhead is color-coded for easy viewing.



Decoding Bytes

Tapping the applicable byte enables an automatic decode - a byte description including the Hexadecimal and Binary value is

40G/100G Manual D07-00-123P Rev A00 provided. For some bytes, an advanced decode of the various bits is also available.

For Overhead Generation, programming some overhead bytes is possible after tapping on the applicable byte, however dedicated test functions are available for OTU/ODU Trace and TCM testing. In some instances, more advanced editing is possible using the dedicated functions.



Byte Analyzer - Advanced Decode

Overhead Analysis

LEDs	Over	head Generation Overhead					d Anal	ysis	0.	TU/OE)U Tra	ice	тсм				
							OD	Uk	Jk						OPUk		
😑 Signal		FAS		4S			MF		SM		GCC0		RES		RES	JC1	
	OA1	OA1	OA1	OA2	OA2	OA2		TTI	BIP	BEI							
🜔 Frame	F6	F6	F6	28	28	28	99	20	94	00	00	00	00	00	00	00	
	R	S	DM	ТС		тсм6			тсм5			тсм4		FTFL	RES	JC2	
😑 Pattern					TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI				
Ŭ	00	00	00	00	52	DF	00	55	77	00	45	4F	00	00	00	00	
ALM/ERR	ТСМЗ		TCM2			тсм1			РМ		E)	KP	RES	JC3			
	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	RR	RR			
History	46	20	00	45	76	00	1C	07	00	00	AF	01	00	00	00	00	
	GC	C1	GC	:C2		APS/	PCC				R	ES			PSI	NJO	
	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
	M	ultifrar	ne	FREE	RUN	▼											
		вүте		DECO	DDING	V											

- Multiframe: Free Run starts capturing bytes after tapping on the byte block, Locked-aligns the bytes with multiframe.
- Byte: Select Decoding-to view current status and description of the byte Capture. Captures up to 256 bytes from a particular field.

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7.5.2 OTU/ODU Trace (Trail Trace Identifier)

OTU/ODU Trace

LEDs	Overhead Genera	tion Overhead	Analysis	OTU/ODU Trac	e	тсм
	Fields		TX-Generation	RX-Expectation		
😑 Signal	OTU SAPI	OTU SAPI TRACI	E		OTU SAPI	TRACE
	OTU DAPI	OTU DAPI TRACI	E		OTU DAPI	TRACE
🜔 Frame	OTU User Define	OTU OP BYTES	FOR USER I	DEFINE		
O Dettern	ODU SAPI	ODU SAPI TRACI	E		ODU SAPI	TRACE
Pattern	ODU DAPI	ODU DAPI TRAC	E		ODU DAPI	TRACE
ALM/ERR	ODU User Define	ODU OP BYTES	FOR USER	DEFINE		
Ě						
History	OTU TIM Monitor	Disable	7			
	ODU TIM Monitor	Disable	/			

TTI is used to identify the signal from the source to the destination within the network. The TTI contains the so called Access Point Identifiers (API), which are used to specify the Source Access Point Identifier (SAPI) and Destination Access Point Identifier (DAPI). The APIs contain information regarding the country of origin, network operator and administrative details.

OTU/ODU TIM Monitor: When enabled, the unit verifies whether TX Generation and RX-Expectation match. If they do not match, a trace identification mismatch flag is generated.

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7.5.3 TCM (Tandem Connection Monitoring)

Tap the TCM tab to display the TCM parameters.

LEDs	Overhead Genera	ation Overhead Ana	alysis OTL	J/ODU Trac	e	тсм			
		TCM 1							
😑 Signal	Tx Status	No source TC[0]		Rx Monitor		Disable 🛛 🔻			
		_	Trace setup						
🜔 Frame	Fields	TX-C	Seneration		R	K-Expectation			
Pattern	SAPI	TCM1 SAPI TRACE			TCM1 SA	PI TRACE			
U Pattern	DAPI	TCM1 DAPI TRACE			TCM1 DA	PI TRACE			
🔵 ALM/ERR	User Define	TCM1 OP BYTES FO							
History	TIM Monitor	Disable 🔻							
		٩	Page 1 of 6	۲					

OTN Tools - TCM

Results are available for up to six tandem connections. The counts are numbers of seconds containing the error or indication.

Tandem connections and corresponding source and sink functions are defined in ITU-T G.707, G.709, and G.783.

TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network. SONET/SDH allowed a single level of TCM to be configured, while ITU G.709 allows six levels of tandem connection monitoring to be configured. The assignment of monitored connections is currently a manual process that involves an understanding between the different parties. There are various types of monitored connection topologies: cascaded, nested, and overlapping.

- LTC: Loss of Tandem Connection Signal
- OCI: Open Connection Indication
- AIS: TC Alarm Indication Signal

- LCK: Locked Defect
- BDI: Backward Defect Indication
- IAE: Incoming Alignment Error
- BIAE: Backward Incoming Alignment Error
- BEI: TC Backward Error Indication

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7.5.4 GCC BERT

GCC BERT

LEDs		GCC BERT		
	GCC Channel	GCC0	V	
😑 Signal	Test Pattern	2^31-1	V	
-		Pattern Sync	O Bit Errors	
🜔 Frame	Round Trip Delay(us)		Calibration required	
😑 Pattern				
	ST:2017-11-7 17:36:40		ET:00:00:14	
😑 ALM/ERR	BIT Errors(Current)	0	0.00E+00	
	BIT Errors(Total)	1	5.21E-09	LASER On/Off
History	LSS(s)	0		
	Stop	BIT Err	or Restart	

General Communication Channel 0 (GCC0) is a 2-byte clear channel, in the OTUk overhead, used for transmission of maintenance or information between regeneration points. The GCC1 and 2 channels are part of the ODUk overhead and carry information related to the client between the two ends of the link (not modified or affected by transit OTN network equipment).

GCC BERT inserts a test pattern in the selected GCC channel to verify error free transmission. Select from GCC0, GCC1, GC22 channels and the test patterns to be inserted.

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7.6 Advanced Tools

7.6.1 Round Trip Delay

Before running RTD, insert a short loopback and calibrate the unit. If the Status displays "Ready to measure", then press **Start**. The calibration function measures the test set's internal delay for the selected configuration, so it doesn't affect the measurement.

Round Trip Delay Setup

LEDs	Rou	und Trip Delay	
	Pattern Sync. Status	Pattern Sync.	
😑 Signal	Current(us)	0.0	
	Minimum(us)	0.0	
🕒 Frame	Maximum(us)	0.0	
😑 Pattern	Status	Ready to measure	
e Alm/err			
History			LASER On/Off
	Start	Calibrate	

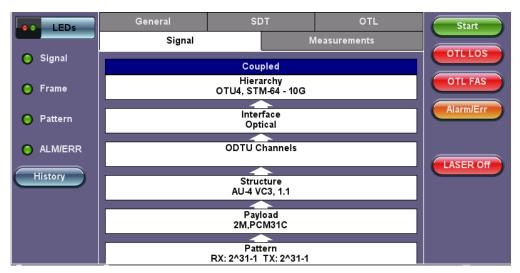
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8.0 OTU3/OTU4 with SDH/SONET Mapping

Note: SDH/SONET STL256.4 (Advanced) is an additional feature that requires separate purchase and may not be available for all modules. For Setup and Results information on the basic version, click <u>here</u>. For an overview of the Basic and Advanced versions, refer to <u>STL256.4 SDH/SONET Basic and Advanced Version Overview</u>.

8.1 Signal Overview

Tap on the Signal tab to set up the Transmitter and Receiver interfaces and associated test parameters prior to running a test.



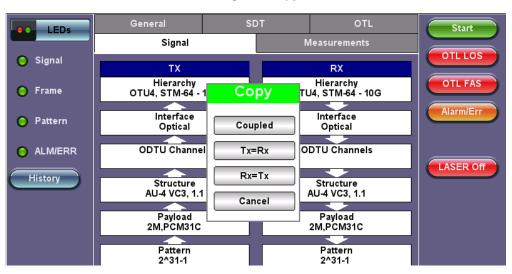
Signal tab

TX and RX Configurations

The Transmitter (TX) and Receiver (RX) signal structure are coupled or set to be identical by default. The coupled signal parameter can be modified by tapping the applicable block which brings up a new dialog window displaying additional input and specific selection settings. The Transmitter transmits as soon as a valid configuration is entered. The Receiver will check for a valid signal on its input so the measurement function is synchronized. When a test is not running, the LEDs will still indicate errors and alarms, but any other results displayed will be the results of a previous test.

Uncoupling TX and RX

When the TX and RX signal structures are required to be independent configurations, tap on the blue "Coupled" header to bring up the Copy menu. Copy menu options are Coupled, Tx=Rx, and Rx=Tx.



Accessing the Copy Menu

Copy Menu Options

- **Coupled:** TX and RX configurations are grouped as one block; TX and RX will have identical configuration. To uncouple TX and RX settings, tap on the blue "Coupled" heading and select Independent from the Copy Menu.
- Tx=Rx: Tx blocks will copy the settings made in the Rx blocks
- Rx=Tx: Rx blocks will copy the settings made in the Tx blocks

Setup Parameters

Changes to the Setup are applied immediately unless an invalid parameter has been selected.

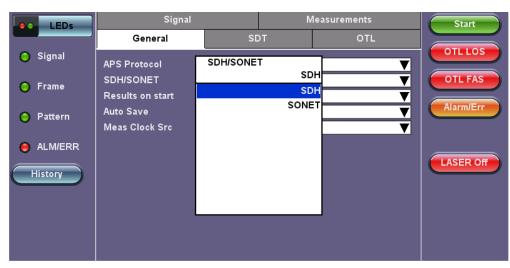
- Hierarchy: Allows the user to configure OTN/SDH, OTN/SONET, PDH signal and network types, including the bit rate and higher order mapping, if applicable.
- Interface: Allows the user to select optical or electrical test ports. Optical test ports apply to OTN/SDH signal types only, while electrical ports can apply to STM-1E or PDH signals. Clock source and offset options are also configured in this screen.
- Structure: Applies to SDH/SONET signals only and allows the user to configure lower order mapping and the channel number.
- **Payload:** Applies to both SDH/SONET and PDH signals and allows the user to configure low rate signal (if applicable) and associated framing.
- Pattern: Applies to both SDH/SONET and PDH signals and allows the user to configure the test pattern to be used. Use the pattern drop-down box to select the test pattern which will be inserted into the transmitted signal. Pseudo Random Bit Sequences (PRBS) defined by ITU-T 0.150 and 0.151 standards, fixed words and 24-bit or 32 bit user defined patterns are available. *Note: If the 32 bit user pattern entered is incorrect, the default pattern will be 0xFFFFFFF.*

Warning Message

While a test is running, it is possible to view the signal configuration, but it is not possible to change the setup or modify other measurement settings. This warning screen is only shown during initial setup to alert the user.

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8.2 Setup: SDH/PDH



SDH/SONET selection from the General tab

Accessing SDH Testing

To display SDH options for the block configuration, tap on the **General** tab from the Setup screen and select SDH from the **SDH/SONET** drop-down menu.

Note: Depending on whether SDH or SONET is selected from the **SDH/SONET** option under the **General** tab, TX and RX configuration screens will look slightly different.

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Coupled Transmitter and Receiver Setup

This section of the manual describes the SDH configuration capabilities. The block diagram of the Tx and Rx structure is described in <u>Signal Overview</u>. Tap on a block diagram to open the setup menu for the selected parameter.

Note: Depending on the platform and module(s) installed as well as the chosen OTU test application, available options will vary.

Hierarchy

LEDs	Hie	rarchy	Start
LEDS	Network Type	OTN 🔻	
😑 Signal	Test Rate	OTU4	OTL LOS
Joighan	OPU Rate	OPU0	
🔵 Frame	OPU4 Mapping	GMP 🔻	OTL FAS
	ODTU4 Type	ODTU4.31	
Pattern	OPU3 Mapping	АМР	Alarm/Err
•	ODTU3 Type	ODTU23	
😑 ALM/ERR	OPU2 Mapping	АМР	
Ĩ	ODTU2 Type	ODTU12	LASER Off
History	OPU1 Mapping	вмр 🔻	
	OPU0 Mapping	GMP 🔻	
	Scrambler	ON 🔻	
	FEC	ON 🔻	
	OPU Type	SDH 🔻	
	Test Rate	STM-1 - 155M 🛛 🔻	

Available options will vary depending on the selected type and rates. The following options are available:

- Network Type: In the OTN mode, only optical interface options are available
- Test Rate: OTU4 or OTU3
- OPU Rate: OPU0 to OPU4
- OPU4 to OPU0 Mapping: GMP, BMP, APM
- ODTU Types:
 - ODTU4 Type: ODTU4.1, ODTU4.2, ODTU4.8, ODTU4.31
 - ODTU3 Type: ODTU13, ODTU23, ODTU3.1
 - ODTU2 Type: ODTU12, ODTU2.1
- Test Rate: STM-1-155M, STM-4-622M, STM-16-2.5G, STM-64-10G, STM-256-40G
- OPU Type: PRBS, SDH
- Scrambler: ON/OFF
- FEC: ON/OFF

Through modes are used to test network behavior under certain conditions, such as alarms. To select Payload Through, the payload has to be the same for the relevant ports.

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Interface

Hierarchy Setup

Interface Setup

-					
	LEDs		Interface		Start
	LEDs	Clock Src	Internal	▼	Start
	😑 Signal	ODTU4 GMP Offset	0.00		OTL LOS
	J Signal	ODTU3 AMP Offset	0.00		
	😑 Frame	ODTU3 Stuffing Method	+2/0/-1 PJO2 used	▼	OTL FAS
		ODTU2 AMP Offset	0.00		
	😑 Pattern	ODTU2 Stuffing Method	+1/0/-1 PJO2 not used	▼	Alarm/Err
	•	ODTU1 AMP Offset	0.00		
	😑 ALM/ERR	OPU0 GMP Offset	0.00		
	Ž				LASER Off
	History				

- Clock Source: Can be configured as follows:
 - Internal clock: The clock for the transmitter is derived from the internal clock. The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
 - External clock: The clock for the transmitter is derived from a 1.5MHz, 2MHz, 1.5Mbps, or 2Mbps signal on the SMA.
 - **Rx:** The clock for the transmitter is derived from the received signal, and the jitter of the incoming signal is suppressed.
 - Offset: The clock for the transmitter is derived from the internal clock generator. It can change the offset while measurements are running. Use the numeric key to increase and decrease the frequency shift, up to 0.01ppm. Frequency offset: ± 50ppm with 1, 0.1, 0.01ppm resolution.
 - Atomic 10 MHz (optional): Built-in Atomic Clock option provides 10 MHz reference and can be disciplined to the built-in GPS receiver option.
- Enter an ODTU, OPU GMP/AMP Offset value
- ODTU Stuffing Method: +1/0/-1 PJO2 not used, +2/0/-1 PJO2 used

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ODTU Channels

LEDs		OD1	ru-4			ODI	ru-3			ODI	TU-2			ODI	ru-1	
	TX Po	ort#						ľ	1							
😑 Signal					_			Width			d: 31					
-	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
🔵 Frame	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
😑 Pattern	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
		Clear	AII									Cop	y RX	Sho	v Cha	nnels
ALM/ERR																
History																

Tap on a timeslot to select a timeslot. Selections are displayed in yellow.

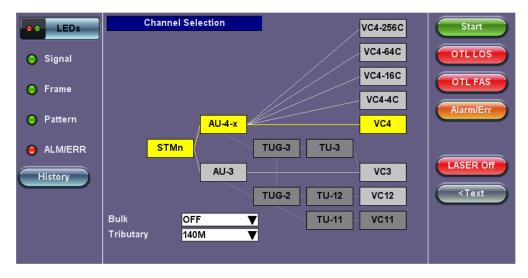
- Clear All: Clear all selected timeslots
- Copy RX: Copies Rx timeslot selections
- Show Channel/Show TS: Toggle between viewing channels and timeslots

PT selections and entering the TX Port # is also available.

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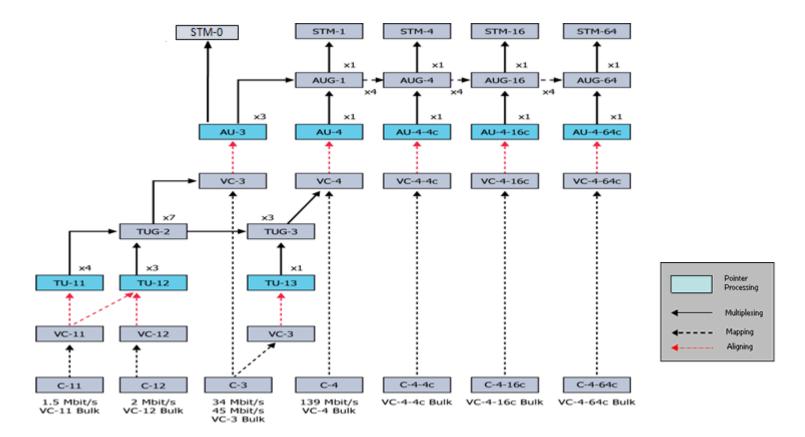
Structure

The Structure Setup screen is displayed in two modes: Text mode and Graphical mode. Tap on the **Text/Graphical** button to switch between display modes.



Structure Setup - Graphical Mode

SDH Mapping: Both AU-4 and AU-3 signal mappings per G.707 recommendations are supported. The multiplexing structure is shown below.



Structure Setup - Text Mode

LEDs	S	tructure	Start
LEDS	SDH Mapping	AU-4 🔻	
😑 Signal	VC Mapping	VC4	OTL LOS
Joighan	Bulk	OFF 🛛 🔻	
😑 Frame	Tributary	140M 🔻	OTL FAS
	Chanr	nel Selection	
😑 Pattern			Alarm/Err
ALM/ERR History			LASER Off <graphical< th=""></graphical<>

- AU4 Mapping: VC-256C, VC4-64C, VC4-16C, VC4-4C, VC4, VC3, and VC12 are available.
- AU3 Mapping: VC3,VC12, and TU11/VC11 are available.
- **Bulk:** Tap the check box to enable the setting. In bulk mode, the entire VT container is filled with a test pattern per ITU-T 0.181 recommendations.
- Tributary: Preset to DS1, E1, DS3, and E3 rates depending upon the options and mapping.

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Payload

Payload Setup

LEDs	Pa	yload	Start
	Rate	140M 🔻	
😑 Signal	E4 Framing	G751 V	OTL LOS
😑 Frame			OTL FAS
😑 Pattern			Alarm/Err
😑 ALM/ERR			LASER Off
History			

Rate: Depends on mapping selected.

In TU11/VC11 mapping mode, the Low Rate options are 1.544M or Fractional DS1 (Nx64 or Nx56) where:

- 1.544M: Configures the transmitter for full rate testing at 1.544Mbps
- Fractional DS1 (Nx64 or Nx56): Configures the transmitter for fractional testing using N or M 64kbps timeslots (contiguous or non-contiguous timeslots)

In VC3 mapping mode/Tributary set to DS3, the Low Rate options are 45M, 1.544M Mux (DS3/DS1 Mux), or Fractional DS1 (Nx64 or Nx56) Mux where:

- 45M: Configures the transmitter for full rate testing at 45Mbps
- 1.544M Mux mode: Configures the transmitter for full rate testing at 45Mbps signal with DS1 payloads (1 to 28 channels)
- Fractional DS1 Mux mode: Configures the transmitter for full rate testing at 45Mbps signal with DS1 payloads (1 to 28 channels) for fractional testing using N or M 64kbps or 56kbps timeslots (contiguous or non-contiguous timeslots)

In VC12 mapping mode, the Low Rate options are 2M or Fractional E1 (N x64) where:

- 2M: Configures the transmitter for full rate testing at 2.048Mbps
- Fractional E1: Configures the transmitter for fractional testing using N or M 64kbps timeslots (contiguous or noncontiguous timeslots)

In VC3 mapping mode/Tributary set to E3, the Low Rate option are 34M or 2M Mux (E3//E1 Mux) or Fractional E1 Mux (E3//E1 Mux w/Nx64) where:

- 34M: Configures the transmitter for full rate testing at 34Mbps
- 2M Mux mode: Configures the transmitter for full rate testing at 34Mbps signal with E1 payloads (1 to 16 channels)
- Fractional E1 Mux mode: Configures the transmitter for full rate testing at 34Mbps signal with E1 payloads (1 to 16 channels) for fractional testing using N or M 64kbps timeslots (contiguous or non-contiguous timeslots)

Framing: Depends on low rate selected.

- In DS1 mode, the options are unframed, D4 (SF), and ANSI T1.107 (ESF).
- In DS3 mode, the options are unframed, M13, and C-Parity.
- In E1 mode, the options are unframed, PCM31, PCM31C, PCM30, and PCM30C. Framing conforms to G.704 and G.706 recommendations and are briefly described below.
- In E3 mode, the options are unframed, framed G.751.

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Pattern

LEDs		Pattern	Start
LEDS		тх	Start
🔵 Signal	PRBS Pattern	2^31-1	
Joigha	Invert	OFF	
🔵 Frame		RX	OTL FAS
	Out of service	ON	
😑 Pattern	PRBS Pattern	2^31-1	Alarm/Err
•	Invert	OFF	T
🔵 ALM/ERR		TX OTU GCC BERT	
Ĩ	Channel	OFF	LASER Off
History		RX OTU GCC BERT	
	Channel	OFF	T

- **PRBS Pattern:** Use the pattern drop-down box to select the test pattern which will be inserted into the transmitted signal. Pseudo Random Bit Sequences (PRBS) defined by ITU-T 0.150 and 0.151 standards, fixed words and 24-bit or 32 bit user defined patterns are available.
- **Invert:** Inversion of polarity is also available.
- Out of Service (RX only): Should be selected if the incoming signal is expected to contain a known test pattern. Deselect this option if signal is expected to contain live traffic.
- OTU GCC BERT: OFF, GCC0, GCC1, GCC2. If enabled, select a PRBS Pattern.

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Pattern Setup

8.3 Setup: SONET

LEDs	Signal		Μ	leasurements	Start
	General	SD	т	OTL	
🜔 Signal	APS Protocol	SDH/SONE1	ſ		OTL LOS
😑 Frame	SDH/SONET Results on start		SONE		OTL FAS
O Pattern	Auto Save Meas Clock Src		SONE		Alarm/Err
O ALM/ERR					
History					LASER Off

SDH/SONET selection from the General tab

Setting up SONET Testing

To display SONET options for the TX and RX block configuration, tap on the **General** tab from the Setup screen and select SONET from the **SDH/SONET** drop-down menu.

Note: Depending on whether SDH or SONET is selected from the **SDH/SONET** option under the **General** tab, TX and RX configuration screens will look slightly different.

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Coupled Transmitter and Receiver Setup

This section of the manual describes the SONET configuration capabilities. The block diagram of the Tx and Rx structure is described in <u>Signal Overview</u>. Tap on a block diagram to open the setup menu for the selected parameter.

Note: Depending on the platform and module(s) installed as well as the chosen OTU test application, available options will vary.

Hierarchy

Hierarchy Setup

LEDs	Hie	rarchy	Start
LEDS	Network Type	οτη 🗸 🔨	Jan
😑 Signal	Test Rate	оти4 🔻	OTL LOS
J Signal	OPU Rate	OPU0 🔻	
😑 Frame	OPU4 Mapping	GMP 🔻	OTL FAS
	ODTU4 Type	ODTU4.31	
😑 Pattern	OPU3 Mapping	AMP 🔻	Alarm/Err
•	ODTU3 Type	ODTU23	
ALM/ERR	OPU2 Mapping	AMP 🔻	
	ODTU2 Type	ODTU12	LASER On
History	OPU1 Mapping	ВМР 🔻	
	OPU0 Mapping	GMP 🔻	
	Scrambler	ON 🔻	
	FEC	ON 🔻	
	OPU Type	SDH 🔻	
	Test Rate	OC-3 - 155M 🛛 🔻	

Available options will vary depending on the selected type and rates. The following options are available:

• Network Type: In the OTN mode, only optical interface options are available

- Test Rate: OTU4 or OTU3
- OPU Rate: OPU0 to OPU4
- OPU4 to OPU0 Mapping: GMP, BMP, APM
- ODTU Types:
 - ODTU4 Type: ODTU4.1, ODTU4.2, ODTU4.8, ODTU4.31
 - ODTU3 Type: ODTU13, ODTU23, ODTU3.1
 - ODTU2 Type: ODTU12, ODTU2.1
- Test Rate: OC-3-155M, OC-12-622M, OC-48-2.5G, OC-192-10G, OC-768-10G
- OPU Type: PRBS, SDH
- Scrambler: ON/OFF
- FEC: ON/OFF

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Interface

Interface Setup

LEDs	Inte	erface	Start
	Clock Src	Internal 🛛 🗸 🔻	
😑 Signal	ODTU4 GMP Offset	0.00	OTL LOS
Joigha	ODTU3 AMP Offset	0.00	
😑 Frame	ODTU3 Stuffing Method	+2/0/-1 PJO2 used 🛛 🔻	OTL FAS
•	ODTU2 AMP Offset	0.00	
😑 Pattern	ODTU2 Stuffing Method	+1/0/-1 PJO2 not used 🛛 🔻 🔻	Alarm/Err
Ŭ	ODTU1 AMP Offset	0.00	
🖲 ALM/ERR	OPU0 GMP Offset	0.00	
History			LASER Off

Use this menu to configure the clock sources used to time the OTN signal, multiplexing levels and payloads. Users can enter individual frequency offsets and select the desired stuffing methods. The content of this screen changes depending on the selected test signal structure.

Clock Source: Can be configured as follows.

- Internal clock: The clock for the transmitter is derived from the internal clock. The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
- External clock: The clock for the transmitter is derived from a 1.5MHz, 2MHz, 1.5Mbps, or 2Mbps on the SMA.
- **Rx**: The clock for the transmitter is derived from the received signal, and the jitter of the incoming signal is suppressed.
- Offset: The clock for the transmitter is derived from internal clock generator. It can change the offset while measurements are running. Use the numeric key to increase and decrease the frequency shift, up to 0.01ppm. Frequency offset: ± 50ppm with 1, 0.1, 0.01ppm resolution.

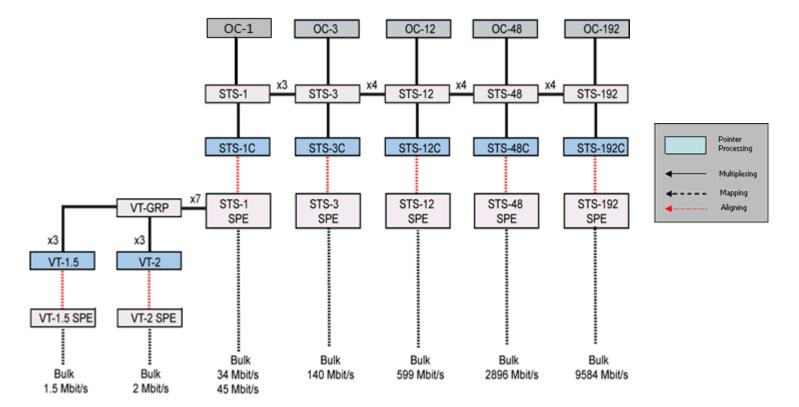
Go back to top Go back to TOC

ODTU Channels

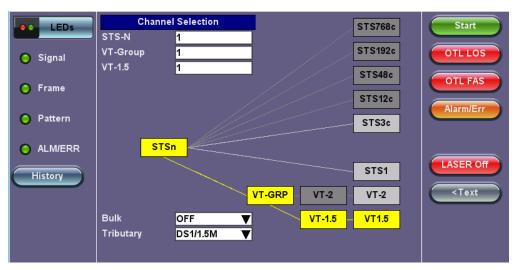
Structure

The Structure Setup screen is displayed in two modes: Text mode and Graphical mode. Tap on the **Text/Graphical** button to switch between display modes.









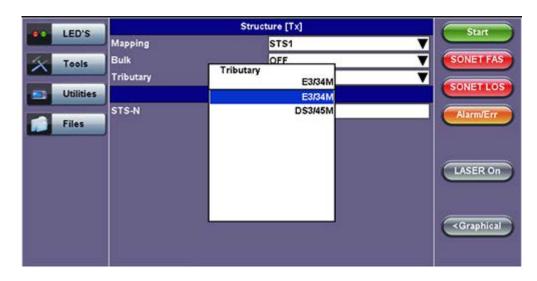
Bulk: Tap on the selection box to enable the setting. In Bulk mode, the entire container is filled with a test pattern per ITU-T 0.181 recommendations.

- Tributary: Preset to DS1, E1, DS3, and E3 depending upon the options and mapping.
- Other channels: Select Unequipped to mark the rest of the tributaries (non-test channels) as not equipped. Select Broadcast to transmits the same test channel structure and test pattern in all the tributaries.
- Sync: Asynchronous, Bit synchronous and Byte synchronous payload mapping selection

Channel Selection: The Tx channel is selected by entering the KLM position of the SDH/SONET channel within the signal channel. K (STS-N), L (VT-GRP), and M (VT-1.5 or VT-2) refer to the tributaries at each multiplexing levels and depend on the test signal configuration.

Note:

- VT-GRP: In order to carry multiple VTs in a STS-1 SPE in an efficient manner, VT Group (VTG) is defined. The size of the VTG is 12 columns, which is the least common multiple of the four sizes of VTs. Only one type of VT can be contained within each VTG. Therefore, a VTG can be formed by byte interleave multiplexing 3 VT-2s and 4 VT-1.5s
- VT-1.5: Each VT 1.5 frame consists of 27 bytes (3 columns of 9 bytes) These bytes provide a transport capacity of 1.728Mbps, and thus, can accommodate the transport of a DS1 signal. 28 VT 1.5s may be multiplexed into the STS-1 SPE.
- VT-2: Each VT-2 frame consists of 36 bytes (4 columns of 9 bytes) These bytes provide a transport capacity of 2.304Mbps, and can accommodate the transport one E1 signal. 21 VT-2s may be multiplexed into the STS-1 SPE.
- The tributary numbering used above is per Bellcore GR.253/ANSI T1.105 standard.



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Payload

Tapping the Tx Payload box opens the Tx Payload Setup screen. The options presented will depend on the test signal structure programmed. **Low Rate** indicates the lowest data rate in the structure, containing the test pattern.

Tx Payload Setup

LED'S				Paylo	ad [Tx]				Start
1003	Low Rate				Nx64 🗸				
Tools	E3 Framing			G751 V			▼	SONET FAS	
	E2 Channel			1					
📑 Utilities	E2 Framing			G742 V			SONETLOS		
	E1 Channel				1				Alarm/Err
Files	E1 Frami	ng			PCM31				
	Unused				AIS 🔻				
				Timeslot	t Selection				
	00	01	02	03	04	05	06	07	LASER On
	08	09	10	11	12	13	14	15	
	16	17	18	19	20	21	22	23	
	24	25	26	27	28	29	30	31	
	Clea	ar All	Select /	AU)					

Rate: Depends on mapping selected.

In VT-1.5 mapping mode, The Low Rate options are 1.544M or Fractional DS1 (Nx64 or Nx56) where:

• 1.544M: Configures the transmitter for full rate testing at 1.544Mbps

Fractional DS1 (Nx64 or Nx56): Configures the transmitter for fractional testing using N or M 64kbps timeslots (contiguous or non-contiguous timeslots)

In STS-1 mapping mode/Tributary set to DS3, the Low Rate option are 45M or 1.544M Mux (DS3/DS1 Mux) or Fractional DS1 (Nx64 or Nx56) Mux where:

- 45M: Configures the transmitter for full rate testing at 45Mbps
- 1.544M Mux mode: Configures the transmitter for full rate testing at 45Mbps signal with DS1 payloads (1 to 28 channels)

In VT-2 mapping mode, the Low Rate options are 2M or Fractional E1 (Nx64) where:

- 2M: Configures the transmitter for full rate testing at 2.048Mbps
- Fractional E1: Configures the transmitter for fractional testing using N or M 64kbps timeslots (contiguous or noncontiguous timeslots)

In STS-1 mapping mode/Tributary set to E3, the Low Rate options are 34M or 2M Mux (E3/E1 Mux) or Fractional E1 Mux (E3/E1 Mux w/Nx64) where:

- 34M: Configures the transmitter for full rate testing at 34Mbps
- 2M Mux mode: Configures the transmitter for full rate testing at 34Mbps signal with E1 payloads (1 to 16 channels)
- Fractional E1 Mux mode: Configures the transmitter for full rate testing at 34Mbps signal with E1 payloads (1 to 16 channels) for fractional testing using N or M 64kbps timeslots (contiguous or non-contiguous timeslots)

Framing: Depends on low rate selected:

In DS1 mode, the options are unframed, D4 (SF) and ANSI T1.107 (ESF).

In DS3 mode, the options are unframed, M13 and C-Parity.

In E1 mode, the options are unframed, PCM31, PCM31C, PCM30, and PCM30C. Framing conforms to G.704 and G.706 recommendations and are briefly described below.

In E3 mode, the options are unframed, framed G.751.

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Pattern

Tapping the Tx Pattern box opens the Tx Pattern Setup screen.

Tx Pattern Setup

LEDs	Р	Start	
LEDs		тх	Start
🔵 Signal	PRBS Pattern	2^31-1	OTL LOS
Joighan	Invert	OFF 🗸	
🜔 Frame		RX	OTL FAS
	Out of service	ON 🔻	
😑 Pattern	PRBS Pattern	2^31-1	Alarm/Err
Ŭ	Invert	OFF 🔻	
🖲 ALM/ERR	ΤΧ ΟΤΙ	GCC BERT	
	Channel	OFF 🛛 🔻	LASER Off
History	RX OTU	GCC BERT	
	Channel	OFF 🛛 🔻	

Pattern: Use the pattern drop-down box to select the test pattern which will be inserted into the transmitted signal. Pseudo Random Bit Sequences (PRBS) defined by ITU-T 0.150 and 0.151 standards, fixed words and 24-bit or 32 bit user defined patterns are available.

Note: If the 32 bit user pattern entered is incorrect, the default pattern will be 0xFFFFFFF.

Invert: Inversion of polarity is also available.

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8.4 Measurement Configuration

Tapping the Measurements tab opens the setup screen for the Timer, Performance Analysis, and General configurations.

LEDs	General	SDT		OTL	Start
	Signal		Measuren		
😑 Signal	Mode	Auto		▼	OTL LOS
😑 Frame		Start			OTL FAS
•	Start Time [yyyy/mm/dd	hh:mm:ss] <mark>1969</mark> Duration	12 31 1	5 30 00	Alarm/Err
😑 Pattern	Duration				
ALM/ERR	Units	10 Second	ls	▼	
		LASER Off			
History	G.821 Allocation	100.00			
	Performance Type	None		V	

Measurements tab

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8.4.1 Timer Setup

Configure a test to run for a fixed duration and/or a delayed start.

Mode: Manual, Timed, and Auto selections are available.

- **Manual:** This is directly linked to the Start/Stop function on the drop-down menu. The test starts as soon as the **Start** button is pressed. Press **Stop** to stop the test.
- **Timed:** The test duration can be set by the user in seconds, minutes, hours or days. The test is activated by the Start button on the drop-down menu and stops automatically when the defined time has elapsed.
- Auto: A predetermined start time can be set by the user. The test duration can be set in seconds, minutes, hours or days. After programming the start time and duration, press the **Start** button and the test will be activated automatically when the programmed start time is reached.

Note: M.2100 and M.2101 performance objectives are only available in Timed and Auto Mode.

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8.4.2 Performance Analysis

The Analysis setup page selects the type of ITU-T performance evaluation that will be performed by the unit. Depending on Test mode, the selections include None, G.821, G.826, G.828, G.829, G.8201, M.2100, and M.2101. The available options may vary depending on configuration.

Analysis

LEDs	General Signal	SDT	OTL Neasurements	Start
 Signal Frame Pattern ALM/ERR History 	Signal Mode Start Time [yyyy/mm/(Duration Units G.821 Allocation Performance Type	Performance Type Nor G.8 G.8 G.8 G.82 G.82 M.21 M.21	ne 1 15 30 00 26 28 29 01 V 00	OTL LOS OTL FAS Alarm/Err
	L			

The recommendations are briefly defined as follows:

- **G.821:** Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an Integrated Service Digital Network (ISDN)
 - Long term error performance conducted Out of Service (OOS)
 - Based on measuring bit errors
 - Evaluation period of 30 days
 - Since there is no overhead structure at these bit rates, in-service measurements are not recommended
- **G.826:** End-to-end error performance parameters and objectives for international, constant bit rate digital paths and connections
 - Long term error performance for Out of Service (OOS) and In-Service Monitoring (ISM)
 - · Based on measuring bit errors for connections and block errors for paths
 - Evaluation period of 30 days
- G.828 Analysis: Error performance parameters and objectives for international constant bit rate synchronous digital paths
 - Deals exclusively with SDH paths
 - Long term error performance for Out of Service (OOS) and In-Service
 - Based on measuring block errors
 - Evaluation period of 30 days
- G.829 Analysis: Error performance events for SDH Regenerator and Multiplexer sections
 - Deals exclusively with SDH sections
 - Error event definition
 - · Based on measuring block errors
- G.8201: Error performance parameters and objectives for multi-operator international paths within optical transport networks (OTN) addressing the objectives for international (and national) ODUk paths. This is a block-based measurement concept using error detection code (EDC) and EDC usage inherent to the path under test. This simplifies in-service measurements.
 - Error performance for Out of Service (OOS) and In-Service Monitoring (ISM)
- **M.2100:** Performance limits for bringing into service and maintenance of international multi-operator PDH paths and connections
 - Deals exclusively with PDH paths, sections and systems
 - · Based on measuring bit errors and block errors
 - Bring-into-Service (BIS) limits for OOS/ISM
 - Evaluation periods of 15 minutes, 2 hours and 24 hours
 - First step is a continuity test for 15 minutes
 - PDH paths are composed of sub-elements of different lengths each with its own set Reference Performance Objectives (RPO)
- **M.2101 Analysis:** Performance limits and objectives for maintenance and bringing into service SDH paths and multiplex sections.
 - Deals exclusively with SDH paths and sections
 - Based on measuring block errors
 - BIS limits for OOS/ISM
 - Evaluation periods of 15 minutes, 2 hours, 24 hours and 7 days
 - First step is a continuity test for 15 minutes

Note: Only one performance analysis can be performed at a time. To view or enable the M.2100 and M.2101 analyses, the

measurement timer has to be set to a determined period. The table below describes the anomalies evaluated for the performance analysis selected.

OTL Alarm/Error Definitions per ITU-T G.709 and G.798									
Analysis	Anomalies								
G.821	•	•	TSE based on bit errors						
G.826 (Out of service)	•	•	TSE based on block errors						
G.826 (In service)		•	B1, B2, B3, LP-BIP, E1/E3/E4 FAS, E1, CRC						
G.828 (In service)		•	B1, B2, TSE						
G.829 (In service)		•	B1, B2, B3, LP-BIP, TSE						
M.2100	•		E1/E3/E4 FAS, E1, CRC, TSE						
M.2101		٠	B1, B2, B3, HP, LP-BIP, TSE						

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8.4.3 General

The General setup page configures the audible alarm and APS protocol settings. Audible alarms may not be supported by all test sets, technologies and applications.

LEDs	Signal		Ν	leasurements	Start
	General	SI	DT	OTL	
😑 Signal	APS Protocol	[Linear	·	OTL LOS
😑 Frame	SDH/SONET		SDH	V	OTL FAS
	Results on start	[ON	V	
Pattern	Auto Save		OFF	V	Alarm/Err
-	Meas Clock Src		Internal	▼	
😑 ALM/ERR					
History					LASER Off

- APS Protocol: Linear or Ring architectures are selectable. This determines how the APS bytes (K1/K2) are decoded in the SDH Overhead Analyzer or how they are generated in the SDH Overhead Generator. It also determines how the APS measurement will be made.
- SDH/SONET: SDH or SONET modes are available options. Defines the reference standard to be used for GUI terminology and functionality. Select SDH for SDH and PDH applications. Select SONET for North American SONET and DSn (T1 and T3). This may also change the behavior of certain menus and function.
- STS-1 Bulk data (SONET only): The STS-1 bulk mode fills the entire payload, except for the POH.
- Result on start: On or Off. Provides an automatic move to Result screen when it starts.
- Auto Save: Tap Auto Save and set it to ON to automatically save the results file.
- Measurement Clock Source: Internal Clock or Tx Clock Source; the measurement is synchronized to the Transmitted (Tx) Clock.

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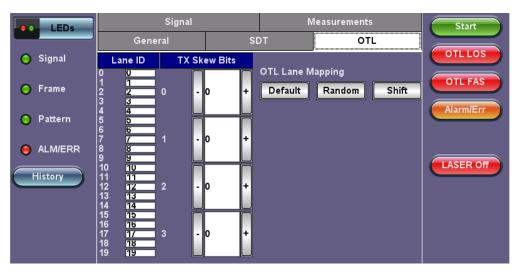
8.4.4 OTL

Advanced users can enter the OTL tab on the Setup screen to configure the OTL Tx Lane Mapping and Skew, as well as

General tab

tolerance thresholds (to generate alarms).

- Lane ID: Manually edit and assign specific Lane IDs to Lane #. Use the **Random** button to assign them arbitrarily, the **Shift** button to slide the Lane IS vs Lane # correlation, or the **Default** button to realign them back.
- Skew (bits): Enter the desired skew values by tapping directly on the fields or use the + and buttons to increment/decrement them by the amount set in the Inc/Dec Size field.





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8.4.5 Service Disruption Test (SDT)

Refer to <u>Service Disruption Test (SDT)</u> in the OTU3 & OTU4 Test Application section for more information.

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8.5 Results: OTN, PDH/DSn Multiplexing, and SDH/SONET

OTU3/OTU4 with PDH/DSn Multiplexing and SDH/SONET STL256.4 (Advanced) test results feature the same measurements and are displayed in an identical format. Test measurements can be accessed from the **Results** icon in the main menu.

8.5.1 Summary

The Summary tab displays a summary of test results and parameters. At a glance, the user is able to see if there are any alarms, errors, or signal failure pertaining to the SDH/SONET signal and its payload.

LEDs	Histogram	Graph	Event Log	SDT	Stop
	Summary	Errors/Alarms	Signal	Analysis	
🕒 Signal	ST:03/21 14:35:29			ET:00/00:00:13	STL LOS
🕒 Frame	LOS Alarm			OK Alarm	STL FAS
	SDH Alarms SDH Errors			Error	Alarm/Err
😑 Pattern					
😑 ALM/ERR					
History					LASER Off
		• Para	1 of 2 🖸		Restart
		Page	1 of 2		

Summary - STL256.4 (Advanced)

Summary displaying alarms/errors per lane

LEDs	Histogram	Graph	Event Log	SDT	Stop
	Summary	Errors/Alarms	Signal	Analysis	
🔘 Signal	Lane ID 01	2 3			STL LOS
🕥 Frame	LOF OOF				STL FAS
Ŭ	FAS OO				Alarm/Err
😑 Pattern					
😑 ALM/ERR					
History	RX ID 31 31	2 3			LASER Off
					Restart
		 Page 	2 of 2 💿		

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8.5.2 Errors and Alarms

The Errors/Alarms tab brings up several pages showing the errors and alarms status.

Page 1 provides an overview of all the Errors and Alarms applicable to the signal or network under test. The color of the page tab is normally blue; however, it will turn red when an alarm error condition has been detected or recorded.

The soft LEDs on screen are arranged logically and will depend on signal hierarchy, structure, payload, and framing selected. The soft LEDs have a tricolor function:

Green: No error or alarm is present.

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

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

LEDs	LEDs Histogram Graph		Even	Event Log		от	Stop		
	Sum	mary	Errors/Alarms		Signal		Analysis		
😑 Signal	STL	STL	RS	MS	AU	HP	Pat		STL LOS
	LOL	FAS	ТІМ	AIS	AIS	UNEQ	LSS		STL FAS
😑 Frame	OOL	LLM	B1	RDI	LOP	RDI	Bit		
	AIS			B2		ТІМ			Alarm/Err
😑 Pattern	LOR			REI		PLM			
	OOR					B3			
😑 ALM/ERR	LOF					REI			
History	OOF								
			•	_					Restart
			•	Page	1 of 7	►			

Errors/Alarms (Page 1)

Note: Tapping the individual soft LED will automatically link directly to the applicable result screen which provides detailed information. Depending on the settings chosen in **Setup** > **Signal**, the Alarms/Errors displayed and page length will vary, but the order in which they are presented remain the same.

SDH LED headers are described in the tables below:

	SDH Alarm Definitions and Descriptions
RS	Regenerator Section
MS	Multiplexer Section
AU	Administrative Unit
HP	High Order Path
TU	Tributary Unit
LP	Low Order Path
E1	2Mbit/s signal (depends on payload selected)
Pat	Pattern detection (PRBS, user, fixed words)

SDH Error and Alarm definitions per ITU-T G.707 and O.150 recommendations:

Signal and BER - Alarm Definitions	
LOS	Loss of Signal • LOS is raised when the synchronous signal (STM-N) level
	drops below the threshold at which a BER of 1 ⁻³ is predicted. It could be due to a cut cable, excessive attenuation of the signal, or equipment fault. The LOS state will clear when two consecutive framing patterns are received and no new LOS condition is detected.
TSE	Test Sequence Error
	Loss of Sequence Synchronization

23P Rev A00	
LSS	• Out-of-service bit error measurements using pseudo-random sequences of PRBS can only be performed if the reference sequence produced on the receiving side of the test set-up is correctly synchronized to the sequence coming from the object under test. Sequence synchronization shall be considered lost and re-synchronization shall be started if:
	 The bit error ratio is ≥ 0.20 during an integration interval of 1 second; or It can be unambiguously identified that the test sequence and the reference sequence are out of phase.

	Regenerator Section - Alarm Definitions
LOF	Loss of Frame • Declared when OOF state exists for up to 3 ms. If OOFS are intermittent, the timer is not reset to zero until an in-frame state persists continuously for 0.25ms.
OOF	Out of Frame • Declared when 4 consecutive SDH frames are received with invalid (errored) framing patterns. Maximum OOF detection time is 625µs.
B1	Regenerator section error monitoring • Parity errors evaluated by the B1 byte (BIP-8) of an STM-N. If any of the eight parity checks fail, the corresponding block is assumed to be in error.

	Multiplexer Section - Alarm Definitions
MS-AIS	 Multiplexer Section Alarm Indication Signal Declared when bits 6, 7, 8 of the K2 byte contain a "111" pattern for five consecutive frames
MS-RDI	 Multiplexer Section Remote Defect Indication Declared when bits 6, 7, 8 of the K2 byte contain a "110" pattern for five consecutive frames
MS-REI	 Multiplexer Section Remote Error Indication For STM-1 signals, declared when the M1 byte located in TS #3 is different For STM-4/16 signals, declared when the M1 byte located in TS #7 is different
B2	Multiplexer Section Error Monitoring • Parity errors evaluated by the B2 byte (BIP-24 x N) of an STM-N. If any of the Nx24 parity checks fail, the corresponding block is assumed to be in error

Administrative Unit- Alarm Definitions	
AU-AIS	Administrative Unit Alarm Indication Signal • Alarm is declared when H1 and H2 pointer bytes contain an all ones pattern for three consecutive frames
AU-LOP	Administrative Unit Loss of Pointer • Indicates that a valid pointer is not found in N consecutive frames where N=8, 9, or 10 or a 1001 pattern is detected (NDF)

	High Order Path - Alarm Definitions
HP-UNEQ	HO path Unequipped • Declared when the C2 byte contains "00H" in five consecutive frames
HP-RDI	HO path Remote Defect IndicationAlarm is declared when bits 5, 6, 7, of the G1 byte contain100 or 111 in five consecutive frames
HP-TIM	 HO path Trace Identifier Mismatch Indicates that the J1 path trace does not match the expected message value. The TIM function must be enabled for this alarm to be active
HP-PLM	HO path Payload MismatchDeclared after receiving five consecutive frames with mismatched VC signal labels
В3	HO path Error Monitoring of VC-3, VC-4 • Parity errors evaluated by the B3 byte (BIP-8) of a VC-N (N=3, 4). If any of the eight parity checks fail, the corresponding block is assumed to be in error.
HP-REI	HO path Remote Error IndicationAlarm is declared when bits 5, 6, 7, of the G1 byte contain 100 or 111 in five consecutive frames

	Tributary Unit - Alarm Definitions	
TU-AIS	Tributary Unit Alarm Indication SignalDeclared when the V1 and V2 bytes for the TU path contain an all ones pattern for five consecutive super-frames	
TU-LOP	Tributary Unit Alarm Indication Signal • Declared when no valid pointer is detected in N consecutive superframes (N>8 and <10), or if N consecutive NDFs "1001" patterns are detected	
TU-LOM	Tributary Unit Loss of Multiframe (H4)	

	Low Order Path - Alarm Definitions
LP-UNEQ	LO path Unequipped • Declared when bits 5, 6, 7, of the V5 byte contain "000" for five consecutive frames
LP-RDI	LO path Remote Defect Indication • Declared when bit 5 of the V5 byte contains a "1" in five consecutive TU super-frames while bits 6, 7 of the K4 byte contain "00" or "11"
LP-RFI	LO path Remote Failure Indication • Declared when bit 4 of the V5 byte contains "1" in five consecutive frames
LP-TIM	LO path Trace Identifier Mismatch • Indicates that the J2 path trace does not match the expected message value. The TIM function must be enabled for this alarm to be active
LP-PLM	LO path Payload Mismatch

	• Declared when bits 5, 6, 7 of the V5 byte are set to "000", "001", or "111" which indicate a mismatch LP signal label
LP-REI	LO path Remote Error Indication • Declared when bit 3 of the V5 byte is set to "0"
LP-BIP	LO path Bit Interleaved Parity (VC-11, VC-12)A BIP-2 parity error calculated over all the bytes of the previous VC frame

SONET LED headers are described in the table below:

SONET Alarm Definitions and Descriptions	
Section	Section Layer
Line	Line Layer
STS Path	STS Path Layer
VT Path	Virtual Tributary Path Layer
DS1	1.5 Mbit/s signal (depends on payload selected)
Pat	Pattern detection (PRBS, user, fixed words)

SONET Error and Alarm definitions per Bellcore GR.253 and ANSI T1.105 recommendations:

Signal and BER - Alarm Definitions	
LOS	Loss of Signal
TSE	Test Sequence Error
LSS	Loss of Sequence Synchronization
AIS	Alarm Indication Signal

Regenerator Section - Alarm Definitions						
LOF	Loss of Frame (A1, A2)					
OOF	Dut of Frame (A1, A2)					
B1	Regenerator Section Error Monitoring (B1)					
TIM-S	Trade Identifier Mismatch (J0)					

Line - Alarm Definitions					
AIS-L	Line AIS (K2)				
RDI-L Line Remote Defect Indication (K2)					
REI-L	Line Remote Error Indication (M1)				
B2	Error Monitoring (B2)				

STS Path - Alarm Definitions							
LOP-P	Loss of STS Pointer (H1, H2)						
AIS-P	Administrative Unit AIS (STS-1 SPE include. H1, H2, H3)						
RDI-P STS path Remote Defect Indication (G1)							

REI-P	STS path Remote Error Indication (G1)					
TIM-P	STS path Trace Identifier Mismatch (J1)					
PLM-P	STS path Payload Label Mismatch (C2)					
В3	Error Monitoring (B3)					
UNEQ-P	STS path Unequipped					

Virtual Tributary Path (VT) - Alarm Definitions						
LOP-V	Loss of TU Pointer (V1, V2)					
AIS-V	TU Alarm Indication Signal (VT incl. V1 to V4)					
LOM	TU Loss of Multiframe (H4)					
UNEQ-V	VT Path Unequipped (V5)					
RDI-V	VT Path Remote Defect Indication (V5)					
REI-V	VT Path Remote Error Indication (V5)					
RFI-V	VT Path Remote Failure Indication (V5)					
TIM-V	VT Path Trace Identifier Mismatch (J2)					
PLM-V	VT Path Payload Label Mismatch (V5)					
BIP-2	VT Path Error (V5)					

SONET Error and Alarm detection criteria per Bellcore GR.253 and ANSI T1.105/231:

Section/Line Layer - Detection Criteria						
LOS	Loss of Signal • All-zero pattern for 2,3 µs ≤ T ≤ 100µs					
LOF	Loss of Frame • A1, A2. No valid framing pattern for 3 ms (24 frames)					
B1	Section BIP Error • Mismatch of the recovered and computed BIP-8 covers the whole STS-N frame					
B2	Line BIP error • Mismatch of the recovered and computed NxBIP-8 covers the whole STS-N frame					
AIS-L	Line-AIS • K2 (bits 6, 7, 8) = 111 for 5 frame					
REI-L	Line Remote Error Indication • Number of detected B2 errors in the sink side encoded in the byte M0 or M1 of source side					
RDI-L	Line Remote Defect Indication • K2 (bits 6, 7, 8) = 110 for z frame (z=5-10)					

STS Path Layer - Detection Criteria						
AIS-P	STS Path AIS • All "1" in the STS pointer bytes H1, H2 for ≥ 3 frames					
LOP-P	STS Path Loss of Pointer • 8-10 NDF enable, 8-10 invalid pointers					

23P Rev A00	
B3	STS Path BIP errorMismatch of the recovered and computed BIP-8 covers the entire STS-SPE
UNEQ-P	 STS Path Unequipped C2 = "0" for ≥ 5 (≥ 3 as per T1.231) frames
TIM-P	STS Path Trace Identifier MismatchMismatch of the accepted and expected Trace Identifier in byte J1 (64 bytes sequence)
REI-P	STS Path Remote Error IndicationNumber of detected B3 errors in the sink side encoded in byte G1 (bits 1, 2, 3, 4) of the source side
RDI-P	STS Path Remote Defect Indication • G1 (bit 5) = 1 for 10 frames
PLM-P	 STS Path Payload Label Mismatch Mismatch of the accepted and expected Payload Label in byte C2 for ≥ 5 (≥3 as per T1.231) frames

	VT Path Layer - Detection Criteria						
LOM	Loss of Multiframe • Loss of synchronization on H4 (bits 7, 8) superframe sequence						
AIS-V	VT Path AIS • All "1" in the VT pointer bytes V1, V2 for ≥ 3 frames						
LOP-V	VT Path Loss of Pointer • 8-10 NDF enable, 8-10 invalid pointers						
BIP-2	VT Path BIP ErrorMismatch of the recovered and computed BIP-2 (V5 bits 1, 2) covers entire VT						
UNEQ-V	VT Path Unequipped • V5 (bits 5, 6, 7) = 000 for ≥ 5 (≥ 3 as per T1.231) superframes						
TIM-V	VT Path Trace Identifier MismatchMismatch of the accepted and expected Trace Identifier in byte J2						
REI-V	 VT Path Remote Error Indication If one or more BIP-2 errors detected in the sink side, byte V5 (bit 3) = 1 on the source side 						
RDI-V	VT Path Remote Defect Indication • V5 (bit 5) = 1 for 10 super frames						
PLM-V	 VT Path Payload Label Mismatch Mismatch of the accepted and expected Payload Label in byte V5 (bits 5, 6, 7) for ≥ 5 (≥3 as per T1.231) superframes 						

Errors/Alarms definitions for OTU, OTL, ODU are listed in OTN Results.

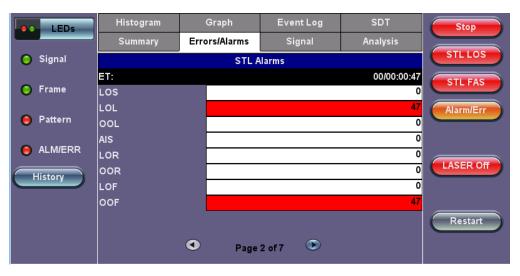
Go back to top Go back to TOC Go to OTL and STL Results for SDH/SONET STL256.4 (Basic Version)

Errors/alarms listed on each page are presented in a logical order associated with the signal under test. All errors are evaluated and stored. The Elapsed Time [ET] is shown in the right hand corner of the header. Error conditions are displayed in red including count and rate. The Errors/Alarms tab brings up several pages of the following errors and alarms statuses:

OTL/OTU/ODU/ODTU/OPU Alarms/Errors

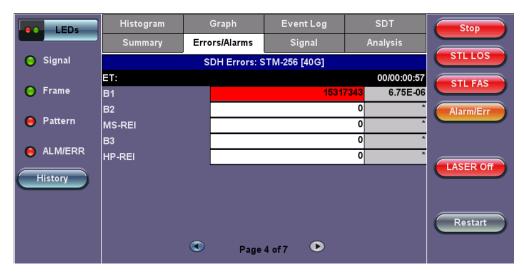
- SDH/SONET/STL Errors/Alarms
- PDH Alarms/Errors
- BERT Errors
- · Section (SOH) and Line Overhead Alarms
- High Order Path and Low Order Path
- STS path and VT path

Refer to the <u>SDH</u> or <u>SONET</u> Error and Alarm definitions tables for error/alarm definitions.



Errors/Alarms - STL Alarms

Errors/Alarms - SDH Errors



8.5.3 Event Log

The Event Log tab brings up the screen listing the Error and Alarm events recorded during a test. The events are presented in chronological sequence - number, type of event, start time, duration (alarms), and ratio/count (errors) are displayed.

Event Log

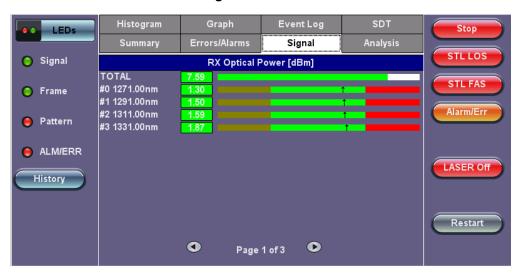
LEDs	Summary	Errors/A	larms	Signal	Analysis	Stop
	Histogram	Grap	bh	Event Log	SDT	
😑 Signal	#	Туре		Start	Dur/Count	STL LOS
🕒 Frame	1	Start	18/0)3/21 14:35:29.0		STL FAS
	2	STL:LOL	18/0)3/21 14:35:29.1		× Alarm/Err
😑 Pattern	3	STL:OOF	18/0	3/21 14:35:29.1		× Alarin/Err
	4	STL:OOF #2	18/0	3/21 14:35:29.1		
ALM/ERR	5	STL:OOF #0	18/0	3/21 14:35:29.6	00:00:00.1	LASER Off
History	6	STL:FAS #0	18/0	03/21 14:35:30.0	2517	
	7	STL:LLM #0	18/0	03/21 14:35:30.0	31	
	8	B1	18/0	03/21 14:35:30.0	201828	Restart
	9	STL:FAS #3	18/0	03/21 14:35:31.0	667	
		٩	Page '	1 of 11 🕒		

Go back to top Go back to TOC

8.5.4 Signal

The signal tab displays the Level and Frequency screen. Page 1 and 2 display the level measurement in electrical units (volts) for STS1, STS3, STM1e and dBm for STM-1, STM-4, STM-16, STM-64 and OC-1, OC-3, OC-12, OC-48, OC-192 signals received (RX) and transmitted (TX).

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



Signal - RX Power

Frequency (Page 3)

The received signal frequency and offset is measured and displayed. The Signal page may display frequency measurements per lane for newer 40G/100G modules, depending on the test set and software version.

Signal - Frequency

01 110 7100							
LEDs	Histogram	G	Braph	Eve	nt Log	SDT	Stop
	Summary	Erro	rs/Alarms	Si	gnal	Analysis	
🔘 Signal			Freq	uency			STL LOS
	SDH current (bps)					39813128192	STL FAS
🜔 Frame	Offset (ppm):					0.2	
😑 Pattern	Min (ppm):					*	Alarm/Err
	Max (ppm):					*	
😑 ALM/ERR							
							LASER Off
History							
							Restart
			Page	2 of 3			

Frequency: The received signal frequency and offset is measured and displayed.

- SDH/SONET Current: Indicates the frequency of the SDH or SONET payload.
- 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.
- Current: Indicates the frequency of any applicable PDH/DSn payload data. Options are 34M, 8M, 2M, 1.5M, 45M, and 140M.
- A Min (ppm) and Max (ppm) function can be used to ensure that the received signal is within a certain clock tolerance and that the network element is transmitting correctly. The frequency limits for the various signal types according to ITU-T recommendations are presented in the table below.

Optical Information (Page 4)

LEDs	Histogram	Graph	Event Log	SDT	Stop
	Summary	Errors/Alarms	Signal	Analysis	
🜔 Signal		(Optical		STL LOS
	Vendor	FINISAR	CORP.		STL FAS
😑 Frame	Part Number	FTLC115	IRDPL		
	Serial Number	UYE0GG	-		Alarm/Err
😑 Pattern	PowerClass	Power Cl	ass 4 Module (<= 3.5	W max)	
	Bit rate			25.5Gbps	
😑 ALM/ERR	Wavelength			1302.3nm	LASER Off
History	Wavelength tolera	nce		1.0nm	LASER OF
		• Pa	ge 3 of 3 💿		Restart

Signal - Optical Module Information

Page 4 displays the Optical module information.

Go back to top Go back to TOC

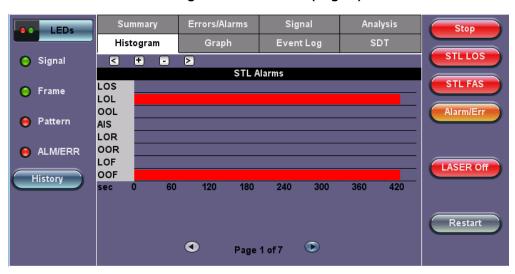
8.5.5 Histogram

The Histogram tab displays the screen showing a historical record of the Alarms and Errors recorded during the measurement interval. A dedicated page is available for errors and alarms including BER. The following Errors/Alarms are displayed:

- OTL/OTU/ODU/ODTU/OPU Alarms/Errors
- Section (SOH) and Line Overhead Alarms/Errors
- SDH/SONET/STL Errors/Alarms

- P Alarms/Errors
- E4 Alarms/Errors
- STS Path Alarms/Errors
- Virtual Tributary (VT)
- PDH Alarms/Errors
- High Order Path and Low Order Path (HP, LP, SDH)
- BERT Alarms/Errors

Refer to the <u>SDH</u> or <u>SONET</u> Error and Alarm definitions tables for a description of each error/alarm.



Histogram - STL Alarms (Page 1)

Note: The alarms and errors presented depend on the signal type and structure selected. A graphical timeline on the horizontal axis indicates when the event occurred. The upper left and right arrows allow the user to scroll through the measurement period while the + and – keys allow zooming in/out of the time axis.

Histogram (Multiple Pages)

Depending on the test signal configuration, mapping and multiplexing structure, the test set groups the errors and alarms layer by layer and are displayed as events over time, so they can be compared and correlated (e.g. visually identify the sequence of events that happened before a major problem occurred).

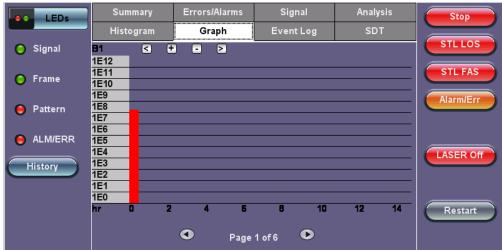
Go back to top Go back to TOC

8.5.6 Graph

The Graph tab displays a visual log of the Errors or Alarm severity over time recorded during the measurement interval. A dedicated page is available for each of the error types applicable to the test signal structure.

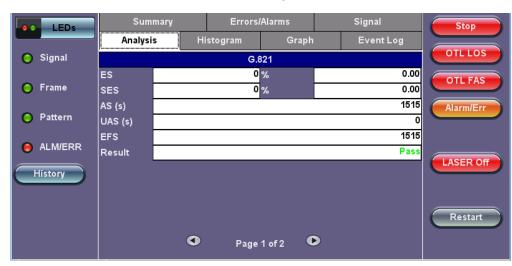
Scroll through the various pages to display the anomaly of interest. A status pop-up screen can be accessed by tapping on the graph area.

Graph



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8.5.7 Performance Analysis



G.821 Analysis

The Analysis tab displays measured objectives from ITU-T performance tests selected from the Measurements tab (**Setup** > **Measurements**). For a brief description of supported G-Series and M-Series performance tests as well as setup instructions, please see <u>Performance Analysis</u> in the Measurement Configuration section.

Evaluation According to ITU-T G.821

This recommendation was originally specified for international circuit-switched N x 64kbps connections and later expanded to include higher bit rates.

ES, SES, AS and UAS are evaluated and can be performed on the following events:

- FAS bit errors (FAS 2, FAS 34)
- CRC errors
- E bit errors
- Bit errors (TSE, Test Sequence Error)

The following signals can be measured when performing G.821 evaluation of bit errors (TSE):

- Unframed patterns
- N x 64kbps
- · Framed patterns and bulk signals
- Pass/Fail result is in conjunction with path allocation between 0.1 and 100%

Note: ITU-T G.821 evaluates bit errors, therefore, facilities for evaluating block errors are disabled. G.821 relies on the evaluation of bit errors, thus the test channel must be taken out of service to perform the measurement.

Definitions:

- Errored Second (ES): A one-second time interval in which one or more bit errors occur.
- Severely Errored Second (SES): A one-second interval in which the bit error ratio exceeds 10⁻³.
- Unavailable Second (UAS): A circuit is considered to be unavailable from the first of at least ten consecutive SES. The circuit is available from the first of at least ten consecutive seconds which are not SES.
- Available Second (AS): A one-second time interval in which no bit errors occur.
- Errored Free Second (EFS): A one-second time interval in AS during which no errors and no pattern slips have been detected.

LEDs	Summary	Errors	Alarms	Signal	Stop
	Analysis	Histogram	Graph	Event Log	
😑 Signal	G.826 [Near End]				OTL LOS
	ES		%	0.00	OTL FAS
🜔 Frame	SES	0	%	0.00	
O Detterm	BE			0	Alarmiterr
🜔 Pattern	BBE	0	Rate	0.00E+00	
ALM/ERR	UAS (s)	0			
	EFS	14			
History	Pass Pass			LASER Off	
		 Page 	2 of 2 💿		Restart

G.826 Analysis

Evaluation According to ITU-T G.826

G.826 recommendation makes provision for higher bit rates and allows in-service measurement using the evaluation of block errors.

The following are evaluated: ES, SES, BE, BBE, and UAS.

Pass/Fail result depends on path allocation of 0.1 to 100%.

In-Service Measurement (ISM): Simultaneous in-service measurement of "near end" and "far-end" of a selected path.

Out-of-Service Measurement (OOS): Out-of-service measurement using bit errors in a test pattern.

Definitions:

- Errored Second (ES): A one-second time interval containing one or more errored blocks.
- Severely Errored Second (SES): A one-second time interval in which more than 30% of the blocks are errored.
- Block Error (BE): A block containing one or more errored bits.
- · Background Block Error (BBE): An errored block that is not a SES.
- Unavailable Second (UAS): A circuit is considered to be unavailable from the first of at least ten consecutive SES. The circuit is available from the first of at least ten consecutive seconds which are not SES.

Note: The recommended measurement time for G.821 and G.826 is 30 days.

Evaluation According to ITU-T G.828

G.828 provides a precise block length for each bit rate as opposed to G.826.

- ES, SES, BBE, UAS and SEP are evaluated.
- Pass/Fail result is in conjunction with path allocation between 0.1 and 100%.

G.828 evaluation can be performed on the following events:

- B1
- B2
- MS-REI
- B3
- HP-REI
- LP-BIP
- LP-REI
- Bit errors (TSE)

Evaluation of the near end and far-end is possible, however far-end evaluations can only be made if REI is available.

Bit errors can be evaluated for:

- Unframed patterns
- · Framed patterns and bulk signals
- Overhead bytes E1/E2 (order wire), F1/F2 (user), D1 D3 and D4 D12 (DCC) in the SDH overhead (SOH and POH)

Note: Bit error evaluation is disabled because G.828 evaluates block errors.

Evaluation According to ITU-T G.829

G.829 is based on the principle of monitoring block errors in service.

ES, SES, BBE and UAS are evaluated.

G.829 evaluation can be performed on the following events:

- B1
- B2
- MS-REI
- Bit errors (TSE)

Evaluation of the near end and far-end is possible, however far-end measurement can only be made if REI is available.

Bit errors can be evaluated for:

- Unframed patterns
- Framed patterns and bulk signals
- Overhead bytes E1/E2 (order wire), F1/F2 (user), D1 D3 and D4 D12 (DCC) in the SDH Overhead (SOH and POH)

Evaluation According to ITU-T M.2100

M.2100 applies to commissioning and maintenance. Commissioning consists of a 15-minute line up phase followed by a 24-hour in-service measurement. Once the line up phase is completed successfully, errors may occur within certain limits.

ES, SES and UAS are evaluated.

Pass/Fail results are based on threshold values S1 and S2 for ES and SES.

Settings for S1 and S2:

- Path allocation: 0.1 to 100%
- BISO multiplication factor: 0.1 to 100

The M.2100 evaluation can be performed on the following events:

- FAS bit errors (FAS2, FAS34, and FAS140)
- CRC-4 errors
- EBIT errors
- Bit errors (TSE)

Evaluation is made at the "Near End" and at the "Far End" for PCM-30/31 signals with CRC.

Bit errors can be evaluated for:

Unframed patterns

- Framed patterns and bulk signals
- N x 64kbps

Since M.2100 evaluates bit errors, facilities for evaluating block errors are disabled.

Evaluation According to ITU-T M.2101

M.2101 is very similar to M.2100 except it deals with SDH systems only.

ES, SES, BBE, SEP and UAS are evaluated.

Pass/Fail results are based on the threshold values S1 and S2 for ES, SES, BBE and SEP.

Settings for S1 and S2:

- Path allocation: 0.1 to 100%
- BISO Multiplier: 0.1 to 100%

The M.2101 evaluation can be performed on the following events:

- B1
- B2
- MS-REI
- B3
- HP-REI
- LP-BIP
- LP-REI
- Bit errors (TSE)

Evaluation of the near end and far-end is possible but far-end evaluations can only be made if REI is available.

Bit errors can be evaluated for:

- Unframed patterns
- Framed patterns and bulk signals
- Overhead bytes E1/E2 (order wire), F1/F2 (user), D1 D3 and D4 D12 (DCC) in the SDH Overhead (SOH and POH)

Note: M.2101 measures block errors, therefore bit error evaluation is disabled.

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8.5.8 Service Disruption Test (SDT) Results

Errors/Alarms Signal Analysis LEDs Stop Graph SDT Histogram ODU AIS 🔵 Signal OTU4 ST:12/06 14:20:23 ET:00/00:00:35 **OTL FAS** 🖲 Frame SDT [ms] Start Time 22004.648 17/12/06 14:20:34.225921 Alarm/Err Last ဓ Pattern 22004.648 17/12/06 14:20:34.225921 Max 22004.648 17/12/06 14:20:34.225921 Min 🖲 ALM/ERR Events LASER Off History Restart Events Detail

SDT Results - OTL

- Last SDT: The duration of the last service disruption detected
- Min/Max: Shortest and longest service disruption duration
- Result: Waiting for trigger or Measure
 - Waiting for trigger: Testing is in progress and the unit is waiting to detect an error/alarm
 Measure: Error/alarm is in progress
- Events: Number of errors/alarms detected

Events Detail displays additional details such as error/alarm type and Pass/Fail status.

SDT Events Detail - STL

LEDs		Service Disrupt	ion Events	Dogo 020 of 020
	Туре	Start	Duration [ms]	Page 938 of 938 Verdict
😑 Signal	-B2	18/03/21 14:41:40.982454	0.001	~ ~
	-B1	18/03/21 14:41:40.982537	0.001	
😑 Frame	-STL:FAS	18/03/21 14:41:41.983378		
	-B1	18/03/21 14:41:41.983411	0.001	
😑 Pattern	-B2	18/03/21 14:41:41.983453	0.001	
	-B3	18/03/21 14:41:41.983485	0.001	
	-B1	18/03/21 14:41:41.983536	0.001	
e ALM/ERR	-B2	18/03/21 14:41:41.983578		
History				

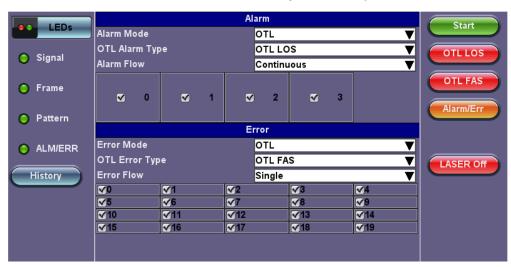
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8.6 Alarm / Error Injection

Alarms and Errors can be injected into different signals. At any time during the test process, tap on the red alarm and error buttons on the right side of the screen to inject errors or generate alarms.

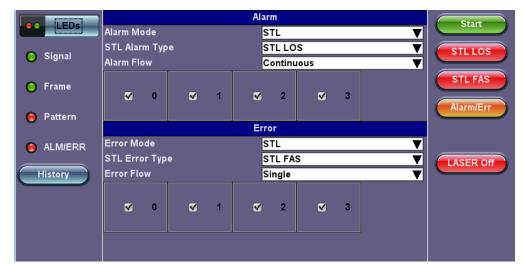
To access the setup for the alarms and errors, tap the **Alarm/Err** button on the right side of the screen or the Alarm/Error icon on the main menu.

The Alarm/Error Injection menu for **OTU3 & OTU4 Test Applications** present the same setup options, but with a different presentation. Refer to <u>Alarm/Error Injection</u> in OTU3 & OTU4 Testing section for setup instructions.



OTL Alarm and Error Injection Setup

STL Alarm and Error Injection Setup



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8.7 OTN Tools

Note: This section refers to OTN Tools for SDH/SONET mapping with PDH/DSn multiplexing, not OTN Tools for OTU3, OTU4 Testing.

8.7.1 Shortcuts



OTN Tools Menu

Note: Depending on the selected OTU test rate, screens may look slightly different.

OTN Tools for OTU4 SDH/SONET mapping with PDH/DSn multiplexing features the following test applications:

- Overhead Analyzer
 - Displays the Optical Channel Transport Unit (OTU)
 - Displays Optical Channel Data Unit (ODU)
 - Displays Optical Channel Payload Unit (OPU) bytes of the received channel
- Overhead Generator
 - Used to edit Optical Channel Transport Unit (OTU)
 - Used to edit Optical Channel Data Unit (ODU)
 - Used to edit Optical Channel Payload Unit (OPU) bytes of the transmitted channel
- Trail Trace Identifier
 - TTI is similar to the J0 byte in SONET/SDH. It is used to identify the signal from the source to the destination within the network.
 - TTI contains the so called Access Point Identifiers (API) which are used to specify the Source Access Point Identifier (SAPI) and Destination Access Point Identifier (DAPI).
 - The APIs contain information regarding the country of origin, network operator and administrative details.
- Payload Structure Identifier (Labels)
 - PSI field transports a 256-byte message aligned with the ODU multiframe.
 - PSI0 contains the Payload Type (PT) identifying the payload being transported.
 - The OPU Payload Type (PT) is a single byte defined within PSI to indicate the composition of the OPU signal, or in other words, the type of payload being carried in the OPU.
- TCM Tasks
 - Used to analyze or edit the sequence of TCMi (i = 1 to 6) bytes by generating alarms and errors in the Tandem connection sub-layer.
- OTU GCC RTD (General Communication Chanel Round Trip Delay)

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8.7.2 Overhead Analyzer & Generator

Tap the Overhead Analyzer icon to display the OH screens shown below.

LEDs								O	DU4							
			F/	AS			MF		SM		GC	:C0	RI	S	RES	JC
😑 Signal	OA1	OA1	OA1	OA2	OA2	OA2		TTI	BIP	BEI						
🜔 Frame	F6 RI	F6 ES	F6 DM	28 TC	28	28 TCM6	00	TI	1B TCM5	00	00	00 TCM4	00	00 FT FL	00 RES	JC 00
😑 Pattern	00	00	00	00	TTI **	BIP 9A	BEI 00	TTI **	BIP 3C	BEI 00	TTI **	BIP 1B	BEI 00	FT	00	00
		тсмз			тсм2			тсм1			РМ		E)	KP	RES	JC
e ALM/ERR	TTI **	BIP 06	BEI 00	TTI **	BIP D1	BEI 00	TTI **	BIP C0	BEI 00	TTI TI	BIP 99	BEI 01	RR 00	RR 00	00	00
History	GC	C1	GC	C2		APS	PCC				R	ËS			PSI	NJO
	00	00	00	00	00	00	00	00	00	00	00	00	00	00	PSI	00
	Multi	frame						[Free F	Run						▼
	Byte							[Decod	ling						V
ΟΤυ						0	PL	J						0	DU	

Overhead Analyzer Menu

The Overhead is color coded for simplified viewing.

Decoding Bytes

Tapping the applicable byte enables an automatic decode – a byte description including the Hexadecimal and Binary value is provided. For some bytes, an advanced decode of the various bits is also available.

LED'S	-	Byte Analyzer	
Signal	Туре	OTU FAS	
0	Byte	1	
🜔 Frame	Value	F6	
O Pattern	Binary	11110110	
X Tools			
Utilities			
Files			

Multiframe: Freerun starts capturing bytes after tapping on the byte block, Locked-Aligns the bytes w/multiframe.

Byte: Select Decoding-to view current status and description of the byte Capture. Captures up to 256 bytes from a particular field.

8.7.2.1 OTN Frame Analysis

The OTU framing is divided into two portions: FAS and MFAS.

• Frame Alignment Signal (FAS)

- Uses the first six bytes and, similar to SONET/SDH, it is used to provide framing for the entire signal
- In order to provide enough 1/0 transitions for synchronization, scrambling is used over the entire OTU frame, except for the FAS bytes

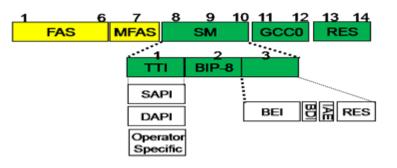
• MultiFrame Alignment Signal (MFAS)

- · Byte is used to extend command and management functions over several frames
- The MFAS counts from 0 to 255, providing a 256 multiframe structure

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8.7.2.2 Optical Transport Unit (OTU) Analysis

The OTU overhead is comprised of the SM, GCC0, and RES bytes.



• Section Monitoring (SM)

- Bytes are used for the Trail Trace Identifier (TTI), Parity (BIP-8) and the Backward Error Indicator (BEI) (also known as the Backward Incoming Alignment Error [BIAE]), Backward Defect Indicator (BDI), and Incoming Alignment Error (IAE).
- The TTI is distributed over the multiframe and is 64 bytes in length. It is repeated four times over the multiframe.

ee LED'S		Byte Analyzer				
Signal	Туре	OTU SM TTI				
•	Byte	1				
😑 Frame	SAPI	VEEX SAPI TRACE				
0.000	DAPI	VEEX DAPI TRACE				
O Pattern	User	OPERATION BYTES FOR USER DEFINE				
ALM/ERR						
•						
× Tools						
Utilities						

SM TTI Type

• General Communication Channel 0 (GCC0)

• Clear channel used for transmission of information between OTU termination points

GCCO Type

eo LED'S		Byte Analyzer	
Signal	Туре	OTU GCC0	
–	Byte	1	
🔵 Frame	Value	00	
O Pattern	Binary	00000000	
X Tools	J		
Utilities			
Files			

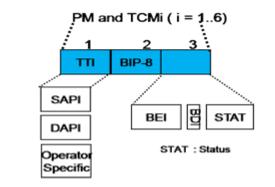
Reserved (RES) bytes are currently undefined in the standard.

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8.7.2.3 Optical Data Unit (ODU) Analysis

The ODU overhead is divided into several fields: RES, PM, TCMi, TCM ACT, FTFL, EXP, GCC1/GCC2 and APS/PCC.

1	3	4	5	7	8	10	11	13 14
RES		TCM ACT	TC	1 6	т	СМ5	тс	VI4 FTFL
тсмз		т	CM2	т	CM1	-	РМ	EXP
GCC1	G	SCC2	AP	S/PCC	>		RES	



Reserved (RES) bytes are undefined and set aside for future applications.

• Path Monitoring (PM)

• Field is similar to the SM field described above. It contains the TTI, BIP-8, BEI, BDI, and Status (STAT) subfields.

PM TTI Type

ec LED'S		Byte Analyzer				
Signal	Туре	ODU PM TTI				
	Byte	1				
🔵 Frame	SAPI	VEEX SAPI TRACE				
	DAPI	VEEX DAPI TRACE				
Pattern	User	OPERATION BYTES FOR USER DEFINE				
ALM/ERR						
Tools						
Utilities						
Files						
rnes	J					

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- TCMi:
 - There are six Tandem Connection Monitoring (TCMi) fields that define the ODU TCM sub-layer, each containing TTI, BIP-8, BEI/BIAE, BDI, and STAT subfields associated to each TCM level (i=1 to 6).
 - The STAT subfield is used in the PM and TCMi fields to provide an indication of the presence or absence of maintenance signals.

TCM1 BEI Type

LED'S		Byte Analyzer
Signal	Туре	ODU TCM1 BEI
U	Byte	3
🜔 Frame	Value	01
0.0	Bit 5: BDI	0
O Pattern	Bits 6-8: Request	001
		In use without IAE
X Tools		
Utilities		
Files		

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- Fault Type and Fault Location (FTFL)
 - Reporting communication channel field used to create a message spread over a 256-byte multiframe
 - Provides the ability to send forward and backward path-level fault indications

FTFL Type

ec LED'S	Byte Analyzer					
Signal	Туре	ODU FTFL				
U	Forward Indication	00				
😑 Frame		No fault				
0	Backward Indication	00				
O Pattern		No fault				
O ALM/ERR						
X Tools						
Utilities						
Files						

ITU-T G.709 Figure 15-20

			F	TFL m					
0	Γ	1		126	127	128	129		255
	_								
			Forward field					Backward field	

0	1	9 10	12	7			
Fault indication field	Operator identifier field		Operator specific field				
	Forward field						

ITU-T G.709 Figure 15-20

128	129	137	138		255
Fault indication field	Operator identifier field			Operator specific field	
				Backward field	

ITU-T G.709 Figure 15-21

Fault indication codes						
Fault Code	Definition					
0000 0000	No fault					
0000 0001	Signal fail					
0000 0010	Signal degrade					
0000 0011 Reserved for future standardization						

ITU-T G.709 Figure 15-6

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- Experimental (EXP)
 - Field not subject to standards and is available for network operator applications

ee LED'S		Byte Analyzer	
Signal	Туре	ODU EXP	
U	Byte	1	
🜔 Frame	Value	00	
O Pattern	Binary	00000000	
O ALM/ERR			
X Tools			
Utilities			
Files			

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- General Communication Channels 1 and 2 (GCC1/GCC2)
 - Fields are very similar to the GCC0 field, except that each channel is available in the ODU

LED'S	Byte Analyzer					
Signal	Туре	ODU GCC1				
U	Byte	1				
🜔 Frame	Value	00				
O Pattern	Binary	00000000				
X Tools						
Utilities						
Files						

GCC1 Type

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- Automatic Protection Switching and Protection Communication Channel (APS/PCC)
 - Supports up to eight levels of nested APS/PCC signals associated to a dedicated-connection monitoring level depending on the value of the multiframe

APS/PCC Type

ec LED'S	Byte Analyzer					
Signal	Туре	ODU APS/PCC				
•••	Byte	1				
😑 Frame	Value	00				
O Pattern	Bits 1-4: Request	0000				
		NR				
ALWERR	Bit 5: A	No APS Channel				
-	Bit 6: B	1+1				
X Tools	Bit 7: C	Uni-directional				
	Bit 8: D	Non-Revertive				
Utilities						
Files						

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8.7.2.4 Optical Payload Unit (OPU) Analysis

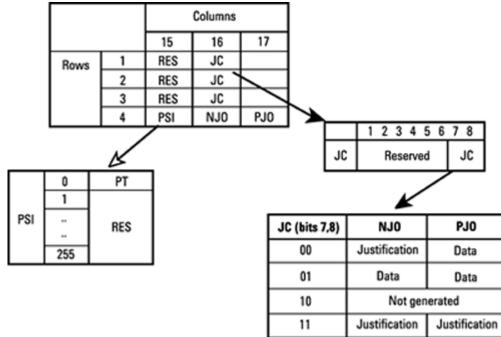
• Payload Structure Identifier (PSI)

- Primary overhead field associated with the OPU
- A 256-byte multiframe whose first byte is defined as the Payload Type (PT). The remaining 255 bytes are currently reserved.

OPU PSI Type

LED'S	Byte Analyzer					
O Signal	Туре	OPU PSI				
U	Value	02				
O Frame	Decode	Async CBR				
O Pattern						
X Tools						
Utilities						
Files						

The other fields in the OPU overhead are dependent on the mapping capabilities associated to the OPU. For an asynchronous mapping (the client signal and OPU clock are different), Justification Control (JC) bytes are available to compensate for clock rate differences. For a purely synchronous mapping (client source and OPU clock are the same), the JC bytes become reserved. Further details on mapping are available in ITU G.708.7.



OPU2, O/H for synch mapping of 10 Gb/s SDH/SONET

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8.7.3 Payload Label (Payload Structure Identifier)

Tap the Payload Label icon to display the screen shown below. Tabs for Tx and Rx label settings are provided.

LEDs	ТХ	RX
	OF	20-4
😑 Signal		254
🕒 Frame	Decode PLM Enabled	PRBS test signal ▼ ON ▼
😑 Pattern		
😑 ALM/ERR		
History		

Payload Label

PSI[0] contains a one-byte Payload type. PSI[1] to PSI[255] are mapping and concatenation specific.

C2 Byte Stru	C2 Byte Structure per ITU-T G.707 Recommendations					
Hex Code	Interpretation					
01	Experimental mapping					
02	Asynchronous CBR mapping					
03	Bit synchronous CBR mapping					
04	ATM mapping					

GFP mapping
Virtual Concatenated signal
Bit stream with octet timing mapping
Bit stream without octet timing mapping
ODU multiplex structure
Not available
Not available
Reserved codes for proprietary use
NULL test signal mapping
PRBS test signal mapping
Not available
PCS Ethernet
FC-1200 into OPU2e
STM-1 mapping into OPU0
STM-4 mapping into OPU0

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8.7.4 Trace Identifier (Trail Trace Identifier)

Tap the Trace Identifier icon to display the screen shown below. There are tabs for Tx and RX settings of the TTI.

Trace Identifier (Trail Trace Identifier)

LEDs		ТΧ		RX
		οτυ		ODU1
😑 Signal	Expected SAPI			VEEX SAPI TRACE
🔵 Frame	Expected DAPI			VEEX DAPI TRACE
•	тім			OFF 🗸 🗸
😑 Pattern				
O ALM/ERR	Received SAPI	Сору	VEEX SAPI TRA	ACE
History	Received DAPI	Сору	VEEX DAPI TRA	ACE
	Received User		OPERATION B	YTES FOR USER DEFINE



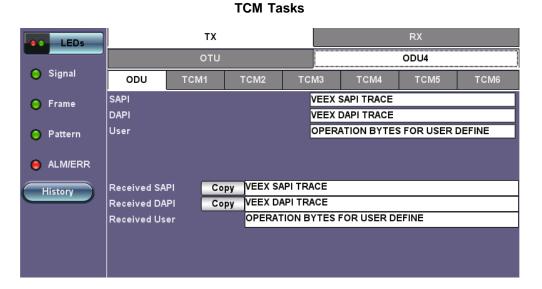
Trail Trace Identifier

TTI similar to the J0 byte in SONET/SDH, is used to identify the signal from the source to the destination within the network. The TTI contains the so called Access Point Identifiers (API) which are used to specify the Source Access Point Identifier (SAPI) and Destination Access Point Identifier (DAPI). The APIs contain information regarding the country of origin, network operator and administrative details.

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8.7.5 TCM Tasks (Tandem Connection Monitoring)

Tap the TCM Tasks icon to display the screen shown below.



Results are available for up to six tandem connections. The counts are numbers of seconds containing the error or indication.

Tandem connections and corresponding source and sink functions are defined in ITU-T G.707, G.709, and G.783.

TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network. SONET/SDH allowed a single level of TCM to be configured, while ITU G.709 allows six levels of tandem connection monitoring to be configured. The assignment of monitored connections is currently a manual process that involves an understanding between the different parties. There are various types of monitored connection topologies: cascaded, nested, and overlapping.

- LTC: Loss of Tandem Connection Signal
- OCI: Open Connection Indication
- AIS: TC Alarm Indication Signal
- LCK: Locked Defect
- BDI: Backward Defect Indication
- IAE: Incoming Alignment Error
- BIAE: Backward Incoming Alignment Error
- BEI: TC Backward Error Indication

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8.7.6 OTU GCC RTD

GCC RTD

LEDs	Setup			Start
LEDS	Repeat	ON	V	
😑 Signal				Calibrate
😑 Frame				
	ST::*	Results	ET::*	
😑 Pattern	Time [ms]		*	
• • • • • • • •	Max Time [ms]		*	
e ALM/ERR	Min Time [ms]		*	
History	Average Time [ms]		*	LASER Off
	Result		*	

To access this feature, make sure that a GCC channel is selected from Pattern setup (Setup > Signal > Pattern). <u>Go back to top Go back to TOC</u>

8.8 SDH/SONET Tools

The Advanced version of SDH/SONET Tools offers the same features as the basic version as well as additional functions. The SDH/SONET Tools (Basic) is referred to <u>here</u>.

Accessing SDH/SONET Tools

Tap on Home (main menu) > SONET/SDH Tools.

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8.8.1 Shortcuts

Overhead Overhead Start I EDs V V Generator Analyzer SDH SDH OTU IAE 🔵 Signal Pointer Trace ODU BEI V i 🔵 Frame Tasks Identifier SDH SDH Alarm/Err ဓ Pattern Payload V Labels 🔴 ALM/ERR SDH LASER Off History Tributary V TCM Tasks V Scan SDH SDH

- Overhead Analyzer: Displays the Section Overhead (SOH) and Path Overhead (POH) bytes of the received channel.
- Overhead Generator: SDH mode. Used to edit Section Overhead (SOH) and Path Overhead (POH) bytes of the transmitted channel.
- Pointer Tasks: Displays both AU and TU pointer values and generates AU and TU pointer movements.
 Pointer sequences according to ITU-T G.783 recommendations are also possible.
- Trace Identifier: Used to generate and edit J0, J1, and J2 path traces and set expected trace for received channel according to G.831 recommendations.
- **Payload Labels:** Used to set the C2 and V5 Path Signal Labels which indicate the content of the High order/STS path and Low order VCs/ VTs.
- **Tributary Scan:** Used to scan individual or multiple tributaries to verify routing and error free operation. Only available in VC-12 or VC-11 mode.
- **TCM Tasks:** Used to analyze or edit the sequence of N1 and N2 TCM bytes by generating alarms and errors in the Tandem connection sub-layer.

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8.8.2 Overhead Analyzer

Tap the Overhead Analyzer icon to display the OH screens shown below. There are tabs for:

- SOH RX, which displays the bytes associated with the Section/LINE Overhead
- POH RX, which displays the bytes associated with the Path Overhead
- Summary, which displays the Path Traces (J0, J1, J2), APS (K1, K2), Synchronization status (S1), STS Path (C2), and VT Path (v5) Signal Label bytes

Overhead Analyzer - SDH/SONET Tools (Advanced)

SDH/SONET Tools Menu

LED'S		SOH			POH			Summary	
	STM# 1						2		
😑 Signal	A1 F6	A1 F6	A1 F6	A2 28	A2 28	A2 28	J0 01	ÄÄ	ÄÄ
🔵 Frame	B1 6D	öö	öö	E1 00	öö	öö	F1 00	00	00
Pattern	D1 00	öö	öö	D2 00	öö	öö	D3 00	öö	öö
•	H1 6A	H1 6A	H1 6A	H2 OA	H2 0A	H2 OA	H3 00	H3 00	H3 00
ALM/ERR	82 32	82 46	82 48	K1 00	őö	öö	K2 00	öö	őŐ
X Tools	D4 00	őö	öö	D5 00	öö	őö	D6 00	őö	őõ
	D7	őö	öö	D8 00	öö	öö	D9 00	öö	öö
Utilities	D10 00	öö	öö	D11	őö	öö	D12 00	00	öö
Files	\$1 00	Z1 00	Z1 00	72 00	72 00	22 00	E2 00	öö	öö

Overhead Analyzer - SDH/SONET Tools (Basic)

LEDs	OH G	enerati	ion	OH Ana	alysis	Trace	PSL/T	СМ	Point	ter	Start
					SOH					РОН	
😑 Signal	A1	A1	A1	A2	A2	A2	JO			J1	
	00	00	00	28	00	00	20	00	00	45	
O 5	B1			E1			F1			B3	
🜔 Frame	97	00	00	00	00	00	00	00	00	BF	
	D1			D2			D3			C2	
O D-#	00	00	00	00	00	00	00	00	00	FE	STL Err Inj.
🜔 Pattern	H1	H1	H1	H2	H2	H2	H3	H3	H3	G1	
	6A	9B	9B	0A	FF	FF	00	00	00	00	STL Alarm Inj.
	B2	B2	B2	K1			K2			F1	STE Alarin Ing.
O ALM/ERR	B8	9C	4D	00	00	00	00	00	00	00	
	D4			D5			D6			H4	LASER On/Off
History	00	00	00	00	00	00	00	00	00	00	
	D7			D8			D9			F3	
	00	00	00	00	00	00	00	00	00	00	
	D10			D11			D12			K3	
	00	00	00	00	00	00	00	00	00	00	
	S1						E2	×		N1	Set Injection
	00	00	00	00	00	00	00	00	00	00	
			SOH	Page	<	1	_>				

Tapping the applicable byte enables an automatic decode – a byte description including the Hexadecimal and Binary value is provided. For some bytes, an advanced decode of the various bits is also available.

Section Overhead

SOH pages are available to scroll through in SDH/SONET Tools (Basic). The following is a partial list of SOH bytes and their corresponding functions:

Section Layer

Framing Bytes (A1/A2)

- The A1/A2 bytes indicate the beginning of the STM-N frame and provide a frame alignment pattern
 - A1 is the 1st framing byte: 11110110 (Hex F6)
 - A2 is the 2nd framing byte: 00101000 (Hex 28)
- Both A1 and A2 bytes are unscrambled
- The Frame Alignment Word of a STM-N frame is composed of (3 x N) A1 bytes followed by (3 x N) A2 bytes

A1 [Framing] Byte

LED'S		Byte Decoder	
😑 Signal	Byte	A1 [Framing]	
-	Value	F6	
🜔 Frame	Binary	11110110	
O Pattern			
X Tools			
Utilities			
Files			

Path Trace Byte (J0)

- Regenerator section trace
- Used to transmit a 16 or 64-byte identifier (trace) (including a CRC-7 byte) repeatedly so that all regenerators can verify their connection
- · Used for continuity testing between regenerators

B1 Byte (RS-BIP)

- An 8-bit even parity code used to check for transmission errors over the regenerator section
- Its value is calculated over all the bits of the STM-1 frame before scrambling
- The checksum value is placed in the RS overhead of the following STM-1 before scrambling

LED'S		Byte Decoder	
O Signal	Byte	J1 [STS Path trace]	
•	Length	16 Bytes	
😑 Frame	Trace	VEEX HP	
O Pattern			
🔀 Tools			
Utilities			
Files			

Path Trace Byte (J0)

Order Wire Byte (E1)

 Local order wire channel for voice communication between regenerators, cross connects, hubs and remote terminal locations

F1 Byte

- Section user channel
- Byte is allocated for user purpose to carry proprietary messages
- The channel is terminated at each regenerator location

Data Communications Channel Bytes (D1/D2/D3)

- Data Communications Channel (DCC)
- D1, D2 and D3 together form a 192kbps message channel for OAM purposes

- It can generate internal or external messages
- It can also be used as a BER function

Pointers

AU Pointers Bytes (H1/H2/H3)

• Enable transfer of STM-1 frames with STM-N frames and are processed by the MS terminating equipment

LED'S		Byte Decoder		
Signal	Byte	H1 [AU Pointer]		
U	Value	6A		
Frame	Binary	01101010		
O Pattern				
X Tools				
Utilities				
Files				

AU Pointer Byte

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Line Layer / Multiplexer Section

B2 Byte (MS-BIP)

- A 24-bit interleaved even parity code used to determine if transmission errors have occurred over the Multiplexer Section
- Its calculated over all the bits of the STM-1 frame except those in the Regenerator Section overhead
- The computed checksum is placed in the MSOH of the following STM-1 frame

K1 Byte (APS-Linear)

- Used to activate and deactivate the switching between the main and protection paths on a multiplexer section
- APS message type conforms to ITU-T G.783 and Bellcore GR.253 for Linear network architectures
 - Bits 1-4 (G.783 Protocol)
 - 1111 Lockout of protection
 - 1110 Forced switch
 - 1101 Signal fail, high priority (1:n only)
 - 1100 Signal fail, low priority
 - 1011 Signal degrade, high priority (1:n only)
 - 1010 Signal degrade, low priority
 - 1000 Manual switch
 - 0110 Wait to restore
 - 0100 Exercise
 - 0010 Reverse request (bidirectional systems only)
 - 0001 Do not revert
 - 0000 No request
 - Other codes are unused
 - Bits 5-8 selects channel used by APS messages
 - 0000 Null channel
 - 0001 to 1110 Channels 1 thru 14
 - 1111 Extra traffic channel

et LED'S		Byte Decoder
Signal	Byte	K1 (APS Linear)
•	Value	00
🜔 Frame	Message	0000
O Dattage		No Request
O Pattern	Channel	0000
		NULL
X Tools		
Utilities		
Files		

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K1 Byte (APS-Ring)

- Used to activate and deactivate the switching between the main and protection paths on a multiplexer section
- APS message type conforms to ITU-T G.841/ Bellcore GR.253 Ring Network architectures
 - Bits 1-4 are the condition
 - 1111 Lockout of protection
 - 1110 Forced switch (span)
 - 1101 Forced switch (ring)
 - 1100 Signal fail (span)
 - 1011 Signal fail (ring)
 - 1010 Signal degrade (protection)
 - 1001 Signal degrade (span)
 - 1000 Signal degrade (ring)
 - 0111 Manual switch (span)
 - 0110 Manual switch (ring)
 - 0101 Wait to restore
 - 0100 Exercise (span)
 - 0011 Exercise (ring)
 - 0010 Reverse request (span)
 - 0001 Reverse request (ring)
 - 0000 No request
 - Bits 5-8 are the destination node ID
 - 0000 Null channel
 - 0001 to 1110 Channels 1 thru 14
 - 1111 Extra traffic channel

K2 Byte (APS-Linear)

- Conforms to ITU-T G.783 and Bellcore GR.253
- Used to activate and deactivate the switching between the main and protection paths on a multiplexer section
- Used to communicate Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) conditions
 - Bits 1-4 selects bridged channel used
 - Bit 5 determines APS architecture
 - 1+1
 - 1:N
 - Bits 6-8
 - 110 MS-RDI
 - 111 MS-AIS
 - Others Not used

K2 Byte (APS-Ring)

- Conforms to and follows ITU-T G.841 Bellcore GR.253 recommendations
- Used to activate and deactivate the switching between the main and protection paths on a multiplexer section

- Used to communicate Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) conditions
 - Bits 1-4 are the source node ID
 - Bit 5 is the path code
 - 0 Short path
 - 1 Long path
 - Bits 6-8
 - 000 Idle
 - 001 Bridged
 - 010 Bridged and switched
 - 110 MS-RDI
 - 111 MS-AIS
 - Others Not used

K2 Byte (APS-Linear)

LED'S		Byte Decoder		
Signal	Byte	K2 [APS Linear]		
U	Value	00		
😑 Frame	Channel	0000		
Pattern		NULL		
Pattern	Path	0		
C ALM/ERR		1+1		
	Message	000		
X Tools		Future use		
Utilities				

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Data Communications Channel (DCC) Bytes (D4-D12)

- DCC together these nine bytes form a 576kbps message channel for OAM purposes.
- They can be used for internally or externally generated messages or BER function.

S1 Byte (Synchronization Status)

- Synchronization status message byte contains information about the quality of the embedded timing and is used to inform the remote Multiplexer of the clock quality used to generate signals.
 - Bits 1-4 carry synchronization messages
 - Bits 5-8
 - 0000 Synchronized Traceability Unknown
 - 0001 Stratum 1
 - 0100 Transit Node Clock
 - 0111 Stratum 2
 - 1010 Stratum 3
 - 1100 SDH Minimum Clock
 - 1101 Stratum 3e
 - 1110 Previsional by the Network Operator
 - 1111 Not used for synchronization
 - Other bytes are reserved

S1 Byte (Synchronization Status)

LED'S		Byte Decoder
Signal	Byte	S1 [Sync Status]
	Value	00
😑 Frame	Channel	0000
0.0	Message	0000
O Pattern		Quality unknown
🔀 Tools		
Utilities		
Files		

Order Wire Byte (E2)

- A 64kbps voice communication channel between multiplexers.
- It's a channel used by craft persons and will be ignored as it passes through regenerators.
- The relief byte is used for ring protection

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Path Overhead Layer

The following is a partial list of POH bytes and their corresponding functions:

• J1 byte (STS Path Trace)

- High Order VC-N path trace byte
- A unique message is assigned to each path in a SDH network therefore the path trace can be used to check continuity between any location on a transmission path and the path source
- This user programmable byte repeatedly transmits a 15-byte string plus 1 (CRC-7) byte so that a receiver can continually verify its connection with the transmitter
- A 64-byte free-format string is also permitted
- The message is transmitted one byte per VC-4 frame

J1 Byte (HP Path Trace)

LED'S		Byte Decoder	
Signal	Byte	J1 [HP Path trace]	
-	Length	16 Bytes	
🜔 Frame	Trace	VEEX HP	
O Pattern			
X Tools			
Utilities			
Files			

- B3 byte
 - Even code parity which determines if a transmission error has occurred over a path
 - Its value is calculated over all the bits of the previous VC-4
 - The computed checksum is placed in the B3 byte before scrambling
- C2 byte (HP signal label) for SDH mode

- Indicates mapping of the VC-n.
- The table below indicates the standard C2 binary values:

C2 Byte (HP signal label)

LED'S		Byte Decoder
Signal	Byte	C2 [HP Signal label]
•	Value	02
Frame	Binary	00000010
O Pattern		TUG structure
X Tools		
Utilities		
Files		

Cź	C2 Byte Structure per ITU-T G.707 Recommendations				
Bits 1 to 4	Bits 5 to 8	Hex value	Description		
0000	0000	00	Unequipped		
0000	0001	01	Equipped non-specific		
0000	0010	02	TUG structure		
0000	0011	03	Locked TU-n		
0000	0100	04	Asynchronous mapping of 34 Mbit/s or 45Mbit/s into a C3 container		
0001	0010	12	Asynchronous mapping of 140Mbit/s into a C4 container		
0001	0011	13	ATM mapping		
0001	0100	14	MAN DQDB mapping		
0001	0101	15	FDDI mapping		
0001	1000	18	HDLC/LAPS		
0001	1010	1A	10 Gigabit Ethernet mapping (IEEE 802.3)		
0001	1011	1B	Generic Framing Protocol (GFP)		
0001	1100	1C	10 Gigabit Fiberchannel mapping		
0010	0000	20	Asynchronous mapping of ODUk		
1111	0000	FE	ITU-T 0.181 test signal mapping		
1111	1111	FF	VC-AIS (TCM)		

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• G1 byte (Path status)

• High Order path status byte

· Used to convey the path terminating status back to the originating path, thus allowing bidirectional monitoring of the

complete path

- Bits 1-4: Remote Error Indication (HP-REI) indicates number of bit errors detected by B3
- Bit 5: Remote Defect indication (HP-RDI) set to 1 if signal failure is detected
- Bits 6-7: Enhanced RDI information to differentiate between payload defects (HP-PLM), connectivity defects (HP-TIM, HP-UNQ) and server defects (HP-AIS, LOP)

LED'S		Byte Decoder	
Signal	Byte	G1 [HP Status]	
-	Value	00	
🜔 Frame	REI	0000	
0	RDI	000	
O Pattern	Spare	0	
O ALM/ERR			
X Tools			
Utilities			
Files			

G1 Byte (HP Status)

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• F2 byte (HP user channel)

- High Order Path user channel
- VC-4 path user channel used for communication between path elements

• H4 byte (TU Indicator)

- Position or Sequence Indicator
- · Multiframe phase indicator used for tributary structured payloads

• F3 byte (LP) user channel

• Used for communication between path elements and is payload dependent.

• K3 byte (HP APS)

- Bits 1-4 are used for protection switching of VC-3 & 4 paths.
- Bits 5-8 are a currently not used

• N1 byte (HP)

- Allocated to provide a High Order (HP) Tandem Connection monitoring function for contiguously concatenated VC-4, VC-4 and VC-3 levels.
 - Bits 1-4: Used as an Incoming Error Count (IEC) per G.707
 - Bit 5: Operates as the TC-REI to indicate errored blocks occurring within the tandem connection
 - Bit 6: Operates as the OEI to indicate errored blocks egressing the VC-n
 - Bits 7-8: Operate in 76 multi-frame structure;
- Frames 1-8 > Frame Alignment Signal (FAS)
 - Frames 9-72 > The Access Point Identifier of the tandem connection (TC-API)
 - Frames 73-76 > TC-RDI indicating defects that have occurred in the tandem connection to the far-end
 - Frame 74 > ODI indicating to the far-end that AU/TU-AIS has been inserted into egressing AU-n TU-n due to defects before or within the tandem connection
 - Frames 73-76 > Reserved capacity

• V5 byte (LP signal label)

- Byte contains error analysis, signal label and path status information
- · Continuous monitoring of anomalies or defects and payload composition at the path end or along the path
 - Bits 1-2 provides error checking (BIP-2)
 - Bit 3 is the LP-REI (0 = no error, 1 = errors)
 - Bit 4 is the LP-RFI (0 = no error, 1 = errors)
 - Bits 5-7 provide the VC-12 signal label

- 000 Unequipped
- 001 Equipped (non-specific)
- 010 Asynchronous
- 011 Bit synchronous
- 100 Byte synchronous
- 101 Extended
- 110 0.181 test signal (TSS4)
- 111 VC-AIS
- Bit 8 is the VC12 path LP-RDI normally set to zero unless there is an error condition (AIS)

V5 Byte (VT signal label)

LED'S	Byte Decoder		
Signal	Byte	V5 [VT Signal Label]	
U	Value	84	
🜔 Frame	BIP	10	
0.000	REI	o la compañía de la c	
O Pattern	RFI	0	
O ALM/ERR	Label	010	
		Async	
X Tools	RDI	p	
Utilities			
Files			

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• J2 byte (LP)

- Used to transmit a configurable 16-byte identifier that enables the receiving path to continuously verify its connection with the transmitter
- Uses the same byte structure as the J0 and J1 bytes

• N2 byte (LP)

- Provides LP/VT tandem connection monitoring function (LP-TCM) for the VC-11 and VC-12 levels
 - Bits 1-2: even parity error checking BIP-2 for the tandem connection
 - Bit 3: Set to "1"
 - Bit 4: Incoming AIS indicator (0 = no defect; 1 = defect occurred before tandem connection)
 - Bit 5: TC-REI indicating errored blocks caused in the tandem connection
 - Bit 6: OEI indicating errored blocks of the egressing VC-n
 - Bits 7-8: Operate in a 76 multi-frame structure:
- Multiframe structure consists of:
 - Frames 1-8 >Frame Alignment Signal (FAS)
 - Frames 9-72 > The Access Point Identifier of the tandem connection (TC-API)
 - Frames 73-76 > TC-RDI indicating defects that have occurred in the tandem connection to the far-end
 - Frame 74 > ODI indicating to the far-end that AU/TU-AIS has been inserted into egressing AU-n/ TU-n due to defects before or within the tandem connection
 - Frames 73-76 > Reserved capacity

N2 Byte Structure per ITU-T G.707 Recommendations									
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8		
BIF	BIP-2		I-AIS	TC-REI	OEI	TC-API, TC Rese			

K4 byte (LP path Extended Label)

- When bits 5-7 of V5 byte are set to 101 (value = 5), then the signal label in K4 byte becomes valid where:
 - Bit 1 is allocated to the extended signal label
 - Bit 2 is allocated to virtual concatenation

Bits 3 and 4 are unassigned and are reserved for LP APS signaling

- Bits 5, 6, 7 are allocated for optional use
- Bit 8 is unassigned
- Bits 12-19

	K4 Multiframe Structure per ITU-T G.707 Recommendations																															
1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	27	29	30	31	32
		Ν	/lult	ifrar	ne /	Aligi	nme	nt S	Signa	al			Exte	ndo	4 6	ian	- I I	abo	J	0	Þ	P	P	P	P	Þ	P	R	Þ	P	R	Þ
	Fr	am	ie C	Cour	nt		Se	q. Ir	ndica	ator		ľ	-710	nue	u J	iyn		auc	;1	0												

	K4 Byte Structure per ITU-T G.707 Recommendations								
Bit 1	Bit 2	Bit 3	Bit4	Bit 5	Bit 6	Bit 7	Bit 8		
Extended Signal Label	Virtual concatenation overhead	Unass	signed		Optional Use		Unassigned		

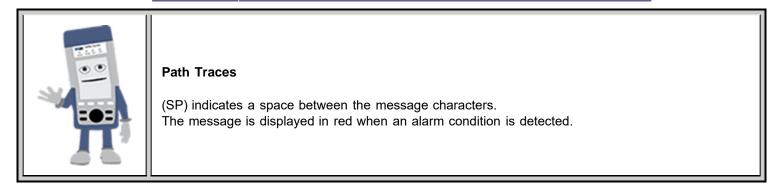
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• Summary

- The Summary tab displays the summary screen listing the major bytes of the received SDH signal.
- Displays the Path Trace Identifiers (J0, J1, J2), APS (K1, K2), Synchronization status (S1), and HP (C2) and LP (V5) Signal Label bytes.
 - Column #1 Indicates the byte type
 - Column #2 Provides the hexadecimal value of the byte (if applicable)
 - Column #3 Provides a byte decode (Please refer to the byte definitions for an explanation of the listed bytes)

Summary

e LEDs			SOH	РОН	Summary
Signal	JO	NIA	0x56		
Frame	J1	NIA	VEEX HP		
Ŭ	J2	NIA	VEEX LP		
😑 Pattern	K1 K2	00	0;No Request 0;Future use;1+1		
e ALM/ERR	S1 C2 V5	01	Quality unknown Equip non-spec		
History	40	64	Async		



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8.8.3 Overhead Generator

LED'S		SOH		e. Line	РОН		l.	Summary	
		ST	M# 1				10 1		
O Signal	A1 F6	A1 F6	A1 F6	A2 28	A2 28	A2 28	J0 xx	ÄÄ	ÄÄ
😑 Frame	B1 xx	öö	00	E1 00	öö	öö	F1 00	00	00
Pattern	D1 00	öö	öö	D2 00	õõ	öö	D3 00	00	öö
0	H1 6A	H1 93	H1 93	HZ	諽	靜	H3 00	H3 00	H3 00
O ALM/ERR	B2 xx	B2 xx	B2 xx	K1 00	öö	öö	K2 00	öö	öö
X Tools	D4 00	öö	öö	D5 00	őö	öö	D6 00	öö	öö
- Tools	D7	öö	öö	D8 00	öö	őö	D9 00	öö	öö
Utilities	D10 00	öö	00	D11 00	öö	öö	D12 00	öö	őö
Files	\$1 00	Z1 00	Z1 00	72	22 00	22 00	E2 00	öö	őõ

Overhead Generator - SDH/SONET Tools (Basic)

LEDs	OH G	enerati	on	OH Ana	alysis	Trace	PSL/T	СМ	Point	ter	Start
					SOH					РОН	
😑 Signal	A1 00	A1 00	A1 00	A2 XX	A2 00	A2 00	J0 TI	00	 00	J1 TI	
🕒 Frame	B1 XX	 XX	 XX	E1 00			F1 00	00		B3 XX	
	D1 00	00		D2 00		00	D3 00	00	 00	C2 FE	STL Err Inj.
😑 Pattern	H1 XX	H1 XX	H1 XX	H2 XX	H2 XX	H2 XX	H3 XX	H3 XX	H3 XX	G1 00	
ALM/ERR	B2 XX	B2 XX	B2 XX	K1 00	 00	 00	K2 00	 00	 00	F1 00	STL Alarm Inj.
History	D4 00	00	00	D5 00	00	00	D6 00	 00	 00	H4 00	LASER On/Off
	D7 00	 00	 00	D8 00	 00	 00	D9 00	 00	 00	F3 00	
	D10 00	 00	 00	D11 00	 00	 00	D12 00	 00	 00	K3 00	
	S1 00	 00	 00	 00	 00	 00	E2 00	 00	 <u>0</u> 0	N1 00	Set Injection
			SOH	Page	<	1	>				

Tap the Overhead Generator icon to display the OH screens shown below. There are three tabs:

- SOH TX, which allows editing of select bytes associated with the Section Overhead. SOH pages are available to scroll through in SDH/SONET Tools (Basic). Editing of J0, K1, K2, S1 is permitted as follows:
 - Hexadecimal value using pop-up keypad.
 - Binary values using simple on-screen bit toggle or pop-up keypad.
 - Convenient drop-down selections. In some instances, the selections will be available over multiple pages.

Note: While programming of most overhead bytes is possible using the OH Generator feature, dedicated functions are available for Pointer Tasks, Payload Labels, Trace Identifier, APS Testing, TCM testing. In some instances, more advanced editing is possible using the dedicated functions.

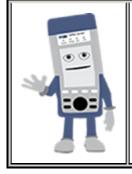
S1 Byte from SOH

LED'S		Byte Generator	
Signal	Byte	S1 [Sync Status]	
-	Value	00	
🜔 Frame	Channel	0000	
0.000	Message	0000	
O Pattern		Quality unknown	V
X Tools	J		
Utilities	J		
Files			

- POH TX, which allows editing of select bytes associated with the Path Overhead.
 - Editing of J1, C2, H4, G1, Z5, and J2, V5, Z6 is permitted as follows:
 - Hexadecimal value using pop-up keypad.
 - Binary values using simple on-screen bit toggle or pop-up keypad.
 - Convenient drop-down selections. In some instances, the drop-down options will be available over multiple pages.

LED'S		Byte Generator	
O Signal	Byte	C2 [HP Signal label]	
U	Value	02	
🜔 Frame	Binary	00000010	
O Pattern		TUG structure	V
X Tools			
Utilities	J		
Files			

C2 Byte from POH



Overhead Generator

Programming most overhead bytes is possible using the OH Generator feature, however dedicated test functions are available for Pointer Tasks, Payload Labels, Trace Identifier, APS Testing, TCM testing.

In some instances, more advanced editing is possible using the dedicated functions.

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8.8.4 Pointer Tasks

Tap the Pointer Tasks icon to display the Pointer testing screens.

Pointers keep SDH signals synchronous by compensating for timing differences without having to use stuffing bits. Pointers are allowed to move up or down every three frames however the actual rate should be slower. The Administrative Unit (AU) and the Tributary Unit (TU) each has its own pointer and the unit has two tabs for displaying the values and measurements.

• For AU pointers:

- SS bits Displays bits 5 and 6 of the H1 byte to indicate SDH [10], SONET [00], Unknown [01] and [11] signal type
 Pointer value Displays the H1 and H2 values (addresses) indicating the offset in bytes between the pointer and first byte of the AU-n
- LOP (Loss of Pointer)
- PJE and NJE
- NDF or New Data Flag. NDF is enabled when all bits match "1001" (or "0001", "1101", "1011" and "1000") and is disabled when all bits match "0110" (or "1110", "0010", "0100", "0111").
- Difference and Sum
- Implied offset

LEDs	Analysis	Generator	G.783	Start
	AU		TU	
😑 Signal		TU Pointer		
😑 Frame	Pointer Value		1	
	LOP			
😑 Pattern	PJE NJE	*		* Alarm/Err
• • • • • • • • •	NDF	k		*
🖲 ALM/ERR	Diff			
History	Sum			
	Implied Offset [ppm]			*

Analysis > AU tab

• For TU pointers:

- Pointer value
- LOP (Loss of Pointer)
- PJE and NJE
- NDF or New Data Flags
- Difference and Sum

Analysis > TU tab

LEDs	Analysis	Generator	G.783	Start
	AU		TU	
😑 Signal		TU Pointer		OTOTAE
😑 Frame	Pointer Value		105	ODU BEI
	LOP		*	
😑 Pattern	PJE	*	*	Alarm/Err
Fattern	NJE	*	*	
e ALM/ERR	NDF	*	*	
	Diff		*	LASER Off
History	Sum		*	
	Implied Offset [ppm]		*	

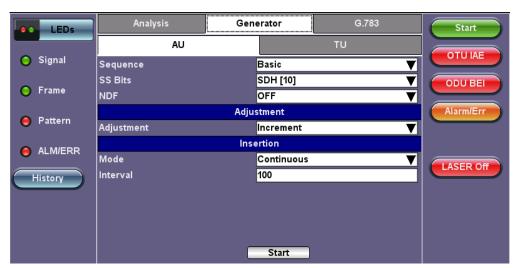
Go back to top Go back to TOC Go to STL256.4 SDH/SONET (Basic Version)

8.8.4.2 Pointer Generation

The Pointer generator is able to generate individual pointer movements as follows:

• For AU pointers:

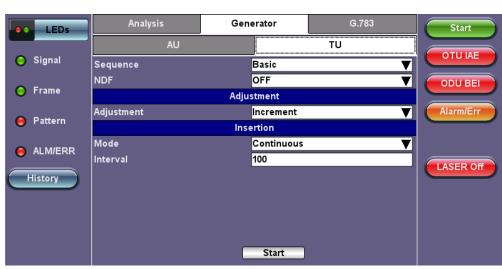
- SS bits: Program bits 5 and 6 of the H1 byte to be either SDH [10], SONET [00], Unknown [01] or [11].
- Pointer value: Transmits a new pointer address or value with or without a new data flag (NDF). Configurable in a range of 0 to 782 pointers.
- o Increment (INC) or Decrement (DEC) pointers with identical polarity by 1 byte in single steps.
- Insert pointers continuously or singularly. Set the interval value in frames for continuous insertion.



Generator > AU tab

For TU pointers

- TU Pointer value: Set value in a range of 0 to 784 (TU-3) and 0 to 139 (TU-12)
- TU-11 Pointer value: Set value in a range of 0 to 109 (TU-11)
- Increment (INC) or Decrement (DEC) pointer value by 1 byte is single steps

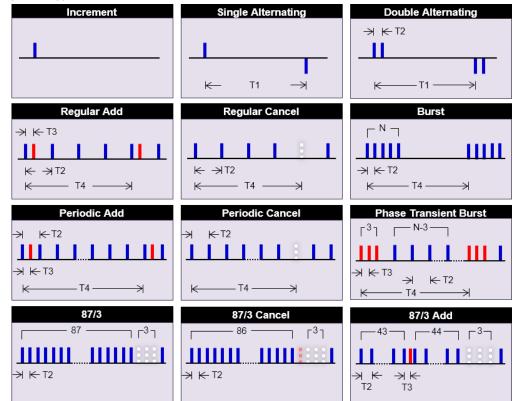


Generator > TU tab

Go back to top Go back to TOC Go to STL256.4 SDH/SONET (Basic Version)

8.8.4.3 Pointer Sequences

The Pointer generator is also able to generate Standard ITU-T G.783 and ANSI T1.105.03 and Bellcore GR-253 sequences as follows:

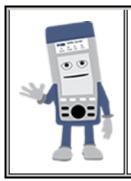


- **Sequence:** Decide how to affect the pointer sequence
 - Basic: Specify whether the pointer is increasing or decreasing
 - Select Inc to increase the pointer value
 - Select Dec to decrease the pointer value
 - Select New Value to set new pointer value
- Single Alternating: Increase or decrease the pointer value
- Burst: Generate a sequence of changes in the pointer value in one direction only (increase or decrease)
- Transient Burst: Generate changes in the phase of the pointer adjustment
- Periodic: Generate periodic changes in the pointer value
- 87-3: Generate an 87-3 pattern (87 consecutive pointer adjustments, 3 consecutive pointer value, with no adjustments)
- 87-3 Add: Generate an 87-3 pattern (87 consecutive pointer adjustments, 3 consecutive pointer value, added to have an additional pointer value)
- 87-3 Cancel: Generate an 87-3 pattern (87 consecutive pointer adjustments, 3 consecutive pointer value, reduced the number of adjustments by one)
- Unit: Select the type of unit to count: Frames
 - N: Specify the number of pointer adjustments in a row: 1-9999 (default=6)
 - T: Specify the average pointer spacing in time. T is known as T1 to T5 in G.783: (default=4)
 - T1, T4: 0.25ms to 600s or 2 to 4,800,000 frames/multiframes
 - T2, T3: 0.25ms to 10s or 2 to 80,000 frames/multiframes
 - T5: 0ms to 600s or 0 to 4,800,000 frames/multiframes

G.873 > AU tab

LEDs	Analysis	Generator	G.783	Start
	AU		τυ	
😑 Signal	Sequence	Basic	V	
😑 Frame	Adjustment Warning! Not	Increment t applicable in Basic Se	equence Mode	
😑 Pattern				Alarm/Err
e ALM/ERR				LASER Off
History				
		Start]	

G.783 Identifier	Pointer Adjustments	Mnemonic
Single Alternating	Single of opposite polarity	+-
Regular Add	Regular plus one double	+&Add
Regular Cancel	Regular with one missing	+&Cancel
Double Alternating	Double of opposite polarity	++-
Single	Single	+
Burst	Burst	+++Burst
87-3	STS periodic 87-3 pattern	+87/3
87-3 Add	STS periodic 87-3 Add position	+87/3 & Add
87-3 Cancel	STS periodic 87-3 Cancel position	+87/3 & Cancel
Periodic Add	Periodic Add position	+Periodical & Add
Periodic Cancel	Periodic Cancel position	+Periodical & Cancel



Pointer Sequence Testing

- It is recommended to run one sequence with positive adjustments followed by a sequence with negative adjustments. Performing the measurement at the maximum positive and negative frequency offset applicable to the line rate increases the stress on the pointer processor.
- The test procedure includes an initialization period followed by a cool down period of 30 seconds with no pointer movements.

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8.8.5 Trace Identifier

Tap the Trace Identifier icon to display the path trace testing application and screens.

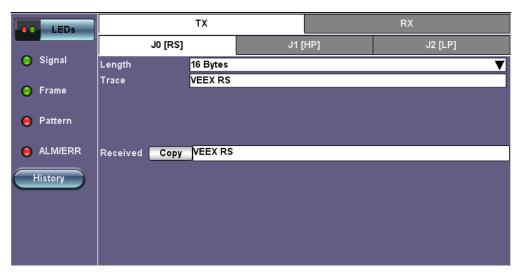
There are dedicated tabs for Transmitted and Received (expected) path traces and setups.

8.8.5.1 Transmitted Traces (TX)

- J0 [RS]: Regenerator section trace
 - Program a 1 or 16-byte identifier to check the connection between regenerators

- J1 [HP]: High order path section trace
 - Program a 16 or 64-byte identifier to check the high order transmission path
- J2 [LP]: Low order path section trace
 - Program a 16 or 64-byte identifier to check the low order transmission path

Note: To program or edit the transmitted trace, tap the applicable trace box to display the pop-up keyboard.



TX - JO [RS]

TX - JO [RS] - STL256.4 SDH/SONET (Basic)



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8.8.5.2 Received Traces (RX)

- J0 [RS]: Regenerator section trace
 - Program a 1 or 16-byte identifier to set and check the expected trace
 - Enable or disable the TIM (Trace Identifier Mismatch) alarm
- J1 [HP Path]: High order path section trace.
 - Program a 16 or 64-byte identifier to set and check the expected trace
 - Enable or disable the TIM (Trace Identifier Mismatch) alarm
- J2 [LP Path]: Low order path section trace
 - Program a 16 or 64-byte identifier to set and check the expected trace
 - Enable or disable the TIM (Trace Identifier Mismatch) alarm

	Ds			RX					
		J0 [RS]		J1 [HP]		J	2 [LP]		
😑 Signa	al	Length	1 Byte				T		
🜔 Frame		Expected Trace TIM Enabled	1 ON						
😑 Patte	rn								
😑 ALM/	ERR	Received					86		
Histor	v								

Go back to top Go back to TOC Go to STL256.4 SDH/SONET (Basic Version)

8.8.6 Payload Labels

This function is used to set the C2 and V5 Path Signal Labels which indicate the content of the High order and Low order VCs.

Tap the Payload Label icon to display the payload label screens. There are dedicated tabs for Transmitted and Received payload labels and setups:

• C2 [HP Path]: Path signal label

- Specifies the mapping type in the VC-n
- Program the TX or RX label by editing the hexadecimal value or by using the convenient drop-down menu selection
- For the RX label, enable or disable the Payload Mismatch (PLM) Alarm

ТХ	RX	Start
C2 [HP]	V5 [LP]	
HP Label	1	OTOTAE
C2 [HP]	Equipped Non-spec 🛛 🔻	
		Alarm/Err
		LASER Off
	C2 [HP] HP Label	C2 [HP] V5 [LP] HP Label 1

TX C2 [HP]

C2 Path Signal Label - STL256.4 SDH/SONET (Basic)

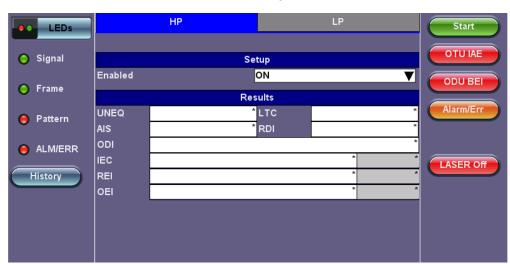
LEDs	OH Generation	OH Analysis	Trace/PSL/TCM	Pointer	Start		
		Tx J1					
😑 Signal	Trace Type	16 Bytes 🛛 🔻	Copy from Rcv.				
Message VEEX J1 MESSAGE			E				
😑 Frame							
		Expected J1 Trace					
😑 Pattern	Trace Type	16 Bytes 🛛 🔻	Copy from Rcv.	Copy from TX	STL Err Inj.		
	Message	VEEX J1 MESSAG	STL Alarm Inj.				
O ALM/ERR							
History	TIM Monitor	Disable 🔻 🔻			LASER On/Off		
	Signal Label	[0xFE]Test signal,					
	Hex.	FE			Set Injection		
	PLM Monitor	Disable 🔻 🔻					
		 Page 	2 of 3 💿				

• V5 [LP Path]: Path signal label

- Program the TX and RX label by editing the hexadecimal value or by using the convenient drop-down menu selection
- For the RX label, enable or disable the Payload Mismatch (PLM) Alarm

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8.8.7 Tandem Connection Monitoring (TCM)



HP Setup

TCM - STL256.4 SDH/SONET (Basic)

LEDs	OH Generation	OH Analysis	Trace/PSL/TCM	Pointer	Start
		тх	тсм		
😑 Signal	тх тсм	Enable 🔻 🔻	7		
	API message	VEEX TCM API			
😑 Frame					
		RX	тсм		STL Err Inj.
😑 Pattern	TCM Monitor	Enable 🛛 🔻	F		
	API message	VEEX TCM API			STL Alarm Inj.
O ALM/ERR					
History					LASER On/Off
					Set Injection
		 Page 	3 of 3 🕞		

• TCM Standards

The Tandem paths are defined in ITU recommendation G.707 Annex D and Annex E

- G.707 Annex D for VC4 and VC3
- G.707 Annex E for VC2 and VC1
- G.707 defines a tandem connection source and sink and describes the responses of each when defect (alarm) and error conditions are detected
- Tandem connection maintenance signals are carried in:
 - N1 byte for VC4 and VC3
 - N2 byte for VC2 and VC
 - These two bytes are structured similarly, but their functions are not identical

			N1 Byte	Structure			
b1	b2	b3	b4	b5	b6	b7	b8
	IE [IAI]			TC-REI	OEI	TC-APId, T rese	

	N2 Byte Structure								
b1	b2	b3	b4	b5	b6	b7	b8		
TC-	BIP	"1"	IAIS	TC-REI	OEI	TC-APId, T rese			

- IEC: Incoming Error Count. Indicates IAIS when set to "1110" (see below)
- IAIS: Incoming AIS alarm
- TC-REI: Tandem Connection Remote Error Indication
- **OEI:** Outgoing Error Indication
- TC-APId: Tandem Connection Remote Defect Indication
- ODI: Outgoing Defect Indication
- TC-BIP: 2-bit Bit Interleaved Parity for Tandem Connection

Go back to top Go back to TOC Go to STL256.4 SDH/SONET (Basic Version)

8.8.8 Tributary Scan

This function requires VC12 or VT-1.5 mapping and allows for a quick check of the signal structure, trace identifier, and the payload.

An important part of any Add Drop Multiplexer (ADM) installation process is the verification of the path routing. Considering that an STM-1 contains 63 x VC-12's and a STM-4 contains 252 x VC-12's checking each path manually can be very time consuming.

The unit automatically performs a sequential BER test on each SDH tributary (C12 channel) - mapping can be either via AU-4 or AU-3. The unit checks for alarms in the received signal, the SDH structure, and for synchronization of the selected test pattern in all channels. The result for each channel is entered in a table:

K.L.M.: ITU-T Tributary numbering scheme

- Report: Pass (OK)
- J2 trace: Corresponds to the VT trace being transmitted
- Label: Corresponds to the V5 byte signal label being transmitted

Tributary Scan

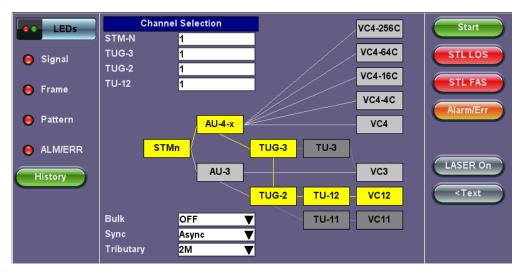
LEDs				
	K.L.M.	Report	J2 Trace	Label
	1.1.1.1	ок	VEEX LP	0x2
😑 Signal	1.1.1.2	LP-UNEQ		0x0
	1.1.1.3	LP-UNEQ		0x0
😑 Frame	1.1.2.1			
Ŭ	1.1.2.2			
D -#1-11	1.1.2.3			
😑 Pattern	1.1.3.1			
	1.1.3.2			
😑 ALM/ERR	1.1.3.3			
History				
		Page	1 of 7 🕒	
		SI	ор	

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9.0 STL256.4 SDH/SONET

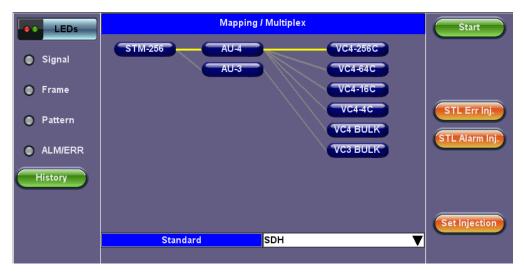
STL256.4 SDH/SONET Basic and Advanced Version Overview

The basic version of STL256.4 SDH/SONET included with the purchase of the test set, supports SDH/SONET testing and is found in the OTU3 and OTU4 Test Modes. If the STL256.4 license was purchased, the advanced version will be available from the Test Mode Selection Menu. The purchased license offers the most complete STL256.4 testing capabilities including PDH/DSn payloads and mapping options.



STL256.4 SDH/SONET Advanced Mapping Options

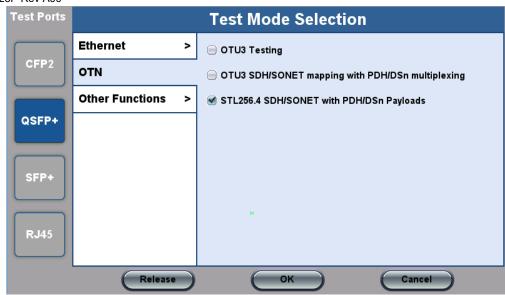
STL256.4 SDH/SONET Basic Mapping Options



Accessing STL256.4 with PDH/DSn Multiplexing (Advanced Version)

The advanced version is available from the Test Mode Selection Menu of the QSFP+ > OTN menu.

STL256.4 SDH/SONET (Advanced) Available from the Test Mode Selection Menu



Accessing STL256.4 SDH/SONET (Basic Version)

The basic version of STL256.4 SDH/SONET is accessed from these menu options:

- 1. Tap on the Test Application icon to access the Test Mode Selection menu.
- 2. Select QSFP+ > OTU 3 Testing > OK.
- 3. Select Setup > Hierarchy & Clocks (OTL/OTU3).
- 4. Select STL/SDH/SONET from Network Type.

STL256.4 SDH/SONET (Basic Version) - Signal tab



STL256.4 SDH/SONET (Basic Version) - Hierarchy tab

LEDs	Hie	rarchy	Start
	Network Type	STL/SDH/SONET	
Signal			-
	Test Rate	SDH/SONET (39.8G)	
Frame			
Pattern			STL Err Inj.
	Tx Clock Source	Internal 🛛 🗸 🗸	STL Alarm Inj.
ALM/ERR	Clock Signal Type	Quartz VCXO	
	Tx Clock Offset(ppm)	0.0	
History			
	Meas Ref. Clock	Internal 🛛 🗸 🔻	
	Clock Signal Type	Quartz VCXO	Set Injection
	Link Fault Response	Disable 🗸 🗸	

9.1 STL256.4 SDH/SONET (Basic Version)

STL256.4 SDH/SONET (Basic) is accessible from the OTU3 and OTU4 Test applications. Refer to OTU3 & OTU4 (Ethernet/Bulk) and STL256.4 (Basic) for information on setup, results, alarm/error injection instructions.

SDH/SONET Tools (Basic)

SDH/SONET Tools (Advanced) offers the same features as the basic version as well as additional tools. Refer to SDH/SONET Tools (Advanced) for information on the tabs in this section. Screens will differ depending on the SDH/SONET Tools version. The links below redirect to the corresponding OTU3/OTU4 section:

- OH Generation
- OH Analysis
- Trace/PSL/TCM: Trace, PSL, TCM
- Pointer Generation

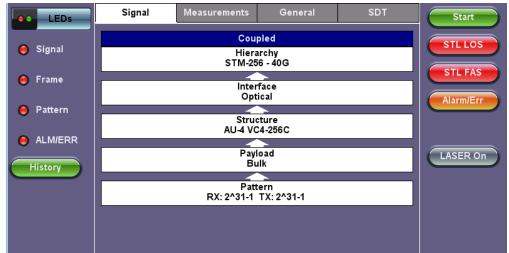
LEDs	OH G	enerati	on	OH Ana	alysis	Trace	PSL/T	см	Point	ter	Start
					SOH					POH	
😑 Signal	A1 00	A1 00	A1 00	A2 XX	A2 00	A2 00	J0 TI	00	 00	J1 TI	
🕒 Frame	B1 XX	 XX	 XX	E1 00			F1 00	00	 00	B3 XX	
Ŭ	D1 00		00	D2 00			D3 00	00	 00	C2 FE	STL Err Inj.
🗿 Pattern	H1 XX	H1 XX	H1 XX	H2 XX	H2 XX	H2 XX	H3 XX	H3 XX	H3 XX	G1 00	
O ALM/ERR	B2 XX	B2 XX	B2 XX	K1 00	00		K2 00	00		F1 00	STL Alarm Inj.
	D4 00		00	D5 00			D6 00	00	 00	H4 00	LASER On/Off
History	D7 00		00	D8 00	00		D9 00		 00	F3 00	
	D10 00		00	D11 00			D12 00	00	 00	K3 00	
	S1 00		00				E2 00	00		N1 00	Set Injection
				Page	<	1	>			30	

SDH Tools (Basic)

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9.2 STL256.4 SDH/SONET with PDH/DSn (Advanced Version)

The menu structure for STL256.4 SDH/SONET testing with PDH/DSn is identical to OTU3 & OTU4 SDH/SONET mapping with PDH/DSn Multiplexing. Refer to <u>OTU3 & OTU4 SDH/SONET Mapping</u> for more information on Setup, Results, Alarm/Error, and Tools.



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10.0 Pluggable Optical Module Diagnostics

Pluggable Optical Module Diagnostics is a diagnostics test that verifies and troubleshoots CFP2, QSFP28, and QSFP+ pluggable optical modules. It runs through a series of tests that check optical module status, signal level, frequency, and Lane BERT measurements. A physical loopback (TX to RX) is required to run the diagnostics. Users can configure a frequency offset up to 150 ppm to stress the optical module and setup BER thresholds to determine a PASS/FAIL condition for the duration of the test.

Setup

Press Start to initiate testing. The laser automatically turns on when starting the test.

Thresholds Pattern Configuration Per Lane Frequency(ppm) 5.000 Lane TX Pattern Invert RX Pattern Invert Maximum BER 1.00E-10 All 2E31-1 ■ 2E31-1 ■ BERT Duration 1 hours ▼ Ranges TX Power(dBm) 5(typical)		Pluggable Optical	Module -	Comp	atibillty & Dia	gnostic	s	
Type: QSFP28 4x25G, 4x28G Rates (Gbps) 103.125G ▼ Thresholds Pattern Configuration Per Lane Frequency(ppm) 5.000 Lane TX Pattern Invert RX Pattern Invert Maximum BER 1.00E-10 All 2E31-1 ■ 2E31-1 ■ BERT Duration 1 hours ▼ Ranges TX Power(dBm) 5(typical)	Setup	Summary	Sig	nal	LANE E	BERT	Module	Info
Thresholds Pattern Configuration Per Lane Frequency(ppm) 5.000 Lane TX Pattern Invert RX Pattern Invert Maximum BER 1.00E-10 All 2E31-1 ■ 2E31-1 ■ BERT Duration 1 hours ▼ Ranges TX Power(dBm) 5(typical)	Vendor: Oclaro Inc	. P/N:	TRQ5E2	0FNF-L	_F000	S/N: T	17D57274	
Frequency(ppm) 5.000 Lane TX Pattern Invert RX Pattern Invert Maximum BER 1.00E-10 All 2E31-1 ■ 2E31-1 ■ BERT Duration 1 hours ▼ ■ Ranges ■ TX Power(dBm) 5(typical)	Type: QSFP28	4x25G, 4x28G		Rates	(Gbps)	103	3.125G	▼
Maximum BER 1.00E-10 All 2E31-1 ▼ ■ 2E31-1 ▼ ■ BERT Duration 1 hours ▼ Ranges TX Power(dBm) 5(typical)	Thresholds			Patter	n Configurati	on 📃	Per Lane	
BERT Duration 1 hours Ranges TX Power(dBm) 5(typical)	Frequency(ppm)	5.000		Lane	TX Pattern	Invert	RX Pattern	Invert
Ranges TX Power(dBm) 5(typical)	Maximum BER	1.00E-10		All	2E31-1 🔻		2E31-1 🔻	
TX Power(dBm) 5(typical)	BERT Duration	1 hours	▼					
	Ranges							
RX Level(dBm) -8.6 to 4.5	TX Power(dBm)	5(typical)						
	RX Level(dBm)	-8.6 to 4.5						

Setup (All Lane Configuration)

Setup (Per Lane Configuration)

	Pluggable Optical	Module -	Comp	atibillty & Dia	gnostic	s	
Setup	Summary	Sig	nal	LANE E	BERT	Module	Info
Vendor: Oclaro Inc.	P/N:	TRQ5E2	0FNF-L	_F000	S/N: T	17D57274	
Type: QSFP28	4x25G, 4x28G		Rates	(Gbps)	103	3.125G	▼
Thresholds			Patter	n Configurati	on	All Lane	
Frequency(ppm)	5.000		Lane	TX Pattern	Invert	RX Pattern	Invert
Maximum BER	1.00E-10		1	2E31-1 🔻		2E31-1 🔻	
BERT Duration	1 hours	▼	2	2E31-1 🔻		2E31-1 🔻	
Ranges			3	2E31-1 🔻		2E31-1 🔻	
TX Power(dBm)	5(typical)		4	2E31-1 🔻		2E31-1 🔻	
RX Level(dBm)	-8.6 to 4.5						

Summary

Displays the test progress, optical module information, and pass/fail status for each measurement in the process. Measurement status is represented by the following icons:

θ	Measurement Not Started
	Pass
	Fail
Ö	In Progress

	Pluggable Optical	Module - Compati	billty & Diagnostic	s	Stop
Setup	Summary	Signal	LANE BERT	Module Info	
Start: 2018-4-6 13	:00:18	Elapsed	: 00:00:25		Restart
Vendor: Oclaro Inc.	P/N:	TRQ5E20FNF-LF	000 S/N: T1	7D57274	
Type: QSFP28	4x25G, 4x28G	Test Rat	:e (Gbps) 103	.125	
	odule Status aser & Levels requency	R	unning		
Lane Ber	t Measuring				

A final pass/fail grade for the module compatibility is displayed at the end of the test.

	Pluggable Optical	Module - Compati	billty & Diagnostic	s	Start
Setup	Summary	Signal	LANE BERT	Module Info	
Start: 2017-12-51	5:16:27	Elapsed	00:43:44		
Vendor: FINISAR C	ORP. P/N:	FTL4C1QM1C	S/N: U	SS19H0	
Type: QSFP+	40G (4X10)	Test Rat	e (Gbps) 41.	250	
Signal - L	lodule Status .aser & Levels [:] requency	Ρ	ASS		
🌏 🛛 Lane Ber	t				

Passed Diagnostics Test

Signal

Level

The Signal tab displays the level and frequency screens. Page 1 and 2 display the level measurements for the transmitting (TX) and receiving signal (RX) along with a table displaying current, minimum, and maximum frequency.

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

Pass/Fail status for Laser Control, Signal Levels, and Frequency are displayed on the left.

Signal Rx - Page 1

	Pluggable Optical	Modul	e - Com	npatibill	ty & Diagi	nostics		Stop
Setup	Summary		Signal		LANE BE	ERT	Module Info	
Laser Control				Level	Rx]			Restart
PASS	Rx Optic	al Powe	er[dBm]]	LOS		SAT	
		Cur.	Min.	Max.	-16	-	+12	
	TOTAL	8.05	8.05	8.06				
Signal Levels					-16		+6	
PASS	#1 1295.60nm	2.12	2.11	2.13			•	
	#2 1300.10nm	2.04	2.04	2.05			•	
	#3 1304.60nm	2.07	2.07	2.08			•	
Frequency	#4 1309.10nm	1.90	1.89	1.91			•	
PASS						-8.6	+4.5	
		◄		Page 1	of 3	۲		

Frequency

Depending on the test set model and version, newer units may display per lane frequency measurements.

- Frequency: Current frequency of the input signal. Depending on the unit, some models will display aggregate (all lanes) or per lane frequency in newer versions.
- 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.

Setup Laser Control PASS Signal Levels PASS Frequency	Summary	Sig	nal Li	ANE BERT	Module Info			
PASS Signal Levels PASS		,			Module Into	Restart		
Signal Levels		Frequency						
PASS	Lane Freq. (kHz) C	Offset (ppm)	Min. (ppm)	Max. (ppm)			
PASS	1 25	781250	0.0	-0.0	0.0			
-	2 25	781249	-0.0	-0.0	0.0			
Frequency	3 25	781249	-0.0	-0.0	0.0			
Fraguanay	4 25	781250	0.0	-0.0	0.0			
Frequency	Total 103	125000	0.0	0.0	0.0			
PASS		G	Page 3 of	3 💿				

Signal - Frequency (Per Lane)

Signal - Frequency (All Lane)

Setup Summary	Signal	LANE BERT	Module Info		
Laser Control	Free	quency			
PASS Frequency		41249999KHz	41249999KHz		
Offset [ppm]		-0.0			
Signal Levels Min [ppm]		-0.0			
PASS Max [ppm]		0.0			
Frequency PASS					

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LANE BERT

Pass/Fail BER status is displayed on the left.

Aggregate

The Aggregate screen displays

- Pattern Loss (Sec)
- BIT Error Count
- BIT Error Ratio

Aggregate

	Pluggable Optical	Module - Compa	tibillty & Diagno	stics	Stop
Setup	Summary	Signal	LANE BER	T Module Info	
BER	Aggregate		Lane	Events	Restart
Running	ST:2018-4-6 13:0	0:18	ET:00:00:51		
	Pattern Loss(Sec	:.)	0		
	BIT Error Count		0		
	BIT Error Ratio		0.000E+00		

Lane

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

Lane

	Pluggable	e Optical	Module - Co	ompatib	illty & Diagnostic	s
Setup	Sumr	nary	Signa	d	LANE BERT	Module Info
BER	A	ggregate		La	ine	Events
Running	Lane #	Pattern	Loss(Sec.)	BIT E	rror Count	BIT Error Ratio
	0	0		0		0.000E+00
	1	0		0		0.000E+00
	2	0		0		0.000E+00
	3	0		0		0.000E+00

Events

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

	Pluggable Optical N	lodule	- Compatil	billty & D	iagno	stics		Stop
Setup	Summary	Si	gnal	LANE	BER	т	Module Info	Destant
BER	Aggregate		L	ane	1		Events	Restart
Running	Time	Event	Туре		# of E	vents	Test	
	2017-12- 5 15:16:27	Test	Started				Lane Bert	
		ļ						-
		<u> </u>						-
								-
								-
			Pa)		
			Pa	ge 1 of 1				

Module Information

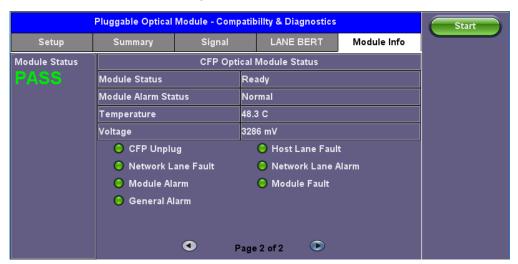
The Module Info tab displays Optical module information and status.

Pass/Fail Module status is displayed on the left.

Optical Module Information

Setup	Summary Signal		LANE BERT	Module Info	
Module Status		CFP Optica	I Module Information		Restar
PASS	Power Class		Power Class 4 Module	≘ (12 W)	
	Vendor		Oclaro Inc.		
	Part Number		TRB5E20FNF-LF000		
	Serial Number		J14H54919		
	MSA H/W Spec. r	ev.	0.0		
	MSA MIS rev.		2.2		
	Control 1 Reg.(IE	EE)	100GE-LR4(SMF)		
	Extended Ability(IEEE)	111.8Gbps,103.125Gb		

Optical Module Status



11.0 Warranty and Software

Warranty Period: The warranty period for hardware, software and firmware is three (3) years from the date of shipment to the customer. 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.

Hardware Coverage: VeEX Inc. warrants hardware products against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- · Replace hardware which proves to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc. by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Software Coverage: VeEX Inc. warrants software and firmware materials against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- Replace the software and/or firmware which prove to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc. by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Additionally, during the warranty period, VeEX Inc. will provide, without charge to the customer, all fixes, patches and enhancements to the purchased software, firmware and software options. VeEX Inc. 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.

Limitations: The warranty is only for the benefit of the customer and not for the benefit of any subsequent purchaser or licensee of any merchandise (hardware, software, firmware and/or accessories).

Revoking the warranty: VeEX Inc. does not guarantee or warrant that the operation of the hardware, software or firmware will be uninterrupted or error-free. The warranty will not apply in any of the following cases:

- · Improper or inadequate maintenance by the customer
- Damage due to software installed by the customer on the unit without prior authorization (written) from VeEX Inc.
- Unauthorized alteration or misuse
- Damage occurred from operating the unit from outside of the environmental specifications for the product
- Improper installation by the customer

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12.0 Product Specifications

Product specifications are available for download in PDF format on the VeEX customer website. Please note that Adobe Reader version 9.0 or higher is needed to open and view the file.

To get the latest free version of Adobe Reader, click here.

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13.0 Certifications and Declarations



Declaration of Conformity



ROHS Statement

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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.

What is RoHS?

RoHS is the acronym for Restriction of Hazardous Substances. Also known as Directive 2002/95/EC, it originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products imported into the EU market after **July 1, 2006** must pass RoHS compliance.

<u>Click here</u> for ROHS Statement relating to VeEX products

14.0 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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