

USER MANUAL



RXT-6200 & RXT-6000e

100G Universal Test Module

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1.0 About This User Manual

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

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

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2.0 Safety Information



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 set platform displays a laser warning icon when the laser source is active to alert the user about a potentially dangerous situation. It is recommended to:

- 1. Deactivate the laser before connecting or disconnecting optical cables or patch cords.
- 2. Never look directly into an optical patch cord or an XFP's or SFP's connector interface while the laser is enabled. Even though XFP and SFP 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 UX400, 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, Li-ion batteries in deep discharge state may limit the initial charging current (pre-recharge) before starting their regular fast charging cycle. The pre-charging state may take several hours.
- Air transportation of Li-ion batteries is regulated by United Nations' International Air Transportation Association (IATA) Dangerous Goods Regulations and by country-specific regulations. Please check local regulations and with common carriers before shipping Li-ion battery packs or products containing relatively large Li-ion battery packs.

Electrical Connectors

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

ESD: Electrostatic Discharge Sensitive Equipment

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

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



3.0 Introduction

The RXT-6200 and RXT-6000e test module is equipped with most common transceiver form-factor ports and optional legacy test interfaces. It offers up to two simultaneous 100GE tests.

Installation, commissioning, monitoring, and maintenance tasks are simplified thanks to a combination intuitive features and powerful test functions. Novice users benefit from the easy-to-use GUI, while experienced users will appreciate an array of advanced features such as OTL/PCS, CAUI-4/XLAUI Lane BERT, overhead monitor/control, Tandem Connection Monitoring, Service Disruption, Protocol Capture/Decode, BERT, Throughput test, and much more.

RXT-6200

Platform Highlights

- Independent Dual-Port testing, up to 2x 112G
- CFP4 (LR4 & SR4) and QSFP28 interfaces for 100GE, OTU4 and 50GE applications
- Supports IEEE 802.3bj Clause 91 RS-FEC as required for SR4
- QSFP+ for 40GE, OTU3
- SFP28 interface for 25GE, 32/16G FC, 24G CPRI 10 and 25G eCPRI Layer 4 with RS-FEC
- SFP+ for 100Base-FX, 1000Base-X, 10GEBase-X, OTU2/2e/1e/1, STM-64/16/4/1/0, OC192/48/12/3/1, and Fiber Channel 16/10/8/4/2/1G and CPRI up to 12G
- RJ45 for 10/100/1000Base-T applications

RXT-6000e

Platform Highlights

- CFP2 (LR4 & SR10) and QSFP28 interfaces for 100GE, OTU4 and 50GE applications
- Supports IEEE 802.3bj Clause 91 RS-FEC as required for SR4 and SR10
- CFP4 support via CFP2-to-CFP4 adapter
- QSFP+ for 40GE, OTU3
- SFP28 interface for 25GE, 32/16G FC, 24G CPRI 10 and 25G eCPRI Layer 4 with RS-FEC
- SFP+ for 100Base-FX, 1000Base-X, 10GEBase-X, OTU2/2e/1e/1, STM-64/16/4/1/0, OC192/48/12/3/1, and Fibre Channel 16/10/8/4/2/1G and CPRI up to 12G
- RJ45 for 10/100/1000Base-T applications
- Optional PDH/DSn with standard connectors

3.1 Connector Panels & Test Ports



RXT-1200 with RXT-6200 blade





4.0 Basic Operations

For information on Basic Operations, Home menu, Launching Test Applications, and other features specific to the RXT-6200 and RXT-6000e Host Chassis, refer to the <u>RXT-1200 Platform Manual</u>.

5.0 Utilities

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

6.0 Setup: SDH/SONET/OTN

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



SONET Home Menu

The Setup page has tabs for setting the OTN, and SDH/SONET.

Go back to top Go back to TOC

6.1 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 Measurements General Auto-config Signal LEDs Start тχ RX BIT 🔵 Signal Hierarchy OC-192 - 10G Hierarchy OC-192 - 10G SONET LOS 🔵 Frame Interface Interface Alarm/En Optical Optical 🖲 Pattern Structure Structure 🔵 ALM/ERR VT1.5, 1.1.1 VT1.5, 1.1.1 LASER On Payload DS1/1.5M,ESF Payload DS1/1.5M,ESF Tools Utilities Pattern Pattern 2^31-1 2^31-1 Files

TX and RX Configurations

The Transmitter (TX) and Receiver (RX) configurations are grouped into a simple yet intuitive block diagram.

The TX and RX signal parameters can be modified by tapping the applicable block that brings up a new dialog RXT-6200_RXT6000e_Module_Manual Page 18 of 387 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.

Coupling TX and RX

When the TX and RX signal structures are required to be identical or symmetrical, coupling the Transmitter and Receiver is possible. Tap on the blue "TX" or "RX" 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

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

When the TX and RX signal structures need to be independent or asymmetrical, uncoupling the transmitter and receiver is possible. For example, the TX could be sending a PRBS of 2^23-1 in a VC12 carried within an optical STM-64, while the RX could be expecting to receive a PRBS of 2^23-1 in a 2Mbps E1 signal.

Hierarchy: Allows the user to configure OTN/SDH, OTN/SONET 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 STTM-1E or PDH signals. Clock source and offset options are also configured in this screen.

Structure: Applies to SDH/SONET signal and allows the user to configure lower order mapping and the channel number.

Payload: Applies to SDH/SONET signal and allows the user to configure low rate signal (if applicable) and RXT-6200_RXT6000e_Module_Manual

associated framing.

Pattern: Applies to SDH/SONET 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.



Warning Message

6.2 Setup: SDH

	Signal	Measurements	General	Auto-config	Start
	Audible Alarm		OFF	T	
🔴 Signal	APS Protocol	SDH/SONE	r l	V	ВІТ
0.5	SDH/SONET		SDH	▼	SDHLOS
- Frame	Results on start		SONET		
😑 Pattern	Auto Save Meas Clock Src		JOILI		Alarm/Err
😑 ALM/ERR				,	LASER On
X Tools					
Utilities					
Files					

Selecting SDH from the General tab

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

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6.2.1 Transmitter Setup

This section of the manual describes the SDH configuration capabilities. The block diagram of the Tx and Rx structure is described in <u>6.1 Signal Overview</u>.

Hierarchy

Tapping the Hierarchy box opens the Tx Hierarchy Setup screen.

LED'S		Start		
	Network Type	SDH	V	
Tools	Test Rate	STM-64 - 10G	▼	1.5M FAS
		Test Rate		
		STM-64 - 10G		1.5M AIS
Utilities		STM-0 - 51M		
		STM-1 - 155M		Alarm/Err
Files		STM-4 - 622M		
		STM-16 - 2.5G		
		STM-64 - 10G		
				LASER On

Tx Hierarchy Setup

Network Type: In the SDH mode, only optical interface options are available.

Test Rate: Options are STM-0, STM-1, STM-4, STM-16 and STM-64 (referring to 51M, 155M, 622M, 2.5G and RXT-6200_RXT6000e_Module_Manual Page 21 of 387

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Tx Hierarchy - Normal Operating Mode

Operating Mode: Normal, Payload, or Transparent

- Normal Mode: Unit working as normal SDH mode.
- **Payload Through Mode:** Overhead overwrite Editing Thru mode allows for some intrusive error and alarm injection through overhead manipulation.
- **Transparent Through Mode:** All the traffic goes through the unit untouched and the unit can monitor it. It is comparable to Monitor mode with a 10/90 splitter. In Transparent mode, the unit regenerates the signal in amplitude. The clock is recovered from the received signal.

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

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Interface

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



Tx Interface Setup

Test Port: Optical

• Optical interface is available for STM-0, STM-1, STM-4, STM-16 and STM-64 signals.

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, 2Mbps, or 64kbps signal on the SMA, RX2 balanced, or RX2 BNC unbalanced interfaces.
- **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.

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Structure

Tapping the Tx Structure box opens the Tx Structure Setup screen which shows two display modes: Text mode and Graphical mode. Tap on the **Text/Graphical** button to switch between the two modes.

I ED'S		Start	
	SDH Mapping	AU-3	T S
X Tools	VC Mapping	VC3	SDH FAS
	Bulk	OFF	
Utilities	Tributary	34M	T 34M AIS
		Channel Selection	Alarm/Err
Files	STM-N	1	
	AU-3	1	
			LASER On
			< Graphical

Tx Structure Setup - Text Mode

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



Tx Structure Setup - Graphical Mode



AU4 Mapping: 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 depending upon the options and mapping.

Channel Selection: The Tx channel is selected by entering the STM-N, TUG-3, TUG-2, and TU-12 numbers for the channel.

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- TUG: A Tributary Unit Group is the structure generated by combining several lower level tributaries into the next higher level tributary
- TU-12: Each TU-12 frame consists of 36 bytes, structured as 4 columns of 9 bytes
 - At a frame rate of 8000Hz, these bytes provide a transport capacity of 2.304Mbps and accommodate the mapping of a 2.048Mbps signal
 - 63 x TU-12s may be multiplexed into a STM-1 VC-4

The tributary numbering used above is per ITU-T G.707 standard.

The high order paths are named using a C, B, A convention as follows:

- C: The AUG-4 are numbered 1 to 4
- B: The AUG-1 are numbered 1 to 4
- A: The AU-3 are numbered 1 to 3

Thus the naming convention per SDH rate is as follows:

- For STM-16: [C, B, A] convention is used
- For STM-4: [B, A] convention is used
- For STM-1 using AU-3 mapping: [A] convention is used
- For STM-1 using AU-4 mapping: [0] convention is used

The low order paths are named using a K, L, M convention as follows:

- K: TUG-3 are numbered 1 to 3
- L: TUG-2 are numbered 1 to 7
- M: TU-11, TU12, within the TUG-2 are numbered 1 to 4

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Payload

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

Payload [Tx] LED'S Stan Low Rate Nx64 ▼ PCM30C ▼ E1 Framing SDH FAS 🔵 Signal Low Rate Unused ▼ Nx64 SDHLOS 🔵 Frame Nx64 06 07 00 01 2M Alarm/En 08 09 14 15 🦲 Pattern 16 17 22 23 24 25 30 31 ALM/ERR Clear All Se LASER Off Tools Utilities Files

Tx Payload Setup

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 non-contiguous 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

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

Tx Pattern Setup

LED'S		Pattern [Tx]	Start
teo s	PRBS Pattern	2^31-1	
C Signal	Invert	OFF	SDH FAS
U Signa		PRBS Pattern 2^31-1	
O Frame		2^31-1	SDHLOS
1.22		2^23-1	Alarm/Err
Pattern		2^20-1	
		2^15-1	
ALM/ERR		2^11-1	
		2^9-1	LASER OF
1000		2^7-1	
X Tools		1010	
		1 of 4 •	
Utilities			
Files			

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.

 \bigcirc 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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6.2.2 Receiver Setup

Hierarchy

Tapping the Hierarchy setup box opens the Rx Hierarchy screen. The Hierarchy setup options for the Rx are the same as for the Tx described previously.

LED'S		Start	
and too	Network Type	SDH	
C Signal	Test Rate	STM-64 - 10G	SDH FAS
•		Test Rate STM-64 - 10G	SOHLOS
O Frame		STM-0 - 51M	
		STM-1 - 155M	Alarm/Err
O Pattern		STM-4 - 622M	
22		STM-16 - 2.5G	
O ALM/ERR		STM-64 - 10G	
			LASER Off
X Tools			
Utilities			
Files			

Rx Hierarchy Setup

Interface

Tapping the Interface setup box opens the Rx Interface screen. The Interface setup options for the Rx are the same as for the Tx described previously, except for clock offset, which is only available in Tx.

Remember to use an optical attenuator to prevent receiver overload or damage – refer to the SFP chart below to determine safe levels. Avoid looping back the Tx and Rx on a 1550nm XFP or SFP using a patchcord only – this will damage the SFP.



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Structure and Payload

SDH Rx Structure and Payload configurations are the same as for SDH Tx setup described previously.

LED'S Tools Utilities Files	Channel Selection V STM-N 1 AU-3 1 TUG-2 1 TU-11 1 AU-4-x STMn	VC4-54C Start VC4-16C SDH FAS VC4-4C 34M AIS VC4 Alarm/Err
	AU-3 TUG-2 TU-12 TU-11 Bulk Tributary	VC3 VC12 VC11 <text< th=""></text<>

Rx Structure Setup

Rx Payload Setup



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Pattern

Tapping the Pattern box opens the Rx Pattern setup screen. The pattern setup options for the Rx are the same as for the Tx described previously, except for the Out of Service selection, which 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.



Rx Pattern Setup

6.3 Setup: SONET

LEDs	Signal	Measurements	General	Auto-config	Start
	Audible Alarm		DFF	V	
🥚 Signal	APS Protocol	SDHISONE	·	V	ВП
	SDH/SONET	SERVICE	SONET	V	SDHLOS
🔵 Frame	STS1 Bulk data colu	um	SDH	▼	
0	Results on start		SONET	▼	Alarm/Err
e Pattern	Auto Save		r	•	
ALM/ERR	Meas Clock Src			T	
U					LASER On
X Tools					
Otilities					
Files					

Selecting SONET from the General tab

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.

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6.3.1 Transmitter Setup

This section of the manual describes the SONET configuration capabilities. The block diagram of the Tx and Rx structure is described in <u>6.0 Setup</u>.

Hierarchy

Tapping the Hierarchy box opens the Tx Hierarchy Setup screen.



Tx Hierarchy Setup

Network Type: In the SONET mode, only optical interface options are available.

Test Rate: Options are STS-1, OC-3, OC-12, OC-48, OC-192 (referring to 51M, 155M, 622M, 2.5G and 9.953G RXT-6200_RXT6000e_Module_Manual Page

respectively).

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Hierarchy > Through Mode

Tapping the Hierarchy box opens the Tx Hierarchy Setup screen.



Tx Hierarchy Setup - Through Mode

Through Mode:

- Normal Mode: Unit working as normal SONET mode.
- **Payload Through Mode:** Overhead overwrite Editing Thru mode allows for some intrusive error and alarm injection through overhead manipulation.
- **Transparent Through Mode:** All the traffic goes through the unit untouched and the unit can monitor it. It is comparable to Monitor Mode with a 10/90 splitter. In Transparent Mode, the unit regenerates the signal in amplitude. The clock is recovered from the received signal.

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

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Interface

Tapping the Tx Interface box opens the Tx Interface Setup screen. In this screen both electrical and optical options can be selected.

Tx Interface Setup

LED'S		Start		
1000	Test Port	Optical	V	
Tools Utilities Files	Test Port Clock Src Clock Offset	Optical Offset Clock Src Interna Externa R) Offse		SONET FAS SONET LOS AlarnvErr

Test Port: Optical

• Optical interface is available for OC-1, OC-3, OC-12, OC-48 and OC-192 signals.

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, 2Mbps, or 64kbps signal on the SMA, RX2 balanced, or RX2 BNC unbalanced interfaces.
- **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.

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Structure

Tapping the Tx Structure box opens the Tx Structure Setup screen which shows two display modes: Text mode and Graphical mode. Tap on the **Text/Graphical** button to switch between the two modes.

Tx Structure Setup - Text Mode



Mapping: STS-192C, STS-48C, STS-12C, STS-3C, STS-1 and VT1.5 is available. VT-2 is optional. STS mappings per Bellcore GR-253 and ANSI T1.105 recommendations are supported. The multiplexing structure is shown below.



Tx Structure Setup - Graphical Mode

LED'S	Channel Selection STS192c	Start
X Tools	STS48c	SONET FAS
Utilities	STS12c	SONETLOS
Files	STS3c	Alarm/Err
	STSN	
	STS1	LASER On
	VT-GRP VT-2 VT-2	
	VT-1.5 VT1.5	Cant
	Bulk OFF V	
	Tributary E3/34M V	

Channel Selection: The Tx channel is selected by entering the STS-N, VT-GRP, and VT-1.5 SPE channel.

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 depending upon the options and mapping.



Tx Structure Setup - Tributary

- VT-GRP: In order to carry a mixed size of 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.

Payload

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

LED'S		Payload [Tx]								Start
	Low i	Low Rate				Nx64 🗸 🗸			▼	
Tools	E3 Fr	E3 Framing				G751			▼	SONET FAS
	E2 CI	hann	el			1				
Utilitie	s E2 Fr	amin	g			G742			▼	SONETLOS
	E1 CI	E1 Channel			1				Alarm/Err	
Files	E1 Fr	E1 Framing				PCM31			▼	
	Unus	Unused				AIS 🗸 🗸			▼	
					Timeslot	Selection	n			
	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	r All	Select /	AII)					

Tx Payload Setup

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)

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 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 non-contiguous 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.

	LED'S		Pattern [Tx]	Start
		PRBS Pattern	2^31-1	
$\boldsymbol{\varkappa}$	Tools	Invert	ON V PRBS Pattern	SONET FAS
	Utilities		2^31-1 2^31-1	SONETLOS
	Files		2^23-1 2^20-1	Alarm/Err
			2^15-1 2^11-1	
			2^9-1 2^7-1	LASER On
			1010	
			1 of 4	

Tx Pattern Setup

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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6.3.2 Receiver Setup

Hierarchy

Tapping the Hierarchy setup box opens the Rx Hierarchy screen. The Hierarchy setup options for the Rx are the same as for the Tx described previously.

Rx Hierarchy Setup
LED'S		Hierarchy [Rx]	Start
	Network Type	SONET 🛛 🔻	
Tools Utilities Files	Test Rate	OC-192 - 10G Test Rate OC-192 - 10G STS-1 - 51M OC-3 - 155M OC-12 - 622M OC-48 - 2.5G OC-192 - 10G	SONET FAS SONET LOS AlarmJErr

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Interface

Tapping the Interface setup box opens the Rx Interface screen. The Interface setup options for the Rx are the same as for the Tx described previously, except for clock offset, which is not possible.

	LED'S		Interface [Rx]	Start
	LEDO	Test Port	Optical	
3	Tools			SONET FAS
	Utilities			SONETLOS
	Files			Alarm/Err
		1		
				LASER On
-				

Interface Rx Setup

Remember to use an optical attenuator to prevent receiver overload or damage – refer to the SFP chart below to determine safe levels. Avoid looping back the Tx and Rx on a 1550nm XFP or SFP using a patchcord only as this will damage the SFP.



Structure

Tapping the Structure setup box opens the Rx Structure screen. The Structure setup options for the Rx are the same as for the Tx described previously.



Rx Structure Setup - Graphical Mode

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Payload

Tapping the Payload setup box opens the Rx Payload screen. The Payload setup options for the Rx are the same as for the SONET Tx setup described previously.

LED'S	Payload [Rx]						Start		
	Low Rate	2			Nx56			▼	
X Tools	DS1 Fran	ning			ESF			▼	SONET FAS
				Timeslot	Selection	n			
Utilities	01	02	03	04	05	06	07	08	SONETLOS
	09	10	11	12	13	14	15	16	
	17	18	19	20	21	22	23	24	Alarm/Err
Files	Cle	ar All	Select/	AII					-
									LASER On

Rx Payload Setup

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Pattern

Tapping the Pattern box opens the Rx Pattern setup screen. The pattern setup options for the Rx are the same as for the Tx described previously, except for the Out of Service selection, which 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.

Rx Pattern Setup



6.4 Setup: OTN/SDH

LEDs	Signal	Measurements	General	Auto-config	Start
	Audible Alarm		DFF	V	
🥚 Signal	APS Protocol	SDH/SONE	r'	V	ВТ
	SDH/SONET		SDH	V	SDHLOS
Frame	Results on start		SDH	▼	
A Pattern	Auto Save		SONET	▼	Alarm/Err
	Meas Clock Src			▼	
🔴 ALM/ERR					
Ŭ					LASER On
Tools					
Utilities					
Files					

Selecting SDH from the General tab

To verify that the Tx and Rx block diagrams are OTN/SDH, verify that SDH is selected from the **SDH/SONET** dropdown menu under the **General** tab.

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6.4.1 OTN Transmitter Setup

This section of the manual describes the OTN configuration capabilities. The block diagram of the Tx and Rx structure has been described in <u>6.0 Setup</u>.

Hierarchy

Tapping the **Hierarchy** box opens the Tx Hierarchy Setup screen.

Tx Hierarchy Setup



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

Test Rate: Options are OTU-1 and OTU-2 (referring to 2.66G and 10.709G respectively) RXT-6200_RXT6000e_Module_Manual *ITU-T G.709 and both AU-4 and AU-3 signal mappings per G.707 recommendations are supported. The multiplexing structure is shown below.*



Scrambler: ON/OFF

FEC: FEC encoder can be ON/OFF (activated / deactivated)

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Interface, Structure, Payload, and Pattern

Interface, Structure, Payload, and Pattern TX block configurations are identical to configurations in <u>Transmitter Setup</u> in the SONET chapter. Please refer to that section for further details.

Tx Interface Setup



Tx Structure Setup - Graphical Mode



Tx Payload Setup

	Payload [Tx]							Start	
	Low Rate	÷			Nx64			▼	
Signal	DS1 Fran	ning			ESF			V	ВІТ
Ŭ	Unused				AIS			V	
😑 Frame				Timeslot	Selection	1			OINLOS
-	01	02	03	04	05	06	07	08	Alarm/Err
Pattern	09	10	11	12	13	14	15	16	
Ŭ	17	18	19	20	21	22	23	24	
😑 ALM/ERR	Clea	ar All	Select /	<u>u</u>]					LASER On
X Tools									
Utilities									
Files									

Tx Pattern Setup

		Start	
	PRBS Pattern	2^31-1	
😑 Signal	Invert	PRBS Pattern	
😑 Frame		2^31-1 2^31-1	OTNLOS
Pattern		2^23-1 2^20-1	Alarm/Err
		2^15-1 2^11-1	
		2^9-1	LASER On
X Tools		1010	
Utilities		1 of 4 •	
Files			

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6.4.2 Receiver Setup

Hierarchy

Tapping the **Hierarchy** setup box opens the Rx Hierarchy screen. The Hierarchy setup options for the Rx are the same as for the Tx described previously.

Rx Hierarchy Setup

	Hiera	rchy [Rx]	Start
LEDS	Network Type	отм 🔻	
X Tools	Test Rate	оти-2 🔻	ВІТ
	OTN Mapping	STM-64 SYNC 🛛 🔻	
Utilities	Scrambler	ON 🔻	UINLUS
	FEC	ON 🔻	Alarm/Err
Files			
			LASER On

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Interface

Tapping the **Interface** setup box opens the Rx Interface screen. The Interface setup options for the Rx are the same as for the Tx described previously, except for clock offset, which is only available in Tx.

Rx Interface



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Structure and Payload

OTN/SDH Rx Structure and Payload configurations are the same as for OTN/SDH Tx setup described previously.

Rx Structure					
••	LEDs	SDH Mapping			

		Start	
	SDH Mapping	AU-4 🔻	
X Tools	VC Mapping	VC12 🔻	ВІТ
	Bulk	OFF 🛛 🔻	
📑 Utilities	Tributary	2M 🔻	OTNLOS
		Channel Selection	Alarm/Err
Files	STM-N	1	
	TUG-3	1	
	TUG-2	1	
	TU-12	1	LASER On
			< Graphical

Rx Payload

				Payload [Rx]			Start
	Low Rate	e		Nx64		▼	
Tools Utilities Files	E1 Frami 00 08 16 24	ng 01 09 17 25 ar All		PCM31 E1 Framing PCM31 PCM31 PCM31C PCM30 PCM30C	06 14 22 30	07 15 23 31	BIT OTN LOS Alarm/Err
		<u>*** ***</u>)	E				LASER On

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Pattern

Tapping the Pattern box opens the Rx Pattern setup screen. The Pattern setup options for the Rx are the same as for the Tx described previously, except for the **Out of Service** selection, which should be selected if the incoming signal is expected to contain a known test pattern. Deselect this option if the signal is expected to contain live traffic.

Rx Pattern



6.5 Setup: OTN/SONET

LEDs	Signal	Measurements	General	Auto-config	Start
	Audible Alarm	0)FF	V	
🔴 Signal	APS Protocol	SDH/SONE1		T	ВІТ
	SDH/SONET		SONET	T	SDHLOS
🔵 Frame	STS1 Bulk data col	um	SDH	T	
0.0.0	Results on start		SONET	▼	Alarm/Err
Pattern	Auto Save			•	
	Meas Clock Src			•	
•					LASER On
A starte					
Tools					
Utilities					
Files					

Selecting SONET from the General tab

To verify that the Tx and Rx block diagrams are OTN/SONET, verify that SONET is selected from the **SDH/SONET** drop-down menu under the **General** tab.

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6.5.1 Transmitter Setup

This section of the manual describes the OTN configuration capabilities. The block diagram of the Tx and Rx structure is described in <u>6.0 Setup</u>.

Hierarchy

Tapping the **Hierarchy** box opens the Tx Hierarchy Setup screen.

Tx Hierarchy Setup



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

Test Rate: Options are OTU-1 and OTU-2 (referring to 2.66G and 10.709G respectively)

OTN Mapping: SYNC, ASYNC, and PRBS pattern

✓ ITU-T G.709 and STS mappings per Bellcore GR-253 and ANSI T1.105 recommendations are supported. The multiplexing structure is shown below.



Scrambler: ON/OFF

FEC: FEC encoder can be ON/OFF (activated / deactivated)

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Interface, Structure, Payload, and Pattern

Interface, Structure, Payload, and Pattern TX block configurations are identical to configurations in <u>6.4.1 Transmitter</u> <u>Setup</u> in the SONET chapter. Please refer to that section for further details.

Tx Interface Setup

>Stopped TX3	300		
>Home>Setup>Int	erface	w w	
LED'S		Interface [Tx]	Start
ter a	Test Port	Optical	
X Tools	Clock Src	Offset	T OTU FAS
	Clock Offset	0.00	
Utilities			CINCOS
			Alarm/Err
Files			
			LASER On
TX: ОТU-2	RX: OTU-2	08-02-2011	16:36:56 Test Mode

Tx Structure Setup - Text Mode

>Stopped TX30	0			
>Home>Setup>Stru	icture			
		Structure [Tx]		Start
	Mapping	VT-2	V	
Tools	Bulk	OFF	▼	OTU FAS
	Tributary	Mapping VT-2	▼	OTNUOS
Utilities		VT1.5		CINCOS
	STS-N	VT-2		Alarm/Err
Files	VT-Group	STS1		
	VT-2	STS3c		
		STS12c		
		51548c STS192c		LASER On
		5151520		
				<graphical< th=""></graphical<>
TX: OTU-2	RX: OTU-2	08-02-20	011 16:38:49	Test Mode

Tx Structure Setup - Graphical Mode

>Stopped TX3 >Home>Setup>Stri	00 ucture		B	S) 🕢 🔇
LED'S Tools Utilities Files	Chan STS-N VT-Group VT-2	nel Selection 1 1 1		STS192c STS48c STS12c STS12c STS3c	Start OTU FAS OTN LOS Alarm/Err
	S		VT-GRP VT-2 VT-1.5	STS1 VT-2 VT1.5	LASER On
TX: OTU-2	Bulk Tributary RX: OTU-:	OFF ▼ E1/2M ▼	08-02-201	1	<text Test Mode</text

Tx Payload Setup

				Paylo	ad [Tx]				Start
	Low Rate	È			Nx64	Nx64 🛛 🔻			
Signal	DS1 Fran	ning			ESF			▼	ВІТ
Ŭ	Unused				AIS			V	
😑 Frame				Timeslot	Selection	1			OINLOS
-	01	02	03	04	05	06	07	08	Alarm/Err
Pattern	09	10	11	12	13	14	15	16	
Ŭ	17	18	19	20	21	22	23	24	
ALM/ERR	Clea	ar All	Select /	AU)					
U									LASER On
Tools									
Utilities									
Files									

Tx Pattern Setup



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6.5.2 Receiver Setup

Hierarchy

Tapping the **Hierarchy** setup box opens the Rx Hierarchy screen. The Hierarchy setup options for the Rx are the same as for the Tx described previously.

Rx Hierarchy Setup

>Stopped TX3	00		💽 🕞 🙈 🚫
>Home>Setup>Hie	erarchy	Hierarchy [Rx]	
LED'S	Network Type	OTN	▼ Start
X Tools	Test Rate	OTU-2	TU FAS
	OTN Mapping	PRBS	
Utilities	Scrambler	ON	
	FEC	ON	Alarm/Err
Files	J		
			LASER On
ТХ: ОТИ-2	RX: OTU-2	08-02-2011	16:26:26 Test Mode

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Interface

Tapping the **Interface** setup box opens the Rx Interface screen. The Interface setup options for the Rx are the same as for the Tx described previously, except for clock offset, which is only available in Tx.

Rx Interface



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Structure and Payload

OTN/SONET Rx Structure and Payload configurations are the same as for OTN/SONET Tx setup described previously.





Rx Payload

LED'S				Paylo	ad [Rx]				Start
LED 3	Low Rate	•			Nx56			▼	
X Tools	DS1 Fran	ning			ESF			▼	OTU FAS
				Timeslo	t Selectio	n			
Utilities	01	02	03	04	05	06	07	08	OINLOS
	09	10	11	12	13	14	15	16	
Files	17	18	19	20	21	22	23	24	Alarm/Err
	Cle	ar All	Select	All					
									LASER On

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Pattern

Tapping the Pattern box opens the Rx Pattern setup screen. The Pattern setup options for the Rx are the same as for the Tx described previously, except for the **Out of Service** selection, which 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.

Rx Pattern



6.6 Measurement Configuration

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

Measurements tab



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6.6.1 Timer Setup

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

Mode: Manual, Timed, and Auto selections are available

- Manual: This is linked to the Start/Stop function on the drop-down menu
- **Timed:** The test duration can be set by the user. The test duration can be set in seconds, minutes, hours or days. The test is activated by the Start/Stop function on the drop-down menu
- 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 on the drop-down menu and the test will be activated automatically when the programmed start time is reached.

The timed mode will be required when running a M.2100 or M.2101 performance objective.

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6.6.2 Performance Analysis

The Analysis setup page selects the ITU-T performance test that will be performed by the unit. Depending on Test mode, the selections include None, G.821, G.826, G.828, G.829, M.2100, and M.2101.

Analysis

LEDs	Signal	Measurements	General	Auto-config	Start
	Mode		Auto	V	
🔴 Signal		Performance	e Type		ВІТ
	Start Time [mm/dd	lyyyr	None 1970	0 00 : 00 : 00	SONETLOS
🔴 Frame			None		
0.0	Duration		G.826		Alarm/Err
e Pattern	Units		G.828	▼	
			M.2100		
	G.821 Allocation		M.2101		LASER On
X Tools	Performance Type			T	
Utilities					
Files					

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 extremely difficult
- **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 Measurement (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
- 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
 - 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

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.

ITU-T Performance Analysis for PDH and SDH systems						
Analysis	PDH	SDH	Anomalies			
G.821	Ð		TSE based on bit errors			
G.826 (Out of service)	Ð	N	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)		N	B1, B2, B3, LP-BIP, TSE			
M.2100	Ø		E1/E3/E4 FAS, E1 CRC, TSE			
M.2101			B1, B2, B3 HP, LP-BIP, TSE			

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6.6.3 General

The General setup page configures the audible alarm and APS protocol settings.

General tab

	LED'S	Signal	Measurements	General	Auto-config	Start
		Audible Alarm		OFF	V	
X	Tools	APS Protocol		Linear	V	1.5M FAS
		SDH/SONET		SONET	V	1.5M AIS
	Utilities	STS1 Bulk data c	olumns	88	V	
	Files	Results on start		ON	Alarm/Err	
	rnes	Auto Save		OFF		
		Meas Clock Src		Internal	V	
						LASER On

- **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.
- 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.
- **Tx Laser Override:** (SONET/SDH MUX measurement) Enabling the Tx Laser Override causes whichever optical device the Rx is using to produce a signal. The Tx data produced is random. The signal is of use to multiplexers that require an input signal before they can transmit an optical signal. Tx Laser Override is only

available when Rx is optical and Tx is in PDH mode, (i.e. a Mux).

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6.6.4 Auto-Config

The Auto-Configuration function is described below.

Auto-config tab

LED'S	Signal	Measurements	General	Auto-config	Start
Tools		XFP Optic	al PASS		SDH FAS
Litilities		STM-64	PASS		SDHLOS
Cunter		VC-12 P	ASS		Alarest
Files		E1 PCM3	PASS		Adamiver
		Traff	īc		
					LASER Off
		Fast	Start		

The **Auto-Config** function automatically sets the receiver of the test set. A search for SDH and PDH signals at both the electrical or optical inputs is performed to determine the signal structure. For electrical signals, both Terminated and PMP voltage ranges are searched and supported.

Procedure

Tap on the **Start** button **Start** to begin the search. The received signal is checked for network type, hierarchy and bit rate, payload structure, payload framing, test pattern and signal level. If the search is successful, a "**PASS**" result is displayed.

Search parameters and criteria

- Interface: Checks physical parameters (bit rate line code).
- Mapping: Checks mapping structure using the signal label and pointer bytes.
- **Payload:** Only test patterns defined in ITU-T or ANSI standards will be recognized. If no test pattern is detected, the unit assumes live traffic.

PDH Signals: Unframed or framed payloads at all hierarchies. For 1.5M signals containing 64kbps timeslots, the test set will assume live traffic and will not search for a test pattern.

7.0 Results

Accessing Results

To access measurements for SDH, SONET, and OTN, tap on Start, which starts testing, or Results.

Results and Start Buttons



7.1 Results: SDH

7.1.1 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 signal and its payload.

LED'S	Analysis	Histogram	Graph	Event Log	Stop
	Summary	Errorsi	Alarms	Signal	
Tools	ST:26/08 16:20:34			ET:00/00:01:41	Erri
	LOS Alarm			ок	Alar
Utilities	SDH Alarms			ок	
Files	SDH Errors			ок	Alarm
	PDH Alarms			ок	
1	PDH Errors			ОК	
		No erro	rs - OK		LASEF
		O Page	1 of 3 💿		C Bast

SDH mapping information is displayed on page 2 and 3.

Summary (Page 2)



Summary (Page 3)

LED'S	Analysis	t t	listogram	Gi	raph	Ev	ent Log	Stop
	Summ	ary	Error	s/Alarms	3	Sigr	al	
X Tools			SDH Ma	pping (Tx	1			Err inj.
			\$1	rm-16				Alarm
Utilities		A	JG		AU4 -4c	AU4 -16c	AU4 -64c	Alarm/Err
Files	1 TUG2	AU3	1 TUG3					LASER Of
	TU11 VC11	1 7U12 7C12	TU3 VC3	VC4	VC4 -4c	VC4 -16c	VC4 -64c	
		٥	Pag	e 3 of 3	۲			Restart

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7.1.2 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.



Errors/Alarms (Page 1)

Tapping the individual soft LED will automatically link directly to the applicable result screen which provides detailed information.

The LED headers are described in the table 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 defection criteria 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 d below the threshold at which a BER of 1^-3 is predicted. It c due to a cut cable, excessive attenuation of the signal, or equipment fault. The LOS state will clear when two consecu framing patterns are received and no new LOS condition is detected.							
TSE	Test Sequence Error						
LSS	 Loss of Sequence Synchronization Out-of-service bit error measurements using pseudo-random sequences or 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 0.25 ms. 						
005	OutofFrame						

OOF	 Out of Frame Declared when 4 consecutive SDH frames are received with invalid (errored) framing patterns. Maximum OOF detection time is 625 μs
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.

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

	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 × N) of an STM-N. If any of the N × 24 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)							
AU-NDF	Administrative Unit New Data Flag							

	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 Indication - Alarm is declared when bits 5,6,7 of the G1 byte contain 100 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 Mismatch Declared after receiving five consecutive frames with mismatched VC signal labels
B3	 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 Indication - Declared when bits 1-4 of the G1 byte contain 0001 to 1000 pattern

	Tributary Unit – Alarm Definitions						
TU-AIS	Tributary Unit Alarm Indication Signal - Declared when the V1 and V2 bytes for the TU path contain an all ones pattern for five consecutive super-frames						
TU-LOP	 Tributary Unit Loss of Pointer Declared when no valid pointer is detected in N consecutive super- frames (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

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Errors/Alarms (Page 2)

Page 2 lists the SDH Errors 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. Error conditions are displayed in red including count and rate.

Errors/Alarms (Page 2)

LED'S	Analysis	Hi	stogram	Graph	Event	Log	Stop
	Summary		Errors	/Alarms	Signal		
X Tools		s	DH Errors:	DH Errors: STM-16 [2.5G]			
	ET:				00	/00:04:18	Alarm
Utilities	FAS				0	0.0E+00	
	B1				0	0.0E+00	Alarm/Err
Files	B2				0	0.0E+00	
	MS-REI				0	0.0E+00	
	B3				0	0.0E+00	LASER Off
	HP-REI				0	0.0E+00	
	LP-BIP				0	0.0E+00	
	LP-REI				0	0.0E+00	
		٩	Page	2 of 8	•		Restart

Errors/Alarms (Page 3)

Page 3 lists the Section and Line Overhead Alarms in logical order associated with the signal under test. All alarms are evaluated and stored. The Elapsed Time [ET] since the start of the test is shown in the upper right hand corner.

The alarms associated with the Section and Line are displayed separately for ease of interpretation.

LED'S	Analysis	His	stogram	Graph		Event Log	Stop
	Summary		Errors	Alarms		Signal	
X Tools			SDH Alarm	s: [RS/Line]			Err inj.
	ET:					00/00:04:33	Alarm
Chinties	LOS					0	
Files	LOF					0	Alarm/Err
	OOF					0	
	RS-TIM						
			SDH Alar	rms: [MS]			LASER Off
	MS-AIS					0	
	MS-RDI					0	
		٩	Page	3 of 8 🔍	>		Restart

Errors/Alarms (Page 3)

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Errors/Alarms (Page 4 & 5)

Page 4 & 5 lists the High Order Path and Low Order path in logical order that are associated with the signal under test. All alarms are evaluated and stored.

Errors/Alarms (Page 4)

LED'S	Analysis	Histogram	Graph	Event Log	Stop
	Summary	Errors	/Alarms	Signal	
X Tools		SDH Ala	rms: [HP]		Err inj.
	ET:			00/00:07:45	Alarm
Othities	AU-AIS			0	
Files	AU-LOP			0	Alarm/Err
	HP-UNEQ			0	
	HP-PLM			0	
	HP-TIM			0	LASER Off
	HP-RDI			0	
		Page	4 of 8 🔹)	Restart

Errors/Alarms (Page 5)

		aco Bi ann	Graph		Event Log	Stop
Summary		Errors	Alarms		Signal	
		SDH Ala	rms: [LP]			Err inj.
iT:					00/00:05:17	Alarm
TU-LOM					0	
TU-AIS					0	Alarm/Err
TU-LOP					0	
.P-UNEQ					0	
.P-PLM					0	LASER Off
.P-TIM						
.P-RDI					0	
.P-RFI					0	
	•	Page	5 of 8	>		Restart
	Summary T: U-LOM U-AIS U-LOP P-UNEQ P-UNEQ P-PLM P-TIM P-RDI P-RDI P-RFI	Summary T: U-LOM U-AIS U-LOP P-UNEQ P-UNEQ P-PLM P-TIM P-RDI P-RDI P-RFI	Summary Errors SDH Alar U-LOM U-AIS U-LOP P-UNEQ P-UNEQ P-PLM P-TIM P-RDI P-RDI P-RFI Page	Summary Errors/Alarms SDH Alarms: [LP] T: U-LOM U-AIS U-LOP P-UNEQ P-UNEQ P-PLM P-TIM P-RDI P-RDI P-RFI	Summary Errors/Alarms SDH Alarms: [LP] T: U-LOM U-AIS U-LOP P-UNEQ P-PLM P-TIM P-TIM P-RDI P-RFI P-RFI Page 5 of 8	Summary Errors/Alarms Signal SDH Alarms: [LP] 00/00:05:17 U-LOM 0 U-AIS 0 U-LOP 0 P-UNEQ 0 P-PLM 0 P-RDI 0 P-RFI 0

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Errors/Alarms (Page 6)

Page 6 lists the PDH Alarms in logical order that are associated with the signal and payload under test. All alarms are evaluated and stored.

Errors/Alarms (Page 6)

	LED'S	Analysis	Histogram	Graph	Event Log	Stop
		Summary	Error	s/Alarms	Signal	
X	Tools		PDI	H : [2M]		Errinj
	Interior	ET:			00/00:05:36	Alarm
	Utilities	AIS			0	
	Files	LOF			0	AlarmvErr
-		LOMF			0	
		RDI			0	
						LASER Off
			• Pag	e 6 of 8 💿		Restart

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Errors/Alarms (Page 7)

Page 7 lists the PDH Errors in logical order that are associated with the signal and payload under test. All errors are evaluated and stored.

Errors/Alarms (Page 7)

	LED'S	Analysis	Histogram	Graph	Event Log	Stop
		Summary	Error	Alarms	Signal	
X	Tools		PDH	: [2M]	Errinj	
		ET:			00/00:05:5	Alarm
	Utilities	FAS			0 0.0E+0	
	Files	CRC			0 0.0E+0	Alarm/Err
L	riles	REI			0 0.0E+0	ō
						LASER OF
			Page	7 of 8 💽		Restart

Errors/Alarms (Page 8)

Page 8 lists the BERT Errors in logical order that are associated with the signal and payload under test. All errors are evaluated and stored.



Errors/Alarms (Page 8)

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7.1.3 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

LED'S	Summa	ny	Errors	Alarms		Signal	Stop
	Analysis	Hist	ogram	Graph		Event Log	
X Tools	*	Туре		Start		Dur/Count	Err inj.
Litilities	1	Start	26/0	8/11 16:20:34	4.0		Alarm
Cuntes	2	2M:AIS	26/0	8/11 16:32:4	3.0	00:00:05.5	
Files	3	LOF	26/0	8/11 16:33:00	0.8	00:00:41.2	Adarmverr
	4	FAS		26/08/11 16:34:13.0		1	
	5	B2	26/0	26/08/11 16:34:29.0		1	
	6	B2	26/0	8/11 16:34:30	0.0	1	LASER OF
	7	B2	26/0	8/11 16:34:3	1.0	1	
	8						
	9						
		۲	Page	1 of 1 🔍		Restart	

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7.1.4 Signal

The signal tab displays the Level and Frequency screen. Page 1 displays the level measurement in electrical units (volts) for STM-1, STM-4, STM-16 and STM-64 signals.

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



Signal (Page 1)

Frequency (Page 2)

The received signal frequency and offset is measured and displayed. For SDH signals, the measurement is performed on both electrical (BNC) and optical interfaces.

Signal - Frequency (Page 2)

	LED'S	Analysis Hist		stogram	Graph	1	Event Log	Stop
		Summary		Errors	Alarms		Signal	
$ \mathbf{x} $	Tools		Freq	uency	Err inj.			
		SDH current (bps)					2488320000	Alarm
	Utilities	Offset (ppm):					0.0	
	Files	Min (ppm):					0.0	Alarm/Err
_		Max (ppm):					0.0	
		2M current (bps)					2048000	
								LASER Off
			٩	Page	2 of 4			Restart

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

- **SDH 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.
- 2M Current: Indicates the frequency of the payload data. Options 1.5M, 45M, 34M are displayed.

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.

Low quality clock sources that deviate from the nominal value cause problems in the operation of network elements. It is necessary and recommended to measure the signal frequency at all hierarchies to reduce synchronization risks. To measure line frequency in service, the test set must be connected to a Protected Monitoring Point (PMP). The frequency of the signal is normally reported in Hz, while the deviation is reported in ppm. Tolerances for the various clock frequencies of SDH hierarchies are presented in the table below.

SONET/SDH Clock Frequencies and Tolerances							
Bit rate (Mbps)	Tolerance (ppm)						
155,520	< 4.6ppm						
622,080	< 4.6ppm						
2,488,320	< 4.6ppm						
9,953,280	< 4.6ppm						

Level: Measures the Peak and Peak-Peak voltage values or optical power of the incoming signal.

Signal > Optical Information (Page 3)

Page 3 displays the Optical module information which includes Vendor name, Part number, and Optical Wavelength.

Signal - Optical (Page 3)

LED'S	Analysis	Histogram	Graph	Event Log	Stop				
	Summary	Errors	/Alarms	Signal					
X Tools		Opt	Optical						
Utilities	Vendor Part Number	FINISAR CORP. FTLF1421P1BCL		Alarm					
Files	Vendor Rev	A							
Thes	Wavelength		1310						
	Nominal Rate		2500 Mbps						
	Transceiver	SONET/SDH - OC Compliant Gigabit Ethernet - Fibre Channel - Io Mode; 200 MBytes	LASER OF						
		 Page 	3 of 4 💽	>	Restart				

Signal > Optical Information (Page 4)

Page 4 displays the Optical module Power Measurement Graph.

Signal - Optical (Page 4)



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7.1.5 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.

Page 1 displays the Alarms associated with the Section Overhead (SOH) Alarm.

Histogram - SOH Alarms (Page 1)

LED'	s	Summary			rs/Alarms		\$	ignal	Stop
	Ana	Analysis		Histogram		Graph		Event Log	
X Tools	s 🗹	• •	>						Errinj
Utilit	LOS LOF			sol	H Alarms		_		Alarm
Files	RS-TIM MS-AIS MS-RDI								
	sec	480	540	600	660	720	780	840	LASER OF
			۲	Pag	ge 1 of 8	۰			Restart

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.

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Histogram (Page 2)

Page 2 displays the Errors associated with the Section Overhead (SOH).

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Histogram (Page 3)

Page 3 displays the Alarms and Errors associated with the Administrative Unit (AU, SDH). The measured parameters are:

- AU-AIS (AU Alarm Indication Signal)
- AU-LOP (AU Loss of Pointer)

Histogram - AU Alarms/Errors (Page 3)

	LED'S		Summary			Errors/A	larms		Signa	d	Stop
		/	Analysis			Histogram		Graph		nt Log	
X	Tools	4	+	Err inj.							
	Utilities	AU-AI	S OP							- ÷	Alarm
	Files	sec	0	60	120	180	240	300	360	420	Alarm/Err
											LASER OF
					•	Page 3	l of 8	۲			Restart

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Histogram (Page 4)

Page 4 displays the Alarms and Errors associated with the High Order Path (HP, SDH). The measured parameters are:

- HP-UNE (HP-Unequipped)
- HP-PLM (HP-Payload Mismatch)
- HP-TIM (HP-Trace Identifier Mismatch)
- HP-RDI (HP-Remote Defect Indication)
- B3 errors
- HP-REI (HP-Remote Error Indication)

Histogram - High Path Alarms/Errors (Page 4)

	LED'S		Summary			Errors/	Alarms		Signa	1	Stop	
		A	nalysi	3 5	Histogram		Graph		Event Log			
X	Tools	<	+	•	2						Errinj.	
	Utilities	HP-UN HP-PL	IE M		High	h Path Al	arms/Err	ors			Alarm	
	Files	HP-TI HP-RC B3 HP-RE									Alarm/Err	
		sec	0	60	120	180	240	300	360	420	LASER Off	
				(0	Page	4 of 8	۲			Restart	

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Histogram (Page 5)

Page 5 displays the Alarms and Errors associated with the Tributary Unit (TU).

• TU-AIS (TU-Alarm Indication Signal)

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• TU-LOP (TU-Loss of Pointer)

Histogram - TU Alarms/Errors (Page 5)

	LED'S		Summary			Errors/A	larms		Signa	ı	Stop
			Analysis		Histogram		Graph		Event Log		
X	Tools	K	+	•	>						Err inj.
	Utilities	TU-LO TU-AIS				TU Alarms	s/Errors			7	Alarm
	Files	sec	0	60	120	180	240	300	360	420	Alarm/Err
											LASER Of
					•	Page 5	of 8	۲			Restart

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Histogram

Page 6 displays the **Alarms and Errors** associated with the **Low Order Path (LP,SDH)**. The measured parameters are:

- LP-UNE (LP-Unequipped)
- LP-PLM (LP-Payload Mismatch)
- LP-TIM (LP-Trace Identifier Mismatch)
- LP-RDI (LP-Remote Defect Indication)
- LP-RFI (LP-Remote Fault Indication)
- LP-BIP (LP-Bit Interleaved Parity)
- LP-REI (LP-Remote Error Indication)

Histogram - Low Path Alarms/Errors (Page 6)



Histogram (Page 7)

Page 7 displays the Alarms associated with the payload. The measured parameters depend on the payload selected.





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Histogram (Page 8)

Page 8 displays the Errors associated with the test pattern.

Histogram - BERT Alarms/Errors (Page 8)

	LED'S		Summary			Errors//	Narms		Signa	4	Stop	
			Analysis			ram	Graph		Event Log			
X	Tools	G O O D									Err inj.	
	Utilities	LSS			86	RT Alari	ms/Error	5		<i>i</i>	Alarm	
	Files	sec	0	60	120	180	240	300	360	420	Alarm/Err	
											LASER OF	
					•	Page	of 8	۲			Restart	

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7.1.6 Graph

The Graph tab brings up the screen displaying a log of the Errors recorded during the measurement interval. A dedicated page is available for each of the following error types:

- FAS
- B1
- B2
- MS-REI
- B3
- HP-REI
- LP-BIP
- LP-REI
- PDH errors depending on payload

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 (Page 3)



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7.1.7 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>.

Evaluation According to ITU-T G.821

This recommendation was originally specified for international circuit-switched N x 64kbps connections and later RXT-6200_RXT6000e_Module_Manual Page 73 of 387 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%

✓ 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.

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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.

The recommended measurement time for G.821 and G.826 is 30 days.

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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)

Bit error evaluation is disabled because G.828 evaluates block errors.

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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)

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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.

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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)

M.2101 measures block errors, therefore bit error evaluation is disabled.

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7.2 Results: SONET

7.2.1 Summary

Summary (Page 1)

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 SONET signal and its payload.

LED'S	Analysis	Histogram	Graph	Event Log	Start
	Summary	Errors	/Alarms	Signal	
😑 Signal	ST:26/08 17:24:25			ET:00/00:00:10	Err inj.
Frame	LOS Alarm			ок	Alarm
0	SONET Alarms SONET Errors			ок	Alarm/Err
Pattern	DSn/PDH Alarms			ок	
ALM/ERR	DSn/PDH Errors			ок	
		No erro	ors - OK		LASER Off
Tools					
Utilities					
Files		Page	1 of 3 🕑		Restart

SONET mapping information is displayed on page 2 and 3.

Summary (Page 2)



Summary (Page 3)

LED'S	Analysis	Histogram	Graph	Event Log	Start
	Summary	Erro	rs/Alarms	Signal	
😑 Signal		SONET	Mapping [Tx]		Errinj
🜔 Frame	1	\$1	OC-192 STS3c STS12	c STS48c STS192	Alarm
O Pattern	1 VT-GRP				Alarm/Err
	VT V 1.5 2	STS1 SPE	STS3 STS12 SPE SPE	2 STS48 STS192 SPE SPE	LASER OF
X Tools					
Utilities					
Files		Paj	ge 3 of 3 💌		Restart

7.2.2 Errors/Alarms

The Errors/Alarms tab brings up several pages showing error and alarm statuses.

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.



Errors/Alarms (Page 1)

Tapping the individual soft LED will automatically link you to the applicable result screen which provides detailed information.

The 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:

Abbreviation	Name	OH byte				
LOS	Loss of Signal					
TSE	Test Sequence Error(bit error)					
LSS	Loss of Sequence Synchronizartion					
AIS	Alarm Indication Signal					
SECTION						
OOF	Out of Frame	A1,A2				
LOF	Loss of Frame	A1,A2				
B1(8bits)	Regenerator Section Error Monitoring	B1				
TIM-S	Trace Identifier Mismatch	JO				
LINE						
AIS-L	LineAIS	К2				
RDI-L	Line Remote Defect Indication	к2				
REI-L	Line Remote Error Indication	M1				
B2(24bits)	Error Monitoring	B2				

STS-PATH	STS-PATH						
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					
B3(8bits)	Error Monitoring	B3					
UNEQ-P	C2						
VIRTUAL TRIBURTARY PATH	I (VT)						
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 defection criteria per Bellcore GR.253 and ANSI T1.105/231:

	Anomalies/Defect	Detection Criteria	Bellcore ANSI				
Section/Line Layer							
LOS	Loss of Signal	All-zero pattern for 2,3 us≤ T ≤ 100us	GR-253 T1.231				
LOF	Loss of Frame	A1, A2 No valid framing pattern for 3 ms (24 frames)	GR-253 T1_231				
B1	Section BIP error	Mismatch of the recovered and computed BIP-8 covers the whole STS-N frame	GR-253 T1.105				
B2	Line BIP error	Mismatch of the recovered and computed NxBIP-8 covers the whole STS-N frame	GR-253 T1.105				
AIS-L	Line-AIS	K2(bits 6, 7, 8) = 111 for 5 frame	GR-253 T1_231				
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	GR-253 T1.105				
RDI-L	Line Remote Defect Indication	K2(bits 6, 7, 8) = 110 for z frame (z= 5 – 10)	GR-253 T1_231				

	Anomalies/Defect	Detection Criteria	Bellcore ANSI
STS Pat	h Layer		
AIS-P	STS Path AIS	All "1" in the STS pointer bytes H1, H2 for \geq 3 frames	GR-253 T1.231
LOP-P	STS Path Loss of Pointer	8 – 10 NDF enable, 8 – 10 invalid pointers	GR-253 T1.231
В3	STS Path BIP error	Mismatch of the recovered and computed BIP-8 covers the entire STS-SPE	GR-253 T1.105
UNEQ- P	STS Path Unequipped	C2 = "0" for \geq 5 (\geq 3 as per T1.231) frames	GR-253 T1.231
тім-р	STS Path Trace Identifier Mismatch	Mismatch of the accepted and expected Trace Identifier in byte J1 (64 bytes sequence)	GR-253 T1.105
REI-P	STS Path Remote Error Indication	Number of detected B3 errors in the sink side encoded in bye G1 (bits 1, 2, 3, 4) of the source side	GR-253 T1.105
RDI-P	STS Path Remote Defect Indication	G1 (bit 5) = 1 for 10 frames	GR-253 T1.231
PLM-P	STS Path Payload Label Mismatch	Mismatch of the accepted and expected Payload Label in bye C2 for ≥ 5 (≥ 3 as per T1.231) frames	GR-253 T1.231

	Anomalies/Defect	Detection Criteria	Bellcore ANSI					
VT Path Layer								
LOM	Loss of Multiframe	Loss of synchronization on H4 (bits 7, 8) superframe sequence	GR-253 T1.105					
AIS-V	VT Path AIS	All "1" in the VT pointer bytes V1, V2 for \geq 3 frames	GR-253 T1.231					
LOP-V	VT Path Loss of Pointer	8 – 10 NDF enable, 8 – 10 invalid pointers	GR-253 T1.231					
BIP-2	VT Path BIP Error	Mismatch of the recovered and computed BIP-2 (V5 bits 1, 2) covers entire VT	GR-253 T1.105					
UNEQ- V	VT Path Unequipped	V5 (bits 5, 6, 7) = 000 for ≥ 5 (≥ 3 as per T1.231) superframes	GR-253 T1.231					
тім₋∨	VT Path Trace Identifier Mismatch	Mismatch 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	GR-253 T1.105					
RDI-V	VT Path Remote Defect Indication	V5 (bit 5) = 1 for 10super frames	GR-253 T1.231					
PLM-V	VT Path Payload Label Mismatch	Mismatch of the accepted and expected Payload Label in bye V5 (bits 5, 6, 7) for \geq 5 (\geq 3 as per T1.231) superframes	GR-253 T1.231					

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Errors/Alarms (Page 2)

Page 2 lists the SONET Errors in logical order that are associated with the signal under test. All errors are evaluated
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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.

Errors/Alarms (Page 2)

LED'S	Analysis	Hi	stogram	Graph		Event	Log	Start
	Summary		Errors	/Alarms		Signal		
😑 Signal		s	NET Errors	NET Errors: OC-192 [10G]				
0.5	ET:					00	00:00:10	Line AIS
Frame	FAS					0	0.0E+00	
O Pattern	S-BIP					0	0.0E+00	Alarm/Err
	L-BIP					2732800	2.8E-05	
ALM/ERR	REI-L					0	0.0E+00	
•	P-BIP					0	0.0E+00	LASER Off
Teals	REI-P					0	0.0E+00	
T Tools	V-BIP					0	0.0E+00	
Utilities	REI-V					0	0.0E+00	
Files		•	Page	2 of 8 🔍	>			

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Errors/Alarms (Page 3)

Page 3 lists the Section and Line Overhead Alarms in logical order associated with the signal under test. All alarms are evaluated and stored. The Elapsed Time [ET] since the start of the test is shown in the upper right hand corner.

Errors/Alarms (Page 3)

LED'S	Analysis	Hi	stogram	Graph		Event Log	Start
	Summary		Errors	/Alarms		Signal	
🧿 Signal		so	NET Alarms	: [Section/Li	ne]		
O 5	ET:					00/00:00:10	Line AIS
o Frame	LOS					0	
Pattern	LOF					0	Alarm/Err
Ŭ	SEF					0	
ALM/ERR	TIM-S						
			SONET	Alarms: (L)			LASER Off
X Tools	AIS-L						
	RDI-L					0	
Utilities							
Files		٩	Page	3 of 8 🤇	•		

The alarms associated with the Section and Line are displayed separately for ease of interpretation.

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Errors/Alarms (Page 4 & 5)

Page 4 & 5 lists the STS Path and VT path in logical order that are associated with the signal under test. All alarms are evaluated and stored.

Errors/Alarms (Page 4)

LED'S	Analysis	Histogram	Graph	Event Log	Start
	Summary	Errors	Alarms	Signal	
😑 Signal		SONET A	larms: (P)		Line BIP
🔿 Frame	ET:			00/00:00:10	Line AIS
O Pattern	LOP-P UNEQ-P	-		0	Alarm/Err
	PLM-P TIM-P			0	LASER Off
Tools	RDI-P			0	
Utilities					
Files		Page	4 of 8 💿		

Errors/Alarms (Page 5)

	LEDs	Analysis	Histo	gram	Graph	Eventi	.og	Start
		Summary		Errorsi	Alarms	Signal		
\times	Tools		s	SONET AI	arms: [VT]			ВТ
	LINE CO.	ET:					-	2M AIS
	Othities	LOM					-	
	Files	AIS-V						Alarm/Err
		LOP-V						
		UNEQ-V					ŕ	
		PLM-V					^	LASER On
		TIM-V					^	
		RDI-V					^	
		RFI-V						
				Page	5 of 8 🛛 🔍	>		Restart

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Errors/Alarms (Page 6)

Page 6 lists the **PDH/DSn Alarms** in logical order that are associated with the signal and payload under test. All alarms are evaluated and stored.

Errors/Alarms (Page 6)

LED'S	Analysis	Histogram	Graph	Event Log	Start
and a	Summary	Errorsi	Alarms	Signal	
🔵 Signal		PDH	[E1]		Line BIP
O Frame	ET: AIS			00/00:00:10 0	Line AIS
O Pattern	LOF			0	Alarm/Err
e ALM/ERR	RDI			0	
X Tools					LASER Off
Utilities		• Page	6 of 8 💿		

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Errors/Alarms (Page 7)

Page 7 lists the **PDH/DSn Errors** in logical order that are associated with the signal and payload under test. All errors are evaluated and stored.

Errors/Alarms (Page 7)



Errors/Alarms (Page 8)

Page 8 lists the BERT Errors in logical order that are associated with the signal and payload under test. All errors are evaluated and stored.

Errors/Alarms (Page 8)

e LEDs	Analysis	Histogram	Graph	Event Log	Start
	Summary	Errors	/Alarms	Signal	
X Tools		BE	RT		
Utilities	ET: LSS				
Files	віт			-	Alarm/Err
					LASER On
		Page	8 of 8 💽	>	Restart

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7.2.3 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 and duration and duration (alarms) and ratio/count (errors) are displayed.

Event Log

LED'S	Summar	٧	Errors/Ala	rms	Signal	Start
	Analysis	Histog	ram	Graph	Event Log	
Signal		Туре		Start	Dur/Count	Line BIP
O Frame	1	Start	13/04/1	1 16:21:41.0		Line AIS
- realize	2	L-BIP	13/04/1	1 16:21:49.0	313856	
O Pattern	3	L-BIP	13/04/1	1 16:21:50.0	1961216	Alarmverr
0	4	L-BIP	13/04/1	1 16:21:51.0	457728	
	5	Stop	13/04/11 16:21:51.0			TACEDOR
100	6					LASER OIT
Tools	7					
Utilities	8					
	9					
Files		٩	Page 1 of	r1 🔍		

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7.2.4 Signal

The Signal tab displays the Level and Frequency screen. Page 1 displays the level measurement in electrical units (volts) for OC-3, OC-12, OC-48 and OC-192 signals.

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

Signal (Page 1)

LED'S	Analysis	Histogram	Graph	Event Log	Start
	Summary	Errorsi	Alarms	Signal	
😑 Signal		Lev	/el		Line BIP
🜔 Frame	Rx Optical	+3dBm	SAT		Line AIS
O Pattern	Power [dBm]				Alarm/Err
	-0.96				LASER Off
X Tools					
Utilities		-30dBm	LOS		
Files		Page	1 of 4 🔍		

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Signal > Frequency (Page 2)

The received signal frequency and offset is measured and displayed. For SONET signals, the measurement is performed on both electrical (BNC) and optical interfaces.

Frequency (Page 2)

LED'S	Analysis	His	itogram	Grap	h	Event Log	Stop
	Summary		Errors/Alarms			Signal	
😑 Signal			Frequ	Frequency			
0.5	SONET current (b	ps)				9953280000	Line AIS
- Frame	Offset (ppm):					0.0	
Pattern	Min (ppm):					0.0	Alarm/Err
0	Max (ppm):					0.0	
ALM/ERR	1.5M current (bps)					1544000	
							LASER Off
X Tools							
Utilities							
Files		٩	Page	2 of 4	۲		

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

- **SONET 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.
- 45M Current: Indicates the frequency of the payload data. Options are 1.5M, 2M, 34M are displayed.

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. Low quality clock sources that deviate from the nominal value cause problems in the operation of network elements. It is necessary and recommended to measure the signal frequency at all hierarchies to reduce synchronization risks. To measure line frequency in service, the test set must be connected to a Protected Monitoring Point (PMP). The frequency of the signal is normally reported in Hz, while the deviation is reported in ppm. Tolerances for the various clock frequencies of SONET hierarchies are presented in the table below

SONET/SDH Clock Frequencies and Tolerances				
Bit rate (Mbps)	Tolerance (ppm)			
155,520	< 4.6ppm			
622,080	< 4.6ppm			
2,488,320	< 4.6ppm			
9,953,280	< 4.6ppm			

Level: Measures the Peak and Peak-Peak voltage values of the incoming signal. The levels for STS-3 electrical signal according to GR.253 recommendations are presented.

ITU-T/GR-253 Performance Analysis for PDH/DSn and SONET systems						
Analysis	PDH/DSn	SONET	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, BIP-V, DS1/E1/DS3, E1 CRC			
G.828 (In service)		~	B1, B2, TSE			
G.829 (In service)		~	B1, B2, B3, BIP-V, TSE			
M.2100	✓		DS1/E1/DS3 FAS, E1 CRC, TSE			
M.2101		~	B1, B2, B3, BIP-V, TSE			

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Optical Information (Page 3)

Page 3 displays the Optical module information which includes Vendor name, Part Number and Optical Wavelength.

Signal - Optical (Page 3)



Signal > Optical Information (Page 4)

Page 4 displays the Optical module Power Measurement Graph.

Signal - Optical (Page 4)



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7.2.5 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.

Page 1 displays the Alarms associated with the SONET Alarm.

Histogram - SONET Alarms (Page 1)



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.

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Histogram (Page 2)

Page 2 displays the Errors associated with the SONET Errors.

Histogram - SONET Errors (Page 2)



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Histogram (Page 3)

Page 3 displays the Alarms and Errors associated with the STS PATH. The measured parameters are:

- AIS-P, STS Path AIS
- LOP-P, STS Path LOP

Histogram - P Alarms/Errors (Page 3)



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Histogram (Page 4)

Page 4 displays the Alarms and Errors associated with the STS Path. The measured parameters are:

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- UNEQ-P (STS Path-Unequipped)
- PLM-P (STS Path-Payload Mismatch)
- TIM-P (STS Path-Trace Identifier Mismatch)
- RDI-P (STS Path-Remote Defect Indication)
- B3 errors
- REI-P (STS Path-Remote Error Indication)

Histogram - P Alarms/Errors (Page 4)



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Histogram (Page 5)

Page 5 displays the Alarms and Errors associated with the Virtual Tributary (VT).

- AIS-V (VT-Alarm Indication Signal)
- LO-VP (VT-Loss of Pointer)

Histogram - VT Alarms/Errors (Page 5)



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Histogram (Page 6)

Page 6 displays the Alarms and Errors associated with the VT Path. The measured parameters are:

- UNEQ-V (VT-Unequipped)
- PLM-V (VT-Payload Mismatch)
- TIM-V (VT-Trace Identifier Mismatch)
- RDI-V (VT-Remote Defect Indication)
- RFI-V (VT-Remote Fault Indication)
- BIP-V (VT-Bit Interleaved Parity)
- REI-V (VT-Remote Error Indication)

Histogram - VT Alarms/Errors (Page 6)



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Histogram (Page 7)

Page 7 displays the **Alarms** and **Errors** associated with the payload. The measured parameters depend on the payload selected.

Histogram - DS1 Alarms (Page 7)



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Histogram (Page 8)

Page 8 displays the **Bit Errors** associated with the test pattern.

Histogram - BERT Alarms/Errors (Page 8)

LED'S		Sum	mary		Errors/A	larms		Signa	ıl	Start	
	1	nalysi	5	Histog	ram	Gra	ph	Eve	nt Log		
😑 Signal	3	+	•		RT Alar	ns/Errora				Line BIP	
O Frame	LSS BIT				D L CIWI				i i i i i i i i i i i i i i i i i i i	Line AIS	Ì
O Pattern	sec	0	60	120	180	240	300	360	420	Alarm/Err)
										LASED OF	
X Tools										CASER OIL	/
Utilities											
Files				•	Page 8	of8	۲				

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7.2.6 Graph

The Graph tab brings up the screen displaying a log of the Errors recorded during the measurement interval. A dedicated page is available for each of the following error types:

- FAS
- B1
- B2
- REI-S
- B3
- REI-P
- BIP-V
- REI-V
- PDH/DSn errors depending on payload

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 (Page 1)



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7.2.7 Performance Analysis

G.821 Analysis



The Analysis tab displays measured objectives from ITU-T performance tests selected from the Measurements tab (Setup > Measurements). Please see <u>Analysis</u> for information on the Analysis tab and test definitions. For a brief description of supported G-Series and M-Series performance tests as well as setup instructions, please see <u>Performance Analysis</u>.

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7.3 Results: OTN

Measurements are accessed by tapping the Results icon in the main menu. The results comprise a range of tabbed pages, similar to the setup pages.

7.3.1 Summary

The Summary tab displays a summary page 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 OTN/SDH signal and its payload. And also shows OTN/SDH mapping information that can identify the setup in results.

Event Log Analysis Histogram Graph LED'S Stop Errors/Alarms Summary Signal BIT 🔵 Signal ST:31/08 14:02:47 ET:00/00:00:59 LOS Alarm 2M AIS 🔵 Frame OK **OTN Alarms** OK Alarm/Err OTN Errors 😑 Pattern OK SDH Alarms OK SDH Errors ALM/ERR PDH Alarms LASER Off OK PDH Errors Tools No errors - OK Utilities • Page 1 of 3 lacksquareFiles Restart

Summary (Page 1)

And also shows OTN/SDH (or OTN/SONET) mapping information that can identify the setup in results.

• RX Mapping

Summary (Page 2)



• TX Mapping

Summary (Page 3)

LED'S	Analysis	Histogram	Grap	n	Eve	ant Log	Stop
	Summary	Error	s/Alarms		Signal		
😑 Signal		SDH Ma	pping [Tx]				ВІТ
😑 Frame		0	TU-2 'M-64				2M AIS
O Pattern	1 AUG			404	AU4	AU4	Alarm/Err
	AU3		104	40			LASER Off
X Tools	1 TUG2						
Utilities	TU11 TU12 VC11 VC12	TU3 VC3	VC4	/C4 -4c	VC4 -16c	VC4 -64 c	
Files		Page	e 3 of 3	۲			Restart

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7.3.2 Errors and Alarms

The Error/Alarm tab brings up several pages showing the errors and alarm 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



Errors/Alarms (Page 1)

Tapping the individual soft LED will automatically link directly to the applicable result screen which provides detailed information.

The LED headers are described in the table below:

	Alarm Definitions and Descriptions				
στυ	Optical channel Transport Unit				
ODU	Optical channel Data Unit				
OPU	Optical channel Payload Unit				
RS	Regenerator Section				
MS	Multiplexer Section				
AU	Administrative Unit				
HP	High Order Path				
τυ	Tributary Unit				
ĽP	Lower Order Path				
E1	2Mbit/s signal (depend on payload selected)				
PAT	Pattern detection (PRBS, User, fixed words)				

OTN Error and Alarm definitions per ITU-T G.709 recommendations:

OTU Alarm Definitions Detection criteria according to G.709 and G.798					
LOF	Loss of Frame - Declared when the OOF states have been constantly observed for 3 ms respectively				
OOF	Out of Frame - Declared if it fails to find an FAS sub-pattern (FAS bytes 3, 4, and 5) for five consecutive frames.				
LOM	Loss of Multiframe - Declared when the OOF states have been constantly observed for 3 ms respectively				
оом	Out of Multiframe - Declared when the received MFAS is out of sequence for five consecutive frames				
OTU-AIS	Alarm Indication Signal - PN-11 sequence (covers complete Och) \ge 3 x 8192 bits				
otu-iae	 Incoming Alignment Error This bit allows the ingress to inform the egress that an alignment error in the incoming signal has been detected. IAE = 1 with error IAE = 0 no error Status (STAT) These three bits indicate the presence of maintenance signals (AIS, OCI, TCM, IAE) 				
otu-BDI	 Backward Defect Indication This single bit conveys information regarding signal failure in the upstream direction BDI = 1 indicates OTUk backward defect BDI = 0 otherwise 				
ΟΤU-ΠΜ	Trail Trace Identifier Mismatch				

OTU Error Definitions Detection criteria according to G.709 and G.798					
FAS	Frame alignment signal - Uses the first six bytes and , to provide framing for the entire signal				
MFAS	Multiframe alignment signal - Used to extend command and management functions over several frames. The MFAS counts from 0 to 255, providing a 256 multiframe structure.				
BIP-8	Bit interleaved parity-8 code				
BEI	Backward error indication -SM byte 3, bit 1 to 4: value 0 to 8: SM BIP-8 error count value 9 to 15: no SM BIP-8 errors value 11: SM BIAE				
BIAE	Backward incoming alignment error - SM byte 3, bit 1 to 4: "1011" ≥ 3 frames				
CFEC	Correctable FEC error				
UFEC	Uncorrectable FEC error				

	ODU Alarm/Error Definitions Detection criteria according to G.709 and G.798					
ODU-BEI	Backward error indication -PM byte 3, bit 1 to 4: value 0 to 8: SM BIP-8 error count value 9 to 15: no SM BIP-8 errors					
ODU-AIS	Alarm Indication Signal - PM byte 3, bit 6 to 8: " $111'' \ge 3$ frames					
ODU-OCI	Open connection indication - PM byte 3, bit 6 to 8: " $110^{"} \ge 3$ frames					
ODU-LCK	Locked - PM byte 3, bit 6 to 8: "101" ≥ 3 frames					
ODU-BDI	Backward Defect Indication - PM byte 3, bit 5 = $1 \ge 5$ frames					
ODU-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.					
ODU-TIM	Trail Trace Identifier Mismatch					

SDH/PDH alarms are described previously

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Errors/Alarms (Page 3)

Page 3 lists the **OTU Errors** 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. Error conditions are displayed in red

including count and rate.

Errors/Alarms (Page 3)

LED'S	Analysis	Hi	stogram	Grap	h Ev	rent Log	Stop
	Summary		Errors	Alarms	Sig	nal	
😑 Signal			οτυ	Errors			вп
0.5	ET:					00/00:03:40	2M AIS
- Frame	FAS					0 0.0E+00	
O Pattern	MFAS					0 0.0E+00	Alarm/Err
	BIP					0 0.0E+00	
ALM/ERR	BEI					0 0.0E+00	
Ŭ	Corr Fec					0 0.0E+00	LASER Off
Tools	Unc Fec					0 0.0E+00	
Utilities							
Files		٩	Page	3 of 14 🤇	۲		Restart

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Errors/Alarms (Page 4 & 5)

Page 4 lists the **OTU Alarms** in logical order associated with the signal under test. All alarms are evaluated and stored. The Elapsed Time [ET] since the start of the test is shown in the upper right hand corner.

Errors/Alarms (Page 4)



Errors/Alarms (Page 5)

LED'S	Analysis	His	stogram	Graph		Event Log	Stop
	Summary		Errors	Alarms	\$	Signal	
😑 Signal			οτυ	Narms			ВІТ
• •	ET:					00/00:05:43	2M AIS
Frame	AIS					0	
Pattern	IAE					1	Alarm/Err
Ŭ	BDI						
ALM/ERR	тім	l					
							LASER Off
Tools							
Utilities							
Files		٩	Page	5 of 14 🔍	>		Restart

The alarms associated with the Section and Line are displayed separately for ease of interpretation.

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Errors/Alarms (Page 6 & 7)

Page 6 & 7 lists the **ODU/OPU errors and alarms** in logical order that are associated with the signal under test. All alarms are evaluated and stored.

Errors/Alarms (Page 6)



Errors/Alarms (Page 7)

LED'S	Analysis	His	stogram	Graph		Event Log	Stop
	Summary		Errors	Alarms		Signal	
😑 Signal			ODU	Alarms			ВІТ
0	ET:					00/00:08:42	2M AIS
e Frame	AIS					0	
Pattern	осі					0	Alarm/Err
U	LCK					0	
😑 ALM/ERR	BDI					2	
	тім						LASER Off
X Tools			OPU /	Marms			
	PLM	l				-	
Utilities							
Files		٩	Page	7 of 14 🔍	>		Restart

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Errors/Alarms (Page 8 to 14)

Page 8 to 14 lists the **SDH/PDH Alarms** in logical order that are associated with the signal and payload under test. All alarms are evaluated and stored.

See SDH details in Section 7.1

Signal (Pages 1 to 4)

The signal tab displays the Level, Frequency and related screens.

- Optical Level (Page 1):
 - The optical level measurement for OTU-1 and OTU-2 signals is displayed in dBm.
 - Loss of Signal (LOS) and the Saturation levels is shown both graphically and in dBm.



Signal (Page 1)

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• Frequency (Page 2)

• The received signal frequency and offset is measured and displayed. RXT-6200_RXT6000e_Module_Manual

- For OTN signals, the measurement is performed on the optical interfaces (SFP+ for OTU-1 and OTU-2).
- OTN Current: 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
- SDH Current: Indicates the frequency of the SDH or SONET signal carried with the OTU frame
- 2M Current: Indicates the frequency of the PDH or T-Carrier payload. Options 1.5Mbps, 45Mbps, 34Mbps, 139Mbps

Signal (Page 2)

LED'S	Analysis	Hi	stogram	Graph	Event Log	Stop
	Summary		Errors	/Alarms	Signal	
😑 Signal			Freq	uency		ВІТ
0	OTN current (bps))			10709225472	2M AIS
Frame	Offset (ppm):				0.0	
Pattern	Min (ppm):				-2.1	Alarm/Err
U	Max (ppm):				2.0	
ALM/ERR	SDH current (bps)				9953281024	
	2M current (bps)				2047992	LASER Off
X Tools						
Utilities						
Files		٩	Page	2 of 4 🔍		Restart

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- Optical Information (Page 3)
 - The Optical Transceiver (SFP or XFP) information including Vendor name, Part #, Firmware revision #, Optical Wavelength, Min/Max bit rates supported and Dynamic Range

LED'S	Analysis	Histogram	Graph	Event Log	Stop
	Summary	Errors	/Alarms	Signal	
😑 Signal		Opt	tical		
Frame	Vendor	FINISAR CORP.			2M AIS
U	Part Number Vendor Rev	00			Alarm/Err
Pattern	Wavelength			1310	
ALM/ERR	Min Rate			9900 Mbps	
Ŭ	Max Rate			11100 Mbps	LASER Off
X Tools		10 Gigabit Etherno 10 Gigabit Fibre C SONET/SDH - I-64	et - 10GBASE hannel - 1200- .1r; I-64.1;	-LR; 10GBASE-LW; ·SM-LL-L;	
Utilities	Transceiver				
Files		Page	3 of 4 💿)	Restart

Signal (Page 3)

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• Optical Histogram (Page 4)

• Displays the Optical Transceiver Power Measurement Graph.

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• This is useful for troubleshooting defective XFPs or for monitoring intermittent optical power fluctuations

Signal (Page 4)

LED'S	Analysis	Histogram	Graph	Event Log	Stop
	Summary	r Error	s/Alarms	Signal	
😑 Signal	XFP <	• • >			ВІТ
😑 Frame	0				2M AIS
O Pattern	-10				Alarm/Err
ALM/ERR	-20				
Tools	-30				LASER Off
	-40				
Utilities	min 0	10	20	30	
Files		Page	e 4 of 4 💿		Restart

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8.0 SDH/PDH Alarms

Accessing Alarm Generation and Error Insertion

Tap on Home (main menu) >Advanced Mode> Alarm/Error

The alarm and error functions are used in conjunction with the drop-down menu which has dedicated buttons for error injection and alarm generation. Alarm and error selections will depend on PDH, SDH, or OTN signal types.

Alarm Setup

	LED'S		Start		
	110 3	Alarm Mode	PDH	V	
\mathbf{x}	Tools	PDH Alarm Type	2M AIS Alarm Mode		BIT
		Alarm Flow	PDH	▼	2M AIS
	Utilities	Alarm Length	PDH	▼	
			SDH		Alarm/Err
	Files	Error Mode	OTN	V	
		Pattern Error Type		▼	
		Error Flow		•	LASER On

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8.1 Alarm Generation

Generation range of different anomalies into the transmit signal. Alarm generation modes include:

- Alarm Flow
 - Continuous: Generates a continuous alarm when button is tapped
 - Count: Specific count for 0.1s, 1s, 10s, 100s when button is tapped

Alarm/Error Generation



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8.1.1 PDH Alarms

The following PDH and T-Carrier alarms can be generated:

- E1 signals: LOS, LOF, AIS, RDI
- E3 signals: LOS, LOF, AIS, RDI
- E4 signals: LOS, LOF, AIS, RDI
- DS1 signals: AIS, Yellow, idle, LOS, LOF
- DS3 signals: LOS, LOF, OOF, AIS, Parity

Mode: Static (enable/disable) using drop-down menu function.

PDH Alarm Type

	1	Alarm		Start
LED 3	Alarm Mode	PDH	V	
X Tools	PDH Alarm Type	2M AIS PDH Alarm Type		2M FAS
	Alarm Flow	2M AIS	▼	2M AIS
Utilities		2M LOS		
	Error Mode	2M AIS	▼	Alarm/Err
Files	PDH Error Type	2M LOF	V	
	Error Flow	2M RDI	Ť	
			•	
			,	

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8.1.2 SDH Alarms

The following SDH Alarms can be generated:

- **STM-1/4/16/64 (depends on signal structure):** LOS, LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HP-UNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LP-UNEQ, LP-PLM, LP-RDI, LP-RFI, LP-TIM
- Payload alarms (depends on payload): DS1-AIS, DS1-LOF, 2M-AIS, 2M-RDI, 2M-LOF, 34M-AIS, 34M-LOF, 34M-RDI, 45M-AIS

Mode: Static (enable/disable) using drop-down menu function.

SDH Alarm Type

	د		Start		
	3	Alarm Mode	SDH	V	
X Tool	ls	SDH Alarm Type Alarm Flow	SDH LOS SDH Alarm Type SDH LOS	V	2M FAS
Utilit	ties		SDH LOS		SURLUS
		Error Mode	SDH LOF	V	Alarm/Err
Files	-	PDH Error Type	SDH MS AIS	▼	
		Error Flow	SDH MS RDI	T	
			SDH RS TIM	· · ·	
			SDH AU LOP		
			SDH AU AIS		
			SDH HP UNEQ		
			🕙 1 of 3 🕑		

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8.1.3 OTN Alarms

The following OTN alarms can be generated:

- OTU-1/OTU-2: LOS, LOF, OOF, OOM, LOM, AIS, IAE, BDI, TIM
- ODU-1/OPU-2:AIS, OCI, LCK, BDI, TIM
- **OPU-1/OTU-2:** PLM
- **SDH Payload alarms:** LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HP-UNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LP-UNEQ, LP-PLM, LP-RDI, LP-RFI, LP-TIM
- PDH Payload alarms (depends on payload): DS1-AIS, DS1-LOF, 2M-AIS, 2M-RDI, 2M-LOF, 34M-AIS, 34M-LOF, 34M-RDI, 45M-AIS

Mode: Static (enable/disable) using drop-down menu function.

OTN Alarm Type



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8.2 Error Insertion

OTN, SDH, PDH and T-Carrier errors can be generated. RXT-6200_RXT6000e_Module_Manual

	LED'S	A	Start	
		Alarm Mode	OTN 🔻	
1	Tools	OTN Alarm Type	OTN LOS 🗸 🔻	OTU FAS
		Alarm Flow	Continuous 🛛 🔻 🔻	
	Utilities	E	rror	UINLOS
		Error Mode	οτη 🔻	Alarm/Err
	Files	OTN Error Type	OTU FAS 🛛 🔻	
		Error Flow	Single 🔻	
				LASER Off

8.2.1 PDH & T-Carrier Errors

The following PDH and T-Carrier errors can be inserted:

- E1 signals: Code, FAS, CRC, REI, E-bit, Bit
- E3 signals: Code, FAS, Bit
- E4 signals: FAS, Bit
- DS1 signals: Code, FAS, Bit
- DS3 signals: Code, FAS, Bit

PDH Error Type



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8.2.2 SDH Errors

The following **SDH errors** can be generated:

- STM-1/4/16/64 signals: FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI,
- Depends on payload: 2M-FAS, 2M-CRC, 2M-REI, 34M-FAS, 45M-FAS, 1.5M-FAS

SDH Error Type

LED'S		Start		
	Alarm Mode	SDH	V	
Tools Utilities Files	SDH Alarm Type Alarm Flow Error Mode SDH Error Type Error Flow	SDH SDH LOS SDH Error Type SDH FAS SDH B1 SDH B2 SDH MS REI SDH MS REI SDH B3 SDH HP REI SDH LP BIP SDH LP REI	▼ ▼ ▼ ▼	SDH FAS SDH LOS Alarm/Err

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8.2.3 OTN Errors

- OTU-1/2 signals: FAS, MFAS, BIP, BEI, Corrected FEC errors, Uncorrectable FEC
- ODU-1/2 signals: BIP, BEI
- STM-16/64 signals: FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI,
- Depends on payload: 2M-FAS, 2M-CRC, 2M-REI, 34M-FAS, 45M-FAS, 1.5M-FAS

OTN Error Type

	LED'S	Alarm			Start
		Alarm Mode	OTN	V	
\mathbf{x}	Tools	OTN Alarm Type	OTNLOS	. ▼	OTU FAS
		Alarm Flow	OTU FAS	T	
	Utilities		OTU FAS		
		Error Mode	OTU MFAS	V	Alarm/Err
	Files	OTN Error Type	OTU BIP	▼	
		Error Flow	OTU BEI	T	
			COR FEC		
			UNCOR FEC		LASER Off
			ODU BIP		
			ODU BEI		
				J	

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Error Flow: OTN, SDH, SONET, PDH signals

Injects different anomalies into the transmit signal. Error insertion flow modes include:

- Single: Inserts a single error every time the insertion button is tapped
- Count: Specific count or number of errors when the insertion button is tapped
- **Rate:** Specific rate between 1×10^{-3} and 5×10^{-6}

The list of available error types depends on the type of framing being used and the SDH or PDH hierarchies and line interfaces that have been selected.
Error Flow

Alarm Mode PDH V PDH Alarm Type 2M AIS V Alarm Flow Single V Utilities Alarm Length Single V	
Tools PDH Alarm Type 2M Als V Alarm Flow Error Flow Single V Utilities Alarm Length Single V	
Files Error Mode Count Rate V Pattern Error Type Error Flow V LASE	AIS IN/Err

Alarm Generation/Error Insertion

At any time during the test process, tap the **Error Injection** or **Alarm Generation** buttons to inject errors or generate alarms.

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9.0 OTN Tools

9.1 Shortcuts

Accessing OTN Tools

Tap on Home (main menu) > OTN Tools

OTN Tools Menu



• 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:

- 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.

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9.2 Overhead Analyzer & Generator

Tap the **Overhead Analyzer** icon to display the OH screens shown below.

Overhead Analyzer Menu

LED'S		Analysis														
			F/	AS			MF		SM		GC	C0	RI	s	RES	JC
😑 Signal	OA1	OA1	OA1	OA2	OA2	OA2		TTI	BIP	BEI						
C Frame	F6	F6	F6	28	28	28	2D	TI	24	00	00	00	00	00	00	00
		RES		тс	TC TCM6			TCM5		TCM4		FT	RES	JC		
Pattern					TTI	BIP	BEI	тті	BIP	BEI	TTI	BIP	BEI			
<u> </u>	00	00	00	00	TI	3C	01	ті	3C	01	TI	B7	01	FT	00	00
	TCM3 TCM2				TCM1			PM EXP			(P	RES	JC			
Contrada	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	TTI	BIP	BEI	RR	RR		
10015	TI	87	01	TI	8A	01	TI	8A	01	TI	C6	00	00	00	00	00
Utilities	GC	:01	GC	C2		APSI	PCC				R	ES			PSI	NJO
Files	00	00	00	00	00	00	00	00	00	00	00	00	00	00	02	00
ΟΤυ						0	PL	J						0	DU	

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.

Byte Analyzer - Advanced Decode

LED'S	Byte Analyzer						
C Signal	Туре	OTU FAS					
0	Byte	1					
😑 Frame	Value	F6					
O Pattern	Binary	11110110					
X Tools							
Utilities	J						
Files							

9.2.1 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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9.2.2 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.

LED'S		Byte Analyzer							
Signal	Туре	OTU SM TTI							
0	Byte	1							
🜔 Frame	SAPI	VEEX SAPI TRACE							
O Pattern	DAPI	VEEX DAPI TRACE							
	User	OPERATION BYTES FOR USER DEFINE							
X Tools	J								
Utilities	J								
Files									

SM TTI Type

• General Communication Channel 0 (GCC0)

• Clear channel used for transmission of information between OTU termination points

GCCO Type

LED'S		Byte Analyzer	
C Signal	Туре	οτυ GCC0	
•	Byte	1	
🜔 Frame	Value	00	
O Pattern	Binary	0000000	
X Tools			
Utilities			
Files			

Reserved (RES) bytes are currently undefined in the standard.

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9.2.3 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.





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

LED'S	Byte Analyzer							
C Signal	Туре	ODU PM TTI						
~	Byte	1						
😑 Frame	SAPI	VEEX SAPI TRACE						
DAPI	DAPI	VEEX DAPI TRACE						
Pattern	User	OPERATION BYTES FOR USER DEFINE						
X Tools								
Utilities								
Files								

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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.

LED'S	Byte Analyzer						
Signal	Туре	ODU TCM1 BEI					
•	Byte	3					
🜔 Frame	Value	01					
0	Bit 5: BDI	o					
Pattern	Bits 6-8: Request	001					
	T.	In use without IAE					
X Tools							
Utilities							
Files							

TCM1 BEI Type

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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

LED'S	Byte Analyzer						
Signal	Туре	ODU FTFL					
•	Forward Indication	00					
🜔 Frame		No fault					
O Dattara	Backward Indication	00					
Pattern		No fault					
X Tools							
Utilities							
Files							

ITU-T G.709 Figure 15-20

	FTFL message structure											
0 1			126	127	128	129					25	5
	I	Forward field					Bac	ward fi	eld			
0	1	9	10								12	27
Fault indication field	id	Operator entifier field			0	perato	r spe	cific fiel	d			
	· · · ·			Forv	vard f	ield						
								ITU-1	ΓG.	709	Figu	re 15-20
128	129) 137	138								25	i5
Fault indication field	id	Operator entifier field			0	perato	or spe	cific fiel	ld			
	<u> </u>		·	Back	ward	field						
								ITU-1	ΓG.	709	Figu	re 15-21
Fau	ılt in	dication codes										
Fault Cod	е	Definition										
0000 0000)	No fault										
0000 0001	1	Signal fail										
0000 0010)	Signal degrade										
0000 0011 1111 1111		Reserved for futu standardization	ıre ı									
ITU-T G	.70	9 Figure 15-	6									

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• Experimental (EXP)

• Field not subject to standards and is available for network operator applications

EXP Type

LED'S	Byte Analyzer							
C Signal	Туре	ODU EXP						
•	Byte	1						
🜔 Frame	Value	00						
Pattern	Binary	0000000						
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

GCC1 Type

LED'S	Byte Analyzer						
Signal	Туре	ODU GCC1					
0	Byte	1					
😑 Frame	Value	00					
0.0	Binary	0000000					
Pattern							
X Tools							
Utilities							
Files							

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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

LED'S	Byte Analyzer						
Signal	Туре	ODU APS/PCC					
0	Byte	1					
😑 Frame	Value	00					
0.0	Bits 1-4: Request	0000					
O Pattern		NR					
O ALMERR	Bit 5: A	No APS Channel					
	Bit 6: B	1+1					
Tools	Bit 7: C	Uni-directional					
	Bit 8: D	Non-Revertive					
Utilities							
Files							

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9.2.4 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.

LED'S	Byte Analyzer			
Signal	Туре	o	PU PSI	
0	Value	02	2	
🜔 Frame	Decode	A	sync CBR	
O Pattern				
X Tools]			
Utilities				
Files				

OPU PSI Type

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.709.



OPU2, O/H for synch mapping of 10 Gb/s SDH/SONET

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9.3 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.

Payload]	Label
-----------	-------

LED'S		тх		RX
	Label		2	
😑 Signal	Decode	Decode	CBR	▼
~		Async	CBR	
😑 Frame		Experime	ental	
-		Async	CBR	
Pattern		Bit sync (CBR	
			ATM	
ALM/ERR			GFP	
		Virt Concat s	ignal	
Teals		Bit stream w/octet tir	ning	
		Bit stream w/o octet tir	ning	
Utilities		1 of 2	∍	
Files				

PSI[0] contains a one-byte Payload type. PSI[1] to PSI[255] are mapping and concatenation specific.

MSB 1 2 3 4	LSB 5678	Hex code (Note 1)	Interpretation
0000	0001	01	Experimental mapping
0000	0010	02	Asynchronous CBR mapping
0000	0011	03	Bit synchronous CBR mapping
0000	0100	04	ATM mapping
0000	0101	05	GFP mapping
0000	0110	06	Virtual Concatenated signal
0001	0000	10	Bit stream with octet timing mapping
0001	0001	11	Bit stream without octet timing mapping
0010	0110	20	ODU multiplex structure
0101	0101	55	Not available
0110	0110	66	Not available
1000	XXXX	80-8F	Reserved codes for proprietary use
1111	1101	FD	NULL test signal mapping
1111	1110	FE	PRBS test signal mapping
1111	1111	FF	Not available

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9.4 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)



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9.5 TCM Tasks (Tandem Connection Monitoring)

Tap the TCM Tasks icon to display the screen shown below.

TCM Tasks



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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10.0 SDH/SONET Tools

10.1 SDH Tools

Accessing SDH Tools

Tap on Home (main menu) >SONET/SDH Tools

10.1.1 Shortcuts

SDH/SONET Tools Menu



- **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.
- **APS Testing:** Used to measure Automatic Protection Switching limits. Using selectable triggers, the drop out times of tributary connections are measured and compared with preset values.
- **Tributary Scan:** Used to scan individual or multiple tributaries to verify routing and error free operation. Only available in VC-12 or VC-11mode
- **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.
- Round Trip Delay (Propagation Delay): Measurement works by sending a test pattern. Bit errors are transmitted in the pattern. The time it takes for the error to reach the receiver is the propagation time through the network.

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10.1.2 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

SOH

LED'S		SOH			РОН			Summary	
	C.	ST	M# 1				34 		
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 0A	H2 0A	H2 OA	H3 00	H3 00	H3 00
	82 32	82 46	82 48	K1 00	öö	öö	K2 00	öö	öö
Tools	D4 00	öö	öö	D5 00	öö	öö	D6 00	öö	öö
	D 7	öö	öö	D8 00	öö	öö	D9 00	öö	öö
Utilities	D10 00	öö	00	D11 00	öö	öö	D12 00	00	öö
Files	\$1 00	Z1 00	Z1 00	72 00	72 00	72 00	62 00	öö	öö

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

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]	
0	Value	F6	
😑 Frame	Binary	11110110	
O Pattern			
O ALM/ERR			
X Tools			
Utilities	J		
Files			

RXT-6200_RXT6000e_Module_Manual

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

Path Trace Byte (J0)

LED'S		Byte Decoder	
Signal	Byte	J0 [RS Path trace]	
0	Length	16 Bytes	
😑 Frame	Trace	VEEX RS	
O Pattern			
X Tools	J		
Utilities			
Files			

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

AU Pointer Byte

e LED'S	Byte Decoder		
Signal	Byte	H1 [AU Pointer]	
•	Value	6A	
😑 Frame	Binary	01101010	
O Pattern			
X Tools			
Utilities			
Files			

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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

K1 Byte (APS-Linear)

LED'S	Byte Decoder		
Signal	Byte	K1 [APS Linear]	
0	Value	00	
😑 Frame	Message	0000	
O Dattara		No Request	
Pattern	Channel	0000	
C ALM/ERR		NULL	
X Tools			
Utilities			
Files			



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]	
0	Value	00	
😑 Frame	Channel	0000	
O Pattern		NULL	
	Path	0	
ALM/ERR		1+1	
	Message	000	
X Tools		Future use	
Utilities	j		
Files			

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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)

ee LED'S		Byte Decoder
Signal	Byte	S1 [Sync Status]
0	Value	00
🜔 Frame	Channel	0000
O Pattern	Message	0000
Pattern		Quality unknown
O ALM/ERR		
X 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)

e LED'S		Byte Decoder	
C Signal	Byte	J1 [HP Path trace]	
<u> </u>	Length	16 Bytes	
😑 Frame	Trace	VEEX HP	
O Pattern			
O ALM/ERR			
X Tools			
Utilities	J		
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)

?

	C2 byte stri	ucture 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 34Mbit/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	18	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)

• 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)

G1 Byte (HP Status)

LED'S		Byte Decoder							
Signal	Byte	G1 [HP Status]							
-	Value	00							
😑 Frame	REI	0000							
0.0	RDI	000							
Pattern	Spare	0							
X Tools									
Utilities									
Files									

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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]
•	Value	84
😑 Frame	BIP	10
0.0	REI	0
Pattern	RFI	0
O ALM/ERR	Label	010.
-		Async
X Tools	RDI	0
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 farend
- 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				
BIP-2		Fixed [1]	I-AIS	TC-REI	OEI	TC-API, ODI, R	TC-RDI, eserved				

• 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 contain the

K4 multiframe structure per ITU-T G.707 recommendations																											
- 20 40	6	~	8	9	10	1	12	ವ :	2	5	6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Multiframe Alignment Signal					đ	E	Exte	en	de	d S	ig	nal		0	T	-	m	-	m	T	-	_	_	_	-		
Frame count	Se	eq. i	Ind	lica	tor				I	ał	eł	Ĩ			Ű	2	~	~	ĩ	~		~	~	~	~	~	~

	K4 byte structure per ITU-T G.707 recommendations											
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8					
Extended Signal Label	Virtual concatenation Overhead	Onassigned			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

LED'S			SOH	POH	Summary
Signal	JO	N/A	VEEX RS^	-^tz.@8y.@^	
Frame	J1	N/A	VEEX HP		
Pattern	J2 K1	00	VEEX LP 0:No Request		
ALM/ERR	K2 51	00	0;Future use;1+1 Quality unknown		
	V5	02 C4	Async		
Tools					
Utilities					
Files					



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10.1.3 Overhead Generator

SOH

LED'S		SOH			РОН		Summary			
		ST	M# 1							
Signal	A1 F6	A1 F6	A1 F6	A2 28	A2 28	A2 28	J0 xx	ÄÄ	ÄÄ	
🜔 Frame	B1 xx	öö	öö	E1 00	öö	öö	F1 00	öö	öö	
Pattern	D1 00	öö	00	D2 00		öö	D3 00	00	00	
-	H1 6A	H1 93	HI SS	H2 OA	靜	靜	H3 00	H3 00	H3 00	
	B2 xx	B2 xx	B2 xx	K1 00	öö	öö	K2 00	öö	öö	
X Tools	D4 00	öö	öö	D5 00	öö	öö	D6 00	öö	öö	
	D7 00	öö	öö	D8 00	öö	öö	D9 00	öö	öö	
Utilities	D10 00	öö	öö	D11 00	öö	öö	D12 00	öö	öö	
Files	\$1 00	Z1 00	Z1 00	2200	72 00	72 00	E2 00	öö	öö	

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. 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.

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

e LED'S		Byte Generator							
C Signal	Byte	S1 [Sync Status]							
-	Value	00							
😑 Frame	Channel	0000							
0.0	Message	0000							
Pattern		Quality unknown	▼						
X Tools									
Utilities									
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	
🔵 Signal	Byte	C2 [HP Signal label]	
	Value	02	
😑 Frame	Binary	00000010	
O Pattern		TUG structure	
X Tools			
Utilities			
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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10.1.4 Pointer Tasks

Tap the **Pointer** Tasks icon to display the Pointer testing screens.

SDH/SONET Tools Menu



10.1.4.1 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 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

Analysis > AU tab

e LED'S	Analysis	Generator	G.783	Stop
	AU		τυ	
😑 Signal		AU Pointer		SUNTAS
C Frame	SS Bits		SDH [10]	SDH MS RDI
	Pointer Value		522	
Pattern	LOP			AlarmVErr
Ŭ	PJE		0s 0	
ALM/ERR	NJE		0s 0	
	NDF		0s 0	LASER Off
X Tools	Diff		0	
	Sum		0	
Utilities	Implied Offset [ppm]		0.00 ppm	
Files				

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

Analysis > TU tab

LED'S	Analysis	Generator		G.783	Stop
	AU		TU		
😑 Signal		TU Pointer			SUNTAS
C Frame	Pointer Value			78	SDH MS RDI
	LOP			0	
Pattern	PJE		0 s	0	AlarmyErr
Ŭ	NJE		0 s	0	
ALM/ERR	NDF		0 s	°	
	Diff			0	LASER Off
X Tools	Sum			0	
	Implied Offset [ppm]			0.00 ppm	
Utilities					
Files					

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10.1.4.2 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.
 - Increment (INC) or Decrement (DEC) pointers with identical polarity by 1 byte in single steps.

Generator > AU tab

LED'S	Analysis	Gene	erator	G.783	Start
	AU			τυ	
😑 Signal	Sequence		Basic	▼	
C Frame	SS Bits		SDH [10]	▼	SDHLOS
	NDF		OFF	V	
Pattern		Adjus	tment		Alarmverr
-	Adjustment		Increment	▼	
ALM/ERR	Insertion				
	Mode		Continuous	v	LASER Off
X Tools	Interval		100		
Utilities					
Files			Start		

- 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

LED'S	Analysis	Genera	tor	G.783	Start
	AU			TU	
😑 Signal	Sequence	Ba	sic	V	
C Frame	NDF	OF	F	V	SDHLOS
0		Adjustm	ient		
Pattern	Adjustment	Inc	rement	V	Alarmverr
Ŭ		Inserti	on		
ALM/ERR	Mode	Co	ntinuous	₹	
	Interval	100	0		LASER Off
X Tools					
Utilities					
Files			Start		

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10.1.4.3 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
-------	---	----	-----

LED'S	Analysis	Gene	rator	G.783	Start
	AU			τυ	BIT
Signal	Sequence	4	Single Altern	ating 🔻 🔻	
😑 Frame	Adjustment	I	ncrement		SDHLOS
	T1	8	30000		Alarm/Err
Pattern					
ALM/ERR					
					LASER Off
X Tools					
Odifices					
Files			Start		

G.783 Identifier	Pointer adjustments	Mnemonic
Single Alternating	Single of opposite polarity	+-
RegularAdd	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

G.873 > TU tab

LED'S	Analysis	Gener	rator	G.783		Start
	AU			τu		PIT
😑 Signal	Sequence	R	tegular Add		▼	
C Frame	Adjustment	Ir	ncrement		▼	SDHLOS
	T2	6	000			
Pattern	тз	1	6			Alarm/Err
Ŭ	T4	2	40000			
ALM/ERR						
X Tools						LASER Off
Utilities						
Files			Start			

	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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10.1.5 Trace Identifier

Tap the **Trace** Identifier icon to display the path trace testing application and screens.

SDH/SONET Tools Menu



There are dedicated tabs for Transmitted and Received (expected) path traces and setups.

10.1.5.1 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

To program or edit the transmitted trace, tap the applicable trace box to display the pop-up keyboard.





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10.1.5.2 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

RX - JO [S]

D
IT
_
off



10.1.6 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.

SDH/SONET Tools Menu



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

TX C2 [HP]

LED'S	тх	RX	Start
	C2 [HP]	V5 [LP]	BIT
😑 Signal	HP Label	2	
😑 Frame	C2 [HP]	TUG Structure 🛛 🔻	SDHLOS
😑 Pattern			Alarm/Err
			LASER Off
X Tools			
Utilities			
Files			

- 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

LED'S	тх	RX	Start
	C2 [HP]	V5 [LP]	BIT
Signal	LP Label	2	
🜔 Frame	V5 [LP]	Async 🔻	SDHLOS
O Pattern			Alarm/Err
ALM/ERR			LASER Off
X Tools			
Utilities			
Files			

TX V5 [LP]

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10.1.7 APS Tasks

10.1.7.1 APS Timing

This function measures the Automatic Protection Switching (APS) limits of the network. APS applies only to the Multiplex sections of a SDH network and enables network elements to re-route traffic to a backup circuit in the event of network failure or problems. The protection mechanism is coordinated by the K1 and K2 bytes in the Multiplexer Section Overhead.

• APS Standards

The principles and protocols of APS in SDH networks are defined in ITU-T G.783 and G.841 and Bellcore GR-253 recommendations for Linear and Ring network architectures respectively. According to recommendations, the re-routing of the signal has to occur within 50ms. Protection switching is initiated as a result of one of the

following conditions:

- "Hard" Failure (SF) condition Loss of Signal (LOS), MS-AIS, BER > 1 x 10^{-3} .
- "Soft" Failure (SD) condition Signal degradation when BER exceeds a predetermined threshold. Normally over a provisioned range of 1 x 10⁻⁵ to 1 x 10⁻⁹.

Tap the APS Testing icon to display the APS testing screen shown below.

- Sensor: Select the trigger that will initiate the APS measurement
 - The selections are LOS, LOF, SDH FAS, B1, MS-AIS, MS-RDI, MS-REI, B2, AU-AIS, AU-LOP, B3, HP-RDI, HP-REI, TU-AIS, 2M-AIS, 2M-LOF, LSS and TSE (bit errors)
- Switch Time Limit: Configurable in the range from 15ms to 200ms
 - Typically 50ms according to ITU-T recommendations
- Gate Time: Configurable in the range from 50ms to 4 seconds
- Used to measure total service disruption when multiple switches or micro interrupts occur
- Repeat: ON/OFF
 - Configurable to measure on a continuous basis
- Start: Press to begin the test

APS Timing Setup

LED'S	APS Timing		APS Sequence		
_	Setup				
😑 Signal	Sensor	Sensor	~_µs ▼		
~	Switch Limit [ms]	MS-	AIS		
Frame	Gate Time [ms]	L	os		
0.0	Repeat	L	OF V		
- Pattern		SUHP	B1		
ALM/ERR	Time (ms)	MS-	AIS		
0	Max Time [ms]	MS-F	RDI		
<u> </u>	Min Time [ms]	MS-I	REI		
Tools	Result		B2		
Utilities		1 of 2			
Files		Sta	n		

• APS Test Procedure:

- The test set should be connected to a tributary port of network element or transmission system to ensure that the switching time is measured for the service transported by the SDH network
- Ensure that no errors or alarms are present on the transmission system because this will impact the measurement
- The measurement will be triggered depending on the condition configured
- The test set measures how long the AIS event remains present after the event is first recognized and will continue to measure the total disruption time in the event of multiple disruptions



Figure 1: Perfect service disruption



Figure 2: Multiple service disruption or micro interrupts

LED'S	APS Timing		APS Sequence		
	Setup				
😑 Signal	Sensor	L	os 🔻		
•	Switch Limit [ms]	50			
😑 Frame	Gate Time [ms]	51			
O Pattern	Repeat	0	FF 🔻		
		Resu	lts		
ALMERR	Time (ms)		51		
Ŭ	Result		Fail		
X Tools					
Utilities					
Files		Star	<u>t</u>		

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10.1.7.2 APS Sequence

The associated K1/K2 sequence and received K1/K2 bytes may be captured.

Event Details

LED'S	APS Timing			APS Sequence
	Frame	K1 K	()	
🔵 Signal		E	Event Details	
	13 Byte	K1	00000000	
🙆 Frame	Request		No Request	
$\mathbf{\circ}$	Channel		Null Channel	
Pattern				
0	Byte	K2	00000000	
A	Channel		Null Channel	
	Arch.		1+1	
X Tools				
Utilities			ОК	
Files			Start	

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10.1.8 Tandem Connection Monitoring (TCM)



HP Setup

• 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
	IEC (IAIS)			TC-REI	OEI	TC-APId, Teser	TC-DI,ODI, rved

N2 byte structure

b1	b2	b3	b4	b5	b6	b7	b8
т	C-B1P	.1.	IAIS	TC-REI	OEI	TC-APId, T reser	C-RDI,ODI, ved

IEC:	Incoming Error Count. Indicates IAIS when set to '1110' (seebelow)
IAIS:	Incoming AIS alarm
TC-REI:	Tandem Connection Remote Error Indication
OEI:	Outgoing Error Indication
TC-APId:	Tandem Connection Access Point Identifier (16-byte message)
TC-RDI:	Tandem Connection Remote Defect Indication
ODI:	Outgoing Defect Indication
TC-BIP.	2-bit Bit Interleaved Parity for Tandem Connection

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10.1.9 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

LED'S				
	K.L.M.	Report	J2 Trace	Label
0	1.1.1	ок	VEEX LP	0x2
😑 Signal	1.1.2	OK	VEEX LP	0x2
	1.1.3	ок	VEEX LP	0x2
Frame	1.1.4			
$\mathbf{\circ}$	1.2.1			
0.000	1.2.2			
C Pattern	1.2.3			
	1.2.4			
ALM/ERR	1.3.1			
Ŭ				
X Tools			-	
Utilities		Page	1 of 598 💌	
Files		\$	top	

Tributary Scan

10.1.10 Round Trip Delay

The Round Trip Delay (Propagation Delay) measurement works by sending a test pattern with an error. The time it takes for the error to reach the receiver is the propagation time through the network.

- Select SDH as TX/RX standard.
- View the Round Trip Delay of a looped back signal.
- Set check box on Setup RX pattern to Out-of-Service.

Round Trip Delay Results

LED'S		Results
	Time [ms]	0.00 ms
😑 Signal	Result	Complete
😑 Frame		
O Pattern		
X Tools		
Utilities		Start
Files		

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10.1.11 Jitter and Wander

For more information on Jitter and Wander, please see Jitter and Wander Application.

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10.2 SONET Tools

Accessing SDH/SONET Tools

Tap on Home (main menu) >SONET/SDH Tools

10.2.1 Shortcuts

SDH/SONET Tools Menu



- **Overhead Analyzer:** Displays the Section/Line Overhead (SOH) and STS Path Overhead (POH) bytes of the received channel.
- **Overhead Generator:** Used to edit Section/Line Overhead (SOH) and STS Path Overhead (POH) bytes of the received channel.
- **Pointer Tasks:** Displays both STS and VT pointer values and generates STS and VT pointer movements. Pointer sequences according to Bellcore GR.253 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 STS path and VTs.
- **APS Testing:** Used to measure Automatic Protection Switching limits. Using selectable triggers, the drop out times of tributary connections are measured and compared with preset values.
- **TCM Tasks:** Used to analyze or edit the sequence of Z5 and Z6 TCM bytes by generating alarms and errors in the Tandem connection sub-layer.
- **Tributary Scan:** Used to scan individual or multiple tributaries to verify routing and error free operation. Available in VT-1.5 or VT-2 mode
- **Round Trip Delay (Propagation Delay):** Measurement works by sending a test pattern. Bit errors are transmitted in the pattern. The time it takes for the error to reach the receiver is the propagation time through the network.

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10.2.2 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

RXT-6200_RXT6000e_Module_Manual

• 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

SOH

LED'S	SOH			РОН		Summary)	
	1	STI	M# 1						
🔵 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	öö	öö
Pattern	D1 00	öö	öö	D2 00	öö	öö	D3 00	öö	öö
	H1 6A	H1 6A	H1 6A	H2 OA	H2 OA	H2 OA	H3 00	H3 00	H3 00
	82 32	82 46	82 48	K1 00	öö	öö	K2 00	öö	öö
Tools	D4 00	öö	öö	D5 00	öö	öö	D6 00	öö	öö
	D7 00	öö	öö	D8 00	öö	öö	D9 00	öö	öö
Utilities	D10 00	öö	00	D11 00	öö	öö	D12 00	00	öö
Files	\$1 00	Z1 00	Z1 00	72 00	72 00	72 00	62 00	öö	öö

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

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 STS-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 STS-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	J		
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 STS-N frame before scrambling
- The checksum value is placed in the SECTION overhead of the following STS-N before scrambling

B1 (Section-BIP) Byte

LED'S		Byte Decoder	
Signal	Byte	B1 [Section-BIP]	
~	Value	4C	
🔵 Frame	Binary	01001100	
O Pattern			
X Tools			
Otilities	J		
Files	J		

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

D1 Byte

LED'S		Byte Decoder	
Signal	Byte	D1 [Section-DCC]	
~	Value	00	
🜔 Frame	Binary	0000000	
O Pattern			
Tools	J		
Utilities			
Files			

Pointers

H1/H2/H3 Bytes (STS Pointers)

• Enable transfer of STS-3 frames with STS-N frames and are processed by the MS terminating equipment

H1 Pointer Byte

LED'S		Byte Decoder	
Signal	Byte	H1 [Line Pointer]	
<u> </u>	Value	62	
🜔 Frame	Binary	01100010	
Pattern ALM/ERR			
Tools			
Otilities			
Files			

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Line Layer

B2 Byte

- A 24-bit interleaved even parity code used to determine if transmission errors have occurred over the Section Layer
- Its calculated over all the bits of the STS-3 frame except those in the Section overhead
- The computed checksum is placed in the TOH of the following STS-N frame

B2 Byte

LED'S		Byte Decoder	
C Signal	Byte	B2 [Line-BIP]	
~	Value	72	
🔵 Frame	Binary	01110010	
O Pattern			
Tools			
Utilities			
Files			

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 channels

K1 Byte (APS-Linear)

LED'S		Byte Decoder	
Signal	Byte	K1 [APS Linear]	
0	Value	00	
😑 Frame	Message	0000	
0		No Request	
Pattern	Channel	0000	
O ALM/ERR		NULL	
Tools Utilities Files			

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 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 RDI-L
 - 111 AIS-L

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 RDI-L
 - 111 AIS-L
 - Others Not used

K2 Byte (APS-Linear)

LED'S	Byte Decoder			
	Byte	K2 [APS Linear]		
0	Value	00		
🜔 Frame	Channel	0000		
O Pattern		NULL		
	Path	0		
O ALM/ERR		1+1		
	Message	000		
X Tools		Future use		
Utilities				
Files				

Data Communications Channel (DCC) Bytes (D4-D12)

- Data Communications Channel (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 SONET Minimum Clock
 - 1101 Stratum 3e

1110 Provisionable 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		
0.000	Message	0000		
O Pattern		Qual unknown		
X Tools				
Utilities				
Files				

Order Wire Byte (E2)

- A 64 kbps 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 STS-N path trace byte
- An unique message is assigned to each path in a SONET 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 STS-3 frame

J1 Byte (STS Path Trace)

e LED'S	Byte Decoder				
Signal	Byte	J1 [STS 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 STS-3
 - The computed checksum is placed in the B3 byte before scrambling

B3 Byte (STS Path BIP)

e LED'S	Byte Decoder			
O Signal	Byte	B3 [STS Path BIP]		
0	Value	A1		
😑 Frame	Binary	10100001		
O Pattern				
X Tools				
📑 Utilities				
Files				

• C2 byte (STS path signal label)

- Indicate the type of payload being transported in the STS, SPE, including the status of the mapped payloads.
- The table below indicates the standard C2 binary values:

C2 Byte (STS Path signal label)

LED'S		Byte Decoder				
Signal	Byte	C2 [STS Path Signal label]				
	Value	02				
	Binary	00000010				
O Pattern		VT structure				
X Tools						
Utilities						
Files						

C2 byte str	ucture per GR.253 recommendations
Code[hex]	Payload type
00	Unequipped
01	Equipped non-specific (standard payload)
02	Floating VT mode
03	Locked VT mode
04	Asynchronous mapping for DS3
12	Asynchronous mapping for 139.264Mbps
13	Mapping for ATM
14	Mapping for DQDB
15	Asynchronous mapping for FDDI
16	Mapping for HDLC over SONET
E1	STS-1 payload with 1 VT-x payload defect
E2	STS-1 payload with 2 VT-x payload defects
E3	STS-1 payload with 3 VT-x payload defects
E4	STS-1 payload with 4 VT-x payload defects
E5	STS-1 payload with 5 VT-x payload defects
E6	STS-1 payload with 6 VT-x payload defects
E7	STS-1 payload with 7 VT-x payload defects
E8	STS-1 payload with 8 VT-x payload defects
E9	STS-1 payload with 9 VT-x payload defects
EA	STS-1 payload with 10 VT-x payload defects
EB	STS-1 payload with 11 VT-x payload defects
EC	STS-1 payload with 12 VT-x payload defects
ED	STS-1 payload with 13 VT-x payload defects
EE	STS-1 payload with 14 VT-x payload defects
EF	STS-1 payload with 15 VT-x payload defects
F0	STS-1 payload with 16 VT-x payload defects
F1	STS-1 payload with 17 VT-x payload defects

RXT-6200_RXT6000e_Module_Manual

F2	STS-1 payload with 18 VT-x payload defects
F3	STS-1 payload with 19 VT-x payload defects
F4	STS-1 payload with 20 VT-x payload defects
F5	STS-1 payload with 21 VT-x payload defects
F6	STS-1 payload with 22 VT-x payload defects
F7	STS-1 payload with 23 VT-x payload defects
F8	STS-1 payload with 24 VT-x payload defects
F9	STS-1 payload with 25 VT-x payload defects
FA	STS-1 payload with 26 VT-x payload defects
FB	STS-1 payload with 27 VT-x payload defects
FC	STS-1 payload with 28 VT-x payload defects, or STS-1, STS-3C, etc., with a non-VT payload defect (DS3, FDDI, etc.)

• 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 (REI-P) indicates number of bit errors detected by B3
- Bit 5: Remote Defect indication (RDI-P) set to 1 if signal failure is detected
- Bits 6-7: Enhanced RDI information to differentiate between payload defects (PLM-P), connectivity defects (TIM-P, UNQ-P) and server defects (AIS-P, LOP-P)

LED'S	Byte Decoder			
Signal	Byte	G1 [HP Status]		
-	Value	00		
🜔 Frame	REI	0000		
0	RDI	000		
Pattern	Spare	0		
Tools	J			
Utilities				
Files				

G1 Byte (HP Status)

• F2 byte (Path user channel)

- STS Path user channel
- STS-3# path user channel used for communication between path elements

• H4 byte (VT Indicator)

- Position or Sequence Indicator
- Multiframe phase indicator used for tributary structured payloads

LED'S	Byte Decoder				
	Byte	H4 [VT Indicator]			
•	Value	03			
😑 Frame	Binary	00000011			
O Pattern					
🔀 Tools					
Utilities					
Files					

• Z3/Z4 byte (STS Path)

• Allocated for future use. Have no defined value. The receiver is required to ignore their content.

• Z5 byte (STS Path TCM)

- Allocated to provide a STS Path Tandem Connection monitoring function for contiguously concatenated STS-3 levels.
 - Bits 1-4: Used as an Incoming Error Count (IEC)
 - 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 STS-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 farend
 - Frame 74 > ODI indicating to the far-end that AU/TU-AIS has been inserted into egressing STS-n VTG-n due to defects before or within the tandem connection
 - Frames 73-76 > Reserved capacity

b1	b2	b3	b4	b5	b6	b7	b8
IEC (IAIS)			TC-REI	OEI	TC-APId, rese	TC-DI,ODI, rved	

Z5 byte structure

Z5 Byte (Path TCM)

LED'S	Byte Decoder			
C Signal	Byte	25 [P-TCM]		
0	Value	00		
🜔 Frame	IEC	0000		
0	REI	0		
Pattern	OEI	0		
O ALM/ERR	Various	00		
Tools				
Files				

• V5 byte (VT path overhead)

- The first byte of a VT SPE provides the functions of error checking, signal label and path status.
- 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 REI-V (0 = no error, 1 = errors), that is sent back towards an originating VT PTE if errors were detected by the BIP-2.
 - Bit 4 is reserved for mapping-specific functions.
 - Bits 5-7 provide the VT signal label
 - 000 Unequipped
 - 001 Equipped (non-specific)
 - 010 Asynchronous mapping for DS1
 - 011 Bit synchronous mapping for DS1
 - 100 Byte synchronous mapping for DS1
 - Bit 8 is the VT path RDI-V normally set to zero unless there is an error condition (AIS)

BI	BIP-2		REI-V RFI-V		Signal label		
1	2	з	4	5 6 7		7	8
Rite 1 and 2: Refermance menitoring							

Bits Land 2:	Penormance monitoring
Bit 3:	REI-V (remote error indication) for VT path
Bit 4:	RFI-V (remote failure indication) for VT path
Bits 5 to 7:	Allocated for a VT path signal label
Bit 8:	RDI-V (remote defect indication) for VT path

V5 Byte (VT signal label)

LED'S	Byte Decoder				
Signal	Byte	V5 [VT Signal Label]			
U	Value	84			
🜔 Frame	BIP	10			
0	REI	0			
Pattern	RFI	0			
O ALM/ERR	Label	010			
		Async			
X Tools	RDI	o			
Utilities					
Files					

- J2 byte (VT path trace)
 - 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

• Z6 byte (VT-TCM)

- Provides VT tandem connection monitoring function (TCM-V) for the VT-1.5, VT-2 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 STS-1n
 - 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 AIS-P/V has been inserted into egressing STS-1n VT-n due to defects before or within the tandem connection
 - Frames 73-76 > Reserved capacity

b3	b4	b5	b6

b1	b2	b3	b4	b5	b6	b7	b8
ו	ГС-В1Р	•1"	IAIS	TC-REI	OEI	TC-APId, T	C-RDI,ODI,
						1636	IVEU

Z6 byte structure

Z6 Byte (VT-TCM)

e LED'S	Byte Decoder				
Signal	Byte	Z6 [VT-TCM]			
•	Value	00			
😑 Frame	BIP	00			
O Dattara	SET	0			
Pattern	AIS	0			
O ALM/ERR	REI	0			
	OEI	0			
X Tools	Various	00			
Utilities					
Files					

• Z7 byte (VT path Extended Label)

- If bits 5-7 of V5 byte are set to 101 (value = 5), then:
 - The signal label in Z7 byte becomes valid where:
 - This is a 32-bit multi-frame string
 - 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 VT APS signaling
 - Bits 5, 6, 7 are allocated for optional use
 - Bit 8 is unassigned

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- Summary
 - The Summary tab displays the summary screen listing the major bytes of the received SONET signal.
 - 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)

•

- For Path traces, (SP) indicates a space between the message characters.
- The message will be displayed in red when an alarm condition is detected. In the example below, the C2 byte has a PLM alarm (Payload Mismatch) (i.e., the received signal label does not match the transmitted signal label).

Summary

LED'S	SOH			РОН	Summary
Signal	JO	N/A	VEEX RS8^ -^t	z.@8y.@4^	
😑 Frame	JI	NJA	VEEX HP		
O Pattern	J2	N/A	VEEX LP		
0	K2 51	00	0;Future use;1+1 Qual unknown		
	C2 V5	02 84	VT structure Async		
X Tools					
Utilities					
Files					

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10.2.3 Overhead Generator

SOH

LED'S	SOH				РОН			Summary	
		ST	S# 1						
😑 Signal	A1 F6	A1 F6	A1 F6	A2 28	A2 28	A2 28	J0 xx	ÄÄ	ÄÄ
🔵 Frame	B1 xx	öö	öö	E1 00	öö	öö	F1 00	00	öö
Pattern	D1 00	öö	öö	D2 00	öö	öö	D3 00	00	öö
•	H1 6A	H1 93	H1 93	H2 0A	₽₽ ₽₽	₽₽ ₽₽	H3 00	H3 00	H3 00
	B2 xx	B2 xx	B2 xx	K1 00	öö	öö	K2 00	öö	öö
Tools	D4 00	öö	öö	D5 00	öö	öö	D6 00	00	öö
	D7	öö	öö	D8 00	öö	öö	D9 00	öö	öö
Utilities	D10 00	öö	öö	D11 00	öö	öö	D12 00	őö	öö
Files	\$1 00	Z1 00	Z1 00	22 00	72 00	72 00	E2 00	őö	öö

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. 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.

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				
0.0	Message	0000				
Pattern		Qual unknown				
X Tools						
Utilities						
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						
Signal	Byte	C2 [STS Path Signal label]					
U	Value	02					
😑 Frame	Binary	00000010					
O Pattern		VT structure	•				
X Tools							
Utilities							
Files							

C2 Byte from POH



• Summary displays the Path Trace Identifiers (J0, J1, J2), APS (K1, K2), Synchronization status (S1), HP (C2), and LP (V5) Signal Label bytes. The operation is the same as the Overhead Analyzer function.

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10.2.4 Pointer Tasks

Tap the **Pointer Tasks** icon to display the Pointer testing screens.

SDH/SONET Tools Menu



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10.2.4.1 Pointer Analysis

Pointers keep SONET 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 STS pointers:

- SS bits displays bits 5 and 6 of the H1 byte to indicate SONET [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 STS-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

Analysis > P Pointer

e LED'S	Analysis	Gene	rator		G.783	Stop
	STS			VT		CONSTRACT
😑 Signal		P Po	inter			SUNET PAS
C Frame	SS Bits				SONET [00]	Line RDI
	Pointer Value				522	
Pattern	LOP				0	Alarm/Err
Ŭ	PJE		0 s		0	
ALM/ERR	NJE		0 s		0	
	NDF		0 s		0	LASER Off
Tools	Diff				0	
	Sum				0	
Utilities	Implied Offset [ppm]				0.00 ppm	
Files						

• For TV pointers:

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

Analysis > VT tab

LED'S	Analysis	Generat	or	G.783		Stop
	STS			VT		
😑 Signal		VT Pointer				SUNET PAS
C Frame	Pointer Value				78	Line RDI
	LOP				0	
Pattern	PJE		0 s		0	AlarmyErr
Ū	NJE		0 s		0	
ALM/ERR	NDF		0 s		0	
	Diff				0	LASER Off
X Tools	Sum				•	
	Implied Offset [ppm]			0	.00 ppm	
Utilities						
Files						

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10.2.4.2 Point Generator

The Pointer generator is able to generate individual pointer movements as follows:

• For STS pointers:

- SS bits: Program bits 5 and 6 of the H1 byte to be either SONET [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.
- Increment (INC) or Decrement (DEC) pointers with identical polarity by 1 byte in single steps.

Generator > STS tab

LED'S	Analysis	Generator	G.783	Stop
	STS		VT	
😑 Signal	Sequence	Basic		SUNET PAS
C Frame	SS Bits	SONET [00]		Line RDI
0	NDF	OFF		
O Pattern		Adjustment		Harnver
0	Adjustment	Increment		
	Mada	Insertion		
-	Mode	Continuous		LASER OF
Tools	Incerval	100		
Utilities				
Files		Start		

- For VT pointers
 - VT Pointer value: Set value in a range of 0 to 109 (VT-1.5) and 0 to 139 (VT-2)
 - Increment (INC) or Decrement (DEC) pointer value by 1 byte is single steps

LED'S	Analysis	Generator	G.783	Stop
	STS		VT	
😑 Signal	Sequence	Basic		SUNETPAS
C Frame	NDF	OFF		Line RDI
United		Adjustment		
Pattern	Adjustment	Increment		Alarmyerr
-				
C ALM/ERR	Mode	Continuous		
100	Interval	100		LASER Off
X Tools				
Utilities				
Files		Start		

Generator > VT tab

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10.2.4.3 Pointer Sequences

The Pointer generator is also able to generate Standard ITU-T G.783 and ANSI T1.105.03 and Bellcore GR-253 pointer 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, with added to have an additional pointer value)
- 87-3 Cancel: Generate an 87-3 pattern (87 consecutive pointer adjustments, 3 consecutive pointer value, with reduce 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.783 Identifier	Pointer adjustments	Mnemonic
Single Alternating	Single of opposite polarity	+-
RegularAdd	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

G.873 > STS tab





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10.2.5 Trace Identifier

Tap the **Trace Identifier** icon to display the path trace testing screens shown below. There are dedicated tabs for Transmitted and Received (expected) path traces and setups.



SDH/SONET Tools Menu

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10.2.5.1 Transmitted Traces (TX)

- J0 [Section]: Regenerator section trace
 - Program a 1 or 16-byte identifier to check the connection between regenerators
- J1 [STS Path]: High order path section trace
 - Program a 16 or 64-byte identifier to check the high order transmission path
 - The message is transmitted one byte per STS-3 frame
- J2 [VT Path]: Low order path section trace
 - Program a 16 or 64-byte identifier to check the low order transmission path

To program or edit the transmitted trace, tap the applicable trace box to display the pop-up keyboard.

LED'S	тх		RX	Stop
	J0 [S]	J1 [P]	J2 [VT]	CONFERENCE
Signal	S Trace Len	16 Bytes		V SUNET PAS
🜔 Frame	S Trace	VEEX RS		
O Pattern				Alarm/Err
				LASER Off
X Tools				
Utilities				
Files				

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10.2.5.2 Received Traces (RX)

- J0 [Section]: Regenerator section trace/Section Layer 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 [STS Path]: High order path section trace/STS 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 [VT 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

To program or edit the received trace, tap on the applicable trace box and this will launch the QWERTY keyboard.

RX - JO [S]

LED'S	тх		RX	Stop
	J0 [S]	J1 [P]	J2 [VT]	CONSTRACT
🔘 Signal	S Trace Len	16 Bytes		T SUNET PAS
C Frame	S Trace	VEEX RS		Line RDI
0	TIM Enabled	OFF		Alarm/Err
Pattern				
				LASER Off
X Tools				
Utilities				
Files				

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10.2.6 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.

SDH/SONET Tools Menu



Tap the **Payload Label** icon to display the payload label screens. There are dedicated tabs for Transmitted and Received payload labels and setups:

- C2 [STS Path]: Path signal label
 - Specifies the mapping type in the STS-1n
 - Program the TX or RX label by editing the hexadecimal value or by using the convenient drop-down menu selection
 - For the RX label, you can enable or disable the Payload Mismatch (PLM) Alarm



TX C2 [P]

• V5 [VT 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, you can enable or disable the Payload Mismatch (PLM) Alarm



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10.2.7 APS Tasks

10.2.7.1 APS Timing

This function measures the Automatic Protection Switching (APS) limits of the network. APS applies only to the Multiplex sections of a SONET network and enables network elements to re-route traffic to a backup circuit in the event of network failure or problems. The protection mechanism is coordinated by the K1 and K2 bytes in the Multiplexer Section Overhead.

• APS Standards

The principles and protocols of APS in SONET networks are defined in ITU-T G.783 and G.841 and Bellcore GR-253 recommendations for Linear and Ring network architectures respectively. According to these recommendations, the re-routing of the signal has to occur within 50ms. Protection switching is initiated as a result of one of the following conditions:

- "Hard" Failure (SF) condition Loss of Signal (LOS), MS-AIS, BER >1 x 10^{-3} .
- "Soft" Failure (SD) condition Signal degradation when BER exceeds a predetermined threshold. Normally over a provisioned range of 1×10^{-5} to 1×10^{-9} .

Tap the **APS Testing** icon to display the APS testing screens shown below.

- Sensor: Select the trigger that will initiate the APS measurement.
 - The selections are: LOS, LOF, SONET FAS, B1, B2, B3, AIS-L, RDI-L, REI-L, AIS-P, LOP-P, RDI-P, REI-P, AIS-V, 2M-LOF, 2M-AIS, LSS and TSE (bit errors)
- Switch Time Limit: Configurable in the range from 15ms to 200ms.
 - Typically 50ms according to ITU-T recommendations.
- Gate Time: Configurable in the range from 50ms to 4 seconds.
- Used to measure total service disruption when multiple switches or micro interrupts occur.
- Repeat: ON/OFF
 - Configurable to measure on a continuous basis.
- Start: Press to begin the test.

APS Timing Setup

LED'S	APS Timing		APS Sequence
		Set	up
😑 Signal	Sensor	Sensor	
C Frame	Switch Limit [ms]	MS	AIS
	Gate Time [ms]		los
Pattern	Repeat	SDH	FAS
Ŭ			B1
ALM/ERR	Time [ms]	MS	-AIS
Ŭ	Max Time [ms]	MS-	RDI *
X Tools	Min Time [ms]	MS	REI B2
Utilities		I of 2	
Files		Sta	Int

APS Test Procedure:

- The test set should be connected to a tributary port of network element or transmission system to ensure that the switching time is measured for the service transported by the SONET network.
- Ensure that no errors or alarms are present on the transmission system because this will impact the measurement.
- The measurement will be triggered by an Alarm Indication Signal (AIS)
- The test set measures how long the AIS event remains present after the event is first recognized and will continue to measure the total disruption time in the event of multiple disruptions.





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10.2.7.2 APS Sequence

The associated K1/K2 sequence and received K1/K2 bytes may be captured.

Event Details

>Running TX30 >Home>SDH/SONE1	0 T Tools>APS 1	Fasks		÷	🕗 🖻	8
LED'S		APS	Timing		APS Sequen	ce
Signal	Frame	K4	Event Deta	ils		
	Byte	K1	0000	0000		
C Frame	Request		No Requ	lest		
•	Channel		Null Char	nnel		
O Pattern	Byte	K2	0000	0000		
- and the second second	Channel		Null Char	nnel		
O ALM/ERR	Arch.		1+1			
X Tools						
📑 Utilities			ОК)		
Files				Stop		
TX: OC-192	RX: OC-19	2		13-04-2011	17:23:50	Test Mode

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10.2.8 Tandem Connection Monitoring (TCM)

LED'S		HP		LP	Stop
Signal		Se	tup		SONET FAS
0	Enabled		ON		
Frame		Res	ults		
Pattern	UNEQ	452	LTC		0 Alarm/Err
•	AIS	0	RDI		0
ALM/ERR	ODI				0
10-240 10-240	IEC			0	LASER Off
X Tools	REI			0	
	OEI			0	
Utilities					
Files					

HP Setup

TCM Standards

The Tandem paths are defined in ITU recommendation G.707 Annex D and Annex E. ITU-T recommendation 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 the Z5 byte for STS-N and in the Z6 byte for VT's. These two bytes are structured similarly, but their functions are not identical.

N1 byte structure

b1	b2	b3	b4	b5	b6	b7	b8
	IEC (IAIS)			TC-REI	OEI	TC-APId, Teser	TC-DI,ODI, rved

N2 byte structure

ь1	b2	b3	b4	b5	b6	b7	b8
	TC-B1P	.1.	IAIS	TC-REI	OEI	TC-APId, T rese	C-RDI,ODI, rved

IEC:	Incoming Error Count. Indicates IAIS when set to '1110' (seebelow)
IAIS:	Incoming AIS alarm
TC-REI:	Tandem Connection Remote Error Indication
OEI:	Outgoing Error Indication
TC-APId:	Tandem Connection Access Point Identifier (16-byte message)
TC-RDI:	Tandem Connection Remote Defect Indication
ODI:	Outgoing Defect Indication
TC-BIP:	2-bit Bit Interleaved Parity for Tandem Connection

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10.2.9 Tributary Scan

This function requires VC12 or VT-1.5 mapping and allows you to quickly check the signal structure, trace identifier and the payload.

LED'S				
	K.L.M.	Report	J2 Trace	Label
0	1.1.1	ок	VEEX LP	0x2
😑 Signal	1.1.2	ок	VEEX LP	0x2
	1.1.3	ок	VEEX LP	0x2
Frame	1.1.4			
$\mathbf{\circ}$	1.2.1			
O D-11-1-1	1.2.2			
O Pattern	1.2.3			
	1.2.4			
ALM/ERR	1.3.1			
Ŭ				
Tools				
			•	
Littletion		Page 1	1 of 598 💌	
Oundes				
		St	top	
Files				

Tributary Scan

An important part of any Add Drop Multiplexer (ADM) installation process is the verification of the path routing. Considering that an STS-3 contains 84 x VT-1.5's and a STS-12 contains 336 x VT-1.5's checking each path manually can be very time consuming.

The test set automatically performs a sequential BER test on each SONET tributary (VT channel) - mapping can be via STS-N. The unit checks for any alarms in the received signal, the SONET 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

10.2.10 Round Trip Delay

Round Trip Delay Results

LED'S		Results
LEDS	Time [ms]	0.00 ms
😑 Signal	Result	Complete
😑 Frame		
O Pattern		
X Tools		
Utilities		Start
Files		

The Round Trip Delay (Propagation Delay) measurement works by sending a test pattern. A errors is transmitted in the pattern. The time it takes for the error to reach the receiver is the propagation time through the network.

- Select SONET as TX/RX standard.
- View the Round Trip Delay of a looped back signal.
- Set check box on Setup RX pattern to Out-of-Service.

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10.2.11 Jitter and Wander

For more information on Jitter and Wander, please see Jitter and Wander Application.

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11.0 Jitter and Wander

Accessing Jitter and Wander

Go to OTN/SDH/SONET Testing from the Test Mode Selection, then select the following:

• For SONET or SDH signals: Home (Main Menu) > SONET/SDH Tools > More > Jitter & Wander

Jitter & Wander displays the Jitter Measurements showing measurements and analysis of jitter in received signal.

Jitter and Wander are usually described as the phase noise in digital signals. This is a natural occurrence in telecommunication networks.

Excessive jitter can lead to transmission errors and deterioration in network quality. ITU defines jitter as follows: "The short-term variations of the significant instances of a digital signal from their ideal positions in time (where short-term implies these variations are of frequency greater than or equal to 10 Hz)." The long-term variation (less than 10 Hz) of a digital signal is called wander.

In simple terms, jitter is an unwanted phase modulation of the digital signal that may cause errors or bit slips in a digital circuit and deteriorate the performance of a transmission network.

In lower-rate digital systems, systematic jitter is dominant. In higher-rate systems, random jitter may become more important. Test environment parameters that affect jitter performance are test sequences, bit rate, pulse shape, cable characteristics, temperature, cross-talk, and noise.

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11.1 Jitter Measurement & Generation (Jitter icon)

Tapping the Jitter icon brings up the Jitter Measurement and Generation screen.

Jitter Measurement and Generation Menu



The Jitter measurements menu allows the user to measure and analyze received signal jitter. The measurement example is shown above (the vertical grid spacing is 2.0 UIpp). The red bar indicates Max. peak jitter during testing and the yellow bar indicates the current peak jitter.

Setup

Configure the following settings before starting the test:

- Filter: HP1+LP or HP2+LP. The frequency for each filter varies depending on the setup mode (E1/E3, DS1/DS3). Frequency ranges for each filter and setup mode are listed as follows:
 - E1: HP1+LP (20Hz to 100KHz); HP2+LP (18 Hz to 100KHz)
 - E3: HP1+LP (100Hz to 800KHz); HP2+LP (10KHz to 800KHz)
 - DS1: HP1+LP (10Hz to 40kHz); HP2+LP (8kHz to 40kHz)
 - DS3: HP1+LP (10Hz to 400kHz); HP2+LP (30kHz to 400kHz)
- Generator: ON or OFF
- Frequency: 2 Hz to 10,000 Hz for E1(2M) options, 2 Hz to 800,000 Hz for E3 (34M) options. 2 Hz to 40,000 Hz for DS1 (1.5M) options, 2 Hz to 400,000 Hz for DS3(45M) options.
- **Amplitude:** Enter the amplitude at which peak to peak jitter generation occurs. See O.172 for the ITU recommendation on minimum jitter generation.

Press Start to start measurements.

Results

Results are displayed for the current jitter value and maximum jitter value during measurement.

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11.2 Max Jitter Tolerance (MTJ)

Jitter Tolerance or jitter accommodation is defined in terms of the sinusoidal jitter amplitude which causes a designated error when applied to digital equipment input. Jitter tolerance is a function of applied jitter's amplitude and frequency. Equipment must pass the lower limit of maximum jitter tolerance, which is specified in ITU-T G.823, G.824, and G.825 standards.

The unit will transmit jitter from point-to-point or low to high frequency at different amplitudes to determine where errors occur. This is known as maximum jitter tolerance (MTJ).

Defects and Anomalies Check

The Max Jitter Tolerance feature checks the health of the incoming signal prior to starting the test. If any alarms or errors are detected, the test set will notify the user that the test cannot be performed and present configuration suggestions to correct the problem.

Error Message: Configuration Suggestions

LED'S		Table	Graph	Start	
		-			
🔴 Signal	Stati	Er	ailed		
ဓ Frame					
😑 Pattern	20 200	Verify that the test signal is pr	_		
😑 ALM/ERR	800 2400	error free before starting the MTJ test.			
X Tools	8000 1800				
Utilities	5000 1000	0	ĸ	H	
Files	Progr	ess			

Loss of Signal (LOS) Check

If the LOS condition is detected at any time during the MTJ test, the data will become invalid and the test will stop automatically. An error message will appear to notify the user to correct the condition before running the test again.

LOS Error Message



Table

Table values include:

- Frequency tested (Hz)
- MTJ (UI): Maximum Tolerable Jitter (in Unit Intervals).
- Mask (UI): Peak-to-Peak jitter limit (in UI) as defined by ITU standard. This is the minimum jitter value to pass (i.e., the MTJ value must exceed the Mask value for the data point to pass).
- Status: Pass/Fail status.
- Start/Stop: Starts or stops the test.
- **Progress:** A green bar at the bottom of the graph shows the test progress.

MTJ Table

LED'S	Table		Graph		Start
X Tools	Status				
Utilities	Frequency (Hz)	MTJ (UI)	Mask (UI)	Status	
Tiles.	20	≻10.00	1.50	Pass	
Files	200	≻10.00	1.50	Pass	
	800	≻10.00	1.50	Pass	
	2400	>3.75	1.50	Pass	
	8000	>1.12	0.45	Pass	
	16000	>0.50	0.20	Pass	
	50000	0.33	0.20	Pass	
	100000	0.28	0.20	Pass	
	Progress				

Graph

A cross (x) indicates the maximum jitter value tolerated at the frequency.

Yellow triangles (\blacktriangle) indicate that the data point is greater than, while the green "X" symbols represent actual measured values. Greater than implies that the jitter tolerance of the DUT (device under test) is much better than the value measured by the test set. Users should expect all data points above the mask (curve) to pass. For this example, the table results and graphical example confirm that all points have passed.

Graph



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11.3 Jitter Transfer Function (JTF)

Jitter Transfer defines the ratio of output jitter to input jitter amplitude versus jitter frequency for a given bit rate. Often, a portion of received jitter is transmitted at a piece of the equipment's output. If LOS is detected during the JTF test, the test will be stopped.

1. Calibration

Using a short and clean patch cord, connect the test set's TX back to the RX to form a local reference loop.

Loop Message



2. Device Under Test (DUT)

Before starting the test, "Connect Device Under Test" will appear. Connect the test set to the DUT then press **Start** to begin testing.

LEDs	Tab	le	Graph			Start
😑 Signal	Status				Failed	
🜔 Frame	Frequency (Hz)	JTF (dB)	Mask (dB)	Status		
O Pattern	100	-3	4.41	0.10	Pass	
	1000		-2.70	0.10	Pass	
O ALM/ERR	10000		0.90	0.10	Pass	
	130000		4.74	0.10	Pass	
X Tools	500000		4.58	-11.60	Fail	
	1300000	-1	4.98	-19.90	Fail	
Litilities	Progress					
Files						

- Frequency (Hz): Frequency measured
- JTF (Jitter Transfer Function) (dB): Jitter in divided by jitter out value (in dB)
- Mask (dB): Jitter output in relationship to the input
- Progress: The bar at the bottom of the graph shows the test progress
| e LEDs | Ta | ble | Graph | Start |
|-----------|------------------------|--------|----------------|----------|
| Signal | dB | | | |
| Frame | -10 | × | \uparrow × × | |
| Pattern | -20 | | | |
| ALM/ERR | -30 | × | | |
| | -50 | | | |
| X Tools | -60 | | | |
| Utilities | -70
-80 | | | |
| Files | 10
ITU-T G.958 Mask | 100 1k | 10k 100k | 1M
Hz |

A green cross (x) indicates the the jitter transfer value has passed.

A red cross (x) indicates that the jitter transfer value has failed.

Yellow triangles (\blacktriangle) indicate that the jitter transfer value is greater than the value measured by the test set.

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11.4 Wander Measurements and Analysis

The test set may be equipped with wander measurement options (or licenses) that add verification of stability (wander) and accuracy for different types of data interfaces. Those signals under test could be physical clocks (1.544, 2.048, 10 MHz or 1PPS), SDH/SONET, PDH/DSn, SyncE slave or 1588v2 precision timing protocol.

Three main wander measurement and analysis applications may be offered by the test set (all optional), along with an off-line MTIE/TDEV analysis software for PC

- Recovered Clock Wander Measurements
- Advanced Clock Wander & Phase Measurements
- Built-in MTIE/TDEV Wander Analysis
- VeEX MTIE/TDEV Wander Analysis PC software

Individual screens, fields and selections may vary among products or technologies, and depend on the options/licenses loaded or available for each test set. Nonetheless, the concepts and procedure flow are very similar.

11.4.1 Recovered Clock Wander Measurements

The test set may offer wander measurement options (or licenses) that add verification of stability (wander) and accuracy for different types of data interfaces. Those signals under test could be SDH/SONET, PDH/DSn, SyncE slave interfaces, or the clock recovered by the 1588v2 PTP. Each individual transmission technology may require its own wander measurement license.

The Recovered Clock Wander Measurements features can usually be found within the test options that the intended technology offers.

- In 1GE and 10GE test modes, the Wander Measurement function may be found under the Advanced Tools menu, provided that SyncE or 1588v2 slave modes have been enabled.
- In PDH test modes, the wander measurement function may be found in >PDH Tools >Jitter & Wander >Wander
- In SDH/SONET test modes, the wander measurement function may be found in >SONET/SDH Tools >Jitter & Wander >Wander
- In DSn test modes, the wander measurement function may be found in >DS1/DS3 Tools >DS1/3 Jitter &

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11.4.1.1 Test Setup

Setup

	Se	tup	
Meas. Clock Reference		External	7
Clock Port		SMA	7
External Clock Type		2Mbit/s	7
Mode		Manual	7
Save TIE		ON	7
Sampling Rate		30/s	7
Filename		MySTM1wanderTest	
ET:			•
Current TIE		0 n	s
Max +TIE		0 n	s
Min -TIE		0 n	s
MTIE		0 n	s

- 1. Measurement Clock Reference or Reference Clock Source offers a selection of external or internal (optional) frequency references. Internal or built-in reference options could be "Atomic 10 MHz" or "Atomic 1PPS", disciplined by GPS or free running.
- 2. Clock Port indicates the connector in which the traceable external clock reference source shall be connected. (Avoid using rigid BNC-to-SMA adapters to prevent any stress on the test set's connector. Flexible adapters or cables are recommended.)
- 3. External Clock Type allows users to select from a list of supported clock signals (e.g. 1.544 MHz, 2.048 MHz, 1544 Mbps, 10 MHz, 2.048 Mbps, 1PPS)
- 4. Test Mode lets user select between Manual start/stop and Timed measurements. If Timed is selected, users can set the length of the test in seconds, minutes, hours or days. Once the selected time has elapsed the test automatically stops.
- 5. Save TIE can be turned ON to write all wander measurements to a FAT32 USB Memory stick in real time, to be analyzed later on.
- 6. The Sampling Rate (samples per second) can be set to 1/s, 5/s, 10/s or 30/s, depending on the application.
- 7. File Name identifies the new folder in which all configuration and measurement data will be stored. This folder will be created in the root of the memory stick.
- 8. Tap on the Start button to initiate the measurements and data logging.
- 9. Tap on the **Stop** button to force the measurement and data logging to stop. This will also stop a Timed test, even if the total time has not finished yet.
- 10. After stopping the test, and if the built-in MTIE/TDEV option is enabled, users can also tap on the Analysis button to view the TIE graph and perform the MTIE/TDE analysis on the recorded TIE data. Refer to the following sections for more details.

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11.4.1.2 Test Result

Numerical counters are provided to let users know the status of the test, with a basic summary of the TIE information.

1. Current TIE: Shows the current time interval error measurement.

- 2. Max TIE: Maximum positive TIE value that has been recorder since the beginning of the test
- 3. Min TIE: lowest or negative TIE value that has been recorded since the beginning of the test. Since wander measurements always start with a TIE=0, then the minimum value can only be zero or negative.
- 4. MTIE: Denotes the maximum span of TIE values recorded since the beginning of the test. In this summary, MTIE = MaxTIE MinTIE. It gives users an idea of how much the signal under test is wandering

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11.4.2 Advanced Clock Wander & Phase Measurements

The test set may offer clock wander and phase error measurement options (or licenses) that add verification of stability (wander) and accuracy (absolute phase error) on external (physical) clock signals. Those signals could be from reference clocks or recovered clock outputs from remote or slave terminals (SDH/SONET, PDH/DSn, SyncE, PTP, GNSS/GPS, Rb clocks, etc.)

The results are the similar to the ones obtained by measuring wander on data interface ports (SDH/SONET, PDH/DSn, SyncE or PTP). The main difference is that the advanced clock wander measurements are performed on a physical (not internally recovered) clock signal.

This feature is usually an independent Test Mode and not linked to any particular data transmission interface.

11.4.2.1 Clock Wander and Phase Measurements (Optional)

The "Clock Wander & Phase Measurements" option offers short and long term Wander measurements for frequency sources (e.g. 1.544, 2.048Mbps or 1.544, 2.048, 10MHz or 1PPS) and Phase Error measurements for timing sources (i.e. 1PPS) and can save the TIE or TE measurements to a FAT32 USB Memory stick for further analysis. The test set itself may also offer a built-in MTIE/TDEV Wander Analysis option to analyze the data or it can also be done by using the free VeEX Wander Analysis PC Software that can be downloaded from <u>www.veexinc.com</u>

Both, Wander and Phase Error, measurements require a stable and accurate reference clock source, which can be an external source connected to the CLK (SMA) input port or optional optional built-in GPS and Chip-scale Atomic Clock references.

- The built-in GPS hardware option provides a (raw) 1PPS timing signal (clock), aligned to the standard second, and can be used to discipline the built-in atomic clock. The direct use of this raw "GPS 1PPS" alone is not recommended for wander or phase measurements. It should be combined with the Atomic Clock to filter and stabilize the timing signal
- The built-in Atomic Clock hardware option can provide highly stable frequency references on its own (Atomic 1PPS and Atomic 10 MHz), suitable for wander measurements
- When disciplined by the internal GPS receiver, the Atomic Clock 1PPS can also be used as a very stable and accurate absolute timing reference aligned to the standard second (1PPS) or very accurate and stable frequency reference (10 MHz)
- External clock signals, directly traceable to PRC or PRTC, can also be used as a reference for even more accurate results (e.g. high-quality GPS-disciplined OCXO, Rb or Cs clock sources)

While wander (stability) measurements use high precision frequency references, the absolute phase error (also known as Time Error ot TE) requires an accurate 1PPS timing signal, aligned to the standard second (UTC). The 1PPS can be sourced from a high precision GPS-disciplined clock (built-in option or external).

The Wander (TIE) and Phase (TE) data logs can be saved in real time to a USB Memory using VeEX proprietary format (to be analyzed by the built-in or PC-based MTIE/TDEV Analysis software) or exported to an open CSV format.

Test Setup

Setup

Test Setup	Results	
Test Type	1PPS Absolute Phase Error 🛛 🔻 🔻	
Reference Clock Source	1PPS (Atomic) 🛛 🔻 🔻	
Test Signal	1PPS (RX1 BNC)	start
		Restart
Test Mode	Manual 🛛 🗸 🔻	
Save to USB	ON 🔻 1 Sample/s 🔻	
File Type	VeEX 🗸 🗸	
File Name	MyFileName	

- 1. Test Type offers a selection of "1PPS Absolute Phase Error" for timing error measurements or "Clock Wander Measurement" for frequency stability measurements
- 2. Reference Clock Source offers a selection of external or internal (optional) frequency or timing references
- 3. The Test Signal is the clock that needs to be measured for stability and/or accuracy
- 4. Test Mode lets user select between Manual start/stop and Timed measurements. If Timed is selected, users can set the length of the test in seconds, minutes, hours or days. Once the selected time has elapsed the test automatically stops.
- 5. Save to USB can be turned ON to write all wander or phase measurements to a FAT32 USB Memory stick in real time, to be analyzed later on. User can also set the sampling rate (samples per second).
- 6. File Types available are the proprietary "VeEX" format (compatible with VeEX Wander Analysis PC software" and an open CSV format that can be analyzed or formatted with a spreadsheet program (e.g. Excel or Numbers) or could be imported to other analysis software.
- 7. File Name identifies the new folder in which all configuration and measurement data will be stored. This folder will be created in the root of the memory stick.
- 8. Tap on the Start button to initiate the measurements and data logging.
- 9. Tap on the **Stop** button to force the measurement and data logging to stop. This will also stop a Timed test, even if the total time has not finished yet.

Results

Results



Wander results are presented in nanoseconds and include: (1) Current TIE, (2) Highest TIE recorded, (3) Lowest or

negative TIE recorded, (4) MTIE for the whole test data, (5) Y scale zoom level, (6) the last 600s of TIE values, Start/Stop/Restart buttons, and Analysis button (if the built-in MTIE & TDEV Analysis option is loaded in the test set)

Results



Phase results are also presented as the difference in nanoseconds between the rise of the reference timing pulse and the signal under test. It includes (1) Current timing or phase error (TE), Maximum time error recorded, (3) Minimum or negative time error recorded, (4) Average time error (cTE) for the whole test.

The 600s graph is provided as a tool to confirm the settings and signals stability before running a long term test, so time is not wasted in testing an unstable signal or with frequency offset. It also gives users a glance of the current status of long term tests.

11.4.2.2 Built-in MTIE & TDEV Analysis (Optional)

This option enables the test set to analyze up to 72 hours' worth of wander measurement data and compare it against standard masks for a PASS/FAIL assessment, without the need for a PC. The test set may allow the analysis to be performed while the test is still running for run-time verification. Longer test take a lot longer to be analyzed, so the VeEX Wander Analysis PC Software is still recommended for tests longer than 24 hours.

Features:

- Provides further post-processing of clock stability data, such as MTIE and TDEV
- Frequency offset calculation and removal for relative TIE analysis
- Standard MTIE and TDEV masks can be selected
- MTIE and TDEV results and mask export to CSV for further report generation using spreadsheets
- Direct PDF report generation to USB

TIE Results





- 1. Date and Time stamp indicating when the test was started
- 2. Total of seconds recorded during the test
- 3. Beginning and end of the data set to be analyzed and displayed in the graph (5) below. Tap in the Start and/or End field and enter the desired time limits, then press the Set Range button to apply these changes.
- 4. Based on all the TIE measurements captured, the test set automatically calculates any small difference in frequency between the signal under test and the reference clock. Once the frequency difference is known, users can remove it to perform Relative TIE measurements. The offset removal tool is important for field tests when the local reference clock used is highly accurate and stable but not traceable to the PRC in the network core (e.g. a portable frequency reference). Even if the frequency of the local reference is a few ppb (parts per billion) different than the PRC, it can still be used for wander measurements, as long as it is highly stable, because the Offset Removal feature can mathematically remove the know difference and make it as if a traceable reference had been used. Once removed, user can perform relative MTIE (or MRTIE) and TDEV analysis.
- 5. Auto-scale TIE graph, based on the limits set.
- 6. Press the Measurement button to return to the current wander measurements
- 7. Fine cursor controls. User can use the stylus to tap on the screen to position the cursor and then use these arrow buttons to position the cursor and read specific TIE values. The rubber cursor keys can also be used to move the cursor.

MTIE & TDEV Pass/Fail Analysis

MTIE Results



- 1. Standard MTIE & TDEV masks selection
- 2. Pass or Fail indicator, evaluated depending on selected masks
- 3. MTIE line color indicator and Enable/Disable check box
- 4. TDEV line color indicator and Enable/Disable check box
- 5. MTIE & TDEV logarithmic graphs and standard masks
- 6. Press this button to return to the wander measurements screen
- 7. Once the mask has been selected, press Analysis to run the MTIE and/or TDEV calculations. Depending on the number of samples collected, this calculation could take a few minutes.
- 8. Save the MTIE, TDEV and mask calculations in CSV format to a USB Memory stick. The graph can be recreated using a spreadsheet program like Microsoft® Excel, printed as a report or shared via email or any other electronic media
- 9. Generates a MTIE and TDEV report in PDF format to a USB Memory stick.

MTIE & TDEV Results Exported to CSV

пи	HOME INSER	T PAGELAN	OUT FORMA	AS DATA	REVIEW	VIEW								
1	+ 1 ×	v fr W	EX Inc.											
1	A		c	0	. t	F	G	н	1		ĸ	L M	N	
Vel	DK Inc.	VePAL TX3005	Constant -					MTI	E & TDE	V Analys	sis in XI	E.		
5/7		TTTA00N0910	372 Rev A00		10000.0	· · · · ·						-		
SW	Version	tx300s-Release	+12.4-1											
24	rt time	8/21/2014	13 35:43			18								
100	o iume	0/21/2014	13 52 21		1000						/			
12	poed time	0.10.30				1				/				
12	farance Clock	E1 GAZA				10				/				
LAT.	IL/TOEV Ransa	010 998				1	1000	-	100					
1.4	notice interval	30/4			100.0	1	_		1				-	
Tet	tal Samoling	29967						-				1	100	
100	ouency Offset(pom)	-4.111-05						-	2 13		/			
					10.0		-	(1994)	-	-00	-	-		
1														
Te	ne(s)	MTIE(na)	MTIE MASK	TDEV(na)	TORV			1			000			
1	0.03333333	8.90096	250.0000	1.1965010	12								1	
1.	0.0666667	15.04686	250.0000	1.6146120	12. 1.0		-			5	-		8	
1	0.1000000	19.49734	250.0000	1.7158920	12.4									
1	0.1666670	26.49095	250.0000	2.6154040	12	- F								
	0.2666670	40.05432	250.0000	3.9492940	12. 0.1	-								
	0.33333330	47.25986	250.0000	4.7803620	12-	0.01	0.3	10	1.00	30	00	100.00	3000	00
1	0.6666670	79.89671	250.0000	8.3194990	12	-	ATTIFICAT	_	MTH MASK		DFV(m)	- 100	MAGE	
	1.0000000	101 51330	250.0000	10.9382500	12.0000	and and a second	arrieford.		and the second of		Par strol	100	i instant	
	1.6666700	119.10330	250.0000	13.5829600	12.000000	0								
	2.6666700	128.85200	266.6667	14.2463800	12.000000	0								
	3.3333300	128.85200	333.3333	13.9004100	12.000000	0								
I	6.6666700	138.17680	666.6666	10.0788200	12.000000	0								
I	10.0000000	138.17680	1000.0000	7.0384880	12.000000	0								
	16.6667000	138.17680	1666.6670	4.1590940	12.000000	0								
<u>} </u>	26.6667000	138.17680	2000.0000	3.1550050	18.666670	0								
	33.3333000	138.17680	2000.0000	3.0487860	23.333330	0								
i	66.6667000	138.17680	2000.0000	2.5389030	46.666660	0								
I	100.0000000	142.83920	2000.0000	2.5930010	70.000000	0								
	166.6670000	149.40900	2000.0000	3.0375060	73.541930	0								
	266.6670000	149.40900	2000.0000	2.3306060	77.675920	0								
Į	333.3330000	154.49520	2000.0000	0.9177201	80.008900	0								
L	666.6670000	169.33020	2000.0000											
	997.9330000	173.99260	2000.0000											
	1588v2wander	•						2.4						

11.4.3 VeEX MTIE/TDEV Wander Analysis PC software

- Provides further post-processing of clock stability data, such as MTIE and TDEV for long-term tests
- Frequency offset calculation and removal for relative TIE analysis
- Standard and user-programmable masks
- PDF report generation
- Fully resizable window, to accommodate any screen size and provide detailed zoom levels

• Compact stand-alone Windows® software. It can be carried in the same USB memory as the TIE data. No installation is necessary.

For added convenience, the software doesn't need installation and can be stored on and run from the same USB stick where the wander log files are being stored.

11.4.3.1 TIE Measurement Results

Click on the Open button to load the desired MTIE of Phase file and see the TIE behavior on the screen. Use the Compare button to load a secondary trace for comparison purposes. Up to two traces can be displayed and analyzed simultaneously.



Click on the MTIE/TDEV Analysis button to go to the wander analysis function

11.4.3.2 MTIE & TDEV Analysis

Select the desired tolerance masks from the pull-down list and click on the Analyze button to perform the MTIE and/or TDEV analysis.



11.4.3.3 MTIE & TDEV Analysis Report in PDF

Click on the Report button to generate a copy of the measurement and analysis in PDF format.



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12.0 OTU-Xe

12.1 OTU-Xe Overview

Overclocked OTN Testing

An Overclocked option verifies extended bit rates to ITU-T series G supplement 43 standards. Overclocked OTN compensates for the rate mismatch between 10 GbE LAN and OPU2 payload by raising the overall OTU2 data rate from the standard 10.709 Gbps to fit the 10GbE LAN client signal.

OTU1e (11.0491Gbps) bit rate support (without fixed stuffing)



OTU2e (11.0957Gbps) bit rate support (with fixed stuffing)



Overclocked OTN supports the following two optical line rates for mapping 10GbE LAN signals.

G.709 Interface	G.709 Interface Line Rate		Line Rate	
OTU-1	2.666 Gbit/s	STM-16/OC-48	2.488 Gbit/s	
OTU-2	10.709 Gbit/s	STM-64/OC-192	9.953 Gbit/s	
OTU-1e	11.0491 Gbit/s	10GbE LAN	10.3125 Gbit/s	
OTU-2e	11.0957 Gbit/s	10GbE LAN	10.3125 Gbit/s	

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12.2 Home Menu and Switch Test Mode

The Home menu can be accessed at anytime during operation by pressing the **Home** key **(Mome b**) on the rubber keypad. The screen is divided into three presentation areas:

- 1 Left:
 - LEDs: Displays soft LEDs associated with Errors and Alarms
 - Tools: IP connection status, Advanced IP features (Net Wiz, WiFi Wiz, VoIP, and IPTV applications)
 - Utilities: Applications (Help, Settings, Files) which are common to all VePAL handheld test sets
- 2 Middle:
 - Test Applications specific to the test set (Setup, Alarm/Error, OTN Tools, RFC 2544, BERT, Throughput)
 - Setup to configure test interfaces
- 3 Right:
 - Test mode: Selects to the test interface(s)
 - Laser On/Off: Enables/Disables the Laser transmitter on optical ports



OTUx Home Menu

OTUx Home Menu with Ethernet Options



RXT-6200_RXT6000e_Module_Manual

Enabling Ethernet Options on the OTUx Home Menu

The Home menu features different test applications depending on Setup configuration. To enable Ethernet options (BERT, RFC 2544, Throughput) and access them from the Home menu, select 10GE SYNC or 10GE ASYNC for the OTN Mapping. For more information on configuring the OTN mapping, please see <u>Hierarchy</u>.

From the menu, select one of the following test modes: Ethernet Testing, Fibre Channel Testing, SONET/SDH Testing, or OTU-x (-1e, -2e) Testing.

OTU-x (-1e, -2e) Testing appears in the Home menu when OTU-1e or OTU-2e options are Enabled or Ordered.



Test Mode Selection

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12.3 OTN Setup

Tap on the Setup icon to access the tabs featured in this section.

12.3.1 Signal Setup



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

12.3.1.1 Hierarchy

To access the Hierarchy setting, tap on the **Hierarchy** box from the Signal tab.

Hierarchy LED'S Test Rate OTU-2e ▼ V **OTN Mapping** 10GE SYNC Err inj 🔵 Signal V Scrambler ON O Frame FEC ON V Alarn Pattern Alarm/Err O ALM/ERR ASER Off Tools Utilities Files

Hierarchy Setup

- Test Rate: Options are OTU-1e and OTU-2e (referring to 11.049G and 11.095G respectively).
- **OTN Mapping:** 10GE SYNC, 10GE ASYNC, and Test pattern. Overclocked OTN is technology that enables the transparent transportation of 10GbE LAN signals over OTN networks as per ITU-T series G supplement 43 are supported. The multiplexing structure is shown below.
- Scrambler: ON/OFF.
- FEC: FEC encoder can be ON/OFF (activated/deactivated).

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12.3.1.2 Interface

Tapping the Interface box opens the Interface Setup screen.

LED'S	Interface	
Test Port	Optical	
 Signal Signal Frame Pattern ALM/ERR Tools Utilities 	Clock Src Internal Internal External RX Offset	Err inj. Alarm AlarmJErr LASER Off

Interface Setup

- Test Port: Optical interface is available for OTU-1e, OTU-2e signals.
- 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
 - 2Mbps (or 1.5Mbps) signal
 - 2MHz (or 1.5MHz) BITS clock
 - 64Kbps (co-directional) present on the SMA connector
 - 2Mbps signal present on the RX2 balanced or RX2 BNC unbalanced
 - These options can be selected from them Clock External box.
 - **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.
- Aux Line Code (1.5 Mbps, 2 Mbps only): HDB3, B8ZS, AMI

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12.3.1.3 Pattern

Tapping the Pattern box opens the Pattern Setup screen. The pattern setup will show when OTN Mapping is set to Test Pattern.

Pattern Setup

LED'S		Pattern	Start	
LED'S		тх		
C Signal	PRBS Pattern	2^31-1	Err inj.)
-	Invert	OFF	V	
😑 Frame		RX		
	Out of service	ON	Alarm	1
Pattern	PRBS Pattern	2^31-1		
-	Invert	OFF	Alarm/Err	1
ALMIERK				
-			LASER OT	1
Tools				
Utilities	J			
Files				
The s				

- **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. Note, if the 32 bit user pattern entered is incorrect, the default pattern will be 0xFFFFFFF.
- Invert: Inversion of PRBS polarity is also available. Inversion of fixed words is not permitted.

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12.3.2 Measurements

LEDs	Signal	Measurements	General	Start
	Mode	Manual	T	Errini
Tools				
Utilities				
Files				Alarm
				AlarnvErr
				LASER Off

Measurements tab

Manual mode is chosen as the default configuration for starting/stopping the test.

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12.3.3 General

General tab

LEDs	Signal	Measurements	General	
	Audible Alarm	OFF	V	
X Tools	Results on start	OFF	V	Err inj.
Utilities	Meas Clock Src	Internal	•	
Files				Alarm
				Alarnu/Err
				LASER Off

- Audible Alarm: OFF, ON.
- Results on start: On or Off. Provides an automatic move to Result screen when it starts.
- Measurement Clock Source: Internal Clock or Tx Clock Source; the measurement is synchronized to the Transmitted (Tx) Clock.

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12.4 OTN Results

Accessing OTN Results

Measurements are accessed by tapping the **Results** icon in the main menu. The results comprise of a range of tabbed pages, similar to the setup pages. If Ethernet options are enabled, the Results icon will not be available on the Home

menu. To access results, press the **OTN Results** button from the selected Ethernet application.

OTN Menu



OTN Menu (Ethernet BERT application)

LED'S	Setup		Results		
	Header	Traffic	Error Inj.		
O Signal	BERT Profile	Last confi	guration		
OOFrame	Test Layer	Layer 2		10GE Err Inj	
OOrraine	Frame Type	Ethernet I	I(DIX)		
Pattern	VLAN	Off	2	Alarm	
O O ALM/ERR				Alarm/Err	
X Tools	MAC	Data	CRC		
Utilities				OTN Result	
Files					

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12.4.1 Summary

The Summary tab displays a summary page 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 OTN signal and its payload.

LED'S	Summary	Errors/Alarms	Signal	Event Log	
	ST:14/09 10:35:27			ET:00/00:00:08	
🕒 Signal	LOS Alarm			ок	Err inj.
0.05	OTN Alarms			OK	
••• Frame	OTN Errors			ок	
• Pattern		No error	(s) - Ok		Alarm
O O ALM/ERR					LASER Off
X Tools	ļ				
Utilities		•			
Files	J	Page 1	of 1		10GE Result

Summary tab

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12.4.2 Errors/Alarms

The Error/Alarm tab brings up several pages showing the errors and alarm 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.

LED'S	Su	ummary		Errors/Alarms	Signal	Event Log	
	Otu	Otu	Odu				
🔘 Signal	Lof	Fas	Ais				Err inj.
	Oof	MFas	Oci				
• Frame	Lom	Bip	Lck				
000	Oom	Bei	Bdi				Alarm
Pattern	Ais	CFec	Tim				
O ALM/ERR	lae	UFec	Plm				Alarmiterr
00	Bdi		Bip				LASER OF
	Tim		Bei				
Tools							
Utilities							
Files				• Page 1	of 6 💿		10GE Result

Errors/Alarms (Page 1)

Tapping the individual soft LED will automatically link to the applicable result screen which provides detailed information.

The LED headers are described in the table below:

Alarm Definitions and Descriptions			
στυ	Optical channel Transport Unit		
ODU	Optical channel Data Unit		
OPU	Optical channel Payload Unit		
PAT	Pattern detection (PRBS, User, fixed words)		

OTN Error and Alarm definitions per ITU-T G.709 recommendations:

OTU Alarm Definitions Detection criteria according to G.709 and G.798			
LOF	Loss of Frame - Declared when the OOF states have been constantly observed for 3 ms respectively		
OOF	 Out of Frame Declared if it fails to find an FAS sub-pattern (FAS bytes 3, 4, and 5) for five consecutive frames. 		
LOM	Loss of Multiframe - Declared when the OOF states have been constantly observed for 3 ms respectively		
оом	Out of Multiframe - Declared when the received MFAS is out of sequence for five consecutive frames		
OTU-AIS	Alarm Indication Signal - PN-11 sequence (covers complete Och) \ge 3 x 8192 bits		
otu-iae	 Incoming Alignment Error This bit allows the ingress to inform the egress that an alignment error in the incoming signal has been detected. IAE = 1 with error IAE = 0 no error Status (STAT) These three bits indicate the presence of maintenance signals (AIS, OCI, TCM, IAE) 		
otu-bdi	 Backward Defect Indication This single bit conveys information regarding signal failure in the upstream direction BDI = 1 indicates OTUk backward defect BDI = 0 otherwise 		
ΟΤU-ΠΜ	Trail Trace Identifier Mismatch		

OTU Error Definitions Detection criteria according to G.709 and G.798			
FAS	Frame alignment signal - Uses the first six bytes and , to provide framing for the entire signal		
MFAS	Multiframe alignment signal - Used to extend command and management functions over several frames. The MFAS counts from 0 to 255, providing a 256 multiframe structure.		
BIP-8	Bit interleaved parity-8 code		
BEI	Backward error indication -SM byte 3, bit 1 to 4: value 0 to 8: SM BIP-8 error count value 9 to 15: no SM BIP-8 errors value 11: SM BIAE		
BIAE	Backward incoming alignment error - SM byte 3, bit 1 to 4: "1011" ≥ 3 frames		
CFEC	Correctable FEC error		
UFEC	Uncorrectable FEC error		

ODU Alarm/Error Definitions Detection criteria according to G.709 and G.798			
ODU-BEI	Backward error indication -PM byte 3, bit 1 to 4: value 0 to 8: SM BIP-8 error count value 9 to 15: no SM BIP-8 errors		
ODU-AIS	Alarm Indication Signal - PM byte 3, bit 6 to 8: " 111" ≥ 3 frames		
ODU-OCI	Open connection indication - PM byte 3, bit 6 to 8: " $110" \ge 3$ frames		
ODU-LCK	Locked - PM byte 3, bit 6 to 8: "101" ≥ 3 frames		
ODU-BDI	Backward Defect Indication - PM byte 3, bit 5 = $1 \ge 5$ frames		
ODU-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.		
ODU-TIM	Trail Trace Identifier Mismatch		

BERT	Description	
LSS	Loss of Sequence Synchronization	
Bit	Bit error	

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Errors/Alarms (Page 2)

Page 2 lists the **OTU Errors** 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. Error conditions are displayed in red including count and rate.



Errors/Alarms (Page 2)

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Errors/Alarms (Page 3 & 4)

Page 3 & 4 lists the **OTU Alarms** in logical order associated with the signal under test. All alarms are evaluated and stored. The Elapsed Time [ET] since the start of the test is shown in the upper right hand corner.



Errors/Alarms (Page 3)

The alarms associated with the Section and Line are displayed separately for ease of interpretation.

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Errors/Alarms (Page 5 & 6)

Page 5 & 6 lists the **ODU/OPU Errors and Alarms** in logical order that are associated with the signal under test. All alarms are evaluated and stored.

Errors/Alarms (Page 5)

LED'S	Summary	Errors/Alarms	Signal	Event Log	
		ODU E	rors		
Signal	ET:			00/00:00:08	Err inj.
	BIP			0 0.0E+00	
• Frame	BEI			0 0.0E+00	
• Pattern					Alarm
					Alarm/Err
X Tools					LASER OT
Utilities					
Files		Page 5	of 6 🕑		10GE Result

Errors/Alarms (Page 7)

Page 7 lists the **BERT Errors/Alarms** in logical order that are associated with the signal under test. All alarms are evaluated and stored.



Errors/Alarms (Page 7)

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12.4.3 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.

- Number (#): Event number; events are numbered sequentially.
- Type: Indicates alarm or error type.
- Start: Indicates when the alarm or error was detected.
- **Dur/Count:** Indicates for how long the alarm or error was detected and provides duration (alarms) and ratio/count (errors). The duration format is day:hour:minute:second.

LED'S	Summary	Errors/A	larms Signal	Event Log	
		Туре	Start	Dur/Count	
😑 Signal	1	Start	14/09/10 10:35:27.0		Err inj.
O Frame	2	EXLOS	14/09/10 10:35:27.1		
UUT ante	3	Stop	14/09/10 10:35:35.8		
Pattern	4				Marm
~~~~	5				Alarm/Err
OO ALM/ERR	6				
	7				LASER OIT
Tools	8				
Utilities	9				
Files		٩	Page 1 of 1 🛛 🕑		10GE Result

## **Event Log**

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#### 12.4.4 Signal

### Level (Page 1)

The Signal tab displays the Level and Frequency screen. Page 1 displays the level measurement Loss of Signal (LOS); the Saturation level for optical signals is shown graphically, including the level measurement in dBm.

Signal (Page 1)

Summary Errors/Alarms Event Log Signal LED'S Level Err inj 🔘 Signal +3dBm SAT Rx Optical Frame Power [dBm] Alarm Pattern -2.74 Alarm/Err O ALM/ERR LASER Off Tools -30dBm LOS Utilities Page 1 of 3 0 Files 10GE Result

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

#### Frequency (Page 2)

The received signal frequency and offset is measured and displayed. For OTN signals, the measurement is performed on optical interfaces.

Signal (Page 2)

LED'S	Summary	Errors/Alarn	ns Si	inal	Event Log	
		F	requency			
😑 Signal	OTN current (bps)				11095727104	Err inj.
	Offset (ppm):	)			-0.1	
<b>OO</b> Frame	Min (ppm):				-128.2	
Pattern	Max (ppm):				-127.9	Alarm
O ALM/ERR						Alarm/Err
X Tools						
Utilities						
Files		• P	age 2 of 3	۲		10GE Result

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

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

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## **Optical Information (Page 3)**

Page 3 displays the Optical module information which includes Vendor name, Part number and Optical Wavelength.

Summary Errors/Alarms Signal Event Log LED'S Optical Err inj FINISAR CORP. 🔘 Signal Vendor FTLX1412M3BTL Part Number O Frame 1310 Wavelength Alarn Pattern Alarm/Err O ALM/ERR ASER Off Tools Utilities Page 3 of 3 10GE Result Files

## Signal (Page 3)

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## **12.5 OTU-Xe Ethernet Applications**

## Accessing Ethernet Applications from OTU-Xe

To enable and access Ethernet applications from the Home menu (RFC 2544, BERT, Throughput), tap on **Setup** [Home menu] > **Hierarchy** > **OTN Mapping** and select 10GE SYNC or 10GE ASYNC from the drop-down menu.

Setup Signal		
	Coupled Hierarchy	
	OTU-2e	
	Hierarchy	
Test Rate	OTU-2e	▼
OTN Mapping	10GE SYNC	T
Scrambler	ON	V
FEC	ON	V

## **Hierarchy Setup**

LED'S				
	Test Rate	OTU-2e	▼	
Signal	OTN Mapping	10GE SYNC	Terrinj.	
	Scrambler	ON	T	
O Frame	FEC	ON	V	
Pattern			Alarm	
Tools			LASER OF	
Utilities				
Files				

After configuring the OTU-Xe signal, press the **Home Key (CO)** on the keypad and tap on the desired Ethernet test.

### **OTN Home Menu with Ethernet Options**



Setup and results for Ethernet applications featured in OTU-x (-1e, -2e) are the same as those featured in Ethernet Testing mode. Please refer to the corresponding Ethernet testing section for more information on the following applications:

- 12.5.1 OTU-Xe with 10GE BERT redirects to BERT
- 12.5.2 OTN/10GE RFC 2544 Conformance Testing redirects to RFC 2544 Conformance Testing
- 12.5.3 OTN/10GE Throughput Testing (Multiple Streams) redirects to Throughput Testing

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# 13.0 Ethernet

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

## **13.1 Ethernet Setup**

## 13.1.1 Test Port Selection

This menu is accessed via the Test Port button located at the top left hand side of the screen. Click on the Test Port (CFP4, CFP2, QSFP+, SFP+, RJ45) to select the test mode. Depending on interface options purchased, the following selections are possible:

Test Ports	Test Mode Selection For Port 1			
CFP4	Ethernet	Interface Type 4x25G(IEEE802.ba)	▼	
	OTN >	100G Ethernet Testing		
QSFP28	Other Functions >	100G Ethernet Auto Profile Testing		
QSFP+		100G Ethernet Layer4 Testing		
SFP28				
SFP+				
RJ45				
	Ē	Cancel		
(B) 402 468 427 6	Remote C11	2019.01.15.16:19:30		
132.100.127.0	W remotecci	2013-04-13 10.19.30		

**Test Mode Seelction RXT-6200** 

**Test Mode Seelction RXT-6000e** 



Shared single/dual port combinations between RXT-6200 and RXT-6000e:

- Single port 100G (CFP2 or CFP4)
- Single port 100G, 50G (QSFP28/QSFP+)

- Single port 40G (QSFP+)
- Single port 25G, 10G, 1G (SFP28/SFP+)
- Single Copper port 1G (1G Copper)
- Dual port 100G, 50G (QSFP28/QSFP+)
- Dual port 40G (QSFP+)
- Dual port 25G, 10G, 1G (SFP28/SFP+)
- Dual Copper port 1G (1G Copper)

Single/dual port combinations present only in RXT-6000e:

- Single port 100G (CFP2)
- Single port 100G, 50G (QSFP28/QSFP+)
- Single port 40G (QSFP+)
- Single port 25G, 10G, 1G (SFP28/SFP+)
- Single Copper port 1G (1G Copper)
- Dual port 100G, 50G (QSFP28/QSFP+)
- Dual port 40G (QSFP+)
- Dual port 25G, 10G, 1G (SFP28/SFP+)
- Dual Copper port 1G (1G Copper)
- ViPAG
- Pass Through Monitor 10G (SFP28/SFP+)
- Pass Through Monitor 10/100Base-X (SFP28/SFP+)
- Pass Through Monitor 10/100/1000Base-T (1G Copper)

After selecting the test interface click **OK**.

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## 13.1.2 Port Setup

Port setup or test interface configuration are accessed via the Setup menu located on the Home page. The available configuration settings depend on the interface selected in the Test Mode selection.

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

LED'S	Port	Measurement	
	Port Selection	1000Base-X	
X Tools	Port 1 fiber profile	Last configuration 🛛 🔻 🔻	
	Auto Negotiation	On 🔻	
Utilities	Speed	1000 Mbps	
Files	Duplex	Full	
	Flow Control	Both On 🛛 🔻 🔻	
	Apply	Discard	LASER On/Off

#### **1 GE Fiber Port Setup**

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### **1 GE Fiber Port**

- Auto Negotiation: On or Off. Matches the test set's negotiation settings to those of the link partner
- Speed: Default set to 1000 Mbps
- **Duplex:** Default set to Full
- Flow Control: TX On, RX On, Both On, or Off
  - When flow control is enabled, the test set will respond to pause frames received by the link partner by adjusting the transmit rate
  - When flow control is disabled, the test set ignores all incoming pause frames from the link partner and continues transmitting at the configured transmit rate

	LEDs	Port Stat		tus Measurement			
		Port Selection		10/100/1000Base-T			
$\left  \mathbf{X} \right $	Tools	Port 1 copper profile		Last configu	iration	V	
		Auto Negotiation		On		V	
	Utilities	Advertisement		Default-ALL		V	
	Files	Flow Control		Both On		V	
-		MDIX	Auto 🗸 🗸 🗸				
							MX Discover
		Apply			Discard		

#### **1 GE Copper Port Setup**

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#### **1 GE Copper Port**

- Auto Negotiation: On or Off. Matches the test set's negotiation settings to those of the link partner.
  - Speed (only when Auto Negotiation is Off): 10 Mbps, 100 Mbps, 1000 Mbps.
  - Duplex (only when Auto Negotiation is Off): Half or Full.
  - Advertisement (only when Auto Negotiation is On): Default-All or Custom. Custom options include 10/100/1000M/Half or 10/100/1000M/Full.
- Flow Control: TX On, RX On, Both On, or Off.
  - When flow control is On, the test set will respond to pause frames received by the link partner by adjusting the transmit rate.
  - When flow control is Off, the test set ignores all incoming pause frames from the link partner and continues transmitting at the configured transmit rate.
- **MDIX:** Off, On, or Auto. When MDIX is set to Auto, the test set detects the required cable connection type and configures the port connection properly for interfacing the partner device, eliminating the need for crossover cables.

#### **10GE Port Setup**

LEDs	Port	Measurement	
	10G port profile	Default 🗸 🔻	
X Tools	10GE Mode	LAN 🔻	
	Flow Control	Enable 🔻 🔻	
Utilities	Clock Offset (ppm)	0	
Files			
			LASER On/Off
			MX Discover
			$\sim$
	Apply	Discard	

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#### 10 GE Port

- 10GE Mode: LAN or WAN
- WIS Mode (only available in WAN mode): SDH or SONET
- Flow Control: Enable chosen as default option
- Clock Offset (ppm): The frequency may be offset in parts per million

#### Status

#### Status tab

	LEDs	Port	Sta	itus I	Measurement	
		Link Advertiseme	nt	Link Down		
$\mathbf{x}$	Tools	Link Config. ACK		Link Down		
		Remote Fault		Link Down		
	Utilities	Local Port		Remote Port		
		Speed	Link Down	Speed	Link Down	
	Files	Duplex	Link Down	Duplex	Link Down	
		MX Link Advertise	ement	Link Partner Adve	rtisement	
		10M/Half	Link Down	10M/Half	Link Down	
		10M/Full	Link Down	10M/Full	Link Down	
		100M/Half	Link Down	100M/Half	Link Down	MX Discover
		100M/Full	Link Down	100M/Full	Link Down	
		1000M/Full	Link Down	1000M/Full	Link Down	
				Symmetric Pause	Link Down	
				Asymmetric Pause	Link Down	

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

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

#### 40 GE Port Setup

	IV OL I	Secup	
LEDs	Port	Measurement	
	40G port profile	Default 🛛 🔻	
Signal	Network Type	LAN 🔻	
<u> </u>	Flow Control	Enable 🛛 🔻	
Frame	Clock Source	Internal 🛛 🗸 🔻	
Pattern	Clock Offset (ppm)	0.0	
Ŭ	Link Fault Response	Disable 🛛 🔻	
ALM/ERR			
History	Apply	Discard	MX Discover
	Apply	Discard	

#### 40 GE Port Setup

- 40G port profile: Default
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxCLK, GPS1PPS
- Clock Offset (ppm): Can be configured; range is +/- 150ppm
- Link Fault Response: Enable/Disable

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#### 100 GE Port

- 100G port profile: Default
- Network Type: LAN
- Flow Control: Enable/Disable
- Clock Source: Internal, External (2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS), RxCLK, GPS1PPS
- Clock Offset (ppm): Can be configured; range is +/- 150ppm

	L.	scrup Clock Source	L	
LEDs	Port	Me	easurement	
	100G port profile	Last configura	ation 🔻 🔻	
😑 Signal	Network Type	Clock Source	ເ 🔻	
	Flow Control	Internal	▼	
😑 Frame	Clock Source	Internal	<b>•</b>	
Pattern	Clock Offset (ppm)	External 2Mbps		
0	Link Fault Response	External 1.5Mbps	▼	
ALM/ERR	Eye Clk	External 1.5MHz	▼	
		External 10MHz		LASER On/Off
History		External 1PPS		
		RxCLK		MX Discover
		GPS 1PPS		
	Арр	ly Dis	scard	
(P) 192.168.0.142	Remote/CLI		2015-07-31 12:33:44	

#### **Setup Clock Source**

<ul> <li>LEDs</li> <li>Signal</li> </ul>	Clock Offset (ppm	)		0	
C Frame	1	2	3		
Pattern	4	5	6		
ALM/ERR     History	7	8	9		LASER On/Off
	+1-	0			
	Del Del All	. A	opply <-		

Setup Clock Offset

#### **13.1.3 Measurement Settings**

LEDs	Port	Measurement	
	Mode	Manual 🗸 🔻	
😑 Signal	Event Log	Circular 🗸 🗸	
	TX Start	Separated 🛛 🔻	
😝 Frame	ToD Synchronization Source	Disable 🛛 🔻	
Pattern	Results Auto Save	OFF 🛛 🔻	
0			
ALM/ERR			LASER On
History			MX Discover
		7045 07 70 4145 20	

**10 GE Measurement Setup** 

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

- Profile: Last configuration, Delete, Save, Save as..., Default.
- Mode: Manual, timed, or auto mode are available.
  - Manual mode: User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start:** Tx & Rx, or Tx Separate. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - Tx & Rx: Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.
  - **Tx Separate:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on -- the user must start the transmitter manually.
  - **Tx Coupled:** Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.

• ToD Synchronization Source: Disable, GPS 1PPS

*Clock Synchronization is not supported on all the test set models. Check with customer care for availability.* <u>Go back to top Go back to TOC</u>

## **13.2 BERT**

## 13.2.1 BERT Setup

#### **Overview:**

BER testing at Layer 1, 2, 3, and 4 is supported. The BERT can be configured to use either regular PRBS test patterns, stress patterns (specifically for 10Gigabit Ethernet) or user defined test patterns to simulate various conditions. The test layer, frame header, traffic profile, error injection, and control settings of the far-end device (if applicable) must be configured prior to testing.

- Layer 1: Unframed mode (fiber ports only) or Framed mode
  - Unframed mode: Test traffic consists of a bit stream of the selected test pattern
  - **Framed mode:** Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field

LED'S	Setup		Res	Start	
	Header	Traffic	:	Error inj.	
X Tools	BERT Profile	Las	st configuration	٦	<b>·</b>
Litilities	Test Layer	Lay	yer 1 Framed		
Councies					
Files					
		Dete		CRO	LASER On/Off
		Data		CRC	MX Discover
					Control
		Data		CRC	LASER Onfo MX Discove Control

#### BERT Setup - Header (Layer 1)

- Layer 2: Framed BERT (same as Layer 1 Framed)
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame

	LEDs	Setup		Res	Results		
		Header	Traffic	Error Inj.	Alarm Inj.		
$\left  \right\rangle$	Tools	BERT Profile		Last configuration	, ▼		
-	Litilities	Encapsulation Typ	pe	PBB-TE	▼		
	Oundes	Test Layer		Layer 2	▼		
	Files	Frame Type		Ethernet II(DIX)			
		VLAN		1 tag			
		PBB	MAC VLAN	Data	CRC	LASER On/Off MX Discover Control	

#### **BERT Setup - Header (Layer 2)**

- Layer 3: Framed BERT (same as Layer 1 & 2 Framed)
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame
    IP Address: A default or user configured IP address is added to the frame

	LEDs	Setup		Res	ults	Start
		Header	Traffic	Error Inj.	Alarm Inj.	
	Tools	BERT Profile		Last configuration	▼	
	Litilities	Encapsulation Typ	e .	PBB-TE	•	
	oundes	Test Layer		Layer 3	▼	
	Files	Frame Type		Ethernet II(DIX)		
_		VLAN		1 tag		
		MPLS		Off	V	
		PBB M	AC V IP L A N	Data	C R C	LASER On/Off MX Discover Control

## BERT Setup - Header (Layer 3)

- Layer 4: Framed BERT (same as Layer 1, 2, & 3 Framed)
  - MAC Address: A default or user configured Media Access Control (MAC) address is added to the frame
  - IP Address: A default or user configured IP address is added to the frame
  - UDP Address: A user defined source and destination port address is added to the frame

				Start	
Header	Traffic	Error Inj.	Alarm Inj.		
ERT Profile		Last configuration	Last configuration		
ncapsulation Typ	•	РВВ-ТЕ	▼		
est Layer		Layer 4	▼		
LAN		1 tag			
PLS		Off			
ROTOCOL		UDP			
			LASER On/Off		
PBB	AAC VLAN IF	P UDP Dat	ta CRC	MX Discover Control	
	RT Profile icapsulation Typ ist Layer AN PLS ROTOCOL PBB	RT Profile Institution Type Inst Layer AN PLS ROTOCOL PBB MAC VLAN IF	Induction     Induction       ERT Profile     Last configuration       icapsulation Type     PBB-TE       isst Layer     Layer 4       AN     1 tag       PLS     Off       ROTOCOL     UDP	RT Profile     Last configuration       Incapsulation Type     PBB-TE       Instrument     Value       AN     1 tag       PLS     Off       ROTOCOL     UDP	

## BERT Setup - Header (Layer 4)

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## **13.2.1.1 Header Settings**

- **BERT Profile:** Load a previously configured test profile or create a new profile from existing settings. Please see **6.0 Profiles** in the **ReVeal MTX300 manual** for more details on how to create new profiles using ReVeal software.
- Encapsulation Type: None or Provider Backbone Bridge (PBB-TE): Provider Backbone Bridge MAC-in-MAC (IEEE 802.1ah) encapsulation are configured trunks that add resiliency and configurable performance levels in the provider backbone network. Available for 1GE Copper/Fiber and 10GE port. PBB encapsulation is available for all Ethernet tests (Layer 2,3 and 4) - BERT, RFC2544, Throughput, V-SAM.

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

- Backbone MAC Source
- Backbone MAC Destination

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

ГВВ										
	LEDs	PBB-TE	MAC	VLAN		P	UDP	DATA	RX Filter	Start
		Backbone	MAC Sou	rce		00-18	00-18-63-1A-2B-4E			
$\mathbf{x}$	Tools	Backbone	MAC Des	tination		00-18	-63-1A-2	B-3C		
		Ethernet 1	ype			88-E7	7			
	Utilities	I-SID				1193	046			
	Files	Backbone	VLAN ID	1082	Prie	ority	6	Гуре	88a8	
										LASER On/Off
										MX Discover
										Control

חחח

- Test: Select the test layer to perform the BERT
  - Options are Layer 1 Unframed, Layer 1 Framed, Layer 2, Layer 3, and Layer 4
- Frame Type: Select the Ethernet frame type for Layer 2 or Layer 3
  - 802.3 Raw (IEEE 802.3 frame without LLC) Not available when Layer 3 is selected
  - 802.3 LLC (IEEE 802.3 frame with LLC header)
  - 802.3 SNAP (IEEE 802.3 frame with SNAP header)
  - Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)
- MAC/IP: Tap the MAC and IP blocks on the Frame image to access the setup menus
  - Set the Source and Destination MAC address for Layer 2
  - Set the Source and Destination MAC and IP addresses for Layer 3 and Layer 4
- VLAN: Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications)

VLAN stacking is an option

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

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

## The most common Ethernet Frame format, Type II



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

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

- MAC Header Tab:
  - MAC Source: Use the default source address of the test set or configure a new or different address.
  - MAC Destination: Configure the destination MAC address of the far-end partner test set or use the ARP or ARP GW keys to determine the MAC address of the destination IP address (ARP) or the Gateway (ARP GW). Note that a valid IP connection needs to be up to use these functions. Refer to 9.1 IP in the V300 Common Functions manual for details on IP connection.
  - Ethernet Type: For Layer 3 testing, the user can also configure the Ethertype:
    - 0800-IP (Internet Protocol Version 4, IPv4)
    - 0600-Xerox
    - 0801-X.75 (X.75 Internet)
    - 0805-X.25 (X.25 Level 3)
    - 0806-ARP (Address Resolution Protocol [ARP])
    - 8035-RARP (Reverse Address Resolution Protocol [RARP])
    - 8137-IPX (Novell IPX)
    - 814C-SNMP
    - 8847-MPLS unicast
    - 8848-MPLS multicast
    - 86DD (Internet Protocol, Version 6 [IPv6]) Future Release

	LED'S	MAC	IP	DATA	RX Filter	Start
		MAC Source		00-18-63-00-0C-40	)	
$\left  \mathbf{X} \right $	Tools	MAC Destination		00-1E-90-A0-57-30	:	
	Utilities	Ethernet Type		0600-IP	•	
	Files					
						MX Discover
						Control
		MAC Source	AI	RP	ARP Gateway	

# BERT Setup - MAC address settings (Layer 3)

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- VLAN Tab: In the VLAN tab the following parameters are configured:
  - VLAN ID: Configurable in the range 1 to 4094.
    - VLAN ID is the identification of the VLAN, which is basically used by the standard 802.1Q.
    - It has 12 bits which allows the identification of 4096 (2¹2) VLANs.
    - Of the 4096 possible VIDs, a VID of 0 is used to identify priority frames and value 4095 (FFF) is reserved.
    - Maximum possible VLAN configurations are therefore set to 4094.
  - VLAN Priority: Configurable in the range 0 to 6
    - Set by the Priority Code Point (PCP), a 3-bit field which refers to the IEEE 802.1p priority.
    - It indicates the frame priority level from 0 (lowest) to 7 (highest), which can be used to prioritize different classes of traffic (voice, video, data, etc.).

- **Type:** The following selections are possible:
  - 8100 (IEEE 802.1Q tagged frame)
  - 88a8 (IEEE 802.1ad Provider Bridging)
- Drop Eligible: If enabled, drop eligibility flag will be set.
- VLAN Flooding: Enable/Disable.
- VLAN Flooding Range: Specifies the number of VLAN IDs. Enter a number from 0-4096. The VLAN IDs will be incremented by 1 until it reaches the number of times entered in the flood range.



# IEEE 802.1Q VLAN Tag in an Ethernet Frame

# BERT Setup - VLAN Tag configuration (Layer 3)



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- MPLS Tab: In the MPLS tab the following parameters are configured:
  - MPLS label: Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved).

Composed of 20 bits which allows for the creation of over one million labels.

• **CoS:** Configurable in the range 0 to 6.

This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS).

• **S-bit:** Configurable 0 or 1.

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

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

Used to decrement the time-to-live counter.

		··· · · I			9		
e LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	MPLS #1	Labe⊫ 0	S=	0			
X Tools		CoS= 0	TTL=	0			
	MPLS #2	Labe⊫ 0	S=	0			
		CoS= 0	TTL=	0			
Files	MPLS #3	Labe⊨ 0	S=	1			
		CoS= 0	TTL=	0			
							LASER UNION
							MX Discover
							Control
							Control
							LASER On/Off MX Discover Control

# **BERT Setup - MPLS label configuration**

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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
  - IP Src and IP Dest: For IP Src, if the IP connection is up, refer to section 9.1 IP in the V300 Common Functions manual. The source address is fixed to the IP address from the IP setup menu.
  - IP TOS (for Quality of Service testing):
    - Legacy TOS (Precedence): The first three bits of the IP TOS field can be edited:
      - 000 Best Effort
      - 001 Bulk Data
      - 010 Transactional
      - 011 Call Signaling
      - 100 Streaming Video
      - 101 Voice
      - 110 Routing
      - 111 Reserve
    - **DSCP (Differentiated Services Code Point):** The first six bits of the IP TOS can be edited to provide more granular service classification.

For more information on the definition of DSCP field in IPv4 and IPv6 headers, refer to RFC2474.

- Time To Live (TTL): Configurable in the range 0 to 255.
- **Fragment offset byte:** Configurable in the range 0 to 65.528.

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

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

e LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
	Source IP A	ddress		192.168.0	).10		
X Tools	Destination	IP Address		192.168.2	2.200		
	IP TOS			DSCP		V	
Utilities	DSCP	01100	1	ЕСТ	0 🔻 CE	o 🔻	
Files	TTL			128			
	Fragment O	ffset		0			
	Protocol			UDP - 0x	11	V	
							LASER On/Off
							MX Discover
							Control

# BERT Setup - IP Address settings (Layer 3)

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- Data Tab: User selects a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). Depending on the test layer, different test pattern options are available.
  - Layer 1 Framed Test Patterns
    - **CRPAT:** Compliant Random Pattern provides broad spectral content and minimal peaking for the measurement of jitter at component or system level.
    - **CJTPAT:** Compliant Jitter Test Pattern is a Jitter Tolerance Pattern that stresses a receiver by exposing it to extreme phase jumps thereby stressing the clock data recovery (CDR) circuitry. The pattern alternates between repeating low transition density patterns and repeating high transition density patterns.
    - CSPAT: Compliant Supply Noise Pattern. Represents worst case power supply noise.

	1	,
LED'S	DATA	Start
X Tools	• CRPAT	
Utilities	CJPAT     CSPAT	
Files		
		LASER On/Off
		MX Discover
	• Page 1 of 2 •	Control

# BERT Setup - Data selection (Layer 1 Framed)



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

# • Layer 1 Unframed Test Patterns

- HFPAT (High Frequency Pattern): This test pattern is to test random jitter (RJ) at a BER of 10-12, and also to test the asymmetry of transition times. This high frequency test pattern generates a one, or light on, for a duration of 1 bit time, followed by a zero, or light off, for a duration of 1 bit time. This pattern can be generated by the repeated transmission of the D21.5 code-group. Disparity rules are followed.
- LFPAT (Low Frequency Pattern): The intent of this test pattern is to test low frequency RJ and also to test PLL tracking error. This low frequency test pattern generates a one, or light on, for a duration of 5 bit times, followed by a zero, or light off, for a duration of 5 bit times. This pattern can be generated by the repeated transmission of the K28.7 code-group. Disparity rules are followed.
- MFPAT (Mixed Frequency Pattern): The intent of this test pattern is to test the combination of RJ and deterministic jitter (DJ). This mixed frequency test pattern generates a one, or light on, for a duration of 5 bit times, followed by a zero, or light off, for a duration of 1 bit times, followed by a zero for 1 bit time followed by a one for 2 bit times followed by a zero for 5 bit times followed by a one for 1 bit time followed by a one for 1 bit time followed by a one for 1 bit time followed by a zero for 2 bit times. This pattern can be generated by the repeated transmission of the K28.5 code-group. Disparity rules are followed.
- **RDPAT (Random Data Pattern):** Designed to provide energy across the entire frequency spectrum providing good simple BER testing.
- JTPAT (Jitter Tolerance Pattern): Designed to verify jitter tolerance on the receivers by exposing a receiver's CDR to large instantaneous phase jumps. The pattern alternates repeating low transition density patterns with repeating high transition density patterns.
- SNPAT (Supply Noise Pattern): Designed to simulate the worst case power supply noise that could be introduced by a transceiver.

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- Layer 2, 3, & 4 test patterns (40GE and 100GE only support up to Layer 3)
  - PRBS:
    - 2³¹ -1 (147 483 647-bit pattern used for special measurement tasks, [e.g., delay measurements at higher bit rates])
    - 2²3 -1 (8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps)
    - 2¹⁵ -1 (32 767 bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736 kbps)
    - 2¹¹ -1 (2047 bit pattern primarily intended for error and jitter measurements on circuits operating at bit rates of 64 kbps and N x 64 kbps)

- Fixed: All 0s or All 1s
- User Defined pattern: Length depends on size of frame
- Inversion: Normal or inverted

						× 0	,
e LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
X Tools	PRBS	2E31-1	•	vert			
Utilities	<ul> <li>PRBS</li> <li>PRBS</li> </ul>	2E23-1 2E15-1					
Files	PRBS     All 0's	2E11-1					
	<ul> <li>All 1's</li> </ul>	;					LASER On/Off
	<ul> <li>User</li> </ul>	Defined	00-00-00	0-00			MX Discover
			Pa	ae 1 of 2 🛈	>		Control
				ge i el a			

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

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

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

	LEDs	MAC	MPLS	DATA	RX Filter	Start
			Auto			
X	Tools	PRBS 2E31	I-SPEC 📄 Ir	ivert		
-	Utilities	PRBS 2E23	3-SPEC			
	oundes	PRBS 2E16	5-SPEC			
	Files	PRBS 2E11	I-SPEC			
						MX Discover
						Control
			e Pa	gezorz 🗢		

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

LED'S	MAC	VLAN	MPLS	IP	DATA	RX Filter	Start
X Tools	MAC     MAC	Destination Source					
Utilities		Priority					
Files	VLAN     Frame	Eligible EType					
	Type	of service col Type					LASER On/Off
	IP De	stination urce					MX Discover
							Control
							Control

# **BERT Setup - RX Filter selection**

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

	LEDs	MAC	VLAN	MPLS	IP	UDP	DATA	RX Filter	Start
		Source Po	ort		0				
$\left  X \right $	Tools	Destinatio	n Port		0				
	Utilities								
	Files								
									MX Discover
									Control

# **BERT Setup - RX Filter selection**

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# 13.2.1.2 Traffic Settings

# **Traffic** Tab

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

- Traffic Flow: Select from the following traffic flows:
  - Constant: The selected frame is transmitted continuously according to the selected bandwidth %.
  - **Ramp:** The selected frame is transmitted at maximum bandwidth according to the selected duty cycle and burst period.
  - **Burst:** The selected frame is transmitted in a staircase profile according to user selectable step time, number of steps, and maximum bandwidth.
  - **Single Burst:** Configure the number of frames to be transmitted in the burst along with the bandwidth. For example, if 100000 frames are transmitted at 12.5% of bandwidth, on a 1Gbps line, 100000 frames will transmit at a rate of 125Mbps and then the burst will stop.
- Frame Size Type: Fixed or Uniform min and max frame length values. Uniform traffic is traffic generated with a uniform distribution of frame lengths.

- Frame Size (bytes): Enter the frame size when a Layer 2, 3, or 4 BERT is selected
  - Frame size configuration is not available for Layer 1 BERT
  - Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 10000 bytes

# • BW (Transmit Bandwidth): Configure the transmit rate for the test

- When traffic flow is equal to Burst, two burst bandwidths are configured with burst time
- When traffic flow is equal to Ramp, starting and an ending bandwidth are configured along with the bandwidth step size and duration

	LEDs	Setup			Results		Start
		Header	Tra	ffic	Error inj.		
$\left  \times \right $	Tools	Traffic Flow		Constant		▼	
	Utilities	Frame Size Type		Fixed		V	
	Connect P	Frame Size (bytes)		1516			
	Files	Constant Bandwidth		10.000	%	▼	
							MX Discover
							Control
							Control

**BERT Setup - Constant Traffic** 



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# 13.2.1.3 Error Injection

(
This description is for 10GE only)

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

- Error type: Select from Bit, CRC, IP Checksum (Layer 3, 4 only), Pause, TCP/UDP Checksum (Layer 4 only). With Pause selected, the unit will transmit a pause frame when Error Injection icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- Injection Flow: The error injection flow determines how the selected errors will be injected.
  Select a single error injection or specific count.
- Count: Configures the error count via a numeric keypad.

# **BERT Setup - Injection Error**

LEDs	Setup			Results	Start
	Header	Trat	ffic	Error inj.	
Tools	Error Type	Error Type		▼	
Utilities	Injection Flow		CR		
			IP Checksu	m	
Files		TCP/UI	DP Checksu Paus	m e	
			В	it	
					MX Discover
					Control



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# 13.2.1.4 Starting/Stopping a BERT

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

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

#### • End-to-End Testing

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

#### • Far-End Unit in Manual Loopback Mode

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

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

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

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

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

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# 13.2.2 BERT Results

# 13.2.2.1 Summary

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

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

LEDs		Setup				Results		Stop
	Summary	Errors	Alarms	Events	Traffic	Delay	Rates	
😑 Signal	ST:2012-2	- 8 01:40:42	2	ET:0	0:00:07			Restart
C Frame			тх		R	х		TX Stop
	Line Rate (	(bps)	1000.000	м	10	M000.000		
😑 Pattern	Utilization	(%)	10.001%		10	0.001%		
	Utilization	(bps)	100.010	vi	10	00.010M		
ALM/ERR	Framed Ra	ite (bps)	98.706M		96	3.706M		
	Data Rate	(bps)	97.536M		97	7.536M		
X Tools	# of Bytes		8578521	6	8	5786734		MX Discover
	Pause Frai	mes	0		0			
Utilities								Control
Files								

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

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#### 13.2.2.2 Errors

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

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

# **BERT Results - Errors**

LEDs		Setu	ib		Results				Stop
	Summary	Errors	Alarms	Events	Traf	ffic	Delay	Rates	
😑 Signal		c	urrent		т	otal			Restart
C Frame	Bits	0			0	I			TX Stop
	BER	0	.000000E+0	0	0	.0000	00E+00		
😑 Pattern	Symbol	N	N/A			N/A			Err Inj.
-	FCS/CRC	0			0				
ALM/ERR	Jabber Fram	ies O	0			0			
	Runt Frames	s 0			0				
X Tools									MX Discov
Utilities									Control
Files									

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#### 13.2.2.3 Events

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

LEDs	Setup			R	esults	Stop
_	Summary Er	rrors	Alarms Even	ts Traffic	Delay Rates	
😑 Signal	Time		Event Type	# of Events	Test	Restart
😑 Frame	2012-2-8 01:4	1:06	Test Started		BERT	TX Stop
O Pattern						Err Inj.
X Tools			0			MX Discove
Utilities			• Page			Control
Files						

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

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

#### 13.2.2.4 Traffic

Traffic tab: The following Traffic statistics are displayed:

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

Tap on the graph for detailed screens.



# **BERT Results - Traffic Distribution**

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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

e LEDs	Frames		Traffic Type		Frame Size	
	RX Frames	#		%		
😑 Signal	Total	1503288		100		
	Test	1503288		100.00	0000	
Frame	VLAN	0		0.0000	00	
Pattern	VLAN Stack	0		0.0000		
•	Non-Test		0		00	
ALM/ERR	TX Frames	#				
-	Total	1503278				
X Tools	Pause Frames	тх		RX		
	Total	0		0		
Utilities						
Files						

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

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

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

LEDs	Frames	Traffic Type		Frame Size	Stop
	Distribution	#	%		
🧿 Signal	L2 Unicast	1820260	100	.000000	Restart
<u></u>	L2 Broadcast	0	0.00	00000	TX Stop
🕒 Frame	L2 Multicast	0	0.00	00000	
😑 Pattern					Err Inj.
ALM/ERR					
Tools					MX Discover
Utilities					Control
Files					

# **BERT Results - Traffic Type**

# Go back to top Go back to TOC

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

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

# **BERT Results - Frame Size**

LEDs	Frames	Traffic Type	Frame Size	Stop
	Distribution	#	%	
😑 Signal	< 64B	0	0.000000	Restart
	64 - 127B	0	0.000000	TX Stop
😑 Frame	128 - 255B	0	0.000000	
O Pattern	256 - 511B	0	0.000000	Err Inj.
	512 - 1023B	0	0.000000	
ALM/ERR	1024 - 1279B	0	0.000000	
Ŭ	1280 - 1518B	1974683	100.000000	
Tools	> 1518B	0	0.000000	
Utilities				Control
Files				

# 13.2.2.5 Rates

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

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



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# 13.2.2.6 Delay

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

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

#### Setup Results Stop LEDs Summary Events Traffic Delay Rates Restart 🔵 Signal Frame Arrival Time 110.912us Average 110.914us Current TX Stop 🔵 Frame Minimum 110.912us Maximum 110.928us Err Inj. Frame Delay Variation 🔵 Pattern 0.002us Current ALM/ERR Tools MX Discover Utilities Control Files

# **BERT Results - Delay**

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#### 13.2.2.7 Alarms

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

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

BERT	Results	- Alarms
------	---------	----------

LEDs	Se	tup		Results		
	Summary Error	s Alarms Eve	nts Traf	ffic Delay	Rates	
🜔 Signal		Current	т	otal		
Frame	LOS (ms)	0	0	0		
0	LOSync	0	0			
😑 Pattern	Pattern Loss	0	0	0		
Ĭ	Service Disruptio	n (ms)	_			
ALM/ERR	Current	0	Total	0		
	Last		0			
X Tools	Min/Max	0	0			
	No. of Occurrence	25	0			
Utilities						
Files						

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#### 13.2.2.8 Signal

The Signal tab (fiber ports only) displays the optical level measured by the SFP or XFP transceiver. RXT-6200_RXT6000e_Module_Manual



# **BERT Results - Signal**

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# 13.3 RFC 2544 Conformance Testing

- <u>Overview</u>
- Setup Standard Mode
  - Header Settings
    - Frames Settings
    - Threshold Settings
    - <u>Peer-to-Peer Asymmetric Testing</u>
    - Throughput Settings
    - Latency Settings
    - Frame Loss Settings
    - Burst Settings
- <u>Starting / Stopping a RFC2544 Measurement</u>
- <u>Results Standard Mode</u>
  - <u>Status</u>
  - <u>Summary</u>
  - <u>Signal</u>
  - Events
  - Latency / Jitter
  - Frame Loss
  - Burst
- Saving Results
- Advanced SLA Mode
  - Background General Setup
  - Background Traffic Setup
  - Background Results

# **Overview:**

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

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

- Test layer (Layer 2, 3, & 4)
- Frame header (PBB, MAC, VLAN, IP, UDP, and Data)
- Test frames selection
- Pass/fail thresholds (optional)
- Far-end unit loop control
- Throughput
- Latency
- Frame loss
- Burst (back-to-back)

LEDs	Set	Setup		Results	Start
	Throughput	Latency	Frame Loss	s Burst	
Tools	Header Fran		mes Thresholds		
Utilities	Profile		Last configura	Ī	
	Encapsulation Typ	e	PBB-TE	V	
Files	Test Layer		Layer 2		
	Frame Type		Ethernet II(DI)	SLA Mode	
	VLAN		1 tag		
	РВВ	MAC VLAN	Data	CRC	Control

# RFC 2544 Setup - Layer 2 parameters

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#### 13.3.1 Setup - Standard Mode

Unless otherwise noted, the Frame Header and related setups are identical to the setups described in the BERT Application above. A summary of the RFC 2544 setup options are outlined below.

# **13.3.1.1 Header Settings**

- **RFC 2544 Profile:** Load a previously configured test profile or create a new profile from existing settings. Please see **6.0 Profiles** in the **ReVeal MTX300 manual** for more details on how to create new profiles using ReVeal software.
- Encapsulation Type: None or Provider Backbone Bridge (PBB-TE): Provider Backbone Bridge MAC-in-MAC (IEEE 802.1ah) encapsulation are configured trunks that add resiliency and configurable performance levels in the provider backbone network. Available for 1GE Copper/Fiber and 10GE port. PBB encapsulation is available for all Ethernet tests (Layer 2, 3 and 4) - BERT, RFC2544, Throughput, V-SAM.

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

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

	I DD									
	LEDs	PBB-TE	MAC	VLAN	IP		UDP	DATA	RX Filter	Start
		Backbone MAC Source				00-18-63-1A-2B-4E				
$\mathbf{x}$	Tools	Backbone MAC Destination				0-18-	63-1A-2B	-3C		
		Ethernet Type 88-E7								
	Utilities	I-SID	I-SID 1193046							
	Files	Backbone	VLAN ID	1082	Prior	ity	6 T	ype 8	8a8	
										LASER On/Off
										MY Discover
										MA DISCOVER
										Control

ррр

- Test: Select the test layer to perform the test.
  - Options are Layer 2, Layer 3, and Layer 4.
- Frame Type: Select the Ethernet frame type for Layer 2, Layer 3 or Layer 4.
  - 802.3 Raw (IEEE 802.3 frame without LLC) Not available when Layer 3 is selected
  - 802.3 LLC (IEEE 802.3 frame with LLC header)
  - 802.3 SNAP (IEEE 802.3 frame with SNAP header)
  - Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)
- MAC/IP: Tap the MAC and IP blocks on the Frame image to access the setup menus.
  - Set the Source and Destination MAC address for Layer 2.
  - Set the Source and Destination MAC and IP addresses for Layer 3.
- VLAN: Off, 1 tag, 2 tags, 3 tags.
  - The user is able to configure up to 3 VLAN tags (VLAN stacking for Q-in-Q applications).

VLAN stacking is an option.

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

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

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

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

For more information on header configuration please see <u>13.2.1.1 Header Settings</u> in the BERT section.

# • MAC Header Tab:

- **MAC Source:** Use the default source address of the test set or configure a new or different address. See MAC address editing screen shot below.
- **MAC Destination**: Configure the destination MAC address of the far-end partner test set. See MAC address editing screen shot below.
- Ethernet Type: For Layer 3 testing, the user can also configure the Ethertype:
  - 0800-IP (Internet Protocol Version 4, IPv4)
  - 0600-Xerox

- 0801-X.75 (X.75 Internet)
- 0805-X.25 (X.25 Level 3)
- 0806-ARP (Address Resolution Protocol [ARP])
- 8035-RARP (Reverse Address Resolution Protocol [RARP])
- 8137-IPX (Novell IPX)
- 814C-SNMP
- 8847-MPLS unicast
- 8848-MPLS multicast
- 86DD (Internet Protocol, Version 6 [IPv6]) Future Release

MAC Destination	00-01-E	3-D6-56-91	
A	В	С	
D	E	F	
1	2	3	
4	5	6	
7	8	9	
	0		
Del Del A	JI - 10	Apply <-	

RFC 2544 Setup - MAC address editing

• **Data Tab:** No payload selection is possible.

The payload area is populated with a VeEX signature field and other proprietary data.



- **RX Filter Tab:** Depending on test layer, allows the user to filter streams by:
  - MAC Destination address
  - MAC Source address
  - VLAN ID
  - IP Destination address
  - IP Source address
- VLAN Tab: VLAN ID, priority, and Tag Type (Ethernet Type) can be configured. Please refer to the BERT application for more details.

- **MPLS Tab:** MPLS label, CoS priority settings, TTL, and S-bit fields are configured for available MPLS tags. Please refer to the BERT application for more details.
- **IP Tab:** User configures the source and destination IP addresses. The user can also configure the following IP header fields; IP TOS (for quality of service testing), TTL, fragment offset byte, and the protocol field. Please refer to the BERT application for more details.

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# 13.3.1.2 Frames Settings

Frames tab: User configures the following:

- Preset Frames: User selects from a list of recommended test frame sizes defined in RFC 2544:
  - Test frames are 64, 128, 256, 512, 1024, 1280, and 1518 bytes.
  - The default selected frames are 64 and 1518 bytes.
  - To select/deselect any of the recommended test frames, check the box to the right of the desired frame.
  - When VLAN tagging or MPLS tagging is enabled, the value in parentheses reflects the actual frame size transmitted. For example one VLAN tag adds 4 bytes to the frame size, therefore a 64B frame becomes a 68 byte frame.
- Add frame: The user can add two additional user configurable test frames of any size ranging from 64 bytes to 10000 bytes.
  - To add additional test frames, tap the Add Frame button.
  - Enter the frame size using the numeric keypad and click apply.
  - Press the back button to return to the frames screen.
  - The new custom frame size is displayed (it can be enabled or disabled as needed).

	LEDs	Setup		Results			Stop
		Throughput	Latency	Frame	Loss	Burst	
🜔 si	gnal	Header	Fra	mes		Thresholds	
	ame	64 (68) bytes					
0		128 (132) bytes	•				
🔘 Pa	attern	256 (260) bytes		₫			
~		512 (516) bytes		•			SLA Mode
	.M/ERR	1024 (1028) bytes		<ul><li>✓</li></ul>			
		1280 (1284) bytes		=			
$\boldsymbol{\times}$	Tools	1518 (1522) bytes		≤	Add Fran	ie –	MX Discover
	Intilities						
	otilities						Control
	Files						

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

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#### 13.3.1.3 Threshold Settings

#### **Threshold tab:**

User enables or disables threshold settings for the throughput and latency tests.

- When enabled, threshold settings can be configured for all of the test frames selected in the frame settings tab.
- A Pass/Fail criteria will be applied when the threshold settings are enabled.
  - 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.

		1			8	
LEDs	Setu	ıp		Resul	ts	Stop
	Throughput	Latency	ncy Frame Los		Burst	
😑 Signal	Header	Fra	mes	Thresholds		
Frame	🗹 Enable	Throughput (%	)	Latency (us)		
	64 (68) bytes	70.00		1000		
Pattern	128 (132) bytes	75.00		2000		
-	256 (260) bytes	80.00		3000		SLA Mode
ALM/ERR	512 (516) bytes	80.00	-	4000		
	1024 (1028) bytes	80.00		5000		
X Tools	1280 (1284) bytes	95.00		6000		MX Discover
	1518 (1522) bytes	100.00		7000		
Utilities						Control
Files						

RFC 2544 Setup - Threshold Settings

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# 13.3.1.4 Peer-to-Peer Asymmetric Testing



When the local unit connects to the remote (peer) partner, it loads the same configuration profile (header, traffic, and frame size) to the remote partner, with the MAC and IP addresses inverted. From the peer-to-peer menu, asymmetric testing becomes available.

Asymmetrical links provide different line rates in the two directions. To verify the information for both the low and the high rates of the link, the user needs to send a test signal from one instrument located at one end of the link to an instrument at the other end of the link and vice versa to test traffic capacity. The two test instruments have to be synchronized because the tests defined in RFC 2544 require the receiver to know the contents of the test signal to be transmitted in detail.

The test set offers an automated RFC 2544 test application to perform throughput, frame loss, and burstability tests in a local-remote unit setup. The user first configures the test setup in the local unit. Once initiated, the local unit transfers the setup information to the remote unit via the line under test. Upon completion, the remote unit transfers the test results back to the local unit, enabling the user to read the results for both directions of the link on the local unit.



# Asymmetric Control

# **Asymmetric Testing Setup**

- **Partner Address:** Select MX Discovered or User Defined. For instructions and further information on the MX Discovered and User Defined options, please see <u>13.5.1.2 MX Discover and Control</u>.
- Mode: Select an asymmetric test configuration:
  - Asymmetric Up: Tests traffic in the upstream direction (local to remote direction).
  - Asymmetric Down: Tests traffic the downstream direction (remote to local direction).
  - Asymmetric Up & Down: Test traffic in both upstream and downstream directions.
- Press Connect.

The user is able to configure and view the local/remote unit's setup and results. Tap on the Local/Remote button on the right side menu to toggle between the two settings.

Local Setup Local Results Start LEDs Burst Throughput Latency Tools Header Thresholds Profile Last configuration Utilities Test Layer Layer 2 ¥ Ethernet II(DIX) ¥ Files Frame Type VLAN Off ¥ SLA Mode Data X Discove Contro ocal/Remo

#### **Local Setup**

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

The RFC 2544 test suite allows the user to run all four tests, one of the four tests, or a combination of any of the four tests. The user simply has to enable/disable which tests to perform by checking/unchecking a selection box in the respective tab for each test. By default all four tests are enabled.

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

# Throughput tab:

- Max Rate: Up to 100% of the negotiated line rate. The default value is 100%.
  - This is the maximum transmit rate to perform the throughput test for each test frame size.
  - The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.
- **Resolution:** Input any value between 0.001% and 1%. The default value is 1%. Resolution refers to the resolution in searching for the throughput rate. If 1% is selected, the throughput rate will be searched with  $\pm 1\%$  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.

	LED'S	Setup			lits	Start	
		Header	Fra	imes		Thresholds	
$\left  \mathbf{X} \right $	Tools	Throughput	Latency	Frame Lo	55	Burst	
_	Utilities	MAX Rate	80.000		%	▼	
		Resolution (%)	1.00				
	Files	Duration (s)	10				
		Enable Test					SLA Mode LASER On/Off MX Discover Control

**RFC 2544 Setup - Throughput Settings** 

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

#### Latency tab:

User configures the following:

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

	LED'S	Setup			Res	Start	
		Header	Fram	es		Thresholds	
X	Tools	Throughput I	atency	Frame Lo	55	Burst	
Utilities		Test Rate	Throughput F	Rate		•	
		Duration (s)	10				
	Files	Repetitions	1				
		<b>√</b> Enable Test					SLA Mode LASER On/Off MX Discover Control

# RFC 2544 Setup - Latency Settings

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#### Frame Loss tab:

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

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

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

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

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

	LED'S	Setup			Start		
		Header	Fra	mes	т	hresholds	
$\left  \boldsymbol{X} \right $	Tools	Throughput I	Latency	Frame Lo	55	Burst	
_	Utilities	MAX Rate	80.000		%	▼	
Otindes		Step Size (%)	10.00				
	Files	Duration (s)	10				
		✓ Enable Test					SLA Mode LASER On/Off MX Discover Control

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

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# Burst (Back-to-Back) tab:

- 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.

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

**RFC 2544 Setup - Burst Settings** 

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# 13.3.1.6 Starting/Stopping a RFC 2544 Measurement

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

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

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

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

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

• If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unit before the RFC 2544 test suite can be started

• To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings RXT-6200_RXT6000e_Module_Manual Page 242 of 387 mode to manual

- Enter the MAC and/or IP address of the far-end unit
- Send the loop up command by pressing Loop Up

Once the far-end unit has been looped back, start the test by pressing the **Start** button. When the all of the selected test are completed, the RFC 2544 test suite will stop automatically. Once all tests have been completed and there is no need to test again, go back to the Control tab, and press the **Loop Down** button. This will send a loop down command to the far-end unit to remove the loopback that is in place.

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

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# 13.3.2 Results - Standard Mode

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

#### **Results tab:**

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

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

LEDs	Setup		Results			Stop
	Throughput	Latency	Frame Lo	55	Burst	
😑 Signal	Status	Sun	mary		Events	
Frame	ST:2011-12-19 16:23:52		ET:00:04:31			
	Throughput Test		Done			
Pattern	Latency	Done				
-	Frame Loss Test	In progress			SLA Mode	
	Burstability Test		Pending			
Tools						MX Discover
Utilities						Control
Files						

RFC 2544 Results - Status

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

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

- Number of bytes
- Pause Frames: Total number of transmitted and received ethernet pause flow-control frames.

LEDs	Setup				ults	Stop
	Throughput	Latency	Frame L	.055	Burst	
😑 Signal	Status	Sum	mary		Events	
C Frame	ST:2011-12-19 16:23:5	52	ET:00:05:0	T:00:05:01		]
		тх		RX		
Pattern	Line Rate (bps)	1000.000M	1000.000M		OOM	
Ŭ	Utilization (%)	89.996%		69.996%		SLA Mode
ALM/ERR	Utilization (bps)	899.960M	899.960M		DM	
	Framed Rate (bps)	835.679M		835.682M		
X Tools	Data Rate (bps)	700.685M	700.68		5M	
	Total Frames	100611412		100611	411	MA Discover
📑 Utilities	Bad Frames	0	0			Control
	Pause Frames	0	0			
Files						

#### RFC 2544 Results - Summary

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# Signal tab:

The Signal tab (fiber ports only) displays the optical level measured by the SFP or XFP transceiver.

RFC 2544 Results - Signal



#### Setup Results Start LED'S Per Stream Global Tools Stream Summary Aggregate Alarms Signal Utilities SFP Optical Module Information Files Vendor Part Number Wavelength (nm) 0 LASER On/Off MX Discover Control 0 Page 2 of 2

#### RFC 2544 Results - Signal (page 2)

# Go back to top Go back to TOC

#### **Events tab:**

A time stamped log of each test is displayed.

	LEDs	Set	ир	Results			Start
		Throughput	Latency	Frame	Loss	Burst	
X	Tools	Status	Summary	Sigr	nal	Events	
Utilities		Time	Events		Test		
		20-2-2012 17:05:31	Test Started		RFC 2544		
	Files	20-2-2012 17:05:31	Test Started		Throughput		
		20-2-2012 17:06:03	Test Stopped		Through	nput	
		20-2-2012 17:06:03	Test Started		Latency		
		20-2-2012 17:06:05	Test Stopped		Latency		LASER On/Off
		20-2-2012 17:06:05	Test Started		Frame L	.055	
		20-2-2012 17:06:26	Test Stopped		Frame L	oss	
		•	Page 1 of	2 🛈	>		Control
							Profiles

#### **RFC 2544 Results - Events**

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

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



# RFC 2544 Results - Throughput (Tx Graphical)

#### RFC 2544 Results - Throughput (Summary Table)

LEDs	Setup	Results			Start	
	Status	Sun	Summary		Events	
😑 Signal	Throughput	iput Latency		55	Burst	
Frame	Summary 🔻	Tx(%)	▼Rx(%)	T	Thresholds	
	128 (132) bytes	80.00	80.00		Pass	
Pattern	256 (260) bytes	80.00	80.00		Pass	
-	512 (516) bytes	80.00	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	80.00	80.00		Pass	
	1518 (1522) bytes	80.00	80.00		Failed	
X Tools						MX Discover
Utilities						Control
Files						

# RFC 2544 Results - Throughput (Test Log Table)

LEDs	Setup			Results	Start
	Status	Sun	nmary	Events	
😑 Signal	Throughput	Latency	Frame Lo	ss Burst	
Frame	Test Log 🛛 🔻	Tx(%)	Rx(%)	Status	
<b>U</b>	126 (132) bytes	80.00	60.00	Pass	
Pattern	256 (260) bytes	80.00	80.00	Pass	
-	512 (516) bytes	80.00	80.00	Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	80.00	80.00	Pass	
	1518 (1522) bytes	80.00	60.00	Pass	
X Tools					MX Discover
Utilities					Control
Files					

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

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

			·····	<b>(</b>		
LEDs	Setup		Results			Start
	Status	Summ	immary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Summary 🔻	Latency	Rate (%)		Thresholds	
	128 (132) bytes	5.90us	80.00		Pass	
Pattern	256 (260) bytes	6.94us	80.00		Pass	
-	512 (516) bytes	9.00us	60.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	13.10us	80.00		Pass	
	1516 (1522) bytes	17.04us	60.00		Pass	
X Tools						MX Discover
Utilities						Control
Files	Page 1 of 1 •					

# RFC 2544 Results - Latency (Summary)

**RFC 2544 Results - Latency (Graphical)** 



			ľ		8/	
LEDs	Setup		Results			Start
	Status	Sumr	mary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Jit. Test Log 🛛 🔻	Jitter	Rate (%)		Status	
	128 (132) bytes	0.00us	80.00		Pass	
Pattern	256 (260) bytes	0.00us	80.00		Pass	
-	512 (516) bytes	0.00us	60.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	0.00us	00.08		Pass	
	1518 (1522) bytes	5.00us	60.00		Pass	
X Tools						MX Discover
Utilities						Control
Files		• Page	1 of 1 🕑			

# RFC 2544 Results - Latency (Test Log)





# RFC 2544 Results - Latency (Jitter Summary)

LEDs	Setup			Res	ults	Start
	Status	Sum	mary		Events	
😑 Signal	Throughput	Latency	Frame Lo	\$55	Burst	
Frame	Jit. Summary 🛛 🔻	Jitter	Rate (%)		Thresholds	
0	128 (132) bytes	0.00us	80.00		Pass	
Pattern	256 (260) bytes	0.00us	80.00		Pass	
	512 (516) bytes	0.00us	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	0.00us	80.00		Pass	
	1518 (1522) bytes	5.00us	80.00		Pass	
X Tools						MX Discover
Utilities						Control
Files	Page 1 of 1 •					

LEDs	Setup			ults	Start	
	Status	Sum	mary		Events	
😑 Signal	Throughput	Latency	Frame Lo		Burst	
Frame	Jit. Test Log 🛛 🔻	Jitter	Rate (%)		Status	
	126 (132) bytes	0.00us	80.00		Pass	
Pattern	256 (260) bytes	0.00us	80.00		Pass	
-	512 (516) bytes	0.00us	80.00		Pass	SLA Mode
ALM/ERR	1024 (1028) bytes	0.00us	80.00		Pass	
_	1518 (1522) bytes	5.00us	80.00		Pass	
X Tools						MX Discover
📑 Utilities						Control
Files	Page 1 of 1 •					



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

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

LEDs	Setu	ą	F	Start		
	Status	Sumn	mmary		Events	
😑 Signal	Throughput	Latency	Frame Loss		Burst	
Frame	Summary V	Frame Loss (%)	Frame Loss (	Cnt R	late (%)	
<b>U</b>	128 (132) bytes	0.000000	0	1	00.00000	
🔵 Pattern	256 (260) bytes	0.000000	0		00.000000	
č	512 (516) bytes	0.000000	0	1	00.00000	SLA Mode
ALM/ERR	1024 (1028) bytes	0.000000	0	1	00.000000	
	1518 (1522) bytes	0.000000	0	1	00.00000	
X Tools						MX Discover
	i					
Utilities	/					Control
Files						

#### RFC 2544 Results - Frame Loss (Summary)



# **RFC 2544 Results - Frame Loss (Graphical)**

LEDs	Setu	ib.		Start		
	Status	Sumn	nmary		Events	
😑 Signal	Throughput	Latency	Frame Lo	55	Burst	
Frame	TestLog	Frame Loss (%)	Frame Los	s Cnt	Rate (%)	]
	128 (132) bytes	0.000000	0		100.000000	
Pattern	128 (132) bytes	0.000000	0		90.000000	
ĭ	256 (260) bytes	0.000000	0		100.000000	SLA Mode
ALM/ERR	256 (260) bytes	0.000000	0		90.00000	
	512 (516) bytes	0.000000	0		100.000000	
X Tools	512 (516) bytes	0.000000	0		90.00000	MX Discover
	1024 (1028) bytes	0.000000	0		100.000000	
Utilities	1024 (1028) bytes	0.000000	0		90.000000	Control
Files		Page 1	of 2 💽			

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

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

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

				-	• •	
e LEDs	Setup				lts	Start
	Status	Sum	mary		Events	-
😑 Signal	Throughput	Latency	atency Frame L		Burst	
C Frame	Summary	🔻 Avg. Frame	Count	Status		
	128 (132) bytes	8223684	8223684			
Pattern	256 (260) bytes	4464285		Pass		
	512 (516) bytes	2332089		Pass		SLA Mode
ALM/ERR	1024 (1028) bytes	1192748		Pass		
	1518 (1522) bytes	810635		Pass		
X Tools						MX Discover
📑 Utilities						Control
Files		Page	1 of 1 🕑			

# RFC 2544 Results - Burstability (Summary)

			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
e LEDs	Setup		Resu	Start	
	Status	Summar	γ	Events	\square
😑 Signal	Throughput	Latency	Frame Loss	Burst	
Frame	Test Log 🛛 🔻	RX Frm. Count	Exp. Frm. Cou	nt Duration (s)	
U	128 (132) bytes	822368	822368	2	
Pattern	128 (132) bytes	8223684	8223684	20	
Ŭ	256 (260) bytes	446428	446428	2	SLA Mode
ALM/ERR	256 (260) bytes	4464285	4464285	20	
	512 (516) bytes	233208	233208	2	
X Tools	512 (516) bytes	2332089	2332089	20	MX Discover
	1024 (1028) bytes	119274	119274	2	
Utilities	1024 (1028) bytes	1192748	1192748	20	Control
Files		Page 1 o	f 2 🕑		

RFC 2544 R	esults - l	Burstabi	ility ([Test]	Log)
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13.3.3 Saving RFC 2544 Results

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

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13.3.4 Advanced SLA Mode

SLA Mode is not available for 40G and 100G.

Using this test function, users are able to verify SLAs while end-to-end QoS is assessed properly. By configuring one primary test stream and up to seven background streams each with independent frame size, bandwidth, and more importantly QoS levels, simulating different service applications is now realized. The Advanced RFC 2544 SLA mode provides detailed visibility of the test parameters for each of the traffic streams being measured, providing an efficient in-depth qualification in a fast and automated way.

Setup

For **Header**, **Frames**, **Thresholds**, **Throughput**, **Latency**, **Frame Loss**, and **Burst**, please refer to <u>Setup - Standard</u> <u>Mode</u>.

Background - General

- # of Back. Streams: From 1 to 7 streams
- RFC 2544 Test Stream (%): This is the max rate set in frame loss
- Background Stream # (%): Allocated Bandwidth per Stream: The total bandwidth for all streams cannot exceed 100%
- Total (%): Sum of all stream rates in %

LEDs	Setup Results		sults	Background Results			Start
	Header	Fram	es	Thr	esholds	Throughput	
😑 Signal	Latency Frame Loss Bu		Bur	rst Background Summary			
Frame	General			Traffic			
U	# of Back. Streams		3	3 🗸			
Pattern	RFC 2544 Test Stream (%)			20.000			
	Background Stream #1 (%)			5.000			SLA Mode
	Background Stream #2 (%)			5.000			
	Background Stream #3 (%)			5.000			
X Tools	Total (%)			35.000			MX Discover
🗩 Utilities						Control	
Files	Page 1 of 1						

Setup - Background - General

Background - Traffic

- **Background Stream #:** Select a stream number to configure.
- Traffic Flow: Select from Constant, Ramp, Burst, or Single Burst traffic flow.
- Frame Size (Type): Fixed or Uniform. If uniform is chosen, the user will have to input a minimum and maximum frame size.
- Frame Size (bytes): If a fixed frame size is chosen, this option is enabled. Enter the frame size when a Layer 2 or 3 is selected. Frame sizes can be from 64bytes to 1518bytes, in addition to jumbo frames up to 10k bytes.
- **BW** (Transmit Bandwidth): Configure the transmit rate for the stream.

The bandwidth allocation per stream is already configured in the **General Settings** tab, but can be modified in this screen as well.
			-	0					
	LEDs	Local Set	Local Setup Local Resu		lits	Backgr	ound Res	ults	Start
		Header	Fram	es	Thr	esholds	Throug	hput	
$\left \times \right $	Tools	Latency	Frame Loss	Bu	irst	Backgrou	nd Sum	mary	
	Utilities	General			Traffic]	
		Background Stream #			Stream #1 🛛 🔻				
	Files	Traffic Flow	Constant 🗸 🔻						
	Frame Size Type				Fixed 🔻				SLA Mode
		Frame Size (by	/tes)		64				
		Constant Band	dwidth		5.000 % 🔻			•	
									MX Discover
									Control
									Local/Remote

Setup - Background - Traffic

Starting/Stopping an Advanced SLA Mode

Please see <u>Starting/Stopping a RFC 2544 Test</u> for information on starting/stopping the test.

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13.3.5 Background Results - Advanced SLA Mode

For information on Global and Per Stream Results in Advanced SLA Mode, please refer to 13.5.2 Throughput Results.

LEDs	Setup	Results	Background Results		nd Results	Stop
	Global			Per Str	ream	
🜔 Signal	gnal Stream Summary		Error	5	Traffic]
Frame	ST:2011-12-19 17:05:3	3	ET:00:03:43	3:43		
U		тх		RX		
Pattern	Pattern Line Rate (bps)			1000.000M		
	Utilization (%)	35.099%		35.099%		SLA Mode
ALM/ERR	Utilization (bps)	350.990M	350.990M		м	
	Framed Rate (bps)	301.745M		301.746M		
X Tools	Data Rate (bps)	202.923M		202.923M		MX Discover
	Total Frames			43187440		
Utilities	Bad Frames	0		0		Control
	Pause Frames			0		
Files						

Background Results - Global



Background Results - Per Stream

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13.4 V-SAM

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



Test Application

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.

Go back to top Go back to TOC

13.4.1 V-SAM Setup

General (Page 1 and 2)

- V-SAM Profile: Delete, Save, Save as..., Default, or Last Configuration.
- # of Services: Select the number of services to run. Up to 8 services can be chosen for a 1 GE interface, up to 10 services can be chosen for a 10 GE interface and up to 32 services for 40GE and 100GE interface.
- Service Configuration Test: Enable or Disable the configuration test.
- Service Performance Test: Enable or Disable the performance test.
- Service Configuration and Performance Tests can be enabled independently.
- CIR Test Config: Tap on the box to configure the Committed Information Rate Test on another screen.
- Duration: Select the Service Performance Test duration. Options are 15min, 30min, 1hr, 2hr, 24hr or user defined. If 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)

V-SAM - Setup - General (Page 2)

LEDs	Setup				Results			Start
_	General				Services			
😑 Signal	V-SAM Profile				Last configuration 🛛 🔻 🔻]
🜔 Frame	# of Services 3 V Service Configuration Test Service Performance Test				CIR Test Config. Duration 15min ▼			
Pattern	Service #	Service Name	Frame Size	FLR (%)	FTD (ms)	IFDV (ms)	AVAIL (%)	
ALM/ERR	✓ 1 ✓ 2 ☑ 3	Service 1 Service 2	9000 1518 1518	0.1	10.000	1.000	99.9	
Tools	V 3 Service 3 1918 0.1 10.000 - -							MX Discover
Utilities								Control
Files	Total IR((21R+EIR):301	.093Mbp •	s(303.953 Page 2 of	Mbps ULF	2)		

CIR Test Configuration

•

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

CIR Test Config

LEDs	CIR Test C	Start	
Signal	Simple Test Starts the tests at the CIR. below the CIR and continues in	: © Simple and Step Load Test Step Load Test is only performed if the Simple Validation test fails.	
😑 Frame	steps until it reaches the CIR		
O Pattern	Step Load Test C		
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		05e	Control
Files			

Go back to top Go back to TOC

13.4.1.1 Header Settings

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

Any EMIX configuration of 5 frames is allowed.

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

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

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

Please see <u>15.3 RFC 2544 Setup</u> and follow the setup procedure to configure the remaining Header Settings for V-SAM.



V-SAM Setup - Services - Header Settings



LEDs		E	MIX Configuration	
🔀 Tools	Frame #	Size		
	1	a-64	▼	
Utilities	2	b-128	V	
Files	3	c-256	V	
	4	e-1024	V	
	5	g-1518	V	
			Close	

V-SAM Setup - Services - PBB Settings

	LEDs	PBB-TE	MAC		DATA		Filter	Start
		Backbone MAC So	ource	00-18-	63-1A-2B-			
$\left \mathbf{X} \right $	Tools	Backbone MAC Destination			63-1A-2B-			
		Ethernet Type		88-E7				
	Utilities	I-SID			46			
	Files	Backbone VLAN ID) 1082 8	riority	6 Ту	oe 88	a8	
-								
								MX Discover Control

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13.4.1.2 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). **Vot supported on 10GE, 40GE** and 100GE.
 - CBS can be enabled without enabling EBS
 - If EBS is enabled, then CBS is automatically enabled too
 - Values between 4 KBytes and 100 KBytes can be input for both CBS and EBS

••	LEDs		Setup			Results		Start	
			General			Service			
$\left \times \right $	Tools	Header Service A			Attributes	Attributes Summary			
	Utilities	Service # Bandwidth	1 Profile Paran	neters	Service Ac	centance P	arameters	_	
		CIR	98.08	IR Mbps	TC FLR	0.100	%		
	Files	VEIR	0.00	IR Mbps	r ≪FTD	10.000	ms	•	
		CBS	20.000	кв	IFDV	1.000	ms	_▼	
		✓EBS	20.000	КВ	AVAIL	99.900	%		
		Color Awar	e Service		Enable 🔻	<u>'</u>			
		Traffic Poli	cing Test		Enable V	<u>'</u>			
		Traffic Poli	icing Rate		125 %				MX Discover
									Control
					opy				

V-SAM Setup - Services - Service Attributes



Enabling/Disabling Tests

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

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.

Copying Services

	eur	s j ing set trees	
LEDs	Co	py Service Header	Start
	Copy FROM	Сору ТО	
🙆 Signal	Service1	Service1	
\sim	Service2	Service2	
😑 Frame	Service3	✓ Service3	
O Pattern			
ALM/ERR			
10015			MX Discover
Utilities	Apply	Discard	Control
Files			



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 <u>13.5.1.2 MX</u> <u>Discover and Control</u>.

Go back to top Go back to TOC

13.4.2 Results

	-	tes ares	com ₅ .	1 0505		-	
LEDs		Setup			Results		Start
	Config	. Tests	Perf.	Tests	Ever	t Log	
🔵 Signal	Service 1 Se		ervice 2	Service 3		ummary	
C Frame		5	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	
	Step3	Pass	75.814	0.0	0.077	0.000	
	Step4	Pass	101.079	0.0	0.077	0.000	
Ī	CIR/EIR						
	Total IR	Pass	121.095	0.0	0.077	0.000	
Tools	Policing	Duration	10 Seconds	, Transmitte	d Rate 146.3	69 Mbps	MY Discover
	Total IR	Failed	146.360	0.0	0.077	0.000	MA DISCOVER
	Tap a	anywhere on	the table for	r detailed re:	sults of each	test.	
Otilities							Control
Files							

Results - Config. Tests - Service 1

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

Configuration Test

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

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

LEDs	CIR Test	CIR/EIR Test		Policing Test		Start			
		Service #1:Pass							
😑 Signal		Step1	Step2	Step3	Step4				
	Pass/Fail	Pass	Pass	Pass	Pass				
O 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									
	Frame Loss Count	0	0	0	0				
	Frame Loss Ratio(%)	0.0	0.0	0.0	0.0				
A 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.

e LEDs	CIR Test	CIR/EIR Test Policing Test			Start
	Ser				
Signal		Green(CIR)	Yellow(EIR)	Total	
~	Pass/Fail			Pass	
C Erama					
U Frame	IR Min(Mbps)	-		121.086	
-	IR Mean(Mbps)	-		121.095	
Pattern IR Max(Mbps)		-		121.158	
Ŭ					
	Frame Loss Count	-		0	
0	Frame Loss Ratio(%)			0.0	
Tools	FTD Min(ms)			0.077	
	FTD Mean(ms)	-		0.077	MX Discover
	FTD Max(ms)			0.077	
Utilities					Control
	FDY Min(ms)			0.000	
Files	FDV Mean(ms)	-		0.000	
	FDV Max(ms)			0.001	

CIR/EIR Test - Service 1

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

		8								
LEDs	CIR Test	CIR/EIR Test	CIR/EIR Test Policing Test							
	Service #1:Failed									
Signal		Green(CIR)	Yellow(EIR)	Total						
U	Pass/Fail			Failed						
A F F F										
🔘 Frame	IR Min(Mbps)			146.297						
	IR Mean(Mbps)			146.360						
🔵 Pattern	IR Max(Mbps)			146.369						
Ŭ										
	Frame Loss Count	-		0						
	Frame Loss Ratio(%)			0.0						
A 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.

LEDs	Set		Res	ults	Start	
	Config. Tests	Perf.	Tests		Event Log	
😑 Signal	Service 1	Service 2	Service 2 Service 3		Summary]
Frame		iled				
	Service	CIR	CIR/EIF	2	Traffic Policing	
-	1	Pass	Pass		Failed	
Pattern	2	Pending	Disable	d	Pending	
Ŭ	3	Pending	Disable	d d	Pending	
Tools						MY Discover
Linkipping						
- Otilities						Control
Files						

Results - Config. Tests - Summary

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

Perf. Test - Service 1

LEDs	Setup		Result	;	Start	
	Config. Tests	Perf.	Tests	Ev	ent Log	
🜔 Signal	Service 1 S	ervice 2	Service	3	Summary	
😑 Frame	Sei					
			F 1	a	_	
O 0-0-0-0	IR Min(Mbps)		Frame Loss	Count		
🔵 Paπem	IR Mean(Mbps)		Frame Loss	Ratio(%)		
	IR Max(Mbps)		Out of Sequ	ence Cou	int	
ALM/ERR						
	FTD Min(ms)		FDV Min(ms)			
	FTD Mean(ms)		FDV Mean(n	1S)		
	FTD Max(ms)		FDV Max(ms	4)		
Tools						MY Discours
	Availability(%)		Errored Fra	me Count		MA Discover
	Unavailability Count		Total RX Fra	ames		
Utilities						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					Resu	ilts		Start
	Config. Tests Perf. Te			Perf. Test	ests Event Log			Log	
🔵 Signal	Service 1 Service 2			2	Service 3 Summary				
Frame			Pe	ending	J				
•		Pass/Fail	IR(Mbps)	FLR(%)	FTD(m	is) FD	V(ms)	AVAIL(%)	
O 0-0-0	1	Pending			<u> </u>	-			
Pattern	2	Disabled			<u> </u>	+			
-		Disabled	<u> </u>		<u> </u>	+			
ALM/ERR						+			
Ŭ					 	_			
Tools									MX Discover
Utilities									C Rented D
									Control
Files									

Perf. Tests - Summary

Event Log

A time stamped record or log of test types and test statuses (start/stop). RXT-6200_RXT6000e_Module_Manual



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13.5 Throughput Testing (Multiple Streams)

Overview:

The throughput application (or the multiple streams application) performs the following measurements: throughput performance, frame loss analysis, delay analysis, frame/packet arrival analysis, received traffic type analysis, and received traffic frame size analysis. On the transmit side, the throughput application allows for the configuration of up to 8 traffic streams with their own MAC and IP addresses, VLAN tags (up to 3 per stream), bandwidth/rate, frame size, and L2 and/or L3 quality of service (QoS) parameters. On the receiver end the traffic is analyzed on a per stream (up to 8 streams) basis as well as a global or aggregate measurement.

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

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

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13.5.1 Setup

Unless otherwise noted, the Frame Header and related setups are the same as the ones described in section <u>13.2 BERT</u> and <u>13.3 RFC 2544</u>. The following parameters must be configured prior to performing a Throughput test:

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

Go back to top Go back to TOC

13.5.1.1 General Throughput Settings (Global Configuration)

Page 1:

• # of Streams: From 1 to 10 streams. 32 streams for 40GE and 100GE.

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

	LEDs		Setup			Resu	ilts	Start
		Header	Traffic	Error In	nj. Alarm Inj.	General Sun	nmary OA	м
$\left \mathbf{X} \right $	Tools	# of Stream	ms		1			V
-	Litilities	Stream #1	(%)		10.000	Ì		
	Guides	Total (%)			10.000			
	Files							
		1						
								LASER ON/OH
								MX Discover
								Control

Throughput Setup - General Settings

Page 2:

- **#of Streams:** From 1 to 10 streams. *# of Streams can be specified either on Page 1 or Page 2. It will be reflected on both pages.*
- Delay Measurement Mode: Disable, Round Trip Delay, One-Way Delay with GPS/CDMA or Local One-Way Delay (for Dual Port Mode).
 - **Round Trip Delay:** Round Trip Delay should only be enabled when running the test to a remote loopback.
 - **One-Way Delay with GPS/CDMA:** One Way Delay (OWD) measurements can be carried out between two units only when their clocks are synchronized. In order to achieve synchronization, both units must be synchronized to the same timing source and at the same time. See <u>Chapter 13-1_Ethernet_Setup</u> for a detailed description of the synchronization process.
- Threshold (Max RTD allowed): Input the value in us, ms or sec. Defines the maximum allowed round trip delay value. If the RTD value exceeds the threshold, an event is logged with corresponding time stamp.
- SDT Threshold and IPG Violation:
 - SDT: Service Disruption Time
 - Measure SDT based on IPG (inter packet gap)
 - SDT Threshold: If the IPG is equal or greater than the threshold configured, the SDT measurement is triggered.
 - IPG Violation Threshold: If the IPG is equal to or greater than the configured threshold, a SDT Violation event is triggered in the Events tab and a SDT Violation is counted in the SDT measurement menu.

LEDs		Setup		Results		Start
	Header	Traffic	General	Summary	OAM	
😑 Signal	Delay Measure	ment Mode	RTD			
😑 Frame	RTD Unit Auto	Scale	ON			
Pattern	SDT Threshold	d(us)	10000			
ALM/ERR	IPG Violation T	'hreshold(us)	50000			
History		0	Page 2 of 2	o		LASER ON/OF

Throughput Setup - General Settings Page 2

Throughput - General Settings Delay Measurement Mode





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13.5.1.2 MX Discover and Control

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

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

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**:

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



Loop Control

The **Loop Control** button becomes available on the right side menu when any Ethernet application (V-SAM, RFC 2544, Throughput, BERT) is selected. Press the **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

Remote Partner Control

	Rate Remote Partn	e Details ner Control Tool				
Looph	ack Control	@Peer-to-Peer	r			
Partne	er Address	MX Discovered				
Те	st Rate	Layer 2				
1						
Partners	IP Address	Location	Status			
MX-300	192.168.1.138	NOC	Loop Up			
	• Page	1 of 1 🕑				
(Loop Down	Close)			

The **Peer-to-Peer** option is available only for RFC 2544 testing. For more information on **Peer-to-Peer** mode, please see <u>15.3.1.4 Peer-to-Peer and Asymmetric Testing</u>.

13.5.1.3 Per Stream Configurations

MAC Setup

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

- Source (SRC) and Destination (Dest) flooding: Enable or Disable.
- Flood Range: Specifies the number of MAC source and/or destination addresses. Enter a number from 0-4095. The source and/or destination MAC addresses will be incremented by 1 until it reaches the number of times entered in the flood range.

For information on header configuration please see <u>13.2.1.1 BERT Header Settings</u> in the BERT section.

			p v ~	p			-8° P*- ^		•
	LEDs		Setu	P		1	Results		Start
		Header	Traffic	Error Inj.	Alarm	Inj. General	Summary	OAM	
$\left \times \right $	Tools	Profile			L	ast configura	tion	▼	
	Litilities	Stream #			1			▼	
	oundes	Encapsula	tion Type		F	BB-TE		▼	
	Files	Test Layer				Layer 2 🗸 🔻			
_		Frame Typ	e		E	thernet II(DIX	3	▼	
		VLAN			1	tag		▼	
									LASER On/Off
		PBB		AC VI	LAN	Data		CRC	MX Discover
									Control

Throughput Setup - Header Settings per Stream



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13.5.1.4 Traffic Settings (Per Stream Configuration)

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

- Stream #: Select a stream number to configure.
- Traffic Flow: Select from Constant, Ramp, Burst, or Single Burst traffic flow.
- Frame Size (Type): Fixed or Uniform. If uniform is chosen, the user will have to input a minimum and maximum frame size.
- Frame Size (bytes): If a fixed frame size is chosen, this option is enabled. Enter the frame size when a Layer 2 or 3 is selected. Frame sizes can be from 64bytes to 1518bytes, in addition to jumbo frames up to 10k bytes.
- BW (Transmit Bandwidth): Configure the transmit rate for the stream.

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

For more information on Traffic Settings, please see 13.2.1.2 BERT Traffic Settings.

	LEDs		Setu	P				Results		Start
		Header	Traffic	Error Inj.	Alarm	lnj.	General	Summary	OAM	
$\left \times \right $	Tools	Stream #			1	1			▼	
-	Utilities	Traffic Flow					tant			
	• • • • •	Frame Size Type					1		▼	
	Files	Frame Size (bytes)					1518			
		Constant E	Bandwidth		1	10.00	0	%	▼	
										LASER On/Off MX Discover Control

Throughput Setup - Traffic Setup - Constant Traffic Flow

13.5.1.5 Error Injection Settings (Per Stream Configuration) - (Only in 10GE)

Error injection can be performed during test. The type of errors and error injection are configured in the Error Injection tab. Once the test is running, error injection can be performed by pressing the **Error Inject** button on the right side of the screen.

- Stream #: Select the stream to configure.
- Error type: Select from CRC, IP Checksum (Layer 3, 4 only), TCP/UDP Checksum (Layer 4 only), or Pause. With Pause selected, the unit will transmit a pause frame when the Error Injection icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- Injection Flow: The error injection flow determines how the selected errors will be injected. The user can select a single error or a specific count.
- Count: The user will be able to configure the error count via numeric keypad.



Throughput Test - Error Injection Settings per Stream

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13.5.1.6 Alarm Injection Settings

(Only in 10GE)

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 Inject** button on the right side of the screen.



• Alarm Type: Local Fault, Remote Fault

Alarm Flow: The alarm flow determines how the selected alarms will be injected. A specific Count or Continue
RXT-6200_RXT6000e_Module_Manual
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(continuous) can be selected.

• Alarm Length: 1s, 10s, or 100s.

	LEDe)	Se	tup	Results		Start
	LEUS	Header Traffi	c Error Inj. Alarr	<mark>m Inj.</mark> General Summary	OAM	
$\left \boldsymbol{\lambda} \right $	Tools	Alarm Type		Local Fault		ĺ
	Litilities	Alarm Flow		COUNT	▼	
	oundes	Alarm Length		15	▼	
	Files					
						TASER ON/OF
						CASER ONON
						MX Discover
						Control

Throughput Alarm Injection Setup

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13.5.1.7 Summary

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

		1 111 0 0	-8-1P-4-	1050 5			(1)		
	LEDs		Setup				Results	i	Start
		Header T	raffic Err	or Inj. Alarm Inj. General <mark>Summary</mark> OAM					
$ \times $	Tools	MAC List IP Lis		t VLAN	t VLAN List Po		Port List Mpls Li		1
	Utilities	# of Streams		MAC Source	MAC Source			tination	
		Stream #1		00-18-63-00-0C-40			00-1E-90-	A0-57-3C	
	Files	Stream #2		00-18-63-00-0C-40			00-1E-90-A0-57-3C		
		Stream #3		00-18-63-00-	0C-40		00-1E-90-	A0-57-3C	
									LASER On/Off
									MX Discover
									Control

Throughput Test - Summary (MAC List)

LEDs		Setup			Results		Start
	Header	Traffic	Error Inj.	General	Summary	OAM	
Tools	MAC Lis	it 🚺	IP List	VLAN LI	st I	Port List	
Utilities	# of Streams		Source IP A	ddress	Destination	IP Address	
	Stream #1		192.168.1.10	1	192.168.2.2	00	
Files	Stream #2		192.168.1.10	1	192.168.2.2	00	
	Stream #3		192.168.1.10	1	192.168.2.2	00	
							MX Discover Control

Throughput Test - Summary (IP List)

Throughput Test - Summary (VLAN List)



Throughput Test - Summary (Port List)

	LEDs	Setup		Results	Start
		Header Traffic Er	ror Inj. Alarm Inj. Gener	ral Summary OAM	
$\left \right\rangle$	Tools	MAC List IP Lis	it VLAN List P	ort List MpIs List	
	Utilities	Background	Source Port	Destination Port	
		Stream #1	0	0	
	Files	Stream #2	0	0	
		Stream #3	0	0	
					LASER On/Off MX Discover Control

13.5.1.8 Starting/Stopping a Throughput (Multiple Streams) Test

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

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

• End-to-End Testing

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

• Far-End Unit in Manual Loopback Mode

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

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

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

- If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unit before the Throughput test suite can be started
- To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings mode to manual
- Enter the MAC and/or IP address of the far-end unit
- Send the loop up command by 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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13.5.2 Throughput Results

13.5.2.1 Viewing Throughput (Multiple Streams) Test Results

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

13.5.2.2 Global/Aggregate Results

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

The Global Stream Summary screen displays:

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

LEDs	Se	tup					Res	ults			Stop	
	Global			Per S	trea	im		OAM			Bester	
😑 Signal	Stream Summary	Aggr	egate	Erro	rs	Alarms	Event	ts	Traffic	Delay	Restart	2
Frame	Stream #	% of B	3W		Ern	ors		Qo:	ŝ		TX Stop	
0	Stream #1	0.00			Nor	1e		0				
Pattern	Stream #2	30.00			Nor	18		0			Err Inj.)
Ŭ	Stream #3	49.94			Not	1e		0			/	
ALM/ERR												
Tools											MX Discover	D
Utilities											Control)
Files												

Throughput Results - Global Stream Summary

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The Aggregate screen displays these parameters:

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

LEDs	Setup				Result	ts		Stop
_	Global	i	Per Stre	am		OAM		
😑 Signal	Stream Summary Ag	gregate	Errors	Alarms	Events	Traffic	Delay	Restart
Frame	ST:2012- 1- 5 19:41:54		ET	:00:00:37				TX Stop
0		тх			RX			Ere Ini
😑 Pattern	Line Rate (bps)	1000.000	М		1000.0001	М		
	Utilization (%)	79.943%			79.942%			
ALM/ERR	Utilization (bps)	799.430N	1		799.420M			
	Framed Rate (bps)	789.042N	1		789.033M			
X Tools	Data Rate (bps)	764.377N	1		764.368M			MY Discover
	Total Frames	2407503			2407500			Liscover)
Utilities	Bad Frames	0			0			Control
	Pause Frames	0			0			
Files								

Throughput Results - Global Aggregate

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The Global Signal screen (fiber ports only) displays the optical level measured by the SFP or XFP transceiver.



Throughput Results - Global Signal



	LED'S	Se	tup	Res	sults	Start
		Gie	bal	PerS	itream	
X	Tools	Events	Traffic	Delay	Stream Summary	
	Utilities	Aggregate	Signal	Errors	Alarms	
			SFP Optical Mo	dule Information		
	Files	Vendor				
		Part Number				
		Wavelength (nm)		0		
						LASER Onfor
						MX Discover
						Control
			Page	2 of 2 💿		

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

- 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

LEDs	Set	tup				F	Result	s		Stop
	Global		P	'er Stre	am			OAM		Restort
🔵 Signal	Stream Summary	Aggr	egate	Errors	Alarm	s Ev	ents	Traffic	Delay	Restart
🔵 Frame		Currer	nt			Total				TX Stop
Ŭ	FCS/CRC	0				0				Errini
Pattern	IP Checksum	0				0				
	TCP/UDP Checks	0				0				
	Jabber Frames	0				0				
	Runt Frames	0				0				
Tools										MX Discover
Utilities										Control
Files										

Throughput Results - Global Errors

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

- LOS: Loss of Signal
- LOSync: Loss synchronization
- Service disruption associated with loss of signal:
 - Current: Duration of the current service disruption
 - Total: Total accumulated duration of the service disruptions
 - Min/Max: Minimum and maximum duration of the service disruption events
 - No. of Occurrences: Counter of service disruption events
 - SDT Threshold Events: Service Disruption Time
 - **IPG Violation Events:** If the IPG is equal to or greater than the configured threshold, a SDT Violation event is triggered in the Events tab and a SDT Violation is counted in the SDT measurement menu.

Throughput Results - Global Alarms

LEDs	S	etup	R	esults				
	Global	Per Stream	PCS	OAM				
O Signal	Stream Summary	Aggregate Sign	al Errors Alarms E	vents Traffic Delay				
C Frame		Current	Total					
	LOS (us)	0	0					
Pattern	Link Down (us)	0	0					
Pattern	Local Fault	0	Remote Fault	0				
	Service Disruption (us)							
ALIMENA	Current	0	Total	110423				
History	Last	1993) 1993)	50163					
	Min/Max	10026	50163					
	No. of Occurrent	es.	7					
	SDT Threshold B	Events	7					
	IPG Vio, Events	1	IPG Vio, Time(u	s) 50163				

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

LEDs	Set	up			Resu	lts		Stop
	Global		Per Stre	am		OAM		
😑 Signal	Stream Summary	Aggregate	Errors	Alarms	Events	Traffic	Delay	Restart
Frame	Time	Event Type		# of Eve	nts T	est		TX Stop
Ŭ	2012- 1- 5 19:41:54	Test Starte	d		G	lobal		Err Ini.
O Pattern								
ALM/ERR								
Tools								MX Discover
Utilities		0	Page 1	lof1 🔍	>			Control
Files								

Throughput Results - Global Events

The Global Traffic screen displays:

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

Setup Results Stop LEDs OAM Global Per Stream Restart Stream Summary Aggregate Errors Alarms Events Traffic Delay 🔵 Signal TX Stop Frame Test Frames Err Ini Frame Type Pattern ALM/ERR Layer 2 Unicast Traffic Туре Layer 3 Unicast Tools MX Discover Utilities Frame Size Control > 1518B Files 50% 100%

Throughput Results - Global Traffic Summary

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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:

- Current, minimum, average, and maximum frame arrival time
- Current Frame Delay Variation

LEDs	Se	tup				Res	ults		Stop
	Global		Per	Stre	am		OAM		- Restant
😑 Signal	Stream Summary	Aggre	egate Er	rors	Alarms	Event	s Traffic	Delay	Restart
🕒 Frame	Frame Arrival Tim	e							TX Stop
Ŭ	Current	3.008u	s	A٧	erage		3.257us		Err Ini.
😑 Pattern	Minimum	0.176u	5	Ma	ximum		28.992us		
	Frame Delay Varia	tion							
	Current			3.2	24us				
X Tools									
									MADISCOVER
Utilities									Control
Files									

Throughput Results - Global Delay

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13.5.2.3 Per Stream Results

The **Per Stream** tab displays the same type of statistics as seen in Global Results, but for each stream. For descriptions of the parameters in each tab, with the exception of **Rates**, please refer back to the corresponding section in <u>13.5.2.2 Global/Aggregate Results</u>.

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

LEDs		Setup			Results		Stop
_	Glo	bal	Per S	itream	OA	M	
🔵 Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restart
🔵 Frame	VLAN ID: N/A	i i	Stream #		2	▼	TX Stop
U	ST:2012-1-5	5 19:41:54		ET:00:06:43			Errini
😑 Pattern		Т	x		RX		
	Utilization (?)	6) 3	0.000%		30.000%		
ALM/ERR	Utilization (b	ops) 31	00.000M		300.000M		
	Framed Rate	:(bps) 2:	96.108M		296.108M		
X Tools	Data Rate (b	ps) 20	86.381M		286.381M		MY Discover
	# of Bytes	1	4913065870		14913064348		MA BISCOVEL
Utilities	Total Frame:	s 9	798335		9798334		Control
	Bad Frames	0			0		
Files							

Throughput Results - Summary per Stream

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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 %
- **OOS**

	0	-				-		
LEDs	Se	tup				Results		Stop
_	Global		Per Si	tream		ÓA	M	
😑 Signal	Summary Err	ors	Events	Traffic	c	Delay	Rates	Restart
Frame	VLAN ID: N/A		Stream #			2	V	TX Stop
U		Curre	nt		Tot	al		Errini
😑 Pattern	Bits	N/A			N/A			
A	BER	N/A			N/A			
	FCS/CRC	0			0			
	IP Checksum	0			0			
X Tools	TCP/UDP Checks	0			0			MX Discover
	Jabber Frames	0			0			
Utilities	Runt Frames	0			0			Control
Files		0	Pag	e 1 of 2		٠		

Throughput Results - Errors per Stream

Throughput Results - Errors per Stream (page 2)

LEDs		Setup				Results		Stop
	Glob	al	Per S	tream		04	ъM	
😑 Signal	Summary	Errors	Events	Traffic		Delay	Rates	Restart
🙆 Frame	VLAN ID: N/A		Stream #			2	V	TX Stop
Ŭ		Curre	ent		Tot	al		Errini
😑 Pattern	Frame Loss	0			0			
	Frame Loss %	5 0.00 %	•		0.00	0%		
	oos	0			0			
X Tools								MX Discover
📑 Utilities								Control
Files		•	Pag	e 2 of 2				

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The **Per Stream SDT** screen displays a VLAN ID, Stream #, Service Distruption information - Current, Total, Last, Min/MA, No. of Occurrences, SDT Threshold Events, IPG Violation events, IPG Violation Time.

LEDs		Setup					Results		Stop			
	Glob	al	Per Stre	am		PCS		OAM				
😑 Signal	Summary	Errors	SDT	Eve	ents	Traffic	Delay	Rates	Restart			
C Frame	VLAN ID: N	I/A	Stre	am#	1	of 1	Prev	Next	TX Stop			
•	Service Di											
O Pattern	Current								Eth. Err inj.			
	Total	Total							Eth Alarm Ini			
ALM/ERR	Last	Last					50151					
	Min/Max	5	0151			5015	1		LASER On/Of			
History	No. of Occ	urrences			1							
	SDT Thres	hold Eve	nts	L.	1				Setup Injectio			
	IPG Vio. Ev	vents			1							
	IPG Vio. Ti	IPG Vio. Time(us)					50151					
				SDT	Res	rt						

Throughput Results - Events per SDT

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





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



Throughput Results - Traffic per Stream

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

Round Trip Delay Results and Histogram:

	1 111 (Jugnpu	t Kesun	S = DCIA	y per su	cam	
LEDs		Setup		Results			Stop
	Global		Per Stream		OAM		
Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restart
C Frame	VLAN ID: N/A		Stream #		1		TX Stop
0	Frame Arriva	Errini					
Pattern	Current	nt N/A		Average			
-	Minimum	N/A		Maximum	N/A		
ALM/ERR	Frame Delay						
-	Current		0.00us				
X Tools	Round Trip [Delay	Histogr	am			MX Discover
	Current	0.00u	s	Average	0.00us		
Utilities	Minimum	0.00u	s Maximum		0.00us		Control
Files					-		

Throughput Results - Delay per Stream

	LEDs	Setup				Results		Start
		Global		Per Stream		OAM		
$\left \times \right $	Tools	Summary	Errors	Events	Traffic	Delay	Rates	
	Utilities	VLAN ID: N/A	кс	Stream #		2	V	
	Files	10	le			Close		
		RTD (us)						LASER On/Off MX Discover
		0 010312 00:00:00	0	10312 0:40:00	0103 01:20	12	010312 02:00:00	Control

Throughput Results - Round Trip Delay Histogram

One Way Delay Results and Histogram (Table and Graph):

LEDs		Setup			Stop		
	Glot	bal	Per Stream			MAC	
O Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restart
C Frame	VLAN ID: N/A		Stream #		1		TX Stop
0	Frame Arriva	Errini					
Pattern	ern Current		Ous	Average	110.	90us	
0	Minimum	110.8	Bus Maximum		110.	91us	
ALM/ERR	Frame Delay						
	Current			0.00us			
Tools	One-Way Del	One-Way Delay Histo		ram			MX Discove
Utilities	Current	13.26	us	Average	13.2	4us	
	Minimum	12.32	us	Maximum	17.8	Ous	Control
Files							

Throughput Results - Delay per Stream (One Way Delay)

Throughput Results - One Way Delay Histogram Graph



LEDs	Setup			Results			Stop	
	Global		Per Stream		OAM			
Signal	Summary	Errors	Events	Traffic	Delay	Rates	Restan	
Frame	VLAN ID: N/A		Stream #		1		TX Stop	
	Grap	h			Close		Errini	
Pattern	Sample#		Time		One-Way Delay			
ALM/ERR	1		2013-7-17 21:50:00		13.24us			
	2 3		2013-7-17 21:50:01 2013-7-17 21:50:02		13.44us 13.36us			
_								
Tools	4		2013-7-17 21:50:03		13.32us		MY Disco	
	5	5		2013-7-17 21:50:04		13.10us		
Utilities	6		2013-7-17 2	21:50:05	13.20us		Control	
	7		2013-7-17 2	21:50:06	13.46us			

Throughput Results - One Way Delay Histogram Table

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The Per Stream Rate screen displays the frame rate and data rate pertaining to each stream.



Throughput Results - Rates per Stream

	8 1	-		,
LEDs		Stop		
	Frames/sec	тх	RX	
😑 Signal	Current	24319	24319	Restart
	Minimum	22071	22069	TX Stop
😑 Frame	Maximum	24320	24320	
O Pattern	Average	24315	24315	Err Inj.
	Data Rate (Mb/s)	тх	RX	
ALM/ERR	Current	286.381M	286.381M	
Ŭ	Minimum	259.908M	259.885M	
Tools	Maximum	286.392M	286.392M	
	Average	286.337 M	286.337 M	MX Discover
Utilities				Control
Files				

Throughput Results - Rates per Stream (Rate Details)

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13.5.2.4 Saving Throughput (Multiple Streams) Results

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

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13.6 Ethernet OAM Testing



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

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13.6.1 OAM Setup

13.6.1.1 Link Level 802.3ah OAM Setup

802.3ah functions include:

- Discovery
- Link Performance Monitoring
- Remote loopback
- Fault detection
- Collecting Performance Statistics (Function not supported in current software release)
- Organizational Specific Extensions (Function not supported in current software release)

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</u> <u>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.

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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.

Unidirection: Checks for unidirectional transmission.

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13.6.1.2 Service Level OAM: 802.1ag/Y.1731 Setup

Under the Service Level OAM tab, the user has the option of starting the 802.1ag or Y.1731 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 or Y.1731 to start the selected test. The transmission of OAM PDUs become active as soon as the checkmark is added to the test.

OAM - Service Level OAM (Page 1)

	LEDs		Setup			Results	Start	
		Header	Traffic	Error Inj.	General	Summary	OAM	
$\left \times \right $	Tools		Link OAM		Ser	vice Level C	DAM	
	Utilities	802.1ag: 🔳	۲.	1731: 🚍				
		MD Name	v	eexMD	MA Name	v	/eexMA	
	Files	Local MEP I	D 1	5	MD Level	5		
		Primary VLA	N ID 1	0	Direction	U	Jp 🔻	
		Destination	MEP ID 2	0				
		CCM Dis	able 🔻					AV Discourse
		Priority	7		Tx Interval	1	sec 🔻	MA DISCOVER
								Control
				•	Page 1 of 1	٠		

Service Level OAM Configuration Parameters

- MD Name: Name of the Maintenance Domain (only for 802.1ag)
- MA Name: Enter the name of the 802.1ag MA or Y.1731 MG
- **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
- 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
- **Destination MEP ID:** MEP ID of the MEP end point



Differences between 802.1ag and Y.1731

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).

IEEE 802.1ag Definitions

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



Some terms differ between the two protocols. The chart below describes the differences.

Definition Equivalencies

IEEE 802.1ag	ITU Y.1731
Maintenance Domain (MD)	No equivalent
Maintenance Association (MA)	Maintenance Entity Group (MEG)
Maintenance End Point (MEP)	Maintenance Entity Group End Point (MEP)
Maintenance Intermediate Point (MIP)	Maintenance Entity Group 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 and/or Y.1731 can be enabled. The tests listed include:

• Continuity Check (CCM)

- Loopback (LBM/LBR)
- Link Trace (LTM/LTR)
- Loss Measurement (LMM/LMR) (Y.1731 Only)
- Delay Measurement (DMM/DMR) (Y.1731 Only)

General Setup

To run any 802.1ag/Y.1731 Tests, fill out the listed parameters and press **Start**. In the case of **CCM**, select **Enable** from the drop-down menu to run that test. Details on individual test parameters will be listed in the specified section.

802.1ag/Y.1731 Connectivity Fault Management Functions

802.1ag/Y.1731 Connectivity Fault Management Functions supported by the test set are as listed:

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

Continuity Check Messages (CCM)

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

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



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

RXT-6200_RXT6000e_Module_Manual

CCM Message Format

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

Service Level OAM (Page 1)

	LEDs		Setup		Results			Start
		Header	Traffic	Error Inj.	General	Summary	OAM	
$\left \times \right $	Tools		Link OAM		Service Level OAM		DAM	
	Utilities	802.1ag: 🔳	¥.	.1731: 🚍				
		MD Name	· · · · · · · · · · · · · · · · · · ·	/eexMD	MA Name	v	eexMA	
	Files	Local MEP I	D 1	15	MD Level	5	i	
		Primary VLA	N ID	10	Direction	L	Jp 🔻	
		Destination	MEP ID	20				
		CCM Dis	able 🔻					NY Discourse
		Priority		,	Tx Interval		sec 🔻	MIX DISCOVER
								Control
				•	Page 1 of 1	۲		

CCM Configuration Parameters

- CCM
 - Enable: Enable sending Continuity Check messages
 - Disable: Disable sending Continuity Check messages
- 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.

Link Trace and Loopback Messages



OAM - Service Level OAM (Page 2)

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.









Link Trace Response Format

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

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).



Loopback Message Format



Link Trace and Loopback Message 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 Performance Management Functions

01200	~~~				8)				
	LEDs		1p			Results		Start	
		Header	Trafi	fic Er	ror Inj.	General	Summary	DAM	
$\left \mathbf{X} \right $	Tools		Link C)AM	AM Servi			AM	1
	Utilities								
		Loss Measu	rement	(LMM/LN	IR)			Start	
	Files	Destination	Туре	MEP `	MEP 🔻 Destination MAC		00-00-00-0	0-00-00	
		# Send		10	10 Rate (ms)		100		
		Priority		7					
		Delay Measu	rement	(DMM/D	MR)			Start	MY Discourse
		Destination	Туре	MEP	🔻 Desti	nation MAC	00-00-00-0	0-00-00	MA Discover
		# Send		10	Rate	(ms)	500		Control
		Priority		7					
				(•	age 3 of 3	٠		

OAM - Service Level OAM (Page 3)

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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13.6.2 OAM Results

13.6.2.1 Link OAM Results

Link OAM Discovery

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

OAM - Link - Discovery (Page 1)

	LEDs	Setup		Results		Start
		Global	Per S	tream	OAM	
X	Tools	Link			Service	
	Utilities	Discovery	/		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			

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

	LEDs	Setup			Results	Start
		Global	Per St	tream	OAM	
$\left \times \right $	Tools	Link			Service	
	Utilities	Discover	У		Statistics	
			Local		Remote	
	Files	Vendor SPI			AD00593F	
		Vendor OUI			0015AD	
		Discovery State	Send Any			
		Parser State	Forward		Forward	
		Multiplexer State	r State Forward		Forward	MX Discover
		Flags	0x0050		0x0050	
		Revision	1		1	Control

- 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 S	tream	OAM	
😑 Signal	Link		Service		
😑 Frame	Discovery		Statistics		
Ŭ		тх		RX	
Pattern	Information	775	833		
	Unique Event	0		0	
	Duplicate Event	0		0	
	Loopback Control	1		0	
Tools	Variable Request	0		0	MX Discover
Litilities	Variable Response	0		0	
Cuntes	Organization Specific 0		0		Control
Files					

OAM PDU

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

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

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13.6.2.2 OAM Service Results

802.1ag/Y.1731 Connectivity Fault Management Functions Results

	LEDs			Setup		Results				Start	
			Global	1	Per St	ream			OAM		
\times	Tools			Link		Service					
	Utilities	CCN	1	LBM	LT	м	DM	м	L	.MM	
		MPID	Remo	te MAC	RDI	LOC	xci	DN U	INEXP	Alarm	
	Files	20	00:18:	:63:00:39:B3	1	I	<u> </u>	1		1	
											MX Discover Control

OAM - Service - CCM

OAM CCM Results

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

• MPID: MEP ID of the remote MEP.

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

LEDs	Setup			Results		Start
	Global	Per S	tream		OAM	
Tools	Link			Service	•	
📑 Utilities	CCM LBM	LT	M	DMM	LMM	
	LBM Status					
Files	To Be Send	0				
	Response Count	5				
	In Order	5				
	Out Of Order	0				
	No Match	0				MX Discover
						Control



OAM LBM Results

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

LEDs	Setup			Results			Start
_	Globa	I	Per S	tream		OAM	
😑 Signal		Link			Service	•	
🙆 Frame	ССМ	LBM	LT	M	DMM	LMM	
Ŭ	Action		MAC		TTL	Flags	
Pattern	0×0	00:0	0:00:00:00:00:0	0 0		0x0	
	 	_					
X Tools							MX Discover
Utilities]	Control
Files			۲	1 of 1	۲		

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

Y.1731 Performance Management Functions Results

	LEDs		Setup			Res	ults	Start
		Globa	ll i	Per Si	tream		OAM	
$\left \times \right $	Tools		Link			Ser	vice	
	Utilities	ссм	LBM	LT	м	DMM	LMM	
		LMM Status						
	Files	Current Near E	Ind	0				
		Current Far En	ıd	0				
		Accum Near Er	ndi	0				
		Accum Far End	I	0				
		Ratio Near End	ł	0				MX Discover
		Ratio Far End		0				
								Control

OAM - Service - LMM

OAM - LMM Message

	Setu)	Results	Start
		Loss Measurem	ent	
X Tool				
Utilit	Status: : Complete	Near End	Far End	
	Current	0	0	
Files	Accumulation	0	0	
	Ratio	0	0	
				Discover
				Centrel
		Close		
		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

OAM - Service - DMM

LEDs	Setup			Results			Start
	Globa	I	Per S	tream	0/	M	
😑 Signal		Link			Service		
😑 Frame	ссм	LBM	LT	м	DMM	LMM	
č	DMM Status						
Pattern	Delay Samples		0				
	Average Delay		0 nSee	:5			
	Average Variation		0 nSee	0 nSecs			
the sector	Last Delay		0 nSee	0 nSecs			
I ools	Last Variation		0 nSee	:5			MX Discover
Utilities							Control
Files							

OAM - DMM Message

LEDs	Setup	Results	Start
X Tools	Delay Mea	asurement	
Utilities	DMM Result : Complete		
Files	Dest Delay Samples : # Se Average Delay :	4 319000 nSecs	
	Prior Average Variation : Last Delay :	1333 nSecs 321000 nSecs	
	Dela Last Variation : Dest	3000 nSecs	MX Discover
	# Se Prioly	ĸ	Control
	O 1	Page 3 of 3 💿	

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

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13.7 Auto Profile Scripting

The Auto Scripting application allows users to run tests with pre-configured 1GE/10GE/40GE/100GE Throughput or BERT profiles in sequence for a certain duration. This allows for a certain degree of automation for lab and field applications. The pre-configured profiles can be either created with ReVeal and loaded to the unit, or created on the unit itself.

The Auto Scripting application can be accessed in two different ways:

- Short cut from the application selection window (CFP4/QSFP28/QSFP+)
- Within the selected application (1GE/10GE/40GE/100GE) Home/Advanced Tools menu

Users can select up to 10 profiles in sequence. At the end of each profile test the results are saved automatically.

Starting from Boot-up:

1. On boot up, tap on the Application window

X Tools	Getting started	
Utilities Files	1 Select a Test Application Test App 1 - Test Mode Selection 1 Test App 1 - Test App 1 - Test Mode Selection 1 Test App 1 - Test App 1 - Test Mode Selection 1 Test App 1 - Test App 1 - Test Mode Selection 1 Test App 1 - Test	

Boot-up Screen

2. Test Mode Selection: The short cut to the Auto Profile Scripting application is found in each of the interface submenus for CFP2, QSFP+/SFP+, and RJ45.

Test Mode Selection

Test Ports	Test M	ode Selection
	Ethernet	😑 100G Ethernet Testing
CFP2	otn >	100G Ethernet Auto Profile Testing
QSFP+		
SFP+		
RJ45		
	ОК	Cancel

3. When the shortcut is selected from the Test Mode selection window, the Auto Script application is automatically launched.

LEDs	В	ERT	THROU	JGHPUT	
	File Prefix		AutoScript		
😑 Signal	If Alarm/Error det	ected:		Continue 🔻	
	Profile1	None 🔻			
e Frame	Profile2	None 🔻 🔻	1		
Pattern	Profile3	None 🔻	1		
0	Profile4	None 🔻 🔻	1		
ALM/ERR	Profile5	None 🔻 🔻	1		
	Profile6	None 🔻 🔻	1		LASER On/Off
History	Profile7	None 🔻	1		
	Profile8	None 🔻 🔻	1		
	Profile9	None 🔻	1		
	Profile10	None 🔻			
		S	tart		

Auto Script Main Menu

Selecting Profiles

• Pre-configured profiles appear in each of the Profile pull down menus. The user can select any profile available one or more than one time.

Pre-configured Profiles

LEDs	81	ERT	THRO	UGHPUT	
	File Prefix		AutoScript		
😑 Signal	If Alarm/Error det	ected Profile1		Continue 🔻	
	Profile1	100	100G-1	View Setup 🔘	
e Frame	Profile2	Nor	Default		
Pattern	Profile3	Nor	100G-1		
0	Profile4	Nor	100 G-2		
ALM/ERR	Profile5	Nor	100G-4		
	Profile6	Nor	100G-5		LASER On/Off
History	Profile7	Nor	None		
	Profile8	Nor			
	Profile9	None			
	Profile10	None 🔻	1		
		S	tart		

• User can select up to 10 profiles, each with a different test duration.

LEDs	BE	RT		THROUG	нрит	
	File Prefix		AutoScri	pt		
😑 Signal	If Alarm/Error dete	ected:			Continue	7
	Profile1	100G-1	▼5	Sec. 🔻	View Setup	D
😝 Frame	Profile2	100G-2	▼5	Sec. 🔻	View Setup	0
Pattern	Profile3	100G-3	▼5	Sec. 🔻	View Setup	0
•	Profile4	100G-4	▼5	Sec. 🔻	View Setup	5
ALM/ERR	Profile5	100G-5	▼5	Sec. 🔻	View Setup	
	Profile6	None	V			LASER On/Off
History	Profile7	None	▼			
	Profile8	None	▼			
	Profile9	None	▼			
	Profile10	None	V			
			Start			

Selected Profiles

Profile Test Duration: The duration of each profile can be in seconds, minutes, hours, or days

Profile Test Duration



Error handling during Test: The user can choose to Continue the auto scripting test if errors occur in any of the profiles by selecting "Continue". Or they can choose to stop the auto script by selecting "Exit".



Status of Profile Test: At the end of each profile tests, the status will be indicated by the soft LEDs next to each profile. Green = the test ran error free. Red = errors occurred during the test.

Status before testing

LEDs	BERT			THROUGHPUT			
	File Prefix		AutoScrip	pt			
😑 Signal	If Alarm/Error det	ected:			Continue	▼	
	Profile1	100G-1 🛛 🔻	5	Sec. 🔻	View Setup	ρ	
😝 Frame	Profile2	100G-2 🔻	5	Sec. 🔻	View Setup	þ	
Pattern	Profile3	100G-3 🛛 🔻	5	Sec. 🔻	View Setup	C	
0	Profile4	100G-4 🛛 🔻	5	Sec. 🔻	View Setup	þ	
ALM/ERR	Profile5	100G-5 🔻	5	Sec. 🔻	View Setup	U	
	Profile6	None 🔻	1				LASER On/Off
History	Profile7	None 🔻	1				
	Profile8	None 🔻	1				
	Profile9	None 🔻					
	Profile10	None 🔻					
		St	tart				

Test Running:

• To identify the profile being tested, progress of the test, and remaining time of each profile being tested, Profile Name, Progress and RT are scrolled on the bottom bar one after the other for a couple of seconds each time.

LEDs	Setu	P	Results		Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary A	ggregate Signal	Errors Alarms Eve	ents Traffic Delay	
Frame	ST:2015-5-5 15:06:4	15	ET:00:00:08		TX Stop
•		тх	RX		General
O Pattern	Line Rate (bps)	100.000G	100.00	0G	Eth. Err in
	Utilization (%)	50.000%	50.000	%	Eth. Alarm
ALM/ERR	Utilization (bps)	50.000G	50.000	G	
Mistan	Framed Rate (bps)	49.350G	49.350	G	LASER On/
History	Data Rate (bps)	48.765G	48.765	G	German
	Total Frames	36089464	360894	157	Setup Inject
	Bad Frames	0	0		
	Pause Frames	0	0		

Bottom Bar - Profile Name

• Progress: Progress (1 of X) profiles being tested is displayed on the bottom bar.

Bottom Bar - Progress

LEDs	Setup		Resi	ults	Stop
	Global	Per Stream	PCS	OAM	
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarms Eve	nts Traffic Delay	
Frame	ST:2015-5-5 14:06	:52	ET:00:00:01		TX Stop
		тх	RX		
O Pattern	Line Rate (bps)	100.000G	100.000	G	Eth. Err Inj.
	Utilization (%)	95.354%	95.354%	6	Eth. Alarm Inj.
ALM/ERR	Utilization (bps)	95.354G	95.354G		
History	Framed Rate (bps)	94.114G	94.1140	3	LASER On/Off
HISTORY	Data Rate (bps)	92.998G	92.9980	3	
	Total Frames 7749861		7749843		Setup Injection
	Bad Frames	0	0		
	Pause Frames	0	0		
192.168.0.116	Remote CLI Pro	gress: [1 of 5]	201	5-05-05 14:06:55	

• **Remaining Time** is displayed on the bottom bar.

Bottom Bar - Remaining Time

LEDs	Setu	ip.		Results	
	Global	Per Stream	PCS	OAM	
🔘 Signal	Stream Summary A	ggregate Signal	Errors Alarms	Events Traffic Delay	
Frame	ST:2015-5-5 14:06:	38	ET:00:00:07		
-		тх	R	x	
Pattern	Line Rate (bps)	100.000G	10	0.000G	I
	Utilization (%)	50.000%	50	.000%	1
ALM/ERR	Utilization (bps)	50.000G	50	.000G	
History	Framed Rate (bps)	49.350G	49	.350G	LASER On/Off
History	Data Rate (bps)	48.765G	48	.765G	
	Total Frames	20286957	20	286957	
	Bad Frames	0	0		
	Pause Frames	0	0		
(P) 192.168.0.116	Remote.CLI RT: 0	0:00:00		2015-05-05 14:06:49	

End of Test

At the end of the auto scripting test a "Profile Script Completed" message is displayed on the bottom bar.

LEDs	Setup		Rest	ilts		
	Global	Per Stream	PCS	OAM		
😑 Signal	Stream Summary A	ggregate Signal E	Errors Alarms Ever	nts Traffic Delay		
Frame	ST:2015- 5- 5 14:07:	37	ET:00:00:07	r:00:00:07		
		тх	RX			
Pattern	Line Rate (bps)	100.000G	100.000	G		
	Utilization (%)	100.000%	100.000	%		
ALM/ERR	Utilization (bps)	100.000G	100.000	G		
History	Framed Rate (bps)	76.190G	76.190 G		LASER On/Off	
History	Data Rate (bps)	54.762G	54.762G			
	Total Frames	737429820	7374298	20		
	Bad Frames	0	0		Restart Script	
	Pause Frames	0	0			
() 192.168.0.116	Remote CLI Profil	le Script Complete	ed 2015	-05-05 14:08:41		

Bottom Bar - Profile Script Completed

At the end of the auto script test the soft LEDs will display the overall status of each profile test that was carried out.

LEDs	BE	RT	тн	ROUGH	PUT		
	File Prefix		AutoScript				
😑 Signal	If Alarm/Error dete	cted:		Co	ntinue	▼	
	Profile1	100G-1 🛛 🔻	5 Sec	c. 🔻 🔪	/iew Setup	P	
Frame	Profile2	100G-2 🔻 🔻	5 Sec	c. 🔻 🔪	/iew Setup	Ο	
Pattern	Profile3	100G-3 🛛 🔻	5 Sec	c. 🔻 🔪	/iew Setup	Ο	
•	Profile4	100G-4 🛛 🔻	5 Sec	c. 🔻 🚺	/iew Setup	Ο	
ALM/ERR	Profile5	100G-5 🛛 🔻	5 Sec	c. 🔻 🔪	/iew Setup	D	
	Profile6	None 🔻 🔻					LASER On/Off
History	Profile7	None 🔻 🔻					-
	Profile8	None 🔻 🔻					
	Profile9	None 🔻 🔻					
	Profile10	None 🛛 🔻					
		St	tart				

Status at the end of the test

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13.8 Monitor (Pass Through)(RXT-6000e Only)

Pass through monitor mode enables the test set to be used for long term in-service testing. This allows for bi-directional monitoring of up to 10GE Ethernet line rate on the two 10GE SFP+ ports or the two 10/100/1000T RJ45 ports.

The Pass Through functionality allows:

- In-line traffic monitoring in both directions
- Long or short term network monitoring for troubleshooting network traffic problems
- Isolate network problems to the customer network or the service provider/operator network
- Monitor traffic between 10GE/1GE Fiber or 10/100/1000T links
- Pass through monitor operation
 - Pass Through Monitor Copper 1GE
 - Pass Through Monitor Fiber 1GE
 - Pass through monitor mode enables bidirectional monitoring between the two 10GE Fiber ports or the two 10/100/1000 Base-T ports

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13.8.1 Setup

The pass through monitor setup and operation is straight forward and simple:

- Press the **Test Port** button on the right side of the screen and select a pass through mode option
- Connect to both 10GE Fiber ports, 1000Base-X fiber ports (port 1 and port 2) or both 10/100/1000T copper ports (port 1 and port 2), depending on the interfaces to be monitored
- Once the cable/interface connections are in place, press Start

e LEDs	Setup	Re	sults	Start
	Three	sholds		\square
X Tools	Monitor Profile	Default	•	
	🗹 Enable	Port 1	Port 2	
Utilities	Utilization (%) >=	50.00	50.00	
Files	CRC Errors(#)≺=	20	20	
	Service Disruption(ms)<=	20	20	
				MX Discover

Monitor Mode Setup

- Thresholds: Set values for Port 1 and Port 2. The thresholds can be enabled or disabled depending on test requirements.
 When enabled, the pass through will show a pass/fail status based on the configured threshold values.
 - Utilization in %
 - CRC error count
 - Service Disruption in ms
 - Optical Power level in dBm (1000Base-X connections only)
- Once the cable/interface 10GE Fiber ports connections are in place and the thresholds have been set, press Start.

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13.8.2 Results

Monitor Mode Results

LED5	Setup		Res	Results	
	Summary	Errors	Alarms	Events	
😑 Signal	Traffic	Delay	Rates	Status	
😑 Frame			Values	Status	
O Pattorn	Utilization (%)		0.00%	Failed	
Pattern	CRC Errors		0	Pass	
ALM/ERR	Service Disruption	n (ms)	0	Pass	
Tools Utilities Files					MX Discover

Monitor Mode Results features the same statistics as BERT Results. Please see <u>15.2.2 BERT Results</u>. The Status screen displays the following statistics:

- Utilization (%)
- CRC Errors
- Service Disruption (ms)

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13.9 Loopback Mode

The Loopback application in the main menu 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 1, 2, 3, or 4). 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 1: All incoming traffic to the Rx loopback interface will be sent out unaltered to the Tx loopback interface.
 - Layer 2, 3, & 4: In a Layer 2 or 3 loopback 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>13.2.1.1 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 & 4 only)
 - IP Destination (Layer 3 & 4 only)
 - Precedence (Layer 3 & 4 only)
 - TOS Value (Layer 3 & 4 only)
 - UDP SPort (Layer 4 only)
 - UDP DPort (Layer 4 only)

Press **Start** to begin loopback. indicates that loopback is in progress. The **Results** tab displays current test results. Please see <u>13.2.2 BERT Results</u> for information on the Results tabs.

	LEDs	Setup	Setup Results	
		Profile	Last configuration 🛛 🔻 🔻	
\mathbf{x}	Tools	Test Layer	Layer 4 🗸 🔻	
		VLAN ID	Disable 🔻	
	Utilities	VLAN Priority	Disable 🔻	
	Files	MAC Source	Disable 🔻	
		MAC Destination	Disable 🔻	
		IP Source	Disable 🔻	
		IP Destination	Disable 🔻	
		Precedence	Disable 🗸 🔻	
		TOS Values	Disable 🗸 🔻	MX Discover
		UDP Source Port	Disable 🔻	
		UDP Destination Port	Disable 🔻	

Loopback Setup

Loopback In Progress

LEDs		Setup	•			F		Stop	
	Summary	Errors	Alarms	Eve	nts	Traffic	Delay	Rates	
😑 Signal	ST:2012-1	- 5 18:15:1:	2		ET:0	0:00:07	1		
Frame					RX				
	Line Rate i	(bps)			1000.	000M			
Pattern	Utilization	(%)			0.000	1%			
	Utilization	(bps)			0.000	ιK			
ALM/ERR	Framed Ra	ite (bps)			0.000	к			
	Data Rate	(bps)			0.000	ιK			
X Tools	# of Bytes				0				MX Discover
	Pause Fra	mes			0				
Utilities									
Files									

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14.0 PCS

14.1 Setup

14.1.1 Tx Lane Mapping and Skew

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





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14.1.2 Tx Alarm/ Error Injection

- Error Injection per PCS lane:
 - Invalid Sync header: first 2 bits of the 64/66 block header
 - Invalid alignment marker: inserted every 16383 block on each virtual lane it contains the Virtual lane identifier
 - BIP: generates bit interleave parity error

• Alarm Generation:

- LOBL: Loss of block lock
- LOA: Loss of Alignment marker
- HI-BER: high bit error rate of sync header

LEDs			Setu	>	Results	Start
	T	(Lane N	Aappin	g and Skew	Tx Alarm/Error Injection	
😑 Signal	VL ID Select VL ID Select		Select	Error Type		
Frame	0 1	×	10 11		 Invalid Sync Header Invalid Align Marker 	
Pattern	2 3		12 13		BIP Error Injection Flow	
ALM/ERR	4		14 15		• Single	
History	6 7		16 17		Rate	LASER On/Off
	8		18		Alarm Type	
	9 Sele	ct All	19 Cle	ar All	● LOBL ● LOAML ● HI-BER	

PCS Setup - Tx Alarm/ Error Injection

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14.2 Results

14.2.1 Summary

PCS Results - Summary



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14.2.2 Rx Lane Skew

PCS Results - Rx Lane Skew

LEDs			Se	tup				Resu	Stop	
	Summary		R	tx Lane	Skew	Alarms	/Errors	Events		
😑 Signal	VL ID	т	x Skew E	Ait	PCS# CAU		Rx VL ID	Fox Skew(bit	s) Rx Skew(ps)	Restart
O Frame	0 1	Ð	0	+	0	0	1	30 29	5818 5624	
	23	$\overline{\cdot}$	0	+	23	1	23	35 35	6787 6787	Errini
Pattern	4	Ð	0	÷	4	2	5 4	46 45	8921 8727	
	6 7	Ð	0	÷	6 7	3	7 6	47 46	9115 8921	Alarm inj.
ALMIERR	8 9	$\overline{\mathbf{\cdot}}$	0	+	8 9	4	8	22 22	4266 4266	TASER ON/OF
History	10 11	$\overline{\ }$	0	+	10 11	5	10 11	93 93	18036 18036	
	12 13	$\overline{\ }$	0	+	12 13	6	12 13	37 37	7175	
	14 15		0	+	14 15	7	14 15	33 33	6400 6400	
	16 17	Ð	0	+	16 17	8	17 16	31 30	6012 5818	
	18 19	Ð	0	+	18 19	9	19 18	1	193	

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14.2.3 Alarms/Errors

PCS Results - Alarms/Errors

LEDs	Setup									Resu	lts				C	St	top			
	Summary Rx L				Lane Skew		-	Alar	ms/Erro	ors	1	Events			F	-				
O Signal	ST:2012	2-10-23	-10-23 11:03:38				ET:00:00:09									C	Res	start		
O 5	64	/66BA	larms		Sec	ond	s													
• Frame	HI-BER				0											6				
Pattern	Aggregate										C	Err	Inj.							
0	PCS La	ne Ala	rms		Seconds		PCS Lane Errors			C	Count			C	Alar	m Ini				
ALM/ERR	LOA				0			Invalid Sync Header			r 0				-			-		
	LOBL				0			Invalid Align Marker			r 0	0		C	SER	(On/	no			
History					5			BIP-8 Block Error 0												
			PC	S La	nes	Alar	rms	and	l Eri	ors Su	mmary									
	0 0	0 1	0 2	0	3	0	4	•	5	0 6	0 7	0	8	0	9					
	10	11	0 12	0	13	۲	14	0	15	0 16	0 17		18	C	19					
	View PCS Lane Details																			

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14.2.4 Events

PCS Results - Events

. LEDs	S	etup	Resul	Stop	
	Summary	Rx Lane Skew	Alarms/Errors	Events	
Signal	Time	Event Type	# of Events	Test	Restart
😑 Frame	2012-10-23 11:03:	38 Test Started		PCS	
Pattern	<u>.</u>				Errinj.
ALM/ERR					Alarm Inj.
History					LASER On/Off
		Pag	ge 1 of 1 💿	1	

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14.3 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

Signal	Save re	Start							
• Frame	1	2	3	4 5	6	7	8	9 0	
Pattern	q	w	e	r t	У	u	1	o p	
ALM/ERR	a	s	d	f	9	h j	k	1	
History	Caps	z	×	c	b	v n	m	Shift	LASER On/On
		Symb	ol De	. @	•	Del Al	<.		
				SPACE		Apply			

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

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15.0 OTU3/ OTU4 Test App

Follow the steps to assign the test module to a test tab as described in RXT-1200 Platform Manual of this manual.

Select the OTU4 Testing Application and press Accept.

The module will be configured and the progress will be displayed on the unit's screen.

The OTU4 home page will be displayed with links to Setup, OTN Results and OTN Tools. The Test Tab in the bottom of the screen will be red in color and so will be the soft LEDs for Signal and Frame on the left side of the screen.



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, while the soft LEDs for Signal and Frame will 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.



Ready for Testing Tasks

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15.1 Setup

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

The parameters are for TX and RX Coupled - TX and RX configurations are grouped as one block; TX and RX will have identical configuration.

- OTL
- **Hierarchy:** Allows the user to configure OTN signal and network types, including the bit rate and higher order mapping, if applicable.
- Data

The following fields are pre defined:

- Interface: Optical Module-CFP For OTN only optical interface is available.
- Mapping / Multiplex: ODU4
- Payload: Bulk

OTU4 Setup Home



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15.1.1 OTL

Tap the OTL tab on the Setup screen to configure the OTL Tx Lane Mapping and Skew.

OTL Tx Lane Mapping and Skew

LEDs		OTL Tx Lane Mapping and Skew								
	Lane ID	Skew (bits)	Lane#	Ch.	OTI Lana Manalan				
😑 Signal		- 0	+	0	0	OTE Lane Mapping	Ch in			
O Frame	23	- 0	+	23	1	Default	Shift			
U Traine	4 5	- 0	+	4	2	Chan Cattle as				
Pattern	6	- 0	+	6	3	Skew Settings	4			
	8	• 0	+	8	4	Inc./Dec. Size	1	Alarm Inj.		
e ALM/ERR	10	- 0	+	10 11	5	Alarm Threshold(bits)	1000			
History	12	- 0	+	12 13	6	Reset Skew Defa	ult Alarm	LASER ON/OH		
	14	• 0	+	14 15	7	· · · · · · · · · · · · · · · · · · ·				
	16 17	- 0	+	16 17	8					
	18 19	- 0	+	18 19	9			Set injection		

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15.1.2 Heirarchy

Tap the Heirarchy tab to enter the Heirarchy configuration screen. The following parameters are displayed:

- Network Type: OTN
- Test Rate: OTU4 (111.819 Gbits/s)
- Scrambler: On/Off
- **FEC:** 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
- Measurement Reference Clock: Internal
- Clock Signal Type: Quartz VCXO

OTU4 Heirarchy Setup (Internal Clock)

LEDs	Hier	Start	
	Network Type	οτη 🔻 🔻	
🕒 Signal	Test Rate	OTU4 (111.810 Gbit/s) 🛛 🔻 🔻	
	Scrambler	on 🔻	
Frame	FEC	on 🔻	
Pattern	Tx Clock Source	Internal 🛛 🔻	Err Inj.
•	Clock Signal Type	Quartz VCXO 🛛 🔻	Alarm Ini
😑 ALM/ERR			
	Tx Clock Offset(ppm)	0.000	LASER On/Off
History			
	Meas Ref. Clock	Internal 🛛 🔻	
	Clock Signal Type	Quartz VCXO 🛛 🔻	Set Injection

OTU4 Heirarchy Setup (Received Clock)

LEDs	Hier	Start	
	Network Type	οτη 🔻 🗡	
🕒 Signal	Test Rate	OTU4 (111.810 Gbit/s) 🛛 🔻 🔻	
	Scrambler	on 🔻	
🜔 Frame	FEC	on 🔻	
Pattern	Tx Clock Source	Received 🛛 🔻	Err Inj.
0			Alarmini
ALM/ERR			-aarin ng.
History			LASER On/Off
	Meas Ref. Clock	internal 🛛 🔻 🔻	
	Clock Signal Type	Quartz VCXO 🛛 🔻	Set Injection

OTU4 Heirarchy Setup (External Clock)

LEDs	Hier	Start	
	Network Type	οτη 🔻 🗡	
🕒 Signal	Test Rate	OTU4 (111.810 Gbit/s) 🛛 🔻 🔻	
	Scrambler	on 🔻	
🜔 Frame	FEC	on 🔻	
Pattern	Tx Clock Source	External(BNC) 🛛 🔻	Err Inj.
•	Clock Signal Type	2048 kHz 🛛 🔻	Alarm Ini
😑 ALM/ERR	Line Code	новз 🔻	
History			LASER On/Off
	Meas Ref. Clock	internal 🛛 🔻 🔻	
	Clock Signal Type	Quartz VCXO 🛛 🔻	Set Injection

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15.1.3 Data

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

• Test Data Mode: PRBS Pattern

- **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.
- Avaiable patterns: 2^31-1, 2^23-1, 2^9-1
- Invert (Logic pattern inversion): On / Off

OTU4 Setup - Test Data Settings



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16.0 CPRI Testing

- Overview
- Interface Specifications
- <u>CPRI Testing</u>
 - <u>Test Areas</u>
 - Test Ports
 - Test Modes
- <u>CPRI Layer 2 Framed Testing</u>
 - <u>Setup</u>
 - <u>Results</u>
 - CPRI Round Trip Delay
 - <u>SDT</u>
 - Control Words
 - Frame Capture

CPRI Overview

- CPRI stands for Common Public Radio Interface
- This protocol has been developed by Ericsson AB, Huawei Technologies Co. Ltd, NEC Corposration, Alcatel Lucent and Nokia Siemens
- It is an industry cooperation aimed at defining a publicly available specification for the key internal interface of radio base stations between the Radio Equipment Control (REC) and the Radio Equipment (RE)
- The standard is public and can be downloaded from http://www.cpri.info

OBSAI:

- OBSAI stands for Open Base Station Architecture Initiative
- This protocol has been developed by Hyundai, LGE, Nokia, Samsung and ZTE
- OBSAI Rates range from 728 Mbps to 6.8 Gbps

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16.1 Interface Specifications



Common Public Radio Interface

- CPRI specification defines only Layer 1 and Layer 2
- Specification written with the goal to be generic enough to support scalable rates, physical access medium type, and air interface technologies

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Protocol Stack


Physical Layer

The following Line bit rates are defined from the standard:

- Line Coding:
 - 8B/10B line coding shall be used for serial transmission according to IEEE 802.3-2005, clause 36. (Same encoding as used for Gigabit Ethernet and Fibre Channel)
- Bit Error Correction/Detection:
 - The physical layer is designed in such a way that a very low bit error ratio can be achieved without expensive forward error correction schemes. Therefore, no general bit error correction is applied at Layer 1.
 - The RE and the REC shall support detection of 8b/10b code violations. Link failures shall be detected by means of 8b/10b code violations.



16.2 CPRI Testing

Test Ports and Modes

RXT-6200



RXT-6200



RXT-6000e



Testing up to 24.330 Gbps

RXT-6000e

Test Ports			Test Mode Selection
CFP2	Ethernet	>	CPRI Layer 2 Testing
	OTN/SDH/SONET	>	CPRI Layer 2 Dual Testing
QSFP28	Fibre Channel	>	CPRI Layer 2 Monitor Testing
W SFFF	CPRI/OBSAI		
SFP28 SFP+	eCPRI	>	
RJ45			
	C	C	OK Cancel
(P) 192.168.127.5	52 🕟 Remote/CLI		2019-05-17 10:57:11 🛛 🔏 🗔

16.3 CPRI Layer 2 Framed Testing



CPRI Layer 2 Main Menu

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16.3.1 Setup

Signal Start LEDs Coupled Hierarchy 4.9152G Err inj. 🔵 Signal Alarm 🔵 Frame Interface Optical Alarm/Err 😑 Pattern Payload CPRI Layer 2 Master ALM/ERR LASER Off History Pattern RX: 2^23-1 TX: 2^23-1 Auto-neg RX: 4.9152G TX: 4.9152G

Setup Menu

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Configure the following:

Signal:

• Hierarchy: CPRI Rate selection from 614.4Mbps to 6.144Gbps. 4.9 and 6.1 Gbps rate requires compatible SFP+.

Hierarchy

		Hierarchy		Start
Leos	Network Type	CPRI	▼	
C Signal	CPRI Rate	4.9152G	▼	Err inj.
0		CPRI Rate		
Frame		4.5 102 G		Alarm
\sim		1 2288G		
Pattern		2,4576G		
Ŭ		3.072G		
ALM/ERR		4.9152G		
		6.144G		LASER Off
History				
				Auto-neg
RX: 4.9152G				
1.4.91020				

- Interface: CPRI Clock Selection Internal/External (Master mode only). Slave uses RX signal recovered clock.
 - **Master:** Internal, External (1.5MHz, 2MHz, 1.5 Mbps, 2Mbps, 10MHz), Or Atomic 10MHz (Atomic clock option required)

For External clock connection use the unit's SMA CLK port.



Interface

- **Payload:** CPRI Layer 2 configuration
 - CPRI Emulation Type: CPRI Master emulation (Radio Equipment Controller Emulation)
 CPRI Slave emulation (Remote Radio Unit). Slave = RE. Master is responsible for CPRI Start up sequence and Synchronization
 - CPRI Protocol: Version 1 supported
 - #Z.0.1 Byte: Sync Control Word Z.0.1 set to D16.2 or D5.6
 - Channels:
 - Single: PRBS test pattern transmitted on one AxC
 - All: PRBS test pattern transmitted on all AxC

Control and Management (C&M) channel configuration:

- Slow C&M Rate:
 - None: HDLC channel disabled
 - Configurable rate: 240kb/s to 2400 kb/s HDLC channel data rate depending on CPRI Link speed
- Fast C&M Enabled: Ethernet channel, configurable start of Ethernet channel pointer in Control word or channel disabled.
 - **OFF:** Ethernet Channel disabled
 - ON: Ethernet Channel enabled, configure Ethernet pointer location from 20 to 63

Auto-negotiation can be used for Master/Slave to negotiate their maximum C&M channels

Payload

		Payload	Start	
LEU'S	CPRI Layer	Layer 2		
Signal	CPRI Emulation Type	Master	Trinj.	
•	CPRI Protocol	1		5
😑 Frame	#Z.0.1 Byte	D16.2	Alarm	–
-	Channels	Single	Alarm/Err	
Pattern		C&M plane		
O	Slow C&M Rate	None	V	
	Fast C&M Enabled	OFF		
History			LASER OF	-
			Auto-neg	
				~
RX: 4.9152G				
TX: 4.9152G				

• Pattern: Independent TX/RX test Pattern selection. PRBS 2^23-1 (normal or inverted) or PRBS 2^31-1 (normal or inverted)

Pattern

LEDs		Pattern	Start	
		тх		2
C Signal	PRBS Pattern	2^23-1	Err inj.	
	Invert	OFF		5
😑 Frame		RX	Alarm	
	Out of service	ON	Alarm/Err	
Pattern	PRBS Pattern	2^23-1		-
O	Invert	OFF	V	
History			LASER OF)
			Auto-neg	5
				~
RX: 4.9152G				
TX: 4.9152G				

Go back to top Go back to TOC

Measurements:

Measurements Setup



- Mode: Manual, Timed, Auto
 - Timed:
 - Duration: Enter the time
 - Units: Select seconds, minutes, hours, days
 - Auto: Start time, and Duration
- Interval Save: Test result automatically saved at configurable interval
 - **ON:** Set the Save Interval (in minutes). Tap the box to enter the value.
 - OFF: To opt to not save

General:

General Setup

e LEDs	Signal	Measurements	General	SDT	Start
	Audible Alarm		OFF	▼	
😑 Signal	Results on start		ои	V	Err inj.
~	Auto Save		OFF	V	Alarm
😑 Frame	Measurement Clo	ck Source	Internal	V	
O Pattern					Alarm/Err
					LASER Off
History					Auto-neg
RX: 3.072G TX: 3.072G					

- Audible Alarm: OFF / ON. A sound will be generated every time there is an alarm.
- Results on start: OFF / ON. Shows the results screen on pressing Start.
- Auto Save: OFF / ON. Automatically Save the test results.
- Measurement Clock Source: Select the Measurement clock source used for Frequency measurement. For Master: Internal or TX clock source (if external clock source is used) For Slave: Internal

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SDT: The Service Disruption Test can be disabled or enabled. If enabled the SDT Test is triggered by a qualifying error or alarm.

If enabled, select:

• Limit Time: Limit time determines qualifying events total time pass/fail criteria. Configurable from 20 to 1000 ms.

Gate Time: Gate time setting determines the duration of the measurement. Configurable from 20 to 10000 ms.

LEDs	Signal	Measureme	nts Gene	eral	SDT	Start
	Setup		CPRI		BERT	
😑 Signal	Enable		ON		V	
😑 Frame	Limit [ms] Gata Time [ms]		50			Alarm
O Pattern	Gate Time [ms]		300			Alarm/Err
O ALM/ERR						
History						Auto-neg
RX: 4.9152G TX: 4.9152G						

SDT Setup

Enable CPRI and/or BERT trigger events

In the CPRI and BERT Tab enable (ON) or disable (OFF) the Alarms and Errors used to determine Service Disruption events. At least one error or alarm must be enabled for SDT to trigger.

CPRI: LOS, LOF, SDI, RAI, RLOS, RLOF, Code

BERT: LSS, Bit

CPRI Event Setup

LEDs	Signal	Measurements	General	SDT	Start
	Setup	CI	PRI	BERT	
😑 Signal	LOS		ON	V	
C Frame	LOF		ON	•	Alarm
	SDI		OFF	▼	
Pattern	RAI		OFF	v	Alarmierr
	RLOS		ON		
C ALM/ERR	RLOF		OFF		
History	Code		ON	•	LASER Off
					Auto-neg
RX: 4.9152G TX: 4.9152G					

BERT Event Setup



Alarm and Error Injection

Alarm Injection: Each alarm can be set to Continuous or Count

- CPRI Alarms:
 - LOS: Trigger a Loss of Signal event (Laser OFF)
 - LOF: Trigger a Loss of Framing event. The Z.0.0 control byte is modified to send an invalid byte of value 0xff
 - SDI: Service Defect Indication is transmitted in the Control bytes for L1 inband protocol
 - RAI: Remote Alarm Indication is transmitted in the Control bytes for L1 inband protocol
 - RLOS: Remote Loss of Signal is transmitted in the Control bytes for L1 inband protocol
 - RLOF: Remote Loss of Framing is transmitted in the Control bytes for L1 inband protocol
- Alarm Flow:
 - Continuous
 - Count: 0.1s, 1s, 10s, 100s

Error Injection:

- Error Mode:
 - Pattern: BIT Bit error injection in test pattern
 - CPRI: Code: 8B/10B Code violation error injection
- Error Flow:
 - Single
 - Count: Enter the value
 - Rate: 1E-3, 5E-4, 2E-4, 1E-4, 5E-5, 2E-5, 1E-5, 5E-6, 2E-6, 1E-6, 5E-7, 2E-7, 1E-7, 5E-8, 2E-8, 1E-8, 5E-9, 2E-9, 1E-9

Alarm and Error Injection



Press Start to start the test.

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16.3.2 Results



Results Summary

Go back to top Go back to TOC

Alarms and Errors

These include Hyperframe Synchronization indication and BFN (NodeB Radio Frame) Synchronization indication.

- Green indicates no alarm
- Red indicates current alarm
- · Grayed out indicates that the measurements are masked by an higher layer alarm or error

Alarms and Errors Page 1

LEDS	Grap	h	Event Log	CPRI	RTD	SDT	Start
	Summa	ary E	Frors/Alarm	s Sign	al	Histogram	
😑 Signal	Cpri Pa	t					Err inj.
G Erama	LOS LS	s					Alarm
Frame	Code Bi	t					
😑 Pattern	LOF						Alarm/Err
	HLOF						
e Alm/Err	BLOF						
History	SDI						LASER Off
	RAI						Automen
	RLOS						- Addeney
	RLOP						
RX: 3.072G TX: 3.072G		(D Pa	age 1 of 3	•		Restart

CPRI:

- LOS: Loss of Signal detection in seconds
- Code: 8b/10b code violation detected count and rate
- LOF: Loss of framing seconds detected if invalid Z.0.0 sync byte is received
- HLOF: Loss of Hyperframe synchronization seconds
- BLOF: Loss for Basic Frame (NodeB) frame synchronization seconds
- SDI: Service Defect Indication is detected in the Control bytes for L1 inband protocol
- RAI: Remote Alarm Indication is detected in the Control bytes for L1 inband protocol
- RLOS: Remote Loss of Signal is detected in the Control bytes for L1 inband protocol
- RLOF: Remote Loss of Framing is detected in the Control bytes for L1 inband protocol





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BERT:

- LSS: Loss of test pattern seconds
- Bit: Number of test pattern bit errors detected count and rate

Alarms and Errors Page 3



Signal

Signal Page 1



Page 2 includes:

- **Frequency:** Measured RX signal frequency
 - o Offset: current frequency offset from the frequency measurement clock (internal or external)
 - Min: minimum frequency offset
 - Max: maximum frequency offset
- Hyperframes TX/RX: counters of Transmitted/Received Hyperframes
- NodeB frames TX/RX: counters of Transmitted/Received NodeB (Radio) framed

Signal Page 2



Signal Page 3

LEDs	Graph	Event Log	CPRI RTD	SDT	Start
	Summary	Errors/Alarms	Signal	Histogram	
😑 Signal		Opt	ical		Err inj.
Come	Vendor	FINISAR CORP.			Alarm
- Frame	Part Number	FTLF1421P1BCL			
😑 Pattern	Vendor Rev	A		4240	Alarmierr
	Wavelength			1310 2500 Mbps	
History	Transceiver	SONET/SDH - OC- Compliant Gigabit Ethernet - Fibre Channel - Ior Mode; 200 MBytes	48 Intermediate ro 1000BASE-LX; ng distance; Long (Sec; 100 MBytes/	each; SONET IR-1 wave laser; Single Sec;	LASER Off Auto-neg
RX: 3.072G TX: 3.072G		Page	3 of 4 💿		Restart

Histogram showing the fluctuation in RX optical signal level.

Graph Event Log CPRI RTD Start LEDS Histogram Signal Err inj 🔵 Signal SFP < ٠ • > Alarm 🦲 Frame 0 Alarm/Er 🔴 Pattern -10 ALM/ERR -20 LASER Off History -30 Auto-neg -40 lin 10 20 30 RX: 1.2288G 0 TX: 1.2288G Restart ۲ Page 4 of 4

Signal Page 4

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Histogram

Histogram showing CPRI alarms and errors events.

Histogram

LEDS	(Graph		Event	Log	CPRI	RTD	s	DT	Start
	SL	ımmar	y	Errors/A	larms	Sig	nal	Hist	ogram	
🔵 Signal	۲.	+	•	>	CPDIA	larme				Err inj.
😑 Frame 😑 Pattern	LOS Code LOF HLOF	E			CPRIA	a arms				Alarm Alarm/Err
ALM/ERR	BLOF SDI RAI RLOS RLOF	E				_				LASER Off
	sec	0	60	120	180	240	300	360	420	Auto-neg
RX: 1.2288G TX: 1.2288G				•	Page	1 of 2	۲			Restart

Histogram showing BERT alarms and errors events.



Histogram Page 2

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Graph

Graph showing CPRI Code and Bit error rate over time.

Graph



Graph Page 2



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Event Log

Logs CPRI Alarms and Errors events along with corresponding count and duration for each event.

LEDS	Summary	Errors/A	larms	Signal	Histogram	Start
	Graph	Graph Event Log		CPRI RTD	SDT	
😑 Signal	#	Type		Start	Dur/Count	Err inj.
A Frame	1	Start	2014	-11-05 17:03:52.0		Alarm
	2	CPRI:LOF	2014	-11-05 17:03:52.1		Alarm/Err
😑 Pattern	3	CODE	2014	-11-05 17:03:53.0	107708729	Alarmiterr
	4	CODE	2014	-11-05 17:03:54.0	107744330	
	5	CODE	2014	-11-05 17:03:55.0	107743821	
History	6	CODE	2014	-11-05 17:03:56.0	107755758	LASER OIL
	7	CODE	2014	-11-05 17:03:57.0	107837711	Auto-neg
	8	CODE	2014	-11-05 17:03:58.0	107843294	
RX: 1.2288G	9	CODE	2014	-11-05 17:03:59.0	107818870	
TX: 1.2288G		٩	Page	1 of 2 🕑		Restart

Event Log

16.3.3 CPRI Round Trip Delay

CPRI Standard Cable Delay Measurement reference points:

- Toffset = Frame offset delay between Slave RX and Slave TX
- T 1,4 = Frame delay between Master TX and Master RX
- Cable Delay (round trip) = T 1,4 Toffset

The figure below shows the definition of reference points for delay calibration (single-hop configuration):



Round trip delay Measurement procedure:

- 1. Slave Side: Start the test and note Toffset value
- 2. Master Side: Enter the Slave Toffset value using keypad
- 3. Master Side: Start the Test
- 4. Master Side: Note Cable Delay measurement min, max and current values



CPRI RTD

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16.3.4 SDT

Limit and Gate Time counters begin at the onset of the first valid event.

SDT Measurement ends after the Gate time is elapsed, to allow the capture of multiple smaller events.

The total time from the beginning of the first event to the end of the last event (within the Gate Time) is the reported SD time.

The measurement process is immediately restarted in search for the next trigger. Results are presented in tabular form (Events table) indicating SD start time (1 ms resolution or better), disruption time, and Pass/Fail evaluation. This table gets populated as new RXT-6200_RXT6000e_Module_Manual Page 340 of 387

SDT Results

LEDs	Summary	Errors/Alarms	Signal	Histogram	Stop
	Graph	Event Log	CPRI RTD	SDT	
😑 Signal	Res	ults	Eve	ent Log	Err inj.
A Frame	ST:2014-11-05 17:1	3:58		ET:00/00:00:05	Alarm
•		SDT	[ms]	Start Time	Alarm/Err
😑 Pattern	Last				
ALM/ERR	Min				
	Result			Measuring	LASER Off
History	Events				
RX: 1.2288G TX: 1.2288G					Restart

SDT Event Log

LEDs	Summary	Errors/Alarms	Signal	H	listogram	Start
	Graph	Event Log	CPRI RT	D	SDT	
😑 Signal		Results		Event Log		Err inj.
6 5-1-1-1	Туре	Start	Dura	tion [ms]	Verdict	Alarm
- rrame	Start	14/11/05 17:14:12.0				
-	Disruption	14/11/05 17:14:12.20003	0		Pending	Alarm/Err
🥚 Pattern	-CPRI:LOF	14/11/05 17:14:12.20003	0			
•	-CODE	14/11/05 17:14:12.20003	0			
ALM/ERR	Stop	14/11/05 17:14:22.0				
						LASER Off
History						
						Auto-neg
RX: 1.2288G						
TX: 1.2288G		Page	1 of 1 🛛 🖲			Restart

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16.3.5 Control Words

Display of Control words content in the 64 Subchannels.

Tap on any subchannel to display Hex and Binary value of the contents.

Control Words Display

LEDs	0-15			16-31		32-47		48-63				
	0	Sync & timing	SYN	HFN	BFN	BFN	8	Reserved	RES	RES	RES	RES
C Signal			BC	58	80	03			00	00	00	00
	1	Slow C&M	C&M	C&M	C&M	C&M	9	Reserved	RES	RES	RES	RES
O Frame			00	00	00	00			00	00	00	00
	2	L1 inband prot.	VER	STR	L1	Ptr	10	Reserved	RES	RES	RES	RES
A A B B B B B B B B B B			01	00	00	00			00	00	00	00
Pattern	3	Reserved	RES	RES	RES	RES	11	Reserved	RES	RES	RES	RES
A			00	00	00	00			00	00	00	00
ALM/ERR	4	Ctrl_AxC low	Ctl	Ctl	Cti	Ctl	12	Reserved	RES	RES	RES	RES
		Byte	00	00	00	00			00	00	00	00
History	5	Ctrl_AxC low	Ctl	Ctl	Ctl	Ctl	13	Reserved	RES	RES	RES	RES
		Byte	00	00	00	00			00	00	00	00
	6	Ctrl_AxC high	Ctl	Ctl	Ctl	Ctl	14	Reserved	RES	RES	RES	RES
		Byte	00	00	00	00			00	00	00	00
RX: 3.072G	7	Ctrl_AxC high	Ctl	Ctl	Cti	Ctl	15	Reserved	RES	RES	RES	RES
TX: 3.072G		Byte	00	00	00	00			00	00	00	00

Byte Analyzer

ee LEDs	Byte Analyzer						
Signal	Туре	Sync byte					
0.000	Value	BC, 50, 50, 50, 50					
e Frame							
O Pattern							
O ALM/ERR							
History							
RX: 3.072G TX: 3.072G							

Byte Analyzer

e LEDs	Byte A	nalyzer
Signal	Туре	Slow C&M
0	Byte	4
😑 Frame	Value	00
O Dattara	Binary	0000000
- Pattern		
O ALM/ERR		
History		
RX: 3.072G TX: 3.072G		

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Frame Capture

The test set must be set to Slave mode or use the Master's ref. Clock.



- Capture up to 5000 Hyperframes
- CSV or raw frame format
- Compression (gzip format)
- Capture file written directly to USB drive

Frame Capture Setup

LEDE	S	etup	Start
	Hyperframes	5000	
Signal	Format	Raw 🔻	
•	Compress	on 🔻	
😑 Frame			
O Pattern			
History			LASER OF
RX: 3.072G TX: 3.072G			

17.0 eCPRI

17.1 eCPRI Testing Overview

The Common Public Radio Interface (CPRI) forum introduced a new more stringent Ethernet packet based fronthaul interface, **eCPRI**, due to limitations for 5G deployments based on traditional CPRI or OBSAI.

To ensure that 5G network's strict requirements are met in the fronthaul, the eCPRI Transport Network requirement document establishes classes of service for data and C&M traffic. With full line rate eCPRI traffic generation capabilities and high accuracy one-way latency measurements, the eCPRI test application provides the tools necessary to ensure that the eCPRI transport network is ready for 5G deployments.



CPRI Mobile Fronthaul Evolution

This protocol has been developed by Ericsson AB, Huawei Technologies Co. Ltd, NEC Corporation, Alcatel Lucent and Nokia Siemens. The standard is public and can be downloaded from http://www.cpri.info.

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17.2 Interface Specifications

eCPRI System Architecture Example* (*eCPRI Interface Specifications ver 1.1)



- CPRI Specification was written with the goal to be generic enough to support scalable rates, physical access medium type, and air interface technologies.
- eCPRI relies on existing standards for Ethernet/IP networking, synchronization, and security.

17.2.1 Protocol Stack

eCPRI Protocol Stack* (*eCPRI Interface Specifications ver 1.2)



17.2.2 eCPRI Key Features

Key features of eCPRI include:

- 25G/10G eCPRI (Protocol ver.1)
- Ethernet Type: AE-FE (eCPRI)
- Configurable C field and message type
- Dual-port testing capabilities
- RS-FEC support
- Multi-stream testing up to 32 independent streams
 - Each stream can be set with independent frame size, bandwidth, traffic profile, and QoS levels
- Throughput testing at Layer 2 and Layer 4
- Frame sizes from 64 to 1518 bytes and jumbo frames up to 16000 bytes (Layer 2 only)
- Configurable Source and Destination MAC
- Fully configurable IPv4 or IPv6 header
 - UDP Header configurable Source and Destination ports
- Q in Q (VLAN stacking up to 3 VLAN tags with configurable priority and type)
- MPLS up to 3 labels with configurable Label/S/CoS and TTL
- Test Patterns:
 - PRBS pattern: 231-1, 223-1, 215-1, 211-1
 - PRBS normal and inverted patterns
 - All 0s, All 1s, and User Defined
- High accuracy One-Way-Delay latency measurement
- Line rate packet capture

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17.2.3 eCPRI Data Framing

eCPRI Data Framing



17.2.4 eCPRI One Way Latency Measurement

The diagram below shows how eCPRI works with RXT-6000e and RXT-6200 test modules.

eCPRI One Way Latency Measurement



17.3 eCPRI Setup

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

17.3.1 Test Port Selection

		•	Test Mode Se	lection					
Test Ports		Test Mode Selection For Port 1							
CFP4	Ethernet	>	Interface Type	10G	▼				
	OTN/SDH/SONET	>	🗹 eCPRI Testin	g					
QSFP28	Fibre Channel	Inte	rface Type	10G					
	CPRI/OBSAI	25G	with DS FEC						
SFP28 SFP+	eCPRI	200 10G	with KS-PEC						
RJ45									
RJ48 BNC									
	Release	\cdot	e	ок	Cancel				

This menu is accessed via the Test Port button located at the top left hand side of the screen.

To select the eCPRI test:

- 1. Click the SFP28/SFP+ Test Port, and then select the eCPRI test mode.
- 2. Select the test interface type (10G, 25G, or 25G with RS-FEC), and then click OK.

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17.3.2 Port Setup

Configure the Test Ports and/or Test Interfaces using the Setup menu on the Home page. The available configuration settings depend on the interface selected.

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

The figure below shows a 10G Port Setup.

10G Fiber Port Setup

		<u> 8</u>	😒 🌍
LEDs	Port	Measurement	
	10G port profile	Default 🛛 🔻	
😑 Signal	Network Type	LAN 🔻	
0	Flow Control	Enable 🗸 🔻	
O Frame	Clock Source	Internal 🛛 🗸 🔻	
Pattern	Clock Offset (ppm)	0.0	
•	Link Fault Response	Disable 🗸 🔻	
ALM/ERR			LASER On/Off
History			
SFP+: 10G	Apply	Discard	

Port Setup

- Port Profile: Lock, Delete, Save, Save as..., Default, Last configuration
- Network Type: LAN
- Flow Control: Enable/Disable
 - When flow control is enabled, the test set will respond to pause frames received by the link partner by adjusting the transmit rate.
 - When flow control is disabled, the test set ignores all incoming pause frames from the link partner and continues transmitting at the configured transmit rate.
- Clock Source:

For one-way delay measurements between remote test units, the clock source should be set to 1PPS external, GPS 1PPS or Atomic 1PPS.

- Internal: The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
- External: 2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS
- **RxCLK**: The clock is derived from the received signal and the jitter of the incoming signal is suppressed.
- **GPS 1PPS**: The optional built-in GPS provides a (raw) 1PPS timing signal (clock) and is aligned to the standard second.
- Atomic 1PPS: The optional built-in Atomic Clock provides a stable 1PPS timing signal.
- Clock Offset (ppm): The clock for the transmitter is derived from the internal clock generator. Frequency offset: +/- 150 ppm with 0.1 ppm resolution.
- Link Fault Response: Enable/Disable

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17.3.3 Measurement Settings

10G Measurement Setup

			😥 🌍
LEDs	Port	Measurement	
	Profile	Default 🛛 🔻	
😑 Signal	Mode	Manual 🛛 🗸 🔻	
0	TX Start	Coupled 🛛 🔻	
O Frame	Results Auto Save	OFF 🛛 🔻	
Pattern	Maximum Number of Saved Events	128 🔻	
ALM/ERR History			LASER On/Off
SFP+: 10G			

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

- Profile: Last configuration, Delete, Save, Save as..., Default.
- Mode: Manual, timed, or auto mode are available.
 - 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 or Coupled. Configure how the measurements are started by separating or coupling the transmitter and receiver.
 - **Separated:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on; the transmitter must be turned on manually.
 - **Coupled:** Transmitter and receiver are turned on at the same time, and the measurements start at the same time at the start of the test.
- Results Auto Save: ON/OFF. When ON is selected, results are saved automatically.
- Maximum Number of Saved Events: 128, 256, 512, 1024. Maximum number of error and alarm events recorded during a test.

17.3.4 eCPRI Tests

After setting up test ports and configuring the measurements, tests are available from the **Throughput** and **Packet Capture** options on the **Home** page.

Actual screens my differ depending on the installed module.

eCPRI Home page



17.4 Throughput Testing

17.4.1 Setup

To access Throughput testing features, tap **Throughput** from the **Home** menu.

Overview:

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.

The Throughput application performs the following measurements:

- Throughput performance
- Frame Loss analysis
- Delay analysis
- Frame/Packet arrival analysis
- Received Traffic Type analysis
- Received Traffic Frame Size analysis.

On the transmit side, the Throughput application currently allows up to 32 streams with its MAC and IP address, VLAN tags (up to 3), bandwidth/rate, frame size, and L2 and/or L4 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.

eCPRI Throughput testing at Layer 2 and 4 is supported. Throughput can be configured to use either stress patterns or user defined test patterns to simulate various conditions. The test layer, frame header, traffic profile, error injection, and control settings of the farend device (if applicable) must be configured prior to testing.

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17.4.1.1 Frame Header Settings

The following parameters must be configured prior to performing a Throughput test:

- Layer 2:
 - Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field
 - A default or user configured Media Access Control (MAC) address is added to the frame
- Layer 4:
 - A default or user configured Media Access Control (MAC) address is added to the frame.
 - A default or user configured IP address is added to the frame.

Header Settings

Throughput Header Settings: Layer 2

	eCPRI	R		()	😥 🌍	
LEDs		Setup	Res	Results		
	Header	Traffic	General	Summary		
🖲 Signal	Profile		Last configuration	, ▼		
Erame	Stream #	1 of 1	Prev	Next		
- I Tame	Test Layer		Layer 2	V		
Pattern	Frame Type		Ethernet II(DIX)	LASER ONIOR		
	VLAN		1 tag	LASER ON/OH		
ALM/ERR						
History	MAC	VLAN eCPRI	Data	CRC		
		1		_		
SFP+: 10G					PCAP Start	

Throughput Header Settings: Layer 4

	eCPRI	Ø		(3)	
LEDs	S	etup	Res	ults	Start
	Header	Traffic	General	Summary	
😑 Signal	Profile		Last configuration	T T	
Frame	Stream #	1 of 1	Prev	Next	
U Traine	Test Layer		Layer 4		
Pattern	VLAN		1 tag	LASER ONOF	
	MPLS		1 tag	LASER OILOIL	
ALM/ERR	PROTOCOL				
History	MAC V L A N	M I U P P D L P	eCPRI Da	ta C R C	
SFP+: 10G	1				PCAP Start

- Profile: Load a previously configured test profile or create a new profile from existing settings.
- Stream #: Number of stream for which to configure the profile. Use the Prev and Next buttons to change streams.

Use the General tab to configure the total number of streams. See <u>General Throughput Settings (Global Configuration)</u> for more details.

- Test Layer: Select layer to perform the test. Layer 2 or 4.
- Frame Type: (Layer 2 only) Ethernet II (DIX); named after DEC, Intel, and Xerox, this is the most common frame type today.
- VLAN: Off, 1 tag, 2 tags, 3 tags (VLAN stacking is an option for Q-in-Q applications)
- MPLS (Layer 4 only): Off, 1 tag, 2 tags, 3 tags
- Protocol (Layer 4 only): UDP
- eCPRI, DATA, and CRC are selected automatically for Layers 2 and 4. IP is selected automatically for Layer 4 only.

The most common Ethernet Frame format, Type II

80 00 20 7A 3F 3E Destination MAC Address Source MAC Address 08 00 EtherType MAC Header (14 bytes) MAC Header (14 bytes) 08 00 00 Data (46 - 1500 bytes)	00 20 20 3A CRC Checksum (4 bytes)							
Ethernet Type II Frame (64 to 1518 bytes)								

MAC, VLAN, MPLS, IP, UDP, eCPRI, DATA, and RX Filter Test Pattern Configurations:

To configure the MAC addresses, IP addresses, VLAN 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.

Tap the **Apply** button at the bottom to save your selections to the current stream or **Apply to All** to save your selections to all streams.

- MAC Header Tab:
 - MAC Source: Use the default source address of the test set or configure a new or different address.
 Tap the Mac Source button at the bottom to populate the fields with default test port settings.
 For Layer 4 (IPv6) only: Tap the NDP Gateway and NDP buttons at the bottom to locate MAC addresses on the local network for the network address designated in the gateway.
 - MAC Destination: Configure the destination MAC address of the far-end partner test set.
 - Ethernet Type:
 - Layer 2: AE-FE (fixed)
 - Layer 4: Set to 0800-IP (fixed), or

select 8847-MPLS unicast or 8848-MPLS multicast if MPLS tagging is enabled.



Throughput Setup - MAC Layer 4

- VLAN Tab:
 - VLAN ID: Configurable in the range 1 to 4094.
 - Identifies the VLAN; used by standard 802.1Q.
 - It has 12 bits which allows the identification of 4096 (2¹2) 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 referring to the IEEE 802.1p priority.
- Indicates the frame priority level from 0 (lowest) to 7 (highest); 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, a drop eligibility flag will be set.



IEEE 802.1Q VLAN Tag in an Ethernet Frame

Throughput Setup - VLAN Tag configuration (Layer 4)



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• MPLS Tab (Layer 4 only):

• MPLS label: Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved).

Composed of 20 bits which allows for the creation of over one million labels.

• **CoS:** Configurable in the range 0 to 6.

This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS).

• S-bit: Configurable 0 or 1.

The S field is one bit in length and is used for stacking labels. This is important as it is used to indicate the last label RXT-6200_RXT6000e_Module_Manual Page 355 of 387

in the label stack.

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

Used to decrement the time-to-live counter.

	eCPRI			-	1×1			(3)	۵
LEDs	UDP			eCPRI			DATA	RX Filter	Start
	MAC			VLAN		MPLS		IP	
😑 Signal	Stream #		1	of 3			Prev	Next	
O Erama	MPLS #1	Label	=	0		S=	0		
O Frame		CoS=		0	T	TL=	128		
Pattern	MPLS #2	Label	=	0		S=	0		
		CoS=		0	Т	TL=	128		
ALM/ERR	MPLS #3	Label	=	0		S=	1		LASER On/Off
History		CoS=		0	T	TL=	128		
SFP+: 10G				A	pl	y to All			PCAP Start

Throughput Setup - MPLS configuration (Layer 4)

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- IP Tab: Configures the destination IP address, source address and header fields.
 - ∘ IPv4
 - IP Type: IPv4, IPv6
 - Source and Destination IP Address: The source address is fixed to the IP address from the IP setup menu.
 - Subnet: Subnet mask
 - Gateway: Address of the network gateway
 - 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. Indicates how many hops have been traversed. It will be decremented by 1 each time it crosses a hop.
 - **Do Not Fragment Flag:** Fragment offset byte configurable in the range 0 to 65.528.

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

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

Throughput Setup - IP Address Settings Layer 4 (IPv4 Legacy TOS)

	eCPRI	•	*	<u> (8</u>		
LEDS	UDP	eCPRI	DATA	RX Filter	Start	
	MAC	VLAN	MPLS	IP		
😑 Signal	Stream #	1 of 3	Prev	Next		
😑 Frame	IP Type		IPv4	IPv4 🗸		
	Source IP Addre	ss	192.168.0.10	192.168.0.10		
Pattern	Destination IP A	ddress	192.168.2.200	192.168.2.200		
•	Subnet		255.255.255.0	255.255.255.0		
ALM/ERR	Gateway		192.168.0.1	192.168.0.1		
History	IP TOS		DSCP	DSCP V		
Thistory	DSCP	011001	ECT 0	▼ CE 0 ▼		
	TTL		128	128		
	Do Not Fragmen	t Flag	0	o 🗸		
SFP+: 10G	Protocol		UDP - 0x11	UDP - 0x11		
	Apply to All	Apply	Ping	ARP	PCAP Start	

• IPv6

- IP Type: IPv6
- Source and Destination IP Address: 128-bit fields. The source address is fixed to the IP address from the IP setup menu.
- Traffic Class: 8-bit level used to designate priority handling of packets.
- Flow Label: 20-bit label used to identify packets for special handling.
- Next Header: 8-bit field to identify the type of header that immediately follows.
- Hop Limit: 8-bit field to designate the maximum number of hops from source to destination. Packet is discarded once number is decremented to zero.







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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• UDP Header Tab:

• Source Port: 16-bit fields used to identify the transmitter's and receiver's ports. Field has limit of 65,535.



Throughput Setup - UDP Settings Layer 4

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• eCPRI Header Tab:

- Protocol Rev.: eCPRI Interface Specification version used (version 1 is default).
- C:
- 0 = indicates last message
- 1 = indicates another eCPRI message follows
- **Message Type**: The following types of messages are allowable in eCPRI specifications ver. 1. The default is set to 5 for One-way latency measurements.
 - 0 = IQ Data
 - 1 = Bit Sequence
 - 2 = Real-Time Control Data
 - 3 = Generic Data Transfer
 - 4 = Remote Memory Access
 - 5 = One-way Delay Measurement
 - 6 = Remote Reset
 - 7 = Event Indication
 - 8 63 = Reserved
 - 64 255 = Custom

Throughput Setup - eCPRI Settings Layer 4

	eCPRI			(3)	🕗 🕞
LEDs	MAC	VLAN	MPLS	IP	Start
	UDP	eCPRI	DATA	RX Filter	
😑 Signal	Stream #	1 of 3	Prev	Next	
😑 Frame	Protocol Rev. C		1 0		
Pattern	Message Type		5		
ALM/ERR					LASER On/Off
History					
SFP+: 10G					PCAP Start

• **Data Tab:** Select a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). For both Layer 2 and 4 the following pattern is available:

• PRBS:

- 2E31 -1 (147 483 647-bit pattern used for special measurement tasks, [e.g., delay measurements at higher bit rates])
- 2²3 -1 (8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps)
- 2¹⁵ -1 (32 767 bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736 kbps)
- All 0's: Set to all zeros
- All 1's: Set to all ones
- User Defined: 2 bit field
- Invert: Normal or inverted
- Rx Live: Select checkbox to check that receiver is active and ready to receive data.

	eCPRI	\Rightarrow		(
LEDs	MAC	VLAN	MPLS	IP	Start
	UDP	eCPRI	DATA	RX Filter	
😑 Signal					1
😑 Frame	• PRBS 2E31	4 ⊡ Ir	ivert		
Pattern	PRBS 2E23	1 🛛 🖻 R	x Live		
A	PRBS 2E20	1			
ALM/ERR	PRBS 2E15	1			LASER On/Off
History	PRBS 2E9-1				
	All 0's				
	All 1's				
SFP+: 10G	🔵 User Define	d 0	0		
					PCAP Start

Throughput Setup - DATA Settings Layer 4

- **RX Filter Tab:** Filters incoming streams. When checked, the incoming traffic flows that do not match these criterion will not be considered for test results.
 - MAC Destination
 - MAC Source
 - VLAN
 - Ethernet Type
 - DSCP (Layer 4 only)
 - Protocol Type (Layer 4 only)
 - IP Destination (Layer 4 only)
 - IP Source (Layer 4 only)
 - Destination Port (Layer 4 only)
 - Source Port (Layer 4 only)
 - VLAN Eligible (Layer 4 only)

Throughput Setup - RX Filter Header Setup Settings Layer 4



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17.4.1.2 Traffic Settings (Per Stream Configuration)

Use the Traffic tab 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:
 - Multiple Streams: Constant
 - Single Stream: Ramp, Burst, or Single Burst
- Frame Size (Type): Fixed
- Frame Size (bytes): If a fixed frame size is chosen, this option is enabled to enter the frame size. Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 9k bytes.
- Constant Bandwidth: Configure the transmit rate for the stream. The parameters depend on the Traffic Flow selected.
 - Constant Traffic Flow: Constant Bandwidth
 - Ramp: Start BW, Stop BW, Step BW, Ramp Time, Repetitions
 - Burst: Burst 1 Bandwidth, Burst 1 Time, Burst 2 Bandwidth, Burst 2 Times
 - Single Burst: Single Burst Bandwidth

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

Throughput Traffic Settings
	eCPRI			()		
LEDs	Setup		Re	Results		
	Header	Traffic	General	Summary		
Signal	Stream #	1 of 3	Prev	Next		
Frame	Traffic Flow		Constant	V		
- France	Frame Size Typ	e	Fixed			
Pattern	Frame Size (byt	es)	130	Apply to All		
	Constant Bandv	vidth	33.333	%		
ALM/ERR					LASER On/Off	
History						
SFP+: 10G					PCAP Start	

17.4.1.3 General Throughput Settings (Global Configuration)

- # of Streams: Up to 32 streams.
- Stream #: Allocated Bandwidth per Stream: The total bandwidth for all streams cannot exceed 100%.
- Total (%): Sum of all stream rates in %.

Throughput General Setup

	eCPRI	-		(3)	
LEDs	Setup		Res	sults	Start
	Header	Traffic	General	Summary	
🔵 Signal	# of Streams		3		
O Eromo	Stream #1 (%)		33.333		
U Frame	Stream #2 (%)		33.333		
Pattern	Stream #3 (%)		33.333		
•	Total (%)		99.999		
ALM/ERR	Set All Stream Bar	ndwidth(%)	1.000	LASER On/Off	
History					
SFP+: 10G		Page	1 of 2 🕒		PCAP Start

Page 2 features One Way Delay 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.

	eCPRI	\rightarrow		3		
LEDs	Setup		Res	Results		
	Header	Traffic	General	Summary		
😑 Signal	Delay Measureme	nt Mode	One-Way			
O 5	RTD Unit Auto Sca	ale	ON	▼		
U Frame	Histogram			Enable 🗸 🗸		
Pattern	Sampling Period		1min			
~	Threshold (Max R	TD allowed)	100.00	us 🔻		
ALM/ERR	Save Histogram		Disable	LASER On/Off		
History						
History	SDT Measuremen	t	Enable	▼		
	SDT Violation Thr	eshold(us)	50000			
	SDT Measuremen	t Trigger(us)	50000			
SFP+: 10G		Page	2 of 2 🕒		PCAP Start	

Throughput General Setup - One Way Delay Service



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17.4.1.4 Error/Alarm Injection Settings (Per Stream Configuration)

Error injection and Alarm Injection can be performed during testing by tapping the **Setup Injection** button. The type of errors and error injection are configured in the Error Injection tab.

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

Error Injection Settings

- Layer: ETHERNET
- **Type:** Type of error: CRC, TCP/UDP Checksum, Pause, OOS, Missing Sequence, or Dup. Sequence. When Pause is selected, the unit will transmit a pause frame when the **Error Inj.** button is pressed.
- Behavior: How the errors will be injected: Single, Single Burst, or Rate.
- Pause Quanta: Field appears when Type is set to Pause. 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.
- Error Count: Field appears when Behavior is set to Single Burst.
- Error Rate: Field appears when Behavior is set to Rate.
- Stream #: The stream to configure.
- Layer: ETHERNET

Alarm Injection Settings

• **Type:** Type of alarm: Local Fault, Remote Fault, or Optical LOS. **Alarm Inj.** Button is pressed.

- Behavior: How the alarms will be injected: Continuous or Single Burst
- Optical LOS Lane Selection: Checkbox appears when Type is set to Optical LOS.



Throughput Error/Alarm Injection Setup

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17.4.1.5 Summary

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



Throughput Summary MAC List - Level 4

Throughput Summary IP List - Level 4

	eCPRI	-	+			3 😣	
LEDs		Setup			Results	Start	
	Header		Traffic	Genera	1 5	Summary	
😑 Signal	Port Li	st	Mpl	s List	Gatev	vay List	
🔵 Frame	MAC Li	ist IP		List	VLA	N List	
	# of Streams	Source II	P C	estination IP	Subne	t Mask	
Pattern	Stream #1	192.168.0	.10 1	92.168.2.200	255.25	5.255.0	
	Stream #2	::			:		
	Stream #3	::	:		:		LASER ON/OF
History							
SFP+: 10G	Src. to Dest.	Dest. to	Src.	Swap 🤇	Page	e 1 of 1 🕑	PCAP Start

Throughput Summary VLAN List - Level 4

	eCPRI				(()	
LEDs	Setup			Result	Start		
	Header	Tr	affic	Genera	վ	Summary	
😑 Signal	Port List		Mpl	s List	List Gateway List		
Frame	MAC List		IP List		VLAN List		
•	# of Streams		ID	Priority	Туре		
Pattern	vlan #1 of stream	1	12	3	8100	V	
	vian #2 of stream	1	12	3	88a8	V	ASER ON/OF
	vlan #3 of stream	1	12	3	88a8	V	LASER ONION
History	vlan #1 of stream :	2	135	3	8100	V	
	vlan #2 of stream :	2	12	3	88a8	V	
	vlan #3 of stream :	2	12	3	88a8	V	
SFP+: 10G			Page	1 of 2 🕨			PCAP Start

Throughput Summary MPLS List - Level 4

	eCPRI		\Rightarrow				
LEDs	Setup				Results		Start
	Header Tr		G	enera	l Summary		
😑 Signal	MAC List		IP List	List \		l List	
🔵 Frame	Port List		Mpls List		Gateway List		
Ŭ	Background	Lat	oel S	Cos	т	TL	
Pattern	mpls #1 of stream	1 0	0	0 0		28	
ALM/ERR	mpls #2 of stream	1 0	0	0	1:	28	ASER ON/OF
	mpls #3 of stream	1 0	1	0	128		LASER ON/ON
History	mpls #1 of stream	2 0	0	0	1:	28	
	mpls #2 of stream 2		0	0	1:	28	
	mpls #3 of stream	2 0	1	0	1:	28	
SFP+: 10G		۲	Page 1 of 2				PCAP Start

Throughput Summary Gateway List - Level 4

	eCPRI			<u></u>	😥 🖻	
LEDs	Se	tup	F	Results		
	Header	Traffic	General	Summary		
😑 Signal	MAC List	IP	List	VLAN List		
Frame	Port List MpIs		List Gateway List			
	# of Streams		Gateway			
Pattern	Stream #1		N/A			
	Stream #2		N/A			
	Stream #3		N/A	LASER ON/OH		
History						
		Page	1 of 1 🕒		PCAP Start	

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17.4.1.6 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.

✓ 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 eCPRI testing.
- After configuring test settings on both units, start the tests.

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17.4.2 Throughput Results

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

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17.4.2.1 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 (#)
- Transmit and Receiver rate (bps)
- Events (errors/alarms) associated with the stream

Throughput Results - Global Stream Summary

	eCPRI				
LEDs	Se	tup	Res	sults	Stop
	Glo	bal	Per St	Restart	
Signal	Stream Summary	Aggregate Signal	Errors Alarms Eve	ents Traffic Delay	
Frame	Stream	TX (bps)	RX (bps)	Last Event	TX Stop
Ŭ	1	3.333G	0.000K	No Event	Eth. Err Inj.
Pattern	2	3.333G	0.000K	No Event	Eth Alarm Ini
	3	3.333G	0.000K	No Event	
ALM/ERR			Histogram		LASER On/Off
History					
SFP+: 10G		40.0000	0.0001/		Setup Injection
	TOTAL	10.000G	0.000K		PCAP Start

The Aggregate screen displays these parameters:

- Line Rate (bps): 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

	eCPRI				(ک
LEDs	Setup		Resul	ts	Stop
	Global		Per Stre	am	Restart
😑 Signal	Stream Summary Ag	gregate Signal	Errors Alarms Event	s Traffic Delay	
Frame	ST:2018-10- 4 14:20:5	1	ET:00:22:12		TX Stop
•		тх	RX		Eth. Err Inj.
Pattern	Line Rate (bps)	10.000G	10.000G		Eth Alarm Ini
	Utilization (%)	100.00%	0.00%		Eur. Biarin Ing.
ALM/ERR	Utilization (bps)	10.00G	0.00K		LASER On/Off
History	Framed Rate (bps)	8.869G	0.000K		
Thistory	Data Rate (bps)	3.783G	0.000K		
	Total Frames	9410356654	0		
	Bad Frames	0	0		Setup Injection
SFP+: 10G	Pause Frames	0	0		Secup injection
					PCAP Start

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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

	eCPRI		(+			×	
LEDs	S	etup			F	Results		Stop
	Global			Per	Stream		Restart	
😑 Signal	Stream Summary	/ Aggre	gate <mark>S</mark>	ignal Er	rors Alarms E	Events Traffic	Delay	
🔵 Frame	14			Level [Rx]			TX Stop
	Rx Optical Power[dBm]			LOS		SAT	Eth. Err Inj.	
Pattern	TOTAL	-2.62	-2.63	-2.58	~30	_	+3	Eth. Alarm Inj.
ALM/ERR								LASER On/Off
History								
								Setup Injection
SFP+: 10G		•		Page 1	of ()			PCAP Start
				agei				ron Start

Throughput Results - Global Signal Page 2

	eCPRI	÷		🐼 🔕	🕗 🕞
LEDs	Setup		Res	ults	Stop
	Global		Per Str	Restart	
😑 Signal	Stream Summary Aggree	gate Signal Er	rors Alarms Eve	nts Traffic Delay	TY Chan
😑 Frame		Level [Tx]		TX Stop
	Tx Optical Powe	r[dBm] Min Max	LOS	SAT	Eth. Err Inj.
Pattern	TOTAL -1.74	-1.94 -1.60	-30	T 3	Eth. Alarm Inj.
ALM/ERR					LASER On/Off
History					
SFP+: 10G	0	Page 2	of 4 💿		Setup Injection PCAP Start

Throughput Results - Global Signal Page 3

	eCP	RI	÷	_	(3)	😥 🕞			
LEDs	Setup			Resu	Stop				
		Global		Per Stre	Restart				
😑 Signal	Stream								
Frame		Frequency							
0		Freq. (kHz)	Offset (ppm)	Min. (ppm)	Max. (ppm)	Eth. Err Inj.			
Pattern	Total	10312500	0.0	0.0	0.0	Eth. Alarm Inj.			
ALM/ERR						LASER On/Off			
History									
SFP+: 10G						Setup Injection			
			Page 3 of	4 💌		PCAP Start			

Throughput Results - Global Signal Page 4

		♦ 🤇		🕗 🕞
LEDs	Setup	Results		Stop
	Global	Per Stream		Restart
😑 Signal	Stream Summary Aggregate <mark>Si</mark>	<mark>gnal</mark> Errors Alarms Events Tr	affic Delay	
Frame	SFP Optica	I Module Information		TX Stop
•	Vendor	FINISAR CORP.		Eth. Err Inj.
Pattern	Part Number	FTLX1471D3BCV		
•	Serial Number	AVB1669		Eth. Alarm Inj.
ALM/ERR	ldentifier	[03h] SFP/SFP+/SFP28		LASER On/Off
	Bit Rate (Gbps)	10.3		
History	Wavelength (nm)	1310.0		
	Temperature	36.1 C		
	Voltage	3362 mV		
	Tranceiver Compliance (Hex)	00	Decode	Setup Injection
SFP+: 10G	•	Page 4 of 4 💿		PCAP Start

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

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

Throughput Results - Global Errors

	eCPRI	\rightarrow)	- 🙆 😣	😥 🖻
LEDs	Setup			Results	Stop
	Global		Pe	r Stream	Restart
🔵 Signal	Stream Summary Aggr	egate Signal	Errors Alarms	Events Traffic Delay	
Frame		Current		Total	TX Stop
•	FCS/CRC	0		0	Eth. Err Inj.
Pattern	IP Checksum	0		0	Eth. Alarm Inj.
0.414/500	TCP/UDP Checksum	0		0	
ALM/ERR	Jabber Frames	0		0	LASER On/Off
History	Runt Frames	0		0	
SFP+: 10G					Setup Injection PCAP Start

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

Throughput Results - Global Alarms

	eCPRI			<u></u>	
LEDs	S	etup	R	esults	Stop
	Glo	bal	Pers	Stream	Pastart
😑 Signal	Stream Summary	Aggregate Signal	Errors Alarms E	vents Traffic Delay	Kestart
Frame		Current	Total		TX Stop
U France	LOS (us) 0		0	Eth. Err Inj.	
0.0	Link Down (us)	0	0		
O Pattern	Local Fault	0	Remote Fault	0	Eth. Alarm Ini.
	Service Disruptic	on (us)			
ALM/ERR	Current	N/A	Total	N/A	LASER On/Off
	Last		0	2012	
History	Min/Max	0	0		
	No. of Occurrenc	es	0		
	No. of SDT Violat	ions	0		
	IPG Trigger Events		0		
	IPG Trigger Meas	surement(us)	0	Setup Injection	
SFP+: 10G		SDT	Reset	PCAP Start	

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

Throughput Results - Global Events

	eCPRI		>	(<u> </u>	
LEDs	Set	up		Result	s	Stop
	Glob	al		Per Strea	m	Restart
😑 Signal	Stream Summary A	Aggregate Signa	Errors /	Alarms Events	Traffic Delay	
🔵 Frame	Time	Event Type		# of Events	Test	TX Stop
•	2018-10-4 14:20:51	Test Started			Global	Eth. Err Inj.
Pattern						Eth. Alarm Inj.
ALM/ERR						LASER On/Off
History						
SFP+: 10G		• Р:	age 1 of 1	•		Setup Injection PCAP Start

The Global Traffic screen displays:

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



Throughput 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

Throughput Results - Global Traffic Details

	eCPRI	\Rightarrow	<u></u>	3 🕗 🕒
LEDs	Frames	Traffic Type	Frame Size	Stop
	RX Frames	#	%	Pactart
😑 Signal	Total	0	100	
0.5	Test	0	0	TX Stop
Frame	VLAN	0	0	Eth. Err Inj.
Pattern	VLAN Stack	0	0	
•	MPLS	0	0	Eth. Alarm Inj.
ALM/ERR	MPLS Stack	0	0	LASER On/Off
	Non-Test	0	0	
History	TX Frames	#		
	Total	9092076782		
	Pause Frames	тх	RX	Setup Injection
SFP+: 10G	Total	0	0	
				PCAP Start

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
- 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

Throughtput Results - Global Delay

	eCPRI		>		🕗 🕞				
LEDs	s	etup		Results	Stop				
	Global		Pe	Restart					
🗿 Signal	Stream Summary	Stream Summary Aggregate Signal Errors Alarms Events Traffic Delay							
Frame	Frame Arrival Tin	Frame Arrival Time							
•	Current	N/A	Average	N/A	Eth. Err Inj.				
Pattern	Minimum	N/A	Maximum	N/A	Eth. Alarm Inj.				
0.000	Frame Delay Vari	ation							
ALM/ERR	Average		N/A	LASER On/Off					
History									
SFP+: 10G					Setup Injection PCAP Start				

17.4.2.2 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. One Way Delay measurements are only available in the per-stream results screen.
- Rates: Rate information associated with each stream.

	eCPRI			ł					🕗 🕞
LEDs	5	Setup				R	esults		Stop
	GI	lobal			Per Stream				Restart
🔵 Signal	Summary	Errors	SDT	Events	Tra	affic	Delay	Rates	
🔵 Frame	VLAN ID: N/A		Stream	# 1	of 3		Prev	Next	TX Stop
	ST:2018-10- 4 14	:20:51		ET:0	0:37:33	3			Eth. Err Inj.
Pattern		1	гх		RX				Eth Alarm Ini
	Utilization (%)	3	33.333%		0.000%				
ALM/ERR	Utilization (bps)	3	3.333G		0.000K				LASER On/Off
History	Framed Rate (bp	ps) 2	2.889G			0.000	ĸ		
Thistory	Data Rate (bps)	8	M088.888			0.000	ĸ		
	# of Bytes 81355379		135537920	90		0			
	Total Frames	6	258106093			0			Setup Injection
SFP+: 10G	Bad Frames	0)			0			Serah ullection
									PCAP Start

Throughput Results - Per Stream Summary

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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: Number of frames lost from receiver
- Frame Loss %: Percentage of total frames that were lost
- OOS: Out of Service errors
- Duplicate Sequence

1= eCPRI Setup Results Stop LEDs Per Stream Restart 🔵 Signal Traffic Delay Summary Errors TX Stop VLAN ID: N/A 1 of 3 Stream # Prev Next 🔵 Frame Current Total Eth. Err In FCS/CRC Pattern 0 th. Alarm Inj IP Checksum 0 ALM/ERR ASER On/O TCP/UDP Checksum Jabber Frames 0 History Runt Frames 0 0 Frame Loss No Test Traffic No Test Traffic 0.00% Frame Loss % etup Injectio SFP+: 10G 005 No Test Traffic 0 PCAP Star No Test Traffic Dup. Sequence

Throughput Results - Per Stream Errors Page 1

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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.

Throughput Results - Per Stream SDT

	eCPRI		-	ł				🕗 🕞
LEDs		Setup			F	Results		Stop
		Global			Per Stream			Restart
😑 Signal	Summary	Errors	SDT	Events	Traffic	Delay	Rates	
Frame	VLAN ID: N/A		Stream #	1	of 3	Prev	Next	TX Stop
•	Service Disru	uption(us)						Eth. Err Inj.
Pattern	Current			0				
the second second	Total			0				Etn. Alarm inj.
ALM/ERR	Last			0	0			LASER On/Off
	Min/Max	0			0			
History	No. of Occurr	rences		0				
	No. of SDT V	iolations		0				
	IPG Trigger E	Events		0	0			
	IPG Trigger N	Neasureme	nt(us)	0				Setup Injection
SFP+: 10G			SD	T Reset				PCAP Start

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

	eCPRI) 🚫	🕗 🕞
LEDs		Setup			Re	sults		Stop
		Global			Per S	tream		Restart
Signal	Summary	Errors	SDT E	vents	Traffic	Delay	Rates	
😑 Frame	VLAN ID: N/A		Stream #	1 of	3 F	Prev	Next	TX Stop
	Time	E	vent Type		#ofEven	nts Tes	t	Eth. Err Inj.
Pattern								Eth. Alarm Inj.
ALM/ERR								LASER On/Off
History	-							
	-							
								Setup Injection
SFP+: 10G			Pa	ge 1 of 1	٢			PCAP Start

Throughput 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.

Throughput 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.

	eCPRI		4					
LEDs		Setup			Re	sults		Stop
	G	Global			Per Stream			Restart
😑 Signal	Summary	Errors	SDT E	vents	Traffic	Delay	Rates	
Frame	VLAN ID: N/A		Stream #	1 0	of 3 🛛 📕	Prev	Next	TX Stop
-	Frame Arrival T	rame Arrival Time						Eth. Err Inj.
Pattern	Current	N/A		Avera	ige	N/A		Eth. Alarm Inj.
A	Minimum	N/A		Maximum N/A		N/A		
ALM/ERR	Frame Delay Va	ariation						LASER On/Off
History	Average			N/A				
	One-Way Delay	r	Histogran					
	Current	N/A		Avera	ige	N/A		
	Minimum	N/A		Maxin	num	N/A		Setup Injection
SFP+: 10G								PCAP Start
								Pohr Start

Throughput Results - Per Stream Delay

Throughput Results - Per Stream Delay - Histogram

	eCPRI) 🔕 🙆 🕒
LEDs	Setup	Results	Stop
	Global	Per Stream	Restart
🔵 Signal	Summary Errors SDT	Events Traffic Delay	Rates
🔵 Frame	VLAN ID: N/A Stre	am# 1 of 3 Prev	Next IX Stop
	Table -	- 🕂 Close	Eth. Err Inj.
Pattern	100		Eth. Alarm Inj.
ALM/ERR	One		LASER On/Off
History	Way		
	(us)		
	0		
SFP+: 10G	041018 041018 14:20:52 14:30:52	041018 2 14:40:52	041018 14:50:52
		→ →	PCAP Start

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



Throughput Results - Per Stream Rates

Throughput Results - Per Stream Rate Details

	eCPRI		<u></u>	🕗 🕞
LEDs		Rate Details		Stop
	Frames/sec	тх	RX	Bostart
😑 Signal	Current	2777750	0	Restart
~ -	Minimum	2777750	0	TX Stop
Frame	Maximum	2777750	0	Eth. Err Ini.
Pattern	Average	2777750	0	
0	Data Rate (Mb/s)	тх	RX	Eth. Alarm Inj.
ALM/ERR	Current	888.880M	0.000K	LASER On/Off
	Minimum	888.880M	0.000K	
History	Maximum	888.880M	0.000K	
	Average	888.880M	0.000K	
SFP+: 10G				Setup Injection PCAP Start

17.4.3 Saving Throughput Results

After stopping the test, save the results by pressing the Save button on the platform's keypad.

A window will open giving the option of namingx 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 test unit's platform manual for more information.

C Signal	Save result as 20121026_144542										Start
O Frame	1	2	3	4	5	6	7	8	9	0	
Pattern	q	w	e	r	t	У	u	-i	•	P	
ALM/ERR	a	S	d		f	9	h	j	k	1	
History	Caps	z	×		c I	ь	v	n	m	Shift	LASER ON/Off
		Symb	ol	Del	@	•	Del	All	<-		
				SP	ACE				Ap	ply	

Throughput Results Save

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17.5 Packet Capture

17.5.1 Packet Capture Setup

The packet capture function can be used to capture packets to eCPRI test ports. The packet capture format is compatible with Wireshark and can be viewed on the unit or 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 (64, 128, 192, 256).

	eCPRI	<u> (8</u>	🕗 🕞
LEDs	Se	Start	
	Capture Mode	Filter	
😑 Signal	Profile	Default 🗸 🔻	
Frame	Mode	Automatic 🛛 🗸 🔻	
U France	Buffer Size	2М 🔻	
Pattern	Truncate	Whole 🔻	
ALM/ERR			
History			
SFP+: 10G			

Capture Mode Setup

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Select from the following Filter options:

eCPRI Mode

- Mode: eCPRI. Only traffic frames matching the source and destination addresses are captured.
- Layer: Layer 2 or Layer 4
- Message Type: Enable or Disable
- **Message Type Value**: (Field appears when Message Type is set to Enable.) The default is set to 5 for One-way latency measurements.

The following types of messages are allowable in eCPRI specifications ver. 1.

- 0 = IQ Data
- 1 = Bit Sequence
- 2 = Real-Time Control Data
- 3 = Generic Data Transfer
- 4 = Remote Memory Access
- 5 = One-way Delay Measurement
- 6 = Remote Reset
- 7 = Event Indication
- 8 63 = Reserved
- 64 255 = Custom

	eCPRI	<u> (8</u>	
LEDs	Se	tup	Start
	Capture Mode	Filter	
🗿 Signal	Mode	eCPRI 🗸 🗸	
O Frame	Layer	Layer 4 🛛 🔻	
U I I ame	Message Type	Enable 🗸 🔻	
Pattern	Message Type Value	5	
ALM/ERR			
History			
SFP+: 10G			

Tap the Start button to begin packet capture. A message appears showing the number of packets being captured.



Packet Capture In Progress

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17.5.2 Packet Capture Results

To finish packet capture and manage packet capture results, press **Stop**. A message appears showing the number of packets captured and the filename to which the results were saved on the test unit. Results are saved in PCAP format and are automatically named.

Packet Capture Save

	eCPRI			(3)					
LEDs		Start							
		Capture Mode	Filte	ər					
🔵 Signal	Profile Mode	Packet Ca	apture	V					
😑 Frame	Buffer Size	uffer Size Packet Capture accomplished!							
Pattern	Truncate	Packet Num: 143/143	ım: 143/143						
ALM/ERR History		Result Saved as:201010	02_094123.pcap						
		ок	\supset						
SFP+: 10G									

Viewing Packet Capture Results

When viewing results, Wire shark will launch 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. For more information on viewing and exporting files, see the RXT-1200 User Manual on <u>www.veexinc.com</u>.

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.

☆																								•	Deco	ode As)
No.	Time	e		S	our	ce						Des	stin	atic	n			P	rotoco	Lengt	Info						
	0.00	000	0	19	92.1	168.	0.14	47				255	5.2	55.2	255.2	255		D)B-L	221	Dropb	ox LAN	V sync	Disc	overy	Proto	
2	0.00	167	1	19	92.1	168.	0.14	47				192	2.1	68.0	0.255	5		D)B-L	221	Dropb	ox LAN	V sync	Disc	overy	Proto	
3	0.00	212	0	19	92.1	168.	0.14	47				255	5.2	55.2	255.2	255		D)B-L	221	Dropb	OX LAN	V sync	Disc	overy	Proto	
4	0.24	420	7	00	0:90):a9	:b8:	07:	f0			ff:ff	:ff:f	ff:ff:	ff			- Ir	ntel	68	Seque	nce: 7	58301	l, Se	nder	ID 2, 1	F
•																											
⊞- Int ⊞- Us ⊞- Dro	ume Ethernet II, Src: ac:81:12:22:c3:2d (ac:81:12:22:c3:2d), Dst: ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff:ff																										
0080	3a 20	22 2	22 2	2c 2	20 2	22 7	0	6f	72	74	22	3a	20	31	37	: '	", "F	o or	rt": 17								
0090	35 30	30 2	2C .	20 2	22 (be 6	51 (6d	65	73	70	61	63	65	73	500), "na	a me	espaces								
0000	22 3a	20 :	50 .	3/ 3	33 3	34 3	SI .	37	33	37	39	32	2C	20	38		[/34]	L /3	3/92, 8 2061771								
0000	21 26	34 3	20.	30 3	20 3	20 2	20 .	20	37	32	20	31	37	37	26	16	, כסכס: המד	, / 	201//1								:::
0000	20 28	20 2	20 .	21 2	20 2	21 5	. eo	52 7d	05 05	59 c1	30	20	20	22	20	0.00	7005	9 23 1 1	75	,							
0000	33 30			51 3			,u	/u	00		57					305	,5191)	1 7.									•
2017	/0922_0	0941	23.	pca	р				Pa	acke	ets:	143	B Di	spla	ayed	143	Mark	ed:	0 Load	time: (0:0.39					×	

Packet Capture Results on Wireshark

Top section:

- Time
- Source
- Destination
- Protocol

Length

• Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

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18.0 Profiles

Profiles can be created in any application that has a "Profiles" drop-down menu available. The SDH, OTN, Ethernet applications all have the ability to save profiles.

Profile autosave ▼ Stop LED'S 🦳 Signal Profile autosave 🔵 Frame autosave tx10gp1 Pattern OTNSTS1DS1 Save ALM/ERR Save As Delete Tools Utilities Files

Profiles can be viewed and loaded in the Profiles folder located in the Files folder structure.

Accessing and Configuring Profiles

To access the Profiles menu from the **OTN/SDH/SONET** Testing main menu, tap on the following icons: **Advanced Mode** > **Profiles**. To save a new profile from the PDH or SDH applications mentioned above, select the **Save as** dropdown option. This will bring up an alphanumeric keypad to name the profile. When the profile is saved, all of the test configurations that apply to the particular application are saved. This allows for fast access to preconfigured test configurations.

Alphanumeric keypad

e LEDs	Need title	for this			filo1	Start
X Tools					IIIeI	ВІТ
Utilities	1 2	3 4	5 6 7	8	9 0	34M AIS
Files	q w	e r	t y ı	i i	ор	Alarm/Err
	a	s d f	g h	i	k I	
	Caps	z x c	b v	n	m Shift	
	S	ymbol Del	@ . D	el All 🛛 <	-	
		SPA		Apply		

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19.0 Common Functions

Please refer to the <u>RXT-1200 Platform Manual</u> for the following functions:

- IP Tools: Ping, Trace Route
- Net Wiz
- WiFi Wiz
- Advanced Tools
- Utilities
- Files
- R-Server
- Backlight
- VeExpress
- M.Upgrade

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20.0 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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21.0 Product Specifications

The most recent product specifications can be found on the VeEX web site at <u>www.veexinc.com</u>.

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22.0 Certifications and Declarations



What is CE?

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.

Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.



ROHS Statement

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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.

For more information about RoHS as it relates to VeEX Inc, go to the VeEX web site at <u>www.veexinc.com/RoHS</u>

23.0 About VeEX

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

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

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Customer Care

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

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