USER MANUAL

RXT-6400

400G Module for RXT-1200 Platform

Please direct all questions to your local VeEX Sales Office, Representative, or Distributor. Or, contact VeEX technical support at www.veexinc.com.

Table of Contents

Go back to top

1.0 About This User Manual

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

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

For more technical resources, visit the VeEX Inc. web site at www.veexinc.com. For assistance or questions related to the use of this product, call or e-mail our customer care department for customer support. Before contacting our customer care department, have the product serial number and software version ready. Please go to the Basic Operations section for details on locating the unit serial number in the menus or locate the serial number on the back of the chassis. Please provide this number when contacting VeEX customer service.

Customer Care:

Phone: + 1 510 651 0500

E-mail: customercare@veexinc.com

Website:www.veexinc.com

Go back to top

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

1. Deactivate the laser before connecting or disconnecting optical cables or patchcords.
2. Never look directly into an optical patchcord or an optical interface (e.g. CFP, CFP2, CFP4, QSFP+, SFP+, SFP, OTDR, LS, VFL) while the laser is enabled. Even though optical transceivers are typically fitted with Class 1 lasers, which are considered eye safe, optical radiation for an extended period can cause irreparable damage to the eyes.
3. Never use a fiber microscope to check the optical connectors when the laser source is active.

Electrical Connectors

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

Safe Module Handling

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

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

Lithium-ion Battery Precautions

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

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

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

- Always charge the unit's battery pack inside the test platform battery bay using the AC/DC adapter supplied by VeEX.
- Do not charge or use the battery pack if any mechanical damage is suspected (shock, impact, puncture, crack, etc).
- Do not continue charging the battery if it does not recharge within the expected charging time
- Storage: For long term storage, the battery pack should be stored at 20°C/68°F (room temperature), charged to about 30 to

50% of its capacity. Spare battery packs should be charged and used at least once a year to prevent over-discharge (rotate them regularly).

- It is recommended to charge and use battery packs at least every three months. Battery packs must not go without recharging (reconditioning) for more than six months.
- After extended storage, battery packs may reach a deep discharge state or enter into sleep mode. For safety reasons, Li-ion batteries in deep discharge state may limit the initial charging current (pre-recharge) before starting their regular fast charging cycle. The pre-charging state may take several hours.
- Air transportation of Li-ion batteries is regulated by United Nations' International Air Transportation Association (IATA) Dangerous Goods Regulations and by country-specific regulations. Please check local regulations and with common carriers before shipping Li-ion battery packs or products containing relatively large Li-ion battery packs.

Electrical Connectors

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

ESD: Electrostatic Discharge Sensitive Equipment

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

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

Go back to top Go back to TOC

3.0 Introduction

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

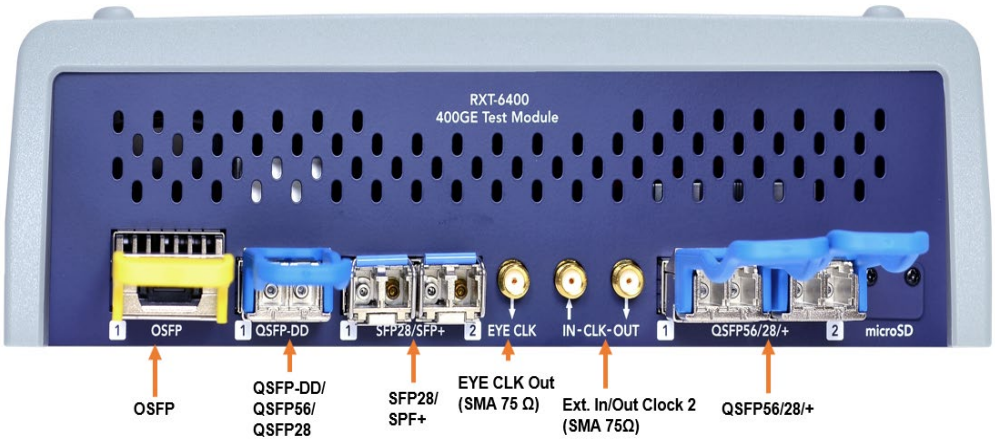
Platform Highlights

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

Go back to top Go back to TOC

3.1 Connector Panels & Test Ports

RXT-1200 with RXT-6400 blade



Go back to top Go back to TOC

4.0 RXT Operations

4.1 Basic Operations

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

4.2 Utilities

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

4.3 Setup

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

Go back to top Go back to TOC

5.0 Ethernet

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

5.1 Ethernet Setup

5.1.1 Test Port Selection

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

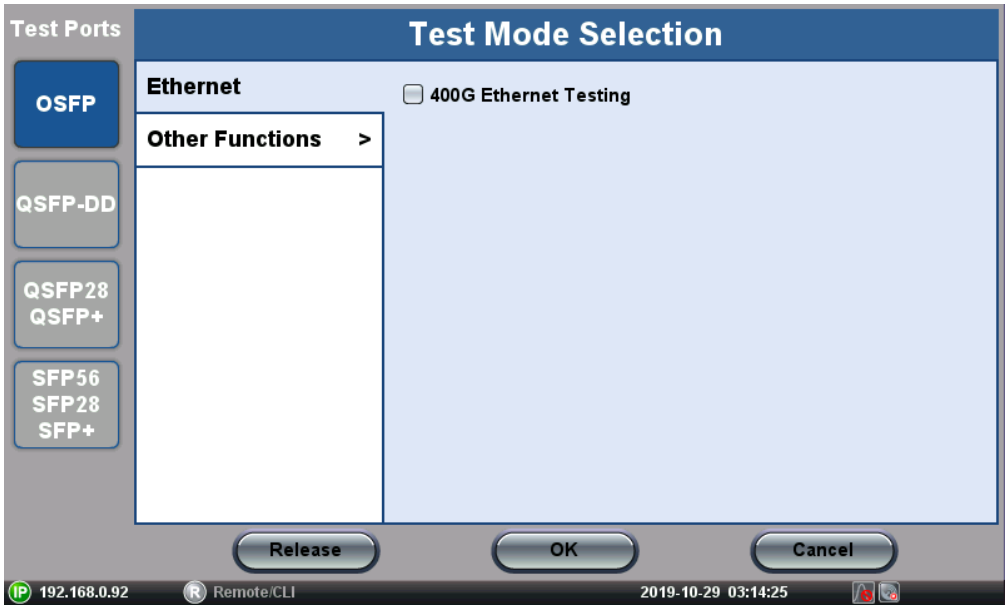
Ethernet test modes are accessed by selecting the Test Application button at the top of the screen  . Tap on a technology group then select a test interface. Depending on interface options purchased, the following selections are possible:

Single/dual port combinations present on RXT-6400:

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

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

Test Mode Selection RXT-6400



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

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

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

Go back to top Go back to TOC

5.1.2 Port Setup

Port setup or test interface configurations are accessed via the Setup menu located on the Home page. The available configuration settings depend on the interface selected in the Test Mode selection.
Select the operation mode and the interfaces that will be used to carry out tests. Once the operating mode and interfaces are selected, independently configure the auto-negotiation, speed, duplex, and flow control settings for each port (where applicable). After configuring settings, tap **Apply** to save changes. Tap **Discard** to revert to previous selections.

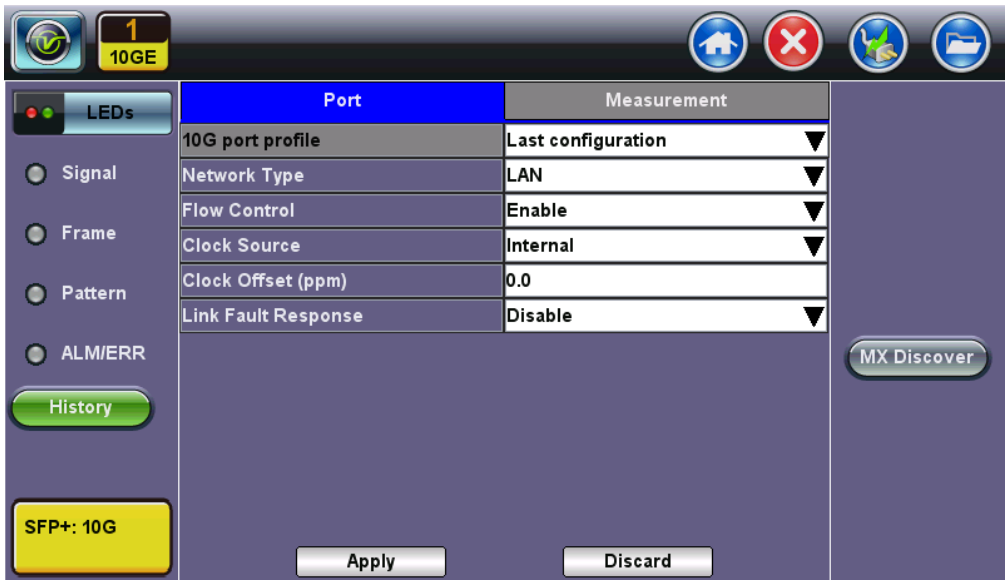
Ethernet Home Menu

1GE Fiber Port Setup

1 GE Fiber Port

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

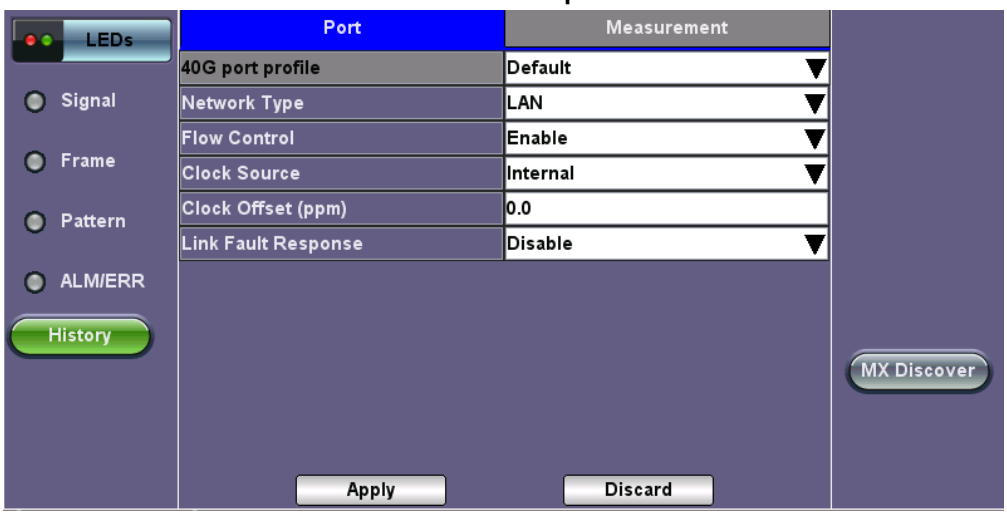
10 GE Setup



10 GE Port

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

40 GE Setup



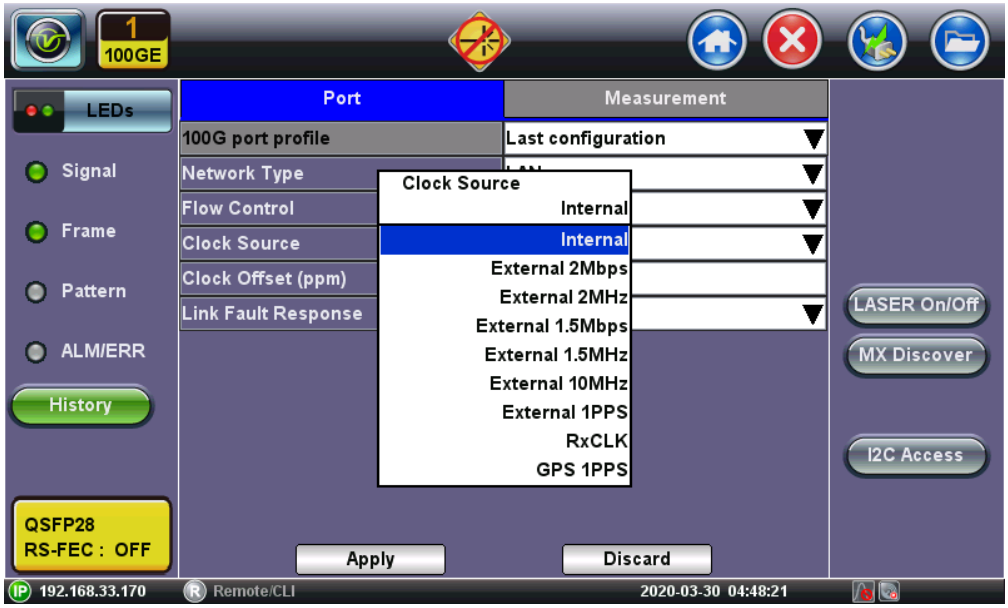
40 GE Port

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

Go back to top Go back to TOC

100 GE Setup

Setup Clock Source

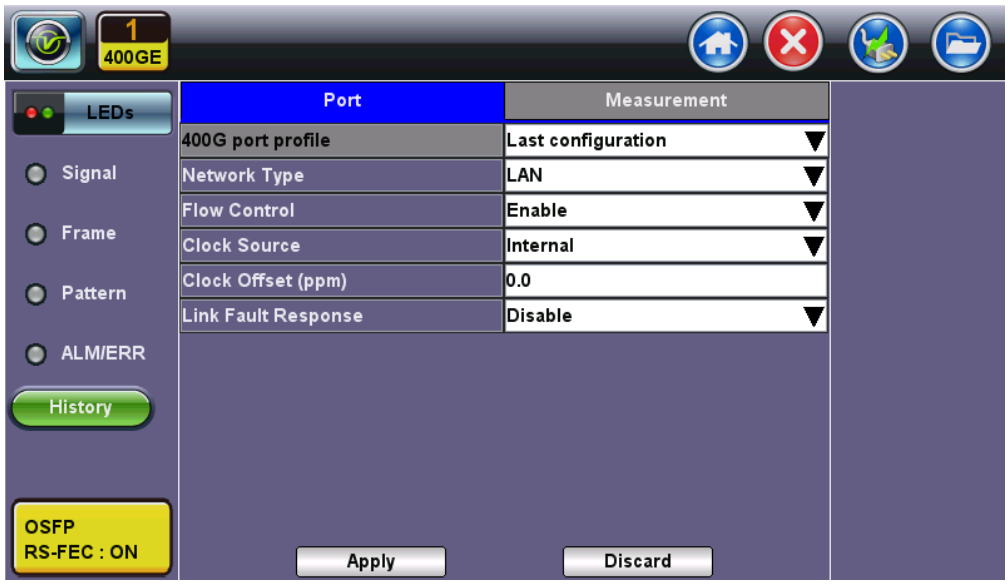


Clock Offset

100 GE Port

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

400 GE Setup



400 GE Port

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

Go back to top Go back to TOC

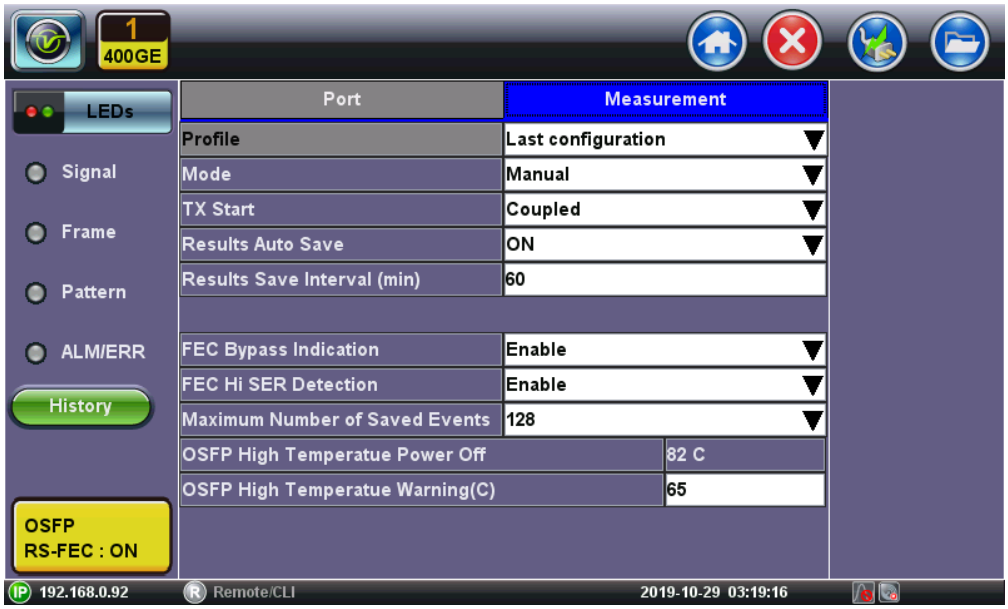
5.1.3 Measurement Settings

1GE/10GE/100 GE Measurement Setup

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

- **Profile:** Last configuration, Lock, Delete, Save, Save as..., Default.
- **Mode:** Manual or timed
  - **Manual mode:** User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start:** Tx & Rx, or Tx Separate. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - **Tx & Rx:** Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.
  - **Tx Separate:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on -- the user must start the transmitter manually.
  - **Tx Coupled:** Transmitter and receiver are turned on at the same time, and the Tx and Rx measurements start at the same time at the start of the test.
- **ToD Synchronization Source:** Disable, GPS 1PPS
- **Results Auto Save:** Off/On
- **Maximum Number of Saved Events:** 128/256/512/1024

400 GE Measurement Setup



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

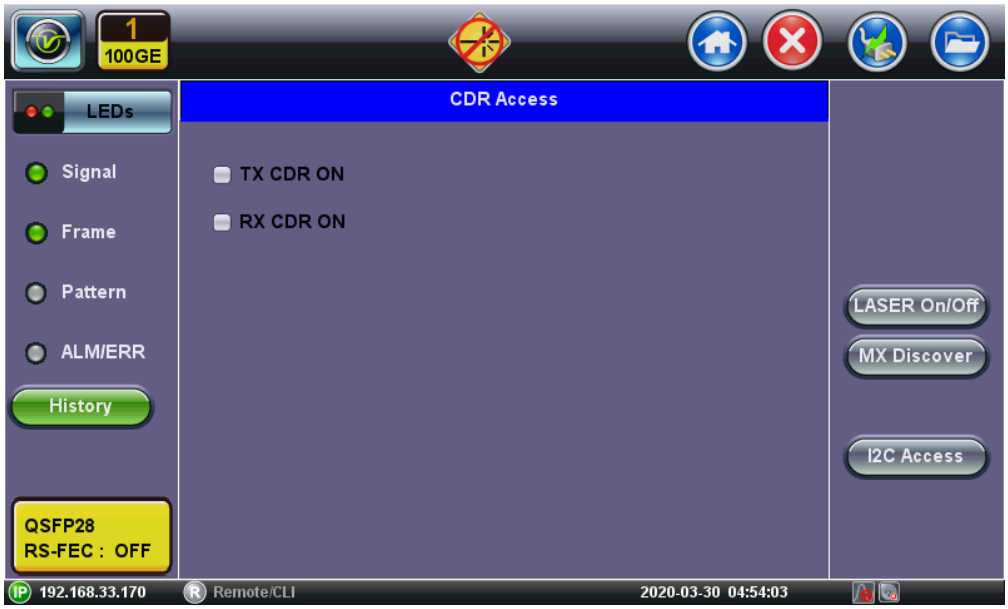
- **Profile:** Last configuration, Lock, Delete, Save, Save as..., Default.
- **Mode:** Manual or timed
  - **Manual mode:** User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test; after the test is started, the test will run for the configured duration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

Go back to top Go back to TOC

5.1.4 CDR Access

(100GE Only)

CDR Access



Enables TX and RX CDR to be turned on

Go back to top Go back to TOC

5.1.5 I2C Access

I2CAccess

- **Transceiver I2C (MDIO) Register Read/Write**
  - Module information, settings, status and control
  - Reconfigure the PHY and monitor status

5.1.6 Pre-emphasis

Pre-emphasis

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

Go back to top Go back to TOC

5.2 IP

5.2.1 IP Connection

Port setup and IP connection are required prior to performing the following Ethernet applications: Ping, Trace Route, Web/FTP, ARPWiz, VoIP, IPTV testing, and 1588v2 (except Layer 2).

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

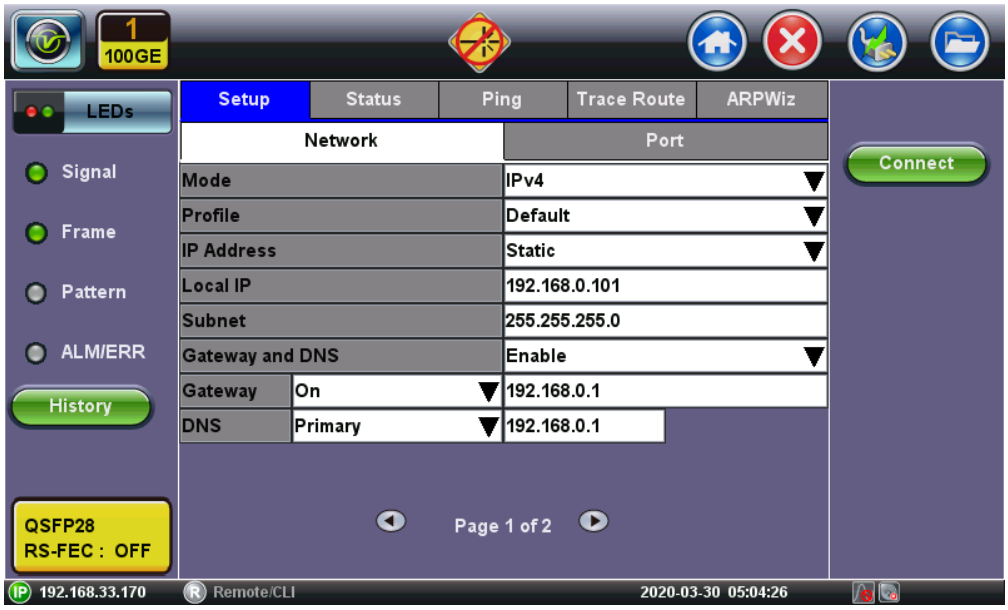
5.2.1.1 Setup

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

Point-to-Point Protocol over Ethernet (PPoE)

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

IP Setup-IPv4



IPv4 or IPv6

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

Go back to top Go back to TOC

5.2.1.2 Status

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

IP Setup-IPv4

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

Go back to top Go back to TOC

5.2.2 Trace Route

Trace Route is a common method used to find the route to the destination IP address or URL. Refer to **Trace Route** in the **TX300S, MTTplus, RXT-1200, or UX400 platform manuals** for more information on this feature including setup and results.

Go back to top Go back to TOC

5.2.3 ARP Wiz

ARP Wiz uses the Address Resolution Protocol (ARP) to verify the status of each IP address in a user-selectable IP range. It is the standard method for finding a host's hardware address when only its network layer address is known. Refer to **ARP Wiz** in the **TX300S, MTTplus, RXT-1200, or UX400 platform manuals** for more information on this feature including setup and results.

Go back to top Go back to TOC

5.2.4 Ping

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

Go back to top Go back to TOC

5.3 BERT

5.3.1 BERT Setup

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

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

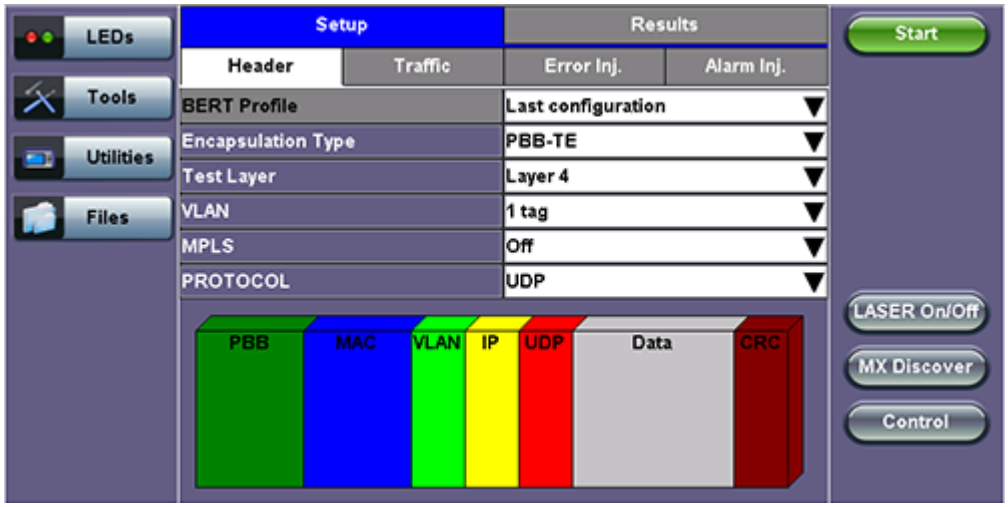
- **Layer 1:** Unframed mode (fiber ports only) or Framed mode
  - **Unframed mode:** Test traffic consists of a bit stream of the selected test pattern
  - **Framed mode:** Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field

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

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

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

BERT Setup - Header (Layer 4)



Go back to top Go back to TOC

5.3.1.1 Header Settings

- **BERT Profile:** Load a previously configured test profile or create a new profile from existing settings.
  Please see **6.0 Profiles** in the **ReVeal MTX300 manual** for more details on how to create new profiles using ReVeal software.

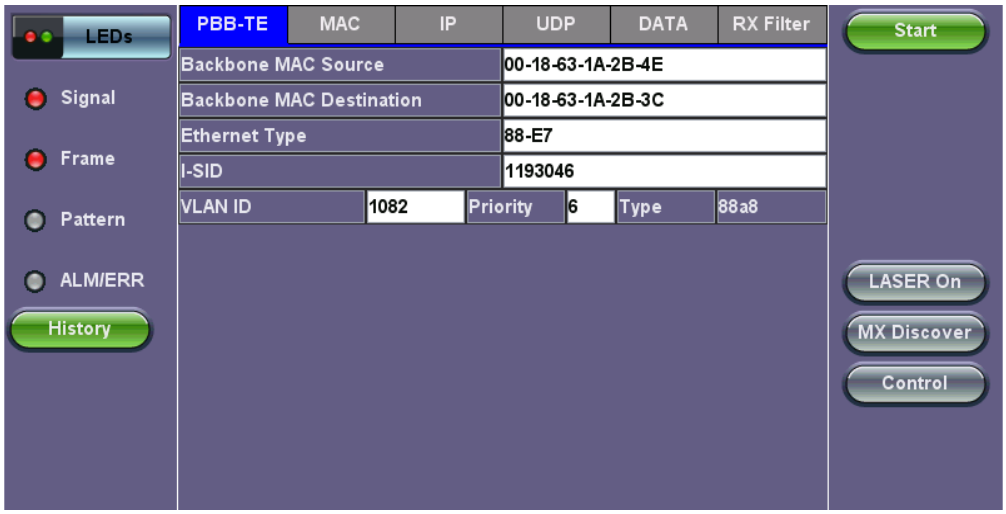
- **Encapsulation Type:** None, MPLS-TP, or Provider Backbone Bridge (PBB-TE). Provider Backbone Bridge MAC-in-MAC (IEEE 802.1ah) encapsulation are configured trunks that add resiliency and configurable performance levels in the provider backbone network. Available for 1GE Copper/Fiber and 10GE port.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

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

  - Backbone MAC Source
  - Backbone MAC Destination

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

PBB



- **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

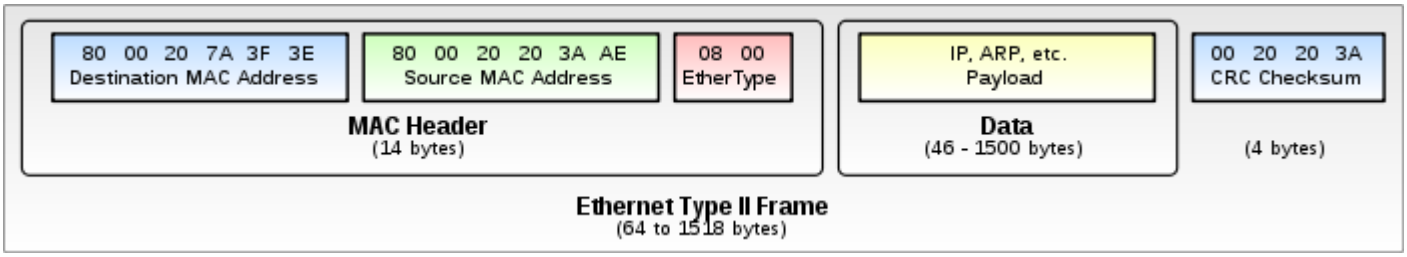
- **VLAN:** Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications)

    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



Go back to top Go back to TOC

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

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

- **MAC Header Tab:**

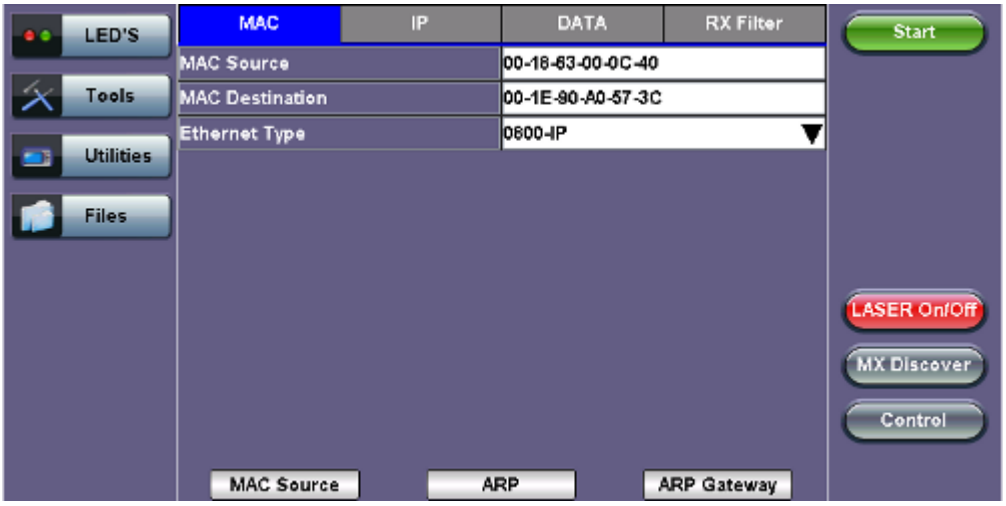
MAC Source: Use the default source address of the test set or configure a new or different address.

- **MAC Destination**: Configure the destination MAC address of the far-end partner test set or use the ARP or ARP GW keys to determine the MAC address of the destination IP address (ARP) or the Gateway (ARP GW).

  A valid IP connection needs to be up to use these functions. Refer to RXT-1200 Platform Manual Chapter 7_Tools>IP Tools.
- **Ethernet Type:** For Layer 3 testing, the user can also configure the Ethertype:
  - 0800-IP (Internet Protocol Version 4, IPv4)
  - 0600-Xerox
  - 0801-X.75 (X.75 Internet)
  - 0805-X.25 (X.25 Level 3)
  - 0806-ARP (Address Resolution Protocol [ARP])
  - 8035-RARP (Reverse Address Resolution Protocol [RARP])
  - 8137-IPX (Novell IPX)
  - 814C-SNMP
  - 8847-MPLS unicast
  - 8848-MPLS multicast
  - 86DD (Internet Protocol, Version 6 [IPv6]) - Future Release

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

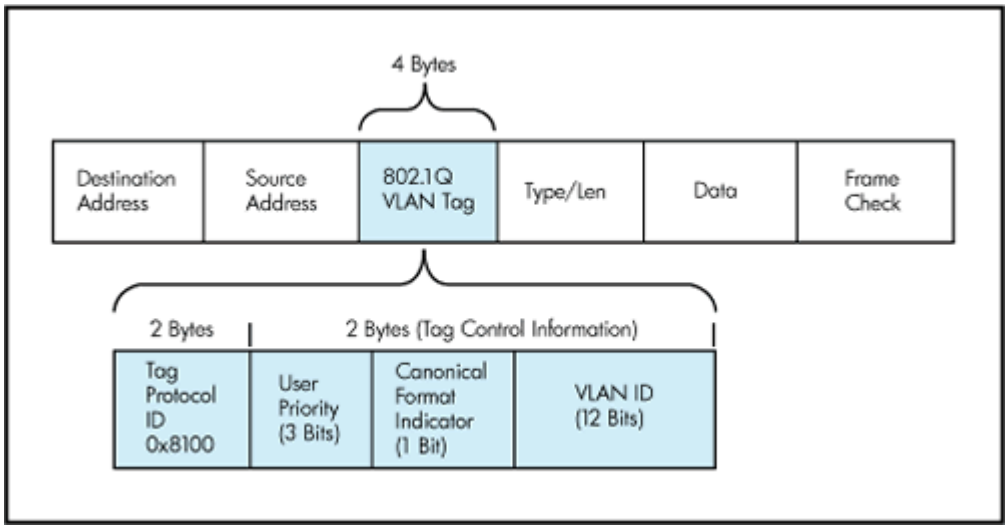
BERT Setup - MAC address settings (Layer 3)



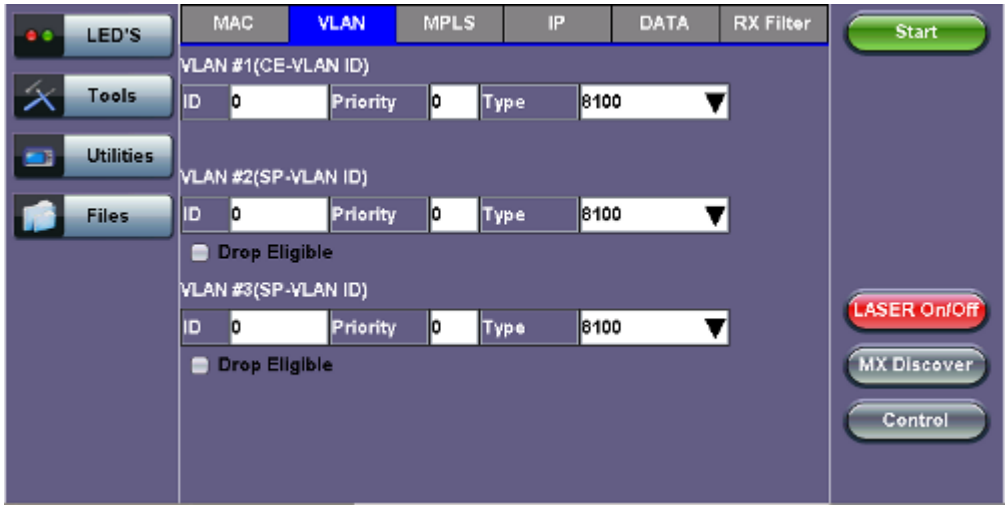
Go back to top Go back to TOC

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



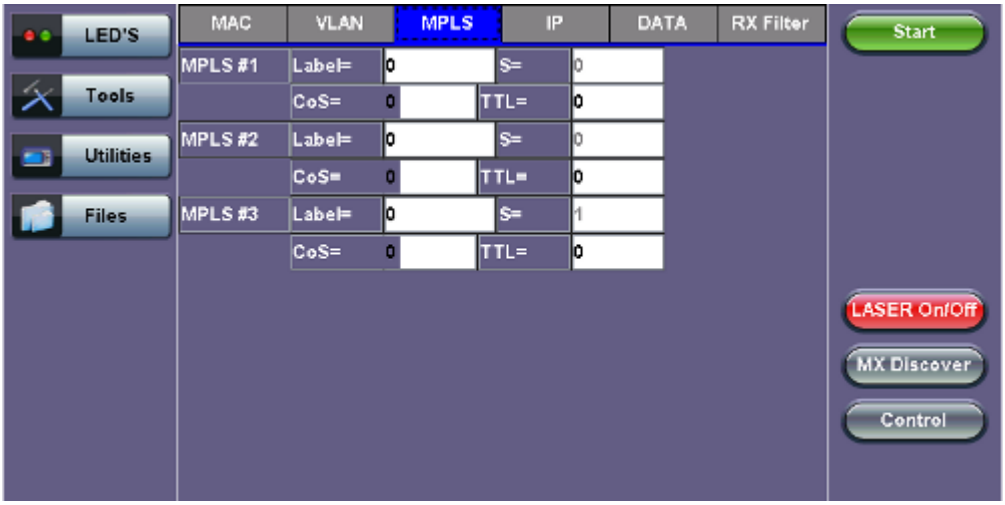
BERT Setup - VLAN Tag configuration (Layer 3)



Go back to top Go back to TOC

- **MPLS Tab:** In the MPLS tab the following parameters are configured:
  - **MPLS label:** Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved).
    (Composed of 20 bits which allows for the creation of over one million labels).
  - **CoS:** Configurable in the range 0 to 6.
    (This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS)).
  - **S-bit:** Configurable 0 or 1.
    (The S field is one bit in length and is used for stacking labels. This is important as it is used to indicate the last label in the label stack).
  - **TTL:** Configurable in the range 0 to 255. The default setting is 128 hops.
    (Used to decrement the time-to-live counter).

BERT Setup - MPLS label configuration

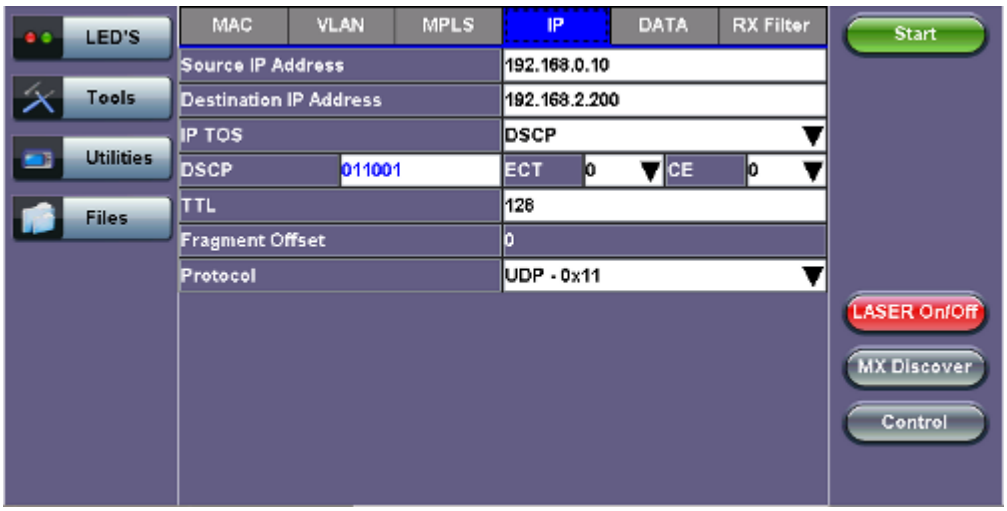


Go back to top Go back to TOC

- **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 RXT-1200 Platform Manual Chapter 7_Tools> IP Tools. The source address is fixed to the IP address from the IP setup menu.
  - **IP TOS (for Quality of Service testing):**
    - **Legacy TOS (Precedence):** The first three bits of the IP TOS field can be edited:
      000 - Best Effort
      001 - Bulk Data
      010 - Transactional
      011 - Call Signaling
      100 - Streaming Video
      101 - Voice
      110 - Routing
      111 - Reserve
    - **DSCP (Differentiated Services Code Point):** The first six bits of the IP TOS can be edited to provide more granular service classification.
      For more information on the definition of DSCP field in IPv4 and IPv6 headers, refer to RFC 2472 .
    - **Time To Live (TTL):** Configurable in the range 0 to 255.
    - **Fragment offset byte:** Configurable in the range 0 to 65.528.

      The fragment offset field, measured in units of eight-byte blocks, is 13 bits long and specifies the offset of a particular fragment relative to the beginning of the original unfragmented IP datagram.
    - **Protocol field:** UDP (0x11), TCP (0x06), User Defined.

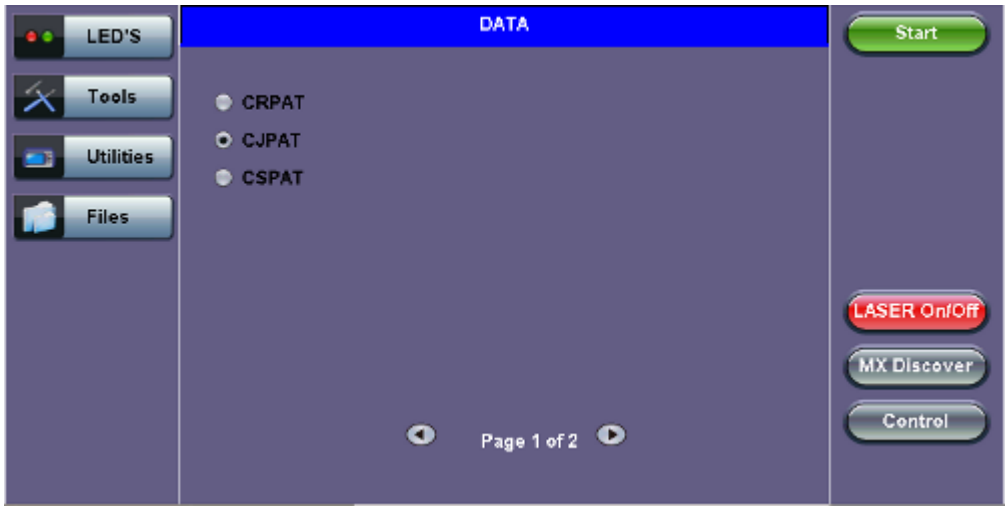
BERT Setup - IP Address settings (Layer 3)



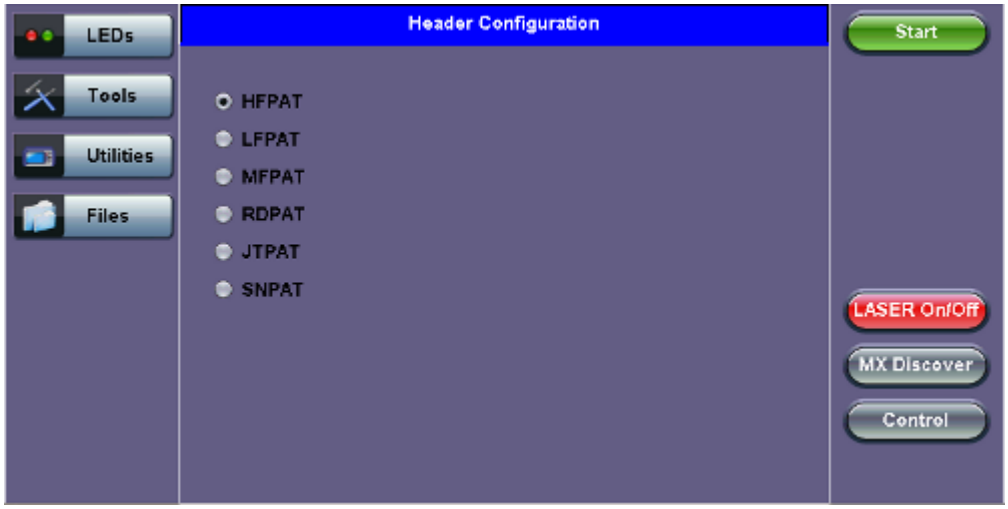
Go back to top Go back to TOC

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

BERT Setup - Data selection (Layer 1 Framed)



BERT Setup - Data selection - (Layer 1 Unframed)



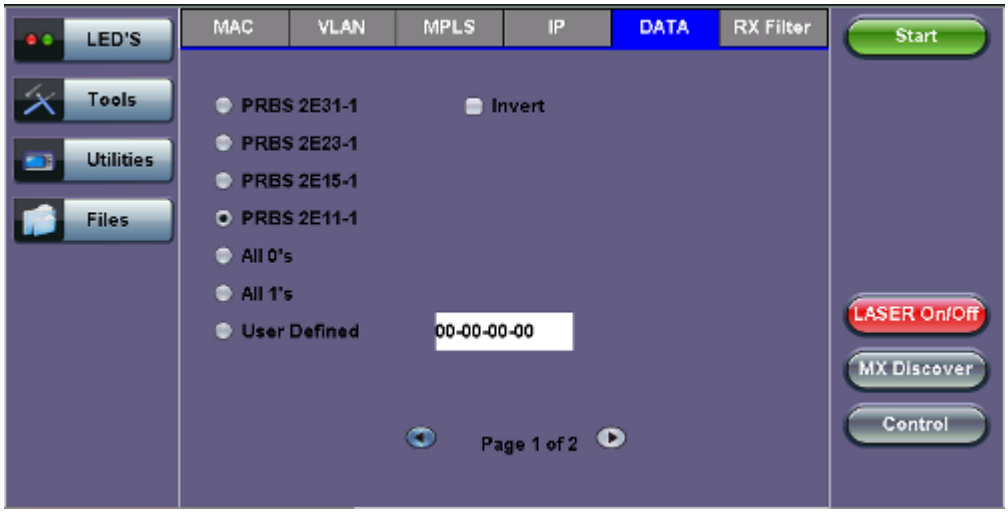
- **Layer 1 Unframed Test Patterns**
    - **HFPAT (High Frequency Pattern):** This test pattern is to test random jitter (RJ) at a BER of 10-12, and also to test the asymmetry of transition times. This high frequency test pattern generates a one, or light on, for a duration of 1 bit time, followed by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

Go back to top Go back to TOC

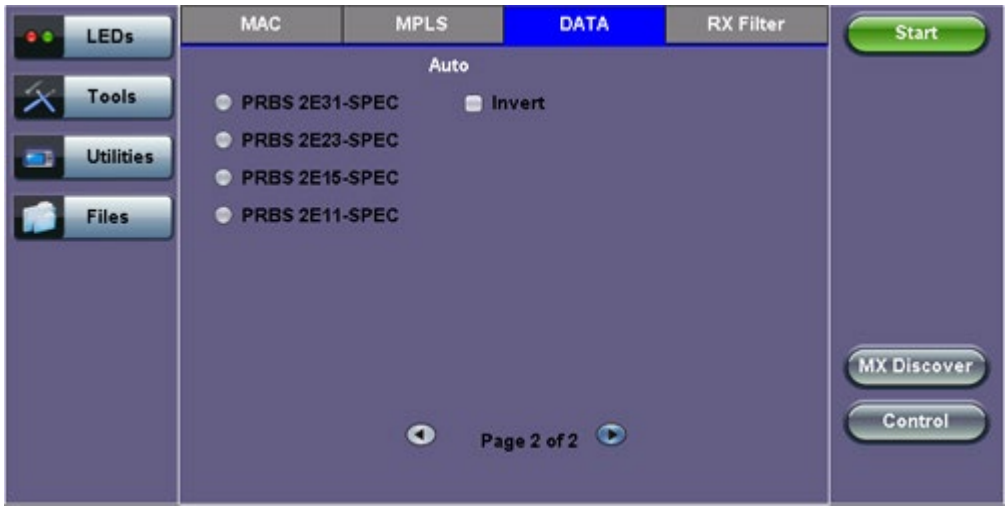
- **Layer 2, 3, & 4 test patterns**
  - **PRBS:**
    - 2^31 -1 (147 483 647-bit pattern used for special measurement tasks, [e.g., delay measurements at higher bit rates])
    - 2^23 -1 (8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps)
    - 2^15 -1 (32 767 bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736 kbps)
    - 2^11 -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

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.

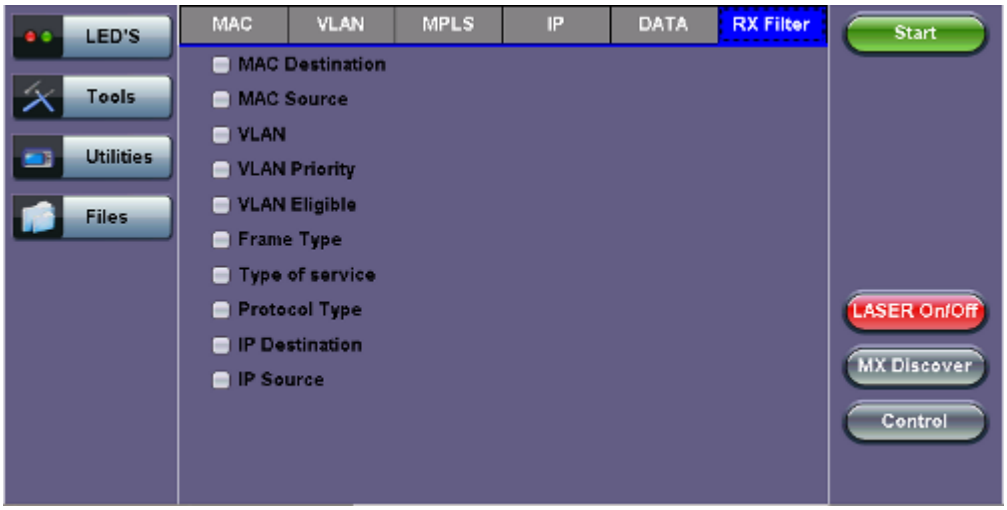
BERT Setup - Data selection - Special Patterns (Page 2)



Go back to top Go back to TOC

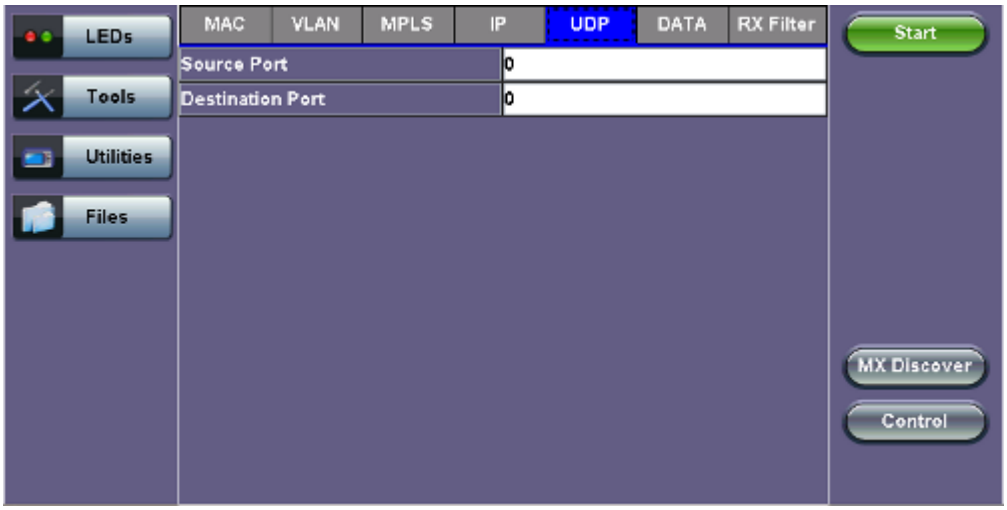
- **RX Filter Tab:** Allows the user to filter incoming streams. When checked, the incoming traffic flows not matching these criteria will not be considered for these results.
  - MAC Destination address
  - MAC Source address
  - VLAN
  - VLAN Priority
  - VLAN Eligible
  - Frame Type
  - Type of Service
  - Protocol Type
  - IP Destination address
  - IP Source address

BERT Setup - RX Filter selection



- **UDP/TCP:** Input Source Port and Destination Port.

BERT Setup - RX Filter selection



Go back to top Go back to TOC

5.3.1.2 Traffic Settings

Traffic tab:

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

- **Traffic Flow:** Select from the following traffic flows:
  - **Constant:** The selected frame is transmitted continuously according to the selected bandwidth %.

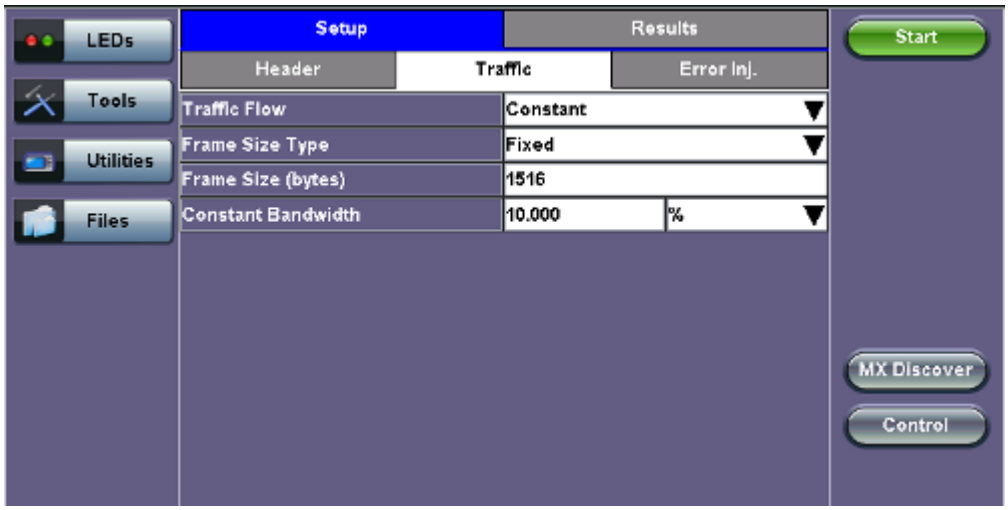
- **Ramp:** The selected frame is transmitted at maximum bandwidth according to the selected duty cycle and burst period.
- **Burst:** The selected frame is transmitted in a staircase profile according to user selectable step time, number of steps, and maximum bandwidth.
- **Single Burst:** Configure the number of frames to be transmitted in the burst along with the bandwidth. For example, if 100000 frames are transmitted at 12.5% of bandwidth, on a 1Gbps line, 100000 frames will transmit at a rate of 125Mbps and then the burst will stop.

- **Frame Size Type:** Fixed or Uniform min and max frame length values. Uniform traffic is traffic generated with a uniform distribution of frame lengths.

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

- **BW (Transmit Bandwidth):** Configure the transmit rate for the test
  - When traffic flow is equal to Burst, two burst bandwidths are configured with burst time
  - When traffic flow is equal to Ramp, starting and an ending bandwidth are configured along with the bandwidth step size and duration

BERT Setup - Constant Traffic



Frame Size Limitations

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

Go back to top Go back to TOC

5.3.1.3 Error Injection

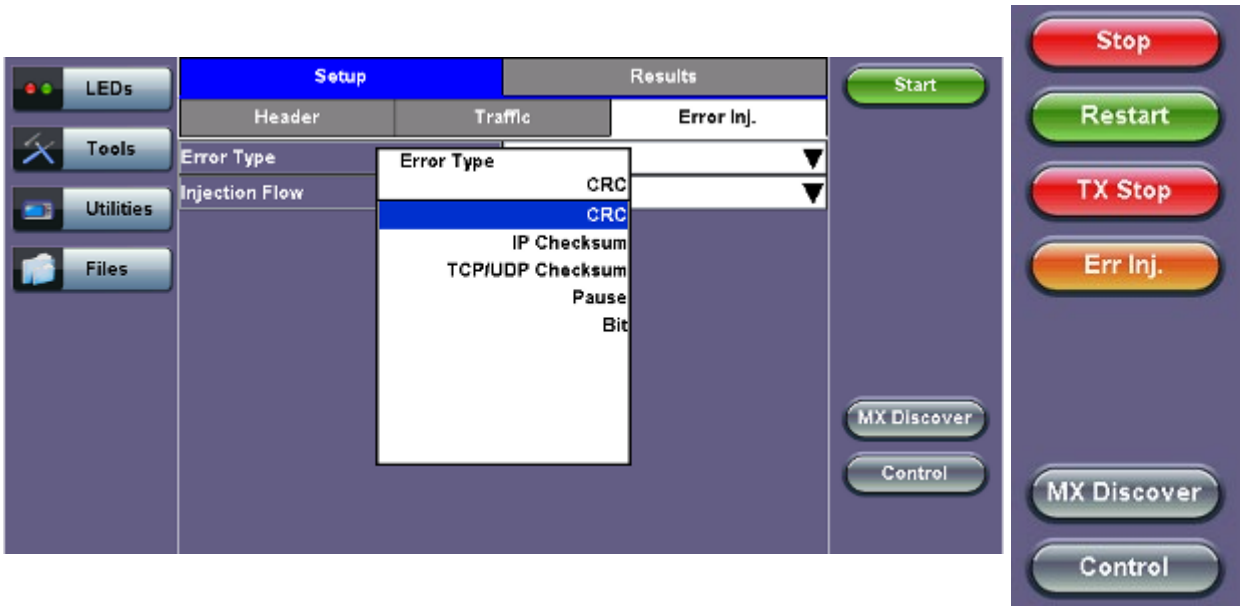
Error injection can be performed during testing. The error type and injection rate are configured in the Error Injection tab.

- **Error type:** Select from Bit, CRC, IP Checksum (Layer 3, 4 only), Pause, TCP/UDP Checksum (Layer 4 only). With Pause selected, the unit will transmit a pause frame when **Error Injection** icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.

- **Injection Flow:** The error injection flow determines how the selected errors will be injected.
  - Select a single error injection or specific count.

Count: Configures the error count via a numeric keypad.

BERT Setup - Error Injection **Error Inj. Function**



Error Injection

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

Go back to top Go back to TOC

5.3.1.4 Starting/Stopping a BERT

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

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

- **End-to-End Testing**
  - Connect the test set to another unit that supports BERT testing.
  - After configuring test settings on both units, start the tests.
- **Far-End Unit in Manual Loopback Mode**
  - If the far-end unit (another MX) is already in a manual loopback mode, do not send a loop up command since it is not necessary.
  - Once the correct control settings are configured, the user can start the test.

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

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

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

loopback that is in place.

Go back to top Go back to TOC

5.3.2 BERT Results

5.3.2.1 Summary

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

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

BERT Results - Summary

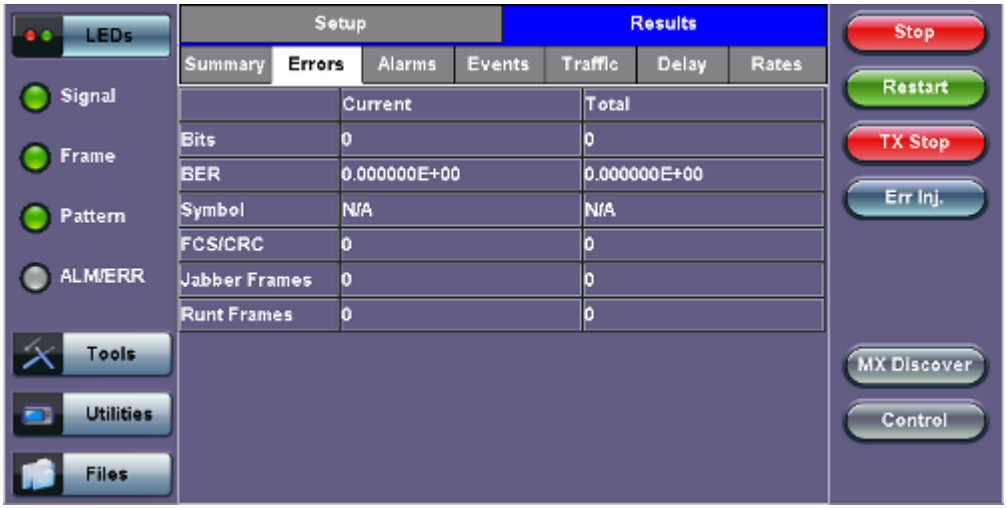
Go back to top Go back to TOC

5.3.2.2 Errors

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

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

BERT Results - Errors

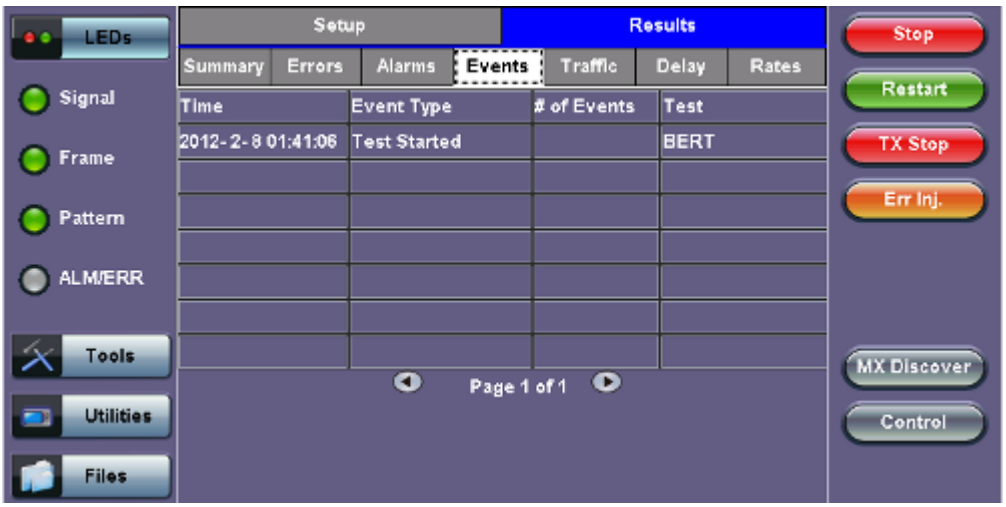


Go back to top Go back to TOC

5.3.2.3 Events

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

BERT Results - Events



Go back to top Go back to TOC

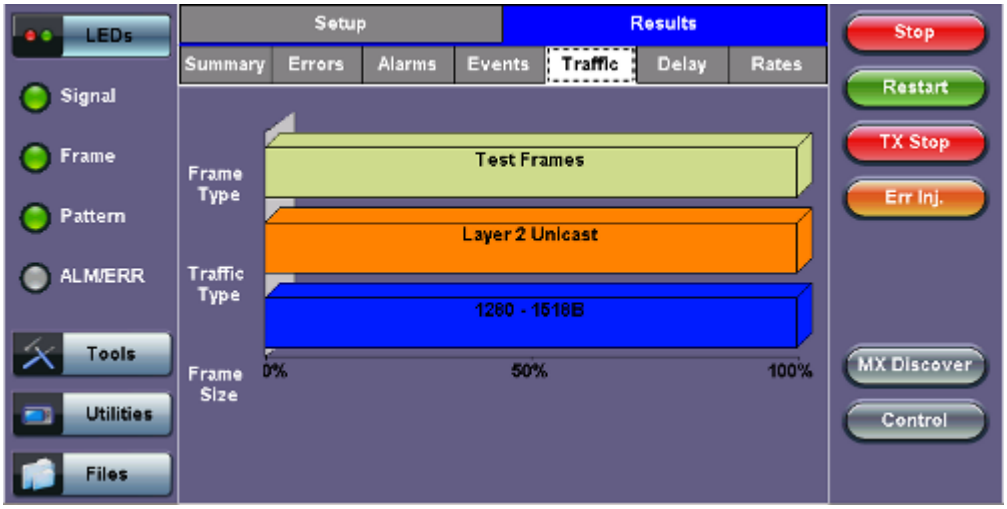
5.3.2.4 Traffic

Traffic tab: The following Traffic statistics are displayed:

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

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

BERT Results - Traffic Distribution

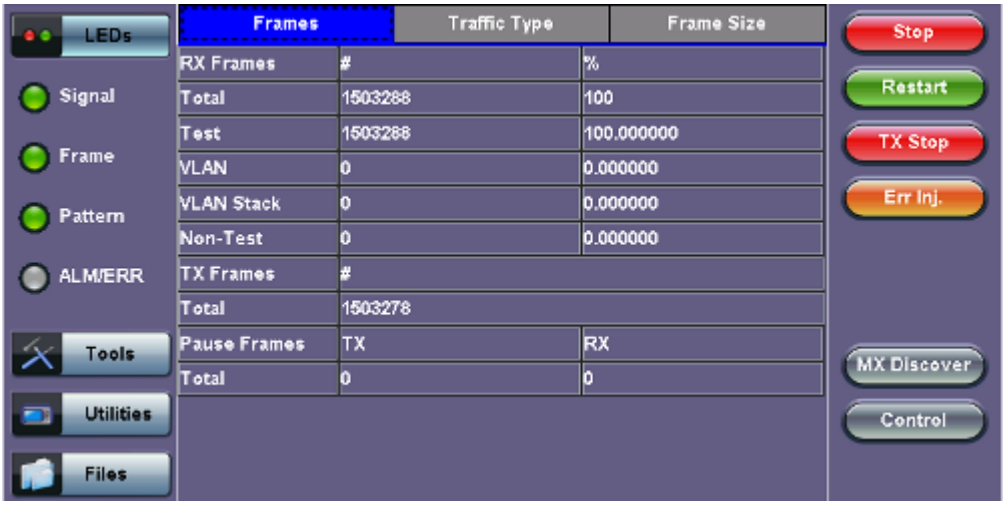


Go back to top Go back to TOC

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

BERT Results - Frames

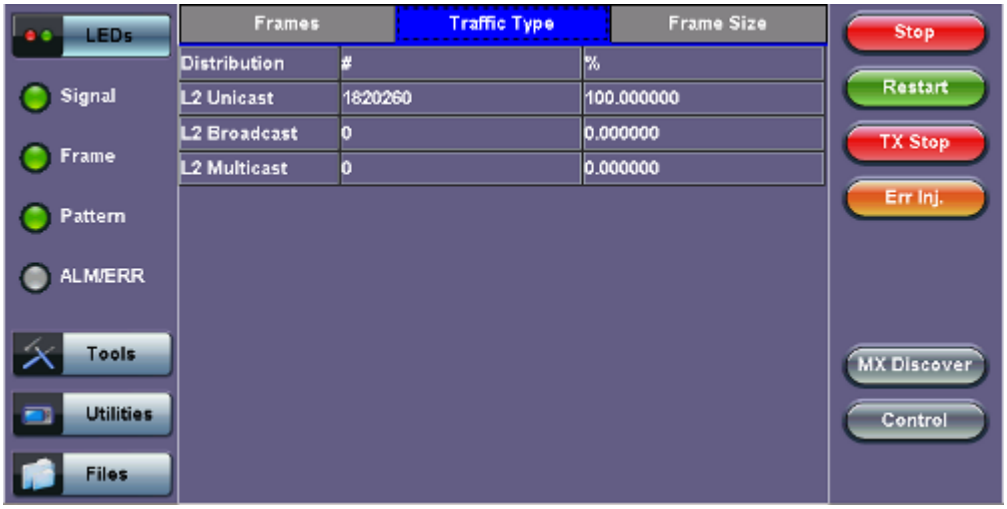


Go back to top Go back to TOC

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

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

BERT Results - Traffic Type

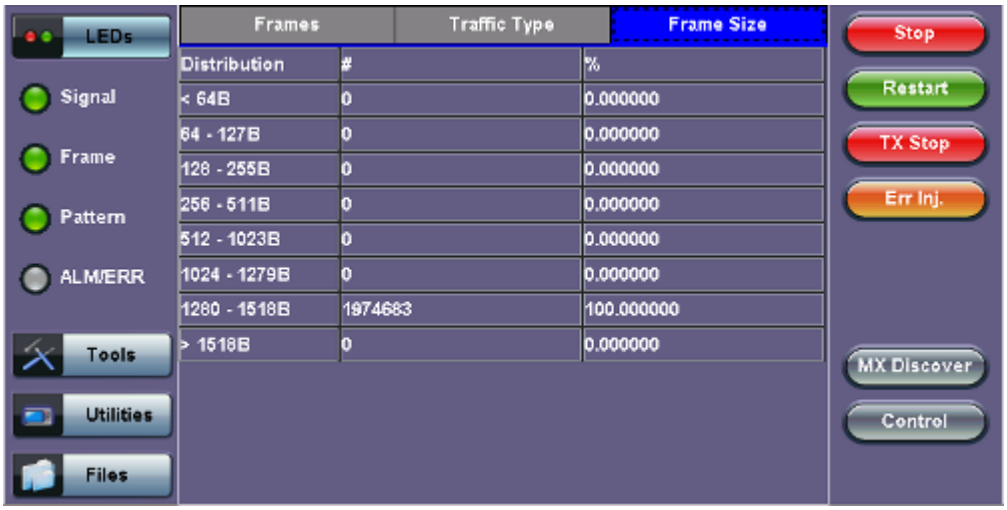


Go back to top Go back to TOC

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



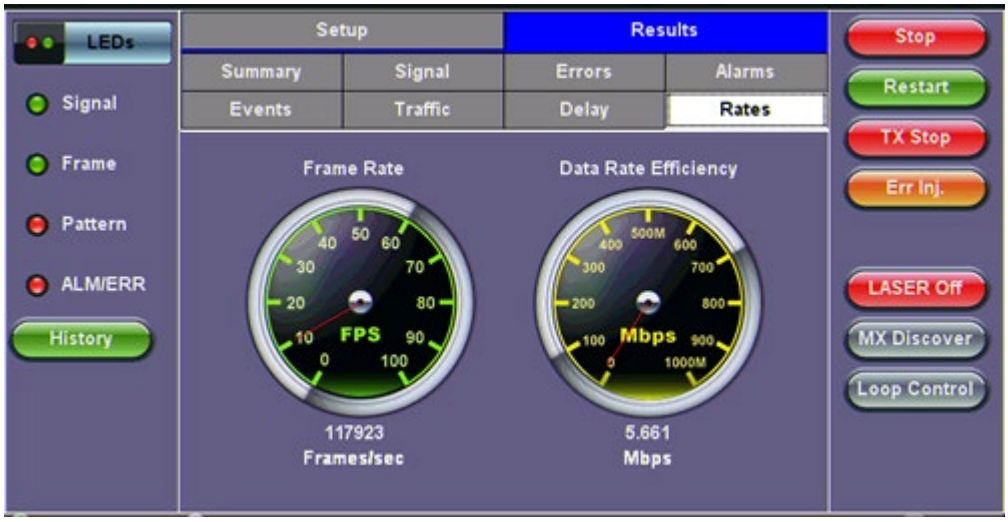
Go back to top Go back to TOC

5.3.2.5 Rates

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

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

BERT Results - Rates



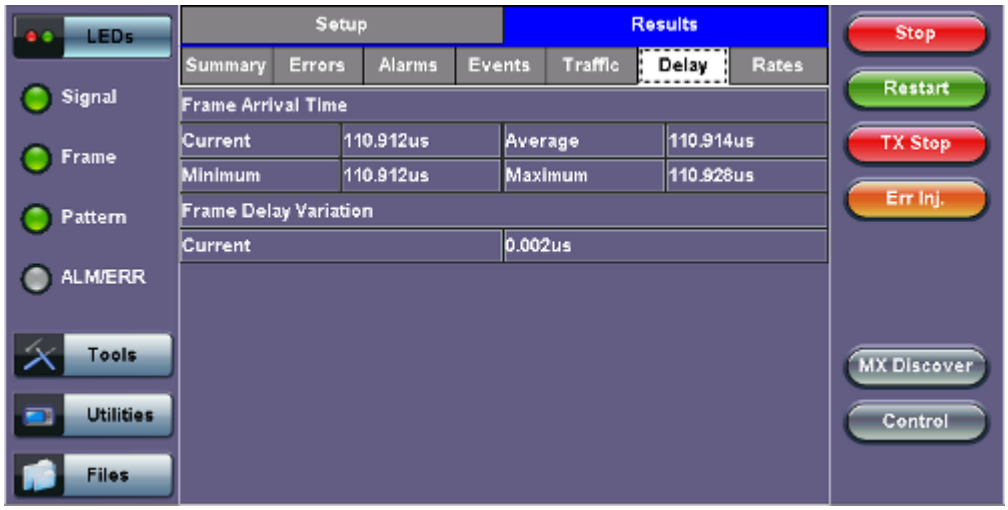
Go back to top Go back to TOC

5.3.2.6 Delay

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

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

BERT Results - Delay



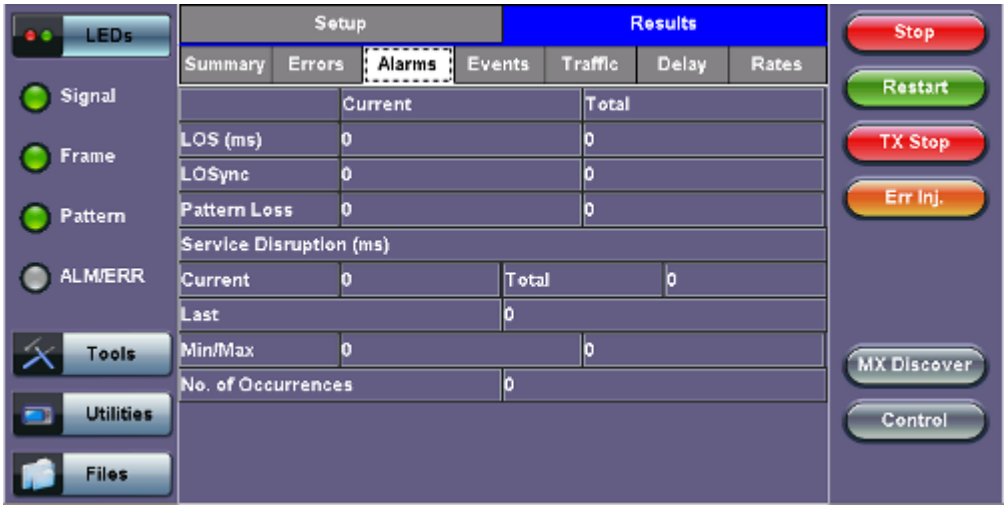
Go back to top Go back to TOC

5.3.2.7 Alarms

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

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

BERT Results - Alarms



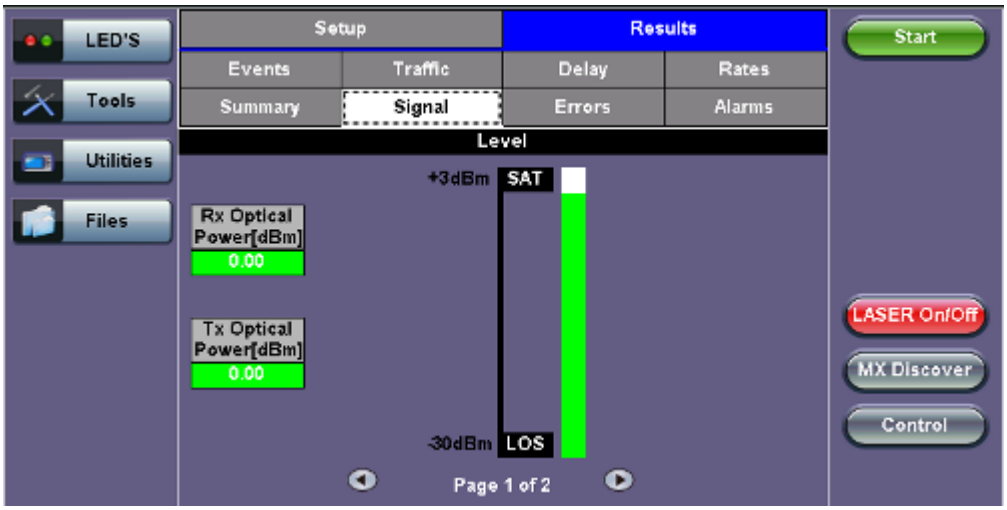
Go back to top Go back to TOC

5.3.2.8 Signal

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

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

BERT Results - Signal



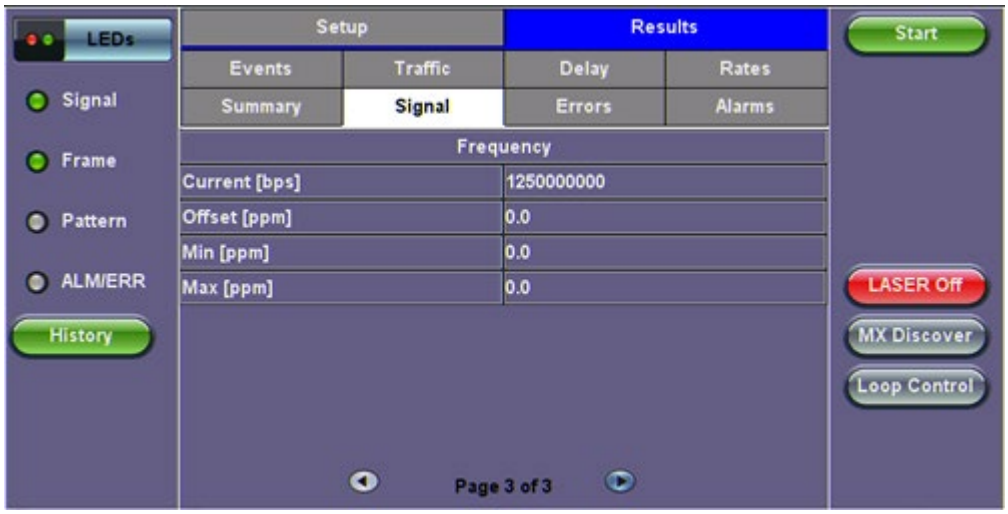
Signal (Page 2)

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

BERT Results - Signal (Page 2)

Signal (Page 3)

BERT Results - Signal (Page 3)



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

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

Go back to top Go back to TOC

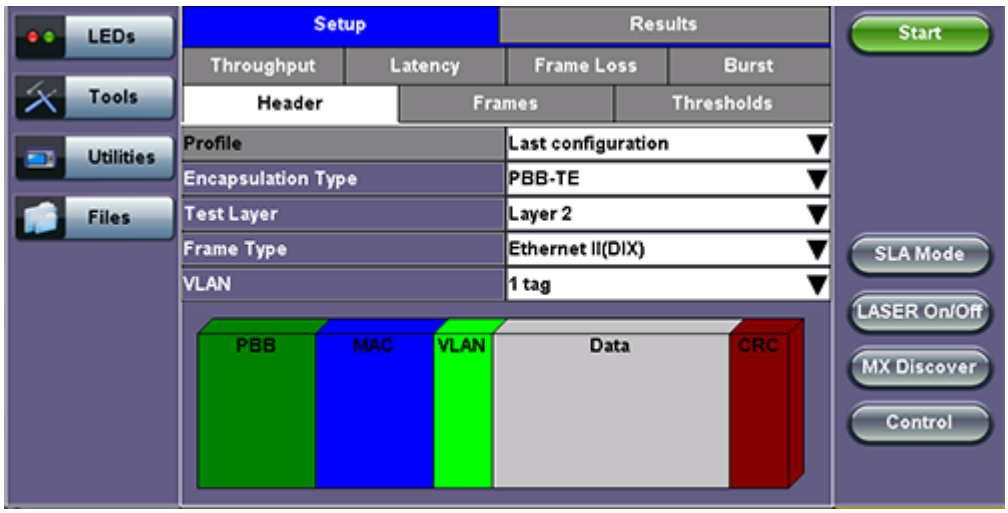
5.4 RFC 2544 Conformance Testing

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)

RFC 2544 Setup - Layer 2 parameters



Go back to top Go back to TOC

5.4.1 Setup - Standard Mode

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

Go back to top Go back to TOC

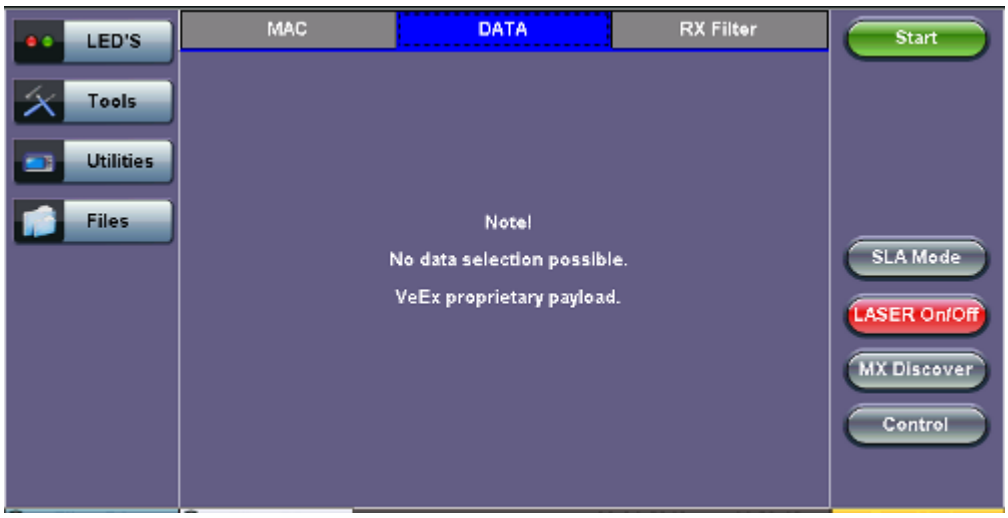
5.4.1.1 Header Settings

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

RFC 2544 setup options are listed below:

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

RFC 2544 Data tab



Go back to top Go back to TOC

5.4.1.2 Frame Settings

Frames tab: User configures the following:

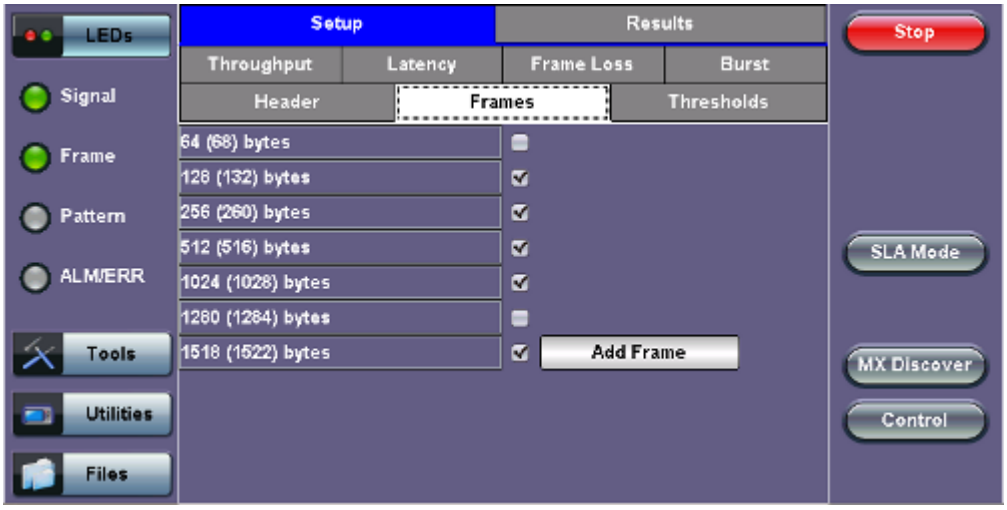
- **Preset Frames:** User selects from a list of recommended test frame sizes defined in RFC 2544:
  - Test frames are 64, 128, 256, 512, 1024, 1280, and 1518 bytes.
  - The default selected frames are 64 and 1518 bytes.
  - To select/deselect any of the recommended test frames, check the box to the right of the desired frame.

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

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

- 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).

RFC 2544 Setup - Frame Settings



Go back to top Go back to TOC

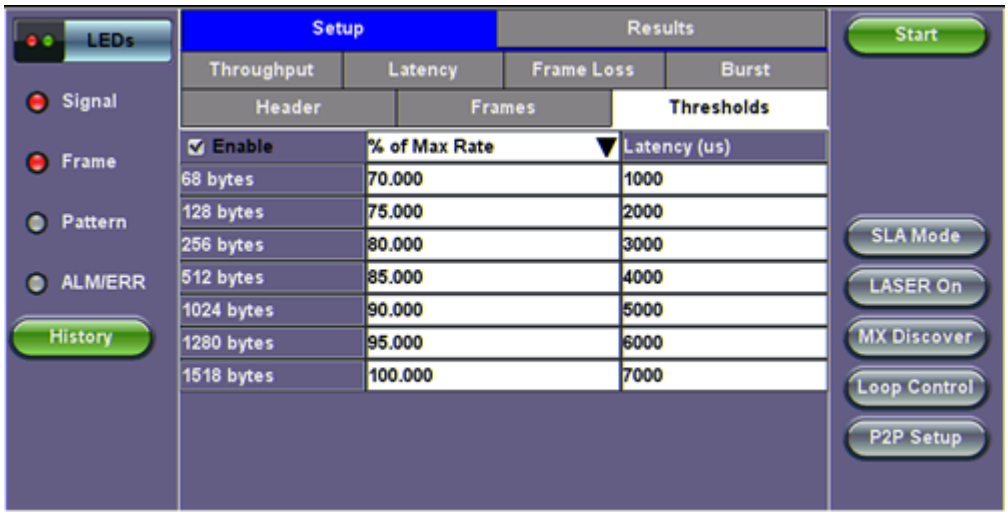
5.4.1.3 Threshold Settings

Threshold tab:

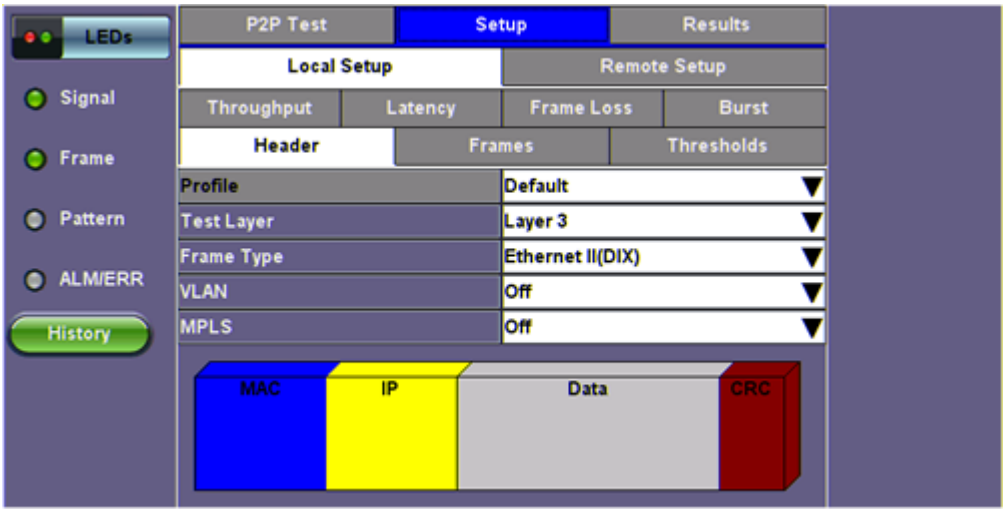
- User enables or disables threshold settings for the throughput and latency tests.
  - When enabled, threshold settings can be configured for all of the test frames selected in the frame settings tab.

- A Pass/Fail criteria will be applied when the threshold settings are enabled. Select a **rate type** from the drop-down menu that will be used to determine pass/fail criteria. Options are % of Max Rate, % of Line Rate, Utlized Line Rate (Mbps).
  - For example, if the throughput threshold value for a 64 byte frame is configured for 80%, then a Pass criteria is assigned if the throughput rate is 80% or better.
  - The threshold values for Throughput and Latency can be customized per user requirements. Tap on the selected value to edit.

RFC 2544 Setup - Threshold Settings



Local Setup



Go back to top Go back to TOC

5.4.1.4 Throughput, Latency, Frame Loss, and Burst Settings

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

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

Throughput tab:

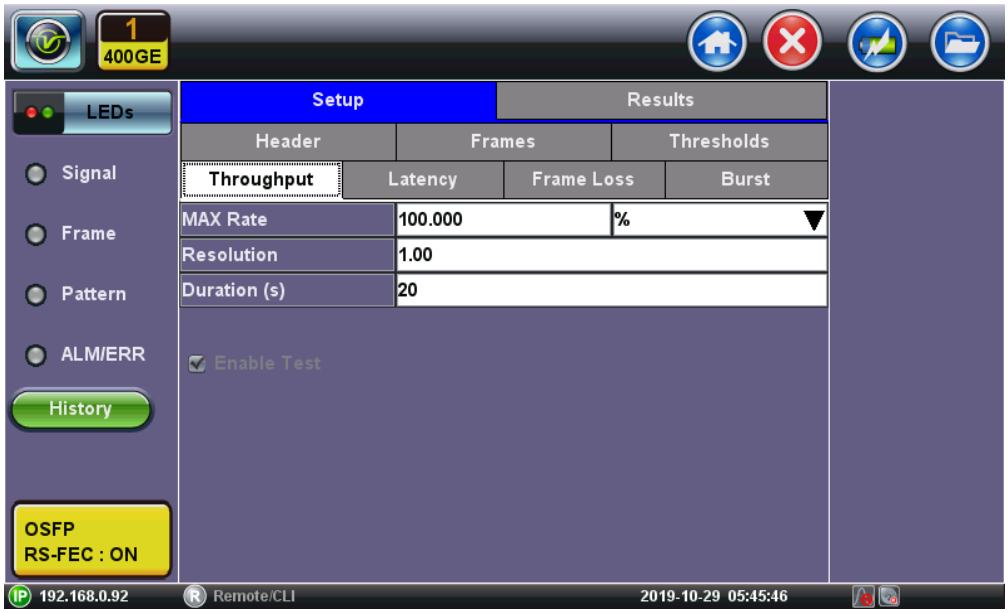
- **Max Rate:** Up to 100% of the negotiated line rate. The default value is 100%.
  - This is the maximum transmit rate to perform the throughput test for each test frame size.
  - The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate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

- **Resolution:** Input any value between 0.001% and 1%. The default value is 1%. Resolution refers to the resolution in searching for the throughput rate. If 1% is selected, the throughput rate will be searched with ±1% accuracy.

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

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

RFC 2544 Setup - Throughput Settings

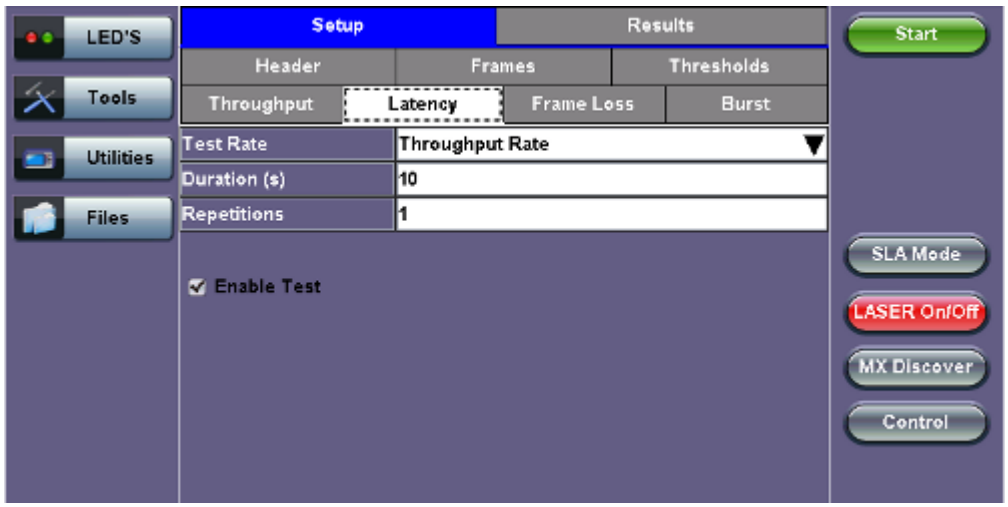


Go back to top Go back to TOC

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.
  - **Custom Rate per frame size:** The user can configure a custom rate in % or Mbps for each test frame. Tap on **Rate Table Config**. to configure rates for each frame. After making edits tap **Apply** to confirm edits or **Apply to All** to apply rates to all tests.
- **Rate:** Only available if Custom Rate is selected. Enter up to 100% of the negotiated line rate or enter the rate in Mbps.
- **Duration:** 5 to 999 seconds. The default value is 20 seconds.
  This is the amount of time that the latency test will be performed for each test frame size.
- **Repetitions:** 1 to 100. The default value is 1.
  This is the amount of times that the latency test will be repeated for each test frame size.

RFC 2544 Setup - Latency Settings



Go back to top Go back to TOC

Frame Loss tab:

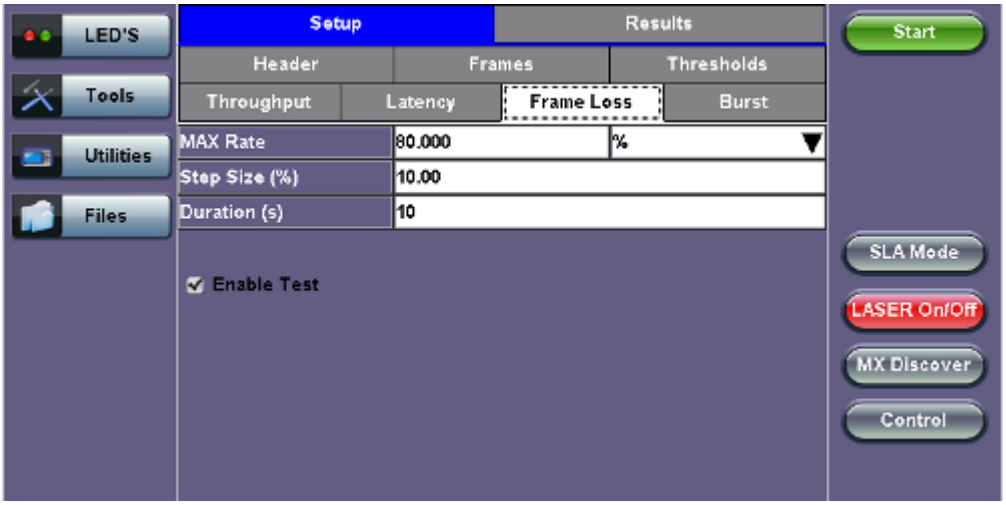
- **Max Rate:** Up to 100% of the negotiated line rate. The default value is 100%.
  This is the maximum transmit rate to perform the frame loss test for each test frame size. The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate to 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.

RFC 2544 Setup - Frame Loss Settings



Go back to top Go back to TOC

Burst (Back-to-Back) tab:

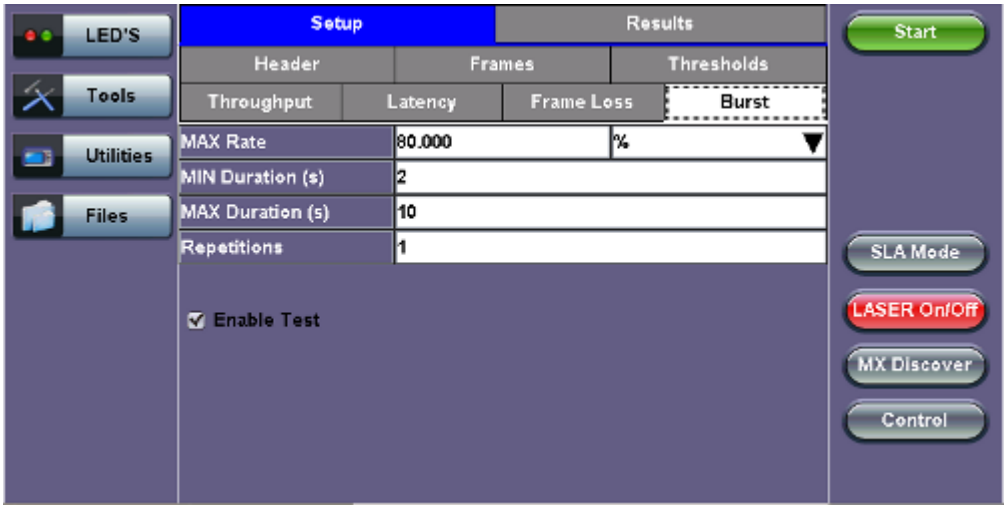
- **Max Rate:** Up to 100% of the negotiated line rate. The default value is 1000 ULR (Mbps).
  In the burst test, frames are always transmitted at the maximum rate for a given minimum and maximum burst duration. The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.

- **Minimum Duration:** Selectable in the range 2 to 999 seconds. Default value is 2 seconds.
  This is the duration of the first burst.

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

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

RFC 2544 Setup - Burst Settings



Go back to top Go back to TOC

5.4.1.5 Starting/Stopping a RFC 2544 Measurement

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

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

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

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

- **Far End Unit Controlled with Loop Up/Down Commands**
  - If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unit before the RFC 2544 test suite can be started
  - To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings mode to manual
  - Enter the MAC and/or IP address of the far-end unit
  - Send the loop up command by pressing **Loop Up**

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

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

Go back to top Go back to TOC

5.4.2 Results - Standard Mode

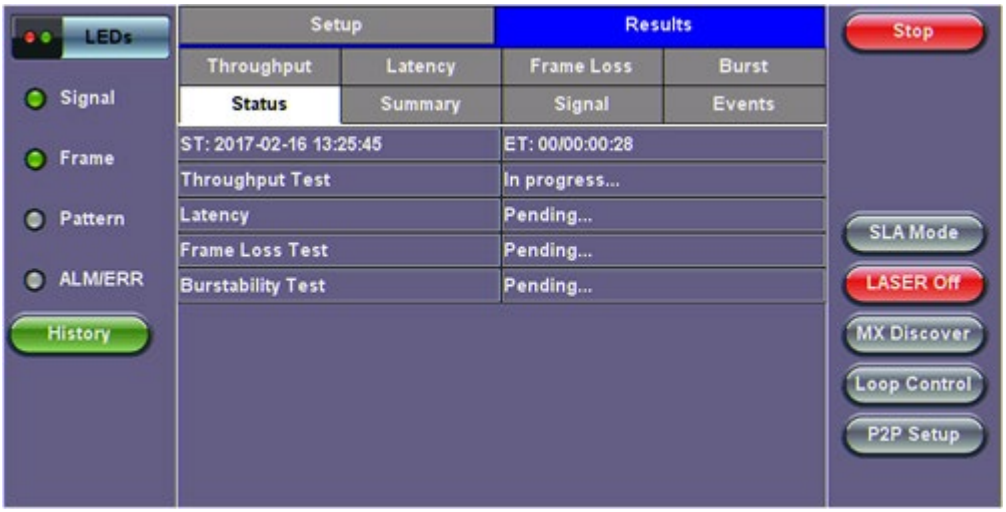
The progress and current result of the RFC 2544 can be viewed as the test is in progress.

Results tab:

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

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

RFC 2544 Results - Status

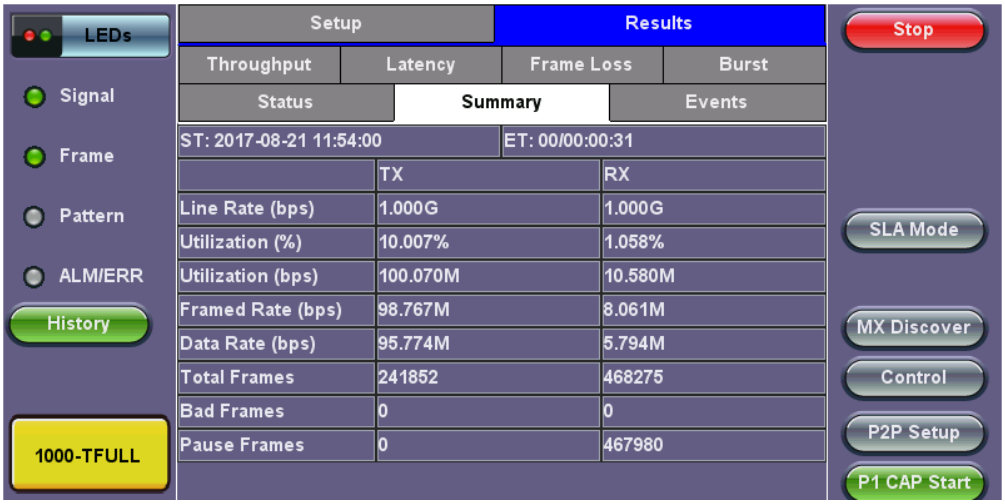


Go back to top Go back to TOC

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

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

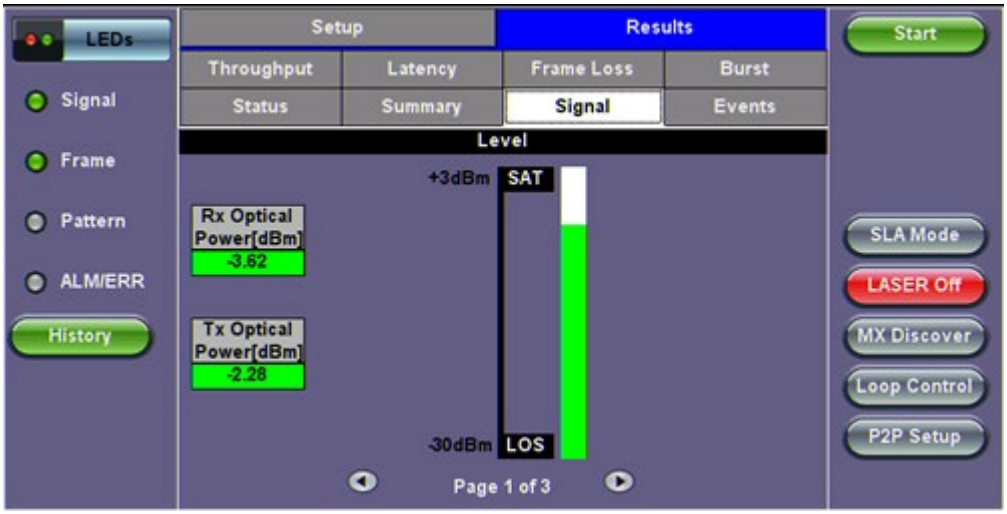
RFC 2544 Results - Summary



Go back to top Go back to TOC

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

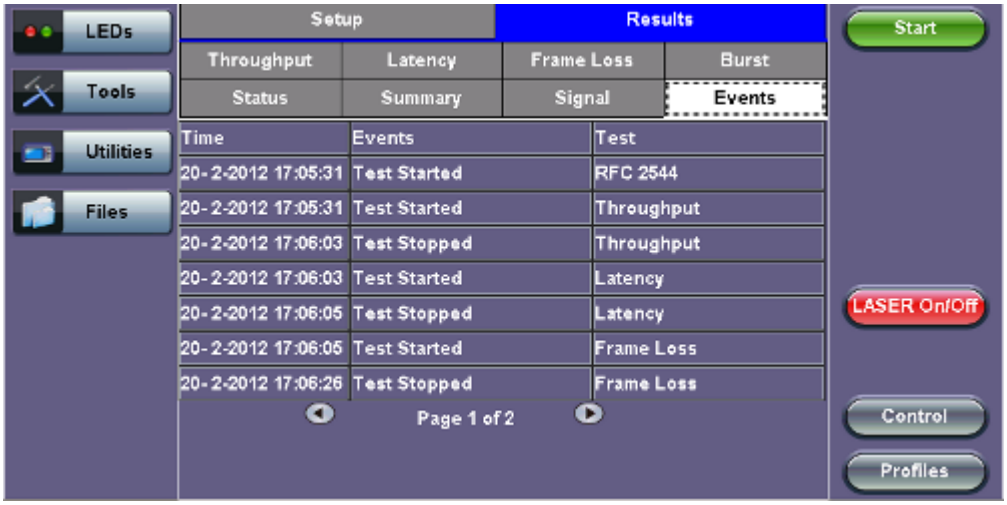
RFC 2544 Results - Signal (Page 1)



Go back to top Go back to TOC

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

RFC 2544 Results - Events



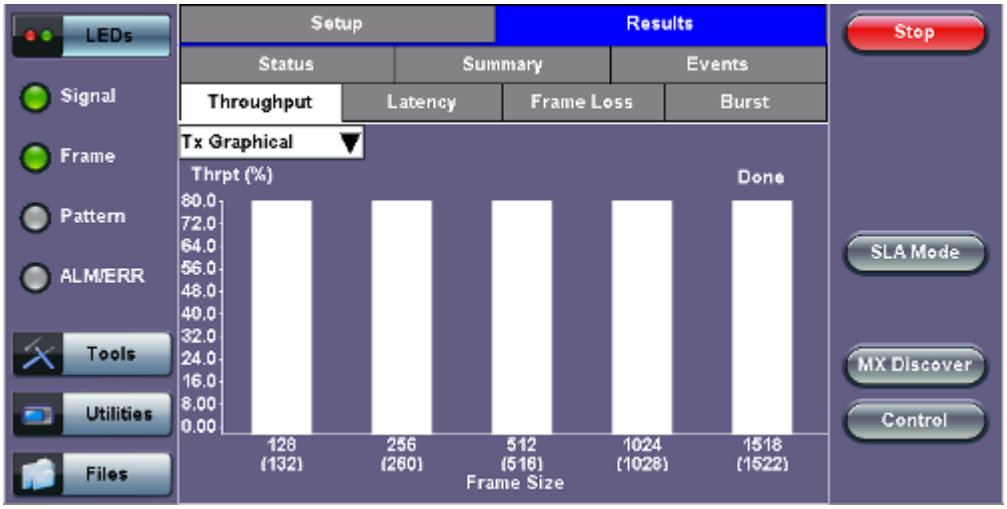
Go back to top Go back to TOC

Throughput tab

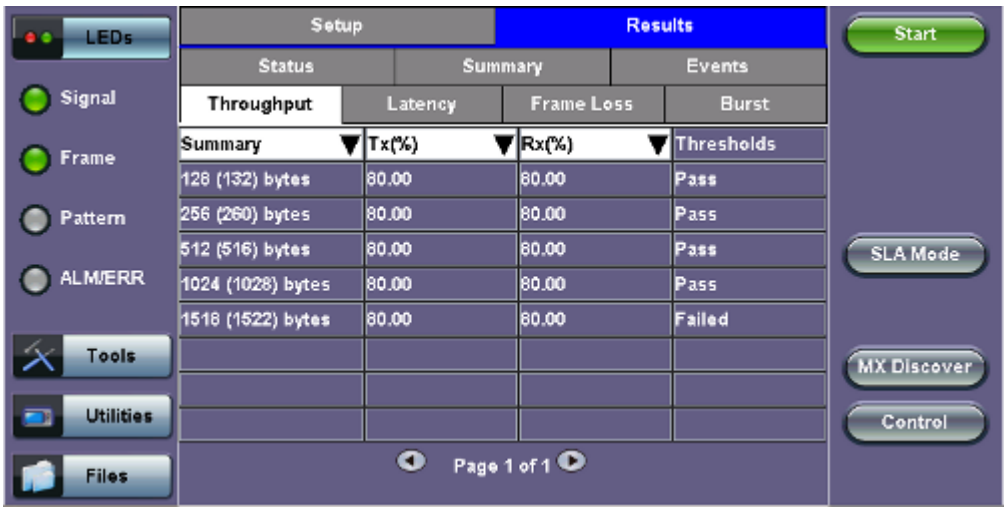
The Throughput tab displays the maximum throughput rate of the link under test. Results are displayed in graphical and table formats. Use the drop-down menu to change the display format.

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

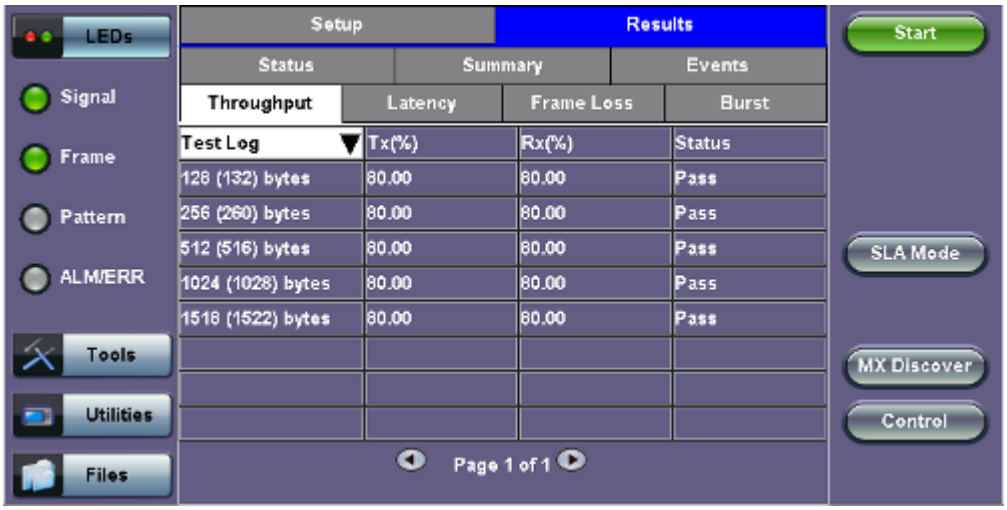
RFC 2544 Results - Throughput (Tx Graphical)



RFC 2544 Results - Throughput (Summary Table)



RFC 2544 Results - Throughput (Test Log Table)



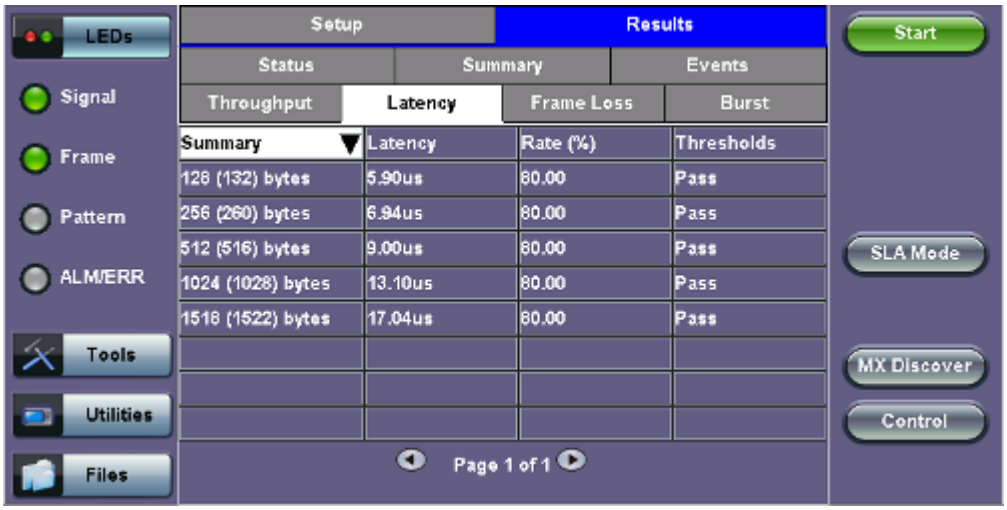
Go back to top Go back to TOC

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

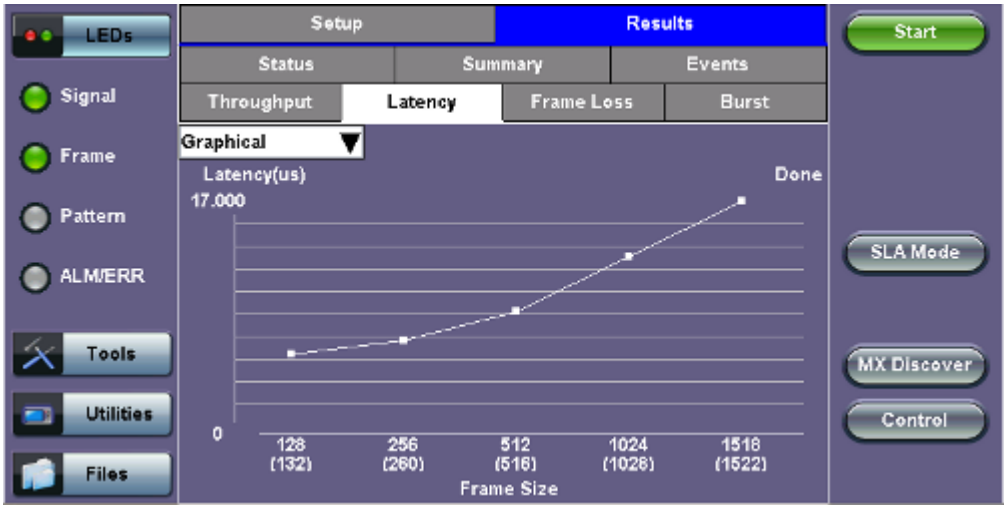
- **Graphical:** Latency results displayed in line graph form (Latency [us] vs Frame size [bytes]).
- Summary and Test log tables display:
  - byte size
  - **Latency (us):** Round trip delay latency.

- **Rate (%):** Percentage of frames transmitted. Data rate used for latency test.
- **Pass/Fail** test status.

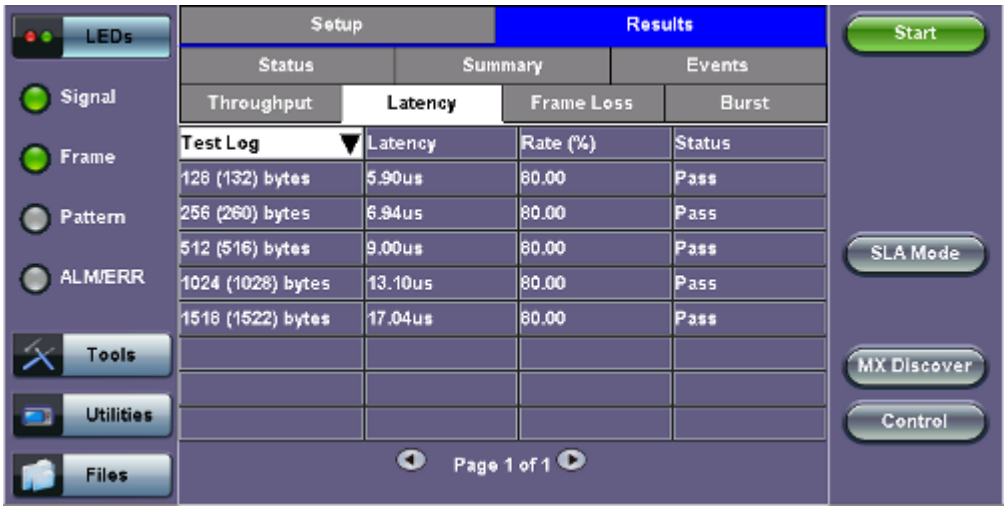
RFC 2544 Results - Latency (Summary)



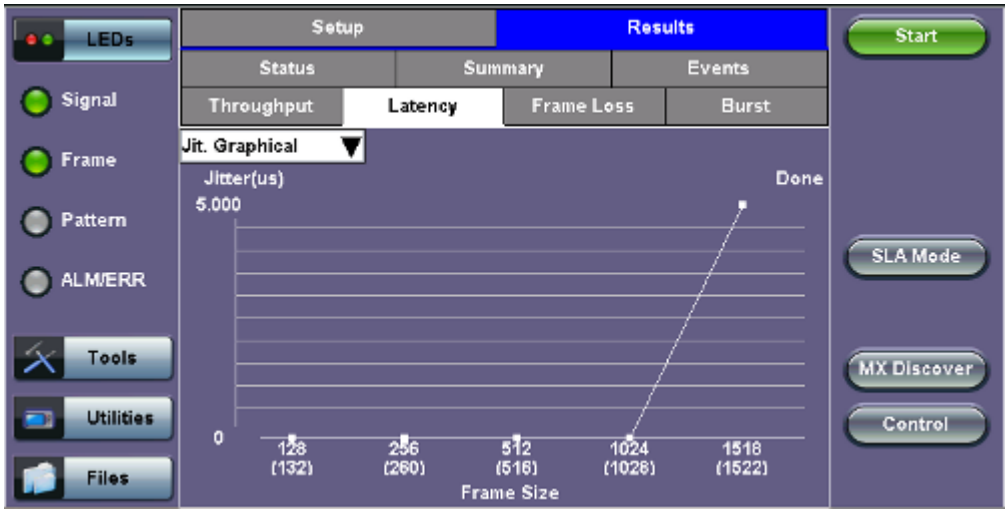
RFC 2544 Results - Latency (Graphical)



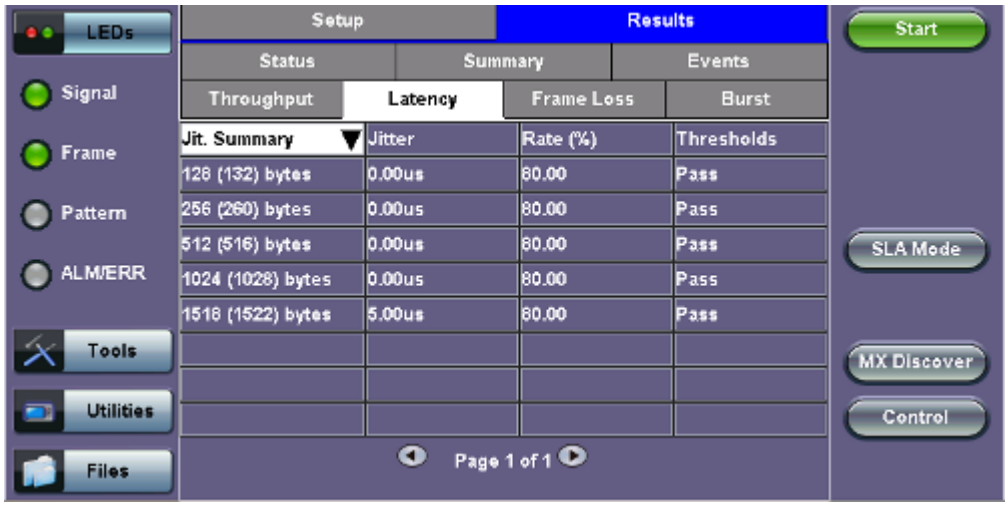
RFC 2544 Results - Latency (Test Log)



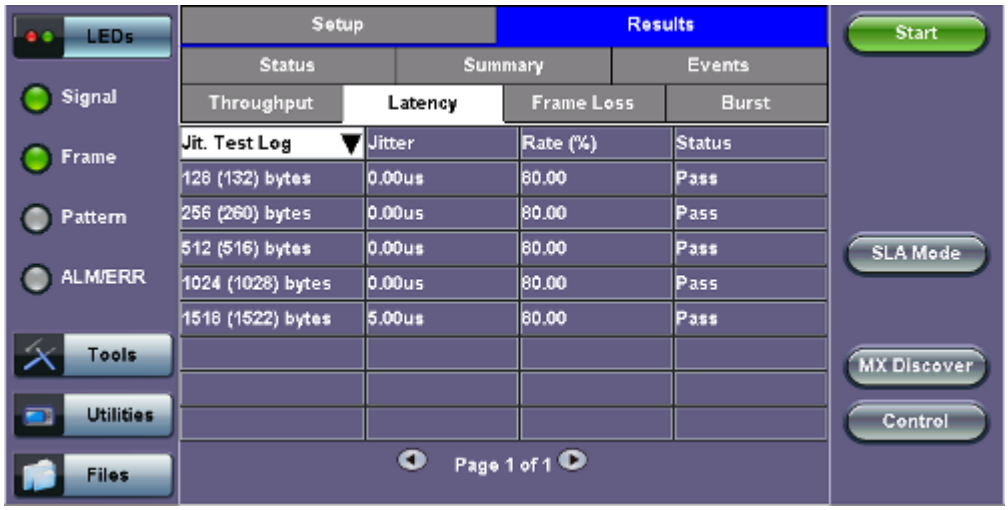
RFC 2544 Results - Latency (Jitter Graphical)



RFC 2544 Results - Latency (Jitter Summary)



RFC 2544 Results - Latency (Jitter Test log)

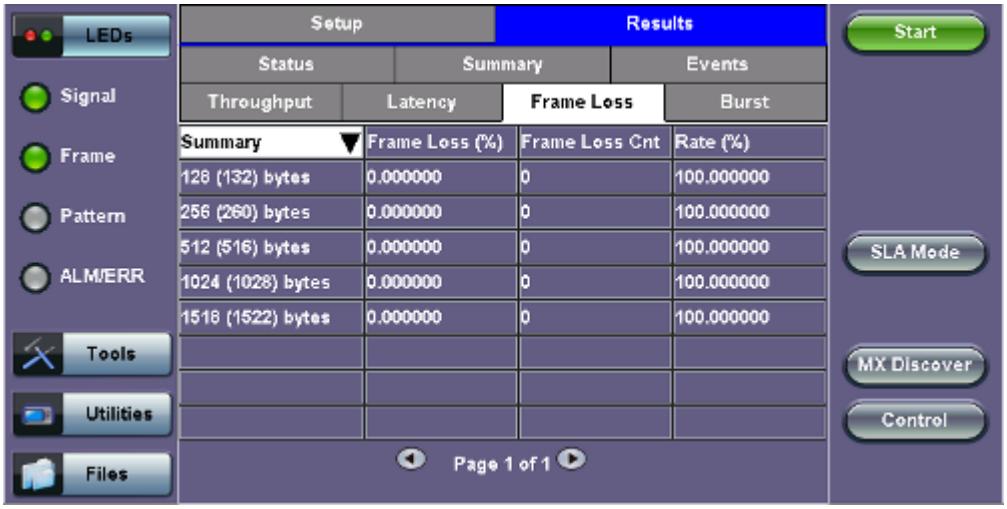


Go back to top Go back to TOC

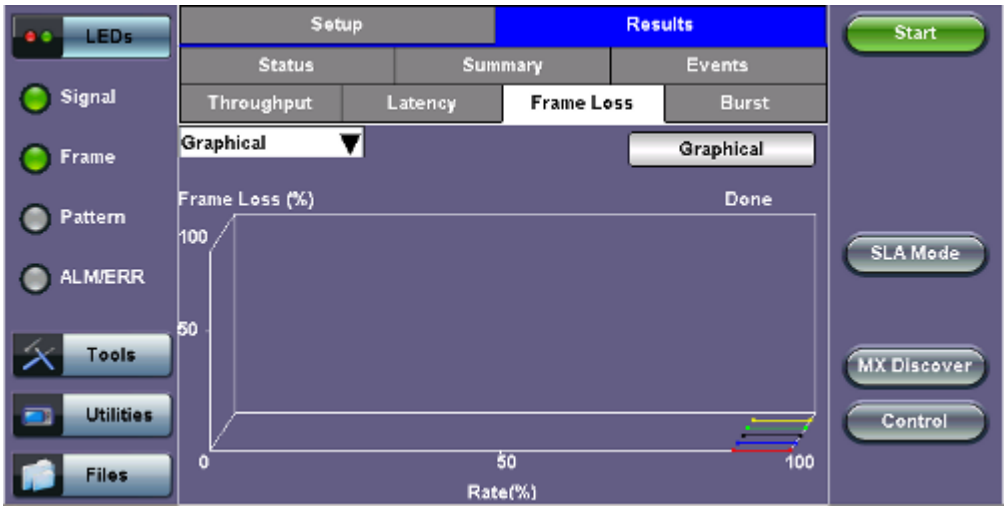
Frame Loss tab: Frame loss displays the percentage of frames not received. Use the drop-down menu to select the Frame Loss format:

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

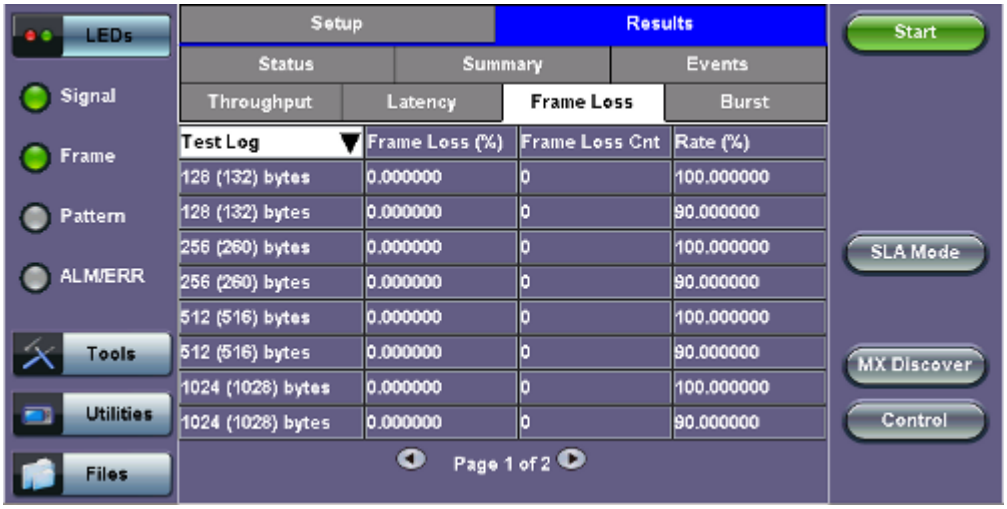
RFC 2544 Results - Frame Loss (Summary)



RFC 2544 Results - Frame Loss (Graphical)



RFC 2544 Results - Frame Loss (Test log)

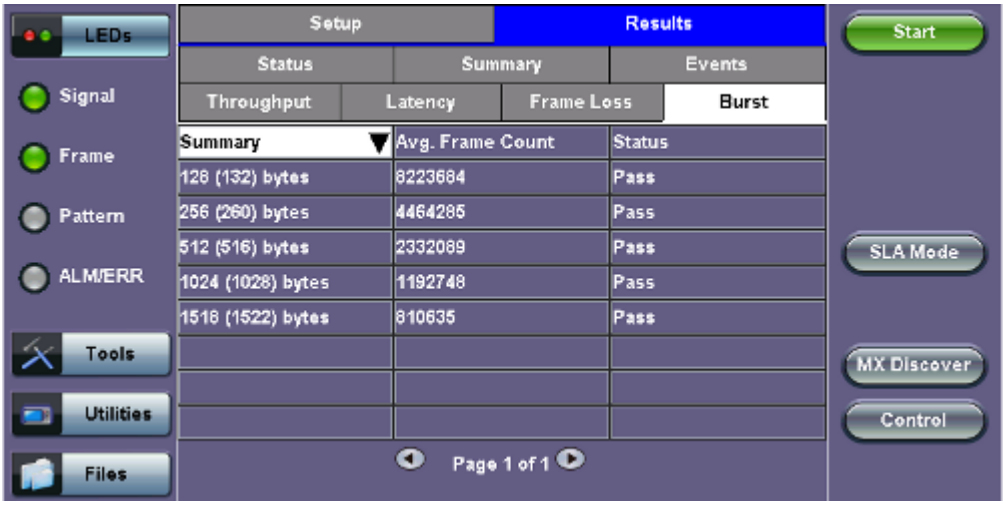


Go back to top Go back to TOC

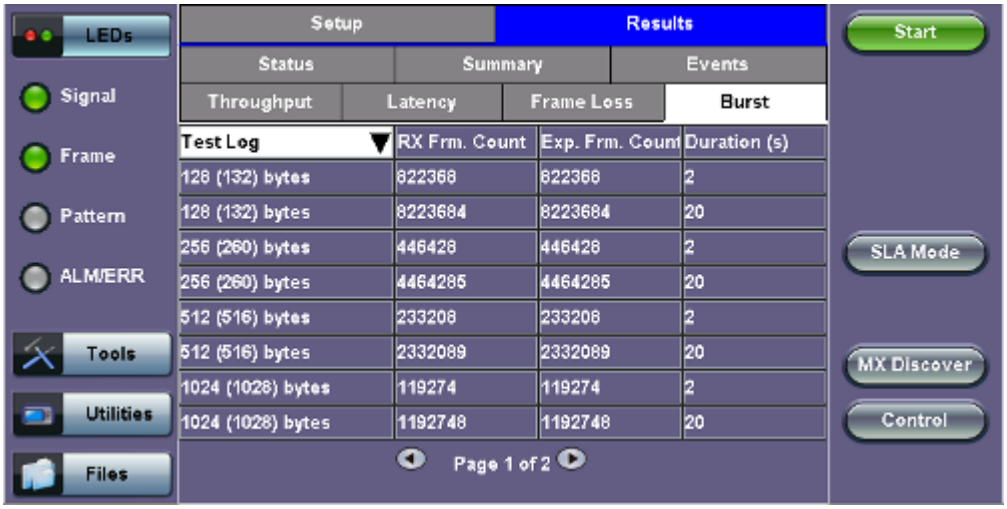
Burst tab: Burstability (back-back) results are the number of frames successfully transmitted/received at the line rate. It is displayed in the following formats:

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

RFC 2544 Results - Burstability (Summary)

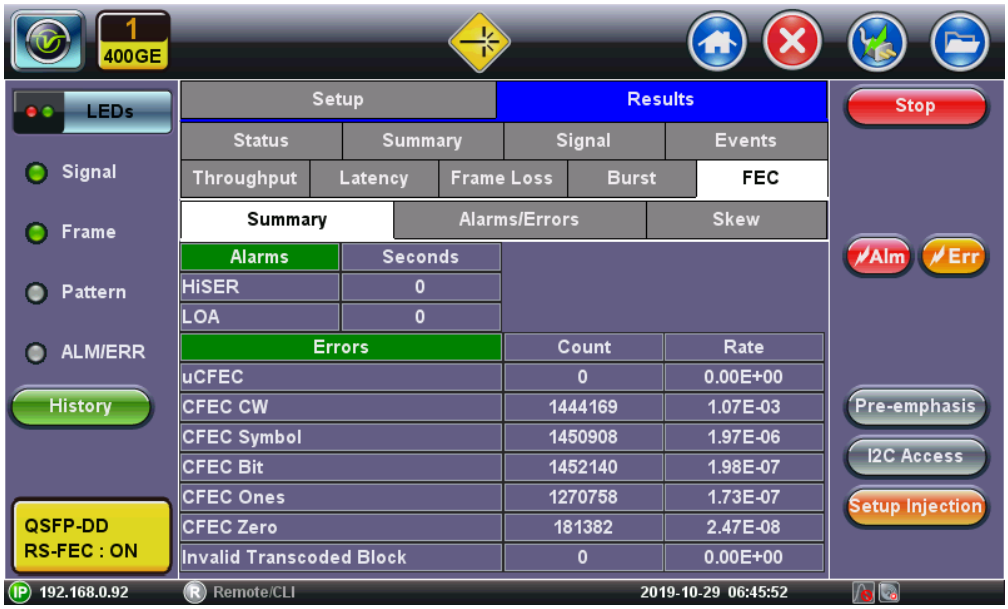


RFC 2544 Results - Burstability (Test Log)

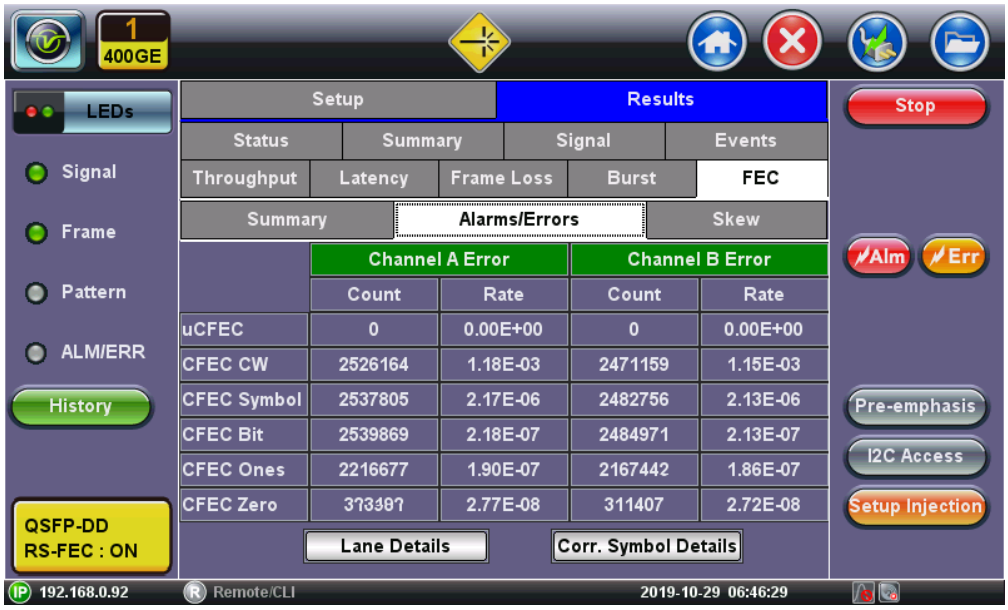


FEC tab:

RFC 2544 Results - FEC Summary

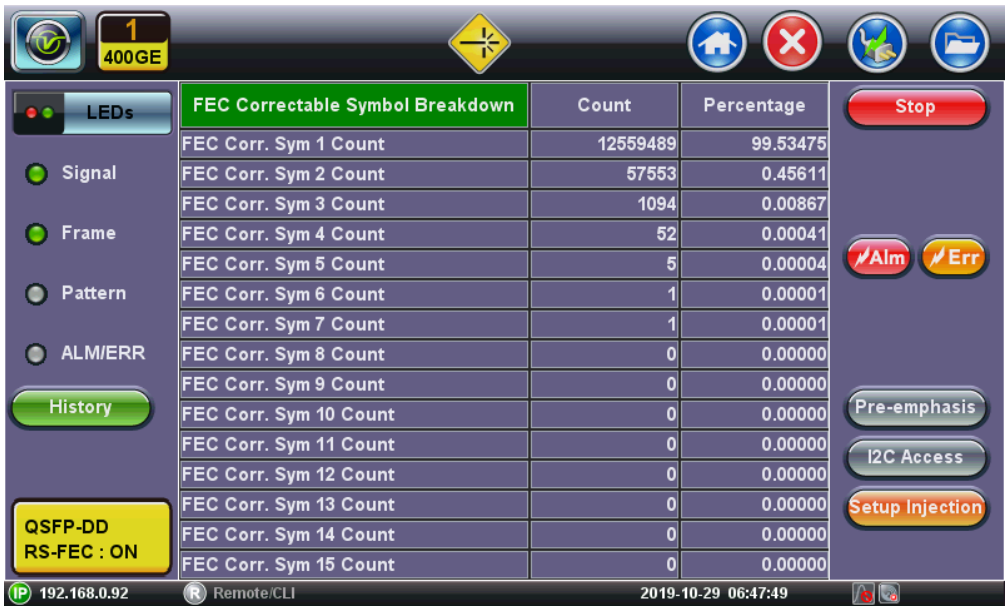


RFC 2544 Results - FEC Alarms/Errors



RFC 2544 Results - FEC Alarms/Errors Lane Details

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



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

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

RFC 2544 Results - FEC Skew

L#	RX ID	RX Skew bits	RX Skew ps	L#	RX ID	RX Skew bits	RX Skew ps
0	1	114	4291	8	9	160	6023
1	0	113	4254	9	8	159	5985
2	3	1	37	10	11	174	6550
3	2	0	0	11	10	173	6512
4	5	142	5345	12	12	60	2258
5	4	141	5308	13	13	60	2258
6	7	78	2936	14	14	172	6475
7	6	77	2898	15	15	172	6475

Go back to top Go back to TOC

5.4.3 Saving RFC 2544 Results

Once the test has been stopped the results can be saved by pressing the **Save** key on the VePAL's keypad. The results will be saved and named automatically. Once the results are saved, the user may view or rename the results file by going to **Utilities** > **Files** > **Saved**. For more information on retrieving saved test results, refer to **File Management** in the **TX300S, MTTplus, RXT-1200, or UX400 platform manuals** for more information.

Go back to top Go back to TOC

5.5 V-SAM

(100G only)

Overview

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

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

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

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

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

Comparison of RFC 2544 and Y.1564

	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

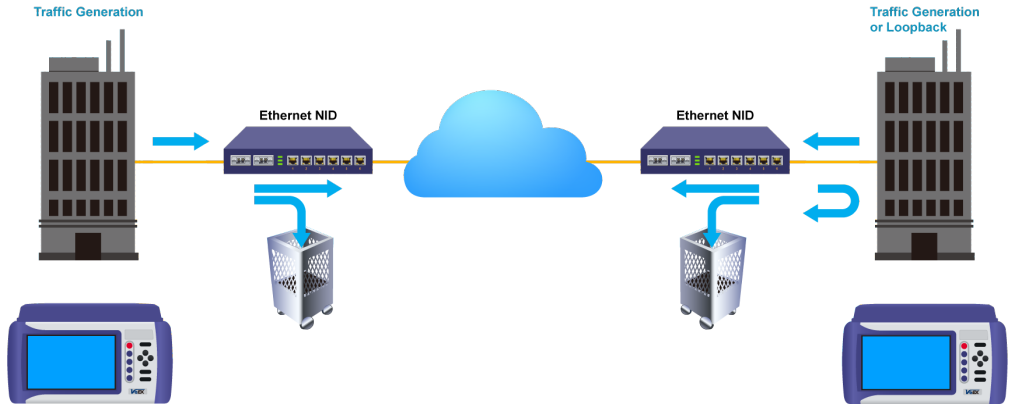
Test Methodology

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



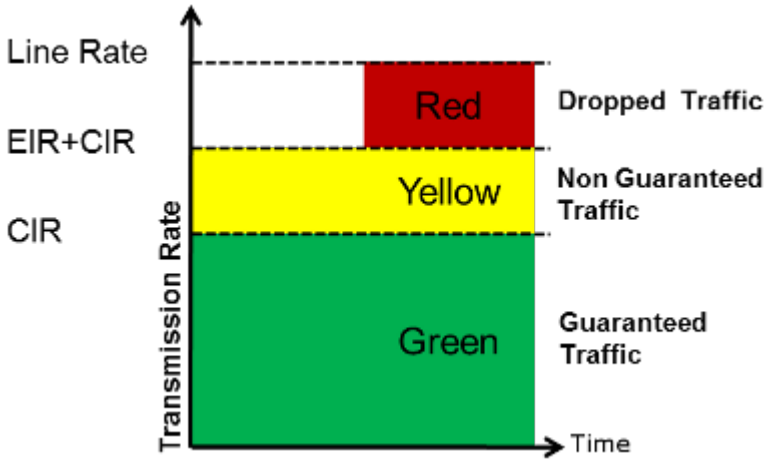
Phase 1: Service Configuration Test

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

5.5.1 V-SAM Setup

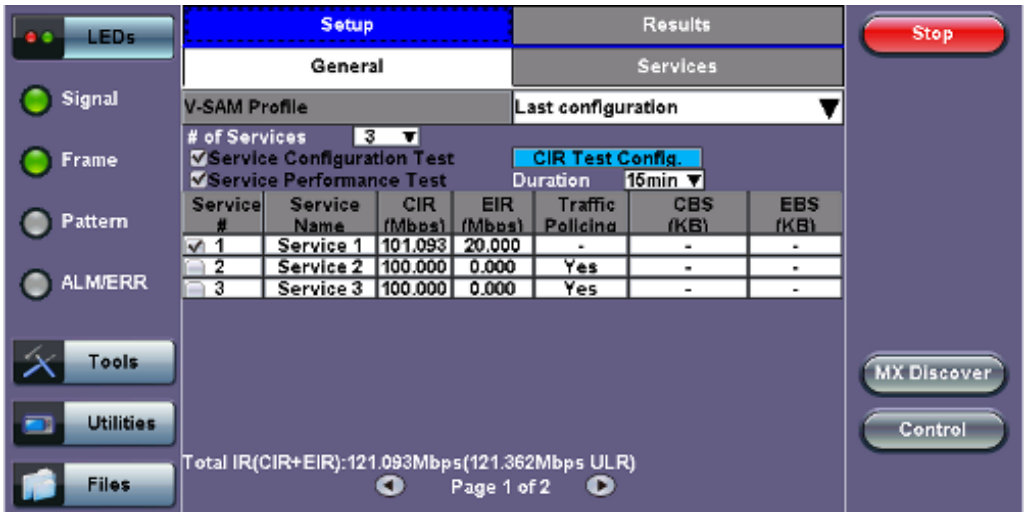
General (Page 1 and 2)

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

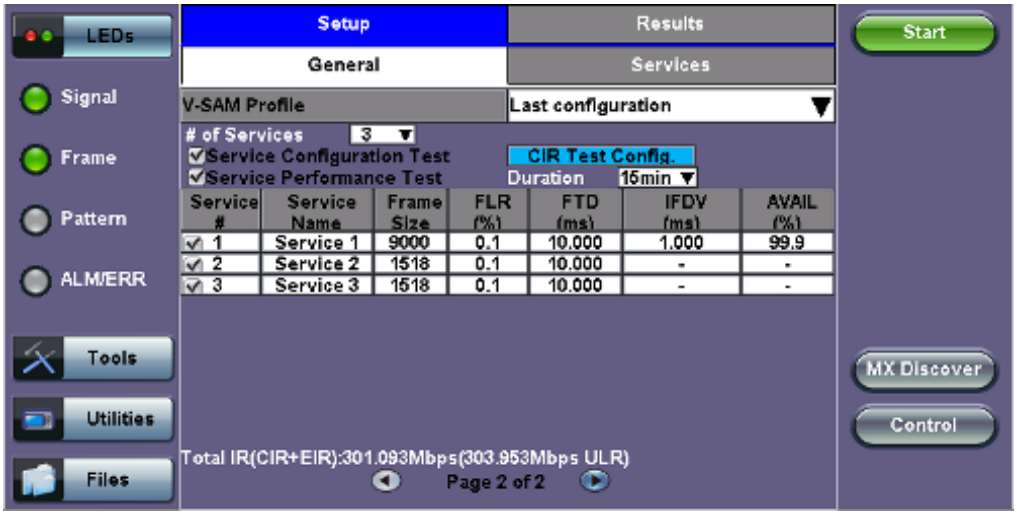
Enabling/Disabling Tests

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)

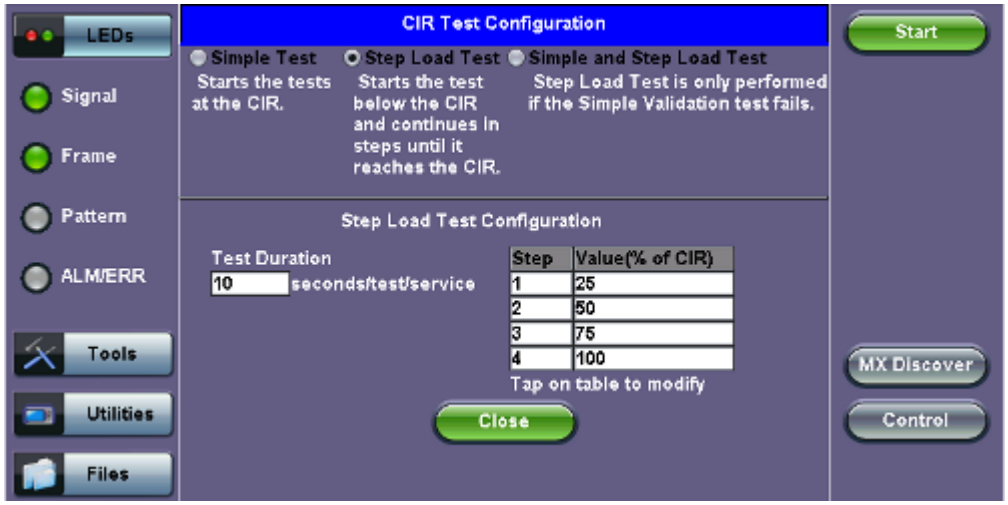


Go back to top Go back to TOC

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



Go back to top Go back to TOC

5.5.1.1 Header Settings

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

    Any EMIX configuration of 5 frames is allowed.
- **Encapsulation Type:** None, Provider Backbone Bridge (PBB-TE), or Multiprotocol Label Switching (MPLS-TP). MPLS-TP is a simplified version of MPLS. Provider Backbone Bridge MAC-in-MAC (IEEE 802.1ah) encapsulation are configured trunks

that add resiliency and configurable performance levels in the provider backbone network. Both options are available for 1GE Copper/Fiber and 10GE port for all Ethernet tests (Layer 2,3 and 4) - BERT, RFC2544, Throughput, V-SAM.

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

PBB:

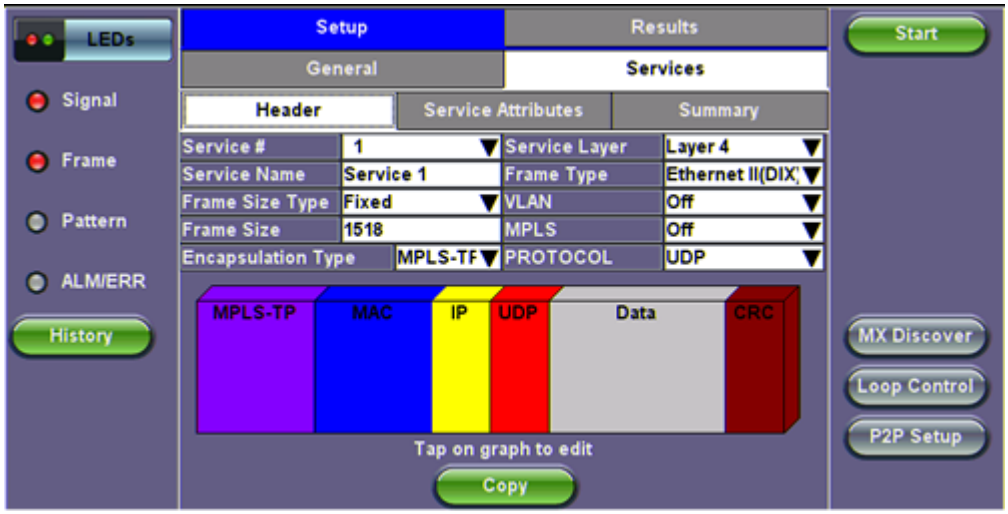
- Backbone MAC Source
- Backbone MAC Destination
- Ethernet Type
- I-SID
- VLAN ID, Priority, Type

MPLS-TP:

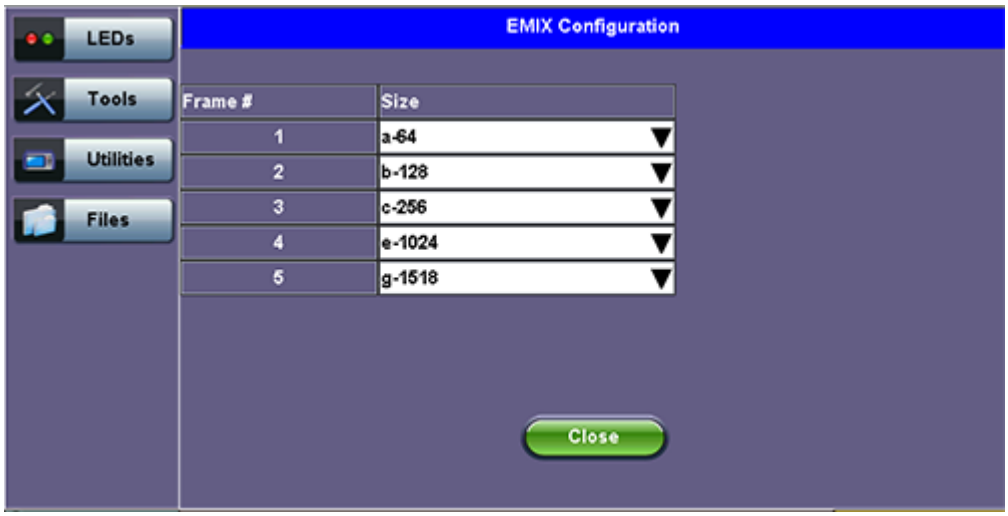
- MPLS-TP MAC Source
- MPLS-TP MAC Destination
- Ethernet Type
- VLAN ID, Priority, Type
- LSP, PW, CW

After making changes, tap **Apply to All**, for MPLS-TP configuration.
Please see RFC 2544 Setup and follow the setup procedure to configure the remaining Header Settings for V-SAM.

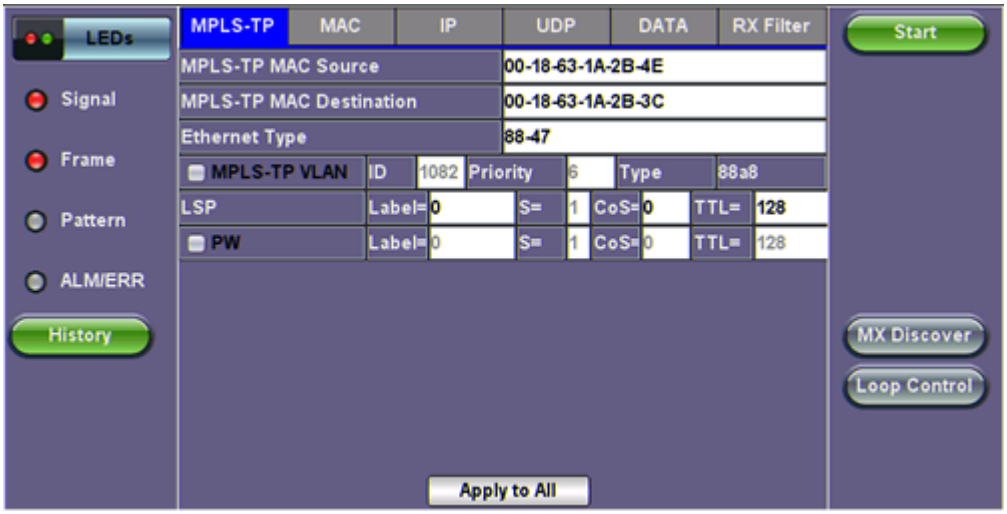
V-SAM Setup - Services - Header Settings



V-SAM Setup - Services - EMIX Frame Size Settings



V-SAM Setup - Services - MPLS-TP Settings



Go back to top Go back to TOC

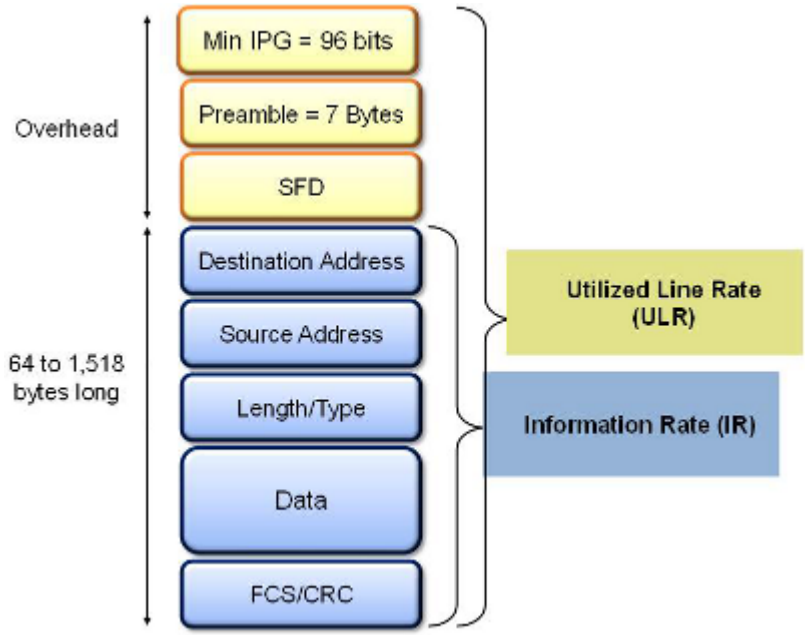
5.5.1.2 Service Attributes

Bandwidth Profile Parameters

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

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

V-SAM Services - Header

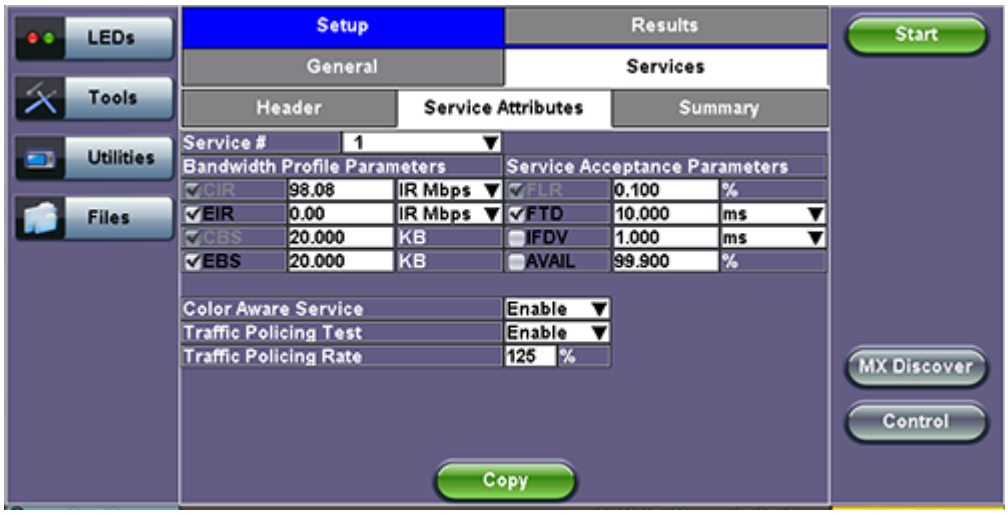


- **Excess Information Rate (EIR):** Maximum rate above the CIR at which the customer can send frames that will be forwarded on a best effort basis, but may be dropped in the event of congestion within the network. The combined CIR and EIR must not exceed the line bandwidth. Traffic beyond CIR + EIR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

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

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

V-SAM Setup - Services - Service Attributes



Enabling/Disabling Tests

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

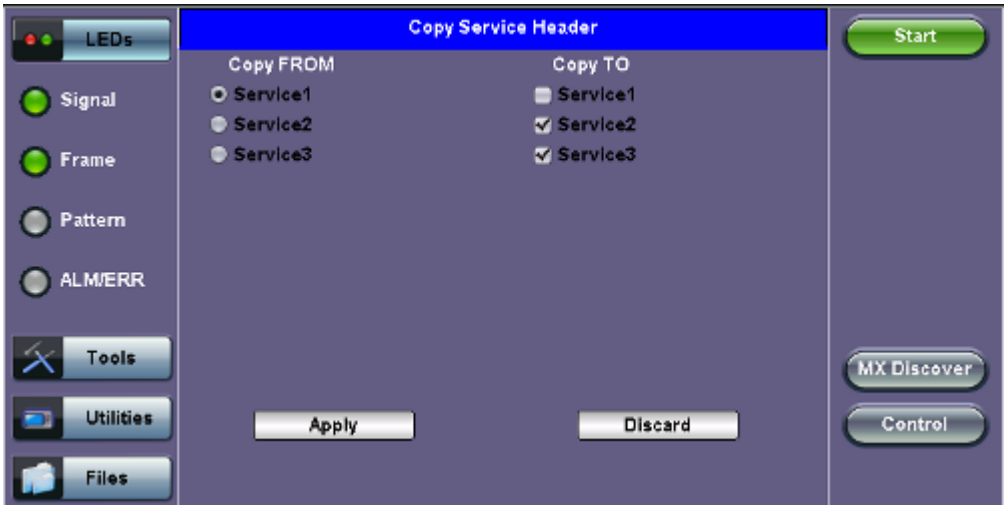
Go back to top Go back to TOC

Service Acceptance Parameters

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

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

Copying Services



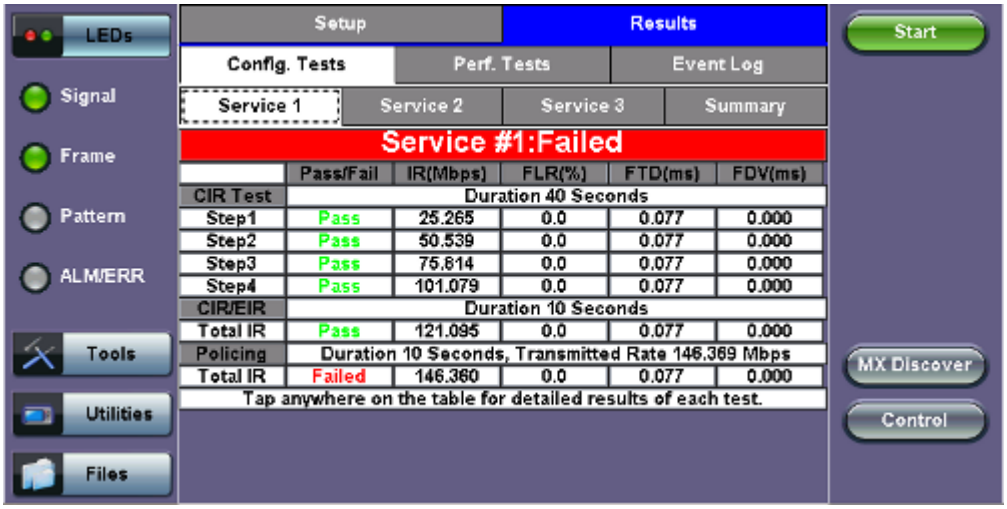
Copying Services

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

Go back to top Go back to TOC

5.5.2 Results

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.

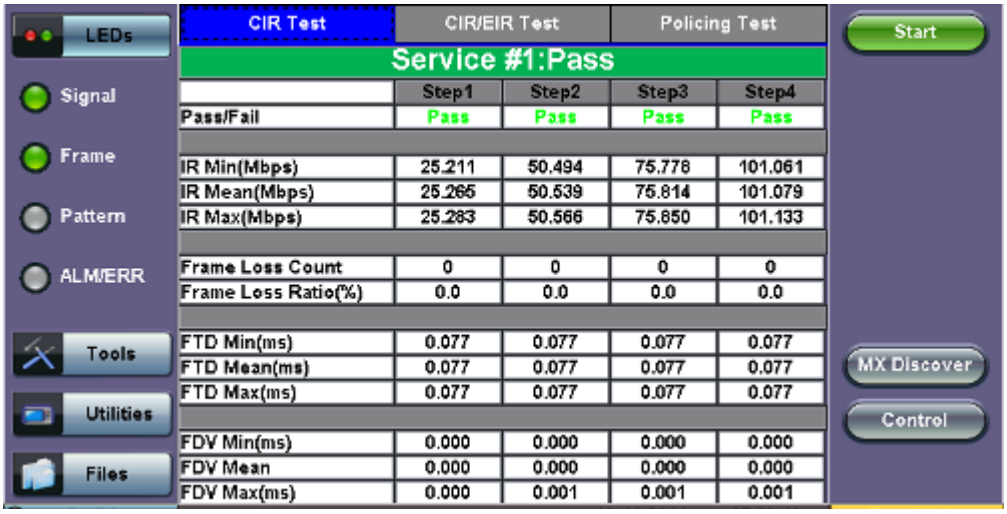
Configuration Test

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.

CIR Test - Service 1

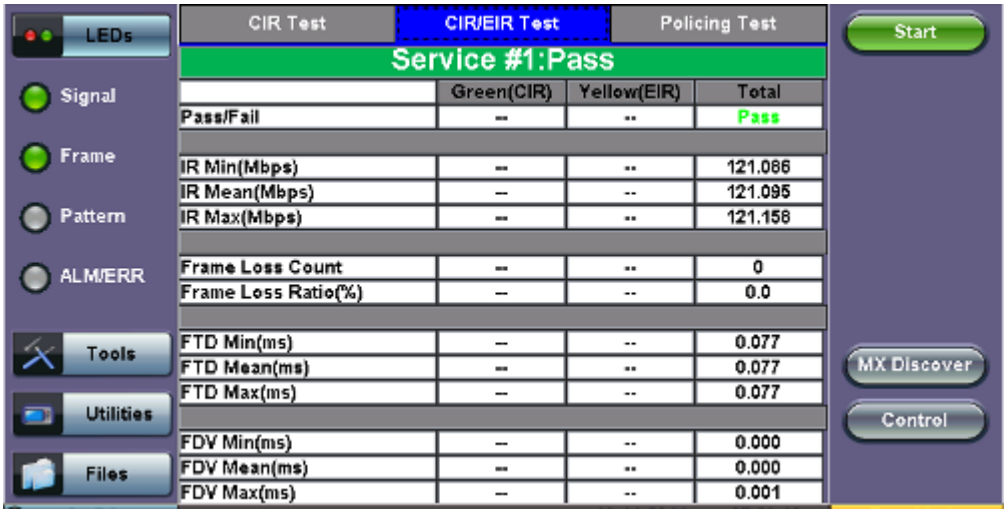


Service #1:Pass

	Step1	Step2	Step3	Step4
Pass/Fail	Pass	Pass	Pass	Pass
IR Min(Mbps)	25.211	50.494	75.776	101.061
IR Mean(Mbps)	25.265	50.539	75.814	101.079
IR Max(Mbps)	25.283	50.566	75.850	101.133
Frame Loss Count	0	0	0	0
Frame Loss Ratio(%)	0.0	0.0	0.0	0.0
FTD Min(ms)	0.077	0.077	0.077	0.077
FTD Mean(ms)	0.077	0.077	0.077	0.077
FTD Max(ms)	0.077	0.077	0.077	0.077
FDV Min(ms)	0.000	0.000	0.000	0.000
FDV Mean	0.000	0.000	0.000	0.000
FDV Max(ms)	0.000	0.001	0.001	0.001

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.

CIR/EIR Test - Service 1

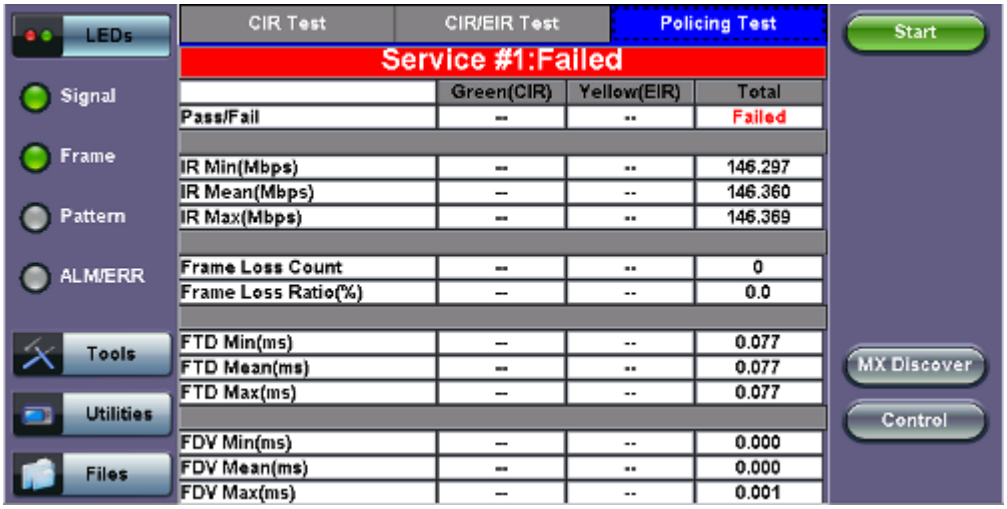


Service #1:Pass

	Green(CIR)	Yellow(EIR)	Total
Pass/Fail	--	--	Pass
IR Min(Mbps)	--	--	121.086
IR Mean(Mbps)	--	--	121.095
IR Max(Mbps)	--	--	121.158
Frame Loss Count	--	--	0
Frame Loss Ratio(%)	--	--	0.0
FTD Min(ms)	--	--	0.077
FTD Mean(ms)	--	--	0.077
FTD Max(ms)	--	--	0.077
FDV Min(ms)	--	--	0.000
FDV Mean(ms)	--	--	0.000
FDV Max(ms)	--	--	0.001

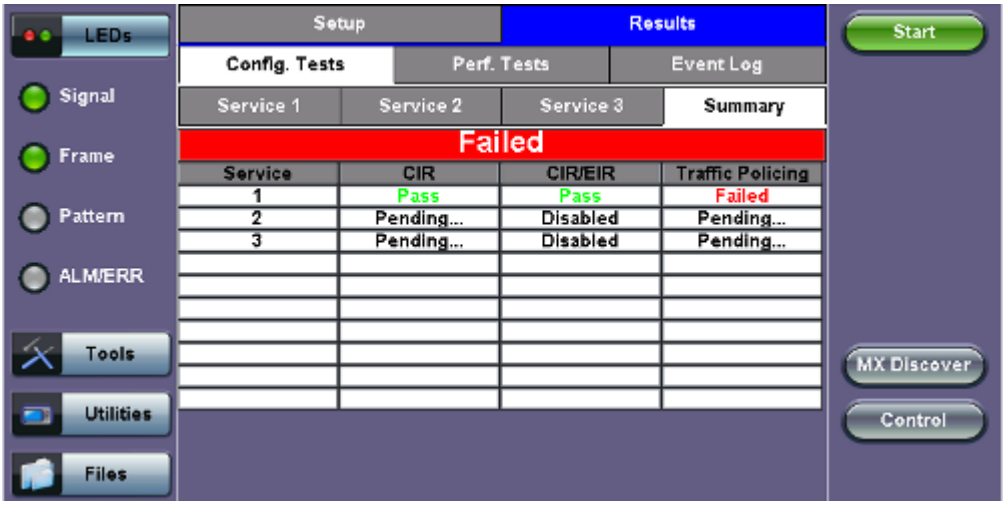
CIR/EIR test: The test passes if the received IR value is between the CIR (minus the margin allowed by the FLR) and CIR+EIR.

Policing Test - Service 1



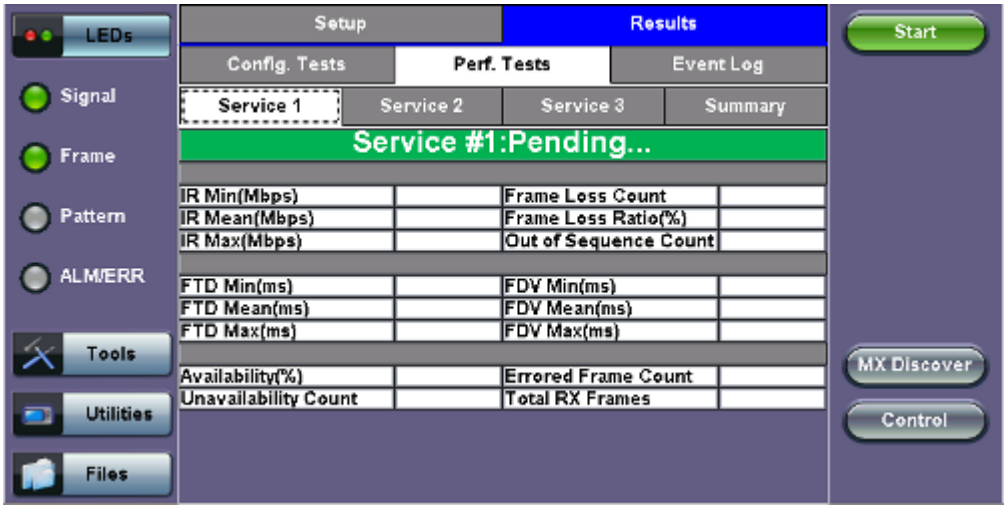
Policing test: The test passes if the received traffic rate is at least at the CIR (minus the margin allowed by the FLR) but does not exceed the allowed CIR+EIR.

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



Go back to top Go back to TOC

Performance Test

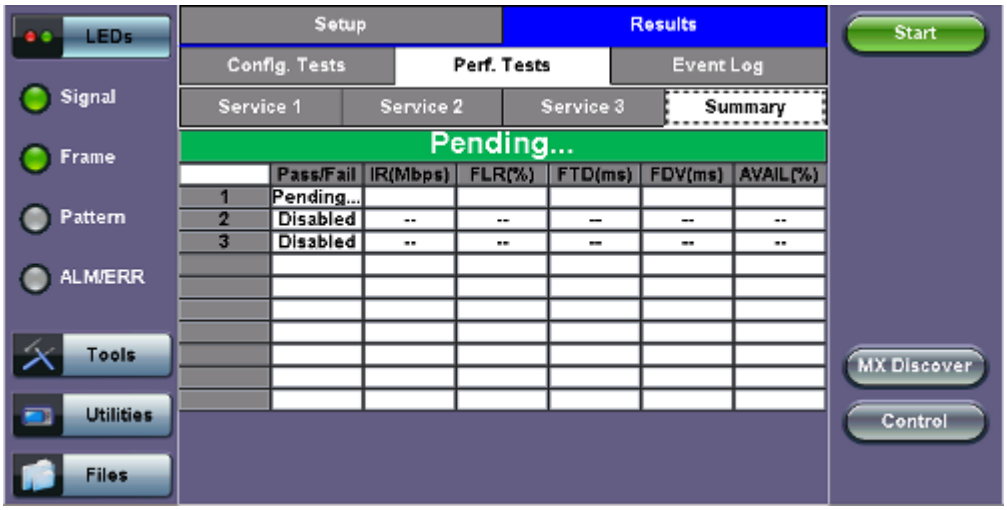
The **Service #** tabs display min, mean, and max values for **IR Mbps**, **FTD**, **FDV**, **Frame Loss Count**, **Frame Loss Ratio (%)**, **Availability**, and **Errored Frame Count**. Pass/Fail/Pending status of each test is displayed on the top of each table.

- **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**.

Perf. Tests - Summary

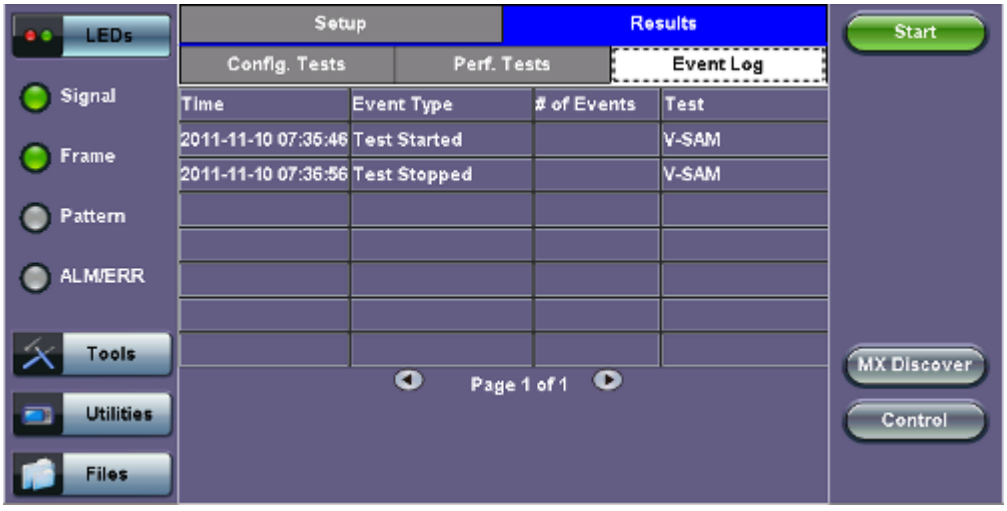


Go back to top Go back to TOC

Event Log

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

Event Log



Go back to top Go back to TOC

5.6 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.

Go back to top Go back to TOC

5.6.1 Setup

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

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

Go back to top Go back to TOC

5.6.1.1 General Throughput Settings (Global Configuration)

Page 1:

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

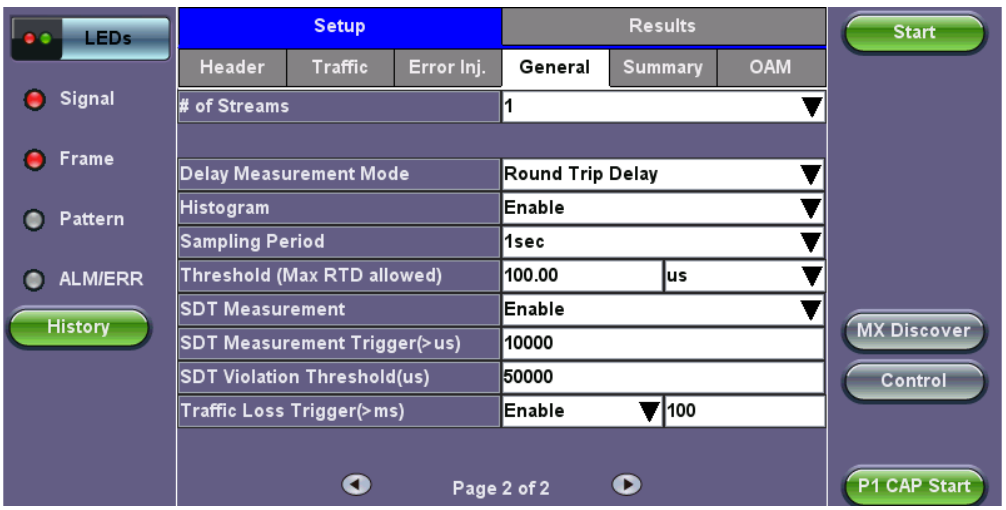
Throughput Setup - General Settings

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. Local One way delay measurement, Atomic one way delay, or GPS one way delay are also available depending on the Clock Synchronization device selected in the **Setup (home menu) > Measurement** menu. Refer to Measurement Settings for more information. Round Trip Delay should only be enabled when running the test to a remote loopback.
- **Histogram:** Enable / Disable
- **Sampling Period:** 1sec, 10secs, 30secs, 1min, 10min, 30min, 1hr. Defines how often the RTD (round trip delay) measurement is evaluated against the RTD threshold.
- **Threshold (Max RTD allowed):** Input the value in us, ms or sec. Defines the maximum allowed round trip delay value. If the RTD value exceeds the threshold, an event is logged with corresponding time stamp.
- **SDT Measurement**: Enable/Disable. The Service Disruption Test is triggered based on user established thresholds.
  - ***SDT Measurement Trigger (>us)***: Any inter-frame gap that is equivalent or greater than the configured threshold will trigger the SDT measurement. This is useful if a known threshold is expected from a given network under test. For example, if the known switchover time is 50ms, the trigger can be set to a value slightly below 50ms to assure that the SDT is measured.
  - ***SDT Violation Threshold (us)***:Triggers an SDT Violation event in the event log. This is helpful for historical purposes during any given test. If the measured SDT is equivalent or greater than the configured threshold an SDT Violation event is counted.
- **Traffic Loss Trigger:** If the receiver does not detect incoming traffic within the configured threshold time, a traffic loss trigger is recorded in the event log.
- **RTD Unit Auto Scale:** On/OFF

Throughput Setup - General Settings (Page 2)



Multiple Streams

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

Go back to top Go back to TOC

5.6.1.2 Per Stream Configurations

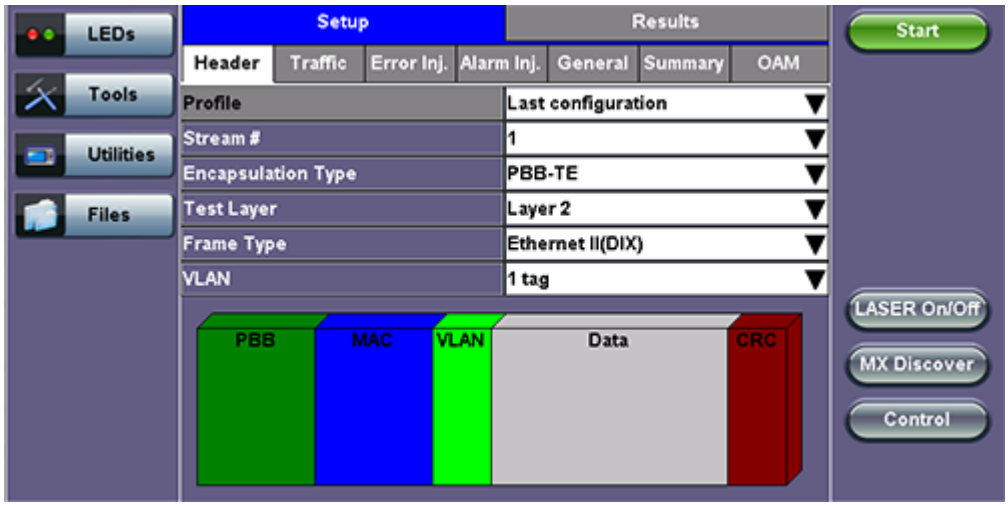
MAC Setup

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

- **Source (SRC) and Destination (Dest) flooding:** Enable or Disable.
- **Flood Range:** Specifies the number of MAC source and/or destination addresses. Enter a number from 0-4095. The source and/or destination MAC addresses will be incremented by 1 until it reaches the number of times entered in the flood range.

For information on header configuration please see BERT Header Settings in the BERT section.

Throughput Setup - Header Settings per Stream



Multiple Streams - MAC/IP Address Setup

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

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

Go back to top Go back to TOC

5.6.1.3 Traffic Settings (Per Stream Configuration)

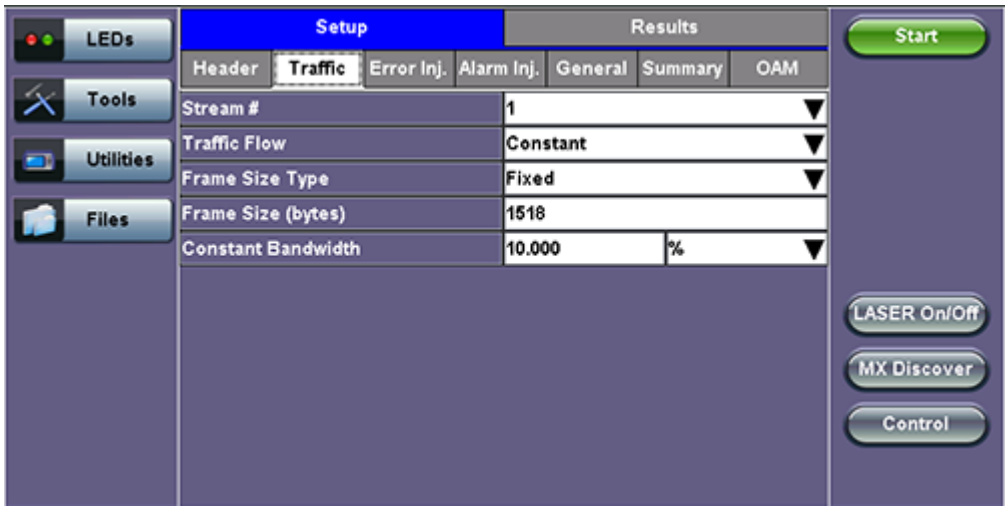
In the Traffic tab the user is able to configure the traffic profile per stream, including frame size selection, traffic type, and transmit rate.

- **Stream #:** Select a stream number to configure.
- **Traffic Flow:** Select from Constant, Ramp, Burst, or Single Burst traffic flow.
- **Frame Size (Type):** Fixed or Uniform. If uniform is chosen, the user will have to input a minimum and maximum frame size.
- **Frame Size (bytes):** If a fixed frame size is chosen, this option is enabled. Enter the frame size when a Layer 2 or 3 is selected. Frame sizes can be from 64bytes to 1518bytes, in addition to jumbo frames up to 10k bytes.
- **BW (Transmit Bandwidth):** Configure the transmit rate for the stream.

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

For more information on Traffic Settings, please see BERT Traffic Settings.

Throughput Setup - Traffic Setup - Constant Traffic Flow



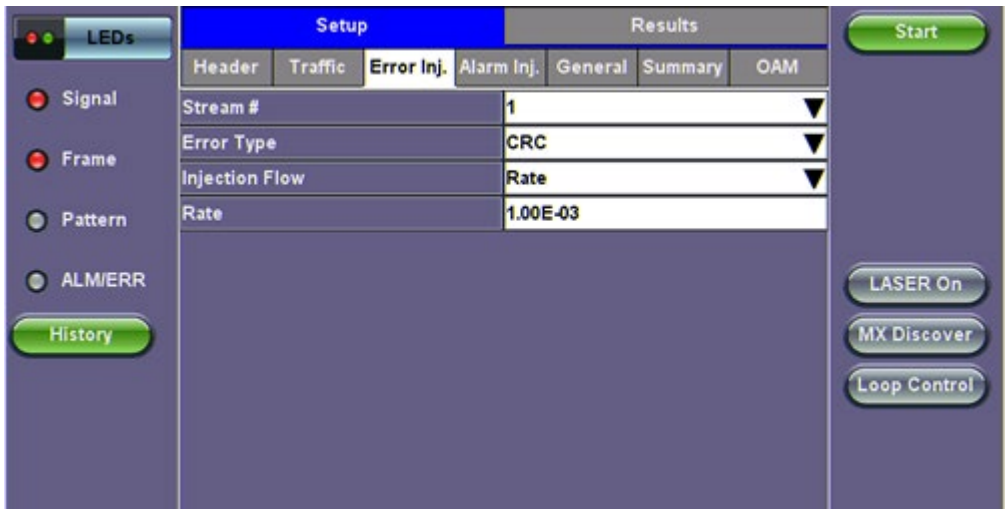
Go back to top Go back to TOC

5.6.1.4 Error Injection Settings (Per Stream Configuration)

Error injection can be performed during test. The type of errors and error injection are configured in the Error Injection tab. Once the test is running, error injection can be performed by pressing the **Error Inject** button on the right side of the screen.

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

Throughput Test - Error Injection Settings per Stream



Go back to top Go back to TOC

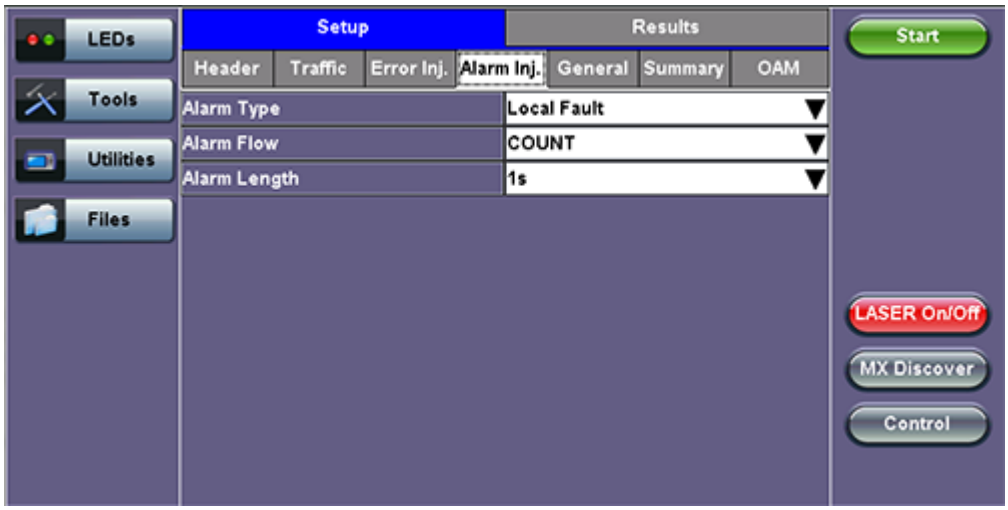
5.6.1.5 Alarm Injection Settings

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

Alarm Injection is available only with 10GE Port Tests.

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

Throughput Alarm Injection Setup

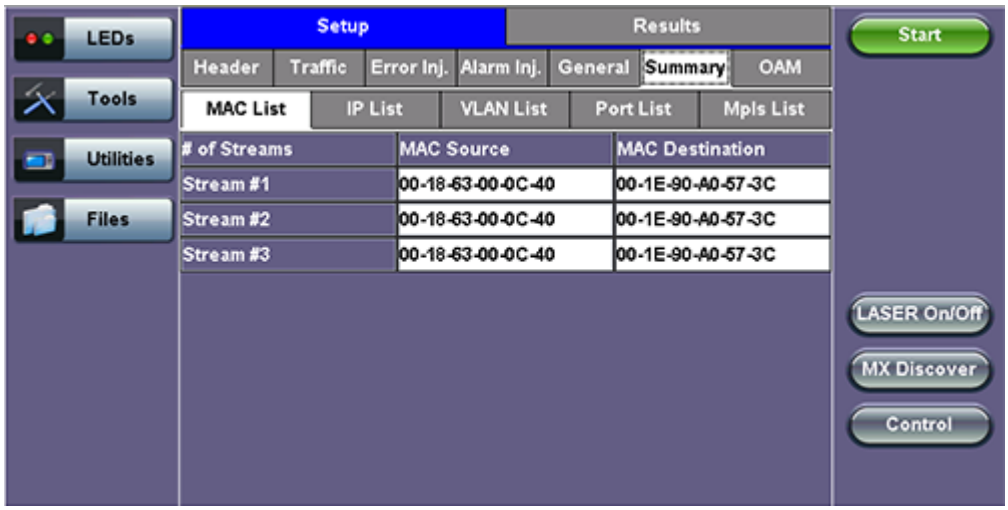


Go back to top Go back to TOC

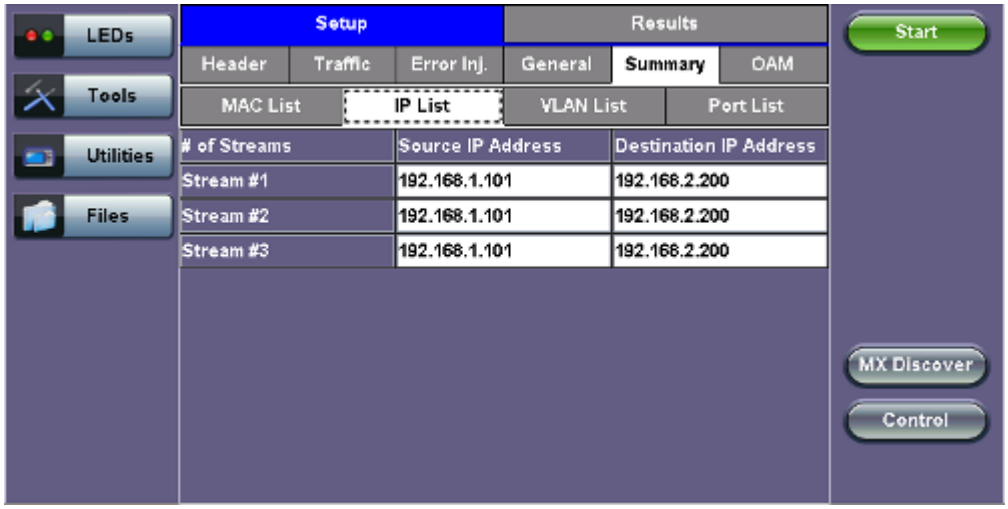
5.6.1.6 Summary

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

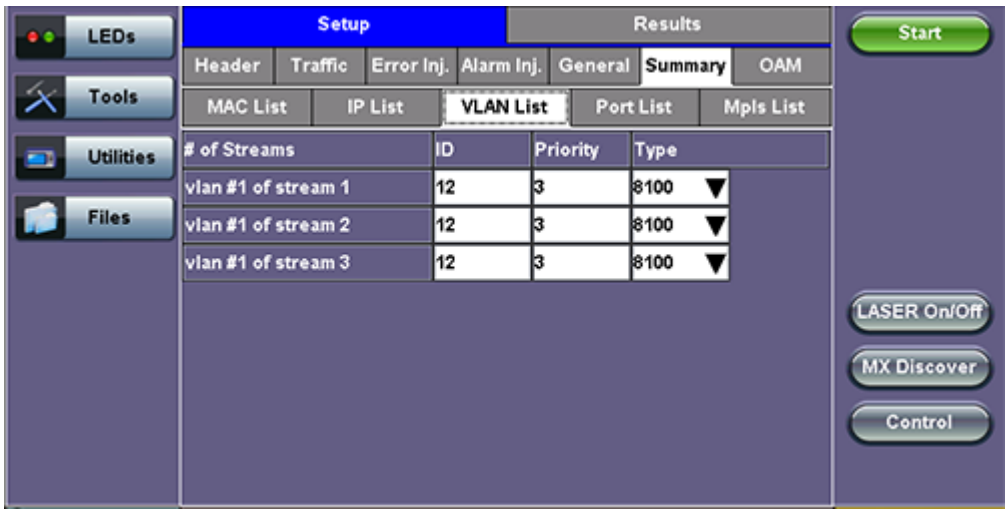
Throughput Test - Summary (MAC List)



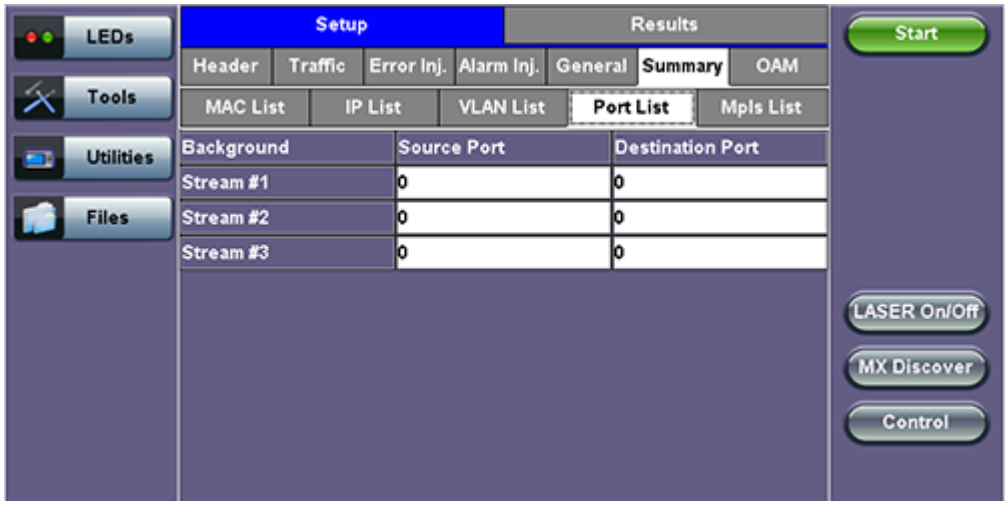
Throughput Test - Summary (IP List)



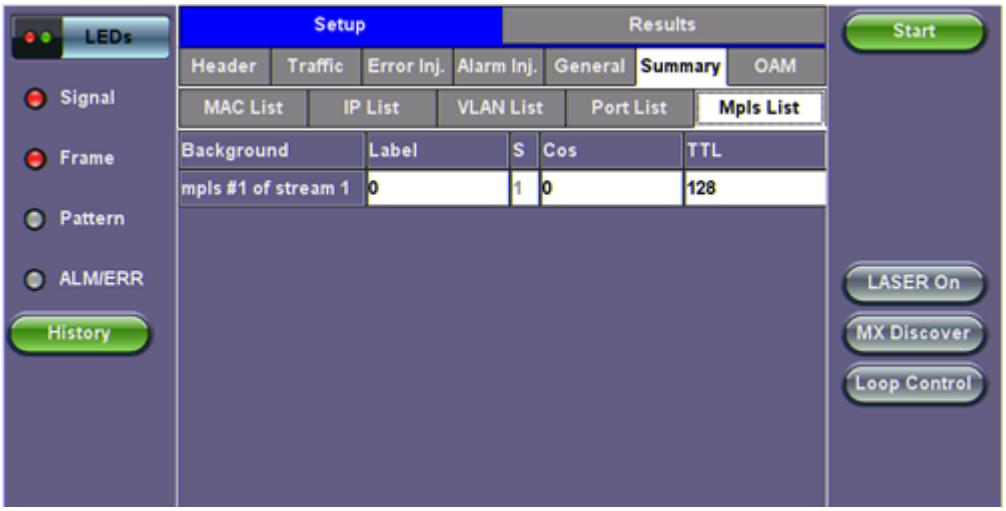
Throughput Test - Summary (VLAN List)



Throughput Test - Summary (Port List)

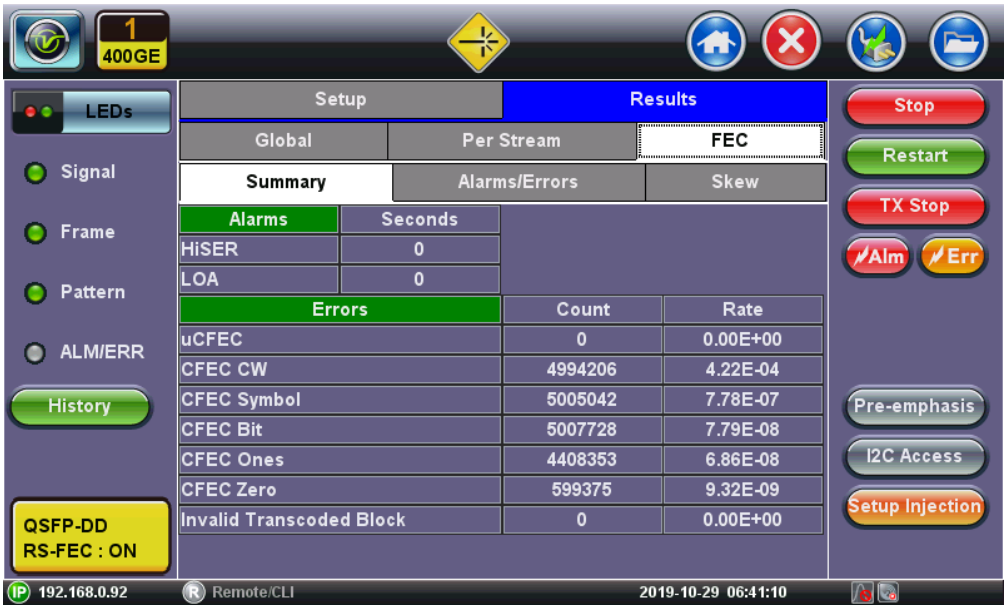


Throughput Test - Summary (MPLS List)

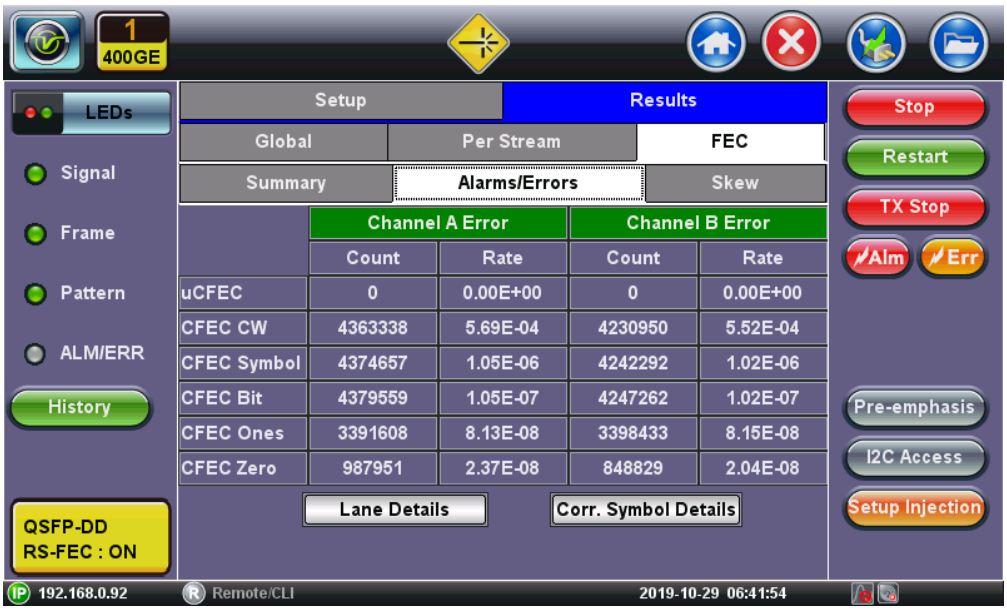


5.6.1.7 FEC

Throughput Test - FEC Summary

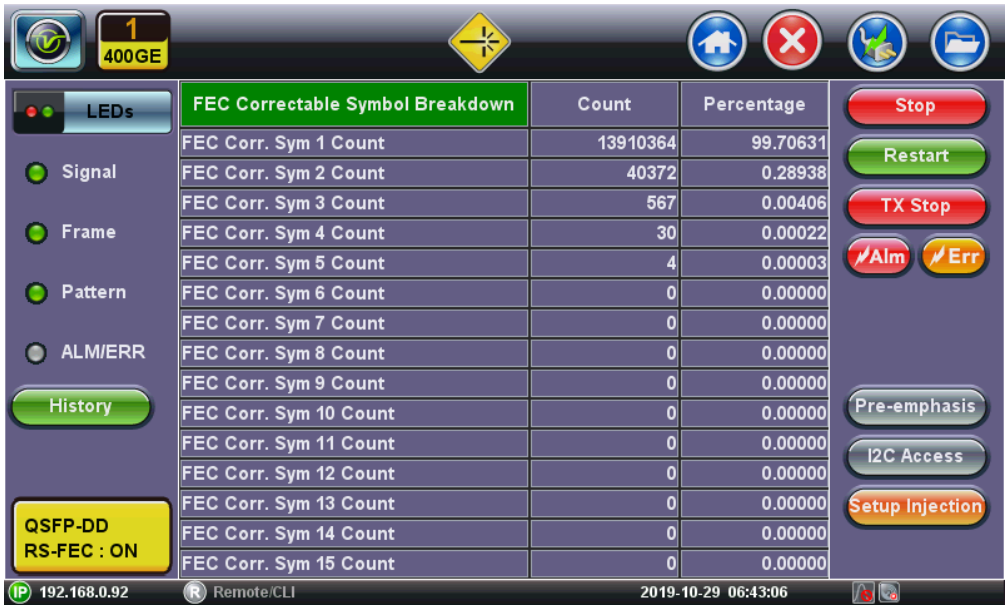


Throughput Test - FEC Alarm/Errors



Throughput Test - FEC Alarm/Errors Lane Details

Throughput Test - FEC Alarm/Errors Corr. Symbol Details



Throughput Test - Skew

Go back to top Go back to TOC

5.6.1.8 Starting/Stopping a Throughput (Multiple Streams) Test

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

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

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

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

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

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

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

Go back to top Go back to TOC

5.6.2 Throughput Results

5.6.2.1 Viewing Throughput (Multiple Streams) Test Results

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

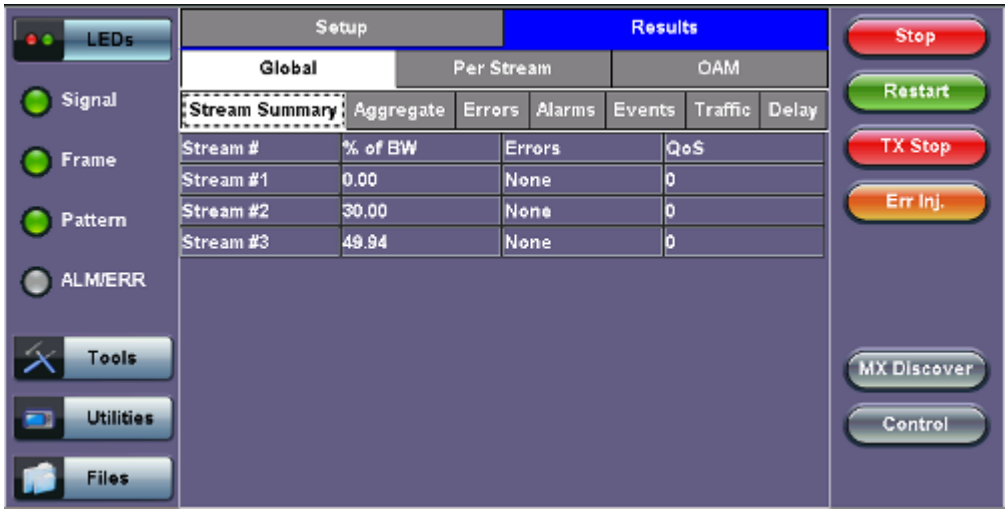
5.6.2.2 Global/Aggregate Results

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

The **Global Stream Summary** screen displays:

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

Throughput Results - Global Stream Summary



QoS

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

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

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

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

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

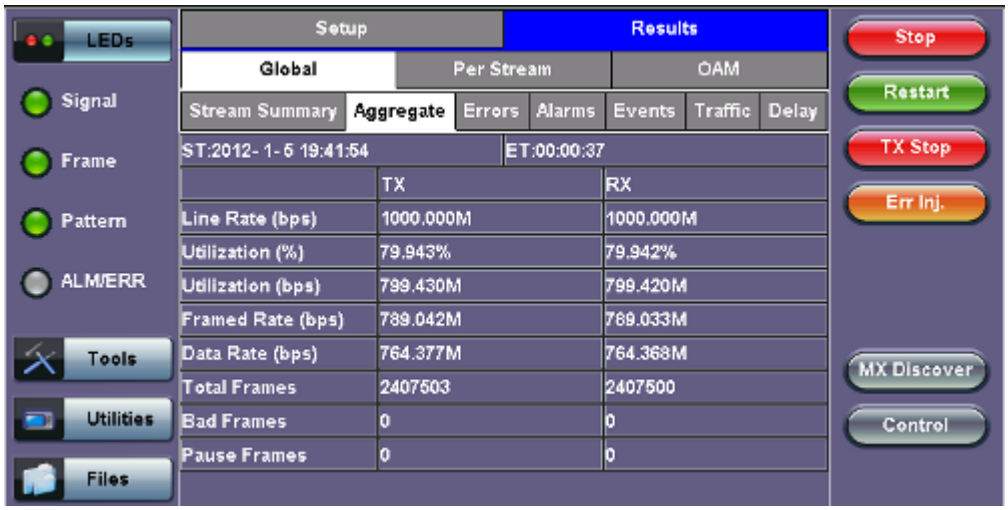
Network Performance Parameter	QoS Classes			
	Class 4	Class 5	Class 6	Class 7
IPTD	≤ 2 s / 2 (1 s one-way) **AND** > 800 ms /2	U	≤ 200 ms / 2 (100 ms one-way)	≤ 800 ms / 2 (400 ms one-way) **AND** > 200 ms/2
IPDV	U	U	≤ 50 ms	≤ 50 ms
IPLR	> 1/100,000 **AND** ≤ 1/1000	U	≤ 1 / 100,000	≤ 1/100,000
IPER	>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

Go back to top Go back to TOC

The Aggregate screen displays these parameters:

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

Throughput Results - Global Aggregate

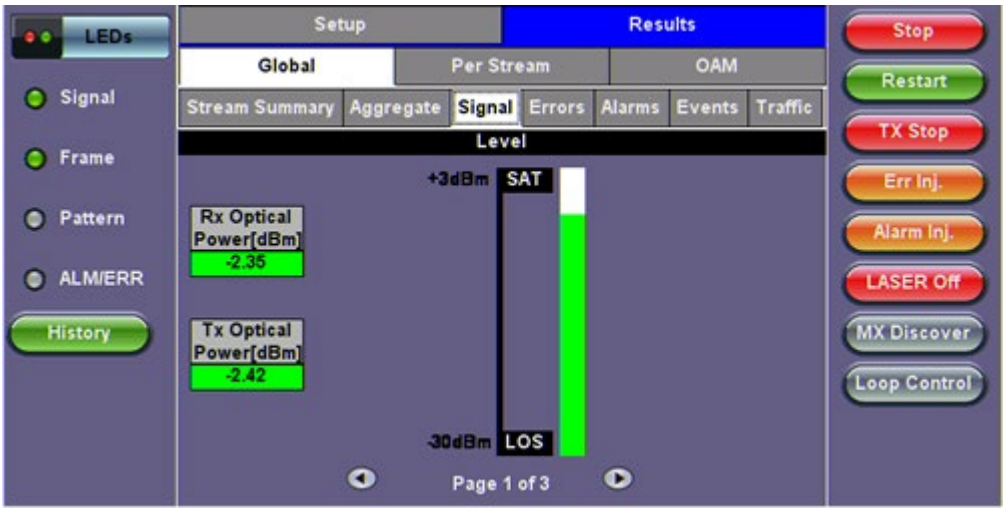


Go back to top Go back to TOC

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

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

Throughput Results - Global Signal (Page 1)



Signal (Page 2)

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

Signal (Page 3)

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

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

Go back to top Go back to TOC

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

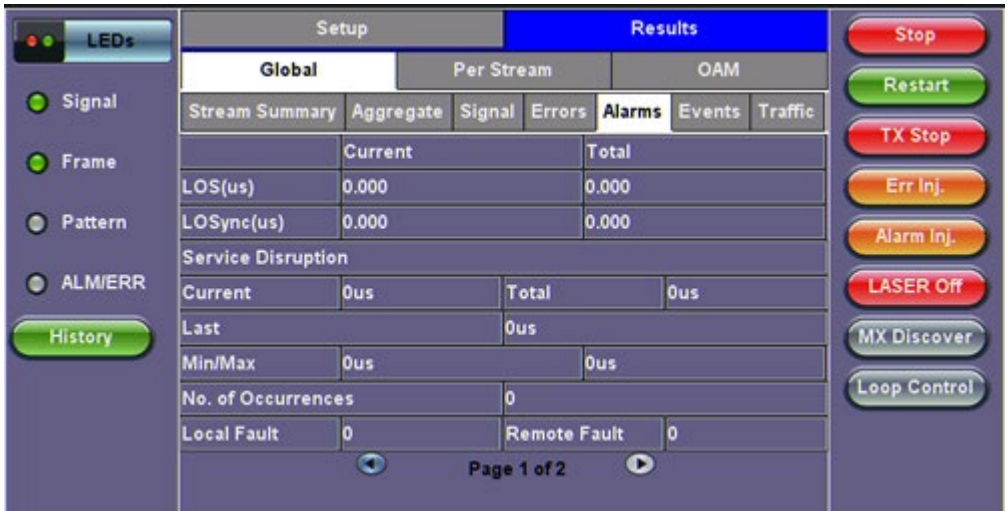
Throughput Results - Global Errors

Go back to top Go back to TOC

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

- **LOS:** Loss of Signal
- **LOSync:** Loss synchronization
- Service disruption associated with loss of signal:
  - **Current:** Duration of the current service disruption
  - **Total:** Total accumulated duration of the service disruptions
  - **Min/Max:** Minimum and maximum duration of the service disruption events
  - **No. of Occurrences:** Counter of service disruption events
- **Local/Remote Fault**
- **PCS-HI-BER:** PCS High BER
- **PCS-LOBL**: PCS Loss of Block Lock

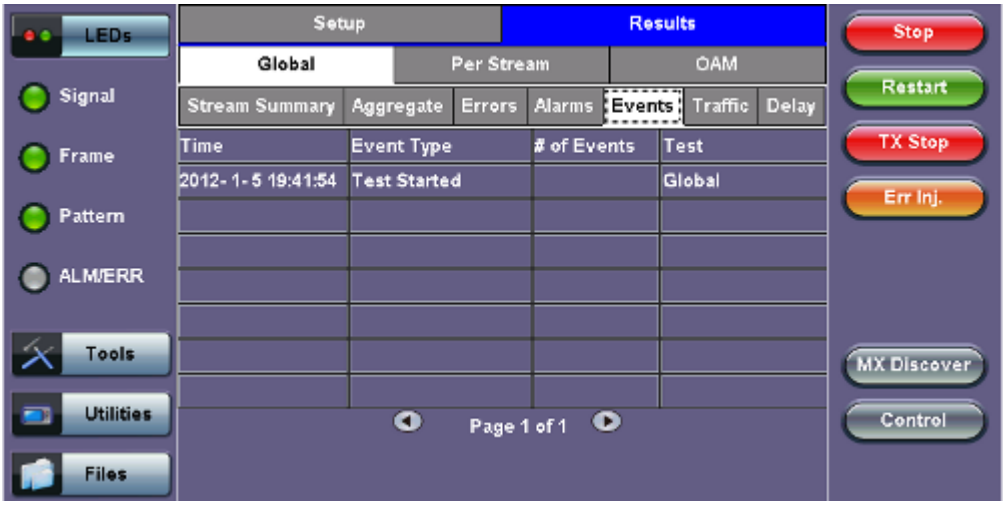
Throughput Results - Global Alarms



Go back to top Go back to TOC

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

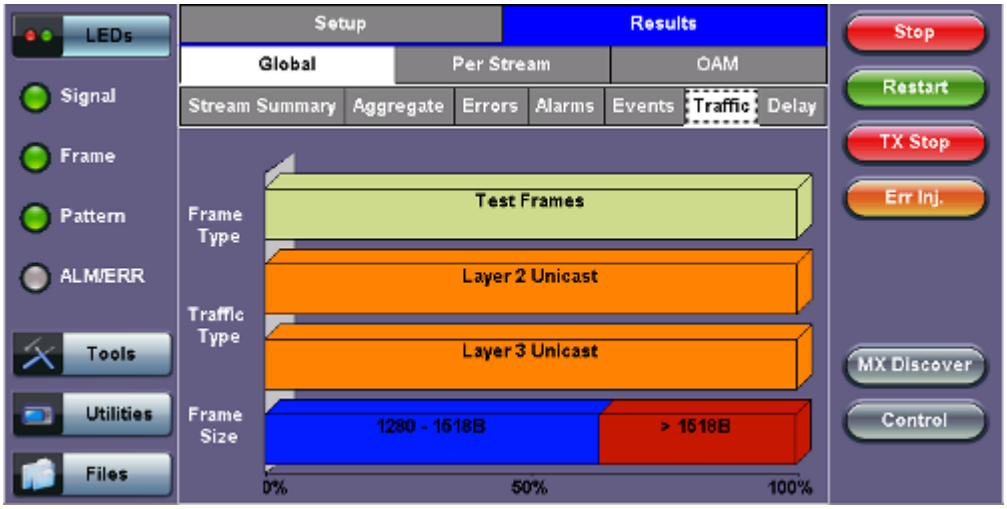
Throughput Results - Global Events



The **Global Traffic** screen displays:

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

Throughput Results - Global Traffic Summary

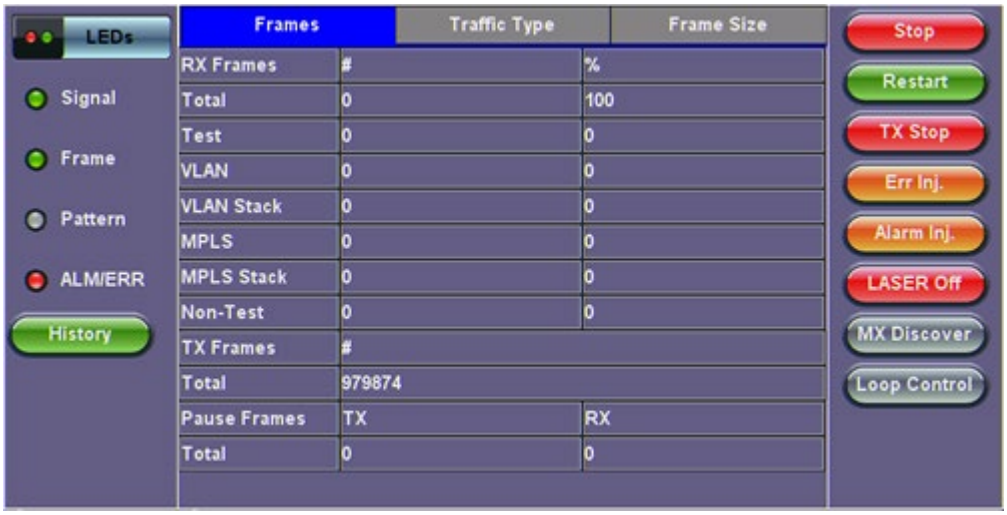


Tap on the **bar graph** for frame and traffic distribution statistics.

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

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

Throughput Results - Frames Type



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-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

Go back to top Go back to TOC

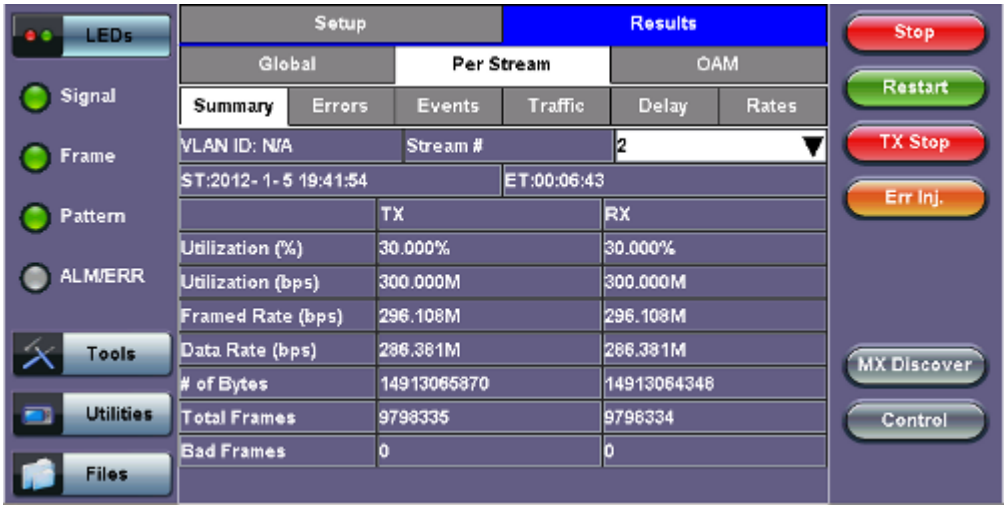
5.6.2.3 Per Stream Results

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

- **Summary:** Framed rate, data rate, # of bytes, total # of frames associated with each stream.
- **Errors:** Errors associated with each stream.
- **Service Disruption Test** results for each stream.
- **Events:** Events associated with each stream.
- **Traffic:** Traffic statistics associated with each stream.
- **Delay:** Delay associated with each stream.

  Round trip delay measurements are only available in the per-stream results screen. Round trip delay measurement requires a traffic loop at the far-end.
- **Rates:** Rate information associated with each stream.

Throughput Results - Summary per Stream



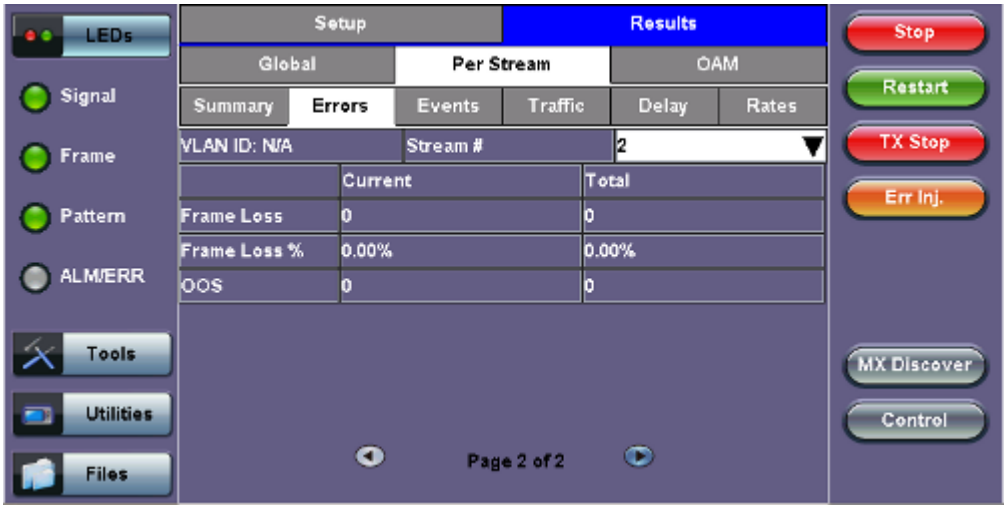
Go back to top Go back to TOC

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**

Throughput Results - Errors per Stream

Throughput Results - Errors per Stream (page 2)



Go back to top Go back to TOC

Service Disruption Test (SDT)

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

SDT Per Stream Results

Go back to top Go back to TOC

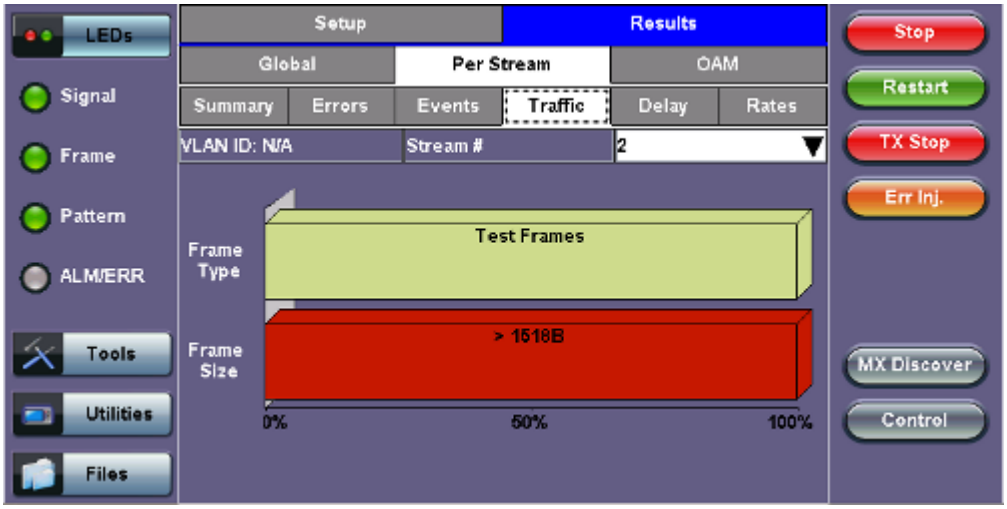
The **Per Stream Events** screen displays a Date and Time stamped record of bit errors, alarms and other anomalies pertaining to each stream.

Throughput Results - Events per Stream

Go back to top Go back to TOC

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

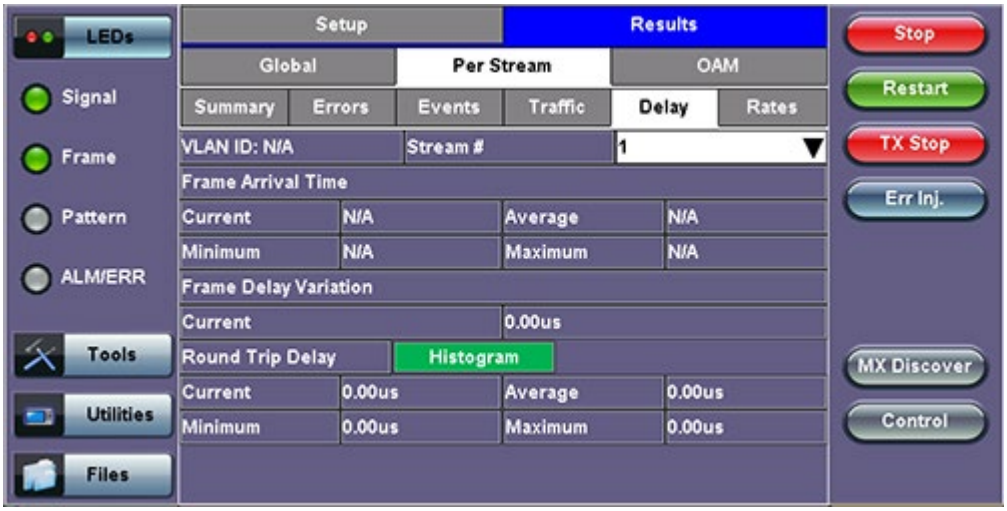
Throughput Results - Traffic per Stream



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

Round Trip Delay Results and Histogram

Throughput Results - Delay per Stream

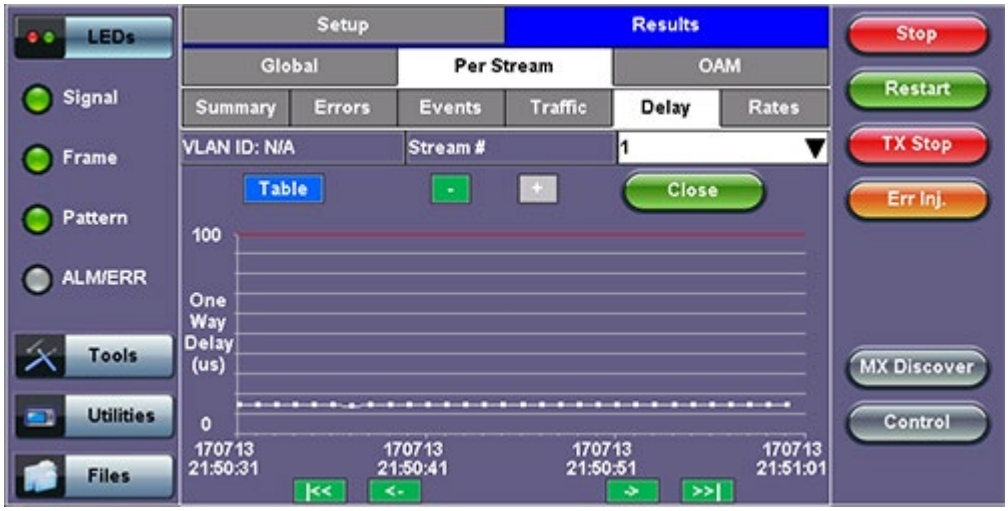


Throughput Results - Round Trip Delay Histogram

One Way Delay Results and Histogram (Table and Graph)

Throughput Results - Delay per Stream (One Way Delay)

Throughput Results - One Way Delay Histogram Graph

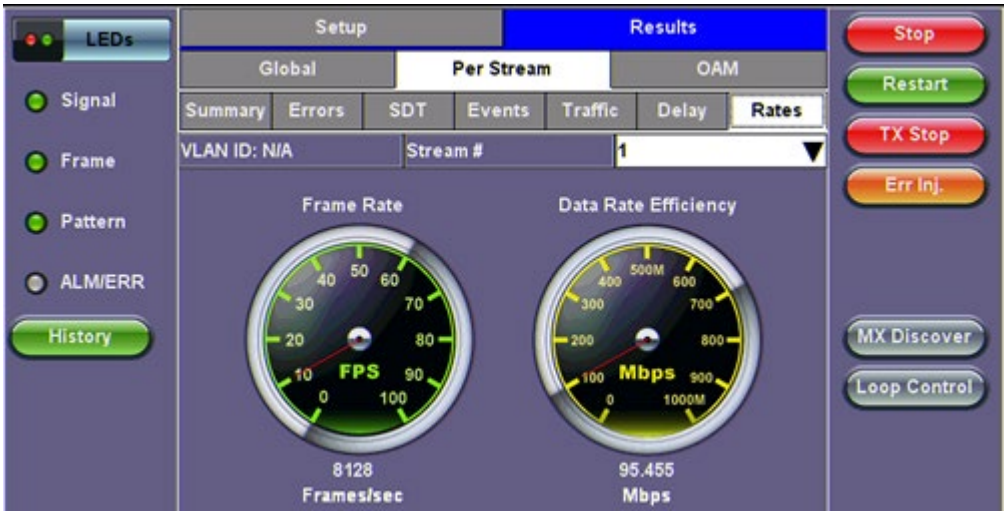


Throughput Results - One Way Delay Histogram Table

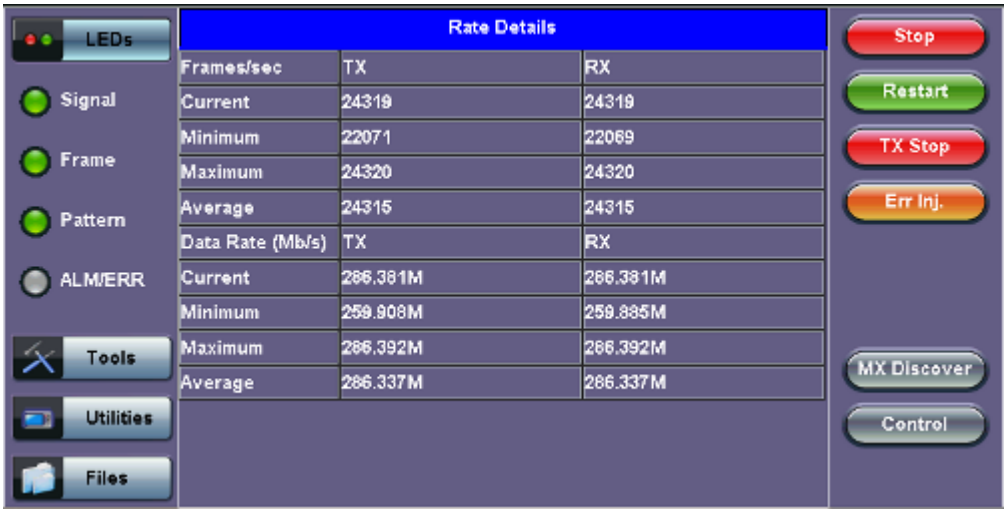
Go back to top Go back to TOC

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

Throughput Results - Rates per Stream



Throughput Results - Rates per Stream (Rate Details)



Go back to top Go back to TOC

5.6.2.4 Saving Throughput (Multiple Streams) Results

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

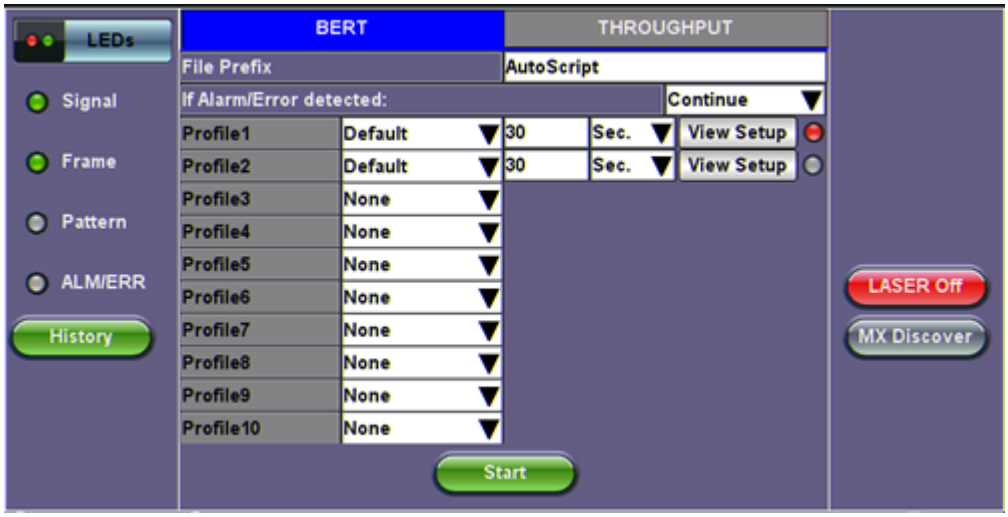
saved and named automatically. Once the results are saved, the user may view or rename the results file by going to **Utilities** > **Files** > **Saved**. For more information on retrieving saved test results, refer to **File Management** in the **TX300S, MTTplus, RXT-1200, or UX400 platform manuals** for more information.

Go back to top Go back to TOC

5.7 Autoscripting

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

Autoscripting - BERT Setup



Autoscripting Setup

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

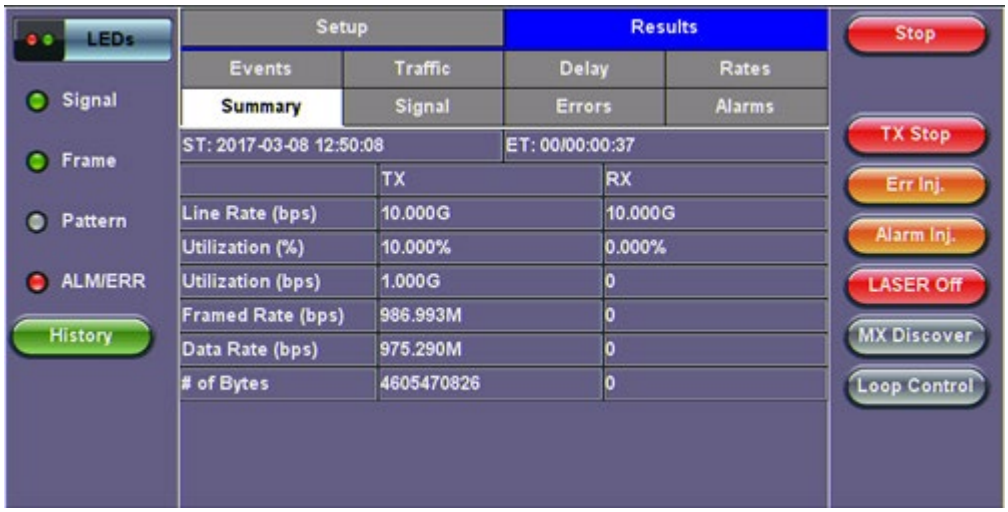
Tap on the green **Start** button to begin Autoscripting.

The soft LED light indicates the status of finished tests:

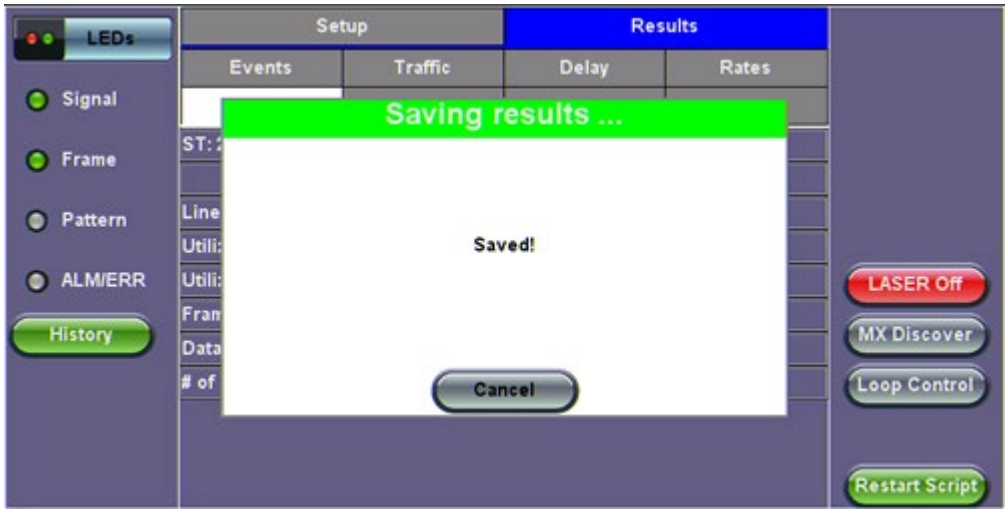
- **Green:** No error or alarm was detected.
- **Red:** An error or alarm was detected.

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

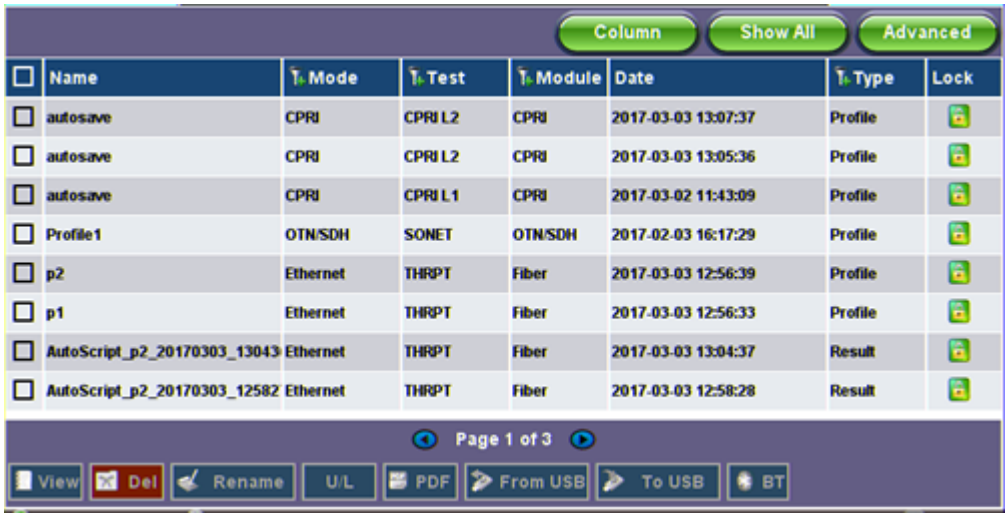
Autoscripting - BERT Results



Autoscripting - Saving Results



File Manager - Saved Results



Go back to top Go back to TOC

5.8 Packet Capture

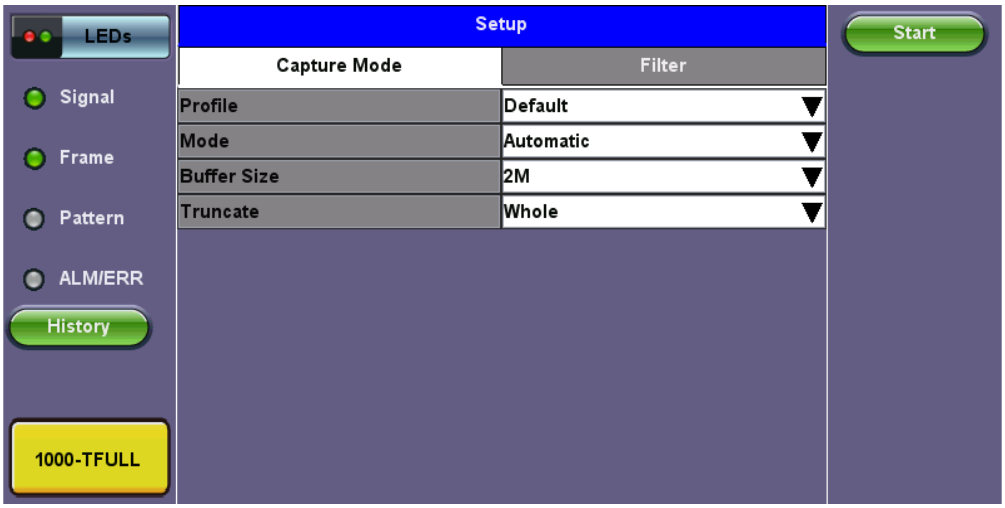
5.8.1 Packet Capture Setup

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

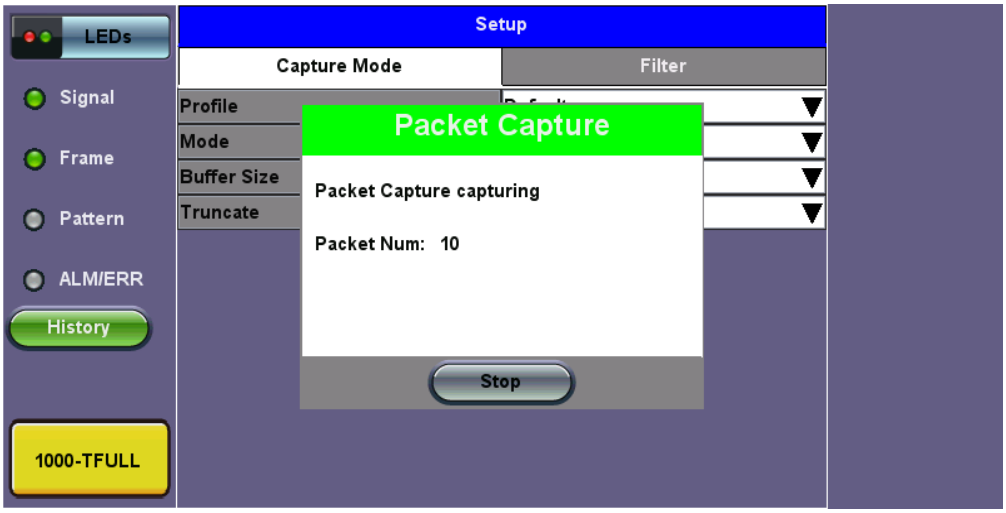
Configure the following **Capture Mode** parameters:

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

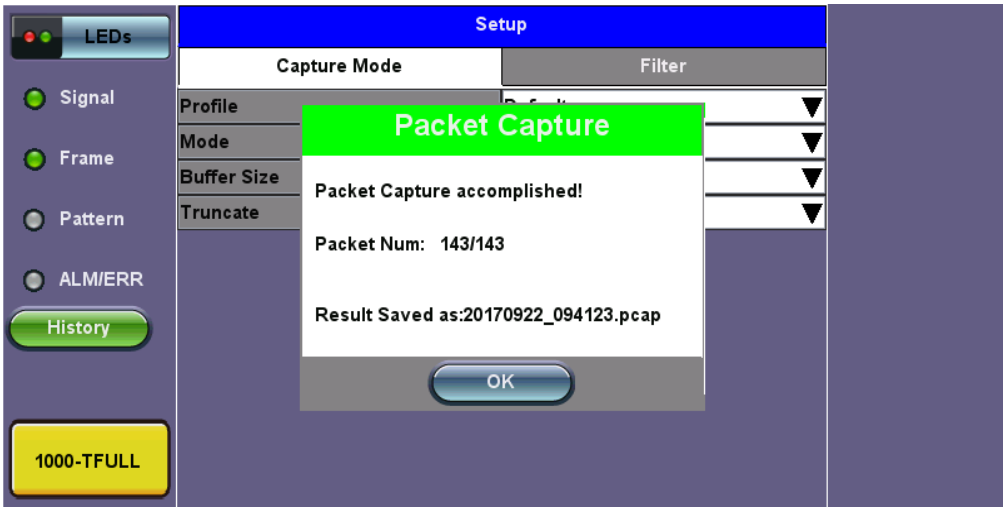
Capture Mode Setup



Packet Capture In Progress



Packet Capture Save



Select from the following Filter options:

MAC and IP Mode

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

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

Go back to top Go back to TOC

5.8.2 Packet Capture Results

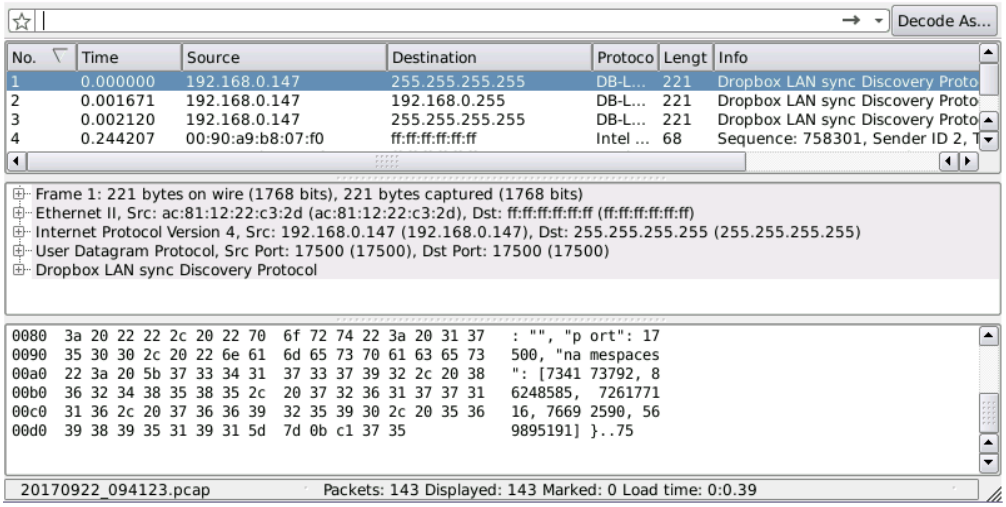
To finish packet capture and manage packet capture results, press **Stop**.

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

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

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

Packet Capture Results on Wireshark



Top section:

- Time
- Source

- Destination
- Protocol
- Length
- Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

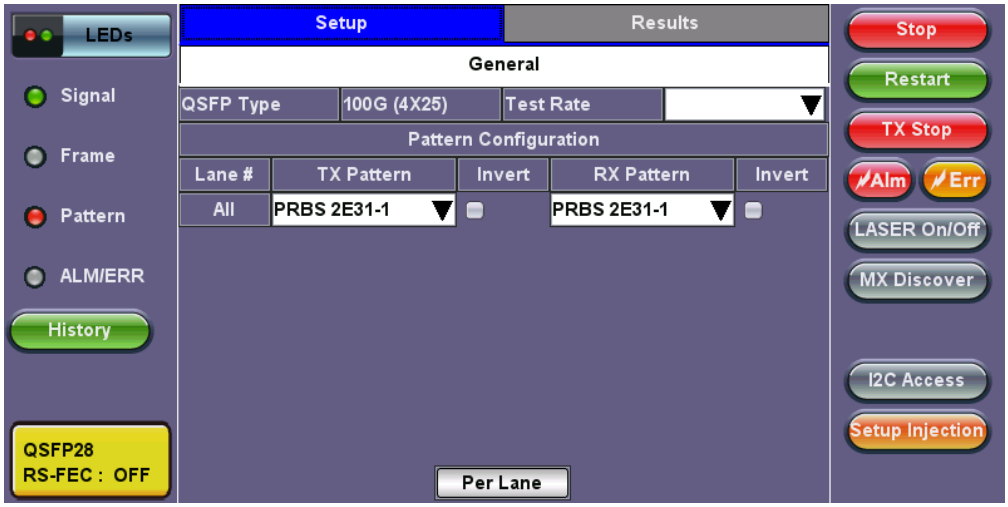
Go back to top Go back to TOC

6.0 Lane BERT

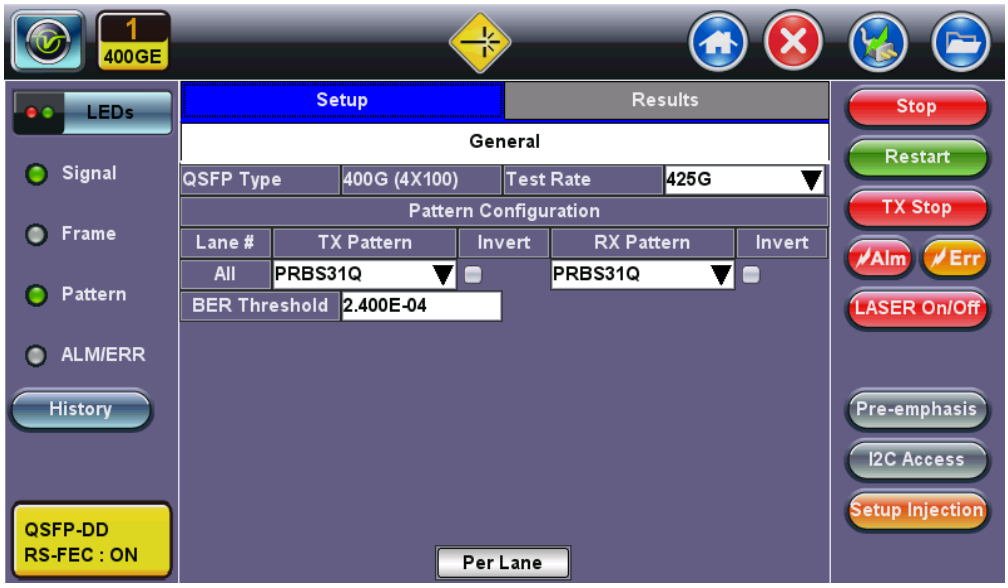
The Lane BERT test is used for validating the physical interface of the optical module (QSFP28-DD, QSFP28, QSFP+, OSFP). It helps verify the performance and integrity of the optical module by checking bit error and BER per optical lane frequency offset measurement per lane. The rates supported are dependent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

6.1 Lane BERT Setup

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



Lane BERT Setup Per Lane



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

The options to set PRBS patterns per lane or for all lanes is available in newer 40G/100G/400G modules, depending on the test set and software version.

Go back to top Go back to TOC

6.1.1 Lane BERT Results

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

Go back to top Go back to TOC

6.1.2 Lane BERT Signal

Signal (Page 1-2)

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

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

Signal (Page 1)

Signal (Page 2)

Signal (Page 3)

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

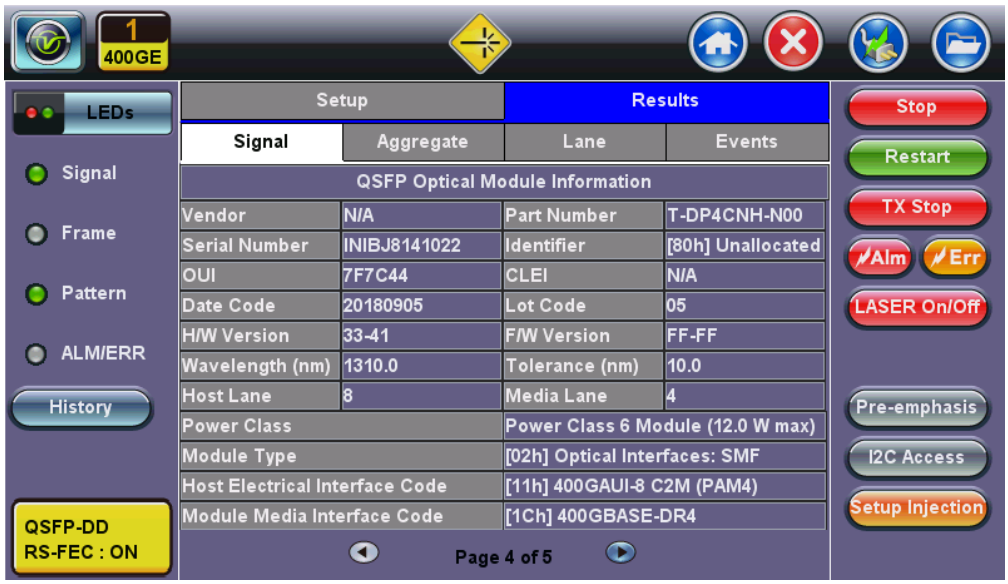
- **Current:** Indicates the frequency of the input signal.
- **Offset:** Indicates the difference between the standard rate and the rate of the input signal.
- **Min (ppm):** Indicates the difference between the standard rate and the minimum deviation detected in the input signal.
- **Max (ppm):** Indicates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

Signal (Page 3)

Signal (Page 4-5)

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

Signal (Page 4)



Signal (Page 5)

Go back to top Go back to TOC

6.1.3 Aggregate

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

Aggregate

Go back to top Go back to TOC

6.1.4 Lane

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

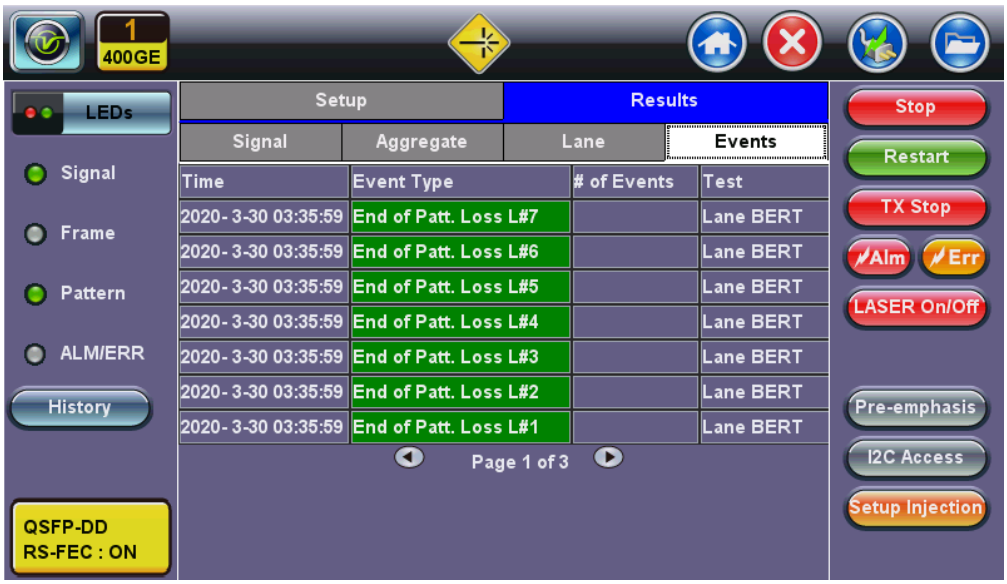
PCS Results - Alarms/Errors

Go back to top Go back to TOC

6.1.5 Events

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

PCS Results - Events



Go back to top Go back to TOC

7.0 FEC

(400G Only)

7.1 FEC Codeword Symbol Error Distribution

Monitor Mode Results

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

Go back to top Go back to TOC

7.1.1 FEC Set Up

Stress Test Setup: After configuring setup, tap **Start**.

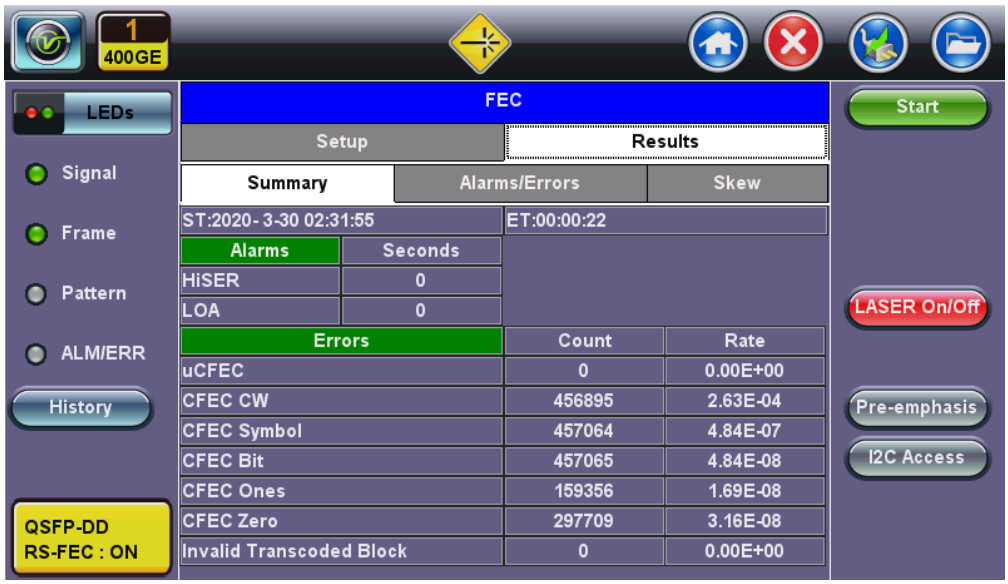
FEC Setup

Go back to top Go back to TOC

7.1.2 FEC Results Summary

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

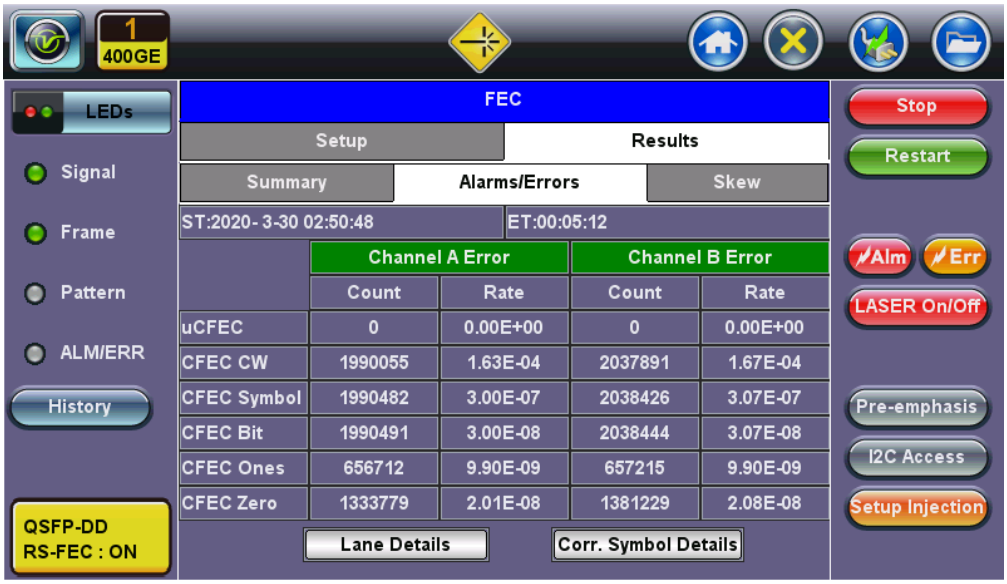
FEC Results Summary



Go back to top Go back to TOC

7.1.3 Alarms and Errors

FEC Alarms/Errors



FEC Results Alarms/Errors Lane Details

FEC Results Alarms/Errors Corr. Symbol Details

Go back to top Go back to TOC

7.1.4 Skew

FEC Skew

Go back to top Go back to TOC

8.0 PCS

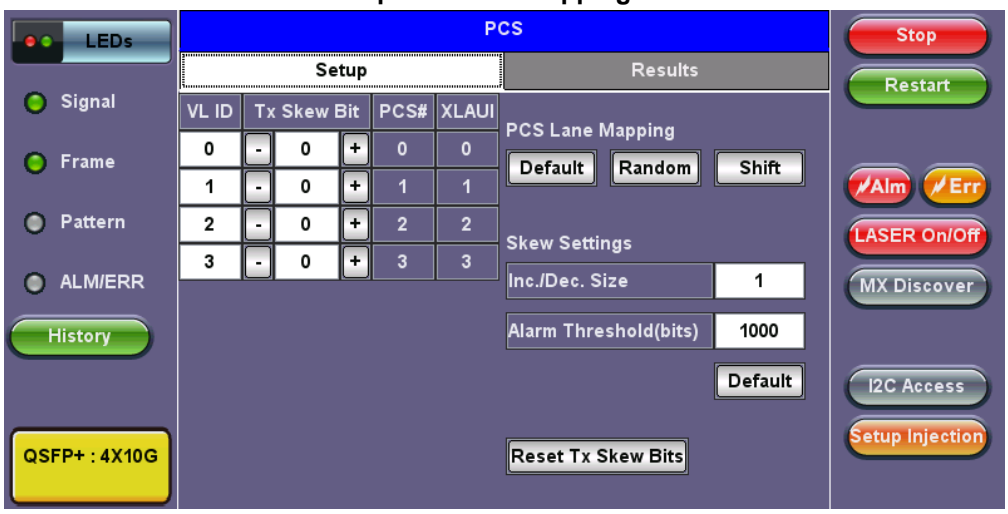
(100G Port 1 Only)

8.1 PCS Setup

8.1.1 Tx Lane Mapping and Skew

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

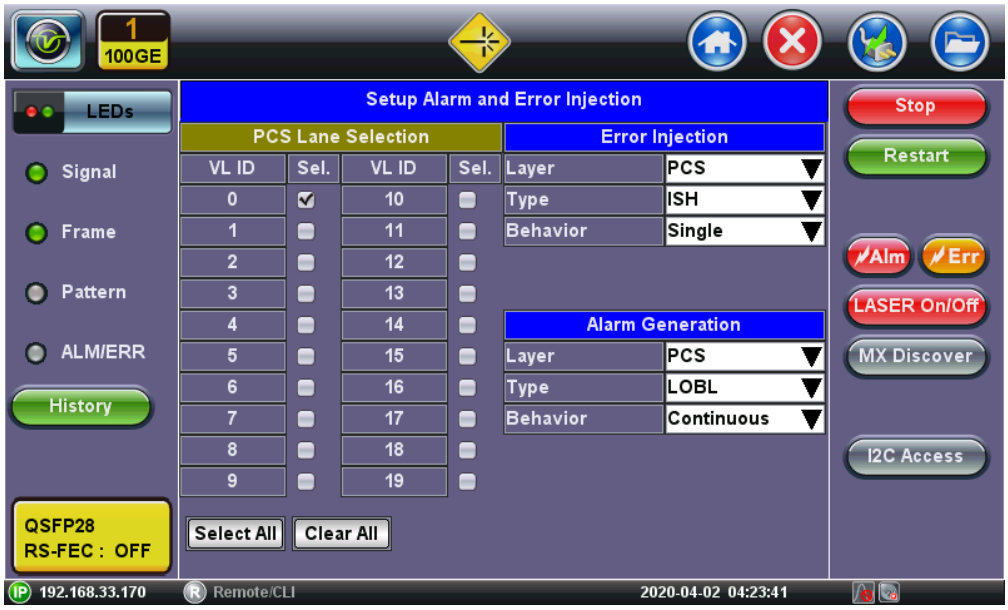
PCS Set Up - TX Lane Mapping and Skew



8.1.2 Tx Alarm/Error Injection

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

PCS Setup - Tx Alarm/ Error Injection

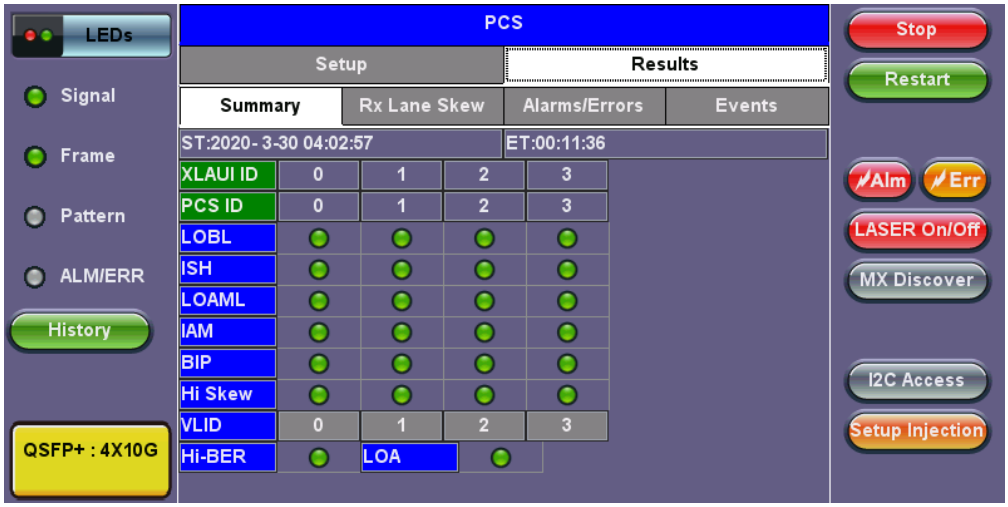


Go back to top Go back to TOC

8.2 Results

8.2.1 Summary

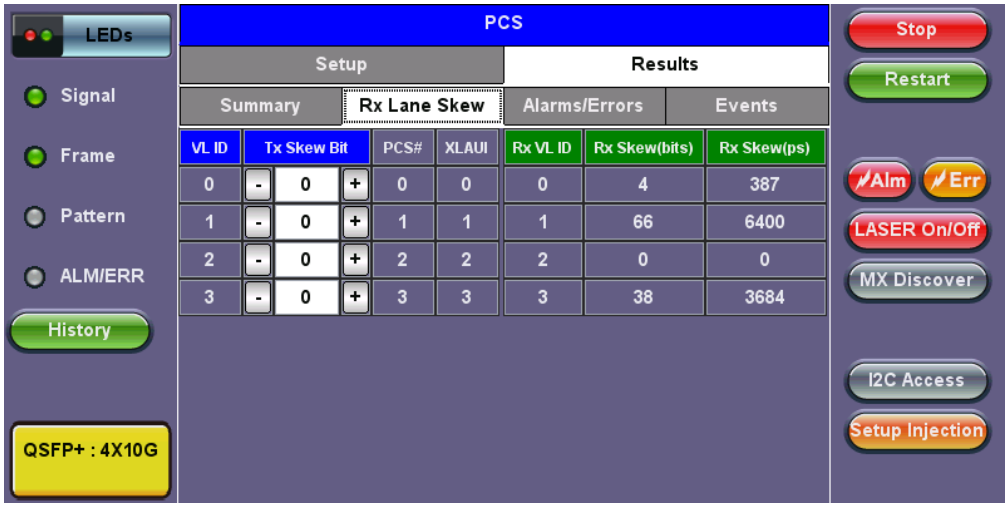
PCS Results Summary



Go back to top Go back to TOC

8.2.2 RX Lane Skew

PCS RX Lane Skew



Go back to top Go back to TOC

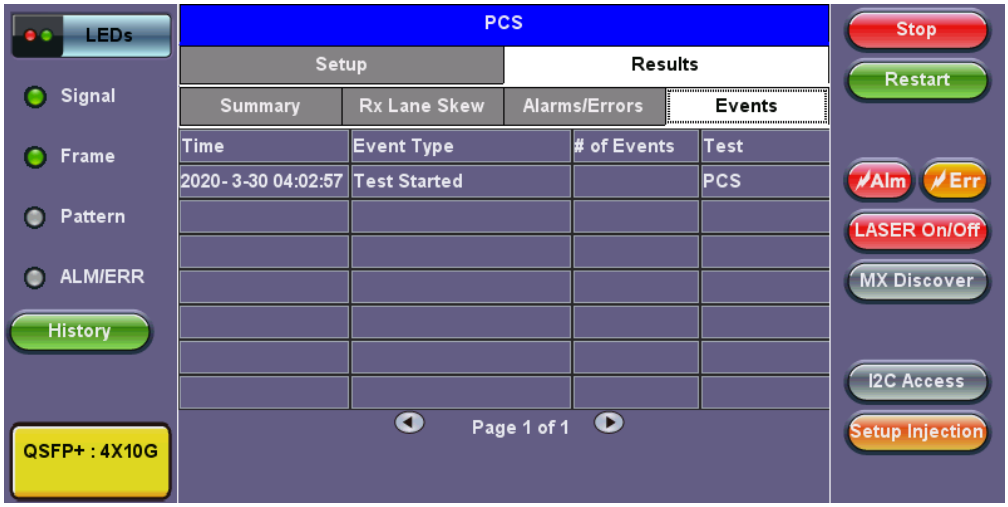
8.2.3 Alarms and Errors

PCS Results Alarms and Errors

Go back to top Go back to TOC

8.2.4 Events

PCS Results - Events



8.3 Saving PCS Results

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

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

PCS Results - Save

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

Go back to top Go back to TOC

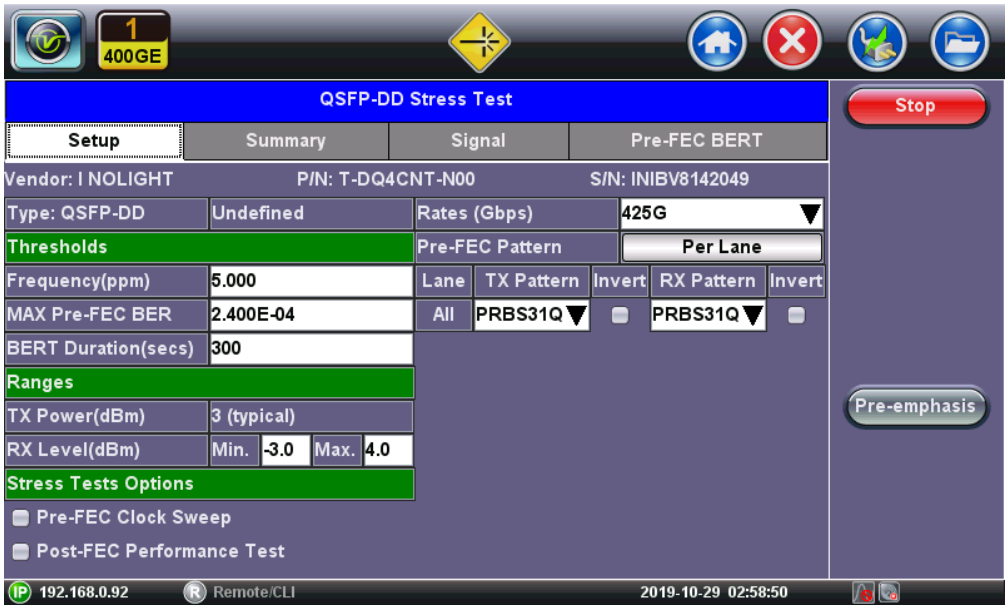
9.0 Advanced Optical Transceiver Test & Stress Test

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

9.1 Transceiver Stress Test

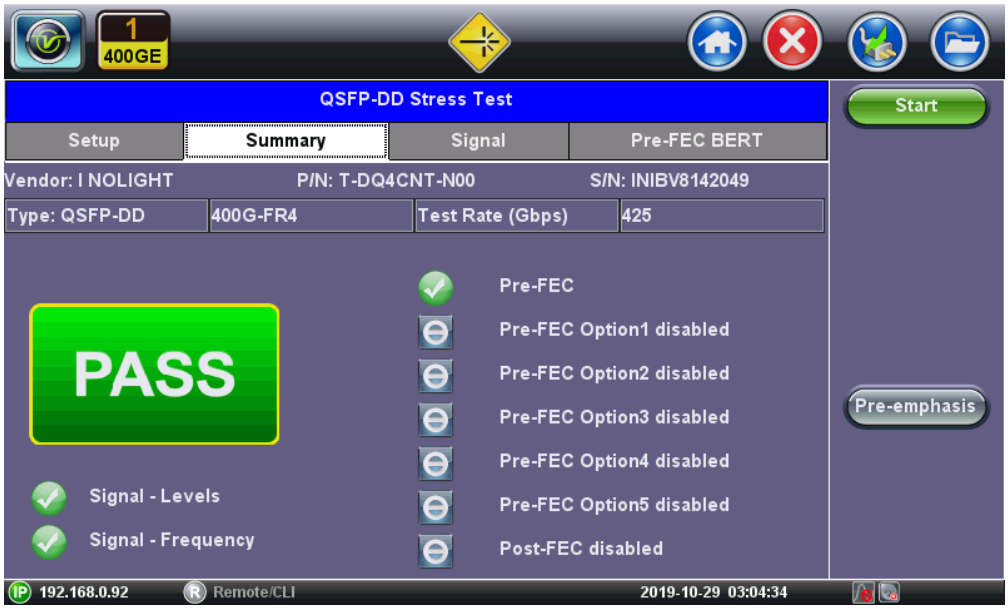
Stress Test Setup: After configuring setup, tap **Start**.

Stress Test Setup



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

Stress Test Summary



Stress Test Signal Tab (Page 1): Tap on the **Signal** tab to view Signal Level (RX)

Stress Test Signal (Page 1)

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

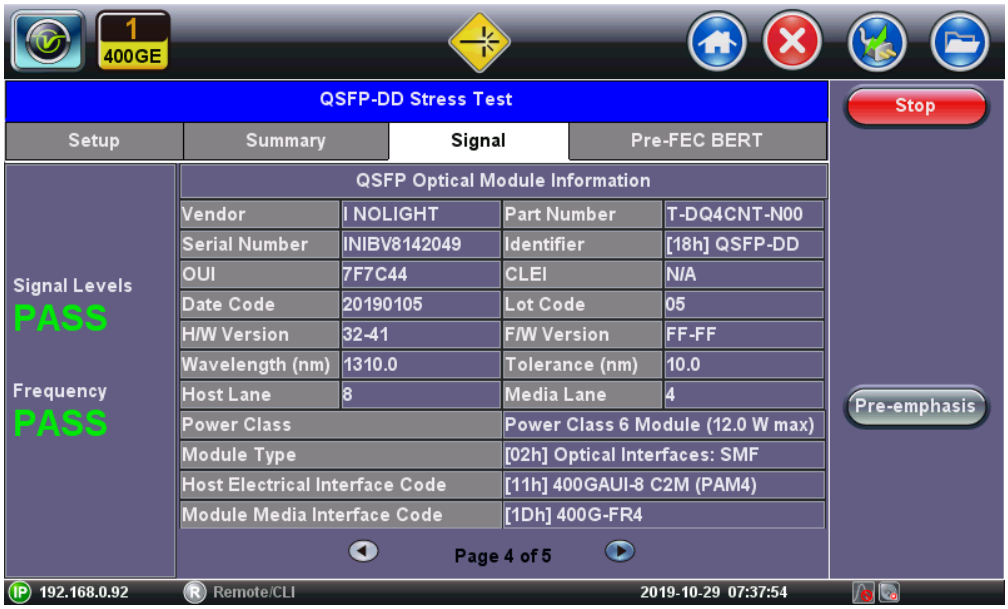
Stress Test Signal (Page 2)

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

Stress Test Signal (Page 3)

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

Stress Test Signal (Page 4)

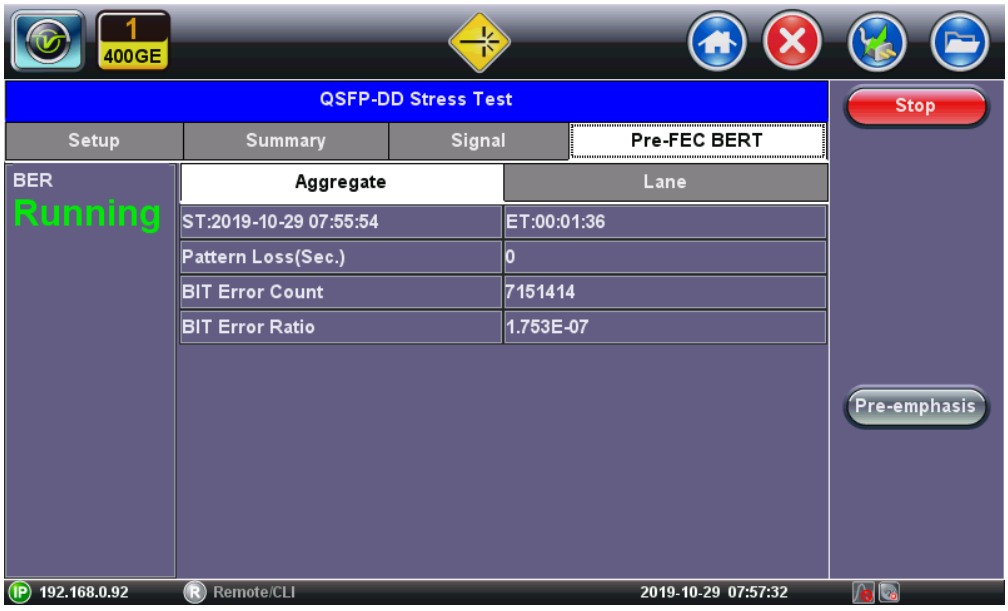


Stress Test Signal Tab (Page 5): Tap on the **Signal** tab to view QSFP Optical Module Status

Stress Test Signal (Page 5)

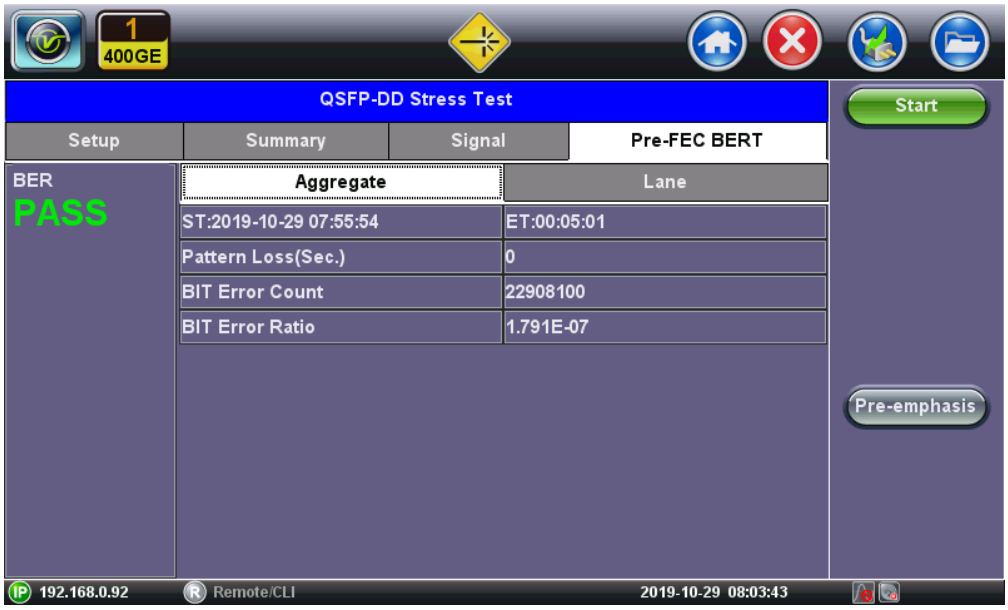
Pre-FEC BERT Aggregate Tab: Tap on the **Pre-FEC BERT** tab and tap **Start**. The test will show as running.

Stress Test Pre-FEC BERT Aggregate



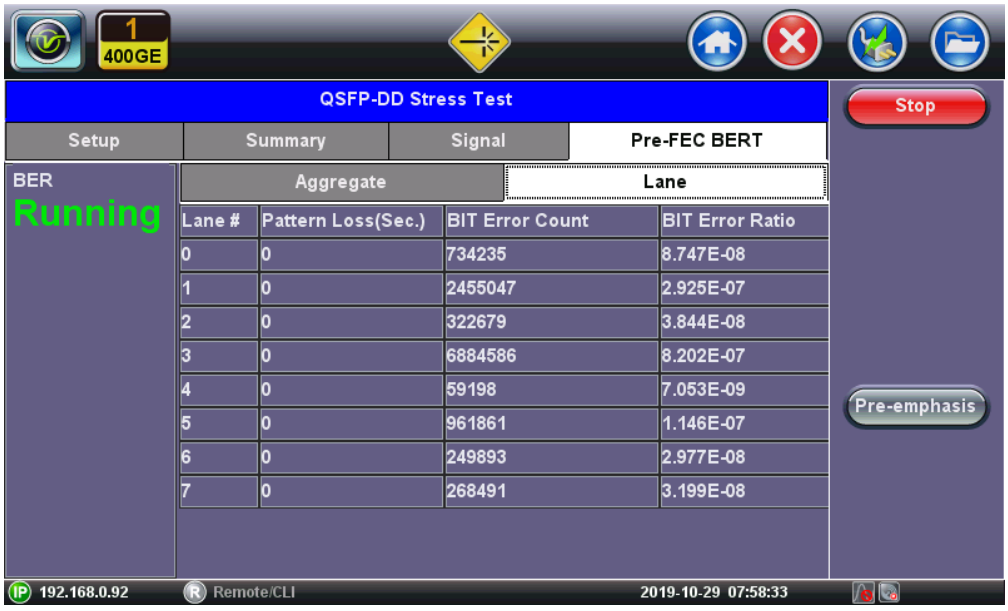
Pre-FEC BERT Aggregate Pass: Once the test has finished the screen will show as **Pass**

Stress Test Pre-FEC BERT Aggregate PASS



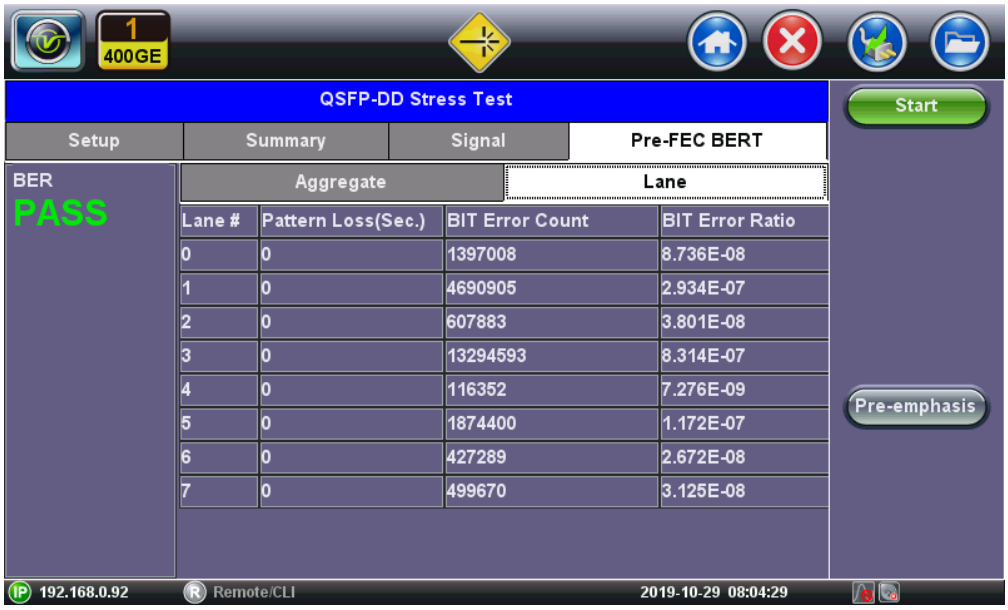
Pre-FEC BERT Lane Tab: Tap on the **Pre-FEC BERT>Lane** tab and tap **Start**. The test will show as running.

Stress Test Pre-FEC BERT Lane



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

Stress Test Pre-FEC BERT Lane Pass



Go back to top Go back to TOC

9.2 Advanced Optical Transceiver Test

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

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

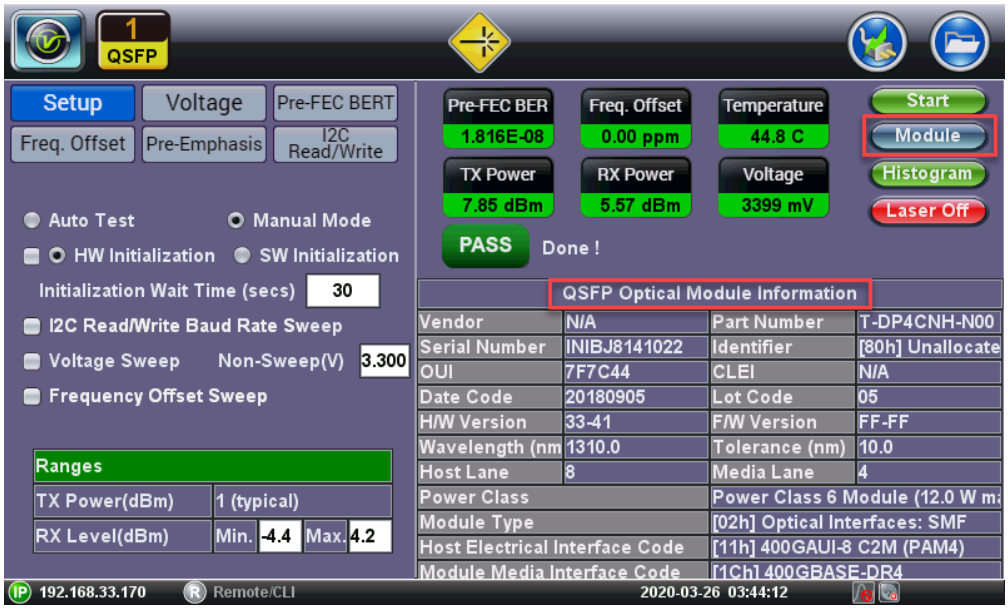
Use the check boxes to enable or disable the different sub tests.

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

Advanced Optical Transceiver Setup

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

Advanced Optical Transceiver Module



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

Advanced Optical Transceiver Histogram Graph

Advanced Optical Transceiver Histogram Table

Voltage Tab:

Advanced Optical Transceiver Voltage

Pre-FEC BERT Tab:

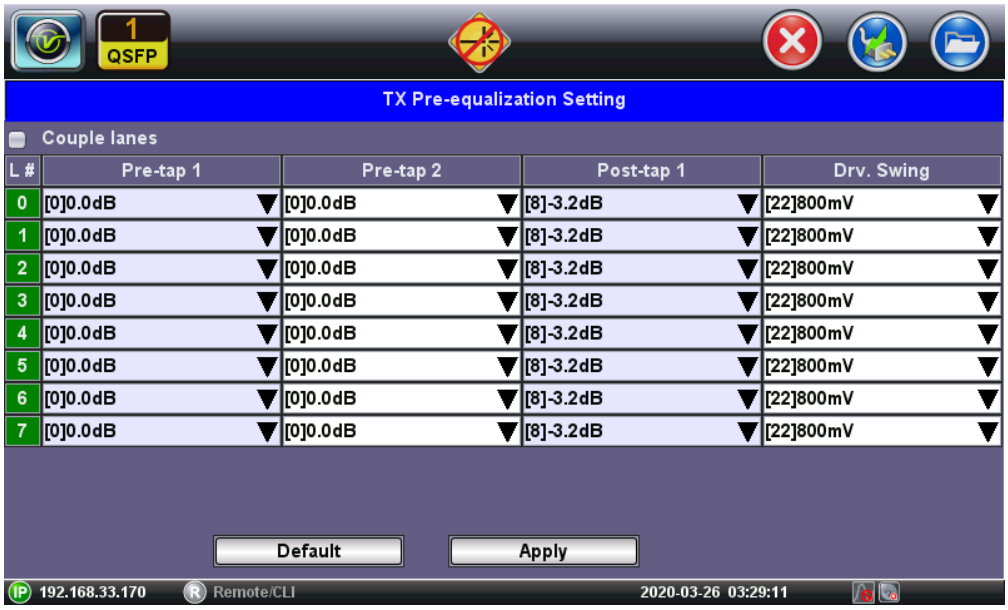
Advanced Optical Transceiver Pre-FEC BERT

Freq. Offset Tab:

Advanced Optical Transceiver Freq. Offset

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

Advanced Optical Transceiver Pre-Emphasis



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

Advanced Optical Transceiver I2C Read/Write

Go back to top Go back to TOC

10.0 Warranty and Software

VeEX Limited Warranty

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

Limited Warranty Start Date

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

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

Limited Hardware Warranty

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

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

This limited hardware warranty does not cover:

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

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

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

Limited Software Warranty

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Go back to top Go back to TOC

11.0 Certifications and Declarations

What is CE?

Declaration of Conformity

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.
Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.

RoHS Compliance

VeEX QUALITY AND ENVIRONMENTAL POLICY

Our quality and environmental policy is to limit and progressively eliminate the use of hazardous substances and chemicals in the design and manufacture of our products.

VeEX products are classified as Monitoring and Control Instruments under Article 2, Section (1), Category 9 of the WEEE 2002/96/EC Directive.

ROHS Statement

RoHS and WEEE Position Statement

The Council of the European Union and the European Parliament adopted Directive 2002/95/EC (January 27, 2003), to Reduce the use of certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment, and Directive 2002/96/EC on Waste Electrical and Electronics Equipment (WEEE), with the purpose of reducing the environmental impact of waste electrical and electronic equipment. Both were later recast by Directives 2011/65/EU and 2012/19/EU respectively. All VeEX products being placed on the EU market conform with these directives.

Additional RoHS substance restrictions for the Monitoring and Control Instruments were adopted by EU Directive 2015/863 (March 31, 2015). These new restrictions will take effect from July 22, 2021. VeEX has established a program to ensure that from July 22, 2021, all its products to be sold and shipped into the EU market will conform with (EU) 2015/863.

VeEX Inc. is committed to comply with RoHS and WEEE Directives to minimize the environmental impact of our products.

For more information about RoHS as it relates to VeEX Inc, go to the VeEX web site at www.veexinc.com/ROHS

Go back to top Go back to TOC

12.0 About VeEX

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

Visit us Online at www.veexinc.com for latest updates and additional documentation.

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Go back to top Go back to TOC