TX300s-100GX

Advanced 100G Hardware Option

for VePAL TX300s

All-in-one Optical and Service Test Platform

Available in stand-alone or combined with other modules, the TX300s-100GX hardware option for the TX300s platform offers a full-featured portable test solution for Ethernet links and services testing — from 10 Mbps and 100 Gbps. This low-cost factory-installed hardware option allow flexibility to fit any modern Core, Metro, NOC, PoP, mobile backhaul, and datacenter applications.

Module Highlights

The TX300s-100GX module, with the latest technology in pluggable physical interfaces, is a complete Ethernet test set on its own and a perfect complement to the TX300s Platform, extending its testing range to 100 Gbps. Compatibility with the companion TX340sm option offers a complete 64k to 100G test solution in a compact portable package.

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

General

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

1. Reference the TX340S module spec sheet for details

2. Configuration dependent

3. Data rate dependent

Ethernet

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

Fibre Channel

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

OTN

- OTU4 Testing with Bulk and 100GE Ethernet Payloads
- 100GE Throughput and RFC2544
- Overhead generation and analysis

Module Highlights *cont'd*

QSFP28 Support

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

Packet Capture and Decode

Configurable capture filters

- MAC and IP
- UDP and/or TCP
- Multicast, Broadcast, IP Checksum error, UDP/TCP Checksum Error events

Integrated Wireshark™ packet decode

Packet captures can be saved and exported PCAP capture format, compatible with Wireshark

Test Interfaces

Optical

	TX300s-100GX (Single Module)	**TX340s-100GX** (with TX340sm)
Test Ports		
QSFP28/QSFP+	1	1
SFP28/SFP+	1	1
RJ-45	1	No*
Applications		
100GE	Yes	Yes
40GE	Yes	Yes
25GE	Yes	Yes
OTU4	Yes	Yes
32G FC	Yes	Yes
10GBASE-X	Yes	No*
100FX/1000BASE-X	Yes	No*
10/100/1000BASE-T	Yes	No*
1G to 16G FC	Yes	No*

**Supported by the TX340sm module*

Physical Layer

RX Optical Power Measurements

- Per-lane input power measurement
- ±2 dB accuracy, 0.01 dB resolution
- Aggregated (total) power in dBm
- LOS and Saturation indication

TX Optical Power Monitoring

- Per-lane output power in dBm
- Aggregated (total) power in dBm

RX Frequency Measurements

- RX Frequency (1 kHz resolution)
- Offset (ppm): Current, Minimum, Maximum

Optical Pluggable Modules**

Pluggable Module Information

- MDIO read/write
- Power Class, Vendor, P/N, Serial Number, MSA HW revision, MSA MIS revision, Control 1 Register (IEEE), Expected Ability (supported rates)

Pluggable Module Status

- Module status, Alarm status, Internal Temperature, Voltage
- Transceiver unplugged
- Host Lane Fault, Network Lane Fault, Module Fault
- Network Lane Alarm, Module Alarm, General Alarm

Automatic transceiver initialization and laser safety reset (OFF) after hot swap

Operating temperature range: 0˚C to 45˚C

Transceivers conforming to Multi Source Agreement (MSA) specifications

Safety: Class 1 Laser Product. Comply with FDA/CDRH 21 CFR 1040.10 and 1040.11, EN (IEC) 60825 eye safety regulations

ROHS compliant and Lead Free per Directive 2002/95/EC

TX Clock Source***

Internal: Quartz, ±3.5 ppm stability per ITU-T G.812

Tx Frequency Offset

- ±150 ppm
- Steps of 0.1 ppm

Recovered: from incoming RX signal

System's High-stability 1 PPS Clock

- GPS clock (TX300s platform option)
- Atomic Clock (TX300s platform option)

Measurement Clock Reference**

Internal: Quartz, ±3.5 ppm per ITU-T G.812

System's High-stability 1PPS and 10 MHz Clock Reference Sources

- 1PPS GPS clock and UTC (TX300s platform option)
- 1PPS and 10 MHz Atomic Clock (TX300s platform option)

***Dependent on module form factor and type.*
****Atomic clock can be disciplined by the GPS if both options are present. Check the TX300s Platform datasheet for details.*

Auto Scripting

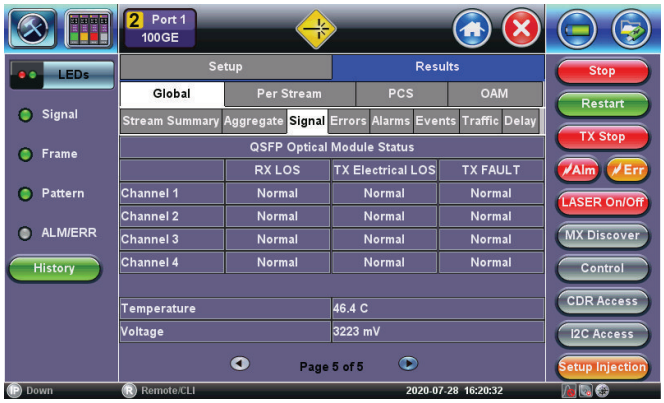
The Auto Scripting feature is the perfect tool for the lab environment where multiple short-term or long-term test configurations are required to stress the network equipment and/or network under test, in order to measure and qualify the performance capabilities. The feature is also important in field operations, not only to speed-up service turn-up times, but also to facilitate the entire workforce the same test profiles and test procedures for day-to-day operations.

The Auto Scripting application is an automated sequence of tests that can be carried out by selecting previously configured Throughput or BERT profiles. The profiles can be created with ReVeal and then loaded to the unit or created directly on the unit in the Throughput and BERT applications. Users can select up to ten profiles, each profile configured with its own duration. The duration can be in seconds, minutes, hours, or days. The test sequence will begin with the first profile configured with its corresponding duration, followed by each profile after that. At the end of each profile tested a results file will be stored automatically before the test sequence continues to the next profile. Users have the option to continue or stop the auto scripting test if errors or alarms are detected.

Application Examples

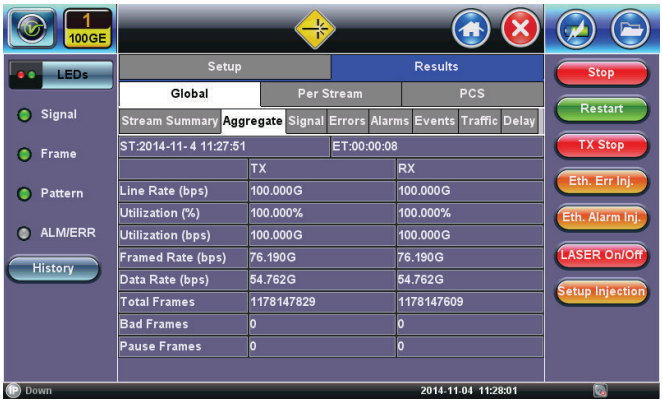
Transceiver Health

Module temperature, alarm and failure information display



100GE-LR4 Receive Optical Power per Lane

Example of 100GE Layer 2 100% Throughput Test Result Display



100GE V-SAM Test Results with 8 Services

TX300s-100GX is able to perform up to 32 services

100GE-LR4 PCS Analysis for Alarms and Errors

100GE-LR4 PCS, CAUI-4

Virtual lane and skew control setup

Ethernet Testing

Reliability, Scalability and Quality of Service are the attributes needed for Ethernet to turn into Carrier-grade Ethernet. With standard features including RFC2544, VSAM, Throughput, MPLS and VLAN support, this test set has all the tools necessary to truly ensure end-to-end carrier-grade Ethernet services.

Key Features

- Transmit frequency offset to stress the network up to ±150 ppm
- Optical Lane BERT
- CAUI-4/XLAUI Lane BERT
- FEC Layer Testing with Skew generation/monitoring
- PCS Layer Testing with Skew generation/monitoring
- Service Disruption Measurements
- Throughput, latency, jitter, frame loss, and back-to-back measurements per industry-standard RFC2544
- Multi-stream testing with up to 32 fully independent and configurable streams
- IPv4 and IPv6 traffic generation
- MAC Flooding
- Q-in-Q (VLAN stacking) and multiple MPLS tag support
- BER testing at Layer 2 and Layer 3 with or without VLAN and MPLS tags
- Smart Loop mode for Layer 2 and Layer 3 with all key measurements on received traffic provided on the loopback port
- One-way latency measurement between remote devices (with GPS synchronization)
- Line rate packet capture with Wireshark™ decode

Test Interfaces

100GE/40GE Compliant with IEEE 802.3ba
MSA compliant transceiver interfaces
QSFP28 Interface bit rates
- 100GBase-R 103.125 Gbps

QSFP+
- 40GBase-R 41.25 Gbps

SFP/SFP+/SFP28

- 25GBASE-R 25.78 Gbps
- 10GBASE-X 9.95/10 Gbps
- 1000BASE-X 1 Gbps
- 100BASE-FX 100 Mbps

RJ45

- 10/100/1000BASE-T

Frequency offset: ±150ppm (0.1 ppm step)
External reference clock input: 2.048 Mbps, 2.048 MHz, 1.544 Mbps, 1.544 MHz, 10 MHz, Received signal

Operating Modes

Terminate
Loopback

100G FEC Layer Testing

FEC lane mapping; default, manually defined, shift
FEC Skew generation per lane pair (0 to 160000 bits)
RX Skew tolerance up to 4000 bits
RX FEC lane monitoring: skew measurements (bits and ps) and lane mapping
FEC Error/Alarm injection per lane or all lanes FEC Error/Alarm injection: Corrected FEC, Uncorrected FEC, Invalid Transcoded Block errors, LOAMPS alarm
FEC Aggregate Error Counters: UFEC, CFEC, Invalid Transcoded Block (count and rate)
FEC Lane Error Counters: CFEC (count and rate)
FEC Aggregate Alarm Counters: HiSER, LOA, LOAMPS, FEC Lane Swap (seconds), LOA event and LOAMPS event (count and rate)
FEC Lane Alarm Counters: LOAMP (secs), LOAMP events (count and rate)

100G/40G PCS Layer Testing

PCS lane mapping: default, manually defined, random or shift
PCS Skew generation per lane pair (0 to 16000 bits)
Configurable Skew alarm threshold
RX Skew tolerance up to 4000 bits
RX PCS lane monitoring: skew measurement (bits and ps) and lane mapping
PCS Error/Alarm injection per lane or all lanes
PCS Error injection (single, burst or rate): Invalid Sync Header, Invalid Alignment Marker, BIP error
PCS Alarm injection (continuous): Loss of Alignment Marker Lock, Loss of Block Lock, High BER
PCS Lane Error counters (aggregate and per lane): Invalid Sync Header, Invalid Alignment Marker, BIP error
PCS Lane Alarm: Loss of Alignment, Loss of block label, High-BER

Lane BERT

Per CAUI-4/XLAUI lane or optical lane unframed BERT
PRBS pattern: 2^{31}-1, 2^{23}-1, 2^{15}-1, 2^{7}-1
Error injection (single or burst) per lane or multiple lanes: Bit error
Alarm injection per optical lane or multiple optical lanes: Optical LOS
Per lane and aggregate Bit error count and rate and Pattern loss

Framed Ethernet Traffic Generation

Layer 2 or Layer 3 traffic
Test Frame Header
- IEEE 802.3 and Ethernet II (DIX) frames
- Configurable Source and Destination MAC and Ethernet Type
- VLAN stacking up to 3 VLAN tags w/configurable priority & type
- MPLS-TP label with configurable LSP, PW and CW fields
- Provider Backbone Bridge (PBB) support with configurable Backbone MAC Source and Destination, I-SID, PBB-VLAN ID and priority
- EoE (Ethernet over Ethernet) support with configurable EoE MAC Source and Destination, Ethernet Type, EoE VLAN ID and Priority, TTL and EID
- Fully configurable IPv4 or IPv6 header
- MPLS up to 3 labels with configurable Label/S/CoS and TTL

Frame generation in fixed, random, increment, decrement modes
- Frame sizes from 64 to 1518 bytes and jumbo frames up to 16000 bytes

MAC flooding feature generates test frames with up to 4096 incremental Source and/or Destination MAC addresses
Traffic Pattern: Constant, Ramp, Multi Bursts, Single Burst
Ethernet Error Injection: Bit, CRC, Pause, IP Checksum, runt (60 bytes)
PCS Error Injection (per lane or multiple lanes): Invalid Sync Header, Invalid Alignment Marker, BIP error
Ethernet Alarm Injection: Local Fault, Remote Fault, Optical LOS
PCS Alarm Injection: Loss of Alignment Marker Lock, Loss of Block Lock, High BER

** Requires GPS option*

Key Measurements

Error Measurements: Bit/BER (BERT and single stream Throughput Test), CRC, PCS Errored Blocks, IP checksum, jabber frames, runt frames, Frame loss (count and %), OSS

Alarm Detection: LOS, Service Disruption, Local and Remote Fault

FEC Alarms and Errors: HiSER, LOA, LOAMPS, FEC Lane Swap, Uncorrected FEC, Corrected FEC errors, LOAMPS Event, LOA Event, Invalid Transcoded Block, and RX AM Sequence

PCS Alarms and Errors: Loss of Alignment, Loss of block label, High-BER, Invalid Sync Header, Invalid Alignment Marker, BIP error

Frame/Packet Statistics: Multicast, broadcast, unicast, pause frames, frame size distribution

Rates (min, max, average and current): frame rate, bandwidth utilization, frame rate, line rate, data rate

Delay (min, max, average and current): round trip delay, inter frame gap, jitter, one-way delay between remote devices with GPS synchronization

Service Disruption Time (SDT)

Concurrent service disruption measurements are integrated to regular Ethernet tests, supporting simultaneous monitoring of multiple triggers at all layers.

Layer 2 BERT triggers

- LOS, LOBL, LOAML, LOA, Local and Remote faults
- FCS error, Pattern loss

Layer 3 BERT triggers

- LOS, LOBL, LOAML, LOA, Local and Remote faults
- FCS error, IP check sum error, Pattern loss

Layer 2 Throughput triggers

- LOS, LOBL, LOAML, LOA, Local and Remote faults
- FCS error, Lost (Missing) frame, Out of sequence, Duplicate frames

Layer 3 Throughput triggers

- LOS, LOBL, LOAML, LOA, Local and Remote faults
- FCS error, IP check sum error, Lost (Missing) frame, Out of sequence, Duplicate frames

Measurements

- Disruption time: Current, Last, Minimum, Maximum, Total
- Number of occurrences
- Resolution: 1 µs

Multiple Streams Throughput Testing

Up to 32 independent traffic streams generation and analysis, with configurable filters on 40GE and 100GE interfaces

Up to 10 independent traffic streams generation and analysis, with configurable filters on 10GE interface

Up to 8 independent traffic streams generation and analysis, with configurable filters on 1GE interface

Each stream can be set with independent frame size, bandwidth, traffic profile, and QoS levels

MAC flooding feature: generates test frames with up to 4096 incrementing Source and/or Destination MAC addresses

Test Patterns: PRBS: 2^{31-1}, 2^{23-1}, 2^{15-1}, 2^{11-1}, normal and inverted patterns, All 0s, All 1s and User Defined

Error Measurements: Bit/BER (Single Stream only), FCS/CRC, Jabber/Runt frames, IP Checksum, TCP/UDP Checksum, Frame Loss (count and %), Out of Sequence

Alarm Detection

- 10GE: LOS, LOSync, Service disruption (current, total, last, min/max, # of occurrences), Local Fault, Remote Fault, PCS-HI-BER, PCS-LOBL, WAN SONET Alarms: LOF, AIS-L and RDI-L WAN SDH Alarms: LOF, MS-AIS, MS-RDI
- 1GE: LOS, LOSync, Service disruption (current, total, last, min/max, # of occurrences)

Frame/Packet Statistics

- Multicast, broadcast, unicast, pause frames, frame size distribution

Rates (min, max, average and current): frame rate, bandwidth utilization, frame rate, line rate, data rate

- Frame arrival time (min, max, average and current), Frame Delay Variation
- Round Trip delay or One-Way Delay OWD* (min, max, average and current) and Histogram distribution with configurable sampling period and threshold

Service Disruption Time (SDT)

- Per stream inter-packet gap based measurement
- Configurable SDT measurement trigger and SDT violation threshold

RFC2544 Compliance Testing

Automated tests compliant with RFC2544 with configurable threshold values and maximum transmit bandwidth settings

Throughput, Latency, Jitter, Frame Loss, and Back-to-Back (burst) tests

Frame sizes: 64, 128, 256, 512, 1024, 1280, and 1518 bytes including 2 user configurable frames

Loopback Mode

Layer 2: all incoming traffic is looped back with MAC source and destination addresses swapped

Layer 3: all incoming traffic is looped back with MAC and IP source and destination addresses swapped

Loopback traffic filters with all MAC/VLAN/IP parameters configurable

All key measurements on received traffic provided on the loopback port

IP Test Suite

IP Configuration and validation (IPv4, IPv6, Static, DHCP, PPPoE)

MAC address (configurable or default)

Ping and trace-route tests (IP address or URL)

Network discovery/ARP wizard

Layer 2 Control Protocol Transparency Test

- Selectable Layer 2 Control protocol frames and configurable frames
- Supported L2CP frame types per MEF 45 standard
- Cisco L2CP frame formats
- Selectable frame rate and count
- TX and RX frames statistics

IPv6

IPv6 compliant test traffic generation and analysis for all test applications (Y.1564 V-SAM, RFC2544, BERT and Multi-stream Throughput)

IPv6 Loopback capability

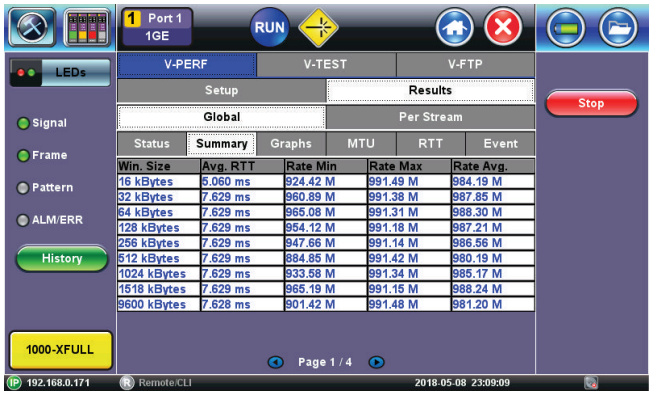
IPv6 Static or Stateless Auto Configuration and Ping function

Layer 4-7 Features

RFC6349 V-PERF TCP/UDP Test

A common source of customer complaints come from file transfer speeds not matching the throughput rates guaranteed in the SLA. While many factors affect TCP applications performance, including customer's operating system hardware performance and settings (TCP window size), carriers need to prove SLA with a test tool that can show TCP performance independent of Operating System or Server limitations and present repeatable reliable results.

The test set V-PERF feature uses RFC6349 test methodology and metrics for qualifying network TCP or UDP performance. It offers a full line rate stateful TCP test with configurable window sizes, client and server modes as well as compatibility with iPerf servers.



V-Perf Test

TCP/UDP Throughput Compliant with RFC6349
Stateful TCP/UDP Test at line rate
TCP/UDP Client and Server modes
Compatible with iPerf Client/Server
MTU search per RFC4821
Round Trip Time Measurement
Configurable TCP Window sizes
Multi-Window size tests
Measurements: TCP/UDP Throughput rate (min, max, average), Transfer file size and duration, Transfer time ratio, Efficiency %, Buffer Delay %

V-FTP and V-TEST Throughput Test

FTP Throughput (V-FTP) and V-TEST features provide additional Layer 4-7 testing. The V-FTP Throughput feature allows the user to test up to full line rate FTP protocol performance to any FTP Server by uploading and downloading files. The V-TEST feature qualifies network TCP/HTTP protocol performance by testing against a V-TEST HTTP server. Both features can test up to the full line rate depending on the server specifications and limitations. Connection time to the server, data transfer time, line rate throughput rates, and protocol (FTP and HTTP) throughput rates key metrics are reported during the tests.

The V-TEST application is flexible enough to operate in different modes depending on user preference; VeEX Managed mode, Speedtest Powered™ mode based on Ookla® technology, and User Managed mode.

In VeEX Managed mode, the customer's servers are added to a customer server list that is maintained and managed by VeEX for the end-user's ease of use and convenience. The full list of server IP addresses or URLs are provided to VeEX. Once added, all the user has to do is select the server from their company list and initiate the test to the selected server.

In Speedtest Powered mode, the test follows Ookla's methodology and tests to the Speedtest® Server Network. In this mode, the test is compatible with Ookla's protocol/methodology; it will scan nearby servers in the local market and test to the server with the fastest (lowest latency) response.

In User Managed mode, the user is allowed to enter the server IP/URL and save it to a server list that they can maintain and manage on their own.

V-Test

HTTP Throughput
Full line rate
HTTP client mode
Connection time to server
Total Data Transfer time
HTTP Throughput rates
Requires V-Test Server
Speedtest® powered node compatible with Ookla Speedtest Server Network

FTP Throughput Test

FTP Throughput
Full line rate
FTP client mode
Connection time to server
Total Data Transfer time
FTP Throughput rates
Compatible with Linux and Windows FTP servers

Fibre Channel

Key Features

- Full line rate traffic generation and analysis up to 32G
- Primitive Sequence Protocol support
- Flow control support with Buffer-to-Buffer credits
- FC-1 and FC-2 BERT and Throughput
- RFC2544: Throughput, Latency, Frame Loss, and Back-to-Back frames tests
- FC-2 Smart Loop mode
- Service Disruption Measurement
- FC-2 Frame Header configuration
- Test traffic shaping: constant, ramp, and burst
- Frame Length configuration up to 2148 bytes

Throughput and Bit Error Rate Test (BERT)

The Fibre Channel protocol specifies a maximum allowable Bit Error Rate (BER) of ≤ 1 x 10^{-12} that must be achieved. The test set allows the user to stress FC-1 and FC-2 network layers to ensure accurate benchmarking.

For FC-1, frequency fluctuations, transceiver noise and phase jumps are tested using CRPAT, CSPAT, and CJPAT patterns. Data dependency and behavior of network components are checked with PRBS patterns, sequence number tracking, and time stamping to calculate frame loss, round trip delay, and other performance metrics.

RFC2544 Benchmarking

Based on the Ethernet test methodology, the RFC2544 routine has been adapted to Fiber Channel circuits where flow-control and buffer verification is important. The feature checks throughput and round trip delay at various buffer sizes to verify optimal buffer size and best possible link performance.

Fibre Channel Interfaces

Dual 1/2/4/8/10/16/32G Fibre Channel SFP+ optical Ports: LC connectors

Fibre Channel Rates

1.0625 Gbps, 2.125 Gbps, 4.25 Gbps, 8.5 Gbps, 10.52 Gbps, 14.03 Gbps and 28.05 Gbps

Modes of Operation

Terminate, Loopback

Fibre Channel Topology

Point-to-Point

Primitive Sequence Protocols

Link initialization, link rest, link failure

Flow Control

Buffer-to-Buffer Credit Configuration: 1-65535

Traffic Generation

FC-1 (with SOF and EOF frame delimiters) and FC-2 Frames
Class 3 Service frames
Scrambling/Descrambling (8.5 Gbps only)
Configurable Header fields
Configurable EOF (EOF_t, EOF_n), and SOF (SOF_i3, SOF_n3, SOF_f)
Traffic Shaping: constant, ramp, burst
Frame Length Configuration: 2148 bytes maximum

RFC2544 Compliance Testing

Automated tests compliant with RFC2544 with configurable threshold values for Throughput and Round Trip Delay (Latency) and maximum transmit bandwidth settings
Throughput, Latency, Frame Loss, and Back-to-Back (burst) tests
Frame sizes: 64, 128, 256, 512, 1024, 1280, and 2000 bytes including 2 user configurable frames

Bit Error Rate Testing

NCITS-TR-25-1999 Patterns (FC-1): CRPAT, CSPAT, CJPAT
PRBS Patterns (FC-2): 2^{31}-1, 2^{23}-1, 2^{15}-1, 2^{11}-1, normal and inverted selections, and user defined patterns
Error Injection: Bit and CRC

Loopback Mode

FC-1
FC-2 (Layer 2): swaps the destination and source IDs (D-ID and S_ID)

Key Measurements

Optical power levels: transmit and receive optical levels in dBm
Error Measurements: Bit error count, BER, symbol, FCS/CRC, oversize, undersize, frame loss (count and %), out of sequence frame count
Alarm Detection: LOS, pattern loss, service disruption
Traffic Statistics: bandwidth utilization, data rate, frame count, byte count, frame size distribution, buffer-to-buffer credit count, RR_RDY count, frame loss count and round trip delay
Rates: line rate, framed rate, data rate, frames per second rate
Delay (min, max, avg, current): round trip delay, frame arrival delay

OTN Testing

This feature offers complete Ethernet over OTN testing capabilities, including service-activation (Bringing-into-Service), performance verification, maintenance, and troubleshooting. It offers Multi-Layer testing from Physical layer (WDM), CAUI-4/XLAUI, OTL, OTUk/ODUk, to bulk payloads, and Ethernet traffic generation up to 100% rate.

OTN Functions

Test Interfaces

MSA compliant transceiver interfaces
QSFP28 Interface bit rates
- OTU4 111.810 Gbps

Key Features

- EoOTN testing with internally generated Ethernet payload mapped into OTU4 (100 Gbps)
- OTU, ODU, OPU overhead manipulation and monitoring
- OTU, ODU, OPU layer alarms/errors generation and analysis
- OTU, ODU, TCMi trace messages
- Service Disruption monitoring
- Forward error correction (FEC)
- Tandem Connection Monitoring
- Frequency offset generation and measurement

Operating Modes

Normal (terminal)
- The instrument terminates the line, serving as source and sink for the generated traffic
- Offers full access to Overhead and Payload alarms and error generation and monitoring

Payload Through
- Instrument retransmits the received Payload and allows access to Overhead manipulation
- Offers full access to Overhead alarms and error generation as well as Payload monitoring

Line Through
- Instrument regenerates and retransmits the entire received signal
- Offers minimal interaction with the test signal
- Provides full access to Overhead and Payload alarms and error monitoring

OTN Mappings

Standards: ITU-T G.709, ITU-T G.798, ITU-T G.872
Mapping Procedures: AMP, BMP and GMP

Direct OTN Mapping Options

Single-step (direct) mapping options
- OTU4-ODU4-Bulk
- OTU4-ODU4-100GE

Test Setup

Test configuration, menus, and results are presented in VeEX's intuitive GUI, requiring little or no training for new or existing VePAL™ users, maintaining a consistent user experience from the lab to the field.

Layer-based graphical configuration interface allows users to build the test signal in a logical layer by layer sequence
- OTL Lanes
- OTN Signal
- ODUk (Mapping)
- Payload (Bulk/PRBS or Ethernet)
- Test Pattern (CBR) or Traffic (Packets)

OTL Layer

OTL4.10 (OTU4)
TX Lane Mapping and Skew Generation
- Lane ID, Lane #, and Channel assignments

Lane Mappings
- Default (1 to 1)
- Random assignment
- Lane ID Shift

Skew Settings
- Skew Range: 0 to 64000 bits
- Adjustable Increment/Decrement steps (0 to 200 bits)
- Increase and Decrease control buttons and direct keypad entry
- Alarm Threshold (1 to 4000 bits)
- Enable/Disable RX MFAS Deskew

Per-Lane Alarm and Error Monitoring
- Alarms: OTL-LOL, OTL-OOL, OTL-LOF, OTL-OOF, OTL-LOR, OTL-OOR, OTL-OOLLM, OTL-OOMFAS, High Skew
- Errors: OTL-LLM, OTL-MFAS, OTL-FAS
- Soft LED overview and individual event counters
- Per-lane Skew measurements in bits and picoseconds
- Independent OTL events log with time stamp

OTU Layer

Alarm and Error Monitoring
- Alarms: LOM, OOM, SM-IAE, SM-BDI, SM-BIAE, SM-TIM
- Errors: MFAS, SM-BIP, SM-BEI, Correctable FEC, Uncorrectable FEC

ODU Layer

Alarm and Error Monitoring
- Alarms: AIS, OCI, LCK, PM-BDI, PM-TIM
- Errors: FAS, MFAS, PM-BIP, PM-BEI

OPU Layer

Payload Type (PT): Generates and displays received PT value
Expected Payload label setting
Enable/Disable PLM monitoring
Alarm and Error Monitoring
- Alarms: PLM, LO-OMFI, OO-OMFI
- Errors: OMFI (ODTU4.M)

GMP Stuffing

TX Settings
- Extended Offset support (Enable/Disable)
- Effective Cm Value

TX Values
- Nominal Cm Value, Nominal Bit Rate (kbps), Effective Bit Rate (kbps), Offset (ppm)

Alarm and Error Monitoring
- Alarms: GMP Loss of Sync, GMP Cm=0; in seconds
- Errors: CRC-5, CRC-8; count and ratio

RX Statistics
- Effective Cm Value, Minimum Cm Value, Maximum Cm Value
- Nominal Bit Rate (kbps), Effective Bit Rate (kbps), Offset (ppm)
- No Change, Single Increments, Double Increments, Single Decrements, Double Decrements, New Values

BER Test (Alarm and Error Monitoring)
- Alarms: LOP (Loss of Pattern)
- Errors: Bit (Test Sequence Error)

Test Patterns
Test sequence availability depends on selected data rate and/or test mode
- PRBS: 2^{31}-1 , 2^{23}-1, 2^{20}-1, 2^{15}-1

Error Insertion
OTL Layer
- FAS, MFAS, LLM
- Affected Lanes: Single or Multiple
- Modes: Single, Single Burst, Rate

OTU/ODU/OPU
- MFAS, SM-BIP, SM-BEI, Correctable FEC, Uncorrectable FEC, ODU-FAS, ODU-MFAS, PM-BIP, PM-BEI, TCMi-BIP, TCMi-BEI, GMP CRC-5, GMP CRC-8, OMFI (ODTU.M)
- Modes: Single, Single Burst, Fixed Rate or Custom Rate

Payload
- Bit (Test Sequence Error)
- Modes: Single, Single Burst, Rate

Alarm Generation
Physical Layer
- LOS
- Affected Optical Lanes: Single or Multiple
- Modes: Continuous (manual)

OTL Layer
- LOF, OOF, OOLLM, OOMFAS
- Affected Lanes: Single or Multiple
- Modes: Continuous (manual), Single Burst (# of ON frames), Continuous Burst (# of ON frames and # of OFF frames)

OTU/ODU/OPU
- OTU-LOM, OTU-OOM, SM-IAE, SM-BDI, SM-BIAE, SM-TIM, ODU-AIS, ODU-OCI, ODU-LCK, ODU-LOF, ODU-OOF, PM-BDI, PM-TIM, TCMi-AIS, TCMi-OCI, TCMi-LCK, TCMi-BDI, TCMi-TIM, TCMi-BIAE, TCMi-LTC, OPU-PLM, GMP LO-Sync, GMP Cm=0
- ODTU4.M: LO-OMFI, OO-OMFI
- Modes: Continuous (manual), Single Burst (# of ON frames), Continuous Burst (# of ON frames and # of OFF frames)

OTN Overhead Analysis and Generation
Multi-stage support: Provides access to OTU and ODUk overheads for all the layers present in complex mapping/multiplex structures
- OTU4, ODU4, ODUk, OPUk

Analysis – Decode and Display

Multiframe selection modes
- Display bytes can be locked to specific multi-fame (0 to 255)
- Free running

Byte Decoding
- On-screen Decode of all bytes and strings
- Byte Capture (raw data): 256 bytes (Hex)

ODUk bytes in hexadecimal, binary or ASCII formats
- SM-TTI (SAPI, DAPI, User), SM-BIP, SM-BEI (BEI/BIAE, BDI, IAE)
- PM-TTI (SAPI, DAPI, User), PM-BIP, PM-BEI (BEI/BIAE, BDI, IAE)
- TC, TCMi-TTI (SAPI, DAPI, User), TCMi-BIP, TCMi-BEI (BEI/BIAE, BDI, IAE)
- GCC0, CCC1, GCC2 bytes
- PCC/APS bytes
- FTFL bytes (forward and backward faults)
- Reserved bytes

OPUk bytes in hexadecimal and binary formats
- JC1, JC2, JC3, JC4, JC5, JC6, PSI, NJO/OMFI

Generation - Programmable Bytes and sequences

OTU and ODU Trace Generation
- SAPI (15 characters)
- DAPI (15 characters)
- User (31 characters)

TCMi Trace Generation
- SAPI (15 characters)
- DAPI (15 characters)
- User (31 characters)

Set TCMi Status
- No source TC, In use without IAE, In use with IAE, Reserved, ODUk-LCK, ODUk-OCI, ODUk-AIS
- Enable/Disable TC monitoring

OTU/ODU Trace Analysis and Generation
- Programmable Transmit and Expected OTU and ODUk Traces
- OTU and ODU SAPI, DAPI, and User
- Enable/Disable OTU/ODU TIM monitoring

GCC Channel BERT
- BER test on GCC0, GCC1 and GCC2 with PRBS
- Rount Trip Delay measurement

Tandem Connection Monitoring (TCM)
TCMi Monitoring (1 through 6)
- Alarms: AIS, OCI, LCK, BDI, BIAE, LTC, TIM
- Errors: BIP, BEI

Trace Identifier Monitoring and Generation
- Programmable Transmit and Expected SAPI, DAPI and User traces
- Copy trace from RX
- Enable/Disable TIM monitoring

Ethernet over OTN Testing
Internally generated Ethernet Payloads into ODU4
- Layer 2
- Layer 3 (IPv4 and IPv6)
- VLAN: Up to 3 tags
- MPLS: Up to 3 tags

Ethernet Testing
- RFC2544
- Throughput
- BERT

Traffic Flows
- Programmable test bandwidth up to 100%
- Constant Bandwidth
- Ramp (Start BW, Stop BW, BW steps, Ramp time, Repetitions)
- Burst (Two traffic levels - Burst 1 BW, Burst 2 BW, Burst 1 time, Bust 2 time)
- Single Burst (1 to 10000 frames)
- Unless otherwise specified, traffic (BW) values can be entered in % of line rate, # of IPG Bytes, Frames per Second, and Mbit/s

Test Patterns (payload)
- PRBS: 2^{31}-1, 2^{23}-1, 2^{20}-1, 2^{15}-1, 2^{9}-1
- Normal, inverted or live traffic

Test Traffic RX Filter
- MAC Source, MAC Destination, Frame Type, DSCP, Protocol Type, IP Source, IP Destination

Events Log

Date and time stamped record of all events occurred during a test, presented in tabular format
Includes event name, time, duration and count/severity
Individual event logs for OTL, OTN, BERT and Ethernet

Soft LED Indicators

Fixed OTN indicators for Signal, Framing, Pattern and Errors/Alarms
Expanded, layer by layer, detailed status summary
Display historical events and conditions
History reset function

- Clears the LED reminder without affecting the measurement counters

**Refer to the Ethernet Testing section for more details on Ethernet test results.*

General

Power Consumption	
Active	60 watts (max)
Environmental	
Operating temperature	0 to 45°C (32 to 113°F)
Storage temperature	-20 to 70°C (-4 to 158°F)
Humidity	5% to 90% non-condensing

ROHS compliant and Lead Free per Directive 2002/95/EC

Additional Functions

Test Results Management

Local and remote web-based interface provides easy access and manipulation to OTN and Ethernet Test Results
Save, View, Rename, Lock and Delete functions

Export results to USB

- PDF, CSV, TXT formats

File Organizer

- Filtering per test result type

File Sorting

- By Name, Port, Test Type, Date, Size, Locked/Unlocked

Screen capture: Screen shots in .bmp format

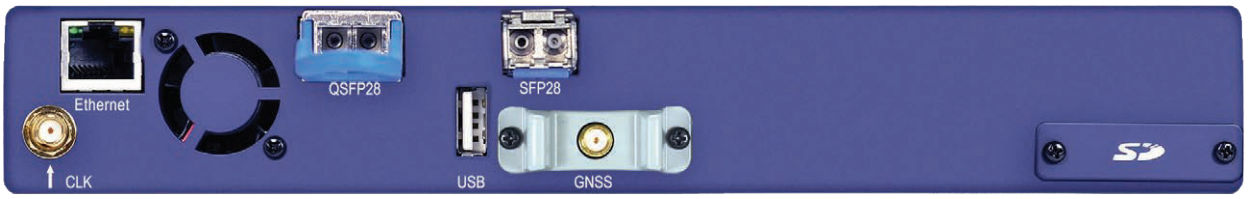
Test Profile Management & Auto Scripting

Save and Recall test profiles to internal memory
Auto Script uses up to 10 saved test profiles to run batch tests

Remote Access and Control

Compatible with VeEX SCPI Remote Client (optional)
Compatible with multi-platform VNC® clients
Web-based VNC® server (no PC client required)
ReVeal RXTS Data Management

- Test results management
- Advanced report generation with html, pdf, or csv formats, combine test results, add logos and comments
- Test profiles management: Online or offline test profile creation, upload and download



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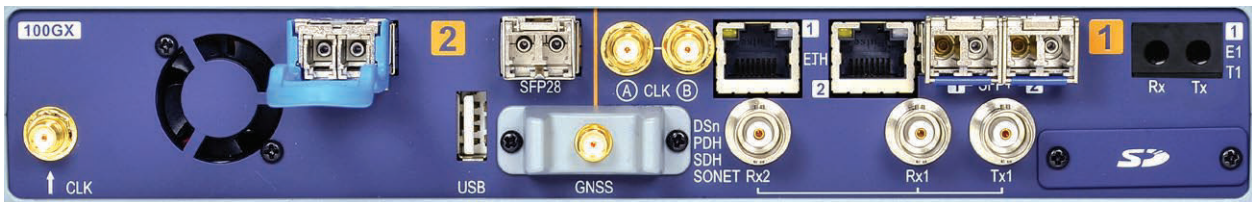

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