

RXT-6000 Module

Universal 10M to 100G Testing



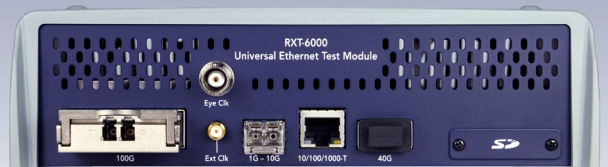
RXT-1200

Modular Test Platform



Advanced All-in-One Test Module for Carrier Ethernet, Backhaul & Transport Technologies

VeEX® RXT is the industry's most flexible, compact, and future-proof hand-held test solution for core and field applications. The RXT-6000 module adds Ethernet, Mobile Backhaul, Storage Area Networks, OTN, SDH/SONET links and services testing, from 10 Mbps up to 100 Gbps.



Platform Highlights

The RXT modular test platform offers a full range of link and service testing capabilities for a complete range of communication technologies, including OTN, SDH/SONET, PDH/DSn, Carrier Ethernet, SyncE, 1588v2 PTP, CPRI/OBSAI (DAS), Fibre Channel, OTDR, OSA, xDSL, Outside Plant, Teleprotection (IEEE C37.94), even down to legacy Datacom and VF TIMS testing. All supported by a single rugged hand-held test platform.

- Optional built-in GPS for One Way Delay (OWD) and Timing (Phase) measurement
- Optional built-in high-precision Atomic Clock reference
- Fast test results transfer via USB memory stick
- Intuitive graphical user interface for easy operation
- 7" color LCD with touch screen
- Ultra high capacity field-exchangeable Li-ion battery pack offers over 1.5 hours of continuous operation at 100GE rate
- Smallest and lightest 100GE test platform, weighing less than 2.8 kg (6 lb) including its high-capacity Li-ion battery

Module Highlights

The RXT-6000 module, with the latest technology in pluggable physical interfaces, is a perfect complement to the RXT Platform, extending its testing range to 100 Gbps.

Installation, commissioning, monitoring and maintenance of Ethernet, Fibre Channel, OTN and SDH/SONET 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 OTL/PCS, CAUI-4/XLAUI Lane BERT, Service Disruption, overhead monitor/control, Tandem Connection Monitoring, Protocol Capture/Decode, BERT, Throughput test, and much more.

General

- CFP2 interface for 100GE and OTU4 applications
- QSFP+ for 40GE and OTU3
- SFP+ for 100Base-FX, 1000Base-X, 10GBase-X, OTU2/2e/1e, STM-64/OC192, and Fibre Channel 1/2/4/8/10G applications
- RJ45 for 10/100/1000Base-T applications
- External clock interface
- 150ppm clock offset generation
- Eye diagram reference clock output
- Soft LED indicators

Module Highlights *cont'd*

Ethernet Testing

- Optical 100 Mbps to 100 Gbps Ethernet testing
- Electrical 10/100/1000 Mbps Ethernet testing
- Optical Lane BERT and CAUI-4/XLAUI Lane BERT
- PCS Layer Testing with Skew generation/monitoring
- Multi-stream testing up to 32 independent streams
- IEEE 802.3ah, ITU-T Y.1731, IEEE 802.1ag, and MPLS-TP OAM support
- Q in Q (VLAN stacking), MPLS, MPLS-TP, PBB, EoE support
- MAC flooding and VLAN flooding
- RFC2544 and V-SAM (Y.1564) testing
- Service Disruption Measurements
- IPv4 and IPv6 traffic generation
- BERT and Throughput testing at Layer 2 and Layer 3
- Smart Loopback mode for Layer 2 and Layer 3
- One-Way-Delay latency measurement (GPS assisted)
- Line rate packet capture with Wireshark™ decode
- Error and Alarm Injection

OTN Testing

- OTN testing for OTU1, OTU2, OTU1e, OTU2e, OTU3 and OTU4
- Complete multi-stage Mapping/Multiplexing
- Ethernet over OTN
- Service Disruption measurements
- Tandem Connection Monitoring
- Overhead monitoring and byte decoding
- Terminate, payload through and line through test modes
- Payload and Line through monitor modes
- Per-lane optical power and frequency measurements
- External clock reference interface
- Histogram Analysis

SDH/SONET Testing

- STM-0 to STM-64, OC-1 to OC-192
- Available as Line Rate or mapped into OTUk payload
- Test payload multiplexing down to VC3/STS-1

CFP2/QSFP+ Support

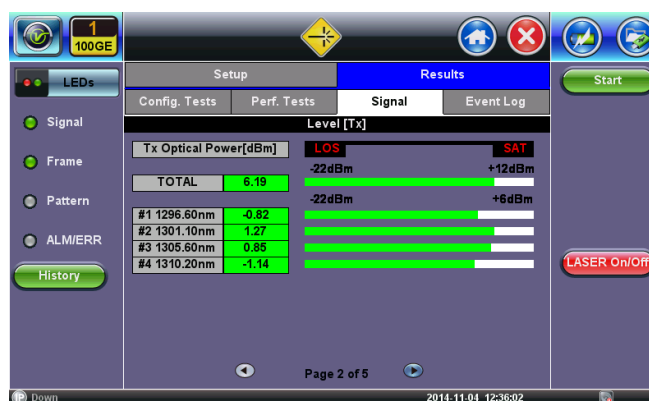
- Optical lane BERT
- PCS layer testing with skew generation/monitoring
- Transmit and receive optical power measurement
- Module status display

Applications

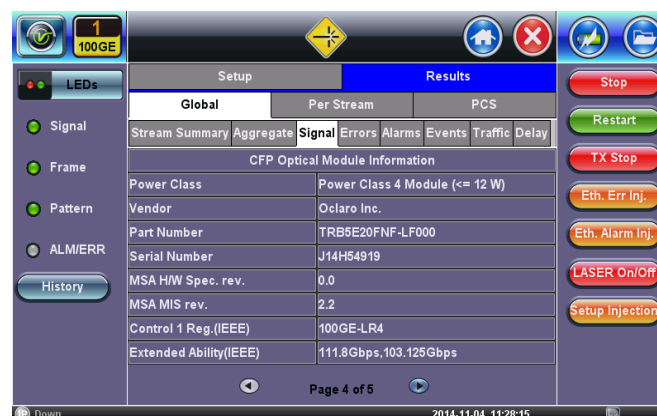
CFP2-LR4 Receive Optical Power per lane



CFP2-LR4 Transmit Optical Power per lane



CFP2 Module vendor specific information display



Applications *cont'd*

CFP2 Module temperature, alarm and failure information display



CFP2-LR4 PCS analysis for alarms and errors



Example of 100GE Layer 2 100% throughput test result display



CFP2-LR4 PCS, CAUI-4, Virtual lane and skew control setup



100GE V-SAM test results with 8 services. RXT-6000 is able to perform up to 32 services



Test Interfaces

Optical

CFP2 Module

- 100GE
- OTU4

QSFP Module

- 40GE
- OTU3

SFP+

- 100Base-FX, 1000Base-X, 10GBase-X
- OTU2, OTU2e, OTU1e, OTU1
- STM-0/4/16/64, OC-1/12/48/192

Electrical

RJ45

- 10/100/1000Base-T

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

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

Pluggable Module Status (CFP2/QSFP/SFP+ dependent)

- Module status, Alarm status, Internal Temperature, Voltage
- CFP2 unplugged
- Host Lane Fault, Network Lane Fault, Module Fault
- Network Lane Alarm, Module Alarm, General Alarm

Automatic CFP2 initialization and laser safety reset (OFF) after hot swap

Operating temperature range: 0°C to 45°C

CFP2 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

*Dependent on module form factor and type

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

External Clock Input

- Connector: 75 Ohm BNC
- 2.048 MHz, 1.544 MHz, 10 MHz
- 1.544 Mbps, 2.048 Mbps (AMI, HDB3, B8ZS)
- 1 PPS

System's High-stability 1 PPS Clock

- GPS clock (RXT-1200 platform option)
- Atomic Clock (RXT-1200 platform option)

Eye Diagram Clock Reference Output

- OTU4 and 100GE (4x25G only)
- Connector: 50 Ohm SMA
- OTU4 Frequency: 3.5 GHz
- 100GE Frequency: 3.22 GHz

**Atomic clock can be disciplined by the GPS if both options are present. Check UX400 Platform datasheet for details.

Measurement Clock Reference**

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

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

- 1PPS GPS clock and UTC (RXT-1200 platform option)
- 1PPS and 10 MHz Atomic Clock (RXT-1200 platform option)

Ethernet Testing

40GE and 100GE Functions

Reliability, Scalability and Quality of Service are the attributes needed for Ethernet to turn into Carrier-grade Ethernet. With standard features including RFC2544 and Ethernet, 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
- 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
- VLAN 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

Interfaces

100GE/40GE Compliant with IEEE 802.3ba

MSA compliant transceiver interfaces

CFP2 Interface bit rates

- 100GBase-R 103.125 Gbps

QSFP+

- 40GBase-R 41.25 Gbps

SFP+

- 10GBase-X 9.95/10 Gbps
- 1000Base-X 1 Gbps
- 100Base-FX 10 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/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

Optical Power Measurement

Per wavelength TX and RX power measurements

CFP2 vendor's detailed register display: Vendor, part number, Serial number, standard compliance

Optical module status: Temperature, Voltage, Alarm status

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

VLAN flooding feature generates test frames with up to 4096 incremental VLAN IDs

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

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

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 μ s

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

VLAN flooding feature: generates test frames with up to 4096 incrementing VLAN IDs

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

* Requires GPS option

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

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

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

OTN Testing

The RXT-6000 Module offers full range of OTN testing capabilities for OTU3 and OTU4 interfaces (CFP2), including service-activation (Bringing-into-Service), performance verification, maintenance, and troubleshooting. It offers Multi-Layer testing from Physical layer (WDM), CFP2, CAUI-4/XLAUI, OTL, OTU/ODUk, to bulk payloads, and Ethernet traffic generation up to 100% rate.

OTN Functions

Test Interfaces

MSA compliant transceiver interfaces

CFP2 Interface bit rates

- OTU4 111.810 Gbps

QSFP+

- OTU3 43.108 Gbps

SFP+

- OTU2e 11.095 Gbps
- OTU1e 11.045 Gbps
- OTU2 10.709 Gbps
- OTU1 2.666 Gbps

Key Features

- Advanced Mapping/Multiplex Structures
- EoOTN testing with internally generated Ethernet payload mapped into OTU3 (up to 40 Gbps) or OTU4 (up to 100 Gbps)
- OTU, ODU, OPU overhead manipulation and monitoring
- OTU, ODU, OPU layer alarms/errors generation and analysis
- OTU, ODU, TCMi trace messages
- Forward error correction (FEC) testing
- Tandem Connection Monitoring
- Frequency offset generation

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-stage (direct) mapping options

- OTU4-ODU4-Bulk
- OTU4-ODU4-100GE
- OTU3-ODU3-Bulk
- OTU3-ODU3-40GE
- OTU2e-ODU2e-Bulk
- OTU2e-ODU2e-10GE
- OTU1e-ODU1e-Bulk

- OTU1e-ODU1e-10GE
- OTU2-ODU2-Bulk
- OTU2-ODU2-STM64/OC192
- OTU1-ODU1-Bulk
- OTU1-ODU1-STM16/OC48

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 allow users to build the test signal in a logical layer by layer sequence

- CAUI-4/XLAUI
- OTL Lanes
- OTN Signal
- ODUk (Mapping and Multiplexing)
- Payload (Bulk or Ethernet)
- Test Pattern (CBR) or Traffic (Packets)

OTL Layer

OTL4.10 (OTU4)

OTL3.4 (OTU3)

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: 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

AMP Stuffing

TX Settings

- Offset (ppm)
- Stuffing Method: +1/0/-1 (PJO2 not used), +2/0/-1 (PJO2 used)

RX Statistics

- Offset (ppm)
- Positive, Double Positive, Negative, Total

BER Test (Alarm and Error Monitoring)

- Alarms: LOP (Loss of Pattern)
- Errors: Bit (Test Sequence Error)

Test Patterns

The following test sequences can be generated in Bulk mode

- PRBS: $2^{31}-1$, $2^{23}-1$, $2^{15}-1$, 2^9-1
- Normal or Inverted

Service Disruption Measurements

Service disruption measurements are integrated to the regular OTN BER test, supporting simultaneous monitoring of multiple Physical, OTL, OTU, ODU alarm and error sensors. Each layer is monitored independently, including all the ODU layers in multi-stage mapping/multiplexing configurations.

Alarm Sensors

- Physical layer: LOS
- OTL layer: LOF, OOF, LOL, OOL
- OTN layers: OTU-LOM, OTU-OOM, SM-IAE, SM-BDI, SM-BIAE, ODU-LOF, ODU-OOF, ODU-LOM, ODU-OOM, ODU-LCK, ODU-OCI, ODU-AIS, PM-BDI

Error Sensors

- OTL layer: FAS, MFAS
- OTN layers: OTU-MFAS, SM-BIP, SM-BEI, ODU-FAS, ODU-MFAS, PM-BIP, PM-BEI, Bit Error/Pattern Loss

Event Separation: 0 to 10000 ms

Pass/Fail Limit: 1 to 1000 ms

Results Summary

- Total number of Service Disruptions
- Current Service Disruption (μ s)
- Last Service Disruption (μ s)
- Longest Service Disruption (μ s)
- Shortest Service Disruption (μ s)
- Time stamped with 1 μ s resolution

Disruption Events Tables

- Track every Service Disruption event for each layer
- Time stamp with 1 μ s resolution
- Duration with 1 μ s resolution
- Pass/Fail Verdict
- Tracks individual sensor events that occurred during the disruption period with time stamp and duration (1 μ s resolution)

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, 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
- OTU3, ODU3, ODUk

Analysis – Decode and Display

Multiframe selection modes

- Display bytes can be locked to specific multi-frame (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

- 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

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

- Layer 2
- Layer 3 (IPv4 and IPv6)
- VLAN: Up to 3 tags
- MPLS: Up to 3 tags

Ethernet Testing

- BERT
- Throughput

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, Burst 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: $2^{31}-1$
- Normal or Inverted

Test Traffic RX Filter

- MAC Source, MAC Destination, Frame Type, DSCP, Protocol Type, IP Source, IP Destination

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

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

SDH/SONET Testing

SDH/SONET signals can be used as physical layer or as OTU1/OTU2 payloads, and can contain multiplexed PDH/DSn clients, providing all the flexibility to address complex test scenarios.

Test Interfaces

SFP+

- STM-64/OC-192 9.953 Gbps
- STM-16/OC-48 2.448 Gbps
- STM-4/OC-12 622 Mbps
- STM-1/OC-3 155 Mbps
- STM-0/OC-1 52 Mbps

Key Features

- STM-64/16/4/1/0
- OC-192/48/12/3/1
- Bulk VC/STS/VT, PDH/DSn and multiplexed payloads
- Overhead manipulation and monitoring
- Alarms/errors generation and analysis
- Service Disruption Time (SDT) and APS
- Round Trip Delay
- Tributary Scan
- Tandem Connection Monitoring
- Pointer Test Sequences

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 (intrusive)

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

Line Through (Transparent)

- 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

SDH Mappings

(According to ITU-T G.707)

- C-11 (Bulk/PRBS, unframed or framed DS1)
- C-12 (Bulk/PRBS, unframed or framed E1)
- C-3 (Bulk/PRBS, unframed, framed or channelized E3 or DS3) via AU-3 or AU-4
- C-4 (Bulk/PRBS, unframed or framed E4)
- C-4-4c (Bulk/PRBS)
- C-4-16c (Bulk/PRBS)

SONET Mappings

(According to Telcordia GR-253/ANSI T1.105)

- VT-2 (unstructured or framed E1)
- VT-1.5 (unstructured or framed DS1)
- STS-1 SPE (unstructured or framed E3 or DS3)
- STS-3c SPE (unstructured or framed E4)
- STS-12c SPE (Bulk) STS-48c SPE (Bulk)
- STS-192c SPE (Bulk)

Test Patterns

The following test patterns can be generated

- PRBS: $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 , 2^7-1 , QRSS
- Fixed: 0000, 1111, 1010, 1100, 1in8, 2in8, 3in24, DALY, NET55 and OCT55
- User defined: Ten 32-bit and one 24-Bit Programmable sequences
- Mode: Normal or Inverted

Errors

Insertion

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-REI, LP-BIP, and bit errors
- SONET: FAS, B1, B2, REI-L, B3, REI-P, REI-V, BIP-V, and bit errors
- Modes: Single, Count (# of errors), Fixed Rates (1E-9 to 1E-3)

Detection

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI, slips and bit errors
- SONET: FAS, B1, B2, REI-L, B3, REI-P, REI-V, BIP-V, slips and bit errors

Alarms

Generation

- SDH: LOS, LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HPUNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LPUNEQ, LP-PLM, LP-RDI, LP-RFI, LP-TIM, 2M AIS, 2M LOF, 2M RDI
- SONET: LOS, LOF, AIS-S, RDI-S, TIM-P, LOP-P, AIS-P, UNEQ-P,
- PLM-P, RDI-P, LOM-V, LOP-V, AIS-V, UNEQ-V, PLM-V, RDI-V,
- RFI-V, TIM-V, DS1-AIS, DS1-LOF, 2M-AIS, 2M-LOF, 2M-RDI,
- 45M-AIS, 45M-LOF
- Modes: Continuous (manual), Count (0.1, 1, 10, 100 seconds)

Monitoring and Detection

- SDH: LOS, LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-UNEQ, HP-PLM, HP-TIM, HP-RDI, TU-LOM, TU-AIS, TU-LOP,
- LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RFI
- SONET: LOS, LOF, OOF, AIS-S, RDI-S, TIM-P, LOP-P, AIS-P,
- UNEQ-P, PLM-P, RDI-P, LOM-V, LOP-V, AIS-V, UNEQ-V, PLM-V, RDI-V, RFI-V, TIM-V

Overhead Analysis and Generation

Network Architectures supported

- Linear (per ITU-T G.783)
- Ring (per ITU-T G.841)

Analysis – Decode and Display SOH/POH bytes in hexadecimal, binary or ASCII formats

- S1 synchronization status
- C2 HP/STS signal label
- J0 trace identifier (1, 16 or 64 bytes) in ASCII format
- J1 trace identifier (16 or 64 bytes) in ASCII format
- J2 trace identifier (16 or 64 bytes) in ASCII format
- K1, K2 APS Control
- V5 LP/VT signal label

Generation - Programmable Bytes RSOH/Section

- J0 trace: 1 byte hexadecimal, 16 byte ASCII with CRC-7 and 64 byte with CR+LF

MSOH/Line

- K1, K2 APS bytes per ITU-T G.783 and G.841
- S1 synchronization status message

HO-POH (VC-4, VC-3)/STS-POH (STS-N SPE, STS-1 SPE)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- C2 signal label
- H4 Sequence/Multiframe Indicator
- G1 (bit 5): End-to-end path status (RDI generation)
- K3 (bits 1-4) APS signaling

LO-POH (VC-3)/STS-POH (STS-1 SPE)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- C2 signal label
- G1 (bit 5): End-to-end path status (RDI generation)
- K3 (bits 1-4) APS signaling

LO-POH (VC-12, VC-11)/VT-POH (VT-1.5, VT-2)

- V5 (bits 5-7) LP/VT signal label
- J2 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
- K4 (bits 3-4) LP/VT APS signaling

Tributary Scan

Automatically scans VC-12, VC-11, VT-1.5 or VT-2 for errors, alarms and events using a sequential BER tests

Pointer Analysis and G.783 Test Sequences

Pointer movements monitoring and generation for SDH and SONET

Monitor

- AU, TU, STS and VT pointer adjustments
- SS bits, LOP, New Data Flags (NDF)
- Current value, increments, decrements, sum, difference
- Tributary frequency offset (ppm of AU/TU or STS/VT)

Generation

- Pointer sequences : ITU-T G.783, Telcordia GR-253
- Pointer Types: AU, TU, STS, VT
- Single pointer, increment, decrement, or increment/decrement
- Sequence: Basic, Single Alternating, Regular Additive, Regular Cancel, Double Alternating, Burst, Transient Burst, 87/3, 87/3 Additive, 87/3 Cancel, Periodic Additive, Periodic Cancel
- Programming of SS bits
- Adjustments: Increment, Decrement, New Value
- Parameters: N, T1, T2, T3, T4

Tandem Connection Monitoring (TCM)

Generation and analysis of N1 (HP-TCM) and N2 (LP-TCM) bytes

Detection, display and analysis of events

- UNEQ, TC-AIS, TC-ODI, TC-IEC, TC-REI, TC-OEI, TC-LTC, TC-RDI

Common Functions & Measurements

Service Disruption and APS Testing

Service disruption time (SDT) measurements are integrated to the regular BER tests, supporting multi-layer sensor monitoring for OTN and SDH/SONET

OTN Sensors

- LOS, OTU-AIS
- OTU-LOF, OTU-LOM, OTU-IAE, OTU-BDI, SM-BIAE, ODU-AIS, ODU-LCK, ODU-OCI
- FAS, MFAS, OTU-BIP, OTU-BEI, ODU-BIP, ODU-BEI

SDH Sensors

- LOS, LOF, FAS
- B1, MS-AIS, MS-RDI, MS-REI, B2, AU-AIS, AU-LOP, B3, HP-RDI, HP-REI, TU-AIS
- PDH payload-related triggers
- LSS

SONET Sensors

- LOS, LOF, FAS
- S-BIP, AIS-L, RDI-L, REI-L, L-BIP, AIS-P, LOP-P, P-BIP, RDI-P, REI-P, AIS-V
- PDH payload-related triggers
- LSS

Pass/Fail range: 15 to 200 ms

Gate Time: 20 to 4000 ms

SDT Results Summary

- Last Service Disruption Time
- Longest Service Disruption Time
- Shortest Service Disruption Time
- Time stamps
- Resolution: 10 μ s
- Total number of Service Disruptions events observed

Disruption Events Table

- Tracks every Service Disruption event for all layers
- Time stamp with 10 μ s resolution
- Duration with 10 μ s resolution
- Individual Pass/Fail Verdicts
- Tracks individual sensor events that occurred during the disruption period with time stamp and duration (10 μ s resolution)

APS Testing

- SDH/SONET APS Byte (K1/K2) sequence capture and decode

Auto Configuration

Available for SDH and SONET signals

Identification of received signal - instrument configuration based on network type, bit rate, line coding, framing, mapping, and test pattern

Signal Level and Frequency Measurement

Available for Optical Interfaces

Signal level

- Optical power in dBm and Loss/Saturation graph

Frequency (Line and Payloads)

- Resolution: 1 bit/s (bps)

Frequency Offset

- Resolution: 0.1 ppm Current, Minimum and Maximum

Round Trip Delay

(Available for all interfaces & mappings)

Measurement Range: 1 μ s to 10 seconds Resolution: $\pm 1 \mu$ s or 1 U.I.

Event Logging

Date and time stamped records of all error and alarm events occurred during a test, presented in tabular format

Histograms

(Available for all interfaces)

Histogram: Simultaneous display of Errors and Alarms versus time for sequence of events correlation

Bar Graph: Individual Error or Alarm severity versus time

Resolution: Seconds, minutes, hours and days

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

General

Power Consumption

Active 58 watts (max)

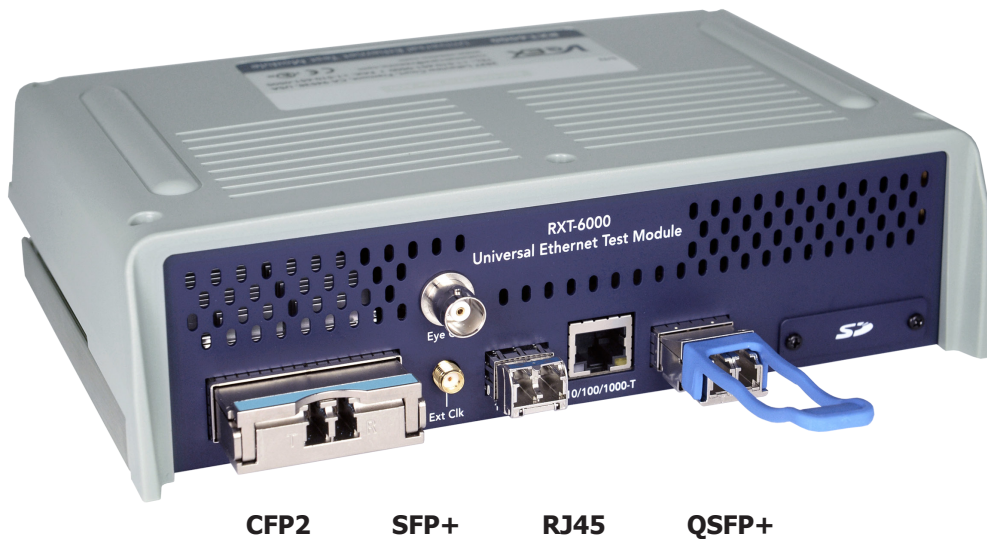
Environmental

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



VeEX Inc.
2827 Lakeview Court
Fremont, CA 94538 USA
Tel: +1.510.651.0500
Fax: +1.510.651.0505
www.veexinc.com
customercare@veexinc.com

© 2015 VeEX Inc. All rights reserved.
VeEX is a registered trademark of VeEX Inc. The information contained in this document is accurate. However, we reserve the right to change any contents at any time without notice. We accept no responsibility for any errors or omissions. In case of discrepancy, the web version takes precedence over any printed literature.
D05-00-100P A00 2015/02