

MPM-100AR™

100G Multi-Protocol Module



MPA Multi-Protocol Analyzer Modular Test Platform

Specifically designed to meet the test and measurement challenges of developers and early adopters of next generation Ethernet/IP, Fibre Channel, OTN & SONET/SDH ASICs, optics, transport/switching modules, and service delivery.



Applications

Ethernet/IP Traffic Generation & Analysis

- 100GE, 40GE, 25GE & 10GE
- Full line rate layer 1-3 multi-stream, throughput, frame loss, latency, packet jitter, and BERT characterization
- PCS & RS-FEC layer testing
- RFC 2544, Y.1564 compliance testing
- Service disruption time SDT measurement

Fibre Channel Generation and Analysis

- 32G, 16G, 10G
- Full line rate throughput, frame loss, latency and BERT characterization
- FEC layer testing
- Fibre Channel switch performance verification with FLOGI/ PLOGI
- Buffer-to-buffer credit and flow control analysis
- Service disruption time measurement

OTN & SDH/SONET Traffic Generation & Analysis

- OTU4, OTU3, OTU3e2, OTU3e1, OTU2, OTU2e, OTU1e & STL256.4
- OTL, FEC, OTN, & SDH/SONET layer testing
- Multi-Channel OTN testing with support for parallel testing of up to 80 x ODU0s
- Advanced multi-stage OTN multiplexing with Ethernet, GFP, Fibre Channel, SDH/SONET, & PRBS clients
- Complete overhead/trace generation and analysis with byte capture
- Thru mode with error & alarm stimulus testing
- Service disruption time and delay measurements

Test Interfaces	QSFP28 QSFP+	SFP28 SFP+
100GE	1	
100GE RS-FEC	1	
40GE	1	
25GE		2
25GE RS-FEC		2
10GE		2
32G Fibre Channel		2
16G Fibre Channel		2
10G Fibre Channel		2
OTU4 OTL4.4	1	
OTU3 OTL3.4	1	
OTU3e2	1	
OTU3e1	1	
OTU2		2
OTU2e		2
OTU1e		2
STL256.4	1	

Optical Layer Analysis

- QSFP28, QSFP+, SFP28, SFP+, SFP module verification
- Unframed BERT for signal integrity testing
- Optical transceiver I2C testing
- Optical transceiver module health check feature
- High speed lane clock stressing/analysis and optical power level verification

Module Highlights

- Multi-rate testing up to 100G
- Native QSFP28 test port
- Native dual independent SFP28/SFP+ test ports
- Advanced and flexible FPGA based test module provides future proof hardware support for emerging standards and test applications.
- The advanced pluggable hardware module supports easy field installation in deployed MPA chassis with existing test modules.

Ethernet/IP

Applications

Layer 1-3 full line rate throughput, frame loss, latency, jitter and BERT characterization
 RS-FEC generation and analysis
 RFC2544 and Y.1564 compliance testing
 Service disruption time measurements

Test Ports

	Number of Test Ports	Interface Options
1x QSFP28/QSFP+ Ports	1 x 100GE (103.125Gbps)	QSFP28: 100GBASE-LR4
	1 x 100GE RS-FEC IEEE 802.3 Clause 91 (103.125Gbps)	QSFP28: 100GBASE-SR4
	1 x 40GEQSFP+ (41.25Gbps)	QSFP+: 100GBASE-LR4, 100G BASE-SR4
2 x SFP28/SFP+ Ports	2 x 25GE (25.78Gbps)	SFP28: 25GBASE-LR, 25GBASE-SR
	2 x 25GE RS-FEC IEEE 802.3 Clause 108 (25.78Gbps)	SFP28: 25GBASE-SR
	2 x 10GE (10.3125Gbps)	SFP+: 10GBASE-LR, 10GBASE-SR

- Each SFP28/SFP+ port support an independent test.
- Both SFP28/SFP+ ports must operate at the same rate and protocol.
- Test module supports 1x QSFP28/QSFP+ port test or 2x SFP28/SFP+ test, ports do not operate at the same time.
- Other Interface options available on request.
- Supports any transceiver compliant to industry standards. Data rates, performance, and supported transmission protocols are only guaranteed for optical modules supplied by VeEX. If selecting or using other vendors, users should exercise caution.

PCS/RS-FEC Layer

40/100GE PCS/FEC Lane Numbering

Supports lane number swapping and rotation
 Displays Lane ID, lane # and channel assignments

40/100G PCS/FEC Lane Skew*

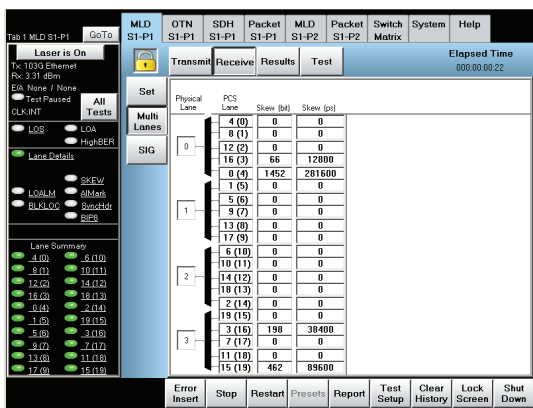
40/100GE

- Per lane skew generation 0 to 4,158 bits
- Per lane skew analysis in bit time and picoseconds, 66-bit resolution up to 4,158 bit periods

100GE RS-FEC

- Per lane skew generation 0 to 4158 bits
- Per lane skew analysis in bit time and picoseconds, 1-bit resolution up to 10,399 bit periods

**Note: User defined alarm threshold for received skew measurement.*



Error Generation*

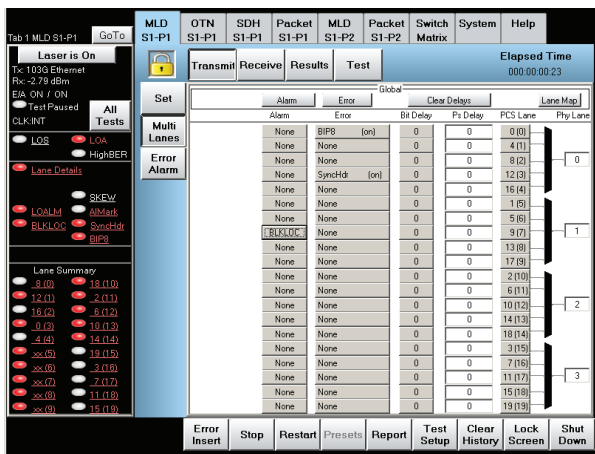
Error Generation	100GE	40GE	100GE RS-FEC	25GE RS-FEC
Sync Header per lane or all lanes (single, max 3.2E-1 to 1E-9, user defined rate)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Alignment Marker per lane or all lanes (single, max 2.0E-1 to 1E-4, user defined rate)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
BIP8 per lane or all lanes (single, max 7.4E-6 to 1E-10, user defined rate)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
FEC Correctable (single, max 1.33E-3 to 1E-10, user defined rate)			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FEC Uncorrectable (single, max 7.14E-2 to 1E-9, user defined rate)			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Note: 40/100G Supports independent error and alarm generation per lane. Each lane can generate a different error and rate and/or alarm.*

Alarm Generation*

Alarm Generation (continuous)	100GE	40GE	100GE RS-FEC	25GE RS-FEC
LOA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
High BER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Block Lock Loss per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Alignment marker loss per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
FEC LOA			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High SER			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FEC Alignment marker loss per lane			<input checked="" type="checkbox"/>	

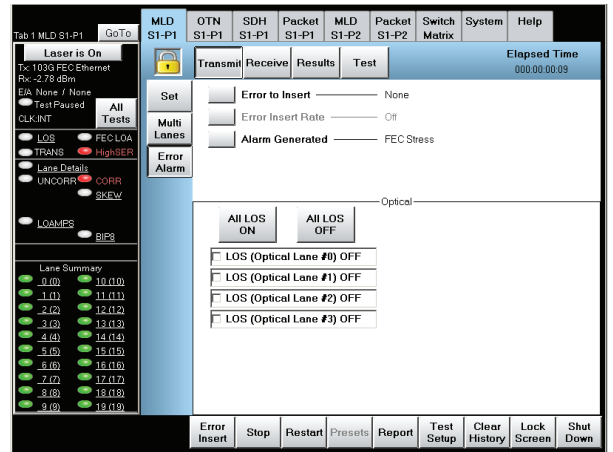
*Note: 40/100G Supports independent error and alarm generation per lane. Each lane can generate a different error and rate and/or alarm.



100GE RS-FEC Stress test

The advanced 100GE RS-FEC stress test provides a one-button method to ensure R&D RS-FEC receiver designs can correct the maximum number of errors over the entire data path.

The test simulates actual optical line errors on the outgoing line injecting 7 symbol errors in the RS FEC block using a pseudo-random 10-bit error mask and a pseudo random symbol error location that guarantees all symbol locations in the RS FEC block will be errored in roughly 4us.



Error Results

Error Detection (counts, average and current rates)	100GE	40GE	100GE RS-FEC	25GE RS-FEC
Sync Header per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Alignment Marker per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
BIP8 per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Alignment marker loss per lane			<input checked="" type="checkbox"/>	
FEC LOA			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High SER			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FEC Alignment marker loss per lane			<input checked="" type="checkbox"/>	
FEC Alignment marker padding			<input checked="" type="checkbox"/>	

Alarm Results

Alarm Detection (seconds)	100GE	40GE	100GE RS-FEC	25GE RS-FEC
LOA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
High BER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Block Lock Loss per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Alignment marker loss per lane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
FEC LOA			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High SER			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FEC Alignment marker loss per lane (LOAMPS)			<input checked="" type="checkbox"/>	

Ethernet/IP Layer

Traffic Generation/Multiple Test Stream Flows

Supports up to 32 independent test stream flows with generation and analysis capability with separate rate, addressing and traffic parameters

Each Test flow is generated with a signature field in the beginning of the UDP payload area for traceability and measurement purposes

Multi-stream configuration utility allows simultaneous configuration of multiple streams

MAC/IP/UDP formatted traffic generation

IP Version: IPv4 or IPv6

MAC/IP/UDP source and destination addressing

User defined Ethernet Type, Traffic Class, Hop Limit, Flow label fields

Frame sizes: 60 to 16,000 bytes

Test Pattern: 2³¹-1, 2²³-1, 2²⁰-1, 2¹⁵-1, 2¹¹-1, 2⁹-1 normal and inverted, 32-bit user

VLAN tags up to 4 levels with user defined TPID, PCP/ QOS, DEI, VID

MPLS tags up to 4 levels with user defined label, TC, S(bottom), TTL

Traffic Rate Generation

Full rate generation and analysis

Constant rate by % BW with 0.01% resolution and accuracy

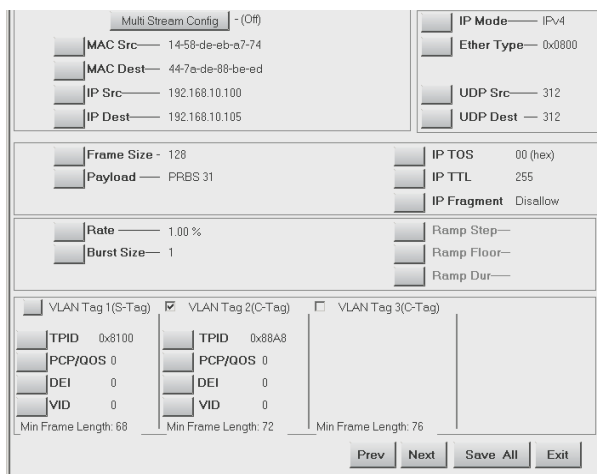
Constant rate by Mbps with 0.001Mbps resolution and accuracy

Constant rate by average interpacket gap in bytes with approximately 1 byte accuracy

Constant rate by average interpacket gap in ms with approximately 1 ms accuracy

Ramp by %BW or Mbps with configurable ramp ceiling, floor, step size and step size duration

Burst size with single burst of traffic from 1 frame to 1 second of frames at minimum interpacket gap



Configurable Preamble/SFD

Supports configurable of preamble and SFD for all port generated test stream traffic

Deficit Idle Count

Allows enable/disable of DIC for 10GE

Seed A/B Pattern Generation & Analysis

Supported for 10GE and 25GE rates

All zeros or local fault patterns

Detects Seed A/B pattern errors

Flow Control

Port responds to received pause frames with option enable/disable

Generate pause packet with 0 to 65535 quanta

Counts transmitted and received pause packets, pause quanta and pause end packets

Error Generation

Code (single, 1E-3 to 1E-10 rates)*

Payload Bit (single, 1E-3 to 1E-4 rates)

Sequence (single, 1E-2 to 1E-4 rates)

Runt (single, 1E-2 to 1E-7 rates), configurable 60-63byte size*

FCS (single, 1E-2 to 1E-7 rates)*

IP Checksum (single, 1E-2 to 1E-7 rates)

**Note: Not supported on 10GE, 25GE, 25GE RS-FEC interfaces.*

Alarm Generation

Remote and local fault alarms

Auto reply to local fault option

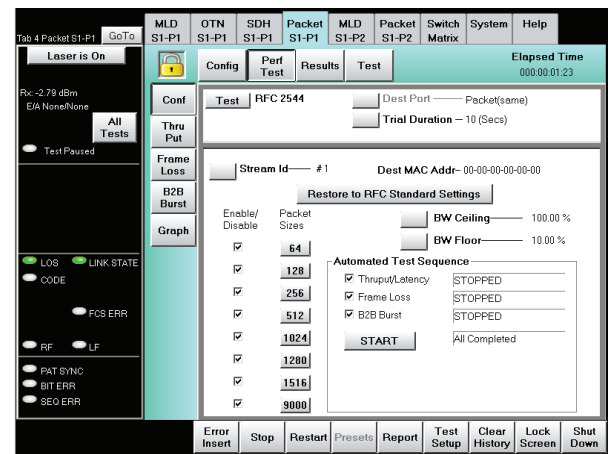
RFC 2544 Benchmarking

Throughput/Latency, Frame loss, Back to Back Burst

Automated test sequence allows single or all tests to be run in sequence

Supports standardized and configurable parameters including graphical results

- Up to 8 configurable frame size test steps
- Trial duration, min/max transmit bandwidth
- Throughput acceptable loss rate, latency iterations, and resolution rate
- Back to Back burst - configurable resolution and number of repetitions



Y.1564 Testing

Compliant with ITU-T Y.1564 standard

Multi-stream traffic flow generation for up to 10 services

Service configuration and performance test

Automated test sequence allows single or both tests to be run in sequence

Independently configurable settings and thresholds for each stream/service

Simple and advanced results with drill down capability

Loopback Modes

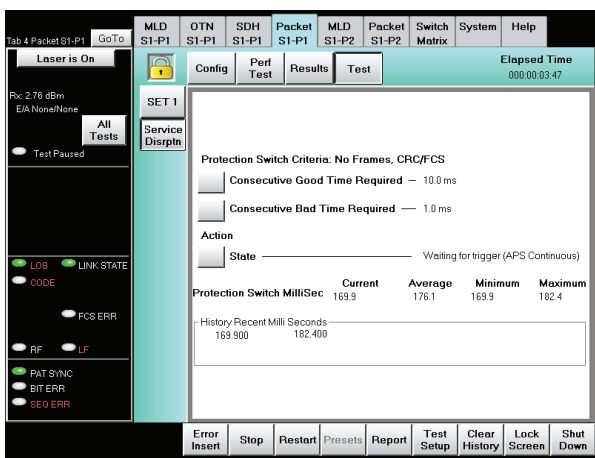
DLI Packets only – analyzes incoming data, reflects the Ethernet frame payload data in regenerated frames reversing the source and destination MAC/IP addresses for tester generated traffic only

All non-routing packets – analyzes incoming data, reflects the Ethernet frame payload data in regenerated frames reversing the source and destination MAC/IP addresses for all non-multicast traffic

Thru mode – line loopback mode, analyzes incoming data, all data is passed back out of test port unaffected with same interface clocking

Service Disruption Time (SDT) Measurement

- Event Triggers: loss of Ethernet frame disruption, FCS error
- Event thresholds: minimum SDT time (0.1 to 1683.3 ms), measurement clearing time (10.0 to 1638.3 ms)
- 0.1ms resolution and accuracy
- Single or continuous measurements
- Reports SDT min, max, and average values in milliseconds
- Displays the last measurement plus 10 historical events, last 250 events saved in test report



Results

Result Filtering

Results can be filtered by up to 4 VLAN tag TPIDs

Transmit and Receive Port Counts

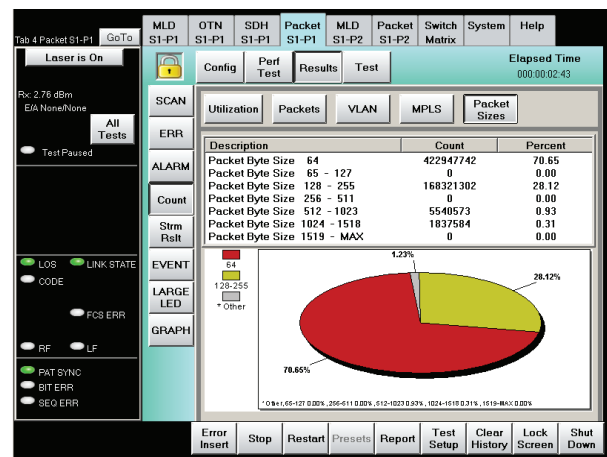
Packets, packets/second, bytes, Mbps, % BW
 VLAN packets, MPLS packets
 IPv4 & IPv6 packets

Receive Port Counts

TCP, UDP, IGMP, ICMP packets
 Broadcast, multicast, unicast
 Jumbo, super jumbo packets (greater than 9000 bytes)

Distribution Results

VLAN distribution by tag level and quality of service level
 MPLS distribution by tag level and traffic class
 Packet size distribution for 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518, 1519-max byte ranges with support for counts, percentage and graphing



Utilization Counts

Total, IPv4, IPv6, VLAN, MPLS binning
 Current, min, max, and average % BW, Mbps, and packets per second statistics for generated and received traffic

Error Detection

Displays counts, errored seconds, current and average error rates
 Code, undersized, runt*, invalid FCS*, invalid IP, invalid UDP

**Note: Not supported for 10GE, 25GE, 25GE FEC interfaces.*

Alarm Detection

Loss of link, local fault, remote fault

Test Stream Results

Supports up to 32 independent sets of test stream performance results
 Transmitted and received packet counts, byte counts and rate in %BW
 Test stream sequence errors, bit errors and lost frame counts in errored seconds, current and average rates
 User-defined pass/fail threshold alarm from sequence errors, bit errors and lost frames
 Latency min, max, and average measurements with 0.1 ms resolution and accuracy
 Packet jitter min, max, and average measurements with 0.1 ms resolution and accuracy

Fibre Channel

Applications

- Full line rate throughput, frame loss, latency and BERT characterization
- Fibre Channel switch login and performance verification
- Buffer-to-Buffer credit and flow control analysis
- Service disruption time measurements

Test Ports

	Number of Test Ports	Interface Options
2x SFP28/ SFP+ Ports	2 x 32G Fibre Channel RS-FEC IEEE 802.3 Clause 91 (28.05 Gbps)	SFP28: 1310 nm LR, 850 nm SR
	2 x 16G Fibre Channel (14.025 Gbps)	SFP+: 1310 nm LR, 850 nm SR
	2 x 10G Fibre Channel (10.52 Gbps)	SFP+: 1550 nm ER, 1310 nm LR, 850 nm SR

- Each SFP28/SFP+ port support an independent test
- Both SFP28/SFP+ ports must operate at the same rate and protocol
- Test module supports 1x QSFP28/QSFP+ port test or 2x SFP28/SFP+ test, ports do not operate at the same time
- Other Interface options available on request
- Other Interface options available on request
- Supports any transceiver compliant to industry standards. Data rates, performance, and supported transmission protocols are only guaranteed for optical modules supplied by VeEX. If selecting or using other vendors, users should exercise caution

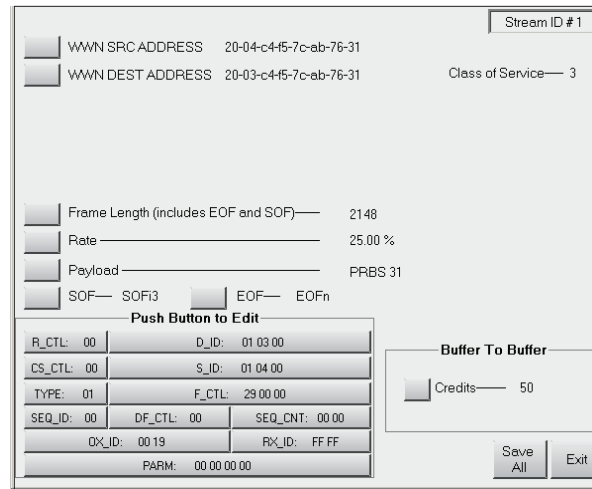
Traffic Generation/Test Stream Flow

Test flow is generated with a signature field in the beginning of the payload area for traceability and measurement purposes

- Class 3 service frames
- WWN source and destination addressing
- Frame sizes: 68 to 2148 bytes
- Test Pattern: 231-1 normal and inverted, 32-bit user
- Configurable frame parameters include D_ID, S_ID, F_CTL, R_CTL, CS_CTL, Type, SEQ_ID, DF_CTL, SEQ_CNT, OX_ID, RX_ID, PARM
- Configurable SOF (SOFc1, SOFi1, SOFi2, SOFn2, SOFi3, SOFn3, SOFc4, SOFi4, SOFn4, SOFf)
- Configurable EOF (EOFc, EOFdt, EOFa, EOFn, EOFni, EOFdti, EOFrt, EOFrti)

Traffic Rate Generation

Full rate generation and analysis
Continuous rate generation in % BW with 0.01% resolution and accuracy

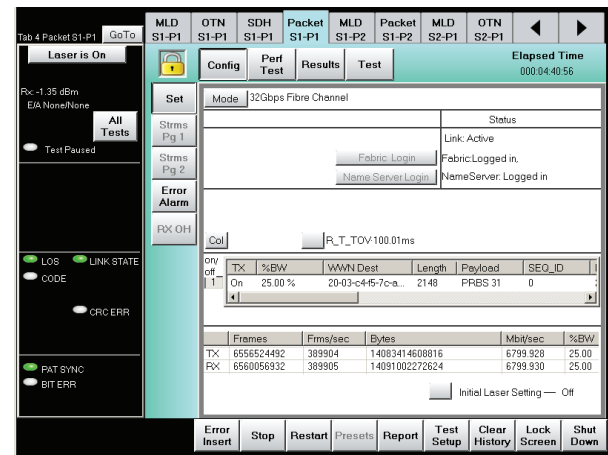


Transmit Training Sequence

Transmit training sequence (TTS) supported for 32G

Switch Fabric and Name Server Login

Supports Fabric login with status
Supports Name Server Login with status
Displays current link status
Buffer-to-Buffer Credit configuration for login: 1-65,535



Configuration

Supports configurable R_T_TOV setting (0.1 to 655.35 ms)

Service Disruption Time (SDT) Measurement

Event Triggers: loss of traffic frames, CRC error
Event thresholds: minimum SDT time (0.1 to 1683.3 ms), measurement clearing time (10.0 to 1638.3 ms)
0.1 ms resolution and accuracy
Single or continuous measurements
Reports SDT min, max, and average values in milliseconds
Displays the last measurement plus 10 historical events, last 250 events saved in test report

OTN

RFC 2544 Benchmarking

Throughput/Latency, Frame loss
Automated test sequence allows single or all tests to be run in sequence

Supports standardized and configurable parameters including graphical results

- Up to 8 configurable frame size test steps
- trial duration, min/max transmit bandwidth
- Throughput acceptable loss rate, latency iterations, and resolution rate

Error Generation

Code (single, 1E-3 to 1E-10 rates)
Payload bit (single, 1E-3 to 1E-9 rates)
CRC (single, 1E-2 to 1E-7 rates)
FEC Correctable (single, max 1.33E-3 to 1E-10, User Defined rates) – 32G only
FEC Uncorrectable (single, max 7.14E-2 to 1E-9, User Defined rates) – 32G only

Alarm Generation

FEC LOA(continuous) – 32G only

Results

Transmit and Receive Port Counts

Frames, Frames/second, bytes, Mbps, % BW

Utilization Counts

Current, min, max, and average % BW, Mbps, and frames per second statistics for generated and received traffic

Error Detection

Displays counts, errored seconds, current and average error rates Code, oversized, undersized, invalid CRC, alignment, EOFA, EOF FEC Correctable Symbol, FEC Uncorrectable – 32G only

Alarm Detection

Loss of link seconds
FEC LOA seconds - 32G only

Test Stream Results

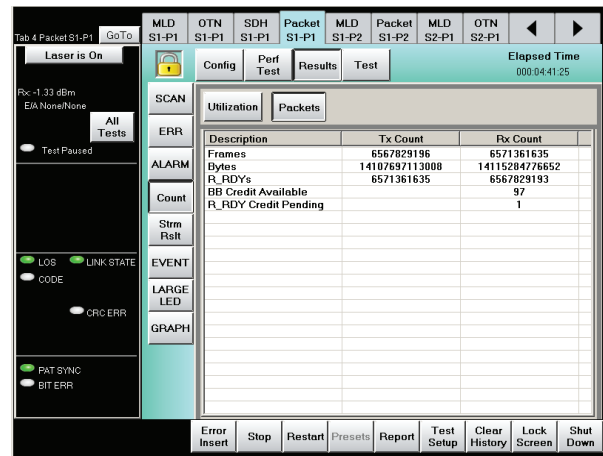
Transmitted and received frame counts, byte counts and rate in %BW
Test stream bit errors and lost frame counts, errored seconds, current and average error rates
User-defined pass/fail threshold alarm for bit errors and lost frames
Latency min, max, and average measurements in with 0.1microsecond resolution and accuracy

Buffer-buffer Credit / Flow Control Analysis

Displays TX/RX R_RDY counts
Available buffer-to-buffer credits counts
R_RDY Credit Pending counts

Applications

OTL/FEC/OTN traffic generation and analysis
OTN multiplexing with Ethernet, GFP, SONET/SDH, Fibre Channel, & PRBS clients



Advanced multi-channel OTN traffic generation and analysis
Thru mode & error and alarm stimulus
Service disruption time measurements
Round trip delay measurements

Test Ports

	Number of Test Ports	Interface Options
QSFP28/ QSFP+	1 x OTU4 (111.809Gbps) OTL4.4	QSFP28: LR4, SR4
	1 x OTU3 (43.018Gbps) OTL3.4	QSFP+: LR4, ER4
	1 x OTU3e2 (44.583Gbps)	QSFP+: LR4, ER4
	1 x OTU3e1 (44.571Gbps)	QSFP+: LR4, ER4
SFP28/SFP+	2 x OTU2 (10.709G)	SFP+: 1550 nm ER, 1310 nm LR, 850 nm SR
	2 x OTU2e (11.095G)	
	2 x OTU1e (11.049G)	

- Each SFP28/SFP+ port support an independent test
- Both SFP28/SFP+ ports must operate at the same rate and protocol
- Test module supports 1x QSFP28/QSFP+ port test or 2x SFP28/SFP+ test, ports do not operate at the same time
- Other interface options available on request
- Supports any transceiver compliant to industry standards. Data rates, performance, and supported transmission protocols are only guaranteed for optical modules supplied by VeEX. If selecting or using other vendors, users should exercise caution

OTL Layer

Lane Mapping

Supports virtual lane number swapping and rotation
Displays Lane ID, lane # and channel assignments

Lane Skew

Per lane skew generation 0 to 65,000 bits in 1 bit resolution
Per lane skew analysis (bit time and ps), 1-bit resolution up to 65,000 bit periods
User configurable alarm threshold for received skew measurement

Alarm Generation

OTL-LOF, OTL-OOF, OTL-AIS
OTL-LOR, OTL-OOR (OTU4 only)
Supports independent alarm generation per lane. Each lane can generate a different alarm
Duration: continuous

Alarm Detection

OTL-LOA
OTL-LOF, OTL-OOF, OTL-AIS, OTL-LOR, OTL-OOR per lane
One second resolution

OTN Mappings & Clients

Standards

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

Settings Control

Setting: coupled or independent transmit and receive settings

Forward Error Correction

G.709 RS FEC (255,239)
TX FEC: Enabled/Disabled
RX FEC: Enabled/Disabled

Scrambling

TX scrambling: Enabled/Disabled
RX scrambling: Enabled/Disabled

Passthru Mode

Non-intrusive - only FEC layer regenerated
Supports optional error, alarm, or OH byte overwrite (OTU, first stage ODU, OPU)

OTN Structures and Mapping Clients

OTU4 Direct & Single-Stage Structures

ODU4

- Bulk PRBS, Null
- 100GE (with Ethernet/IP or PRBS)

ODU4-ODUflex (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed

ODU4-ODU3 (PT=21)

- Bulk PRBS, Null
- 40GE (with Ethernet/IP or PRBS)
- STM-256 SYNC/ASYN (AU-4-256c, AU-4-64c, AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)

- STS-768 SYNC/ASYN (STS-768c, STS-192c, STS48c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU2e (PT=21)

- Bulk PRBS, Null
- 10GE SYNC

ODU4-ODU2 ODUflex (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed
- 4G & 8G Fibre Channel

ODU4-ODU2 (PT=21)

- Bulk PRBS, Null
- GFP G.Sup43 7.3, GFP Bulk, GFP Framed, GFP Transparent
- STM-64 SYNC/ASYN (AU-4-64c, AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-192 SYNC/ASYN (STS-192c, STS48c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU1 (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYN (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYN (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU0 (PT=21)

- PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

OTU4 Multi-Stage Structures

ODU4-ODU3 (PT=21)-ODU2e (PT=21)

- Bulk PRBS, Null
- 10GE SYNC

ODU4-ODU3 (PT=21)-ODU2 (PT=20/21)

- Bulk PRBS, Null
- GFP G.Sup43 7.3, GFP Bulk, GFP Framed, GFP Transparent
- STM-64 SYNC/ASYN (AU-4-64c, AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-192 SYNC/ASYN (STS-192c, STS48c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU3 (PT=21)-ODU2-ODUflex (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed
- 4G & 8G Fibre Channel

ODU4-ODU3 (PT=21)-ODU2 (PT=20/21) -ODU1 (PT=20/21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYN (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYN (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU3 (PT=21)-ODU2 (PT=20/21)-ODU1 (PT=20/21)-ODU0 (PT=20)

- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

ODU4-ODU3 (PT=21)-ODU1 (PT=20/21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYNC (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYNC (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU3 (PT=21)-ODU1 (PT=20/21)-ODU0 (PT=20)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

ODU4-ODU3 (PT=21)-ODU0 (PT=21)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM4 (AU-4-4c, AU-4 C-4, AU-3 C-3 - PRBS), STM1 (AU-4 C-4, AU-3 C-3 PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

ODU4-ODU2 (PT=21)-ODU1 (PT=20/21)

- Bulk PRBS, Null
- GFP-Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYNC (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYNC (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU4-ODU2 (PT=21)-ODU1 (PT=20/21)-ODU0 (PT=20)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

ODU4-ODU1 (PT=21)-ODU0 (PT=20)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

OTU3 Direct & Single-Stage Structures

ODU3

- Bulk PRBS, Null
- 40GE (with Ethernet/IP or PRBS)
- STM-256 SYNC/ASYNC (AU-4-256c, AU-4-64c, AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-768 SYNC/ASYNC (STS-768c, STS-192c, STS48c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU3-ODUflex (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed

ODU3-ODU2e (PT=21)

- Bulk PRBS, Null
- 10GE SYNC

ODU3-ODU2 (PT=20/21)

- Bulk PRBS, Null
- GFP G.Sup43 7.3, GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYNC (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)

- STS-48 SYNC/ASYNC (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU3-ODU2-ODUflex (PT=20/21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed
- 4G & 8G Fibre Channel

ODU3-ODU1 (PT=20/21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYNC (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYNC (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU3-ODU0 (PT=21)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

OTU3 Multi-Stage Structures

ODU3-ODU2 (PT=20/21)-ODU1 (PT=20/21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed, GFP Transparent
- STM-16 SYNC/ASYNC (AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-48 SYNC/ASYNC (STS-48c, STS12c, STS-12c, STS-3c, STS-1 Bulk PRBS)

ODU3-ODU2 (PT=20/21)-ODU1 (PT=20/21)-ODU0 (PT=20)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

ODU3-ODU1 (PT=20/21)-ODU0 (PT=20)

- Bulk PRBS, Null
- GFP Transcoded 1000BASE-X
- STM-4 (AU-4-4c, AU-4 C-4, AU-3 C-3 – Bulk PRBS), STM-1 (AU-4 C-4, AU-3 C-3 Bulk PRBS)
- STS-12 (STS-12c, STS-3c, STS-1 Bulk PRBS), STS-3 (STS-3c, STS-1 Bulk PRBS)

OTU3e2 Direct Structures

ODU3e2

- Bulk PRBS, Null

OTU3e1 Direct Structures

ODU3e2

- Bulk PRBS, Null

ODU4-ODU3 (PT=21)-ODU2-ODUflex (PT=21)

- Bulk PRBS, Null
- GFP Bulk, GFP Framed
- 4G & 8G Fibre Channel

OTU2 Direct Structures

ODU2

- Bulk PRBS, Null

OTU2e Direct Structures

ODU2e

- Bulk PRBS, Null
- 10GE SYNC

OTU1e Direct Structures

ODU1e

- Bulk PRBS, Null
- 10GE SYNC

Notes:

GFP Bulk & GFP Framed have a max 10G data rate (OPU-2 capacity).
 GFP in ODUflex supports a maximum of 8 time slots.
 Background ODU channels are generated as Null client.

Multi-Channel OTN Generation and Analysis

The multi-channel OTN feature supports advanced traffic generation and analysis allowing simultaneously and independent testing all ODU containers of the OTN transport interface.

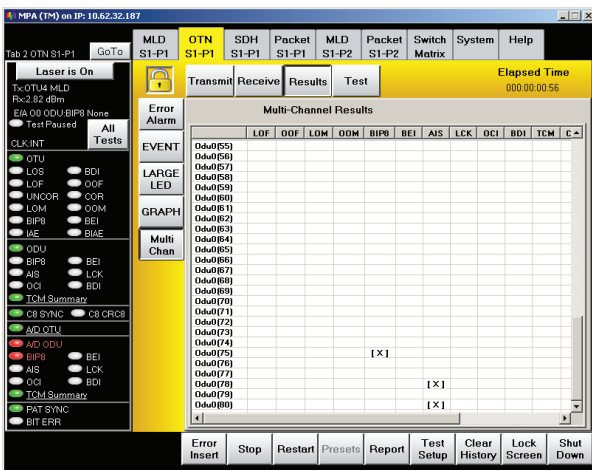
Generation

Each ODU supports independent error, alarm and overhead generation
 Supports independent stuffing and test pattern generation

Analysis

Independent error, alarm, overhead, stuffing, and test pattern analysis per ODU

Service Disruption Time (SDT) Measurement



Channel	State	Cur	Avg	Min	Max	EventTime
odu0(59)	Inactive	35,900	37,966	35,900	39,146	06/07/17 17:41:12
odu0(60)	Inactive	35,999	37,966	35,999	39,048	06/07/17 17:41:12
odu0(61)	Inactive	35,999	37,966	35,999	39,048	06/07/17 17:41:12
odu0(62)	Inactive	35,999	37,966	35,999	39,048	06/07/17 17:41:12
odu0(63)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(64)	Inactive	35,999	37,868	35,999	39,048	06/07/17 17:41:12
odu0(65)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(66)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(67)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(68)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(69)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(70)	Inactive	35,900	37,868	35,900	38,950	06/07/17 17:41:12
odu0(71)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(72)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(73)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(74)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(75)	Inactive	35,999	37,868	35,999	39,048	06/07/17 17:41:12
odu0(76)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(77)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(78)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(79)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12
odu0(80)	Inactive	35,999	37,868	35,999	38,950	06/07/17 17:41:12

Interface	ODTU Structure	# of Channels Tested in Parallel	Clients
OTU4	ODU4-ODU2e (PT=21)	10 x ODU2e	Bulk PRBS, Null
	ODU4-ODU2 (PT=21)	10 x ODU2	Bulk PRBS, Null
	ODU4-ODU1 (PT=21)	40 x ODU1	Bulk PRBS, Null
	ODU4-ODU0 (PT=21)	80 x ODU0	Bulk PRBS, Null
OTU3	ODU3-ODU2 (PT=20/21)	4 x ODU2	Bulk PRBS, Null
	ODU3-ODU1 (PT=20/21)	16 x ODU1	Bulk PRBS, Null
	ODU3-ODU0 (PT=21)	32 x ODU0	Bulk PRBS, Null

Provides simultaneous SDT measurement on all channels in parallel ODU Bulk Test Patterns

Supports generation and analysis of the following test patterns

- 2³¹-1, 2²³-1, 2²⁰-1, 2¹⁵-1, 2¹¹-1, 2⁹-1 normal and inverted, 32-bit user, Live (receive only)

ODUflex

ODUflex Tributary slots

- ODU4-ODUflex 1 to 80 TS
- ODU3-ODUflex 1 to 32 TS
- ODU2-ODUflex 1 to 8 TS
- Flexible TS selection

Configurable PRBS data rate: 10M to full ODUflex frame rate
 ODUflex received data rate measurement in Mbps

Justification & Stuffing

Supports generation and analysis of all AMP, BMP, GMP justification/stuffing at all levels and for all clients

Transmit Offset Range

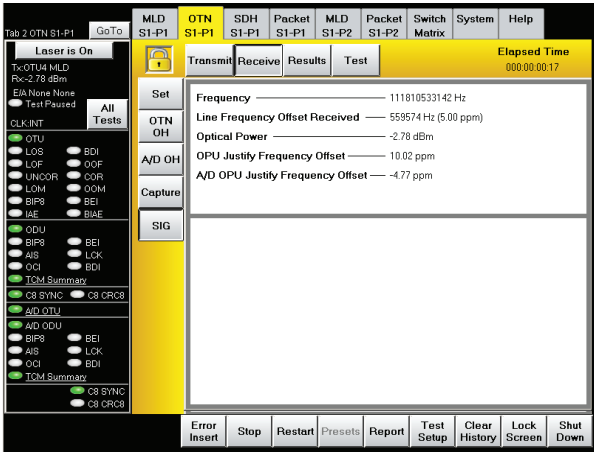
Configurable value in .01 steps

- ODTU34: +47.40 to -84.28 ppm
- ODTU2e4: +/-120.00 ppm
- ODTU24: +95.63 to -40.88 ppm
- ODTU14: +65.67 to -71.42 ppm
- ODTU04: +/-68.83 ppm
- ODTU2e3: +/-120.00 ppm
- ODTU23: +101.11 to -95.85 ppm
- ODTU13: +101.39 to -96.40 ppm
- ODTU03: +/-66.20 ppm
- ODTU12: 83.31 to -113.65 ppm
- ODTU02: +/-65.93 ppm
- ODTU01: +/-65.65 ppm
- ODUflex: +/-100.00 ppm
- 40/100GE clients: +/-100.00 ppm
- ODU0: GFP Transcoded 1000BASE-X, STM-4/STS-12, STM-1/STS-3: +/-100.00 ppm
- ODU3 SONET/SDH ASYNC: +/- 66.21 ppm, single positive or negative adjustment

- ODU2 SONET/SDH ASYNC: +/- 65.93 ppm, single positive or negative adjustment
- ODU1 SONET/SDH ASYNC: +/- 65.65 ppm, single positive or negative adjustment

Received Offset Measurement

Supported for all levels
Displays measurement in ppm



GMP

Displays transmitted min and max Cn value
Displays received current, min, and max Cn value
Transmit GMP Cn Plus 1, Plus 2, Minus 1, Minus 2, Gtr 2, Lt 2 counts
Receive GMP Cn Plus 1, Plus 2, Minus 1, Minus 2, Gtr 2, Lt 2 counts

SONET/SDH ASYNC

Positive and negative justification counts and justification seconds

Overhead and Trace Generation

- OTU manually editable bytes
- OA1(1-3), OA2(1-3), BEI/BDI/IAE/RES, GCC0-1, GCC0-1, RES-1, RES-2
 - SAPI, DAPI, Specific traces
- ODU manually editable bytes
- Forward FTFL: Fault, OI, OS
 - Backward FTFL: Fault, OI, OS
 - BEI/BDI/STAT
 - SAPI, DAPI, Specific traces
 - RES-1, RES-2, PM and TCM, TCM/ACT, EXP-1, EXP-2, GCC1-1, GCC1-2, GCC2-1, GCC2-1
 - APS/PCC-1 to APS/PCC-4
 - RES-4 to RES=9

TCM manually editable bytes

- TCMi(i=1-6) Selection
- BEI/BDI/STAT
- SAPI, DAPI, Specific traces

OPU

- RES-1 to RES-8
- PT (PSI-0)
- MSI overhead

Decode & Display of Overhead and Traces

OTU

- OA1(1-3), OA2(1-3), MFAS, TTI, BIP8, BEI/BDI/IAE/RES, GCC0-1, GCC0-1, RES-1, RES-2
- SAPI, DAPI, Specific traces

ODU

- Forward FTFL: Fault, OI, OS
- Backward FTFL: Fault, OI, OS
- TTI, BIP-8, BEI/BDI/STAT
- SAPI, DAPI, Specific traces
- RES-1, RES-2, PM and TCM, TCM/ACT, EXP-1, EXP-2, GCC1-1, GCC1-2, GCC2-1, GCC2-1
- APS/PCC-1 to APS/PCC-4
- RES-4 to RES=9

TCM

- TCMi(i=1-6) Selection
- TTI, BIP-8, BEI/BDI/STAT
- SAPI, DAPI, Specific traces

OPU

- RES-1 to RES-3
- RES-5/JC-1, RES-6/JC2, RES-7/JC3, RES-8/NJO
- PT (PSI-0)
- MSI overhead

Optional TCM Layer and Trace Alarm Reporting

Supports configuration of TCM, TIM, and PLM layer alarms to be optionally reported

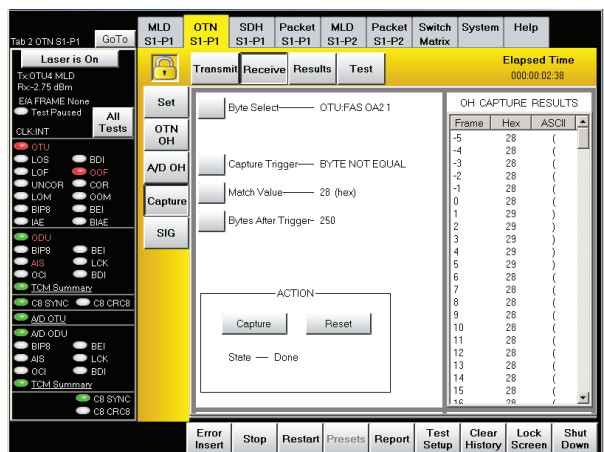
- OTU SM TIM, ODU PM TIM
- TCMi(i=1-6): Disabled, enabled with or without TIM
- OPU PLM
- Configurable expected values for all TIM, PLM levels
- OPU Out of Frequency with configurable threshold

Overhead Byte Capture

Captures specified overhead byte for 256 consecutive frames
Supports capture of all OTU, ODU (first stage), OPU overhead
Configurable number of bytes pre/post capture
Displays captured overhead in hexadecimal and ASCII format by captured frame number

Event Triggers:

- Error capture triggers: frame, bit, FEC-COR, FEC-UNCOR, MFAS, OTU-BIP8, OTU-BEI, ODU-BEI
- Alarm capture triggers: LOM, OOM, OTU-IAE, OTU-BDI, ODU-AIS, ODU-OCI, ODU-LCK, ODU-BDI
- Other triggers: manual, byte equal, byte not equal, positive/negative justify



Error Generation*

- FEC
 - FEC-COR(single, max 3.923-2 to 1E-10, user defined rates)
 - FEC-UNCOR(single, max 6.25E-2 to 1E-9, user defined rates)

- OTU
 - Frame (single, periodic burst, 1E-3 to 1E-8, user defined rates)
 - MFAS (single, periodic burst, 1E-3 to 1E-7, user defined rates)
 - OTU-BIP8 (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)
 - OTU-BEI (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)
 - OTU-AIE (periodic burst)
 - OTU-BIAE (periodic burst)

- ODU
 - ODU-BIP8 (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)
 - ODU-BEI (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)

- TCM
 - TCMi (i=1-6)-BIP8 (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)
 - TCMi (i=1-6)-BEI (single, periodic burst, max 6.56E-5 to 1E-10, user defined rates)

- OTU4 ODU3/2/1/0 & ODU4 ODUflex
 - OPU-OMFI (single, periodic burst, 1E-3 to 1E-7, user defined rates)

- GMP
 - OPU-Cn CRC8 (single, periodic burst, max 4.17E-2 to 1E-6, user defined rates)

- ODU3-40GE
 - LAN 1027B Block (single, 1E-3 to 1E-6, user defined rates)
 - LAN OTN-BIP8 Lane 0-3 (single, 1E-3 to 1E-6, user defined rates)

- PRBS Client
 - Payload Bit (single, 1E-3 to 1E-10, user defined rates)

Alarm Generation*

- OTU
 - LOF (continuous)
 - OOF (continuous)
 - OOM (continuous)
 - LOM (continuous)
 - OTU-IAE (continuous)
 - OTU-BIAE (continuous)
 - OTU-BDI (periodic burst, continuous)

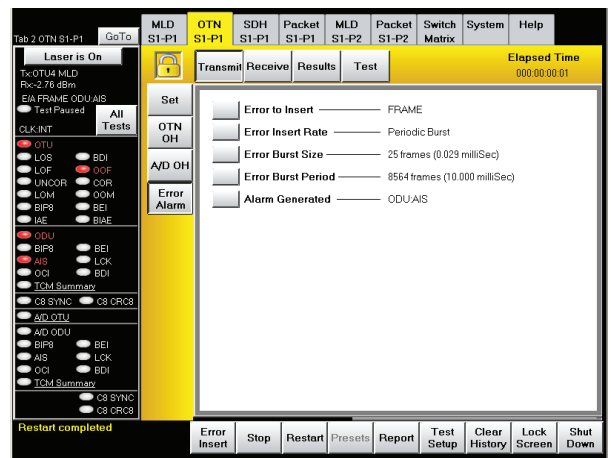
- ODU
 - ODU-AIS (continuous)
 - ODU-LCK (continuous)
 - ODU-OCI(continuous)
 - ODU-BDI (periodic burst, continuous)

- TCM
 - TCMi (i=1-6)-BDI (periodic burst, continuous)
 - TCMi (i=1-6)-BIAE (periodic burst, continuous)

- OTU4 ODU3/2/1/0 & ODU4 ODUflex
 - OPU-LOOMFI, OPU-OOMFI (continuous)

- GMP
 - OPU-Cn Sync (continuous)

*Note: Periodic burst insert supports error burst size and burst period (ranges depend on configuration).



Results

Error Detection

- OTU
 - Frame
 - MFAS
 - FEC-COR
 - FEC-UNCOR
 - OTU-BIP8
 - OTU-BEI
- ODU
 - ODU-BIP8
 - ODU-BEI
 - TCMi(i=1-6)-BIP8
 - TCMi(i=1-6)-BEI
- OPU
 - Payload bit
- OTU4 ODU3/2/1/0 & ODU4 ODUflex
 - OPU-OMFI
- GMP
 - OPU-Cn CRC8
- ODU3-40GE
 - LAN 1027B Block
 - LAN OTN-BIP8 LaneN (N=0-3)
 - LAN OTN-PCS LaneN (N=0-3)
- PRBS Client
 - Payload bit

Alarm Detection

Resolution: seconds

- OTU
 - LOF
 - OOF
 - LOM
 - OOM
 - OTU-IAE
 - OTU-BAIE
 - OTU-BDI
 - OTU-SAPI
 - OTU-DAPI

GFP

ODU

- ODU-AIS
- ODU-LCK
- ODU-OCI
- ODU-BDI
- ODU-SAPI
- ODU-DAPI
- OPU-PLM
- OPU-CSF

TCM

- TCMi (i=1-6)-BDI
- TCMi (i=1-6)-BIAE
- TCMi (i=1-6)-SAPI
- TCMi (i=1-6)-DAPI

ODU4/ODU3 ODUflex

- OPU-LOOMFI
- OPU-OOMFI

GMP

- OPU-Cn Sync

PRBS Client

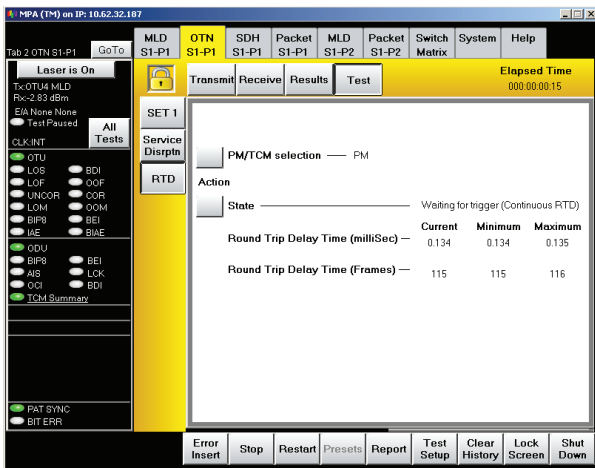
- Loss of Pattern Sync

Service Disruption Time (SDT) Measurement

Measures service disruption for all OTU/ODU levels
 Event Triggers: OOF, OTU-AIS, OTU-BIP8, ODU-AIS, ODU-BIP8, payload bit
 Event thresholds: measurement clearing time (dependent on rate)
 Resolution and accuracy: 1 OTN frame
 Single or continuous measurements
 Reports current, min, and average values in ms and number of frames
 Displays the last measurement plus 10 historical events, last 250 events saved in test report

Delay Measurements

Measurement per ITU-T G.709
 Measures delay for all PM and TCM levels
 Resolution and accuracy: 1 OTN frame
 Single or continuous measurements
 Reports current, min, and max values in ms and number of frames

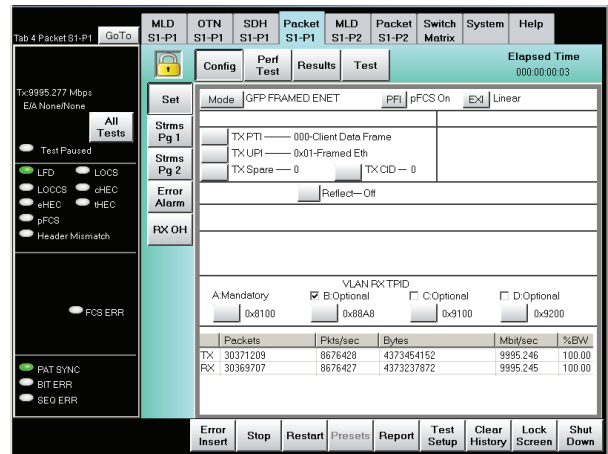


GFP Modes

- GFP Bulk ITU-T G.7041/Y.1303, ITU-T G.709 17.4
 - GFP Framed testing with PRBS payload data - no MAC/IP/UDP testing
 - Bandwidth is determined by mapping container capacity, max 10G data rate (OPU-2 capacity)
- GFP Framed ITU-T G.7041/Y.1303, ITU-T G.709 17.4
 - GFP frames with up to 32 streams of MAC/IP/UDP testing
 - Bandwidth is determined by mapping container capacity, max 10G data rate (OPU-2 capacity)
- GFP Transparent ITU-T G.7041/Y.1303, ITU-T G.709 17.4
 - GFP frames with up to 32 stream MAC/IP/UDP testing, for transporting 1GE
 - Fixed bandwidth of 1.25G and requires mapping containers of this capacity or larger
 - Superblock setting: auto, configurable 2 to 977
- GFP G.Sup43 7.3 ITU-T G.7041/Y.1303 clause 7.9, ITU-T G.709 17.4.1
 - GFP frames with up to 32 stream MAC/IP/UDP testing, for transporting 10GE
- GFP Transcoded 1000BASE-X ITU-T G.7041/Y.1303, ITU-T G.709 17.7.1.1
 - GFP frames with up to 32 stream MAC/IP/UDP testing, for transporting 1GE in ODU0

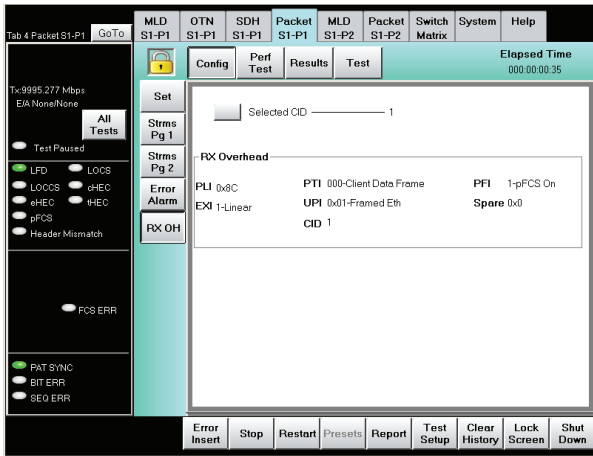
Settings

- GFP Bulk, Framed, and Transparent supports Null or Linear Extension header
- Linear header supports configurable TX Spare (0 to 255), TX CID (0 to 255), and RX CID (0 to 255)
- GFP Bulk, Framed, Transparent supports pFCS enable/disable



GFP Overhead Display

- Supports display of received overhead
- Configurable CID filter (All, 0-255)
- Configurable PLI, PTI, FPI, EXI, UPI, Spare, CID



Error Generation

- GFP Bulk and Framed
- Corr cHec, Corr tHec, Uncorr tHec (single, 1E-2 to 1E-7 rates)
- Uncorr cHec (single)

GFP Transparent

- Corr cHec, Corr tHec, pFCS (single, 1E-2 to 1E-7 rates)
- sFCS (single)

GFP Transcoded 1000BASE-X

- Corr cHec, Corr tHec, (single, 1E-2 to 1E-7 rates)
- GFP ITU-T G.Sup43 7.3
- Corr cHec, Corr tHec, Uncorr tHec (single, 1E-2 to 1E-7 rates)
- Uncorr cHec (single)

GFP ITU-T G.Sup43 7.3

- Corr cHEC, Uncorr cHec, Corr tHec, Uncorr tHec

Alarm Generation

Duration: continuous

GFP Bulk, Framed, and Transparent, ITU-T G.Sup43 7.3

- LFD, LOCCS, LOCS

GFP Transcoded 1000BASE-X

- LFD

GFP ITU-T G.Sup43 7.3

- LFD, LOCS, LOCCS, 10GE Local & Remote Faults

Results

Errors

Error Detection includes counts, average and current rates
GFP Bulk and Framed

- Corr cHEC, Uncorr cHec, Corr tHec, Uncorr tHec, Corr eHec, Uncorr eHec, pFCS

GFP Transparent

- Corr cHEC, Uncorr cHec, Corr tHec, Uncorr tHec, Corr eHec, Uncorr eHec, InvalidSuper, sFCS, pFCS

GFP Transcoded 1000BASE-X

- Corr cHEC, Uncorr cHec, Corr tHec, Uncorr tHec, InvalidSuper, sFCS

GFP ITU-T G.Sup43 7.3

- Corr cHEC, Uncorr cHec, Corr tHec, Uncorr tHec

Alarms

Resolution: seconds

GFP Bulk and Framed

- LFD, LOCS, LOCCS, header mismatch

GFP Transparent

- LFD, LOCS, LOCCS, header mismatch

GFP Transcoded 1000BASE-X

- LFD, header mismatch

GFP ITU-T G.Sup43 7.3

- LFD, LOCS, LOCCS, header mismatch

SDH/SONET

Applications

SDH/SONET traffic generation & analysis
 Passthru mode with error and alarm stimulus testing
 APS/K1K2 sequence generation and analysis
 Pointer sequence generation and analysis
 Service disruption time (SDT) measurements
 Round trip delay measurements

Test Interfaces

Number of Test Ports		Interface Options
1x QSFP28/QSFP+ Port	1 x STL256.4 (39.813Gbps) STM-256/OC-768	QSFP+: LR4

- Each SFP28/SFP+ port support an independent test
- Both SFP28/SFP+ ports must operate at the same rate and protocol
- Test module supports 1x QSFP28/QSFP+ port test or 2x SFP28/SFP+ test, ports do not operate at the same time
- Other Interface options available on request
- Supports any transceiver compliant to industry standards. Data rates, performance, and supported transmission protocols are only guaranteed for optical modules supplied by VeEX. If selecting or using other vendors, users should exercise caution.

STL Layer

Lane Mapping

Supports virtual lane number swapping and rotation
 Displays Lane ID, lane # and channel assignments

Lane Skew

Per lane skew generation: 0 to 65,000 bits in 1 bit resolution
 Per lane skew measurement: in bit time and ps with 1 bit resolution up to 65,000 bits
 User configurable alarm threshold for received skew measurement

Alarm Generation

LOF, OOF, AIS per lane (continuous)
 Supports independent alarm generation per lane, each lane can generate a different alarm

Alarm Monitoring and Detection

LOA seconds
 LOF, OOF, AIS, LOR, OOR per lane seconds

SDH/SONET Interfaces and Mappings

SDH/SONET can be used as a physical test interface or mapping client

- STM-256/OC-768 test interface
- STM-64/OC-192 client
- STM-16/OC-48 client
- STM-4/OC-12 client
- STM1-OC-3 client

Settings Control

Setting: coupled or independent transmit and receive settings

Scrambling

TX Scrambling: Enabled/Disabled
 RX Scrambling: Enabled/Disabled

Passthru Mode

Non-Intrusive
 Intrusive - supports optional error/alarm insertion or OH byte overwrite for all overhead levels
 When SDH/SONET is mapped as an OTN client Passthru Mode may be supported for either layer or both

Interface

STL256.4 STM-256/OC-768

SDH Mappings

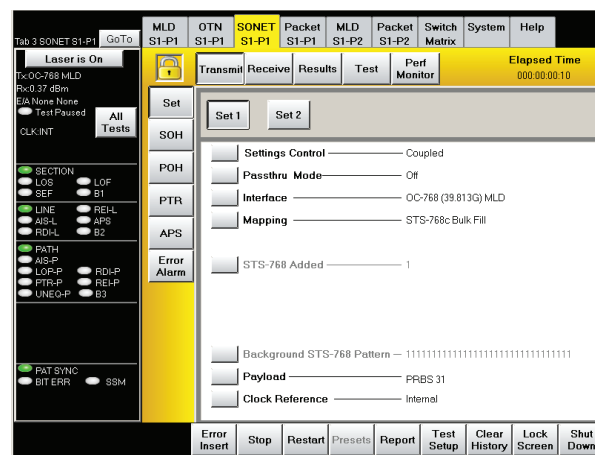
(According to ITU-T G.707)

AU-4-256c Bulk PRBS
 AU-4-64c Bulk PRBS
 AU-4-4c Bulk PRBS
 AU-4 C-4 Bulk PRBS
 AU-3 C-3 Bulk PRBS

SONET Mappings

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

STS-768c Bulk PRBS
 STS-192c Bulk PRBS
 STS-48c Bulk PRBS
 STS-12c Bulk PRBS
 STS-3c Bulk PRBS
 STS-1 Bulk PRBS



Foreground Test Channel

Supports generation over single SDH AU / SONET STS channel or broadcast on all channels for sub rate mappings.

Supports analysis of single SDH AU / SONET STS channel

Test Patterns

Foreground Channel

- Supports generation and analysis of the following test patterns
- $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 normal and inverted, 32-bit user, Live (receive only)

Background Channels

- Background channels supports generation of the following test patterns
- $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 normal and inverted, 32-bit user

Error Generation

SDH

- Frame (single, $1E-3$ to $1E-8$, user defined rates)
- B1 (single, max $1.61E-6$ to $1E-10$, user defined rates)
- B2 (single, max $1.25E-3$ to $1E-10$, user defined rates)
- MS-REI (single, max $5.18E-5$ to $1E-10$, user defined rates)
- B3 (single, max $1.66E-6$ to $1E-10$, user defined rates)
- HP-REI (single, max $1.66E-6$ to $1E-10$, user defined rates)
- Bit (single, $1E-3$ to $1E-10$, user defined rates)

SONET

- Frame (single, $1E-3$ to $1E-8$, user defined rates)
- B1 (single, max $1.61E-6$ to $1E-10$, user defined rates)
- B2 (single, max $1.25E-3$ to $1E-10$, user defined rates)
- REI-L (single, max $5.18E-5$ to $1E-10$, user defined rates)
- B3 (single, max $1.66E-6$ to $1E-10$, user defined rates)
- REI-P (single, max $1.66E-6$ to $1E-10$, user defined rates)
- Bit (single, $1E-3$ to $1E-10$, user defined rates)

Alarm Generation

SDH

- LOF, MS-AIS, MS-RDI, AU-LOP, AU-AIS, HP-RDI, HP-UNEQ (constant)

SONET

- LOF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P (constant)

Error Detection

Supports error counts, average and current error rates

SDH

- Frame, B1, B2, MS-REI, B3, HP-REI, Bit, AU-NDF

SONET

- Frame, B2, B2, REI-L, B3, REI-P, Bit, NDF-P

Alarm Monitoring and Detection

SDH

- OPU Generic AIS, LOF, MS-AIS, APS-L, OOF, MS-RDI,
- Pattern sync, Concatenation, AU-AIS, AU-LOP, HP-UNEQ, HP-RDI seconds

SONET

- OPU Generic AIS, LOF, AIS-L, APS-L, SEF, RDI-L,
- Pattern sync, Concatenation, AIS-P, LOP-P, UNEQ-P, RDI-P seconds

Overhead Generation and Analysis

Please reference the separate specifications for traces, pointers, signal label, APS, synchronization status, & TCM

Generation

Provides the ability to manually program the specified overhead byte location for all defined and undefined overhead locations

- Supports value entered in hexadecimal, decimal or binary SDH RS and MS Overhead
- A1, A2, Z0, E1, F1, D1-D3, H1-H3, K1, K2, D4-D12, S1, E2
- All undefined bytes
- Slot selection: user configurable

SDH High Order Path Overhead

- H4, F3, C2, K3, G1, N1, F2
- AU Selected: user configurable

SONET Section and Line Overhead

- A1, A2, Z0, E1, F1, D1-D3, H1-H3, K1, K2, D4-D12, S1, Z1, Z2, E2
- All undefined bytes
- Slot selection: user configurable

SONET Path Overhead

- H4, Z3, C2, Z4, G1, Z5, F2
- STS Selected: user configurable

Analysis

Provides decode and display of overhead bytes for all defined and undefined overhead locations

- Displays overhead value in hexadecimal with specific bytes decoded in ASCII format

SDH RS and MS Overhead

- A1, A2, J0, Z0, B1, E1, F1, D1-D3, H1-H3, B2, K1, K2, D4-D12, S1, E2
- All undefined bytes
- Slot selection: user configurable

SDH High Order Path Overhead

- J1, H4, B3, F3, C2, K3, G1, N1, F2
- AU Selected: user configurable

SONET Section and Line Overhead

- A1, A2, J0, Z0, B1, E1, F1, D1-D3, H1-H3, B2, K1, K2, D4-D12, S1, Z1, Z2, E2
- All undefined bytes
- Slot selection: user configurable

SONET Path Overhead

- J1, H4, B3, Z3, C2, Z4, G1, Z5, F2
- STS Selected: user configurable

Overhead Trace Generation and Analysis

Supports generation and analysis of SDH/SONET traces with optional Trace Identifier Mismatch alarm

SDH/SONET Trace Generation

- J0 & J1: 64 byte ASCII format with CR+LF, 16 byte ASCII format with CRC-7, All 01's, All 00's or 1 byte hexadecimal
- TC: Default 16 byte ASCII format with CRC-7, 1 byte ASCII format, All 01's, All 00's or 1 byte hexadecimal
- SDH/SONET Trace Analysis
- Decodes and displays received overhead traces in ASCII format

Trace Identifier Mismatch Alarm

- TIM Alarm: enabled or disabled
- Expected trace settings: separate user configurable value for J0, J1, TC traces

Synchronization Status (S1)

Supports generation of user configurable S1: 00 (Quality unknown), 02 (Rec, G.811), 04 (Rec.G.812 Transit), 08 (Rec, G.812 Local), 0B (Sync Equip Timing Src (SETS)), 0F (Do Not use for Sync), user defined

Supports Decode and display of received S1 status

Path Signal Label

Supports generation and analysis of Path Label with optional Path Label Mismatch Alarm

Generation of configurable Signal Label

Decodes and displays received label in hexadecimal and formal decode in ASCII format

PLM Alarm Reporting

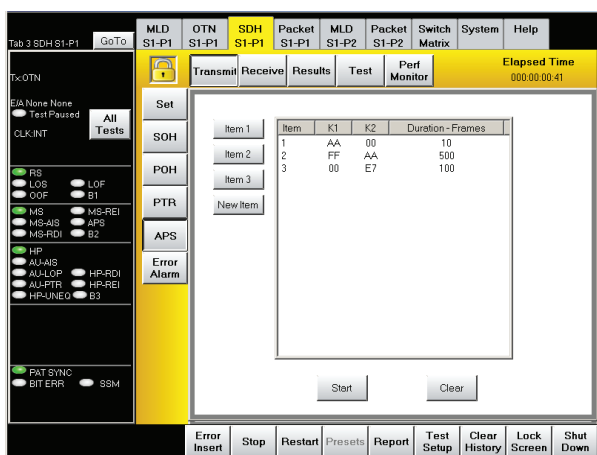
- PLM Alarm: enabled or disabled
- Expected Signal label: user configurable value

APS Sequence Generator

Supports generation of K1/K2 overhead byte sequences to test automatic protection switching

- Number of consecutive sequences: 1 to 15
- APS Mode: Linear or Ring
- K1/K2 byte values: user configurable
- Duration: 1 to 65,535 frames for each K1/K2 sequence

Overhead Byte Capture



Captures specified overhead byte for 256 consecutive frames Supports capture of all SDH/SONET overhead bytes with slot selection

Configurable number of bytes pre/post capture

Displays captured overhead in hexadecimal and ASCII format by captured frame number

Event Triggers

- SDH capture triggers
 - o Errors: Frame, B1, B2, B3, MS-REI, HP-REI, Bit
 - o Alarms: MS-AIS, MS-RDI, AU-AIS, HP-RDI, AU-LOP
- SONET Capture triggers:
 - o Errors: Frame, B1, B2, B3, REI-L, REI-P, Bit
 - o Alarms: AIS-L, RDI-L, AIS-P, RDI-P, LOP-P
- Other triggers: Pointer increment, pointer decrement, NDF, No NDF alarm

Pointer Generation and Analysis

(Pointer sequences: ITU-T G.783, Telcordia GR-253)

Supports AU / STS Pointer Actions

Generation

- NDF Flag: enable/disable
- Manual Pointer value: 1 to 782
- Frequency offset: +/-100.0ppm in 0.1 resolution

Pointer Actions

- Single: burst count (1-8), INC/DEC
- Single Add: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- Single Cancel: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- Increment/Decrement: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- Continuous: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- Continuous Add: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- Continuous Phase: burst count (1-8), ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- 87-3: ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- 87-3: Add: ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC
- 87-3: Cancel: ms between bursts (5.5 to 35000.0ms, default 250.0ms), INC/DEC

Analysis

- Positive justification counts
- Negative justification counts
- Pointer justification seconds
- NDF count
- RX Pointer Bytes (hexadecimal)
- RX Pointer value
- Pointer frequency offset measurement in ppm (to 0.01ppm)

SS Bits

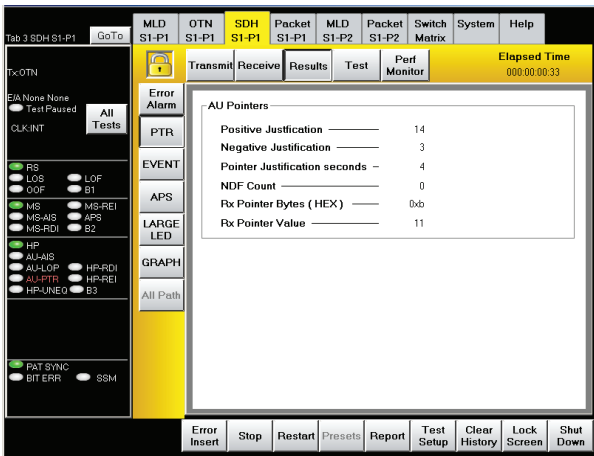
Supports generation of all pointer SS bits

- Configurable Value: 00 (SONET), 01 (Undefined) 10 (SDH), 11 (undefined)

Supports decode and display of SS bit values in H1/H2/H3 bytes

SS Bits Mismatch Alarm

- SS Bits Alarm Reporting: enabled or disabled
- Expected SS Bits: 00 (SONET), 01 (Undefined) 10 (SDH) 11 (undefined)



Tandem Connection Monitoring (TCM)

Generation and Analysis of N1 (HP-TCM) bytes

TCM Mode: enable/disable

SDH Error Generation

- HP-IEC (single, max 6.65E-6 to 1E-10, user defined rates)
- HP-REI (single, max 8.31E-7 to 1E-10, user defined rates)
- HP-OEI (single, max 8.31E-7 to 1E-10, user defined rates)

SONET Error Generation

- TC-IEC-P (single, max 6.65E-6 to 1E-10, user defined rates)
- TC-REI-P (single, max 8.31E-7 to 1E-10, user defined rates)
- TC-OEI-P (single, max 8.31E-7 to 1E-10, user defined rates)

SDH Alarm Generation

- HP-RDI, HP-ODI, HP-AIS, HP-UNEQ, HP-LOF (constant)

SONET Alarm Generation

- TC-RDI-P, TC-ODI-P, TC-AIS-P, TC-UNEQ-P, TC-LOF-P (constant)

Error Detection (count, average and current rates)

- SONET: TC-IEC-P, TC-REI-P, TC-OEI-P
- SDH: HP-TC-IEC, HP-TC-REI, HP-TC-OEI

Alarm Monitoring and Detection (seconds)

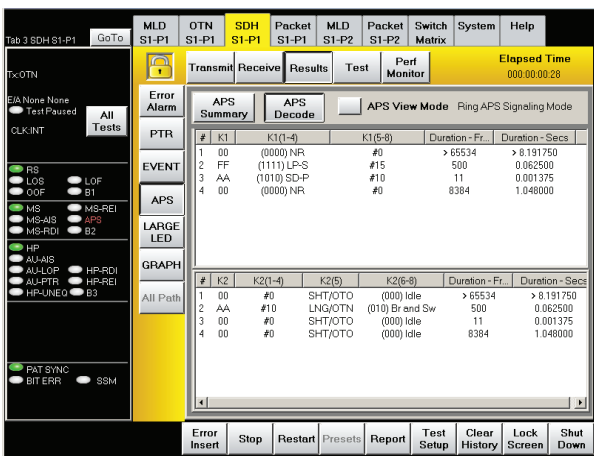
- SDH: TC-RDI-P, TC-ODI-P, TC-AIS-P, TC-UNEQ-P, TC-LOF-P, TC-TIM-P
- SONET: HP-TC-RDI, HP-TC-ODI, HP-TC-AIS, HP-TC-UNEQ, HP-TC-LOF, HP-TC-TIM

Reference Overhead Trace Generation and Analysis section for trace information

APS Analysis

Provides frame by frame display and decode of received K1/K2 byte APS sequences

- Supports up to 65,533 byte sequences
- Decode Mode: APS Summary or APS Decode
- APS Mode: Ring APS Signaling Mode or Linear Protection Switching
- Summary display provides K1/K2 byte values in hexadecimal, duration in frames and seconds for each received sequence
- Decode feature provides additional formal decoded value of K1(1-4), K1(5-8), K2(1-4), K2(5-8)



Service Disruption Time (SDT) Measurement

- SDH Event Triggers: B1, OOF, MS-AIS, AU-AIS, PRBS
- SONET Event Triggers: B1, SEF, AIS-L, AIS-P, PRBS
- Event thresholds: measurement clearing time in frames and ms (0.125 to 2047.875ms)
- Resolution and accuracy: 1 frame/0.125ms
- Measurement: Single or Continuous
- Results: displays current, min, and average measurements in ms and number of frames
- Displays the last measurement plus 10 historical events, last 250 events saved in test report

Delay Measurements

- Measures round trip delay
- Resolution and accuracy: 1 frame/0.125ms
- Measurement: Single or Continuous
- Event thresholds: measurement clearing time in frames and ms (0.125 to 2047.875ms)
- Results: displays current, min, and max measurement in ms and number of frames

Performance Monitoring

G.821, G.826, G.828, G.829, M.2101, M.2120/M.2110, ANSI T1.105, T1.231, & GR-253

OTUCn Preliminary Specifications

The MPM-100AR QSFP28 test port modules provide a flexible feature rich test solution for the emerging beyond 100G (B100G) OTUCn optical transport networking standards.

Applications

OTUCn traffic generation and analysis
 Optical, FEC, & OTL layer verification
 Overhead generation and analysis
 Error and alarm stimulus and response testing
 BERT test
 Service disruption time measurements
 Round trip delay measurements

Standards

ITU-T G.709 (06/2016)

OTUCn Interface Support

OTUC1: 1x QSFP28 Port
 OTUC2: 2x QSFP28 Ports
 OTUC3: 3x QSFP28 Ports
 OTUC4: 4x QSFP28 Ports
 OTUC5: 5x QSFP28 Ports
 OTUC6: 6x QSFP28 Ports

Note: Multiple test modules are synchronized to support rates above OTUC1.

Optical Power

Reference Common specifications

- Optical power control and measurement per QSFP28 port

Transmit and Receive Clocking

Reference OTN specifications

- Transmit reference clock control and offset
- Receive clock measurement

Forward Error Correction (FEC)¹

- Supports ITU-T G.709 RS-FEC (255,239)
- FEC code error insertion and analysis
- TX FEC: Enabled/Disabled
- RX FEC: Enabled/Disabled

OTLC.n Layer¹

Reference OTN specifications

- Lane mapping and monitoring
- Lane skew generation and analysis
- Alarm generation and detection

Flexible OTUCn Configurations

An MPA configured with multiple MPM-100AR test modules supports flexible OTUCn test solution combinations.

MPA Chassis with 6x MPM-100AR Modules	OTUCn Configuration Examples				
	6x OTUC1	1x OTUC6	3x OTUC2	2x OTUC3	1x OTUC4 + 1x OTUC2
MPM-100AR #1 QSFP28	OTUC1 #1	OTUC6 #1 Slice 1	OTUC2 #1 Slice 1	OTUC3 #1 Slice 1	OTUC4 #1 Slice 1
MPM-100AR #2 QSFP28	OTUC1 #2	OTUC6 #1 Slice 2	OTUC2 #1 Slice 2	OTUC3 #1 Slice 2	OTUC4 #1 Slice 2
MPM-100AR #3 QSFP28	OTUC1 #3	OTUC6 #1 Slice 3	OTUC2 #2 Slice 1	OTUC3 #1 Slice 3	OTUC4 #1 Slice 3
MPM-100AR #4 QSFP28	OTUC1 #4	OTUC6 #1 Slice 4	OTUC2 #2 Slice 2	OTUC3 #2 Slice 1	OTUC4 #1 Slice 4
MPM-100AR #5 QSFP28	OTUC1 #5	OTUC6 #1 Slice 5	OTUC2 #3 Slice 1	OTUC3 #2 Slice 2	OTUC2 #1 Slice 1
MPM-100AR #6 QSFP28	OTUC1 #6	OTUC6 #1 Slice 6	OTUC2 #3 Slice 2	OTUC3 #2 Slice 3	OTUC2 #1 Slice 2

OTUCn Structures and Mapping Clients

OPUCn 100G Bulk PRBS or Null Client Signal

Nx100G BERT tests can be operated simultaneously and independently to verify end to end transport

- OTUC1: 1x OPUCn 100G Bulk PRBS BERT Test
- OTUC2: 2x OPUCn 100G Bulk PRBS BERT Tests
- OTUC3: 3x OPUCn 100G Bulk PRBS BERT Tests
- OTUC4: 4x OPUCn 100G Bulk PRBS BERT Tests
- OTUC5: 5x OPUCn 100G Bulk PRBS BERT Tests
- OTUC6: 6x OPUCn 100G Bulk PRBS BERT Tests

Bulk Test Patterns

Supports generation and analysis of the following test patterns

- $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 normal and inverted, 32-bit user, Live (receive only)

Overhead Control and Monitoring¹

- User configurable overhead and trace generation
- Decode, display and monitoring of all overhead and traces
- TCM layer and trace alarm reporting
- Overhead byte capture

Error Generation¹

- FEC: COR, UNCOR
- OTUCn: Frame, MFAS (synchronized frame error generation), BIP8, BEI
- ODUCn: BIP8, BEI
- TCM: TCM_i(i=1-6) BIP8, BEI
- PRBS Client: Payload BIT

Alarm and Maintenance Signal Generation¹

- OTUCn: LOF, OOF, OOM, LOM, IAE, BIAE, BDI
- ODUCn: AIS, LCK, OCI, BDI
- TCM: TCM_i(i=1-6) BDI, BIAE

Error Detection¹

- FEC: COR, UNCOR
- OTUCn: Frame, MFAS, BIP8, BEI
- ODUCn: BIP8, BEI
- TCM: TCM_i(i=1-6) BIP8, BEI
- PRBS Client: Payload BIT

Alarm and Maintenance Signal Detection¹

- OTUCn: LOF, OOF, OOM, LOM, IAE, BIAE, BDI, SAPI & DAPI traces
- ODUCn: AIS, LCK, OCI, BDI, SAPI & DAPI traces
- TCM: TCM_i(i=1-6) BDI, BIAE, SAPI & DAPI traces
- OPUCn: PLM
- PRBS Client: Loss of pattern sync

Note 1: Supported by slice/port according to G.709 (range depends on configuration)

Service Disruption Time (SDT) Measurement

Provides SDT measurement

Delay Measurement

Provides delay measurement

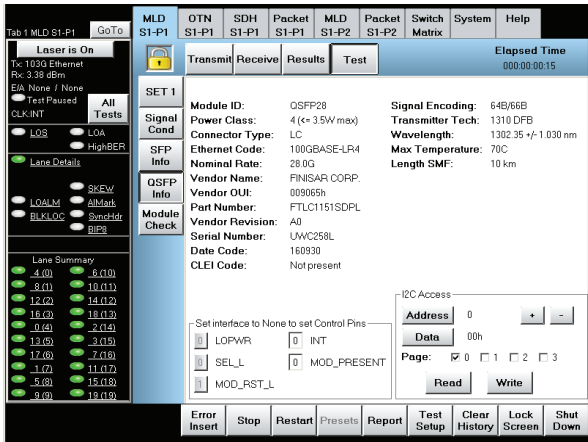
Licensing

OTUCn is an MPM-100AR module licensed based test option

Common Features

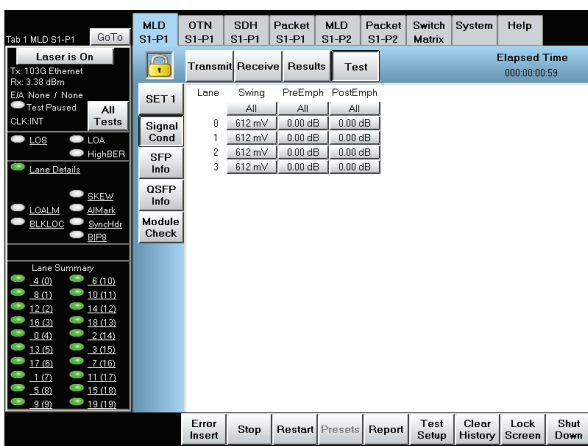
Transceiver I2C Testing

- Complete I2C register access
- Raw read/write capability for all I2C registers
- Formal display of commonly used fields
- Module hardware control pin read/write access



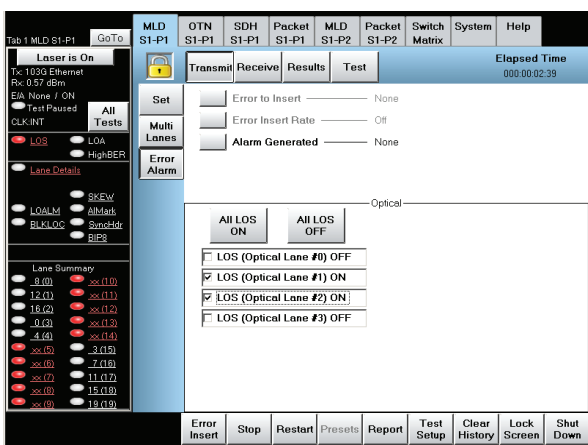
Advanced PHY Features

- Per lane user controllable swing, pre & post emphasis signal conditioning settings to stress transceiver interfaces
- Receiver auto-tune mode for best optimization of receive SerDes



Optical Testing

- Global and per optical lane power output enable/disable
- Received per lane and broadband optical power level monitoring with optical power level warning alarms
- User-defined alarm threshold for received optical power level
- Option to restore laser state on power up
- Supported for all line rates including multi-lane and single lane interfaces
- All optical test interfaces support LOS alarm generation and detection



Transmit Clock Sources

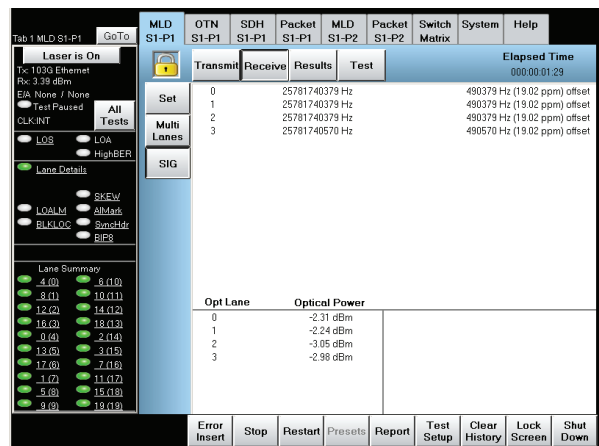
- Chassis: Internal stratum 3
- Chassis: External 1.544 MHz, 2.048 MHz, BITS/1.544 Mbps, SETS/2.048 Mbps, 100/120 Ohm RJ-48
- Recovered: from the incoming signal
- External: TTL level via 50 Ohm MMCX connector (connector shared with trigger input)

Line Frequency Offset Generation

- Line frequency offset generation +/- 300ppm (mode dependent) in steps of 0.1ppm
- Supports constant and ramp offset options

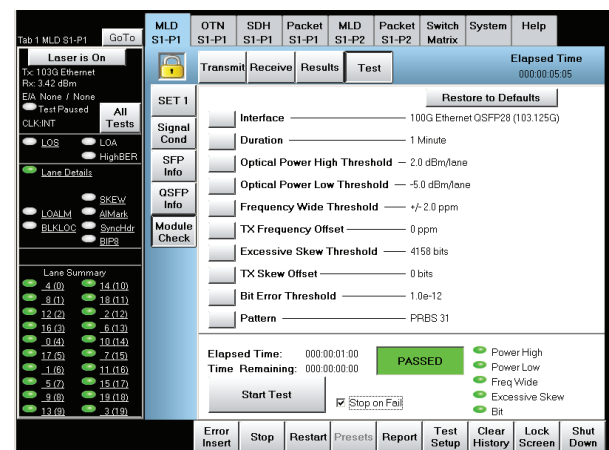
Line Frequency Measurement Capability

- Displays measured transmit line frequency offset in Hz
- Displays measured transmit line frequency offset from external reference clock in both Hz and ppm
- User defined alarm threshold for external transmit reference clock offset measurements
- Provides received line frequency measurements in Hz with offset in Hz and ppm. Supported for all line rates including multi-lane and single lane interfaces
- User defined alarm threshold for received line frequency measurements



Module Health Check

- Simple one button pass/fail test for verifying all transceiver properties
- Advanced user defined thresholds
- Simple test report includes settings, results and transceiver Module I2C information



Acceptance Tests

- Module optical power threshold high/low
- Module line frequency generation and tolerance
- Module skew generation and tolerance
- Module BERT performance with PRBS Test pattern selection

Reference Clock Outputs

Eye Clock out: 1/80 for 100G rates, 1/32 for 40G rates, 1/128 for 10/16/32G FC rates, 1/160 for 10/25GE rates (connector shared with trigger output)

Advanced Triggering

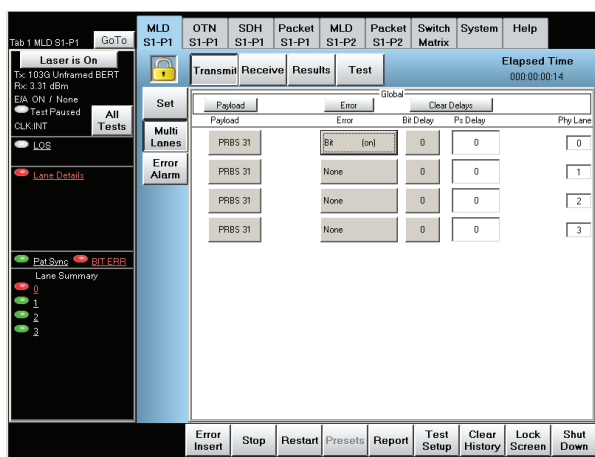
- Trigger in: TTL level via 50 Ohm MMCX connector (connector shared with external clock input)
- Trigger out: TTL level via 50 Ohm MMCX connector (connector shared with eye clock out)

Multi-lane Unframed BERT Testing

Per lane BERT testing for transceiver and equipment characterization and acceptance testing

Test Patterns

- Supported for all line rates including multi-lane and single lane interfaces
- PRBS $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1 normal or inverted
- Per lane test pattern selection



Error Generation

- Bit error per lane and global
- Insertion: single, rates from 1E-3 to 1E-10 user defined rates

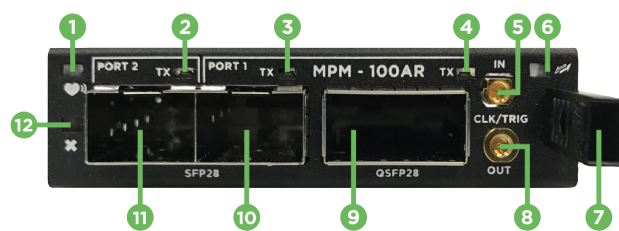
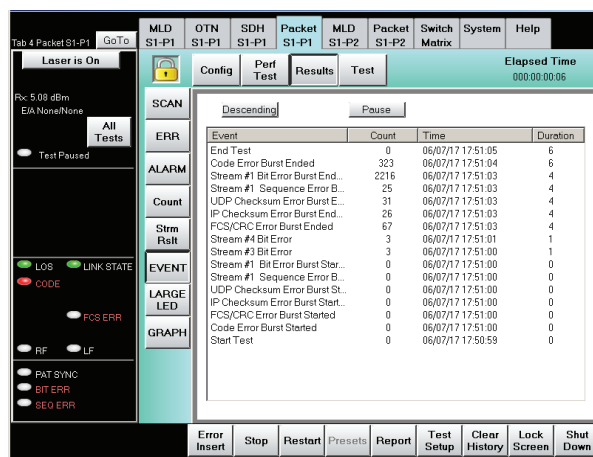
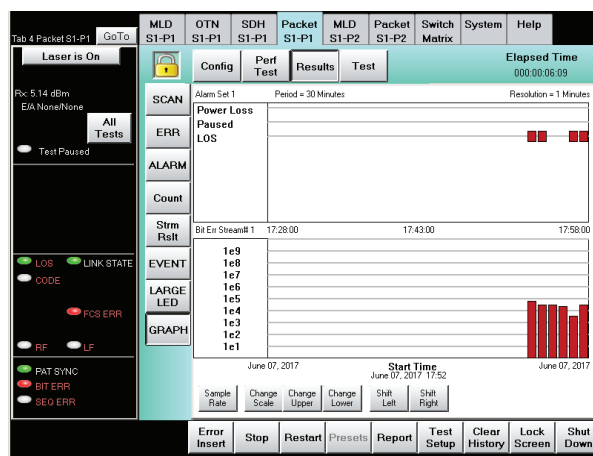
Error Measurement

- Per lane loss of pattern sync
- Per lane bit error count, average and current bit error rates

Results

- LEDs and detailed statistical counters
- Graphs and Histograms
- Event log history showing event, count, day/time, and duration for last 1,000 events

- Flexible test reporting options including PDF
- Pause mode option allows test duration and result accumulation to be temporarily paused while changing test configuration



- 1 Module Out-of-Service LED
- 2 SFP28 Port 2 Activity Indicator
- 3 SFP28 Port 1 Activity Indicator
- 4 QSFP28 Port Activity Indicator
- 5 External Clock Reference Input or Trigger Input
- 6 Module Hot Swap LED
- 7 Module Extraction Handle
- 8 Eye Clock Out or Trigger Output
- 9 QSFP28 Port
- 10 SFP28 Port 1
- 11 SFP28 Port 2
- 12 Module Health LED



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