VIAVI

T-BERD/MTS 5800–100G

Specifications

Platform

Platform Attributes
The mainframe is expandable with modules
The product is field upgradeable
Operating system is Linux to ensure optimum stability and offer high security

Display
Display size 7 inches with 1200x600 resolution
Screen Saver support
Physical screen potector provided
Mode that 'locks' the touchscreen for use without a password

Power/Battery
Supports battery operation
Built-in battery charger
Battery is field replaceable
Can perform two 100GE tests for at least 1 hour on battery power
Can perform one 100GE test for at least 1:30 hours on battery power
Can perform two 10G tests for at least 2:00 hours on battery power
Unit power input 19VDC, 150 Watt Power supply input 100 to 240 VAC, 50/60 Hz, auto-sensing

Industry Standards and Compliance
Safety: UL, CE
EMC: CE compliant, FCC part 15 subpart A, Class A
FCC Part 15 Compliant

Physical and Environment Specifications
Temperature range:
Operating, with dual 100GE: 0°C to +40°C
Operating, with dual 10GE: 0°C to +50°C
Storage: - 20°C to +60°C (-4°F to +140°F)
Storage Humidity: 10-95% without condensing.
Operating Humidity: 10-90% without condensing.

Drop Test - Shock
per IEC 68-2-7 and 68-2-29 Ed. 2.0

Drop Test - Durability
per IEC 721-3-7 2nd Ed./IEC 61010-1

Vibration
per IEC 68-2-6 and MIL-PRF-2800F (Class 2)

Field Operation
Portable, AC or battery operated, switches without disruption, and is rugged for field operations
Protected by bumpers

Weight and Size
Weight of 2.45kg while supporting dual 100G rates Size of 17.78 x 24.13 x 8cm

Operation
Can be turned on and operational in 2 minutes or less
Accepts operations on display screen or with an external keyboard
Boots to a simplified launch page allowing the user to select previous test configurations and/or favorite test configurations

Platform (Continued)

I/O's	
Includes the following I/O interfaces	
VT100 (RJ-45)	
2 x USB	
RJ-45 (Ethernet/IP)	
Serial	
Wifi	
Bluetooth	**Comments:** · Bluetooth headset support for VoIP and PRI calls · Bluetooth tethering to iOS devices for file transfer
Can download data to PC, Android device, IOS device or compatible device via standard interface or protocol	

Test, Files and Data Storage
Report Generation: HTML, PDF, TXT, CSV, XML
Ability to create a customized name structure
Supports screen capture
Internal storage capacity shall of at least 3GBbytes
Job Manager to push common job information into multiple test applications
Ability to create summary reports including all tests performed in a job with pass/fail verdict of each

Remote Operation
Can be remotely controlled via Web browser and/or Smart Access Anywhere
Access via SSH encryption or local tether with Smart Access Anywhere application
Can control the UI and transfer files concurrently with Smart Access Anywhere application
In remote operation, the remote user can FTP files from and to the test set
Does not require the installation of client software on a PC for remote operation

Calibration
Calibration interval of 3 years

Warranty
3 year warranty

Included Items
User manual
AC power source
AC power cords
Soft carrying case

Saved Configurations
Can save test configurations for future recall
Can transfer pre-defined test configurations between test sets

40G 100G Ethernet

Test Interfaces/Bit Rates	
40GigE (41.25Gb/s)	
Dual Port Capable	
100GigE (103.125Gb/s)	
Dual Port Capable	

Interface Type	
QSFP+	**Applications:** · 40G
QSFP28	**Applications:** · 100G
CFP4	**Applications:** · 100G

General	
Line Rate Traffic Tx and RX for all Interfaces	
Single Stream Generation/Analysis	
10 Streams Generation/Analysis	**Comments:** · With Viavi (Acterna) test frame pattern (ATP)
Power Level (aggregate)	**Comments:** · Provided by optics
Tx/Rx Power Level (per lambda)	**Comments:** · Provided by optics

Modes Of Operation	
Terminate	
Monitor/Thru	**Comments:** · Monitoring on Rx while keeping Tx up via idles
Logical Loopback	**Comments:** · Manual and Loop up/down; switching of addresses at Layer 2 and Layer 3

Timing	
Recovered from Rx	**Comments:** · Synchronous Ethernet Applications
Internal (Stratum 3)	
Recovered from External (BITs/SETs)	**Comments:** · BITS / SETS / 2.048MHz / 10MHz
Frequency Offset Transmit/Receive	**Comments:** · Required for Synchronous Ethernet Applications, +/- 150ppm range

Ethernet Features
Layer 1 (Unframed) Patterns
Scrambled idle PCS BERT pattern
Framed Pattern Test
PRBS 2^31-1 and inverse
PRBS Payload Patterns
2^31-1, 2^31-1 Inverse
MAC Frame Payload
PRBS Pattern

40G 100G Ethernet (Continued)

ATPv2 and ATPv3	
Flow Control	
Emulation On/Off	
Pause Frames	
Tx Insert	
Pause Quanta - Definable	
Pause Frame Analysis (counts etc)	
Ethernet Generator	
Skew injection per Virtual Lane:	
100GE: 0 to 32000 (6206 ns) bits per lane	
40GE: 0 to 32000 (3103 ns) bits per lane	
Skew alarm (Rx) threshold settings	**Compliance:** · Defaults to 180 ns
	Comments: · Up to 6206 ns for 40GE; Up to 12412 ns for 100GE
Skew reporting per virtual lane	
Tx/Rx Decoupling Mode (for Service Disruption Measurements)	**Comments:** · On incoming alarms such as LOF or Remote Fault, traffic generator is not affected (no alarm response)
Frame Type	
802.3	
DIX (Type II)	
VLAN / Q-in-Q	
MPLS (1 or 2 labels)	
Ethertype editing	
MAC Addressing	
Destination MAC Address - Unicast	
Destination MAC Address - Broadcast	
Destination MAC Address - Multicast	
Destination MAC Address - ARP Support (IPv4)	
Source MAC Address - User Defined	
Source MAC Address - Auto-increment MAC	**Comments:** · For LAG testing, No. of MACs in sequence, disable OOS
MAC Frame Size	
64, 128, 256, 512, 1024, 1280, 1518	
User defined	
Jumbo (up to 9600 bytes)	
Random	
VLAN (802.1q)	
VLAN Tag Editable Fields	
VLAN ID	
user Priority	
VLAN Stacking (Q-in-Q)	
SVLAN Tag Editable Fields	
SVLAN ID	

SVLAN User Priority	
SVLAN DEI Bit	
SVLAN TPID	
CVLAN Tag Editable Fields	
VLAN ID	
user Priority	
MPLS	
Single and Dual Label Support	
MPLS Unicast	
MPLS Multicast	
MPLS Editable Parameters	
MPLS Label	
MPLS Priority	
MPLS TTL	
IP Packet Generator	
IP	
IPv4 Frame Format	
IPv6 Frame Format	
IP Addressing	
Destination IP Address - User Defined	
Source IP Address - User Defined	
IPv4 Editable Fields	
ToS	
DSCP	
Flags	
Protocol	
TTL	
IPv6 Editable Fields	
Traffic Class	
Flow Label	
Next Header	
Hop Limit	
IP Ping	
Fast Ping	
IP TraceRoute	
Traffic Generator	
Traffic Profiles	
Traffic generation in Mbit/s and % utilization	
Constant B/W	
Burst B/W (duty cycle, bytes/frames/burst up to 33.6 Mbytes, continuous/no. of bursts)	
Ramp B/W (timed step, load step %, stop increment on errors/dropped)	
Flood B/W	**Comments:** · Full line rate
Constant B/w	

40G 100G Ethernet (Continued)

Bit Rate	**Comments:** · 0.1 Mbps granularity
Percentage	**Comments:** · 0.001% granularity
Burst B/w	
Bytes and Information Rate (IR)	
Information Rate (Mbps)	
Burst kBytes	
Continuous or fixed (up to 65535) bursts	
Burst Time and Information Rate (IR)	
Information Rate (Mbps)	
Burst Time	
Continuous or fixed (up to 65535) bursts	
Bytes and Gap Time	
Gap/Idle Time	
Burst kBytes	
Continuous or fixed (up to 65535) bursts	
Burst Time and Gap Time	
Burst Time	
Gap/Idle Time	
Continuous or fixed (up to 65535) bursts	
Frames and Duty Cycle	
Duty Cycle (%)	
Frames/Burst (up to 2M)	
Continuous or fixed (up to 65535) bursts	
Ramp B/w	
Timed Step (0.1 sec granularity)	
Load Step (0.001% granularity)	
Stop load incr conditions	
Errored Frames (count parameter)	
Dropped Frames (count parameter)	
Pause Frames (count parameter)	

RS-FEC Settings

Incoming FEC	
Find and fix errors (default)	
Find but don't fix errors	
Ignore	
Disable HI SER Alarms	
Off (default)	
On	
Calibration and RS-FEC Sync procedure built into SW for lane discovery	**Comments:** · Requires loopback device

RFC2544

Asymmetric Testing	
Symmetric Testing	
Throughput	
Frame Loss	
Out of sequence frames	
Errored Frames	
Delay	
Back to Back	
Commited Burst Size (CBS)	
Policer Test	
Jitter	
Master/Slave	
Pass/Fail Thresholds per MEF 23.1	
Connectivity QuickCheck	**Comments:** · Enables quick verification of end to end connectivity before executing an RFC test
Parrallel Testing	**Comments:** · Reduces test times by 50% by performing Latency, Throughput and Jitter tests simultaneously
Optional Testing with line rate LBM frames	
Definable Frame Size	
LAG Support	
Sequential MAC Addresses	
Suppression of OOS Frames	
Report formats	
Graphical Results	
Total Test Time Display	

ITU-T Y.1564

10 Traffic Streams	
Service Configuration Test	
Service Performance Test	
Committed Information Rate (CIR)	
Extended IR (EIR)	
Maximum Ir (MIR)	
Frame Loss Rate (FLR)	
Frame Delay (FD)	
Frame Delay Variation	
Commited Burst Size (CBS)	
Policer Test	
Round Trip Testing	
Concurrent Bi-directional Testing	**Comments:** · Enables each test set to perform and collect 1564 results for bi-directional analysis.
Configurable VLAN, Priority, Addressing and Pass/Fail Thresholds	
Programmable Pass/Fail Thresholds	
Graphical Results	
Screenshot Support	

40G 100G Ethernet (Continued)

Auto-Negotiation Check	
Saved Test Profiles	
Saved Reports	
Configurable DEI, TPID, TOS/DSCP	
Inclusive of L2 Ethernet, IPv4, and IPv6	
Integrated TrueSpeed TCP traffic stream with background streams	
Optional Testing with line rate LBM frames	
Asymmetric Testing	
LAG Support	
Sequential MAC Addresses	
Suppression of OOS Frames	

Layer 2 Transparency Testing

Verifies Transparent forwarding of Control Plane traffic through Ethernet switch fabrics.

Send/Receive Ethernet Control Plane Traffic	
Encapsulation Supported - VLAN	
Encapsulation Supported - QinQ	
Encapsulation Supported - Spanning Tree	
Encapsulation Supported - Cisco Protocols (Discovery etc.)	
Encapsulation Supported - IEEE	
Send/Receive Ethernet Control Plane Traffic	
Spanning Tree Protocol (STP)	
Rapid Spanning Tree Protocol (RSTP)	
Multiple Spanning Tree Protocol (MSTP)	
Link Layer Discovery (LLDP)	
Generic Multicast Registration (GMRP)	
Generic VLAN Registration (GVRP)	
Cisco Discovery Protocol (CDP)	
Link Aggregation Control Protocol (LACP)	
Port Aggregate Protocol (PAgP)	
Unidirection Link Detection (UDLD)	
Dynamic Trunking Protocol (DTP)	
Inter-Switch Link (ISL)	
Per VLAN Spanning Tree (PVST-PVST+)	
STP-ULFAST	
VLAN-BRDGS	
802.1d	
VLAN Trunking (VTP)	
Custom Frame Builder	

Loopback

Manual (LLB)	
Automatic	
Local	
Far End	**Comments:** · Can you send a loop command to another test set.

Class of Service Measurements

Throughput (Tx/Rx)	
Frame Loss (Rate and Ratio)	
OoS Frames	**Comments:** · Out-of-sequence
Round-trip delay measurements	
Acterna Test Protocol Version 3 (default)	
Acterna Test Protocol Version 2 with Fill byte	
Packet Jitter (Frame Delay Variation)	

Capture/Decode

Wirespeed Capture	
Integrated Wireshark on the TestSet	**Comments:** · Viewing capture files can be performed directly on the test set and not require a separate laptop/PC.
256MB Capture Buffer	
Triggers and filters	
Tx and Rx Capture	**Comments:** · Captures traffic on the test interface receiver and transmitter.
Frame Slicing	

Expert Decode/Analysis

Decode/Analysis Capture Files	
Detect Half-Duflex Ports	
Detect ICMP Layer Issues	
Identify Top Talkers	
TCP Layer Diagnosis - ex. Retransmissions	

40G 100G Ethernet (Continued)

Traffic Filtering	
Ethernet (Layer 2) Traffic Filtering	
MAC destination address	
MAC source address	
VLAN (Layer 2.5) Tag	
VLAN ID	
VLAN User Priority	
Q-in-Q VLAN (Layer 2.5) Tags	
SVLAN Fields	
SVLAN ID	
SVLAN User Priority	
SVLAN DEI Bit	
SVLAN TPID	
CVLAN Fields	
VLAN ID	
User Priority	
MPLS	
MPLS Label	
MPLS Priority	
IP (Layer 3) Traffic Filtering	
Destination address	
Source address	
Source Subnet mask	
TOS/DSCP fields (IPv4)	
Protocol (IPv4)	
IPv6 Traffic Class	
IPv6 Next Header	
Payload analysis on/off	

Errors Tx/Rx	
Errors	
Code Violation	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
Alignment Marker	**Comments:** · Per lane/all lanes; Single/Burst (up to 8)/Rate (10^{-3} to 10^{-10})
BIP-8	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
Undersized	**Comments:** · Single/Burst (up to 16)
Runt	**Comments:** · Single/Burst (up to 16)
FCS	**Comments:** · Single/Burst (up to 32767)
Acterna Payload	**Comments:** · Single/Burst (up to 32767)
IPv4 Checksum	**Comments:** · Single/Burst (up to 32767)

Bit Error (PRBS)	**Comments:** · Single/Rate (10^{-3} to 10^{-10})
RS-FEC Correctable	**Comments:** · Single/Continuous
RS-FEC Uncorrectable	**Comments:** · Single/Continuous

Alarms Tx/Rx	
Alarms	
HI BER	**Comments:** · High Bit Error Rate (from Sync Header Bits)
LOBL	**Comments:** · Per lane/all lanes; Loss of Block Lock
LOAML	**Comments:** · Per lane/all lanes; Loss of Alignment Marker Lock
RS-FEC LOAMP	
RS-FEC HI SER	
Faults	
Local Fault	
Remote Fault	

Results	
Custom results	
Histogram and Graphical Results Script	
LEDS	
Signal Present	
Sync Acquired	
Link Active	
Marker Lock	
Loss of Alignment	
HI BER	
Frame Detect	
ATP Detect	
Pattern Sync	
VLAN Frame Detect	
SVLAN Frame Detect	
Local Fault	
Remote Fault	
RS-FEC LOAMP	**Comments:** · Loss of Alignment Marker Payload
RS-FEC LOA	**Comments:** · Loss of Alignment
RS-FEC HI SER	**Comments:** · High Symbol Error Rate
Throughput Current	
Rx & Tx Mbps L1	
Rx & Tx Mbps L2	
Frame Loss (count & ratio)	

40G 100G Ethernet (Continued)

Round Trip Delay/FD (average, current, maximum)

Packet Jitter/FDV (average, max avg, peak, instantaneous)

Interface

Signal Losses

Signal Loss Seconds

Sync Loss Seconds

Link Loss Seconds

CFP2 Optical Rx Overload

Optical Rx Level (dBm)

Rx Frequency (Hz)

Rx Frequency Deviation (ppm)

Rx Frequency Max Deviation (ppm)

Tx Clock Source

Tx Frequency (Hz)

Tx Frequency Deviation (ppm)

Tx Freq Max Deviation (ppm)

Local Fault Seconds

Remote Fault Seconds

Per lambda Rx power	**Comments:** · Optics dependent

L2 Link counts/statistics (most stats also per stream)

Bandwidth utilization % (avg, current, min, peak)

Bandwidth utilization Mbps (Rx, Tx, L1, L2)

Current utilization % (unicast, multicast, broadcast)

Rx Pause Length (ms) (current, min, max)

Frame rate (avg, current, min, peak)

Frame size (avg, min, max)

Round Trip Delay/FD (average, current, max, min)

Packet Jitter/FDV (average, max avg, peak, instantaneous)

VLAN (ID, User Priority)

SVLAN (ID, User Priority, DEI)

Service disruption time (usec)

Received frames

Transmitted frames

Tx Acterna frames

Pause frames

Rx VLAN frames

Rx Q-in-Q frames

Unicast frames

Multicast frames

Broadcast frames

Rx Frame Bytes

Tx Frame Bytes

Span Tree Frames

64 Byte Frames

65-127 Byte Frames

128-255 Byte Frames

256-511 Byte Frames

512-1023 Byte Frames

1024-<Jumbo Frames

Jumbo Frames	**Comments:** · Measures longest gap between frames

L3 Link counts/statistics (most stats also per stream)

Bandwidth utilization % (avg, current, min, peak)

Packet rate (avg, current, min, peak)

Packet size (avg, min, max)

Bandwidth utilization Mbps (Rx, Tx, L3)

TOS

Received Packets

Transmitted Packets

Unicast Packets

Multicast Packets

Broadcast Packets

20-45 Byte Packets

46-63 Byte Packets

64-127 Byte Packets

128-255 Byte Packets

256-511 Byte Packets

512-1023 Byte Packets

1024-1500 Packets

>1500 Packets

IPv6 Tx Router Solicitations

IPv6 Rx Router Advertisements

L2 Filtered counts/statistics

L3 Filtered counts/statistics

BERT

Pattern Losses

Pattern Loss Seconds

Bit Errors

Bit Error Rate

Bit Error Seconds

Bit Error-Free Seconds

Bit Error-Free Seconds, %

PCS Stats

invalid Alignment Markers

invalid Alignment Marker Rate

invalid Alignment Marker Seconds

Alignment Marker Lock

Alignment Marker Lock History

Alignment Marker Loss Seconds

BIP-8 AM Bit Errors

BIP-8 AM Bit Error Rate

40G 100G Ethernet (Continued)

BIP-8 AM Bit Error Seconds	
BIP-8 AM Block Errors	
BIP-8 AM Block Error Rate	
BIP-8 AM Block Error Seconds	
Max Skew (Bits)	
Current Max Skew (Bits)	
Max Skew (ns)	
Current Max Skew (ns)	
Max Virtual Lane Skew (VLID)	
Min Virtual Lane Skew (VLID)	
Loss of Alignment	
HI BER	
HI BER History	
HI BER Seconds	
PCS Block Errors	**Comments:** · List similar to L2 Link counts/ statistics
PCS Block Error Seconds	**Comments:** · List similar to L3 Link counts/ statistics

Per Lane

Lane #
Virtual Lane ID
Skew (Bits, nsec)
Sync Acquired
Marker Lock
Code Violations
Invalid Alignment Markers
BIP-8 AM Bit Errors
BIP-8 AM Block Errors

RS-FEC

LOAMP Alarm
LOAMP Seconds
LOA Alarm
LOA Seconds
HI SER Alarm
HI SER Seconds
RS-FEC Correctable Count
RS-FEC Correctable Rate
RS-FEC Uncorrectable Count
RS-FEC Uncorrectable Rate

Capture	**Comments:** · Up to 256 Mbytes
Packets processed	
Capture progress %	

J-Proof Results

Name
Tx

Rx
Status

Error Statistics

Code Violations
Code Violation Rate
Code Violation Seconds
Runts/Undersized
Jabbers
FCS errored frames
Errored Frames
IP Checksum Errors (IPv4)
IP Packet Length Errors
Acterna Payload Errors
Packet Error Rate
Lost Frames
Frame Loss Ratio
OoS Frames
Errored Second
Severely Errored Seconds
Unavailable Seconds
Errored Second Ratio
Severely Errored Second Ratio

Event Log

Event, Date, Start Time, Stop Time, Duration, Value

Real Time Histogram

Seconds, Minutes, Hours, Days

Time

Current Date, Current Time, Test Elapsed Time

Graphical Displays

Errors versus Time
Frame Loss versus Time
Packet Jitter versus Time
Latency versus Time
Throughput versus Time

1G 10G Ethernet

Test Interfaces/Bit Rates

10/100/1000M Electrical
Dual Port Capable
GigE (Optical)
Dual Port Capable
10GigE WAN Phy (9.9G)
Dual Port Capable
10GigE LAN Phy (10.3G)
Dual Port Capable

1G 10G Ethernet (Continued)

Interface Type	
RJ-45	
SFP	
SFP+	
SFP28	

General	
Line Rate Traffic Tx and RX for all Interfaces	
Single Stream Generation/Analysis	
10 Streams Generation/Analysis	
Auto Discovery of Test Sets	**Comments:** · Automatically discovers additional test sets on the network for loopback/end to end testing
Power Level	**Comments:** · Provided by SFP/SFP+

Modes Of Operation	
Terminate	
Monitor	
Thru (Intrusive)	
Loopback	
Half Duplex	
Full Duplex	

Timing	
Recoverd from Rx	**Comments:** · Required for Synchronous Ethernet Applications
Internal (Stratum 3)	
Recoverd from External (BITs/SETs)	
Freq Offset Transmit/Receive	**Comments:** · Required for Synchronous Ethernet Applications

Ethernet Features	

GE Layer 1 (Unframed) Bit Error Testing Patterns

High Frequency test pattern	**Comments:** · Per IEEE 802.3, 2000 Edition, Annex 36A:
Low frequency test pattern	**Comments:** · Per IEEE 802.3, 2000 Edition, Annex 36A:
Mixed frequency test pattern	**Comments:** · Per IEEE 802.3, 2000 Edition, Annex 36A:
Random Data Pattern (RPAT)	**Comments:** · Per NCITS TF-25-1999
Jitter Tolerance Test Pattern (JTPAT)	**Comments:** · Per NCITS TF-25-1999
Supply Noise Test Sequence (SPAT)	**Comments:** · Per NCITS TF-25-1999

GE Layer 2 (Framed) Bit Error Testing Patterns

Compliant Random Data Pattern (CRPAT)	
Compliant Jitter Tolerance Pattern (CJPAT)	
Compliant Supply Noise Pattern (CSPAT)	

10 GE Layer 1 (Unframed) Bit Error Testing Patterns

A Seed	
B Seed	
PRBS 31	

Framed Pattern Test

PRBS (2^11-1, 2^15-1, 2^20-1, 2^23-1, 2^31-1 and inverse)	
All 1s	
All 0s	
1:3	
1:7	
3:1	
7:1	
2 in 8	
User defined	

MAC Frame Payload

PRBS Pattern	
Editable Digital Word	
ATPv2 and ATPv3	

Flow Control

Emulation On/Off	

Pause Frames

Tx Insert	
Pause Quanta - Definable	
Pause Frame Analysis (counts etc)	

Ethernet Generator	
10GE Tx/Rx Decoupling Mode (for Service Disruption Measurements)	**Comments:** · On incoming alarms such as LOF or Remote Fault, traffic generator is not affected (no alarm response)

Frame Type

802.3	
DIX	
VPLS with inner and outer MAC	
MAC in MAC 802.1ah	
EtherType Field - Editable	

MAC Addressing

Destination MAC Address - Unicast	
Destination MAC Address - Broadcast	
Destination MAC Address - Multicast	
Destination MAC Address - ARP Support (IPv4)	
Source MAC Address - User Defined	
Source MAC Address - Auto Increment	**Comments:** · Automatically increments the source MAC address to replicate multiple source MACs.

1G 10G Ethernet (Continued)

MAC Frame Size
64, 128, 256, 512, 1024, 1280, 1518
User defined
Jumbo (to 10k)
EMIX
Random

VLAN
VLAN Tagging 802.1q
VLAN Tag Editable Fields
Priority
VID
VLAN Scan

VLAN Stacking (Q-in-Q)
SVLAN Tag Editable Fields
SVLAN ID
SVLAN Priority
SVLAN DEI
SVLAN TPID
CVLAN ID
CVLAN Priority
Support up to 8 stacked VLAN Tags

VPLS
VPLS Parameters - MAC Addresses
VPLS Parameters - Frame Type
VPLS Parameters - Ethertype
VPLS Tunnel and VC Label - Lavel, CoS, TTL
VPLS Control Word - Reserved Bits, Sequence Number

MAC in MAC/PBT/PBB
Parameters - MAC Address
B-Tag - TPI, VID, Priority, DEI
I-Tag - TPI, SID, Priority, DEI, NCA, Res1, Res2

MPLS	
Single Label Support	
Stacked Label Support - Up to 2	**Comments:** · Supports up to 2 MPLS tags
Editable Parameters/Results - Label	
Editable Parameters/Results - CoS	
Editable Parameters/Results - TTL	

MPLS-TP
MPLS-TP Label Support (Tunnel and VC)
VLAN Tag Support
Linerate Traffic Generation
Traffic Analysis
Editable Parameters/Results - Label
Editable Parameters/Results - Priority
Editable Parameters/Results - TTL

Rx Filters	
GAL (Label 13) + ACH from ITU-T G.8113.1	
Common Header Label - PW, LSP, Section	
CCM Generation and Analysis	
LBM/LBR Generate and Analysis	
AIS Generate and and Analysis	
OAM Alert Label (Label 14) from ITU-T G.8114	
Common Header Label - PW, LSP, Section	
CCM Generation and Analysis	
LBM/LBR Generate and Analysis	
AIS Generate and and Analysis	
OAM Alert Label (Label 14) from ITU-T Y.1711	
Common Header Label - PW, LSP, Section	
CCM Generation and Analysis	
FFD Generation and Analysis	
BDI Generation and Analysis	
FDI Generation and Analysis	
Simultaneous OAM and background traffic generation	

Ethernet OAM	
Y.1731 Service OAM and 802.1agCFM	
CCM Messages	
Programmable CCM Rate	
CCM Type - Unicast, MultiCast	
MEG ID End Point	
Maintenance Domain Level	
AIS Tx/Rx	
RDI Tx/Rx	
LBR/LBM (Ping) - Unicast, MultiCast	
LTM/LTR (Trace)	
MEP Discovery	**Comments:** · Autodiscovery of all MEPs on the Network

802.3ah Link OAM
Mode - Passive/Active
Vendor OUI
Vendor Specific Info
Max PDU Size
Unidirectional Links
Remote Loopback
Link Events
Variable Retrieval
Dying Gasp
Link Fault
Critical Event
Errored Symbol Period Event
Errored Frame Event
Errored Frame Period Event

1G 10G Ethernet (Continued)

Errored Frame Second Summary Event	
IP Packet Generator	
IP	
IPv4 Frame Format	
IPv6 Frame Format	
TCP Port Number	**Comments:** · Source & Destination Port
UDP Port Number	**Comments:** · Source & Destination Port
IP Addressing	
Destination IP Address - User Defined	
Source IP Address - User Defined	
IPv4 Editable Fields	
ToS	
DSCP	
Flags	
Protocol	
TTL	
IPv6 Editable Fields	
Traffic Class	
Flow Label	
Next Header	
Hop Limit	
IP Ping	
Fast Ping	
IP TraceRoute	
Traffic Generator	
Number of Traffic Engines	**Comments:** · How many concurrent streams can be generated with different frame sizes and bandwidths
Bandwidth Contolled	**Comments:** · User can specify bandwidth by directly specifying the bandwidth setting
Bandwidth Specification in Mbps or kbps	
Bandwidth Granularity	
Bandwidth Specification in %	
Bandwidth Utilization Accuracy - 0.1%	
Burst Mode - Burst Size - 1 to 2M frames	
Bandwidth Specified - Definable	
Continuous Tx	**Comments:** · Ongoing traffic as defined
Once Tx - Definable frames/burst	
Traffic generation in LBM frames at line rate	
Analysis of LBR frames at line rate	
Traffic Profiles	
Constant B/W	

Ramp B/W	
Bursty B/W	
Flood B/W	
Traffic generation in Mbps, kbps, or % utilization	
B/W configurable based on L1 or L2	
TCP Throughput	
10/100/1000M Linerate Stateful Emulation	
1GigE Linerate Stateful Emulation	
10GigE Linerate Stateful Emulation	
Configurable Src and Dest IP address	
Packet length	
TCP/UDP Traffic Modes	
Source Port	
Destination Port	
Listen Port	
Configurable TCP Window Size	
Measures TCP Efficiency	
Measures Buffer Delay	
TCP Client Emulation	
TCP Server Emulation	
Up to 64 TCP Stateful Sessions Simultaneously	
Supports 4 Background Streams	
Compatible with IPERF	
RFC2544	
Asymmetric Testing	
Symmetric Testing	
Throughput	
Frame Loss	
Out of sequence frames	
Errored Frames	
Delay	
Back to Back	
Commited Burst Size (CBS)	
Policer Test	
Jitter	
Master/Slave	
Pass/Fail Thresholds per MEF 23.1	
Connectivity QuickCheck	**Comments:** · Enables quick verification of end to end connectivity before executing an RFC test
Parrallel Testing	**Comments:** · Reduces test times by 50% by performing Latency, Throughput and Jitter tests simultaneously
Optional Testing with line rate LBM frames	
Definable Frame Size	

1G 10G Ethernet (Continued)

LAG Support
Sequential MAC Addresses
Suppression of OOS Frames
Report formats
Graphical Results
Total Test Time Display

One Way Delay with GPS or CDMA receiver	Comments: · GPS receiver is Spectrum Instruments TM-4M; CDMA receiver is Precious

ITU-T Y.1564

10 Traffic Streams
Service Configuration Test
Service Performance Test
Committed Information Rate (CIR)
Extended IR (EIR)
Maximum Ir (MIR)
Frame Loss Rate (FLR)
Frame Delay (FD)
Frame Delay Variation
Commited Burst Size (CBS)
Policer Test
Round Trip Testing

Concurrent Bi-directional Testing	Comments: · Enables each test set to perform and collect 1564 results for bi-directional analysis.

Configurable VLAN, Priority, Addressing and Pass/Fail Thresholds
Programmable Pass/Fail Thresholds
Graphical Results
Screenshot Support
Auto-Negotiation Check
Saved Test Profiles
Saved Reports
Configurable DEI, TPID, TOS/DSCP
Inclusive of L2 Ethernet, IPv4, and IPv6
Integrated TrueSpeed TCP traffic stream with background streams
Optional Testing with line rate LBM frames
Asymmetric Testing
LAG Support
Sequential MAC Addresses
Suppression of OOS Frames

One Way Delay with GPS or CDMA receiver	Comments: · GPS receiver is Spectrum Instruments TM-4M; CDMA receiver is Praecis II Receiver

IETF RFC 6349

Supported on 10/100/1000 M Electrical and 1/10 G Optical Interfaces
Automated TCP Throughput test per RFC 6349
Path MTU Detection Test
Round Trip TimeTest
Walk the Window Test
TCP Throughput Test
Traffic Shaping Test
TCP Efficiency Metric
Buffer Delay Metric
Up to 64 TCP Stateful Sessions Simultaneously
1 KB TCP Window Size Granularity
Jumbo Frame Support
Graphical Results and Report Generation
Configurable File Sizes and Window Sizes
Total Test Time Display
Configurable Saturation Window Test
Compatable with the following endpoints:
T-BERD/MTS instruments
QT-600 Ethenet Probes
TrueSpeed VNF Server

Layer 2 Transparency Testing

Verifies Transparent forwarding of Control Plane traffic through Ethernet switch fabrics.

Send/Receive Ethernet Control Plane Traffic
Encapsulation Supported - VLAN
Encapsulation Supported - QinQ
Encapsulation Supported - Spanning Tree
Encapsulation Supported - Cisco Protocols (Discovery etc.)
Encapsulation Supported - IEEE
Send/Receive Ethernet Control Plane Traffic
Spanning Tree Protocol (STP)
Rapid Spanning Tree Protocol (RSTP)
Multiple Spanning Tree Protocol (MSTP)
Link Layer Discovery (LLDP)
Generic Multicast Registration (GMRP)
Generic VLAN Registration (GVRP)
Cisco Discovery Protocol (CDP)
Link Aggregation Control Protocol (LACP)
Port Aggregate Protocol (PAgP)
Unidirection Link Detection (UDLD)
Dynamic Trunking Protocol (DTP)
Inter-Switch Link (ISL)
Per VLAN Spanning Tree (PVST-PVST+)
STP-ULFAST

1G 10G Ethernet (Continued)

VLAN-BRDGS	
802.1d	
VLAN Trunking (VTP)	
Custom Frame Builder	

Synchronous Ethernet	
10GigE Tx/Rx	
1000M/100M/10M Electrical Tx/Rx	**Comments:** · Electrical SycnE PIM required
100M/1000M Optical Tx/Rx	
G.826x Compliant	
Frequency offsets ± 100 ppm in 1 or 10 ppm increments	
Recovered Interface Timing	
4.6ppm Frequency Accuracy	
SSM Message Decode	
ESMC Message Transmit & Capture	
Quality Message Decode	
Definable SSM PDU Rate (pps)	
Background Dataplane traffic generation	

IEEE 1588v2 PTP	
1G and 10G Tx/Rx	
1588v2 Master Emulation	
1588v2 Slave Emulation	
1 G Dual Monitor	
Encapsulations supported: None, VLAN, and Q-in-Q	
Packet Delay Variation Measurements on Control Plane Traffic	**Compliance:** · Add ipdv add per message type
Generate up to 4 streams of Background Dataplane traffic	**Comments:** · To see the effect of dataplane network traffic on PTP PDV.
Frame/Packet Capture and Decode via Wireshark	**Comments:** · message rates for annonce request sync
Layer 2 1588v2 Messaging	
Layer 4 1588v2 Messaging	
Message rates Multicast: fastest 2/16/64/64 (DelayResponse/Announce/Sync/DelayRequest) ; slowest one message every 16 seconds	
Message rates Unicast: fastest 2/16/16/16 (DelayResponse/Announce/Sync/DelayRequest); slowest one message every 16 seconds	
Support for Unicast and Multicast Address Mode	
Support for Forwardable and Non-forwardable Address	
Static unicast message negotion: ON or OFF	
Thresholds for Delay, PDV and Time Error	
Single- & Dual Step operation in both slave and master modes	
Master Mode Clock Classes Supported	
Primary	
Primary Holdover	

Arbitrary	
Arbitrary Holdover	
Primary A	
Arbitrary A	
1588v2 Delay Measurements (Master/Slave)	**Comments:** · Requires Precision Timing Reference Module
One-way (Master to Slave and Slave to Master) Delay	**Comments:** · Requires Precision Timing Reference Module
Differential Delay and Delay Asymmetry Measurements	
Time Error Measurements (1ns resolution)	
max |TE| Measurement	
cTE Measurement	
Wander Analysis of Time Error Masurement	
Automated Time Error Measurement workflow.	

Loopback	
Manual (LLB)	
Automatic	
Local	
Far End	**Comments:** · Can you send a loop command to another test set.
Auto Discovery of Test Sets	**Comments:** · Automatically discovers additional test sets on the network for loopback/end to end testing

Class of Service Measurements	
Throughput (Tx/Rx)	
Frame Loss (Rate and Ratio)	
OoS Frames	**Comments:** · Out-of-sequence

Round Trip Delay	
Acterna Test Protocol Version 3 (default)	
Acterna Test Protocol Version 2 with Fill byte	
10GE/GE Optical High Precision - low delay	
Lower Precision - high delay	
One Way Delay	**Comments:** · Across Geographically different locations
Packet Jitter (Frame Delay Variation)	

1G 10G Ethernet (Continued)

CAT-5 Testing	
Link speed	
Link status	
Cable status	
Crossover/straight (MDI/MDIX)	
Distance to fault	
Pin mapping	
Pair length	
Polarity	
Skew	
Capture/Decode	
Wirespeed Capture	
Integrated Wireshark on the TestSet	**Comments:** · Viewing capture files can be performed directly on the test set and not require a separate laptop/PC.
256MB Capture Buffer per port	
Triggers and filters	
Tx and Rx Capture	**Comments:** · Captures traffic on the test interface receiver and transmitter.
Frame Slicing	
Expert Decode/Analysis	
Decode/Analysis Capture Files	
Detect Half-Duflex Ports	
Detect ICMP Layer Issues	
Identify Top Talkers	
TCP Layer Diagnosis - ex. Retransmissions	
Traffic Profiling	
Detect and display up to 128 streams of live traffic	
Specify Filters for stream detection	
Stream Classification	**Comments:** · Organize streams by VLAN, MAC, IP Address etc for analysis
Network Discovery	
Automatically detect networks, domains, devices, and hosts	

Traffic Filtering
Ethernet (Layer 2) Traffic Filtering
MAC source and destination address
Frame Type/Length
VLAN ID
VLAN Priority
VLAN Discovery
VLAN (Layer 2.5) Tags - 802.1q
TPI
Priority
CFI/DEI
VID
VLAN (Layer 2.5) Tags - QnQ, 802.1ah
SVLAN ID
SVLAN Priority
SVLAN TPI
CVLAN ID
CVLAN Priority
MPLS
MPLS Label
MPLS Priority
IP (Layer 3) Traffic Filtering
Source and destination IP address
Subnet mask
IPv6 Traffic Class
TOS/DSCP fields
TCP/UDP (Layer 4) Traffic Filtering
ATP Listen Port
Protocol Analysis
CDP and LLDP Frame Discovery and Decode
CDP Analysis
Device Identifier
Port Identifier
VLAN ID
Source MAC Address
IP Subnet Addresses
LLDP Analysis
Chassis Identifier
Port Identifier
Time To Live
Source MAC address and optional VLAN ID
Management IP Address
MAU Type Information

1G 10G Ethernet (Continued)

Errors Tx/Rx	
Code Error Tx/Rx	**Comments:** · Single/Burst (up to 16)/Rate $(10^{-3}$ to $10^{-9})$
FCS Error Tx/Rx	**Comments:** · Single/Burst (up to 32767)
Acterna Payload	**Comments:** · Single/Burst (up to 32767)
IP Checksum Tx/Rx	**Comments:** · Single/Burst (up to 32767)
Bit Error Tx/Rx	**Comments:** · Single/Rate $(10^{-3}$ to $10^{-9})$
Insertion Profile - Once	
Insertion Profile - Rate	
Insertion Profile - Burst	

Alarms Tx/Rx

- Local Fault Tx/Rx
- Remote Fault Tx/Rx

Ethernet Results

Custom results

Histogram and Graphical Results Script

LEDS

- Signal Present
- Sync Acquired
- Link Active
- Frame Detect
- IP Packet Detect
- Pattern Sync
- VLAN Frame Detect
- SVLAN Frame Detect
- Local Fault
- Remote Fault

Time Source

- ToD Sync
- 1PPS Sync

SLA/KPI

Throughput Current

- Rx & Tx Mbps L1
- Rx & Tx Mbps L2
- Rx & Tx Mbps L3

Frame Loss (count & ratio)

Round Trip Delay/FD (average, current, maximum)

Packet Jitter/FDV (average, max avg, peak, instantaneous)

One Way Delay (average, current, maximum)

Time

Current Date, Current Time, Test Elapsed Time

Auto-negotiation status

Link configuration ack

Link advertisement status

Pause capable

Remote fault

Destination MAC address when using ARP

Interface

- Signal Losses
- Signal Loss Seconds
- Sync Loss Seconds
- Link Loss Seconds
- Optical Rx Overload
- Optical Rx Level (dBm)
- Rx Frequency (Hz)
- Rx Frequency Deviation (ppm)
- Rx Frequency Max Deviation (ppm)
- Tx Clock Source
- Tx Frequency (Hz)
- Tx Frequency Deviation (ppm)
- Tx Freq Max Deviation (ppm)
- Local Fault Seconds
- Remote Fault Seconds

L2 Link counts/statistics (most stats also per stream)

- Total utilization % (avg, current, min, peak)
- Current utilization % (unicast, multicast, broadcast)
- Rx Pause Length (ms) (current, min, max)
- Frame rate (avg, current, min, peak)
- Frame size (avg, min, max)
- Bandwidth utilization Mbps (Rx, Tx, L1, L2)
- Round Trip Delay/FD (average, current, max, min)
- One Way Delay (average, current, max, min)
- One Way Delay % Valid
- Packet Jitter/FDV (average, max avg, peak, instantaneous)
- VLAN (ID, User Priority)
- SVLAN (ID, User Priority, DEI)
- Service disruption time (usec)
- Received frames
- Transmitted frames
- Rx Acterna frames
- Tx Acterna frames
- Pause frames
- Rx VLAN frames
- Rx Q-in-Q frames
- Unicast frames
- Multicast frames
- Broadcast frames
- Rx Frame Bytes
- Tx Frame Bytes

1G 10G Ethernet (Continued)

Span Tree Frames

64 Byte Frames

65-127 Byte Frames

128-255 Byte Frames

256-511 Byte Frames

512-1023 Byte Frames

1024-<Jumbo Frames

Jumbo Frames

L3 Link counts/statistics/Config Status (most stats also per stream)

Total utilization % (avg, current, min, peak)

Packet rate (avg, current, min, peak)

Packet size (avg, min, max)

Bandwidth utilization Mbps (Rx, Tx, L3)

TOS

Received Packets

Transmitted Packets

Unicast Packets

Multicast Packets

Broadcast Packets

20-45 Byte Packets

46-63 Byte Packets

64-127 Byte Packets

128-255 Byte Packets

256-511 Byte Packets

512-1023 Byte Packets

1024-1500 Packets

>1500 Packets

IPv6 Tx Router Solicitations

IPv6 Rx Router Advertisements

Source IP Address

IP Gateway

IP Subnet Mask

Destination IP Address

Destination MAC Address

L2 Filtered counts/statistics

L3 Filtered counts/statistics

L4 Link counts/statistics (many stats also per stream)

Rx Source Port

Rx Destination Port

Rx/Tx Mbps, current L4

Rx Mbps, current TCP

Rx Mbps, current UDP

TCP Packets

UDP Packets

BERT

Pattern Losses

Pattern Loss Seconds

Bit Errors

Bit Error Rate

Bit Error Seconds

Bit Error-Free Seconds

Bit Error-Free Seconds, %

Capture	Comments: · Up to 256 Mbytes
Packet Processed	
Capture Progress %	

Sync Status Messages

CDMA/GPS Receiver

Event, Time

J-Proof Results

Name

Tx

Rx

Status

Error Statistics

Code Violations

Code Violation Rate

Code Violation Seconds

Undersized Frames

Runts

Jabbers

FCS errored frames

Errored Frames

Errored Blocks (PCS)

Errored Block Losses (PCS)

IP Checksum Errors (IPv4)

IP Packet Length Errors

Acterna Payload Errors

Packet Error Rate

Lost Frames

Frame Loss Ratio

OoS Frames

TCP/UDP Checksum Errors

Errored Second

Severely Errored Seconds

Unavailable Seconds

Errored Second Ratio

Severely Errored Second Ratio

Event Log

Event, Date, Start Time, Stop Time, Duration, Value

1G 10G Ethernet (Continued)

Real Time Histogram
Seconds, Minutes, Hours, Days
Time
Current Date, Current Time, Test Elapsed Time
Graphical Displays
Errors versus Time
Frame Loss versus Time
Packet Jitter versus Time
Latency versus Time
Throughput versus Time
Application Testing
Walk the Window
FTP Throughput
HTTP Throughput

SONET SDH

Test Interfaces/Bit Rates
STS-1(e) (51.84 Mbps)
Dual Port Capable
STM-1(e) (155.52Mb/s)
Dual Port Capable
STM-1(o) (155.52Mb/s)
Dual Port Capable
OC-3 (155.52Mb/s)
Dual Port Capable
OC-12 (622.08Mb/s)
Dual Port Capable
STM-4 (622.08Mb/s)
Dual Port Capable
OC-48 (2.488Gb/s)
Dual Port Capable
STM-16 (2.488Gb/s)
Dual Port Capable
OC-192 (9.953Gb/s)
Dual Port Capable
STM-64 (9.953Gb/s)
Dual Port Capable
Interface Type
SFP
SFP+
SFP+ Tunable
Modes Of Operation
Terminate
Monitor
Thru (Intrusive)

Tributary Scan	
Drop and Insert	
Timing	
Recoverd from Rx	
Internal (Stratum 3)	
Recoverd from External (BITs/SETs)	
Recoverd from 10MHz clock	
Frequency Offset Transmit/Receive	
Traffic Mappings	
SONET/SDH Bulk BERT	**Comments:** · PRBS as payload in SONET/ SDH frames
J-Scan	**Comments:** · Tributatry scan monitor tool
SONET Mappings	
STS-1 Bulk BERT	**Comments:** · OC-3/12/48/192
STS-3c Bulk BERT	**Comments:** · OC-3/12/48/192
STS-12c Bulk BERT	**Comments:** · OC-12/48/192
STS-48c Bulk BERT	**Comments:** · OC-48/192
STS-192c Bulk BERT	**Comments:** · OC-192
SDH Mappings	
AU-3 | VC-3 Bulk BERT	**Comments:** · STM-1/4/16/64
AU-4 | VC-3 Bulk BERT	**Comments:** · STM-1/4/16/64
AU-4 | VC-4 Bulk BERT	**Comments:** · STM-1/4/16/64
AU-4 | VC-4-4c Bulk BERT	**Comments:** · STM-4/16/64
AU-4 | VC-4-16c Bulk BERT	**Comments:** · STM-16/64
AU-4 | VC-4-64c Bulk BERT	**Comments:** · STM-64
PRBS Patterns	
2^15-1, 2^15-1 Inverse	
2^20-1, 2^20-1 Inverse	
2^23-1, 2^23-1 Inverse	
2^31-1, 2^31-1 Inverse	**Comments:** · OC-48/129 STM-16/64
Digital Word	
Delay pattern	
Rx Live	
SONET/SDH Injection/Detection	
Alarms/Defects	
Signal Present / LOS	**Comments:** · Terminate & Thru

SONET SDH (Continued)

LOF	**Comments:** · Terminate & Thru
TIM-S / RS-TIM	**Comments:** · Terminate & Thru
AIS-L / MS-AIS	**Comments:** · Terminate
RDI-L / MS-RDI	**Comments:** · Terminate
AIS-P / AU-AIS	**Comments:** · Terminate
LOP-P / AU-LOP	**Comments:** · Terminate
RDI-P / HP-RDI	**Comments:** · Terminate
TIM-P / HP-TIM	**Comments:** · Terminate & Thru
PLM-P / HP-PLM	**Comments:** · Terminate & Thru
UNEQ-P / HP-UNEQ	**Comments:** · Terminate & Thru

Errors/Anomalies

Frame Word	**Comments:** · Burst (1 to 32) Terminate & Thru
B1	**Comments:** · Single/Rate (10^{-6} to 10^{-9}) Terminate
B2	**Comments:** · Single/Rate (10^{-4} to 10^{-9}) Terminate
REI-L /MS-REI	**Comments:** · Single/Rate (10^{-4} to 10^{-9}) Terminate
B3	**Comments:** · Single/Rate (10^{-6} to 10^{-9}) Terminate & Thru
REI-P / HP-REI	**Comments:** · Single/Rate (10^{-6} to 10^{-9}) Terminate
Bit/TSE	**Comments:** · Single/Rate (10^{-4} to 10^{-9}) Terminate

Pointers

Increment

Decrement

+2 NDF

-2 NDF

Sequence

SONET/SDH Overhead

Overhead Manipulation/Analysis

Overhead viewing & editor for TOH/SOH and POH bytes

User can set TOH/SOH Tx & Rx Channels

POH Byte Capture (manual trigger)

Set STS-N/STM-N Channel

Section/RS Trace Message Editor (J0)

Tx Edit and Rx Display functionality

Unformatted, Single Byte, CR/LF Terminated, ITU-T G.707

TIM-S / RS-TIM alarms on mismatch

Path/Trace Message Editor (J1)

Tx Edit and Rx Display functionality

Unformatted, Single Byte, CR/LF Terminated, ITU-T G.707

TIM-P / HP-TIM alarms on mismatch

APS (K1/K2)

Set based on Ring or Linear Topology

Set Bridge Request Code, Dest Node ID, Src Node ID, Path Code, Status

Set Sync Status (S1) based on message

Signal Label generation/display (C2)

Tx Edit and Rx Display functionality

PLM-P / HP-PLM alarms on mismatch

TCM (N1) Monitoring / Generation

Pointer Movements

Set Pointer Movements

+/- Single pointers of opposite polarity

+/- Regular pointers plus one double pointer

+/- Regular pointers with one missing

+/- Double pointers of opposite polarity

+/- Single

+/- Burst

+/- Periodic - 87-3 pattern

+/- with add: Periodic - 87-3 pattern

+/- with cancel Periodic - 87-3 pattern

+/- Periodic - continuous pattern

+/- with add: Periodic - continuous pattern

+/- with cancel: Periodic - continuous pattern

+/- Periodic - 26-1 pattern

+/- with add: Periodic - 26-1 pattern

+/- with cancel Periodic - 26-1 pattern

+/- Phase transient

Service Disruption Measurements

Measurement Parameters

SD Separation/Debounce Time Setting	**Comments:** · Mandatory for handling debounce of the NE's Tx.
SD Threshold Time Settings	

Triggers

Signal Loss

Bit/TSE Error	**Comments:** · For PRBS errors
Frame Sync Loss / LOF	

SEF / OOF	
Frame Word Error	
AIS-L / MS-AIS	
RDI-L / MS-RDI	
AIS-P / HP-AIS	
LOP-P / AU-LOP	
P-RDI / HP-RDI	
B1 error	
B2 error	
REI-L / MS-REI Error	
B3 error	
REI-P / HP-REI	

Performance Monitoring

G.828 Path Allocation % Setting	
G.828 Enable UAS Limit on/off	**Compliance:** · 10 to 100000
G.826 Path Allocation % Setting	
G.828 Enable UAS Limit on/off	**Compliance:** · 10 to 100000
M.2101	**Compliance:** · MS/HP Setups

See Results section

J-Scan

Tributary Scan with STS/STM reporting	**Compliance:** · High Path Scan

Results

Custom results

LEDS

   Signal Present / LOS

   Frame Sync / LOF

   Path Pointer Present / AU Pointer Present

   Pattern Sync / LSS

Summary Status

Event Log (Event, Date, Start & Stop time, Duration/Value)

Histogram (multiple alarms & errors)

Service Disruption Summary Table

Service Disruption Details

Service Disruption Statistics

   Longest

   Shortest

   Last

   Average

   Number of Disruptions

Time

   Current Date, Current Time, Test Elapsed Time

Interface

   Invalid Rx Signal Seconds

   Signal Losses / LOS

   Signal Losses Seconds / LOS Seconds

   Optical Rx Overload

   Optical Rx Level (dBm)

   Rx Frequency (Hz)

   Rx Frequency Deviation (ppm)

   Rx Frequency Max Deviation (ppm)

   Tx Clock Source

   Tx Frequency (Hz)

   Tx Frequency Deviation (ppm)

   Tx Freq Max Deviation (ppm)

   Round-Trip Delay Current, Avg, Min, Max (100 nsec res.)

Section / RSOH

   Frame Sync Losses

   Frame Sync Loss Seconds / LOF Seconds

   OOFs / SEFs

   OOF / SEF Seconds

   Frame Word Errors

   Frame Word Error Rate

   B1 Errors

   B1 Error Rate

   Section/RS Trace Format (J0)

   Section/RS Trace (J0)

Line / MSOH

   AIS-L / MS-AIS Seconds

   RDI-L / MS-RDI Seconds

   B2 Errors

   B2 Error Rate

   REI-L / MS-REI Errors

   REI-L / MS-REI Rate

   APS Messages

   APS K1 Bridge Request Code (Ring)

   APS K1 Destination Node ID (Ring)

   APS 2 Source Node ID (Ring)

   APS K2 Path Code (Ring)

   APS K2 Status (Ring)

   Sync Status (S1)

Path / HP

   AIS-P / AU-AIS Seconds

   LOP-L / AU-LOP Seconds

   Path/AU Pointer Loss Seconds

   P-RDI / HP-RDI Seconds

   Path/AU Pointer Adjustments

   Path/AU Pointer Increments

   Path/AU Pointer Decrements

   Path/AU New Pointer

SONET SDH (Continued)

Path/AU Pointer Value	UAS (NE)
Path/AU Pointer Size	BBER (NE)
Tx Path Pointer Value	ESR (NE)
Tx Path Pointer Size	SESR (NE)
B3 Errors	G.829 MS ISM
B3 Error Rate	BBE (NE & FE)
REI-P / HP-REI Errors	ES (NE & FE)
REI-P / HP-REI Rate	SES (NE & FE)
Path/HP Trace Format (J1)	UAS (NE & FE)
Path/HP Trace (J1)	BBER (NE & FE)
Signal Label (C2)	ESR (NE & FE)
UNEQ-P / HP-UNEQ Seconds	SESR (NE & FE)
TCM (Forward)	G.828 HP ISM
TC-UNEQ	Verdict (NE & FE)
TC-UNEQ Seconds	BBE (NE & FE)
TC-LTC	ES (NE & FE)
TC-LTC Seconds	SES (NE & FE)
TC-AIS	UAS (NE & FE)
TC-AIS Seconds	SEP (NE & FE)
B3 Errors	BBER (NE & FE)
TC-IEC	ESR (NE & FE)
TC-DIFF	SESR (NE & FE)
TC-APId Label	SEPI (NE & FE)
TCM (Backward)	G.828 HP OOS
TC-RDI	Verdict
TC-RDI Seconds	BBE
TC-ODI	ES
TC-ODI Seconds	SES
TC-REI	UAS
TC-REI Seconds	SEP
TC-OEI	BBER
TC-OEI Seconds	ESR
TC-REIs	SESR
TC-OEIs	SEPI
TC-APId Label	M.2101 MS ISM
K1/K2 Log (Linear)	Verdict (NE & FE)
K1/K2 Log (Ring)	BBE (NE & FE)
Payload	ES (NE & FE)
Pattern Sync Losses	SES (NE & FE)
Pattern Sync Loss Seconds	UAS (NE & FE)
Bit/TSE Errors	SEP (NE & FE)
Bit/TSE Error Rate	BBER (NE & FE)
G.829 RS ISM	ESR (NE & FE)
BBE (NE)	SESR (NE & FE)
ES (NE)	SEPI (NE & FE)
SES (NE)	M.2101 HP ISM

SONET SDH (Continued)

Verdict (NE & FE)
BBE (NE & FE)
ES (NE & FE)
SES (NE & FE)
UAS (NE & FE)
SEP (NE & FE)
BBER (NE & FE)
ESR (NE & FE)
SESR (NE & FE)
SEPI (NE & FE)
M.2101 HP OOS
Verdict
BBE
ES
SES
UAS
SEP
BBER
ESR
SESR
SEPI
T1.514 ISM
BBE (Path NE)
ES (Path NE)
SES (Path NE)
UAS (Path NE)
SEP (Path NE)
% BBE (Path NE)
% ES (Path NE)
% SES (Path NE)
SEPI (Path NE)
T1.514 OOS
BBE (Path)
ES (Path)
SES (Path)
UAS (Path)
SEP (Path)
% BBE (Path)
% ES (Path)
% SES (Path)
SEPI (Path)
T1.231
ES (Section NE ISM)
SES (Section NE ISM)
UAS (Section NE ISM)
ES (Line NE ISM)

SES (Line NE ISM)
UAS (Line NE ISM)
ES (Path NE ISM)
SES (Path NE ISM)
UAS (Path NE ISM)

OTU4 OTU3

Test Interfaces/Bit Rates	
OTU3 (43.02Gb/s)	
Dual Port Capable	
OTU4 (111.8Gb/s)	
Dual Port Capable	
Interface Type	
QSFP+	**Compliance:** · 40G
QSFP28	**Compliance:** · 100G
CFP4	**Compliance:** · 100G
Modes Of Operation	
Terminate	
Monitor/Thru	**Comments:** · Monitoring on Rx with no Tx laser. Thru mode provides a full loopback with monitoring capabilities
Timing	
Recovered from Rx	
Internal (Stratum 3)	
Recovered from External (BITs/SETs)	**Comments:** · BITS / SETS / 2.048MHz / 10MHz
Frequency Offset Transmit/ Receive	**Comments:** · +/- 150ppm
Frequency Reporting	**Comments:** · Resolution in Hz, deviation in PPM
Traffic Mappings	
OTN Bulk BERT	**Comments:** · PRBS as payload in OTN frames
OTL BERT	**Comments:** · PRBS on OTL (with Lane Alignment)
OTU4 with 100GE Client using GMP	**Comments:** · Full Ethernet functionality at client level
OTU4 with ODU Multiplexing	**Comments:** · Full SONET/SDH functionality at client level (PRBS as per 40G SONET/SDH)

OTU4 OTU3 (Continued)

ODU3 with bulk. Direct into ODU4

ODU2e with bulk. Direct into ODU4

ODU2e with 10GE Transparent client (layer 1 and layer 2). Direct into ODU4

ODU2 with bulk. Direct in ODU4

ODU2 with 10GE client via GFP-F (G.7041 Sect 7.1) (layer 2 and layer 3). Direct in ODU4

ODU1 with bulk. Direct in ODU4 and via ODU2

ODU0 with bulk. Direct in ODU4, via ODU1, via ODU0

ODU0 with GE client via GFP-T (layer 2 and layer 3). Direct in ODU4, via ODU1, via ODU0

ODUFlex with bulk. Direct in ODU4

ODUFlex with layer 2 MAC via GFP-F. Direct in ODU4

OTU3 with OC-768/STM-256 Client

OTU3 with 40GE Client transcoded

OTU3 with ODU Multiplexing

ODU2e with bulk. Direct into ODU3

ODU2e with 10GE Transparent client (layer 1 and layer 2) Direct into ODU3

ODU2 with bulk. Direct in ODU3

ODU2 with 10GE client via GFP-F (G.7041 Sect 7.1) (layer 2 and 3). Direct into ODU3

ODU1 with bulk. Direct in ODU3 and via ODU2

ODU0 with bulk. Direct in ODU3, via ODU1, via ODU2

ODU0 with GE client via GFP-T (layer 2 and layer 3). Direct into ODU3, via ODU1, via ODU2

ODUFlex with bulk. Direct in ODU3	**Comments:** · 1 to 8 Tributary Slots worth of bandwidth
ODUFlex with layer 2 MAC via GFP-F. Direct in ODU3	**Comments:** · 1 to 8 Tributary Slots worth of bandwidth

OTU3/4 Bulk PRBS Patterns

2^9-1, 2^9-1 Inverse

2^23-1, 2^23-1 Inverse

2^31-1, 2^31-1 Inverse

Delay pattern

Rx Live

OTL/OTN Injection/Detection

Set Tx Scramble on/off

Set Rx Descramble on/off

Skew injection per Virtual Lane:

OTU4: 0 to 32000 (5724 ns) bits per lane

OTU3: 0 to 32000 (2975.5 ns) bits per lane

Skew alarm (Rx) threshold settings	**Compliance:** · Defaults to 180 ns
	Comments: · Up to 5951 ns for OTU3; Up to 11448 ns for OTU4

Skew reporting per virtual lane

Transcoding HI BER Detection on/off

Errors

OTL FAS	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
OTL MFAS	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
OTL LLM (OTU4)	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
FEC Uncorrectable	**Comments:** · Single/Rate (10^{-2} to 10^{-5})
FEC Correctable	**Comments:** · Single/Rate (10^{-2} to 10^{-5})
OOM	
SM-BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
SM-BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
PM-BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
PM-BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
TCM1-6 BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
TCM1-6 BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
Bit Error/TSE	**Comments:** · Single/Rate (10^{-3} to 10^{-10})

Additional Client Level Errors

Transcoding Errors

LOBL (1027B)

LOAML	**Comments:** · Per lane/all lanes

HI BERD (1027B)

Alarms

OTL OOF	**Comments:** · Per lane/all lanes
OTL LOF	**Comments:** · Per lane/all lanes

LOM

SM-IAE

SM-TIM

SM-BDI

SM-BIAE

ODU AIS

ODU LCK

ODU OCI

PM-BDI

PM-TIM

Fwd Sig Fail

Fwd Sig Degrade	
Bwd Sig Fail	
Bwd Sig Degrade	
TCM1-6 IAE	
TCM 1-6 BDI	
TCM1-6 BIAE	
TCM1-6 TIM	
PT Mismatch	
Client Loss	
Additional Client Level Alarms	
Transcoding Alarms	
Flag Parity	**Comments:** · Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
Marker Seq Violation	**Comments:** · Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
OTN BIP-8	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
Ingress BIP-8	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})
Code	**Comments:** · Per lane/all lanes; Single/Burst (up to 128)/Rate (10^{-3} to 10^{-10})

OTN Overhead

Support of AMP, GMP, BMP as per client mapping	**Comments:** · AMP client offset up to +/- 65 PPM for SONET/SDH Clients
GCC Transparency Test	**Comments:** · Selection of GCC0, GCC1, GCC2. PRBS verification on Rx interface with bits, errors, and BER
Round-Trip Delay (RTD) as per G.709 section 15.8 (100 nsec accuracy)	**Comments:** · Selection of PM or TCM1-6
Overhead Manipulation/Analysis	
Overhead editor for OTU, ODU, OPU bytes	**Comments:** · Multiple ODU levels for ODU multiplexing
Full structured PSI editor	
Full PSI and MSI byte maps for each ODU multiplexed level	**Comments:** · Rx & Tx MSI with Byte value, ODU Type, and Tributary Port #
Can copy Rx MSI values to Tx MSI	
Full setting of Tx and Rx Tributary Ports	
Display of tributary slots and port for each ODU multiplexed level	
SM/PM and TCM1-6 Trace (TTI) messages	
Tx and Rx SAPI/DAPI functionality	
TIM alarms on SAPI and/or DAPI mismatch or disable	

Fault Signaling (FTFL) processing	
Forward and Backward messaging	
Payload Type (PT) Label generation/display	
Set transmitted and Display received PT value	
PLM alarms enable/disable	
Forward Error Correction	
Outgoing FEC: GFEC (G.709 FEC) or all-zeroes	
Incoming FEC: ignore, correct errors, do not correct errors	

GMP Layer Injection/Detection

Tx Payload Mapping Type	
Expected Payload Mapping Type	
CM value overwrite	
Nominal and Effective CM Value	
Payload Offset (ppm)	**Comments:** · +/- 100ppm
Error Injections	
CRC-5	**Comments:** · Single/Burst (up to 16)
CRC-8	**Comments:** · Single/Burst (up to 16)
Ethernet	
As per Ethernet Injection/Detection	

GFP Layer Injection/Detection

With Ethernet Clients	
Set PFI	
Set EXI	
Set UPI	
Rx filter on CID	
Rx filter on UPI	
GFP-T Superblocks per frame	**Comments:** · 1 to 978

Service Disruption Measurement

Measurement Parameters	
SD Separation/Debounce Time Setting	**Comments:** · Mandatory for handling debounce of the NE's Tx. Up to 60000 msec
SD Threshold Time Settings	**Comments:** · Up to 60000 msec
Triggers	
Signal Loss / LOS	
Bit/TSE Error	**Comments:** · For PRBS errors
OTL LOF	
OTL FAS Error	
OTL MFAS Error	
OTL LLM (OTU4)	
OTU LOM	
OTU SM-IAE	

OTU SM-BIAE	
ODU AIS	
ODU LCK	
ODU OCI	
ODU PM-BDI	
OTU OOM	
ODU PM-BIP	
ODU PM-BEI	
SONET/SDH when present as a client	
Ethernet SD based on gap measurement when present as a client	

Results

Custom results

LEDS

Signal Present / LOS
Frame Sync / LOF
Marker Lock / LOR
Lanes Aligned / LOL
Pattern Sync / LSS
GMP Sync
GMP (Cm=0)
GFP CSF-LCCS Alarm
GFP CSF-LCS Alarm
Client or muxed Level extra

Summary Status

Event Log (Event, Date, Start & Stop time, Duration/Value)

Histogram (multiple alarms & errors)

Service Disruption Summary Table

Service Disruption Details

Service Disruption Statistics

Longest
Shortest
Last
Average
Number of Disruptions

Time

Current Date, Current Time, Test Elapsed Time

Interface

Invalid Rx Signal Seconds
Signal Losses / LOS
Signal Losses Seconds / LOS Seconds
QSFP State
CFP2 State
CFP2 Optical Rx Overload
Optical Rx Level (dBm)
Rx Frequency (Hz)

Rx Frequency Deviation (ppm)	
Rx Frequency Max Deviation (ppm)	
Tx Clock Source	
Tx Frequency (Hz)	
Tx Frequency Deviation (ppm)	
Tx Freq Max Deviation (ppm)	
Round-Trip Delay Current, Avg, Min, Max (100 nsec res.)	
Per lambda Rx power	**Comments:** · Optics dependent
Per lambda Tx power	**Comments:** · Optics dependent

OTL Stats

Frame Sync Loss Seconds / LOF Seconds	
OOF Seconds	
OOMFAS Seconds	
Marker Lock Loss Seconds / LOR Seconds	**Comments:** · Loss of Recovery
OOR Errors	**Comments:** · Out of Recovery
Lane Aligned Loss Seconds / LOL Seconds	
OOL Seconds	
OOLLM Seconds	
FAS Errors	
FAS Error Rate	
FAS Error Seconds	
MFAS Errors	
MFAS Error Rate	
MFAS Error Seconds	
Logical Lane Marker Errors	
Logical Lane Marker Error Rate	
Logical Lane Marker Error Seconds	
Max Skew (Bits)	
Current Max Skew (Bits)	
Max Skew (ns)	
Current Max Skew (ns)	
Max Logical Lane Skew (LL ID)	
Min Logical Lane Skew (LL ID)	

OTL Per Lane

Lane #	
Logical Lane ID	
Skew (Bits, nsec)	
Frame Sync / OTL LOF	
OTL OOF	
OOMFAS	
Marker Lock / OOLLM	
OTL LOR (OTU4)	**Comments:** · Out of Recovery

OTU4 OTU3 (Continued)

OTL OOR	
FAS Errors	
MFAS Errors	
Logical Lane Marker Errors (OTU4)	
Ethernet Virtual Lane ID	**Comments:** · For Ethernet in OTN
Sync Acquired	**Comments:** · For Ethernet in OTN
Eth Marker Lock	**Comments:** · For Ethernet in OTN
Code Violations	**Comments:** · For Ethernet in OTN
Invalid Alignment Markers	**Comments:** · For Ethernet in OTN
BIP-8 AM Bit Errors	**Comments:** · For Ethernet in OTN
BIP-8 AM Block Errors	**Comments:** · For Ethernet in OTN

FEC
- Uncorrected Word Errors
- Uncorrected Word Error Rate
- Uncorrected Word Errored Seconds
- Corrected Word Errors
- Corrected Word Errors Rate
- Corrected Word Errored Seconds
- Corrected Bit Errors
- Corrected Bit Errors Rate
- Corrected Bit Errored Seconds

Framing
- OOM Seconds

OTU
- AIS Seconds
- SM-IAE Seconds
- SM-BIP Errors
- SM-BIP Error Rate
- SM-BDI Seconds
- SM-BIAE Seconds
- SM-BEI Errors
- SM-BEI Error Rate
- SM-SAPI
- SM-DAPI
- SM-Operator Specific
- GCC BERT Bits
- GCC BERT Bit Errors
- GCC BERT Bit Error Rate

ODU
- ODU-AIS Seconds
- ODU-LCK Seconds
- ODU-OCI Seconds
- PM-BIP Errors
- PM BIP Error Rate
- PM-BDI Seconds
- PM-BEI Errors
- PM-BEI Error Rate
- PM-SAPI
- PM-DAPI
- PM-Operator Specific
- GCC BERT Bits
- GCC BERT Bit Errors
- GCC BERT Bit Error Rate
- PM Round Trip Delay Recent
- PM Round Trip Delay Last

OPU
- Payload Type
- PT Mismatch Seconds

FTFL
- Forward-Fault Type
- Forward-SF Seconds
- Forward-SD Seconds
- Forward-Operator Identifier
- Forward-Operator Specific
- Backward-Fault Type
- Backward-SF Seconds
- Backward-SD Seconds
- Backward-Operator Identifier
- Backward-Operator Specific

TCM 1-6
- IAE Seconds
- BIP Errors
- BIP Error Rate
- BDI Seconds
- BIAE Seconds
- BEI Errors
- BEI Error Rate
- SAPI
- DAPI
- Operator Specific
- PM Round Trip Delay Recent
- PM Round Trip Delay Previous

AMP
- Rx Offset (PPM)
- Max Rx Offset (PPM)
- PJO1 Count
- NJO1 Count

OTU4 OTU3 (Continued)

Payload

- Pattern Sync Losses \ LSSs
- Pattern Sync Loss Seconds \ LLS Seconds
- TSE/Bit Errors
- TSE/Bit Error Rate
- TSE/Bit Error Seconds
- Bit Error-Free Seconds
- Bit Error-Free Seconds, %

GMP (under OTU when used to map payload)

- Sync Status
- Sync Loss Seconds
- OOS Status
- OOS Seconds
- GMP Alarm (Cm=0)
- Effective CM
- Minimum CM
- Maximum CM
- CM Offset (PPM)
- Unchanged CM Count
- +1 CM Count
- +2 CM Count
- -1 CM Count
- -2 CM Count
- New CM Count
- CRC-5 Bit Errors
- CRC-5 Bit Error Rate
- CRC-5 Bit Seconds
- CRC-8 Bit Errors
- CRC-8 Bit Error Rate
- CRC-8 Bit Seconds

GFP

- Payload FCS Errors (count, seconds, ratio, rate)
- Core Header Single Bit Errors (count, seconds, ratio, rate)
- Core Header Multi Bit Errors (count, seconds, ratio, rate)
- Type Header Single Bit Errors (count, seconds, ratio, rate)
- Type Header Multi Bit Errors (count, seconds, ratio, rate)
- Extension Header Single Bit Errors (count, seconds, ratio, rate)
- Extension Header Multi Bit Errors (count, seconds, ratio, rate)
- GFP-T CRC-16 Correctable Errors (count, seconds, ratio, rate)
- GFP-T CRC-16 Uncorrectable Errors (count, seconds, ratio, rate)
- GFP-T 10B_ERR (count, seconds, ratio, rate)

Client

- Client Rx Frequency (Hz)
- Client Rx Freq Deviation (ppm)
- Client Rx Freq Max Deviation (ppm)

Transcoding Stats

- Sync Loss Seconds
- HI BER Seconds
- 1027B Flag Parity Err
- 1027B Flag Parity Err Rate
- 513B Mkr Seq Vio Cnt
- 513B Mkr Seq Vio Rate
- 513B Mkr Seq Vio Seconds
- Total OTN BIP-8 Err Cnt
- Total OTN BIP-8 Err Rate
- Total Ingress BIP-8 Err Cnt
- Total Ingress BIP-8 Err Rate

Transcoding Per Lane

- Lane #
- OTN BIP-8 Err Cnt
- OTN BIP-8 Err Rate
- Ingress BIP-8 Err Cnt
- Ingress BIP-8 Err Rate

Ethernet Client

- As per Ethernet results

SONET/SDH Client

- As per SONET/SDH results

OTN Check

Automated workfolw is available at all OTN rates for OTN Bulk	**Comments:** · Key use case is OTN service activation

Set test duration based on Bit Error Rate Theory or actual time

Bit Error Rate Therory paramters for test duration:

- Data Rate (e.g. OTU4)
- BER Threshold

Confidence Level (% value)	**Comments:** · Statistical degree of certainty

Key automated tests

- Payload BERT
  - PRBS pattern selection
  - Pass/Fail BER Threshold
- Round Trip Delay
  - Selection of applicable OH fields: PM, TCM1-6
  - Measurement Frequency
  - Pass/Fail Threshold (ms)
- GCC Transparency
  - Selection of applicable OH field: GCC0, GCC1 or GCC2
  - Pass/Fail BER Threshold
- Far-end loopback auto-detect function

Report generation and formats

OTU1 OTU2 OTU1e OTU2e

Test Interfaces/Bit Rates	
OTU1 (2.7G)	
Dual Port Capable	
OTU2 (10.7G)	
Dual Port Capable	
OTU1e (11.045G)	
Dual Port Capable	
OTU2e (11.095G)	
Dual Port Capable	
Interface Type	
SFP	
SFP+	
SFP+ - Tunable	
Modes Of Operation	
Terminate	
Monitor/Thru	
Timing	
Recovered from Rx	
Internal (Stratum 3)	
Recovered from External (BITs/SETs)	**Comments:** · BITS / SETS / 2.048MHz / 10MHz
Frequency Offset Transmit/Receive	**Comments:** · +/- 50ppm
Frequency Reporting	**Comments:** · Resolution in Hz, deviation in PPM
Traffic Mappings	
OTN Bulk BERT	**Comments:** · PRBS as payload in OTU1/2/1e/2e frames
OTU2e with Layer 1 and Layer 2 Traffic	**Comments:** · Full Ethernet functionality at client level
OTU1e with Layer 1 and Layer 2 Traffic	**Comments:** · Full Ethernet functionality at client level
OTU2 with STS-192 Bulk BERT	**Comments:** · Full SONET functionality at client level
OTU2 with STM-64 Bulk BERT	**Comments:** · Full SDH functionality at client level
OTU2 with ODU Multiplexing	
ODU1 with bulk. Direct in ODU2	
ODU0 with bulk. Direct in ODU2	
ODU0 with GE client via GFP-T (layer 2 and layer 3). Direct in ODU2	
ODUFlex with bulk. Direct in ODU2	
ODUFlex with layer 2 MAC via GFP-F. Direct in ODU2	

OTU1 with STS-48 Bulk BERT	**Comments:** · Full SONET functionality at client level
OTU1 with STM-16 Bulk BERT	**Comments:** · Full SDH functionality at client level
OTU1 with ODU Multiplexing	
ODU0 with bulk. Direct in ODU1	
ODU0 with GE client via GFP-T (layer 2 and layer 3). Direct in ODU1	
OTN Bulk PRBS Patterns	**Comments:** · PRBS as payload in OTU1/2/1e/2e frames
2^23-1, 2^23-1 Inverse	
2^31-1, 2^31-1 Inverse	
Delay pattern	
Rx Live	
Digital Word	**Comments:** · 32 bits
OTN Injection/Detection	
Set Tx Scramble on/off	
Set Rx Descramble on/off	
Errors	
FEC Uncorrectable	**Comments:** · Single/Rate (10^{-2} to 10^{-5})
FEC Correctable	**Comments:** · Single/Rate (10^{-2} to 10^{-5})
FAS	**Comments:** · Single/Burst (up to 300)
OOF	**Comments:** · Single
MFAS	**Comments:** · Single/Burst (up to 300)
OOM	**Comments:** · Single
SM-BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
SM-BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
PM-BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
PM-BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
TCM1 BIP	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
TCM1 BEI	**Comments:** · Single/Rate (10^{-5} to 10^{-7})
Bit Error/TSE	**Comments:** · Single/Rate (10^{-4} to 10^{-9})
Additional Client Level Errors	
Alarms	
LOF	

OTU1 OTU2 OTU1e OTU2e (Continued)

LOM	
AIS	
SM-IAE	
SM-TIM	
SM-BDI	
SM-BIAE	
ODU AIS	
ODU LCK	
ODU OCI	
PM-BDI	
PM-TIM	
Fwd Sig Fail	
Fwd Sig Degrade	
Bwd Sig Fail	
Bwd Sig Degrade	
TCM1 IAE	
TCM1 BDI	
TCM1 BIAE	
TCM1-6 TIM	
PT Mismatch	
Client Loss	
Additional Client Level Alarms	

OTN Overhead

Support of AMP, GMP, BMP as per client mapping	**Comments:** · AMP client offset up to +/- 65 PPM for SONET/SDH Clients
GCC Transparency Test	**Comments:** · Selection of GCC0, GCC1, GCC2. PRBS verification on Rx interface with bits, errors, and BER
Round-Trip Delay (RTD) as per G.709 section 15.8 (100 nsec accuracy)	**Comments:** · Selection of PM or TCM1-6
Overhead Manipulation/Analysis	
Overhead editor for OTU, ODU, OPU bytes	**Comments:** · Multiple ODU levels for ODU multiplexing
Full structured PSI editor	
Full PSI and MSI byte maps for each ODU multiplexed level	**Comments:** · Rx & Tx MSI with Byte value, ODU Type, and Tributary Port #
Can copy Rx MSI values to Tx MSI	
Full setting of Tx and Rx Tributary Ports	
Display of tributary slots and port for each ODU multiplexed level	
SM/PM and TCM1-6 Trace (TTI) messages	
Tx and Rx SAPI/DAPI functionality	
TIM alarms on SAPI and/or DAPI mismatch or disable	
Fault Signaling (FTFL) processing	

Forward and Backward messaging	
Payload Type (PT) Label generation/display	
Set transmitted and Display received PT value	
PLM alarms enable/disable	
Forward Error Correction	
Outgoing FEC: GFEC (G.709 FEC) or all-zeroes	
Incoming FEC: ignore, correct errors, do not correct errors	

Service Disruption Measurement

Measurement Parameters	
SD Separation/Debounce Time Setting	**Comments:** · Mandatory for handling debounce of the NE's Tx. Up to 60000 msec
SD Threshold Time Settings	**Comments:** · Up to 60000 msec
Triggers	
Signal Loss / LOS	**Comments:** · For PRBS errors
Bit/TSE Error	
OTU LOM	
OTU SM-IAE	
OTU SM-BIAE	
ODU AIS	
ODU LCK	
ODU OCI	
ODU PM-BDI	
OTU OOM	
ODU PM-BIP	
ODU PM-BEI	
Ethernet SD based on gap measurement when present as a client	

Results

Custom results	
LEDS	
Signal Present / LOS	
Frame Sync / LOF	
Marker Lock / LOR	
Lanes Aligned / LOL	
Pattern Sync / LSS	
GMP Sync	
GMP (Cm=0)	
Client or muxed Level extra	
Summary Status	
Event Log (Event, Date, Start & Stop time, Duration/Value)	
Histogram (multiple alarms & errors)	
Service Disruption Summary Table	
Service Disruption Details	
Service Disruption Statistics	

OTU1 OTU2 OTU1e OTU2e (Continued)

Longest	SM-BEI Error Rate
Shortest	SM-SAPI
Last	SM-DAPI
Average	SM-Operator Specific
Number of Disruptions	GCC BERT Bits
Time	GCC BERT Bit Errors
Current Date, Current Time, Test Elapsed Time	GCC BERT Bit Error Rate
Interface	**ODU**
Invalid Rx Signal Seconds	ODU-AIS Seconds
Signal Losses / LOS	ODU-LCK Seconds
Signal Losses Seconds / LOS Seconds	ODU-OCI Seconds
Rx Frequency (Hz)	PM-BIP Errors
Rx Frequency Deviation (ppm)	PM BIP Error Rate
Rx Frequency Max Deviation (ppm)	PM-BDI Seconds
Tx Clock Source	PM-BEI Errors
Tx Frequency (Hz)	PM-BEI Error Rate
Tx Frequency Deviation (ppm)	PM-SAPI
Tx Freq Max Deviation (ppm)	PM-DAPI
FEC	PM-Operator Specific
Uncorrected Word Errors	GCC BERT Bits
Uncorrected Word Error Rate	GCC BERT Bit Errors
Uncorrected Word Errored Seconds	GCC BERT Bit Error Rate
Corrected Word Errors	PM Round Trip Delay Recent
Corrected Word Errors Rate	PM Round Trip Delay Previous
Corrected Word Errored Seconds	**OPU**
Corrected Bit Errors	Payload Type
Corrected Bit Errors Rate	PT Mismatch Seconds
Corrected Bit Errored Seconds	**FTFL**
Framing	Forward-Fault Type
Frame Sync Losses	Forward-SF Seconds
Frame Sync Losses Seconds	Forward-SD Seconds
OOF Seconds	Forward-Operator Identifier
FAS Errors	Forward-Operator Specific
FAS Error Rate	Backward-Fault Type
Multiframe Sync Loss Seconds	Backward-SF Seconds
OOM Seconds	Backward-SD Seconds
MFAS Errors	Backward-Operator Identifier
MFAS Error Rate	Backward-Operator Specific
OTU	**TCM 1-6**
AIS Seconds	IAE Seconds
SM-IAE Seconds	BIP Errors
SM-BIP Errors	BIP Error Rate
SM-BIP Error Rate	BDI Seconds
SM-BDI Seconds	BIAE Seconds
SM-BIAE Seconds	BEI Errors
SM-BEI Errors	BEI Error Rate

OTU1 OTU2 OTU1e OTU2e (Continued)

SAPI	
DAPI	
Operator Specific	
PM Round Trip Delay Recent	
PM Round Trip Delay Previous	
AMP	
Rx Offset (PPM)	
Max Rx Offset (PPM)	
PJO1 Count	
NJO1 Count	
Payload	
Pattern Sync Losses \ LSSs	
Pattern Sync Loss Seconds \ LLS Seconds	
TSE/Bit Errors	
TSE/Bit Error Rate	
Client	
Client Rx Frequency (Hz)	
Client Rx Freq Deviation (ppm)	
Client Rx Freq Max Deviation (ppm)	
Ethernet Client	
As per Ethernet results	
SONET/SDH Client	
As per SONET/SDH results	

Ethernet in OTN applications

Applicable to:
10GE in OTU2e/1e
40GE in OTU3
100GE in OTU4
Includes:
QuickCheck
RFC 2544 test suite

OTN Check

Automated workfolw is available at all OTN rates for OTN Bulk	**Comments:** · Key use case is OTN service activation
Set test duration based on Bit Error Rate Theory or actual time	
Bit Error Rate Therory paramters for test duration:	
Data Rate (e.g. OTU4)	
BER Threshold	
Confidence Level (% value)	**Comments:** · Statistical degree of certainty
Key automated tests	
Payload BERT	
PRBS pattern selection	
Pass/Fail BER Threshold	
Round Trip Delay	
Selection of applicable OH fields: PM, TCM1-6	

Measurement Frequency
Pass/Fail Threshold (ms)
GCC Transparency
Selection of applicable OH field: GCC0, GCC1 or GCC2
Pass/Fail BER Threshold
Far-end loopback auto-detect function
Report generation and formats

Fibre Channel

Test Interfaces/Bit Rates

1G FC (1.0625Gb/s)
Dual Port Capable
2G FC(2.125Gb/s)
Dual Port Capable
4G FC (4.25Gb/s)
Dual Port Capable
8G FC (8.5Gb/s)
Dual Port Capable
10G FC (10.5175Gb/s)
Dual Port Capable
16G FC (14.025Gb/s)
Dual Port Capable
32G FC (28.05Gb/s)
Dual Port Capable

Laser Type

SFP
SFP+
SFP28

Modes Of Operation

Terminate
Monitor
Thru
Loopback

Timing

Internal	
Frequency Offset Transmit/Receive	**Comments:** · +/- 110ppm

Traffic Attributes

Line Rate Traffic Tx and RX	
Layer 1 Test Patterns	
HFPAT	**Comments:** · 1G/2G/4G FC
LFPAT	**Comments:** · 1G/2G/4G FC
MFPAT	**Comments:** · 1G/2G/4G FC

Fibre Channel (Continued)

RDPAT	**Comments:** · 1G/2G/4G FC
JTPAT	**Comments:** · 1G/2G/4G FC
SNPAT	**Comments:** · 1G/2G/4G FC
A seed	**Comments:** · 10G/16G FC
B seed	**Comments:** · 10G/16G FC
PRBS31	**Comments:** · 10G/16G FC

Layer 2 Test Patterns

CRPAT	**Comments:** · 1G/2G/4G/8G FC
CJPAT	**Comments:** · 1G/2G/4G/8G FC
CSPAT	**Comments:** · 1G/2G/4G/8G FC

PRBS Payload Patterns

2^31-1, 2^23-1, 2^20-1, All Ones, All Zeroes

Scrambling (on/off)	**Comments:** · 8G FC In FC-1 on total frame
Emissions Lowering Protocol (on/off)	**Comments:** · 8G FC

Emissions Lowering Protocol Type (Idle-ARBff, ARBff-ARBff)

Incoming FEC (32G)	**Comments:** · Find and fix errors, Find but don't fix errors, ignore
Disable Hi SER Alarm (32G)	**Comments:** · off, on

Fibre Channel Generator

Frame Length

28 (no payload), 32, 76 (ATP), 128, 256, 512, 1024, 1536, 2076, 2140 settings

User defined (28 to 2140)

Fibre Channel Fields

Unicast or Broadcast

Destination ID

Source ID

Sequence ID

Originator ID

Responder ID

FC Frame Payload

BERT/PRBS Pattern

Acterna Test Protocol Version 2

Auto-traffic start on laser on

Traffic Generator

Traffic Profiles

Traffic generation in Mbit/s and % utilization

Constant B/W

Burst B/W	
Ramp B/W	
Flood B/W	**Comments:** · Full line rate

Constant B/w

Bit Rate

Percentage

Burst B/w

Burst Time and Gap Time

Burst Time

Gap/Idle Time

Continuous or fixed (up to 65535) bursts

Frames and Duty Cycle

Duty Cycle (%)

Frames/Burst

Continuous or fixed (up to 65535) bursts

Ramp B/w

Timed Step (0.1 sec granularity)

Load Step (%)

Stop load incr conditions

Errored Frames (count parameter)

Dropped Frames (count parameter)

Flow Control Login

General

Flow Control (on/off)

Login

Implicit

Explicit (E-port)

Explicit (Fabric/N-port)

Buffer-to-Buffer Credits

MAC ID

Unit Identifier

Port Name

Fabric/N_Port Login

Topology (Fabric, Point-to-Point)

Source N-port Name

Source Node Name/Source ID

Dest N-port Name

Dest Node Name/Dest ID

Traffic Filtering

Routing Control

Destination ID

Source ID

Data Type

Sequence Control

Fibre Channel (Continued)

Data	
BERT Rx=Tx	
Payload Analysis	
Rx BERT Pattern	
Injection/Detection	
Errors	
Code	**Comments:** · Single/Rate (10^{-3} to 10^{-9})
CRC	**Comments:** · Single/Burst (up to 32767)
Bit Error (PRBS)	**Comments:** · Single/Rate (10^{-3} to 10^{-9})
RS-FEC Uncorr CW (32G)	**Comments:** · Single/Burst (up to 512)/Rate (10-2 to 10-9)
RS-FEC Corr CW (32G)	**Comments:** · Single/Burst (up to 512)/Rate (10-2 to 10-9)
Faults	
Local Fault (10G)	
Remote Fault (10G)	
Alarms	
HI SER (32G)	
Results	
Custom results	
LEDS	
Signal Present	
RS-FEC LOA (32G)	
RS-FEC HI SER (32G)	
Sync Acquired	
Link Active	
ATP Detect	
Pattern Sync	
Local Fault (10G)	
Remote Fault (10G)	
SLA/KPI	
Frame Loss (count & ratio)	
Round Trip Delay/FD (average, current, maximum)	
Event Log (Event, Date, Start & Stop time, Duration/Value)	
Histogram	
Optical Rx Overload	
Signal Loss	
Link Loss	
Timing Src Loss	
Sync Loss	
Local Fault (10G/16G)	
Remote Fault (10G/16G)	
Code Violation	

Runts
Jabbers
Undersized Frames
CRC errored frames
Errored Frames
Lost frames
OoS Frames
EB (PCS)
BSL (PCS)
Bit Errors (PRBS)
Acternal Payload Errors
Time
Current Date, Current Time, Test Elapsed Time
Interface
Signal Losses
Signal Loss Seconds
Sync Loss Seconds
Link Loss Seconds
Optical Rx Overload
Tx Clock Source
Local Fault Seconds (10G/16G)
Remote Fault Seconds (10G/16G)
L2 Link Statistics
Total Utilization % (avg, current, min, peak)
Frame Rate (avg, current, min, peak)
Frame Size (Avg, Min, Max)
Rx Mbps (L1, L2)
Tx Mbps (L1, L2)
Round Trip Delay (us) (Avg, current, min, max)
Service Disruption (us)
ELP Mismatch Link Active
L2 Link Counts
Rx Frames
Tx Frames
Rx Acterna
Tx Acterna Frames
28-64 Byte Frames
68-124 Byte Frames
128-252 Byte Frames
256-508 Byte Frames
512-1020 Byte Frames
1024-2140 Byte Frames
Rx Frame Bytes
Tx Frame Bytes
Rx R_RDYs
Tx R_RDYs

Fibre Channel (Continued)

Near-end B-B Credits

Tx Avail B-B Credit, Current

Class F Frames

Class 1 Frames

Class 2 Frames

Class 3 Frames

L2 Filtered counts/statistics

Bert Stats

Pattern Losses

Pattern Loss Seconds

Bit Error Rate

Bit Errors

Bit Errored Seconds

Bit Error-Free Seconds

Bit Error-Free Seconds (%)

Login status

Login Status

Tx/Rx ELP Request

Tx/Rx ELP Accept

Tx/Rx ELP Ack1

Fabric Present

Fabric Login Status

F Port Name

Fabric Name

N Port Login Status

Dest N Port ID

Dest N Port Name

Dest Node Name

Source N Port ID

Source N Port Name

Source Node Name

RS-FEC

LOA Alarm

LOA Seconds

HI SER Alarm

HI SER Seconds

Corr. CW Errors

Corr. CW Error Rate

Corr. Bit Errors

Corr. Bit Error Rate

Uncorr. CW Errors

Uncorr. CW Error Rate

Corr+Uncorr Bit Error Rate

Error Stats

Symbol Errors

CRC Errored Frames

Fibre Runts

Fibre Jabbers

Undersized Frames

Errored Frames

Code Violations

Code Violation Rate

Code Violation Seconds

Graphical Displays

Throughput versus Time

Frame Loss versus Time

Latency/FD (RTD) versus Time

Errors versus Time

CRC Errored Frames

Fibre Runts

Fibre Jabbers

Bit Errors

OoS Frames

FC RFC2544

Symmetric, Loopback

Loopback

Set addresses, Loop Type, IDs

Tests

Throughput

Zeroing-in: RFC 2544 standard or Viavi enhanced

Bandwidth Granularity

Test Duration and Number of Trials

Pass/Fail Threshold

Latency (RTD)

Pass/Fail Threshold

Frame Loss

Test Duration and Number of Trials

Pass/Fail Threshold

Back-to-back

Max Burst Duration

Burst Granularity

Buffer Credit

Flow control Login Type (Implicit, Explicit)

Max Buffer Size

Buffer Credit Throughput

Throughput Steps

Traffic in Mbps or %

Up to 10 frame/packet sizes (max 2140 bytes)

Can run multiple tests concurrently for speed

Report generation and formats

Graphical Results

Total Test Time Display

PDH

Test Interfaces
E4 (140Mbps)
DS3 (44.736Mbps)
E3 (34Mbps)
E1 Balanced (2.048Mbps)
E1 Unbalanced (2.048Mbps)
DS1 (1.544Mbps)

Interface Type
BNC
Bantam
RJ-48

Modes Of Operation
Terminate
Monitor
Thru (Intrusive)

Timing
Recoverd from Rx
Internal (Stratum 3)
Recoverd from External (BITs/SETs)

Framing
Framed
Unframed

Test Patterns
2^15-1* (Inverse)
2^20-1* (Inverse)
2^23-1* (Inverse)
User Programmable
Round Trip Delay
ANSI and ITU

Mappings
E3
E1
64k

Anomaly/Error Insert/Analysis
Frame Errors
TSE/Bit Error
Single
Rate

Defect/Alarm Insert/Analysis
AIS
RDI/FAS Distant

General
Frequency Offset +/- 100ppm
National Bit Support

Performance Measures
G.821 (OOS)
G.826 (ISM/OOS)
M.2100 (ISM/OOS)

Results

Signal Category
Receive Frequency
Receive Frequency Deviation
Receive Frequency Max Deviation
Transmit Frequency
Round Trip Delay

Frame Category
FAS TSE Count
FAS TSE Rate
FAS Word Error Count
FAS Word Error Rate
Frame Synchronization Loss Count
Frame Synchronization Loss Seconds

Logic Category
TSE/Bit Error Count
TSE/Bit Error Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Loss Seconds

DS3

Modes Of Operation
Terminate
Monitor
Thru (Intrusive)

Timing
Recoverd from Rx
Internal (Stratum 3)
Recoverd from External (BITs/SETs)

Framing
M13
Cbit
Unframed

Test Patterns
All 1s
All 0s
2^15-1* (Inverse)
2^20-1* (Inverse)
2^23-1* (Inverse)
Round Trip Delay
User Progammable (3,,,,32 bits)
User Byte
100

PDH (Continued)

1100 (aka IDLE)	
1010 (aka BLUE)	
ANSI and ITU	
Mappings	
E1	
T1	
64k	
Anomaly/Error Insert/Analysis	
BPV/Code Error	
Frame	
Parity	
C-Bit Parity	
TSE/Bit Error	
Single	
Rate	
Multiple	
Defect/Alarm Insert/Analysis	
AIS	
RDI/FAS Distant	
REBE	
TS-16 AIS	
TS-16 RDI/MFAC Distant	
General	
Frequency Offset +/- 100ppm	
Loop Codes Tx NIU, CSU, Line	**Comments:** · FEAC Loopcodes
Rx Compensation - High - 0 ft	
Rx Compensation - Low - 450 ft	
Rx Compensation - Low - 900 ft	
Service Disruption	**Comments:** · Frame Sync
Performance Measures	
G.826 (ISM/OOS)	
G.821	
M.2100	
M.2101	
T1.231	
T1.510	
Results	
Signal Category	
Receive Frequency	
Receive Frequency Deviation	
Receive Frequency Maximum Deviation	
Transmit Frequency	
BPV/Code Rate	
BPV/Code Count	
Electrical Input Level	

Round Trip Delay (ms)	
Frame	
Frame Error Count	
Frame Error Rate	
Frame Error Seconds	
Frame Synchronization Loss Count	
Near End Out of Frame Seconds	
Far-End Out of Frame Seconds	
C-Bit Format	
RX X-Bits	
FEAC Word	
Parity Error Count	
Parity Error Rate	
Parity Error Seconds	
C-Bit Parity Error Count	
C-Bit Parity Error Rate	
C-Bit Error Seconds	
FEBEs	
DS2 Frame Synchronization Loss Count	
Logic	
Bit Error/TSE Count	
Bit Error/TSE Rate	
Pattern Slips	
Pattern Slip Seconds	
Pattern Synchronization Loss Count	
Pattern Synchronization Loss Seconds	
Pattern Synchronization Status	
E3	
Modes Of Operation	
Terminate	
Monitor	
Thru (Intrusive)	
Timing	
Recoverd from Rx	
Internal (Stratum 3)	
Recoverd from External (BITs/SETs)	
Framing	
Framed	
Unframed	
Test Patterns	
All 1s	
All 0s	
2047	
2^{11-1}* (Inverse)	
2^{15-1}* (Inverse)	

PDH (Continued)

Left Column	Right Column
2^20-1* (Inverse)	FAS Word Error Rate
2^23-1* (Inverse)	Frame Synchronization Loss Count
User Progammable (3,,,,32 bits)	8M FAS Word Error Rate
User Byte	8M FAS Bit Error Count
Round Trip Delay	8M FAS Bit Error Rate
1:1	8M FAS Word Error Count
1:3	8M FAS Word Error Rate
1:4	**Logic Category**
1:7	TSE/Bit Error Count
ANSI and ITU	TSE/Bit Error Rate
Mappings	Pattern Slips
E1	Pattern Slip Seconds
64k	Pattern Synchronization Loss Count
Anomaly/Error Insert/Analysis	Pattern Synchronization Loss Seconds
Code Error	Pattern Synchronization Status
FAS Error	**E1**
TSE/Bit Error	**Modes Of Operation**
Single	Terminate
Rate	Monitor
Defect/Alarm Insert/Analysis	Thru (Intrusive)
AIS	**Timing**
RDI/FAS Distant	Recoverd from Rx
General	Internal (Stratum 3)
Frequency Offset Tx +/- 100ppm	Recoverd from External (BITs/SETs)
Tx LBO - 0 dB Loss	**Framing**
Tx LBO - 6 dB Loss	Unframed
National Bit Support - On/Off	PCM30
Service Disruption	PCM30C
Performance Measures	PCM31
G.826 (ISM/OOS)	PCM31C
G.821	**Test Patterns**
M.2100	All 1s
Results	All 0s
Signal Category	2^15-1* (Inverse)
Transmit Frequency	2^20-1* (Inverse)
Receive Frequency	2^23-1* (Inverse)
Receive Frequency Maximum Deviation	QRSS
Electrical Input Level	User Progammable (32 bits)
Code Error Count	Round Trip Delay
Code Error Rate	1:1
Round Trip Delay (ms)	1:3
APS Switch Time (ms)	1:4
Frame Category	1:7
FAS Bit Error Count	ANSI and ITU
FAS Bit Error Rate	
FAS Word Error Count	

PDH (Continued)

Mappings
64k

Anomaly/Error Insert/Analysis
Code Error
FAS Error
MFAS Error
TSE/Bit Error
Single
Multiple
Rate

Defect/Alarm Insert/Analysis
AIS
REBE
TS-16 AIS
TS-16 RDI/MFAS Distant

General	
Frequency Offset Tx +/- 100ppm	
Service Disruption	**Comments:** · Frame Sync

Performance Measures
G.826 (ISM/OOS)
G.821
G.829 (ISM/OOS)
M.2100

Results
Signal Category
2M Receive Frequency
2M Reference Frequency
2M Receive Frequency Deviation
2M Receive Frequency Maximum Deviation
2M Transmit Frequency
Electrical Input Level
Code Error Count
Code Error Rate
Round Trip Delay (ms)
Timing Slips
Frame Slips
APS Switch Time
Logic Category
TSE/Bit Error Count
TSE/Bit Error Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Status
Alarm Category
FAS/Frame Synchronization
MFAS Synchronization
CRC Synchronization
AIS
RDI
Power Loss Count
2M Alarm
Frame Category
FAS Bit Error Count
FAS Bit Error Rate
FAS Word Error Count
FAS Word Error Rate
Non-Frame Alignment Word
MFAS Word Error Count
MFAS Word Error Rate
Time Slot Rx Byte
CRC Error Count
CRC Error Rate
CRC Synchronization Loss Count
FAS Synchronization Loss Count
MFAS Synchronization Loss Count
Remote End Block Error (REBE)

T1
Modes Of Operation
Terminate
Monitor
Thru (Intrusive)

Timing
Recoverd from Rx
Internal (Stratum 3)
Recoverd from External (BITs/SETs)

Framing
Unframed
SF
ESF
SLC-96

Test Patterns
63
511
511 QRSS
2047 QRSS
2047
All 1s
All 0s
2^{15-1}* (Inverse)

PDH (Continued)

2^20-1* (Inverse)	**Service Disruption**
2^23-1* (Inverse)	**Loop Codes**
QRSS	Loop Code Tx - NIU
User Progammable (3,,,,32 bits)	Loop Code Tx - CSU
User Byte	Loop Code Tx - Repeater
BridgeTap	Loop Code Emulation - NIU
MultiPat	Loop Code Emulation - CSU
Round Trip Delay	HDSL Loopcode Tx
1:1	CO to Customer direction
1:3	Customer to CO direction
1:4	User Defined Loopcode Support
1:7	**Results**
2 in 8	**Signal Category**
3 in 24	Receive Frequency
MIN/MAX	Reference Frequency
T1 DALY	Receive Frequency Deviation
55 OCTET	Receive Frequency Maximum Deviation
T1-2/96	Transmit Frequency
T1-3/54	Simplex Current
T1-4/120	Receive Level (Vp)
T1-5/53	Receive Level (dBdsx)
Mappings	Receive Level (dBm)
64k	BPV Error Count
56k	BPV Error Rate
Anomaly/Error Insert/Analysis	Frame Slip Count
Frame Errors	Signal Loss Count
BPV Errors	Signal Loss Seconds
TSE/Bit Error	Round Trip Delay (ms)
Single	Timing Slips
Rate	Frame Slips
Multiple	APS Switch Time
Defect/Alarm Insert/Analysis	**Frame Category**
AIS	Frame Error Count
REBE	Frame Error Rate
General	Frame Error Seconds
Frequency Offset Tx +/- 100ppm	Frame Loss Count
Performance Measures	Frame Loss Seconds
G.826 (ISM/OOS)	Severely Errored Seconds
G.828 (ISM/OOS)	CRC Error Count
G.829 (ISM/OOS)	CRC Error Rate
M.2100	CRC Errored Seconds
T1.231	CRC Severely Errored Seconds
Tx LBO - 0 dB Loss	**Logic Category**
Tx LBO - 7.5 dB Loss	Bit Error/TSE Count
Tx LBO - 15 dB Loss	Bit Error/TSE Rate
Tx LBO - 22.5 dB Loss	Bit Error/TSE Seconds

PDH (Continued)

Pattern Slips	
Pattern Slip Seconds	
Pattern Synchronization Loss Count	
Pattern Synchronization Loss Seconds	

Channel

DSO Channel Payload View	**Comments:** · View the data in all 24 embedded channels.
ABCD Bit Signaling View	

DS1 Dual HDLC Monitor and PPP Ping

Modes of Operation

Bridge
Terminate
DSX Monitor

Line Code

B8ZS
AMI

Clock Source (PPP Ping Only)

Internal
Recovered
External
Selectable Clock Offset

Transmit LBO (PPP Ping Only)

0 dB
-7.5 dB
-15.0 dB
-22.5 dB

Framing

Unframed
ESF
D4 (SF)
SLC-96

Payload

Bulk
Fractional Rate

HDLC

Normal or Inverted HDLC Mode
CRC16 or CRC32

PPP (PPP Ping Only)

PPP Mode (Client or Server)
IP Mode (Static or Auto)
Optional Authentication

IP (PPP Ping Only)

IPv4 Frame Format
Local IP
Remote IP
Destination IP Address - User Defined

Subnet Mask
Preferred & Alternate DNS Server

IPv4 Editable Fields

ToS
DSCP
TTL

IP Ping

Editable Packet Length (46 - 1500 bytes)
Single
Multiple
Continuous
Fast

Alarms/Errors Generation and Analysis (PPP Ping Only)

LOS
LOF
AIS
RAI
BPV
Frame

Results

Interface

Signal Losses
Signal Loss Seconds
Rx Level (Vpp)
Rx Level (dBsx)
Rx/Tx Frequency (Hz)
Rx/Tx Frequency Deviation (ppm)
Rx/Tx Frequency Max Deviation (ppm)
Bi-Polar Violations (BPVs)
BPV Rate
Excess Zeros State Count
Ones Density State Count

DS1

Frame Sync Losses
Frame Sync Loss Seconds
AIS Alarms
AIS Seconds
T1 Alarm Seconds
Frame Errors
Frame Error Rate
Frame Error Seconds
Excess Zeros
Maximim Consecuitive Zeros

HDLC

Rx/Tx Frame Count
Rx/Tx Octet Count

PDH (Continued)

Frame Aborts	Rx Frequency (Hz)
Short Frames	Rx Frequency Deviation (ppm)
FCS Errored Frames	Rx Frequency Max Deviation (ppm)
Percent Utilization (Average, Current, Maximim)	Bi-Polar Violations (BPVs)
Throughput (Average, Current, Maximim)	BPV Rate
Average Fame Rate (frames/sec)	BPV Error Seconds
Average Frame Size (octets)	Excess Zeros Count
PPP (PPP Ping Only)	Excess Zeros Seconds
PPP Status	**DS3**
Local IP	Frame Sync Losses
IP Subnet Mask	Frame Sync Loss Seconds
Remote IP	Near End OOF Seconds
Preferred & Alternate DNS Server	Far End OOF Seconds
Destination IP Address	AIS Seconds
Resolved Host Name	RAI Seconds
Ping (PPP Ping Only)	FEAC Word
Ping Requests Tx	Frame Errors
Ping Replies Rx	Frame Error Rate
Lost Pings	Parity Errors
Lost Ping %	Parity Error Bit Rate
Delay (ms)	C-Bit Errors
Ping Requests Rx	C-Bit Error Rate
Ping Replies Tx	C-Bit Error Seconds
Capture/Decode	C-Bit Frame Mismatch Seconds
Wirespeed Capture	C-Bit Sync Loss Seconds
Integrated Wireshark on the TestSet	FEBEs
256MB Capture Buffer	FEBE Rate
Triggers	FEBE Seconds
Frame Slicing	Rx X-Bits
DS3 HDLC Dual Monitor	**HDLC**
Modes of Operation	Rx Frame Count
DSX-MON	Rx Octet Count
Terminate	Frame Aborts
Framing	Short Frames
Unframed	FCS Errored Frames
M13	Percent Utilization (Average, Current, Maximim)
C-Bit	Throughput (Average, Current, Maximim)
HDLC	Average Fame Rate (frames/sec)
Normal or Inverted HDLC Mode	Average Frame Size (octets)
CRC16 or CRC32	
Results	
Interface	
Signal Losses	
Signal Loss Seconds	
Rx Level (Vpeak)	
Rx Level (dBdsx)	

Jitter

General Features

Generate and measure Jitter

    on electrical interfaces: DS1 & E1

Automatic Measurement Sequences

    Maximum Tolerable Jitter (MTJ)

    Measure Intrinsic Jitter

    Jitter Transfer Funtion (JTF)

Support different Measurement Bands

    High Band

    Wide Band

    Extended Band

    Ability to set user definable band

Common Jitter mask selectable

Ability to create user definable masks

Results

Jitter Results per measurement band

    Current peak to peak jitter [UI]

      Peak to peak jitter [UI]

      Positive peak jitter [UI]

      Negative peak jitter [UI]

    Maximum peak to peak jitter [UI]

      Peak to peak jitter [UI]

      Positive peak jitter [UI]

      Negative peak jitter [UI]

    Phase Hits

    Percentage of mask

    RMS Jitter [UI]

    Jitter Graphs

CPRI

Test Interfaces/Bit Rates

614 Mbps Optical - Option 1

    Dual Port Capable

1.2 Gbps Optical - Option 2

    Dual Port Capable

2.4 Gbps Optical - Option 3

    Dual Port Capable

3.1 Gbps Optical - Option 4

    Dual Port Capable

4.9 Gbps Optical - Option 5

    Dual Port Capable

6.1 Gbps Optical - Option 6

    Dual Port Capable

9.8 Gbps Optical - Option 7

    Dual Port Capable

10.137G Gbps Optical - Option 8

    Dual Port Capable

Laser Type

SFP

SFP+

SFP+ Tuneable

SFP28

Modes Of Operation

Terminate

Monitor/Thru

Timing

Recoverd from Rx (Slave)

Internal (Stratum 3) (Master)

Recoverd from External (BITs/SETs) (Master)

Recoverd from 10MHz clock (Master)

CPRI Features

Optical/Electrical Power Level	**Comments:** · List Accuracy

Freq Offset Transmit/Receive

CPRI Startup Sequence - Normal or Bypass

Signal Generation and Monitoring

    L1 - PRBS Pattern Inserted in Hyperframe Structure

    L2 - PRBS Pattern Inserted in CPRI Basic Frame

    L2 - PRBS Pattern Inserted in CPRI Antenna-carrier (AxC) Group

    L2 Test Waveform Inserted in CPRI Antenna-carrier (AxC) Group

Interface Type

    Master

    Slave

    Selectable CPRI Protocol Verion

Control and Management (C&M) Channel

    Ethernet

    HDLC

    Selectable C&M Channel Rate

Service Disruption Measurements

    SD Seperation/Debounce Time Setting

    SD Threshold Time Settings

Round Trip Delay Measurement

PRBS Patterns

    $2^{15}-1$, $2^{15}-1$ Inverse

    $2^{20}-1$, $2^{20}-1$ Inverse

    $2^{23}-1$, $2^{23}-1$ Inverse

    $2^{31}-1$, $2^{31}-1$ Inverse

    Delay

    Live

    Digital Word

    ANSI and ITU implementations

CPRI (Continued)

Anomaly/Errors generation	**Start-up State**
Bit/TSE	**CPRI Counts**
Code	Code Word Count Tx/Rx
K30.7	Frame Count Tx/Rx
Running Disparity	**Error Stats**
Insert - Single	Word Sync Loss Events
Insert - Rate	Word Sync Loss Seconds
CPRI AxC Mapping	Code Violations
Mapping Method: Method 1	Code Violation Rate
Sample Width	Code Violation Seconds
Bandwidth	K30.7 Words
AxC Group Number	Frame Sync Loss Events
Offset	Frame Sync Loss Seconds
Test Waveform Selections	Pattern Sync Losses
Continuous Wave (CW)	Pattern Sync Loss Seconds
LTE-FDD TM1.1	Bit Error Rate
LTE-FDD TM1.2	Bit Errors
LTE-FDD TM2	Errored Seconds
LTE-FDD TM3.1	Error-Free Seconds
LTE-FDD TM3.2	Error Free Seconds, %
LTE-FDD TM3.3	Total bits Received
Defects/Alarms generation/analysis	Round Trip Delay Current (ms)
LOS	Round Trip Delay Average (ms)
LOF	Round Trip Delay Minimum (ms)
SDI	Round Trip Delay Maximum (ms)
RAI	Remote LOS
Results	Remote LOS Seconds
Results Accuracy	Remote LOF
1ns	Remote LOF Seconds
Signal Category	RAI
Signal Losses	RAI Seconds
Sync Loss Seconds	SDI
Optical Rx Overload	SDI Seconds
Optical Rx Level (dBm)	Running Disparity Errors
Receive Frequency	Running Disparity Error Rate
Receive Frequency Deviation	
Receive Frequency Maximum Deviation	
Transmit Frequency	
Tx Frequency Deviation (Hz)	
Tx Frequency Deviation (ppm)	
Tx Frequency Max Deviation (ppm)	
CPRI CPRI Inband Protocol	
Tx/Rx Protocol Version	
Tx/Rx C&M HDLC Rate	
Tx/Rx C&M Etherent Subchannel Number	
Port Type (Master/Slave)	

Wander

General Features	
Measure Wander on 1PPS Signal	**Comments:** · Use Ext Clk input and Multi Access timing adapter 22035030 or Precision Timing Reference Module
Measure Wander on 1G Optical SyncE Interface	
Measure Wander on T1, E1, & unframed 2.048 MHz Signals	**Comments:** · O.171
Measure Wander on 10 MHz Signal	
Selectable Peak Time Offset Threshold	
Resolution 1 ns	
Sample Rate 1, 30, 60 samples per second	
Internal Data Storage - 256M	
External Data Storage on USB stick	
Start Stop via key	
Results	
Time Interval Error (TIE)	
Current TIE [s]	
Maximum TIE [s]	
Minimum TIE [s]	
Maximum Peak-to-Peak TIE (MTIE) [s]	
Offset Between Test Signal and Reference	
Current Offset [µs]	
Minimum Offset [µs]	
Maximum Offset [µs]	
Pass/Fail Result	
TIE Graph	
Reference Clock for 1pps wander: 1pps reference signal	**Comments:** · Use Ext Clk input and Multi Access timing adapter 22035030 or Precision Timing Reference Module
Reference Clock for 1G SyncE Optical, T1, E1, 2 MHz, & 10 MHz wander: 2MHz or 10 MHz reference signal	**Comments:** · Use Ext Clk input and Multi Access timing adapter 22035030 or Precision Timing Reference Module
Cables for 1pps Wander	
Wander Analysis Tool	
Offline analysis of captured/imported TIE measurements	
Maximum Peak-to-Peak TIE (MTIE) [s]	
TDEV (Time Deviation)	**Comments:** · for GigE Optical; compliant to O.174, Available in wander analysis tool; not availble on 1PPS signal

Frequency Offset (ppm)	
Drift Rate (ppm/s)	
Masks	
ANSI	**Compliance:** · SMC Holdover (T1.105.109)
ETSI	**Compliance:** · SEC (ETS 300 462-5-1)
	Compliance: · SEC Netw. IF (ETS 300 462-3-1)
	Compliance: · SSU (ETS 300 462-4-1)
	Compliance: · SSU Netw. IF (ETS 300 462-3-1)
GR253	**Compliance:** · SMC Transient
ITU	**Compliance:** · G.8261
	Compliance: · SEC Netw. IF (G.832, G.825)
	Compliance: · SEC Opt. 1 (G.813)
	Compliance: · SEC Opt. 2 (G.813)
	Compliance: · SEC Hold. Opt. 2 (G.813)
	Compliance: · SEC Trans. Opt. 2 (G.813)
	Compliance: · SSU Netw. IF (G.823, G.825)
	Compliance: · SSU Type I (G.812)
	Compliance: · SSU Type II, III (G.812)
	Compliance: · SSU Type IV (G.812)
	Compliance: · PRC (G.811)
	Compliance: · EEC-1 Noise Generation (G.8262 constant temp.)
	Compliance: · EEC-1 Noise Generation (G.8262 with temp. effects)
	Compliance: · EEC-2 Noise Generation (G.8262 constant temp.)
	Compliance: · EEC-1 Noise Tolerance (G.8261)
	Compliance: · EEC-1 Noise Tolerance (G.8262)
	Compliance: · PRC (G.811)

	Compliance: · DTE Network Limit (G.8271.1)
	Compliance: · Wander Generation (G.8272)
	Compliance: · DTE Noise Generation (G.8273.2 constant temp.)
	Compliance: · DTE Noise Generation (G.8273.2 variable temp.)

Masks
PRC/SSU/SEC: Masks for G.811/G.812/G.813 closcks (ETS 300 462-2)
Networks: According to G.823/G.824
SyncE: According to G.8261, G.8262
ANSI-Standard: DS1 masks

Services

Triple Play Automated Test Script
10/100/1000M Electrical Ethernet Interfaces
1GigE Optical Ethernet Interface
10GigE Optical Ethernet Interface
Over 11,000 simulated calls with configurable Codec and sampling rate
Configurable voice call or tone with configurable silence supression, sampling rate and jitter buffer
up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression
up to 52 simulated HDTV channels with configurable frame size and MPEG-2/4 compression
2 configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames

Primary Rate T1 ISDN
Test Access - T1
TE Emulation
NT Emulation
D-Channel Signaling Decodes
Call Control - National
Call Control - 5ESS
Call Control - NI-1
D-Channel Rate - 64k
D-Channel Rate - 56k
Call Type - Data
Call Type - Voice
Call Type - 3.1k Audio
Channel Number - 1 to 24
D-Channel Rate - 56k
DTMF Digits

Primary Rate E1 ISDN
Test Access - E1
TE Emulation
NT Emulation
Codec µ-law, A-law
Call Controls - 1TR6, 1TR67, EDSS-1, VN3, VN4, VN6, TPH1962, Q.SIG, Q.931, TN-1R6, SwissNet-3, CorNet-N, CorNet-NQ, DREX, Alcatel QSIG
D-Channel Signaling Decodes
Services - Speech, 3.1 KHz, Data, Fax G4, Teletex, Videotex, Speech BC, Data BC, Data 56Kb, Fax 2/3
Channel Number - 1 to 31
DTMF Digits

Signaling - Place/Receive Call
Test Access - T1
E&M Signaling
Loop Start Signaling
Ground Start Signaling
Audio Drop/Insert
Signaling Bits
Place Call
Receive Call
MF Digits
DTMF Digits
Event Log
VF Tone Insertion

Fractional T1/E1
Test Access - T1
Fractional T1 - n x 64k
Fractional T1 - n x 56k
Contiguous Channels
Non Contiguous Channels
V.54 Loop Codes Support

Services (Continued)

Voice Frequency
Test Access - T1
Listed to an Audio Call
Insert VF Tones
404 Hz
1004 Hz
1804 Hz
2713 Hz
2804 Hz
User Frequency
Quiet Tone
Holding Tone
Three Tone
Frequency Sweep
Impulse Noise
Rx Frequency
Level (dBm)
DC Offset mV

Fibre Inspection

Optical Fiber Microscope
Accepts an optical video microscope with autofocus capability
Microscope connector image displayed on the Test Equipment and saved into a .JPEG file format.
Microscope offer a switchable 200/400x magnification capabilities
Microscope provided with the dedicated tips to connect to the patch panel or directly to the connector ferrule
Capable of automatically centering the fiber image
Capable of performing on-board Pass/Fail analysis
Compatible with Android tablets/smartphones
Microscope supports MPO connectors

OTDR

OTDR Solution for Troubleshooting from Central Offices
Wavelengths: 1310 & 1550nm
Connector type: UPC or APC (Note: Only one should be selected)
Adapter type: FC or SC (Note: Only one should be selected)
Dynamic Range:
at 1310nm: 35dB
at 1550nm: 33dB
Event Dead Zone:
at 1310nm/1550nm: 1.5m maximum
Attenuation Dead Zone:
at 1310nm/1550nm: 6m maximum
Pulse width: 5ns to 20ms
Number of data points: up to 128,000
Light source:
On the OTDR port
Wavelength: same as the OTDR
Output power: -3.5 dBm typical
Test results shall be stored in SOR format (Telcordia GR-196-CORE) as well as in PDF format
The test result page shall display the graphical OTDR trace and event table
The test solution shall be able to convert automatically the OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy
OTDR Solution for FTTA & DAS Singlemode & Multimode Network Testing
Wavelengths: 850, 1300, 1310, 1550 nm
Connector type: UPC or APC for 1310nm/1550nm (Note: Only one should be selected) and UPC for 850/1300nm
Adapter type: FC, SC, LC or ST (Note: One or several can be selected)
Dynamic Range:
at 850nm: 26 dB
at 1300nm: 24 dB
at 1310nm: 37 dB
at 1550nm: 35 dB
Event Dead Zone:
at 850nm/1300nm: 0.8m maximum
at 1310nm/1550nm: 0.9m maximum
Attenuation Dead Zone:
at 850nm/1300nm: 4m maximum
at 1310nm/1550nm: 4m maximum
Pulse width:
at 850nm/1300nm: 3ns to 1ms
at 1310nm/1550nm: 3ns to 20µs
Number of data points: up to 128,000
Light source:
On the OTDR port
Wavelength: same as the OTDR

OTDR (Continued)

Output power: -3.5 dBm typical

Power meter:

On the OTDR port

Calibrated wavelengths: 850, 1300, 1310, 1490, 1550, 1625, 1650 nm

Power level range (MM/SM): -3 to -30dBm / -2 to -50 dBm

The test result page shall display the graphical OTDR trace and event table

The test solution shall be able to convert automatically the OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy

The test solution shall be able to identify and label network elements

OTDR Solution for Cloud RAN & Access/Backhaul Network Testing

Wavelengths: 1310, 1550, 1625 nm (Note: 1625nm is optional)

Connector type: UPC or APC (Note: Only one should be selected)

Adapter type: FC, SC, LC or ST (Note: One or several can be selected)

Dynamic Range:

at 1310nm: 40 dB

at 1550nm: 38 dB

at 1625nm : 37 dB

Event Dead Zone:

at 1310/1550/1625nm: 0.9m maximum

Attenuation Dead Zone:

at 1310/1550/1625nm: 4m maximum

Pulse width: 3ns to 20ms

Number of data points: up to 128,000

Light source:

On the OTDR port

Wavelength: same as the OTDR

Output power: -3.5 dBm typical

Power Meter:

On the OTDR port

Calibrated wavelengths: 1310, 1490, 1550, 1625, 1650 nm

Power level range: 0 to -50 dBm

The test result page shall display the graphical OTDR trace and event table

The test solution shall be able to convert automatically the OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy

OTDR Solution for Metro & Access/Backhaul Network Testing

Wavelengths: 1310, 1550, 1625 nm (Note: 1625nm is optional)

Connector type: UPC or APC (Note: Only one should be selected)

Adapter type: FC, SC, LC or ST (Note: One or several can be selected)

Dynamic Range:

at 1310nm: 43 dB

at 1550nm: 43 dB

at 1625nm : 41dB

Event Dead Zone:

at 1310/1550/1625nm: 0.8m maximum

Attenuation Dead Zone:

at 1310/1550/1625nm: 4m maximum

Pulse width: 3ns to 20ms

Number of data points: up to 256,000

Light source:

On the OTDR port

Wavelength: same as the OTDR

Output power: -3.5 dBm typical

Power Meter:

On the OTDR port

Calibrated wavelengths: 1310, 1490, 1550, 1625, 1650 nm

Power level range: 0 to -50 dBm

The test result page shall display the graphical OTDR trace and event table

The test solution shall be able to convert automatically the OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy

OTDR Solution for CWDM Network Testing

8 CWDM wavelengths should be available on 1 optical port

Wavelengths:1471, 1491, 1511, 1531, 1551, 1571, 1591, 1611nm

Connector type: UPC or APC (Note: Only one should be selected)

Adapter type: FC, SC or LC (Note: One or several can be selected)

Dynamic Range: 35dB

Event Dead Zone:

at 1310/1550/1625nm: 1.5m maximum

Attenuation Dead Zone:

at 1310/1550/1625nm: 5m maximum

Pulse width: 10ns to 20ms

Number of data points: up to 256,000

Light source:

On the OTDR port

Wavelength: same as the OTDR

Output power: -3.5 dBm typical

The test result page shall display the graphical OTDR trace and event table

The test solution shall be able to convert automatically the OTDR trace into an icon-based map that makes OTDR results interpretation quick and easy

Optical Spectrum Analyzer

Optical Spectrum Analyzer Solution for Mobile Backhaul Service Activation
Connector type: PC
Adapter type: FC, SC, LC or ST (Note: One or several can be selected)
Spectral measurement
Wavelength range: From 1260 to 1625 nm
Wavelength accuracy: ±0.5 nm
Readout resolution: 0.001nm
Resolution bandwidth FWHM: 4nm
Minimum channel spacing: 8 nm
Power measurement
Dynamic range: −55 to +10 dBm
Noise floor RMS -55 dBm
Absolute accuracy: ±0.5 dB
Linearity: ±0.1 dB
Readout resolution: 0.01 dB
Scanning time (1260 to 165 nm): <4 sec
Maximum total safe power: +15 dBm
Optical return loss: > 35 dB
The Optical Spectrum Analyzer shall be equipped with a bay for up to 2 SFPs (optional)

Precision Timing Reference

Optical Spectrum Analyzer Solution for Mobile Backhaul Service Activation
Connector type: PC
Adapter type: FC, SC, LC or ST (Note: One or several can be selected)
Spectral measurement
Wavelength range: From 1260 to 1625 nm
Wavelength accuracy: ±0.5 nm
Readout resolution: 0.001nm
Resolution bandwidth FWHM: 4nm
Minimum channel spacing: 8 nm
Power measurement
Dynamic range: −55 to +10 dBm
Noise floor RMS -55 dBm
Absolute accuracy: ±0.5 dB
Linearity: ±0.1 dB
Readout resolution: 0.01 dB
Scanning time (1260 to 165 nm): <4 sec
Maximum total safe power: +15 dBm
Optical return loss: > 35 dB
The Optical Spectrum Analyzer shall be equipped with a bay for up to 2 SFPs (optional)

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