

Data Sheet

# VIAVI T-BERD®/MTS-5800 Specifications

## Platform

<b>Platform Requirements</b>
The mainframe shall be non modular
The product shall be field upgradeable
The test system shall utilize Linux operating system to ensure optimum stability
<b>Display</b>
The size of the display shall be 7 inches minimum, and 1200x600 type for best resolution
The Test Set shall support a Screen Saver
The Test Set shall support a mode that 'locks' the touchscreen for use without a password

<b>Power/Battery</b>
The Test Equipment must be battery operated
The Test Equipment must have a built-in battery charger
The battery must be field replaceable
The equipment shall perform a 10G test for a minimum of 3 hours on battery power.
Operating time Between 2 to 5 hours depending on the application
Charging time Approximately 7 hours from empty
Unit power input 12VDC, 60 Watt Max
Power supply input 100 to 240 VAC, 50/60 Hz, auto-sensing
Power supply output 12VDC, 5 AMP Max

<b>Industry Standards and Compliance</b>
CE Class A Compliant
EMI/ESD: CE compliant, FCC part 15 subpart A Class A
FCC Part 15 Compliant

<b>Physical and Environment Specifications</b>
Temperature range:
· Operating, all options: 0°C to +50°C (+32°F to +122°F)
· Storage: - 20°C to +60°C (-4°F to +140°F)
Storage Humidity: 10-95% without condensing.
Operating Humidity: 10-90% without condensing.

<b>Drop Test - Shock</b>
per IEC 68-2-27 and 68-2-29 Ed. 2.0

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

<b>Vibration</b>
per IEC 68-2-6 and MIL-PRF-28800F (Class 2)

<b>Field Operation</b>
The Test Equipment shall be portable, battery operated and rugged for field operations.
The Test Equipment must be protected by bumpers.

<b>Weight and Size</b>
The weight of the test set shall not be greater than 4.2 lbs/1.9kg while supporting up to 10G rates
The size of the test set shall not be greater than 17.8 x 24.13 x 7.62cm (7"x9.5"x3") while supporting up to 10G rates

<b>Operation</b>
The base unit shall be able to be turned on and operational in less than 2 minute
The Test Equipment shall accept operations with an external keyboard.
The unit will boot to a simplified launch page allowing the user to select previous test configurations and/or favorite test configurations.

<b>I/O's</b>
The Test Equipment shall include the following I/O interfaces
· VT100 (RJ-45)
· 2 x USB
· RJ-45 (Ethernet/IP)
· Serial
· Wifi (optional)
· Bluetooth (optional)

The Test Equipment shall be able to download data to PC or compatible device via standard interface or protocol:
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T-BERD®/MTS-5800

## Test, Files and Data Storage

Report Generation - HTML, PDF, TXT, CSV, XML

Ability to create a customized name structure.

The Test Set UI supports a screen capture

The internal storage capacity shall be at least 1GB.

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

The Test Equipment shall be remotely controlled via Web browser.

In remote operation, the remote user can FTP files from the test set.

In remote operation, the remote user can FTP files to the test set.

The Test Equipment should not require the installation of client software on a PC for remote operation.

Access via Smart Access Anywhere Codes

## Calibration

Minimum calibration interval must be 3 years

## Warranty

The Product shall support a 3 year warranty

## Included Items

User manual

AC Power Source

AC Power cords

## Optical Fiber Microscope

The Test Equipment shall be able to accept an optical video microscope with autofocus capability.

The connector image shall be displayed on the Test Equipment and saved into a .JPEG file format.

The microscope shall offer a switchable 200/400x magnification capability.

It shall be provided with the dedicated tips to connect to the patch panel or directly to the connector ferrule.

## Saved Configurations

Users shall be able to save test configurations for future recall

Users shall be able to transfer pre-defined test configurations between test sets

# Ethernet

## Test Interfaces/Bit Rates

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

RJ-45

SFP

SFP+

SFP+Tunable

## General

Line Rate Traffic Tx and RX for all Interfaces

Single Stream Generation/Analysis

10 Streams Generation/Analysis

Auto Discovery of Test Sets

## Modes of Operation

Terminate

Monitor

Thru (Intrusive)

Loopback

Half Duplex

Full Duplex

## Timing

Recovered from Rx

Internal (Stratum 3)

Recoverd from External (BITS/SETs)

Freq Offset Transmit/Receive

## Ethernet Features

### Layer 1 (Unframed) Bit Error Testing Patterns

High Frequency test pattern

Low frequency test pattern

Mixed frequency test pattern

Random Data Pattern (RPAT)

Jitter Tolerance Test Pattern (JTPAT)

Supply Noise Test Sequence (SPAT)

### Layer 2 (Framed) Bit Error Testing Patterns

Compliant Random Data Pattern (CRPAT)

Compliant Jitter Tolerance Pattern (CJPAT)

Compliant Supply Noise Pattern (CSPAT)

## Framed Pattern Test

PRBS (2<sup>11</sup>-1, 2<sup>15</sup>-1, 2<sup>20</sup>-1, 2<sup>23</sup>-1, 2<sup>31</sup>-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

## Flow Control

Emulation On/Off

## Pause Frames

Tx Insert

Pause Quanta - Definable

Pause Frame Analysis (counts etc)

## Ethernet Generator

### 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

Source MAC Address - User Defined

Source MAC Address - Auto Increment

### 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
Supports up to 8 stacked VLAN Tags
<b>VPLS</b>
VPLS Parameters - MAC Addresses
VPLS Parameters - Frame Type
VPLS Parameters - EtherType
VPLS Tunnel and VC Label - Label, CoS, TTL
VPLS Control Word - Reserved Bits, Sequence Number
<b>MAC in MAC/PBT/PBB</b>
Parameters - MAC Address
B-Tag - TPI, VID, Priority, DEI
I-Tag - TPI, SID, Priority, DEI, NCA, Res1, Res2
<b>MPLS</b>
Single Label Support
Stacked Label Support - Up to 2
Editable Parameters/Results - Label
Editable Parameters/Results - CoS
Editable Parameters/Results - TTL
<b>MPLS-TP</b>
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 Generation and Analysis
· AIS Generation and Analysis
OAM Alert Label (Label 14) from ITU-T G.8114
· Common Header Label - PW, LSP, Section
· CCM Generation and Analysis
· LBM/LBR Generation and Analysis
· AIS Generation 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

<b>Ethernet OAM</b>
<b>Y1731 Service OAM and 802.1ag CFM</b>
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
<b>802.3ah Link OAM</b>
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
Errored Frame Second Summary Event
<b>IP Packet Generator</b>
<b>IP</b>
IPv4 Frame Format
IPv6 Frame Format
TCP Port Number
UDP Port Number
<b>IP Addressing</b>
Destination IP Address - User Defined
Source IP Address - User Defined
<b>IPv4 Editable Fields</b>
ToS
DSCP
Flags
Protocol
TTL

<b>IPv6 Editable Fields</b>
Traffic Class
Flow Label
Next Header
Hop Limit
<b>IP Ping</b>
<b>Fast Ping</b>
<b>IP TraceRoute</b>
<b>Traffic Generator</b>
Number of Traffic Engines
Bandwidth Controlled
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
Once Tx - Definable frames/burst
Traffic generation in LBM frames at line rate
Analysis of LBR frames at line rate
<b>Traffic Profiles</b>
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
<b>TCP Throughput</b>
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
<b>RFC 2544</b>
Asymmetric Testing
Symmetric Testing
Throughput
Frame Loss
Out of sequence frames
Errored Frames
Delay
Back to Back
Committed Burst Size (CBS)
Policer Test
Jitter
Master/Slave
Pass/Fail Thresholds per MEF 23.1
Connectivity QuickCheck
Parallel Testing
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
One Way Delay with GPS or CDMA receiver
<b>ITU-T Y.1564</b>
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
Committed Burst Size (CBS)
Policer Test
Round Trip Testing
Concurrent Bi-directional Testing
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
<b>IETF RFC 6349</b>
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 Time Test
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
Compatible with the following endpoints:
· T-BERD/MTS instruments
· QT-600 Ethernet Probes
· TrueSpeed VNF Server
<b>Layer 2 Transparency Testing</b>
Send/Receive Ethernet Control Plane Traffic
Encapsulation supported
· VLAN
· Q-in-Q
· Spanning Tree
· Cisco Protocols (Discovery etc.)
· GARP
· STP

Send/Receive Ethernet Control Plane Traffic
· Spanning Tree Frames Tx/Rx
· Cisco Discovery Protocol
· LDP Frames Tx/Rx
· Link Aggregation LACP
· Cisco UDLD, ISL, PagP, DTP, PVST-PVST+
· MAC Bridging 802.1d
· VLAN-BRDGSTP
· Custom Frame Builder
<b>Synchronous Ethernet</b>
1GE and 10GigE Tx/Rx
1000M/100M/10M Electrical Tx/Rx
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
<b>IEEE 1588v2 PTP</b>
1GE and 10G Tx/Rx
1588v2 Master Emulation
1588v2 Slave Emulation
1G Dual Monitor
Encapsulations supported
None, VLAN, and Q-in-Q
Packet Delay Variation Measurements on Control Plane Traffic
Generate up to 4 streams of Background Dataplane traffic
Frame/Packet Capture and Decode via Wireshark
Layer 2 1588v2 Messaging
Layer 4 1588v2 Messaging
Message rates Multicast: Fastest = 16/128/8 (Announce/Sync/Delay); Slowest = one message every 16 seconds
Message rates Unicast: Fastest = 16/128/8 (Announce/Sync/Delay); Slowest = one message every 16 seconds
Support for Unicast and Multicast Address Mode
Support for Forwardable and Non-forwardable Address
Static Unicast message negotiation: ON or OFF
Thresholds for Sync and Delay PDV and FPP (Floor Packet Processing)

Single- & Dual Step operation in both slave and master modes	Far End	Frame Type/Length
Master Mode Clock Classes Supported	Auto Discovery of Test Sets	VLAN ID
· Primary	<b>Delay</b>	VLAN Priority
· Primary Holdover	Round Trip Delay	VLAN Discovery
· Arbitrary	Acterna Test Protocol Version 3 (default)	<b>VLAN (Layer 2.5) Tags - 802.1q</b>
· Arbitrary Holdover	· 10GE High Precision - low delay	TPI
· Primary A	· GE Optical High Precision - low delay	Priority
· Arbitrary A	Acterna Test Protocol Version 2 with Fill byte	CFI/DEI
1588v2 Delay Measurements (Master/Slave)	· High Precision - low delay	VID
One-way (Master to Slave and Slave to Master) Delay	· Lower Precision — high delay	<b>VLAN (Layer 2.5) Tags - QnQ, 802.1ah</b>
Differential Delay and Delay Asymmetry Measurements	One Way Delay	SVLAN ID
Time Error Measurements (1ns resolution)	Delay Measurement Accuracy	SVLAN Priority
Max  TE  and cTE Measurement	<b>CAT-5 Testing</b>	SVLAN TPI
PktSelected2wayTE Measurements including:	Link speed	CVLAN ID
APTS: pk to pk	Link status	CVLAN Priority
PTS: Abs Max	Cable status	<b>IP (Layer 3) Traffic Filtering</b>
Wander Analysis of Time Error Measurement	Crossover/straight (MDI/MDIX)	Source and destination IP address
Automated Time Error Measurement workflow.	Distance to fault	Subnet mask
<b>NTP Features</b>	Pin mapping	IPv6 Traffic Class
Capture	Pair length	TOS/DSCP Fields
Analyze	Polarity	<b>TCP/UDP (Layer 4) Traffic Filtering</b>
Monitor	Skew	ATP Listen Port
<b>PDV Analysis</b>	<b>Capture/Decode</b>	<b>Protocol Analysis</b>
Supports distribution analysis of PDV and comparison against ITU limits	Wirespeed Capture up to 10Gb/s	<b>CDP and LLDP Frame Discovery and Decode</b>
Graph resolution of up to 5ns	Wirespeed Capture up to 10/100/1000 Mb/s	<b>CDP Analysis</b>
Supports evaluation according to MAFE	Integrated Wireshark on the TestSet	Device Identifier
Supports FPP analysis according to G.8261.1 and comparison against ITU limits	256MB Capture Buffer per port	Port Identifier
Supports masks defined by user	Triggers	VLAN ID
Supports sample rates up to 100 samples per second	Tx and Rx Capture	Source MAC Address
Supports offline data analysis	Frame Slicing	IP Subnet Addresses
Supports packet synchronization data analysis for NTP protocols	<b>Expert Decode/Analysis</b>	<b>LLDP Analysis</b>
Supports measured data analysis according to PDD packet delay allocation level	Decode/Analysis Capture Files	Chassis Identifier
Supports measured data analysis according to FPP minimum packet rate	Detect Half-Duplex Ports	Port Identifier
Supports PDV data collection of PTP for laboratory analysis and corrective path	Detect ICMP Layer Issues	Time To Live
<b>Loopback</b>	Identify Top Talkers	Source MAC address and optional VLAN ID
Manual (LLB)	TCP Layer Diagnosis - ex. Retransmissions	Management IP Address
Automatic	<b>Traffic Profiling</b>	MAU Type Information
Local	Detect and display up to 128 streams of live traffic	<b>Errors Tx/Rx</b>
	Specify Filters for stream detection	Code Error Tx/Rx
	Stream Classification	FCS Error Tx/Rx
	<b>Network Discovery</b>	IP Checksum Tx/Rx
	Automatically detect networks, domains, devices, and hosts	Bit Error Tx/Rx
	<b>Traffic Filtering</b>	Insertion Profile - Once
	<b>Ethernet (Layer 2) Traffic Filtering</b>	Insertion Profile - Rate
	MAC source and destination address	Insertion Profile - Burst

<b>Alarms Tx/Rx</b>
Local Fault Tx/Rx
Remote Fault Tx/Rx
<b>Ethernet Results</b>
<b>Custom Results</b>
<b>Histogram and Graphical Results Script</b>
<b>Link Status</b>
Loss of signal
Link active
Frame detected
Sync obtained
VLAN tagged frame detected
<b>Auto-negotiation status</b>
Link configuration ack
Link advertisement status
Pause capable
Remote fault
Destination MAC address when using ARP
<b>Link counts/statistics</b>
Bandwidth utilization
Frame rate
Tx Mbit/s
Rx Mbit/s
Round trip delay
Service disruption time
Received frames
Transmitted frames
Received packets
Transmitted packets
Pause frames
Lost frames
Out of sequence frames
Out of sequence packets
VLAN frames
CVLAN ID
SVLAN ID
CVLAN Priority
SVLAN Priority
Unicast frames
Unicast packets
Multicast frames
Multicast packets
Broadcast frames
Broadcast packets
Frame length

Packet length
Packet jitter, Avg
Packet jitter, Max
<b>Errored Counts</b>
Symbol errors
Code violation
FCS errored frames
Runts
Jabbers
Oversized frames
Undersized frames
OOS frames
Lost frames
IP checksum errors
IP packet length errors
Pkt Payload Errors
Bit error
Bit error rate
<b>QoS Measurements</b>
Throughput
Frame Loss
Packet Jitter
Delay
Out of Sequence
Frame/Packet Size Binning
MAC Throughput Rx
IP Throughput Rx
TCP/UDP Throughput Rx
Payload Throughput Rx
Service Disruption Measurements · Definable Threshold Time
Round Trip Delay Measurements
One Way Delay Measurements
Rx Bytes
Rx Mbits
Rx Frames
Rx frames per Second
Utilization %
Current Rx Results
Min Rx Results
Average Rx Results
Max/Peak Rx Results
Ratio Rx Results
Seconds Rx Results
<b>Event Log</b>

Event, Date, Start Time, Stop Time, Duration, Value
<b>Real Time Histogram</b>
Seconds, Minutes, Hours, Days
<b>Time</b>
Current Date, Current Time, Test Elapsed Time
<b>Graphical Displays</b>
Errors versus Time
Frame Loss versus Time
Packet Jitter versus Time
Latency versus Time
Throughput versus Time
<b>Application Testing</b>
Walk the Window
FTP Throughput
HTTP Throughput

## SONET/SDH

<b>Test Interfaces/Bit Rates</b>	
STS-1 (e)	Dual Port Capable
STM-1 (e)	Dual Port Capable
STM-1 (o)	Dual Port Capable
OC-3	Dual Port Capable
OC-12	Dual Port Capable
STM-4	Dual Port Capable
OC-48	Dual Port Capable
STM-16	Dual Port Capable
OC-192	Dual Port Capable
STM-64	Dual Port Capable
<b>Laser Type</b>	
SFP	
SFP+	
SFP - Tunable	
<b>Modes of Operation</b>	
Terminate	
Monitor	
Thru (Intrusive)	
Tributary Scan	
Drop and Insert	
<b>Timing</b>	
Recovered from Rx	
Internal (Stratum 3)	
Recovered from External (BITS/SETs)	
Recovered from 10 MHz clock	

<b>SONET/SDH Features</b>
SONET/SDH Framing
Overhead Manipulation/Analysis
Optical/Electrical Power Level
PRBS Generation
PM/SM TTI messages Tx/Rx
Overhead Byte Viewing/Manipulation
Service Disruption Measurements
· SD Separation/Debounce Time Setting
· SD Threshold Time Settings
Signal Label generation/display
Freq Offset Transmit/Receive
<b>Round Trip Delay Measurement</b>
RTD Measurement Accuracy
<b>PRBS Patterns</b>
215-1, 215-1 Inverse
2^20-1, 2^20-1 Inverse
2^23-1, 2^23-1 Inverse
2^31-1, 2^31-1 Inverse
Programmable - 32 bit
ANSI and ITU implementations
<b>Anomaly/Error generation</b>
Bit/TSE
Frame Word
B1
B2
B3
HP-REI
MS-REI, LP-BIP
LP-REI
Insert - Single
Insert - Rate
Multiple
<b>Defects/Alarms Generation/Analysis</b>
LOS
LOF
RS-TIM
MS-AIS
MS-RDI
AU-LOP
AU-AIS
HP-UNEQ
HP-RDI
HP-TIM
HP-PLM
TU-LOP

TU-AIS	
TU-LOM	
LP-UNEQ	
LP-RDI	
LP-TIM	
LP-PLM	
LP-RFI	
<b>SDH Mappings</b>	
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c	
VC12	
VC4	
VC3	
E4	
DS3	
E3	
E1	
<b>SONET Mappings</b>	
STS-1, STS-3c, STS-12c, STS-48c, STS-192c	
VT1.5	
DS3	
DS1	
E1	
<b>Results</b>	
<b>Signal Category</b>	
Signal Present	
Signal Loss Count	
Signal Loss Seconds	
Receive Frequency	
Receive Frequency Deviation	
Receive Frequency Maximum Deviation	
Transmit Frequency	
Electrical Input Level	dBdsx, dBm, volts
STS-1	dBnom only
STM-1e	
BPV Count (STS-1 only)	
BPV-Error Rate (STS-1 only)	
<b>Regenerator/Section OH Category</b>	
FAS/Frame Word Error Count	
FAS/Frame Word Error Rate	
LOF Count	
OOF Count	
B1-BIP error Count	
B1-BIP Error Rate	
Severely Errored Seconds	
OOF Seconds	

Section Trace Mismatch	TIM
J0-Regenerator Trace	
Multiplexer/Line OH Category	
APS Message Count	
APS Bridge Request Code	Ring
APS Destination Node	Ring
APS Source Node	Ring
APS Path Code	Ring
APS Status	Ring
APS Request Code	Linear
APS K1 Channel Number	Linear
APS K2 Channel Number	Linear
APS MSP Architecture	Linear
APS Status	Linear
B2-BIP Error Count	
B2-BIP Error Rate	
SES	
Unavailable Seconds	
AIS Seconds	
REI Count	
REI Rate	
S1 Synchronization Message	
Z1 Byte Value	
<b>High Path (AU, VC3/4) OH Category</b>	
Pointer Justification Count	
Pointer Increment Count	
Pointer Decrement Count	
Pointer NDF Count	
Pointer Value	
Pointer Size	SS Bits
LOP Count	
B3 (BIP) Error Count	
B3 (BIP) Error Rate	
B3 (BIP) Errored Seconds	
REI Count	
VC-3/4 REI Rate	
POH SES	
POH Unavailable Seconds	
Signal Label	C2
J1 Trace Message	
Path Status	G1

<b>Low Path (VC3/12, TU3/12, VT1.5) Category</b>	
Pointer Transmitted	
Pointer Received	
Pointer Just Count	
Pointer Increment Count	
Pointer Dec Count	
Pointer NDF Count	
LOP Count	
LOP Seconds	
B3/V5 BIP Count	
B3/V5 BIP Error Rate	
REI Count	
Pointer Transmitted	
Pointer Received	
Signal Label	C2/V5
Signal Label Mismatch	
J2-Lower Order Trace Message	
J2 Lower Order TIM	
<b>Logic Category</b>	
Pattern loss Count	
Bit Error/TSE Count	
Bit Error/TSE Rate	
Pattern Slip Count	
Pattern Slip Secs	
Pattern Loss Count	
Pattern Synchronization Loss Secs	
Pattern Synchronization Status	
<b>Alarms</b>	
<b>Signal Loss Status</b>	
Frame Synchronization Loss Status	
Pattern Synchronization Loss Status	
MS/Line-AIS	
AIS (HP)	
AIS (LP)	
LOP (HP)	
LOP (LP)	
LOS	
OOF	
LOF	
MS/Line RDI	
LP RDI	
HP RDI	
MS/Line-REI	

Regenerator Trace Identifier Mismatch	TIM
High Path Trace Identifier Mismatch	TIM
HP-UNEQ/UNEQ-P	
Low Path Trace Identifier Mismatch	TIM
Loss of Multiframe	TU-12, TU-3, VT-1.5

### Overhead Byte Manipulation/Viewing – High Path

A1, A2, J0, J1, D1, D2, D3, C2, H1, H2, H3, G1, B2, K1, K2, F2, D4, D5, D6, H4, D7, D8, D9, H4, D7, D8, D9, Z3/F3, D10, D11, D12, Z4/K3, S1, Z1, M1/Z2, E2, Z5/N1

### SDH Low Order View (AU/VT)

V5, S2, N6, K4

### SOH and POH Evaluation

Text decode of S and C bytes for the trace identifier. J0 display of 16-byte ASCII sequence. J1, J2 display of 16- or 64-byte ASCII sequence.

### Tandem Connection Monitoring (TCM)

Analysis of the N1 and N2 bytes, Monitoring/Display of: AIS, ODI, RDI, OEI, REI, APId, incoming B3/Computed BIP Comparison, IEC, TC-UNEQ

### Performance Measures

G.826	ISM/OOS
G.828	ISM/OOS
G.829	ISM/OOS
M.2101	
T1.231	
T1.514	

### K1/K2 Event Log

Date, Time, K1 Value, Code, Channel, K2, Bridge, MSP, Status

### 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

## OTN G.709

### 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

<b>Laser Type</b>	
SFP	
SFP+	
SFP+ - Tunable	
<b>Modes of Operation</b>	
Terminate	
Monitor	
Monitor/Thru	
<b>OTN Layer</b>	
OTN/ODU Framing	
ODU1 in ODU2 Multiplexing	
ODU0 Multiplexing	
<ul style="list-style-type: none"> <li>• ODU-0 Bulk BERT from an OTU-2</li> <li>• ODU-0 1-Gigabit Ethernet Layer 2 &amp; IPv4 traffic from an OTU-2</li> <li>• ODU-0 Bulk BERT from an OTU-1</li> <li>• ODU-0 1-Gigabit Ethernet Layer 2 &amp; IPv4 traffic from an OTU-1</li> <li>• ODUflex Bulk BERT from an OTU-2</li> <li>• ODUflex 1-Gigabit Ethernet Layer 2 from and OTU-2</li> <li>• Generic Mapping Procedure (GMP) supported</li> <li>• GFP-T encapsulation of Ethernet 8B/10B PCS</li> </ul>	
<b>GFP-T</b>	
<ul style="list-style-type: none"> <li>• CID</li> <li>• UPI</li> </ul>	
Overhead Manipulation/Analysis	
Power Level	
PM/SM TTI messages Tx/Rx	
Overhead Manipulation/Analysis	
Service Disruption Measurements	
<ul style="list-style-type: none"> <li>• SD Separation/Debounce Time Setting</li> <li>• SD Threshold Time Settings</li> </ul>	
Payload Type (PT) Label generation/display	
Transfer Delay	
Freq Offset Transmit/Receive	
<b>PRBS Patterns</b>	
2 <sup>20</sup> -1, 2 <sup>20</sup> -1 Inverse	
2 <sup>23</sup> -1, 2 <sup>23</sup> -1 Inverse	
2 <sup>31</sup> -1, 2 <sup>31</sup> -1 Inverse	
Programmable - 32 bit	
ANSI and ITU implementations	
<b>Error Insertion Capability</b>	
Single, Rate	
<b>OTU Error Tx/Rx</b>	
FAS	
MFAS	
SM-BIP/BEI	



PM-BIP/BEI
FEC Uncorrectable
FEC Correctable
TCM1-6 BIP
TCM1-6 BEI
Bit Error
Code Word Errors (Corr/Incorrect)
<b>OTU Alarm Tx/Rx</b>
LOF
OOF
LOM
OOF
OOM
SM-IAE
SM-TIM
SM-BDI
SM-BIAE
PM-TIM
PM-BDI
FTFL Fwd Sig Fail
FTFL Fwd Sig Degr.
FTFL Bwd Sig Fail
FTFL Bwd Sig Degr
TCM1-6 IAE
TCM1-6 TIM
TCM 1-6 BDI
TCM1-6 BIAE
<b>ODU Errors Tx/Rx</b>
FAS
MFAS
PM BIP/BEI
TCM BIP/BEI
Bit Error
<b>ODU Alarms Tx/Rx</b>
LOF
OOF
LOM
OOM
AIS
OCI
LCK
PM-TIM
PM-BDI
FTFL
FTFL Fwd Sig Fail

FTFL Fwd Sig Degr.
FTFL Bwd Sig Fail
FTFL Bwd Sig Degr
TCM1-6 IAE
TCM1-6 TIM
TCM 1-6 BDI
TCM1-6 BIAE
<b>OPU Errors/Alarms Tx/Rx</b>
PT Label Mismatch
Client Loss
Bit Error
<b>ODU Mappings</b>
Bulk
ODU0
ODU1
ODU2
<b>SDH Mappings</b>
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c
VC4
VC3
<b>SONET Mappings</b>
STS-1, STS-3c, STS-12c, STS-48c, STS-192c
<b>Ethernet Mappings</b>
10GigE
1GigE
<b>Results</b>
<b>LEDS</b>
Signal Present
Frame Sync
Pattern Sync
LOS
LOF
LSS
<b>Interface</b>
Invalid Rx Signal Seconds
LOS Count
Optical Rx Level (dBm)
Reference Frequency
Round Trip Delay
Rx Frequency Max Deviation (ppm)
Rx Frequency (Hz)
Rx Frequency Deviation (ppm)
Signal Losses Count
Tx Clock Source
Tx Freq Max Deviation (ppm)

Tx Frequency (Hz)
Tx Frequency Deviation (ppm)
<b>FEC</b>
Uncorrected Word Errors
Uncorrected Word Error Rate
Corrected Word Errors
Correctable Word Errors
Corrected Word Errors Rate
Correctable Word Error Rate
Corrected Bit Errors
Corrected Bit Errors Rate
Correctable Bit Errors
Correctable Bit Error Rate
<b>Framing</b>
Frame Sync Loss Seconds
Frame Sync Losses
OOF Seconds Count
FAS Errors
FAS Error Rate
LOF
LOF Seconds
Multiframe Sync Loss Seconds
OOM Seconds Count
MFAS Errors
MFAS Error Rate
<b>OTU</b>
OTU-AIS
OTU AIS Seconds
SM-IAE
SM-IAE Seconds
SM-BIP Error Counts
SM-BIP Error Rate
SM-BDI Seconds
SM-BDI Count
SM-BIAE Seconds
SM-BIAE Count
SM-BEI Count
SM-BEI Error Rate
SM-TIM Count
SM-TIM Seconds
SM-SAPI
SM-DAPI
SM-Operator Specific
GCC BERT Bits
GCC BERT Bit Errors

GCC BERT Bit Error Rate
<b>ODU</b>
ODU-AIS
ODU-AIS Seconds
ODU-LCK
ODU-LCK Seconds
ODU-OCI
ODU-OCI Seconds
PM-BIP Count
PM BIP Error Rate
PM-BDI Seconds
PM-BDI Count
PM-BEI Count
PM-BEI Error Rate
PM-TIM Seconds
PM-TIM Count
PM-SAPI
PM-DAPI
PM-Operator Specific
PM Round Trip Delay Recent
PM Round Trip Delay Last
<b>FTFL</b>
Forward-Fault Type
Forward-SF Seconds
Forward-Operator Specific
Forward-Operator Identifier
Backward-Fault Type
Backward-SF Seconds Count
Backward-SD Seconds Count
Backward-Operator Identifier
Backward-Operator Specific
<b>TCM 1-6</b>
IAE Seconds
BIP Errors
BIP Error Rate
BDI Seconds
BIAE Seconds
BEI Errors
BEI Error Rate
TIM Seconds
SAPI
DAPI
Operator Specific
GCC BERT Bits
GCC BERT Bit Errors
GCC BERT Bit Error Rate

<b>OPU</b>	
Payload Type Mismatch Seconds	
Payload Type	
<b>Payload</b>	
Pattern Sync Loss Seconds	
Pattern Sync Losses	
TSE/Bit Errors	
TSE/Bit Error Rate	
<b>Ethernet Client</b>	
As per Ethernet results	
RFC 2544 on 10 GE client	
<b>SONET/SDH Client</b>	
As per SONET/SDH results	
<b>OTN Check</b>	
Automated workflow is available at all OTN rates for OTN Bulk	
Set test duration based on Bit Error Rate Theory or actual time	
Bit Error Rate Theory parameters for test duration:	
<ul style="list-style-type: none"> <li>• Data Rate (e.g. OTU4)</li> <li>• BER Threshold</li> <li>• Confidence Level (% value)</li> </ul>	
<b>Key automated tests</b>	
Payload BERT	
<ul style="list-style-type: none"> <li>• PRBS pattern selection</li> <li>• Pass/Fail BER Threshold</li> </ul>	
Round Trip Delay	
<ul style="list-style-type: none"> <li>• Selection of applicable OH fields: PM, TCM1-6</li> <li>• Measurement Frequency</li> <li>• Pass/Fail Threshold (ms)</li> </ul>	
GCC Transparency	
<ul style="list-style-type: none"> <li>• Selection of applicable OH field: GCC0, GCC1 or GCC2</li> <li>• Pass/Fail BER Threshold</li> </ul>	
<b>Report generation and formats</b>	
<b>Fibre Channel</b>	
<b>Laser Type</b>	
SFP	
SFP+	
<b>Modes of Operation</b>	
Terminate	
Monitor	
Thru	
<b>Test Interfaces/Bit Rates</b>	
1.0625 Gbit/s	Dual Port Capable
2.125 Gbit/s	Dual Port Capable

4.25 Gbit/s	Dual Port Capable
8.5 Gbit/s	Dual Port Capable
10.519 Gbit/s	Dual Port Capable
14.025 Gbit/s	Dual Port Capable
<b>Fibre Channel Features</b>	
<b>General</b>	
Flow Control	
Login	
Buffer Credits	
<b>Fibre Channel Login</b>	
at "F-Port"	
at "N-Port"	
<b>Layer 1 (Unframed) Bit Error Testing Patterns</b>	
High frequency test pattern	
Low frequency test pattern	
Mixed frequency test pattern	
Random Data Pattern (RPAT)	
Jitter Tolerance Test Pattern (JTPAT)	
Supply Noise Test Sequence (SPAT)	
<b>Layer 2 (Framed) Bit Error Testing Patterns</b>	
Compliant Random Data Pattern (CRPAT)	
Compliant Jitter Tolerance Pattern (CJPAT)	
Compliant Supply Noise Pattern (CSPAT)	
<b>Framed Pattern Test</b>	
PRBS (2 <sup>23</sup> -1, 2 <sup>31</sup> -1 and inverse)	
All 1s	
All 0s	
User defined	
<b>Fibre Channel Traffic Generation</b>	
Transmit Traffic profiles	
Constant	
Ramp	
Bursty	
Traffic generation in Mbit/s and % utilization	
Configurable Source and Destination ID	
Sequence ID	
Originator ID	
Responder ID	
Frame length	28, 32, 76, 512, 1024, 1536, 2076, 2140, User defined
Packet payload	
Granularity	1 to 6.7%

<b>Fibre Channel Traffic Filtering</b>
Routing Control
Destination Identifier
Source Identifier
Data Structure Type
Sequence Count
<b>Fibre Channel Error Insertion</b>
Bit error
CRC
Framed Bit
Code violation
Insertion Type - Single, Rate, Burst
<b>Enhanced Fibre Channel Test (RFC 2544 like)</b>
Selectable Configuration Template
Throughput
Latency
Frame Loss
Back to Back
Buffer Credits
Buffer Credit Throughput
Selectable Flow Control Login Type
Definable Frame Length
Pass Fail Thresholds
Report Generation
Screen Capture Support
Graphical Results
<b>8 Gig Fibre Channel Specific</b>
Scrambling in FC-1/MAC layer, on total FC frame
Supported IDLE and FILL WORD patterns include IDLE on Link INIT and as FILL WORD; IDLE on INIT and ARBFF on FILL WORD; ARBFF on INIT and as FILL WORD
<b>Results</b>
<b>Interface</b>
Signal Losses
Signal Loss Seconds
Sync Loss Seconds
Optical Rx Overload
Optical Rx Level (dBm)
<b>Login Status</b>
Far-end Buffer to Buffer Credits
Login Status
Tx/Rx ELP Accept
Tx/Rx ELP Ack1
Tx/Rx ELP Reject

Tx/Rx ELP Request
<b>L2 Link Statistics</b>
Total Utilization %
Frame Rate
Frame Size
Rx Mbps
Tx Mbps
Round Trip Delay (us)
Service Disruption (us)
<b>L2 Link Counts</b>
Rx Frames
Tx Frames
Rx Acterna Frames
Tx Acterna Frames
Rx Frame Bytes
Tx Frame Bytes
Class F Frames
Class 1 Frames
Class 2 Frames
Class 3 Frames
<b>BERT Stats</b>
Pattern Losses
Pattern Loss Seconds
Bit Error Rate
Bit Errors
Bit Errored Seconds
Bit Error-Free Seconds
Bit Error-Free Seconds (%)
<b>Error Stats</b>
Symbol Errors
CRC Errored Frames
Fiber Runts
Fiber Jabbers
Undersized Frames
Code Violations
Code Violation Rate
Code Violation Seconds
<b>PDH</b>
<b>Test Interfaces</b>
E4
DS3
E3
E1 Balanced
E1 Unbalanced
T1

<b>Interface Type</b>	
BNC	
Bantam	
RJ48	
<b>E4</b>	
<b>Modes of Operation</b>	
Terminate	
Monitor	
Thru (Intrusive)	
<b>Timing</b>	
Recovered from Rx	
Internal (Stratum 3)	
Recoverd from External (BITS/SETs)	
<b>Framing</b>	
Framed	
Unframed	
<b>Test Patterns</b>	
2 <sup>15</sup> -1* (Inverse)	
2 <sup>20</sup> -1* (Inverse)	
2 <sup>23</sup> -1* (Inverse)	
User Programmable	
Round Trip Delay	
ANSI and ITU	
<b>Mappings</b>	
E3	
E1	
64 k	
<b>Anomaly/Error Insert/Analysis</b>	
Frame Errors	
TSE/Bit Error	
Single	
Rate	
<b>Defect/Alarm Insert/Analysis</b>	
AIS	
RDI/FAS Distant	
<b>General</b>	
Frequency Offset ±100 ppm	
National Bit Support	
<b>Performance Measures</b>	
G.821	OOS
G.826	ISM/OOS
M.2100	ISM/OOS
<b>Results</b>	
<b>Signal Category</b>	
Receive Frequency	

Receive Frequency Deviation
Receive Frequency Max Deviation
Transmit Frequency
Round Trip Delay
<b>Frame Category</b>
FAS TSE Count
FAS TSE Rate
FAS Word Error Count
FAS Word Error Rate
Frame Synchronization Loss Count
Frame Synchronization Loss Seconds
<b>Logic Category</b>
TSE/Bit Error Count
TSE/Bit Error Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Loss Seconds
<b>DS3</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (Intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recoverd from External (BITS/SETs)
<b>Framing</b>
M13
C-bit
Unframed
<b>Test Patterns</b>
All 1s
All 0s
2 <sup>15</sup> -1* (Inverse)
2 <sup>20</sup> -1* (Inverse)
2 <sup>23</sup> -1* (Inverse)
Round Trip Delay
User Programmable (3,32 bits)
User Byte
100
1100 (aka IDLE)
1010 (aka BLUE)
ANSI and ITU

<b>Mappings</b>
E1
T1
64k
<b>Anomaly/Error/Insert/Analysis</b>
BPV/Code Error
Frame
Parity
C-Bit Parity
TSE/Bit Error
Single
Rate
Multiple
<b>Defect/Alarm Insert/Analysis</b>
AIS
RDI/FAS Distant
REBE
TS-16 AIS
TS-16 RDI/MFAC Distant
<b>General</b>
Frequency Offset +/- 100ppm
Loop Codes Tx NIU, CSU, Line
Rx Compensation - High - 0 ft
Rx Compensation - Low - 450 ft
Rx Compensation - Low - 900 ft
Service Disruption
<b>Performance Measures</b>
G.826
G.821
M.2100
M.2101
T1.231
T1.510
<b>Results</b>
<b>Signal Category</b>
Receive Frequency
Receive Frequency Deviation
Receive Frequency Maximum Deviation
Transmit Frequency
BPV/Code Rate
BPV/Code Count
Electrical Input Level
Round Trip Delay (ms)
<b>Frame</b>
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
<b>Logic</b>
Bit Error/TSE Count
Bit Error/TSE Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Loss Seconds
Pattern Synchronization Status
<b>E3</b>
<b>Modes of Operation</b>
Terminate
Monitor
Thru (Intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recoverd from External (BITS/SETs)
<b>Framing</b>
Framed
Unframed
<b>Test Patterns</b>
All 1s
All 0s
2047
2 <sup>11</sup> -1* (Inverse)
2 <sup>15</sup> -1* (Inverse)
2 <sup>20</sup> -1* (Inverse)
2 <sup>23</sup> -1* (Inverse)
User Programmable (3,32 bits)

User Byte
Round Trip Delay
1:1
1:3
1:4
1:7
ANSI and ITU
<b>Mappings</b>
E1
64k
<b>Anomaly/Error Insert/Analysis</b>
Code Error
FAS Error
TSE/Bit Error
Single
Rate
<b>Defect/Alarm Insert/Analysis</b>
AIS
RDI/FAS Distant
<b>General</b>
Frequency Offset Tx +/- 100ppm
Tx LBO - 0 dB Loss
Tx LBO - 6 dB Loss
National Bit Support - On/Off
Service Disruption
<b>Performance Measures</b>
G.826
ISM/OOS
G.821
M.2100
<b>Results</b>
<b>Signal Category</b>
Transmit Frequency
Receive Frequency
Receive Frequency Maximum Deviation
Electrical Input Level
Code Error Count
Code Error Rate
Round Trip Delay (ms)
APS Switch Time (ms)
<b>Frame Category</b>
FAS Bit Error Count
FAS Bit Error Rate
FAS Word Error Count
FAS Word Error Rate
Frame Synchronization Loss Count

8M FAS Word Error Rate
8M FAS Bit Error Count
8M FAS Bit Error Rate
8M FAS Word Error Count
8M FAS Word Error Rate
<b>Logic Category</b>
TSE/Bit Error Count
TSE/Bit Error Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Loss Seconds
Pattern Synchronization Status
<b>E1</b>
<b>Modes of Operation</b>
Terminate
Monitor
Thru (Intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recoverd from External (BITS/SETs)
<b>Framing</b>
Unframed
PCM30
PCM30C
PCM31
PCM31C
<b>Test Patterns</b>
All 1s
All 0s
2 <sup>15</sup> -1* (Inverse)
2 <sup>20</sup> -1* (Inverse)
2 <sup>23</sup> -1* (Inverse)
QRSS
User Programmable (32 bits)
Round Trip Delay
1:1
1:3
1:4
1:7
ANSI and ITU
<b>Mappings</b>
64k

<b>Anomaly/Error Insert/Analysis</b>
Code Error
FAS Error
MFAS Error
TSE/Bit Error
Single
Multiple
Rate
<b>Defect/Alarm Insert/Analysis</b>
AIS
REBE
TS-16 AIS
TS-16 RDI/MFAS Distant
<b>General</b>
Frequency Offset Tx +/- 100ppm
Service Disruption
<b>Performance Measures</b>
G.826
ISM/OOS
G.821
G.829
ISM/OOS
M.2100
<b>Results</b>
<b>Signal Category</b>
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
<b>Logic Category</b>
TSE/Bit Error Count
TSE/Bit Error Rate
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Status
<b>Alarm Category</b>
FAS/Frame Synchronization
MFAS Synchronization

CRC Synchronization
AIS
RDI
Power Loss Count
2M Alarm
<b>Frame Category</b>
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)
<b>T1</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (Intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recoverd from External (BITS/SETs)
<b>Framing</b>
Unframed
SF
ESF
SLC-96
<b>Test Patterns</b>
63
511
511 QRSS
2047 QRSS
2047
All 1s
All 0s
2 <sup>15</sup> -1* (Inverse)
2 <sup>20</sup> -1* (Inverse)
2 <sup>23</sup> -1* (Inverse)

QRSS	
User Programmable (3,,,,32 bits)	
User Byte	
BridgeTap	
MultiPat	
Round Trip Delay	
1:1	
1:3	
1:4	
1:7	
2 in 8	
3 in 24	
MIN/MAX	
T1 DALY	
55 OCTET	
T1-2/96	
T1-3/54	
T1-4/120	
T1-5/53	
<b>Mappings</b>	
64k	
56k	
<b>Anomaly/Error Insert/Analysis</b>	
Frame Errors	
BPV Errors	
TSE/Bit Error	
Single	
Rate	
Multiple	
<b>Defect/Alarm Insert/Analysis</b>	
AIS	
REBE	
<b>General</b>	
Frequency offset Tx ±100 ppm	
<b>Performance Measures</b>	
G.826	ISM/OOS
G.828	ISM/OOS
G.829	ISM/OOS
M.2100	
T1.231	
Tx LBO	0, 7.5, 15, 22.5 dB Loss
Service disruption	
<b>Loop Codes</b>	
Loop Code Tx	NIU, CSU
Loop Code Emulation	NIU, CSU

Loop Code Tx - Repeater
HDSL Loop Code Tx
CO to Customer direction
Customer to CO direction
User Defined Loop Code Support
<b>Results</b>
<b>Signal Category</b>
Receive Frequency
Reference Frequency
Receive Frequency Deviation
Receive Frequency Maximum Deviation
Transmit Frequency
Simplex Current
Receive Level (Vp)
Receive Level (dBdsx)
Receive Level (dBm)
BPV Error Count
BPV Error Rate
Frame Slip Count
Signal Loss Count
Signal Loss Seconds
Round Trip Delay (ms)
Timing Slips
Frame Slips
APS Switch Time
<b>Frame Category</b>
Frame Error Count
Frame Error Rate
Frame Error Seconds
Frame Loss Count
Frame Loss Seconds
Severely Errored Seconds
CRC Error Count
CRC Error Rate
CRC Errored Seconds
CRC Severely Errored Seconds
<b>Logic Category</b>
Bit Error/TSE Count
Bit Error/TSE Rate
Bit Error/TSE Seconds
Pattern Slips
Pattern Slip Seconds
Pattern Synchronization Loss Count
Pattern Synchronization Loss Seconds
<b>Channel</b>
DSO Channel Payload View
ABCD Bit Signaling View

<b>DS1 Dual HDLC Monitor and PPP Ping</b>
<b>Modes of Operation</b>
Bridge
Terminate
DSX Monitor
<b>Line Code</b>
B8ZS
AMI
<b>Clock Source (PPP Ping Only)</b>
Internal
Recovered
External
Selectable Clock Offset
<b>Transmit LBO (PPP Ping only)</b>
0 dB
-75 dB
-15.0 dB
-22.5 dB
<b>Framing</b>
Unframed
ESF
D4 (SF)
SLC-96
<b>Payload</b>
Bulk
Fractional Rate
<b>HDLC</b>
Normal or inverted HDLC Mode
CRC16 or CRC32
<b>PPP (PPP Ping Only)</b>
PPP Mode (Client or Server)
IP Mode (Static or Auto)
Optional Authentication
<b>IP (PPP Ping Only)</b>
IPv4 Frame Format
Local IP
Remote IP
Destination IP Address - User Defined
Subnet Mask
Preferred & Alternate DNS Server
<b>IPv4 Editable Fields</b>
ToS
DSCP
TTL
<b>IP Ping</b>

Editable Packet Length (46 - 1500 bytes)
Single
Multiple
Continuous
Fast
<b>Alarms/Errors Generation and Analysis (PPP Ping only)</b>
LOS
LOF
AIS
RAI
BPV
Frame
<b>Results</b>
<b>Interface</b>
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
<b>DS1</b>
Frame Sync Losses
Frame Sync Loss Seconds
AIS Alarms
AIS Seconds
T1 Alarm Seconds
Frame Errors
Frame Error Rate
Frame Error Seconds
Excess Zeros
Maximum Consecutive Zeros
<b>HDLC</b>
Rx/Tx Frame Count
Rx/Tx Octet Count
Frame Aborts
Short Frames
FCS Errored Frames
Percent Utilization (Average, Current, Maximum)
Throughput (Average, Current, Maximum)

Average Frame Rate (frames/sec)
Average Frame Size (octets)
<b>PPP (PPP Ping Only)</b>
PPP Status
Local IP
IP Subnet Mask
Remote IP
Preferred & Alternate DNS Server
Destination IP Address
Resolved Host Name
<b>Ping (PPP Ping Only)</b>
Ping Requests Tx
Ping Replies Rx
Lost Pings
Lost Ping %
Delay (ms)
Ping Requests Rx
Ping Replies Tx
<b>Capture/Decode</b>
Wirespeed Capture
Integrated Wireshark on the TestSet
256MB Capture Buffer
Triggers
Frame Slicing
<b>DS3 HDLC Dual Monitor</b>
<b>Modes of Operation</b>
DSX-MON
Terminate
<b>Framing</b>
Unframed
M13
C-Bit
<b>HDLC</b>
Normal or Inverted HDLC Mode
CRC16 or CRC32
<b>Results</b>
<b>Interface</b>
Signal Losses
Signal Loss Seconds
Rx Level (Vpeak)
Rx Level (dBdsx)
Rx Frequency (Hz)
Rx Frequency Deviation (ppm)
Rx Frequency Max Deviation (ppm)
Bi-Polar Violations (BPVs)

BPV Rate
BPV Error Seconds
Excess Zeros Count
Excess Zeros Seconds
<b>DS3</b>
Frame Sync Losses
Frame Sync Loss Seconds
Near End OOF Seconds
Far End OOF Seconds
AIS Seconds
RAI Seconds
FEAC Word
Frame Errors
Frame Error Rate
Parity Errors
Parity Error Bit Rate
C-Bit Errors
C-Bit Error Rate
C-Bit Error Seconds
C-Bit Frame Mismatch Seconds
C-Bit Sync Loss Seconds
FEBEs
FEBE Rate
FEBE Seconds
Rx X-Bits
<b>HDLC</b>
Rx Frame Count
Rx Octet Count
Frame Aborts
Short Frames
FCS Errored Frames
Percent Utilization (Average, Current, Maximum)
Throughput (Average, Current, Maximum)
Average Frame Rate (frames/sec)
Average Frame Size (octets)

## CPRI

Test Interfaces/Bit Rates	
614 Mbps optical (Rate 1)	Dual Port Capable
1.2 Gbps optical (Rate 2)	Dual Port Capable
2.4 Gbps optical (Rate 3)	Dual Port Capable

3.1 Gbps optical (Rate 4)	Dual Port Capable
4.9 Gbps optical (Rate 5)	Dual Port Capable
6.1 Gbps optical (Rate 6)	Dual Port Capable
9.8 Gbps optical (Rate 7)	Dual Port Capable
10.137 Gbps optical (Rate 8)	Dual Port Capable
12.2 Gbps Optical (Rate 9)	Dual Port Capable
<b>Laser Type</b>	
SFP	
SFP+	
SFP+ Tuneable	
<b>Modes of Operation</b>	
Terminate	
Monitor/Thru	
<b>Timing</b>	
Recoverd from Rx (Slave)	
Internal (Stratum 3) (Master)	
Recoverd from External (BITS/SETs) (Master)	
Recoverd from 10MHz clock (Master)	
<b>CPRI Automation</b>	
CPRI Service Activation automated workflow	
<b>CPRI Features</b>	
Optical/Electrical Power Level	
Freq Offset Transmit/Receive	
CPRI Startup Sequence - Normal or Bypass	
<b>Signal Generation and Monitoring</b>	
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	
<b>Interface Type</b>	
Master	
Slave	
Selectable CPRI Protocol Verion	
<b>Control and Management (C&amp;M) Channel</b>	
Ethernet	
HDLC	
Selectable C&M Channel Rate	
<b>Service Disruption Measurements</b>	

SD Separation/Debounce Time Setting
SD Threshold Time Settings
<b>Round-Trip Delay Measurement</b>
RTD Measurement Accuracy
<b>PRBS Patterns</b>
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
<b>Anomaly/Errors Generation</b>
Bit/TSE
Code
K30.7
Running Disparity
Insert - Single
Insert - Rate
<b>CPRI AxC Mapping</b>
Mapping Method: Method 1
Sample Width
Bandwidth
AxC Group Number
Offset
<b>Test Waveform Selections</b>
Continuous Wave (CW)
LTE-FDD TM1.1
LTE-FDD TM1.2
LTE-FDD TM2
LTE-FDD TM3.1
LTE-FDD TM3.2
LTE-FDD TM3.3
<b>Loopback AxC (ALU/Nokia RRH)</b>
<b>Set Power levels and Bands (ALU/Nokia RRH)</b>
<b>Defects/Alarms Generation/Analysis</b>
LOS
LOF
SDI
RAI
<b>Results</b>
<b>Results Accuracy</b>
1ns
<b>Signal Category</b>
Signal Losses



Sync Loss Seconds
Optical Rx Overload
Optical Rx Level (dBm)
Receive Frequency
Receive Frequency Deviation
Receive Frequency Maximum Deviation
Transmit Frequency
Tx Frequency Deviation (Hz)
Tx Frequency Deviation (ppm)
Tx Frequency Max Deviation (ppm)
<b>CPRI Inband Protocol</b>
Tx/Rx Protocol Version
Tx/Rx C&M HDLC Rate
Tx/Rx C&M Ethernet Subchannel Number
Port Type (Master/Slave)
Start-up State
<b>CPRI Counts</b>
Code Word Count Tx/Rx
Frame Count Tx/Rx
<b>Error Stats</b>
Word Sync Loss Events
Word Sync Loss Seconds
Code Violations
Code Violation Rate
Code Violation Seconds
K30.7 Words
Frame Sync Loss Events
Frame Sync Loss Seconds
Pattern Sync Losses
Pattern Sync Loss Seconds
Bit Error Rate
Bit Errors
Errored Seconds
Error-Free Seconds
Error Free Seconds, %
Total bits Received
Round Trip Delay Current (ms)
Round Trip Delay Average (ms)
Round Trip Delay Minimum (ms)
Round Trip Delay Maximum (ms)
Remote LOS
Remote LOS Seconds
Remote LOF
Remote LOF Seconds
RAI

RAI Seconds
SDI
SDI Seconds
Running Disparity Errors
Running Disparity Error Rate
<b>RRH Testing (available for ALU RRH)</b>
RRH SW version
RRH serial number
RRH SFP information
RRH CPRI Reset
RRH Alarm Insertion

### OBSAI

<b>Test Interfaces/Bit Rates</b>	
768 Mbps Optical	Dual Port Capable
1.5 Gbps Optical	Dual Port Capable
3.1 Gbps Optical	Dual Port Capable
6.1 Gbps Optical	Dual Port Capable
<b>Laser Type</b>	
SFP	
SFP+	
SFP+ Tunable	
<b>Modes of Operation</b>	
Terminate	
Monitor/Thru	
<b>Timing</b>	
Recoverd from Rx (Slave)	
Internal (Stratum 3) (Master)	
Recoverd from External (BITS/SETs) (Master)	
Recoverd from 10MHz clock (Master)	
<b>OBSAI Features</b>	
Optical/Electrical Power Level	
Freq Offset Transmit/Receive	
<b>PRBS Generation and Monitoring</b>	
Unframed	
L1 - Pattern Inserted in Frame Structure	
L2 - Pattern Inserted in OBSAI Message	
<b>OBSAI Interface</b>	
Selectable Port Type (Master or Slave)	
LOS Enable (On or Off)	
Force Tx Idle (On or Off)	
Definable RP3 Address	
Selectable RP3 Type (WCDMA/FDD, GSM/EDGE, WiMAX 802.16, LTE)	
Selectable Number of Message Groups in Master Frame	

Selectable Number of Message Slots in Message Group
Selectable Number of Idle Bytes After Message Group
FCB Message Generation
<b>Round Trip Delay Measurement</b>
RTD Measurement Accuracy
<b>PRBS Patterns</b>
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
D6.6 D25.6
Delay
Live
Digital Word
<b>Anomaly/Errors Generation</b>
Bit
Code
Insert - Single
Insert - Rate
<b>Results</b>
<b>Signal Category</b>
Signal Losses
Sync Loss Seconds
Optical Rx Overload
Optical Rx Level (dBm)
Receive Frequency
Receive Frequency Deviation
Receive Frequency Maximum Deviation
Transmit Frequency
Tx Frequency Deviation (Hz)
Tx Frequency Deviation (ppm)
Tx Frequency Max Deviation (ppm)
<b>OBSAI Counts</b>
Code Word Count Tx/Rx
Frame Count Tx/Rx
Message Group Counts Tx/Rx
Receive Message Counts: Control, Measurement, WCDMA/FDD, WCDMA/TDD, GSM/EDGE, TETRA, CDMA2000, WLAN, Loopback, Frame Clock Burst, Ethernet, RTT, WiMAX, Virtual HW Reset, LTE, Generic Packet, Multi-hop RTT
<b>Error Stats</b>
Word Sync Loss Events
Word Sync Loss Seconds
Code Violations

Code Violation Rate
Code Violation Seconds
K30.7 Words
Frame Sync Losses
Frame Sync Loss Seconds
Pattern Sync Losses
Pattern Sync Loss Seconds
Bit Error Rate
Bit Errors
Errored Seconds
Error-Free Seconds
Error Free Seconds, %
Total bits Received
Round Trip Delay Current (ms)
Round Trip Delay Average (ms)
Round Trip Delay Minimum (ms)
Round Trip Delay Maximum (ms)
Tx/Rx OBSAI State

## Jitter O.172

General Features	
Generate and measure Jitter on electrical interfaces	DS1, E1, DS3, E3, E4, STM1e
Automatic Measurement Sequences	<ul style="list-style-type: none"> <li>Maximum Tolerable Jitter (MTJ)</li> <li>Measure Intrinsic Jitter</li> <li>Jitter Transfer Function (JTF)</li> </ul>
Support different Measurement Bands	<ul style="list-style-type: none"> <li>High Band</li> <li>Wide Band</li> <li>Extended Band</li> <li>Ability to set user definable band</li> </ul>
Common Jitter mask selectable	
Ability to create user definable masks	
Results	
Jitter Results per measurement band	
Current peak to peak jitter [UI]	<ul style="list-style-type: none"> <li>Peak to peak jitter [UI]</li> <li>Positive peak jitter [UI]</li> <li>Negative peak jitter [UI]</li> </ul>
Maximum peak to peak jitter [UI]	<ul style="list-style-type: none"> <li>Peak to peak jitter [UI]</li> <li>Positive peak jitter [UI]</li> <li>Negative peak jitter [UI]</li> </ul>
Phase Hits	
Percentage of mask	
RMS Jitter [UI]	
Jitter Graphs	

## Wander

General Features	
Measure Wander on 1PPS Signal	
Measure Wander on 1G Optical SyncE Interface	
Measure Wander on T1, E1, & unframed 2.048 MHz Signals	
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)	<ul style="list-style-type: none"> <li>Current TIE(s)</li> <li>Maximum TIE(s)</li> <li>Minimum TIE(s)</li> </ul>
Maximum Peak-to-Peak TIE (MTIE) [s]	
Offset Between Test Signal and Reference	<ul style="list-style-type: none"> <li>Current Offset (µs)</li> <li>Minimum Offset (µs)</li> <li>Maximum Offset (µs)</li> </ul>
Pass/Fail Result	
TIE Graph	
Reference Clock for 1 pps wander	1 pps reference signal
Reference Clock for 1G SyncE Optical, T1, E1, 2 MHz, & 10 MHz wander	2 MHz or 10 MHz reference signal
Cables for 1 pps Wander	
Wander Analysis Tool	
Offline analysis of captured/imported TIE measurements	
Maximum Peak-to-Peak TIE (MTIE) [s]	
TDEV (Time Deviation)	
Frequency Offset (ppm)	
Drift Rate (ppm/s)	
Masks	
ANSI	SMC holdover (T1.105.109)
ETSI	SEC (ETS 300 462-5-1) SEC network IF (ETS 300 462-3-1) SSU (ETS 300 462-4-1) SSU network IF (ETS 300 462-3-1)
GR253	SMC transient

ITU	G.8261 SEC network IF (G.832, G.825) SEC option 1 (G.813) SEC option 2 (G.813) SEC holdover option 2 (G.813) SEC trans. option 2 (G.813) SSU network IF (G.823, G.825) SSU Type I (G.812) SSU Type II, III (G.812) SSU Type IV (G.812) PRC (G.811) EEC-1 Noise Generation (G.8262 constant temp.) EEC-1 Noise Generation (G.8262 with temp. effects) EEC-2 Noise Generation (G.8262 constant temp.) EEC-1 Noise Tolerance (G.8261) EEC-1 Noise Tolerance (G.8262) PRC (G.811) DTE Network Limit (G.8271.1) Wander Generation (G.8272) DTE Noise Generation (G.8273.2 constant temp.) DTE Noise Generation (G.8273.2 variable temp.)
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### Masks

PRC/SSU/SEC: Masks for G.811/G.812/G.813 clocks (ETS 300 462-2)

Networks: According to G.823/G.824

SyncE: According to G.8261, G.8262

ANSI-Standard: DS1 masks

## Services

### VoIP Testing

10/100/1000M Electrical Ethernet Interfaces

1GigE Optical Ethernet Interface

10GigE Optical Ethernet Interface

SIP, Cisco SCCP and H.323 Fast Connect

### Supported SIP Parameters

Dial by phone/URL/e-mail

Nortel & Huawei SIP emulation

Proxy login and proxyless operation

### Supported SCCP Parameters

Selectable Cisco Phone emulation supporting at least 15 models

Configurable device name

### Supported H.323 Parameters

H.323 ID

Bearer Capability including Unrestricted Digital, Speech & 31K Audio

Configurable Calling & Called Party Number Plans and Number Types

Static, auto-discoverable and no gatekeeper operation
Configurable Local and Gatekeeper RAS port and Call Control Port
Configurable Time Zone
Configurable RTP port range
<b>General Parameters</b>
Auto answer on/off
Codecs:
<ul style="list-style-type: none"> <li>• G.711 A Law</li> <li>• G.711 U Law</li> <li>• G.723 5.3 K</li> <li>• G.723 6.3 K</li> <li>• G.729A</li> <li>• G.726</li> <li>• G.722</li> </ul>
Configurable Call Manager port
Selectable silence suppression
Configurable jitter buffer and speech per frame parameters
ACR or G.107 MOS Scoring
Configurable Jitter, Loss, Delay and Content Threshold pass/fail
Mean Opinion Score Results (MOS)
Graphical Summary Results including Ethernet, transport & Content
Transaction Log including call log and protocol signaling
Phone book of last 10 numbers and IP addresses called
DTMF Digits
<b>Triple Play Automated Test Script</b>
10/100/1000M Electrical Ethernet Interfaces
1GigE Optical Ethernet Interface
10GigE Optical Ethernet Interface
<ul style="list-style-type: none"> <li>• Over 11,000 simulated calls with configurable Codec and sampling rate</li> <li>• Configurable voice call or tone with configurable silence suppression, sampling rate and jitter buffer</li> <li>• Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression</li> <li>• Up to 52 simulated HDTV channels with configurable frame size and MPEG-2/4 compression</li> <li>• 2 configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames</li> </ul>
<b>IPTV</b>
10/100/1000M Electrical Ethernet Interfaces
1GigE Optical Ethernet Interface

10GigE Optical Ethernet Interface
<ul style="list-style-type: none"> <li>• Single Program Transport Stream (SPTS) and Multiple Program Transport Stream (MPTS) formats</li> <li>• Video explorer capable of detecting 512 SPTS and 32 MPTS and a video analyzer that supports 16 SPTS and 1 MPTS</li> <li>• Supported measurements include bandwidth utilization, packet loss, packet jitter, PCR jitter, continuity error bit and error bit indicator</li> <li>• TR 101 290 priority 1 errors such as program identification (PID), program association table (PAT) and program map table (PMT)</li> <li>• Loss distance and period errors per RFC3357, results per transport stream and per PID</li> <li>• Media Delivery Index (MDI) measurements</li> <li>• Measure ICC latency and R-UDP latency</li> <li>• Microsoft Television (MSTV) Support</li> <li>• Internet Group Management Protocol (IGMP) support</li> </ul>

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

<b>Primary Rate E1 ISDN</b>	
Test Access	E1
TE Emulation	
NT Emulation	
D-Channel Signaling Decodes	
Codec $\mu$ -law, A-law	

Call Control	1TR6 1TR67 EDSS-1 VN3 VN4 VN6 TPH1962 Q.SIG Q.931 TN-1R6 SwissNet-3 CorNet-N CorNet-NQ DREX Alcatel QSIG
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 64 k
---------------	----------

Fractional T1	n x 56 k
---------------	----------

Contiguous Channels

Non Contiguous Channels

V.54 Loop Codes Support

**Voice Frequency**

Test Access - T1

Listed to an Audio Call

Insert VF Tones	404, 1004, 1804, 2713, and 2804 Hz
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User Frequency
Quiet Tone
Holding Tone
Three Tone
Frequency Sweep
Impulse Noise
Rx Frequency
Level (dBm)
DC Offset mV

## Fiber Inspection

### Optical Fiber Microscope

The Test Equipment shall be able to accept an optical video microscope.

The connector image shall be displayed on the Test Equipment and saved into a .JPEG file format.

The microscope shall offer a switchable 200/400x magnification capability.

It shall be provided with the dedicated tips to inspect fiber connectors on the patch panel and the patch cords.

The microscope shall be capable of automatically centering the fiber image

The microscope shall be capable of performing on-board Pass/Fail analysis

The microscope shall be compatible with Android tablets/smartphones

## 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  
 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
- 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:
<ul style="list-style-type: none"> <li>On the OTDR port</li> <li>Calibrated wavelengths: 1310, 1490, 1550, 1625, 1650 nm</li> <li>Power level range: 0 to -50 dBm</li> </ul>

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:  $\pm 0.5$  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:  $\pm 0.5$  dB

Linearity:  $\pm 0.1$  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

### Precision Timing Reference for Mobile Backhaul (PTP) Service Activation

Connector types:

- SMA for GPS Antenna,
- SMB for 1PPS and
- 10 MHz Timing Inputs and Outputs

#### Integral GPS Receiver

Support for GNSS tuning including GPS, GLONASS, Beidou, and SBAS

Support for Cable/Antenna Calibration factor

GPS Synchronization Modes; Dynamic, Static, and Survey

Capable of savings surveyed locations and recalling saved locations

Capable of powering external antenna with 5 VDC or 3.3 VDC

Capable of detecting short circuit and open circuit fault conditions with external antenna

Capable of providing accurate timing with only a single satellite visible in static timing mode

Support for user tuning of minimum satellite elevation angle

Provides realtime satellite constellation sky plot identifying potential visible satellites and those being used

Provides realtime bar graph of satellite Carrier to Noise Ratio (CNR) for all visible satellites

Support for 72 channels; 32 for satellite tracking, 40 for acquisition aiding and noise estimation

#### Rubidium Clock

Support for two 1PPS inputs and capable of measuring phase difference between them down to 5nsec

Support for measuring ToD offset for a device under test with NMEA and G.8271 (draft) formats

Support for a 10MHz input

Support for a 1PPS output disciplined to the Rubidium clock

Support for a 10MHz output disciplined to the Rubidium clock

Selectable auto-power on for the Rubidium clock upon instrument power-up

Minimum holdover of 7 usec over 24 hours over full temperature range

Minimum oscillator stability of 1.5E-11 over 2 hours.

#### GPS Results

Number of satellites used

UTC Time

Estimated position error

Sky plot

Carrier to Noise bar graph

Carrier to Noise (C/No) measurement per satellite

Mean C/No measurement (current and average)

C/No Bar Chart

Mean 3D Accuracy

Position Dilution of Precision (current and average)

Leap seconds

Event Log

#### Rubidium Clock Results

Total holdover time elapsed

Holdover time remaining (for selectable clock accuracy)

Synchronization state (Course tune, Intermediate Tune, Fine Tune)

Event Log

## C37.94

Test Interfaces/Bit Rates	
2.048Mhz	Dual Port Capable
Laser Type	
SFP	
Modes of Operation	
Terminate	
Framing	
Framed	
Payload	
N x 64 kbps	
Test Patterns	
2 <sup>11</sup> -1 (INV)	
2 <sup>15</sup> -1 (INV)	
2 <sup>20</sup> -1 (INV)	
2 <sup>23</sup> -1 (INV)	
QRSS	
All Ones	
All Zeros	
Delay	
Live	
ANSI and ITU	
Performance	
G.826	
G.821	
M.2100	
Alarms	
LOF	
RDI	
Errors	
FAS	

Results
Interface
Signal Losses
Signal Loss Seconds
Optical Rx Overload
Optical Rx Level (dBm)
Optical Tx Level (dBm)
Laser Bias Current (mA)
Rx Frequency (Hz)
Rx Frequency Deviation (ppm)
Rx Frequency Maximum Deviation (ppm)
Tx Clock Source
Tx Frequency (Hz)
Tx frequency Deviation (ppm)
Tx Frequency Maximum Deviation (ppm)
C37.94 - Frame
Frame Sync Losses
Frame Sync Loss Seconds
LOFs
LOF Seconds
RDI Alarms
RDI Seconds
FAS Word Errors
FAS Word Error Rate
FAS Bit Errors
FAS Bit Error Rate
N x 64 kbps
Payload - BERT
Pattern Sync Losses
Pattern Sync Loss Seconds
Round Trip Delay (ms)
Round Trip Delay Avg (ms)
Round Trip Delay Minimum (ms)
Round Trip Delay Maximum (ms)