VIAVI T-BERD®/MTS-5800 Specifications

Platform

Platform Requirements
The mainframe shall be non modular
The product shall be field upgradeable
The test system shall utilize Linux operating system to ensure optimum stability

Display
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

Power/Battery
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

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

Physical and Environment Specifications
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.

Drop Test - Shock
per IEC 68-2-27 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-28800F (Class 2)

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

Weight and Size
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 17.78 x 24.13 x 7.62cm (7”x9.5”x3”) while supporting up to 10G rates

Operation
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.

I/O's
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.
**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
  - 100M Ethernet Optical
  - GigE (Optical)
  - 10GigE WAN Phy (9.9G)
  - 10GigE LAN Phy (10.3G)

- **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)
  - Recovered 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 (2^11-1, 2^15-1, 2^20-1, 2^23-1, 2^31-1 and inverse)
- All 1s, All 0s
- 1, 2, 3, 7, 11, 2, 1 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

VPLS
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

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
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 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.1731 (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 802.1ag CFM
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

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
Errored Frame Second Summary Event

IP Packet Generator
IP
IPv4 Frame Format
IPv6 Frame Format
TCP Port Number
UDP Port Number

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
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
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
**RFC 2544**
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

**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
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

**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 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
Total Test Time Display
Configurable Saturation Window Test
Compatible with the following endpoints:
  - T-BERD/MTS instruments
  - QT-600 Ethernet Probes
  - TrueSpeed VNF Server

**Layer 2 Transparency Testing**
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-BRIDGE
  - Custom Frame Builder

**Synchronous Ethernet**
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

**IEEE 1588v2 PTP**
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

Master Mode Clock Classes Supported
- Primary
- Primary Holdover
- Arbitrary
- Arbitrary Holdover
- Primary A
- Arbitrary A

1588v2 Delay Measurements (Master/Slave)
One-way (Master to Slave and Slave to Master) Delay
Differential Delay and Delay Asymmetry Measurements
Time Error Measurements (1ns resolution)
Max $|TE|$ and cTE Measurement
PktSelected2wayTE Measurements including:
  - APTS: pk to pk
  - PTS: Abs Max
Wander Analysis of Time Error Measurement
Automated Time Error Measurement workflow.

**NTP Features**
- Capture
- Analyze
- Monitor

**PDV Analysis**
Supports distribution analysis of PDV and comparison against ITU limits
Graph resolution of up to 5ns
Supports evaluation according to MAFE
Supports FFP analysis according to G.8261.1 and comparison against ITU limits
Supports masks defined by user
Supports sample rates up to 100 samples per second
Supports offline data analysis
Supports packet synchronization data analysis for NTP protocols
Supports measured data analysis according to PDD packet delay allocation level
Supports measured data analysis according to FPP minimum packet rate
Supports PDV data collection of PTP for laboratory analysis and corrective path

**Loopback**
- Manual (LLB)
- Automatic
- Local

Far End
Auto Discovery of Test Sets

**Delay**
Round Trip Delay
Acterna Test Protocol Version 3 (default)
  - 10GE High Precision - low delay
  - GE Optical High Precision - low delay
Acterna Test Protocol Version 2 with Fill byte
  - High Precision - low delay
  - Lower Precision — high delay
One Way Delay
Delay Measurement Accuracy

**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 up to 10Gb/s
- Wirespeed Capture up to 10/100/1000 Mb/s
- Integrated Wireshark on the TestSet
- 256MB Capture Buffer per port
- Triggers
- Tx and Rx Capture
- Frame Slicing

**Expert Decode/Analysis**
- Decode/Analysis Capture Files
- Detect Half-Duplex 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

**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

**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

**Errors Tx/Rx**
- Code Error Tx/Rx
- FCS Error Tx/Rx
- IP Checksum Tx/Rx
- Bit Error Tx/Rx
- 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
- Link Status
- Link counts/statistics

Auto-negotiation status
- Link configuration ack
- Link advertisement status
- Pause capable
- Remote fault
- Destination MAC address when using ARP

QoS Measurements
- Throughput
- Frame Loss
- Packet Jitter
- Delay
- Out of Sequence

Packet/Jacket 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

Event Log

SONET/SDH
- Test Interfaces/Bit Rates
- 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

Laser Type
- SFP
- SFP+
- SFP - Tunable

Modes of Operation
- Terminate
- Monitor
- Thru (Intrusive)
- Tributary Scan
- Drop and Insert

Timing
- Recovered from Rx
- Internal (Stratum 3)
- Recovered from External (BITS/SETs)
- Recovered from 10 MHz clock
**SONET/SDH Features**

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  

**Round Trip Delay Measurement**  
RTD Measurement Accuracy  

**PRBS Patterns**  
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  

**Anomaly/Error generation**  
Bit/TSE  
Frame Word  
B1  
B2  
B3  
HP-REI  
MS-REI LP-BIP  
LP-REI  
Insert - Single  
Insert - Rate  
Multiple  

**Defects/Alarms Generation/Analysis**  
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  

**SONET Mappings**  
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c  
VC12  
VC4  
VC3  
E4  
DS3  
E3  
E1  

**SDH Mappings**  
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c  
VC12  
VC4  
VC3  
E4  
DS3  
E3  
E1  

**Results**  
Signal Category  
Signal Present  
Signal Loss Count  
Signal Loss Seconds  
Receive Frequency  
Receive Frequency Deviation  
Receive Frequency Maximum Deviation  
Transmit Frequency  
Electrical Input Level  
STS-1  
STM-1e  
BPV Count (STS-1 only)  
BPV-Error Rate (STS-1 only)  

**Regenerator/Section OH Category**  
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  
J0-Regenerator Trace  
Multiplexer/Line OH Category  
APS Message Count  
APS Bridge Request Code  
APS Destination Node  
APS Source Node  
APS Path Code  
APS Status  
APS Request Code  
APS K1 Channel Number  
APS K2 Channel Number  
APS MSP Architecture  
APS Status  
B2-BIP Error Count  
B2-BIP Error Rate  
SES  
Unavailable Seconds  
AIS Seconds  
REI Count  
REI Rate  
Si Synchronization Message  
Z1 Byte Value  

**High Path (AU, VC3/4) OH Category**  
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
Low Path (VC3/12, TU3/12, VT1.5) Category

- 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

Logic Category

- 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

Alarms

- Signal Loss Status
  - 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

High Path Trace Identifier Mismatch

LP-UNEQ/UNEQ-P

Low Path Trace Identifier Mismatch

Loss of Multiframe

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, 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, D1, D2, REI, REI API, 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

<table>
<thead>
<tr>
<th>Interface</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU1 (2.7G)</td>
<td>Dual Port Capable</td>
</tr>
<tr>
<td>OTU2 (10.7G)</td>
<td>Dual Port Capable</td>
</tr>
<tr>
<td>OTU1e (11.045G)</td>
<td>Dual Port Capable</td>
</tr>
<tr>
<td>OTU2e (11.095G)</td>
<td>Dual Port Capable</td>
</tr>
</tbody>
</table>

OTN Layer

OTN/ODU Framing

ODU1 in ODU2 Multiplexing

ODU0 Multiplexing

- ODU-0 Bulk BERT from an ONU-2
- ODU-0 1-Gigabit Ethernet Layer 2 & IPv4 traffic from an ONU-2
- ODU-0 Bulk BERT from an ONU-1
- ODU-0 1-Gigabit Ethernet Layer 2 & IPv4 traffic from an ONU-1
- ODUflex Bulk BERT from an ONU-2
- ODUflex 1-Gigabit Ethernet Layer 2 from and ONU-2
- Generic Mapping Procedure (GMP) supported
- GFP-T encapsulation of Ethernet 8B/10B PCS

GFP-T

- CID
- UPI

Overhead Manipulation/Analysis

Power Level

PM/SM TTI messages Tx/Rx

Overhead Manipulation/Analysis

Service Disruption Measurements

- SD Separation/Debounce Time Setting
- SD Threshold Time Settings

Payload Type (PT) Label generation/display

Transfer Delay

Freq Offset Transmit/Receive

PRBS Patterns

- 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

Error Insertion Capability

Single, Rate

OTU Error Tx/Rx

FAS

MFAS

SM-BIP/BEI

Laser Type

- SFP
- SFP+
- SFP+ - Tunable
PM-BIP/BEI
FEC Uncorrectable
FEC Correctable
TCM1-6 BIP
TCM1-6 BEI
Bit Error
Code Word Errors (Correct/Incorrect)

OTU Alarm Tx/Rx
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

OPU Errors/Alarms Tx/Rx
PT Label Mismatch
Client Loss
Bit Error

ODU Mappings
Bulk
ODU0
ODU1
ODU2

SDH Mappings
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c
VC4
VC3

SONET Mappings
STS-1, STS-3c, STS-12c, STS-48c, STS-192c

Ethernet Mappings
10GigE
1GigE

Results

LEDS
Signal Present
Frame Sync
Pattern Sync

LOS
LOF
LSS

Interface
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)

FEC
Uncorrected Word Errors
Uncorrected Word Error Rate
Corrected Word Errors
Correctable Word Errors
Corrected Word Errors Rate
Correctable Word Error Rate
Corrected Bit Errors
Correctable Bit Errors
Corrected Bit Errors Rate
Correctable Bit Error Rate

Framing
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

OTU
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

ODU
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-DAPI
PM-Operator Specific
PM Round Trip Delay Recent
PM Round Trip Delay Last

FTFL
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

TCM 1-6
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

OPU
Payload Type Mismatch Seconds
Payload Type
Payload
Pattern Sync Loss Seconds
Pattern Sync Losses
TSE/Bit Errors
TSE/Bit Error Rate

Ethernet Client
As per Ethernet results
RFC 2544 on 10 GE client

SONET/SDH Client
As per SONET/SDH results

OTN Check
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:
  - Data Rate (e.g. OTU4)
  - BER Threshold
  - Confidence Level (% value)

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

Fibre Channel Features
General
Flow Control
Login
Buffer Credits
Fibre Channel Login
at "F-Port"
at "N-Port"

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 (2^23-1, 2^31-1 and inverse)
All 1s
All 0s
User defined

Fibre Channel Traffic Generation
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%
Fibre Channel Traffic Filtering
Routing Control
Destination Identifier
Source Identifier
Data Structure Type
Sequence Count

Fibre Channel Error Insertion
Bit error
CRC
Framed Bit
Code violation
Insertion Type - Single, Rate, Burst

Enhanced Fibre Channel Test (RFC 2544 like)
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

8 Gig Fibre Channel Specific
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

Results
Interface
Signal Losses
Signal Loss Seconds
Sync Loss Seconds
Optical Rx Overload
Optical Rx Level (dBm)

Login Status
Far-end Buffer to Buffer Credits
Login Status
Tx/Rx ELP Accept
Tx/Rx ELP Ack1
Tx/Rx ELP Reject

Language
Tx/Rx ELP Request
L2 Link Statistics
Total Utilization %
Frame Rate
Frame Size
Rx Mbps
Tx Mbps
Round Trip Delay (us)
Service Disruption (us)

L2 Link Counts
Tx Frames
Rx 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
BERT Stats
Pattern Losses
Pattern Loss Seconds
Bit Error Rate
Bit Errors
Bit Errored Seconds
Bit Error-Free Seconds
Bit Error-Free Seconds (%)

Error Stats
Symbol Errors
CRC Errored Frames
Fiber Runts
Fiber Jabbers
Undersized Frames
Code Violations
Code Violation Rate
Code Violation Seconds

PDH
Test Interfaces
E4
DS3
E3
E1 Balanced
E1 Unbalanced
T1

Interface Type
BNC
Bantam
RJ48
E4

Modes of Operation
Terminate
Monitor
Thru (Intrusive)
Timing
Recovered from Rx
Internal (Stratum 3)
Recovered 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
64 k

Anomaly/Error Insert/Analysis
Frame Errors
TSE/Bit Error
Single
Rate
Defect/Alarm Insert/Analysis
AIS
RDI/FAS Distant
General
Frequency Offset ±100 ppm
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
- Through (Intrusive)

**Timing**
- Recovered from Rx
- Internal (Stratum 3)
- Recovered from External (BITS/SETS)

**Framing**
- M13
- C-bit
- Unframed

**Test Patterns**
- All 1s
- All 0s
- 2^15-1* (Inverse)
- 2^20-1* (Inverse)
- 2^23-1* (Inverse)
- Round Trip Delay
- User Programmable (3, 32 bits)
- User Byte
- 100
- 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
- Rx Compensation - High - 0 ft
- Rx Compensation - Low - 450 ft
- Rx Compensation - Low - 900 ft
- Service Disruption

**Performance Measures**
- G.826
- 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**
- Recovered from Rx
- Internal (Stratum 3)
- Recovered from External (BITS/SETS)

**Framing**
- Framed
- Unframed

**Test Patterns**
- All 1s
- All 0s
- 2047
- 2^11-1* (Inverse)
- 2^15-1* (Inverse)
- 2^20-1* (Inverse)
- 2^23-1* (Inverse)
- User Programmable (3, 32 bits)
## VIAVI T-BERD/MTS-5800 Specifications

### User Byte
- Round Trip Delay
  - 1:1
  - 1:3
  - 1:4
  - 1:7
- ANSI and ITU

### Mappings
- E1
- 64k

### Anomaly/Error Insert/Analysis
- Code Error
- FAS Error
- TSE/Bit Error
- Single
- Rate

### Defect/Alarm Insert/Analysis
- AIS
- RDI/FAS Distant

### General
- Frequency Offset Tx +/- 100ppm
- Tx LBO - 0 dB Loss
- Tx LBO - 6 dB Loss
- National Bit Support - On/Off
- Service Disruption

### Performance Measures
- G.826 | ISM/OOS
- G.821
- M.2100

### Results

### Signal Category
- 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)

### Frame Category
- 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

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

### E1 Modes of Operation
- Terminate
- Monitor
- Thru (Intrusive)

### Timing
- Recovered from Rx
- Internal (Stratum 3)
- Recovered from External (BITS/SETs)

### Framing
- Unframed
- PCM30
- PCM30C
- PCM31
- PCM31C

### Test Patterns
- All 1s
- All 0s
- 2^15-1* (Inverse)
- 2^20-1* (Inverse)
- 2^23-1* (Inverse)
- QRSS
- User Programmable (32 bits)

### Round Trip Delay (ms)
- 1:1
- 1:3
- 1:4
- 1:7
- ANSI and ITU

### 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

### 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

---

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<tr>
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<td></td>
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<td></td>
<td>DSO Channel Payload View</td>
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<tr>
<td>ABCD Bit Signaling View</td>
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</table>

**Notes:**
- T1: Modes of Operation
- Terminate
- Monitor
- Through (Intrusive)
- Timing
- Recovered from Rx
- Internal (Stratum 3)
- Recover from External (BITs/SETs)
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- Unframed
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- ESF
- SLC-96
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- 2047
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- G.828: ISM/OOS
- G.829: ISM/OOS
- M.2100
- T1.231
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- Service disruption
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- Loop Code Emulation: NIU, CSU
- Loop Code Tx - Repeater
- HDSL Loop Code Tx
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- Customer to CO direction
- User Defined Loop Code Support
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- Reference Frequency
- Receive Frequency Deviation
- Receive Frequency Maximum Deviation
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- Receive Level (dBdx)
- Receive Level (dBm)
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- BPV Error Rate
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- Signal Loss Count
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<td>Throughput (Average, Current, Maximum)</td>
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<td>Throughput (Average, Current, Maximum)</td>
<td><strong>IP Ping</strong></td>
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</tr>
<tr>
<td>Throughput (Average, Current, Maximum)</td>
<td><strong>IP Ping</strong></td>
</tr>
</tbody>
</table>
BPV Rate
BPV Error Seconds
Excess Zeros Count
Excess Zeros Seconds
DS3
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Frame Sync Loss Seconds
Near End OOF Seconds
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C-Bit Error Rate
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FEBE Rate
FEBE Seconds
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Short Frames
FCS Errored Frames
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Throughput (Average, Current, Maximum)
Average Frame Rate (frames/sec)
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**CPRl**

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<th>Dual Port Capable</th>
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<tr>
<td>1.2 Gbps optical (Rate 2)</td>
<td></td>
</tr>
<tr>
<td>2.4 Gbps optical (Rate 3)</td>
<td></td>
</tr>
</tbody>
</table>

**Laser Type**
- SFP
- SFP+
- SFP+ Tuneable

**Modes of Operation**
- Terminate
- Monitor/Thru

**Timing**
- Recovered from Rx (Slave)
- Internal (Stratum 3) (Master)
- Recovered from External (Bits/SEts) (Master)
- Recovered from 10MHz clock (Master)

**CPRl Automation**
- CPRl Service Activation automated workflow

**CPRl Features**
- Optical/Electrical Power Level
- Freq Offset Transmit/Receive
- CPRl Startup Sequence - Normal or Bypass

**Signal Generation and Monitoring**
- L1 - PRBS Pattern Inserted in Hyperframe Structure
- L2 - PRBS Pattern Inserted in CPRl Basic Frame
- L2 - PRBS Pattern Inserted in CPRl Antenna-carrier (AxC) Group
- L2 Test Waveform Inserted in CPRl Antenna-carrier (AxC) Group

**Interface Type**
- Master
- Slave
- Selectable CPRl Protocol Version

**Control and Management (C&M) Channel**
- Ethernet
- HDLC
- Selectable C&M Channel Rate

**Service Disruption Measurements**

- SD Separation/Debounce Time Setting
- SD Threshold Time Settings
- Round-Trip Delay Measurement
- RTD Measurement Accuracy
- 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

**Anomaly/Errors Generation**
- Bit/TSE Code
- K30.7
- Running Disparity
- Insert – Single
- Insert – Rate

**CPRl AxC Mapping**
- Mapping Method: Method 1
- Sample Width
- Bandwidth
- AxC Group Number
- Offset

**Test Waveform Selections**
- Continuous Wave (CW)
- LTE-FDD TM11
- LTE-FDD TM12
- LTE-FDD TM2
- LTE-FDD TM31
- LTE-FDD TM32
- LTE-FDD TM33

**Loopback AxC (ALU/Nokia RRH)**
- Set Power levels and Bands (ALU/Nokia RRH)

**Defects/Alarms Generation/Analysis**
- LOS
- LOF
- SDI
- RAI

**Results**
- Results Accuracy
- 1ns

**Signal Category**
- Signal Losses
Sync Loss Seconds
Optical Rx Overload
Receive Frequency
Receive Frequency Deviation
Receive Frequency Maximum Deviation
Transmit Frequency
Tx Frequency Deviation (Hz)
Tx Frequency Deviation (ppm)
Tx Frequency Max Deviation (ppm)

**CPRI Inband Protocol**
- Tx/Rx Protocol Version
- Tx/Rx C&M HDLC Rate
- Tx/Rx C&M Ethernet Subchannel Number
- Port Type (Master/Slave)
- Start-up State

**CPRI Counts**
- Code Word Count Tx/Rx
- Frame Count Tx/Rx

**Error Stats**
- Word Sync Loss Events
- Word Sync Loss Seconds
- Code Violations
- Code Violation Rate
- Code Violation Seconds
- K307 Words

**Frame Sync Loss Events**
- Pattern Sync Losses
- Pattern Sync Loss Seconds

**Timing**
- Bit Error Rate
- Bit Errors

**Error-Free Seconds**
- Error-Free Seconds, %

**Round Trip Delay**
- Round Trip Delay Current (ms)
- Round Trip Delay Average (ms)
- Round Trip Delay Minimum (ms)
- Round Trip Delay Maximum (ms)

**Remote LOS**
- Remote LOS
- Remote LOS Seconds
- Remote LOF
- Remote LOF Seconds
- RAI

**RAI**
- RAI Seconds
- SDI Seconds

**Running Disparity Errors**
- Running Disparity Error Rate

**RRH Testing (available for ALU RRH)**
- RRH SW version
- RRH serial number

**OBSAI Features**
- Optical/Electrical Power Level
- Freq Offset Transmit/Receive

**PRBS Generation and Monitoring**
- Unframed
- L1 - Pattern Inserted in Frame Structure
- L2 - Pattern Inserted in OBSAI Message

**OBSAI Interface**
- 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**

**Round Trip Delay Measurement**
- RTD Measurement Accuracy

**PRBS Patterns**
- D6.6 D25.6
- Delay
- Live
- Digital Word

**Anomaly/Errors Generation**
- Bit
- Code
- Insert - Single
- Insert - Rate

**Results**

**Signal Category**
- 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)

**OBSAI Counts**
- 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**

**Error Stats**
- Word Sync Loss Events
- Word Sync Loss Seconds
- Code Violations
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### Jitter O.172

#### General Features
- Generate and measure Jitter on electrical interfaces: DS1, E1, E3, E4, STM1e
- Automatic Measurement Sequences
  - Maximum Tolerable Jitter (MTJ)
  - Measure Intrinsic Jitter
  - Jitter Transfer Function (JTF)
- Support different Measurement Bands
  - High Band
  - Wide Band
  - Extended Band
- Ability to set user definable band
- Common Jitter mask selectable
- Ability to create custom 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
- Offset Between Test Signal and Reference
  - Current Offset (μs)
  - Minimum Offset (μs)
  - Maximum Offset (μs)
- TIE Graph
- Reference Clock for 1pps 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

#### Wander Analysis Tool
- Offline analysis of captured/imported TIE measurements
- Maximum Peak-to-Peak TIE (MTIE) [μs]
- TDEV (Time Deviation)
- Frequency Offset (ppm)
- Drift Rate (ppm/s)

#### Masks
- 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, II (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.82711)
  - Wander Generation (G.8272)
  - DTE Noise Generation (G.8273.2 constant temp.)
  - DTE Noise Generation (G.8273.2 variable temp.)
- 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 & 1K Audio
  - Configurable Calling & Called Party Number Plans and Number Types
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<td><strong>Configurable RTP port range</strong></td>
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</table>

### General Parameters
- Auto answer on/off
- Codecs:
  - G.711 A Law
  - G.711 U Law
  - G.723 5.3 K
  - G.723 6.3 K
  - G.729A
  - G.726
  - G.722
- 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

### Triple Play Automated Test Script
- 10/100/1000M Electrical Ethernet Interfaces
- 1GigE Optical Ethernet Interface

### 10GigE Optical Ethernet Interface
- Single Program Transport Stream (SPTS) and Multiple Program Transport Stream (MPTS) formats
- Video explorer capable of detecting 512 SPTS and 32 MPTS and a video analyzer that supports 16 SPTS and 1 MPTS
- Supported measurements include bandwidth utilization, packet loss, packet jitter, PCR jitter, continuity error bit and error bit indicator
- TR 101 290 priority 1 errors such as program identification (PID), program association table (PAT) and program map table (PMT)
- Loss distance and period errors per RFC3357, results per transport stream and per PID
- Media Delivery Index (MDI) measurements
- Measure ICC latency and R-UDP latency
- Microsoft Television (MSTV) Support
- Internet Group Management Protocol (IGMP) support

#### Primary Rate ISDN
- **Test Access**: T1
- **TE Emulation**: National SESS NI-1
- **D-Channel Rate**: 64 k 56 k
- **Call Type**: Data Voice 31 k audio
- **Channel Number**: 1 to 24
- **D-Channel Rate**: 56 k

#### Primary Rate E1 ISDN
- **Test Access**: E1
- **TE Emulation**: National SESS NI-1
- **D-Channel Rate**: 64 k 56 k
- **Call Type**: Data Voice 31 k audio
- **Channel Number**: 1 to 24
- **D-Channel Rate**: 56 k

### D-Channel Signaling Decodes
- **Codec**: μ-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**

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<th><strong>Services</strong></th>
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<td>Speech</td>
<td>Data</td>
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<td>Fax G4</td>
<td>Teletext</td>
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<tr>
<td>Videotext</td>
<td>Speech BC</td>
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<td>Data BC</td>
<td>Data 56Kb</td>
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<td>Fax 2/3</td>
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<table>
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<tr>
<th><strong>Channel Number</strong></th>
<th>1 to 31</th>
</tr>
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</table>

### 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**: TE Access T1
- **Fractional T1**: n x 64 k
- **Fractional T1**: n x 56 k
- **Contiguous Channels**: Non Contiguous Channels
- **VS4 Loop Codes Support**: Voice Frequency
- **Test Access**: T1
- **Listed to an Audio Call**: Insert VF Tones 404, 1004, 1804, 2713, and 2804 Hz
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 & 1550 nm

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 1310 nm: 35 dB
- at 1550 nm: 33 dB

Event Dead Zone:
- at 1310 nm/1550 nm: 1.5 m maximum

Attenuation Dead Zone:
- at 1310 nm/1550 nm: 6 m maximum

Pulse width: 5 ns to 20 ms

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 FT TA & DAS Singlemode & Multimode Network Testing

Wavelengths: 850, 1300, 1550 nm

Connector type: UPC or APC for 1310 nm/1550 nm (Note: Only one should be selected) and UPC for 850 nm/1300 nm

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

Dynamic Range:
- at 850 nm: 26 dB
- at 1300 nm: 24 dB
- at 1310 nm: 37 dB
- at 1550 nm: 35 dB

Event Dead Zone:
- at 850 nm/1300 nm: 0.8 m maximum
- at 1310 nm/1550 nm: 0.9 m maximum

Attenuation Dead Zone:
- at 850 nm/1300 nm: 4 m maximum
- at 1310 nm/1550 nm: 4 m maximum

Pulse width:
- at 850 nm/1300 nm: 3 ns to 1 ms
- at 1310 nm/1550 nm: 3 ns to 20 μs

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: 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 Backhaul Network Testing

Wavelengths: 1310, 1550, 1625 nm (Note: 1625 nm 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 1310 nm: 40 dB
- at 1550 nm: 38 dB
- at 1625 nm: 37 dB

Event Dead Zone:
- at 1310/1550/1625 mn: 0.9 m maximum

Attenuation Dead Zone:
- at 1310/1550/1625 mn: 4 m maximum

Pulse width:
- 3 ns to 20 ms

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

OTDR Solution for Cloud RAN & Access/Backhaul Network Testing

Wavelengths: 1310, 1550, 1625 nm (Note: 1625 nm 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 1310 nm: 43 dB
- at 1550 nm: 43 dB
- at 1625 nm: 41 dB

Event Dead Zone:
- at 1310/1550/1625 mn: 0.8 m maximum

Attenuation Dead Zone:
- at 1310/1550/1625 mn: 4 m maximum

Pulse width:
- 3 ns to 20 ms

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, 1611 nm
- 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: 35 dB
- Event Dead Zone:
  - at 1310/1550/1625 nm: 1.5 m maximum
- Attenuation Dead Zone:
  - at 1310/1550/1625 nm: 5 m maximum
- Pulse width: 10 ns to 20 ms
- 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

#### 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

#### Rubidium Clock
- Support for two 1PPS inputs and capable of measuring phase difference between them down to 5 nsec
- Support for measuring ToD offset for a device under test with NMEA and G.8271 (draft) formats
- Support for a 10 MHz input
- Support for a 1PPS output disciplined to the Rubidium clock
- Support for a 10 MHz 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
- 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

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### Results

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