# T-BERD®/MTS-6000A MSAM Specifications

## Ethernet features

<table>
<thead>
<tr>
<th>Ethernet features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layer 1 (unframed) Bit Error testing patterns</strong></td>
<td>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)</td>
</tr>
<tr>
<td><strong>Layer 2 (framed) Bit Error testing patterns</strong></td>
<td>Compliant random-data pattern (CRPAT), Compliant jitter-tolerance pattern (CJPAT), Compliant supply-noise pattern (CSPAT)</td>
</tr>
<tr>
<td><strong>Layered Pattern test</strong></td>
<td>PRBS (2^n-1, 2^n-15-1, 2^n-20-1, 2^n-23-1, 2^n-31-1 and inverse)</td>
</tr>
<tr>
<td><strong>All 1s, all 0s</strong></td>
<td>1:3, 1:7, 3:1, 7:1, 2 in 8</td>
</tr>
<tr>
<td><strong>User-defined</strong></td>
<td></td>
</tr>
</tbody>
</table>

## Ethernet generator

<table>
<thead>
<tr>
<th>Frame type</th>
<th>802.3, DIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC with inner and outer MAC</td>
<td></td>
</tr>
<tr>
<td>EtherType field-editable</td>
<td></td>
</tr>
<tr>
<td><strong>MAC addressing</strong></td>
<td>Destination MAC address - Unicast, Destination MAC address - Broadcast, Source MAC address - User-defined, Source MAC address - Auto-increment</td>
</tr>
<tr>
<td><strong>MAC frame size</strong></td>
<td>64, 128, 256, 512, 1024, 1280, 1518, user-defined, jumbo (to 10 k)</td>
</tr>
</tbody>
</table>

## VLAN stacking (Q-in-Q)

| SVLAN (tag-editable fields) | SVLAN ID, VLAN priority, VLAN DEI, VLAN TPID, CVLAN ID, VLAN priority, Supports up to 8 stacked VLAN tags |

## VPLS

| VPLS parameters | MAC addresses, Frame type, Ethernet type, VPLS tunnel and VC label - Lavel, GoS, TTL, VPLS control word - Reserved bits, sequence number |

## MAC in MAC/PBT/PBB 802.1ah

| Parameters | MAC address, B-Tag - TPI, VID, priority, DEI, I-Tag - TPI, SID, priority, DEI, NCA, Res1, Res2 |

## MPLS

| Parameters | 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, Line-rate traffic generation, Traffic analysis, Editable parameters/results - Label, Editable parameters/results - Priority, Editable parameters/results - TTL, Rx filters |

## VLAN

| VLAN tagging 802.1q | VLAN tag-editable fields - Priority, - VID |

## Ethernet

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<thead>
<tr>
<th>Test interfaces/bit rates</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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## Interface type

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## General

| Line-rate traffic Tx and Rx for all interfaces | Single-stream generation/analysis |
| 10-stream generation/analysis per stream | Auto-discovery of test sets |

## Modes of operation

| Terminate, Monitor, Thru (intrusive), Loopback, Half duplex, Full duplex | Traffic analysis, Editable parameters/results - Label, Editable parameters/results - Priority, Editable parameters/results - TTL, Rx filters |

## Timing

| Recovery from Rx, Recovered from external (bits/set), Frequency offset Tx/Rx | CCM message generation and analysis, AIS generation, Common header label - PW, LSP, Section, OAM alert label (Label 14) from ITU-T G.8114, GAL (Label 13) + ACH from IETF Draft, Generate/monitor OAM messages - CCM, - LBM/LBR, - AIS |

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## VLAN

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**Specifications cont’d.**

<table>
<thead>
<tr>
<th><strong>Ethernet OAM</strong></th>
<th><strong>IP ping</strong></th>
<th><strong>ITU-T.Y.1564</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y.1731 Service OAM and 802.1ag CFM</td>
<td><strong>Fast ping</strong></td>
<td>10 Traffic streams</td>
</tr>
<tr>
<td>CCM messages</td>
<td><strong>IP traceroute</strong></td>
<td>Service Configuration test</td>
</tr>
<tr>
<td>Programmable CCM rate</td>
<td><strong>Traffic Generator</strong></td>
<td>Service Performance test</td>
</tr>
<tr>
<td>CCM type - Unicast, multicast</td>
<td>Number of traffic engines</td>
<td>Committed information rate (CIR)</td>
</tr>
<tr>
<td>MEG ID end point</td>
<td>Bandwidth controlled</td>
<td>Maximum IR (MIR)</td>
</tr>
<tr>
<td>Maintenance domain level</td>
<td>Bandwidth specification in Mb</td>
<td>Frame loss rate (FLR)</td>
</tr>
<tr>
<td>AIS Tx/Rx</td>
<td>Bandwidth granularity</td>
<td>Frame delay (FD)</td>
</tr>
<tr>
<td>RDI Tx/Rx</td>
<td>Bandwidth specification in %</td>
<td>Frame delay variation</td>
</tr>
<tr>
<td>LBD/LBM (Ping) - Unicast, multicast</td>
<td>Burst mode - Burst size - 1 to 2 M frames</td>
<td>Configurable VLAN, priority, addressing, and pass/fail</td>
</tr>
<tr>
<td>LTM/LTR (Trace)</td>
<td>Continuous Tx</td>
<td>Thresholds</td>
</tr>
<tr>
<td><strong>802.3ah Link OAM</strong></td>
<td>Once Tx - Definable frames/burst</td>
<td>Graphical results</td>
</tr>
<tr>
<td>Mode - Passive/active</td>
<td><strong>Traffic profiles</strong></td>
<td>Saved test profiles</td>
</tr>
<tr>
<td>Vendor OUI</td>
<td>Constant B/W</td>
<td>Configurable DEI, TPID, ID/UDP/CCP</td>
</tr>
<tr>
<td>Vendor-specific info</td>
<td>Ramp B/W</td>
<td>Inclusive of L2 Ethernet and IPv4</td>
</tr>
<tr>
<td>Max PDU size</td>
<td>Bursty B/W</td>
<td>Integrated TrueSpeed TCP traffic stream with background</td>
</tr>
<tr>
<td>Unidirectional links</td>
<td>Flood B/W</td>
<td>streams</td>
</tr>
<tr>
<td>Remote loopback</td>
<td>Traffic generation in Mbps and % utilization</td>
<td>Asymmetric testing</td>
</tr>
<tr>
<td>Link events</td>
<td><strong>TCP/IP packet generator</strong></td>
<td>One-way delay with CDMA receiver</td>
</tr>
<tr>
<td>Variable retrieval</td>
<td>10/100/1000 M Line rate stateful emulation</td>
<td><strong>IETF RFC 6349</strong></td>
</tr>
<tr>
<td>Dying gosp</td>
<td>10 GE Line rate stateful emulation</td>
<td>Automated TCP-Throughput test per RFC 6349</td>
</tr>
<tr>
<td>Link fault</td>
<td>Configurable Src and Dest IP address</td>
<td>Path MTU Detection test</td>
</tr>
<tr>
<td>Critical event</td>
<td>Packet length</td>
<td>Round-Trip Time test</td>
</tr>
<tr>
<td><strong>MAC frame payload</strong></td>
<td>TCP/UDP traffic modes</td>
<td>Walk-the-Window test</td>
</tr>
<tr>
<td>PRBS pattern</td>
<td>Source port</td>
<td>TCP-Throughput test</td>
</tr>
<tr>
<td>Editable digital word</td>
<td>Destination port</td>
<td>Traffic-Shaping test</td>
</tr>
<tr>
<td><strong>Flow control</strong></td>
<td>Listen port</td>
<td>TCP-Efficiency metric</td>
</tr>
<tr>
<td>Emulation on/off</td>
<td>Configurable TCP window size</td>
<td>Buffer-Delay metric</td>
</tr>
<tr>
<td><strong>Pause frames</strong></td>
<td>TCP client emulation</td>
<td>Up to 64 simultaneous TCP stateful sessions</td>
</tr>
<tr>
<td>Tx insert</td>
<td>TCP server emulation</td>
<td>Graphical results and report generation</td>
</tr>
<tr>
<td>Pause quanta - definable</td>
<td>Up to 64 simultaneous TCP stateful sessions</td>
<td>Configurable file and window sizes</td>
</tr>
<tr>
<td>Pause frame analysis (for example, counts)</td>
<td>Supports 4 background streams</td>
<td>Total-test-time display</td>
</tr>
</tbody>
</table>

**Layer 2 Transparency testing**

<table>
<thead>
<tr>
<th><strong>IP packet generator</strong></th>
<th><strong>RFC 2544</strong></th>
<th><strong>Layer 2 Transparency testing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP</strong></td>
<td>Asymmetric testing</td>
<td>Send/receive Ethernet control plane traffic</td>
</tr>
<tr>
<td>IPv4 frame format</td>
<td>Symmetric testing</td>
<td>Encapsulation supported - VLAN</td>
</tr>
<tr>
<td>IPv6 frame format</td>
<td>Throughput</td>
<td>Encapsulation supported - Q-in-Q</td>
</tr>
<tr>
<td>TCP port number</td>
<td>Frame loss</td>
<td>Encapsulation supported - Spanning Tree</td>
</tr>
<tr>
<td>UDP port number</td>
<td>Out-of-sequence frames</td>
<td>Encapsulation supported - Cisco protocols (Discovery, etc.)</td>
</tr>
<tr>
<td><strong>IP addressing</strong></td>
<td>Delay</td>
<td>Encapsulation supported - GARP</td>
</tr>
<tr>
<td>Destination IP address - User-defined</td>
<td>Back to back</td>
<td>Encapsulation supported - STP</td>
</tr>
<tr>
<td>Source IP Address - User-defined</td>
<td>Jitter</td>
<td>Send/receive Ethernet control plane traffic</td>
</tr>
<tr>
<td><strong>IPv4 editable fields</strong></td>
<td>Master/Slave</td>
<td>- Spanning Tree frames Tx/Rx</td>
</tr>
<tr>
<td>Tos</td>
<td>Connectivity QuickCheck</td>
<td>- Cisco discovery protocol</td>
</tr>
<tr>
<td>DSCP</td>
<td>Parallel testing</td>
<td>- LDP frames Tx/Rx</td>
</tr>
<tr>
<td>Flags</td>
<td>Definable frame size</td>
<td>- Link aggregation LACP</td>
</tr>
<tr>
<td>Protocol</td>
<td>Report formats</td>
<td>- Cisco UDDL, ISL, PAgP, DTP, PVST-PVST+</td>
</tr>
<tr>
<td>TTL</td>
<td>Graphical results</td>
<td>- MAC bridging 802.1d</td>
</tr>
<tr>
<td><strong>IPv6 editable fields</strong></td>
<td>Total-test-time display</td>
<td>- VLAN-BRIDGE</td>
</tr>
<tr>
<td>Traffic class</td>
<td></td>
<td>- Custom frame builder</td>
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</tbody>
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### Synchronous Ethernet ITU G.826x
- 10 GE Tx/Rx
- 1000/100/10 M Tx/Rx
- Recovered interface timing
- 4.6 ppm frequency accuracy
- SSM message decode
- ESMC message capture
- Quality message decode
- Definable SSM PDU rate (pps)
- Background data plane traffic generation

### 1588v2
- 1 GE Tx/Rx
- 1588v2 master PRC emulation
- 1588v2 slave emulation
- Packet delay variation measurements on control plane traffic
- Generate up to 4 streams of background dataplane traffic
- Frame/packet capture and decode via Wireshark

### Loopback
- Manual (LLB)
- Automatic
- Local
- Far end

### Delay
- Round-trip 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 10 Gbps
- Wirespeed capture up to 1000/100/10 M
- Integrated Wireshark on the test set
- 256 MB capture buffer
- 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 - Q-in-Q, 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/DSIP fields
- **TCP/UDP (Layer 4) traffic filtering**
  - ATP listen port

### 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
- Loss of signal
- Link active
- Frame detected
- Sync obtained
- VLAN-tagged frame detected

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

### Link counts/statistics
- Bandwidth utilization
- Frame rate
- Tx Mbps
- Rx Mbps
- 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
- Unicast frames
- Unicast packets
- Multicast frames
- Multicast packets
- Broadcast frames
- Broadcast packets
- Frame length
- Packet length
- Packet jitter, avg
- Packet jitter, max

### Link counts/statistics

### Link counts/statistics
SONET/SDH

Test interfaces/bit rates

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<td>OC-3</td>
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<td>STM-4</td>
<td></td>
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Laser type

- SFP
- XFP
- XFP - Tunable

Modes of operation

- Terminate
- Monitor
- Thru (intrusive)
- Tributary scan
- Drop and insert

Timing

- Recovered from Rx
- Internal (Stratum 3)
- Recovered from external (bits/set)
- 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
- Recovered byte viewing/manipulation
- Service disruption measurements
  - SD separation/debounce time setting
  - SD threshold time settings
- Signal label generation/display
- Frequency offset Rx/Rx

Round-trip delay measurement

- RTD measurement accuracy

PRBS patterns

- 2^25-1
- 2^25-1 inverse
- 2^23-1
- 2^23-1 inverse
- 2^31-1
- 2^31-1 inverse
- Programmable - 32 bit

Anomoly/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-ROJ
- AU-LOP
- AU-AIS
- HP-UNEQ
- HP-ROJ
- HP-TIM
- HP-PLM
- TU-LOP
- TU-AIS
- TU-LOM
- LP-UNEQ
- LP-ROJ
- LP-TIM
- LP-PLM
- LP-RIJ

SDH mappings

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

SONET mappings

- STS-1, STS-3c, STS-12c, STS-48c, STS-192c
- VT1.5
- DS3
- DS1
- 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 (dBdsx, dBm, volts) and STM-1e (dBnom only)
- BPN count (STS-1 only)
- BPN-error rate (STS-1 only)
Specifications cont’d.

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 (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

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-justification count
- Pointer-increment count
- Pointer-decrease 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 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 seconds
- Pattern-loss count
- Pattern-synchronization-loss seconds
- 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 (TIM)
- High-path trace identifier mismatch (TIM)
- Low-path trace identifier mismatch (TIM)
- Tunnel loss of multiframe (n=12/12)

Overhead-byte manipulation/viewing – high path
- A1, A2, J0, J1, D1, D2, D3, C2, H1, H2, H3, G1, B1, 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)
- VS, 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, elapsed test time

OTN G.709

Test interfaces/bit rates
- OTU1 (2.7G)
- OTU2 (10.7G)
- OTU1e (11.045G)
- OTU2e (11.095G)

Laser type
- SFP
- XFP
- XFP - Tunable

Modes of operation
- Terminate
- Monitor

OTN layer
- OTN/ODU framing
- ODU1 in ODU2 multiplexing
- ODU0 multiplexing
- ODU-0 bulk BERT from an OTU-2
- ODU-0 1 GE Layer 2 and IPv4 traffic from an OTU-2
- ODU-0 bulk BERT from an OTU-1
- ODU-0 1 GE Layer 2 and IPv4 traffic from an OTU-1
- 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 To/Rx
- Overhead manipulation/analysis
- Service-disruption measurements
- - SD separation/debounce time setting
- - SD threshold time settings
- Payload type (PT) label generation/display
- Transfer delay
- Frequency offset To/Rx
**Specifications** cont'd.

### 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
- PM-BIP/BEI
- FEC uncorrectable
- FEC correctable

#### TCM1-6 BIP

#### TCM1-6 BEI

#### Bit error

Gedekword errors (correct/incorrect)

### OTU alarm Tx/Rx
- LOF
- OOF
- LOM
- OOF
- OOM
- SM-IAE
- SM-TIM
- SM-BDI
- SM-BIAE
- PM-TIM
- PM-BOI
- FTFL Fwd signal fail
- FTFL Fwd signal degraded
- FTFL Bwd signal fail
- FTFL Bwd signal degraded

#### TCM1-6 IAE

#### TCM1-6 TIM

#### TCM 1-6 BDI

#### SM-BPI/BEI

#### PM-BIP/BEI

### 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
- 10 GE
- 1 GE

### 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 maximum deviation (ppm)
- Rx-frequency (Hz)
- Rx-frequency deviation (ppm)
- Signal-loss count
- Tx clock source
- Tx-frequency maximum 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-error rate
- Correctable word-error rate
- Corrected bit errors
- Correctable bit errors
- Corrected bit-error 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-BP/BEI errors
- SM-BP/BEI error rate
- SM-BDI seconds
- SM-BDI count
- SM-BIAE seconds
- SM-BIAE count
- SM-BEI count
- SM-BEI-error rate
- SM-TIM seconds
- SM-TIM count
- SM-TIM seconds
- SM-SAIF
- SM-SAIF
- SM-operator specific
- ODU-AIS
- ODU-AIS seconds
- ODU-LCK
- ODU-LCK seconds
- ODU-OCI
- ODU-OCI seconds
- PM-BIP count
- PM-BIP-error rate
- PM-BDI count
- PM-BDI seconds
- PM-BEI count
- PM-BEI-error rate
- PM-TIM seconds
- PM-TIM count
- PM-SAIF
- PM-SAIF
- PM-operator specific

### FTFL
- Forward-fault type
- Forward-OOF seconds
- Forward-operator specific
- Forward-operator identifier
- Backward fault type
- Backward SF-seconds count
- Backward SD-seconds count
- Backward-operator identifier
- Backward-operator specific
**Specifications cont'd.**

### TCM 1-6
- IAE seconds
- BIP errors
- BIP-error rate
- BDI seconds
- BDI-error seconds
- BEI errors
- BEI-error rate
- TIM seconds
- DAPI
- Operator-specific

### OPU
- Payload type mismatch seconds
- Payload type

### Payload
- Pattern-sync-loss seconds
- Pattern-sync losses
- TSE/bit errors
- TSE/bit-error rate

### Fibre Channel
**Laser type**
- SFP
- XFP

**Modes of operation**
- Terminate
- Monitor
- Thru

**Test interfaces/bit rates**
- 1.0625 or 2.125 Gbps
- 4.25 Gbps
- 8.5 Gbps
- 10.125 Gbps

**Fibre Channel features**
- General
  - Flow control
  - Login
  - Buffer credits
- Fibre Channel login
  - at “F-port”
  - at “N-port”
- Fibre Channel traffic generation
  - Transmit traffic profiles
  - Constant
  - Ramp
  - Bursty
  - Traffic generation in Mbps and % utilization
  - Configurable source and destination ID
  - Sequence ID
  - Originator ID
  - Responder ID
  - Frame length - 28, 32, 76, 12, 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

**Fibre Channel script (RFC-2544-like)**
- 8 G 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**
- Login status
  - Far-end buffer-to-buffer credits
  - Login status
  - Tx/Rx ELP accept
  - Tx/Rx ELP Ack1
  - Tx/Rx ELP reject
  - Tx/Rx ELP request

**PDH**
- Test interfaces
  - E4
  - DS3
  - E1 balanced
  - E1 unbalanced
  - T1
  - Dual receivers
  - Dual receivers
- Interface type
  - BNC
  - Bantam
  - RJ-48
  - Dual receivers

**E4**
- Modes of operation
  - Terminate
  - Monitor
  - Thru (Intrusive)

**Timing**
- Recovered from Rx
- Internal (Stratum 3)
- Recover 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/OO5)

### Results
- Signal category
  - Receive frequency
  - Receive-frequency deviation
  - Receive-frequency maximum 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
### Specifications cont'd.

<table>
<thead>
<tr>
<th><strong>DS3</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modes of operation</strong></td>
</tr>
<tr>
<td>Terminate</td>
</tr>
<tr>
<td>Monitor</td>
</tr>
<tr>
<td>Thru (intrusive)</td>
</tr>
<tr>
<td><strong>Timing</strong></td>
</tr>
<tr>
<td>Recovered from Rx</td>
</tr>
<tr>
<td>Internal (Stratum 3)</td>
</tr>
<tr>
<td>Recovered from external (bits/set)</td>
</tr>
<tr>
<td><strong>Framing</strong></td>
</tr>
<tr>
<td>M13</td>
</tr>
<tr>
<td>C-Bit</td>
</tr>
<tr>
<td>Unframed</td>
</tr>
<tr>
<td><strong>Test Patterns</strong></td>
</tr>
<tr>
<td>All 1s</td>
</tr>
<tr>
<td>All 0s</td>
</tr>
<tr>
<td>$2^{11} - 1^*$ inverse</td>
</tr>
<tr>
<td>$2^{15} - 1^*$ inverse</td>
</tr>
<tr>
<td>$2^{20} - 1^*$ inverse</td>
</tr>
<tr>
<td>$2^{23} - 1^*$ inverse</td>
</tr>
<tr>
<td>User-programmable (3...32 bits)</td>
</tr>
<tr>
<td>User byte</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>1100 (aka IDLE)</td>
</tr>
<tr>
<td>1010 (aka BLUE)</td>
</tr>
<tr>
<td>ANSI and ITU</td>
</tr>
<tr>
<td><strong>Mappings</strong></td>
</tr>
<tr>
<td>E1</td>
</tr>
<tr>
<td>T1</td>
</tr>
<tr>
<td>64 k</td>
</tr>
<tr>
<td><strong>Anomaly/error insert/analysis</strong></td>
</tr>
<tr>
<td>BPV/code error</td>
</tr>
<tr>
<td>Frame</td>
</tr>
<tr>
<td>Parity</td>
</tr>
<tr>
<td>C-Bit parity</td>
</tr>
<tr>
<td>TSE/bit error</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Rate</td>
</tr>
<tr>
<td>Multiple</td>
</tr>
<tr>
<td><strong>Defect/Alarm Insert/Analysis</strong></td>
</tr>
<tr>
<td>AIS</td>
</tr>
<tr>
<td>RDI/FAS distant</td>
</tr>
<tr>
<td>REBE</td>
</tr>
<tr>
<td>T1-16 AIS</td>
</tr>
<tr>
<td>T1-16 RDI/MFAC distant</td>
</tr>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>Frequency offset ±100 ppm</td>
</tr>
<tr>
<td>Loop codes Tx NIU, CSU, line</td>
</tr>
<tr>
<td>Rx compensation - High - 0 ft</td>
</tr>
<tr>
<td>Rx compensation - Low - 450 ft</td>
</tr>
<tr>
<td>Rx compensation - Low - 900 ft</td>
</tr>
<tr>
<td>Service disruption</td>
</tr>
</tbody>
</table>

| **Performance measures** |
| G.826 (ISI/OOS) |
| G.821 |
| M.2100 |
| M.2101 |
| T.123 |
| T.510 |

| **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) |
| User byte |
| Round-trip delay (ms) |
| 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 ±100 ppm |
| Tx LBO - 0 db loss |
| Tx LBO - 6 db loss |
| National bit support - On/off |
| Service disruption |

| **Performance measures** |
| G.826 (ISI/OOS) |
| G.821 |
| M.2100 |

<p>| <strong>Results</strong> |
| <strong>Signal category</strong> |
| Receive frequency |
| Receive-frequency deviation |
| Receive-frequency maximum deviation |
| Transmit frequency |
| BPV/code rate |
| BPV/code count |
| Electrical input level |
| Round-trip delay (ms) |
| <strong>Frame</strong> |
| Frame-error count |
| Frame-error rate |
| Frame-error seconds |
| Frame-synchronization-lost 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 |
| <strong>FEBEs</strong> |
| DS2 frame-synchronization-lost count |
| <strong>Logic</strong> |
| Bit-error/TSE count |
| Bit-error/TSE rate |
| Pattern slips |
| Pattern error |
| Pattern-synchronization-lost count |
| Pattern-synchronization status |
| <strong>E3</strong> |
| <strong>Modes of operation</strong> |
| Terminate |
| Monitor |
| Thru (intrusive) |
| <strong>Timing</strong> |
| Recovered from Rx |
| Internal (Stratum 3) |
| Recovered from external (bits/set) |</p>
<table>
<thead>
<tr>
<th>Frame category</th>
<th>Specifications</th>
<th>T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAS bit-error count</td>
<td></td>
<td>Modes of operation</td>
</tr>
<tr>
<td>FAS bit-error rate</td>
<td></td>
<td>Terminate</td>
</tr>
<tr>
<td>FAS word-error count</td>
<td></td>
<td>Monitor</td>
</tr>
<tr>
<td>FAS word-error rate</td>
<td></td>
<td>Thru (intrusive)</td>
</tr>
<tr>
<td>Frame-synchronization-loss count</td>
<td></td>
<td>Timing</td>
</tr>
<tr>
<td>8M FAS bit-error rate</td>
<td></td>
<td>Recovered from Rx</td>
</tr>
<tr>
<td>8M FAS word-error count</td>
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<td>Recovered from external (bits/set)</td>
</tr>
<tr>
<td>Logic category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSE/bit-error count</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
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<tr>
<td>Pattern slips</td>
<td></td>
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<tr>
<td>Pattern-slip seconds</td>
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<td>Pattern-synchronization-loss count</td>
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<tr>
<td>Pattern-synchronization-loss seconds</td>
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<td>Pattern-synchronization status</td>
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<td></td>
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<tr>
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<td></td>
<td></td>
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<tr>
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<tr>
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<td></td>
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<td>PCM30</td>
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<td>Test patterns</td>
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<tr>
<td>2^23-1* inverse</td>
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<td>QRSS</td>
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<tr>
<td>Round-trip Delay</td>
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<td>Frequency offset Tx ±100 ppm</td>
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<td>Results</td>
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Specifications cont’d.

**Defect/alarm insert analysis**
- AIS
- REBE

**General**
- Frequency offset Tx ±100 ppm

**Performance measures**
- G.826 (ISM/OOS)
- G.828 (ISM/OOS)
- G.829 (ISM/OOS)
- M.2100
- T.1.231
- Tx LBO - 0 dB loss
- Tx LBO - 7.5 dB loss
- Tx LBO - 15 dB loss
- Tx LBO - 22.5 dB loss
- Service disruption

**Loop codes**
- Loop-code Tx - NIU
- Loop-code Tx - CSU
- Loop-code emulation - NIU
- Loop-code emulation - CSU
- HDSL loop-code Tx
- CO-to-customer direction
- Customer-to-CO direction
- User-defined loop-code support

**Results**

**Signal category**
- Receive frequency
- Reference frequency
- Receive-frequency deviation
- Receive-frequency maximum deviation
- Transmit frequency
- Simplex current
- Receive level (Vp)
- Receive level (dBdisx)
- 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

**Frame category**
- 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

**Logic category**
- 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

**Channel**
- DSO channel-payload view
- ABCD bit-signaling view

**CPRI**

**Test interfaces/bit rates**
- CPRI 3.1G optical Tx/Rx

**Laser type**
- SFP
- Tuned SFP

**Modes of operation**
- Terminate
- Monitor

**CPRI features**
- Optical/electrical power level
- Frequency offset Tx/Rx

**Round-trip delay measurement**
- RTD measurement accuracy

**PRBS patterns**
- 2^23-1, 2^23-1 inverse
- ANSI and ITU implementations

**Anomaly/errors generation**
- Bit
- Insert - Single
- Insert - Rate

**Results**

**Signal category**
- Signal losses
- Signal-loss seconds
- Receive frequency
- Receive-frequency deviation
- Receive-frequency maximum deviation
- Transmit frequency
- Transmit-frequency deviation (Hz)
- Transmit-frequency deviation (ppm)
- Transmit-frequency maximum deviation (ppm)

**Error stats**
- Pattern-sync losses
- Pattern-sync-loss seconds
- Bit-error rate
- Bit errors
- Errored seconds
- Error-free seconds
- Error-free seconds, %
- Total bits received

**Jitter O.172**

**General features**
- Generate and measure jitter on electrical interfaces (DS1, E1, DS3, 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
- Set user-definable band
- Select common jitter mask
- Create user-definable masks

**Results**
- Jitter results per measurement band
- Current peak-to-peak jitter (UI)
  - Peak-to-peak jitter (UI)
  - Positive peak jitter (UI)
  - Negative peak jitter (UI)
- Maximum peak-to-peak jitter (UI)
- Peak peak jitter (UI)
- Positive peak jitter (UI)
- Negative peak jitter (UI)
- Phase bits
- Percentage of mask
- RMS jitter (UI)
- Jitter graphs

**NextGen SONET/SDH**

**Test interfaces/bit rates**
- OC-3
- OC-12
- STM-4
- OC-48
- STM-16
- OC-192
- STM-64

**Laser type**
- SFP
- XFP
- XFP - Tunable

**Modes of operation**
- Terminate
- Monitor

**Timing**
- Recovered from Rx
- Internal (Stratum 3)
- Recovered from external (bits/set)
- Recovered from 10 MHz clock
## SONET/SDH features

- **VCAT** - High order
- **VCAT** - Low order
- LCAS emulation/analysis
- Differential delay measurement
- Maximum VCAT group size
- GFP-F
- Ethernet client
- Maximum Ethernet client size: 1 GB

### SONET/SDH mappings
- VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c
- VC12
- VC4
- GFP-F
- Ethernet

### SONET mappings
- STS-1, STS-3c, STS-12c, STS-48c, STS-192c
- VT1.5
- GFP-F
- Ethernet

### Results

- **Signal category**
- **Signal present**
- **Signal-loss count**
- **Signal-loss seconds**
- **Receive frequency**
- **Receive-frequency deviation**
- **Receive-frequency maximum deviation**
- **Transmit frequency**

### Regenerator/section OH category
- **FAS/frame word-error count**
- **FAS/frame word-error rate**
- **LOF count**
- **B1-BIP-error count**
- **B1-BIP-error rate**
- **Severely errored seconds**
- **G2F 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 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**

### Defects/alarms generation/analysis

- **GFP-CSF alarm**
- **GFP-FED alarm**
- **LDM2 alarm**
- **LOF**
- **RS-TIM**
- **MS-REI**
- **MS-RDI**
- **AU-LOP**
- **AU-AIS**
- **HP-UNEQ**
- **HP-RDI**
- **HP-TIM**
- **HP-PLM**
- **TU-LOP**
- **TU-AIS**
- **TU-LOM**
- **LD-UNEQ**
- **LP-RDI**
- **LP-TIM**
- **LP-PLM**
- **LP-RFI**

### Alarms

- **Signal-loss status**
- **Frame-synchronization-loss status**
- **Pattern-synchronization-loss status**
- **MS-Line-AIS**
- **AIS (HP)**
- **AIS (LP)**
- **LOF (HP)**
- **LOP (LP)**
- **LOS**
- **OOF**
- **LOF**
- **MS-Line-RDI**
Specifications cont'd.

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<th>General parameters</th>
<th>Description</th>
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<tr>
<td><strong>Codes:</strong></td>
<td>G.711 A Law, G.711 U Law, G.723 5.3 K, G.723 6.3 K, G.729A, G.726, G.722</td>
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**Triple-play automated test script**

<table>
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<tr>
<th>Test &amp; Measurement Regional Sales</th>
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<tbody>
<tr>
<td><strong>NORTH AMERICA</strong></td>
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<tr>
<td>TEL: +1 866 228 3762</td>
</tr>
<tr>
<td>FAX: +1 301 353 9216</td>
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</table>

**Primary rate ISDN**

- Test access - T1
- TE emulation
- NT emulation
- D-Channel signaling decodes
- Call control - National
- Call control - SCESS
- Call control - NT-1
- D-Channel rate - 64 k
- D-Channel rate - 56 k
- Call type - Data
- Call type - Voice
- Call type - 3.1 k audio
- Channel number - 1 to 24
- D-Channel rate - 56 k

**Voice frequency**

- Test access - T1
- Listed to an audio call
- Insert voice tones
  - 404, 1004, 1804, 2713, and 2804 Hz
- User frequency
- Quiet tone
- Holding tone
- Three tone
- Frequency sweep
- Impulse noise
- RF frequency
- Level (dBm)
- DC off-set mV

<table>
<thead>
<tr>
<th><strong>TANDM connection monitoring (TCM)</strong></th>
<th><strong>General parameters</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameters:</strong></td>
<td><strong>Descriptive Parameters:</strong></td>
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<tr>
<td><strong>H.323 parameters</strong></td>
<td>Configurable local and gateway registration and Call Control port</td>
</tr>
<tr>
<td><strong>H.323 ID</strong></td>
<td>Configurable RTP port range</td>
</tr>
<tr>
<td><strong>Bearer capability including unrestricted digital, speech, and 3.1 k audio</strong></td>
<td>Configurable time zone</td>
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<tr>
<td><strong>Configurable calling and called-party number plans and number types</strong></td>
<td>Configurable Call Manager port</td>
</tr>
<tr>
<td><strong>Selectable silence suppression</strong></td>
<td>Configurable jitter buffer and speech-per-frame parameters</td>
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<tr>
<td><strong>Auto answer on/off</strong></td>
<td>ACR or G.107 MOS scoring</td>
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<tr>
<td><strong>Codec support</strong></td>
<td>Configurable jitter, loss, and delay thresholds pass/fail</td>
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<tr>
<td><strong>Supported voice codecs:</strong></td>
<td>Graphical summary results including Ethernet, transport, and content</td>
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<td><strong>G.711 A-Law, G.711 U-Law, G.723 5.3 k, G.723 6.3 k, G.729A, G.726, G.722</strong></td>
<td>Transaction log including call log and protocol signaling</td>
</tr>
</tbody>
</table>

**SDH Lower-order view (AU/VT)**

- Configurable voice call or tone with configurable silence suppression, sampling rate, and jitter buffer |
- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames |

**IPTV**

- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames |

**Test access - T1**

- Fractional T1 - n x 64 k |
- Fractional T1 - n x 56 k |
- Contiguous channels |
- Non-contiguous channels |
- V.54 Loop-code support

**Event log**

- Event, start time, duration, value |
- Real-time histogram |
- Seconds, minutes, hours, days |
- Time |
- Current date, current time, elapsed test time |

**Test access - T1**

- Fractional T1 - n x 64 k |
- Fractional T1 - n x 56 k |
- Contiguous channels |
- Non-contiguous channels |
- V.54 Loop-code support

**Voice frequency**

- Test access - T1 |
- Listed to an audio call |
- Insert voice tones |
- 404, 1004, 1804, 2713, and 2804 Hz |
- User frequency |
- Quiet tone |
- Holding tone |
- Three tone |
- Frequency sweep |
- Impulse noise |
- RF frequency |
- Level (dBm) |
- DC offset mV

**General parameters**

- Auto answer on/off |
- Codec support |
- Configurable voice call or tone with configurable silence suppression, sampling rate, and jitter buffer |
- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames |

**Transaction log including call log and protocol signaling**

- Configurable jitter buffer and speech-per-frame parameters |
- ACR or G.107 MOS scoring |
- Configurable jitter, loss, and delay thresholds pass/fail |
- Graphical summary results including Ethernet, transport, and content |

**General parameters**

- Auto answer on/off |
- Codec support |
- Configurable voice call or tone with configurable silence suppression, sampling rate, and jitter buffer |
- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
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**Transaction log including call log and protocol signaling**

- Configurable jitter buffer and speech-per-frame parameters |
- ACR or G.107 MOS scoring |
- Configurable jitter, loss, and delay thresholds pass/fail |
- Graphical summary results including Ethernet, transport, and content |

**TPV**

- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames |

**IPTV**

- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Up to 52 simulated SDTV channels with configurable frame size and MPEG-2/4 compression |
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames |

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