T-BERD®/MTS-6000A MSAM Specifications

Ethernet

Test Interfaces/Bit Rates

10/100/1000 Mbps electrical	Dual-port capable
100 Mbps Ethernet optical	Dual-port capable
Gigabit Ethernet (Optical)	Dual-port capable
10 GE WAN Phy (9.9 Gbps)	Dual-port capable
10 GE LAN Phy (10.3 Gbps)	Dual-port capable

Interface Type

RJ45
SFP
SFP+
XFP
XFP - Tunable

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
Through (intrusive)
Loopback
Half duplex
Full duplex

Timing

Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
Frequency offset Tx/Rx

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
1:3, 1:7, 3:1, 7:1, 2 in 8
User-defined

MAC Frame Payload

PRBS pattern
Editable digital word

Flow Control

Emulation on/off

Pause Frames

Tx insert
Pause quanta - Definable
Pause frame analysis (for example, counts)

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 10 k)
User-defined
Jumbo (to 10 k)
EMIX
Random

VLAN

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

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 802.1ah

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
Line-rate traffic generation
Traffic analysis
Editable parameters/results - Label
Editable parameters/results - Priority
Editable parameters/results - TTL
Rx filters
GAL (Label 13) + ACH from ITU-T G.8113.1
- Common header label - PW, LSP, section
- CCM generation and analysis
- LBM/LBR generation and analysis
- AIS generation and analysis
OAM alert label (Label 14) from ITU-T G.8114
- Common header label - PW, LSP, section
- CCM generation and analysis
- LBM/LBR generation and analysis
- AIS generation and analysis
OAM alert label (Label 14) from ITU-T Y.1711
- Common header label - PW, LSP, section
- CCM generation and analysis
- FFD generation and analysis
- BDI generation and analysis
- FDI generation and analysis
Simultaneous OAM and background-traffic generation

Specifications *cont'd.*

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 contolled
- Bandwidth specification in Mbps or kbps
- Bandwidth granularity
- Bandwidth specification in %
- Bandwidth utilization accuracy - 0.1%
- Burst mode - Burst size - 1 to 2 Mbps 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 bandwidth
- Ramp bandwidth
- Bursty bandwidth
- Flood bandwidth
- Traffic generation in Mbps or kbps and % utilization
- Bandwidth-configurable based on L1 or L2

TCP Throughput

- 10/100/1000 Mbps line rate stateful emulation
- 1 GE line rate stateful emulation
- 10 GE line rate stateful emulation
- Configurable source and destination 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 simultaneous TCP stateful sessions
- Supports 4 background streams
- Compatible with iPerf

RFC 2544

- Asymmetric testing
- Symmetric testing
- Throughput
- Frame loss
- Out-of-sequence 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
- Definable frame size
- Report formats
- Graphical results
- Total-test-time display

ITU-T Y.1564

- 10 Traffic streams
- Service Configuration test
- Service Performance test
- Committed information rate (CIR)
- Extended IR (EIR)
- Maximum IR (MIR)
- Frame loss rate (FLR)
- Frame delay (FD)
- Frame delay variation
- Commited burst size (CBS)
- Policer test
- Round-trip testing
- Concurrent bidirectional testing
- Configurable VLAN, priority, addressing, and pass/fail thresholds
- Programmable pass/fail thresholds
- Graphical results
- Screenshot support
- Auto-negotiation check
- Saved reports
- Saved test profiles
- Configurable DEI, TPID, TOS/DSCP
- Inclusive of L2 Ethernet and IPv4
- Integrated TrueSpeed TCP traffic stream with background streams
- Asymmetric testing
- One-way delay with CDMA receiver

IETF RFC 6349

- 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 simultaneous TCP stateful sessions
- Graphical results and report generation
- Configurable file and window sizes
- Total-test-time display

Layer 2 Transparency Testing (J-Proof)

Encapsulation supported

- VLAN
- Q-in-Q
- Spanning Tree
- Cisco protocols (Discovery, etc.)
- GARP
- STP

Send/receive Ethernet control-plane traffic

- Spanning Tree frames Tx/Rx
- Cisco discovery protocol
- LDP frames Tx/Rx
- Link aggregation LACP
- Cisco UDLD, ISL, PagP, DTP, PVST-PVST+
- MAC bridging 802.1d
- VLAN-BRDGSTP
- Custom frame builder

Specifications *cont'd.*

Synchronous Ethernet ITU G.826x

10 GE Tx/Rx
1000/100/10 Mbps Electrical Tx/Rx
100/1000 Mbps Optical 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 data plane traffic
Frame/packet capture and decode via Wireshark
Layer 2 1588v2 messaging
Layer 4 1588v2 messaging
1588v2 delay measurements (Master/Slave)

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 Mbps
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-duflex ports
Detect ICMP layer issues
Identify top talkers
TCP layer diagnosis - ex. retransmissions

Traffic Profiling

Detect and display up to 128 streams of live traffic
Specify filters for stream detection
Stream classification

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/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

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
SVLAN priority
Unicast frames
Unicast packets
Multicast frames
Multicast packets
Broadcast frames
Broadcast packets
Frame length
Packet length
Packet jitter, avg
Packet jitter, max

Specifications *cont'd.*

Errored Counts
Symbol errors
Code violation
FCS-errored frames
Runts
Jabbers
Oversized frames
Undersized frames
Out-of-sequence frames
Lost frames
IP checksum errors
IP packet-length errors
Packet payload errors
Bit error
Bit-error rate

QoS Measurements
Throughput
Frame loss
Packet jitter
Delay
Out of sequence
Frame/packet size binning
MAC throughput Rx
IP throughput Rx
TCP/UDP throughput Rx
Payload throughput Rx
Service disruption measurements
- Definable threshold time
Round-trip delay measurements
One-way delay measurements
Rx bytes
Rx Mbits
Rx frames
Rx frames per second
Utilization %
Current Rx results
Min Rx results
Average Rx results
Max/peak Rx results
Ratio Rx results
Seconds Rx results

Event Log
Event, date, start time, stop time, duration, value

Real-Time Histogram
Seconds, minutes, hours, days

Time
Current date, current time, test-elapsed time

Graphical Displays
Errors versus time
Frame loss versus time
Packet jitter versus time
Latency versus time
Throughput versus time

Application-Layer Testing
Walk the Window
FTP Throughput
HTTP Throughput

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+
XFP
XFP - Tunable

Modes of Operation
Terminate
Monitor
Through (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
Overhead byte viewing/manipultion
Service disruption measurements
- SD separation/debounce time setting
- SD threshold time settings
Signal label generation/display
Frequency offset Tx/Rx

Round-Trip Delay Measurement
RTD measurement accuracy

PRBS Pattern
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
Programmable - 32 bit
ANSI and ITU implementations

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-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

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
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency

Specifications *cont'd.*

Signal Category (Cont'd)

Electrical input level	
- STS-1	dBdsx, dBm, volts
- STM-1e	dBnom only
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	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	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 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
Loss of multiframe	TU-12, TU-3, VT-1.5

Overhead-Byte Manipulation/Viewing – High Path

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

SDH Low-Order View (AU/VT)

V5, S2, N6, K4

SOH and POH Evaluation

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

Tandem Connection Monitoring (TCM)

Analysis of the N1 and N2 bytes, monitoring/display of: AIS, ODI, RDI, OEI, REI, APId, incoming B3/computed BIP comparison, IEC, TC-UNEQ

Performance Measures

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

K1/K2 Event Log

Date, time, K1 value, code, channel, K2, bridge, MSP, status

Event Log

Event, date, start time, stop time, duration, value

Real-Time Histogram

Seconds, minutes, hours, days

Time

Current date, current time, elapsed test time

OTN G.709

Test Interfaces/Bit Rates

OTU1	2.7 Gbps
OTU2	10.7 Gbps
OTU1e	11.045 Gbps
OTU2e	11.095 Gbps

Laser Type

SFP
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
- ODUflex bulk BERT from an OTU-2
- ODUflex 1 GE Layer 2 from an OTU-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

Specifications *cont'd.*

OTN Layer (Cont'd.)

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 Tx/Rx

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
Codeword 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 signal fail
FTFL Fwd signal degraded
FTFL Bwd signal fail
FTFL Bwd signal degraded
TCM1-6 IAE
TCM1-6 TIM
TCM 1-6 BDI
TCM1-6 BIAE

ODU Errors Tx/Rx

FAS
MFAS
PM BIP/BEI
TCM BIP/BEI
Bit error

ODU Alarms Tx/Rx

LOF
OOF
LOM
OOM
AIS
OCI
LCK
PM-TIM
PM-BDI
FTFL
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
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

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)

Interface (Cont'd.)

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
Corrected bit-error rate
Correctable bit errors
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
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

Specifications *cont'd.*

OTU (Cont'd.)

PM-BDI count
PM-BEI count
PM-BEI-error rate
PM-TIM seconds
PM-TIM count
PM-SAPI
PM-DAPI
PM-operator specific

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

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
SFP+
XFP

Modes of Operation

Terminate
Monitor
Thru

Test Interfaces/Bit Rates

1.0625 or 2.125 Gbps	Dual-port capable
4.25 Gbps	Dual-port capable
8.5 Gbps	Dual-port capable
10.519 Gbps	Dual-port capable

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, 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

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	Dual receivers
E3	Dual receivers
E1 balanced	Dual receivers
E1 unbalanced	Dual receivers
T1	Dual receivers

Interface Type

BNC
Bantam
RJ48

E4

Modes of Operation

Terminate
Monitor
Thru (Intrusive)

Timing

Recovered from Rx
Internal (Stratum 3)
Recoverd from external (bits/sets)

Framing

Framed
Unframed

Test Patterns

2^15-1* inverse
2^20-1* inverse
2^23-1* inverse
User-programmable
Round-trip delay
ANSI and ITU

Mappings

E3
E1
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

Specifications *cont'd.*

Performance Measures

G.821	OOS
G.826	ISM/OOS
M.2100	ISM/OOS

Results

Signal Category

- Rx frequency
- Rx-frequency deviation
- Rx-frequency maximum deviation
- Tx 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/set)

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-progammable (3...32 bits)
- User byte
- 100
- 1100 (aka Idle)
- 1010 (aka Blue)
- ANSI and ITU

Mappings

- E1
- T1
- 64 k

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 ±100 ppm
- 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	ISM/OOS
G.821	
M.2100	
M.2101	
T1.231	
T1.510	

Results

Signal Category

- Receive frequency
- Receive-frequency deviation
- Receive-frequency maximum deviation
- Transmit frequency
- BPV/code rate
- BPV/code count
- Electrical input level
- Round-trip delay (ms)

Frame

- Frame-error count
- Frame-error rate
- Frame-error seconds
- Frame-synchronization-loss count
- Near-end out-of-frame seconds
- Far-end out-of-frame seconds
- C-bit format
- Rx X-bits
- FEAC word

Frame (Cont'd.)

- 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
- Through (intrusive)

Timing

- Recovered from Rx
- Internal (Stratum 3)
- Recovered from external (bits/set)

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-progammable (3...32 bits)
- User byte
- Round-trip delay
- 1:1
- 1:3
- 1:4
- 1:7
- ANSI and ITU

Mappings

- E1
- 64k

Specifications *cont'd.*

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 ISM/OOS
G.821
M.2100

Results

Signal Category

Tx frequency
Rx frequency
Rx-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
Through (intrusive)

Timing

Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)

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-progammable (32 bits)
Round-trip delay
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 ±100 ppm
Service disruption

Performance Measures

G.826 ISM/OOS
G.821
G.829 ISM/OOS
M.2100

Results

Signal Category

2 Mbps receive frequency
2 Mbps reference frequency
2 Mbps receive-frequency deviation
2 Mbps receive-frequency maximum deviation
2 Mbps transmit frequency
Electrical-input level
Code-error count
Code-error rate
Round-trip delay (ms)
Timing slips
Frame slips
APS switch time

Logic Category

TSE/bit-error count
TSE/bit-error rate
Pattern slips
Pattern-slip seconds
Pattern-synchronization-loss count
Pattern-synchronization status

Alarm Category

FAS/frame synchronization
MFAS synchronization
CRC synchronization
AIS
RDI
Power-loss count
2 Mbps alarm

Frame Category

FAS bit-error count
FAS bit-error rate
FAS word-error count
FAS word-error rate
Nonframe-alignment word
MFAS word-error count
MFAS word-error rate
Time-slot Rx byte
CRC-error count
CRC-error rate
CRC-synchronization-loss count
FAS-synchronization-loss count
MFAS-synchronization-loss count
Remote-end block error (REBE)

T1

Modes of Operation

Terminate
Monitor
Through (intrusive)

Timing

Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)

Specifications *cont'd.*

Framing

Unframed
SF
ESF
SLC-96

Test Patterns

63
511
511 QRSS
2047 QRSS
2047
All 1s
All 0s
2^15-1* inverse
2^20-1* inverse
2^23-1* inverse
QRSS
User-progammable (3...32 bits)
User byte
Bridged tap
MultiPat
Round-trip delay
1:1
1:3
1:4
1:7
2 in 8
3 in 24
MIN/MAX
T1 DALY
55 OCTET
T1-2/96
T1-3/54
T1-4/120
T1-5/53

Mappings

64 k
56 k

Anomaly/Error/Insert/Analysis

Frame errors
BPV errors
TSE/bit error
Single
Rate
Multiple

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	
T1.231	
Tx LBO	0, 7.5, 15, 22.5 dB loss
Service disruption	

Loop Codes

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

Results

Signal Category

Rx frequency
Reference frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency
Simplex current
Receive level Vp, dBdsx, 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

614 Mbps optical	Dual-port capable
1.2 Gbps optical	Dual-port capable
2.4 Gbps optical	Dual-port capable
3.1 Gbps optical	Dual-port capable
4.9 Gbps optical	Dual-port capable
6.1 Gbps optical	Dual-port capable
9.8 Gbps optical	Dual-port capable

Laser Type

SFP
SFP+
Tuned SFP

Modes of Operation

Terminate
Monitor/Through

Timing

Recovered from Rx (slave)
Internal (Stratum 3) (master)
Recovered from external (bits/sets) (master)
Recovered from 10 MHz clock (master)

CPRI Features

Optical/electrical power level
Frequency offset Tx/Rx
CPRI startup sequence - normal or bypass

PRBS Generation and Monitoring

Unframed
L1 - Pattern inserted in hyperframe structure
L2 - Pattern inserted in CPRI basic frame

Interface Type

Master
Slave
Selectable CPRI protocol Version

Control and Management (C&M) Channel

Ethernet
HDLC
Selectable C&M channel rate

Service Disruption Measurements

SD Seperation/Debounce time setting
SD Threshold time setting

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

Specifications *cont'd.*

Anomaly/Errors Generation
Bit
Code
K30.7
Insert - Single
Insert - Rate

Defects/Alarms Generation/Analysis
LOS
LOF
SDI
RAI

Results

Signal Category
Signal losses
Sync-loss seconds
Optical Rx overload
Optical Rx level (dBm)
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency
Tx-frequency deviation (Hz)
Tx-frequency deviation (ppm)
Tx-frequency maximum deviation (ppm)

CPRI Counts
Word sync loss events
Word sync loss seconds
Code word count Tx/Rx
Frame count Tx/Rx

Error Stats
Code violations
Code violation rate
Code violation seconds
K30.7 words
Frame-sync loss events
Frame-sync loss seconds
Pattern-sync losses
Pattern-sync-loss seconds
Bit-error rate
Bit errors
Errored seconds
Error-free seconds
Error-free seconds, %
Total bits received
Round-trip delay current (ms)
Round-trip delay average (ms)
Round-trip delay minimum (ms)
Round-trip delay maximum (ms)
Remote LOS seconds
Remote LOS
Remote LOF seconds
Remote LOF
RAI
RAI seconds
SDI seconds
SDI

OBSAI

Test Interfaces/Bit Rates

3.1 Gbps optical	Dual-port capable
6.1 Gbps optical	Dual-port capable

Laser Type
SFP
SPF+
Tuned SFP

Modes of Operation
Terminate
Monitor/Through

Timing
Recovered from Rx (slave)
Internal (Stratum 3) (master)
Recovered from external (bits/sets) (master)
Recovered from 10 MHz clock (master)

OBSAI Features
Optical/electrical power level
Frequency offset Tx/Rx

PRBS Generation and Monitoring
Unframed
L1 - Pattern inserted in frame structure

Interface Type
Master
Slave
Selectable number of message groups in master frame
Selectable number of message slots in message group
Selectable number of idle bytes after message group

Round-Trip Delay Measurement
RTD measurement accuracy

PRBS Patterns
D6.6 D25.6
2^23-1, 2^23-1 inverse
2^31-1, 2^31-1 inverse
Delay

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

Results

Signal Category
Signal losses
Sync-loss seconds
Optical Rx overload
Optical Rx level (dBm)
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency
Tx-frequency deviation (Hz)
Tx-frequency deviation (ppm)
Tx-frequency maximum deviation (ppm)

OBSAI Counts
Code word count Tx/Rx
Frame count Tx/Rx

Error Stats
Code violations
Code violation rate
Code violation seconds
K30.7 words
Frame sync losses
Frame sync loss seconds
Pattern sync losses
Pattern sync loss seconds
Bit error rate
Bit errors
Errored seconds
Error-free seconds
Error-free seconds, %
Total bits received
Round-trip delay current (ms)
Round-trip delay average (ms)
Round-trip delay minimum (ms)
Round-trip delay maximum (ms)

Specifications *cont'd.*

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 hits	
Percentage of mask	
RMS jitter [UI]	
Jitter graphs	

Wander

General Features

Measure wander on 1 PPS signal	
Measure wander on 1 G optical Ethernet interface	
Selectable peak-time offset threshold	

Results

Time-interval error (TIE)	
- Current TIE(s)	
- Maximum TIE(s)	
- Minimum TIE(s)	
Maximum peak-to-peak TIE (MTIE)(s)	
Offset between test signal and reference	
- Current offset (µs)	
- Minimum offset (µs)	
- Maximum offset (µs	
Pass/fail result	
TIE graph	
Time deviation (TDEV)	
Reference clock for 1 pps wander	1 pps reference signal
Reference clock for GigE optical wander	2 MHz reference signal
Cables for 1 pps wander	

NextGen SONET/SDH

Test Interfaces/Bit Rates

OC-3
OC-12
STM-4
OC-48
STM-16
OC-192
STM-64

Laser Type

SFP
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

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
Programmable - 32 bit
ANSI and ITU implementations

Anomoly/Errors Generation

GFP-Idle-frame error
GFP-Short-frame error
GFP-Core-header error
GFP-Type-header error
GFP-EXI error
GFP-PFI error
GFP-PLE error
FCS
B1
B2
B3

Anomoly/Errors Generation (Cont'd.)

HP-REI
MS-REI, LP-BIP
LP-REI
Insert - Single
Insert - Rate

Defects/Alarms Generation/Analysis

GFP-CSF alarm
GFP-LFD alarm
LOM2 alarm
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
LO-UNEQ
LP-RDI
LP-TIM
LP-PLM
LP-RFI

SDH Mappings

VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c
VC12
VC4
VC3
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
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency

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

Specifications *cont'd.*

Regenerator/Section OH Category (Cont'd.)

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-just count	
Pointer-increment count	
Pointer-decrement count	
Pointer-NDF count	
LOP count	
LOP seconds	
B3/V5 BIP count	
B3/V5 BIP-error rate	
REI count	
Pointer transmitted	
Pointer received	

Low-Path Category (Cont'd.)

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 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
Loss of multiframe	TU-12, TU3, VT-1.5

Overhead Byte Manipulation/Viewing – High Path

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

SDH Lower-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 and 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

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

Services

VoIP Testing

10/100/1000 Mbps electrical Ethernet interfaces	
1 GE optical Ethernet interface	
10 GE optical Ethernet interface	
SIP, Cisco SCCP, and H.323 fast connect	

SIP Parameters

Dial by phone/URL/e-mail	
Nortel and Huawei SIP emulation	
Proxy login and proxyless operation	

SCCP Parameters

Selectable Cisco phone emulation supporting at least 15 models	
Configurable device name	

H.323 Parameters

H.323 ID	
Bearer capability including unrestricted digital, speech, and 3.1 K audio	
Configurable calling and called-party number plans and number types	
Static, auto-discoverable, and no-gatekeeper operation	
Configurable local and gatekeeper RAS port and call control port	
Configurable time zone	
Configurable RTP port range	

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 supression	
Configurable jitter buffer and speech-per-frame parameters	
ACR or G.107 MOS scoring	
Configurable jitter, loss, delay, and content thresholds pass/fail	
Mean Opinion Score results (MOS)	
Graphical summary results including Ethernet, transport and content	
Transaction log including call log and protocol signaling	

Specifications *cont'd.*

Triple-Play Automated Test Script

10/100/1000 Mbps electrical Ethernet interfaces
1 GE optical Ethernet interface
10 GE optical Ethernet interface
- More than 11,000 simulated calls with configurable codec and sampling rate
- Configurable voice call or tone with configurable silence supression, sampling rate, and jitter buffer
- Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression
- Up to 52 simulated HDTV channels with configurable frame size and MPEG-2/4 compression
- Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames

IPTV

10/100/1000 Mbps electrical Ethernet interfaces
1 GE optical Ethernet interface
10 GE optical Ethernet interface
- Single- and multiple-program transport stream (SPTS/MPTS) formats
- Video explorer capable of detecting 512 SPTSs and 32 MPTSs and a video analyzer that supports 16 SPTSs 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 RFC 3357, results per-transport stream and per PID
- 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	
NT emulation	
D-channel signaling decodes	
Call control	National 5ESS NI-1
D-Channel rate	64 k 56 k
Call type	Data Voice 3.1 k audio
Channel number	1 to 24
D-channel rate	56 k

Signaling - Place/Receive Call

Test access	T1
E&M signaling	
Loop-start signaling	
Ground-start signaling	
Audio drop/insert	
Signaling bits	
Place call	
Receive call	
MF digits	
DTMF digits	
Event log	
VF tone insertion	

Fractional T1/E1

Test access	T1
Fractional T1	n x 64 k
Fractional T1	n x 56 k
Contiguous channels	
Noncontiguous channels	
V.54 Loop-code 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	

Datacom

Test Interfaces

Datacom

X.21

Connector	15-pin D-type
Emulate DTE or DCE with X or S timing	
Receiver input termination	unterminated or 78/100/124 Ω
Data rates	5 bps to 20 Mbps synchronous with X
Cable length dependent with S	
Supported signaling leads	C and I

RS232/V.24

Connector	25-pin D-type
Emulate DTE or DCE with TT or ST timing	
Data rates	5 bps to 256 kbps synchronous 5 bps to 128 kbps asynchronous
Supported signaling leads	CTS, RTS, DSR, DTR, RLSD, RI

EIA530/530A

Connector	25-pin D-type
Emulate DTE or DCE with TT or ST timing	
Signal formats and input terminations	
Balanced unterminated or 78/100/124 Ω terminated	
Unbalanced	
Data rates	
Balanced	5 bps to 20 Mbps synchronous
Unbalanced	5 bps to 256 kbps synchronous
Supported signaling leads	RTS, CTS, DSR, DTR, RLSD, LL, RL, TM

MIL-STD-188c

25-pin D-type connector
Emulate DTE or DCE with TT or ST timing
Signal formats and input terminations unbalanced

Data rates	5 bps to 64 kbps synchronous and recovered
Supported signaling leads	RTS, CTS, DSR, DTR, RLSD, LL, RL, TM, RI

RS449/V.36 and MIL-188-114

37-pin and 25-pin D-type connectors
Emulate DTE or DCE with TT or ST timing
Signal formats and input terminations
- RS422 and MIL-188-114 balanced unterminated
- 78/100/124 terminated
- RS423 and MIL-188-114 unbalanced

Data rates	
- RS422/balanced	5 bps to 20 Mbps synchronous
- RS423/unbalanced	5 bps to 64 kbps synchronous
Supported signaling leads	RS, CS, DM, TR, RR, LL, RL, TM, IC

Specifications *cont'd.*

V.35

34-pin Winchester using an adapter cable to 25-pin D-type connector

Emulate DTE or DTC with TT (306) or ST timing

Receiver input termination	124 Ω
Data rates	5 bps to 15 Mbps synchronous

Note: Due to propagation delay (cable length dependencies), users may have to invert their clock.

Supported signaling leads	RTS, CTS, DSR, DTR, RLSD, RL, LL, TM, CI

Conditioned Diphase

2 BNC connectors 1 Tx and 1 Rx (via plug-in interface module)

Selectable-input termination	58, 135, or bridge (>2000)
Single-ended operation	58 Ω
Differential operation	135 or bridge
Automatic compensation	Up to 30 dB of cable loss
Valid signal indication	Signal valid if > ±90 mV

Transmit timing selectable from internal synthesizer or recovered from receiver interface

Data rates	1.2 to 4608 kbps

Clock and data encoding
- Diphase (Manchester)
- Conditioned diphase (differential Manchester)

Key Functionality

BER Test Patterns

Mark (all ones)
Space (all zeros)
1:1
63
511
2047
2047R (reversed)
2047RI (reversed and inverted)
2^15-1*
2^20-1
2^23-1*
QRSS
User byte pattern
QBF1 (FOX)
Long user (1,2,3)
Delay
All zeros
1:3
1:4
1:7
3:1
7:1

**Note: Supports both ANSI and ITU variations of these patterns.*

Transmit Clock Sources

Internal from synthesizer
Recovered from test interface (with the Recovered Clock option)
External BNC (via clock adapter cable)

Internal Clock Synthesizer

5 Hz to 20 MHz, ±1 Hz resolution, 1.5 ppm accuracy, 1 ppm per year aging

Error Insertion

Bit error(s) single and rate (1E-3 through 1E-7)

Pattern Slip Insertion

Single-bit insertion

Signaling Lead Control

Emulate DTE	RTS, DTR, (LL), (RL)
Emulate DCE	RLSD (RR), DSR (DM), CTS, RI

Self Loop

All test interfaces will loop transmit to receive for the purpose of validating the instrument and the selected test interface.

Asynchronous Operation

Parity selection	Odd, even, and none
Data bits	5, 6, 7, or 8 bits
Stop bits	1, 1.5, or 2 bits

In-band flow control
Out-of-band flow control

Key Results

BERT Category

Delay
Pattern losses
Pattern slips
Bit errors
Bit error rate
Interval BER
Total blocks
Block errors
Block error rate
Interval block error rate
Character errors (async only)

Signal Category

Transmitter clock frequency
Receiver clock frequency
Clock-in frequency
Clock-out frequency
Receiver clock loss
Data loss
Pattern sync loss
Transmitter clock losses

G.821

Errored seconds
Percentage errored seconds
Error-free seconds
Percentage error-free seconds
Severely errored seconds
Percentage severely errored seconds
Available seconds
Percentage avail seconds
Unavailable seconds

Time Category

Date
Time
Elapsed seconds
Elapsed time

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