T-BERD®/MTS-6000A MSAM Specifications

Ethernet

Test interfaces/bit rates

10/100/1000 M Electrical	Dual-port capable
100 M Ethernet Optical	Dual-port capable
Gigabit Ethernet (Optical)	Dual-port capable
10 GE WAN Phy (9.9G)	Dual-port capable
10 GE LAN Phy (10.3G)	Dual-port capable

Interface type

RJ45

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

Thru (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

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)

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 - Lavel, 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)

Line-rate traffic generation

Traffic analysis

Editable parameters/results - Label

Editable parameters/results - Priority

Editable parameters/results - TTL

Rx filters

Y.1731 OAM generation

Y.1731 OAM analysis

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

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)

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

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)

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 Mb
Bandwidth granularity
Bandwidth specification in %
Bandwidth utilization accuracy - 0.1%
Burst mode - Burst size - 1 to 2 M frames
Bandwidth specified - Definable
Continuous Tx
Once Tx - Definable frames/burst

Traffic profiles

Constant B/W
Ramp B/W
Bursty B/W
Flood B/W
Traffic generation in Mbps and % utilization

TCP/IP packet generator

10/100/1000 M Line rate stateful emulation
1 GE Line rate stateful emulation
10 GE Line rate stateful emulation
Configurable Src and Dest IP address
Packet length
TCP/UDP traffic modes
Source port
Destination port
Listen port
Configurable TCP window size
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
Jitter
Master/slave
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
Configurable VLAN, priority, addressing, and pass/fail
Thresholds
Graphical results
Saved test profiles
Configurable DEI, TPID, TOX/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

Send/receive Ethernet control plane traffic
Encapsulation supported - VLAN
Encapsulation supported - Q-in-Q
Encapsulation supported - Spanning Tree
Encapsulation supported - Cisco protocols (Discovery, etc.)
Encapsulation supported - GARP
Encapsulation supported - 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

3

Specifications *cont'd.*

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
Layer 2 1588v2 messaging
Layer 4 1588v2 messaging

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

4

Specifications *cont'd.*

Errored counts

Symbol errors
Code violation
FCS-errored frames
Runts
Jabbers
Oversized frames
Undersized frames
OOS frames
Lost frames
IP checksum errors
IP packet-length errors
Pkt payload errors
Bit error
Bit-error rate

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 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
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
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 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

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
Receive frequency
Receive-frequency deviation
Receive-frequency maximum deviation
Transmit frequency
Electrical input level (STS-1 (dBdsx, dBm, volts) and STM-1e (dBnom only)
BPV count (STS-1 only)
BPV-error rate (STS-1 only)

5

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 (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)
TUn loss of multiframe (n=12/3)

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 (2.7G)
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 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
Frequency offset Tx/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
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)
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
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

7

Specifications *cont'd.*

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

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

RJ-48

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

Performance measures

G.821 (OOS)

G.826 (ISM/OOS)

M.2100 (ISM/OOS)

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

8

Specifications *cont'd.*

DS3

Modes of operation
Terminate
Monitor
Thru (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
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/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

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
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)

9

Specifications *cont'd.*

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 Ccategory

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/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

2M receive frequency

2M reference frequency

2M receive-frequency deviation

2M receive-frequency maximum deviation

2M transmit frequency

Electrical-input level

Code-error count

Code-error rate

Round-trip delay (ms)

Timing slips

Frame slips

APS switch time

Logic category

TSE/bit-error count

TSE/bit-error rate

Pattern slips

Pattern-slip seconds

Pattern-synchronization-loss count

Pattern-synchronization status

Alarm category

FAS/frame synchronization

MFAS synchronization

CRC synchronization

AIS

RDI

Power-loss count

2M alarm

Frame category

FAS bit-error count

FAS bit-error rate

FAS word-error count

FAS word-error rate

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

Thru (intrusive)

Timing

Recovered from Rx

Internal (Stratum 3)

Recovered from external (bits/set)

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

10

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
T1.231
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 (dBdsx)
Receive level (dBm)
BPV-error count
BPV-error rate
Frame-slip count
Signal-loss count
Signal-loss seconds
Round-trip delay (ms)
Timing slips
Frame slips
APS switch time

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

DS0 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 hits
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

11

Specifications *cont'd.*

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

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

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

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

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

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-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

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

Specifications *cont'd.*

LP RDI

HP RDI

MS/Line-REI

Regenerator trace identifier mismatch (TIM)

High path trace identifier mismatch (TIM)

Low path trace identifier mismatch (TIM)

TUn loss of multiframe (n=12/3)

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 M 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

Triple-play automated test script

10/100/100 0M 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 M 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

Call control - 5ESS

Call control - NI-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

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

Test & Measurement Regional Sales