

# T-BERD®/MTS-5800

## Handheld Network Test Product Family



### Benefits

- All-in-one handheld tool simplifies multitechnology testing
- Optimized for easy field use with multi-touch screen, scripted workflows, and support for emerging network technologies
- Guarantees maximum efficiency and success in evolving carrier Ethernet and mobile backhaul networks
- TrueSAM™ and advanced IP test tools follow best practices with repeatable methods and procedures for faster service activation and troubleshooting tests with easy-to-understand results

### Applications

- Tests and troubleshoots converged Ethernet/IP networks at 10 Mbps to 10 G interfaces
  - Tests Layer 1-3 Ethernet/IP SLAs with an automated, enhanced RFC 2544/SAMComplete per ITU-T.Y.1564
  - Integrated burst testing approach including CBS verifies buffer settings and TrueSpeed per RFC 6349 for performance testing so you can experience your network the way your customers do
  - Robust network discovery, top talker analysis, deep packet capture, packet analysis, and expert troubleshooting guidance capabilities
- Tests TDM/PDH to SONET/SDH at OC-3/STM-1 to OC-192/STM-64, including service disruption measurements and path overhead (POH) capture with triggers
- Enables installation and maintenance of OTN networks up to 11.1 Gbps interface with ODU-0 and Flex support for Ethernet/IP client interfaces
- Supports 8 G FC dual-port interfaces (along with 1/2/4/10 Gbps) for installation and maintenance of SANs and low-latency circuits
- Verifies network synchronization
  - Emulates a 1588v2 master clock/slave recovery for proper point-to-point (PTP) message propagation and packet-delay variation (PDV) verification
  - Verifies SyncE frequency synchronization accuracy and Ethernet synchronization message channel (ESMC) message propagation
  - Measures wander on SyncE, 1PPS, T1, E1, and 2 and 10 MHz signals
- Tests remote radio head (RRH) health with CPRI and OBSAI FTTA tests
- Supports SFP+ pluggable optics
- Two simple T-BERD/MTS-5800 configurations:
  - Single- and dual-port versions
  - Fully loaded TDM/PDH to dual 10 G Ethernet, SONET, SDH, Fibre Channel, and OTN support

The T-BERD/MTS-5800 Handheld Network Tester addresses the challenges of carrier Ethernet evolution. It supports both legacy and emerging technologies required to handle various network applications including metro/core, mobile backhaul, and business services installations.

The industry's smallest handheld instrument can test throughout the service life cycle, including fiber characterization, service activation, troubleshooting, and maintenance. Advanced Ethernet test functionality, such as J-Profiler, wirespeed capture/decode, and automated J-Mentor, guides field technicians through troubleshooting without using a separate analyzer instrument.

The T-BERD/MTS-5800 ensures successful mobile backhaul transitions by validating both Ethernet backhaul synchronization (1588v2 and SyncE) and front haul (CPRI/OBSAI) BER and delay to guarantee successful mobile handoff between cell sites, thereby avoiding service degradation.

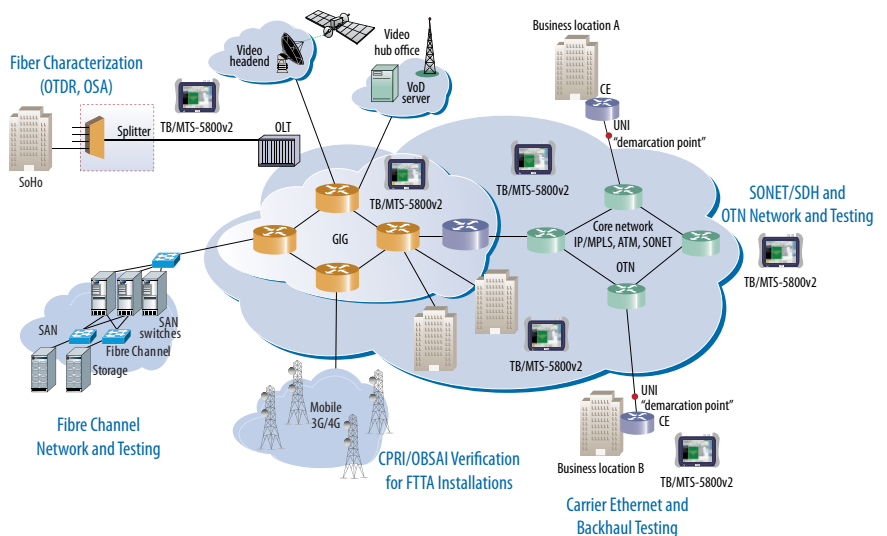
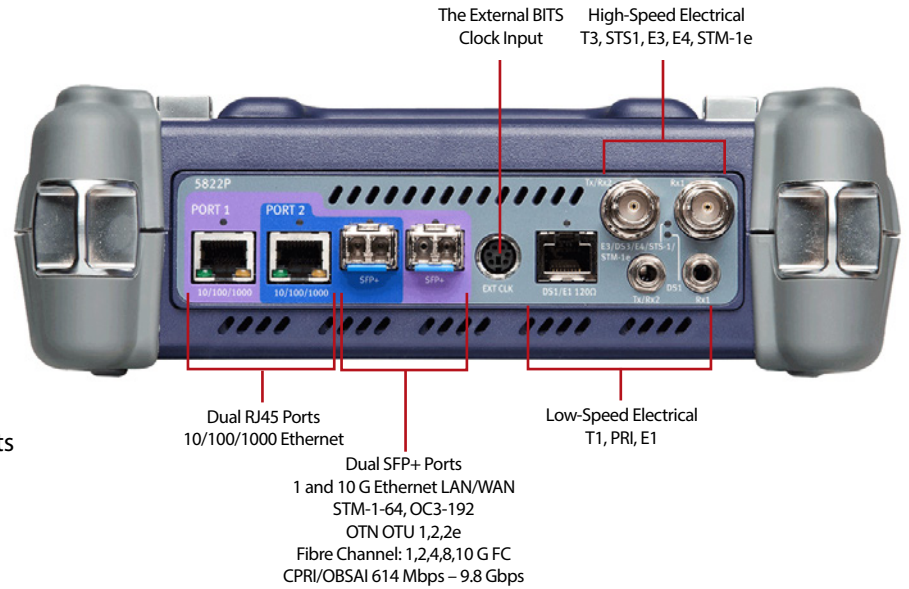


Figure 1. Carrier Ethernet network

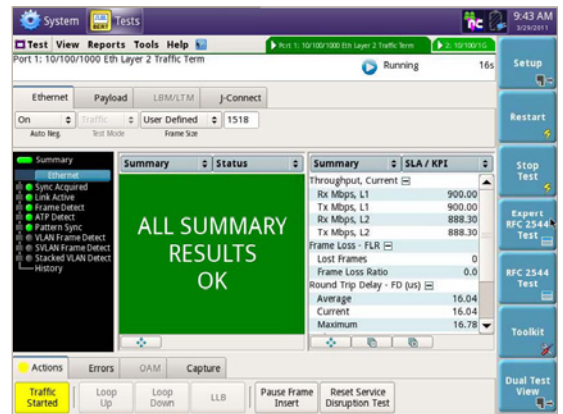
## All-in-One Handheld Tool

- Industry's smallest dual 10 G handheld instrument for Ethernet, SONET, SDH, OTN, Fibre Channel, and CPRI/OBSAI testing
  - All test interfaces readily available
  - Large screen (7 inches) to display test information
  - Multi-touch screen for easier navigation and advanced workflows
  - Configure to best meet your needs
- State-of-the-art platform supports:
  - Integrated Bluetooth to easily offload results
  - Integrated WiFi for test set connectivity
  - Store 1000s of reports
  - FiberScope connectivity

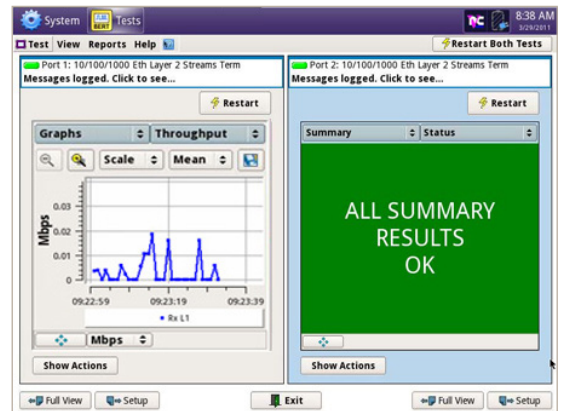


## Optimized for Easy Field Use

- Fixed test interfaces eliminate loose pluggable modules
- LEDs indicate plug-ins for tests
- Streamlined user interface with simple pass/fail, green/red results
- Extended battery life for longer test times
- Rapid boot-up from power-on to test start
- Dual-port operation to run two tests simultaneously, including 10 G/high-speed tests



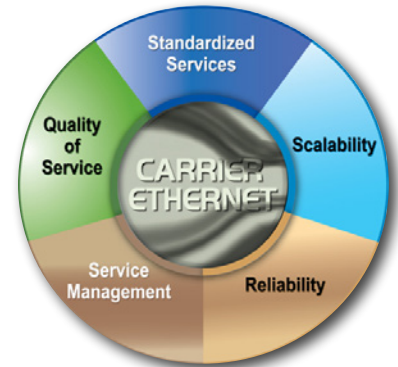
All key results in one view



Two tests: One streamlined view

## Enables Network Evolution – Today and Tomorrow

- Guarantees leading-edge carrier-grade Ethernet requirements:
  - Ensures **reliability** with link and service OAM (IEEE 802.3ah, 802.1ag, and ITU-T Y.1731)
  - Validates **network scalability** with VLAN, Q-in-Q, MPLS/VPLS tunnelling technologies
  - Certifies **network synchronization** with synchronous Ethernet and IEEE 1588v2
- **PTN Ready:** Supports **packet transport network (PTN)** evolution with MPLS-TP technology
- Architected to meet future technology needs

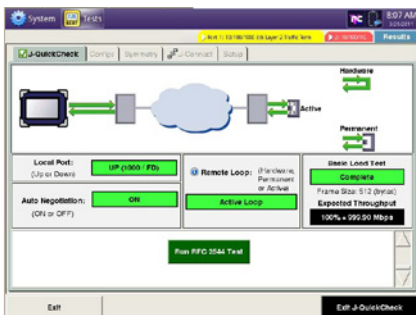
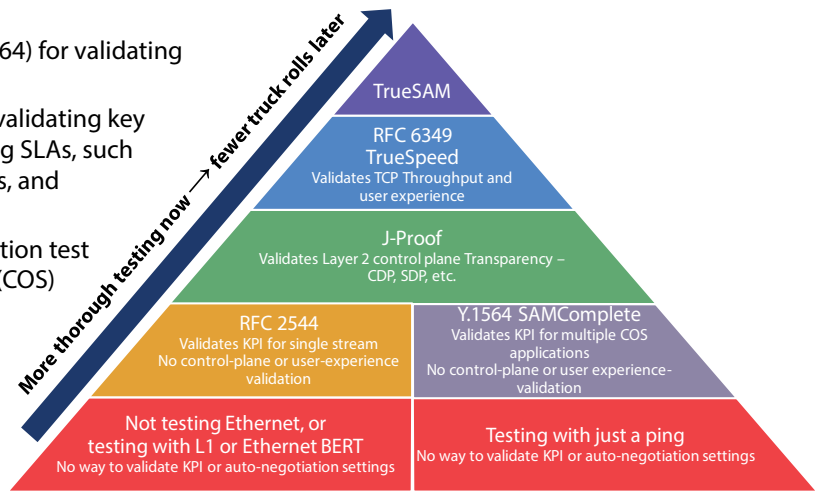


Carrier Ethernet graphic courtesy of the Metro Ethernet Forum (MEF), of which JDSU is a member.

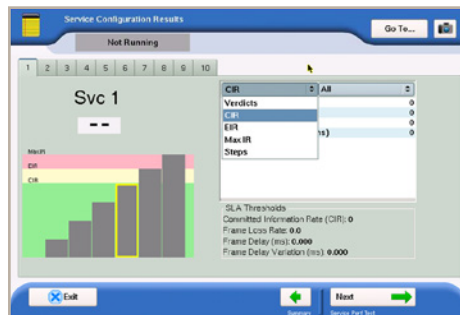
## Save Valuable Service Activation Time

### Test better and quicker with automated tests

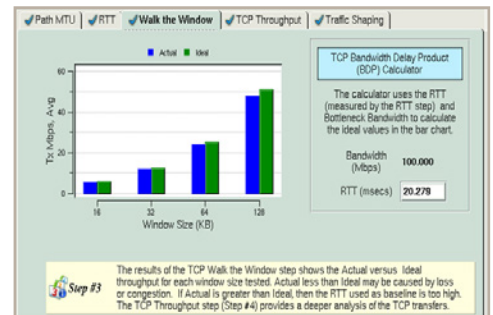
- J-QuickCheck is a fast, automated test (RFC 2544, Y.1564) for validating end-to-end and auto-negotiation configuration
- Enhanced RFC 2544 is an automated turn-up test for validating key performance indicators (KPIs)/ concurrently measuring SLAs, such as throughput, frame delay, delay variation, frame loss, and optionally committed burst size (CBS)
- Y.1564 SAMComplete is an automated service verification test speeds the installation of multiple classes of services (COS)
- TrueSpeed per RFC 6349 is an automated, standards-based test that can save nearly a quarter in operating expenses (OpEx) and reveals the reason for slow file downloads, eliminating finger-pointing
- TrueSAM combines all of these tests into one ultimate installation tool



Enhanced RFC 2544 with J-QuickCheck



SAMComplete per ITU-T.Y.1564

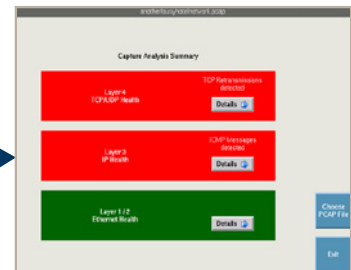
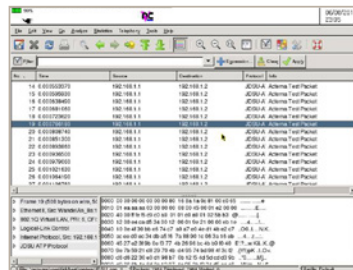


TrueSpeed per RFC 6349

## Reduce Mean Time to Repair for Network Problems

**Immediately identify problems with automated tests without the need for a separate analyzer**

- Network Discovery automatically identifies equipment present on the network
- J-Profiler discovers live traffic streams for real-time troubleshooting with in-service top-talkers analysis
- Integrated Capture/Decode offers 10 G line-rate packet capture and analysis in a handheld test tool
- J-Mentor provides expert troubleshooting guidance and interprets packet decodes
- Reduce CapEx/OpEx and still identify problems immediately without the need for a field expert or a separate analyzer



J-Mentor — Provides expert troubleshooting guidance

## Part of the Leading T-BERD/MTS Test Portfolio

Activate services more quickly and accurately

Reduce mean time to repair (MTTR) on network problems

Test the widest range of traditional and emerging telecom interfaces



### Common Application Base

Same user interface + same results + same methods and procedures

## StrataSync

### Empower Your Assets

StrataSync is a hosted, cloud-enabled solution for managing assets, configurations, and test-data on JDSU instruments. It also ensures that all instrument software is current and the latest options are installed. StrataSync lets you manage inventory, test results, and performance data anywhere with browser-based ease while it also improves technician and instrument efficiency. StrataSync manages and tracks test instruments, collects and analyzes results from the entire network, and it informs and trains the workforce.



North America  
Tel: 1 855 ASK-JDSU  
1 855 275-5378

Latin America  
Tel: +1 954 688 5660  
Fax: +1 954 345 4668

Asia Pacific  
Tel: +852 2892 0990  
Fax: +852 2892 0770

EMEA  
Tel: +49 7121 86 2222  
Fax: +49 7172 86 1222

www.jdsu.com/nse





# T-BERD®/MTS-5800 Specifications

Model Numbers 5822P and 5811PL

## Ethernet

<b>Test Interfaces/Bit Rates</b>		<b>Timing</b>	<b>Pause Frames</b>
10/100/1000 Mbps electrical	Dual-port capable	Recovered from Rx	Tx insert
100 Mbps Ethernet optical	Dual-port capable	Internal (Stratum 3)	Pause quanta - Definable
Gigabit Ethernet (Optical)	Dual-port capable	Recovered from external (bits/set)	Pause frame analysis (for example, counts)
10 GE WAN Phy (9.9 Gbps)	Dual-port capable	Frequency offset Tx/Rx	<b>Ethernet Generator</b>
10 GE LAN Phy (10.3 Gbps)	Dual-port capable	<b>Ethernet Features</b>	<b>Frame Type</b>
<b>Interface Type</b>		<b>Layer 1 (unframed) Bit Error Testing Patterns</b>	802.3
RJ45		High-frequency test pattern	DIX
SFP		Low-frequency test pattern	VPLS with inner and outer MAC
SFP+		Mixed-frequency test pattern	MAC in MAC 802.1ah
<b>General</b>		Random data pattern (RPAT)	EtherType field-editable
Line-rate traffic Tx and Rx for all interfaces		Jitter-tolerance test pattern (JTPAT)	<b>MAC Addressing</b>
Single-stream generation/analysis		Supply-noise test sequence (SPAT)	Destination MAC address - Unicast
10-stream generation/analysis per stream		<b>Layer 2 (framed) Bit Error Testing Patterns</b>	Destination MAC address - Broadcast
Auto-discovery of test sets		Compliant random-data pattern (CRPAT)	Destination MAC address - Multicast
<b>Modes of Operation</b>		Compliant jitter-tolerance pattern (CJPAT)	Source MAC address - User-defined
Terminate		Compliant supply-noise pattern (CSPAT)	Source MAC address - Auto-increment
Monitor		<b>Framed Pattern Test</b>	<b>MAC Frame Size</b>
Through (intrusive)		PRBS (2 <sup>11</sup> -1, 2 <sup>15</sup> -1, 2 <sup>20</sup> -1, 2 <sup>23</sup> -1, 2 <sup>31</sup> -1 and inverse)	64, 128, 256, 512, 1024, 1280, 1518, user-defined, jumbo (to 10 k)
Loopback		All 1s, all 0s	User-defined
Half duplex		1:3, 1:7, 3:1, 7:1, 2 in 8	Jumbo (to 10 k)
Full duplex		User-defined	EMIX
		<b>MAC Frame Payload</b>	Random
		PRBS pattern	<b>VLAN</b>
		Editable digital word	VLAN tagging 802.1q
		<b>Flow Control</b>	VLAN tag-editable fields
		Emulation on/off	<ul style="list-style-type: none"> <li>Priority</li> <li>VID</li> </ul>

<b>VLAN Stacking (Q-in-Q)</b>	<b>Ethernet OAM</b>	Bandwidth granularity
SVLAN tag-editable fields	Y.1731 Service OAM and 802.1ag CFM	Bandwidth specification in %
SVLAN ID	<ul style="list-style-type: none"> <li>• CCM messages</li> <li>• Programmable CCM rate</li> <li>• CCM type - Unicast, multicast</li> <li>• MEG ID end point</li> <li>• Maintenance domain level</li> </ul>	Bandwidth utilization accuracy - 0.1%
SVLAN priority	<ul style="list-style-type: none"> <li>• AISTx/Rx</li> <li>• RDITx/Rx</li> </ul>	Burst mode - Burst size - 1 to 2 Mbps frames
SVLAN DEI	<ul style="list-style-type: none"> <li>• LBR/LBM (Ping) - Unicast, multicast</li> <li>• LTM/LTR (Trace)</li> <li>• MEP discovery</li> </ul>	Bandwidth specified - Definable
SVLAN TPID	802.3ah Link OAM	Continuous Tx
CVLAN ID	<ul style="list-style-type: none"> <li>• Mode - Passive/active</li> <li>• Vendor OUI</li> <li>• Vendor-specific info</li> <li>• Max PDU size</li> <li>• Unidirectional links</li> <li>• Remote loopback</li> <li>• Link events</li> <li>• Variable retrieval</li> <li>• Dying gasp</li> <li>• Link fault</li> <li>• Critical event</li> <li>• Errored symbol period event</li> <li>• Errored frame event</li> <li>• Errored frame period event</li> <li>• Errored frame second summary event</li> </ul>	Once Tx - Definable frames/burst
CVLAN priority	<b>IP Packet Generator</b>	Traffic generation in LBM frames at line rate
Supports up to 8 stacked VLAN tags	<b>IP</b>	Analysis of LBR frames at line rate
<b>VPLS</b>	IPv4 frame format	<b>Traffic Profiles</b>
VPLS parameters - MAC addresses	IPv6 frame format	Constant bandwidth
VPLS parameters - Frame type	TCP port number	Ramp bandwidth
VPLS parameters - Ethertype	UDP port number	Bursty bandwidth
VPLS tunnel and VC label - Label, CoS, TTL	<b>IP Addressing</b>	Flood bandwidth
VPLS control word - Reserved bits, sequence number	Destination IP address - User-defined	Traffic generation in Mbps or kbps and % utilization
<b>MAC in MAC/PBT/PBB 802.1ah</b>	Source IP address - User-defined	Bandwidth-configurable based on L1 or L2
Parameters - MAC address	<b>IPv4-Editable Fields</b>	<b>TCP Throughput</b>
B-Tag - TPI, VID, priority, DEI	ToS	10/100/1000 Mbps line rate stateful emulation
I-Tag - TPI, SID, priority, DEI, NCA, Res1, Res2	DSCP	1 GE line rate stateful emulation
<b>MPLS</b>	Flags	10 GE line rate stateful emulation
Single-label support	Protocol	Configurable source and destination IP address
Stacked-label support - Up to 2	TTL	Packet length
Editable parameters/results - Label	<b>IPv6-Editable Fields</b>	TCP/UDP traffic modes
Editable parameters/results - CoS	Traffic class	Source port
Editable parameters/results - TTL	Flow label	Destination port
<b>MPLS-TP</b>	Next header	Listen port
MPLS-TP label support (tunnel and VC)	Hop limit	Configurable TCP window size
VLAN tag support	<b>IP Ping</b>	Measures TCP efficiency
Line-rate traffic generation	<b>Fast Ping</b>	Measures buffer delay
Traffic analysis	<b>IP Traceroute</b>	TCP client emulation
Editable parameters/results - Label	<b>Traffic Generator</b>	TCP server emulation
Editable parameters/results - Priority	Number of traffic engines	Up to 64 simultaneous TCP stateful sessions
Editable parameters/results - TTL	Bandwidth controlled	Supports 4 background streams
Rx filters	Bandwidth specification in Mbps or kbps	Compatible with iPerf
GAL (Label 13) + ACH from ITU-T G.8113.1		<b>RFC 2544</b>
<ul style="list-style-type: none"> <li>• Common header label - PW, LSP, section</li> <li>• CCM generation and analysis</li> <li>• LBM/LBR generation and analysis</li> <li>• AIS generation and analysis</li> </ul>		Asymmetric testing
OAM alert label (Label 14) from ITU-T G.8114		Symmetric testing
<ul style="list-style-type: none"> <li>• Common header label - PW, LSP, section</li> <li>• CCM generation and analysis</li> <li>• LBM/LBR generation and analysis</li> <li>• AIS generation and analysis</li> </ul>		Throughput
OAM alert label (Label 14) from ITU-T Y.1711		Frame loss
<ul style="list-style-type: none"> <li>• Common header label - PW, LSP, section</li> <li>• CCM generation and analysis</li> <li>• FFD generation and analysis</li> <li>• BDI generation and analysis</li> <li>• FDI generation and analysis</li> </ul>		Out-of-sequence frames
Simultaneous OAM and background-traffic generation		Delay
		Back to back
		Committed burst size (CBS)
		Policer test
		Jitter
		Master/slave
		Pass/fail thresholds per MEF 23.1
		Connectivity QuickCheck
		Parallel testing

<b>RFC 2544 continued</b>	Graphical results and report generation	<b>Loopback</b>
Optional testing with line rate LBM frames	1 KB TCP window-size granularity	Manual (LLB)
Definable frame size	Jumbo frame support	Automatic
LAG support	Configurable file and window sizes	Local
<ul style="list-style-type: none"> <li>Sequential MAC addresses</li> <li>Suppression of OOS frames</li> </ul>	Total-test-time display	Far end
Report formats	<b>Layer 2 Transparency Testing (J-Proof)</b>	<b>Delay</b>
Graphical results	Encapsulation supported	Round-trip delay
Total-test-time display	<ul style="list-style-type: none"> <li>VLAN</li> <li>Q-in-Q</li> <li>Spanning Tree</li> <li>Cisco protocols (Discovery, etc.)</li> <li>GARP</li> <li>STP</li> </ul>	One-way delay
<b>ITU-TY.1564</b>	Send/receive Ethernet control-plane traffic	Delay measurement accuracy
10 Traffic streams	<ul style="list-style-type: none"> <li>Spanning Tree frames Tx/Rx</li> <li>Cisco discovery protocol</li> <li>LDP frames Tx/Rx</li> <li>Link aggregation LACP</li> <li>Cisco UDLD, ISL, PagP, DTP, PVST-PVST+</li> <li>MAC bridging 802.1d</li> <li>VLAN-BRDGSTP</li> <li>Custom frame builder</li> </ul>	<b>CAT-5 Testing</b>
Service Configuration test	<b>Synchronous Ethernet ITU G.826x</b>	Link speed
Service Performance test	10 GE Tx/Rx	Link status
Committed information rate (CIR)	1000/100/10 Mbps Electrical Tx/Rx	Cable status
Extended IR (EIR)	100/1000 Mbps Optical Tx/Rx	Crossover/straight (MDI/MDIX)
Maximum IR (MIR)	G.826x-compliant	Distance to fault
Frame loss rate (FLR)	Frequency offsets $\pm 100$ ppm in 1 or 10 ppm increments	Pin mapping
Frame delay (FD)	Recovered interface timing	Pair length
Frame delay variation	4.6 ppm frequency accuracy	Polarity
Committed burst size (CBS)	SSM message decode	Skew
Policer test	ESMC message capture	<b>Capture/Decode</b>
Round-trip testing	Quality message transmit and decode	Wirespeed capture up to 10 Gbps
Concurrent bidirectional testing	Definable SSM PDU rate (pps)	Wirespeed capture up to 1000/100/10 Mbps
Configurable VLAN, priority, addressing, and pass/fail thresholds	Background data plane traffic generation	Integrated Wireshark on the test set
Programmable pass/fail thresholds	<b>IEEE 1588v2 PTP</b>	256 MB capture buffer per port
Graphical results	1 GE Tx/Rx	Triggers
Screenshot support	1588v2 master PRC emulation	Tx and Rx capture
Auto-negotiation check	1588v2 slave emulation	Frame slicing
Saved reports	Packet delay variation measurements on control-plane traffic	<b>Expert Decode/Analysis</b>
Saved test profiles	Generate up to 4 streams of background data plane traffic	Decode/analysis capture files
Configurable DEI, TPID, TOS/DSCP	Frame/packet capture and decode via Wireshark	Detect half-duplex ports
Inclusive of L2 Ethernet and IPv4	Layer 2 1588v2 messaging	Detect ICMP layer issues
Integrated TrueSpeed TCP traffic stream with background streams	Layer 4 1588v2 messaging	Identify top talkers
Optional testing with line rate LBM frames	Support for unicast and multicast address mode	TCP layer diagnosis - ex. retransmissions
Asymmetric testing	Master-mode clock classes supported	<b>Traffic Profiling</b>
One-way delay with CDMA or GPS receiver	<ul style="list-style-type: none"> <li>Primary</li> <li>Primary holdover</li> <li>Arbitrary</li> <li>Arbitrary holdover</li> <li>Primary A</li> <li>Arbitrary A</li> </ul>	Detect and display up to 128 streams of live traffic
LAG support	1588v2 delay measurements (master/slave)	Specify filters for stream detection
<ul style="list-style-type: none"> <li>Sequential MAC addresses</li> <li>Suppression of OOS frames</li> </ul>		Stream classification
<b>IETF RFC 6349</b>		<b>Network Discovery</b>
Automated TCP-Throughput test per RFC 6349		Automatically detect networks, domains, devices, and hosts
Supported on 10/100/1000 Mbps electrical and 1/10 G optical interfaces		<b>Traffic Filtering</b>
Path MTU Detection test		<b>Ethernet (Layer 2) Traffic Filtering</b>
Round-Trip Time test		MAC source and destination address
Walk-the-Window test		Frame type/length
TCP-Throughput test		VLAN ID
Traffic-Shaping test		VLAN priority
TCP-Efficiency metric		VLAN discovery
Buffer-Delay metric		<b>VLAN (Layer 2.5) Tags - 802.1q</b>
Up to 64 simultaneous TCP stateful sessions		TPI
		Priority
		CFI/DEI
		VID

<b>VLAN (Layer 2.5) Tags - Q-in-Q, 802.1ah</b>	<b>Auto-Negotiation Status</b>	<b>QoS Measurements</b>
SVLAN ID	Link configuration ack	Throughput
SVLAN priority	Link advertisement status	Frame loss
SVLAN TPI	Pause capable	Packet jitter
CVLAN ID	Remote fault	Delay
CVLAN priority	Destination MAC address when using ARP	Out of sequence
<b>IP (Layer 3) Traffic Filtering</b>	<b>Link Counts/Statistics</b>	Frame/packet size binning
Source and destination IP address	Bandwidth utilization	MAC throughput Rx
Subnet mask	Frame rate	IP throughput Rx
IPv6 traffic class	Tx Mbps	TCP/UDP throughput Rx
TOS/DSCP fields	Rx Mbps	Payload throughput Rx
<b>TCP/UDP (Layer 4) Traffic Filtering</b>	Round-trip delay	Service disruption measurements
ATP listen port	Service-disruption time	• Definable threshold time
<b>Protocol Analysis</b>	Received frames	Round-trip delay measurements
<b>CDP and LLDP Frame Discovery and Decode</b>	Transmitted frames	One-way delay measurements
CDP Analysis	Received packets	Rx bytes
• Device identifier	Transmitted packets	Rx Mbps
• Port identifier	Pause frames	Rx frames
• VLAN ID	Lost frames	Rx frames per second
• Source MAC address	Out-of-sequence frames	Utilization %
• IP Subnet addresses	Out-of-sequence packets	QoS Measurements (con't)
LLDP Analysis	VLAN frames	Current Rx results
• Chassis identifier	CVLAN ID	Min Rx results
• Port identifier	SVLAN ID	Average Rx results
• Time to live	CVLAN priority	Max/peak Rx results
• Source MAC address and optional VLAN ID	SVLAN priority	Ratio Rx results
• Management IP address	Unicast frames	Seconds Rx results
• MAU Type information	Unicast packets	<b>Event Log</b>
<b>Errors Tx/Rx</b>	Multicast frames	Event, date, start time, stop time, duration, value
Code error Tx/Rx	Multicast packets	<b>Real-Time Histogram</b>
FCS error Tx/Rx	Broadcast frames	Seconds, minutes, hours, days
IP checksum Tx/Rx	Broadcast packets	<b>Time</b>
Bit error Tx/Rx	Frame length	Current date, current time, test-elapsed time
Insertion profile - Once	Packet length	<b>Graphical Displays</b>
Insertion profile - Rate	Packet jitter, avg	Errors versus time
Insertion profile - Burst	Packet jitter, max	Frame loss versus time
<b>Alarms Tx/Rx</b>	<b>Errored Counts</b>	Packet jitter versus time
Local fault Tx/Rx	Symbol errors	Latency versus time
Remote fault Tx/Rx	Code violation	Throughput versus time
<b>Ethernet Results</b>	FCS-errored frames	<b>Application-Layer Testing</b>
<b>Custom Results</b>	Runs	Walk the Window
<b>Histogram and Graphical Results Script</b>	Jabbers	FTP Throughput
<b>Link Status</b>	Oversized frames	HTTP Throughput
Loss of signal	Undersized frames	
Link active	Out-of-sequence frames	
Frame detected	Lost frames	
Sync obtained	IP checksum errors	
VLAN-tagged frame detected	IP packet-length errors	
	Packet payload errors	
	Bit error	
	Bit-error rate	



**SONET/SDH**

<b>Test Interfaces/Bit Rates</b>
STS-1 (e)
STM-1 (e)
STM-1 (o)
OC-3
OC-12
STM-4
OC-48
STM-16
OC-192
STM-64
<b>Laser Type</b>
SFP
SFP+
<b>Modes of Operation</b>
Terminate
Monitor
Through (intrusive)
Tributary scan
Drop and insert
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
Recovered from 10 MHz clock
<b>SONET/SDH Features</b>
SONET/SDH framing
Overhead manipulation/analysis
Optical/electrical power level
PRBS generation
PM/SMTTI messages Tx/Rx
Overhead byte viewing/manipulation
Service disruption measurements
<ul style="list-style-type: none"> <li>SD separation/debounce time setting</li> <li>SD threshold time settings</li> </ul>
Signal label generation/display
Frequency offset Tx/Rx
<b>Round-Trip Delay Measurement</b>
RTD measurement accuracy
<b>PRBS Pattern</b>
2 <sup>15</sup> -1, 2 <sup>15</sup> -1 inverse
2 <sup>20</sup> -1, 2 <sup>20</sup> -1 inverse
2 <sup>23</sup> -1, 2 <sup>23</sup> -1 inverse
2 <sup>31</sup> -1, 2 <sup>31</sup> -1 inverse
Programmable - 32 bit
ANSI and ITU implementations

<b>Anomaly/Error Generation</b>
Bit/TSE
Frame word
B1
B2
B3
HP-REI
MS-REI, LP-BIP
LP-REI
Insert - Single
Insert - Rate
Multiple
<b>Defects/Alarms Generation/Analysis</b>
LOS
LOF
RS-TIM
MS-AIS
MS-RDI
AU-LOP
AU-AIS
HP-UNEQ
HP-RDI
HP-TIM
HP-PLM
TU-LOP
TU-AIS
TU-LOM
LP-UNEQ
LP-RDI
LP-TIM
LP-PLM
LP-RFI
<b>SDH Mappings</b>
VC4 Bulk, AU-4-4c, AU-4-16c, AU-4-64c
VC12
VC4
VC3
E4
DS3
E3
E1
<b>SONET Mappings</b>
STS-1, STS-3c, STS-12c, STS-48c, STS-192c
VT1.5
DS3
DS1
E1

<b>Results</b>	
<b>Signal Category</b>	
Signal present	
Signal-loss count	
Signal-loss seconds	
Rx frequency	
Rx-frequency deviation	
Rx-frequency maximum deviation	
Tx frequency	
Electrical input level	dBdsx, dBm, volts dBnom only
<ul style="list-style-type: none"> <li>STS-1</li> <li>STM-1e</li> </ul>	
BPV count (STS-1 only)	
BPV-error rate (STS-1 only)	
<b>Regenerator/Section OH Category</b>	
FAS/frame word-error count	
FAS/frame word-error rate	
LOF count	
OOF count	
B1-BIP-error count	
B1-BIP-error rate	
Severely errored seconds	
OOF seconds	
Section trace mismatch	TIM
J0-Regenerator trace	
<b>Multiplexer/Line OH Category</b>	
APS message count	
APS bridge-request code	Ring
APS destination node	Ring
APS source node	Ring
APS path code	Ring
APS status	Ring
APS request code	Linear
APS K1 channel number	Linear
APS K2 channel number	Linear
APS MSP architecture	Linear
APS status	Linear
B2-BIP-error count	
B2-BIP-error rate	
SES	
Unavailable seconds	
AIS seconds	
REI count	
REI rate	
S1 Synchronization message	
Z1 Byte value	

<b>High-Path (AU, VC3/4) OH Category</b>	<b>Signal-Loss Status</b>	<b>OTN G.709</b>
Pointer-justification count	Frame-synchronization-loss status	<b>Test Interfaces/Bit Rates</b>
Pointer-increment count	Pattern-synchronization-loss status	OTU1
Pointer-decrement count	MS/Line-AIS	OTU2
Pointer-NDF count	AIS (HP)	OTU1e
Pointer value	AIS (LP)	OTU2e
Pointer size	LOP (HP)	<b>Laser Type</b>
LOP count	LOP (LP)	SFP
B3-BIP-error count	LOS	SFP+
B3-BIP-error rate	OOF	<b>Modes of Operation</b>
B3-BIP-errored seconds	LOF	Terminate
REI count	MS/Line RDI	Monitor
VC-3/4 REI rate	LP RDI	<b>OTN Layer</b>
POH SES	HP RDI	OTN/ODU framing
POH unavailable seconds	MS/Line-REI	ODU1 in ODU2 multiplexing
Signal label	Regenerator trace identifier mismatch	ODU0 multiplexing
J1 trace message	High-path trace identifier mismatch	<ul style="list-style-type: none"> <li>• ODU-0 bulk BERT from an OTU-2</li> <li>• ODU-0 1 GE Layer 2 and IPv4 traffic from an OTU-2</li> <li>• ODU-0 bulk BERT from an OTU-1</li> <li>• ODU-0 1 GE Layer 2 and IPv4 traffic from an OTU-1</li> <li>• ODUflex bulk BERT from an OTU-2</li> <li>• ODUflex 1 GE Layer 2 from an OTU-2</li> <li>• Generic mapping procedure (GMP) supported</li> <li>• GFP-T encapsulation of Ethernet 8B/10B PCS</li> </ul>
Path status	HP-UNEQ/UNEQ-P	GFP-T
<b>Low-Path (VC3/12, TU3/12, VT1.5) Category</b>	Low-path trace identifier mismatch	<ul style="list-style-type: none"> <li>• CID</li> <li>• UPI</li> </ul>
Pointer transmitted	Loss of multiframe	Overhead manipulation/analysis
Pointer received	<b>Overhead-Byte Manipulation/Viewing – High Path</b>	Power level
Pointer-justification count	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	PM/SMTTI messages Tx/Rx
Pointer-increment count	<b>SDH Low-Order View (AU/VT)</b>	Overhead manipulation/analysis
Pointer-decrease count	V5, S2, N6, K4	Service-disruption measurements
Pointer-NDF count	<b>SOH and POH Evaluation</b>	<ul style="list-style-type: none"> <li>• SD separation/debounce time setting</li> <li>• SD threshold time settings</li> </ul>
LOP count	Text decode of S and C bytes for the trace identifier.	Payload type (PT) label generation/display
LOP seconds	J0 display of 16-byte ASCII sequence. J1, J2 display of 16- or 64-byte ASCII sequence.	Transfer delay
B3/V5 BIP count	<b>Tandem Connection Monitoring (TCM)</b>	Frequency offset Tx/Rx
B3/V5 BIP-error rate	Analysis of the N1 and N2 bytes, monitoring/display of: AIS, ODI, RDI, OEI, REI, APId, incoming B3/computed BIP comparison, IEC, TC-UNEQ	<b>PRBS Patterns</b>
REI count	<b>Performance Measures</b>	2 <sup>20</sup> -1, 2 <sup>20</sup> -1 inverse
Pointer transmitted	G.826	2 <sup>23</sup> -1, 2 <sup>23</sup> -1 inverse
Pointer received	G.828	2 <sup>31</sup> -1, 2 <sup>31</sup> -1 inverse
Signal label	G.829	Programmable - 32 bit
Signal label mismatch	M.2101	ANSI and ITU implementations
J2 Lower-order trace message	T1.231	<b>Error-Insertion Capability</b>
J2 Lower-order TIM	T1.514	Single, rate
<b>Logic Category</b>	<b>K1/K2 Event Log</b>	
Pattern-loss count	Date, time, K1 value, code, channel, K2, bridge, MSP, status	
Bit-error/TSE count	<b>Event Log</b>	
Bit-error/TSE rate	Event, date, start time, stop time, duration, value	
Pattern-slip count	<b>Real-Time Histogram</b>	
Pattern-slip seconds	Seconds, minutes, hours, days	
Pattern-loss count	<b>Time</b>	
Pattern-synchronization-loss seconds	Current date, current time, elapsed test time	
Pattern-synchronization status		
<b>Alarms</b>		

<b>OTU Error Tx/Rx</b>	FTFL Fwd signal fail	<b>FEC</b>
FAS	FTFL Fwd signal degraded	Uncorrected word errors
MFAS	FTFL Bwd signal fail	Uncorrected word-error rate
SM-BIP/BEI	FTFL Bwd signal degraded	Corrected word errors
PM-BIP/BEI	TCM1-6 IAE	Correctable word errors
FEC uncorrectable	TCM1-6 TIM	Corrected word-error rate
FEC correctable	TCM 1-6 BDI	Correctable word-error rate
TCM1-6 BIP	TCM1-6 BIAE	Corrected bit errors
TCM1-6 BEI	<b>OPU Errors/Alarms Tx/Rx</b>	Corrected bit-error rate
Bit error	PT label mismatch	Correctable bit errors
Codeword errors (correct/incorrect)	Client loss	Correctable bit-error rate
<b>OTU Alarm Tx/Rx</b>	Bit error	<b>Framing</b>
LOF	<b>ODU Mappings</b>	Frame-sync-loss seconds
OOF	Bulk	Frame-sync losses
LOM	ODU0	OOF-seconds count
OOF	ODU1	FAS errors
OOM	ODU2	FAS-error rate
SM-IAE	<b>SDH Mappings</b>	LOF
SM-TIM	VC4 bulk, AU-4-4c, AU-4-16c, AU-4-64c	LOF seconds
SM-BDI	VC4	Multiframe-sync-loss seconds
SM-BIAE	VC3	OOF-seconds count
PM-TIM	<b>SONET Mappings</b>	MFAS errors
PM-BDI	STS-1, STS-3c, STS-12c, STS-48c, STS-192c	MFAS-error rate
FTFL Fwd signal fail	<b>Ethernet Mappings</b>	<b>OTU</b>
FTFL Fwd signal degraded	10 GE	OTU-AIS
FTFL Bwd signal fail	1 GE	OTU AIS seconds
FTFL Bwd signal degraded	<b>Results</b>	SM-IAE
TCM1-6 IAE	<b>LEDS</b>	SM-IAE seconds
TCM1-6 TIM	Signal present	SM-BIP-error counts
TCM 1-6 BDI	Frame sync	SM-BIP-error rate
TCM1-6 BIAE	Pattern sync	SM-BDI seconds
<b>ODU Errors Tx/Rx</b>	LOS	SM-BDI count
FAS	LOF	SM-BIAE seconds
MFAS	LSS	SM-BIAE count
PM BIP/BEI	<b>Interface</b>	SM-BEI count
TCM BIP/BEI	Invalid Rx signal seconds	SM-BEI-error rate
Bit error	LOS count	SM-TIM count
<b>ODU Alarms Tx/Rx</b>	Optical Rx level (dBm)	SM-TIM seconds
LOF	Reference frequency	SM-SAPI
OOF	Round-trip delay	SM-DAPI
LOM	Rx-frequency maximum deviation (ppm)	SM-operator specific
OOM	Rx-frequency (Hz)	GCC BERT bits
AIS	Rx-frequency deviation (ppm)	GCC BERT bit errors
OCI	Signal-loss count	GCC BERT bit error rate
LCK	Tx clock source	
PM-TIM	Tx-frequency maximum deviation (ppm)	
PM-BDI	Tx-frequency (Hz)	
FTFL	Tx-frequency deviation (ppm)	

<b>ODU</b>
ODU
ODU-AIS
ODU-AIS seconds
ODU-LCK
ODU-LCK seconds
ODU-OCI
ODU-OCI seconds
PM-BIP count
PM BIP-error rate
PM-BDI seconds
PM-BDI count
PM-BEI count
PM-BEI-error rate
PM-TIM seconds
PM-TIM count
PM-SAPI
PM-DAPI
PM-operator specific
PM round-tip delay recent
PM round-trip delay last
<b>FTFL</b>
Forward-fault type
Forward-SF seconds
Forward-operator specific
Forward-operator identifier
Backward fault type
Backward SF-seconds count
Backward SD-seconds count
Backward-operator identifier
Backward-operator specific
<b>TCM 1-6</b>
IAE seconds
BIP errors
BIP-error rate
BDI seconds
BIAE seconds
BEI errors
BEI-error rate
TIM seconds
SAPI
DAPI
Operator-specific
GCC BERT bits
GCC BERT bit errors
GCC BERT bit error rate
<b>OPI</b>
Payload type mismatch seconds
Payload type

<b>Payload</b>
Pattern-sync-loss seconds
Pattern-sync losses
TSE/bit errors
TSE/bit-error rate
<b>Ethernet Client</b>
As per Ethernet results
RFC 2544 on 10 GE client
<b>SONET/SDH Client</b>
As per SONET/SDH results

**Fibre Channel**

<b>Laser Type</b>
SFP
SFP+
<b>Modes of Operation</b>
Terminate
Monitor
Thru
<b>Test Interfaces/Bit Rates</b>
1.0625
2.125 Gbps
4.25 Gbps
8.5 Gbps
10.519 Gbps
<b>Fibre Channel Features</b>
<b>General</b>
Flow control
Login
Buffer credits
<b>Fibre Channel Login</b>
at "F-port"
at "N-port"
<b>Layer 1 (unframed) Bit Error Testing Patterns</b>
High frequency test pattern per IEEE 802.3, 2000 edition, Annex 36A
Low frequency test pattern per IEEE 802.3, 2000 edition, Annex 36A
Mixed frequency test pattern per IEEE 802.3, 2000 edition, Annex 36A
Random data pattern (RPAT) per NCITS TF-25-1999
Jitter tolerance test pattern (JTPAT) per NCITS TF-25-1999
Supply noise test sequence (SPAT) per NCITS TF-25-1999
<b>Layer 2 (framed) Bit Error Testing Patterns</b>
Compliant random data pattern (CRPAT)
Compliant jitter tolerance pattern (CJPAT)
Compliant supply noise pattern (CSPAT)

<b>Framed Pattern Test</b>
PRBS (2 <sup>23</sup> -1, 2 <sup>31</sup> -1 and inverse)
All 1s
All 0s
User defined
<b>Fibre Channel Traffic Generation</b>
Transmit traffic profiles
Constant
Ramp
Bursty
Traffic generation in Mbps and % utilization
Configurable source and destination ID
Sequence ID
Originator ID
Responder ID
Frame length
User-defined
Packet payload
Granularity
<b>Fibre Channel Traffic Filtering</b>
Routing control
Destination identifier
Source identifier
Data structure type
Sequence count
<b>Fibre Channel Error Insertion</b>
Bit error
CRC
Framed bit
Code violation
Insertion type - Single, rate, burst
<b>Enhanced Fibre Channel Test (RFC-2544-like)</b>
Selectable configuration template
Throughput
Latency
Frame loss
Back-to-back
Buffer credits
Buffer credit throughput
Selectable flow control login type
Definable frame length
Pass/fail thresholds
Report generation
Screen capture support
Graphical results
<b>8 G Fibre Channel Specific</b>
Scrambling in FC-1/MAC layer, on total FC frame
Supported IDLE and FILL WORD patterns include IDLE on Link INIT and as FILL WORD; IDLE on INIT and ARBFF on FILL WORD; ARBFF on INIT and as FILL WORD

<b>Results</b>
<b>Interface</b>
Signal losses
Signal loss seconds
Sync loss seconds
Optical Rx overload
Optical Rx level (dBm)
<b>Login Status</b>
Far-end buffer-to-buffer credits
Login status
Tx/Rx ELP accept
Tx/Rx ELP Ack1
Tx/Rx ELP reject
Tx/Rx ELP request
<b>L2 Link Statistics</b>
Total utilization %
Frame rate
Frame size
Rx Mbps
Tx Mbps
Round trip delay (us)
Service disruption (us)
<b>L2 Link Counts</b>
Rx frames
Tx frames
Rx frame bytes
Tx frame bytes
Class F frames
Class 1 frames
Class 2 frames
Class 3 frames
<b>BERT Stats</b>
Pattern losses
Pattern loss seconds
Bit error rate
Bit errors
Bit errored seconds
Bit error-free seconds
Bit error-free seconds (%)
<b>Error Stats</b>
Symbol errors
CRC errored frames
Fiber runts
Fiber jabbers
Undersized frames
Code violations
Code violation rate
Code violation seconds

**PDH**

<b>Test Interfaces</b>	
E4	
DS3	
E3	
E1 balanced	
E1 unbalanced	
T1	
<b>Interface Type</b>	
BNC	
Bantam	
RJ48	
<b>E4</b>	
<b>Modes of Operation</b>	
Terminate	
Monitor	
Thru (intrusive)	
<b>Timing</b>	
Recovered from Rx	
Internal (Stratum 3)	
Recoverd from external (bits/sets)	
<b>Framing</b>	
Framed	
Unframed	
<b>Test Patterns</b>	
2 <sup>15</sup> -1* inverse	
2 <sup>20</sup> -1* inverse	
2 <sup>23</sup> -1* inverse	
User-programmable	
Round-trip delay	
ANSI and ITU	
<b>Mappings</b>	
E3	
E1	
64 k	
<b>Anomaly/Error Insert/Analysis</b>	
Frame errors	
TSE/bit error	
Single	
Rate	
<b>Defect/Alarm Insert/Analysis</b>	
AIS	
RDI/FAS distant	
<b>General</b>	
Frequency offset ±100 ppm	
National bit support	
<b>Performance Measures</b>	
G.821	OOS
G.826	ISM/OOS
M.2100	ISM/OOS

<b>Results</b>
<b>Signal Category</b>
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency
Round-trip delay
<b>Frame Category</b>
FASTSE count
FASTSE rate
FAS word-error count
FAS word-error rate
Frame-synchronization-loss count
Frame-synchronization-loss seconds
<b>Logic Category</b>
TSE/bit-error count
TSE/bit-error rate
Pattern slips
Pattern-slip seconds
Pattern-synchronization-loss count
Pattern-synchronization-loss seconds
<b>DS3</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
<b>Framing</b>
M13
C-bit
Unframed
<b>Test Patterns</b>
All 1s
All 0s
2 <sup>15</sup> -1* inverse
2 <sup>20</sup> -1* inverse
2 <sup>23</sup> -1* inverse
Round-trip delay
User-programmable (3...32 bits)
User byte
100
1100 (aka idle)
1010 (aka blue)
ANSI and ITU



<b>Mappings</b>
E1
T1
64 k
<b>Anomaly/Error/Insert/Analysis</b>
BPV/code error
Frame
Parity
C-bit parity
TSE/bit error
Single
Rate
Multiple
<b>Defect/Alarm Insert/Analysis</b>
AIS
RDI/FAS distant
REBE
TS-16 AIS
TS-16 RDI/MFAC distant
<b>General</b>
Frequency offset $\pm 100$ ppm
Loop codes Tx NIU, CSU, line
Rx compensation - High - 0 ft
Rx compensation - Low - 450 ft
Rx compensation - Low - 900 ft
Service disruption
<b>Performance Measures</b>
G.826
G.821
M.2100
M.2101
T1.231
T1.510
<b>Results</b>
<b>Signal Category</b>
Receive frequency
Receive-frequency deviation
Receive-frequency maximum deviation
Transmit frequency
BPV/code rate
BPV/code count
Electrical input level
Round-trip delay (ms)
<b>Frame Category</b>
Frame-error count
Frame-error rate
Frame-error seconds
Frame-synchronization-loss count
Near-end out-of-frame seconds
Far-end out-of-frame seconds

C-bit format
Rx X-bits
FEAC word
Parity-error count
Parity-error rate
Parity-error seconds
C-bit parity-error count
C-bit parity-error rate
C-bit error seconds
FEBEs
DS2 frame-synchronization-loss count
<b>Logic Category</b>
Bit-error/TSE count
Bit-error/TSE rate
Pattern slips
Pattern-slip seconds
Pattern-synchronization-loss count
Pattern-synchronization-loss seconds
Pattern-synchronization status
<b>E3</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
<b>Framing</b>
Framed
Unframed
<b>Test Patterns</b>
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
1:1
1:3
1:4
1:7
ANSI and ITU
<b>Mappings</b>
E1
64k

<b>Anomaly/Error/Insert/Analysis</b>
Code error
FAS error
TSE/bit error
Single
Rate
<b>Defect/Alarm/Insert/Analysis</b>
AIS
RDI/FAS distant
<b>General</b>
Frequency offset Tx $\pm 100$ ppm
Tx LBO - 0 dB loss
Tx LBO - 6 dB loss
National bit support - On/off
Service disruption
<b>Performance Measures</b>
G.826
G.821
M.2100
<b>Results</b>
<b>Signal Category</b>
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)
<b>Frame Category</b>
FAS bit-error count
FAS bit-error rate
FAS word-error count
FAS word-error rate
Frame-synchronization-loss count
8M FAS word-error rate
8M FAS bit-error count
8M FAS bit-error rate
8M FAS word-error count
8M FAS word-error rate
<b>Logic Category</b>
TSE/bit-error count
TSE/bit-error rate
Pattern slips
Pattern-slip seconds
Pattern-synchronization-loss count
Pattern-synchronization-loss seconds
Pattern-synchronization status

<b>E1</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (intrusive)
<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
<b>Framing</b>
Unframed
PCM30
PCM30C
PCM31
PCM31C
<b>Test Patterns</b>
All 1s
All 0s
2 <sup>15</sup> -1* inverse
2 <sup>20</sup> -1* inverse
2 <sup>23</sup> -1* inverse
QRSS
User-programmable (32 bits)
Round-trip delay
1:1
1:3
1:4
1:7
ANSI and ITU
<b>Mappings</b>
64k
<b>Anomaly/Error/Insert/Analysis</b>
Code error
FAS error
MFAS error
TSE/bit error
Single
Multiple
Rate
<b>Defect/Alarm/Insert/Analysis</b>
AIS
REBE
TS-16 AIS
TS-16 RDI/MFAS distant
<b>General</b>
Frequency offset Tx ±100 ppm
Service disruption
<b>Performance Measures</b>
G.826
G.821
G.829
M.2100

<b>Results</b>
<b>Signal Category</b>
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
<b>Logic Category</b>
TSE/bit-error count
TSE/bit-error rate
Pattern slips
Pattern-slip seconds
Pattern-synchronization-loss count
Pattern-synchronization status
<b>Alarm Category</b>
FAS/frame synchronization
MFAS synchronization
CRC synchronization
AIS
RDI
Power-loss count
2 Mbps alarm
<b>Frame Category</b>
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)
<b>T1</b>
<b>Modes of Operation</b>
Terminate
Monitor
Through (intrusive)

<b>Timing</b>
Recovered from Rx
Internal (Stratum 3)
Recovered from external (bits/set)
<b>Framing</b>
Unframed
SF
ESF
SLC-96
<b>Test Patterns</b>
63
511
511 QRSS
2047 QRSS
2047
All 1s
All 0s
2 <sup>15</sup> -1* inverse
2 <sup>20</sup> -1* inverse
2 <sup>23</sup> -1* inverse
QRSS
User-programmable (3...32 bits)
User byte
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
<b>Mappings</b>
64 k
56 k
<b>Anomaly/Error/Insert/Analysis</b>
Frame errors
BPV errors
TSE/bit error
Single
Rate
Multiple
<b>Defect/Alarm/Insert/Analysis</b>
AIS
REBE

<b>General</b>	<b>IP (PPP ping only)</b>	<b>HDLC</b>
Frequency offset Tx $\pm 100$ ppm	IPv4 frame format	Rx/Tx frame count
<b>Performance Measures</b>	Local IP	Rx/Tx octet count
G.826	Remote IP	Frame aborts
G.828	Destination IP address — user defined	Short frames
G.829	Subnet mask	FCS errored frames
M.2100	Preferred and alternate DNS server	Percent utilization (average, current, maximum)
T1.231	<b>IPv4 Editable Fields</b>	Throughput (average, current, maximum)
Tx LBO	ToS	Average fame rate (frames/s)
Service disruption	DSCP	Average frame size (octets)
<b>Loop Codes</b>	TTL	<b>PPP (PPP ping only)</b>
Loop-code Tx	<b>IP Ping</b>	PPP status
Loop-code emulation	Editable packet length (46 – 1500 bytes)	Local IP
Loop code Tx repeater	Single	IP subnet mask
HDSL loop-code Tx	Multiple	Remote IP
• CO-to-customer direction	Continuous	Preferred and alternate DNS server
• Customer-to-CO direction	Fast	Destination IP address
User-defined loop-code support	<b>Alarms/Errors Generation and Analysis (PPP ping only)</b>	Resolved host name
<b>DS1 Dual HDLC Monitor and PPP Ping</b>	LOS	<b>Ping (PPP ping only)</b>
<b>Modes of Operation</b>	LOF	Ping requests Tx
Bridge	AIS	Ping replies Rx
Terminate	RAI	Lost pings
DSX monitor	BPV	Lost ping %
<b>Line Code</b>	Frame	Delay (ms)
B8ZS	<b>Results</b>	Ping requests Rx
AMI	<b>Interface</b>	Ping replies Tx
<b>Clock Source (PPP ping only)</b>	Signal losses	<b>Capture/Decode</b>
Internal	Signal loss seconds	Wirespeed capture
Recovered	Rx level (Vpp)	Integrated Wireshark on the test set
External	Rx level (dBsx)	256 MB capture buffer
Selectable clock offset	Rx/Tx frequency (Hz)	Triggers
<b>Transmit LBO (PPP ping only)</b>	Rx/Tx frequency deviation (ppm)	Frame slicing
0 dB	Rx/Tx frequency max deviation (ppm)	<b>DS3 HDLC Dual Monitor</b>
-7.5 dB	Bi-polar violations (BPVs)	Modes of operation
-15.0 dB	BPV rate	DSX-MON
-22.5 dB	Excess zeros state count	Terminate
<b>Framing</b>	Ones density state count	<b>Framing</b>
Unframed	<b>DS1</b>	Unframed
ESF	Frame sync losses	M13
D4 (SF)	Frame sync loss seconds	C-Bit
SLC-96	AIS alarms	<b>HDLC</b>
<b>Payload</b>	AIS seconds	Normal or inverted HDLC mode
Bulk	T1 alarm seconds	CRC16 or CRC32
Fractional rate	Frame errors	Interface
<b>HDLC</b>	Frame error rate	Signal losses
Normal or inverted HDLC mode	Frame error seconds	Signal loss seconds
CRC16 or CRC32	Excess zeros	Rx level (Vpeak)
<b>PPP (PPP ping only)</b>	Maximim consecutive zeros	Rx level (dBdsx)
PPP mode (client or server)		Rx frequency (Hz)
IP mode (static or auto)		Rx frequency deviation (ppm)
Optional authentication		Rx frequency max deviation (ppm)

<b>HDLC continued</b>
Bipolar violations (BPVs)
BPV rate
BPV error seconds
Excess zeros count
Excess zeros seconds
<b>DS3</b>
Frame sync losses
Frame sync loss seconds
Near end OOF seconds
Far end OOF seconds
AIS seconds
RAI seconds
FEAC word
Frame errors
Frame error rate
Parity errors
Parity error bit rate
C-Bit errors
C-Bit error rate
C-Bit error seconds
C-Bit frame mismatch seconds
C-Bit sync loss seconds
FEBEs
FEBE rate
FEBE seconds
Rx X-Bits
<b>HDLC</b>
Rx frame count
Rx octet count
Frame aborts
Short frames
FCS errored frames
Percent utilization (average, current, maximum)
Throughput (average, current, maximum)
Average frame rate (frames/s)
Average frame size (octets)

**CPRI**

<b>Test Interfaces/Bit Rates</b>	
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
<b>Laser Type</b>	
SFP	
SFP+	
Tuned SFP	

<b>Modes of Operation</b>
Terminate
Monitor/Through
<b>Timing</b>
Recovered from Rx (slave)
Internal (Stratum 3) (master)
Recovered from external (bits/sets) (master)
Recovered from 10 MHz clock (master)
<b>CPRI Features</b>
Optical/electrical power level
Frequency offset Tx/Rx
CPRI startup sequence - normal or bypass
<b>PRBS Generation and Monitoring</b>
Unframed
L1 - Pattern inserted in hyperframe structure
L2 - Pattern inserted in CPRI basic frame
<b>Interface Type</b>
Master
Slave
Selectable CPRI protocol Version
<b>Control and Management (C&amp;M) Channel</b>
Ethernet
HDLC
Selectable C&M channel rate
<b>Service Disruption Measurements</b>
SD Separation/Debounce time setting
SD Threshold time setting
<b>Round-Trip Delay Measurement</b>
RTD measurement accuracy
<b>PRBS Patterns</b>
2 <sup>15</sup> -1, 2 <sup>15</sup> -1 inverse
2 <sup>20</sup> -1, 2 <sup>20</sup> -1 inverse
2 <sup>23</sup> -1, 2 <sup>23</sup> -1 inverse
2 <sup>31</sup> -1, 2 <sup>31</sup> -1 inverse
Delay
Live
Digital word
ANSI and ITU implementations
<b>Anomaly/Errors Generation</b>
Bit
Code
K30.7
Insert - Single
Insert - Rate
<b>Defects/Alarms Generation/Analysis</b>
LOS
LOF
SDI
RAI

<b>Results</b>
<b>Signal Category</b>
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)
<b>CPRI Inband Protocol</b>
Tx/Rx protocol version
Tx/Rx C&M HDLC rate
Tx/Rx C&M Ethernet subchannel number
Port type (master/slave)
Start-up state
CPRI Counts
Word sync loss events
Word sync loss seconds
Code word count Tx/Rx
Frame count Tx/Rx
<b>Error Stats</b>
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

<b>Test Interfaces/Bit Rates</b>
768 Mbps optical
1.5 Gbps optical
3.1 Gbps optical
6.1 Gbps optical
<b>Laser Type</b>
SFP
SPF+
Tuned SFP
<b>Modes of Operation</b>
Terminate
Monitor/Through
<b>Timing</b>
Recovered from Rx (slave)
Internal (Stratum 3) (master)
Recovered from external (bits/sets) (master)
Recovered from 10 MHz clock (master)
<b>OBSAI Features</b>
Optical/electrical power level
Frequency offset Tx/Rx
<b>PRBS Generation and Monitoring</b>
Unframed
L1 - Pattern inserted in frame structure
L2 - Pattern inserted in OBSAI message
<b>Interface Type</b>
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
<b>Round-Trip Delay Measurement</b>
RTD measurement accuracy
<b>PRBS Patterns</b>
D6.6 D25.6
2 <sup>15</sup> -1, 2 <sup>15</sup> -1 inverse
2 <sup>20</sup> -1, 2 <sup>20</sup> -1 inverse
2 <sup>23</sup> -1, 2 <sup>23</sup> -1 inverse
2 <sup>31</sup> -1, 2 <sup>31</sup> -1 inverse
Live
Digital Word
Delay

## Anomaly/Errors Generation

Bit
Code
Insert - Single
Insert - Rate
<b>Results</b>
<b>Signal Category</b>
Signal losses
Sync-loss seconds
Optical Rx overload
Optical Rx level (dBm)
Rx frequency
Rx-frequency deviation
Rx-frequency maximum deviation
Tx frequency
Tx-frequency deviation (Hz)
Tx-frequency deviation (ppm)
Tx-frequency maximum deviation (ppm)
<b>OBSAI Counts</b>
Code word count Tx/Rx
Frame count Tx/Rx
Message group counts Tx/Rx
Receive message counts: control, measurement, WCDMA/FDD, WCDMA/TDD, GSM/EDGE, TETRA, CDMA2000, WLAN, loopback, frame clock burst, Ethernet, RTT, WiMAX, virtual HW reset, LTE, generic packet, multihop RTT
<b>Error Stats</b>
Word sync loss events
Word sync loss seconds
Code violations
Code violation rate
Code violation seconds
K30.7 words
Frame sync losses
Frame sync loss seconds
Pattern sync losses
Pattern sync loss seconds
Bit error rate
Bit errors
Errored seconds
Error-free seconds
Error-free seconds, %
Total bits received
Round-trip delay current (ms)
Round-trip delay average (ms)
Round-trip delay minimum (ms)
Round-trip delay maximum (ms)
Tx/Rx OBSAI state

## Jitter O.172

<b>General Features</b>	
Generate and measure jitter on electrical interfaces	DS1, E1, DS3, E3, E4, STM1e
Automatic measurement sequences	
<ul style="list-style-type: none"> <li>Maximum tolerable jitter (MTJ)</li> <li>Measure intrinsic jitter</li> <li>Jitter transfer function (JTF)</li> </ul>	
Support different measurement bands	
<ul style="list-style-type: none"> <li>High band</li> <li>Wide band</li> <li>Extended band</li> <li>Set user-definable band</li> </ul>	
Select common jitter mask	
Create user-definable masks	
<b>Results</b>	
Jitter results per measurement band	
Current peak-to-peak jitter [UI]	
<ul style="list-style-type: none"> <li>Peak-to-peak jitter [UI]</li> <li>Positive peak jitter [UI]</li> <li>Negative peak jitter [UI]</li> </ul>	
Maximum peak-to-peak jitter [UI]	
<ul style="list-style-type: none"> <li>Peak peak jitter [UI]</li> <li>Positive peak jitter [UI]</li> <li>Negative peak jitter [UI]</li> </ul>	
Phase hits	
Percentage of mask	
RMS jitter [UI]	
Jitter graphs	

## Wander

<b>General Features</b>	
Measure wander on 1 PPS signal	
Measure wander on 1 G optical Ethernet interface	
Measure wander on T1, E1, and unframed 2.048 MHz signals	
Measure wander on 10 MHz signal	
Selectable peak-time offset threshold	
Resolution	1 ns
Sample rate	1, 30, 60 samples per second
Internal data storage	256 M
External data storage on USB stick	
Start/Stop via key	
<b>Results</b>	
Time-interval error (TIE)	
<ul style="list-style-type: none"> <li>Current TIE(s)</li> <li>Maximum TIE(s)</li> <li>Minimum TIE(s)</li> </ul>	
Maximum peak-to-peak TIE (MTIE)(s)	



Results continued	
Offset between test signal and reference	
<ul style="list-style-type: none"> <li>• Current offset (μs)</li> <li>• Minimum offset (μs)</li> <li>• Maximum offset (μs)</li> </ul>	
Pass/fail result	
TIE graph	
Time deviation (TDEV)	
Reference clock for 1 pps wander	1 pps reference signal
Reference clock for GigE optical, T1, E1, 2 MHz, and 10 MHz wander	2 MHz or 10 MHz reference signal
Cables for 1 pps wander	
Wander Analysis Tool	
Offline analysis of captured/imported TIE measurements	
Maximum peak-to-peak TIE (MTIE) [s]	
Frequency offset (ppm)	
Drift rate (ppm/s)	
Masks	
ANSI	
<ul style="list-style-type: none"> <li>• SMC holdover (T1.105.109)</li> </ul>	
ETSI	
<ul style="list-style-type: none"> <li>• SEC (ETS 300 462-5-1)</li> <li>• SEC network IF (ETS 300 462-3-1)</li> <li>• SSU (ETS 300 462-4-1)</li> <li>• SSU network IF (ETS 300 462-3-1)</li> </ul>	
GR253	
<ul style="list-style-type: none"> <li>• SMC transient</li> </ul>	
ITU	
<ul style="list-style-type: none"> <li>• G.8261</li> <li>• SEC network IF (G.832, G.825)</li> <li>• SEC option 1 (G.813)</li> <li>• SEC option 2 (G.813)</li> <li>• SEC holdover option 2 (G.813)</li> <li>• SEC trans. option 2 (G.813)</li> <li>• SSU network IF (G.823, G.825)</li> <li>• SSU Type I (G.812)</li> <li>• SSU Type II, III (G.812)</li> <li>• SSU Type IV (G.812)</li> <li>• PRC (G.811) EEC-1 noise generation (G.8262 constant temperature)</li> <li>• EEC-1 noise generation (G.8262 constant temperature)</li> <li>• EEC-1 noise generation (G.8262 with temperature effects)</li> <li>• EEC-2 noise generation (G.8262 constant temperature)</li> <li>• EEC-1 noise tolerance (G.8261)</li> <li>• EEC-1 noise tolerance (G.8262)</li> </ul>	

## 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:
<ul style="list-style-type: none"> <li>• G.711 A Law</li> <li>• G.711 U Law</li> <li>• G.723 5.3 K</li> <li>• G.723 6.3 K</li> <li>• G.729A</li> <li>• G.726</li> <li>• G.722</li> </ul>
Configurable call manager port
Selectable silence suppression
Configurable jitter buffer and speech-per-frame parameters
ACR or G.107 MOS scoring
Configurable jitter, loss, delay, and content 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	
10/100/1000 Mbps electrical Ethernet interfaces	
1 GE optical Ethernet interface	
10 GE optical Ethernet interface	
<ul style="list-style-type: none"> <li>• More than 11,000 simulated calls with configurable codec and sampling rate</li> <li>• Configurable voice call or tone with configurable silence suppression, sampling rate, and jitter buffer</li> <li>• Up to 250 simulated SDTV channels with configurable frame size and MPEG-2/4 compression</li> <li>• Up to 52 simulated HDTV channels with configurable frame size and MPEG-2/4 compression</li> <li>• Two configurable data streams with individual constant or ramp traffic and configurable frame sizes including random frames</li> </ul>	
IPTV	
10/100/1000 Mbps electrical Ethernet interfaces	
1 GE optical Ethernet interface	
10 GE optical Ethernet interface	
<ul style="list-style-type: none"> <li>• Single- and multiple-program transport stream (SPTS/MPTS) formats</li> <li>• Video explorer capable of detecting 512 SPTSs and 32 MPTSs and a video analyzer that supports 16 SPTSs and 1 MPTS</li> <li>• Supported measurements include bandwidth utilization, packet loss, packet jitter, PCR jitter, continuity-error bit and error-bit indicator</li> <li>• TR 101 290 priority 1 errors, such as program identification (PID), program association table (PAT), and program map table (PMT)</li> <li>• Loss-distance and period errors per RFC 3357, results per transport stream and per PID</li> <li>• Measure ICC latency and R-UDP latency</li> <li>• Microsoft Television (MSTV) Support</li> <li>• Internet Group Management Protocol (IGMP) support</li> </ul>	
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	

**OTDR**

The T-BERD/MTS-5800 is compatible with the following JDSU 4100-Series OTDR modules:

- MA
- LA
- QUAD

See OTDR module specifications for details:

[www.jdsu.com/en-us/Test-and-Measurement/products/a-z-product-list/Pages/otdr-4000.aspx](http://www.jdsu.com/en-us/Test-and-Measurement/products/a-z-product-list/Pages/otdr-4000.aspx)

**Specifications**

Physical	
<b>Dimension</b>	<b>5811PL and 5822P</b>
Height	17.78 cm (7 in)
Width	24.13 cm (9.5 in)
Depth	7.62 cm (3 in)
Weight	1.9 kg (4.2 lb)
Power*	
<b>Parameter</b>	
Operating time	Up to 4 hours (depending on type of test)
Charging time	Approximately 7 hours from empty
Unit power input	12VDC, 60W Max
Power supply input	100 to 240 VAC, 50/60 Hz, autosensing
Power supply output	12VDC, 5 AMP Max
Environmental	
Operating temperature	0 to 50°C
Operating humidity	10–90% RH noncondensing
Storage temperature	–20 to 60°C
Storage humidity	10–95% RH noncondensing
Shock/Drop/Vibe	
• Shock	per IEC 68-2-27 and 68-2-29 Ed. 2.0
• Drop	per IEC 721-3-7 2nd Ed. /IEC 61010-1
• Vibration	per IEC 68-2-6 and MIL-PRF-28800F (Class 2)
General	
Touch screen	7-inch LCD Resolution 1200x600 high visibility
Storage and I/O Interfaces Internal Memory Ports	Minimum of 1G (thousands of reports) 2x USB 2.0, 1x RJ45 Ethernet, 1x serial RS-232, 1x Bluetooth, WiFi, 1x Analog headset jack



**North America**  
**Latin America**  
**Asia Pacific**  
**EMEA**

Toll Free: 1 855 ASK-JDSU (1 855 275-5378)  
 Tel: +1 954 688 5660 Fax: +1 954 345 4668  
 Tel: +852 2892 0990 Fax: +852 2892 0770  
 Tel: +49 7121 86 2222 Fax: +49 7121 86 1222