SPEC SHEET

MAX-800 Series handheld tester

ETHERNET AND TRANSPORT TESTING UP TO 100G

The MAX-800 Series comprises five easy to use, portable testing models offering Ethernet, OTN, SONET/SDH, DSn/PDH test applications from 10M to 100G. Optimize your field technicians' tasks and expedite service activation by running up to four 100GE tests simultaneously.

KEY FEATURES AND BENEFITS

Platform highlights

Custom-designed platform with extensive onboard memory including a micro SD card interface (massively expand the memory)

Ultra-bright 8-inch multitouch screen

Built-in connectivity—choose between Gigabit interface, WiFi, Bluetooth, and 3G or 4G LTE via USB dongle

Lightweight and portable solution designed for field engineers or cell technicians installing, troubleshooting and maintaining backhaul, OTN, SONET/SDH, DSn/PDH Carrier and Ethernet networks from 10M to 100GE

Transport testing

OTU testing: OTU1, OTU2, OTU4

TCP traffic performance evaluation with RFC 6349

Optical and electrical SONET and SDH testing up to 10G

DSn testing DS1, DS3 and dual DS1/DS3 RX

Plesiochronous digital hierarchy (PDH) testing: E1, E3 and E4

Ethernet

Ethernet bit error rate testing with round-trip latency from 10M to 100G with configurable test verdict thresholds

Service disruption testing (SDT) with comprehensive statistics

RFC 2544 test application with multiple graphical results and dual test set configuration for asymmetric traffic with precise per-direction test results

Industry-first EtherSAM (Ethernet service activation methodology) based on ITU-T Y.1564 for complete SLA evaluation including throughput, latency, jitter, CIR, EIR, CBS, EBS, frame loss, out-of-sequence measurements and other parameters

Traffic generation and monitoring for extensive troubleshooting and fast resolution of customer complaints

Second-port loopback tool for optimum use of test equipment reducing OPEX

Quad-port testing up to 100G on portable platform

EXFO

Setting a new GUI standard: unprecedented simplicity in configuration setup and navigation

The MAX-800 Series' intelligent situational configuration setup feature guides technicians through complete, accurate testing processes (e.g., suggestion prompts and help guides). In addition, it reduces navigation by combining associated testing functions on a single screen, and offers intelligent autodiscovery enabling a single technician to perform end-to-end testing.

Dedicated quick-action buttons

- Remote discovery to find all the other EXFO and third-party units (allowing a single user to perform end-to-end testing by looping up and looping down remote devices up to layer 4)
- Laser on/off
- Test reset to clear the results and statistics while running a test
- Report generation
- Save and load test configurations
- Quick error injection

Assorted notifications

- Clear indication of link status for single or dual ports
- Negotiated speed display
- Power status available at all times for single or dual ports
- Pass/fail indication at all times
- Pattern and clock synchronization
- Frequency offset with valid-range color indicator
- Overhead overwrite indicator
- Error/alarm injection
- Alarm hierarchy pinpointing the root-cause (when possible)

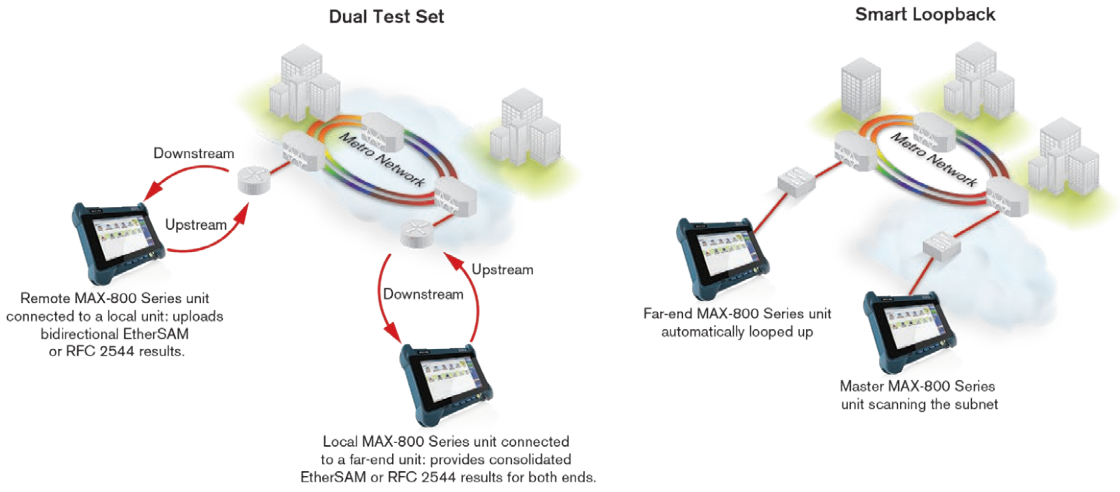
Streamlined navigation

- Remote discovery button available at all times; no reason to leave your current location to scan for a remote unit
- Testing status can be maximized to fill the entire screen by simply clicking on the alarm status button; whether the unit is in your hand or across the room, test verdicts can be easily determined with a simple glance at the display screen
- RFC 2544 results and graphs are available in a single page, eliminating the need to navigate through multiple screens to view individual RFC subtest results
- Simplified test structure definition using task-based test-application selection, signal configuration
- Centralized functions: error/alarm management, performance monitoring and overhead manipulation/monitoring
- Remote access: test set can be easily accessed remotely via VNC, remote desktop or third-party applications

Ethernet key features

Intelligent network discovery mode

Using the MAX-800 Series, you can single-handedly scan the network and connect to any available EXFO datacom remote tester. Simply select the unit to be tested and choose whether you want traffic to be looped back via Smart Loopback or Dual Test Set for simultaneous bidirectional EtherSAM or RFC 2544 results. With this approach, you no longer need an additional technician at the far end to relay critical information—the MAX-800 Series testers take care of everything. The discover remote feature also allows a user to perform end-to-end testing by looping up and looping down third-party units up to layer 4.



Smart loopback flexibility

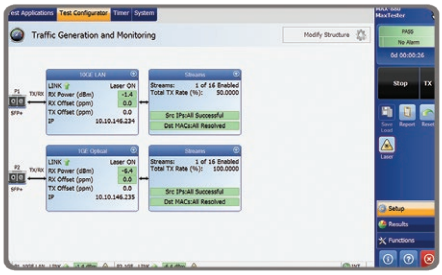
The Smart Loopback functionality has been enhanced to offer five distinct loopback modes. Whether you are looking to pinpoint loopback traffic from a user-datagram-protocol (UDP) or transmission control protocol (TCP) layer, or all the way down to a completely promiscuous mode (Transparent Loopback mode), the MAX-800 Series has the flexibility to adjust to all unique loopback situations.

Dual-port test topology

With dual-port testing, one technician can use a single MAX-800 Series module to launch either EtherSAM or RFC 2544, and obtain bidirectional results using just one module. With traffic generation and monitoring, as well as EtherBERT tests, the technician can set up two distinct tests, one on port 1 and the other on port 2. Both ports can also be bound to different interfaces (e.g., 10BASE-T electrical on port 1 and 10 GigE on port 2). On MAX-890Q, with the dual-port test topology, one technician can test 4 100GE circuits simultaneously at layer 2.

VLAN/MPLS

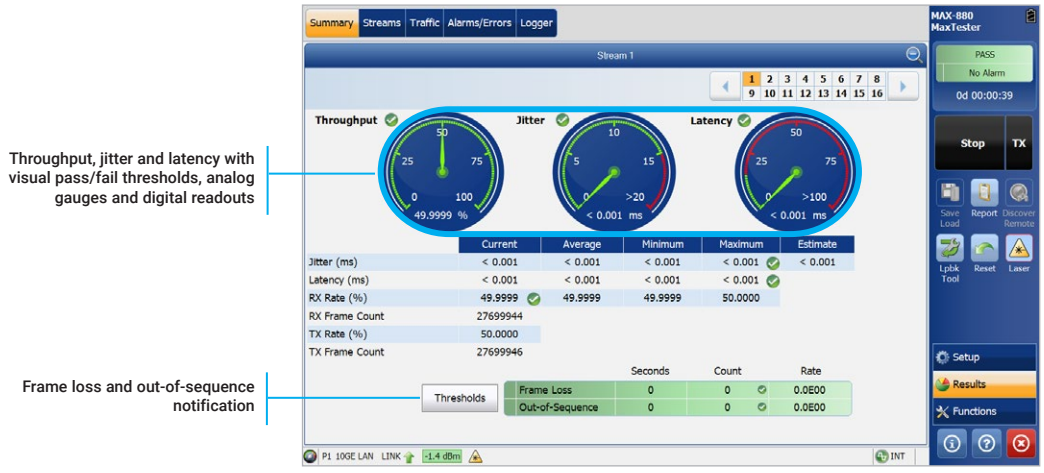
Today's networks are expected to deliver high performance. To meet such high expectations, service providers must rely on various mechanisms, such as Ethernet tagging, encapsulation and labeling. Thanks to these additions, service providers can enhance security, scalability, reliability and performance. The MAX-800 Series supports virtual-local-area-network (VLAN) tags, Q-in-Q VLAN tags and multiprotocol label switching (MPLS).



TRAFFIC GENERATION AND MONITORING

Unparalleled analog visual gauges combined with user-defined thresholds instantaneously show whether or not the test traffic is in or out of expected performance ranges.

Additionally, technicians can simultaneously monitor up to 16 different streams, each one configured to meet specific service level agreement thresholds. Traffic generation brings together over 10 critical stats in a very visual and organized fashion, ensuring that technicians can quickly and easily interpret the outcome of the test.



*The analog gauges are lined with **green** and **red** regions to represent the expected thresholds.*

ETHERSAM: THE INDUSTRY-LEADING ETHERNET SERVICE ACTIVATION METHODOLOGY

RFC 2544 used to be the most widespread Ethernet testing methodology. However, it was designed for network-device testing in the lab, not service testing in the field. ITU-T Y.1564, for turning up and troubleshooting Carrier Ethernet services, has a number of advantages over RFC 2544, including validation of critical service-level agreement (SLA) criteria such as packet jitter and quality-of-service (QoS) measurements. This methodology is also significantly faster, saving both time and resources while optimizing QoS.

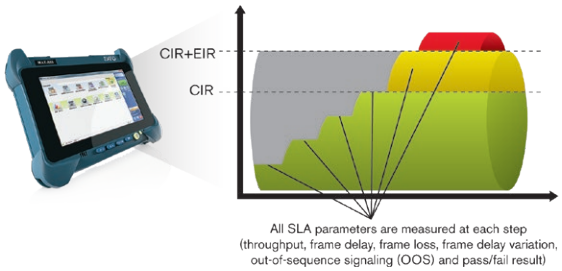
EXFO's EtherSAM test suite—based on the ITU-T Y.1564 Ethernet service activation methodology—provides comprehensive field testing for business Ethernet deployment and troubleshooting activities.

Contrary to other methodologies, EtherSAM supports multiservice offerings, and can simulate all types of services that will run on the network while simultaneously qualifying all key SLA parameters for each of these services. Moreover, it validates the QoS mechanisms provisioned in the network to prioritize the different service types, resulting in better troubleshooting, more accurate validation and much faster deployment. EtherSAM is comprised of two phases, the service configuration test and the service performance test.

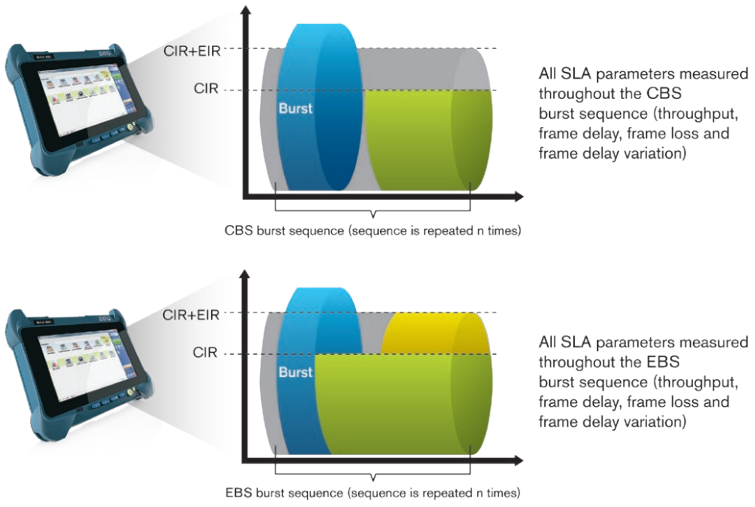
Service configuration test

The service configuration test involves sequential testing of each service in order to validate that it is properly provisioned, and that all specific key performance indicators (KPIs) or SLA parameters are met. A ramp test and burst test are performed in order to verify the committed information rate (CIR), excess information rate (EIR), committed burst size (CBS) and excess burst size (EBS).

Ramp test

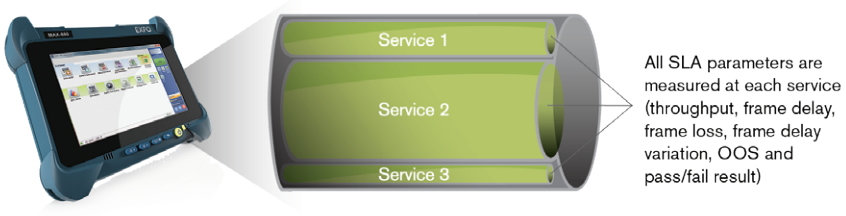


Burst test



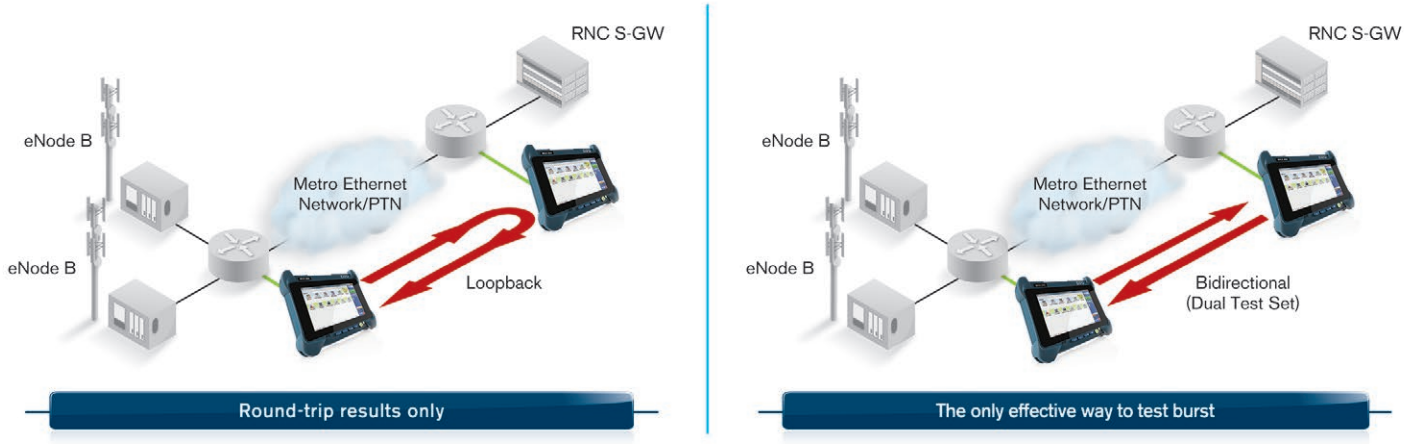
Service performance test

Once the configuration of each individual service is validated, the service performance test simultaneously validates the quality of all the services over time.



ETHERSAM BIDIRECTIONAL RESULTS

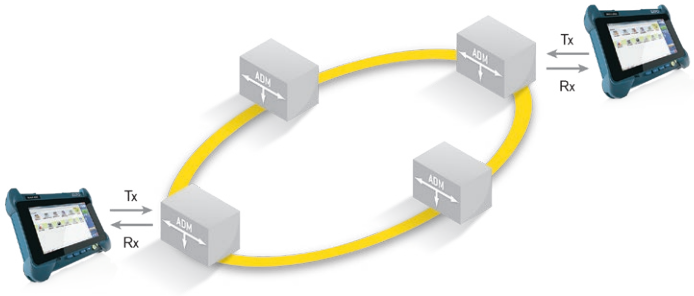
EXFO's EtherSAM approach proves itself even more powerful as it executes the complete ITU-T Y.1564 test with bidirectional measurements. Key SLA parameters are measured independently in each test direction, providing 100% first-time-right service activation—the highest level of confidence in service testing.

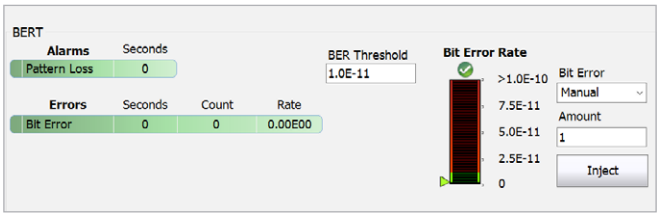


Key DSn/PDH and SONET/SDH features

Simplified BER testing

The multiple MAX-800 models offer the ability to preconfigure bit-error-rate (BER) thresholds that are user-defined prior to running the test, thereby generating a simple pass/fail verdict at the conclusion of test to overcome misinterpretation of test results.





Decoupled mode

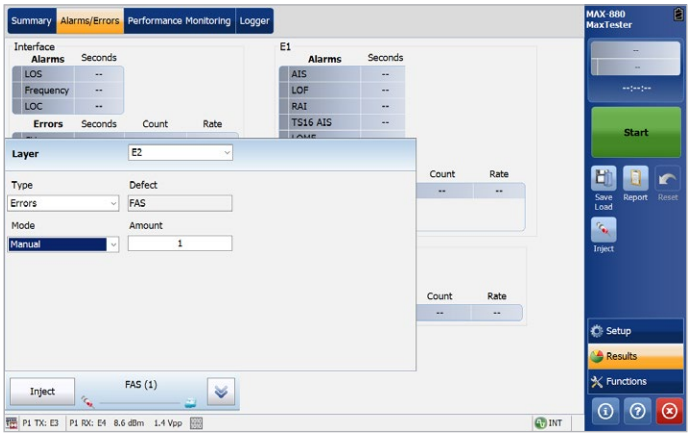
Decoupled mode enables users to independently configure the Tx and Rx ports in order to test the mapping and demapping functionality of a network element, or to test at cross-connect points in the network.

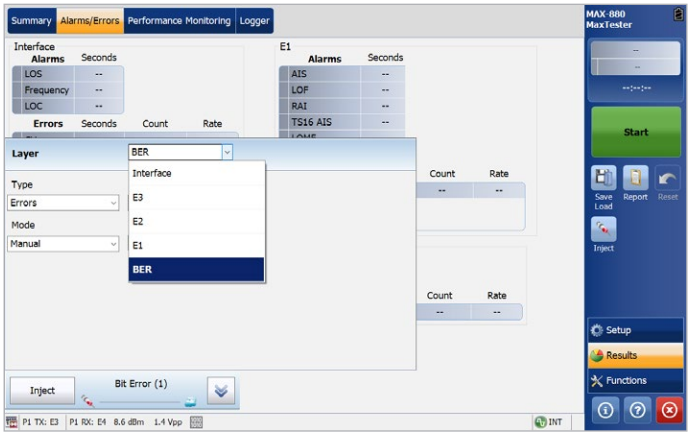
Through mode

This mode is required for in-service monitoring of the network. The MAX-800 unit can be inserted in-line on a specific link in order to monitor and analyze the errors and alarms in a non-intrusive manner.

Simplified error injection

This feature allows the user to inject errors with a single click from any screen so that technicians can verify circuit continuity prior to starting a test. Furthermore, the error injection functionality can be preprogrammed for any given type of error, not just bit errors.

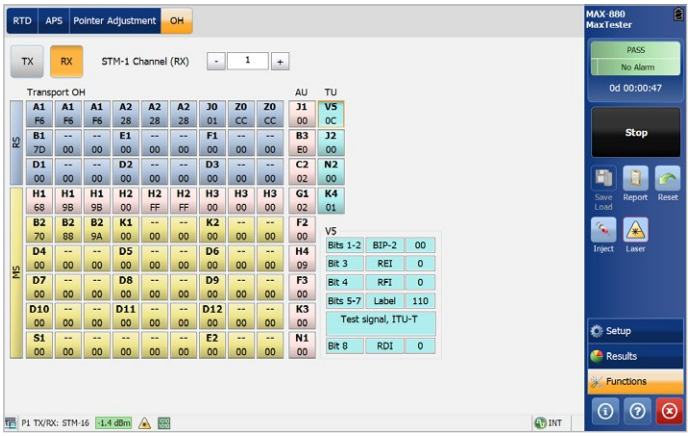




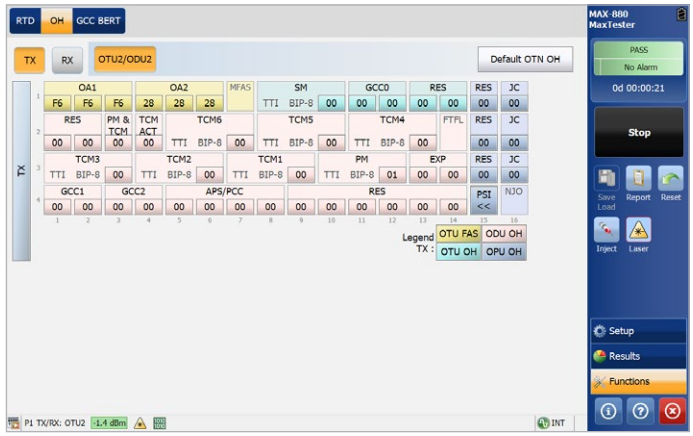
Complete overhead monitoring

The MAX-800 units offer access to all SONET/SDH or optical transport network (OTN) overhead (OH) bytes. Furthermore, by selecting any given OH byte, the user can retrieve additional detailed information about that byte without having to switch pages.

STM-16 Rx



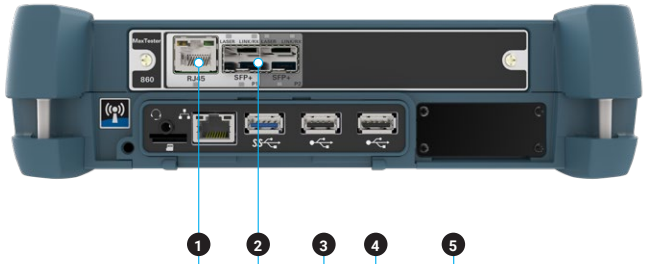
OTU2 Tx



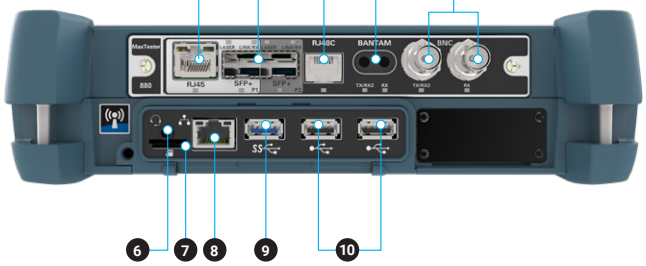
CHOOSE THE RIGHT MAX-800 FOR YOU

	MAX-860	MAX-860G	MAX-880	MAX-890	MAX-890Q
Storage	64G	64G	64G	128G	128G
Ethernet 10/100/1000M	•	•	•	•	•
Ethernet 10/100/1000M and 10G		•	•	•	•
100G				•	•
Dual-port testing	•	•	•	•	•
Quad-port testing					•
IPv6	•	•	•	•	•
MPLS	•	•	•	•	•
EtherBERT	•	•	•	•	•
RFC 2544	•	•	•	•	•
EtherSAM ITU-T Y.1564	•	•	•	•	•
Multistream traffic generation	•	•	•	•	•
RFC 6349	•	•	•	•	•
Carrier OAM	•	•	•	•	•
Ethernet filter and capture	•	•	•	•	•
Ethernet Through Mode	•	•	•	•	•
SONET/SDH			•	•	•
DSn/PDH			•		
OTU1, OTU2			•	•	•
OTU4				•	•

MAX-860/860G

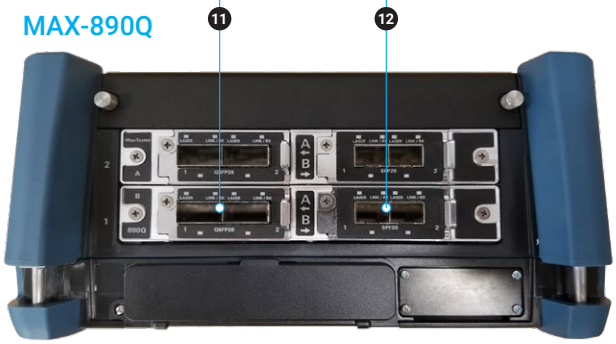


MAX-880



MAX-890

MAX-890Q



1. **RJ45**
   10/100/1000BASE-T
2. **SFP/SFP+**
   Up to 1 Gbit/s (MAX-860)
   Up to 10 Gbit/s (MAX-860G and MAX-880)
   10/100/1000BASE-T with copper SFP
   SONET/SDH up to 10G
   OTN OTU1/2
3. **RJ48C**
   DSn/PDH
   EXT CLK
4. **Bantam**
   DSn/PDH
   RX2: DS1
   EXT CLK
5. **BNC connectors**
   Electrical SONET/SDH
   DSn/PDH
   RX2: DS1/DS3
   EXT CLK
6. **Mic./Headset jack**
7. **Micro SD card slot**
8. **1 GigE maintenance port**
9. **USB 3.0 port (1)**
10. **USB 2.0 port (2)**
11. **QSFP28**
    100GE
    OTU4
12. **SFP/SFP+**
    Up to 10 Gbit/s
    10/100/1000BASE-T with copper SFP
    SONET/SDH up to 10G
    OTN OTU1/2

ELECTRICAL ETHERNET INTERFACES				
	One port: 10/100BASE-T half/full duplex, 1000BASE-T full duplex Automatic or manual detection of straight/crossover cable			
Model	Connector on module			FTB-85919 SFP to RJ45 adapter
Transceiver type	**10BASE-T**	**100BASE-TX**	**1000BASE-T**	**1000BASE-T**
Tx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s	1 Gbit/s
Tx accuracy (uncertainty) (ppm)	±4.6	±4.6	±4.6	±4.6
Rx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s	1 Gbit/s
Rx measurement accuracy (uncertainty) (ppm)		±4.6	±4.6	±4.6
Duplex mode	Half and full duplex	Half and full duplex	Full duplex	Full duplex
Jitter compliance	IEEE 802.3	IEEE 802.3	IEEE 802.3	IEEE 802.3
Connector	RJ45	RJ45	RJ45	RJ45
Maximum reach (m)	100	100	100	100

SYNCHRONIZATION INTERFACES (MAX-860, MAX-860G, MAX-880)				
	External Clock DS1/1.5M	**External Clock E1/2M**	**External Clock E1/2M**	**Trigger 2 MHz**
Tx pulse amplitude	2.4 to 3.6 V	3.0 V	2.37 V	0.75 to 1.5 V
Tx pulse mask	GR-499 Figure 9-5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 20
Tx LBO preamplification	Typical power dBdsx +0.6 dBdsx (0 to 133 ft) +1.2 dBdsx (133 to 266 ft) +1.8 dBdsx (266 to 399 ft) +2.4 dBdsx (399 to 533 ft) +3.0 dBdsx (533 to 655 ft)			
Rx-level sensitivity	TERM: ≤ 6 dB (cable loss only) (at 772 kHz for T1) DSX-MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	TERM: ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	TERM: ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	≤ 6 dB (cable loss only)
Transmission bit rate	1.544 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	
Reception bit rate	1.544 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	2.048 Mbit/s ± 50 ppm	
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 6.1	G.823 section 6.1	G.703 table 11
Input jitter tolerance	AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.2 G.813	G.823 section 7.2 G.813	G.823 section 7.1 G.751 section 3.3
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	
Input impedance (resistive termination)	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced
Connector type	BNC[a]	BNC[a]	BNC	BNC

a. Adaptation cable required for BANTAM.

DSn/PDH AND SONET/SDH ELECTRICAL INTERFACES (MAX-880)

Transceiver type	DS1	E1/2M		E3/34M	DS3/45M		52M	E4/140M	155M	
Tx pulse amplitude	2.4 to 3.6 V	3.0 V	2.37 V	1.0 ±0.1 V	0.36 to 0.85 V			1.0 ±0.1 Vpp	0.5 V	
Tx pulse mask	GR-499 Figure 9-5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 17	DS-3 GR-499 Figure 9-8	45M G.703 Figure 14	GR-253 Figure 4-10/4-11	G.703 Figure 18/19	STS-3e GR-253 Figure 4-12, 4-13, 4-14	STM-1e/ 155M G.703 Figure 22 and 23
Tx LBO preamplification	0 to 133 ft 133 to 266 ft 266 to 399 ft 399 to 533 ft 533 to 655 ft				0 to 225 ft 225 to 450 ft				0 to 225 ft	
Cable simulation	−22.5 dB −15.0 dB −7.5 dB 0 dB				450 to 900 (927) ft					
Rx level sensitivity	For 772 kHz: TERM: ≤ 26 dB (cable loss only) at 0 dBdsx Tx DSX-MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)	For 1024 kHz: TERM: ≤ 6 dB (cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤ 6 dB (cable loss only)		For 17.184 MHz: TERM: ≤12 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	For 22.368 MHz: TERM: ≤ 10 dB (cable loss only) DSX-MON: ≤ 26.5 dB (21.5 dB resistive loss + cable loss ≤ 5 dB)		For 25.92 MHz: TERM: ≤ 10 dB (cable loss only) MON: ≤ 25 dB (20 dB resistive loss + cable loss ≤ 5 dB)	For 70 MHz: TERM: ≤ 12 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	For 78 MHz: TERM: ≤ 12.7 dB (coaxial cable loss only) MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	
Transmit bit rate	1.544 Mbit/s ±4.6 ppm	2.048 Mbit/s ±4.6 ppm	2.048 Mbit/s ±4.6 ppm	34.368 Mbit/s ±4.6 ppm	44.736 Mbit/s ±4.6 ppm		51.84 Mbit/s ±4.6 ppm	139.264 Mbit/s ±4.6 ppm	155.52 Mbit/s ±4.6 ppm	
Frequency offset generation	1.544 Mbit/s ±140 ppm	2.048 Mbit/s ±70 ppm	2.048 Mbit/s ±70 ppm	34.368 Mbit/s ±50 ppm	44.736 Mbit/s ±50 ppm		51.84 Mbit/s ±50 ppm	139.264 Mbit/s ±50 ppm	155.52 Mbit/s ±50 ppm	
Receive bit rate	1.544 Mbit/s ±140 ppm	2.048 Mbit/s ±100 ppm	2.048 Mbit/s ±100 ppm	34.368 Mbit/s ±100 ppm	44.736 Mbit/s ±100 ppm		51.84 Mbit/s ±100 ppm	139.264 Mbit/s ±100 ppm	155.52 Mbit/s ±100 ppm	
Measurement accuracy (uncertainty) Frequency (ppm) Electrical power (dB)	±4.6 ±1.5									
Peak-to-peak voltage	±10 % down to 500 mVpp				±10 % down to 200 mVpp					
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1 G.751 section 2.3	GR-499 section 7.3 (categories I and II)		GR-253 section 5.6.2.2 (category II)	G.823 section 5.1 G.751 section 3.3	G.825 section 5.1 GR-253 section 5.6.2.2	
Input jitter tolerance	AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	GR-499 section 7.3 (categories I and II)		GR-253 section 5.6.2.3 (Category II)	G.823 section 7.1 G.751 section 3.3	G.825 section 5.2 GR-253 section 5.6.2.3	
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	HDB3	B3ZS		B3ZS	CMI	CMI	
Input impedance (resistive termination)	100 Ω ±5 %, balanced	120 Ω ±5 %, balanced	75 Ω ±5 %, unbalanced	75 Ω ±5 %, unbalanced	75 Ω ±5 %, unbalanced		75 Ω ±5 %, unbalanced	75 Ω ±10 %, unbalanced	75 Ω ±5 %, unbalanced	
Connector type	BANTAM and RJ48C		BNC							

SONET AND DSn FUNCTIONAL SPECIFICATIONS		SDH AND PDH FUNCTIONAL SPECIFICATIONS	
Optical interfaces	OC-1, OC-3, OC-12, OC-48, OC-192	Optical interfaces	STM-0, STM-1, STM-4, STM-16, STM-64
Available wavelengths (nm)	1310, 1550	Available wavelengths (nm)	1310, 1550
Electrical interfaces	DS1, DS3	Electrical interfaces [a]	1.5M (DS1), 2M (E1), 34M (E3), 45M (DS3), 140M (E4)
DS1 framing	Unframed, SF, ESF, SLC-96	2M (E1) framing	Unframed, PCM30, PCM31, PCM30 CRC-4, PCM31 CRC-4
DS3 framing	Unframed, M13, C-bit parity	8M (E2), 34M (E3), 140M (E4) framing	Unframed (not applicable to E2), framed
Clocking	Internal, loop-timed, external (BITS)	Clocking	Internal, loop-timed, external (MTS/SETS), 2 MHz
Mappings			
VT1.5	Bulk, DS1	AU-3-TU-11, AU-4-TU-11	Bulk, 1.5M,
VT2	Bulk, E1	AU-3 -TU-12, AU-4-TU-12	Bulk, 1.5M, 2M
STS-1 SPE	Bulk, DS3	AU-3-Bulk, 34M, 45M, TU-3-AU-4	Bulk, 34M, 45M
STS-3c	Bulk	AU-4	Bulk, 140M
STS-12c/48c/192c, SPE	Bulk	AU-4-4c/16c/64c	Bulk
SONET overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5, N1, N2, Z6, Z7	SDH overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1 G1, F2, F3, K3, N1, N2, K4, E2, J1, C2, H4
Error insertion			
DS1	Framing bit, BPV, CRC-6, bit error, EXZ	E1 (2M)	Bit error, FAS, CV, CRC-4, E-bit
DS3	BPV, C-bit, F-bit, P-bit, FEBE, bit error, EXZ	E2 (8M), E3 (34M), E4 (140M)	Bit error, FAS, CV (not applicable to E2)
OC-1, OC-3, OC-12, OC-48, OC-192	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error	STM-0, STM-1, STM-4, STM-16, STM-64	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error
Error measurement			
DS1	Framing bit, BPV, CRC-6, EXZ, bit error	E1 (2M)	Bit error, FAS, CV, CRC-4, E-bit
DS3	BPV, C-bit, F-bit, P-bit, FEBE, bit error, EXZ	E2 (8M), E3 (34M), E4 (140M)	Bit error, FAS, CV (not applicable to E2)
OC-1, OC-3, OC-12, OC-48, OC-192	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error	STM-0, STM-1, STM-4, STM-16, STM-64	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error
Alarm insertion			
DS1	LOS, RAI, AIS, OOF, pattern loss	E1 (2M)	LOS, LOS Mframe, LOF, AIS, TS16 AIS, RAI, RAI Mframe, pattern loss
DS3	LOS, RDI, AIS, OOF, DS3 idle, pattern loss	E2 (8M), E3 (34M), E4 (140M)	LOS, LOF, RAI, AIS, pattern loss
OC-1, OC-3, OC-12, OC-48, OC-192	LOS, LOF-S, SEF, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, UNEQ-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, pattern loss	STM-0, STM-1, STM-4, STM-16, STM-64	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-UNEQ, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, pattern loss
Alarm detection			
DS1	LOS, LOC, RAI, AIS, OOF, pattern loss	E1 (2M)	LOS, LOS Mframe, LOC, LOF, AIS, TS16 AIS, RAI, RAI Mframe, pattern loss
DS3	LOS, LOC, RDI, AIS, OOF, DS3 idle, pattern loss	E2 (8M), E3 (34M), E4 (140M)	LOS, LOC, LOF, RAI, AIS, pattern loss
OC-1, OC-3, OC-12, OC-48, OC-192	LOS, LOC, LOF-S, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, PLM-P, UNEQ-P, TIM-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, TIM-V, PLM-V, pattern loss	STM-0, STM-1, STM-4, STM-16, STM-64	LOS, RS-LOF, LOC, RS-OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-RDI, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-PLM, HP-UNEQ, HP-TIM, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, LP-TIM, LP-PLM, pattern loss
Frequency alarm on all supported interfaces			
Patterns			
DS0	2E9-1, 2E11-1, 2E20-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors	E0 (64K)	2E9-1, 2E11-1, 2E20-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors
DS1	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), T1-DALY, 55-octet, bit errors, multipattern	E1 (2M)	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors
DS3	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 2-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors	E3 (34M), E4 (140M)	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24 [b], 32 bit programmable (inverted or non-inverted), bit errors
VT1.5/2	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors	TU-11/12/3	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors
STS-1, STS-3c/12c/48c/192c	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors	AU-3/AU-4/AU-4-4c/16c/64c	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors
Pattern loss and bit-error generation and analysis supported on all patterns			

a. 1.5M (DS1) and 45M (DS3) interfaces described under SONET and DSn column.

b. Not supported for E4 (140M).

DSn/PDH AND SONET/SDH TEST FEATURES	
Frequency measurements	Supports clock frequency measurements (i.e., received frequency and deviation of the input signal clock from nominal frequency), displayed in ppm, for optical and electrical interfaces. Measurements are performed using a local oscillator.
Frequency offset generation	Supports offsetting the clock of the transmitted signal on a selected interface to exercise clock recovery circuitry on network elements
Dual DSn receivers	Supports two DS1 or DS3 receivers, allowing users to simultaneously monitor two directions of a circuit under test in parallel, resulting in quick isolation of the source of errors
Performance monitoring	The following ITU-T recommendations, and corresponding performance-monitoring parameters, are supported: **ITU-T recommendation** / **Performance-monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM G.826 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER G.828 — ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI G.829 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER M.2100 — ES, SES, UAS M.2101 — ES, SES, BBE, UAS
Pointer adjustment and analysis	Generation and analysis of HO/AU and LO/TU pointer adjustments as per GR-253, and ITU-T G.707 **Generation** • Pointer increment and decrement • Pointer jump with or without NDF • Pointer value **Analysis** • Pointer increments • Pointer decrements • Pointer jumps (NDF, no NDF) • Pointer value and cumulative offset
Service-disruption-time (SDT) measurements	The service disruption time test tool measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels Measurements: last disruption, shortest disruption, longest disruption, average disruption, total disruption, and service disruption count
Round-trip delay (RTD) measurements	The round-trip delay test tool measures the time required for a bit to travel from the MAX unit transmitter back to its receiver after crossing a far-end loopback Measurements are provided on all supported MAX unit interfaces and mappings Measurements: last, minimum, maximum, average; measurement count: number of successful RTD tests and failed measurement count
APS message control and monitoring	Ability to monitor and set up automatic protection switching messages (K1/K2 byte of SONET/SDH overhead)
Synchronization status	Ability to monitor and set up synchronization status messages (S1 byte of SONET/SDH overhead)
Signal label control and monitoring	Ability to monitor and set up payload signal labels (C2, V5 byte of SONET overhead)
Tandem connection monitoring (TCM) [a]	TCM is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The T&D module supports transmitting and receiving alarms and errors on a TCM link; also, transmission and monitoring of the tandem connection (TC) trace can be generated to verify the connection between TCM equipment. Error generation: TC-IEC, TC-BIP, TC-REI, TC-OEI Error analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL (non-standardized alarm) Alarm generation: TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS Alarm analysis: TC-TIM, TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS
Pointer sequence testing	Perform pointer sequence testing as per G.783, GR253 and T1.105-3 standards
M13 mux/demux	Ability to multiplex/demultiplex a DS1 signal into/from a DS3 signal. (Note: E1 to DS3 mux/demux available with G.747 software option)
DS1 FDL	Support for DS1 Facility Data Link testing
DS1 loopcodes	Support for generation of DS1 in-band loopcodes with the availability of up to 10 pairs of user-defined loopcodes
NI/CSU loopback emulation	Ability to respond to DS1 in-band/out-of-band loopcodes
DS3 FEAC	Support for DS3 far-end alarms and loopback code words
DS1/DS3 autodetection	Ability to automatically detect DS1/DS3 line coding, framing and test pattern
DS1 multipattern	BER test that includes five automated patterns: all ones, 1-in-8, 2-in-8, 3-in-2, QRSS
DS1 signaling bits	Ability to monitor the ABCD signaling bits for all 24 DS0 channels
Through mode	Perform Through mode analysis of any incoming electrical (DSn, PDH, SONET, SDH) and optical line (OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64) transparently

OTN TEST FEATURES		
OTN	Standards compliance	ITU-T G.709, ITU G.798, ITU G.872
	Interfaces	OTU1 (2.6660 Gbit/s), OTU2 (10.7092 Gbit/s), OTU4 (112 Gbit/s)
OTL (OTU4 signal)	OTL (OTU4 signal)	Invalid marker, FAS
	Alarms per lane	OOF, LOF, LOR, OOR, excessive skew
	Global alarm	LOL
OTU layer	Errors	OTU-FAS, OTU-MFAS, OTU-BEI, OTU-BIP-8
	Alarms	LOF, OOF, LOM, OOM, OTU-AIS, OTU-TIM, OTU-BDI, OTU-IAE, OTU-BIAE
	Traces	64-byte trail trace identifier (TTI) as defined in ITU-T G.709
ODU TCM layer	Errors	TCMi-BIP-8, TCMi-BEI (i = 1 to 6)
	Alarms	TCMi-LTC, TCMi-TIM, TCMi-BDI, TCMi-IAE, TCMi-BIAE
	Traces	64-byte trail trace identifier (TTI) as defined in ITU-T G.709
ODU layer	Errors	ODU-BIP-8, ODU-BEI
	Alarms	ODU-AIS, ODU-OCI, ODU-LCK, ODU-TIM, ODU-BDI, ODU-FSF, ODU-BSF, ODU-FSD, ODU-BSD
	Traces	Generates 64-byte trail trace identifier (TTI), as defined in ITU-T G.709
	FTFL	As defined in ITU-T G.709
OPU layer	Alarms	OPU-PLM, OPU-AIS, OPU-CSF
	Payload type (PT) label	Generates and displays received PT value
Forward error correction (FEC)	Errors	FEC-correctable (codeword), FEC-uncorrectable (codeword), FEC-correctable (symbol), FEC-correctable (bit), and FEC-stress (codeword)
Pattern	Patterns	2E-9, 2E-15, 2E-20, 2E-23, 2E-31, NULL, 32-bit programmable (inverted or noninverted)
	Error	Bit error
	Alarm	Pattern loss

ADDITIONAL OTN FUNCTION	
Frequency measurements	Supports clock frequency measurements (i.e., received frequency and deviation of the input signal clock from nominal frequency), displayed in ppm; measurements are performed using an internal oscillator
Frequency offset generation	Supports offsetting the clock of the transmitted signal on a selected interface to exercise clock recovery circuitry on network elements
Performance monitoring	The following ITU-T recommendations and corresponding performance-monitoring parameters are supported: **ITU-T recommendation** — **Performance-monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM M.2100 — ES, SES, UAS
Service-disruption-time (SDT) measurements	The service-disruption-time test tool measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels Measurements: last disruption, shortest disruption, longest disruption, average disruption, total disruption, and service disruption count
Round-trip delay (RTD) measurements	The round-trip delay test tool measures the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback; measurements are supported on all interfaces and mappings Measurements: last RTD time, minimum, maximum, average, measurement count (no. of successful RTD tests) and failed measurement count

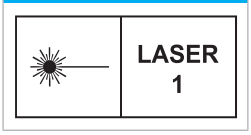
ETHERNET TEST FEATURES	
EtherSAM (ITU-T Y.1564)	Perform service configuration and service performance tests as per ITU-T Y.1564, including EBS, CBS and EMIX. Tests can be performed using remote loopback or dual test set mode for bidirectional results.
RFC 2544	Throughput, back-to-back, frame loss and latency measurements according to RFC 2544; frame size: RFC-defined or user-configurable between one to ten frame sizes
Traffic generation and monitoring	Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic including the simultaneous monitoring of throughput, frame loss, packet jitter, latency and out-of-sequence frames. It includes the ability to generate traffic with fixed-size frames, random frame sizes or sweep from a minimum to a maximum frame size. Moreover, it allows layer 2 MAC flooding.
Through mode	Sectionalize traffic between a service provider's network and customer premises equipment
BER testing	Up to layer 4 supported with or without VLAN Q-in-Q
Round-trip latency	Simultaneous BERT and round-trip latency measurements with statistics and pass/fail verdict based on multiple thresholds
Patterns (BERT)	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1 and one user pattern. Capability to invert patterns.
Error measurement (BERT)	Bit error, bit mismatch 0, bit mismatch 1.
VLAN stacking	Generates up to three layers of VLAN (including IEEE 802.1ad and Q-in-Q tagged VLAN)
VLAN preservation	Validates that CE-VLAN tags classes of service (CoS), and that ID is passed transparently through the network
MPLS	Generate and analyze streams with up to two layers of MPLS labels
Carrier Ethernet OAM	Fault-management and performance-monitoring Ethernet and MPLS-TP OAM protocols, including Y.1731, 802.1ag, MEF, Link OAM (802.3ah) and G.8113.1 OAMs
Traffic filtering	Incoming traffic analysis and statistics according to a set of configurable filters; filters can be configured for MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TCP source/destination port and UDP source/destination port; VLAN filtering can be applied to any of the stacked VLAN layers
Advanced filtering	Ability to enhance the filters with up to four fields each, which can be combined with and/or/not operations; a mask is also provided for each field value to allow for wild cards; complete statistics are gathered for each defined filter
Data capture	Full line-rate data capture and decoding at up to 100G; configuration of detailed capture filters and triggers, as well as capture slicing parameters
Cable testing	The cable test application provides test functions to diagnose UTP cables transmitting Ethernet over twisted pair. It verifies connectivity errors and evaluates cabling performance
Service disruption time (SDT)	Includes statistics such as longest, shortest, last, average, count, total and pass/fail thresholds
IPv6 testing	Performs the following tests up to 100G over IPv6: EtherSAM, RFC 2544, BERT, traffic generation and monitoring, Through mode, intelligent auto discovery, ping and traceroute
10 GigE WAN testing	Includes WAN interface sublayer, J0/J1 trace and C2 label generation, J0/J1 trace and C2 label monitoring.
10 GigE WAN alarm monitoring	Includes SEF, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LCD-P, LOP-P, PLM-P, UNEQ-P, ERDI-P, WIS link down, B1, B2, B3, REI-L, REI-P
One-way delay	Measurement of the one-way frame delay at up to 10G as part of EtherSAM (Y.1564) and RFC 2544 (MAX-880)
RFC 6349	Performs TCP testing with single or multiple TCP connections from 10BASE-T up to 100G; discovers the MTU, RTT, actual and ideal TCP throughput; user can apply suggested window size boost factor to optimize test results; user can perform multiple client iPerf tests against the RFC 6349 iPerf Server mode of operation
Error measurement	Jabber/giant, runt, undersize, oversize, FCS, symbol, alignment, collision, late collision, excessive collision, IP checksum, UDP checksum, TCP checksum and 10G block error
Alarm detection	LOS, link down, pattern loss, frequency, LOC, 10G local/remote fault
Flow control	Inject or monitor pause frames, including frame counts of pause, abort frames and total, last, maximum and minimum pause time
Ethernet filter and capture	Advanced filtering capability for in-depth network troubleshooting
Batch configuration	Ability to automatically set a specific source IP address, subnet mask, default gateway, DHCP, destination MAC address or destination IP address to one or all EtherSAM services or traffic generation streams
Dual-port	Dual-port testing with EtherSAM (ITU-T Y.1564), EtherBERT, RFC 2544, and traffic generation and monitoring when using 10/100/1000BASE-T, 100BASE-X, GigE and 10 GigE. Dual-port testing with EtherBERT layer 2 at 100GE (MAX-890).
Quad-port (MAX-890Q)	Quad-port testing with EtherSAM (ITU-T Y.1564), EtherBERT, RFC 2544, and traffic generation and monitoring when using 10/100/1000BASE-T, 100BASE-X, GigE and 10 GigE. Quad-port testing with EtherBERT layer 2 at 100GE

ADDITIONAL FEATURES	
Power measurement	Supports power measurement at all times, displayed in dBm (dBdsx for DS1 and DS3), for optical and electrical interfaces
Power-up and restore	In the event of power failure to the unit, the active test configuration and test logger are saved and restored upon boot-up
Save and load configuration	Store and load test configurations to/from a non-volatile USB memory stick or internal flash
Pass/fail analysis	Provides a pass/fail outcome with user-adjustable thresholds, based on bit error rate and/or service disruption time
Alarm hierarchy	Alarms are displayed according to a hierarchy based on root cause. Secondary effects are not displayed. This hierarchy serves to facilitate alarm analysis.
Report generation	Generates test reports with customizable selections, company logos and clear pass/fail color-coded analysis in both HTML and PDF formats, and saves them directly on the unit or a USB device. Reports can be automatically generated at the conclusion of each test.
Event logger	Log test results with absolute or relative time and date, details and duration of events, color-coded events and pass/fail outcome
Remote control	Remote control via VNC or Remote Desktop
Remote loopback	Detects other EXFO and third-party datacom units and sets them to Smart Loopback mode. This features allows a user to perform end-to-end testing by looping up and looping down EXFO or third-party units up to layer 4.
Dual Test Set mode	Detects and connects to other EXFO transport and datacom units to perform bidirectional RFC 2544 and EtherSAM testing
IP tools	Performs ping and traceroute functions. User can configure up to 1000 ping messages
Smart loopback	Return Ethernet traffic to the local unit by swapping packet overhead up to layer 4
Test timer	Select a predefined duration or enter start and stop times

GENERAL SPECIFICATIONS[a]

Description	MAX-860	MAX-860G	MAX-880	MAX-890	MAX-890Q
Size (H x W x D)	210 mm x 254 mm x 66 mm (8 ¼ in x 10 in x 2 5/8 in)			210 mm x 254 mm x 96 mm (8 ¼ in x 10 in x 3 7/8 in)	210 mm x 254 mm x 122 mm (8 ¼ in x 10 in x 4 ¾ in)
Weight (with battery)	2.1 kg (4.6 lb)	2.5 kg (5.6 lb)	2.6 kg (5.7 lb)	2.99 kg (6.59 lb)	4.16 kg (9.17 lb)
Temperature Operation Storage[b]	0 °C to 40 °C (32 °F to 104 °F)[c] −40 °C to 70 °C (−40 °F to 158 °F)				
Relative humidity	0% to 95%, non-condensing				
Processing	Dual-core processor / 4 GB RAM / Windows 10			Quad-core processor / 4 GB RAM / Windows 10	
Display	Multitouch, widescreen, color, 1280 x 800 TFT 203 mm (8 in)				
Interfaces	RJ45 LAN 10/100/1000 Mbit/s Two USB 2.0 ports One USB 3.0 port Micro SD card slot 3.5 mm headset/microphone port				
Storage	64 GB internal memory (flash)			128 GB internal memory (flash)	
Battery	Rechargeable Li-ion smart battery				2 rechargeable Li-ion smart batteries
Power supply	AC/DC adapter, input: 100–240V; 50/60 Hz; 2.5 A max, output: 24 V; 3.75 A				AC/DC adapter, input: 100–240V; 50/60 Hz; 4 A max, output: 24 V; 8.33 A

LASER SAFETY



a. All specifications valid at 23 °C (73 °F).

b. Battery storage temperatures: −20 °C to 60 °C (−4 °F to 140 °F) for shipping, and −20 °C to 45 °C (−4 °F to 113 °F) for long-term storage.

c. With the MAX-890Q, when testing 4 x 100GE EtherBERT Layer 2, the maximum operation temperature is 35ºC or 95ºF.

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