# MAX-800 Series Handheld Tester

## ETHERNET AND TRANSPORT TESTING UP TO 10G


Feature(s) of this product is/are protected by one or more of patent appl. US 2012/0307666 A1 and equivalents in other countries.

SPEC SHEET

The MAX-800 Series is an easy-to-use, portable 10G test solution. Optimize your field technicians' tasks by running up to two 10G tests simultaneously.

## KEY FEATURES AND BENEFITS

### Platform Highlights

- Custom-designed platform with 64 GB of 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, Wi-Fi, 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 and DSn/PDH Carrier Ethernet networks

### Ethernet

- Dual-port testing up to 10G
- EtherSAM, RFC 2544, traffic generation, EtherBERT, Through mode, Smart Loopback and second-port loopback tool

### Transport Testing

- OTN testing OTU 1/2
- Optical SONET and SDH testing up to 10G
- Electrical SONET and SDH testing
- DSn testing DS1, DS3 and dual DS1/DS3 RX
- Plesiochronous digital hierarchy (PDH) testing: E1, E3 and E4
- Automatic protection switching and service disruption on all interfaces and mappings
- Round-trip delay on all interfaces and payload mappings
- Overhead monitoring and modification for all time slots
- Pointer adjustment

## 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 amd 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 units
- Laser on/off
- Test reset to clear the results and statistics while running a test
- Report generation
- Save or load test configurations
- Quick error injection

### Assorted Notifications

- Clear indication of link status for single or dual ports
- Negotiated speed display for single or dual ports
- 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)

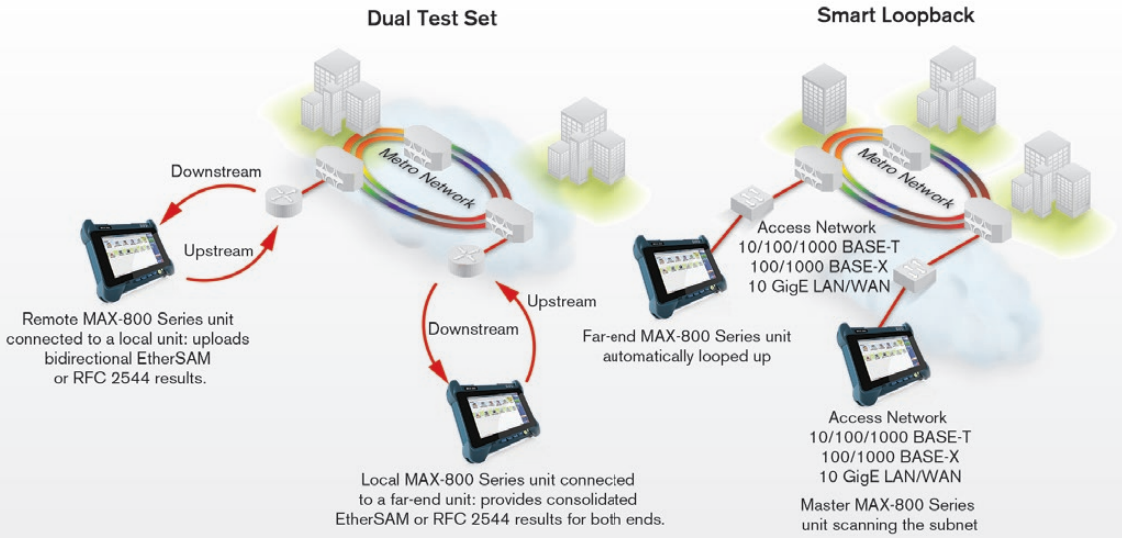
### Streamlined Navigation

- 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 results can be easily determined with a simple glance at the display screen
- RFC 2544 configuration is displayed on a single page, with no need to navigate through multiple screens to view individual RFC subtest results
- RFC 2544 results and graphs are also 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, front-end and smart timeslot selection
- Centralized functions: error/alarm management, performance monitoring and overhead manipulation/monitoring

## Key Ethernet 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 modules take care of everything.



### 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 and Through Mode Testing

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).

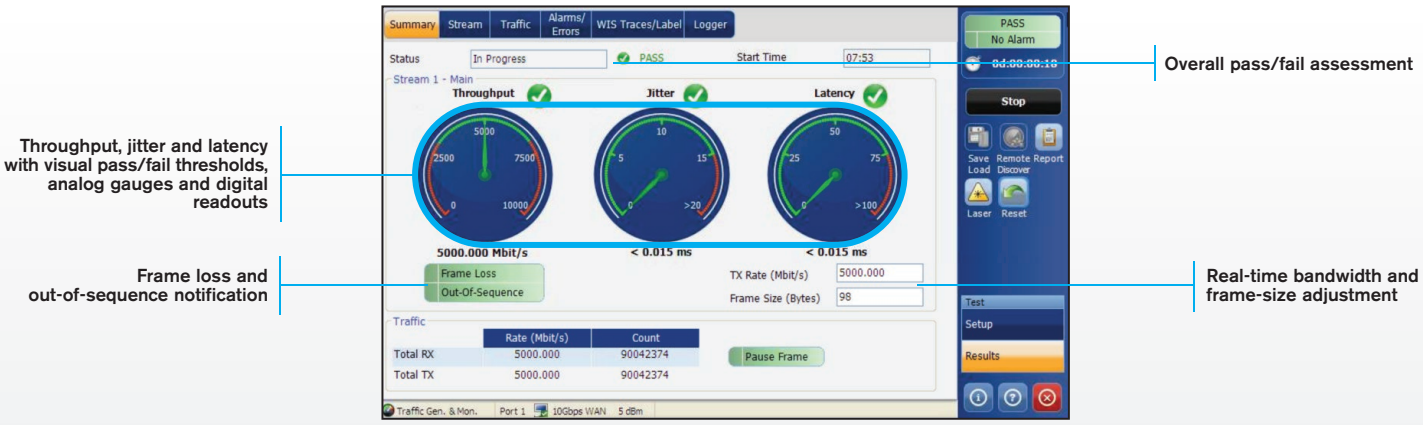
### VLAN/MPLS

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 ranges.

Additionally, bandwidth and frame size can be modified on the fly with no need for navigation to a different page, giving technicians instantaneous reaction from the gauges. 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** layers to represent the expected thresholds.*

## EtherSAM: The New Standard in Ethernet Testing

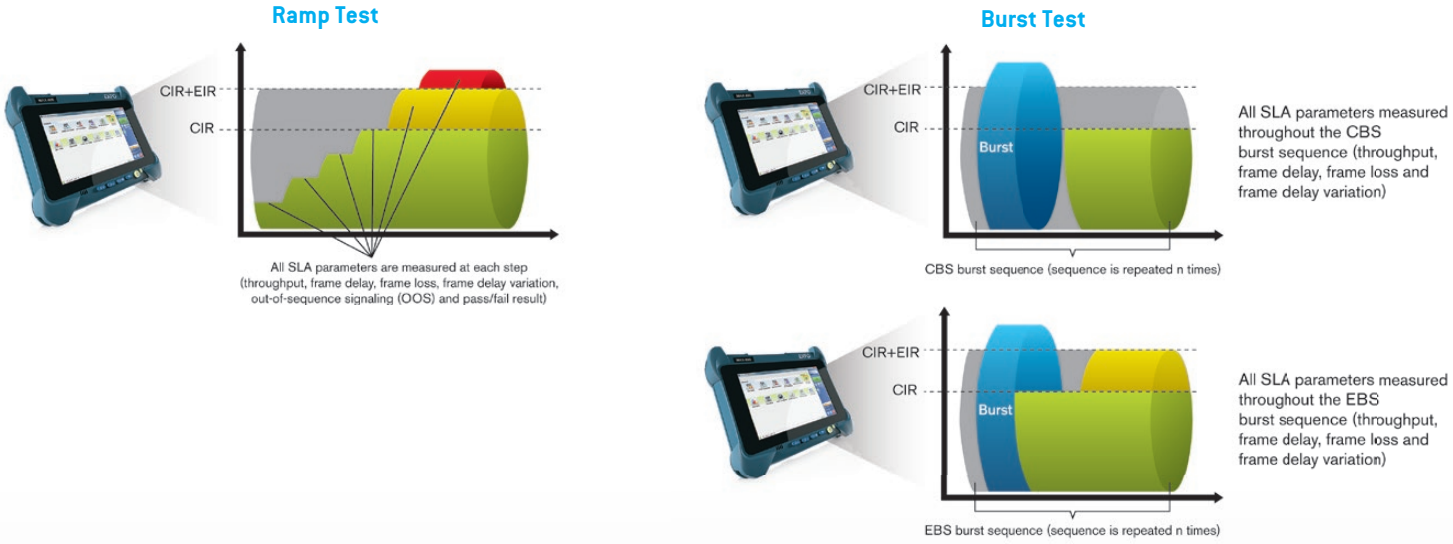
RFC 2544 used to be the most widespread Ethernet testing methodology. However, it was designed for network-device testing in the lab, not service testing in the field. ITU-T Y.1564, the new standard for turning up and troubleshooting Carrier Ethernet services, has a number of advantages over RFC 2544, 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 mobile backhaul and commercial services.

Contrary to other methodologies, EtherSAM supports new 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).

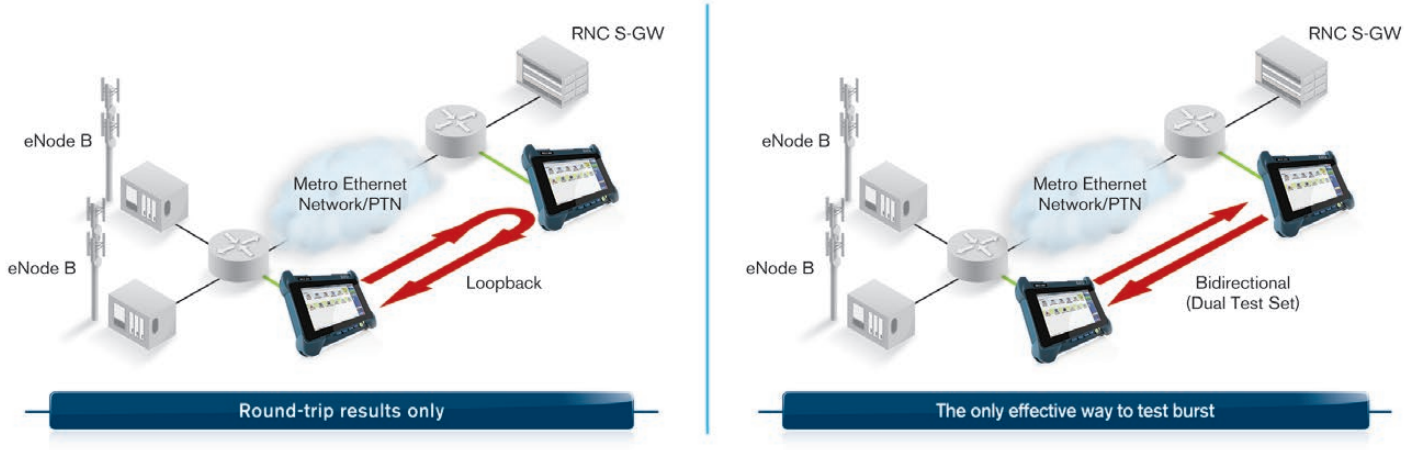



### Service Performance Test

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

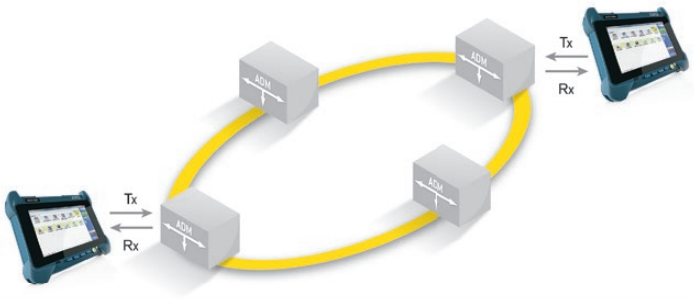
EXFO's EtherSAM approach proves itself even more powerful as it executes the complete ITU-T Y.1564 test with bidirectional measurements. Key SLA parameters are measured independently in each test direction, providing 100% first-time-right service activation–the highest level of confidence in service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

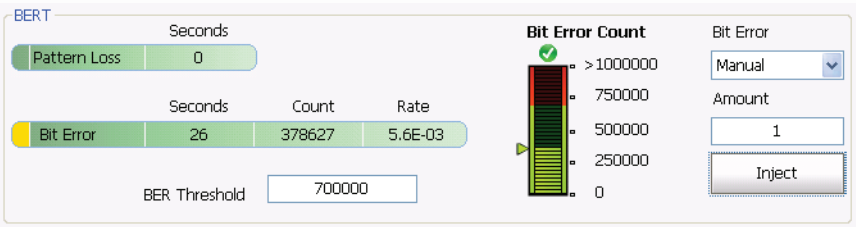



## Key DSn/PDH and SONET/SDH Features

### Simplified BER Testing

The MAX-880 offers 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

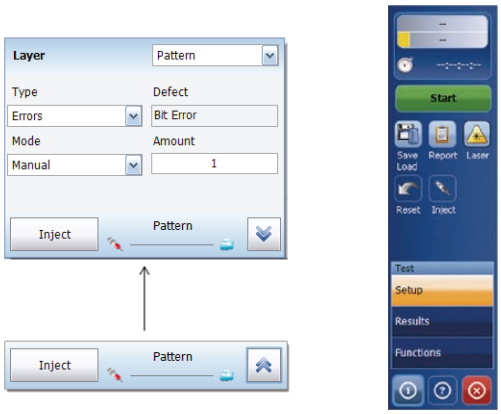
Decoupled mode enables users to independently configure the Tx and Rx ports of the MAX-880 in order to test the mapping and demapping functionality of a network element, or to test at cross-connect points in the network.

## Through Mode

This mode is required for in-service monitoring of the network. The MAX-880 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 MAX-880 feature enables 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-880 offers 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.

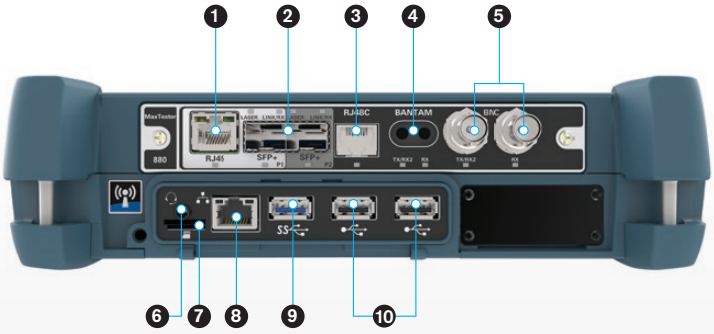
## CHOOSE THE RIGHT MAX-800 FOR YOU

| | MAX-860 | MAX-860G | MAX-880 |
|---|---|---|---|
| Ethernet 10/100/1000M | • | • | • |
| Ethernet 10/100/1000M and 10G | | • | • |
| Dual-port option | • | • | • |
| Y.1564 (EtherSAM) | • | • | • |
| RFC 2544 | • | • | • |
| Cable test | • | • | • |
| IPv6 | • | • | • |
| MPLS | • | • | • |
| EtherBERT | • | • | • |
| Multistream traffic generation | • | • | • |
| Ethernet Through mode | • | • | • |
| OTN, Sonet/SDH via optical port | | | • |
| DSn, PDH via electrical port | | | • |

### MAX-860/860G

### MAX-880

## STREAMLINED FOR EASE OF USE




1. **ETHERNET**
   10 to 1000 BASE-T
2. **OPTICAL ETHERNET**
   Up to 10 Gbit/s
   1000 BASE-T
   SONET/SDH up to 10G
   OTN OTU1/2
3. DSn/PDH
   EXT CLK
4. DSn/PDH
   RX2: DS1
   EXT CLK
5. 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. One USB 3.0 port
10. Two USB 2.0 ports

# SPECIFICATIONS

## SFP ETHERNET OPTICAL INTERFACES[c]

| | Two ports: 100M and GigE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Available wavelengths (nm) | 850, 1310 and 1550 | | | | | | | | |
| Model | FTB-85910 | FTB-85911 | FTB-8590 | FTB-8190 | FTB-8192 | FTB-8596 | FTB-8597 | FTB-8598 | FTB-8599 |
| Transceiver type | **100BASE-FX** | **100BASE-LX** | **1000BASE-SX** | **1000BASE-LX** | **1000BASE-ZX** | **1000BASE-BX10-D** | **1000BASE-BX10-U** | **1000BASE-BX40-U** | **1000BASE-BX40-D** |
| Wavelength (nm) | 1310 | 1310 | 850 | 1310 | 1550 | Tx: 1490<br>Rx: 1310 | Tx: 1310<br>Rx: 1490 | Tx: 1310<br>Rx: 1550 | Tx: 1550<br>Rx: 1310 |
| Tx level (dBm) | –20 to –15 | –15 to –8 | –9 to –2.5 | –5 to 0 | –2 to 3 | –9 to –3 | –9 to –3 | –2 to –3 | –2 to –3 |
| Rx level sensitivity (dBm) | –31 | –28 | –18 | –22 | –30 | –20 | –20 | –24 | –24 |
| Maximum reach | 2 km | 15 km | 500 m | 10 km | 80 km | 10 km | 10 km | 40 km | 40 km |
| Transmission bit rate (Gbit/s) | 0.125 | 0.125 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Reception bit rate (Gbit/s) | 0.125 | 0.125 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Tx operational wavelength range (nm) | 1280 to 1380 | 1261 to 1360 | 830 to 860 | 1270 to 1360 | 1500 to 1580 | 1480 to 1500 | 1260 to 1360 | 1260 to 1360 | 1530 to 1570 |
| Measurement accuracy (uncertainty)<br>Frequency (ppm)<br>Optical power (dB) | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 | <br>±4.6<br>±2 |
| Maximum Rx before damage (dBm)[a] | 3 | 3 | 6 | 6 | 6 | 6 | 6 | 3 | 3 |
| Jitter compliance | ANSI X3.166 | IEEE 802.3 | IEEE 802.3 | IEEE 802.3 | | IEEE 802.3ah | IEEE 802.3ah | IEEE 802.3 | IEEE 802.3 |
| Ethernet classification | ANSI X3.166 | IEEE 802.3 | IEEE 802.3 | IEEE 802.3 | | IEEE 802.3ah | IEEE 802.3ah | IEEE 802.3 | IEEE 802.3 |
| Laser type | LED | FP | VCSEL | DFB | DFB | DFB | FP | DFB | DFB |
| Laser product | Class 1 | Class 1 | Class 1 | Class 1 | Class 1 | Class 1 | Class 1 | Class 1 | Class 1 |
| Connector[b] | LC | LC | LC | LC | LC | LC | LC | LC | LC |

## SFP SONET/SDH AND OTN OPTICAL INTERFACES[c]

| Transceiver type | **OC-3/STM-1** | | | | **OC-12/STM-4** | | | | **OC-48/STM-16/OTU1** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach and wavelength | 15 km; 1310 nm | 40 km; 1310 nm | 40 km; 1550 nm | 80 km; 1550 nm | 15 km; 1310 nm | 40 km; 1310 nm | 40 km; 1550 nm | 80 km; 1550 nm | 15 km; 1310 nm | 40 km; 1310 nm | 40 km; 1550 nm | 80 km; 1550 nm |
| Model | FTB-8190 | FTB-8191 | FTB-8193 | FTB-8192 | FTB-8190 | FTB-8191 | FTB-8193 | FTB-8192 | FTB-8190 | FTB-8191 | FTB-8193 | FTB-8192 |
| Tx level (dBm) | –5 to 0 | –2 to 3 | –5 to 0 | –2 to 3 | –5 to 0 | –2 to 3 | –5 to 0 | –2 to 3 | –5 to 0 | –2 to 3 | –5 to 0 | –2 to 3 |
| Rx operating range (dBm) | –23 to –10 | –30 to –15 | –23 to –10 | –30 to –15 | –22 to 0 | –27 to –9 | –22 to 0 | –29 to –9 | –18 to 0 | –27 to –9 | –18 to 0 | –28 to –9 |
| Transmit bit rate | 155.52 Mbit/s ± 4.6 ppm | | | | 622.08 Mbit/s ± 4.6 ppm | | | | 2.48832 Gbit/s ± 4.6 ppm<br>2.66606 Gbit/s ± 4.6 ppm | | | |
| Frequency offset generation (ppm) | ±50 | | | | ±50 | | | | ±50 | | | |
| Receive bit rate | 155.52 Mbit/s ± 100 ppm | | | | 622.08 Mbit/s ± 100 ppm | | | | 2.48832 Gbit/s ± 100 ppm<br>2.66606 Gbit/s ± 100 ppm (OTU1) | | | |
| Operational wavelength range | 1261 to 1360 nm | 1263 to 1360 nm | 1430 to 1580 nm | 1480 to 1580 nm | 1270 to 1360 nm | 1280 to 1335 nm | 1430 to 1580 nm | 1480 to 1580 nm | 1260 to 1360 nm | 1280 to 1335 nm | 1430 to 1580 nm | 1500 to 1580 nm |
| Spectral width | 1 nm (–20 dB) | | | | 1 nm (–20 dB) | | | | 1 nm (–20 dB) | | | |
| Measurement accuracy (uncertainty)<br>Frequency (ppm)<br>Optical power (dB) | <br>±4.6<br>±2 | | | | <br>±4.6<br>±2 | | | | <br>±4.6<br>±2 | | | |
| Maximum Rx before damage (dBm)[a] | 3 | | | | 3 | | | | 3 | | | |
| Jitter compliance | GR-253 (SONET)<br>G.958 (SDH) | | | | GR-253 (SONET)<br>G.958 (SDH) | | | | GR-253 (SONET)<br>G.958 (SDH)<br>G.8251 (OTN) | | | |
| Line coding | NRZ | | | | NRZ | | | | NRZ | | | |
| Laser product | Class 1 | | | | Class 1 | | | | Class 1 | | | |
| Connector[b] | LC | | | | LC | | | | LC | | | |

**Notes**

a. In order not to exceed the maximum receiver power level before damage, an attenuator must be used.

b. External adapters can be used for other types of connectors.

c. SFP compliance: The MAX-800 selected SFP shall meet the requirements stated in the small form-factor pluggable (SFP) transceiver multisource agreement (MSA). The MAX-800's selected SFP shall meet the requirements stated in the Specification for Diagnostic Monitoring Interface for Optical Xcvrs.

## SFP+ ETHERNET OPTICAL INTERFACES [c]

| Transceiver type | 10GBASE-SR/SW | 10GBASE-LR/LW | 10GBASE-ER/EW |
|---|---|---|---|
| Wavelength (nm) | 850 | 1310 | 1550 |
| Model | FTB-8690 | FTB-8691 | FTB-8692 |
| Tx level (dBm) | –5 to –1 | –8 to 0.5 | –4.7 to 4.0 |
| Rx-level sensitivity (dBm) | –11.1 | –12.6 | –14.1 |
| Maximum reach | 300 m | 10 km | 40 km |
| Tx bit rate (Gbit/s) | 9.95 to 10.3 | 9.95 to 10.3 | 9.95 to 10.3 |
| Rx bit rate (Gbit/s) | 9.95 to 10.3 | 9.95 to 10.3 | 9.95 to 10.3 |
| Tx operational wavelength range (nm) | 840 to 860 | 1260 to 1355 | 1530 to 1565 |
| Measurement accuracy (uncertainty)<br>Frequency (ppm) | ±4.6 | ±4.6 | ±4.6 |
| Maximum Rx before damage (dBm) [a] | 6 | 5 | 5 |
| Jitter compliance | IEEE 802.3ae | IEEE 802.3ae | IEEE 802.3ae |
| Laser type | VCSEL | DFB | CML |
| Laser product | Class 1 | Class 1 | Class 1 |
| Connector [b] | LC | LC | LC |

## SFP+ 10G SONET/SDH AND OTN OPTICAL INTERFACES [c]

| Transceiver type | OC-192/STM-64/OTU2 | OC-192/STM-64/OTU2 | OC-192/STM-64/OTU2 |
|---|---|---|---|
| Wavelength (nm) | 1310 | 1550 | 1550 |
| Model | FTB-8693 | FTB-8694 | FTB-8695 |
| Tx level (dBm) | –6 to –1 | –1 to 2 | 0 to 4 |
| Rx level sensitivity (dBm) | –11 to 0.5 | –14 to –1 | –24 to –7 |
| Maximum reach | 10 km | 40 km | 80 km |
| Transmission bit rate (Gbit/s) | 9.9532 ± 4.6 ppm<br>10.7092 ± 4.6 ppm (OTU2) | 9.9532 ± 4.6 ppm<br>10.7092 ± 4.6 ppm (OTU2) | 9.9532 ± 4.6 ppm<br>10.7092 ± 4.6 ppm (OTU2) |
| Frequency offset generation (ppm) | ±50 | ±50 | ±50 |
| Reception bit rate (Gbit/s) | 9.9532 ± 100 ppm<br>10.7092 ± 100 ppm (OTU2) | 9.9532 ± 100 ppm<br>10.7092 ± 100 ppm (OTU2) | 9.9532 ± 100 ppm<br>10.7092 ± 100 ppm (OTU2) |
| Tx operational wavelength range (nm) | 1260 to 1355 | 1530 to 1565 | 1530 to 1565 |
| Measurement accuracy (uncertainty)<br>Frequency (ppm)<br>Optical power (dB) | ±4.6<br>±2 | ±4.6<br>±2 | ±4.6<br>±2 |
| Maximum Rx before damage (dBm) [a] | 5 | 5 | 3 |
| Jitter compliance | GR-253 (SONET)<br>G.825 (SDH)<br>G.8251 (OTN) | GR-253 (SONET)<br>G.825 (SDH)<br>G.8251 (OTN) | GR-253 (SONET)<br>G.825 (SDH)<br>G.8251 (OTN) |
| Laser product | Class 1 | Class 1 | Class 1 |
| Connector [b] | LC | LC | LC |

## LASER SAFETY


**Notes**

a. In order not to exceed the maximum receiver power level before damage, an attenuator must be used.

b. External adaptors can be used for other types of connectors.

c. SFP+ compliance: The MAX-800 selected SFP+ shall meet the requirements stated in the SFP-8431 Enhanced Small Form-Factor Pluggable Module SFP+ Transceiver Multisource Agreement (MSA). The MAX-800 selected SFP+ shall meet the requirements stated in the Specification for Diagnostic Monitoring Interface for Optical Xcvrs.

## ELECTRICAL ETHERNET INTERFACES

| | One port: 10/100 BASE-T half/full duplex, 1000BASE-T full duplex<br>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

| | **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<br>+0.6 dBdsx (0 to 133 ft)<br>+1.2 dBdsx (133 to 266 ft)<br>+1.8 dBdsx (266 to 399 ft)<br>+2.4 dBdsx (399 to 533 ft)<br>+3.0 dBdsx (533 to 655 ft) | | | |
| Rx-level sensitivity | TERM: ≤6 dB (cable loss only)<br>(at 772 kHz for T1)<br>DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤6 dB)<br>Bridge: ≤6 dB (cable loss only) | TERM: ≤6 dB (cable loss only)<br>MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤6 dB)<br>Bridge: ≤6 dB (cable loss only) | TERM: ≤6 dB (cable loss only)<br>MON: ≤26 dB (20 dB resistive loss + cable loss ≤6 dB)<br>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<br>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<br>GR-499 section 7.3 | G.823 section 7.2<br>G.813 | G.823 section 7.2<br>G.813 | G.823 section 7.1<br>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 |

**Note**

a. Adaptation cable required for BANTAM.

## DSN/PDH AND SONET/SDH ELECTRICAL INTERFACES

| 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<br>133 to 266 ft<br>266 to 399 ft<br>399 to 533 ft<br>533 to 655 ft | | | | 0 to 225 ft<br>225 to 450 ft | | 0 to 225 ft<br>225 to 450 ft | | 0 to 225 ft | |
| Cable simulation | –22.5 dB<br>–15.0 dB<br>–7.5 dB<br>0 dB | | | | 450 to 900 (927) ft | | 450 to 900 (927) ft | | | |
| Rx level sensitivity | For 772 kHz:<br>TERM: ≤ 26 dB (cable loss only) at 0 dBdsx Tx<br>DSX-MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)<br>Bridge: ≤ 6 dB (cable loss only) | For 1024 kHz:<br>TERM: ≤ 6 dB (cable loss only)<br>MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)<br>Bridge: ≤ 6 dB (cable loss only) | For 1024 kHz:<br>TERM: ≤ 6 dB (cable loss only)<br>MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB)<br>Bridge: ≤ 6 dB (cable loss only) | For 17.184 MHz:<br>TERM: ≤12 dB (coaxial cable loss only)<br>MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) | For 22.368 MHz:<br>TERM: ≤ 10 dB (cable loss only)<br>DSX-MON: ≤ 26.5 dB (21.5 dB resistive loss + cable loss ≤ 5 dB) | | For 25.92 MHz:<br>TERM: ≤ 10 dB (cable loss only)<br>MON: ≤ 25 dB (20 dB resistive loss + cable loss ≤ 5 dB) | For 70 MHz:<br>TERM: ≤ 12 dB (coaxial cable loss only)<br>MON: ≤ 26 dB (20 dB resistive loss + cable loss ≤ 6 dB) | For 78 MHz:<br>TERM: ≤ 12.7 dB (coaxial cable loss only)<br>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)<br>Frequency (ppm)<br>Electrical power (dB) | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | <br>±4.6<br>±1.5 | |
| Peak-to-peak voltage | ±10 % down to 500 mVpp | ±10 % down to 500 mVpp | ±10 % down to 500 mVpp | ±10 % down to 500 mVpp | ±10 % down to 200 mVpp | | ±10 % down to 200 mVpp | ±10 % down to 200 mVpp | ±10 % down to 200 mVpp | |
| Intrinsic jitter (Tx) | ANSI T1.403 section 6.3<br>GR-499 section 7.3 | G.823 section 5.1 | G.823 section 5.1 | G.823 section 5.1<br>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<br>G.751 section 3.3 | G.825 section 5.1<br>GR-253 section 5.6.2.2 | |
| Input jitter tolerance | AT&T PUB 62411<br>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<br>G.751 section 3.3 | G.825 section 5.2<br>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 | BANTAM and RJ48C | BNC | BNC | BNC | | BNC | BNC | 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* | | | |

**Notes**

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:<br>**ITU-T recommendation** — **Performance monitoring statistics**<br>G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM<br>G.826 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER<br>G.828 — ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI<br>G.829 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER<br>M.2100 — ES, SES, UAS<br>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<br>**Generation**<br>› Pointer increment and decrement<br>› Pointer jump with or without NDF<br>› Pointer value<br>**Analysis**<br>› Pointer increments<br>› Pointer decrements<br>› Pointer jumps (NDF, no NDF)<br>› 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.<br>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-880 transmitter back to its receiver after crossing a far-end loopback.<br>Measurements are provided on all supported MAX-880 interfaces and mappings.<br>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] | Tandem connection monitoring (TCM) is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The The MAX-880 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.<br>Error generation: TC-IEC, TC-BIP, TC-REI, TC-OEI<br>Error analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL (non-standardized alarm)<br>Alarm generation: TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS<br>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. |

**Note**

a. HOP and LOP supported as per ITU G.707 option 2.

## 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) |
| **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 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. |
| Performance monitoring | The following ITU-T recommendations and corresponding performance monitoring parameters are supported:<br>**ITU-T recommendation** — **Performance monitoring statistics**<br>G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM<br>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.<br>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.<br>Measurements are supported on all interfaces and mappings.<br>Measurements: last RTD time, minimum, maximum, average, measurement count (number of successful RTD tests) and failed measurement count. |
| Through mode | Performs Through mode analysis of any incoming OTN signal transparently. |

## 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 seven 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. Also includes the ability to generate fixed, random and frame size sweep, as well as 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. |
| 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. |
| 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 10G 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. |
| 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. |
| 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 10/100/1000 BASE-T, 100BASE-X, GigE and 10 GigE. |

## 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. |
| 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 MAX-800/NetBlazer/Power Blazer units and sets them to Smart Loopback mode. |
| Dual Test Set mode | Detects and connects to other MAX-800/NetBlazer/Power Blazer units to perform bidirectional RFC 2544 and EtherSAM testing. |
| Dual Port mode | Enables any Ethernet test (e.g., EtherSAM, RFC 2544, traffic generation and monitoring, or BERT) to run directly to itself using one self-contained unit with loopback. |
| IP tools | Performs ping and traceroute functions. |
| 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]

| | |
|---|---|
| Size (H x W x D) | 210 mm x 254 mm x 66 mm (8 ¼ in x 10 in x 2 ⅝ in) |
| Weight (with battery) | |
| MAX-860 | 2.1 kg (4.6 lb) |
| MAX-860G/800 | 2.6 kg (5.7 lb) |
| Temperature | |
| Operation | 0 °C to 50 °C (32 °F to 122 °F) |
| Storage [b] | –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 Embedded 8 Standard |
| Display | Multitouch, widescreen, color, 1280 x 800 TFT 203 mm (8 in) |
| Interfaces | RJ45 LAN 10/100/1000 Mbit/s<br>Two USB 2.0 ports<br>One USB 3.0 port<br>Micro SD card slot<br>3.5 mm headset/microphone port |
| Storage | 64 GB internal memory (flash) |
| Battery | Rechargeable Li-ion smart battery |
| Power supply | AC/DC adapter, input: ~ 100 – 240 V; 50/60 Hz; 2.5 A max,<br>output: ⎓ 24 V; 3.75 A |

**Notes**

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.

## ORDERING INFORMATION (ETHERNET ONLY)

### MAX-860-XX-XX-XX-XX-XX-XX-XX

**Models**
MAX-860-1 = Ethernet 10/100/1000 BASE-T electrical and GigE optical

**Display**
S1 = Standard display
S2 = Enhanced display for outdoor use

**Wi-Fi/Bluetooth option**
00 = Without RF components
RF = With RF capability (Wi-Fi and Bluetooth)

**Ethernet rate option**
100optical = 100 Mbit/s optical [a]

**Software options**
Cable_Test = Cable test
DUAL-PORT = Dual-port testing for any Ethernet rate
ETH-THRU = Enables through mode capability
IPV6 = Internet protocol version 6
IPT = Ping and traceroute functionalities
MPLS = Enables MPLS

**Inspection probe base tips** [e]
APC = Includes FIPT-400-U25MA and FIPT-400-SC-APC
UPC = Includes FIPT-400-U25M and FIPT-400-FC-SC

**Inspection probe models**
FIP-410B = Digital video inspection probe [f]
Triple magnification
FIP-420B = Analysis digital video inspection probe [f]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-425B = Wireless digital video inspection probe [f, g]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-430B = Automated analysis digital video inspection probe [f]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-435B = Wireless analysis digital video inspection probe [f, g]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering

Example: MAX-860-1-S1-IPV6-ETH-THRU

### MAX-860G-XX-XX-XX-XX-XX-XX-XX

**Models**
MAX-860G-1 = Ethernet 10/100/1000 BASE-T electrical and GigE optical
MAX-860G-100 = Ethernet 10/100/1000 BASE-T electrical, 100 Mbit/s optical, GigE optical and 10 GigE LAN/WAN

**Display**
S1 = Standard display
S2 = Enhanced display for outdoor use

**Wi-Fi/Bluetooth option**
00 = Without RF components
RF = With RF capability (Wi-Fi and Bluetooth)

**Ethernet rate options**
100optical = 100 Mbit/s optical [b, c]
10GigE = 10G LAN and 10G WAN [b, d]

**Software options**
Cable_Test = Cable test
DUAL-PORT = Dual-port testing for any Ethernet rate
ETH-THRU = Enables through mode capability
IPV6 = Internet protocol version 6
IPT = Ping and traceroute functionalities
MPLS = Enables MPLS

**Inspection probe base tips** [e]
APC = Includes FIPT-400-U25MA and FIPT-400-SC-APC
UPC = Includes FIPT-400-U25M and FIPT-400-FC-SC

**Inspection probe models**
FIP-410B = Digital video inspection probe [f]
Triple magnification
FIP-420B = Analysis digital video inspection probe [f]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-425B = Wireless digital video inspection probe [f, g]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-430B = Automated analysis digital video inspection probe [d]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-435B = Wireless analysis digital video inspection probe [f, g]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering

Example: MAX-860G-100-S1-100Optical-IPV6-ETH-THRU

**Notes**

a. Requires purchase of SFP.
b. Included with MAX-860G-100.
c. Requires purchase of SFP or SFP+.
d. Requires purchase of SFP+.
e. Available if inspection probe is selected.
f. Includes ConnectorMax 2 software.
g. Requires RF capability (Wi-Fi and Bluetooth hardware option).

## ORDERING INFORMATION (MULTISERVICE)

**MAX-880-XX-XX-XX-XX-XX-XX-XX-XX-XX-XX**

**Models**
MAX-880-1 = Ethernet 10/100/1000 BASE-T electrical and GigE optical
MAX-880-100 = Ethernet 10/100/1000 BASE-T electrical, 100 Mbit/s optical, GigE optical and 10 GigE LAN/WAN

**Display**
S1 = Standard display
S2 = Enhanced display for outdoor use

**Wi-Fi/Bluetooth option**
00 = Without RF components
RF = With RF capability (Wi-Fi and Bluetooth)

**Ethernet rate options**
100optical = 100 Mbit/s optical [a, b]
10GigE = 10G LAN and 10G WAN [b, c]

**Test options**
SONET = SONET testing
SDH = SDH testing
SONET-SDH = SONET and SDH testing

**Transport rate options**
52M = 52 Mbit/s (OC-1/STM-0) [d]
155M = 155 Mbit/s (OC-3/STM-1)
622M = 622 Mbit/s (OC-12/STM-4)
2488M = 2.5 Gbit/s (OC-48/STM-16)
9953M = 10 Gbit/s (OC-192/STM-64)

**OTN rate options**
OTU1 = OTN optical rate 2.666 Gbit/s
OTU2 = OTN optical rate 10.709 Gbit/s

**Software options**
Cable_Test = Cable test
DS1-FDL = DS1 FDL test capability
DS3-FEAC = DS3 FEAC test capability
DS3-G747 = G.747 test capability
DSn = DSn test capability
DUAL-PORT = Dual-port testing for any Ethernet rate
DUAL-RX = DS1/DS3 dual Rx testing
ETH-THRU = Through mode capability
IPV6 = Internet protocol version 6
IPT = Ping and traceroute functionalities
MPLS = Enables MPLS
NI-CSU = NI-CSU loopback emulation
PDH = PDH test capability
TCM = Tandem connection monitoring

**Inspection probe base tips [e]**
APC = Includes FIPT-400-U25MA and FIPT-400-SC-APC
UPC = Includes FIPT-400-U25M and FIPT-400-FC-SC

**Inspection probe models**
FIP-410B = Digital video inspection probe [f]
Triple magnification
FIP-420B = Analysis digital video inspection probe [f]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-425B = Wireless digital video inspection probe [f, g]
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-430B = Automated analysis digital video inspection probe [f]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering
FIP-435B = Wireless analysis digital video inspection probe [f, g]
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering

Example: MAX-880-100-S2-RF-100Optical-10GE-SONET-52M-155M-2488M-OTU1-DSN-DUAL-PORT-IPV6-IPT-MPLS-PDH

**Notes**

a. Requires purchase of SFP.
b. Included with MAX-860G-100.
c. Requires purchase of SFP or SFP+.
d. Included with SONET or SDH option.
e. Available if inspection probe is selected.
f. Includes ConnectorMax 2 software.
g. Requires RF capability (Wi-Fi and Bluetooth hardware option).

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