FTB-880 NetBlazer Multiservice Tester

POWERFUL, COMPREHENSIVE AND FAST MULTISERVICE TESTING

EtherSAM

EXFO Connect Compatible

Wi Fi

Bluetooth™

SPEC SHEET

Comprehensive, yet simple test suites for field technicians to easily turn up, validate and troubleshoot DSn/PDH, SONET/SDH, OTN, Fibre Channel and Ethernet services at up to 11.3 Gbit/s.

KEY FEATURES AND BENEFITS

- Comprehensive testing for DSn/PDH, SONET/SDH, OTN and Ethernet interfaces up to 10 Gbit/s
- Efficiently assess Fibre Channel networks with best-in-class coverage via 1x, 2x, 4x, 8x and 10x interfaces
- FTTA validation (CPRI and OBSAI) at up to 3.1 Gbit/s via BER testing
- Simplified BER testing with pass/fail indicators based on user-defined thresholds
- OTN testing (as per ITU-T G.709) including forward error correction (FEC)
- Faster Ethernet service activation with bidirectional EtherSAM (ITU-T Y.1564) and RFC 2544 test suites, multistream traffic generation, Through mode and bit-error-rate (BER) testing
- Unprecedented configuration simplicity with hybrid touchscreen/keypad navigation and data entry
- Increase technician autonomy and productivity with intelligent discovery of remote EXFO Ethernet testers, as well as in-service Ethernet testing via dual-port Through mode
- No data interpretation errors with revolutionary new GUI on 7-inch TFT screen, historical event logger, visual gauges and 3D-icon depictions of pass/fail outcomes
- Simpler reporting with integrated Wi-Fi and Bluetooth connectivity capabilities
- Centralized support for injection/monitoring of errors and alarms, trace messaging, overhead monitoring/manipulation and performance monitoring statistics
- Integrated applications to test VoIP services, and additional IP test utilities, including VLAN scan and LAN discovery via EXpert VoIP and EXpert IP test tools
- Support for packet capture and analysis, wireless troubleshooting and TCP throughput testing
- Extended field autonomy with a compact, lightweight platform equipped with a long-duration battery pack
- **EXFO Connect-compatible**: automated asset management; data goes through the cloud and into a dynamic database

PLATFORM COMPATIBILITY

Platform
FTB-1

EXFO | Assessing Next-Gen Networks

THE ULTRA-PORTABLE CHOICE FOR MULTISERVICE TESTING

The ongoing transition towards a converged network infrastructure for legacy DSn/PDH, SONET/SDH, OTN, Fibre Channel and packet-based Ethernet services requires a test tool that can cover a wide range of interfaces and rates, without sacrificing portability, speed or cost. Leveraging the powerful, intelligent FTB-1 handheld platform, the FTB-880 NetBlazer streamlines processes and empowers field technicians to test and validate DSn/PDH, SONET/SDH, OTN, Fibre Channel and Ethernet circuits efficiently.

Powerful and Fast

The FTB-880 NetBlazer is a fully integrated DSn/PDH, SONET/SDH, OTN, Fibre Channel and Ethernet handheld tester. It offers the industry's largest touchscreen with unprecedented configuration simplicity via hybrid touchscreen/keypad navigation. Platform connectivity is abundant via Wi-Fi, Bluetooth, Gigabit Ethernet or USB ports, making it accessible in any environment.

What you need for any DSn/PDH, SONET/SDH, OTN, Fibre Channel or Ethernet application

- Installation, commissioning and maintenance of access and metro networks
- Turn-up of DSn/PDH or SONET/SDH circuits
- Performance assessment of Carrier Ethernet services
- Validation of OTN networks and services
- Installation, activation and maintenance of metro Ethernet networks
- Deployment of active Ethernet (point-to-point) access services
- Installation and activation of Fibre Channel networks
- Testing and troubleshooting
- In-service troubleshooting of live traffic
- Performance monitoring of DSn/PDH, SONET/SDH and OTN circuits
- Round-trip delay assessment of transport circuits
- BER testing up to 11.3 Gbit/s
- FTTA validation (CPRI and OBSAI) at up to 3.1 Gbit/s via BER testing

DSn/PDH, SONET/SDH, OTN, FIBRE CHANNEL AND ETHERNET AT UP TO 10 Gbit/s

If the need is for multiservice testing up to 10 Gbit/s, then the FTB-880 is the perfect solution.

- RJ-45 port for electrical 10/100/1000M Ethernet
- SFP port for OC-1/3/12/48 or STM-0/1/4/16, OTU1 and Fibre Channel 1, 2, 4x or 100/1000M Ethernet
- SFP+ port for OC-192, STM-64, 10 GigE LAN/WAN or Fibre Channel 8, 10x, OTU2, OTU1e/2e and OTU1f/2f
- RJ-48C and bantam port for DS1 or E1
- BNC port for DS3 or E1/E3/E4 or STS-1e/STS-3e or STM-0e/STM-1e
- One 2.5 and 3.1 Gbit/s port

- DS1/DS3 and E1/E3/E4 testing
- SONET/SDH and OTN BER testing with configurable threshold settings
- Coupled, Decoupled and Through mode testing
- Error and alarm insertion and monitoring
- Overhead monitoring and manipulation
- High-order and low-order mappings
- Tandem connection monitoring (TCM)
- Pointer manipulation, including pointer sequence testing as per Telcordia GR-253, ANSI T1.105-03 and ITU G.783
- Performance monitoring as per G.821, G.826, G.828, G.829, M.2100, M.2101
- Frequency analysis and offset generation
- Automatic protection switching
- Service-disruption time measurements
- Round-trip delay measurements
- Dual DS1/DS3 receiver (Rx) support
- DS1 loop codes and NI/CSU emulation
- DS1/DS3 autodetection of line code, framing and pattern

- DS1 FDL and DS3 FEAC
- Fractional T1/E1 testing
- External clock sync support
- 10 Base-T to 10 GigE testing
- EtherSAM (ITU-T Y.1564) (bidirectional)
- RFC 2544 (bidirectional)
- Traffic generation and monitoring
- Through mode
- Dual-port testing
- Intelligent autodiscovery
- IPv6 testing
- VLAN stacking MPLS
- Ping/Traceroute
- Cable testing
- Dual Test Set mode
- Smart loopback
- Fibre Channel 1x, 2x, 4x, 8x, 10x
- FTTA BERT

Setting a New GUI Standard: Unprecedented Simplicity in Configuration Setup and Navigation

The FTB-880 NetBlazer's intelligent situational configuration setup feature guides technicians through complete, accurate testing processes (suggestion prompts, help guides, etc.). It reduces navigation by combining associated testing functions on a single screen, and offers intelligent autodiscovery that allows 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)

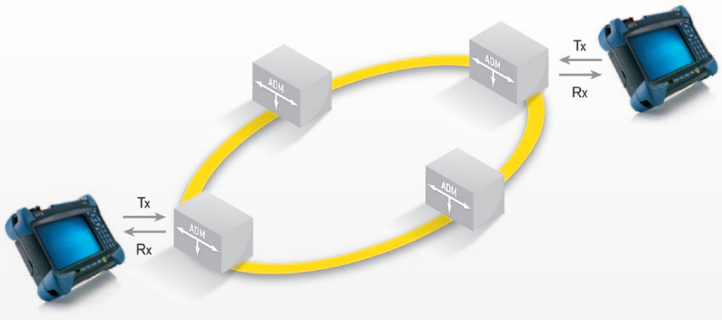
Streamlined Navigation

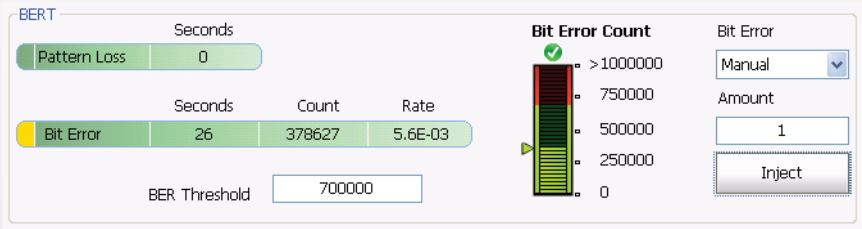
- Remote discovery button available at all times; no reason to leave your current location to scan for a remote unit
- Testing status can be maximized to fill the entire screen by simply clicking on the alarm status button; whether the unit is in your hand or across the room, test results can be easily determined with a simple glance at the display screen
- RFC 2544 configuration is maximized in a single page; no need to navigate through multiple screens to configure individual subtests
- RFC 2544 results and graphs are also maximized in a single page; no 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 DSn/PDH, SONET/SDH and OTN Features

Simplified BER Testing

The FTB-880 NetBlazer provides the ability to preconfigure bit-error-rate (BER) thresholds that are user-defined prior to running the test. This allows for a simple pass/fail verdict at the conclusion of the test, leaving no room for misinterpretation of the test results.



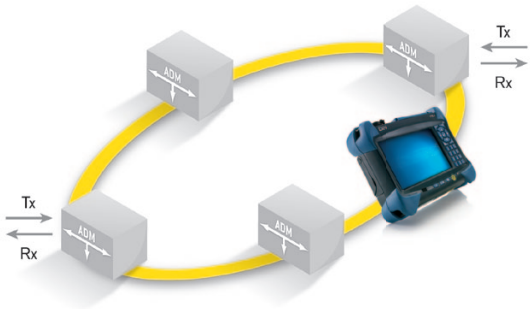


Decoupled Mode

The Decoupled mode enables the user to independently configure the Tx and Rx ports of the FTB-880 NetBlazer module. This makes it possible to test the mapping and demapping functionality of a network element or at cross-connect points in the network.

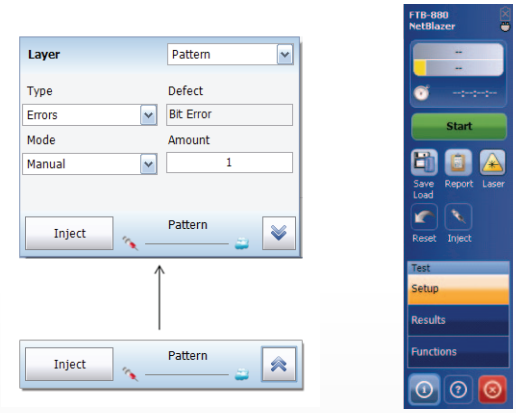
Through Mode

This mode is required for in-service monitoring of the network. The FTB-880 NetBlazer can be inserted in-line on a specific link to monitor and analyze the errors and alarms in a non-intrusive manner.



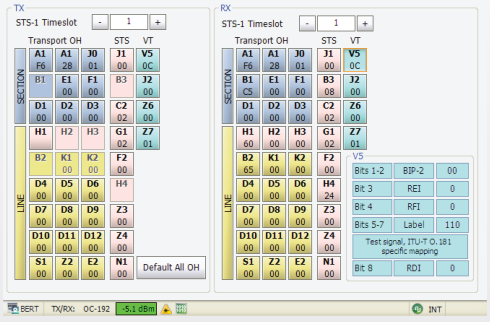
Simplified Error Injection

This FTB-880 feature enables the user to inject errors with a single click from any screen, allowing technicians to ensure circuit continuity prior to starting a test. Furthermore, the error injection functionality can be preprogrammed for any given type of error, and not just for bit errors.



Complete Overhead Monitoring

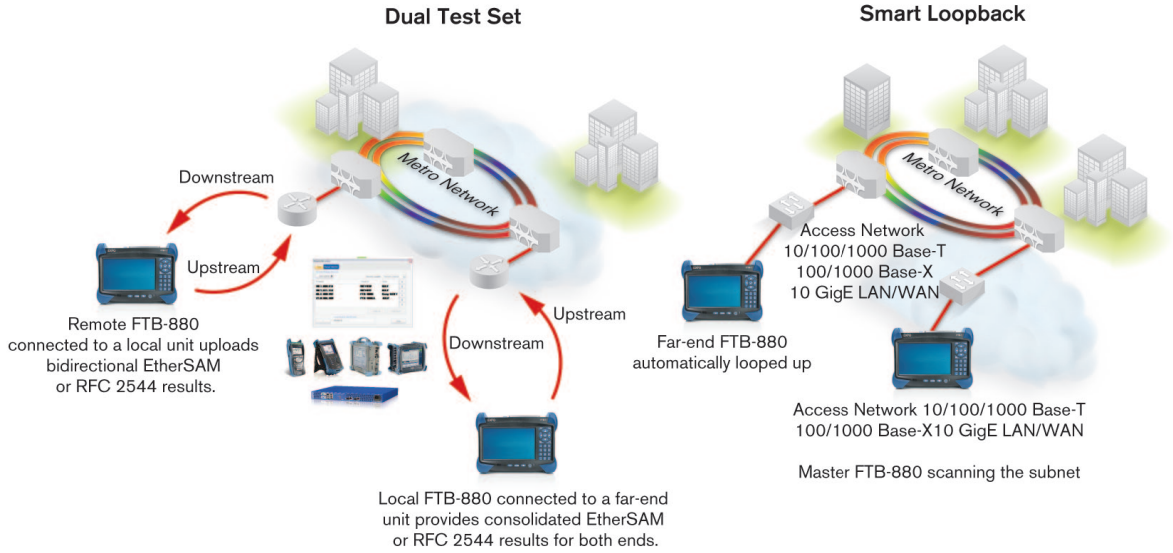
The FTB-880 NetBlazer offers access to all SONET/SDH or OTN overhead (OH) bytes. Furthermore, by selecting any given OH byte, the user can retrieve additional detailed information about that byte without having to switch pages.



Key Ethernet Features

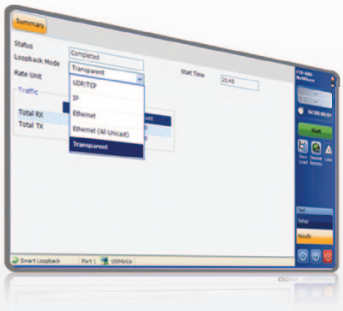
Intelligent Network Discovery Mode

Using the FTB-880 or the FTB-860x test set, 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 and RFC 2544 results. No more need for an additional technician at the far end to relay critical information–these NetBlazer products take care of it all.



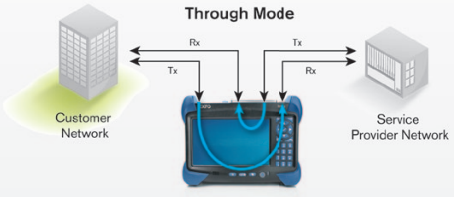
Smart Loopback Flexibility

The Smart Loopback functionality has been enhanced to offer five distinct loopback modes. Whether you are looking to pinpoint loopback traffic from a UDP or TCP layer, or all the way down to a completely promiscuous mode (Transparent Loopback mode), the FTB-880 or the FTB-860x has the flexibility to adjust for all unique loopback situations.



Dual-Port and Through Mode Testing

The NetBlazer series is equipped for both Through mode or dual-port testing. Through mode allows traffic to pass through either of the NetBlazer's two electrical or optical ports for in-service troubleshooting of live traffic between the carrier/service provider network and the customer's network. This allows technicians to access circuits under test without the need for a splitter. With dual-port testing, the technician can use a single NetBlazer module to launch the test and perform the loopback. With two NetBlazer series modules, the dual-port feature also enables users to run two simultaneous tests to maximize time and efficiency.



VLAN/MPLS

Today's networks are expected to deliver high performance. To match 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 NetBlazer series supports virtual local area network (VLAN) tags, Q-in-Q VLAN tags and multiprotocol label switching (MPLS).

EtherSAM: The New Standard in Ethernet Testing

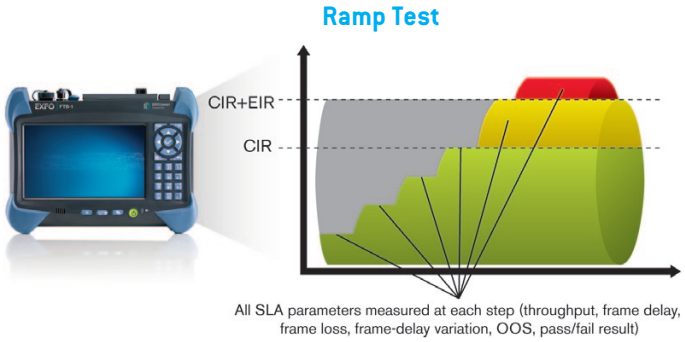
RFC 2544 used to be the most widespread Ethernet testing methodology. However, it was designed for network-device testing in the lab, not for service testing in the field. ITU-T Y.1564 is the new standard for turning up and troubleshooting Carrier Ethernet services. It has a number of advantages over RFC 2544, including validation of critical SLA criteria, such as packet jitter and QoS measurements. This methodology is also significantly faster, therefore saving 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. It can simulate all types of services that will run on the network and simultaneously qualify 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.

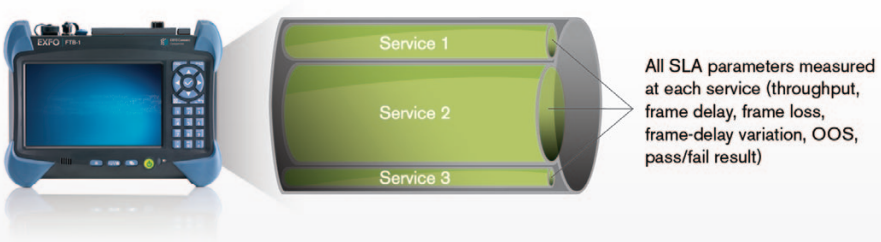
Service Configuration Test

The service configuration test consists of sequentially testing each service. It validates that the service is properly provisioned and that all specific KPIs or SLA parameters are met. A ramp test is performed to verify the committed information rate (CIR), excess information rate (EIR) and traffic policing.



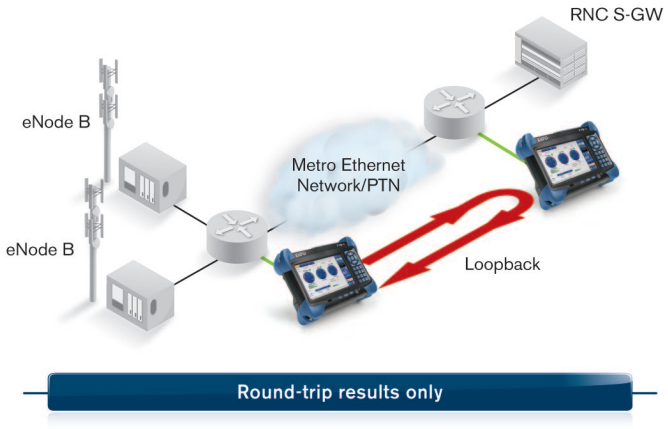
Service Performance Test

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

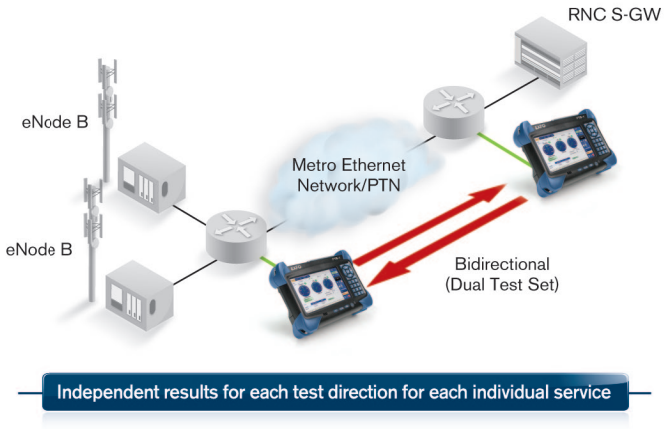


EtherSAM Bidirectional Results

EXFO's EtherSAM approach proves 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, thus providing 100% first-time-right service activation–the highest level of confidence in service testing.



Round-trip results only



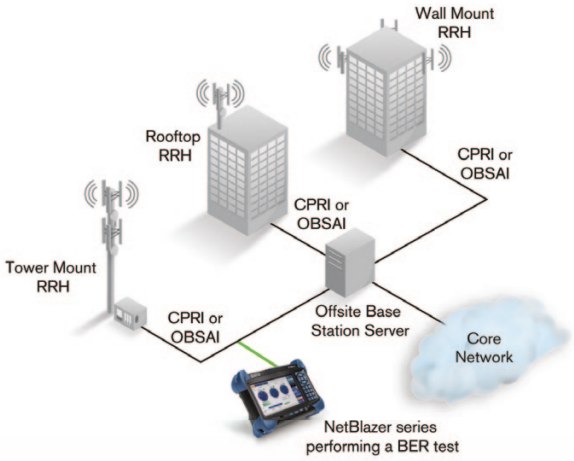
Independent results for each test direction for each individual service

FTTA Testing

The times are constantly changing and the telecommunications industry is rapidly evolving to keep pace. This is especially true when it comes to mobile network operators (MNOs) and the delivery of their services. Bandwidth-hogging applications like high-definition video, media-rich content and interactive mobile applications are being introduced at an ever-increasing rate. The wireless infrastructure has to be modernized to keep up with this continuous, high bandwidth growth and to minimize latency. To meet these expectations, MNOs are now switching their infrastructures from legacy "copper to the antenna" to fiber-to-the-antenna (FTTA). With the introduction of FTTA, MNOs can offer better performance with lower base-station costs. One key component of evolving to FTTA requires the addition of either the common public radio interface (CPRI) or the open base station architecture initiative (OBSAI).

Incorporating either CPRI or OBSAI, the actual base stations can be located in much less challenging locations, where size, climate and availability of power are much more easily managed. In addition, wireless network providers can maximize the base-station output by having multiple antennas per offsite base station.

With the NetBlazer series of modules, field techs can perform FTTA tests (CPRI or OBSAI). Whether the need is for 2.5 or 3.1 Gbit/s, the NetBlazer modules can perform a BER test that validates the fiber from the remote base station all the way to the remote radio head.



Distributed Wireless Base Station System

EFFICIENTLY ASSESSING PERFORMANCE OF FIBRE CHANNEL SERVICES

The NetBlazer Series modules provide comprehensive testing capabilities for Fibre Channel network deployments, supporting multiple Fibre Channel interfaces.

APPLICATIONS

Since most storage area networks (SANs) cover large distances and because Fibre Channel has stringent performance requirements, it is imperative to test at each phase of network deployment to ensure appropriate service levels. EXFO's NetBlazer series modules provide full wire-speed traffic generation at the FC-2 layer, which allows BER testing for link integrity measurements. The NetBlazer series also supports latency, buffer-to-buffer credit measurements for optimization as well as login capabilities.

Latency

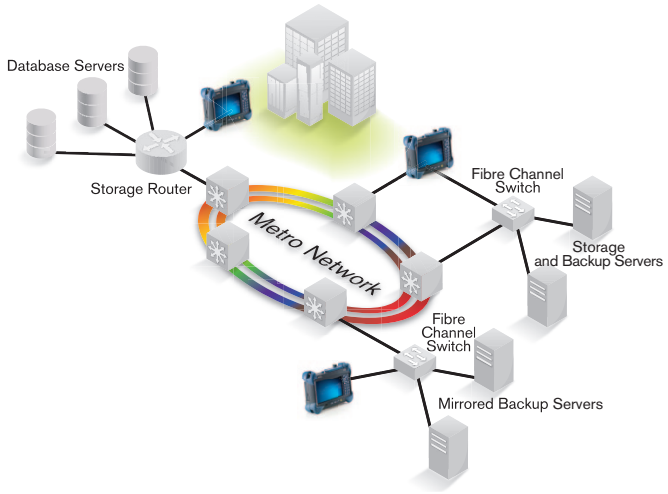
Transmission of frames in a network is not instantaneous, and is subject to multiple delays caused by the propagation delay in the fiber and by the processing time inside each piece of network equipment. Latency is the total accumulation of delays between two end points. Some applications, such as VoIP, video and storage area networks, are very sensitive to excess latency.

It is therefore critical for service providers to properly characterize network latency when offering Fibre Channel services. The NetBlazer series modules estimate buffer-to-buffer credit value requirements from the performed latency measurement.

COMPLETE SUITE OF FIBRE CHANNEL INTERFACES

Interface	Signal Rate (Gbit/s)	Data Rate (MB/s)
1x	1.0	100
2x	2.1	200
4x	4.2	400
8x	8.5	800
10x	10.5	1200

End-to-End Networking



Thanks to end-to-end network testing capabilities, EXFO's FTB-880 enables fast deployment and configuration of Fibre Channel networks. Communication between the transport network, interconnection devices and end nodes can be validated with features such as BER testing, latency measurement, buffer-to-buffer credit estimation and port login capabilities.

Buffer-to-Buffer Credit Estimation

In order to regulate traffic flow and congestion, Fibre Channel ports use "buffers" to temporarily store frames. The number of frames a port can store is referred to as a "buffer credit". Each time a frame is received by a port, an acknowledgement frame is sent. The buffer-to-buffer credit threshold refers to the amount of frames a port can transmit without receiving a single acknowledgement.

This is a crucial configuration parameter for optimal network performance. Usually, network administrators calculate the value by taking the traveled distance and the data rate into consideration; however, since latency issues are not considered, poor accuracy is to be expected. The NetBlazer series modules are capable of estimating buffer credit values with respect to latency by calculating the distance according to the round-trip latency time. This value can then be used by network administrators to optimize the network configuration.

Login Testing

Most new-generation transport devices (xWDM or SONET/SDH mux) supporting Fibre Channel are no longer fully transparent; they also have increased built-in intelligence, acting more as Fibre Channel switches. With switch fabric login ability, the NetBlazer series modules support connections to a remote location through a fabric or semitransparent network.

The login process not only permits the unit to connect through a fabric, but it also exchanges some of the basic port characteristics (such as buffer-to-buffer credit and class of service) in order to efficiently transport the traffic through the network.

The login feature allows automatic detection of port/fabric login, login status (successful login, in progress, failure and logout) and response to remote buffer-to-buffer advertised credit.

EXFO Connect

EXFO Connect

AUTOMATED ASSET MANAGEMENT. PUSH TEST DATA IN THE CLOUD. GET CONNECTED.

EXFO Connect pushes and stores test equipment and test data content automatically in the cloud, allowing you to streamline test operation from build-out to maintenance.

EXPERT TEST TOOLS ON THE FTB-1 PLATFORM

EXpert Test Tools is a series of platform-based software testing tools that enhance the value of the FTB-1 platform, providing additional testing capabilities without the need for additional modules or units.

EXpert TEST TOOLS

EXpert VoIP TEST TOOLS

The EXpert VoIP Tools generate a voice-over-IP call directly from the test platform to validate performance during service turn-up and troubleshooting.

- Supports a wide range of signaling protocols, including SIP, SCCP, H.248/Megaco and H.323
- Supports MOS and R-factor quality metrics
- Simplifies testing with configurable pass/fail thresholds and RTP metrics

EXpert IP TEST TOOLS

The EXpert IP Tools integrate six commonly used datacom test tools into one platform-based application to ensure that field technicians are prepared for a wide range of testing needs.

- Rapidly perform debugging sequences with VLAN scan and LAN discovery
- Validate end-to-end ping and traceroute
- Verify FTP performance and HTTP availability

EXpert IPTV TEST TOOLS

This powerful IPTV quality assessment solution enables set-top-box emulation and passive monitoring of IPTV streams, allowing quick and easy pass/fail verification of IPTV installations.

- Real-time video preview
- Analyzes up to 10 video streams
- Comprehensive QoS and QoE metrics, including MOS score

SPECIFICATIONS

SFP ETHERNET OPTICAL INTERFACES

	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
Transceiver type	**100 Base-FX**	**100 Base-LX**	**1000 Base-SX**	**1000 Base-LX**	**1000 Base-ZX**	**1000 Base-BX10-D**	**1000 Base-BX10-U**
Wavelength (nm)	1310	1310	850	1310	1550	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490
Tx level (dBm)	–20 to –15	–15 to –8	–9 to –3	–9.5 to –3	0 to 5	–9.5 to –3	–9.5 to –3
Rx level sensitivity (dBm)	–31	–28	–20	–22	–22	–20	–20
Maximum reach	2 km	15 km	550 m	10 km	80 km	10 km	10 km
Transmission bit rate (Gbit/s)	0.125	0.125	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
Tx operational wavelength range (nm)	1280 to 1380	1261 to 1360	830 to 860	1270 to 1360	1540 to 1570	1480 to 1500	1260 to 1360
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Maximum Rx before damage (dBm) [a]	3	3	6	6	6	6	6
Jitter compliance	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Ethernet classification	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Laser type	LED	FP	VCSEL	FP	DFB	DFB	FP
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC	LC	LC	LC	LC

SFP SONET/SDH AND OTN OPTICAL INTERFACES

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 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 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) Frequency (ppm) Optical power (dB)	 ±4.6 ±2				 ±4.6 ±2				 ±4.6 ±2			
Maximum Rx before damage (dBm) [a]	3				3				3			
Jitter compliance	GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH) G.8251 (OTN)			
Line coding	NRZ				NRZ				NRZ			
Eye safety	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 adaptors can be used for other types of connectors.

c. SFP compliance: The FTB-880 selected SFP shall meet the requirements stated in the “Small Form-Factor Pluggable (SFP) Transceiver Multisource Agreement (MSA)”. The FTB-880 selected SFP shall meet the requirements stated in the “Specification for Diagnostic Monitoring Interface for Optical Xcvrs”.

SFP+ ETHERNET OPTICAL INTERFACES

Transceiver type	10G Base-SR/SW	10G Base-LR/LW	10G Base-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) 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
Eye safety	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC

SFP+ 10G SONET/SDH AND OTN OPTICAL INTERFACES

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 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)	9.9532 ± 4.6 ppm 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)	9.9532 ± 4.6 ppm 10.7092 ± 4.6 ppm (OTU2) 11.0491 ± 4.6 ppm (OTU1e) 11.0957 ± 4.6 ppm (OTU2e) 11.2701 ± 4.6 ppm (OTU1f) 11.3176 ± 4.6 ppm (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Reception bit rate (Gbit/s)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)	9.9532 ± 100 ppm 10.7092 ± 100 ppm (OTU2) 11.0491 ± 120 ppm (OTU1e) 11.0957 ± 120 ppm (OTU2e) 11.2701 ± 120 ppm (OTU1f) 11.3176 ± 120 ppm (OTU2f)
Tx operational wavelength range (nm)	1260 to 1355	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2
Maximum Rx before damage (dBm) [a]	5	5	3
Jitter compliance	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)
Eye safety	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 adaptors can be used for other types of connectors.

c. SFP+ compliance: The FTB-880 selected SFP+ shall meet the requirements stated in the SFP-8431 “Enhanced Small Form-Factor Pluggable Module SFP+” Transceiver Multisource Agreement (MSA)”. The FTB-880 selected SFP+ shall meet the requirements stated in the “Specification for Diagnostic Monitoring Interface for Optical Xcvrs”.

ELECTRICAL ETHERNET INTERFACES

	Two ports: 10/100 Base-T half/full duplex, 1000 Base-T full duplex Automatic or manual detection of straight/crossover cable		
Transceiver type	**10 Base-T**	**100 Base-TX**	**1000 Base-T**
Tx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s
Tx accuracy (uncertainty) (ppm)	±4.6	±4.6	±4.6
Rx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s
Rx measurement accuracy (uncertainty) (ppm)		±4.6	±4.6
Duplex mode	Half and full duplex	Half and full duplex	Full duplex
Jitter compliance	IEEE 802.3	IEEE 802.3	IEEE 802.3
Connector	RJ-45	RJ-45	RJ-45
Maximum reach (m)	100	100	100

DSN/PDH AND SONET/SDH ELECTRICAL INTERFACES

Transceiver type	**DS1**	**E1/2M**		**E3/34M**	**DS3/45M**		**STS-1e/STM-0e/52M**	**E4/140M**	**STS-3e/STM-1e/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	0-133 ft 133-266 ft 266-399 ft 399-533 ft 533-655 ft				0 to 225 ft 225 to 450 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		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 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	 ±4.6 ±1.5	 ±4.6 ±1.5	 ±4.6 ±1.5	 ±4.6 ±1.5		 ±4.6 ±1.5	 ±4.6 ±1.5	 ±4.6 ±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 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.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 5.6.2.2 (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 ohms ±5 %, balanced	120 ohms ±5 %, balanced	75 ohms ±5 %, unbalanced	75 ohms ±5 %, unbalanced	75 ohms ±5 %, unbalanced		75 ohms ±5 %, unbalanced	75 ohms ±10 %, unbalanced	75 ohms ±5 %, unbalanced	
Connector type	BANTAM and RJ-48C	BANTAM and RJ-48C	BNC	BNC	BNC		BNC	BNC	BNC	

SFP FIBRE CHANNEL INTERFACES

FC-1x/2x/4x				
Wavelength (nm)	850	1310	1310	1550
Model	FTB-85912	FTB-85913	FTB-85914	FTB-85915
Tx level (dBm)	−9 to −2.5	−8.4 to −3	0 to 5	1 to 5
Rx level sensitivity (dBm)	−15 at FC-4	−18 at FC-4	−18 at FC-4	−16.5 at FC-4
	−18 at FC-2	−21 at FC-2	−21 at FC-2	−20.5 at FC-2
	−20 at FC-1	−22 at FC-1	−22 at FC-1	−22 at FC-1
Maximum reach (FC-1)	500 m on 50/125 µm MMF 300 m on 62.5/125 µm MMF	4 km	30 km	40 km
Transmission bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25
Reception bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25
Tx operational wavelength range (nm)	830 to 860	1260 to 1350	1285 to 1345	1544.5 to 1557.5
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Max Rx before damage (dBm)	3	3	3	3
Jitter compliance	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
FC classification	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
Laser type	VCSEL	Fabry-Perot	DFB	DFB
Eye safety	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC

SFP+ FIBRE CHANNEL INTERFACES

FC-8x/10x					
Wavelength (nm)	850	850	1310	1550	1550
Model	FTB-8696	FTB-8690	FTB-8693	FTB-8694	FTB-8695
Tx level (dBm)	−8.2 to −2	−5 to −1	−6 to −1	−1 to 2	0 to 4
Rx level sensitivity (dBm)	−11.1 to 0	−11.1 to 0.5	−14.4 to 0.5	−14 to −1	−24 to −7
Maximum reach	150 m on OM3 MMF	300 m on OM3 MMF	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Reception bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Tx operational wavelength range (nm)	840-860	840-860	1260 to 1355	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Max Rx before damage (dBm)	+5	+5	+5	+5	+3
Jitter compliance	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
FC classification	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
Laser type	VCSEL	VCSEL	DFB	CML	EML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC

SFP FTTA INTERFACES

CPRI/OBSAI 2.4576/3.072 Gbit/s				
Wavelength (nm)	850	1310	1310	1550
EXFO product number	FTB-8590	FTB-8190	FTB-8191	FTB-8192
Tx level (dBm)	−9 to −3	−5 to 0	−2 to 3	−2 to 3
Rx level sensitivity (dBm)	−18 to 0	−18 to 0	−27 to −9	−28 to −9
Maximum reach	300 m on OM3 MMF	15 km	40 km	80 km
Transmission bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	2.4576/3.072
Reception bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	2.4576/3.072
Tx operational wavelength range (nm)	830-860	1270-1360	1280 to 1355	1500 to 1580
Measurement accuracy (uncertainty) Optical power (dB)	±2	±2	±2	±2
Max Rx before damage (dBm)	+5	+5	+3	+3
Jitter compliance	IEEE 802.3	GR-253 (SONET) G-958 (SDH)	GR-253 (SONET) G-958 (SDH)	GR-253 (SONET) G-958 (SDH)
Laser type	VCSEL	DFB	DFB	CML
Eye safety	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC
Transceiver type	SFP	SFP	SFP	SFP

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 +0.6 dBdsx (0-133 ft) +1.2 dBdsx (133-266 ft) +1.8 dBdsx (266-399 ft) +2.4 dBdsx (399-533 ft) +3.0 dBdsx (533-655 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 (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 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced	75 ohms ± 5 %, unbalanced
Connector type	BNC[a]	BNC[a]	BNC	BNC

Note

a. Adaptation cable required for BANTAM.

FIBRE CHANNEL FUNCTIONAL SPECIFICATIONS

TESTING 1x, 2x, 4x, 8x, 10x	
BERT	Framed FC-2
Patterns (BERT)	PRBS 2E31-1, 2E23-1, 2E20-1, 2E15-1, 2E11-1, 2E9-1, one user-defined pattern and capability to invert patterns
Error insertion	Bit error, amount and rate
Error measurement	Bit error, symbol error, oversize error, crc error, undersize error and block error (10x only)
Alarm detection	LOS, pattern loss, link down, local and remote fault (10x only)
Buffer-to-buffer credit testing	Buffer-to-buffer credity estimation based on latency
Latency	Round-trip latency

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, STS-1e, STS-3e	Electrical interfaces [a]	1.5M (DS1), 2M (E1), 34M (E3), 45M (DS3), 140M (E4), STM-0e, STM-1e
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)
STS-1e, STS-3e	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, BPV, FAS, CV, bit error	STM-0e, STM-1e	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, CV, FAS, bit error
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)
STS-1e, STS-3e	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, BPV, FAS, CV, bit error	STM-0e, STM-1e	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, CV, FAS, bit error
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
STS-1e, STS-3e, 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-0e, STM-1e, 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
STS-1e, STS-3e, 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-0e, STM-1e, 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	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, 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 on the FTB-880. **ITU-T recommendation** / **Performance monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM G.826 — ES, EFS, EB, SES, BBE, UAS, ERS, 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, ESR, SESR M.2101 — ES, SES, BBE, UAS, ESR, SESR, BBER
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 FTB-880 transmitter back to its receiver after crossing a far-end loopback. Measurements are provided on all supported FTB-880 interfaces and mappings. Measurements: last, minimum, maximum, average; measurement count: no. 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 FTB-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. 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.
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), OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s), OTU2f (11.3176 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-bytes 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-bytes 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-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709
	FTFL[b]	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-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 on the FTB-880. **ITU-T recommendation** — **Performance monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM M.2100 — ES, SES, UAS, ESR, SESR
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.
Through mode	Perform Through mode analysis of any incoming OTN signal transparently.

ETHERNET TEST FEATURES

EtherSAM (ITU-T Y.1564)	Capability to perform the service configuration test and the service performance test as per ITU-T Y.1564. 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 sizes, user-configurable between 1-7 sizes.
Traffic generation and monitoring	Generate, shape and monitor Ethernet and IP traffic with throughput, frame loss, sequencing, packet jitter, latency, frame size, traffic type and flow control.
Multistream background traffic	Transmit and monitor up to nine additional streams over Ethernet and IP networks. Configurable per-stream analysis and capability to set packet size, MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TTL, UDP source/destination port and payload.
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 2E31-1, 2E23-1, 2E20-1, 2E15-1, 2E11-1, 2E9-1, one user-defined pattern and capability to invert patterns
Error measurement (BERT)	Bit error, bit mismatch 0, bit mismatch 1.
Error measurements	Jabber/giant, runt, undersize, oversize, FCS, symbol, alignment, collision, late collision, excessive collision, 10G block error.
Alarm detection	LOS, link down, pattern loss, frequency, 10G local/remote fault.
VLAN stacking	Generate streams with up to two layers of VLAN (including IEEE 802.1ad Q-in-Q tagged VLAN) traffic by VLAN ID or VLAN priority at any of the stacked VLAN layers.
MPLS	Capability to generate and analyze streams with up to two layers of MPLS labels and to filter received traffic by MPLS label or COS.
Cable testing	Category 5 cable (or better), 100 UTP/STP cable, ≤120 meters.
Service disruption time (SDT)	Includes statistics such as longest, shortest, last, average, count, total and pass/fail thresholds.
IPv6 testing	Includes BERT, RFC 2544, traffic generation and monitoring, background streams, Smart Loopback, Remote Loopback, 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 and REI-P.

ADDITIONAL FEATURES

FTTA BER testing	Includes BER measurement, bit error injection, round-trip delay measurement and pass/fail verdict for 2.5 and 3.1 Gbit/s rates.
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 a power failure to the unit, the active test configuration and test logger are saved and restored upon boot-up. Applicable to transport test applications only.
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	Generate test reports on the unit or exported via USB.
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 AXS-200/850, FTB-860 and FTB-880 units and sets them into Smart Loopback mode.
Dual test set	Detects and connects to any of EXFO's Ethernet testers to perform bidirectional RFC 2544 and EtherSAM testing.
Dual-port mode	Enables any Ethernet test, such as EtherSAM, RFC2544, Traffic Generation and monitoring, or BERT to run directly to itself using one self-contained unit with loopback.
IP tools	Perform ping and traceroute functions.
Smart loopback	Return Ethernet traffic to the local unit by swapping packet overhead up to layer 4.

UPGRADES

SFP upgrades	FTB-8590	SFP module GigE/FC/2FC, CPRI/OBSAI 2.45/3.07 Gbit/s at 850 nm, MM, <500 m
	FTB-85910	SFP modules 100 Base-FX, 1340 nm, MM, 2 km
	FTB-85911	SFP modules 100 Base-LX10, 1310 nm, SM, 15 km
	FTB-85912	SFP modules GigE/FC/2FC/4FC at 850 nm, <500 m
	FTB-8190	SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC, CPRI/OBSAI 2.45/3.07 Gbit/s at 1310 nm, LC connector, 15 km reach
	FTB-8191	SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC; CPRI/OBSAI 2.45/3.07 Gbit/s at 1310 nm, LC connector, 40 km reach
	FTB-8192	SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC; 1550 nm, LC connector, 80 km reach
	FTB-8193	SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC; 1550 nm, LC connector, 40 km reach
	FTB-85913	SFP modules GigE/FC/2FC/4FC at 1310 nm, 4 km
	FTB-85914	SFP modules GigE/FC/2FC/4FC at 1310 nm, 30 km
	FTB-85915	SFP modules GigE/FC/2FC/4FC at 1550 nm, <50 km
SFP+ upgrades	FTB-8690	SFP+ modules 10FC/10 GigE at 850 nm, MM, 300 m
	FTB-8691	SFP+ modules 10 GigE at 1310 nm, 10 km
	FTB-8693	SFP+ modules 9.953-10.709/11.3, 8FC/10FC/10 GigE at 1310 nm, SMF, 10 km
	FTB-8694	SFP+ modules 8FC/10FC/10 GigE at 1550 nm, 40 km
	FTB-8695	SFP+ modules 8FC/10FC/10 GigE at 1550 nm, 80 km
Bidirectional SFP upgrades	FTB-8596	SFP modules bidirectional 1490 Tx 1310 Rx 1000 BASE-BX10
	FTB-8597	SFP modules bidirectional 1310 Tx 1490 Rx 1000 BASE-BX10
	FTB-8598	SFP modules bidirectional 1310 Tx 1490/1550 Rx 1000 BASE-BX
	FTB-8599	SFP modules bidirectional 1550 Tx 1310 Rx 1000 BASE-BX

GENERAL SPECIFICATIONS

Size (H x W x D)	130 mm x 252 mm x 56 mm (5 ⅛ in x 9 15⁄16 in x 2 3⁄16 in)
Weight (without battery)	0.97 kg (2.1 lb)
Temperature	
Operating	0 °C to 50 °C (32 °F to 122 °F)
Storage	–40 °C to 70 °C (–40 °F to 158 °F)
Relative humidity	0 % to 93 %, non-condensing
Battery life (typical usage)	Over 4 hours
Battery charging time	2 hours from full discharge to full charge
Languages	English, Chinese and Japanese

ORDERING INFORMATION

FTB-880-FLEX-XX-XX-XX-XX-XX-XX-XX

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

Transport rate options
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)

Software options
00 = Without software options
DS3-G747 = G.747 test capability
DS1-FDL = DS1 FDL test capability
DUAL-RX = DS1/DS3 dual Rx testing
DS3-FEAC = DS3 FEAC test capability
TCM = Tandem connection monitoring
DSn = DSn test capability
PDH = PDH test capability
NI-CSU = NI-CSU loopback emulation
Cable_test = Cable test
MULTIPLE_STREAMS = Multiple streams
IPV6 = Internet protocol version 6
ETH-THRU = Through mode capability
TRAFFIC_GEN = Traffic generation capability
CPRI-OBSAI = Enables 2.5 and 3.1 Gbit/s [a]
MPLS = Enables MPLS

OTN rate options
OTU1 = OTN optical rate 2.666 Gbit/s
OTU2 = OTN optical rate 10.709 Gbit/s
OTU2-1e-2e = OTN optical rates 11.049/11.096 Gbit/s
OTU2-1f-2f = OTN optical rates 11.270/11.318 Gbit/s

Fibre Channel rate options
FC1X = 1x Fibre Channel interface [a]
FC2X = 2x Fibre Channel interface [a]
FC4X = 4x Fibre Channel interface [a]
FC8X = 8x Fibre Channel interface [b]
FC10X = 10x Fibre Channel interface [b]

Ethernet rate options
100 OPTICAL = 100 Mbit/s optical
GigE = 1000 Mbit/s optical and electrical
10G LAN = 10 GigE LAN interface
10G WAN = 10 GigE WAN interface

Example: FTB-880-FLEX-SONET-155M-DSn-GigE

Notes

a. Requires purchase of SFP.
b. Requires purchase of SFP+.

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Assessing Next-Gen Networks