

# FTB-880 NetBlazer Multiservice Tester

POWERFUL, COMPREHENSIVE AND FAST MULTISERVICE TESTING



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

## KEY FEATURES AND BENEFITS

Comprehensive testing for DSn/PDH, ISDN, 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

Complete ISDN solution for testing and troubleshooting DS1 or E1 primary rate interfaces (PRI)

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

SPEC SHEET



Assessing  
Next-Gen Networks

## THE ULTRA-PORTABLE CHOICE FOR MULTISERVICE TESTING

The ongoing transition towards a converged network infrastructure for legacy DSn/PDH, ISDN, 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, ISDN, SONET/SDH, OTN, Fibre Channel and Ethernet circuits efficiently.

### Powerful and Fast

The FTB-880 NetBlazer is a fully integrated DSn/PDH, ISDN, 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, ISDN, SONET/SDH, OTN, Fibre Channel or Ethernet application

- › Installation, commissioning and maintenance of access and metro networks
- › Turn-up of DSn/PDH, ISDN 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, ISDN, 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, ISDN, 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.

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"> <li>› RJ-45 port for electrical 10/100/1000M Ethernet</li> <li>› 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</li> <li>› SFP+ port for OC-192, STM-64, 10 GigE LAN/WAN or Fibre Channel 8, 10x, OTU2, OTU1e/2e and OTU1f/2f</li> <li>› RJ-48C and bantam port for DS1 or E1</li> <li>› BNC port for DS3 or E1/E3/E4 or STS-1e/STS-3e or STM-0e/STM-1e</li> <li>› One 2.5 and 3.1 Gbit/s port</li> <li>› Bantam/RJ-48C for DS1 ISDN PRI; bantam, RJ-48C, BNC for E1 ISDN PRI</li> </ul> | <ul style="list-style-type: none"> <li>› DS1/DS3 and E1/E3/E4 testing</li> <li>› SONET/SDH and OTN BER testing with configurable threshold settings</li> <li>› Coupled, Decoupled and Through mode testing</li> <li>› Error and alarm insertion and monitoring</li> <li>› Overhead monitoring and manipulation</li> <li>› High-order and low-order mappings</li> <li>› Tandem connection monitoring (TCM)</li> <li>› Pointer manipulation, including pointer sequence testing as per Telcordia GR-253, ANSI T1.105-03 and ITU G.783</li> <li>› Performance monitoring as per G.821, G.826, G.828, G.829, M.2100, M.2101</li> <li>› Frequency analysis and offset generation</li> <li>› Automatic protection switching</li> <li>› Service-disruption time measurements</li> <li>› Round-trip delay measurements</li> <li>› Dual DS1/DS3 receiver (Rx) support</li> <li>› DS1 loop codes and NI/CSU emulation</li> <li>› DS1/DS3 autodetection of line code, framing and pattern</li> </ul> | <ul style="list-style-type: none"> <li>› DS1 FDL and DS3 FEAC</li> <li>› Fractional T1/E1 testing</li> <li>› ISDN PRI for DS1 or E1 interfaces</li> <li>› External clock sync support</li> <li>› 10 Base-T to 10 GigE testing</li> <li>› EtherSAM (ITU-T Y.1564) (bidirectional)</li> <li>› RFC 2544 (bidirectional)</li> <li>› Traffic generation and monitoring</li> <li>› Through mode</li> <li>› Dual-port testing</li> <li>› Intelligent autodiscovery</li> <li>› IPv6 testing</li> <li>› VLAN stacking MPLS</li> <li>› Ping/Traceroute</li> <li>› Cable testing</li> <li>› Dual Test Set mode</li> <li>› Smart loopback</li> <li>› Fibre Channel 1x, 2x, 4x, 8x, 10x</li> <li>› FTTA BERT</li> </ul> |
|---|---|--|

## 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)

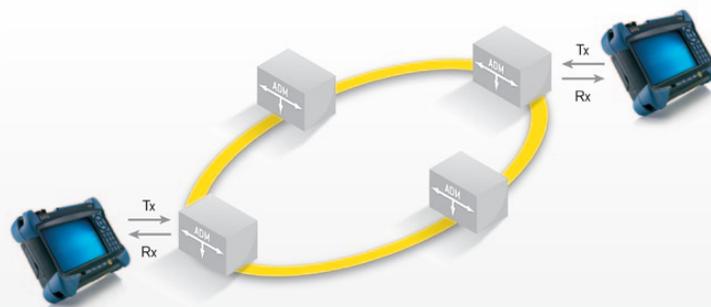
### Streamlined Navigation

- › 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 and SONET/SDH Features

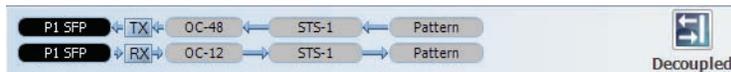
### Simplified BER Testing

The FTB-880 NetBlazer provides the ability to pre-configure 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.



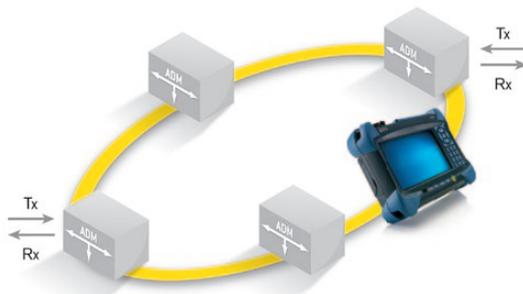
### Decoupled Mode

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.



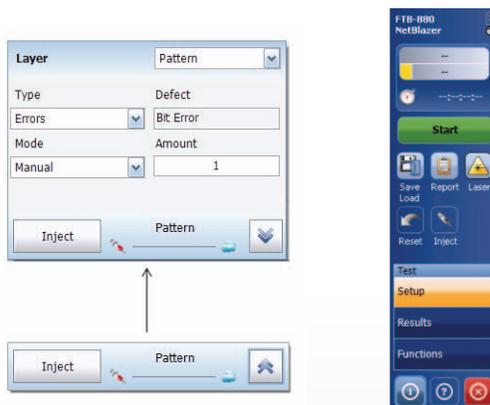
### Through Mode

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.



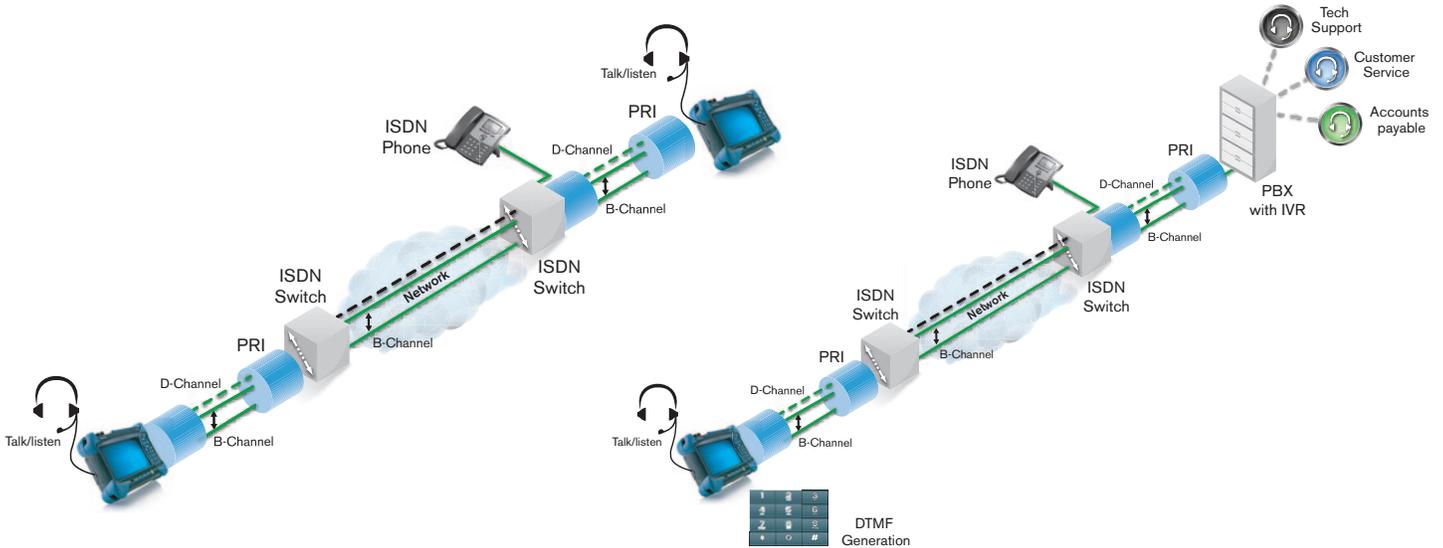
### Complete Overhead Monitoring

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.

TX STS-1 Timeslot												RX STS-4 Timeslot											
Transport OH						STS						Transport OH						STS					
A1	A3	A0	A1	V5	OC	B1	E1	F1	B3	J2	OC	A1	A3	A0	A1	V5	OC	B1	E1	F1	B3	J2	OC
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
D1	D2	D3	C2	Z6	OC	D1	D2	D3	C2	Z6	OC	D1	D2	D3	C2	Z6	OC	D1	D2	D3	C2	Z6	OC
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
H1	H2	H3	G1	Z7	OC	H1	H2	H3	G1	Z7	OC	H1	H2	H3	G1	Z7	OC	H1	H2	H3	G1	Z7	OC
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B2	K1	K2	F2	V5	OC	B2	K1	K2	F2	V5	OC	B2	K1	K2	F2	V5	OC	B2	K1	K2	F2	V5	OC
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
D4	D5	D6	H4			D4	D5	D6	H4			D4	D5	D6	H4			D4	D5	D6	H4		
00	00	00	00			00	00	00	00			00	00	00	00			00	00	00	00		
D7	D8	D9	Z3			D7	D8	D9	Z3			D7	D8	D9	Z3			D7	D8	D9	Z3		
00	00	00	00			00	00	00	00			00	00	00	00			00	00	00	00		
D10	D11	D12	Z4			D10	D11	D12	Z4			D10	D11	D12	Z4			D10	D11	D12	Z4		
00	00	00	00			00	00	00	00			00	00	00	00			00	00	00	00		
S1	Z2	E2	N1			S1	Z2	E2	N1			S1	Z2	E2	N1			S1	Z2	E2	N1		
00	00	00	00			00	00	00	00			00	00	00	00			00	00	00	00		

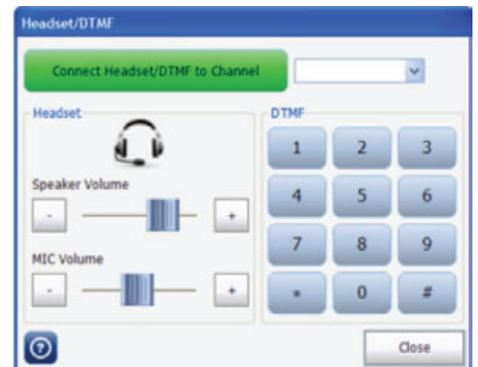
## KEY ISDN FEATURES

The FTB-880 lets you test and troubleshoot North American or European ISDN PRI configurations. It offers best-in-class ISDN PRI testing by allowing field technicians to call one or all 24 DS1 or 31 E1 PRI channels. Once connected, the user can go channel by channel to perform a BER test on individual or all channels as well as talk and listen via a headset.



### Talk? Listen? Inject DTMF?

With one click, field technicians can talk and listen with simplicity—no need for a clumsy butt set. The FTB-1 platform allows the use of a handy, lightweight headset, which can be controlled via software to inject DTMF tones or speaker and microphone levels.



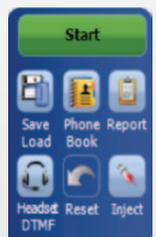
### Who's Calling? What Type of Calls?

As the calls come in or leave the ISDN primary rate interface, the summary results screen shows a crystal-clear analysis with its own unique call monitoring grid. With one glance, users see all call information: types of calls, stats such as idle, voice, 3.1 kHz, ringing, alerts, In Error, BER, pass or fail.



### Centralized Control

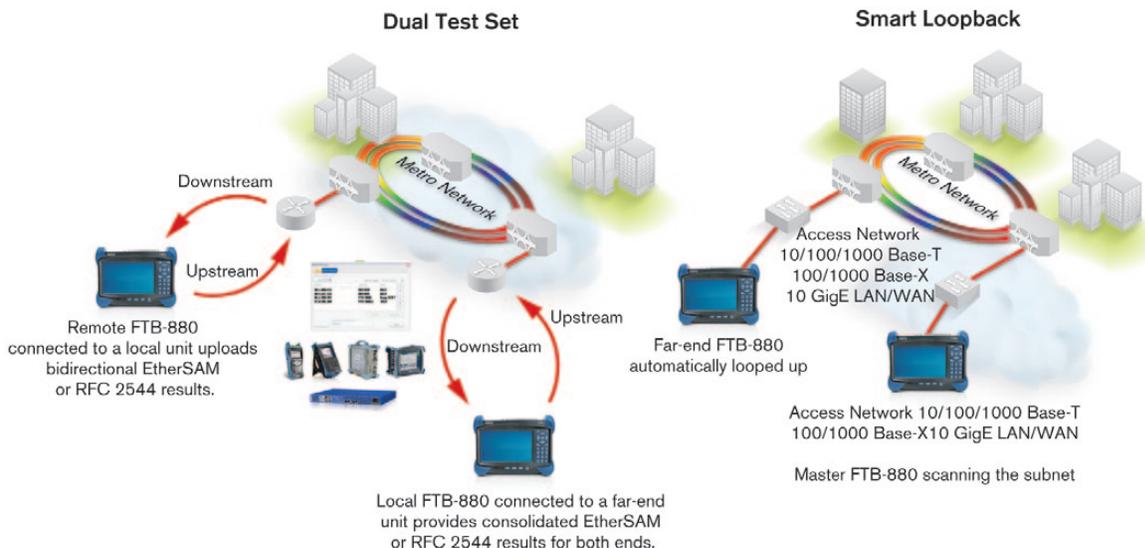
As with all NetBlazer modules, field technicians have complete control at their fingertips at all times, whether it's a phone book, headset activation, DTMF injection, error injection, report generation, or save and load configurations. These utilities are always a finger's touch away from activation.



## 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

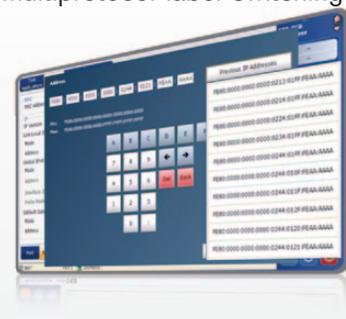
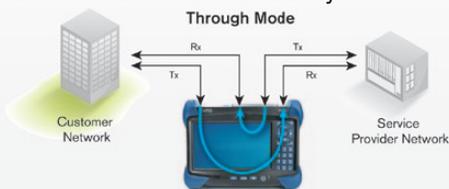
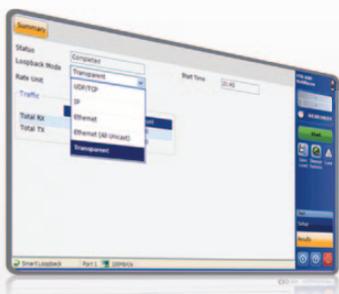
The Smart Loopback functionality has been enhanced to offer five distinct loopback modes. Whether you are looking to pinpoint loopback traffic from a UDP or TCP layer, or all the way down to a completely promiscuous mode (Transparent Loopback mode), the FTB-880 or the FTB-860x has the flexibility to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



### Dual Port Modes



## ETHERSAM: THE NEW STANDARD IN ETHERNET TESTING

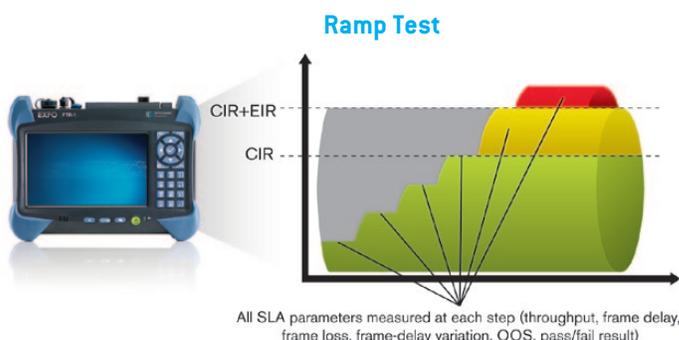
RFC 2544 used to be the most widespread Ethernet testing methodology. However, it was designed for network-device testing in the lab, not for service testing in the field. ITU-T Y.1564 is the new standard for turning up and troubleshooting Carrier Ethernet services. It has a number of advantages over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



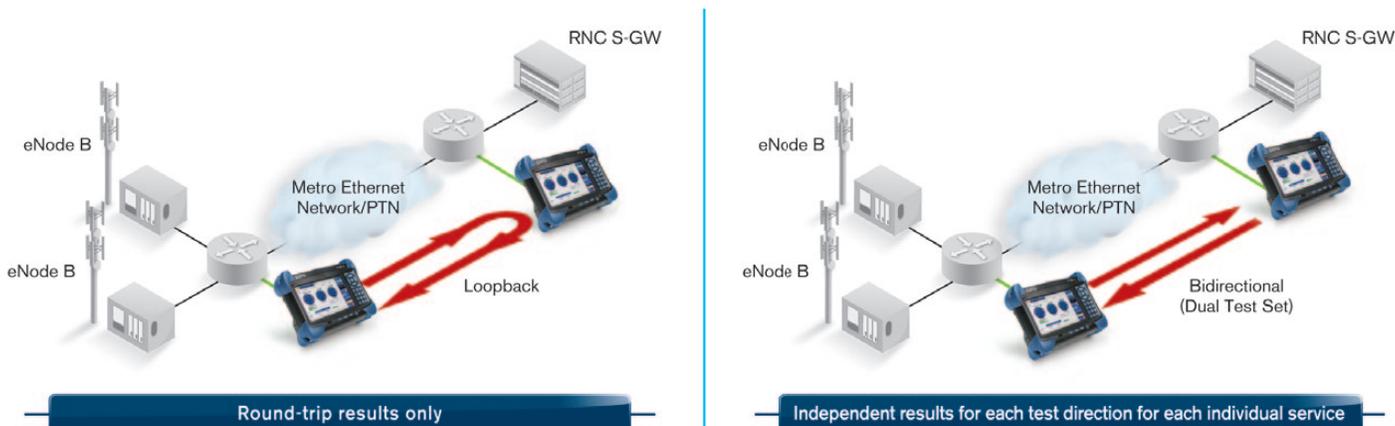
### Service Performance Test

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.

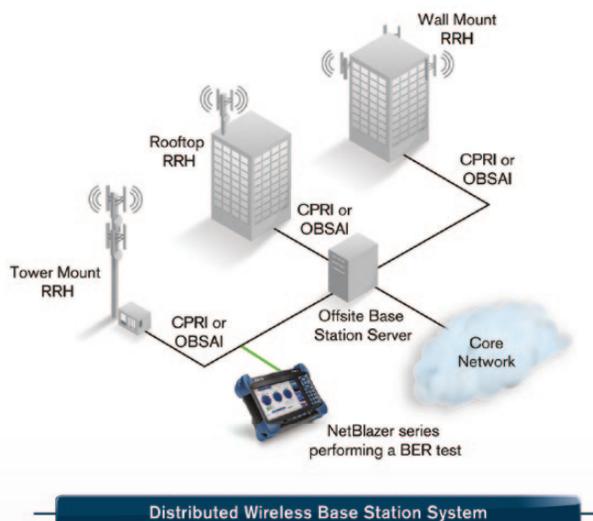


### FTTA Testing

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 FTFA, MNOs can offer better performance with lower base-station costs. One key component of evolving to FTFA 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 FTFA 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.

#### 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.

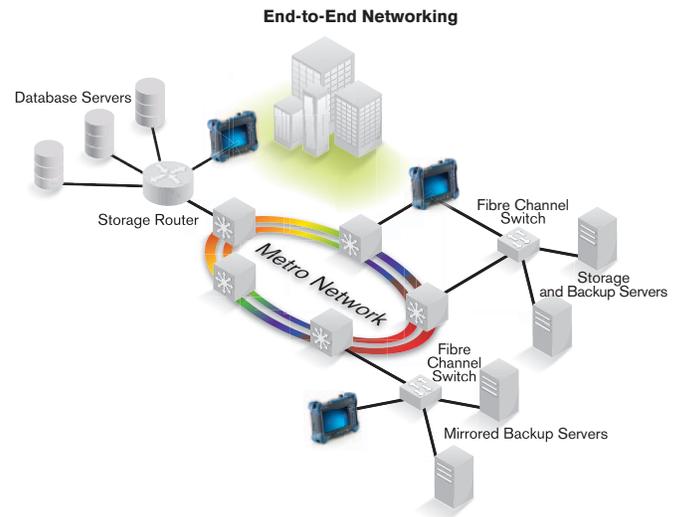
#### Login Testing

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.

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



*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.*

**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	<b>100 Base-FX</b>	<b>100 Base-LX</b>	<b>1000 Base-SX</b>	<b>1000 Base-LX</b>	<b>1000 Base-ZX</b>	<b>1000 Base-BX10-D</b>	<b>1000 Base-BX10-U</b>
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)	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2	±2	±2	±2	±2
Maximum Rx before damage (dBm) <sup>a</sup>	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	VCSSEL	FP	DFB	DFB	FP
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector <sup>b</sup>	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)	±4.6				±4.6				±4.6			
Optical power (dB)	±2				±2				±2			
Maximum Rx before damage (dBm) <sup>a</sup>	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 <sup>b</sup>	LC				LC				LC			

### Notes

- In order not to exceed the maximum receiver power level before damage, an attenuator must be used.
- External adaptors can be used for other types of connectors.
- 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) <sup>a</sup>	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 <sup>b</sup>	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) <sup>a</sup>	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 <sup>b</sup>	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	<b>10 Base-T</b>	<b>100 Base-TX</b>	<b>1000 Base-T</b>
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 dBd <sub>sx</sub> 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)	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6	±4.6		
Electrical power (dB)	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±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	CM1	CM1		
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-2 -20 at FC-1	-18 at FC-4 -21 at FC-2 -22 at FC-1	-18 at FC-4 -21 at FC-2 -22 at FC-1	-16.5 at FC-4 -20.5 at FC-2 -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)	±4.6	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2	±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)	±4.6	±4.6	±4.6	±4.6	±4.6
Optical power (dB)	±2	±2	±2	±2	±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 <sup>a</sup>	BNC <sup>a</sup>	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 credit estimation based on latency
Latency	Round-trip latency

SONET AND DS <sub>N</sub> 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 <sup>a</sup>	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
<b>Mappings</b>			
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
<b>Error insertion</b>			
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
<b>Error measurement</b>			
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
<b>Alarm insertion</b>			
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
<b>Alarm detection</b>			
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
<i>Frequency alarm on all supported interfaces</i>			
<b>Patterns</b>			
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 <sup>b</sup> , 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 DS<sub>n</sub> 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. <table border="0"> <tr> <td><b>ITU-T recommendation</b></td> <td><b>Performance monitoring statistics</b></td> </tr> <tr> <td>G.821</td> <td>ES, EFS, EC, SES, UAS, ESR, SESR, DM</td> </tr> <tr> <td>G.826</td> <td>ES, EFS, EB, SES, BBE, UAS, ERS, SESR, BBER</td> </tr> <tr> <td>G.828</td> <td>ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI</td> </tr> <tr> <td>G.829</td> <td>ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER</td> </tr> <tr> <td>M.2100</td> <td>ES, SES, UAS, ESR, SESR</td> </tr> <tr> <td>M.2101</td> <td>ES, SES, BBE, UAS, ESR, SESR, BBER</td> </tr> </table>	<b>ITU-T recommendation</b>	<b>Performance monitoring statistics</b>	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
<b>ITU-T recommendation</b>	<b>Performance monitoring statistics</b>														
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 <table border="0"> <tr> <td><b>Generation</b></td> <td><b>Analysis</b></td> </tr> <tr> <td>· Pointer increment and decrement</td> <td>· Pointer increments</td> </tr> <tr> <td>· Pointer jump with or without NDF</td> <td>· Pointer decrements</td> </tr> <tr> <td>· Pointer value</td> <td>· Pointer jumps (NDF, no NDF)</td> </tr> <tr> <td></td> <td>· Pointer value and cumulative offset</td> </tr> </table>	<b>Generation</b>	<b>Analysis</b>	· Pointer increment and decrement	· Pointer increments	· Pointer jump with or without NDF	· Pointer decrements	· Pointer value	· Pointer jumps (NDF, no NDF)		· Pointer value and cumulative offset				
<b>Generation</b>	<b>Analysis</b>														
· Pointer increment and decrement	· Pointer increments														
· Pointer jump with or without NDF	· Pointer decrements														
· Pointer value	· 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) <sup>a</sup>	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 <sup>b</sup>	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. <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;"><b>ITU-T recommendation</b></td> <td style="width: 50%;"><b>Performance monitoring statistics</b></td> </tr> <tr> <td>G.821</td> <td>ES, EFS, EC, SES, UAS, ESR, SESR, DM</td> </tr> <tr> <td>M.2100</td> <td>ES, SES, UAS, ESR, SESR</td> </tr> </table>	<b>ITU-T recommendation</b>	<b>Performance monitoring statistics</b>	G.821	ES, EFS, EC, SES, UAS, ESR, SESR, DM	M.2100	ES, SES, UAS, ESR, SESR
<b>ITU-T recommendation</b>	<b>Performance monitoring statistics</b>						
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.						

ISDN PRIMARY RATE INTERFACE TEST FEATURES	
Supported interfaces	DS1: bantam or RJ45C (SF or ESF) E1: bantam, RJ45C or BNC (PCM31 with or without CRC-4)
Supported switch types	DS1: national ISDN, Nortel DMS and AT&T 4/5ESS E1: euro ISDN, euro VN6 and Q.SIG
Emulation modes	Terminal equipment (TE) Network termination (NT)
Call types/rates	Data (64K or 56K), voice or 3.1 kHz (audio)
BER test	Configurable test pattern Provides simultaneous BER testing on multiple B-channels configured with data traffic
Call setting	Calling party (numbering type, numbering plan and number up to 30 digits) Called party (number type, numbering plan and number up to 30 digits) Network (network transit selection code of up to four digits, and operator system access: None, Principal or Alternate) > All parameters are configurable on a per-call basis > Highlights missing calls or called party numbers
Call control	Call origination > Establishment of calls prior to starting the test > Automatically initiate single, multiple or all configured calls upon starting a test Call reception > Auto-Answer mode, Auto-Reject or prompt Call release > Hang up individual or all channels
DTMF injection	Generate DTMF tones for all standard digits, including 0-9, # and * as per Q.23/G.224 Available for one of the connected voice or 3.1 kHz B-channel
Headset support	Talk/listen through a selectable connected voice or 3.1 kHz B-channel
D-channel control	D-channel timeslot configuration Rate (64K or 56K) HDLC mode (Normal or Inverted)
Statistics	Call status, CRV, incoming or outgoing calls, call duration BERT (bit error count and rate) with graphical BERT meter on a per B-channel (data) basis Performance monitoring statistics: EFS, ES and SES Active calls (data, voice, 3.1 kHz) Total call count (connected, cleared, failed/rejected, placed) Frequency (Rx, offset, max +/-max - offset)
Alarms	DS1: LOS, frequency, LOC, AIS, OOF, RAI, D-channel down E1: LOS, frequency, LOC, AIS, LOF, RAI, D-channel down Pattern loss (per B-channel injection)
Errors	DS1: BPV, EXZ, framing bit, CRC-6, D-channel FCS E1: CV, FAS, CRC-4, E-bit, D-channel FCS Bit error (per B-channel injection)
ISDN logger	Logs layer 2 (Q.921) and layer 3 (Q.931) messages Filter: All, layer 2 or layer 3 Information: ID, time, message type, direction, channel number, called number, call type, cause values/definition, status and progress
Pass/fail verdict	BERT, call establishment and termination
Phone book	Easy access to phone book to manage names and associated numbers. Save/load functions to update the phone book and import/export to exchange the phone book with other FTB-880 or FTB-810 units

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 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.
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, 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

<b>SFP upgrades</b>	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	
	<b>SFP+ upgrades</b>	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	
<b>Bidirectional SFP upgrades</b>	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 1/8 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

#### 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  
 DS<sub>n</sub> = DS<sub>n</sub> test capability  
 PDH = PDH test capability  
 ISDN-PRI = ISDN primary rate interface  
 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<sup>a</sup>  
 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<sup>a</sup>  
 FC2X = 2x Fibre Channel interface<sup>a</sup>  
 FC4X = 4x Fibre Channel interface<sup>a</sup>  
 FC8X = 8x Fibre Channel interface<sup>b</sup>  
 FC10X = 10x Fibre Channel interface<sup>b</sup>

#### 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-DS<sub>n</sub>-GigE

#### Notes

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

EXFO Headquarters > Tel.: +1 418 683-0211 | Toll-free: +1 800 663-3936 (USA and Canada) | Fax: +1 418 683-2170 | info@EXFO.com | [www.EXFO.com](http://www.EXFO.com)

EXFO serves over 2000 customers in more than 100 countries. To find your local office contact details, please go to [www.EXFO.com/contact](http://www.EXFO.com/contact).

EXFO is certified ISO 9001 and attests to the quality of these products. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. EXFO has made every effort to ensure that the information contained in this specification sheet is accurate. However, we accept no responsibility for any errors or omissions, and we reserve the right to modify design, characteristics and products at any time without obligation. Units of measurement in this document conform to SI standards and practices. In addition, all of EXFO's manufactured products are compliant with the European Union's WEEE directive. For more information, please visit [www.EXFO.com/recycle](http://www.EXFO.com/recycle). Contact EXFO for prices and availability or to obtain the phone number of your local EXFO distributor.

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In case of discrepancy, the Web version takes precedence over any printed literature.

# Инструменты для тестирования IP – EXpert IP

ПРОГРАММНОЕ ОБЕСПЕЧЕНИЕ ДЛЯ ТЕСТИРОВАНИЯ



Незаменимый набор инструментов тестирования IP для любого вида измерений

## КЛЮЧЕВЫЕ ОСОБЕННОСТИ И ПРЕИМУЩЕСТВА

Набор инструментов включает:

- › Ping
- › Traceroute
- › Сканирование VLAN
- › Обнаружение LAN
- › Производительность FTP
- › Доступность HTTP

Общий набор инструментов и интерфейс тестирования для всех платформ

Доступен для платформ FTB-1 и FTB-200 v2

EXpert IP  
TEST TOOLS

ОПИСАНИЕ

## ШЕСТЬ ИНСТРУМЕНТОВ – ОДНО ПРИЛОЖЕНИЕ

Инструменты для тестирования Expert IP представляют собой программное приложение для платформ, которое позволяет получить шесть наиболее часто используемых инструментов в одном приложении. Это облегчает работу техперсонала, который сталкивается со сложной средой тестирования в современных сетях. Широко известно, что готовность ко всяким неожиданностям является ключом к успеху, позволяющим успешно преодолевать и разрешать возникающие затруднения.

Независимо от задачи, набор инструментов Expert IP всегда поможет Вам разрешить возникшее затруднение – будь то проверка IP-подключения к маршрутизатору с использованием утилиты ping, поиск проблем с VLAN при помощи утилиты VLAN Scan или проверка сервиса передачи файлов (FTP) с использованием инструмента проверки производительности FTP. Этот набор инструментов поддерживается на платформах FTB-1 и FTB-200 v2 и представляет собой незаменимый измерительный комплекс, который всегда под рукой в любом месте и в любое время, когда Вы работаете с платформами EXFO – независимо от установленных и работающих модулей.

КЛЮЧЕВЫЕ ФУНКЦИИ
Обнаружение LAN
Сканирование VLAN
Ping
Traceroute
Производительность FTP
Доступность HTTP
Статистика Ethernet-порта

## ОСОБЕННОСТИ ПРОДУКТА

### Обнаружение LAN

Обнаружение LAN активно опрашивает сетевые устройства для получения информации о подключенных компьютерах, серверах, коммутаторах и маршрутизаторах. Обнаруженные устройства, подключенные к сети, выводятся в списке вместе с дополнительной информацией о каждом устройстве (например, IP-адрес, доменное имя, предоставляемые сервисы, администратор, расположение и т.п.). Предоставляемые метрики включают IP-адрес обнаруженных компьютеров вместе с их сетевыми адресами, MAC-адресами и информацией SNMP.

### Сканирование VLAN

Функция сканирования VLAN выводит список всех присутствующих VLAN в IP-сети, к которой подключен тестер. Он позволяет определить наличие вложенных VLAN до трех уровней вглубь. Результат заключается в выдаче номера VLAN, приоритета и количества кадров. Этот инструмент полезен для обнаружения настроенных для данного порта VLAN и использования полосы пропускания для каждой VLAN, а также даёт возможность обнаружения ошибок в настройке VLAN.

### Ping

Инструмент ping проверяет наличие IP-соединения к другому, работающему на протоколе IP устройству, с помощью отправки эхо-запроса ICMP в сторону конечного устройства и ожидания ICMP-ответа для проверки соединения между оконечными точками. Дополнительно также предоставляется информация о времени прохождения туда-обратно (задержки) для пакетов, отправленных локальным устройством в сторону устройства на удаленном конце. Другая информация включает отправленные и потерянные пакеты.

### Traceroute

Тест Traceroute представляет собой инструмент для поиска неисправностей, который позволяет выявить маршрут, по которому проходит IP-пакет в IP-сети. Этот инструмент идентифицирует узлы (hops), которые пакет пересекает, перемещаясь к адресату. Информация, которая предоставляется данным инструментом, включает: IP-адреса узлов и количество прыжков до этого узла, а также общее количество узлов до устройства назначения. Примером использования утилиты traceroute может послужить идентификация маршрутизаторов на пути для обнаружения проблем с маршрутизацией или выявление проблем со шлюзами безопасности, которые могут блокировать пакеты ICMP.

## Тестирование производительности FTP

FTP позволяет передавать файлы между локальным ПК и удаленным FTP-сервером. Используя FTP, Вы можете подключиться к FTP-серверу и положить файлы на сервер или загрузить файлы с сервера. Передача файла включает в себя установление двух видов соединения: контрольное и «передача данных».

Типичным использованием инструмента измерения производительности FTP является измерение доступности и времени ответа FTP-сервера. Этот тест может быть настроен для загрузки файла на сервер, скачивания с сервера или выполнения обеих задач. Файл генерируется тестом и передается в указанное место.

## Доступность HTTP

Тестирование доступности HTTP позволяет измерить доступность и время ответа HTTP-сервера с помощью загрузки web-страницы. Результаты включают время установки TCP-соединения, общее время загрузки страницы, количество перенаправлений и время перенаправления.

## ТЕХНИЧЕСКИЕ ХАРАКТЕРИСТИКИ

### КОНФИГУРАЦИИ ИНТЕРФЕЙСА LAN

IP-адрес (статический или DHCP)
Маска подсети
Шлюз по умолчанию
DNS-сервер
VLAN

### СТАТИСТИКА ПОРТА/ETHERNET

Статус линии	Кадров отправлено/получено
Скорость линии	Байтов отправлено/получено
Доменное имя	Отброшенных кадров
	Тх коллизий
	Кадров с ошибками

### ИНСТРУМЕНТЫ ТЕСТИРОВАНИЯ IP

Обнаружение LAN	IP-узла, MAC-адрес, доменное имя, предоставляемые сервисы, SNMP- информация
Сканирование VLAN	Номер VLAN, приоритет и счетчик кадров
Ping	Время туда-обратно (минимальное/максимальное/среднее), отправлено пакетов и потерянные пакеты
Traceroute	IP-адрес узла, количество прыжков, общее количество прыжков до места назначения
Производительность FTP	IP-адрес сервера, начальное время приветствия, время логина, время загрузки на сервер, пропускная способность для загрузки, время скачивания, пропускная способность скачивания, размер
Доступность HTTP	Время подключения, общее время загрузки страницы, количество перенаправлений и время перенаправления

**ИНФОРМАЦИЯ ДЛЯ ЗАКАЗА**

EXpert IP = Набор тестов для IP/Ethernet

Включает: Производительность FTP, Доступность HTTP, Сканирование VLAN, Обнаружение LAN, Ping, Traceroute, Статистика порта IP/Ethernet  
 Одна лицензия для платформ FTB-1 и FTB-200 v2

Центральный офис EXFO > 400 Godin Avenue, Quebec City (Quebec) G1M 2K2 CANADA | Тел.: +1 418 683-0211 | Факс: +1 418 683-2170 | [info@EXFO.com](mailto:info@EXFO.com)

Бесплатный тел.: 1 800 663-3936 (США и Канада) | [www.EXFO.com](http://www.EXFO.com)

EXFO Америка	3701 Plano Parkway, Suite 160	Plano, TX 75075 USA	Тел.: +1 800 663-3936	Факс: +1 972 836-0164
EXFO Азия	151 Chin Swee Road, #03-29 Manhattan House	SINGAPORE 169876	Тел.: +65 6333 8241	Факс: +65 6333 8242
EXFO Китай	36 North, 3 <sup>rd</sup> Ring Road East, Dongcheng District Room 1207, Tower C, Global Trade Center	Beijing 100013 P. R. CHINA	Тел.: + 86 10 5825 7755	Факс: +86 10 5825 7722
EXFO Европа	Omega Enterprise Park, Electron Way	Chandlers Ford, Hampshire S053 4SE ENGLAND	Тел.: +44 2380 246810	Факс: +44 2380 246801
EXFO NetHawk	Elektronikkatie 2	FI-90590 Oulu, FINLAND	Тел.: +358 (0)403 010 300	Факс: +358 (0)8 564 5203
EXFO Контроль качества	270 Billerica Road	Chelmsford, MA 01824 USA	Тел.: +1 978 367-5600	Факс: +1 978 367-5700

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За самой последней версией данной спецификации, пожалуйста, обращайтесь на сайт компании EXFO по адресу [www.EXFO.com/specs](http://www.EXFO.com/specs)

В случае разногласий, версия, опубликованная на сайте, имеет преимущественную силу перед любой печатной литературой.

# Инструменты для тестирования VoIP – EXpert VoIP

ПРОГРАММНОЕ ОБЕСПЕЧЕНИЕ ДЛЯ ТЕСТИРОВАНИЯ



Всегда доступный набор инструментов контроля качества VoIP-звонка, специально созданный для обслуживания и эксплуатации

## КЛЮЧЕВЫЕ ОСОБЕННОСТИ И ПРЕИМУЩЕСТВА

Инструмент для генерации звонков VoIP, для тестирования, активации и поиска неисправностей

Интуитивный интерфейс пользователя для быстрой оценки качества сервисов VoIP

Настраиваемые пороги для упрощенного тестирования с оценкой по критерию «годен/негоден»

Поддерживается широкий выбор протоколов сигнализации, включая SIP, SCCP, H.248/Megaco и H.323, для работы с большинством приложений

Включает полный диапазон метрик RTP для поиска неисправностей

Поддерживает метрики качества MOS и R-фактор

Единый набор инструментов и интерфейс тестирования для всех платформ

Доступен для платформ FTB-1 и FTB-200 v2

EXpert VoIP  
TEST TOOLS

ОПИСАНИЕ

## ПРОВЕРКА ПРОИЗВОДИТЕЛЬНОСТИ СЕРВИСА VoIP

Инструменты для тестирования VoIP Expert VoIP представляют собой программное приложение для платформ EXFO, которое позволяет проводить оценку производительности приложений VoIP при активации сервисов, поиске и устранении неисправностей в сетях предприятий и провайдеров. Поддерживаемое на платформах FTB-1 и FTB-200 v2, с поддерживающей Expert VoIP-платформы, приложение генерирует один звонок VoIP, который отправляется или на другую платформу EXFO, или на любой VoIP-телефон. Тестовый звонок может быть голосовым или может использовать предназначенный для этого аудиофайл для генерации тестового трафика. Expert VoIP поддерживает несколько технологий сигнализации, включая SIP, SCCP, H.323 и H.248, для обеспечения совместимости с большинством VoIP-сред, которые используются в отрасли.

Expert VoIP обладает исключительно гибкой средой настройки, которая обеспечивает максимальный контроль над параметрами теста, и при этом сохраняет удобство пользования. Интуитивный пользовательский интерфейс оснащен самой современной концептуальной моделью EXFO, которая позволяет даже неопытному пользователю быстро настроить и запустить тест. Все тесты поддерживают стандартный набор метрик качества, которые включают среднюю субъективную оценку качества (MOS), R-фактор и полный набор метрик потерь протокола реального времени (RTP). Метрики могут быть скомбинированы с настраиваемыми пороговыми значениями для упрощения проверки сервиса или ускорения поиска неисправностей.

Тесты выполняются между двумя платформами с Expert VoIP или в сторону оконечной точки VoIP (такой, как прокси-сервер SIP, программный телефон или телефон, например, ATA). Платформа, которая запускает тест, иницирует звонок, настраивает медиа-канал, передает медиа-данные и выдает статистическую информацию. В зависимости от типа оконечного оборудования, оно отвечает на звонок, передает медиа-данные и собирает статистику. Тесты сервиса могут опросить оконечное оборудование для определения доступности или для установки звонка.



### КЛЮЧЕВЫЕ ОСОБЕННОСТИ

Интуитивный пользовательский интерфейс для быстрой проверки качества голоса в сервисах VoIP

Настраиваемые пороговые значения для упрощенной оценки по критерию «годен/негоден»

Поддержка широкого диапазона протоколов сигнализации, включающих SIP, SCCP, H.248/Megaco и H.323, для большинства приложений

Поддержка полного диапазона RTP-метрик для поиска и устранения неисправностей

Поддержка метрик качества: MOS и R-фактор

Конфигурации теста могут быть предварительно настроенными и сохраненными для быстрого повторяющегося тестирования

Доступны подробные отчеты для отслеживания и документирования изменений в сервисе

Доступно для работы с приложениями в среде FTB-1 и FTB-200 v2

Единообразный набор инструментов и интерфейсов для всех платформ

## ОСОБЕННОСТИ ПРОДУКТА

### Тестирование сети RTP

Тест сети VoIP RTP является основным тестом приложения EXpert VoIP. Это тест, который проводится между двух VoIP-устройств с помощью отправки RTP-пакетов, позволяет измерить все относящиеся к VoIP параметры. Вся поддерживаемая функциональность этого теста соответствует рекомендациям RFC 1889. Тест RTP-сети симулирует VoIP-трафик, отправляя RTP-пакеты между тестером, который инициирует поток, и респондентом, который инициирует отправку собственного потока в сторону контролирующего измерение тестера.

### Протоколы сигнализации

Приложение EXpert VoIP было создано для поддержки большого разнообразия VoIP-сред, для обеспечения максимальной универсальности работы. Таким образом, приложение может быть настроено для использования некоторых наиболее часто используемых протоколов сигнализации звонка VoIP, включая SIP, SCCP, H.248/Megaco и H.323.

### Измерение качества голоса

Приложение EXpert VoIP включает полный набор метрик качества голоса, включающих MOS, R-фактор и факторы деградации, которые основываются на кодеке, задержке и потерях пакетов. Все это помогает изолировать проблемы с качеством голоса в сети. Функция измерения качества голоса, разработанная EXFO, рассчитывает R-фактор (еще один стандартизованный параметр качества передачи) для звонка, основанного на расширениях G.107 E-model. Эти расширения, такие как взрывная потеря пакетов, позволяют более точно предсказать субъективную оценку качества, которую слушающий мог бы присвоить для этого звонка. R-фактор затем конвертируется в значение EXFO MOS для получения значения разговорного качества.

Используемый в приложении алгоритм EXFO MOS основан на рекомендации ITU-T P.800, которая позволяет получить объективное измерение на основе субъективного тестирования. Корпорация EXFO инвестировала значительные ресурсы в развитие и отладку алгоритма EXFO MOS, и он успешно прошел сравнительные испытания с известными коммерчески доступными алгоритмами.

## ТЕХНИЧЕСКИЕ ХАРАКТЕРИСТИКИ

### КОНФИГУРАЦИИ LAN-ИНТЕРФЕЙСА

IP-адрес (статический или DHCP)
Маска подсети
Шлюз по умолчанию
DNS-сервер
VLAN

### ПРОТОКОЛЫ СИГНАЛИЗАЦИИ

SIP
SCCP
H.323
H.248/Megaco

### КОДЕКИ

G.711
G.722
G.723
G.726
G.728
G.729 (A, B и AB)

### МЕТРИКИ КАЧЕСТВА ГОЛОСА

Разговорный MOS	Деградация из-за кодека
Пользовательский R-фактор	Деградация из-за задержки
	Деградация из-за потерянных пакетов

### МЕТРИКИ RTP

Счетчик пакетов	Пакеты, пришедшие не по порядку
Потерянные пакеты	Дублирующиеся пакеты
Опоздавшие пакеты	Количество периодов с потерями
Пришедшие раньше пакеты	Размер периода с потерями (минимальный/максимальный/средний)
Общее количество утерянных пакетов (счетчик/%)	Тип потерь пакетов
	Потеря аудио

### НАСТРАИВАЕМЫЕ ПОРОГИ «ГОДЕН/НЕГОДЕН»

Максимальный джиттер
Максимальная задержка
Максимальная потеря пакетов
Максимальный разговорный MOS
Минимальный пользовательский R-фактор

### ИНФОРМАЦИЯ ДЛЯ ЗАКАЗА

EXpert VoIP = Программное обеспечение, основанное на тестировании RTP-звонка, включающее анализ потерь пакетов, джиттер и полные метрики контроля качества

#### Опции

- EXpert SIP = Поддержка сигнализации звонка SIP для EXpert VoIP
- EXpert SCCP = Поддержка сигнализации звонка SCCP для EXpert VoIP
- EXpert H.323 = Поддержка сигнализации звонка H.323 для EXpert VoIP
- EXpert H.248 = Поддержка сигнализации звонка H.248/Megaco для EXpert VoIP

Центральный офис EXFO > 400 Godin Avenue, Quebec City (Quebec) G1M 2K2 CANADA | Тел.: +1 418 683-0211 | Факс: +1 418 683-2170 | [info@EXFO.com](mailto:info@EXFO.com)

Бесплатный тел.: 1 800 663-3936 (США и Канада) | [www.EXFO.com](http://www.EXFO.com)

EXFO Америка	3701 Plano Parkway, Suite 160	Plano, TX 75075 USA	Тел.: +1 800 663-3936	Факс: +1 972 836-0164
EXFO Азия	151 Chin Swee Road, #03-29 Manhattan House	SINGAPORE 169876	Тел.: +65 6333 8241	Факс: +65 6333 8242
EXFO Китай	36 North, 3 <sup>rd</sup> Ring Road East, Dongcheng District Room 1207, Tower C, Global Trade Center	Beijing 100013 P. R. CHINA	Тел.: + 86 10 5825 7755	Факс: +86 10 5825 7722
EXFO Европа	Omega Enterprise Park, Electron Way	Chandlers Ford, Hampshire S053 4SE ENGLAND	Тел.: +44 2380 246810	Факс: +44 2380 246801
EXFO NetHawk	Elektroniikkatie 2	FI-90590 Oulu, FINLAND	Тел.: +358 (0)403 010 300	Факс: +358 (0)8 564 5203
EXFO Контроль качества	270 Billerica Road	Chelmsford, MA 01824 USA	Тел.: +1 978 367-5600	Факс: +1 978 367-5700

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За самой последней версией данной спецификации, пожалуйста, обращайтесь на сайт компании EXFO по адресу [www.EXFO.com/specs](http://www.EXFO.com/specs)

В случае разногласий, версия, опубликованная на сайте, имеет преимущественную силу перед любой печатной литературой.

# EXpert Test Tools

PLATFORM SOFTWARE TOOLS FOR TESTING IP-BASED SERVICES



Comprehensive triple-play test suite for FTTx/FTTH and commercial deployments.

SPEC SHEET

## EXpert IP TEST TOOLS

- > Combines six of the most common IP test tools into one: ping, traceroute, HTTP availability, FTP performance, VLAN scan and LAN discovery
- > Tests connectivity, throughput and response time
- > Automatically detects up to 100 VLANs on a link
- > Platform compatibility: FTB-1 and FTB-200

## EXpert VoIP TEST TOOLS

- > Generates VoIP calls
- > Fast verification of voice quality, thanks to intuitive user interface
- > Configurable pass/fail thresholds for simplified testing
- > Supports most common signaling protocols: SIP, H.323, H.248, SCCP
- > Supports MOS, R-factor and RTP metrics
- > Platform compatibility: FTB-1 and FTB-200

## EXpert IPTV TEST TOOLS

- > Powerful solution for IPTV quality assessment
- > Set-top-box emulation and passive monitoring of IPTV streams
- > Real-time video preview
- > Analyzes up to 10 video streams
- > Comprehensive QoS and QoE metrics including MOS score
- > Platform compatibility: FTB-1 and FTB-200



Assessing  
Next-Gen Networks

## COMBINE ALL TOOLS FOR FULL TRIPLE-PLAY TESTING, OR GET THEM INDIVIDUALLY

With the EXpert IP, EXpert VoIP and EXpert IPTV Test Tools, the FTB-1 and FTB-200 platforms are now equipped with triple-play testing capabilities. This allows technicians to test their voice, video and data services at residential and business premises with one test unit.

The combination of EXpert test applications and EXFO's FTB-1 OTDR test modules brings to the industry the most comprehensive and powerful triple-play solution in a portable device designed for growing FTTH deployments worldwide.



## PLATFORM APPLICATIONS THAT SPEED UP NETWORK DEPLOYMENTS, AVAILABLE THROUGH THE FTB ECOSYSTEM

EXFO's FTB Ecosystem\* is software-scalable. What this means is that from the moment you purchase your solution, you know that its productivity will always be improved with apps, software upgrades and updates—a truly future-proof approach. EXpert Test Tools are merely one of the many applications provided through the FTB Ecosystem.

\* The FTB Ecosystem gathers EXFO's family of portable platforms and modules, the EXFO Connect cloud-based test management environment, and a growing offering of software applications.



### TRY ANY OF THE EXPERT TOOLS FOR FREE ON YOUR FTB PLATFORM

EXFO gives you the opportunity to download the latest EXpert Tools and try them for free for a limited time. Simply log on to [www.EXFO.com/EXFO-Store](http://www.EXFO.com/EXFO-Store) and download the applications to find out just how easy it is to add new functions and upgrades to your FTB platform.

# EXpert VoIP TEST TOOLS

## VoIP SERVICE PERFORMANCE VALIDATION

EXpert VoIP Test Tools is an EXFO platform-based software application that provides voice-over-IP (VoIP) performance validation for service turn up and troubleshooting in enterprise and service provider networks. Supported on the FTB-1 and FTB-200 platforms, the application generates a single VoIP call from an EXpert VoIP-enabled platform to another EXFO platform supporting the application or any IP phone. The test calls can either be "live" or use a predefined audio file for test traffic. EXpert VoIP supports several signaling technologies including SIP, SCCP, H.323 and H.248 to ensure compatibility with the majority of VoIP environments currently used in the industry.

EXpert VoIP boasts a highly configurable test interface to maximize control over the test parameters yet maintains a strong emphasis on usability. The intuitive user interface features EXFO's latest generation framework that allows even the uninitiated user the ability to quickly set up and run tests. All tests support a uniform set of quality metrics that include opinion score (MOS), R-factor and a full range of real-time protocol (RTP) loss metrics, which combine with configurable thresholds to simplify service validation or accelerate troubleshooting.

Tests are executed between two EXpert VoIP-enabled platforms or to a VoIP endpoint (such as a SIP proxy server, soft phone or telephone, i.e., ATA). The platform that launches the test initiates a call, sets up a media channel, transmits media and reports statistics. Depending on the endpoint, it answers the call, transmits media and gathers statistics. Service tests can query the endpoint to determine availability or to set up a call.

## PRODUCT HIGHLIGHTS

### RTP Network Test

The VoIP RTP Network test is the base test of the EXpert VoIP Test Tools application. This peer-to-peer test measures VoIP-related parameters by streaming RTP packets between two endpoints. All supported functionality for this test conforms to RFC 1889. The RTP Network test simulates VoIP traffic by streaming RTP packets between a controller test set, which initiates the packet stream, and a responder endpoint that initiates its own stream to the controller test set.

### Signaling Protocols

EXpert VoIP has been designed to support a wide variety of VoIP environments to ensure the maximum utility of the tools. As such the application can be configured to use some of the most frequently used VoIP call signaling protocols including SIP, SCCP, H.248/Megaco and H.323.

### Voice Quality Metrics

The EXpert VoIP Test Tools base application includes a full set of voice quality metrics including MOS, R-factor and degradation factors based on codec, latency and packet loss to help pinpoint the source of any voice quality issues. EXFO's voice quality measurement agent calculates R-factor (another standardized transmission quality rating) for a call based on the G.107 E-model extensions. These model extension factors such as packet loss burst to more accurately predict the subjective score a listener would assign that call. The R-factor is then converted to an EXFO MOS score. The EXpert VoIP tests report the raw R-factor and EXFO's MOS voice quality results for conversational call quality.

The EXFO MOS algorithm used in the application is based on the ITU-T P.800 recommendation, which provides an objective measurement to subjective testing. EXFO has invested significant resources into developing and refining the EXFO MOS algorithm and it has been successfully benchmarked against leading commercially available algorithms.

# EXpert IP TEST TOOLS

## SIX TOOLS, ONE APPLICATION

EXpert IP Test Tools is an EXFO platform-based software application that brings together six commonly used test tools into one application to help field technicians deal with the complex testing environments of today's networks. As any technician knows, being prepared for the unexpected is key to successfully getting through the day and solving customer issues.

Whether it is to verify IP connectivity to a router or customer endpoint using the Ping tool, debugging VLAN issues with VLAN Scan or verifying a file transfer protocol (FTP) service using the FTP performance tool, EXpert IP Test Tools has you covered. Supported on the FTB-1 and FTB-200 test platforms, it is an indispensable test kit that is always available for use anywhere and anytime you are using EXFO's test platforms—regardless of the specific module in use.

## PRODUCT HIGHLIGHTS

### LAN Discovery

LAN Discovery actively interrogates network devices to learn about attached hosts, servers, switches and routers. The discovered devices connected to the network are listed and additional details about each device are provided such as IP address, domain name, services provided, administrator, location, etc. Metrics provided include the IP address of the discovered hosts along with the network address, MAC address and SNMP information.

### VLAN Scan

VLAN Scan detects and lists all the VLANs present on the IP network the test set is connected to. It can support the detection of nested VLANs on up to three layers. Results include the VLAN number, priority, and frame count. This tool is useful to discover configured VLANs on a port and bandwidth utilization per VLAN as well as providing the ability to detect VLAN configuration errors.

### Ping

The Ping tool validates if there is IP connectivity to another IP-enabled device (host) by sending control message protocol (ICMP) echo request packets to the destination device and waiting for an ICMP response to validate the end-to-end connection. In addition, it also provides a round-trip time (latency) for packets sent by the local device to the destination far-end device. Other metrics include sent and lost packets.

### Traceroute

The Traceroute test is a troubleshooting tool that discovers the path taken by IP packets across an IP network. It identifies the nodes or "hops" that the packet traversed on its way to the destination. The information provided by the tool includes the IP address of the nodes and the number of hops to that node and the total hops to reach the destination node. An example of how the traceroute tool can be used is to identify the routers along a data path to discover routing problems or to highlight firewall issues that may be blocking ICMP packets.

### FTP Performance Test

FTP allows the transfer of files between a local PC and a remote FTP server. Using FTP, you can connect to an FTP server and transfer files in either direction by uploading a file to or downloading a file from an FTP server. File transfer involves two types of connections, a control connection and a data connection.

A typical use of the FTP Performance test tool is to measure the availability and response time of an FTP server. This test can be configured to upload a file to the server, download a file from the server or perform both tasks. The file is generated by the test and transferred to the specified location.

### HTTP Availability

The HTTP Availability test measures the availability and response time of a hypertext transfer protocol (HTTP) server by downloading a web page. Results include the TCP connection time, the total page download time, the number of redirects and the redirect time.

# EXpert IPTV TEST TOOLS

## POWERFUL IPTV ANALYZER

The EXpert IPTV application enables FTB-1 and FTB-200 platform users to quickly and easily perform pass/fail verification of IPTV installations. It also reduces the amount of service calls by detecting and clearly identifying through simple pass/fail indications any degrading conditions during service turn-up, ensuring subscribers' quality of experience. EXpert IPTV can emulate a set-top box and display a real-time video preview, allowing the technician to determine video and audio quality before any other equipment is installed.



### Set-Top-Box Emulation

The Expert IPTV Test Tools allow technicians to emulate an actual set-top box. When operating in that mode, the application can join and leave live IPTV channels. The user can connect and view one or several standard-definition or high-definition videos simultaneously, or request a specific one.

### Passive or Promiscuous Mode

The Passive mode allows the Expert IPTV Test Tools application to seamlessly discover, view and provide metrics for any IPTV stream available on a specific link. No application configuration is required, and the user can run the test without being familiar with the application.

### Multiple Video Streams Analysis

The Expert IPTV application can analyze up to 10 video streams simultaneously. It also allows joining (so the user can view the stream) and leaving the discovered and selected streams simultaneously. This time-saving feature can be used for STB emulation as well as in Passive mode.

### Video-on-Demand

The video-on-demand (VoD) feature of the Expert IPTV Test Tools allows the user to request a specific video channel and connect to it. Valuable video metrics and analysis are then provided as well as a live view of the stream.

**TECHNICAL SPECIFICATIONS**

Interface	10/100/1000 Ethernet
Platforms	FTB-1 and FTB-200
EXpert IP Test Tools	Ping Traceroute FTP performance HTTP availability VLAN scan LAN discovery
EXpert VoIP Test Tools	SIP, H.323, SCCP, H.248/Megaco MOS and R-factor RTP metrics G.711, G.722, G.723, G.728 G.729 (A and B)
EXpert IPTV Test Tools	IGMP versions 2 and 3 MPEG2, MPEG4 part 2&10 (H.264), Mediaroom/MS-IPTV Live video preview Up to 10 simultaneous streams Transport packet metrics RTP packet metrics Video perceptual quality metrics Audio description information MPEG2-TS TR101290 Priority 1 and Priority 2

**ORDERING INFORMATION**

**EXpert IP** = IP/Ethernet test tool suite  
Includes: FTP performance, HTTP availability, VLAN scan, LAN discovery, ping, traceroute, IP/Ethernet port statistics  
Single license for the FTB-1 and FTB-200 platforms

**EXpert VoIP** = RTP base call testing software application including packet loss analysis, jitter measurement and complete voice quality metrics

**Options**

- EXpert SIP** = SIP call signaling support for EXpert VoIP
- EXpert SCCP** = SCCP call signaling support for EXpert VoIP
- EXpert H.323** = H.323 call signaling support for EXpert VoIP
- EXpert H.248** = H.248/Megaco call signaling support for EXpert VoIP

**EXpert IPTV** = IPTV test tool suite  
Single software to support all IPTV features on the FTB-1 and FTB-200 platforms

**EXpert TPP Bundle** = Triple-play bundle for voice, video and data testing on the FTB-1 and FTB-200 platforms  
Includes: EXpert IP Test Tools, EXpert IPTV Test Tools, EXpert VoIP Test Tools and EXpert SIP

**EXFO Corporate Headquarters** > 400 Godin Avenue, Quebec City (Quebec) G1M 2K2 CANADA | Tel.: +1 418 683-0211 | Fax: +1 418 683-2170 | info@EXFO.com

Toll-free: +1 800 663-3936 (USA and Canada) | [www.EXFO.com](http://www.EXFO.com)

<b>EXFO America</b>	3400 Waterview Parkway, Suite 100 Richardson, TX 75080 USA	Tel.: +1 972 761-9271	Fax: +1 972 761-9067
<b>EXFO Asia</b>	100 Beach Road, #22-01/03 Shaw Tower SINGAPORE 189702	Tel.: +65 6333 8241	Fax: +65 6333 8242
<b>EXFO China</b>	36 North, 3 <sup>rd</sup> Ring Road East, Dongcheng District Room 1207, Tower C, Global Trade Center Beijing 100013 P. R. CHINA	Tel.: + 86 10 5825 7755	Fax: +86 10 5825 7722
<b>EXFO Europe</b>	Omega Enterprise Park, Electron Way Chandlers Ford, Hampshire S053 4SE ENGLAND	Tel.: +44 23 8024 6810	Fax: +44 23 8024 6801
<b>EXFO Finland</b>	Elektronikkatie 2 FI-90590 Oulu, FINLAND	Tel.: +358 (0)403 010 300	Fax: +358 (0)8 564 5203
<b>EXFO Service Assurance</b>	270 Billerica Road Chelmsford, MA 01824 USA	Tel.: +1 978 367-5600	Fax: +1 978 367-5700

EXFO is certified ISO 9001 and attests to the quality of these products. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. EXFO has made every effort to ensure that the information contained in this specification sheet is accurate. However, we accept no responsibility for any errors or omissions, and we reserve the right to modify design, characteristics and products at any time without obligation. Units of measurement in this document conform to SI standards and practices. In addition, all of EXFO's manufactured products are compliant with the European Union's WEEE directive. For more information, please visit [www.EXFO.com/recycle](http://www.EXFO.com/recycle). Contact EXFO for prices and availability or to obtain the phone number of your local EXFO distributor.

For the most recent version of this spec sheet, please go to the EXFO website at [www.EXFO.com/specs](http://www.EXFO.com/specs).

In case of discrepancy, the Web version takes precedence over any printed literature.



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