FTB/IQS-8830NGE Power Blazer

10G MULTISERVICE TEST MODULE

EXFO TFv*
Test Function Virtualization

EXFO Connect
Compatible

EtherSAM

iSAM

COMPLETE IP6 TESTING

Comprehensive test suite for the turn-up, circuit validation and troubleshooting of Ethernet, SONET/SDH, OTN, Fibre Channel and SyncE/1588 PTP services up to 10G.

KEY FEATURES AND BENEFITS

Comprehensive testing for SONET/SDH, OTN and Ethernet interfaces up to 10G

Dual-port Ethernet testing up to 10 Gigabit Ethernet

iSAM ultra-simple multiservice activation (one of the intelligent apps)

OTN testing (as per ITU-T G.709) including forward error correction (FEC)

Efficiently assesses Fibre Channel networks with best-in-class coverage via 1x, 2x, 4x, 8x, 10x and 16x interfaces

Packet synchronization turn-up and troubleshooting (SyncE/1588 PTP)

True wire-speed, stateful TCP throughput based on RFC 6349 for undisputable SLA enforcement of Ethernet services

IPv4 and IPv6 protocol testing capability allowing IP transition stack validation and qualification

FTTA framed and unframed CPRI testing, including CPRI service disruption tests (CPRI SDTs)

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

OTN, SONET/SDH, FC and Ethernet BER testing (BERT) with real-time pass/fail status, quick action buttons, clear results and assorted notifications

Simpler reporting thanks to integrated Wi-Fi and Bluetooth connectivity capabilities **

FTB Ecosystem and EXFO Connect-compatible with software upgrade manager as well as automated cloud-based asset and test data management capabilities **

Housed in an FTB-500, FTB-2 or FTB-2 Pro Platform complete with integrated optical tools, battery operation, power-up and restore, remote access, GPS capabilities and test reports. Also available in an IQS-600 format allowing for increased port density and customized test environments

Offers EXFO TFv—Test Function Virtualization, including FTB Anywhere floating licenses and FTB OnDemand time-based licenses

* Available only for FTB modules

** A complete list of all the best-in-class test modules supporting this functionality is available on our FTB OnDemand web page.

PLATFORM COMPATIBILITY

Platform
FTB-500

Platform
FTB-2 or FTB-2 Pro

Integrated Qualification System
IQS-600

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THE POWERFUL CHOICE FOR MULTISERVICE TESTING

The ongoing transition towards a converged network infrastructure for SONET/SDH, OTN, Fibre Channel (FC) 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 intelligent FTB-2, FTB-2 Pro, the FTB-500 Platform and the IQS-600 multimodule platform, the FTB/IQS-8830NGE Power Blazer streamlines processes and empowers technicians to customize their testing solution in order to efficiently validate SONET/SDH, OTN, FC and Ethernet circuits.

POWERFUL YET SIMPLE

Because next-generation networks are becoming more and more complex, the FTB/IQS-8830NGE Power Blazer module is designed to cover all testing needs up to 10G without sacrificing simplicity. Thanks to a highly intuitive graphical user interface (GUI), streamlined procedures and predefined configurations, new users will be able to master this tool with little to no training. By combining the FTB/IQS-8830NGE Power Blazer module with any EXFO optical module for fiber characterization and OSNR qualification, technicians can run both simultaneously, and speed up both the testing and time-to-service.

What you need for any SONET/SDH, OTN, FC or Ethernet application

› Installation, commissioning and maintenance of access and metro networks

› Turn-up of SONET/SDH circuits

› Performance assessment of Carrier Ethernet services

› Validation of OTN networks and services

› Installation, activation and maintenance of metro Ethernet networks

› Unframed and framed CPRI BTS and RRH emulation from 1.2 Gbit/s to 9.8 Gbit/s with RTD and SDT support

› Deployment of active Ethernet (point-to-point) access services

› Installation and activation of FC networks

› Testing and troubleshooting

› In-service troubleshooting of live traffic

› Performance monitoring of SONET/SDH and OTN circuits

› Round-trip delay assessment of transport circuits

› BER testing up to 11.3 Gbit/s

SONET/SDH, OTN, FIBRE CHANNEL AND ETHERNET UP TO 10 Gʙɪᴛ/s

The FTB-8830NGE is the perfect solution for multiservice testing up to 11.3 Gbit/s.

› RJ45 port for electrical 10/100/1000M Ethernet

› SFP port for OC-1/3/12/48 or STM-0/1/4/16, OTU1 and Fibre Channel 1x, 2x, 4x or 100/1000M Ethernet

› SFP+ port for OC-192, STM-64, 10 GigE LAN/WAN or Fibre Channel 8x, 10x, 16x, OTU2, OTU1e/2e and OTU1f/2f

› SONET/SDH and OTN BER testing with configurable threshold settings

› Coupled, Decoupled and Through mode testing

› Error and alarm insertion and monitoring

› Overhead monitoring and manipulation

› High-order and low-order mappings

› Tandem connection monitoring (TCM)

› Pointer manipulation, including pointer sequence testing as per Telcordia GR-253, ANSI T1.105-03 and ITU G.783

› Performance monitoring as per G.821, G.826, G.828, G.829, M.2100, M.2101

› Frequency analysis and offset generation

› Automatic protection switching

› Service-disruption time measurements

› Round-trip delay measurements

› External clock sync support

› 10BASE-T to 10 GigE testing

› EtherSAM (ITU-T Y.1564) (bidirectional)

› iSAM ultra-simple ITU-T Y.1564 and RFC 6349 service activation methodology

› VLAN preservation

› RFC 2544 (bidirectional)

› RFC 6349 service activation methodology

› Traffic generation and monitoring

› Through mode

› Dual-port testing

› Intelligent autodiscovery

› IPv6 testing

› VLAN stacking MPLS

› Traffic Scan

› Ping/Traceroute

› Cable testing

› Dual Test Set mode

› Smart Loopback

› Fibre Channel 1x, 2x, 4x, 8x, 10x, 16x

› One-way latency

› Carrier Ethernet OAM (MEF, IEEE 802.1ag, ITU-T Y.1731 and ITU-T G.8113.1 MPLS-TP), and Link OAM (IEEE 802.3ah)

› Ethernet MAC flooding

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SIMPLIFIED BER TESTING

With the FTB/IQS-8830NGE Power Blazer, you can preconfigure OTN (from OTU1 or OTU2, including standard overclocked rates), Ethernet (from 10M to 10G), SONET/SDH (from OC-3/STM-1 to OC-192/STM-64), and Fibre Channel (1x, 2x, 4x, 8x, 10x, 16x) BERT parameters prior to arrival at the test site, and then load them from the Favorites menu with one click.

Furthermore, the preconfigured Favorites can be copied from one platform to another, or even sent to technicians out in the field via e-mail, where they can load them using the USB port on their platform. Once the BER test has started, the FTB/IQS-8830NGE provides clear results, assorted notifications and real-time pass/fail status via text or icons. Clicking on the pass/fail indicator maximizes this important status to full screen, providing instant and easily understood notification at various distances, whether the unit is in your hand or on the other side of the room.
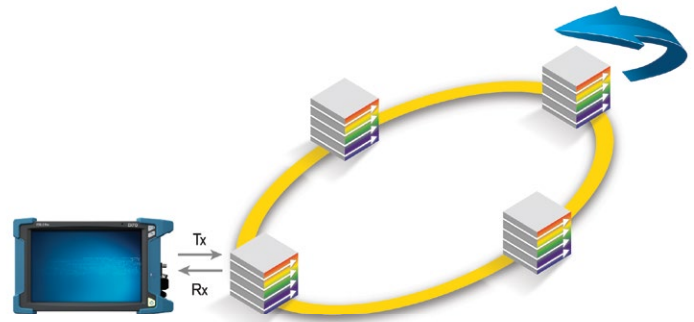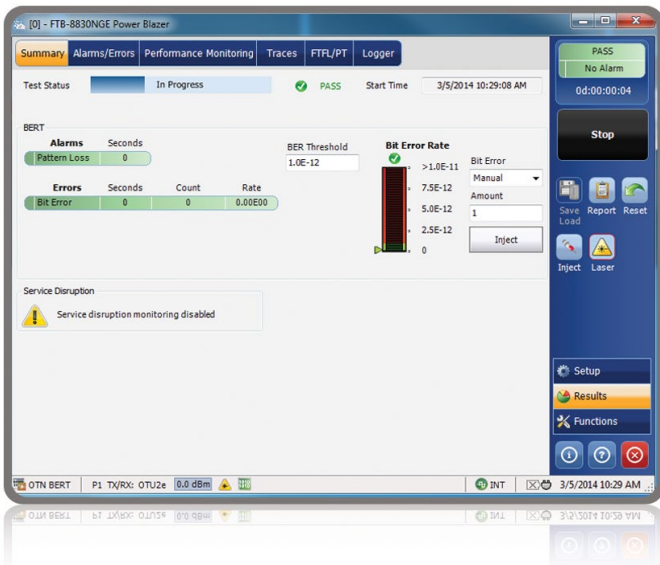
ETHERNET PERFORMANCE ASSESSMENT

The FTB/IQS-8830NGE offers an automated RFC 2544 test suite for all supported Ethernet interfaces at all frame sizes and at full line rate, delivering repeatable test results and error-free circuit certification at 100% utilization.

RFC 2544 is complemented by five Smart Loopback modes. So, whether you are looking to pinpoint loopback traffic from a user-datagram protocol (UDP) or transmission-control-protocol (TCP) layer, or all the way down to a completely promiscuous mode (Transparent Loopback), the FTB/IQS-8830NGE can adjust to all loopback situations, through which the remote unit will return traffic to the local unit by swapping packet overhead up to layer 4 of the OSI stack. The Ethernet performance assessment capabilities of the FTB/IQS-8830NGE also include test reports with detailed throughput, frame loss, back-to-back and latency measurements, and clear histograms for future reference regarding specific service-level agreements (SLAs).


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ETHERSAM: ITU-T Y.1564 ETHERNET SERVICE ACTIVATION

With more and more Ethernet services being activated today, the new ITU-T Y.1564 standard addresses the growing demand for turning up and troubleshooting Carrier Ethernet services. Supported on the FTB/IQS-8830NGE Power Blazer module for 10M-to-10G Ethernet client services, this new methodology brings numerous advantages, including validation of critical SLA criteria such as packet jitter and QoS measurements, as well as faster time to service. 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. 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 in sequentially testing each service in order to validate that each is properly provisioned and that all specific KPIs or SLA parameters are met. A ramp test and a burst test are performed to verify the committed information rate (CIR), excess information rate (EIR), committed burst size (CBS) and excess burst size (EBS).
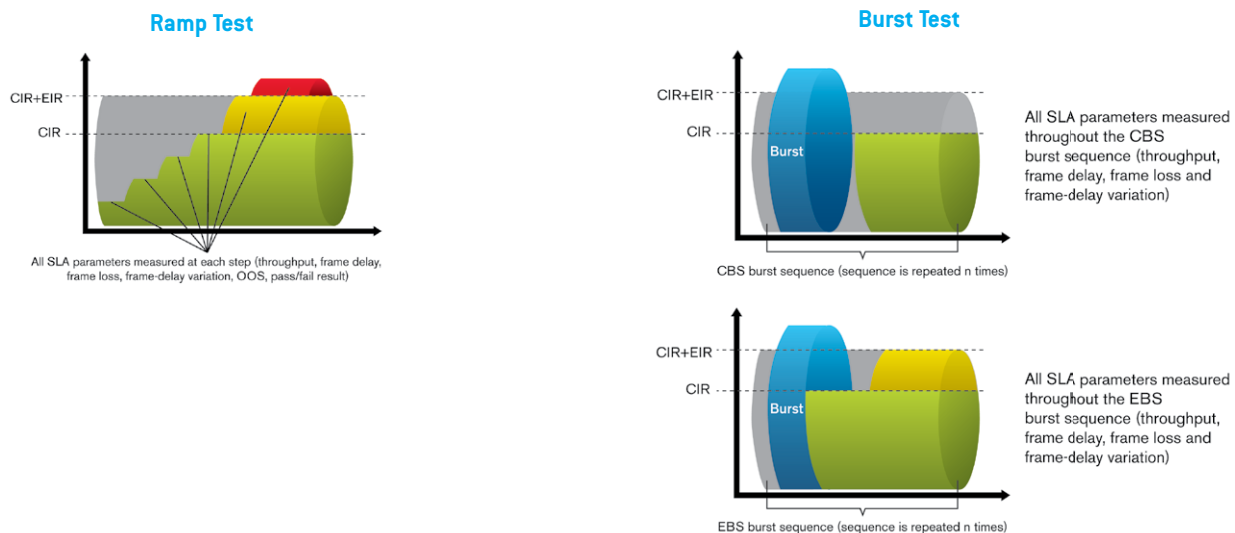
Service Performance Test

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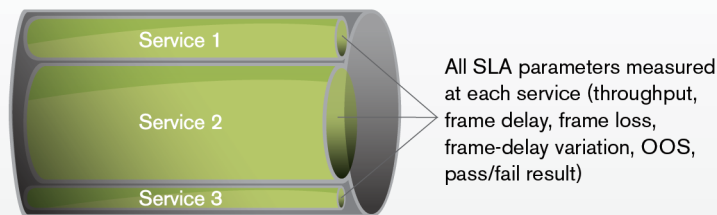
iSAM

With iSAM, which includes Y.1564 (EtherSAM) and RFC 6349, the focus is on minimalism and simplicity, making both tests as simple as possible for all users. This is in sharp contrast with the current situation in the test and measurement market today. One key aspect of iSAM's simplicity lies in its efficiency: it only requires a limited number of steps to set up, run and receive valid test results.

The core objective of iSAM is to remove friction between the user and the testing solution. The end goal is to enable field technicians of any skill level to set up and run an iSAM test, and all of this is done within a one-page setup.

The innovation does not stop there. iSAM also takes the lead in delivering the latest test and measurement standards. iSAM has achieved an industry first by introducing actual Metro Ethernet Forum (MEF) standards and thresholds to guarantee that service providers, mobile network operators and multisystem operators are able to test against the latest MEF 23.1 standard.
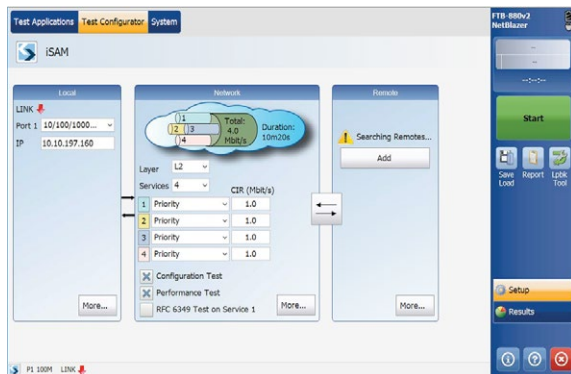
One-page setup
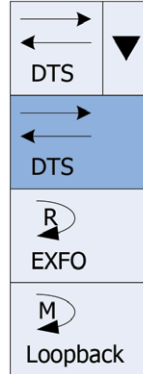
Multiple modes of connection

One-page results

DUAL TEST SET

Whether the customer is using RFC 2544, RFC 6349 or Y.1564 (EtherSAM) for service activation, these tests can be executed in Dual Test Set mode. In this case, two test sets, one designated as local and the other as remote, are used to communicate and independently run tests per direction. The Dual Test Set approach is a more accurate test scenario. In this case, two units perform an asymmetrical SLA measurement, providing test results per direction. This scenario's main strength is that it quickly pinpoints which direction has not been configured properly or is at fault, while providing performance metrics for each direction.

Results from both directions are displayed on the local unit to ensure that the entire test routine can be completed by a single person in control of a single unit, thus resulting in shorter test time and reduced manpower. This flexibility also guarantees that different units can be set as a remote unit. The most interesting scenario is a centralized unit that is always configured as a remote unit with fixed addresses. The carrier can simply dispatch a single test person to a test site, following which the tester can quickly discover and execute service turn-up and burn-in quickly and efficiently without requiring an extra worker in the central office.

The Dual Test Set approach also provides the capability to segment the network and quickly pinpoint in which direction issues occur. This is especially important in cases where the bandwidth differs between the upstream and downstream directions. In such instances, using a loopback tool will always yield the same results, because the measurement will be affected by the lowest throughput, and the test results will not reflect that one direction has higher performance than the other. The same scenario will occur if a network misconfiguration is present in only one direction of the service. Depending on the error, the problem will not be identified with round-trip measurements. This often results in customer complaints and additional truck rolls. With the Dual Test Set approach, both directions are independently analyzed at the same time, and pass/fail results are provided per direction, yielding the highest level of confidence in service testing.

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ETHERNET TRAFFIC GENERATION AND MONITORING

Multiservice offerings such as triple-play services have fuelled the need for QoS testing to ensure the condition and reliability of each service and qualify SLA parameters. The FTB/IQS-8830NGE Power Blazer, with the traffic generation and monitoring application, allows service providers to simultaneously simulate and qualify different applications. Up to 16 streams can be configured with different Ethernet and IP QoS parameters, such as VLAN ID (802.1Q), VLAN priority (802.1p), VLAN stacking (802.1ad Q-in-Q), ToS and DSCP. In addition, the FTB/IQS-8830NGE Power Blazer now supports monitoring of multiple VLAN streams through the Traffic Scan functionality. Traffic simulation also includes traffic shaping with burst and ramp capabilities. In the same line, a MAC flooding capability is available for switch-addressable memory testing, where the range of MAC addresses can be cycled, forcing the switch to learn each of these MAC addresses. The FTB/IQS-8830NGE also offer the flexibility to define one configuration profile and apply it to as many streams as required. From there, it is just a matter of tweaking them to each stream. The FTB/IQS-8830NGE also simultaneously measures throughput, latency, packet jitter (RFC 3393), frame loss and out-of-sequence errors in all streams, yielding fast and in-depth qualification of all SLA criteria. Results are displayed in tabular format and on analog visual gauges to ensure that test outcomes are quickly and easily interpreted.

CARRIER ETHERNET OAM

Metro Ethernet networks with carrier-class Ethernet services demand performance measurements for proper system maintenance. Ethernet service operations, administration and management (OAM) covers the end-to-end measurements and standards needed for systems maintenance. OAM utilizes a variety of protocols for installing, monitoring and troubleshooting networks, including network discovery, link monitoring, remote fault detection, and remote loopback. This in turn simplifies Ethernet service deployments as Ethernet moves to mass deployment. Carrier Ethernet OAM is also a mechanism for monitoring and validating SLAs that eliminates finger-pointing between carriers. Most service providers are focusing today on implementing connectivity fault management and performance monitoring OAM protocols, including Ethernet (ITU-T Y.1731, IEEE 802.1ag, MEF and Link OAM [802.3ah]) and MPLS-TP (G.8113.1) OAMs.
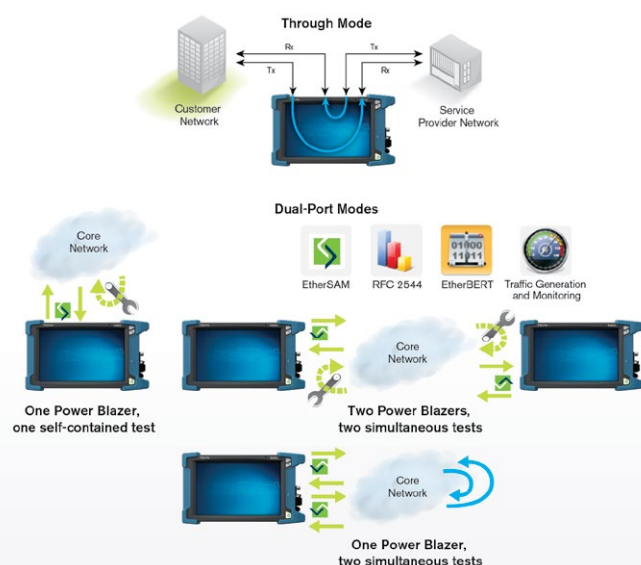
DUAL-PORT AND THROUGH MODE TESTING

With dual-port testing, one technician can use a single Power Blazer module to launch either EtherSAM, RFC 6349 or RFC 2544 and obtain bidirectional results with just one module. With traffic generation, monitoring and EtherBERT tests, the technician can set up two distinct tests: one on port 1, and another on port 2. Both ports can also be set to different interfaces and rates (e.g., 10BASE-T electrical on port 1 and 10 GigE on port 2).

VLAN/MPLS

Today's networks are expected to deliver high performance. To meet such high expectations, service providers must rely on various mechanisms, such as Ethernet tagging, encapsulation and labeling. Thanks to these additions, service providers can enhance security, scalability, reliability and performance. The FTB/IQS-8830NGE supports virtual local area network (VLAN) tags, Traffic Scan, Q-in-Q VLAN tags and multiprotocol label switching (MPLS).

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RFC 6349

The Internet Engineering Task Force (IETF) ratified RFC 6349 as a new method for validating an end-to-end TCP service. This new TCP throughput test methodology provides a repeatable standards-based test that validates TCP applications such as web browsing, file transfer, business applications, streaming video and more. After running the RFC 6349 test, service providers will have all the metrics needed to optimize TCP performance from within their networks or customer-premises equipment.

The RFC 6349 test is important, because it includes the steps that follow to help locate and diagnose TCP issues correctly. The first step consists of finding the maximum transmission unit (MTU) size. This ensures that the network is not fragmenting the traffic. The aim of the second step is to determine the baseline round-trip delay, which means letting the technician know that this latency value is the best-case scenario that the network under test can deliver. The third step uses either single or multiple TCP connections to fill the pipe and then report back the actual TCP throughput. Once the test is complete, all TCP metrics are clearly laid out. If changes are required to optimize the TCP performance, the technician will have all the values needed to rectify the situation. In the end, the RFC 6349 test helps resolve any potential discrepancies that could occur between the service provider network and the customer-premises equipment.

PATH MTU discovery

Baseline round-trip time (RTT) and bandwidth to determine ideal window size

Single or multiple TCP connections to enable full pipe testing

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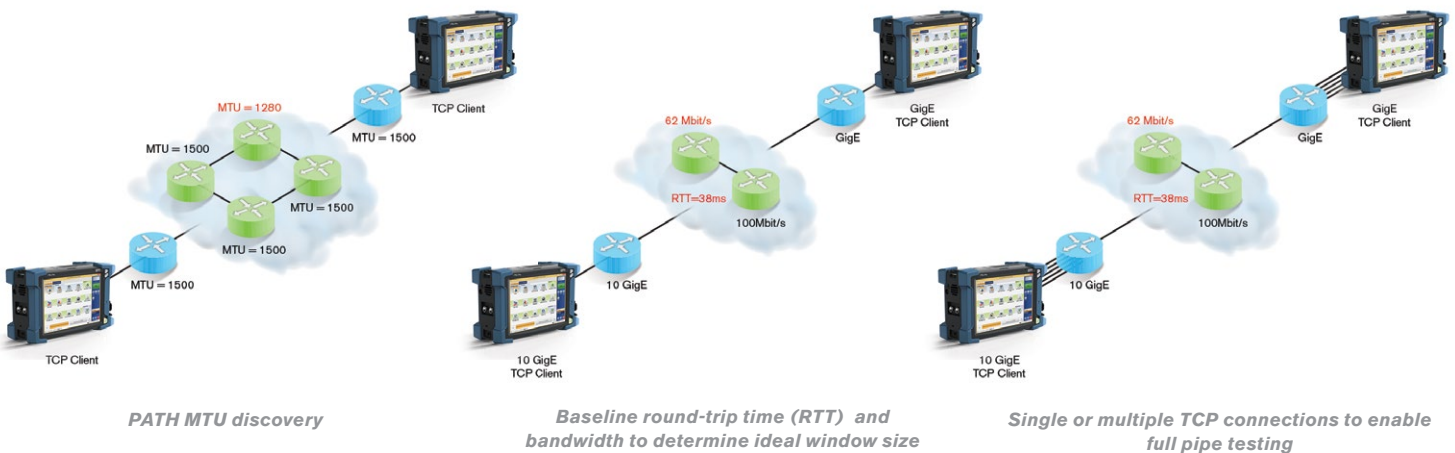
FTTA TESTING

With the Power Blazer Series modules, field technicians can carry out a variety of FTTA tests. For instance, when installing a remote radio head (RRH), it is critical that all equipment be verified before the riggers have finished the construction phase. The Power Blazer Series' CPRI protocol feature verifies that the RRH is fully operational and that the correct small form-factor pluggable (SFP) transceivers are installed and connected correctly.

Using these multiservice test modules enabled with the layer-2 CPRI protocol, technicians can easily connect to the RRH without having to climb the cell tower. Regardless of whether the cell site's base station (BTS) is connected to the RRH, these multiservice test modules are always ready to emulate a CPRI-enabled BTS. Once connected to the RRH, these modules are able to supply the field technician with a complete analysis of vital CPRI statistics that includes the following: optical power levels, protocol version, frequency and frequency offset, hyperframe and code word counts, the negotiated Ethernet or HDLC control and maintenance channels.

Having this information readily accessible enables field technicians to ensure that the RRH is working at the correct, specified line rate, and that it is timed and fully transmitting continuous frames from the top to the bottom of the tower. In addition, the reverse verification can be made by using the Power Blazer Series to emulate the RRH in order to validate the CPRI link with the BTS.

Moving closer towards CPRI-enabled infrastructures, a significant challenge arises as a result of human error occurring between the RRH and the BTS; faulty configurations, bad wiring and incorrect SFPs can lead to problems when trying to initialize the CPRI start-up sequence between the BTS and RRH. The Power Blazer Series test suite better equips field technicians to decipher and solve these basic yet very costly human errors.

In addition to performing CPRI service disruption tests (CPRI SDTs), field technicians can perform an unframed and framed layer-2 CPRI BER test from 1.2 Gbit/s all the way up to 9.8 Gbit/s. These modules are able to validate that the fiber from the BTS located at the base of the tower or kilometers away in a Cloud-RAN environment is running with the expected latency and is error-free.
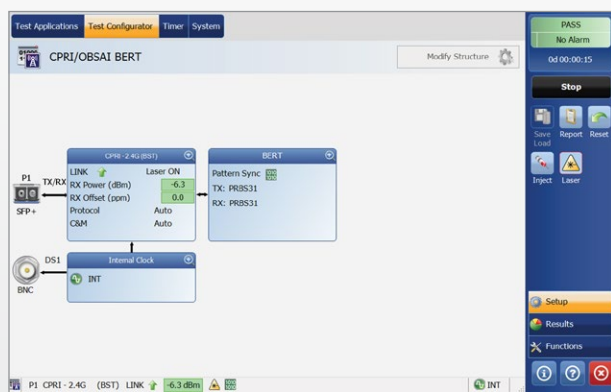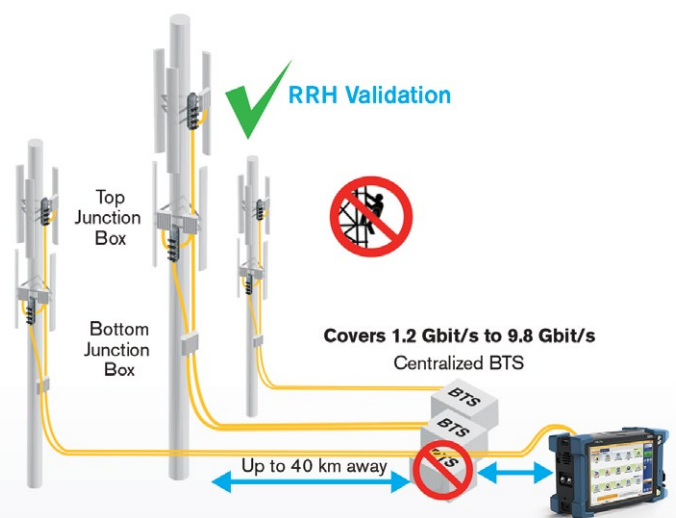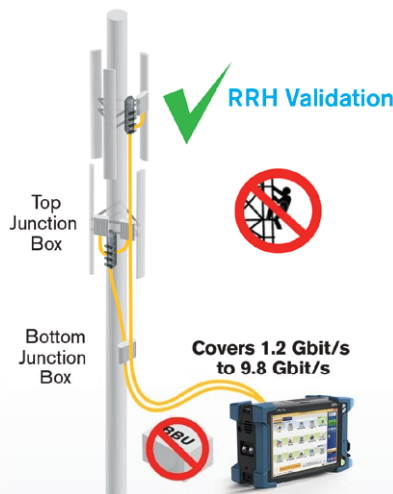
Framed CPRI BER Test
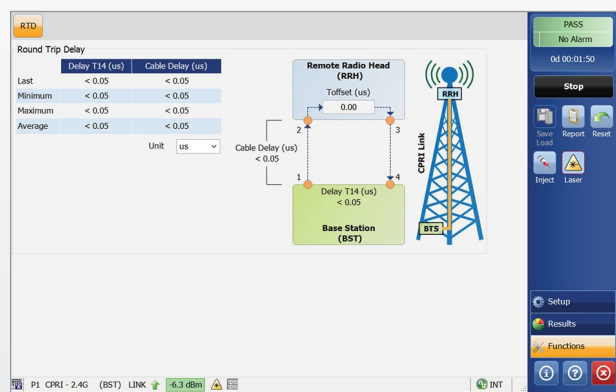
CPRI Round-Trip Delay

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IP CONNECTIVITY TOOLS

As part of the IP connectivity tools, the ping tool is used to verify that the user can reach a specific address within or outside of a subnetwork. The traceroute tool is a modified version of the ping tool and is used to determine the route or the number of hops that are required to reach a destination host. These basic tools are essential when testing through routed networks. These test results can pinpoint critical configuration issues within the network.

SIMPLIFIED ERROR INJECTION

This FTB/IQS-8830NGE 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 MANIPULATION AND MONITORING

EXFO's FTB/IQS-8830NGE module allows for complete OTN and SONET/SDH overhead manipulation and monitoring for advanced testing and troubleshooting. Furthermore, and consistent with this module's simplified testing approach, the overhead manipulation and monitoring capability is categorized under Functions in the GUI, and is separate from the default setup and results pages. The Functions category offers various testing capabilities required for advanced troubleshooting.

DELAY MEASUREMENT

Today, carriers have an opportunity to turn optical networks into a competitive advantage by guaranteeing low-latency traffic transmission for delay-sensitive applications, including video, cloud computing and financial trading applications. With this in mind, the FTB/IQS-8830NGE Power Blazer module enables OTN, SONET/SDH and Ethernet delay measurements across all supported testing interfaces. This enables carriers to solidify their competitive advantage when building low-latency optical transport networks and guarantee speed of service to their end-customers.

This functionality measures the time required for a bit to travel from the transmitter of the FTB/IQS-8830NGE and back to the receiver after crossing a far-end loopback, thereby providing complete delay results, including delay measurement and minimum/maximum/average delay statistics.

EFFICIENTLY ASSESSING THE PERFORMANCE OF FIBRE CHANNEL SERVICES

The Power Blazer Series modules provide comprehensive testing capabilities for FC network deployments, supporting multipleFC interfaces.
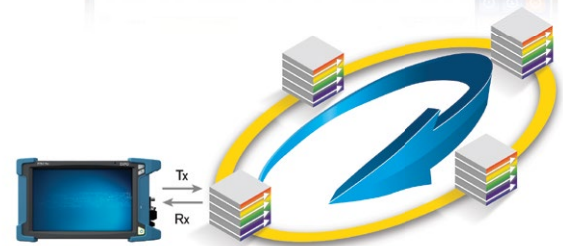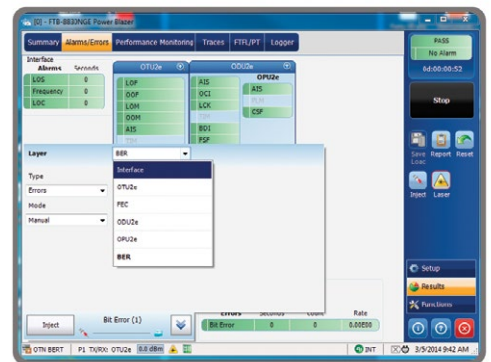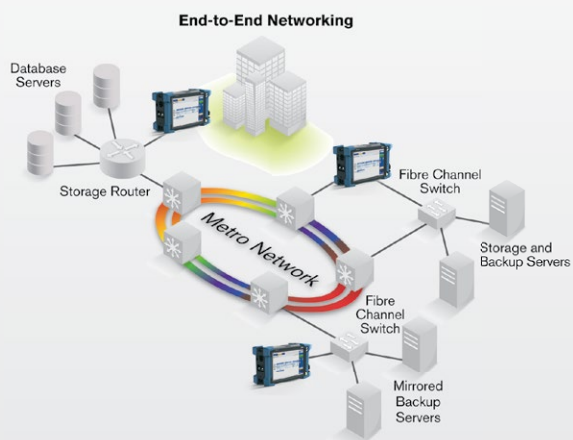
COMPLETE SUITE OF FIBRE CHANNEL INTERFACES

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
16x	14.0	1600

APPLICATIONS

Since most storage area networks (SANs) cover large distances, and because FC has stringent performance requirements, it is imperative to test at each phase of network deployment to ensure appropriate service levels. EXFO's Power Blazer Series modules provide full wire-speed traffic generation at the FC2 layer, which allows for BER testing for link integrity measurements. The Power Blazer Series also supports latency, buffer-to-buffer credit measurements for optimization, as well as login capabilities.

Thanks to end-to-end network testing capabilities, EXFO's Power Blazer enables fast deployment and configuration of FC 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.

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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 the processing time inside each piece of network equipment. Latency is the total accumulation of delays between two endpoints. 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 FC services. The Power Blazer 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, FC 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 Power Blazer 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 FC are no longer fully transparent; they also have increased built-in intelligence, acting more as FC switches. With switch fabric login ability, the Power Blazer Series modules support connections to a remote location through a fabric or semitransparent network.

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

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

EXFO TFv

EXFO TFv—Test Function Virtualization is a cloud-based suite of defined offerings for service providers who are looking to scale their testing requirements to their specific needs. Under the EXFO TFv umbrella are FTB Anywhere floating licenses, and the newly launched FTB OnDemand time-based software licenses.

FTB Anywhere: Floating Test Licenses

FTB Anywhere is an EXFO Connect-enabled offering that allows FTB platform users to share floating test licenses and get the required functionality—anywhere, anytime. In short, the customer owns the software licenses and can share them between FTB platforms.

FTB OnDemand: Time-Based Software Licenses

FTB OnDemand allows customers to activate time-based software licenses covering a wide range of test functionalities (e.g., 100G testing) to match their exact needs. FTB OnDemand enables users to obtain a license for specific test for a specific module for a specific period of time. FTB OnDemand is available for a number of best-in-class EXFO test modules. For a complete list of all the available modules, visit our FTB OnDemand web page.

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.

* Available only for FTB modules

10M-TO-10G TECHNICAL SPECIFICATIONS

SFP ETHERNET OPTICAL INTERFACES

	100M and GigE rates						
Available wavelengths (nm)	850, 1310 and 1550						
Model	FTB-85910	FTB-85911	FTB-8590	FTB-8190	FTB-8192	FTB-8596	FTB-8597
Transceiver type	100BASE-FX	100BASE-LX	1000BASE-SX	1000BASE-LX	1000BASE-ZX	1000BASE-BX10-D	1000BASE-BX10-U
Wavelength (nm)	1310	1310	850	1310	1550	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490
Tx level (dBm)	−20 to −15	−15 to −8	−9 to −3	−9.5 to −3	0 to 5	−9.5 to −3	−9.5 to −3
Rx level sensitivity (dBm)	−31	−28	−20	−22	−22	−20	−20
Maximum reach	2 km	15 km	550 m	10 km	80 km	10 km	10 km
Transmission bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Reception bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Tx operational wavelength range (nm)	1280 to 1380	1261 to 1360	830 to 860	1270 to 1360	1540 to 1570	1480 to 1500	1260 to 1360
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2
Maximum Rx before damage (dBm) [a]	3	3	6	6	6	6	6
Jitter compliance	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Ethernet classification	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Laser type	LED	FP	VCSEL	FP	DFB	DFB	FP
Laser product	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC	LC	LC	LC	LC

SFP SONET/SDH AND OTN OPTICAL INTERFACES

Transceiver type	OC-1/ STM-0	OC-3/STM-1				OC-12/STM-4				OC-48/STM-16/OTU1			
Reach and wavelength	2 km, 1310 nm	30 km; 1310 nm	50 km; 1310 nm	60 km; 1550 nm	100 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-85910	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)	−20 to −15	−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)	−31	−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	52 Mbit/s ± 4.6 ppm	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				±50			
Receive bit rate	52 Mbit/s ± 100 ppm	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	1280 nm to 1380 nm	1270 nm to 1360 nm	1280 nm to 1335 nm	1430 nm to 1580 nm	1500 nm to 1580 nm	1270 nm to 1360 nm	1280 nm to 1335 nm	1430 nm to 1580 nm	1480 nm to 1580 nm	1260 nm to 1360 nm	1280 nm to 1335 nm	1430 nm to 1580 nm	1500 nm to 1580 nm
Spectral width	1 nm (−20 dB)	1 nm (−20 dB)				1 nm (−20 dB)				1 nm (−20 dB)			
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2				±4.6 ±2				±4.6 ±2			
Maximum Rx before damage (dBm) [a]	3	3				3				3			
Jitter compliance	GR-253 (SONET) G.958 (SDH)	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				NRZ			
Laser product	Class 1	Class 1				Class 1				Class 1			
Connector [b]	LC	LC				LC				LC			

Notes

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

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

EXFO

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) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2
Max Rx before damage (dBm)	3	3	3	3
Jitter compliance	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
FC classification	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
Laser type	VCSEL	Fabry-Perot	DFB	DFB
Eye safety	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC

SFP+ FIBRE CHANNEL INTERFACES

FC-8x/10x/16x

Wavelength (nm)	850	850	1310	1550	1550	850	1310
Model	**FTB-8696**	**FTB-8690**	**FTB-8693**	**FTB-8694**	**FTB-8695**	**SFP-8697**	**SFP-8698**
Tx level (dBm)	−8.2 to −2	−5 to −1	−6 to −1	−1 to 2	0 to 4	−7.8 to 0.5	−5 to 2
Rx level sensitivity (dBm)	−11.1 to 0	−11.1 to 0.5	−14.4 to 0.5	−15 to −1	−24 to −7	0 to 10.5	2 to −12
Maximum reach	150 m on OM3 MMF	300 m on OM3 MMF	10 km	40 km	80 km	100 m on OM3 MMF	10 km SMF
Transmission bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5	4.25/8.5/14.025	4.25/8.5/14.025
Reception bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5	4.25/8.5/14.025	4.25/8.5/14.025
Tx operational wavelength range (nm)	840 to 860	840 to 860	1260 to 1355	1530 to 1565	1530 to 1565	840 to 860	1295 to 1325
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2
Max Rx before damage (dBm)	5	5	5	5	3	3	3
Jitter compliance	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	FC-PI-5 rev 6.00	FC-PI-5 rev 6.00
FC classification	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	FC-PI-5 rev 6.00	FC-PI-5 rev 6.00
Laser type	VCSEL	VCSEL	DFB	CML	EML	VCSEL	DFB
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC	LC	LC

EXFO

XFP FIBRE CHANNEL INTERFACES

FC-10x

Wavelength (nm)	850	1310	1310	1550	1550
Model	**FTB-85900**	**FTB-85901**	**FTB-81900**	**FTB-85902**	**FTB-81902**
Tx level (dBm)	−5 to −1	0.5 max	−6 to −1	−1 to 2	0 to 4
Rx level sensitivity (dBm)	−11.1	−12.6	−14.4	−16	−23
Maximum reach	300 m on 50/125 μm MMF 30 m on 62.5/125 μm MMF	10 km	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	10.5	10.5	10.5	10.5	10.5
Reception bit rate (Gbit/s)	10.5	10.5	10.5	10.5	10.5
Tx operational wavelength range (nm)	840 to 860	1260 to 1355	1290 to 1330	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2
Max Rx before damage (dBm)	6	6	6	2	4
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	DFB	DFB	EML	EML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC

SFP+ 10G ETHERNET OPTICAL TRANSCEIVERS

Transceiver type	**10GBASE-SR/SW**	**10GBASE-LR/LW**	**10GBASE-ER/EW**
Wavelength (nm)	850	1310	1550
Model	**FTB-8690**	**FTB-8691**	**FTB-8692**
Tx level (dBm)	−5 to −1	−8.2 to 0.5	−4.7 to 4
Rx level (dBm)	−11.1 to 0.5	−14.2 to 0.5	−15.8 to −1
Maximum reach	300 m (OM3)	10 km	40 km
Tx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Rx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Tx wavelength range (nm)	840 to 860	1260 to 1355	1530 to 1565
Frequency offset generation (ppm)	±120	±120	±120
Rx wavelength range (nm)	840 to 860	1260 to 1600	1260 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2
Rx damage level max. (dBm) [a]	6	5	5
Jitter compliance	IEEE 802.3ae	IEEE 802.3ae	IEEE 802.3ae
Laser type	VCSEL	DFB	CML
Laser product	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC

Notes

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

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

EXFO

SFP+ 10G SONET/SDH AND OTN OPTICAL TRANSCEIVERS

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 (dBm)	−11 to 0.5	−15 to −1	−24 to −7
Maximum reach	10 km	40 km	80 km
Tx bit rate (Gbit/s)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Rx bit rate (Gbit/s)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Tx wavelength range (nm)	1260 to 1355	1530 to 1565	1530 to 1565
Rx wavelength range (nm)	1260 to 1600	1260 to 1600	1260 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2
Rx damage level max. (dBm) [a]	5	5	5
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)
Laser type	DFB	EML	EML
Laser product	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC

SFP/SFP+ FTTA INTERFACES

CPRI/OBSAI

Wavelength (nm)	850	1310	1310	1310	1550
EXFO product number	FTB-8590	FTB-8190	FTB-8191	SFP-8600	FTB-8192
Tx level (dBm)	−9 to −3	−5 to 0	−2 to 3	−8.2 to 0.5	−2 to 3
Rx level sensitivity (dBm)	−18 to 0	−18 to 0	−27 to −9	0.5 (max)	−28 to −9
Maximum reach	300 m on OM3 MMF	15 km	40 km	1.4 km (SMF)	80 km
Transmission bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288 to 9.8304	2.4576/3.072
Reception bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288 to 9.8304	2.4576/3.072
Tx operational wavelength range (nm)	830 to 860	1270 to 1360	1280 to 1355	1260 to 1355	1500 to 1580
Measurement accuracy (uncertainty) Optical power (dB)	±2	±2	±2	±2	±2
Max Rx before damage (dBm)	+5	+5	+3	+5	+3
Jitter compliance	IEEE 802.3	GR-253 (SONET) G-958 (SDH)	GR-253 (SONET) G-958 (SDH)	IEEE 802.3ae	GR-253 (SONET) G-958 (SDH)
Laser type	VCSEL	DFB	DFB	FP	CML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC
Transceiver type	SFP	SFP	SFP	SFP+	SFP

Notes

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

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

EXFO

XFP 10G ETHERNET OPTICAL TRANSCEIVERS

Transceiver type	10GBASE-SR/SW	10GBASE-LR/LW	10GBASE-ER/EW
Wavelength (nm)	850	1310	1550
Model	FTB-85900	FTB-85901	FTB-85902
Tx level (dBm)	−5 to −1	−6 to 0.5	−1 to 2
Rx level (dBm)	−11.1 to 0.5	−12.6 to 0.5	−16 to −1
Maximum reach	300 m (OM3)	10 km	40 km
Tx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Rx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Tx wavelength range (nm)	840 to 860	1260 to 1355	1530 to 1565
Frequency offset generation (ppm)	±120	±120	±120
Rx wavelength range (nm)	840 to 860	1260 to 1600	1270 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2
Rx damage level max. (dBm)	6	5	6
Jitter compliance	IEEE 802.3ae	IEEE 802.3ae	IEEE 802.3ae
Laser type	VCSEL	DFB	EML
Laser product	Class 1	Class 1	Class 1
Connector	LC	LC	LC

XFP SONET/SDH AND OTN OPTICAL TRANSCEIVERS

Transceiver type	OC-192/STM-64/OTU2	OC-192/STM-64/OTU2	OC-192/STM-64/OTU2
Wavelength (nm)	1310	1550	1550
Model	FTB-81900	FTB-81901	FTB-81902
Tx level (dBm)	−6 to −1	−1 to 2	0 to 4
Rx level (dBm)	−13.4 to 0.5	−15 to −1	−22.5 to −7
Maximum reach	10 km	40 km	80 km
Tx bit rate (Gbit/s)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Rx bit rate (Gbit/s)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Tx wavelength range (nm)	1290 to 1330	1530 to 1565	1530 to 1565
Rx wavelength range (nm)	1270 to 1600	1270 to 1600	1270 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2
Rx damage level max. (dBm)	5	6	5
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)
Laser type	DFB	EML	EML
Laser product	Class 1	Class 1	Class 1
Connector	LC	LC	LC

EXFO

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-byte trail trace identifier (TTI), as defined in ITU-T G.709
	FTFL	As defined in ITU-T G.709
OPU layer	Alarms	OPU-PLM, OPU-AIS, OPU-CSF
	Payload type (PT) label	Generates and displays received PT value
Forward error correction (FEC)	Errors	FEC-correctable (codeword), FEC-uncorrectable (codeword), FEC-correctable (symbol), FEC-correctable (Bit), and FEC-stress (codeword)
ODU multiplexing	Single-stage multiplexing	ODU12 (PT20 and PT21)
Pattern	Patterns	2E-9, 2E-15, 2E-20, 2E-23, 2E-31, NULL, 32-bit programmable (inverted or noninverted)
	Error	Bit error
	Alarm	Pattern loss

ADDITIONAL OTN FUNCTION

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

ELECTRICAL ETHERNET INTERFACES

	10/100 BASE-T half/full duplex, 1000BASE-T full duplex Automatic or manual detection of straight/crossover cable			Pluggable SFP Ethernet copper transceivers
Transceiver type	**10BASE-T**	**100BASE-TX**	**1000BASE-T**	**1000BASE-T**
Tx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s	1 Gbit/s
Tx accuracy (uncertainty) (ppm)	±4.6	±4.6	±4.6	±100
Rx bit rate	10 Mbit/s	125 Mbit/s	1 Gbit/s	1 Gbit/s
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	±4.6 ±2	±4.6 ±2	±4.6 ±2	±4.6 ±2
Duplex mode	Half and full duplex	Half and full duplex	Full duplex	Full duplex
Jitter compliance	IEEE 802.3	IEEE 802.3	IEEE 802.3	IEEE 802.3
Connector	RJ45	RJ45	RJ45	RJ45
Maximum reach (m)	100	100	100	100

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ETHERNET TEST FEATURES

EtherSAM (ITU-T Y.1564)	Performs service configuration and service performance tests as per ITU-T Y.1564 including EBS, CBS and EMIX; use remote loopback or Dual Test Set mode for bidirectional results including VLAN preservation for monitoring and analysis of VLAN priority CoS and ID
iSAM	Simplified ITU-T Y.1564 test that performs service configuration and service performance tests using Remote Loopback or Dual Test Set mode for bidirectional results; an additional, completely automated RFC 6349 test can be run in conjunction with the EtherSAM (Y.1564) tests, or on its own to perform layer-4 TCP testing, with the inclusion of discovering the maximum transmission unit (MTU) and round-trip time (RTT), as well as the actual and ideal TCP throughput of the circuit under test
RFC 2544	Throughput, back-to-back, frame loss and latency measurements according to RFC 2544; frame size: RFC-defined sizes, user-configurable between one to seven sizes
RFC 6349	RFC 6349 Performs TCP testing with single or multiple TCP connections from 10BASE-T up to 10G; discovers the MTU, RTT, actual and ideal TCP throughput
Dual Test Set	Complementing RFC 2544, RFC 6349 and EtherSAM (ITU-T Y.1564) for bidirectional measurements, including one-way latency
Intelligent autodiscovery	Offers intelligent autodiscovery of other EXFO modules, allowing single user to perform end-to-end testing
10 GigE dual-port test	10 GigE dual-port testing with EtherBERT, EtherSAM (ITU-T Y.1564), iSAM, RFC 2544, and traffic generation and monitoring when using 100BASE-X, GigE and 10 GigE
Traffic generation and monitoring	Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic, including the simultaneous monitoring of throughput, frame loss, packet jitter, latency and out-of-sequence frames, including MAC flooding for source and destination MAC addresses
Through mode	Sectionalizes 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
Frame size	Fixed (from 64 to 16 000 bytes), Random and Sweep (from 64 to 16 000 bytes)
Framing	IEEE 802.3 SNAP and Ethernet II frame format testing
10 GigE LAN patterns	Seed A, seed B, PRBS 32 unscrambled
Error measurement (BERT)	Bit error, bit mismatch 0, bit mismatch 1
Traffic Scan	Discover multiple levels of VLAN channels (C-/S-/E-VLAN) including their ID and priority, as well as the total VLAN tagged frame count and associated bandwidth
VLAN stacking	Generates up to three levels of VLANs (including IEEE 802.1ad and Q-in-Q tagged VLAN)
VLAN preservation	Validate that CE-VLAN Tags Classes of Service (CoS) and ID are passed transparently
MPLS	Generates and analyzes streams with up to two layers of MPLS labels
Service disruption time (SDT)	Service disruption time measurements based on No Traffic mode, with statistics including longest disruption time, shortest, last, average, count, total, and pass/fail thresholds
IPv6 testing	Performs the following tests up to 10G over IPv6, EtherSAM, RFC 2544, BERT, traffic generation and monitoring, through mode, intelligent auto discovery, ping and trace route
10 GigE WAN testing	Includes WAN interface sublayer, J0/J1 trace and C2 label generation and 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
TCP throughput	True wire-speed, stateful TCP throughput test based on RFC 6349 for undisputable SLA enforcement of Ethernet services
Error measurement	Jabber/giant, runt, undersize, oversize, FCS, symbol, alignment, collision, late collision, excessive collision, IP checksum, UDP checksum, TCP checksum and 10G block error
Alarm detection	LOS, link down, pattern loss, frequency, LOC, 10G local/remote fault
Flow control statistics	Injects or monitors pause frames, including frame counts of pause, abort frames and total, last, maximum and minimum pause time
1588 PTP	Validates 1588 PTP packet network synchronization services, emulates PTP clients, generates and analyzes messages between master/clients, clock quality level and IPDV
SyncE	Validates SyncE frequency, ESMC messages and clock quality levels
Carrier Ethernet OAM	Fault-management and performance-monitoring Ethernet and MPLS-TP OAM protocols, including ITU-T Y.1731, IEEE 802.1ag, MEF, Link OAM (802.3ah) and ITU-T G.8113.1 OAMs; addresses metro Ethernet networks; supports continuity check, loopback, link trace, test, frame delay, frame loss and synthetic loss functions, as well as AIS, CSF, RDI, and LCK alarm generation and monitoring
Traffic filtering	Incoming traffic analysis and statistics according to a set of up to 10 configurable filters; filters can be configured for MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TCP source/destination port and UDP source/destination port; VLAN filtering can be applied to any of the stacked VLAN layers
Advanced filtering	Ability to enhance the filters with up to four fields each, which can be combined with AND/OR/NOT operations; a mask is also provided for each field value to allow for wild cards; complete statistics are gathered for each defined filter
Data capture	Full-line-rate data capture and decoding at up to 10G; configuration of detailed capture filters and triggers, as well as capture slicing parameters
IP tools	Performs ping and traceroute functions
Smart Loopback	Returns Ethernet traffic to the local unit by swapping packet overhead up to layer 4
Cable testing	Category 5 cable (or better), 100 UTP/STP cable, ≤120 meters
FTTA	
CPRI layer-2 protocol testing	Supports BTS and RRH emulation modes by supporting start-up sequence states, autodetection of protocols, negotiated parameters for control and maintenance, Ethernet and HDLC channels, hyperframe and codeword counts, injection, and monitoring of layer-1 alarms and frequency
CPRI SDT	Measurements in milliseconds (ms) for the longest, shortest, last, average, total and count of disruptions
CPRI RTD	Determine the CPRI protocol round-trip delay measurement

EXFO

SONET/SDH FUNCTIONAL SPECIFICATIONS

SONET		SDH	
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
Clocking	Internal, loop-timed, external (BITS)	Clocking	Internal, loop-timed, external (MTS/SETS), 2 MHz
Mappings			
VT1.5	Bulk	AU-3-TU-11, AU-4-TU-11	Bulk
VT2	Bulk	AU-3 -TU-12, AU-4-TU-12	Bulk
STS-1 SPE	Bulk	AU-3, AU-4-TU-3	Bulk
STS-3c	Bulk	AU-4	Bulk
STS-12c/48c/192c, SPE	Bulk	AU-4-4c/16c/64c	Bulk
SONET overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5, N1, N2, Z6, Z7	SDH overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1, G1, F2, F3, K3, N1, N2, K4, E2, J1, C2, H4
Error insertion			
OC-1, OC-3, OC-12, OC-48, OC-192	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error	STM-0, STM-1, STM-4, STM-16, STM-64	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error
Error measurement			
OC-1, OC-3, OC-12, OC-48, OC-192	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error	STM-0, STM-1, STM-4, STM-16, STM-64	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error
Alarm insertion			
OC-1, OC-3, OC-12, OC-48, OC-192	LOS, LOF-S, SEF, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, UNEQ-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, pattern loss	STM-0, STM-1, STM-4, STM-16, STM-64	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-UNEQ, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, pattern loss
Alarm detection			
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-PSD, PLM-P, UNEQ-P, TIM-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, TIM-V, PLM-V, pattern loss	STM-0, STM-1, STM-4, STM-16, STM-64	LOS, RS-LOF, LOC, RS-OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-RDI, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-PLM, HP-UNEQ, HP-TIM, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, LP-TIM, LP-PLM, pattern loss
	Frequency alarms on all supported interfaces		
Patterns			
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		

EXFO

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.
Performance monitoring	The following ITU-T recommendations, and corresponding performance monitoring parameters, are supported:

ITU-T recommendation   **Performance monitoring statistics**
- G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM
- G.826 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER
- G.828 — ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI
- G.829 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER
- M.2100 — ES, SES, UAS
- M.2101 — ES, SES, BBE, UAS

Pointer adjustment and analysis	Generation and analysis of HO/AU and LO/TU pointer adjustments as per GR-253, and ITU-T G.707

Generation
› Pointer increment and decrement
› Pointer jump with or without NDF
› Pointer value

Analysis
› Pointer increments
› Pointer decrements
› Pointer jumps (NDF, no NDF)
› Pointer value and cumulative offset

Pointer sequence testing	Performs pointer sequence testing as per G.783, GR253 and T1.105-3 standards.
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 provided on all supported Power Blazer interfaces and mappings. Measurements: last, minimum, maximum, average; measurement count: no. of successful RTD tests and failed measurement count.
APS message control and monitoring	Ability to monitor and set up automatic protection switching messages (K1/K2 byte of SONET/SDH overhead).
Synchronization status	Ability to monitor and set up synchronization status messages (S1 byte of SONET/SDH overhead).
Signal label control and monitoring	Ability to monitor and set up payload signal labels (C2, V5 byte of SONET overhead).
Tandem connection monitoring (TCM) [a]	Tandem connection monitoring (TCM) is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The Power Blazer 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
Through mode	Performs Through mode analysis of any incoming 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-T G.707 option 2.

FIBRE CHANNEL FUNCTIONAL SPECIFICATIONS

Testing 1x, 2x, 4x, 8x, 10x, 16x

BERT	Framed FC2
Patterns (BERT)	PRBS 2E31-1, 2E23-1, 2E20-1, 2E15-1, 2E11-1, 2E9-1, one user-defined pattern and the 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
Buffer-to-buffer credit testing	Buffer-to-buffer credit estimation based on latency
Latency	Round-trip latency

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ELECTRICAL INTERFACES

The following section provides detailed information on all supported electrical interfaces.

SYNCHRONIZATION INTERFACES

	External Clock DS1/1.5M	External Clock E1/2M	2 MHz
Tx pulse amplitude (V)	2.4 to 3.6	2.37	0.75 to 1.5
Tx pulse mask	GR-499 figure 9.5	G.703 figure 15	G.703 figure 20
Tx LBO pre-amplification (typical) (dBdsx)	0.6 for 0 to 40.5 m (0 to 133 ft) 1.2 for 40.5 to 81.1 m (133 to 266 ft) 1.8 for 81.1 to 121.6 m (266 to 399 ft) 2.4 for 121.6 to 162.5 m (399 to 533 ft) 3 for 162.5 to 200 m (533 to 655 ft)		
Rx-level sensitivity	TERM: ≤6 dB (cable loss only) (at 772 kHz for T1) DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB)	TERM: ≤6 dB (cable loss only) MON: ≤26 dB (resistive loss + cable loss ≤ 6 dB)	≤6 dB (cable loss only)
Transmission bit rate	1.544 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	
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	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	
Line coding	AMI and B8ZS	AMI and HDB3	
Input impedance (resistive termination)	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced
Connector type	SMB [a]	SMB [b]	SMB [b]

REF-OUT INTERFACE

Tx pulse amplitude	400 ± 200 mVpp
Transmission frequency	155 MHz to 3.5 GHz
Output configuration	AC-coupled
Load impedance	50 Ω
Maximum cable length	1 m
Connector type	SMA

Notes

a. Specification measured with 100 Ω Bantam cable.
b. SMB to BNC adapter is available.

MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

Size (H x W x D)		96 mm x 25 mm x 280 mm	(3 ¾ in x 1 in x 11 in)
Weight		0.55 kg	(1.2 lb)
Temperature	operating storage	0 °C to 40 °C −40 °C to 60 °C	(32 °F to 104 °F) (−40 °F to 140 °F)

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ORDERING INFORMATION

IQS-8830NGE-XX-XX-XX-XX-XX-XX-XX-XX
FTB-8830NGE-XX-XX-XX-XX-XX-XX-XX-XX

Model
FTB-8830NGE = Base HW model
FTB-8830NGE-16X = HW option for FC16X support

Ethernet Rate Options
GigE Bundle = 10/100/1000 BASE-T, 100BASE-FX (optical),
1000BASE-X (optical)
10GigE = 10G LAN and 10G WAN

SONET/SDH Rate Options [a]
2.5G Bundle = OC-1/STM-0, OC3/STM-1, OC-12/STM-4, OC-48/STM-16
9953M = OC-192/STM-64

Fibre Channel Rate Options
00 = No Fibre Channel option
FC1X = 1x Fibre Channel interface [b]
FC2X = 2x Fibre Channel interface [b]
FC4X = 4x Fibre Channel interface [b]
FC8X = 8x Fibre Channel interface [c]
FC10X = 10x Fibre Channel interface [c]
FC16X = 16x Fibre Channel interface [d]

OTN Rate Options
00 = No OTN option
OTU1 = OTN optical rate of 2.666 Gbit/s
OTU2 = OTN optical rate 10.709 Gbit/s
OTU2-1e-2e = OTN optical rates of 11.049/11.096 Gbit/s
OTU2-1f-2f = OTN optical rates of 11.270/11.318 Gbit/S

CPRI Rate Options [c]
CPRI-OBSAI = Enables 1.2G to 3.1G CPRI, and 3.1G OBSAI [b]
CPRI-1.2G
CPRI-4.9G
CPRI-6.1G
CPRI-9.8G
CPRI_ALLRATES

Ethernet Options
00 = No Ethernet option
ADV-FILTERS = Advanced filtering [e]
ETH-CAPTURE = Full-line-rate packet capture [e]
ETH-OAM = Enables four OAM modes, including Y.1731,
802.1ag, MEF and G.8113.1 [e]
LINK-OAM = Enables 802.3ah Link OAM [e]
IPV6 = Internet protocol version 6 [e]
ETH-THRU = Through mode capability [f]
MPLS = Enables MPLS [e]
1588PTP = Generates and analyzes 1588 PTP [e]
SyncE = Generates and analyzes SyncE protocol [e]
Cable_Test = Cable test [f]
TCP-THPUT = Enables TCP throughput measurements [f]
TRAFFIC-SCAN = Discover and monitor VLAN
traffic flows on a live signal [e]
DUAL-PORT = 10 GigE dual-port testing [e]
iSAM = Enables simplified ITU-T 1564 test [e]
RFC6349 = Enables TCP testing as per RFC 6349 [e]

SONET/SDH Options and Mapping
00 = Without SONET/SDH software option
SONET = SONET-BASE and mapping [g]
SDH = SDH-BASE and mapping [g]
SONET-SDH = SONET and SDH combo software [g]
TCM = Tandem connection monitoring [h]

OTN Options
00 = No OTN option
ODUMUX = 10G single ODU multiplexing [i]

Example: FTB-8830NGE-10GigE-9953M-FC10X-OTU2-SONET-SDH-ETH-CAPTURE

Notes
a. Requires SONET, SDH or SONET-SDH option.
b. Requires purchase of SFP.
c. Requires purchase of SFP+.
d. Requires FTB-8830NGE-16X HW.
e. Requires GigE bundle or 10 GigE.
f. Requires GigE bundle.
g. Requires enabling at least one of the following rate options: OTU1, OTU2, 2.5G Bundle or 9953M.
h. Requires enabling 2.5G bundle or 9953M rate.
i. Requires enabling OTU2.

SFP MULTIRATE OPTICAL TRANSCEIVERS

FTB-8590 = SFP module: Gig/FC/2FC, CPRI/OBSAI 2.45/3.07 Gbit/s at 850 nm, MM, <500 m reach
FTB-8690 = Multirate SFP supporting: GigE, 850 nm, LC connector, MMF, < 500 m reach
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 = Multirate Optical Transceiver; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1550 nm, LC connector, SMF, 80 km reach
FTB-8193 = Multirate SFP supporting: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1550 nm, LC connector, SMF, 40 km reach
FTB-85912 = SFP modules: GigE/FC/2FC/4FC at 850 nm, < 500 m reach
FTB-85913 = SFP modules: GigE/FC/2FC/4FC at 1310 nm, 4 km reach
FTB-85914 = SFP modules: GigE/FC/2FC/4FC at 1310 nm, 30 km reach
FTB-85915 = SFP modules: GigE/FC/2FC/4FC at 1550 nm, < 50 km reach
FTB-85919 = SFP copper, multirate 10/100/1000 BASE-T, Cat5 UTP 100 m reach

100M SFP SINGLE-RATE OPTICAL TRANSCEIVERS

FTB-85910 = Single-rate SFP supporting: 100BASE-FX, 1310 nm, LC connector, SMF, 2 km reach
FTB-85911 = Single-rate SFP supporting: 100BASE-FX, 1310 nm, LC connector, SMF, 15 km reach

1000M SFP BIDIRECTIONAL OPTICAL TRANSCEIVERS

FTB-8596 = Bidirectional SFP supporting: 1000BASE-BX10, 1490TX/1310RX, 10 km reach (should be paired and sold with the FTB-8597)
FTB-8597 = Bidirectional SFP supporting: 1000BASE-BX10, 1310TX/1490RX, 10 km reach (should be paired and sold with the FTB-8596)
FTB-8598 = Bidirectional SFP supporting: 1000BASE-BX40, 1310TX/1490/1550RX, 40 km reach (should be paired and sold with the FTB-8599)
FTB-8599 = Bidirectional SFP supporting: 1000BASE-BX40, 1550TX/1310RX, 40 km reach (should be paired and sold with the FTB-8598)

1000M SFP COPPER TRANSCEIVERS

SFP-85919 = SFP copper, multirate 10/100/1000 BASE-T, Cat5 UTP, 100 m reach

10G SFP+ MULTIRATE OPTICAL TRANSCEIVERS

FTB-8600 = SFP+ modules: CPRI 1.228 to 9.83 Gbit/s at 1310 nm, LC connector, 1.4 km reach
FTB-8690 = Multirate SFP+ supporting: 10 GigE LAN/WAN (9.95 to 10.3 Gbit/s), 850 nm, LC connector, MMF, 300 m reach (not rated for SONET/SDH)
FTB-8691 = SFP+ modules: 10 GigE at 1310 nm, 10 km reach
FTB-8693 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (8.5, 9.95 to 11.3 Gbit/s), 1310 nm, LC connector, SMF, 10 km reach
FTB-8694 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN (9.95 to 11.3 Gbit/s), 1550 nm, LC connector, SMF, 40 km reach
FTB-8695 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (9.95 to 11.3 Gbit/s), 1550 nm, LC connector, SMF, 80 km reach
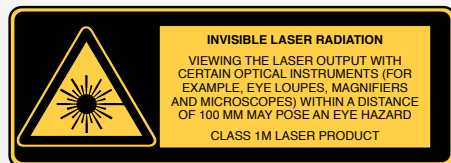
10G XFP MULTIRATE OPTICAL TRANSCEIVERS

FTB-81900 = Multirate XFP supporting: 10/10.7/10 GigE LAN-WAN, 1310 nm, LC connector, SMF, 10 km reach
FTB-81901 = Multirate XFP supporting: 10/10.7/10 GigE LAN-WAN, 1550 nm, LC connector, SMF, 40 km reach
FTB-81902 = Multirate XFP supporting: 10/10.7/10 GigE LAN-WAN, 1550 nm, LC connector, SMF, 80 km reach

10 GigE XFP OPTICAL TRANSCEIVERS

FTB-85900 = Single-rate XFP supporting: 10GBASE-SR/-SW, 850 nm, 10 GigE LAN/WAN, LC connector, MMF, < 500 m reach
FTB-85901 = Single-rate XFP supporting: 10GBASE-LR/-LW, 1310 nm, 10 GigE LAN/WAN, LC connector, SMF, 10 km reach
FTB-85902 = Single-rate XFP supporting: 10GBASE-ER/-EW, 1550 nm, 10 GigE LAN/WAN, LC connector, SMF, 40 km reach

LASER SAFETY

INVISIBLE LASER RADIATION

VIEWING THE LASER OUTPUT WITH
CERTAIN OPTICAL INSTRUMENTS (FOR
EXAMPLE, EYE LOUPES, MAGNIFIERS
AND MICROSCOPES) WITHIN A DISTANCE
OF 100 MM MAY POSE AN EYE HAZARD

CLASS 1M LASER PRODUCT

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**

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