

# FTB-88100NGE/88100G Power Blazer Series

HIGH-SPEED COMPACT MULTISERVICE TEST SOLUTION



Turnkey compact field-test solution for deploying and troubleshooting networks up to 100G

## KEY FEATURES AND BENEFITS

10M-to-100G compact multiservice field-test solution addressing testing, troubleshooting and performance assessment requirements of next-generation networks

Comprehensive and fully integrated test solution covering OTN, Ethernet and SONET/SDH technologies

Cost-effective, scalable and future-proof module with 10M-to-100G flexible offering as well as CFP and CFP2 transceiver coverage – no hardware upgrade, no return to factory required

Unprecedented testing simplicity requiring minimum training for new users and maintaining a consistent experience from the lab to the field

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

10G Dual Port Ethernet capabilities for simultaneous traffic generation and analysis at 100 % wire-speed at any packet size

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

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

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

100% line-rate testing of IP traffic at up to 100G and faster Ethernet service activation with EtherSAM (ITU-T Y.1564) service configuration and performance tests, complemented by Remote Discovery, Smart Loopback and Dual Test Set capabilities

Housed in either the compact FTB-2 Pro or the FTB-500 platform and complemented with integrated optical tools, battery operation, power-up and restore, remote access, GPS capabilities and test reports

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

## COMPLEMENTARY PRODUCTS



Platform  
FTB-2 Pro

Platform  
FTB-500

Optical Spectrum Analyzers  
FTB-5240S/BP



## HIGH-SPEED NETWORK ROLLOUT CHALLENGES

SLA CONFORMANCE	REDUCING CAPEX AND OPEX	ACCELERATING SERVICE TURN-UP
Carriers and service providers must support both legacy and packet-based services up to 100G on the same network. Since these services differ and have their own key parameters, the challenge lies in ensuring their service level agreements.	For service providers, bandwidth demands are increasing dramatically, while revenues are not. This means cutting equipment costs, reducing truck-rolls and dispatching technicians only when it is critical to do so.	40G/100G technology is complex and brings with it a number of new concepts, specifically parallel transmission and new pluggable optics or CFPs, which are in their early stages, in short supply and relatively high priced. To overcome these challenges, Carriers must reduce their time-to-service without compromising network performance and quality.

### Compact, Steel-Toed and Field-Ready

Rising to the multiservice field-testing challenges of today and offering the scalability to cover the unforeseeable future, EXFO's FTB-88100NGE (10M to 100G) and FTB-88100G (40G/100G) Power Blazer test modules have been designed to specifically address high-speed field deployments. Housing the FTB-88100NGE in EXFO's FTB-2 Pro platform provides the most compact 10M-to-100G field testing solution on the market and supports wide range of technologies, including legacy TDM and new packet-based services. This EXFO innovation sets a new benchmark: 10M-to-100G Ethernet, OTU1 to OTU4 (including standard and overclocked rates), OC-1/STM-0 to OC-768/STM-256—all in one compact, powerful solution. Furthermore, both the FTB-88100NGE and the FTB-88100G are EXFO Connect-ready, which means that both technicians and managers can reap the benefits of EXFO's FTB cloud-based services.

### A GAME CHANGER FOR HIGH-SPEED SERVICE DEPLOYMENT

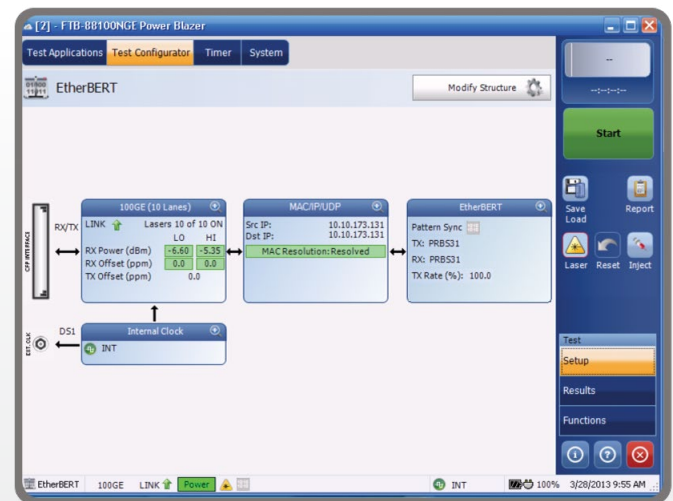
The FTB-88100NGE Power Blazer introduces new OPEX and CAPEX saving factors, as its FLEX configuration capitalizes on EXFO's flexible platform architecture to enable any testing capability from 10M to 100G, anywhere, anytime, with simple point-and-click to enable software options. This flexibility guarantees a cost-effective, future-proof offering and ensures immediate access to testing capabilities and faster service provisioning, while avoiding unnecessary costs for shipping back the test equipment.

In addition, since the FTB-88100NGE and the FTB-88100G are housed in the FTB-2 Pro compact platform, they provide you with the added benefits of EXFO's FTB Ecosystem—including EXFO Connect automated, cloud-based asset and test data management, in addition to EXFO's Update Manager software utility—allowing you to streamline test operations from build-out to maintenance.

### POWERFUL, YET SIMPLE

Regardless of the fact that high-speed technologies and next-generation networks are becoming more and more complex, the FTB-88100NGE and FTB-88100G Power Blazer modules address all field-testing needs up to 100 Gbit/s without sacrificing simplicity. Thanks to EXFO's highly intuitive graphical user interface (GUI), streamlined procedures and predefined configurations, it requires minimal to no training for new users. Furthermore, with unmatched connectivity via Wi-Fi, Bluetooth, Gigabit Ethernet or USB ports, the FTB-2 Pro Windows-based platform is accessible in any environment and at any time, reducing unnecessary Tier-2 technician dispatching and truck rolls to remote sites.

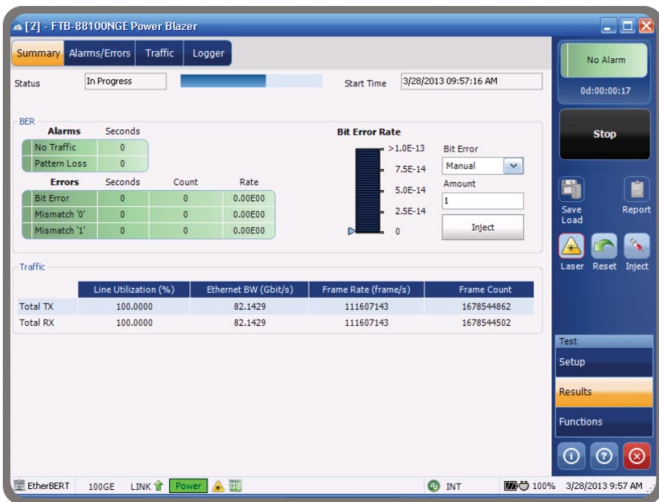
In addition, the FTB-500 platform allows you to customize your testing solution. Combine the FTB-88100NGE and the FTB-88100G Power Blazer modules with any EXFO optical module for fiber characterization and OSNR qualification, and run them simultaneously to speed up testing and accelerate time to service.



## SIMPLIFIED BER TESTING

With the FTB-88100NGE Power Blazer, you can preconfigure OTN (from OTU1 to OTU4, including standard and overclocked rates), Ethernet (from 10M to 100G), and SONET/SDH (from OC-3/STM-1 to OC-768/STM-256) bit-error-rate (BER) test parameters prior to arrival at the test site, and then load them from the Favorites menu with one click. The same flexibility is available on the FTB-88100G for supported 40G/100G rates, allowing for simple BER testing with no risk of misconfiguration between two remote sites.

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-88100NGE and FTB-88100G provide 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, easily understood notification, whether a given unit is in your hand or across the room.



## ETHERNET PERFORMANCE ASSESSMENT

The FTB-88100NGE and FTB-88100G offer an automated RFC 2544 test suite for all supported Ethernet interfaces on both modules 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 UDP or TCP layer, or all the way down to a completely promiscuous mode (Transparent Loopback), the FTB-88100NGE and FTB-88100G can adjust to all loopback situations where 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-88100NGE and FTB-88100G 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).



## 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-88100NGE Power Blazer module for 10M-to-100G 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 of sequentially testing each service. It validates that the service is properly provisioned and that all specific KPIs or SLA parameters are met.

### > 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.

In addition, EXFO's EtherSAM approach proves even more powerful as it executes the complete ITU-T Y.1564 test bidirectionally. 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.



## DUAL TEST SET

Whether the customer is using RFC 2544 or Y.1564 (EtherSAM) for service activation, both tests can be executed in Dual Test Set mode. In this case, two 40G/100G 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.

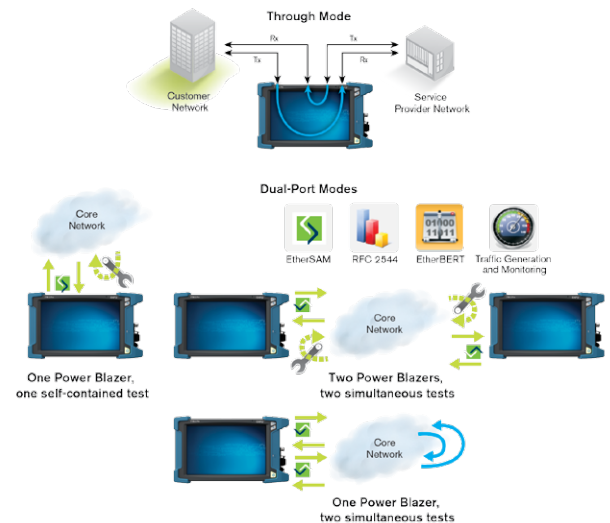
Results from both directions are sent and displayed on the local unit to ensure that the entire test routine can be completed by a single person in control of a single unit, thus resulting in shorter test time and reduced manpower. This flexibility also guarantees that different units can be set as a 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.



## DUAL-PORT AND THROUGH MODE TESTING

The FTB-88100NGE Power Blazer Series is equipped for both Through mode and dual-port testing. Through mode allows traffic to pass through the Power Blazer's two 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 Power Blazer module to launch the test and perform a bidirectional EtherSAM or RFC-2544 test, this removes the need for a second unit and provides Ethernet statistics on both segments of the network simultaneously, quickly pinpointing the direction in which issues occur.



## ETHERNET TRAFFIC GENERATION AND MONITORING

Data services Carrier over 40G/100G networks are making a significant shift toward supporting a variety of applications. Multiservice offerings such as triple-play services have fuelled the need for QoS testing to ensure the condition and reliability of each service as well as quality SLA parameters. The FTB-88100NGE and FTB-88100G Power Blazer, with their supported traffic generation and monitoring application, allow 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. 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 every single one. The FTB-88100NGE and FTB-88100G 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-88100NGE and FTB-88100G also simultaneously measure 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 (Y.1731, 802.1ag, MEF) and MPLS-TP (G.8113.1) OAMs.

## VLAN/MPLS

To meet the high performance expectations for today's networks, 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-88100NGE supports virtual local area network (VLAN) tags, Q-in-Q VLAN tags, VLAN preservation and multiprotocol label switching (MPLS).

## SIMPLIFIED ERROR INJECTION

The FTB-88100NGE and FTB-88100G Power Blazer modules enable error and alarm injection with a single click from any screen, allowing you to ensure circuit continuity prior to starting a test. This capability applies to single optical channels when addressing testing interfaces from 10M to 100G on the FTB-88100NGE and 40G/100G on the FTB-88100G, and extends to four or ten optical channels for 40G and 100G when using parallel CFPs. Furthermore, this functionality can be preprogrammed for any type of error, not just bit errors. In addition, alarm injection can be selected per lane, and not necessarily on all lanes simultaneously.

## COMPLETE OVERHEAD MANIPULATION AND MONITORING

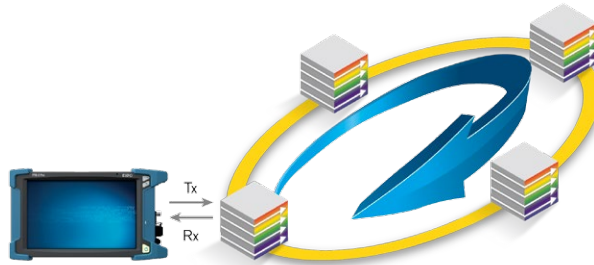
EXFO's FTB-88100NGE and FTB-88100G modules allow for complete OTN and SONET/SDH overhead manipulation and monitoring for advanced testing and troubleshooting. Furthermore and consistent with this module's simplified testing approach, the overhead manipulation and monitoring capability is categorized under *Functions* in the GUI and are apart from the default setup and results pages. The Functions category offers various 40G/100G testing capabilities required by Tier-2 engineers for advanced field troubleshooting.

OTU3/ODU3		Default OTN OH																			
TX	1	OA1		OA2		MFAS	SM	GCC0		RES		RES		JC							
	2	F6	F6	28	28	28	TTI BIP-8	00	00	00	00	00	00	00	00						
	3	RES	PM & TCM	TCM ACT	TCM6		TCM5		TCM4		FTFL		RES		JC						
	4	00	00	00	00	00	TTI BIP-8	00	00	00	00	00	00	00	00						
RX	1	OA1		OA2		MFAS	SM	GCC0		RES		RES		JC							
	2	RES	PM & TCM	TCM ACT	TCM6		TCM5		TCM4		FTFL		RES		JC						
	3	TTI BIP-8	00	00	00	00	TTI BIP-8	00	00	00	00	00	00	00	00						
	4	GCC1	GCC2	APS/PPC		RES		PSI <<<		NJO											
RX OH		OA1		Bits 1-8																	
Byte Details:		00		--																	
						Legend TX/RX: OTU FAS ODU OH OTU OH OPU OH															

## 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-88100NGE and FTB-88100G Power Blazer modules enable OTN, SONET/SDH and Ethernet delay measurements across all supported testing interfaces, enabling Carriers to solidify their competitive advantage when building low-latency optical transport networks, and guarantee the speed of service to their end customers.

This functionality measures the time required for a bit to travel from the transmitter of the FTB-88100NGE or the FTB-88100G and back to the receiver after crossing a far-end loopback, thereby providing complete delay results including delay measurement and min./max./average delay statistics.



## EFFICIENTLY ASSESSING PERFORMANCE OF FIBRE CHANNEL SERVICES

The Power Blazer 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 Power Blazer Series modules provide full wire-speed traffic generation at the FC-2 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.

#### 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 Fibre Channel 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, 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 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

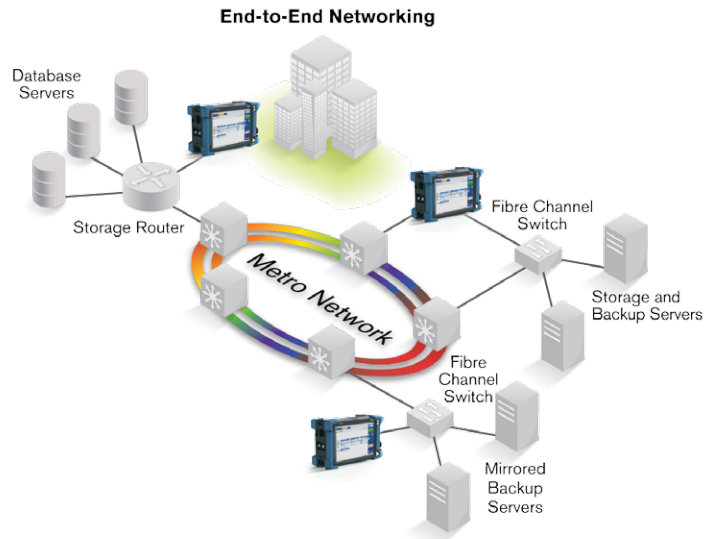
Most new-generation transport devices (xWDM or SONET/SDH mux) supporting Fibre Channel are no longer fully transparent; they also have increased built-in intelligence, acting more as Fibre Channel switches. With switch fabric login ability, the Power Blazer Series modules support connections to a remote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

### 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 Power Blazer 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.*

## RAPID DIAGNOSTIC TEST TOOLS

### Per-Wavelength Laser Control and Power Measurements

Verifying the power level may seem obvious, but it is a vital step often omitted due to lack of convenience or test equipment. The built-in power-measurement capability of the FTB-88100NGE and FTB-88100G enables you to accurately test per-channel ingress and egress levels without risking damage to expensive 40G/100G circuit packs caused by high power, or signal degradation resulting from low power on any of the transmitted optical channels.

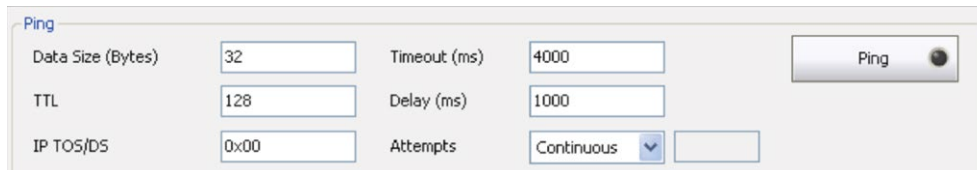


### Per-Lane Frequency and Offset Measurements

Along with optical power measurements, frequency accuracy verification is a good sanity check to determine network health prior to BER testing during 40G/100G network commissioning. The FTB-88100NGE and FTB-88100G Power Blazer modules offer per-lane frequency and frequency offset testing capabilities to verify that the NE's clock recovery circuitry is operating accurately.

### IP Connectivity Tools

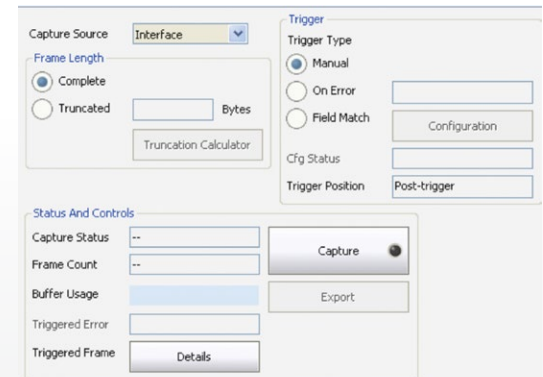
As part of the IP connectivity tools, the ping tool is used to verify that the user can reach a specific address within or outside of a subnetwork. The traceroute tool is a modified version of the ping tool and is used to determine the route or the number of hops that are required to reach a destination host. These basic tools, which are supported on the FTB-88100NGE and FTB-88100G Power Blazer modules, are essential when testing through 40G/100G routed networks. The results of these tests can pinpoint critical configuration issues within the network.



## ADVANCED TROUBLESHOOTING TOOLS

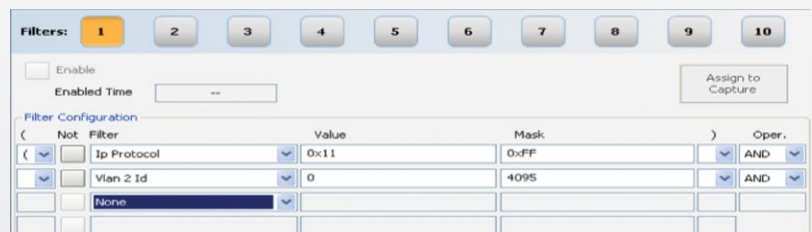
### Capturing

The capturing power of EXFO's FTB-88100NGE and FTB-88100G extends far beyond basic capabilities. The module adds extra features and functionalities to boost test cycle efficiency and provide more value. Its packet capture tool offers comprehensive filtering, triggering and truncation methods to target specific traffic and quickly pinpoint issues in the lab and in the field.



### Advanced Traffic Filtering

In some cases, troubleshooting only concerns a particular traffic flow. The advanced traffic-filtering capability of the FTB-88100NGE and FTB-88100G allows you to restrict traffic by using up to four trigger fields and operands (and, or, not). A complete set of triggers is available, such as MAC, IP and TCP/UDP fields, as well as VLAN, MPLS fields.





## CFP Health Check

The FTB-88100NGE and FTB-88100G also offer 40G/100G CFP health check testing capabilities. Unlike the single wavelength transceiver used in legacy 2.5G and 10G networks, each CFP parallel optical channel must be monitored for transmitted and received power levels to avoid damaging expensive 100G circuits and equipment. Moreover, each parallel lane must be monitored for frequency and frequency offset to ensure proper clock and timing recovery.

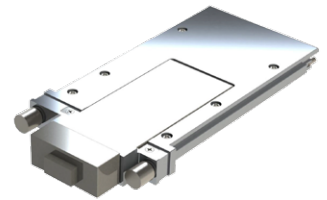


The CFP information page now provides detailed information on the module, no longer requiring the removal of the CFP to read the CFP module details. Complete management data input/output (MDIO) read/write access has also been given, allowing advanced network engineers to verify the management interface in the CFP through a registered access, as per the CFP Multi-Source Agreement (MSA). For example, access to the MDIO allows the user to read the CFP operational temperature when needed for troubleshooting purposes.

The FTB-88100NGE and FTB-88100G also include a 100G automated stress-test application that covers transmission tolerance tests like static skew measurement, crosstalk, electrical amplitude and pattern dependency. Essentially, all manual interventions have been removed, thus simplifying the CFP qualification process. In short, this tool will allow Carriers to ensure the optimal performance of 100G networks during evaluation and deployments.

## CFP2—THE SECOND-GENERATION HIGH-SPEED TRANSCEIVERS

In today's competitive market, service providers strive to meet their bandwidth requirements by upgrading their networks to higher speeds. Taking this into consideration, network element manufacturers (NEM) have shifted their 100G development to leverage the second-generation high-speed transceivers known as CFP2s. These new CFP2 transceivers have the significant advantages of being 50% smaller in form factor and saving more than 50% on power consumption when compared to first-generation transceivers (CFP). They also enable higher port density on high-speed transmission, switching and routing systems required for 100G mass deployments.



EXFO's FTB-88100NGE/88100G Power Blazer modules offer 100G testing capabilities for CFP2 transceivers thanks to the new FTB-85970 CFP-to-CFP2 adapter, which requires no additional high-speed modules. This CFP-to-CFP2 adapter provides the flexibility needed to support the industry's different implementations of 100G transceivers, including the 4x25G and 10x10G. Customers can therefore have full access to 100G testing capabilities on their lab unit using both CFP and CFP2 transceivers at a fraction of the cost of upgrading their full fleet of test units to dedicated CFP2-based modules. This unique offering on the market ensures a maximum ROI and eliminates the need for multiple test modules.



**EXFO TFv**  
Test Function Virtualization

### 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.

**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.



**10M-TO-100G KEY FEATURES<sup>a</sup>****Ethernet**

Rates	10/100/1000M Base-T, 100M (optical) GigE, 10 GigE LAN/WAN, 40 GigE and 100 GigE
Power measurement	Optical channel power measurement with color indicators
Frequency measurement	Clock frequency measurements displayed in Hz
EtherSAM (ITU-T Y.1564)	Service configuration tests, including ramp and burst tests, as well as the service performance test as per EtherSAM (ITU-T Y.1564) up to 100G with VLAN preservation; tests can be performed in Loopback or Dual Test Set mode for bidirectional results
RFC 2544	Throughput, back-to-back, frame loss and latency measurements according to RFC 2544; frame size: RFC-defined or user-configurable between one to seven sizes
Smart loopback	Returns Ethernet traffic to the local unit by swapping packet overhead up to layer 4
Dual test set	Complementing RFC 2544 and EtherSAM (ITU-T Y.1564) for bidirectional measurements, including one-way latency
Intelligent autodiscovery	Offers intelligent autodiscovery of other EXFO modules, allowing a single user to perform end-to-end testing
BER testing	Up to layer 4 supported with or without VLAN Q-in-Q
10 GigE Dual Port test	EtherSAM (ITU-T Y.1564) and RFC2544 Dual Port topology testing with bidirectional measurements
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
Frame size	Fixed (from 64 to 16 000 bytes), Random and Sweep (from 64 to 16 000 bytes)
VLAN stacking	Generates up to three layers of VLAN (including IEEE 802.1ad Q-in-Q tagged VLAN)
VLAN preservation	Monitoring and analysis of VLAN information presentation including VLAN priority CoS and ID
Ethernet statistics	Multicast, broadcast, unicast, N-unicast, pause frame, frame size distribution, bandwidth, utilization, frame rate, frame loss, out-of-sequence frames and in-sequence frames
Packet jitter statistics	Delays variation statistics (ms): min., max., last, average and jitter measurement estimate (RFC 3393)
Flow control statistics	Injects or monitors pause frames, including frame counts of pause, abort frames and total, last, maximum and minimum pause time
Service disruption time (SDT)	No Traffic mode up to 10G; disruption time statistics include shortest, longest, last, average, total and count
Auto-negotiation	Capability to auto-negotiate the rate, duplex and flow control capabilities with another Ethernet port
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	Capability 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
MPLS	Generates and analyzes streams with up to two layers of MPLS labels
IPv6 testing	Performs the following tests up to 100G over IPv6, EtherSAM, RFC 2544, BERT, traffic generation and monitoring, Through mode, intelligent autodiscovery, ping and traceroute
IP tools	Performs ping and traceroute functions
Signal label control and monitoring	Configuration and monitoring of J0 trace, J1 trace and payload signal label C2 (WAN) for 10 GigE
DHCP client	Connection to a DHCP server to obtain its IP address and subnet mask to connect to the network
TCP throughput	True wire-speed, stateful TCP throughput test based on RFC 6349 for undisputable SLA enforcement of Ethernet services
Cable testing	Category 5 cable (or better), 100 UTP/STP cable, ≤120 meters
Through mode	Sectionalizes traffic between a service provider's network and customer premises equipment
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 Y.1731, 802.1ag, MEF, and G.8113.1 OAMs. Addresses metro Ethernet networks. Supports Continuity Check, Loopback, Link Trace, Test, Frame Delay, Frame Loss, Synthetic Loss functions, and AIS, CSF, RDI, and LCK alarms generation and monitoring

**Note**

a. 10M-to-10G test capabilities are only supported on the FTB-88100NGE Power Blazer module.

**10M-TO-100G KEY FEATURES (CONT'D) <sup>a</sup>****OTN**

Rates	OTU1 (2.7 Gbit/s), OTU2 (10.7 Gbit/s), OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s), OTU3 (43 Gbit/s), OTU3e1 (44.57 Gbit/s), OTU3e2 (44.58 Gbit/s) and OTU4 (111.82 Gbit/s)
Power measurement	Optical channel power measurement with color indicators
Frequency measurement	Clock frequency measurements displayed in Hz
Frequency offset	Offsetting of the transmitted signal's clock on a selected interface, and monitoring to exercise clock recovery circuitry on network elements
Alarms and errors	Generation and analysis of OTL, OTU, ODU and OPU alarms and errors
Forward error correction (FEC)	Generation and analysis of FEC correctable and uncorrectable errors
Service disruption time (SDT)	Measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels
Round-trip delay (RTD)	Measures the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback
ODU0	ODU0 (1.25 Gbit/s) container with Gigabit Ethernet, SONET/SDH client signal mapping and PRBS pattern
ODUflex	ODUflex with Ethernet client signal mapping and PRBS pattern
ODU multiplexing	ODU3 single and multistage multiplexing down to ODU0, ODU1 into ODU2 PT-20 and PT-21
Client mappings	SONET/SDH, GigE and 10 GigE client mappings into OPU payloads
Through mode	Ability to perform intrusive and transparent Through mode analysis of any OTN signal

**SONET/SDH**

Rates	OC-1/STM-0, OC3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64, OC-768/STM-256
High-order mappings	STS-1/3c/12c/48c/192c/768c and AU-3/AU-4/AU-4-4c/16c/64c/256c
Low-order mappings	VT1.5, TU-11/12/3
Power measurement	Optical channel power measurement with color indicators
Frequency measurement	Clock frequency measurements displayed in Hz
Frequency offset	Offsetting of the transmitted signal's clock on a selected interface, and monitoring to exercise clock recovery circuitry on network elements
Performance monitoring	G.821, G.826, G.828, G.829, M.2100, M.2101
Pointers	Generation and analysis of STS/AU and VT/TU pointer adjustments as per GR-253, and ITU-T G.707
Service disruption time (SDT)	The SDT 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
Round-trip delay (RTD)	The RTD test tool measures the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback
Automatic protection switching (APS)	Ability to monitor and set up automatic protection switching messages (K1/K2 byte of SONET/SDH overhead)
Programmable errors/alarms	Ability to inject errors/alarms in the following modes: Manual, Constant Rate, Burst (Periodic and Continuous)
Through mode	Ability to perform intrusive and transparent Through mode analysis of any SONET/SDH signal
Payload block and replace	Ability to terminate and analyze a specific high-order path element and replace it with a PRBS pattern on the Tx side

**Note**

a. 10M-to-10G test capabilities are only supported on the FTB-88100NGE Power Blazer module.

## ORDERING INFORMATION

## FTB-88100NGE-XX-XX-XX-XX-XX-XX-XX

**Ethernet Rate Options**

**GigE Bundle** = 10/100/1000 BASE-T, 100BASE-FX (optical),  
1000BASE-X (optical)  
**10GigE** = 10G\_LAN and 10G\_WAN  
**40GE** = Ethernet optical rate of 41.25 Gbit/s  
**100GE** = Ethernet optical rate of 103.125 Gbit/s

**SONET/SDH Rate Options**<sup>a</sup>

**2.5G Bundle** = 52M (OC-1/STM-0), 155M (OC-3/STM-1),  
622M (OC-12/STM-4), 2488M (OC-48/STM-16)  
**9953M** = 9953M (OC-192/STM-64)  
**40G** = 39.81G (OC-768/STM-256)

**Fibre Channel Rate Options**

**00** = No Fibre Channel option  
**FC1X** = 1x Fibre Channel interface<sup>b</sup>  
**FC2X** = 2x Fibre Channel interface<sup>b</sup>  
**FC4X** = 4x Fibre Channel interface<sup>b</sup>  
**FC8X** = 8x Fibre Channel interface<sup>c</sup>  
**FC10X** = 10x Fibre Channel interface<sup>c</sup>

**OTN Rate Options**

**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  
**OTU3** = OTN optical rate of 43.018 Gbit/s  
**OTU3-e1-e2** = OTN optical rates of 44.57 Gbit/s and 44.58 Gbit/s  
**OTU4** = OTN optical rate of 111.81 Gbit/s

**Ethernet Options**

**00** = No Ethernet option  
**ADV-FILTERS** = Advanced filtering  
**DUAL-PORT** = 10 GigE Dual Port testing<sup>d</sup>  
**ETH-CAPTURE** = Full-line-rate packet capture  
**ETH-OAM** = Enables four OAM modes, including Y.1731, 802.1ag,  
MEF and G.8113.1<sup>d</sup>  
**IPV6** = Internet protocol version 6<sup>d</sup>  
**IPV6\_40-100GE** = 40GE and 100GE IPv6 internet protocol version 6<sup>i</sup>  
**ETH-THRU** = Through mode capability<sup>d</sup>  
**MPLS** = Enables MPLS<sup>d</sup>  
**1588PTP** = Generates and analyzes 1588 PTP<sup>d</sup>  
**SyncE** = Generates and analyzes SyncE protocol<sup>d</sup>  
**Cable\_Test** = Cable test<sup>e</sup>  
**TCP-THPUT** = Enables TCP throughput measurements<sup>e</sup>

**OTN Options**

**00** = No OTN option  
**EoOTN** = Ethernet mapping over OTN<sup>f</sup>  
**ODUMUX** = Single and multistage ODU multiplexing<sup>f</sup>  
**ODU0** = ODU0 (1.25 Gbit/s) mapping<sup>g</sup>  
**ODUflex** = ODUflex functionality<sup>g</sup>  
**OTN-INTR-THRU** = OTN intrusive Through mode<sup>f</sup>

**SONET/SDH Options and Mapping**

**00** = Without SONET/SDH software option  
**SONET** = SONET-BASE and mapping<sup>h</sup>  
**SDH** = SDH-BASE and mapping<sup>h</sup>  
**SONET-SDH** = SONET and SDH combo software<sup>h</sup>  
**SONETSDH-INTR-THRU** = SONET/SDH intrusive Through mode<sup>a</sup>  
**TCM** = Tandem connection monitoring<sup>i</sup>

Example: FTB-88100NGE-100GE-40G-FC10X-OTU3-SONET-SDH-EoOTN-ETH-CAPTURE

**Notes**

- a. Requires SONET, SDH or SONET-SDH option.
- b. Requires purchase of SFP.
- c. Requires purchase of SFP+.
- d. Requires GigE bundle or 10 GigE.
- e. Requires GigE bundle.
- f. Requires enabling OTU3 and/or OTU2 rates.
- g. Requires enabling ODUMUX OTN option.
- h. Requires enabling OTU3 and/or 40G SONET/SDH rates.
- i. Requires enabling 2.5G bundle or 9953M rate, or OTU3 with SONET or SDH or SONET-SDH.
- j. Requires 40 GigE or 100 GigE.



## ORDERING INFORMATION

## FTB-88100G-XX-XX-XX-XX-XX-XX

## Model ■

## Ethernet Rate Options ■

40GE = Ethernet optical rate of 41.25 Gbit/s

100GE = Ethernet optical rate of 103.125 Gbit/s

SONET/SDH Rate Options <sup>a</sup> ■

40G = 39.81G (OC-768/STM-256)

## OTN Rate Options ■

OTU3 = OTN optical rate of 43.018 Gbit/s

OTU3-e1-e2 = OTN optical rates of 44.57 Gbit/s and 44.58 Gbit/s

OTU4 = OTN optical rate of 111.81 Gbit/s

## Ethernet Options

00 = No Ethernet option

ADV-FILTERS = Advanced filtering

ETH-CAPTURE = Full-line-rate packet capture

IPV6\_40-100GE = 40GE and 100GE IPv6 internet protocol version 6<sup>f</sup>

## OTN Options

00 = No OTN option

EoOTN = Ethernet mapping over OTN<sup>b</sup>ODUMUX = Single and multistage ODU multiplexing<sup>b</sup>ODU0 = ODU0 (1.25 Gbit/s) mapping<sup>c</sup>ODUflex = ODUflex functionality<sup>c</sup>OTN-INTR-THRU = OTN intrusive Through mode<sup>b</sup>

## SONET/SDH Options and Mapping

SONET = SONET-BASE and mapping<sup>d</sup>SDH = SDH-BASE and mapping<sup>d</sup>SONET-SDH = SONET and SDH combo software<sup>d</sup>SONETSDH-INTR-THRU = SONET/SDH intrusive Through mode<sup>a</sup>TCM = Tandem connection monitoring<sup>e</sup>

Example: FTB-88100G-100GE-40G-OTU3-SONET-SDH-EoOTN-ETH-CAPTURE

## Notes

- Requires SONET, SDH or SONET-SDH option.
- Requires enabling OTU3 rate.
- Requires enabling ODUMUX OTN option.
- Requires enabling OTU3 and/or 40G SONET/SDH rates.
- Requires enabling OTU3 or OTU4, and SONET or SDH or SONET-SDH.
- Requires 40 GigE or 100 GigE.

## 40G/100G PLUGGABLE TRANSCEIVERS (CFPS)

FTB-85951 = 100G BASE-LR10 dual-rate (100GE, OTU4) CFP (10 x 10G WDM, 10 km)

FTB-85953 = 100G BASE-LR10 dual-rate (100GE, OTU4) CFP (10 x 10G WDM, 2 km)

CFP-85954 = 40 Gbit/s Ethernet and OTN transceiver (4 x 10G WDM, 10 km)

FTB-85955 = 100G BASE-LR4 dual-rate (100GE, OTU4) CFP (4 x 28G WDM, 10 km), low power

FTB-85958 = 100G BASE-LR4 dual-rate (100GE, OTU4) CFP (4 x 28G WDM, 10 km)

FTB-85960 = 40G BASE-FR multirate (OC-768/STM-256, OTU3, OTU3e1-e2) serial CFP (1550 nm, 2 km)

CFP-85961 = 100GBASE-SR10 dual-rate (100GE/OTU4) CFP (10 x 10G) MMF, 100 m reach)

## 100G PLUGGABLE TRANSCEIVERS (CFP2S)

FTB-85970 = CFP-to-CFP2 adapter supporting 4x25G and 10x10G CFP2 transceiver implementations

CFP2-85974 = 100GBASE-SR10 dual-rate (100GE/OTU4) CFP2 (10x10G MMF, 100 m reach)

CFP2-85975 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP2 (4x28G LAN-WDM, 10 km reach)

CFP2-85978 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP2 (4x28G LAN-WDM, 10 km reach)

## ACCESSORIES

TJ-MP24-LB = MPO-24 Loopback Multimode 24 Fiber 50/125 μm CXP Pin Out

TJ-MP24-MP24-5M = MPO-24 to MPO-24 Multimode Fiber Ribbon, 5 m

## SFP MULTIRATE OPTICAL TRANSCEIVERS

FTB-8690 = Multirate SFP supporting: GigE, 850 nm, LC connector, MMF, < 500 m reach  
 FTB-8190 = Multirate SFP supporting: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1310 nm, LC connector, SMF, 15 km reach  
 FTB-8191 = Multirate SFP supporting: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1310 nm, LC connector, SMF, 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  
 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

## 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)

## 10G SFP+ MULTIRATE OPTICAL TRANSCEIVERS

FTB-8690 = Multirate SFP+ supporting: 10 GigE LAN/WAN (9.95-10.3 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  
 FTB-8693 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (8.5, 9.95-11.3 Gbit/s), 1310 nm, LC connector, SMF, 10 km reach  
 FTB-8694 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN (9.95-11.1 Gbit/s), 1550 nm, LC connector, SMF, 40 km reach  
 FTB-8695 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (9.95-11.1 Gbit/s), 1550 nm, LC connector, SMF, 80 km reach

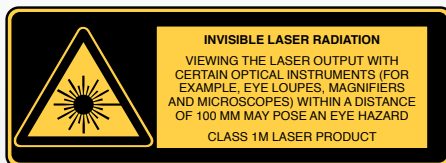
## 10G XFP MULTIRATE OPTICAL TRANSCEIVERS

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

## 10 GIG E 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



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