FTBx-88200NGE Power Blazer

100G MULTISERVICE TEST MODULE

EXFO TFv
Test Function Virtualization

EXFO Connect
Compatible

EtherSAM

iSAM

COMPLETE IPv6 TESTING

iOptics

EXFO | MULTILINK

TECHNICAL SHEET

Feature(s) of this product is/are protected by US patent 9,432,206 and equivalents in other countries.

EXFO's next-generation, 100G, advanced multiservice test solution with CFP4 and QSFP28 interfaces.

KEY FEATURES AND BENEFITS

- Integrated CFP4 and QSFP28 interfaces to facilitate the testing of next-generation 100G networks
- Full-support QSFP+ interfaces for 40GE/OTU3 validation
- SFP+ interface to address lower rate signals for added versatility
- Advanced test functionality to address multiple technologies including OTN, Ethernet, SONET/SDH, Fibre Channel, packet sync and CPRI
- Unprecedented testing simplicity requiring minimal training for new users and maintaining a consistent experience from the lab to the field
- Supports EXFO TFv—Test Function Virtualization, including FTB Anywhere floating licenses and FTB OnDemand time-based licenses for ultimate flexibility
- 100G Ethernet Through mode capability for in-line monitoring and troubleshooting of bidirectional Ethernet traffic
- Compatible with EXFO's rackmount LTB-8 platform featuring hot-swap capability for lab use and best-in-class 100G port density with up to eight modules running simultaneously
- Compatible with the compact FTB-2 Pro portable platform with integrated optical tools and battery capable of running up to two modules simultaneously
- Supported by EXFO Multilink, a web-based application for easy multi-user management and remote access
- iOptics—Intelligent Pluggable Optics test application that quickly validates the sanity of an optical device using minimal configuration

COMPLEMENTARY PRODUCTS AND APPLICATIONS

Platform
FTB-2 Pro

Platform
LTB-8

10G Multiservice Test Modules
FTBx-8870/8880

Multi-User Interface
EXFO Multilink

EXFO

THE 100G MARKET CONTINUES TO GROW AND EVOLVE

The demand for 100G in the network continues to grow, fueled by the increasing need for more bandwidth—a trend showing no signs of slowing down. With the continued proliferation of data centers and growing demand for inter-data-center connectivity, service providers continue to expand their 100G network deployments while constantly looking for more efficient and cost effective ways to deploy those 100G circuits.

In the face of these market realities, network equipment manufacturers (NEMs) continue to push the limits of technology, bringing forth increasingly innovative 100G solutions. With the advent of new, high-speed pluggable optics in the form of CFP4 and QSFP28 interfaces offering lower cost and better density, NEMs are taking advantage and bringing to market their next-generation 100G solutions that are better suited to the mass deployment of 100G in the network.

NEW TEST SOLUTION FOR THE NEXT-GENERATION 100G NETWORK

As it becomes clear that 100G networks will be using new CFP4 and QSFP28 interfaces, enabling both data center and carriers to deploy 100G circuits more cost effectively, it follows that 100G test solutions will evolve in that same direction. EXFO's FTBx-88200NGE is the first test solution that offers integrated CFP4 and QSFP28 interfaces; ready for the 100G network evolution.

The FTBx-88200NGE offers a full suite of Ethernet and OTN test capabilities, including advanced lab test options, making it the perfect test solution to help NEMs develop and test their next-generation 100G network equipment.

NEMs can also benefit from EXFO's LTB-8 platform and EXFO Multilink application to have a complete and agile lab test solution. Due to the compact size and versatility of EXFO's FTB-2 Pro portable platform, the FTBx-88200NGE is also ready to take testing from the lab to the field.

OPTICAL TRANSPORT NETWORK (OTN) TESTING

OTN (ITU-T G.709) is the transport technology of choice for 40G/100G Ethernet traffic over the core network because of its operation, administration, maintenance and provisioning (OAM&P) capability for troubleshooting and maintenance as well as its forward error correction (FEC) mechanism for performance enhancement.

The FTBx-88200NGE supports numerous OTN testing capabilities, enabling breakthrough level qualification of 40G and 100G transponders and muxponders in network equipment manufacturer (NEM) labs. These capabilities include OTU4 (112 Gbit/s) and OTU3 (43 Gbit/s) full line-rate testing with OTN framing and FEC testing as per ITU-T G.709, over-clocked OTU3 including OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s), 40G/100G Ethernet mapping over OTU3/OTU4, single and multistage ODU multiplexing as well as OTN service disruption time (SDT) measurements.

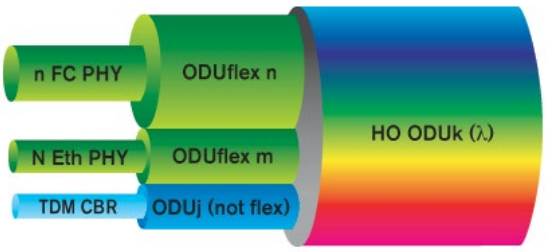
EXFO's FTBx-88200NGE supports ODU0 and ODUflex mapping into ODU4/ODU3, among many other multiplexing schemes, in order to address the growing demand for Ethernet service turn-up and to prove that new 40G/100G circuits are capable of handling all future services.

Complete Overhead Manipulation and Monitoring

EXFO's FTBx-88200NGE 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 the Functions menu in the GUI, and is separate from the default setup and results pages. The Functions category offers various 40G/100G testing capabilities required for advanced troubleshooting.

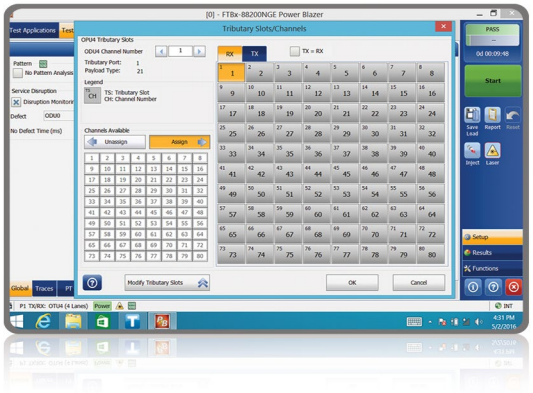
ODUflex

The fixed OTN rates, including OTU3 (43 Gbit/s) and OTU4 (112 Gbit/s), among many other OTN rates, provide an efficient transport mechanism for constant bit rate (CBR) clients such as SONET/SDH, Ethernet and Fibre Channel. On the other side, ODUflex provides the ability to create a container that is appropriately sized for the data rate of the client, offering a single manageable entity across the OTN that can be a permanently fixed for CBR clients, or adjusted based on connectivity demand in the network using the generic framing procedure (GFP). ODUflex uses 1.25 Gbit/s tributary time slots (ODTUGk) to create the variable container in which a client signal is mapped and then transported. Using ODUflex in carrier networks brings significant benefits, including higher efficiency for network configuration and bandwidth allocation, and also provides a future-proof solution for transporting any client signal at any rate, when needed.



Multichannel OTN

A key element for network equipment manufacturers is the capability to demonstrate that the bit error rate (BER) of each channel composing the high-rate pipe complies with the network specifications and therefore meets the expected quality of services. Again, all the channels must be individually monitored and the BER performance evaluated separately. It is paramount to have a testing tool that is capable of performing this evaluation of all independent channels simultaneously with no wasted time. EXFO's Multichannel OTN supports single-stage multiplexing from ODU0 to ODU4 with the support of 80 concurrent channels, including channelized service disruption measurement of all channels.



Ethernet and SONET/SDH Mapping over OTU3/OTU4

EXFO's FTBx-88200NGE offer the 40G/100G Ethernet and SONET mapping capability over OTU3/OTU4 through the EoOTN or SONET/SDH software options. This is a key testing capability that allows NEMs to qualify their 40G/100G transponder development, such as mapping and demapping capabilities as well as client signal timing transparency. It also provides the 40 GigE-specific transcoding capability that must be qualified to ensure that the 40 GigE-frame is properly transcoded from 64B/66B to 1024B/1027B, and properly mapped into the OTU3 (43G) standard frame.

Thanks to the FTBx-88200NGE, customers can now map 40G/100G Ethernet clients or SONET/SDH over OTN with different traffic characteristics, run end-to-end BER tests across an OTN and measure the ratio of bit errors to the number of bits sent. In this testing configuration, the FTBx-88200NGE module provides complete analysis of the OTN transport layers, including OTU/ODU/OPU and GMP statistics to ensure proper recovery of the client signal at the receive end and complete SONET/SDH analysis. EXFO's EoOTN testing capability also validates the 40G/100G Ethernet traffic transmission with 100% throughput, and ensures that latency does not impact service providers' service-level agreements (SLAs) with their customers.

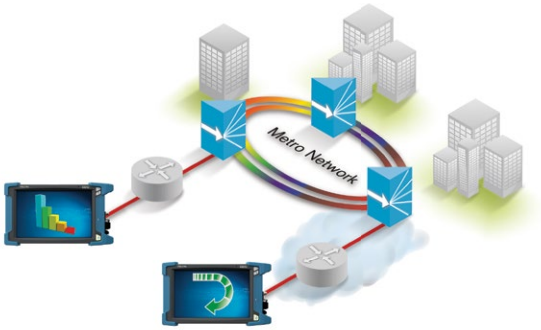
Delay Measurement

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 FTBx-88200NGE 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 FTBx-88200NGE 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.

ETHERNET PERFORMANCE ASSESSMENT

The FTBx-88200NGE 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 FTBx-88200NGE 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 FTBx-88200NGE also include test reports with detailed throughput, frame loss, back-to-back and latency measurements, and clear histograms for future reference regarding specific SLAs.

Ethernet Traffic Generation and Monitoring

Data services carried 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, and qualify SLA parameters. With supported traffic generation and monitoring application, the FTBx-88200NGE 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 FTBx-88200NGE 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 every single one. The FTBx-88200NGE also offers 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 FTBx-88200NGE 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.

EtherSAM: ITU-T Y.1564 Ethernet Service Activation

With more and more Ethernet services being activated today, the ITU-T Y.1564 standard addresses the growing demand for turning up and troubleshooting Carrier Ethernet services. Supported on the FTBx-88200NGE 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 quality-of-service (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. EtherSAM 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.

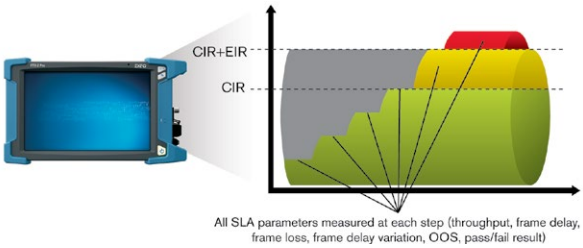
› Service Configuration Test

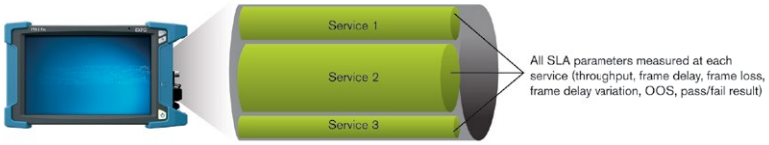
The service configuration test consists of sequentially testing each service. It validates that the service is properly provisioned and that all specific KPIs or SLA parameters are met.

› 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.





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.

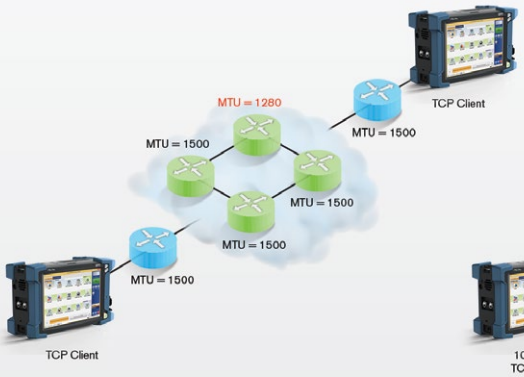
The core objective of iSAM is to remove friction between the user and the testing solution. The end goal is to enable field technicians of any skill level to set up and run an iSAM test, and all of this is done within a one-page setup.

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.

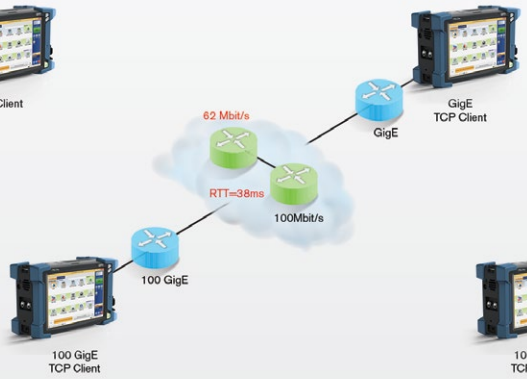
RFC 6349

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.

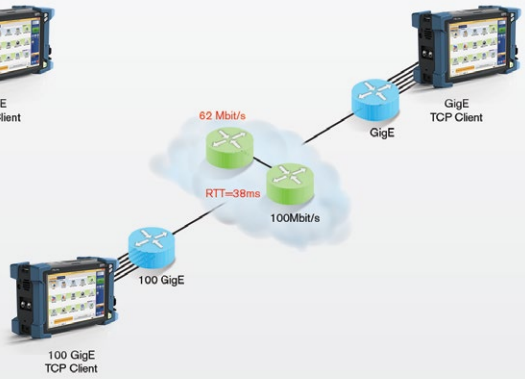
The RFC 6349 test is important because it includes the steps that follow to help locate and diagnose TCP issues correctly. The first step consists of finding the maximum transmission unit (MTU) size. This ensures that the network is not fragmenting the traffic. The aim of the second step is to determine 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

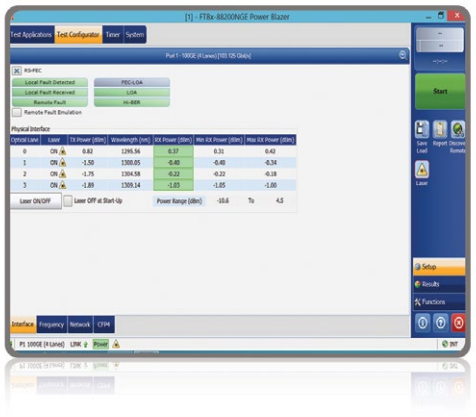


Baseline round-trip time (RTT) and bandwidth to determine ideal window size



Single or multiple TCP connections to enable full pipe testing

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 FTBx-88200NGE 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 FTBx-88200NGE module offers per-lane frequency and frequency offset testing capabilities to verify that the NE's clock recovery circuitry is operating accurately.

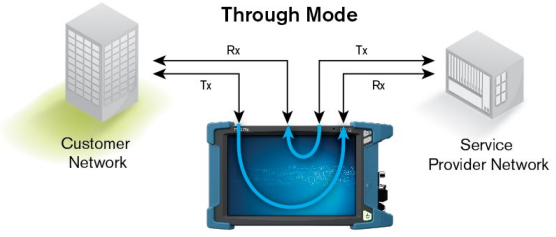
IP Connectivity Tools

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 FTBx-88200NGE module, are essential when testing through 40G/100G routed networks. The results of these tests can pinpoint critical configuration issues within the network.

100G Through Mode Testing

Sectionalize traffic between networks and customer premises equipment by transparently monitoring Ethernet traffic between two endpoints. 100G Ethernet Through mode is a unique in-line monitoring tool that eliminates the need for an external tapping module, switch mirror port, and any other traffic redirection scheme.

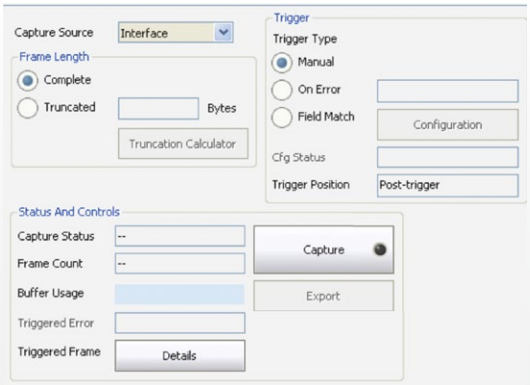
The monitoring is bidirectional, with statistics cumulated on traffic entering and leaving the test set in both directions. The adjacent figure shows the typical usage of Through mode monitoring.



ADVANCED TROUBLESHOOTING TOOLS

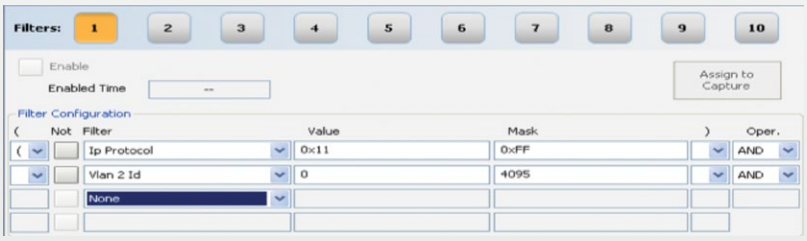
Capturing

The capturing power of EXFO's FTBx-88200NGE 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.



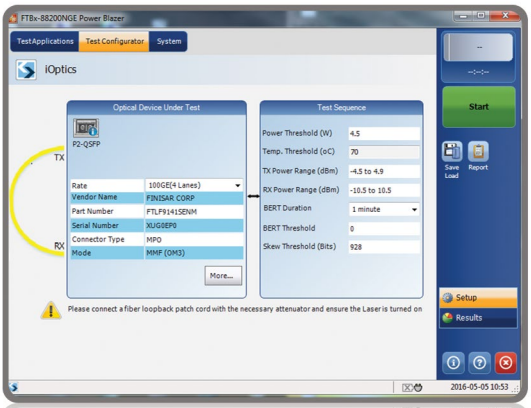
Advanced Traffic Filtering

In some cases, troubleshooting only concerns a particular traffic flow. The advanced traffic-filtering capability of the FTBx-88200NGE allows you to restrict the packets 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 and MPLS fields.



iOptics

The iOptics–Intelligent Pluggable Optics test application is a first-alert test that can be used in the field or lab environment to efficiently evaluate proper operation of an optical device using minimal user configuration. The test application performs the validation using several subtests, in addition to monitoring the optical-device power consumption and temperature, and reports an individual verdict for each subtest and monitoring task. The test application also automatically collects the device manufacturing information, enabling the user to ensure that the desired device has been tested.



SFP

CFP4

QSFP+/QSFP28

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.

SUMMARY OF KEY FEATURES

KEY FEATURES	
Detailed compliance testing	› IEEE 802.3ba standard (2010) › CFP MSA CFP4 Hardware Specification Revision 1.1 18 Mar 2015 › CFP MSA Management Interface Specification Version 2.4 (R06b) › ITU-T G.709, G.798 and G.872
Multi-interface support	› Pluggable, MSA-compliant 4 x 10G QSFP+ transceivers › Pluggable, MSA-compliant 4 x 25G CFP4 and QSFP28 transceivers › Pluggable, MSA-compliant SFP/SFP+ electrical and optical transceivers › External timing reference (DS1/E1/2 MHz) › Low-speed and high-speed reference clock output for eye diagram measurements
Robust physical-layer validation	› 40G/100G CAUI/XLAUI lane error generation and monitoring › PCS lane mapping and monitoring capability › Per-lane skew generation and measurement › PCS error generation and monitoring per lane › Full MDIO/I2C read/write access
PRBS patterns per lane	Allows users to configure different PRBS patterns on different CAUI/XLAUI lanes in 40G/100G, and on physical lanes in OTU3/OTU4 unframed configurations; typically used to identify crosstalk issues when looking at the eye diagram
Per-wavelength power measurement	Allows users to measure the received optical power per wavelength in the used parallel CFP4 and QSFP+/QSFP28 transceivers
iOptics	› Optical-device I/O interface quick check › Optical TX power-level range test › Optical RX signal-presence and level range test › BERT bit error and frequency offset standard › Framed excessive skew test › Temperature and power consumption monitoring
Layer-2/3/4 Ethernet testing	› Unframed BERT and EtherBERT up to 100G › 100G Through mode testing › RFC 2544, including throughput, back-to-back, latency and frame loss with Dual Test Set for bidirectional measurements › EtherSAM (ITU-T Y.1564) with Dual Test Set for bidirectional measurements › RFC 6349: Performs TCP testing with single or multiple TCP connections from 10BASE-T up to 100G; discovers the MTU, RTT, actual and ideal TCP throughput › 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 › Dual Test Set mode › Intelligent autodiscovery › Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic, and monitoring of throughput, latency, packet jitter, frame loss and out-of-sequence › Q-in-Q capability with the ability to go up to three layers of stacked VLANs › VLAN CoS and ID preservation › Discover up to three levels of VLAN tagged traffic (C-/S-/E-VLAN) including their ID and priority, as well as the total VLAN tagged frame count and associated bandwidth › Ping and traceroute › Advanced filtering capability for in-depth network troubleshooting › Smart Loopback › Flow control › 100G and 40G IPv6 protocol generation and analysis › Service disruption time (SDT) › Ethernet MAC flooding › Frame size sweep
100G and 40G MPLS	› Generates and analyzes streams with up to two layers of labels.
Advanced filtering	› Ability to configure up to 10 filters, each with four fields that can be combined with AND/OR/NOT operations; a mask is also provided for each field value with IPv4 and IPv6 capabilities
Packet capture	› Ethernet packet capture up to 4 Mbits › Configurable triggers including errors and header fields › Data capture in packet capture (PCAP) format; read through Wireshark

KEY FEATURES (CONT'D)

40G/100G OTN testing	› OTU4 (112 Gbit/s), OTU3 (43 Gbit/s), OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s) unframed and framed BER tests › FEC testing: error insertion and monitoring › OTL 3.4 and 4.4: alarm and error generation and monitoring › OTL lane mapping, and skew generation and measurement › OTU, ODU, OPU overhead manipulation and monitoring › OTU, ODU (including ODU TCM), OPU layer alarm/error generation and analysis › OTU, ODU (including ODU TCM) trace messages › Round-trip delay (RTD) measurement › OTN SDT measurement › Multiplexing/demultiplexing of ODU13, ODU23, ODU123, ODU03, ODU013, ODU0123, ODU04, ODU014, ODU134, ODU24, ODU234, ODU34, ODU14, ODU01234, ODU0124, ODU024, ODU034, ODU1e4, ODUflex24, ODU2e4 and ODU124, ODU1234 with PRBS pattern and GigE and 10 GigE client mappings into OPU payloads. ODUflex at ODU3 and ODU4 rates with full flexibility to configure the required bandwidth based on n x 1.25 Gbit/s tributary time slots with a PRBS pattern into the ODUflex payload; 40 GigE client mapping into ODU3 into ODU4 › Performance monitoring: G.821, M.2100 › Frequency analysis and offset generation
Multichannel OTN	› 100G OTN validation of individual channel connectivity for up to 80 channels › Support for ODU0, ODU1, ODU2 and ODU3 into ODU4 › Alarm/error monitoring › Single alarm/error injection on one single channel or on all channels at one time › Concurrent OTN BERT analysis › Simultaneous channelized SDT measurement › Flexible channel/tributary slot selection
Ethernet mapping over OTN	› 40G and 100G Ethernet mapping over OTU3 and OTU4 respectively, using GMP › 40G transcoding capability with alarms, errors and statistics › GMP alarms, errors and statistics › GigE mapping into ODU0 using GFP-T, 10 GigE mapping into ODU2 using GFP-F, direct 10 GigE mappings into ODU2e in different ODU multiplexing structures, and 40 GigE client mapped into ODU3/ODU4 › Flexibility to map up to a 10G Ethernet client signal into ODUflex
SONET/SDH mapping over OTN	› OC-768/STM-256 mapping in ODU3 › OC-192/STM-64 mapping in ODU2 › OC-48/STM-16 mapping in ODU1 › OC-12/STM-4 and OC-3/STM1 mapping in ODU0
SONET/SDH testing	› PRBS pattern payload generation and analysis down to STS-1/AU-3 granularity › High-order mappings: STS-1/3c/12c/48c/192cand AU-3/AU-4/AU-4-4c/16c/64c › Section/RS, Line/MS and high-order (STS/AU) path overhead manipulation and monitoring › Section/RS, Line/MS and high-order (STS/AU) path alarm/error generation and monitoring › Single, rate and burst error insertion modes › High-order (STS/AU) pointer generation and monitoring › Performance monitoring: G.821, G.828, G.829, M.2100, M.2101 › Frequency analysis and offset generation › Automatic protection switching (APS) and SDT measurements › Round-trip delay (RTD) measurements › Tandem connection monitoring
Remote access	Remote access: supported via EXFO Remote ToolBox, VNC or Web VNC

ORDERING INFORMATION

FTBx-88200NGE-XX-XX-XX-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
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)

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

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

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

Optics Options
iOptics = Intelligent Pluggable Optics test application

Ethernet Options
00 = No Ethernet option
ADV-FILTERS = Advanced filtering [c, j]
ETH-CAPTURE = Full-line-rate packet capture [c, j]
ETH-OAM = Enables four OAM modes, including Y.1731, 802.1ag, MEF and G.8113.1 [c]
ETH-THRU = 100G Ethernet Through mode capability [l]
LINK-OAM = Enables 802.3ah Link OAM [d]
IPV6 = Internet protocol version 6 [c]
IPV6_40-100GE = 40GE and 100GE IPv6 internet protocol version 6 [i]
MPLS = Enables MPLS [c]
MPLS_40-100GE = Enables 40GE and 100GE MPLS tags [j]
1588PTP = Generates and analyzes 1588 PTP [c]
G82751 = Enables ITU-T G.8275.1 profile
SyncE = Generates and analyzes SyncE protocol [c]
RFC6349 = Enables TCP testing as per RFC 6349 [c]
RFC6349_40-100GE = 40GE and 100GE enables TCP testing as per RFC 6349 [j]
iSAM = Enables simplified ITU-T Y.1564 test
TCP-THPUT = Enables TCP throughput measurements [e]
TRAFFIC-SCAN = Discover and monitor VLAN [c, j]
TST-OAM = Enables OAM testing within EtherSAM application

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

SONET/SDH Options and Mapping
SONET-SDH = SONET and SDH combo mapping [h]
TCM = Tandem connection monitoring [i]

Example: FTBx-88200NGE-100GE-OTU3-FC10X-SONET-SDH-EoOTN-ETH-CAPTURE

Notes

a. Requires purchase of SFP.
b. Requires purchase of SFP+.
c. Requires GigE bundle and/or 10 GigE.
d. Requires enabling ETH-OAM.
e. Requires GigE bundle.
f. Requires enabling OTU3 and/or OTU4 rates.
g. Requires enabling ODUMUX OTN option.
h. Requires enabling OTU3.
i. Requires enabling 2.5G bundle or 9953M rate.
j. Requires 40GE and 100GE.
k. Requires enabling OTU3 rate.
l. Requires 100GE.

CFP4 TRANSCEIVERS

CFP4-85980 = 100GBASE-LR4/OTU4 Multi-Rate 10 km SMF 4x25/28G LAN WDM EML LC
CFP4-85981 = 100GBASE-LR4/OTU4 Dual-Rate 10 km SMF 4x25/28G LAN WDM LC
CFP4-85982 = 100GBASE-SR4/OTU4 Dual-Rate 100 m MMF 4x25/28G MPO12

QSFP28 TRANSCEIVERS

QSFP-85990 = 100GBASE-LR4 Single-Rate 2 km SMF LAN WDM EML LC
QSFP-85991 = 100GBASE-LR4 Single-Rate 10 km SMF LAN WDM EML LC
QSFP-85992 = 100GBASE-SR4/OTU4 128GFC Multi-Rate 100 m MMF 4x25/28G MPO12

QSFP+ TRANSCEIVER

QSFP-85940 = 40GBASE-LR4/OTU3 Dual-Rate 1310nm 10km SMF 4x10G CWDM LC

SFP MULTIRATE OPTICAL TRANSCEIVERS

FTB-8590 = SFP module GigE/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

SFP-8600 = SFP+ modules: CPRI 1.228 to 9.83 Gbit/s at 1310 nm, LC connector, 1.4 km reach
SFP-8601 = SFP+ 10G (1.25 Gbit/s to 10.3125 Gbit/s) CWDM at 1471 nm, LC SMF, 10 km reach
SFP-8602 = SFP+ 10G (1.25 Gbit/s to 10.3125 Gbit/s) CWDM at 1511 nm, LC SMF, 10 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 11.1 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 to 11.1 Gbit/s), 1550 nm, LC connector, SMF, 80 km reach

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