ООО "Техэнком" Контрольно-измерительные приборы и оборудование www.tehencom.com

Power Blazer Series

MULTISERVICE TEST MODULES

EXFO TFv Test Function Virtualization

EXFO Connect Compatible

EtherSAM

iSAM

iOptics

EXFO MULTILINK

OpticalRF

TECHNICAL SHEET

Versatile 10M-to-100G multiservice test modules for lab and field applications

KEY FEATURES AND BENEFITS

- Integrated CFP/CFP2/CFP4 and QSFP28 interfaces to facilitate the testing of next-generation 100G networks
- SFP/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/OBSAI
- 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 and FTB-4 Pro portable platforms with integrated optical tools and battery capable of running from two to four modules simultaneously
- Supported by EXFO Multilink, a web-based application for easy multi-user management and remote access
- Supports quick optical transceiver validation and sanity check using an Intelligent Pluggable Optics test application—iOptics
- Dual-port Ethernet testing capability up to 100G
- Wander time error testing
- CPRI layer-2 link validation for BBU or RRH from 1.2G to 10.1G
- Real-time high-resolution RF spectrum analysis over CPRI
- EXFO's innovative Open Transceiver System for swapping in/out different test interfaces on the same module; providing testing flexibility now and ready for future transceivers later (available on the FTBx-88260)

RELATED PRODUCTS AND APPLICATIONS

Platform
FTB-1v2 Dual Carrier

Platform
FTB-2 Pro

Platform
FTB-4 Pro

Platform
LTB-8

Multi-user Interface
EXFO Multilink

CHOOSE THE RIGHT POWER BLAZER FOR YOU

POWER BLAZER MODULES	FTBx-8870	FTBx-8880	FTB-88100G	FTB-88100NGE	FTBx-88200NGE	FTBx-88260
DSn/PDH (DS1/E1)	•	•				
DSn/PDH (DS3, E3 and E4)		•				
OTN OTU1/2	•	•		•	•	
OTN OTU3/4			•	•	•	
ODUMux	•	•	•	•	•	
Multichannel OTN and mixed mapping testing					• [a]	
OTN GCC BERT	•	•	•	•	•	
SONET/SDH	•	•	•	•	•	
40G OC-768/STM-256			•	•		
Fibre Channel (1X, 2X, 4X, 8X and 10X)	•	•		•	•	
Fibre Channel 16X					•	
1588 PTP/SyncE	•	•		•	•	
Wander		•				
Carrier Ethernet OAM	•	•		•	•	
Link OAM	•	•		•	•	
25GE						•
RFC 2544 (up to 100G)	•	•	•	•	•	•
ITU-T Y.1564 testing	•	•	•	•	•	
RFC 6349 (up to 10G TCP)	•	•		•	•	
RFC 6349 (40G and 100G)			•	•	•	
CPRI 1.2 Gbit/s to 10.1 Gbit/s	•	•		•	•	
OBSAI 1.5 Gbit/s, 3.1 Gbit/s and 6.1 Gbit/s	•	•		•	•	
Dual-port Ethernet testing	•	•		•	•	•
Smart loopback	•	•	•	•	•	•
Dual test set	•	•	•	•	•	•
iOptics	•	•	•	•	•	•
OpticalRF and BBU emulation	•	•				

Note

a. Feature not available on FTB-1v2 Dual Carrier.

COMPLETE AND AGILE TEST SOLUTION FOR 10G SERVICES

The Power Blazer series of modules offers a full suite of test capabilities for multiple technologies up to 10G, addressing different test applications ranging from lab to field.

THE TEST SOLUTION FOR THE NEXT-GENERATION 100G NETWORK

As it becomes clear that 100G networks will be using 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 and FTB-4 Pro portable platforms, the Power Blazer modules are also ready to take testing from the lab to the field.

RAPID EVOLUTION OF TRANSCEIVERS

A shared challenge in the telecom industry today is the large number of various pluggable transceivers available and the rapid rate at which new types of transceivers are being launched. Whether we consider SFP and SFP+ (for rates up to 10G) or we look at QSFP28 and CFP4 (for 100G rates) or start adding SFP28 (for 25G rates), it becomes clear that integrating all these into the network is a challenge. With the imminent arrival of even more transceiver types (e.g., SFP56, SFP-DD, QSFP-56), the challenge to keep up (for NEMs) as well as struggle to integrate all these into a network (for data center and network operators) will be daunting.

With those challenges in mind, EXFO introduces the FTBx-88260, the newest addition to the Power Blazer family of test modules. Customizable, it's built with EXFO's Open Transceiver System (OTS), an innovative evolutionary design concept that enables users to match the type of interfaces on the module with their specific testing needs. Future-proof, as new transceivers are developed and launched, testing them will be as simple as changing an OTS insert in the test module rather than having to purchase an entirely new test unit.

The FTBx-88260 offers two OTS slots that can each house any of these options:

Filler | Sync | Dual SFP28 | Dual QSFP28 | Single CFP4

TRANSCEIVER ADAPTER	NUMBER OF PORTS	INTERFACES SUPPORTED
TA-SFP28	2	SFP, SFP+, SFP28
TA-QSFP28	2	QSFP+, QSFP28
TA-CFP4	1	CFP4
TA-SYNC	1	N/A

OPTICAL TRANSPORT NETWORK (OTN) TESTING

OTN (ITU-T G.709) is a transport technology that provides granularity on different areas, including operations, administration and provisioning. It even offers tools for maintenance and troubleshooting, making it the technology of choice for 40G/100G networks.

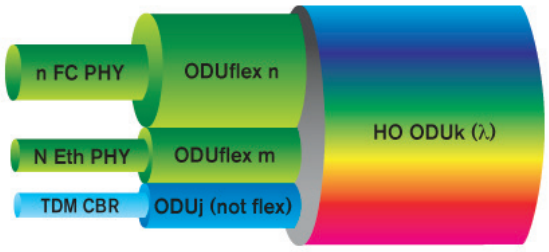
The Power Blazer Series offers numerous OTN testing capabilities, enabling breakthrough level qualification of 10G, 40G and 100G transponders and muxponders in network equipment manufacturer (NEM) labs. These capabilities include OTU1 (2.6660 Gbit/s), OTU2 (10.7092 Gbit/s), OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s), OTU3 (43 Gbit/s), over-clocked OTU3 including OTU3e1 (44.57 Gbit/s), OTU3e2 (44.58 Gbit/s) and OTU4 (112 Gbit/s), Ethernet mapping over OTN, single and multistage ODU multiplexing as well as OTN service disruption time (SDT) measurements including ODU0 and ODUflex mapping to address the growing demand for Ethernet service turn-up.

Complete overhead manipulation and monitoring

EXFO's Power Blazer modules allow 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 testing capabilities required for advanced troubleshooting.

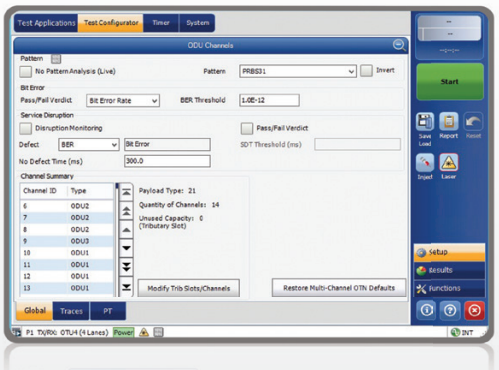
ODUflex

The fixed OTN rates, including OTU2 (10 Gbit/s), 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 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 and mixed mapping testing

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.



Additionally, a mixed mapping configuration can be applied, this mixing of ODU container types is closer to what users would transport on a real OTN link, enabling NEMs to test the response of their network elements and allowing service providers to verify link operation during turn-up. This provides users with the flexibility to select either a different channel configuration or a tributary slot to validate, including the possibility of choosing different data unit containers (ODU0, ODU1, ODU2 or ODU3).

Ethernet and SONET/SDH mapping over OTN

EXFO's solution offers 10G/40G/100G Ethernet and SONET mapping capability over OTU3/OTU4 through EoOTN or SONET/SDH software options. This key testing capability allows NEMs to qualify their high-speed 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.

Customers can now map Ethernet clients or SONET/SDH over OTN with different traffic characteristics, run end-to-end BER tests across OTN and measure the ratio of bit errors to the number of bits sent. In this testing configuration, the 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 received end and complete SONET/SDH analysis. The EoOTN testing capability also validates the Ethernet traffic transmission with 100% throughput, and ensures that latency does not impact service providers' service-level agreements (SLAs) with their customers.

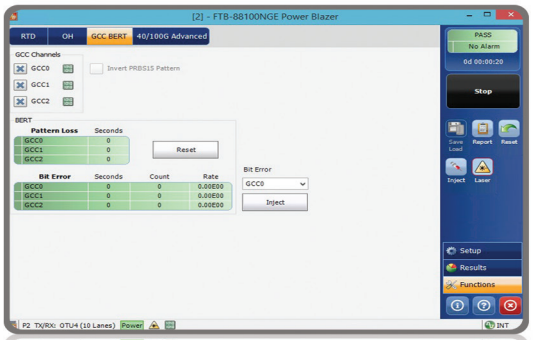
Delay measurement

By guaranteeing low-latency traffic transmission for delay-sensitive applications including video, cloud computing and financial trading applications, carriers have an opportunity to turn optical networks into a competitive advantage. Our Power Blazer modules enable OTN, SONET/SDH and Ethernet delay measurements across all supported testing interfaces. This enables carriers to consolidate their competitive advantage when building low-latency optical transport networks and guarantee speed of service to their end-users.

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

OTN GCC BERT

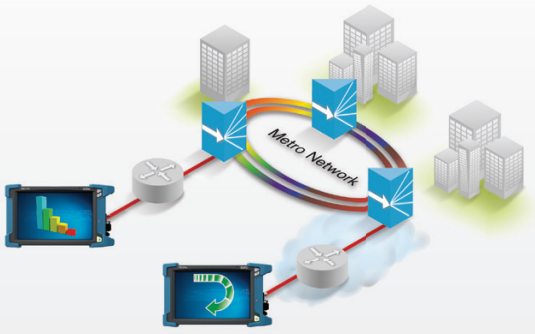
OTN GCC Bert allows the user to run a BERT test through the GCC channels. The test supports BERT on GCC0/1/2 channels individually or on all channels simultaneously.



ETHERNET PERFORMANCE ASSESSMENT

It is possible to automate an 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 can be combined with EXFO Smart loopback test application to 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 modules 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 modules 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 high-speed networks are making a significant shift towards 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 high-speed modules 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. In addition, the modules support 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 modules 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. They 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.

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. The Power Blazer modules support Ethernet client services, 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.

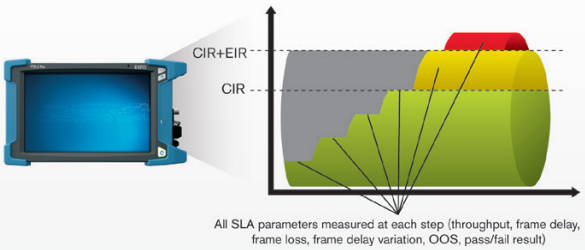
› Service configuration test

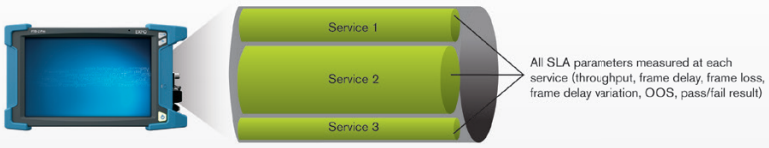
The service configuration test consists of sequentially testing each service. It validates that the service is properly provisioned and that all specific KPIs or SLA parameters are met.

› 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, EtherSAM's 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.

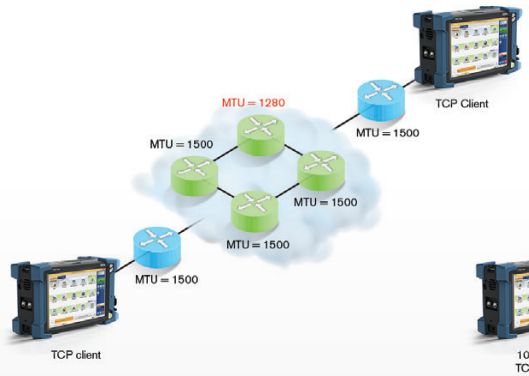
The core objective of iSAM is to remove friction between the user and the testing solution. The end goal is to enable field technicians of any skill level to set up and run an iSAM test, and all of this is done within a one-page setup.

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.

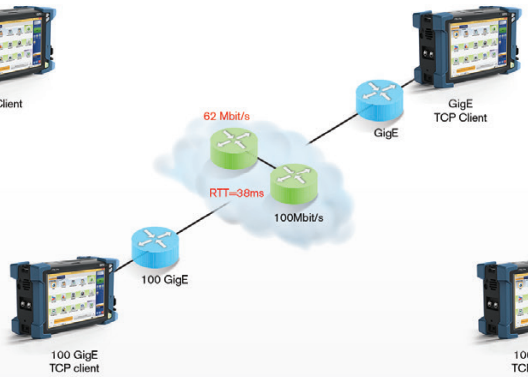
RFC 6349

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.

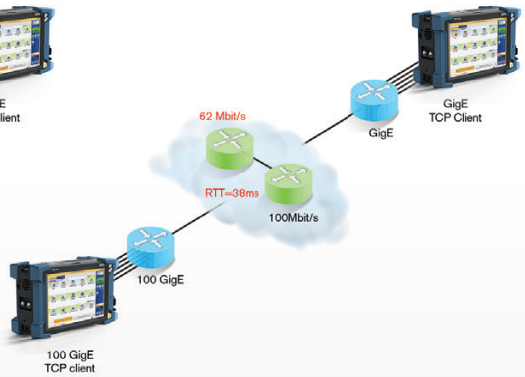
The RFC 6349 test is important because it includes the steps that follow to help locate and diagnose TCP issues correctly. The first step consists of finding the maximum transmission unit (MTU) size. This ensures that the network is not fragmenting the traffic. The aim of the second step is to determine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

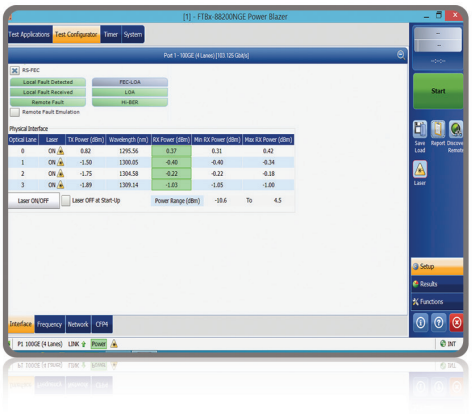


Baseline round-trip time (RTT) and bandwidth to determine ideal window size



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 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. In addition, the Power Blazer FTBx-88200NGE offers support for RS-FEC correction with FEC status monitoring.

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

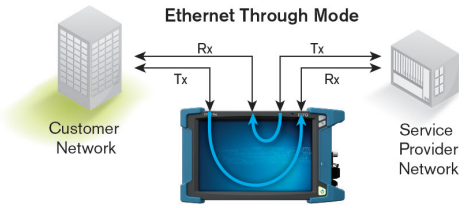
IP connectivity tools

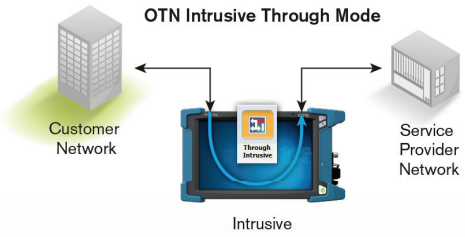
As part of the IP connectivity tools, the ping tool is used to verify that the user can reach a specific address within or outside of a subnetwork. The traceroute tool can be used to determine the route or the number of hops that are required to reach a destination host. These basic tools are essential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

High-speed Ethernet and OTN through mode testing

Sectionalize traffic between networks and customer premises equipment by transparently monitoring Ethernet traffic between two endpoints. 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 figures show the typical usage of through mode monitoring and intrusive through mode generation.





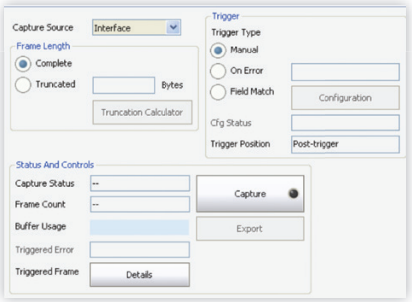
DUAL PORT

The dual-port testing feature enables technicians to use a single Power Blazer module to launch two simultaneous tests (one on port 1 and the other on port 2), including rates from 10M to 100G. Having a separate set of statistics for alarms and errors provides the capability to inject errors independently. This feature helps technicians reduce testing time during new link implementations.

ADVANCED TROUBLESHOOTING TOOLS

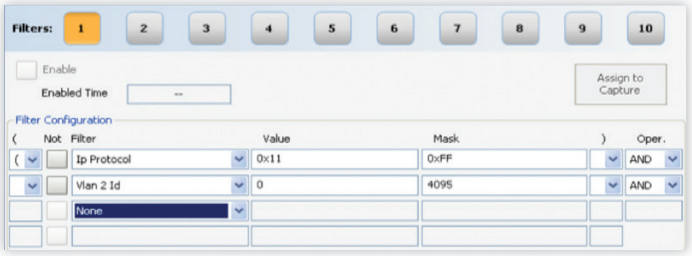
Capturing

The capturing power of the Power Blazer Series 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.



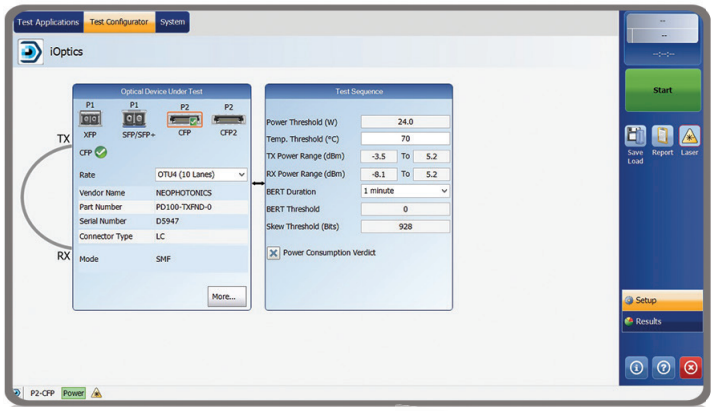
Advanced traffic filtering

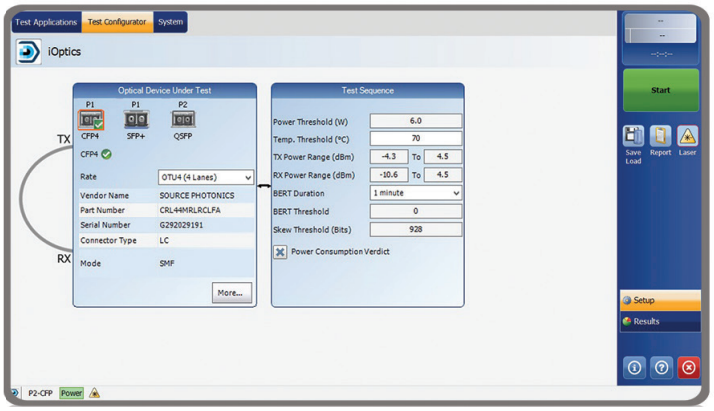
In some cases, troubleshooting only concerns a particular traffic flow. The advanced traffic-filtering capability allows you to restrict the packets by using up to four trigger fields and operands (and, or, not). A complete set of triggers is available, such as MAC, IP and TCP/UDP fields, as well as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

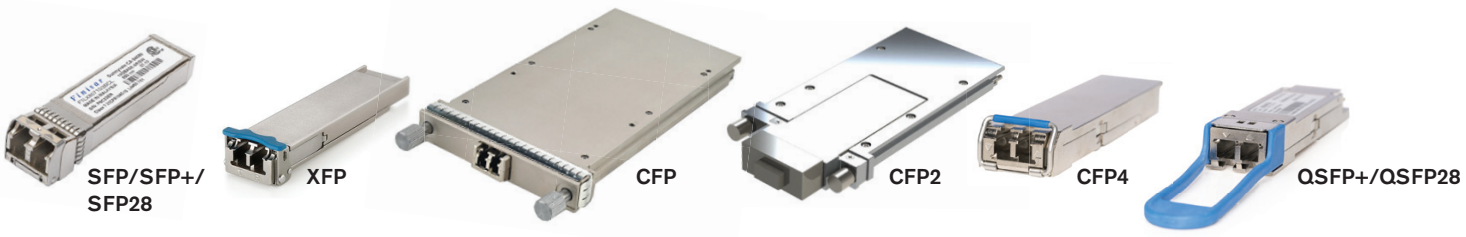


iOptics

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/SFP+/SFP28 XFP CFP CFP2 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 the 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 a 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 available modules, visit our FTB OnDemand web page.

EXFO Connect

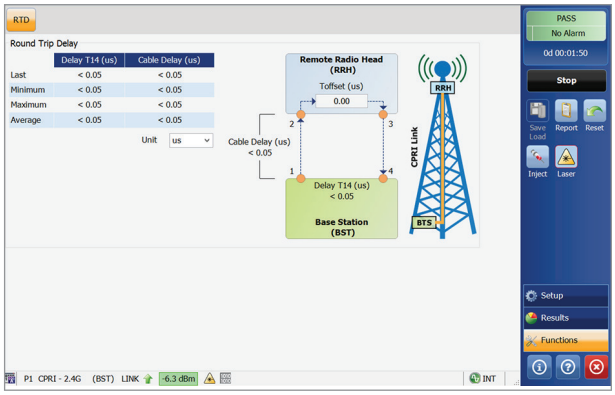
AUTOMATED ASSET MANAGEMENT. PUSH TEST DATA IN THE CLOUD. GET CONNECTED.

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.

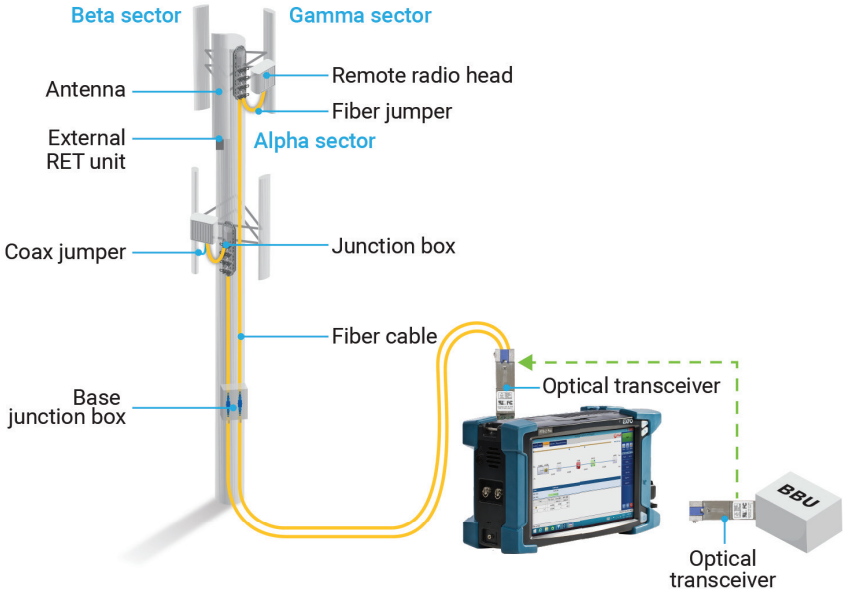
FRONTHAUL/FTTA/C-RAN TESTING

Using the Power Blazer enabled with the layer-2 CPRI/OBSAI protocol, technicians can easily connect to the remote radio head (RRH) without having to climb the cell tower. Regardless of whether the cell site's baseband unit (BBU) is connected to the RRH, EXFO's unit is always ready to validate a CPRI/OBSAI-enabled BBU and can supply the field technician with a complete analysis of vital CPRI/OBSAI statistics.

With this feature, field technicians can perform an unframed and framed layer-2 CPRI/OBSAI BER test that help them to validate that the fiber from the BBU 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.



CPRI/OBSAI round-trip delay



RRH validation

BASEBAND UNIT (BBU) EMULATION

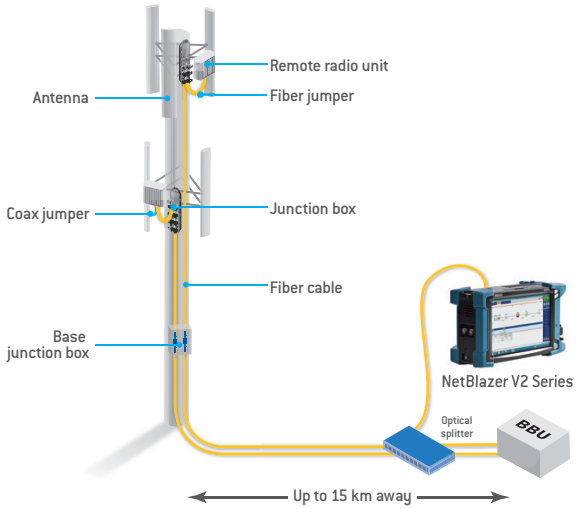
EXFO's BBU emulation feature enables mobile contractors, technicians and engineers to ensure that cell sites are installed correctly the first time, prior to handing them over to the mobile network operator (MNO) for integration. The solution is designed for simple one-click operation with clear pass/fail verdicts, enabling problems to be quickly isolated and successful test reports to be generated, creating a birth certificate for the cell site.

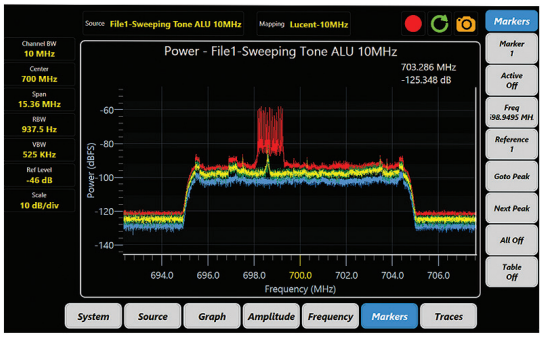
OpticalRF™

RF SPECTRUM ANALYSIS OVER CPRI

Most of today's modern mobile installations interconnect baseband units (BBUs) and far-end remote radio heads (RRHs) with fiber optic cables. This new network configuration, known as fronthaul, provides many advantages. RRHs can now be physically separated from BBUs. However, with this new mobile installation, analog RF signals can only be accessed at RRHs, which are often placed in hard-to-reach locations, such as tower tops or rooftops.

The Power Blazer module offers a new application that eliminates dangerous and difficult climbs by providing access to RF signals through the digital CPRI link available at the BBU site (at the bottom of the tower or at the BBU hotel located kilometers away). The digital link uses the CPRI protocol to carry RF signals in digital format (IQ data). By accessing the RF signal at the BBU location, costs associated with truck rolls and tower climbs are reduced. In addition, time to resolution of complex RF issues is accelerated by multiple user collaboration via remote access capabilities to OpticalRF from any smart device or laptop.





REAL-TIME HIGH-RESOLUTION RF SPECTRUM ANALYSIS OVER CPRI

This feature provides the most powerful real-time high-resolution RF spectrum analysis over CPRI. It automatically scans for the correct CPRI rate option and configures it to get an active link.

OpticalRF is an easy-to-use solution that quickly identifies issues, such as external RF interference, internal PIM and external PIM. It detects RF interference even when the BBUs are kilometers away at more convenient locations, such as in a centralized radio access network (C-RAN) architecture.

RF INTERFERENCE ANALYSIS WITH MULTI-ANTENNA DISPLAY

OpticalRF provides the ability to display multiple antenna carriers (AxC) at the same time. Multiple antenna carriers can be displayed either in a side-by-side or overlaid view. This facilitates the ability to visualize diversity imbalances or passive intermodulation (PIM).

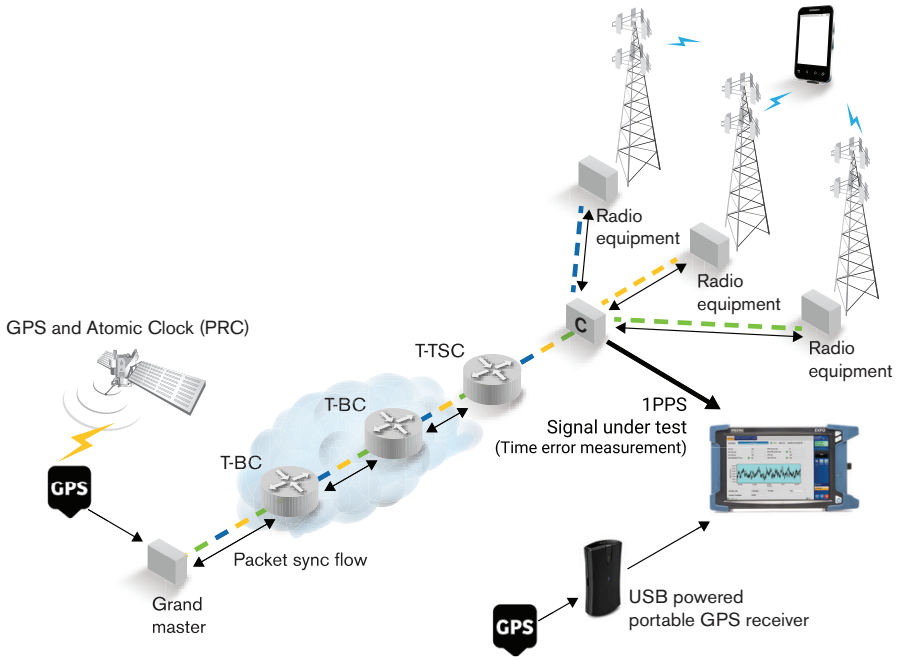
Dual AxC overlay display

Dual AxC side-by-side display

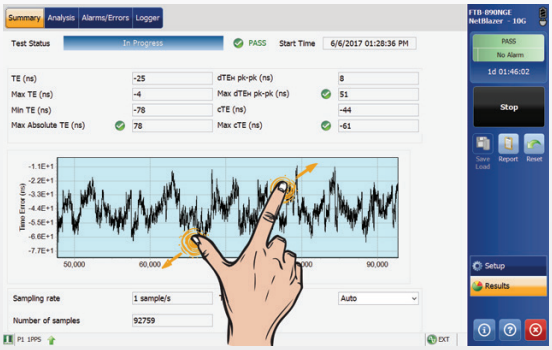
EXFO

WANDER

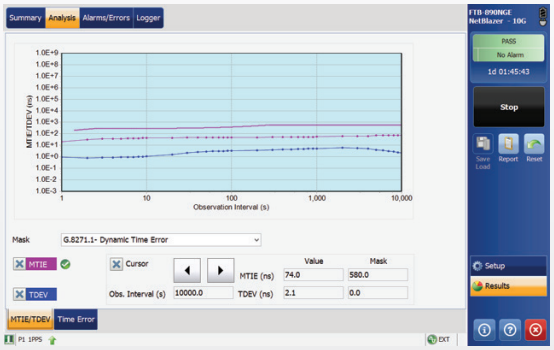
MNOs face continuous pressure related to the synchronization of their multiple network elements. Typical deployments involve not only a primary reference time clock and a telecom grand master clock, but also several telecom boundary clocks (T-BC) and telecom time secondary clocks (T-TSC) that feed network elements directly connected to the radio equipment (RE) at the cell towers. A time error budget is defined for different reference points of the network. With 5G technology soon to be widely deployed, time constraints are even higher. MNOs must–more than ever–validate that their reference clocks at multiple points of the network are compliant to standardized time error thresholds and expected time error budgets.



Wander delivers all the test results that MNOs require in order to diligently evaluate the reference signal/clock during turn-up or troubleshooting at cell tower locations. Wander performs multiple time error measurements such as Maximum Absolute Time Error (Max |TE|), dynamic Time Error (dTE), constant Timer Error (cTE), Maximum Time Interval Error (MTIE), Time Deviation (TDEV), etc. The Wander application automatically evaluates if the signal under test meets different standardized masks such as the MTIE mask defined by ITU G.8271.1, G8261, G.8262, G.811, G.812, G.813 and others. Signals under evaluation can be 1PPS, Ethernet-SyncE at various rates, 2 MHz, 10 MHz, DS1 and E1. Users do not need additional software or hardware tools to obtain test results. All analysis and results are performed and available on the test platform. Synchronization specialists may need access to the raw data (Time Error/Timer Interval Error) and this capability is also readily offered to the users. Verdicts are presented to the user based on several different criteria. Wander also allows users to zoom into time error graphical results of tests for the whole duration of the activity. Users can configure wander tests to run up to 30 days depending on the sampling rate. Synchronization experts can easily identify the most important events during their time error measurements.



Wander results/multitouch pinch-to-zoom



Wander analysis

SUMMARY OF KEY FEATURES

KEY FEATURES	
Detailed compliance testing	› IEEE 802.3ba and IEEE 802.3by standard › 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 SFP28 optical transceiver › 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	› 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 CFP/CFP2/CFP4 and QSFP+/QSFP28 transceivers
iOptics	› Optical-device I/O interface quick check › Optical TX power-level test › Optical RX signal-presence and level test › BERT and frequency offset standard › Framed excessive skew test › Temperature and power consumption monitoring
Layer 2/3/4 Ethernet testing	› Unframed BERT up to 100G › EtherBERT from 10M, 1G, 10G, 25G up to 100G › Dual-port Ethernet testing capabilities from 10M, 1G, 10G, 25G up to 100G › 100 GigE 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 injects or monitors pause frames, including frame counts of pause, abort frames and total, last, maximum and minimum pause time › IPv6 protocol generation and analysis › Service disruption time (SDT) › Ethernet MAC flooding › Frame size sweep
Synchronization	› Validates 1588 PTP packet network synchronization services, emulates PTP clients, and generates and analyzes messages between master/clients, clock quality level and IPDV › Validates SyncE frequency, ESMC messages and clock quality levels › Ability to perform time error analysis and wander measurement including evaluation, even if the signal under test meets multiple standardized masks (MTIE, TDEV)
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 Mbit/s › Configurable triggers including errors and header fields › Data capture in packet capture (PCAP) format; read through Wireshark

KEY FEATURES (CONT'D)

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 › OTN through and OTN intrusive through mode testing › Multiplexing/demultiplexing of ODU13, ODU23, ODU123, ODU03, ODU013, ODU0123, ODU04, ODU014, ODU134, ODU24, ODU234, ODU34, ODU14, ODU01234, ODU0124, ODU12, ODU024, ODU034, ODU1e4, ODUflex24, ODU2e4 and ODU124, ODU1234 with PRBS pattern and GigE and 10 GigE client mappings into OPU payloads. ODUflex at ODU2, 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 and mixed mapping testing	› 100G OTN validation of individual channel connectivity › Support for mixing and mapping of ODU0, ODU1, ODU2, or ODU3 data containers into an ODU4 container › 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	› Ethernet mapping over OTN respectively, with GMP support › 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 ODU1e/2e 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/192c/STS-768c and AU-3/AU-4/AU-4-4c/16c/64c/AU-4-256c › 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
Fronthaul	› CPRI layer-2 link validation for BBU or RRH from 1.2G to 9.8G › OBSAI layer-2 link validation for BBU or RRH from 1.5G to 6.1G › BBU emulation allowing RF level validation of RRHs, RET status and control and remote SFP identification
Remote access	Remote access: supported via EXFO Remote ToolBox, EXFO Multilink, VNC or Web VNC
RF spectrum analysis	Real-time high-resolution RF spectrum analysis over CPRI

MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

	FTBx-8870	FTBx-8880	FTBx-88260	FTB-88100G	FTB-88100NGE	FTBx-88200NGE
Size (H x W x D)	25 mm x 160 mm x 118 mm (1 in x 6 5/16 in x 4 5/8 in)		25 mm x 160 mm x 118 mm (1 in x 6 5/16 in x 4 5/8 in)	51 mm x 96 mm x 288 mm (2 in x 3 3/4 in x 11 5/16 in)		25 mm x 160 mm x 118 mm (1 in x 6 5/16 in x 4 5/8 in)
Weight	0.35 kg (0.75 lb)	0.41 kg (0.9 lb)	0.9 kg (1.9 lb)	1.1 kg (2.4 lb)		0.5 kg (1.1 lb)
Temperature operating	0 °C to 40 °C (32 °F to 104 °F)		0 °C to 40 °C (32 °F to 104 °F)	0 °C to 40 °C (32 °F to 104 °F)		0 °C to 40 °C (32 °F to 104 °F)
storage	−40 °C to 70 °C (−40 °F to 158 °F)		−40 °C to 70 °C (−40 °F to 158 °F)	−40 °C to 60 °C (−40 °F to 140 °F)		−40 °C to 70 °C (−40 °F to 158 °F)

FTB-85970 CFP-TO-CFP2 ADAPTER

Size (H x W x D)	87 mm x 17 mm x 280 mm (3 1/2 in x 11/16 in x 6 7/16 in)
Weight	0.2 kg (0.4 lb)
Temperature operating	0 °C to 40 °C (32 °F to 104 °F)
storage	−40 °C to 70 °C (−40 °F to 158 °F)

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