# FTB/IQS-8830NGE Power Blazer

## 10G MULTISERVICE TEST MODULE


EXFO TFv* Test Function Virtualization

EXFO Connect Compatible

EtherSAM

iSAM

COMPLETE IPv6 TESTING

**Please note that this model has been discontinued. For more information, visit EXFO.com**

SPEC SHEET

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

## KEY FEATURES AND BENEFITS

- Comprehensive testing for SONET/SDH, OTN and Ethernet interfaces up to 10G
- Dual-port Ethernet testing up to 10 Gigabit Ethernet
- iSAM ultra-simple multiservice activation (one of the intelligent apps)
- OTN testing (as per ITU-T G.709) including forward error correction (FEC)
- Efficiently assesses Fibre Channel networks with best-in-class coverage via 1x, 2x, 4x, 8x, 10x and 16x interfaces
- Packet synchronization turn-up and troubleshooting (SyncE/1588 PTP)
- True wire-speed, stateful TCP throughput based on RFC 6349 for undisputable SLA enforcement of Ethernet services
- IPv4 and IPv6 protocol testing capability allowing IP transition stack validation and qualification
- FTTA framed and unframed CPRI testing, including CPRI service disruption tests (CPRI SDTs)
- Faster Ethernet service activation with bidirectional EtherSAM (ITU-T Y.1564) and RFC 2544 test suites, multistream traffic generation, Through mode and bit-error-rate (BER) testing
- OTN, SONET/SDH, FC and Ethernet BER testing (BERT) with real-time pass/fail status, quick action buttons, clear results and assorted notifications
- Simpler reporting thanks to integrated Wi-Fi and Bluetooth connectivity capabilities **
- FTB Ecosystem and EXFO Connect-compatible with software upgrade manager as well as automated cloud-based asset and test data management capabilities **
- Housed in an FTB-500, FTB-2 or FTB-2 Pro Platform complete with integrated optical tools, battery operation, power-up and restore, remote access, GPS capabilities and test reports. Also available in an IQS-600 format allowing for increased port density and customized test environments
- Offers EXFO TFv—Test Function Virtualization, including FTB Anywhere floating licenses and FTB OnDemand time-based licenses

* Available only for FTB modules

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

## PLATFORM COMPATIBILITY

**Platform**
FTB-500

**Platform**
FTB-2 or FTB-2 Pro

**Integrated Qualification System**
IQS-600

EXFO

# THE POWERFUL CHOICE FOR MULTISERVICE TESTING

The ongoing transition towards a converged network infrastructure for SONET/SDH, OTN, Fibre Channel (FC) and packet-based Ethernet services requires a test tool that can cover a wide range of interfaces and rates without sacrificing portability, speed or cost. Leveraging the intelligent FTB-2, FTB-2 Pro, the FTB-500 Platform and the IQS-600 multimodule platform, the FTB/IQS-8830NGE Power Blazer streamlines processes and empowers technicians to customize their testing solution in order to efficiently validate SONET/SDH, OTN, FC and Ethernet circuits.

## POWERFUL YET SIMPLE

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

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

- Installation, commissioning and maintenance of access and metro networks
- Turn-up of SONET/SDH circuits
- Performance assessment of Carrier Ethernet services
- Validation of OTN networks and services
- Installation, activation and maintenance of metro Ethernet networks
- Unframed and framed single and dual CPRI BTS and RRH emulation from 1.2 Gbit/s to 9.8 Gbit/s with RTD and SDT support
- Deployment of active Ethernet (point-to-point) access services
- Installation and activation of FC networks
- Testing and troubleshooting
- In-service troubleshooting of live traffic
- Performance monitoring of SONET/SDH and OTN circuits
- Round-trip delay assessment of transport circuits
- BER testing up to 11.3 Gbit/s

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

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

- RJ45 port for electrical 10/100/1000M Ethernet
- SFP port for OC-1/3/12/48 or STM-0/1/4/16, OTU1 and Fibre Channel 1x, 2x, 4x or 100/1000M Ethernet
- SFP+ port for OC-192, STM-64, 10 GigE LAN/WAN or Fibre Channel 8x, 10x, 16x, OTU2, OTU1e/2e and OTU1f/2f

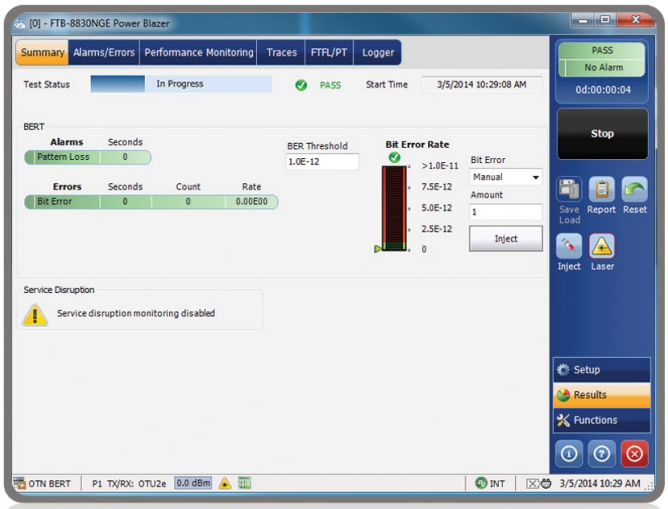
- SONET/SDH and OTN BER testing with configurable threshold settings
- Coupled, Decoupled and Through mode testing
- Error and alarm insertion and monitoring
- Overhead monitoring and manipulation
- High-order and low-order mappings
- Tandem connection monitoring (TCM)
- Pointer manipulation, including pointer sequence testing as per Telcordia GR-253, ANSI T1.105-03 and ITU G.783
- Performance monitoring as per G.821, G.826, G.828, G.829, M.2100, M.2101
- Frequency analysis and offset generation
- Automatic protection switching
- Service-disruption time measurements
- Round-trip delay measurements
- External clock sync support
- 10BASE-T to 10 GigE testing
- EtherSAM (ITU-T Y.1564) (bidirectional)
- iSAM ultra-simple ITU-T Y.1564 and RFC 6349 service activation methodology

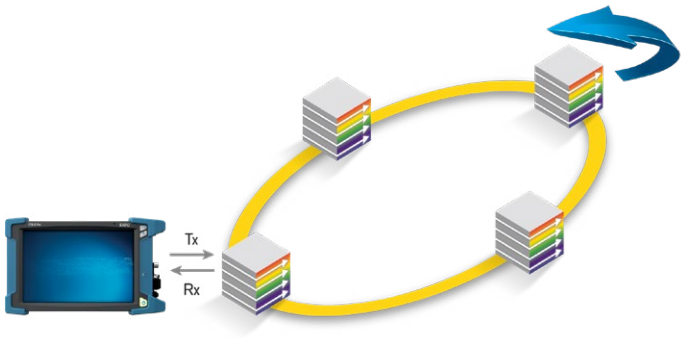
- VLAN preservation
- RFC 2544 (bidirectional)
- RFC 6349 service activation methodology
- Traffic generation and monitoring
- Through mode
- Dual-port testing
- Intelligent autodiscovery
- IPv6 testing
- VLAN stacking MPLS
- Traffic Scan
- Ping/Traceroute
- Cable testing
- Dual Test Set mode
- Smart Loopback
- Fibre Channel 1x, 2x, 4x, 8x, 10x, 16x
- One-way latency
- Carrier Ethernet OAM (MEF, IEEE 802.1ag, ITU-T Y.1731 and ITU-T G.8113.1 MPLS-TP), and Link OAM (IEEE 802.3ah)
- Ethernet MAC flooding
- Single and Dual port CPRI FTTA testing

## SIMPLIFIED BER TESTING

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

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

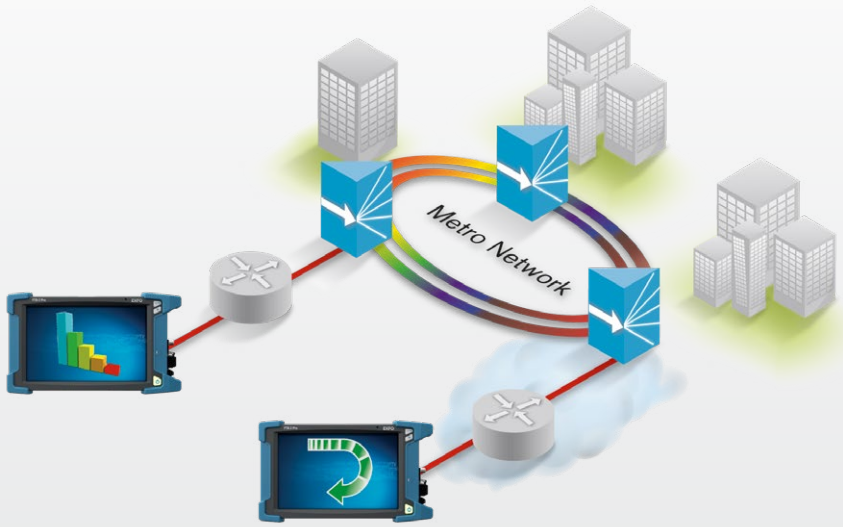



## ETHERNET PERFORMANCE ASSESSMENT

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

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



## EtherSAM: ITU-T Y.1564 Ethernet Service Activation

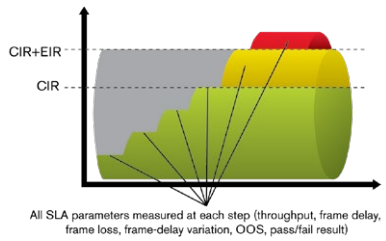
With more and more Ethernet services being activated today, the new ITU-T Y.1564 standard addresses the growing demand for turning up and troubleshooting Carrier Ethernet services. Supported on the FTB/IQS-8830NGE Power Blazer module for 10M-to-10G Ethernet client services, this new methodology brings numerous advantages, including validation of critical SLA criteria such as packet jitter and QoS measurements, as well as faster time to service. EXFO's EtherSAM test suite–based on the ITU-T Y.1564 Ethernet service activation methodology–provides comprehensive field testing for mobile backhaul and commercial services. It can simulate all types of services that will run on the network and simultaneously qualify all key SLA parameters for each of these services.

Moreover, it validates the QoS mechanisms provisioned in the network to prioritize the different service types, resulting in better troubleshooting, more accurate validation and much faster deployment. EtherSAM is comprised of two phases: the service configuration test and the service performance test.

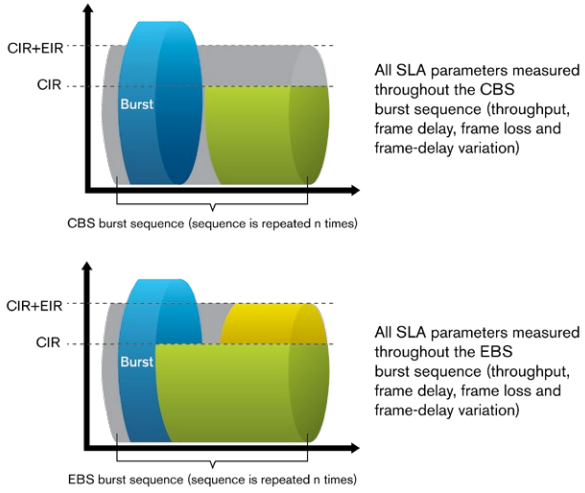
### Service Configuration Test

The service configuration test consists in sequentially testing each service in order to validate that each is properly provisioned and that all specific KPIs or SLA parameters are met. A ramp test and a burst test are performed to verify the committed information rate (CIR), excess information rate (EIR), committed burst size (CBS) and excess burst size (EBS).

**Ramp Test**

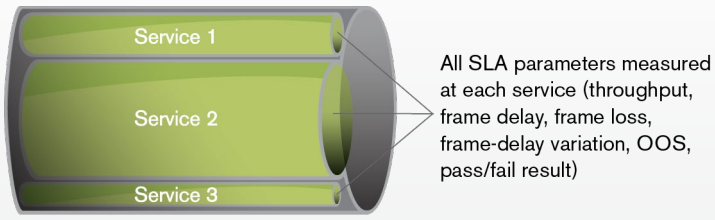



**Burst Test**




### Service Performance Test

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

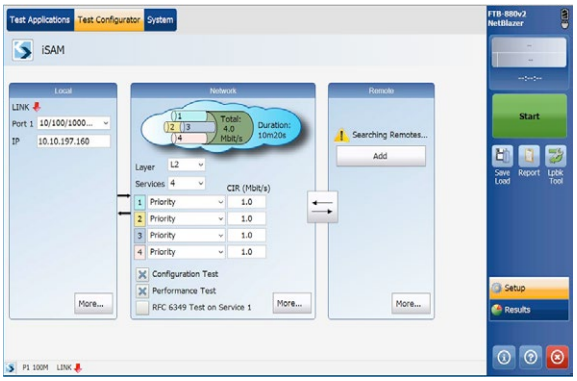


## iSAM

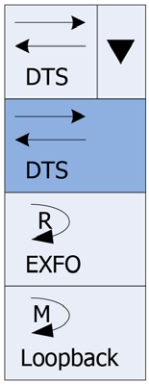
With iSAM, which includes Y.1564 (EtherSAM) and RFC 6349, the focus is on minimalism and simplicity, making both tests as simple as possible for all users. This is in sharp contrast with the current situation in the test and measurement market today. One key aspect of iSAM's simplicity lies in its efficiency: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

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

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




*One-page setup*




*Multiple modes of connection*


*One-page results*

## DUAL TEST SET

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

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

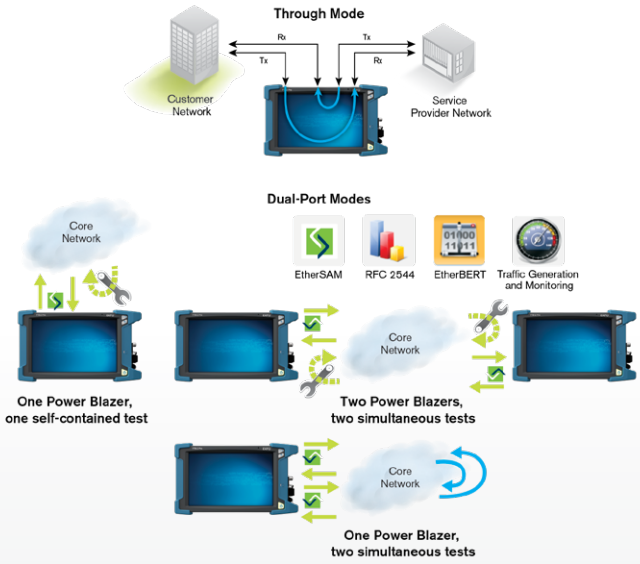
The Dual Test Set approach also provides the capability to segment the network and quickly pinpoint in which direction issues occur. This is especially important in cases where the bandwidth differs between the upstream and downstream directions. In such instances, using a loopback tool will always yield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

## ETHERNET TRAFFIC GENERATION AND MONITORING

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

## CARRIER ETHERNET OAM

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




## DUAL-PORT AND THROUGH MODE TESTING

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

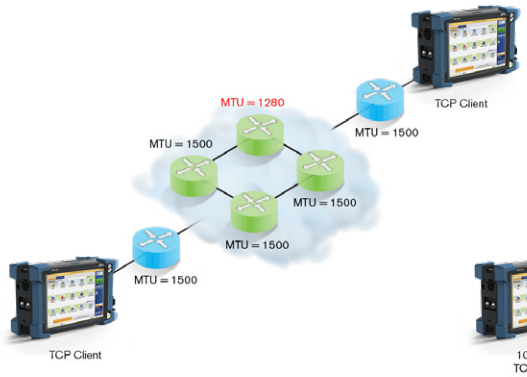
## VLAN/MPLS

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

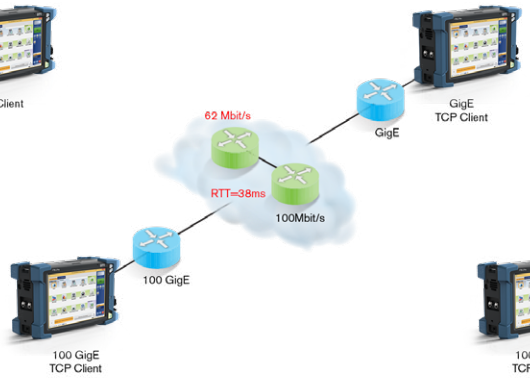
## RFC 6349

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.

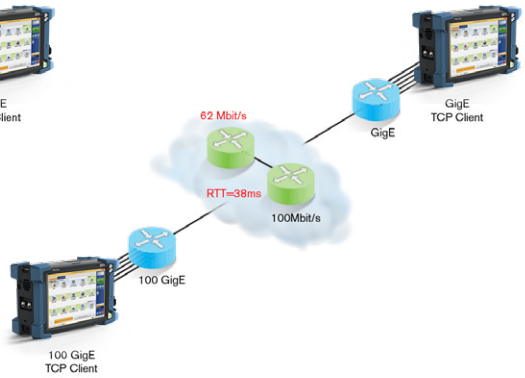
The RFC 6349 test is important, because it includes the steps that follow to help locate and diagnose TCP issues correctly. The first step consists of finding the maximum transmission unit (MTU) size. This ensures that the network is not fragmenting the traffic. The aim of the second step is to determine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

## FTTA TESTING

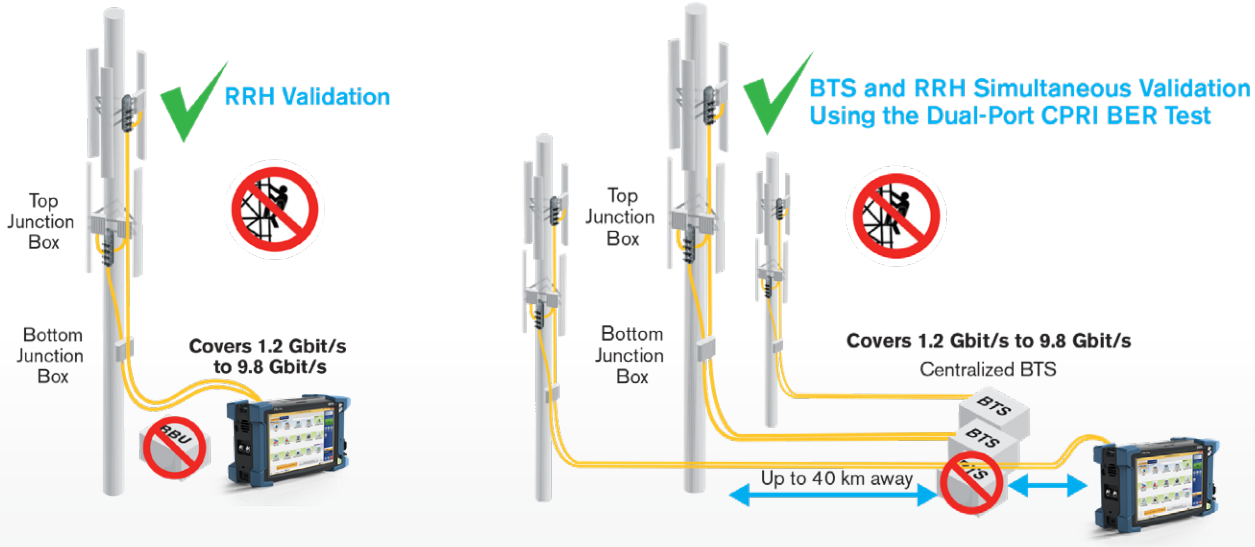
With the Power Blazer Series modules, field technicians can carry out a variety of FTTA tests. For instance, when installing a remote radio head (RRH), it is critical that all equipment be verified before the riggers have finished the construction phase. The Power Blazer Series' CPRI protocol feature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

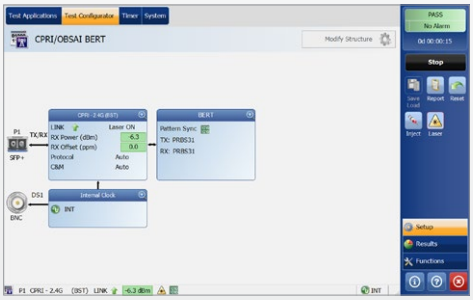
Using these multiservice test modules enabled with the layer-2 CPRI protocol, technicians can easily connect to the RRH without having to climb the cell tower. Regardless of whether the cell site's base station (BTS) is connected to the RRH, these multiservice test modules are always ready to emulate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

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

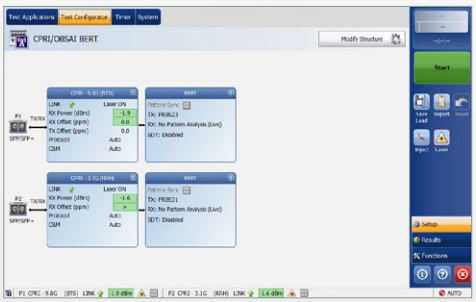
Moving closer towards CPRI-enabled infrastructures, a significant challenge arises as a result of human error occurring between the RRH and the BTS; faulty configurations, bad wiring and incorrect SFPs can lead to problems when trying to initialize the CPRI start-up sequence between the BTS and RRH.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

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

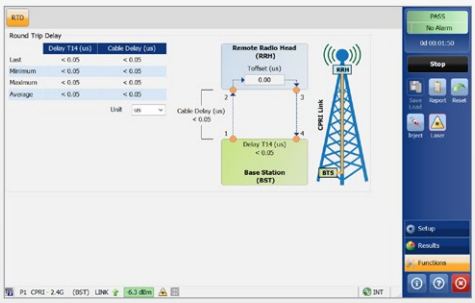



*Framed CPRI BER Test*



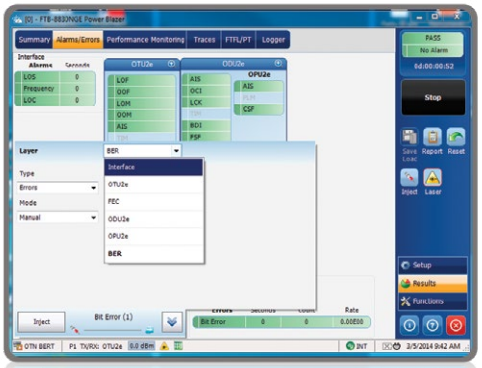

*Dual Port CPRI BER test*




*CPRI Round-Trip Delay*

## IP CONNECTIVITY TOOLS

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



## SIMPLIFIED ERROR INJECTION

This FTB/IQS-8830NGE feature enables the user to inject errors with a single click from any screen, allowing technicians to ensure circuit continuity prior to starting a test. Furthermore, the error injection functionality can be preprogrammed for any given type of error, and not just for bit errors.

## COMPLETE OVERHEAD MANIPULATION AND MONITORING

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

## DELAY MEASUREMENT

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

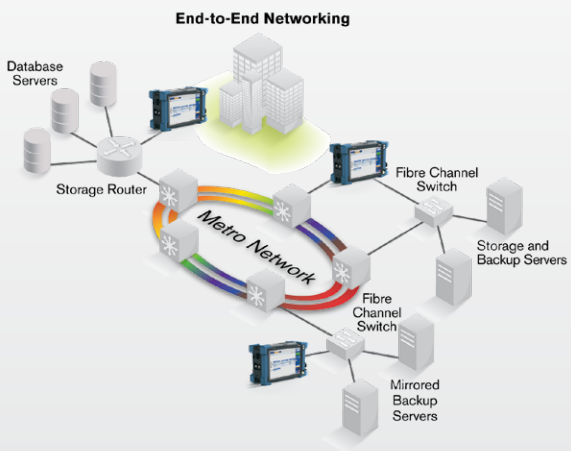
This functionality measures the time required for a bit to travel from the transmitter of the FTB/IQS-8830NGE and back to the receiver after crossing a far-end loopback, thereby providing complete delay results, including delay measurement and minimum/maximum/average delay statistics.


## EFFICIENTLY ASSESSING THE PERFORMANCE OF FIBRE CHANNEL SERVICES

The Power Blazer Series modules provide comprehensive testing capabilities for FC network deployments, supporting multipleFC interfaces.

**COMPLETE SUITE OF FIBRE CHANNEL INTERFACES**

| Interface | Signal Rate (Gbit/s) | Data Rate (MB/s) |
|---|---|---|
| 1x | 1.0 | 100 |
| 2x | 2.1 | 200 |
| 4x | 4.2 | 400 |
| 8x | 8.5 | 800 |
| 10x | 10.5 | 1200 |
| 16x | 14.0 | 1600 |




## APPLICATIONS

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

*Thanks to end-to-end network testing capabilities, EXFO's Power Blazer enables fast deployment and configuration of FC networks. Communication between the transport network, interconnection devices and end nodes can be validated with features such as BER testing, latency measurement, buffer-to-buffer credit estimation and port login capabilities.*

## Latency

Transmission of frames in a network is not instantaneous, and is subject to multiple delays caused by the propagation delay in the fiber and the processing time inside each piece of network equipment. Latency is the total accumulation of delays between two endpoints. Some applications, such as VoIP, video and storage area networks, are very sensitive to excess latency.

It is therefore critical for service providers to properly characterize network latency when offering FC services. The Power Blazer Series modules estimate buffer-to-buffer credit value requirements from the performed latency measurement.

## Buffer-to-Buffer Credit Estimation

In order to regulate traffic flow and congestion, FC ports use *buffers* to temporarily store frames. The number of frames a port can store is referred to as a *buffer credit*. Each time a frame is received by a port, an acknowledgement frame is sent. The buffer-to-buffer credit threshold refers to the amount of frames a port can transmit without receiving a single acknowledgement.

This is a crucial configuration parameter for optimal network performance. Usually, network administrators calculate the value by taking the traveled distance and the data rate into consideration; however, since latency issues are not considered, poor accuracy is to be expected. The Power Blazer Series modules are capable of estimating buffer credit values with respect to latency by calculating the distance according to the round-trip latency time. This value can then be used by network administrators to optimize the network configuration.

## Login Testing

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

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

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

EXFO TFv* 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.

* Available only for FTB modules

EXFO

## OTN TEST FEATURES

| | | |
|---|---|---|
| **OTN** | Standards compliance | ITU-T G.709, ITU G.798, ITU G.872 |
| | Interfaces | OTU1 (2.6660 Gbit/s), OTU2 (10.7092 Gbit/s), OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s) |
| **OTU layer** | Errors | OTU-FAS, OTU-MFAS, OTU-BEI, OTU-BIP-8 |
| | Alarms | LOF, OOF, LOM, OOM, OTU-AIS, OTU-TIM, OTU-BDI, OTU-IAE, OTU-BIAE |
| | Traces | 64-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709 |
| **ODU TCM layer** | Errors | TCMi-BIP-8, TCMi-BEI (i = 1 to 6) |
| | Alarms | TCMi-LTC, TCMi-TIM, TCMi-BDI, TCMi-IAE, TCMi-BIAE |
| | Traces | 64-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709 |
| **ODU layer** | Errors | ODU-BIP-8, ODU-BEI |
| | Alarms | ODU-AIS, ODU-OCI, ODU-LCK, ODU-TIM, ODU-BDI, ODU-FSF, ODU-BSF, ODU-FSD, ODU-BSD |
| | Traces | Generates 64-byte trail trace identifier (TTI), as defined in ITU-T G.709 |
| | FTFL | As defined in ITU-T G.709 |
| **OPU layer** | Alarms | OPU-PLM, OPU-AIS, OPU-CSF |
| | Payload type (PT) label | Generates and displays received PT value |
| **Forward error correction (FEC)** | Errors | FEC-correctable (codeword), FEC-uncorrectable (codeword), FEC-correctable (symbol), FEC-correctable (Bit), and FEC-stress (codeword) |
| **ODU multiplexing** | Single-stage multiplexing | ODU12 (PT20 and PT21) |
| **Pattern** | Patterns | 2E-9, 2E-15, 2E-20, 2E-23, 2E-31, NULL, 32-bit programmable (inverted or noninverted) |
| | Error | Bit error |
| | Alarm | Pattern loss |

## ADDITIONAL OTN FUNCTION

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

## ELECTRICAL ETHERNET INTERFACES

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

## ETHERNET TEST FEATURES

| | |
|---|---|
| EtherSAM (ITU-T Y.1564) | Performs service configuration and service performance tests as per ITU-T Y.1564 including EBS, CBS and EMIX; use remote loopback or Dual Test Set mode for bidirectional results including VLAN preservation for monitoring and analysis of VLAN priority CoS and ID |
| iSAM | Simplified ITU-T Y.1564 test that performs service configuration and service performance tests using Remote Loopback or Dual Test Set mode for bidirectional results; an additional, completely automated RFC 6349 test can be run in conjunction with the EtherSAM (Y.1564) tests, or on its own to perform layer-4 TCP testing, with the inclusion of discovering the maximum transmission unit (MTU) and round-trip time (RTT), as well as the actual and ideal TCP throughput of the circuit under test |
| RFC 2544 | Throughput, back-to-back, frame loss and latency measurements according to RFC 2544; frame size: RFC-defined sizes, user-configurable between one to seven sizes |
| RFC 6349 | RFC 6349 Performs TCP testing with single or multiple TCP connections from 10BASE-T up to 10G; discovers the MTU, RTT, actual and ideal TCP throughput |
| Dual Test Set | Complementing RFC 2544, RFC 6349 and EtherSAM (ITU-T Y.1564) for bidirectional measurements, including one-way latency |
| Intelligent autodiscovery | Offers intelligent autodiscovery of other EXFO modules, allowing single user to perform end-to-end testing |
| 10 GigE dual-port test | 10 GigE dual-port testing with EtherBERT, EtherSAM (ITU-T Y.1564), iSAM, RFC 2544, and traffic generation and monitoring when using 100BASE-X, GigE and 10 GigE |
| Traffic generation and monitoring | Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic, including the simultaneous monitoring of throughput, frame loss, packet jitter, latency and out-of-sequence frames, including MAC flooding for source and destination MAC addresses |
| Through mode | Sectionalizes traffic between a service provider's network and customer premises equipment |
| BER testing | Up to layer 4 supported with or without VLAN Q-in-Q |
| Patterns (BERT) | PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1 and one user pattern. Capability to invert patterns |
| Frame size | Fixed (from 64 to 16 000 bytes), Random and Sweep (from 64 to 16 000 bytes) |
| Framing | IEEE 802.3 SNAP and Ethernet II frame format testing |
| 10 GigE LAN patterns | Seed A, seed B, PRBS 32 unscrambled |
| Error measurement (BERT) | Bit error, bit mismatch 0, bit mismatch 1 |
| Traffic Scan | Discover multiple levels of VLAN channels (C-/S-/E-VLAN) including their ID and priority, as well as the total VLAN tagged frame count and associated bandwidth |
| VLAN stacking | Generates up to three levels of VLANs (including IEEE 802.1ad and Q-in-Q tagged VLAN) |
| VLAN preservation | Validate that CE-VLAN Tags Classes of Service (CoS) and ID are passed transparently |
| MPLS | Generates and analyzes streams with up to two layers of MPLS labels |
| Service disruption time (SDT) | Service disruption time measurements based on No Traffic mode, with statistics including longest disruption time, shortest, last, average, count, total, and pass/fail thresholds |
| IPv6 testing | Performs the following tests up to 10G over IPv6, EtherSAM, RFC 2544, BERT, traffic generation and monitoring, through mode, intelligent auto discovery, ping and trace route |
| 10 GigE WAN testing | Includes WAN interface sublayer, J0/J1 trace and C2 label generation and monitoring |
| 10 GigE WAN alarm monitoring | Includes SEF, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LCD-P, LOP-P, PLM-P, UNEQ-P, ERDI-P, WIS link down, B1, B2, B3, REI-L, REI-P |
| TCP throughput | True wire-speed, stateful TCP throughput test based on RFC 6349 for undisputable SLA enforcement of Ethernet services |
| Error measurement | Jabber/giant, runt, undersize, oversize, FCS, symbol, alignment, collision, late collision, excessive collision, IP checksum, UDP checksum, TCP checksum and 10G block error |
| Alarm detection | LOS, link down, pattern loss, frequency, LOC, 10G local/remote fault |
| Flow control statistics | Injects or monitors pause frames, including frame counts of pause, abort frames and total, last, maximum and minimum pause time |
| 1588 PTP | Validates 1588 PTP packet network synchronization services, emulates PTP clients, generates and analyzes messages between master/clients, clock quality level and IPDV |
| G82751 | 1588 PTP Precision-time-protocol profile for phase and time synchronization with network full-timing support |
| SyncE | Validates SyncE frequency, ESMC messages and clock quality levels |
| Carrier Ethernet OAM | Fault-management and performance-monitoring Ethernet and MPLS-TP OAM protocols, including ITU-T Y.1731, IEEE 802.1ag, MEF, Link OAM (802.3ah) and ITU-T G.8113.1 OAMs; addresses metro Ethernet networks; supports continuity check, loopback, link trace, test, frame delay, frame loss and synthetic loss functions, as well as AIS, CSF, RDI, and LCK alarm generation and monitoring |
| Traffic filtering | Incoming traffic analysis and statistics according to a set of up to 10 configurable filters; filters can be configured for MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TCP source/destination port and UDP source/destination port; VLAN filtering can be applied to any of the stacked VLAN layers |
| Advanced filtering | Ability to enhance the filters with up to four fields each, which can be combined with AND/OR/NOT operations; a mask is also provided for each field value to allow for wild cards; complete statistics are gathered for each defined filter |
| Data capture | Full-line-rate data capture and decoding at up to 10G; configuration of detailed capture filters and triggers, as well as capture slicing parameters |
| IP tools | Performs ping and traceroute functions |
| Smart Loopback | Returns Ethernet traffic to the local unit by swapping packet overhead up to layer 4 |
| Cable testing | Category 5 cable (or better), 100 UTP/STP cable, ≤120 meters |
| **FTTA** | |
| CPRI layer-2 protocol testing | Supports BTS and RRH emulation modes by supporting start-up sequence states, autodetection of protocols, negotiated parameters for control and maintenance, Ethernet and HDLC channels, hyperframe and codeword counts, injection, and monitoring of layer-1 alarms and frequency |
| CPRI SDT | Measurements in milliseconds (ms) for the longest, shortest, last, average, total and count of disruptions |
| CPRI RTD | Determine the CPRI protocol round-trip delay measurement |
| CPRI DUAL PORT | Provides two simultaneous ports of CPRI BBU or RRH emulation with rates from 1.2 to 9.8G Gbit/s. |

## SONET/SDH FUNCTIONAL SPECIFICATIONS

| SONET | | SDH | |
|---|---|---|---|
| Optical interfaces | OC-1, OC-3, OC-12, OC-48, OC-192 | Optical interfaces | STM-0, STM-1, STM-4, STM-16, STM-64 |
| Available wavelengths (nm) | 1310, 1550 | Available wavelengths (nm) | 1310, 1550 |
| Clocking | Internal, loop-timed, external (BITS) | Clocking | Internal, loop-timed, external (MTS/SETS), 2 MHz |
| **Mappings** | | | |
| VT1.5 | Bulk | AU-3-TU-11, AU-4-TU-11 | Bulk |
| VT2 | Bulk | AU-3 -TU-12, AU-4-TU-12 | Bulk |
| STS-1 SPE | Bulk | AU-3, AU-4-TU-3 | Bulk |
| STS-3c | Bulk | AU-4 | Bulk |
| STS-12c/48c/192c, SPE | Bulk | AU-4-4c/16c/64c | Bulk |
| SONET overhead analysis and manipulation | A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5, N1, N2, Z6, Z7 | SDH overhead analysis and manipulation | A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, M1, G1, F2, F3, K3, N1, N2, K4, E2, J1, C2, H4 |
| **Error insertion** | | | |
| OC-1, OC-3, OC-12, OC-48, OC-192 | Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error | STM-0, STM-1, STM-4, STM-16, STM-64 | RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error |
| **Error measurement** | | | |
| OC-1, OC-3, OC-12, OC-48, OC-192 | Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, FAS, bit error | STM-0, STM-1, STM-4, STM-16, STM-64 | RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, FAS, bit error |
| **Alarm insertion** | | | |
| OC-1, OC-3, OC-12, OC-48, OC-192 | LOS, LOF-S, SEF, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, UNEQ-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, pattern loss | STM-0, STM-1, STM-4, STM-16, STM-64 | LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-UNEQ, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, pattern loss |
| **Alarm detection** | | | |
| OC-1, OC-3, OC-12, OC-48, OC-192 | LOS, LOC, LOF-S, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, PLM-P, UNEQ-P, TIM-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, TIM-V, PLM-V, pattern loss | STM-0, STM-1, STM-4, STM-16, STM-64 | LOS, RS-LOF, LOC, RS-OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-RDI, HP-ERDI-CD, HP-ERDI-PD, HP-ERDI-SD, LP-ERDI-CD, LP-ERDI-PD, LP-ERDI-SD, HP-PLM, HP-UNEQ, HP-TIM, TU-AIS, LP-RFI, LP-RDI, LP-RFI, LP-UNEQ, LP-TIM, LP-PLM, pattern loss |
| *Frequency alarms on all supported interfaces* | | | |
| **Patterns** | | | |
| VT1.5/2 | 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors | TU-11/12/3 | 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors |
| STS-1, STS-3c/ 12c/48c/192c | 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors | AU-3/AU-4/AU-4-4c/ 16c/64c | 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors |
| *Pattern loss, and bit-error generation and analysis supported on all patterns* | | | |

## SONET/SDH TEST FEATURES

| | |
|---|---|
| Frequency measurements | Supports clock frequency measurements (i.e., received frequency and deviation of the input signal clock from nominal frequency), displayed in ppm, for optical and electrical interfaces. Measurements are performed using a local oscillator. |
| Frequency offset generation | Supports offsetting the clock of the transmitted signal on a selected interface to exercise clock recovery circuitry on network elements. |
| Performance monitoring | The following ITU-T recommendations, and corresponding performance monitoring parameters, are supported:<br><br>**ITU-T recommendation** — **Performance monitoring statistics**<br>G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM<br>G.826 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER<br>G.828 — ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI<br>G.829 — ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER<br>M.2100 — ES, SES, UAS<br>M.2101 — ES, SES, BBE, UAS |
| Pointer adjustment and analysis | Generation and analysis of HO/AU and LO/TU pointer adjustments as per GR-253, and ITU-T G.707<br><br>**Generation**<br>› Pointer increment and decrement<br>› Pointer jump with or without NDF<br>› Pointer value<br><br>**Analysis**<br>› Pointer increments<br>› Pointer decrements<br>› Pointer jumps (NDF, no NDF)<br>› Pointer value and cumulative offset |
| Pointer sequence testing | Performs pointer sequence testing as per G.783, GR253 and T1.105-3 standards. |
| Service disruption time (SDT) measurements | The service disruption time test tool measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels.<br>Measurements: last disruption, shortest disruption, longest disruption, average disruption, total disruption, and service disruption count. |
| Round-trip delay (RTD) measurements | The round-trip delay test tool measures the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback. Measurements are provided on all supported Power Blazer interfaces and mappings.<br>Measurements: last, minimum, maximum, average; measurement count: no. of successful RTD tests and failed measurement count. |
| APS message control and monitoring | Ability to monitor and set up automatic protection switching messages (K1/K2 byte of SONET/SDH overhead). |
| Synchronization status | Ability to monitor and set up synchronization status messages (S1 byte of SONET/SDH overhead). |
| Signal label control and monitoring | Ability to monitor and set up payload signal labels (C2, V5 byte of SONET overhead). |
| Tandem connection monitoring (TCM) [a] | Tandem connection monitoring (TCM) is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The Power Blazer supports transmitting and receiving alarms and errors on a TCM link; also, transmission and monitoring of the tandem connection (TC) trace can be generated to verify the connection between TCM equipment.<br>Error generation: TC-IEC, TC-BIP, TC-REI, TC-OEI<br>Error analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL (non-standardized alarm)<br>Alarm generation: TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS<br>Alarm analysis: TC-TIM, TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS |
| Through mode | Performs Through mode analysis of any incoming optical line (OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64) transparently. |

**Note**

a. HOP and LOP supported as per ITU-T G.707 option 2.

## FIBRE CHANNEL FUNCTIONAL SPECIFICATIONS

| **Testing 1x, 2x, 4x, 8x, 10x, 16x** | |
|---|---|
| BERT | Framed FC2 |
| Patterns (BERT) | PRBS 2E31-1, 2E23-1, 2E20-1, 2E15-1, 2E11-1, 2E9-1, one user-defined pattern and the capability to invert patterns |
| Error insertion | Bit error, amount and rate |
| Error measurement | Bit error, symbol error, oversize error, CRC error, undersize error and block error (10x only) |
| Alarm detection | LOS, pattern loss, link down, local and remote fault |
| Buffer-to-buffer credit testing | Buffer-to-buffer credit estimation based on latency |
| Latency | Round-trip latency |

# ELECTRICAL INTERFACES

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

## SYNCHRONIZATION INTERFACES

| | External Clock DS1/1.5M | External Clock E1/2M | 2 MHz |
|---|---|---|---|
| Tx pulse amplitude (V) | 2.4 to 3.6 | 2.37 | 0.75 to 1.5 |
| Tx pulse mask | GR-499 figure 9.5 | G.703 figure 15 | G.703 figure 20 |
| Tx LBO pre-amplification (typical) (dBdsx) | 0.6 for 0 to 40.5 m (0 to 133 ft)<br>1.2 for 40.5 to 81.1 m (133 to 266 ft)<br>1.8 for 81.1 to 121.6 m (266 to 399 ft)<br>2.4 for 121.6 to 162.5 m (399 to 533 ft)<br>3 for 162.5 to 200 m (533 to 655 ft) | | |
| Rx-level sensitivity | TERM: ≤6 dB (cable loss only) (at 772 kHz for T1)<br>DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) | TERM: ≤6 dB (cable loss only)<br>MON: ≤26 dB (resistive loss + cable loss ≤ 6 dB) | ≤6 dB (cable loss only) |
| Transmission bit rate | 1.544 Mbit/s ± 4.6 ppm | 2.048 Mbit/s ± 4.6 ppm | |
| Reception bit rate | 1.544 Mbit/s ± 50 ppm | 2.048 Mbit/s ± 50 ppm | |
| Intrinsic jitter (Tx) | ANSI T1.403 section 6.3<br>GR-499 section 7.3 | G.823 section 6.1 | G.703 table 11 |
| Input jitter tolerance | AT&T PUB 62411<br>GR-499 SECTION 7.3 | G.823 section 7.2<br>G.813 | |
| Line coding | AMI and B8ZS | AMI and HDB3 | |
| Input impedance (resistive termination) | 75 Ω ± 5 %, unbalanced | 75 Ω ± 5 %, unbalanced | 75 Ω ± 5 %, unbalanced |
| Connector type | SMB [a] | SMB [b] | SMB [b] |

## REF-OUT INTERFACE

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

**Notes**

a. Specification measured with 100 Ω Bantam cable.

b. SMB to BNC adapter is available.

## MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

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

## ORDERING INFORMATION

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

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

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

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

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

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

**CPRI Rate Options** [c]
CPRI-OBSAI = Enables 1.2G to 3.1G CPRI, and 3.1G OBSAI [b]
CPRI-1.2G = Enables CPRI 1.2G
CPRI-4.9G = Enables CPRI 4.9G
CPRI-6.1G = Enables CPRI 6.1G
CPRI-9.8G = Enables CPRI 9.8G
CPRI_ALLRATES = Enables all CPRI rates
DP-CPRI = Enables two CPRI ports

**Ethernet Options**
00 = No Ethernet option
ADV-FILTERS = Advanced filtering [e]
ETH-CAPTURE = Full-line-rate packet capture [e]
ETH-OAM = Enables four OAM modes, including Y.1731, 802.1ag, MEF and G.8113.1 [e]
LINK-OAM = Enables 802.3ah Link OAM [e]
TST-OAM = Enables OAM testing within EtherSAM
IPV6 = Internet protocol version 6 [e]
ETH-THRU = Through mode capability [f]
MPLS = Enables MPLS [e]
1588PTP = Generates and analyzes 1588 PTP [e]
G82751 = Enables ITU-T G.8275.1 profile
SyncE = Generates and analyzes SyncE protocol [e]
Cable_Test = Cable test [f]
TCP-THPUT = Enables TCP throughput measurements [f]
TRAFFIC-SCAN = Discover and monitor VLAN traffic flows on a live signal [e]
DUAL-PORT = 10 GigE dual-port testing [e]
iSAM = Enables simplified ITU-T 1564 test [e]
RFC6349 = Enables TCP testing as per RFC 6349 [e]

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

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

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

**Notes**

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

## SFP MULTIRATE OPTICAL TRANSCEIVERS

FTB-8590 = SFP module: Gig/FC/2FC, CPRI/OBSAI 2.45/3.07 Gbit/s at 850 nm, MM, <500 m reach
FTB-8690 = Multirate SFP supporting: GigE, 850 nm, LC connector, MMF, < 500 m reach
FTB-8190 = SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC, CPRI/OBSAI 2.45/3.07 Gbit/s at 1310 nm, LC connector, 15 km reach
FTB-8191 = SFP module; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC; CPRI/OBSAI 2.45/3.07 Gbit/s at 1310 nm, LC connector, 40 km reach
FTB-8192 = Multirate Optical Transceiver; rates: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1550 nm, LC connector, SMF, 80 km reach
FTB-8193 = Multirate SFP supporting: 155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE, 1550 nm, LC connector, SMF, 40 km reach
FTB-85912 = SFP modules: GigE/FC/2FC/4FC at 850 nm, < 500 m reach
FTB-85913 = SFP modules: GigE/FC/2FC/4FC at 1310 nm, 4 km reach
FTB-85914 = SFP modules: GigE/FC/2FC/4FC at 1310 nm, 30 km reach
FTB-85915 = SFP modules: GigE/FC/2FC/4FC at 1550 nm, < 50 km reach
FTB-85919 = SFP copper, multirate 10/100/1000 BASE-T, Cat5 UTP 100 m reach

## 100M SFP SINGLE-RATE OPTICAL TRANSCEIVERS

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

## 1000M SFP BIDIRECTIONAL OPTICAL TRANSCEIVERS

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

## 1000M SFP COPPER TRANSCEIVERS

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

## 10G SFP+ MULTIRATE OPTICAL TRANSCEIVERS

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

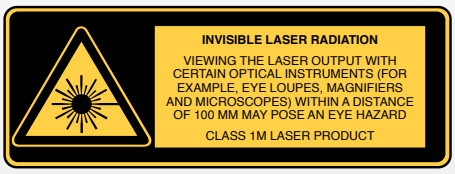
## 10G XFP MULTIRATE OPTICAL TRANSCEIVERS

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

## 10 GigE XFP OPTICAL TRANSCEIVERS

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

## LASER SAFETY

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