FTB-85100G Packet Blazer

40G/100G MULTISERVICE TEST MODULE

CFP2 READY

EtherSAM

iSAM

COMPLETE IPv6 TESTING

CFP Health Check

FROST & SULLIVAN
2011 BEST PRACTICES AWARD
GLOBAL SONET/SDH & OTN TEST EQUIPMENT GROWTH LEADERSHIP OF THE YEAR AWARD

SPEC SHEET

EXFO's 40G/100G integrated multiservice testing solution for carrier labs and the NEM market.

KEY FEATURES

40G/100G Ethernet fully compliant with IEEE 802.3ba standard and OTU3/OTU4 as per ITU-T G.709 and OC-768/STM-256 testing capabilities—all in a single module

OTU3/OTU4 and OTU3e1/e2 with forward error correction (FEC) and optical transport layer (OTL) testing capabilities as software options

40G/100G Ethernet mapping and SONET/SDH mapping over OTN, OTU3/OTU4 single and multistage multiplexing, and ODUflex capabilities for transponder and muxponder testing

40G/100G IP traffic at 100% transmission with full Ethernet statistics, clear pass/fail verdicts, packet capture and advanced traffic filtering capabilities

Enhancing the 40G/100G Ethernet stack with support for IPv6 protocol capability for transition IP stack testing

Faster Ethernet service activation with EtherSAM (ITU-T Y.1564) service configuration and performance tests, as well as RFC 2544 test suites complemented by remote discovery, Smart Loopback and Dual Test Set capabilities

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

40G/100G Ethernet traffic generation and monitoring with up to 16 fully configurable streams to simulate a multiservice offering and complete QoS results to fully qualify SLA parameters

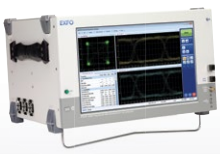
Fully integrated testing capabilities for assessing CFP MSA optical modules and physical-layer performance: PCS into CAUI/XLAUI, logical into physical mappings, skew testing, advanced signal conditioning and full MDIO access

Single instrument for carrier lab qualifications and NEM applications with 40G/100G multiservice offering, remote management, predefined user configurations and complete automation capabilities

COMPLEMENTARY PRODUCTS

Platform
FTB-500

Power Blazer
FTB-8130NGE



Optical Modulation Analyzer
PSO-200

Optical Analyzers
FTB-5230S-OCA

EXFO

40G/100G ETHERNET—A RAPIDLY EMERGING MARKET

The ongoing growth of enterprise, residential and mobile multimedia services (such as peer-to-peer, IPTV and video-over-Internet) is producing unprecedented levels of traffic, stressing the bandwidth capabilities of metro and core transport networks. Consequently, carriers worldwide are actively seeking strategies to efficiently and cost-effectively scale IP packet transmission. Designed to facilitate this transition, 40G/100G Ethernet technologies give carriers the flexibility to phase in the implementation of these higher-speed rates to better align capacity increases with their specific growth and budget strategies.

These new data rates are based on the IEEE 802.3ba standard. The most significant concept introduced in this new working standard is the use of parallel optics that strongly influence the physical coding sublayer (PCS) implementation, which is one of the new building blocks for 40G/100G Ethernet. The key difference between the IEEE 802.3ba standard and its predecessor is the introduction of PCS lanes (formerly known as virtual lanes). PCS lanes provide an effective method for handling various parallel optical configurations, and therefore require a comprehensive solution that can easily qualify and integrate both 40G/100G CFP and 10x10 multi-source agreement (MSA)-compliant pluggable optics. Thorough PCS testing is among the critical layer-1/2/3/4 tests needed to ensure that 40G/100G Ethernet equipment and network services can be deployed rapidly and confidently.

40G/100G MULTISERVICE TESTING SOLUTION FOR CARRIER AND NEM LABS

Leveraging over a decade of field-programmable gate array (FPGA) experience, EXFO has integrated Ethernet (IEEE 802.3ba) and OTN (ITU-T G.709) functionalities into the same module, the FTB-85100G Packet Blazer. With this upgrade, you will be able to efficiently and cost-effectively share the equipment in the lab, perform field trials and carry out early deployments. Purpose-built for applications where thorough testing, portability, true ruggedness and ease of use are required, this module offers powerful layer-1/2/3 Ethernet traffic generation and analysis, as well as RFC 2544 with Smart Loopback testing capabilities to stress and validate network elements and services against demanding corner cases.

The FTB-85100G Packet Blazer also supports OTU3/OTU4 bit-error-rate testing (BERT) and ODU muxing capabilities for 40G/100G transponder and muxponder qualification in network equipment manufacturer (NEM) labs, as well as for optical transport network (OTN) turn-up in the field. In addition, its FPGA-based architecture ensures rapid and seamless incorporation of updates as the standard is ratified and refined, protecting your testing investment without sacrificing timely support of features and functions.

All existing and newly developed testing capabilities are available via an intuitive graphical user interface (GUI) and through software keys for field upgrades. No additional hardware or shipping to the manufacturer is required.

OPTICAL TRANSPORT NETWORK (OTN) TESTING

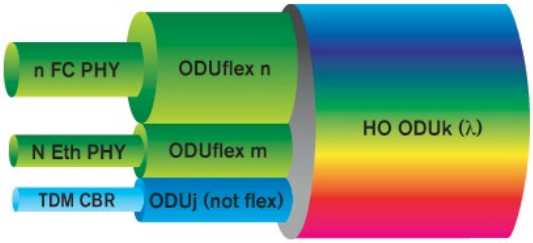
OTN (ITU-T G.709) is the transport technology of choice for 40G/100G Ethernet traffic over the core network because of its operation, administration, maintenance and provisioning (OAM&P) capability for troubleshooting and maintenance as well as its forward error correction (FEC) mechanism for performance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

The FTB-85100G Packet Blazer supports numerous OTN testing capabilities, enabling breakthrough level qualification of 40G and 100G transponders and muxponders in NEM labs. These capabilities include OTU4 (112 Gbit/s) and OTU3 (43 Gbit/s) full line-rate testing with OTN framing and FEC testing as per ITU-T G.709, over-clocked OTU3 including OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s), 40G/100G Ethernet mapping over OTU3/OTU4, single and multistage ODU multiplexing as well as OTN service disruption time (SDT) measurements.

EXFO's FTB-85100G Packet Blazer supports ODU0 and ODU multiplexing into ODU4/ODU3, among many other multiplexing schemes, in order to address the growing demand for Ethernet service turn-up and to prove that new 40G/100G circuits are capable of handling all future services.

ODUflex

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



ETHERNET AND SONET/SDH MAPPING OVER OTU3/OTU4

EXFO's FTB-85100G Packet Blazer offers the 40G/100G Ethernet and SONET mapping capability over OTU3/OTU4 through the EoOTN or SONET/SDH software options. This is a key testing capability that allows NEMs to qualify their 40G/100G transponder development, such as mapping and demapping capabilities as well as client signal timing transparency. It also provides the 40 GigE-specific transcoding capability that must be qualified to ensure that the 40 GigE-frame is properly transcoded from 64B/66B to 1024B/1027B, and properly mapped into the OTU3 (43G) standard frame.

Thanks to the FTB-85100G Packet Blazer, customers can now map 40G/100G Ethernet clients or SONET/SDH over OTN with different traffic characteristics, run end-to-end BER tests across an OTN and measure the ratio of error bits to the number of bits sent. In this testing configuration, the FTB-85100G Packet Blazer module provides complete analysis of the OTN transport layers, including OTU/ODU/OPU and GMP statistics to ensure proper recovery of the client signal at the receive end and complete SONET/SDH analysis. EXFO's EoOTN testing capability also validates the 40G/100G Ethernet traffic transmission with 100% throughput, and ensures that latency does not impact service providers' service-level agreements (SLAs) with their customers.

ETHERNET PERFORMANCE VALIDATION

The Internet Engineering Task Force (IETF) has put together a test methodology to address the issues of performance verification at the layer-2 and 3 levels. The RFC 2544 benchmarking methodology for network-interconnect devices specifies the requirements and procedures for testing throughput (performance availability), back-to-back frames (link burstability), frame loss (service integrity) and latency (transmission delay).

The FTB-85100G Packet Blazer supports the RFC 2544 test suite for 40G and 100G Ethernet interfaces at all frame sizes and at full line rate, enabling service providers to certify that the circuit is efficient and error-free at 100% utilization. In addition, it supports automated RFC 2544 testing, which helps ensure repeatable results. The FTB-85100G's RFC 2544 testing capabilities include 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 mode), this module has the flexibility to adjust to all loopback situations.

The FTB-85100G's unique Smart Loopback capability also enables customers to perform end-to-end testing through which the remote unit will return traffic to the local unit by swapping packet overhead up to layer 4 of the open-systems-interconnection (OSI) stack. In short, this tools enables manufacturers and carriers to ensure optimal performance of 40G/100G optics during lab evaluations and field deployments.

EtherSAM: ITU-T Y.1564 Ethernet Service Activation

Supported on the FTB-85100G Packet Blazer module for 40G/100G Ethernet services, this new methodology brings numerous advantages, including validation of critical SLA criteria such as packet jitter and quality-of-service (QoS) measurements, as well as faster time-to-service. EXFO's EtherSAM test suite is based on the ITU-T Y.1564 Ethernet service activation methodology, and provides comprehensive testing capabilities. EtherSAM can simulate all the types of services running on the network and simultaneously qualify all the key SLA parameters for each of these services.

Moreover, it validates the QoS mechanisms provisioned in the network in order 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.

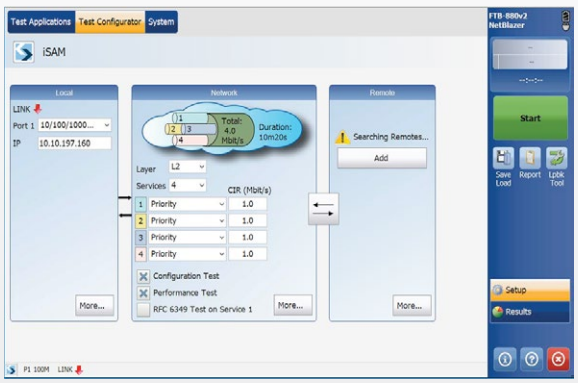
- **Service Configuration Test**
  The service configuration test consists of sequentially testing each service to validate that the service is properly provisioned and that all specific KPIs or SLA parameters are met.
- **Service Performance Test**
  Once the configuration of each individual service is validated, the service performance test simultaneously validates the quality of all the services over time.

iSAM

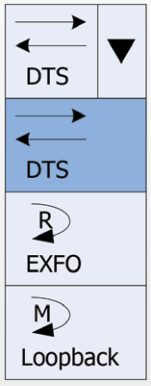
With iSAM, which includes Y.1564 (EtherSAM) and RFC 6349, the focus is on minimalism and simplicity, making both tests as simple as possible for all users. This is in sharp contrast with the current situation in the test and measurement market today. One key aspect of iSAM's simplicity lies in its efficiency: 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.

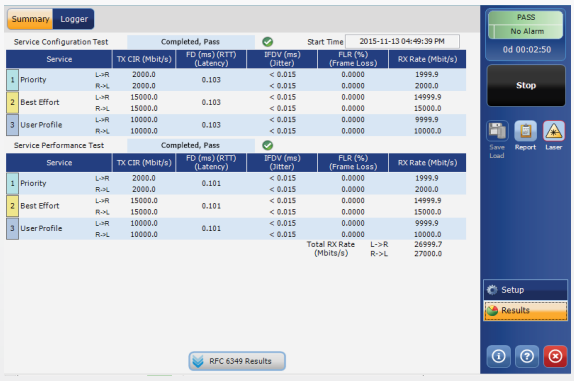
The innovation does not stop there. iSAM also takes the lead in delivering the latest test and measurement standards. iSAM has achieved an industry first by introducing actual Metro Ethernet Forum (MEF) standards and thresholds to guarantee that service providers, mobile network operators and multisystem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



One-page setup



Multiple modes of connection

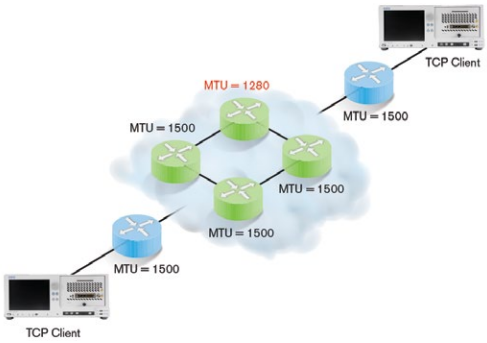


One-page results

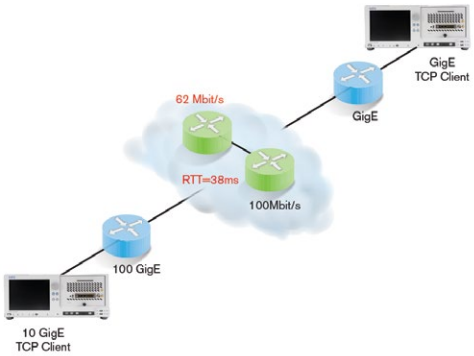
RFC 6349

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.

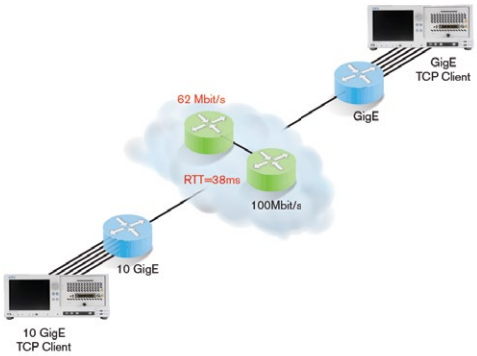
The RFC 6349 test is important as it includes the following steps that help locate and diagnose TCP issues correctly. The first step consists of finding the maximum MTU size. This ensures that the network is not fragmenting the traffic. The second step aims to determine the baseline round-trip delay, 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 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 has all the values to rectify the situation. In the end, the RFC 6349 test helps to resolve any potential discrepancies that occur between the service provider network and the customer-premises equipment.



PATH MTU discovery



Baseline RTT and bandwidth to determine ideal window size



Single or multiple TCP connections to enable full pipe testing

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 40G/100G test sets, one designated as local and the other as remote, are used to communicate and independently run tests in each 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

Data services carried over 40G/100G networks are making a significant shift toward supporting a variety of applications. Multiservice offerings such as triple-play services have fuelled the need for QoS testing to ensure the condition and reliability of each service as well as qualify SLA parameters. The FTB-85100G Power Blazer, with its 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 every single one. The FTB-85100G also offers the flexibility to define one configuration profile and apply it to as many streams as required. From there, it is just a matter of tweaking them to each stream. The FTB-85100G also simultaneously measures throughput, latency, packet jitter (RFC 3393), frame loss and out-of-sequence errors in all streams, yielding a fast and in-depth qualification of all SLA criteria. Results are displayed in tabular format as well as on analog visual gauges to ensure that test outcomes are quickly and easily interpreted.

40G SONET/SDH BER TESTING

SONET/SDH solutions have been the fundamental basis of optical networks for the better part of the past 20 years, during which they provided the stability and scalability required for data applications. This large installation of SONET/SDH systems still needs to be tested, monitored and properly maintained, along with newly deployed services over OTN and WDM networks. EXFO's FTB-85100G Packet Blazer Test Module provides advanced 40G OC-768/STM-256 bit-error-rate test (BERT) functionality over 40G serial CFP. This capability includes full flexibility for generation and monitoring of 40G SONET/SDH alarms, errors and overhead bytes at all layers. In addition, the FTB-85100G module supports standard SONET/SDH automatic protection switching (APS), service disruption time (SDT) and round trip delay (RTD) measurements.

CFP HEALTH CHECK

The FTB-85100G Packet Blazer also offers a 100G CFP/CFP2 Health Check. Unlike the single wavelength transceiver used in legacy 2.5G and 10G networks, each CFP parallel optical channel must be monitored for transmitted and received power levels to avoid damaging expensive 100G circuits and equipment. Moreover, each parallel lane must be monitored for frequency and frequency offset to ensure proper clock and timing recovery.

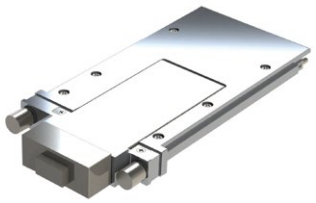
The CFP information page now provides detailed information on the module, no longer requiring the removal of the CFP to read the CFP module details. Complete management data input/output (MDIO) read/write access has also been given, allowing advanced network engineers to verify the management interface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

The FTB-85100G also includes a 100G automated stress-test application that covers transmission tolerance tests like skew measurement, crosstalk, electrical amplitude and pattern dependency. Essentially, all manual interventions have been removed, thus simplifying the CFP/CFP2 qualification process. In short, this tool enables carriers to ensure the optimal performance of 100G networks during evaluation and deployments.

SIGNAL CONDITIONING

EXFO's FTB-85100G Packet Blazer module offers a signal-conditioning tool to characterize the electrical CAUI/XLAUI and physical lanes as well as to troubleshoot electrical-level issues on standard optical interfaces used within 40G/100G systems. This capability provides direct access to amplitude and pre/post-emphasis control of the 10G electrical CAUI/XLAUI lane transmitters, as well as equalization correction at the receivers. The signal-conditioning interface provides access to the electrical parameters, enabling users to better compensate for signal integrity issues or modify specific electrical parameters to observe the effects of stressing the pluggable optical device. By having the ability to modify signal parameters with a wide dynamic range of amplitude, pre-emphasis and equalization controls, CFP manufacturers can evaluate and optimize the performance of their modules.

CFP2—THE SECOND-GENERATION HIGH-SPEED TRANSCEIVERS



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

EXFO's FTB-85100G Packet Blazer offers 100G testing capabilities for CFP2 transceivers thanks to the new FTB-85970 CFP-to-CFP2 adapter, which requires no additional high-speed modules. This CFP-to-CFP2 adapter provides the flexibility needed to support the industry's different implementations of 100G transceivers, including the 4 x 25G and 10 x 10G. Customers can therefore have full access to 100G testing capabilities on their lab unit using both CFP and CFP2 transceivers at a fraction of the cost of upgrading their full fleet of test units to dedicated CFP2-based modules. This unique offering on the market ensures a maximum return on investment and eliminates the need for multiple test modules.

KEY FEATURES

Detailed compliance testing	› IEEE 802.3ba standard (2010) › CFP MSA hardware specifications, 10x10 MSA and CFP MSA management interface (MDIO) › ITU-T G.709, G.798 and G.872
Multi-interface support	› Pluggable, MSA-compliant 4 x 10G, 4 x 25G, 10 x 10G and 40G serial CFPs › MSA-compliant pluggable 4 x 25G LR and 10 x 10G SR CFP2s using EXFO's CFP-to-CFP2 adapter › External timing reference (DS1/E1/2 MHz) › Low-speed and high-speed reference clock output for eye diagram measurements
Robust physical-layer validation	› 40G/100G CAUI/XLAUI lane error generation and monitoring › PCS lane mapping and monitoring capability › Per-lane skew generation and measurement › PCS error generation and monitoring per lane › Full MDIO read/write access › Signal conditioning–CAUI/XLAUI pre-emphasis and gain equalization capability
PRBS patterns per lane	Allows users to configure different PRBS patterns on different CAUI/XLAUI lanes in 40G/100G, and on physical lanes in OTU3/OTU4 unframed configurations; typically used to identify crosstalk issues when looking at the eye diagram
Per-wavelength power measurement	Allows users to measure the received optical power per wavelength in the used parallel CFP/CFP2 transceivers
CFP Health Check	› Individual optical channel laser ON/OFF control › Per-wavelength Tx/Rx power level measurement with a clear power range and color code indicator › Frequency and frequency-offset measurements › CFP and CFP2 optical modules and test-configuration crosscheck › Display of pluggable CFP-related information, including: manufacturer, serial number, revision, speed, laser type and more
CFP2	› CFP2 testing interface and capabilities using EXFO's CFP-to-CFP2 adapter on the FTB-85100G module › Two operation modes with Gearbox ON/OFF, covering 4 x 25G and 10 x 10G CFP2 transceiver implementations, respectively
Layer-2/3/4 Ethernet testing	› 100G and 40G unframed BERT and EtherBERT › RFC 2544, including throughput, back-to-back, latency and frame loss with Dual Test Set for bidirectional measurements › EtherSAM (ITU-T Y.1564) with Dual Test Set for bidirectional measurements › RFC 6349: Performs TCP testing with single or multiple TCP connections from 10BASE-T up to 100G; discovers the MTU, RTT, actual and ideal TCP throughput › Simplified ITU-T Y.1564 test that performs service configuration and service performance tests using Remote Loopback or Dual Test Set mode for bidirectional results; an additional, completely automated RFC 6349 test can be run in conjunction with the EtherSAM (Y.1564) tests, or on its own to perform layer-4 TCP testing, with the inclusion of discovering the maximum transmission unit (MTU) and round-trip time (RTT), as well as the actual and ideal TCP throughput of the circuit under test › Dual Test Set mode › Intelligent autodiscovery › Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic, and monitoring of throughput, latency, packet jitter, frame loss and out-of-sequence › Q-in-Q capability with the ability to go up to three layers of stacked VLANs › VLAN CoS and ID preservation › Discover up to three levels of VLAN tagged traffic (C-/S-/E-VLAN) including their ID and priority, as well as the total VLAN tagged frame count and associated bandwidth › Ping and traceroute › Advanced filtering capability for in-depth network troubleshooting › Smart Loopback › Flow control › 100G and 40G IPv6 protocol generation and analysis › Service disruption time (SDT) › Ethernet MAC flooding › Frame size sweep
100G and 40G MPLS	› Generates and analyzes streams with up to two layers of labels.
Advanced filtering	› Ability to configure up to 10 filters, each with four fields that can be combined with AND/OR/NOT operations; a mask is also provided for each field value with IPv4 and IPv6 capabilities
Packet capture	› Ethernet packet capture up to 4 Mbits › Configurable triggers including errors and header fields › Data capture in packet capture (PCAP) format; read through Wireshark

KEY FEATURES (CONT'D)

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, 4.4 and 4.10: alarm and error generation and monitoring › OTL lane mapping, and skew generation and measurement › OTU, ODU, OPU overhead manipulation and monitoring › OTU, ODU (including ODU TCM), OPU layer alarm/error generation and analysis › OTU, ODU (including ODU TCM) trace messages › Round-trip delay (RTD) measurement › OTN SDT measurement › Multiplexing/demultiplexing of ODU13, ODU23, ODU123, ODU03, ODU013, ODU0123, ODU04, ODU014, ODU134, ODU24, ODU234, ODU34, ODU14, ODU01234, ODU0124, ODU024, ODU034, ODU1e4, ODUflex24, ODU2e4 and ODU124, ODU1234 with PRBS pattern and GigE and 10 GigE client mappings into OPU payloads. ODUflex at ODU3 and ODU4 rates with full flexibility to configure the required bandwidth based on n x 1.25 Gbit/s tributary time slots with a PRBS pattern into the OPUflex payload; 40 GigE client mapping into ODU3 into ODU4 › Performance monitoring: G.821, M.2100 › Frequency analysis and offset generation
Ethernet mapping over OTN	› 40G and 100G Ethernet mapping over OTU3 and OTU4 respectively, using GMP › 40G transcoding capability with alarms, errors and statistics › GMP alarms, errors and statistics › GigE mapping into ODU0 using GFP-T, 10 GigE mapping into ODU2 using GFP-F, direct 10 GigE mappings into ODU2e in different ODU multiplexing structures, and 40 GigE client mapped into ODU3/ODU4 › Flexibility to map up to a 10G Ethernet client signal into ODUflex
SONET/SDH mapping over OTN	› OC-768/STM-256 mapping in ODU3 › OC-192/STM-64 mapping in ODU2 › OC-48/STM-16 mapping in ODU1 › OC-12/STM-4 and OC-3/STM1 mapping in ODU0
SONET/SDH testing	› PRBS pattern payload generation and analysis down to STS-1/AU-3 granularity › High-order mappings: STS-1/3c/12c/48c/192c/768c and AU-3/AU-4/AU-4-4c/16c/64c/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
Remote access	Remote access: supported via EXFO Remote ToolBox, VNC or Web VNC

TECHNICAL SPECIFICATIONS

EXFO's 40G/100G Ethernet test solution is comprised of the FTB-85100G Packet Blazer module (housed in the FTB-500 portable platform) or the IQS-85100G Packet Blazer module (housed in the IQS-600 rackmount platform). For complete technical specifications on the FTB-500 or IQS-600 platforms, refer to their respective product page on EXFO's website.

FTB-85100G PACKET BLAZER MODULE

CFP Interface	
Mechanical	Compliant with CFP MSA hardware specification revision 1.4
Electrical	Compliant with CFP MSA hardware specifications revision 1.4
Signaling	Compliant with IEEE 802.3ba standard (2010)
Management	Compliant with CFP MSA management interface specifications revision 1.4
Additional features on high-speed interface	
Frequency measurement accuracy (uncertainty)	±4.6 ppm using internal clock
Unframed Ethernet frequency offset generation	±120 ppm
Framed Ethernet frequency offset generation	±120 ppm
Unframed OTN frequency offset generation	±120 ppm
Framed OTN frequency offset generation	±50 ppm
Framed SONET/SDH frequency offset	±50 ppm
Framed OTN client mapping frequency offset	±115 ppm

SYNCHRONIZATION INTERFACES

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

Note

a. Adaptation cable required for Bantam connector (EXFO part number: TJ-ELEC-BALUN).

REF-OUT INTERFACES

	Low Speed	High Speed
Tx pulse amplitude	600 ± 200 mVpp	600 ± 200 mVpp
Transmission frequency	161 MHz to 699 MHz	3.2 GHz to 3.5 GHz
Output configuration	AC-coupled	AC-coupled
Load impedance	50 Ω	50 Ω
Maximum cable length	1 m	1 m
Connector type	SMA	SMA

40G/100G PLUGGABLE TRANSCEIVERS (CFPs)

	FTB-85953	CFP-85954	FTB-85955 [a]	FTB-85958	CFP-85961	CFP-85962 [a]	CFP-85963	CFP-85964
	100GBASE-LR10 dual-rate (100GE/OTU4) CFP	40GBASE-LR4 multirate (40GE, OTU3, OTU3e1, OTU3e2) CFP	100GBASE-LR4 dual-rate (100GE/OTU4) CFP	100GBASE-LR4 dual-rate (100GE/OTU4) CFP	100GBASE-SR10/OTU4 dual-rate	100GBASE-LR4 dual-rate (100GE/OTU4) CFP	40GBASE-SR4 single-rate 41.25 Gbit/s	40GBASE-FR multirate (OC-768/STM-256, OTU3, OTU3e1-e2) serial CFP
Manufacturer part number	NEOPHOTONICS PD100-TXFND-0	SUMITOMO SCF0421L4CNGG01	SUMITOMO SCF1011L4CNGG01	FINISAR FTLC1182SDNS	FINISAR FTLC8281SCNM	FINISAR FTLC1183SDNL	FINISAR FTL Q8181EBLM	FINISAR FTLQ1381M7NL
Compliance	CFP 10x10 MSA	ITU-T G.695: C4S1-2D1 and 40GBASE-LR4 CFP MSA	ITU G.959.1, 4I1-9D1F and 100GBASE-LR4 CFP MSA	ITU G.959.1, 4I1-9D1F and 100GBASE-LR4 CFP MSA	CFP MSA 100GBASE-SR10 IEEE 802.3ba CAUI	CFP MSA CAUI 100GBASE-LR4 OTN OTU4 4I1-9D1F ITU-T G.959.1	CFP MSA IEEE 802.3ba 40GBASE-SR4	ITU-T G.693, G.709, VSR2000-3R2, IEEE 802.3bg, 40G BASE-FR CFP MSA
Average Tx power per lane (dBm)	−6.9 to 3.5	−2.3 to 2.3	−2.5 to 2.9	−4.3 to 4.5/ −2.5 to 2.9	−7.6 to 2.4	−4.3 to 4.5/ −0.6 to 4	−7.6 to +2.4	0 to 3
Average Rx level per lane (dBm)	−9.5 to 3.5	−10.5 to 2.3	−10.3 to 4.5	−10.6 to 4.5/ −8.8 to 2.9	−9.5 to 2.4	−10.6 to 4.5/ −6.9 to 4	−9.5 to +2.4	−7 to 3
Max. reach	2 km	10 km	10 km	10 km	100 m/OM3 150 m/OM4	10 km	100 m (OM3)	2 km
Transmission bit rate, per optical lane (Gbit/s)	10.3125/ 11.181	10.3125/10.7546/ 11.1427/11.1458	25.78125/ 27.95249	25.78125/ 27.95249	10.3125/ 11.181	25.78125/ 27.95249	10.3125 (40 GigE)	39.8 to 44.6 (single wavelength)
Reception bit rate per optical lane (Gbit/s)	10.3125/ 11.181	10.3125/10.7546/ 11.1427/11.1458	25.78125/ 27.95249	25.78125/ 27.95249	10.3125/ 11.181	25.78125/ 27.95249	10.3125 (40 GigE)	39.8 to 44.6 (single wavelength)
Operational wavelength range (nm)	1521 to 1597	1264.5 to 1337.5	1294.53 to 1310.19	1294.53 to 1310.19	840 to 860	1294.53 to 1310.19	840 to 860	1530 to 1565
Operational wavelengths	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.	Refer to the FTB/IQS-88100 Series User Guide for full list.
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 +/120 +/−4.5	 ±4.6 ±2
Max. Rx before damage, per lane (dBm)	7.8	3.3	5.5	5.5	5.5	5.5	+3.4	6 (single lane)
Jitter compliance	Per 802.3ba and G.8251	Per 802.3ba and G.8251	Per 802.3ba and G.8251	Per 802.3ba and G.8251	Per 802.3ba and G.8251	Per 802.3ba	Per 802.3ba	Per 802.3ba, G.783 and G.8251
Laser product	Class 1M	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	SC	SC	SC	24-fiber MTP-MPO	LC	MPO	LC
Transceiver type	CFP	CFP	CFP	CFP	CFP	CFP	CFP	CFP

Note

a. Low-power Gen2 CFP.

100G PLUGGABLE TRANSCEIVERS (CFP2s)

	CFP2-85974	CFP2-85975	CFP2-85978
	100GBASE-SR10 single-rate (100GE) CFP2	**100GBASE-LR4 dual-rate (100GE/OTU4) CFP2**	**100GBASE-LR4/OTU4 dual-rate**
Manufacturer part number	AVAGO AFBR-8420Z	NEOPHOTONICS PT-C24C3LDCL	FINISAR FTLC1121SDNL
Compliance	CFP2 MSA CAUI/CPPI 100GBASE-SR10 IEEE 802.3ba	CFP2 MSA CAUI-4 100GBASE-LR4 IEEE 802.3ba OTN OTU4 4I1-9D1F ITU-T G.959	CFP2 MSA CAUI-4 100GBASE-LR4 IEEE 802.3ba OTN OTU4 4I1-9D1F ITU-T G.959
Average Tx power per lane (dBm)	–7.6 to 2.4	–2.5 to 2.9	–4.3 to 4.5/–0.6 to 4
Average Rx level per lane (dBm)	–9.5 to 2.4	Up to 2.9	–10.6 to 4.5/–6.9 to 4
Max. reach	100 m/OM3 150 m/OM4	10 km	10 km
Transmission bit rate, per optical lane (Gbit/s)	10.3125	25.78125/27.95249	25.78125/27.95249
Reception bit rate per optical lane (Gbit/s)	10.3125	25.78125/27.95249	25.78125/27.95249
Operational wavelength range (nm)	840 to 860	1294.53 to 1310.19	1294.53 to 1310.19
Operational wavelengths	Refer to the FTB/IQS-85100G User Guide for full list.	Refer to the FTB/IQS-85100G User Guide for full list.	Refer to the FTB/IQS-85100G User Guide for full list.
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Max. Rx before damage, per lane (dBm)	3.4	5.5	5.5
Jitter compliance	Per 802.3ba	Per 802.3ba and G.8251	Per 802.3ba
Laser product	Class 1	Class 1	Class 1
Connector	MPO-24	LC	LC
Transceiver type	CFP2	CFP2	CFP2

FUNCTIONAL SPECIFICATIONS

40GE/100GE UNFRAMED BER TEST

Line rates	103.125 Gbit/s and 41.25 Gbit/s
Pattern configuration	10 unframed physical lanes (CAUI), 4 unframed physical lanes (XLAUI), and 20 unframed logical lanes (PCS)
Patterns	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1, square waves
Error injection configuration	Single, rate and continuous
Error measurement	Mismatch 0, mismatch 1, bit error count and rate

FUNCTIONAL SPECIFICATIONS (CONT'D)

40G/100G ETHERNET TESTING	
Standard compliance	IEEE802.3ba
Line rates	103.125 Gbit/s and 41.25 Gbit/s
Framing	Framed and unframed
Power measurement	Optical channel power measurement with color indicators
Frequency measurement	Clock frequency measurements displayed in Hz
EtherSAM (ITU-T Y.1564)	Service configuration tests, including ramp and burst tests, as well as the service performance test as per EtherSAM (ITU-T Y.1564) up to 100G; tests can be performed in 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
RFC 6349	Performs TCP testing up with single or multiple TCP connections from 10BASE-T up to 100G; discovers the MTU, RTT, actual and ideal TCP throughput
Dual Test Set mode	Complementing RFC 2544, RFC 6349 and EtherSAM (ITU-T Y.1564) for bidirectional measurements
Intelligent autodiscovery	Offers intelligent autodiscovery of other EXFO modules, allowing a single user to perform end-to-end testing
Smart Loopback	Returns Ethernet traffic to the local unit by swapping packet overhead up to layer 4
BER testing	Up to layer 4 supported with or without VLAN Q-in-Q
Layer-2/3/4 header	IP, MAC and UDP source/destination addresses
Patterns	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1, square waves
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
Transmit mode	N-Frames, Burst, N-Burst, Ramp, N-Ramp and Continuous
Tx rate	Utilization
Frame size	Fixed (from 64 to 16 000 bytes), Random and Sweep (from 64 to 16 000 bytes)
IFG	Tx minimum IFG value of 8, 9, 10, 11, 12
Rx frame size analysis	< 64, 64, 65-127, 128-255, 256-511, 512-1023, 1024-1518 and > 1518
Rx rate	Bandwidth (bit/s), utilization (%) and frame rate (frames per second)
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 layers of VLAN (including IEEE 802.1ad Q-in-Q tagged VLAN)
VLAN preservation	Monitoring and analysis of VLAN information presentation including VLAN priority CoS and ID
40GE/100GE MPLS testing	Generates and analyzes streams with up to two layers of labels
Ethernet statistics	Rx alarms, Rx errors, Rx valid frame count, IP errors analysis, Rx frame size analysis, total frame count, Rx throughput and flow control analysis
Ethernet latency and packet jitter statistics	Current, minimum, maximum, average
Rx valid frame count	Multicast, broadcast, unicast, non-unicast and total valid count
IP error analysis	IP Checksum
Ethernet alarms	Link down, local fault detected, local fault received, remote fault, LOA, Hi-BER, invalid mapping
Per-lane alarms	LOS, LOC-lane, frequency, excessive skew, LOBL, LOAML
Ethernet errors	FCS, jabber, runt, undersize, oversize
Per-lane errors	Block error, invalid marker, PCS BIP-8
Higher-layer error analysis	UDP Checksum
Error Injection mode	Manual, rate and continuous
Traffic analysis	Incoming traffic analysis and statistics according to a set of up to 10 configurable filters; filters can be configured for MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TCP source/destination port and UDP source/destination port; VLAN filtering can be applied to any of the stacked VLAN layers
Advanced filtering	Capability to configure up to 10 filters of 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 filter
Data capture	Full-line-rate data capture and decoding at up to 100G; configuration of detailed capture filters and triggers, as well as capture slicing parameters
IP tools	Ping and traceroute functions
40GE/100GE IPv6 testing	Performs the following tests up to 100G over IPv6, EtherSAM, RFC 2544, BERT, traffic generation and monitoring, intelligent autodiscovery, ping and traceroute
Service disruption time (SDT)	Service disruption time measurements based on No Traffic mode, with statistics including the longest disruption time, shortest, last, average, count, total, and pass/fail thresholds

FUNCTIONAL SPECIFICATIONS (CONT'D)

OTU3/OTU4 UNFRAMED BER TEST

Line rates	OTU4 (111.81 Gbit/s), OTU3 (43.018 Gbit/s), OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s)
Pattern configuration	10 unframed in physical, four unframed in physical, and 20 unframed in logical
Patterns	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1
Error injection configuration	Single, rate and maximum rate
Error measurement	Mismatch 0, mismatch 1, bit error count and rate

OTU3/OTU4 FRAMED BER TEST

	Line rates	OTU4 (111.81 Gbit/s), OTU3 (43.018 Gbit/s), OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s) BER test
	Standards compliance	ITU-T G.709, G.798, G.872 and ITU-T G series supplement 43
Interface	Alarms per lane	LOS, LOC-lane, frequency
OTL layer	Errors per lane	Invalid marker, FAS
	Alarms per lane	OOF, LOF, LOR, OOR, excessive skew
	Global alarms	LOL
OTU layer	Errors	OTU-FAS, OTU-MFAS, OTU-BEI, OTU-BIP-8
	Alarms	OTU-AIS, LOF, OOF, LOM, OOM, 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 [a], TCMi-BDI, TCMi-IAE, TCMi-BIAE
	Traces	64 byte 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, ODU-LOFLOM
	Traces	64-bytes trail trace identifier (TTI) as defined in ITU-T G.709
	FTFL	Fault type and fault location byte; as defined in ITU-T G.709 standard
OPU layer	Errors	OMFI
	Alarm	OPU-PLM, OPU-CSF, OPU-AIS, MSIM, OOMFI and LOOMFI
	Payload type	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)
Ethernet mapping over OTN	40G and 100G Ethernet mapping over OTU3 and OTU4, respectively, using GMP	
	40G transcoding capability with alarms, errors and statistics	
	GMP alarms, errors and statistics	
	GigE mapping into ODU0 using GFP-T, 10 GigE mapping into ODU2 using GFP-F, direct 10 GigE mappings into ODU1e and ODU2e in different ODU multiplexing structures	
	Flexibility to map up to a 10G Ethernet client signal into ODUflex	
40GE transcoding	Errors	Invalid flag, POS violation, MSEQ violation, PCS-BIP-8 mask per lane, PCS-BIP-8 per lane, OTN-BIP-8 per lane, SEQ violation
	Alarms	LOBL 1027B, Hi-BER 1027B, LOAML 1027B
GMP	Errors	Cm CRC-8, CnD CRC-5
	Alarms	GMP OOS [a]
	Statistics	Cm minimum/maximum values and CnD minimum/maximum values for both GMP Tx and Rx
ODU multiplexing	Mappings	ODU03, ODU013, ODU0123, ODU04, ODU014, ODU024, ODU034, ODU0124, ODU01234, ODU13, ODU123, ODU124, ODU134, ODU14, ODU1e4 , ODU23, ODU24, ODU234, ODU2e4, ODUFlex24, ODU34, ODU1234 with PRBS pattern into OPU payloads
	Alarms	OPU-MSIM, ODU-LOFLOM
	ODU0	ODU0 (1.25 Gbit/s) container with Gigabit Ethernet client signal mapping and PRBS pattern
	ODUflex	Configurable bandwidth up to 32 x 1.25G TS into OTU3, and up to 80 x 1.25G TS into OTU4 with PRBS pattern up to 100G and Ethernet client signal mapping up to 10G
GFP-F/T	Errors	GFP-cHEC-CORR, GFP-cHEC-UNCORR, GFP-tHEC-CORR, GFP-tHEC-UNCORR, GFP-eHEC-CORR, GFP-eHEC-UNCORR, GFP-pFCS
	Alarms	GFP-LFD, GFP-EXM, GFP-UPM, GFP-DCI, GFP-FDI, GFP-RDI, GFP-LOCS, GFP-LOCCS, GFP-reserved CMF
	Frame Type Statistics	Client data, client management, idle, reserved PTI, reserved PLI, invalid, discarded
	Rx Mismatch	PFI, EXI, UPI, CID
	GFP-T Superblock Statistics	Valid, invalid and total

Note

a. Alarm analysis only.

ADDITIONAL OTU3/OTU4 TEST AND MEASUREMENT FUNCTIONS	
Service disruption time (SDT)	The SDT test tool measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels User-selectable triggers: all supported alarms and errors Measurements: last disruption, shortest disruption, longest disruption, average disruption, total disruption and service disruption count
Round-trip delay (RTD) measurements	The RTD test tool measures the time required for a bit to travel from the FTB-85100G transmitter back to its receiver after crossing a far-end loopback Measurements are available on all supported FTB-85100G interfaces and mappings Measurements: last RTD time, minimum, maximum, average, measurement count (number of successful RTD tests) and failed measurement count

SONET/SDH FUNCTIONAL SPECIFICATIONS

The following section provides detailed information about all SONET/SDH functional specifications.

	SONET	SDH
Clocking	Internal, external (BITS), backplane	Internal, loop-timed, external building integrated timing supply (BITS) and backplane
Mappings	STS-1, STS-3c/12c/48c/192c/768c	AU-3, AU-4, AU-4-4c/16c/64c/256c
Overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, E2, J1, C2, G1, F2, H4, Z3, Z4, N1, N2	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, G1, F2, F3, K3, N1, N2, E2, J1, C2, H4
Error insertion	Section BIP (B1), line BIP (B2), path BIP (B3),REI-L, REI-P, FAS, bit error	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, FAS, bit error
Error measurement	Section BIP (B1), line BIP (B2), path BIP (B3), REI-L, REI-P, FAS, bit error	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, FAS, bit error
Alarm insertion	LOS, LOF, SEF, AIS-L, RDI-L, AIS-P, LOP-P, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, UNEQ-P, pattern loss	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, ERDI-SD, ERDI-CD, ERDI-PD HP-UNEQ, pattern loss
Alarm detection	LOS, LOC, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOPP, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, PLM/SLM-P, UNEQ-P, TIM-P, pattern loss	LOS, LOF, LOC, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, ERDI-SD, ERDI-CD, ERDI-PD, HP-PLM/SLM, HP-UNEQ, HP-TIM, pattern loss
Patterns	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	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

ADDITIONAL SONET/SDH FUNCTIONS	
Performance monitoring	Compliant with ITU-T recommendations and corresponding performance-monitoring parameters.
ITU-T recommendation	Performance-monitoring statistics
G.821	ES, EFS, EC, SES, UAS, ESR, SFSR, BM
G.828	ES, EFS, EB, SES, BBE, SEP, UAS, ESR, SESR, BBER, SEPI
G.829	ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER
M.2100	ES, SES, UAS, ESR, SESR
M.2101	ES, SES, BBE, UAS, ESR, SESR, BBER
Pointer adjustment and analysis	Generation and analysis of STS/AU pointer adjustments as per GR-253 and ITU-T G.707
Generation	Pointer increment and decrement, pointer jump with or without NDF and pointer value
Analysis	Pointer increments, pointer decrements, pointer jumps (NDF, no NDF), pointer value and cumulative offset
Programmable error/alarm injection	Ability to inject errors/alarms in the following modes: Manual, Constant Rate, Burst (periodic and continuous)
Service disruption time (SDT)	Ability to measure the time of disruption when the network switches from active channels to backup channels
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 byte of SONET/SDH overhead)

MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

FTB-85100G Module			
Size (H x W x D)		96 mm x 152 mm x 292 mm	(3 ¾ in x 6 in x 11 ½ in)
Weight		1.9 kg	(4.2 lb)
Temperature	operating storage	0 °C to 40 °C –40 °C to 60 °C	(32 °F to 104 °F) (–40 °F to 140 °F)
FTB-85970 CFP-to-CFP2 Adapter			
Size (H x W x D)		17 mm x 82 mm x 163 mm	($^{11}/_{16}$ in x 3 $^{1}/_{4}$ in x 6 $^{7}/_{16}$ in)
Weight		0.2 kg	(0.4 lb)
Temperature	operating storage	0 °C to 40 °C –40 °C to 70 °C	(32 °F to 104 °F) (–40 °F to 158 °F)

ORDERING INFORMATION

TK-500-85100G-XX-XX-XX-XX-XX-XX-XX-XX-XX-XX-XX-XX-XX

Display
S1 = TFT active screen
S2 = Outdoor-enhanced screen

Module capacity [a]
OCT = Eight-slot module capacity

Battery [a]
BTY = With batteries

Power meter
00 = Without power meter
VPM3 = VFL, power meter with InGaAs detector

Connector adapter [b]
FOA-12 = Biconic
FOA-14 = NEC D4: PC, SPC, UPC
FOA-16 = SMA/905, SMA-906
FOA-22 = FC/PC, FC/SPC, FC/UPC, FC/APC
FOA-28 = DIN 47256, DIN 47256/APC
FOA-32 = ST: ST/PC, ST/SPC, ST/UPC
FOA-54 = SC: SC/PC, SC/SPC, SC/UPC, SC/APC
FOA-78 = Radial EC
FOA-96B = E-2000 E-2000/APC
FOA-98 = LC
FOA-99 = MU

Inspection probe
FP410B = Digital video inspection probe
Triple magnification
FP420B = Digital video inspection probe analysis
Automated pass/fail analysis
Triple magnification
Autocentering
FP430B = Automated digital video inspection probe analysis
Automated focus
Automated pass/fail analysis
Triple magnification
Autocentering

Ethernet Options
ADV-FILTERS = Advanced filtering [j]
ETH-CAPTURE = Full-line-rate packet capture [j]
IPV6_40-100GE = 40GE and 100GE IPv6 Internet protocol version 6 [j]
iSAM = Enables simplified ITU-T Y.1564 test [j]
MPLS_40-100GE = Enables simplified ITU-T Y.1564 test [j]
RFC6349_40-100GE = 40GE and 100GE enables TCP testing as per RFC 6349 [j]
TRAFFIC-SCAN = Discover and monitor VLAN traffic flows on a live signal [j]

OTN options
EoOTN = Ethernet over OTN [c]
ODUMUX = ODU multiplexing [c]
ODU0 = ODU0 mapping [d]
ODUflex = ODUflex functionality [d]
OTU3e1-e2 = Enables OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 Gbit/s) rates [e]

SONET/SDH options
SONET = SONET-BASE software
SDH = SDH-BASE software
SONET-SDH = SONET and SDH combo software
TCM = Tandem connection monitoring [k]

SONET/SDH rate [g]
40G = 39.81G (OC-768/STM-256)

OTN rates
OTU3 = Enables OTU3/G.709 (43.018 Gbit/s) rate [h]
OTU4 = Enables OTU4/G.709 (111.81 Gbit/s) rate [i]

Ethernet rates
40GE = Enables 40GE/IEEE802.3ba (41.25 Gbit/s) rate
100GE = Enables 100GE/IEEE802.3ba (103.125 Gbit/s) rate

Example: TK-500-85100G-S1-OCT-BTY-VPM3-FOA-22-FP410B-100GE-OTU4-40G-SDH-ODUMUX-ETH-CAPTURE

Notes

a. Always included.
b. Available if power meter selected.
c. Requires OTU3 or OTU4 option(s).
d. Requires (OTU3 or OTU4) and ODUMUX options.
e. Requires OTU3 option.
f. Requires enabling OTU3 or OTU4, and SONET or SDH or SONET-SDH.
g. Requires SONET, SDH or SONET-SDH option.
h. Requires 40GE or 40G rate.
i. Requires 100GE rate.
j. Requires 40GE and 100GE.
k. Requires 40G SONET, SDH or SONET-SDH option.

40G/100G PLUGGABLE TRANSCEIVERS (CFPs)

FTB-85953 = 100 Gbit/s Ethernet and OTN CFP (10 x 10G WDM, 2 km reach)
CFP-85954 = 40 Gbit/s Ethernet and OTN CFP (4 x 10G WDM, 10 km reach)
FTB-85955 = 100 Gbit/s Ethernet and OTN CFP (4 x 28G WDM, 10 km reach), low power
FTB-85958 = 100 Gbit/s Ethernet and OTN CFP (4 x 28G WDM, 10 km reach)
CFP-85961 = 100GBASE-SR10 dual-rate (100GE/OTU4) CFP (10 x 10G MMF, 100 m reach)
CFP-85962 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP (4 x 28G WDM, 10 km reach)
CFP-85963 = 40GBASE-SR4 dual-rate CFP (4 x 10G LAN-WDM, MMF, 850 nm, 100 m reach) MPO
FTB-85964 = 40GBASE-FR multirate (OC-768/STM-256, OTU3, OTU3e1-e2) serial CFP (1550 nm, 2 km reach) LC

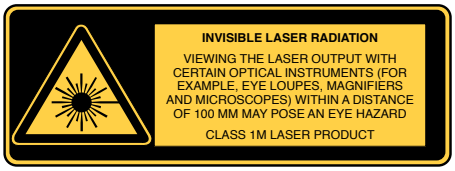
100G PLUGGABLE TRANSCEIVERS (CFP2s)

FTB-85970 = CFP-to-CFP2 adapter supporting 4 x 25G and 10 x 10G CFP2 transceiver implementations
CFP2-85974 = 100GBASE-SR10 dual-rate (100GE/OTU4) CFP2 (10 x 10G MMF, 100 m reach)
CFP2-85975 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP2 (4 x 28G LAN-WDM, 10 km reach)
CFP2-85978 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP2 (4 x 28G LAN-WDM, 10 km reach)

ACCESSORIES

TJ-MP24-LB = MPO-24 loopback multimode 24 fiber 50/125 µm CXP pin out
TJ-MP24-MP24-5M = MPO-24 to MPO-24 multimode fiber ribbon, 5 m

LASER SAFETY



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