FTB-88100NGE/88100G Power Blazer Series

HIGH-SPEED COMPACT MULTISERVICE TEST SOLUTION

EXFO TFv
Test Function Virtualization

EXFO Connect
Compatible

EtherSAM

iSAM

COMPLETE IPv6 TESTING

CFP2 READY

CFP Health Check

TECHNICAL SHEET

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

KEY FEATURES AND BENEFITS

- 10M-to-100G compact multiservice field-test solution addressing testing, troubleshooting and performance-assessment requirements of next-generation networks
- Comprehensive and fully integrated test solution covering OTN, Ethernet and SONET/SDH technologies
- Cost-effective, scalable and future-proof module with 10M-to-100G flexible offering, as well as CFP and CFP2 transceiver coverage—no hardware upgrade, no return to factory required
- Unprecedented testing simplicity requiring minimal training for new users and maintaining a consistent experience from the lab to the field
- Packet synchronization turn-up and troubleshooting (SyncE/1588 PTP)
- True wire-speed, stateful TCP throughput based on RFC 6349 for undisputable SLA enforcement of Ethernet services
- FTTA framed and unframed CPRI testing, including CPRI service disruption tests (CPRI SDTs)
- 10G dual-port Ethernet capabilities for simultaneous and bidirectional traffic generation and analysis at 100% wire speed at any packet size
- iSAM ultra-simple ITU-T Y.1564 and RFC 6349 service activation methodology
- Efficiently assesses Fibre Channel networks with best-in-class coverage via 1x, 2x, 4x, 8x and 10x interfaces
- FTB Ecosystem and EXFO Connect-compatible with software upgrade manager, as well as automated cloud-based asset and test data management capabilities
- OTN, SONET/SDH, FC and Ethernet bit-error-rate testing (BERT) with real-time pass/fail status, quick action buttons, clear results and assorted notifications
- 100% line-rate testing of IP traffic at up to 100G and faster Ethernet service activation with EtherSAM (ITU-T Y.1564) service configuration and performance tests, complemented by Remote Discovery, Smart Loopback and Dual Test Set capabilities
- Housed in either the compact FTB-2 Pro or the FTB-500 Platform, and complemented with integrated optical tools, battery operation, power-up and restore, remote access, GPS capabilities and test reports
- Offers EXFO TFv—Test Function Virtualization, including FTB Anywhere floating licenses and FTB OnDemand time-based licenses

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

COMPLEMENTARY PRODUCTS

Platform
FTB-2 Pro

Platform
FTB-500

Optical Spectrum Analyzers
FTB-5240S/BP

EXFO

40G/100G TECHNICAL SPECIFICATIONS [a]

40G/100G OPTICAL INTERFACES

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

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, 40GBASE-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-85100G 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-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.	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	±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	LC	LC
Transceiver type	CFP	CFP	CFP	CFP	CFP	CFP	CFP	CFP

Notes

a. 40G/100G technical specifications are applicable to both the FTB-88100NGE and the FTB-88100G.

b. 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-88100G User Guide for full list.	Refer to the FTB/IQS-88100G User Guide for full list.	Refer to the FTB/IQS-85100G Series 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 and G.8251
Laser product	Class 1	Class 1	Class 1
Connector	MPO-24	LC	LC
Transceiver type	CFP2	CFP2	CFP2

40G/100G PHYSICAL-LAYER FUNCTIONAL SPECIFICATIONS

The following section provides detailed information on all physical-layer functional specifications.

PHYSICAL LAYER	
40GE/100GE	
CAUI/XLAUI alarms	LOS, LOC lane, frequency
PCS lane alarms	LOBL, LOAML, excessive skew
PCS lane errors	Block error, invalid marker, PCS BIP-8
Per-lane skew insertion	Range = 0 to 4095 for 40GE Range = 0 to 2047 for 100GE
OTU3/OTU3e1-e2/OTU4	
Physical-lane alarms	LOS, LOC lane, frequency
Logical-lane alarms	LOF, OOF, LOL, LOR, OOR, excessive skew, LOL global alarm
Logical-lane errors	OTN BIP-8, PCS BIP-8, PCS BIP-8 error mask
Per-lane skew insertion	Range = 0 to 4095 for OTU3/OTU3e1-e2 Range = 0 to 2047 for OTU4
Additional Functions	
Power measurements	Allows users to measure the transmitted and received optical power per wavelength in the used parallel optics CFPs
Frequency measurements	Allows users to measure the received frequency per wavelength in the used parallel optics CFPs
Frequency offset (min./max.)	±120 ppm for 40GE and 100GE ±50 ppm for OTU3, OTU3e1-e2 and OTU4 ±115 ppm for Ethernet client mapping into ODU3 and ODU4 multiplexing schemes
PCS logical lane mapping	Manual and random
MDIO read/write	Full MDIO read/write access
Signal conditioning	Pre-emphasis and gain equalization

40G/100G ETHERNET AND OTN FUNCTIONAL SPECIFICATIONS

The following section provides detailed information about all 40G and 100G Ethernet and OTN functional specifications.

40GE/100GE UNFRAMED BER TEST	
Line rates	OTU4 (112 Gbit/s), OTU3 (43 Gbit/s), OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 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 0/1, bit error count and rate

40G/100G ETHERNET FUNCTIONAL SPECIFICATIONS (CONT'D)

The following section provides detailed information on all 40G and 100G Ethernet functional specifications.

40G/100G ETHERNET (IEEE 802.3ba)	
Standards compliance	IEEE 802.3ba
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)	Performs service configuration and service performance tests as per ITU-T Y.1564, including excess burst size (EBS) and committed burst size (CBS), and can be performed using 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 or user-configurable
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 a single user to perform end-to-end testing
Smart Loopback	Traffic return to the local unit by swapping packet overhead up to layer 4 of the OSI stack
BERT	Unframed and framed layer 2, with or without VLAN Q-in-Q
Layer-2/3/4 header	IP, MAC, UDP source/destination addresses
Patterns	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1 and user-configurable pattern
Traffic generation and monitoring	Traffic generation and shaping of up to 16 streams of Ethernet and IP traffic, including the simultaneous monitoring of throughput, frame loss, packet jitter, latency and out-of-sequence frames, including MAC flooding for source and destination MAC addresses
Frame size	Fixed (from 64 to 16 000 bytes), Random and Sweep (from 64 to 16 000 bytes)
Framing	IEEE 802.3 SNAP and Ethernet II frame format testing
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	Line utilization (%), Ethernet BW (Mbit/s), frame rate (frame/s) and frame count
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	Capability to generate one stream with 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
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
40GE/100GE MPLS testing	Generates and analyzes streams with up to two layers of labels
Ethernet statistics	Multicast, broadcast, unicast, N-unicast, pause frame, frame size distribution, bandwidth, utilization, frame rate, frame loss, out-of-sequence frames and in-sequence frames
Packet jitter statistics	Delay variation statistics (ms): minimum, maximum, last, average and jitter measurement estimate (RFC 3393)
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 (maximum rate)
Traffic filtering	Incoming traffic analysis and statistics according to a set of up to 10 configurable filters; filters can be configured for MAC source/destination address, VLAN ID, VLAN priority, IP source/destination address, ToS field, DSCP field, TCP source/destination port and UDP source/destination port; VLAN filtering can be applied to any of the stacked VLAN layers
Advanced filtering	Capability to enhance the filters with up to four fields each, which can be combined with AND/OR/NOT operations; a mask is also provided for each field value to allow for wildcards; complete statistics are gathered for each defined 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
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 longest disruption time, shortest, last, average, count, total, and pass/fail thresholds
Pass/fail verdict	Provides a pass/fail outcome with user-adjustable thresholds, based on bit error rate and/or service disruption time

40G/100G OTN FUNCTIONAL SPECIFICATIONS

The following section provides detailed information on all 40G and 100G OTN functional specifications.

OTN UNFRAMED BER TEST

Line rates	OTU4 (112 Gbit/s), OTU3 (43 Gbit/s), OTU3e1 (44.57 Gbit/s) and OTU3e2 (44.58 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

OTN (ITU-T G.709)

	Standards compliance	ITU-T G.709, G.798, G.872 and ITU-T G series Supplement 43
	Line rates	OTU3 (43 Gbit/s), OTU3e1 (44.57 Gbit/s), OTU3e2 (44.58 Gbit/s), OTU4 (111.81 Gbit/s)
	Power measurement	Optical channel power measurement with color indicators
	Frequency measurement	Clock frequency measurements displayed in Hz
	Frequency offset	Offsetting of the transmitted signal's clock on a selected interface, and monitoring to exercise clock recovery circuitry on network elements
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	LOF, OOF, LOM, OOM, OTU-TIM, OTU-BDI, OTU-IAE, OTU-BIAE, OTU-AIS
	Traces alarms	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-byte 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
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
OPU layer	Alarms	OPU-PLM, OPU-CSF, OPU-AIS, OPU-MSIM [a]
	Payload type	Generates and displays received PT value
Forward error correction (FEC)	Errors	Generation and analysis of FEC correctable and uncorrectable errors
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	
	40GE into OTU3 into OTU4	
	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
ODU3/ODU4 multiplexing	Mappings	ODU13, ODU23, ODU123, ODU03, ODU013, ODU0123, ODU01, ODU14, ODU24, ODU34
	Alarms	OPU-MSIM, ODU-LOFLOM
	Clients	SONET/SDH, GigE, 10 GigE, 40 GigE and 100 GigE client mappings into OPU payloads
	ODU0	ODU0 (1.25 Gbit/s) container with Gigabit Ethernet, SONET/SDH client signal mapping and PRBS pattern
	ODUflex	Configurable bandwidth up to 32 x 1.25G TS into OTU3, with PRBS pattern up to 40G 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
Service disruption time (SDT)	Measures the time during which there is a disruption of service due to the network switching from the active channels to the backup channels	
Through mode	Ability to perform intrusive and transparent Through mode analysis of any OTN signal	
Clocking	Internal, loop-timed, external (BITS), backplane	

Note

a. Alarm analysis only.

40G SONET/SDH FUNCTIONAL SPECIFICATIONS

The following section provides detailed information on all 40G SONET/SDH functional specifications.

	SONET	SDH
Optical Interfaces	**OC-768**	**STM-256**
Available wavelengths (nm)	1550	1550
Clocking	Internal, loop-timed, external (BITS), backplane	Internal, loop-timed, external (BITS), 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
Pointer sequence testing	Performs pointer sequence testing as per G.783, GR 253 and T1.105-3 standards.
Generation	Pointer increment and decrement, pointer jump with or without NDF, 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)
Tandem connection monitoring (TCM)	TCM is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The Power Blazer supports transmission and receiving of alarms and errors on a TCM link; transmission and monitoring of the tandem connection (TC) trace can also be generated to verify the connection between TCM equipment. Error generation: TC-IEC, TC-BIP, TC-REI, TC-OEI Error analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL (non-standardized alarm) Alarm generation: TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS Alarm analysis: TC-TIM, TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS
Pass/fail verdict	Simplified BER testing with pass/fail indicators based on user-defined thresholds with the ability to preconfigure user-defined bit-error-rate (BER) thresholds.

10M-TO-10G TECHNICAL SPECIFICATIONS [a]

SFP ETHERNET OPTICAL INTERFACES

	100M and GigE rates						
Available wavelengths (nm)	850, 1310 and 1550						
Model	**FTB-85910**	**FTB-85911**	**FTB-8590**	**FTB-8190**	**FTB-8192**	**FTB-8596**	**FTB-8597**
Transceiver type	**100BASE-FX**	**100BASE-LX**	**1000BASE-SX**	**1000BASE-LX**	**1000BASE-ZX**	**1000BASE-BX10-D**	**1000BASE-BX10-U**
Wavelength (nm)	1310	1310	850	1310	1550	Tx: 1490 Rx: 1310	Tx: 1310 Rx: 1490
Tx level (dBm)	−20 to −15	−15 to −8	−9 to −3	−9.5 to −3	0 to 5	−9.5 to −3	−9.5 to −3
Rx level sensitivity (dBm)	−31	−28	−20	−22	−22	−20	−20
Maximum reach	2 km	15 km	550 m	10 km	80 km	10 km	10 km
Transmission bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Reception bit rate (Gbit/s)	0.125	0.125	1.25	1.25	1.25	1.25	1.25
Tx operational wavelength range (nm)	1280 to 1380	1261 to 1360	830 to 860	1270 to 1360	1540 to 1570	1480 to 1500	1260 to 1360
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	 ±4.6 ±2
Maximum Rx before damage (dBm) [b]	3	3	6	6	6	6	6
Jitter compliance	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Ethernet classification	ANSI X3.166	IEEE 802.3	IEEE 802.3	IEEE 802.3		IEEE 802.3ah	IEEE 802.3ah
Laser type	LED	FP	VCSEL	FP	DFB	DFB	FP
Laser product	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1	Class 1
Connector [c]	LC	LC	LC	LC	LC	LC	LC

SFP SONET/SDH AND OTN OPTICAL INTERFACES

Transceiver type	**OC-1/ STM-0**	**OC-3/STM-1**				**OC-12/STM-4**				**OC-48/STM-16/OTU1**			
Reach and wavelength	2 km, 1310 nm	30 km; 1310 nm	50 km; 1310 nm	60 km; 1550 nm	100 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm
Model	**FTB-85910**	**FTB-8190**	**FTB-8191**	**FTB-8193**	**FTB-8192**	**FTB-8190**	**FTB-8191**	**FTB-8193**	**FTB-8192**	**FTB-8190**	**FTB-8191**	**FTB-8193**	**FTB-8192**
Tx level (dBm)	−20 to −15	−5 to 0	−2 to 3	−5 to 0	−2 to 3	−5 to 0	−2 to 3	−5 to 0	−2 to 3	−5 to 0	−2 to 3	−5 to 0	−2 to 3
Rx operating range (dBm)	−31	−23 to −10	−30 to −15	−23 to −10	−30 to −15	−22 to 0	−27 to −9	−22 to 0	−29 to −9	−18 to 0	−27 to −9	−18 to 0	−28 to −9
Transmit bit rate	52 Mbit/s ± 4.6 ppm	155.52 Mbit/s ± 4.6 ppm				622.08 Mbit/s ± 4.6 ppm				2.48832 Gbit/s ± 4.6 ppm 2.66606 Gbit/s ± 4.6 ppm			
Frequency offset generation (ppm)	±50	±50				±50				±50			
Receive bit rate	52 Mbit/s ± 100 ppm	155.52 Mbit/s ± 100 ppm				622.08 Mbit/s ± 100 ppm				2.48832 Gbit/s ± 100 ppm 2.66606 Gbit/s ± 100 ppm (OTU1)			
Operational wavelength range	1280 to 1380 nm	1270 to 1360 nm	1280 to 1335 nm	1430 to 1580 nm	1500 to 1580 nm	1270 to 1360 nm	1280 to 1335 nm	1430 to 1580 nm	1480 to 1580 nm	1260 to 1360 nm	1280 to 1335 nm	1430 to 1580 nm	1500 to 1580 nm
Spectral width	1 nm (−20 dB)	1 nm (−20 dB)				1 nm (−20 dB)				1 nm (−20 dB)			
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2				 ±4.6 ±2				 ±4.6 ±2			
Maximum Rx before damage (dBm) [b]	3	3				3				3			
Jitter compliance	GR-253 (SONET) G.958 (SDH)	GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH) G.8251 (OTN)			
Line coding	NRZ	NRZ				NRZ				NRZ			
Laser product	Class 1	Class 1				Class 1				Class 1			
Connector [c]	LC	LC				LC				LC			

Notes

a. 10M-to-10G technical specifications are applicable to the FTB-88100NGE module only.

b. In order not to exceed the maximum receiver power level above which damage occurs, an attenuator must be used.

c. External adapters can be used for other types of connectors.

SFP FIBRE CHANNEL INTERFACES

FC1x/2x/4x				
Wavelength (nm)	850	1310	1310	1550
Model	**FTB-85912**	**FTB-85913**	**FTB-85914**	**FTB-85915**
Tx level (dBm)	−9 to −2.5	−8.4 to −3	0 to 5	1 to 5
Rx-level sensitivity (dBm)	−15 at FC4 −18 at FC2 −20 at FC1	−18 at FC4 −21 at FC2 −22 at FC1	−18 at FC4 −21 at FC2 −22 at FC1	−16.5 at FC4 −20.5 at FC2 −22 at FC1
Maximum reach (FC-1)	500 m on 50/125 µm MMF 300 m on 62.5/125 µm MMF			
Transmission bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25
Reception bit rate (Gbit/s)	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25	1.06/2.125/4.25
Tx operational wavelength range (nm)	830 to 860	1260 to 1350	1285 to 1345	1544.5 to 1557.5
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Maximum Rx before damage (dBm)	3	3	3	3
Jitter compliance	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
FC classification	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2	ANSI FC-PI-2
Laser type	VCSEL	Fabry-Perot	DFB	DFB
Eye safety	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC

SFP+ FIBRE CHANNEL INTERFACES

FC8x/10x					
Wavelength (nm)	850	850	1310	1550	1550
Model	**FTB-8696**	**FTB-8690**	**FTB-8693**	**FTB-8694**	**FTB-8695**
Tx level (dBm)	−8.2 to −2	−5 to −1	−6 to −1	−1 to 2	0 to 4
Rx-level sensitivity (dBm)	−11.1 to 0	−11.1 to 0.5	−14.4 to 0.5	−15 to −1	−24 to −7
Maximum reach	150 m on OM3 MMF	300 m on OM3 MMF	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Reception bit rate (Gbit/s)	8.5	10.5	8.5/10.5	8.5/10.5	8.5/10.5
Tx operational wavelength range (nm)	840 to 860	840 to 860	1260 to 1355	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Maximum Rx before damage (dBm)	5	5	5	5	3
Jitter compliance	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
FC classification	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
Laser type	VCSEL	VCSEL	DFB	CML	EML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC

XFP FIBRE CHANNEL INTERFACES

FC10x					
Wavelength (nm)	850	1310	1310	1550	1550
Model	**FTB-85900**	**FTB-85901**	**FTB-81900**	**FTB-85902**	**FTB-81902**
Tx level (dBm)	−5 to −1	0.5 max.	−6 to −1		0 to 4
Rx-level sensitivity (dBm)	−11.1	−12.6	−14.4	−16	−23
Maximum reach	300 m on 50/125 µm MMF 30 m on 62.5/125 µm MMF	10 km	10 km	40 km	80 km
Transmission bit rate (Gbit/s)	10.5	10.5	10.5	10.5	10.5
Reception bit rate (Gbit/s)	10.5	10.5	10.5	10.5	10.5
Tx operational wavelength range (nm)	840 to 860	1260 to 1355	1290 to 1330	1530 to 1565	1530 to 1565
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Maximum Rx before damage (dBm)	6	6	6	2	4
Jitter compliance	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
FC classification	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3	ANSI FC-PI-3
Laser type	VCSEL	DFB	DFB	EML	EML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC

SFP+ 10G ETHERNET OPTICAL TRANSCEIVERS

Transceiver type	**10GBASE-SR/SW**	**10GBASE-LR/LW**	**10GBASE-ER/EW**
Wavelength (nm)	850	1310	1550
Model	**FTB-8690**	**FTB-8691**	**FTB-8692**
Tx level (dBm)	−5 to −1	−8.2 to 0.5	−4.7 to 4
Rx level (dBm)	−11.1 to 0.5	−14.2 to 0.5	−15.8 to −1
Maximum reach	300 m (OM3)	10 km	40 km
Tx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Rx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Tx wavelength range (nm)	840 to 860	1260 to 1355	1530 to 1565
Frequency offset generation (ppm)	±120	±120	±120
Rx wavelength range (nm)	840 to 860	1260 to 1600	1260 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Rx damage level max. (dBm) [a]	6	5	5
Jitter compliance	IEEE 802.3ae	IEEE 802.3ae	IEEE 802.3ae
Laser type	VCSEL	DFB	CML
Laser product	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC

SFP+ 10G SONET/SDH AND OTN OPTICAL TRANSCEIVERS

Transceiver type	**OC-192/STM-64/OTU2**	**OC-192/STM-64/OTU2**	**OC-192/STM-64/OTU2**
Wavelength (nm)	1310	1550	1550
Model	**FTB-8693**	**FTB-8694**	**FTB-8695**
Tx level (dBm)	−6 to −1	−1 to 2	0 to 4
Rx level (dBm)	−11 to 0.5	−15 to −1	−24 to −7
Maximum reach	10 km	40 km	80 km
Tx bit rate (Gbit/s)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Rx bit rate (Gbit/s)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Tx wavelength range (nm)	1260 to 1355	1530 to 1565	1530 to 1565
Rx wavelength range (nm)	1260 to 1600	1260 to 1600	1260 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Rx damage level max. (dBm) [a]	5	5	5
Jitter compliance	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)
Laser type	DFB	EML	EML
Laser product	Class 1	Class 1	Class 1
Connector [b]	LC	LC	LC

SFP/SFP+ FTTA INTERFACES

CPRI/OBSAI					
Wavelength (nm)	850	1310	1310	1310	1550
EXFO product number	FTB-8590	FTB-8190	FTB-8191	SFP-8600	FTB-8192
Tx level (dBm)	−9 to −3	−5 to 0	−2 to 3	−8.2 to 0.5	−2 to 3
Rx-level sensitivity (dBm)	−18 to 0	−18 to 0	−27 to −9	0.5 (max)	−28 to −9
Maximum reach	300 m on OM3 MMF	15 km	40 km	1.4 km (SMF)	80 km
Transmission bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288 to 9.8304	2.4576/3.072
Reception bit rate (Gbit/s)	2.4576/3.072	2.4576/3.072	2.4576/3.072	1.2288 to 9.8304	2.4576/3.072
Tx operational wavelength range (nm)	830 to 860	1270 to 1360	1280 to 1355	1260 to 1355	1500 to 1580
Measurement accuracy (uncertainty) Optical power (dB)	 ±2	 ±2	 ±2	 ±2	 ±2
Max Rx before damage (dBm)	+5	+5	+3	+5	+3
Jitter compliance	IEEE 802.3	GR-253 (SONET) G-958 (SDH)	GR-253 (SONET) G-958 (SDH)	IEEE 802.3ae	GR-253 (SONET) G-958 (SDH)
Laser type	VCSEL	DFB	DFB	FP	CML
Eye safety	Class 1	Class 1	Class 1	Class 1	Class 1
Connector	LC	LC	LC	LC	LC
Transceiver type	SFP	SFP	SFP	SFP+	SFP

XFP 10G ETHERNET OPTICAL TRANSCEIVERS

Transceiver type	**10GBASE-SR/SW**	**10GBASE-LR/LW**	**10GBASE-ER/EW**
Wavelength (nm)	850	1310	1550
Model	**FTB-85900**	**FTB-85901**	**FTB-85902**
Tx level (dBm)	−5 to −1	−6 to 0.5	−1 to 2
Rx level (dBm)	−11.1 to 0.5	−12.6 to 0.5	−16 to −1
Maximum reach	300 m (OM3)	10 km	40 km
Tx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Rx bit rate (Gbit/s)	9.953/10.3125	9.953/10.3125	9.953/10.3125
Tx wavelength range (nm)	840 to 860	1260 to 1355	1530 to 1565
Frequency offset generation (ppm)	±120	±120	±120
Rx wavelength range (nm)	840 to 860	1260 to 1600	1270 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Rx damage level max. (dBm)	6	5	6
Jitter compliance	IEEE 802.3ae	IEEE 802.3ae	IEEE 802.3ae
Laser type	VCSEL	DFB	EML
Laser product	Class 1	Class 1	Class 1
Connector	LC	LC	LC

Notes

a. In order not to exceed the maximum receiver power level before damage, an attenuator must be used.

b. External adapters can be used for other types of connectors.

XFP SONET/SDH AND OTN OPTICAL TRANSCEIVERS

Transceiver type	**OC-192/STM-64/OTU2**	**OC-192/STM-64/OTU2**	**OC-192/STM-64/OTU2**
Wavelength (nm)	1310	1550	1550
Model	**FTB-81900**	**FTB-81901**	**FTB-81902**
Tx level (dBm)	−6 to −1	−1 to 2	0 to 4
Rx level (dBm)	−13.4 to 0.5	−15 to −1	−22.5 to −7
Maximum reach	10 km	40 km	80 km
Tx bit rate (Gbit/s)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Frequency offset generation (ppm)	±50	±50	±50
Rx bit rate (Gbit/s)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)	9.953 (OC-192/STM-64) 10.709 (OTU2) 11.049 (OTU1e) 11.095 (OTU2e) 11.27 (OTU1f) 11.31 (OTU2f)
Tx wavelength range (nm)	1290 to 1330	1530 to 1565	1530 to 1565
Rx wavelength range (nm)	1270 to 1600	1270 to 1600	1270 to 1600
Measurement accuracy (uncertainty) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2
Rx damage level max. (dBm)	5	6	5
Jitter compliance	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)	GR-253 (SONET) G.825 (SDH) G.8251 (OTN)
Laser type	DFB	EML	EML
Laser product	Class 1	Class 1	Class 1
Connector	LC	LC	LC

ELECTRICAL ETHERNET INTERFACES

	10/100 BASE-T half/full duplex, 1000BASE-T full duplex 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) Frequency (ppm) Optical power (dB)	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±2	 ±4.6 ±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, EMIX and VLAN preservation; use remote loopback or dual test set mode for bidirectional results
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
Dual Test Set mode	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 including: 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)
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 VLAN (including IEEE 802.1ad and Q-in-Q tagged VLAN
VLAN preservation	Validates that the CE-VLAN tags and ID, which are part of classes of service (CoS), 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 autodiscovery, ping and traceroute
10 GigE WAN testing	Includes the 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
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
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, and generates and analyzes messages between master/clients, clock quality level and IPDV
SyncE	Validates SyncE frequency, ESMC messages and clock quality levels
Carrier Ethernet OAM	Fault-management and performance-monitoring Ethernet and MPLS-TP OAM protocols, including Y.1731, 802.1ag, MEF, Link OAM (802.3ah), and G.8113.1 OAMs; addresses metro Ethernet networks; supports continuity check, loopback, link trace, test, frame delay, frame loss and synthetic loss functions, and 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	Return 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
Pass/fail verdict	Provides a pass/fail outcome with user-adjustable thresholds, based on bit error rate and/or service disruption time
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

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, ODU-LOFLOM
	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, OPU-MSIM
	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), ODU04, ODU14, ODU24 and ODU34
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: **ITU-T recommendation** — **Performance-monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM 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 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 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
Overhead manipulation	Performs section/RS, line/MS, high-order (HO) and low-order (LO) path overhead manipulation and monitoring

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 building integrated timing supply (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: **ITU-T recommendation** / **Performance-monitoring statistics** G.821: ES, EFS, EC, SES, UAS, ESR, SESR, DM G.826: ES, EFS, EB, SES, BBE, UAS, ESR, SESR, BBER 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 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 **Generation** › Pointer increment and decrement › Pointer jump with or without NDF › Pointer value **Analysis** › Pointer increments › Pointer decrements › Pointer jumps (NDF, no NDF) › Pointer value and cumulative offset
Pointer sequence testing	Performs pointer sequence testing as per the 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 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 interfaces and mappings 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, b]	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 Error generation: TC-IEC, TC-BIP, TC-REI, TC-OEI Error analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL (non-standardized alarm) Alarm generation: TC-RDI, TC-UNEQ, TC-ODI, TC-LTC, TC-IAIS 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

Notes

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

b. SONET/SDH rates up to 10G.

FIBRE CHANNEL FUNCTIONAL SPECIFICATIONS

Testing 1x, 2x, 4x, 8x, 10x	
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) 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)	TERM: ≤6 dB (cable loss only) 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 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 [a]	SMB	SMB	SMB

Note

a. An SMB-to-BNC adapter is available.

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

MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

FTB-88100NGE/88100G Modules			
Size (H x W x D)		96 mm x 51 mm x 288 mm	(3 ¾ in x 2 in x 11 5/16 in)
Weight		1.1 kg	(2.4 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)		82 mm x 17 mm x 163 mm	(3 ½ in x 11/16 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

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

Ethernet Rate Options
GigE Bundle = 10/100/1000 BASE-T, 100BASE-FX (optical), 1000BASE-X (optical)
10GigE = 10G_LAN and 10G_WAN
40GE = Ethernet optical rate of 41.25 Gbit/s
100GE = Ethernet optical rate of 103.125 Gbit/s

SONET/SDH Rate Options [a]
2.5G Bundle = 52M (OC-1/STM-0), 155M (OC-3/STM-1), 622M (OC-12/STM-4), 2488M (OC-48/STM-16)
9953M = 9953M (OC-192/STM-64)
40G = 39.81G (OC-768/STM-256)

Fibre Channel Rate Options
00 = No Fibre Channel option
FC1X = 1x Fibre Channel interface [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]

OTN Rate Options
OTU1 = OTN optical rate of 2.666 Gbit/s
OTU2 = OTN optical rate 10.709 Gbit/s
OTU2-1e-2e = OTN optical rates of 11.049/11.096 Gbit/s
OTU2-1f-2f = OTN optical rates of 11.270/11.318 Gbit/s
OTU3 = OTN optical rate of 43.018 Gbit/s
OTU3-e1-e2 = OTN optical rates of 44.57 Gbit/s and 44.58 Gbit/s
OTU4 = OTN optical rate of 111.81 Gbit/s

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

Ethernet Options
00 = No Ethernet option
ADV-FILTERS = Advanced filtering [d, j]
DUAL-PORT = 10 GigE Dual Port testing [d]
ETH-CAPTURE = Full-line-rate packet capture [d, j]
ETH-OAM = Enables four OAM modes, including Y.1731, 802.1ag, MEF and G.8113.1 [d]
LINK-OAM = Enables 802.3ah Link OAM [d]
IPV6 = Internet protocol version 6 [d]
IPV6_40-100GE = 40GE and 100GE IPv6 internet protocol version 6 [j]
ETH-THRU = Through mode capability [d]
MPLS = Enables MPLS [d]
MPLS_40-100GE = Enables 40GE and 100GE MPLS tags [j]
1588PTP = Generates and analyzes 1588 PTP [d]
SyncE = Generates and analyzes SyncE protocol [d]
RFC6349 = Enables TCP testing as per RFC 6349 [d]
RFC6349_40-100GE = 40GE and 100GE enables TCP testing as per RFC 6349 [j]
iSAM = Enables simplified ITU-T Y.1564 test [d, j]
Cable_Test = Cable test [e]
TCP-THPUT = Enables TCP throughput measurements [e]
TRAFFIC-SCAN = Discover and monitor VLAN [d, j]

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

SONET/SDH Options and Mapping
00 = Without SONET/SDH software option
SONET = SONET-BASE and mapping [h]
SDH = SDH-BASE and mapping [h]
SONET-SDH = SONET and SDH combo software [h]
SONETSDH-INTR-THRU = SONET/SDH intrusive Through mode [l]
TCM = Tandem connection monitoring [i]

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

Notes

a. Requires SONET, SDH or SONET-SDH option.
b. Requires purchase of SFP.
c. Requires purchase of SFP+.
d. Requires GigE bundle and/or 10 GigE.
e. Requires GigE bundle.
f. Requires enabling OTU2 and/or OTU3, and/or OTU4 rates.
g. Requires enabling ODUMUX OTN option.
h. Requires enabling OTU3 and/or 40G SONET/SDH rates.
i. Requires enabling 2.5G bundle or 9953M rate, with SONET or SDH or SONET-SDH.
j. Requires 40GE and 100GE.
k. Requires enabling OTU3 rate.
l. Requires 40G SONET, SDH or SONET-SDH option.

ORDERING INFORMATION

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

Ethernet Rate Options
40GE = Ethernet optical rate of 41.25 Gbit/s
100GE = Ethernet optical rate of 103.125 Gbit/s

SONET/SDH Rate Options [a]
40G = 39.81G (OC-768/STM-256)

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

Ethernet Options
00 = No Ethernet option
ADV-FILTERS = Advanced filtering [f]
ETH-CAPTURE = Full-line-rate packet capture [f]
IPV6_40-100GE = 40GE and 100GE IPv6 internet protocol version 6 [f]
iSAM = Intelligent service activation methodology based on ITU-T Y.1564 [f]
MPLS_40-100GE = Enables 40GE and 100GE MPLS tags [f]
RFC6349_40-100GE = 40GE and 100GE enables TCP testing as per RFC 6349 [f]
TRAFFIC-SCAN = Discover and monitor VLAN traffic flows on a live signal

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

SONET/SDH Options and Mapping
SONET = SONET-BASE and mapping [d]
SDH = SDH-BASE and mapping [d]
SONET-SDH = SONET and SDH combo software [d]
SONETSDH-INTR-THRU = SONET/SDH intrusive Through mode [a]
TCM = Tandem connection monitoring [e]

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

Notes

a. Requires SONET, SDH or SONET-SDH option.
b. Requires enabling OTU3 and/or OTU4 rates.
c. Requires enabling ODUMUX OTN option.
d. Requires enabling OTU3 and/or 40G SONET/SDH rates.
e. Requires enabling 2.5G bundle or 9953M rate, with SONET or SDH or SONET-SDH.
f. Requires 40GE and 100GE.
g. Requires enabling OTU3 rate.

40G/100G PLUGGABLE TRANSCEIVERS (CFPs)

FTB-85953 = 100GBASE-LR10 dual-rate (100GE/OTU4) CFP (10 x 10G WDM, 2 km)
CFP-85954= 40 Gbit/s Ethernet and OTN CFP (4 x 10G WDM, 10 km)
FTB-85955 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP (4 x 28G WDM, 10 km), low power
FTB-85958 = 100GBASE-LR4 dual-rate (100GE/OTU4) CFP (4 x 28G WDM, 10 km)
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)
CFP-85963 = 40GBASE-SR4 dual-rate CFP (4 x 10G LAN-WDM, MMF, 850 nm, 100 m reach) MPO
CFP-85964 = 40GBASE-FR multirate (OC-768/STM-256, OTU3, OTU-3e1-e2) serial CFP (1550 nm, 2 km) 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

SFP MULTIRATE OPTICAL TRANSCEIVERS

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

100M SFP SINGLE-RATE OPTICAL TRANSCEIVERS

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

1000M SFP BIDIRECTIONAL OPTICAL TRANSCEIVERS

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

1000M SFP COPPER TRANSCEIVERS

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

10G SFP+ MULTIRATE OPTICAL TRANSCEIVERS

SFP-8600 = SFP+ modules: CPRI 1.228 to 9.83 Gbit/s at 1310 nm, LC connector, 1.4 km reach
SFP-8601 = SFP+ 10G (1.25 Gbit/s to 10.3125 Gbit/s) CWDM at 1471 nm, LC SMF, 10 km reach
SFP-8602 = SFP+ 10G (1.25 Gbit/s to 10.3125 Gbit/s) CWDM at 1511 nm, LC SMF, 10 km reach
FTB-8690 = Multirate SFP+ supporting: 10 GigE LAN/WAN (9.95 to 10.3 Gbit/s), 850 nm, LC connector, MMF, 300 m reach (not rated for SONET/SDH)
FTB-8691 = SFP+ modules: 10 GigE at 1310 nm, 10 km reach
FTB-8693 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (8.5, 9.95 to 11.3 Gbit/s), 1310 nm, LC connector, SMF, 10 km reach
FTB-8694 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN (9.95 to 11.1 Gbit/s), 1550 nm, LC connector, SMF, 40 km reach
FTB-8695 = Multirate SFP+ supporting: Sonet/SDH, 10 GigE LAN/WAN, OTU2, OTU1e/2e (9.95 to 11.1 Gbit/s), 1550 nm, LC connector, SMF, 80 km reach

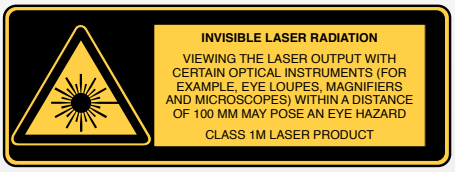
10G XFP MULTIRATE OPTICAL TRANSCEIVERS

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



Az Ön méréstechnikai szakértője:
equicom ICT MÉRÉSTECHNIKA
EQUICOM Méréstechnikai Kft.
1162 Budapest, Mátyás király utca 12.
www.equicom.hu
info@equicom.hu

EXFO Headquarters > Tel.: +1 418 683-0211 | Toll-free: +1 800 663-3936 (USA and Canada) | Fax: +1 418 683-2170 | info@EXFO.com | **www.EXFO.com**

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