FTB-8140
Transport Blazer
NETWORK TESTING – TRANSPORT AND DATACOM

The industry's most compact, portable 40/43 Gigabit test solution, built for field commissioning and troubleshooting

- OC-768/STM-256 testing with STS-1/AU-3 granularity

- Supports OTN testing at the OTU3 level including forward error correction (FEC) as per ITU-T G.709

- Supports single and dual stage optical channel data unit ODU multiplexing with SONET/SDH and Ethernet mapped client signals

- Offers ODU0 (1.25 Gbit/s) container with Gigabit Ethernet and SONET/SDH client signals for qualifying newly and efficiently mapped transport and datacom services over OTN

- Supports circuit and packet ODUflex testing capabilities for OTN bandwidth optimization

- Multichannel SDT measurements and real-time error/alarm monitoring for SONET/SDH and OTN

- Intuitive, feature-rich user interface with automated test scripting and multi-user remote management capabilities

- Compatible with any of EXFO's FTB-500 supported modules, including its industry-leading 40 Gbit/s fiber characterization modules

Platform Compatibility

- FTB-500 Platform

EXFO
Assessing
Next-Gen Networks

SONET/SDH Testing Reaches New Level

Increased demand for data and video services continues to put a strain on existing networks, driving the need for higher performance metro and core networks. As a result, the shift from 10 gigabit- to 40 gigabit-enabled networks has accelerated over the last year, and will continue at a strong pace, allowing service providers to ensure their next-generation SONET/SDH networks are scaled to meet these growing bandwidth demands.

This upgrade to 40 Gbit/s transmission creates new challenges for service providers, driving the need for 40 gigabit field test equipment to ensure that new network deployments meet industry standards and offer the required service quality and reliability.

EXFO's FTB-8140 Transport Blazer test module, the industry's most compact 40/43 gigabit field tester, provides advanced SONET/SDH and OTN test functions in a single module. This module is compatible with the FTB-500 Platform, which also supports 40 Gbit/s physical layer modules such as CD, PMD and OSA, ensuring that field technicians have a truly portable solution that meets every testing requirement.

SONET/SDH Service Turn-Up and Troubleshooting

The FTB-8140 Transport Blazer offers a wide range of SONET/SDH test functions ranging from simple bit-error-rate (BER) testing to advanced characterization and troubleshooting procedures. These functions include:

- Mixed and bulk payload generation and analysis from 51.84 Mbit/s to 40 Gbit/s
- High-order mappings: STS-1/3c/12c/48c/192c/768c and AU-3/AU-4/AU-4-4c/16c/64c/256c
- Unframed optical signal testing at 40 Gbit/s rate
- Section/RS, Line/MS and high-order (HO) path overhead manipulation and monitoring
- Section/RS, Line/MS and high-order (HO) path alarm/error generation and monitoring
- High-order (HO) pointer generation and monitoring
- K1/K2 OH byte capture
- Performance monitoring: G.821, G.828, G.829, M.2100, M.2101
- Frequency analysis and power measurement
- Frequency offset generation
- Automatic protection switching (APS) and service disruption time (SDT) measurements
- Multichannel SDT measurements and real-time error/alarm monitoring for all STS-1/AU-4 channels
- Round-trip delay (RTD) measurements
- Intrusive and transparent Through mode analysis
- Programmable error/alarm injection
- Independent transmitter and receiver testing
- Payload block and replace

Optical Transport Network (OTN) Testing

Prevalent in 10 Gbit/s networks, OTN has become a necessity for 40 Gbit/s transmission due to its forward error correction capabilities; critical for high bandwidth transmission applications. The FTB-8140 Transport Blazer offers optional OTN test capabilities for verifying compliancy with ITU-T G.709 standards.

OTN as per ITU-T G.709 has recently introduced two new concepts: ODU0 and ODUflex. ODU0 is a new virtual container of 1.25 Gbit/s bandwidth specifically defined for efficiently mapping Gigabit Ethernet services over OTN. As for ODUflex, it is the most efficient sub-wavelength bandwidth management capability for transport line rates of 10 Gbit/s, 40 Gbit/s and upcoming 100 Gbit/s. ODUflex allows providers to interconnect routers in ways that enable efficient bandwidth growth in steps of 1.25 Gbit/s, eliminating the need to allocate a full fixed-rate ODU container to each connection and allowing service providers to transport efficiently and seamlessly across lower-cost optical infrastructures. Tests include:

- OTU3 (43 Gbit/s) bit rate (framed and unframed)
- Synchronous mapping of SONET/SDH signals within OTN as well as synchronous/asynchronous demapping
- Forward error correction (FEC) testing—error insertion and monitoring
- Service disruption time (SDT) measurements
- Multichannel SDT measurements and real-time error/alarm monitoring for all ODU0 channels
- Round-trip delay (RTD) measurements
- OTU, ODU, OPU overhead manipulation and monitoring
- OTU, ODU (including ODU TCM), OPU layer alarms/errors generation and analysis
- OTU, ODU (including ODU TCM) trace messages
- Intrusive and transparent Through mode analysis
- Multiplexing/demultiplexing of ODU13, ODU23, ODU123, ODU03, ODU013 and ODU0123 with capability of mapping SONET/SDH, Gigabit Ethernet and 10 Gigabit Ethernet client signals into ODU0, ODU1 and ODU2
- ODU0 (1.25 Gbit/s) container with Gigabit Ethernet and SONET/SDH client signals mapping
- ODUflex with SONET/SDH and Ethernet client signal mapping

Unsurpassed Configuration and Operational Flexibility

The FTB-500 platform configuration with eight-slot (GP-408) receptacle provides users with an all-in-one solution supporting a mix of SONET/SDH, OTN, Ethernet, Fibre Channel and optical-layer test modules, making it the industry's first truly integrated network testing platform. This modularity enables users to upgrade their systems in the field according to their testing needs. This multitechnology test platform is the ideal solution for field, central office and lab applications.

Combining the FTB-8130NGE module with the FTB-8140 provides a multiservice portable test solution that addresses SONET/SDH and OTN testing needs from DS0/E0 to OC-768/STM-256/OTU3 as well as Ethernet testing needs from 10 Mbit/s to 10 GigE LAN/WAN and Fibre Channel 1x/2x/4x/10x.

Combined with EXFO's optical CD, PMD and OSA modules, the FTB-8140 is a unique portable solution addressing all 40 Gbit/s testing requirements from the physical to the transmission layer.

Product Option Flexibility

The FTB-8140 Transport Blazer provides customers with the flexibility to purchase SONET/SDH-only configurations and upgrade to OTN test functions via software options to meet evolving needs—reducing hardware and/or platform retrofits, and significantly decreasing capital and training expenses.

Remote Management

Through its optional Visual Guardian Lite™ management software, the FTB-8140 Transport Blazer allows you to perform remote testing, monitoring and data analysis via standard Ethernet.

Automated Test Scripting

The FTB-8140 Transport Blazer comes with a built-in macro recorder enabling users to easily record test actions and automatically create test scripts. This functionality also allows them to build standard test routines that can be accessed and run by field technicians with little or no manual intervention.

Electrical Interfaces

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

SYNCHRONIZATION INTERFACES

	External Clock DS1/1.5M	External Clock E1/2M	External Clock E1/2M	2 MHz (Trigger)
Tx pulse amplitude	2.4 to 3.6 V	3.0 V	2.37 V	0.75 to 1.5 V
Tx pulse mask	GR-499 figure 9.5	G.703 figure 15	G.703 figure 15	G.703 figure 20
Tx LBO preamplification	Typical power dBdsx +0.6 dBdsx (0-133 ft) +1.2 dBdsx (133-266 ft) +1.8 dBdsx (266-399 ft) +2.4 dBdsx (399-533 ft) +3.0 dBdsx (533-655 ft)			
Rx level sensivity (dynamic range)	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 (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	2.048 Mbit/s ± 4.6 ppm	
Reception bit rate	1.544 Mbit/s ± 50 ppm	2.048 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.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	G.823 section 7.2 G.813	
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	
Input impedance (resistive termination)	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced
Connector type	BNC [a]	BNC [a]	BNC	BNC

REF-OUT INTERFACE

Parameter	SONET/SDH	OTN
	Value	Value
Tx pulse amplitude	600 ± 200 mVpp	600 ± 200 mVpp
Transmission frequency	2.48832 GHz	2.68865 GHz
Output configuration	AC coupled	AC coupled
Load impedance	50 Ω	50 Ω
Maximum cable length	1 m	1 m
Connector type	SMA	SMA

NOTE

a. Adaptation cable required for BANTAM.

SONET/SDH and OTN Optical Interfaces

The following section provides detailed information on all supported SONET/SDH and OTN optical interfaces.

OC-768/STM-256/OTU3

Line coding	NRZ	NRZ-DPSK
Level Tx (dBm)	0 to 3	4 to 7.5
Rx operating range (dBm)	−5 to 3	3 to 8
Transmit bit rate	39.81312 Gbit/s ± 4.6 ppm	39.81312 Gbit/s ± 4.6 ppm
	43.01841 Gbit/s ± 4.6 ppm (OTU3)	43.01841 Gbit/s ± 4.6 ppm (OTU3)
Receive bit rate	39.81312 Gbit/s ± 100 ppm	39.81312 Gbit/s ± 100 ppm
	43.01841 Gbit/s ± 100 ppm (OTU3)	43.01841 Gbit/s ± 100 ppm (OTU3)
Operational wavelength range (nm)	1530 to 1565	1528.77 to 1563.86
Frequency offset generation	39.81312 Gbit/s ± 50 ppm	39.81312 Gbit/s ± 50 ppm
	43.01841 Gbit/s ± 50 ppm	43.01841 Gbit/s ± 50 ppm
Measurement accuracy (uncertainty)		
Frequency (ppm)	±4.6	±4.6
Optical power (dB)	±2	±1.3
Rx overload (dBm)	3	8
Rx damage level [a] (dBm)	6	10
Jitter compliance	GR-253 (SONET)	GR-253 (SONET)
	G.958 (SDH)	G.958 (SDH)
	G.8251 (OTN)	G.8251 (OTN)
Line coding compliance	G.693 VSR 2000 compliant	NRZ-DPSK
Connector	SC, FC, LC, ST	SC, FC, LC, ST

NOTE

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

SONET/SDH Functional Specifications

SONET			SDH		
Optical Interfaces	OC-768		**Optical Interfaces**	STM-256	
Available wavelengths (nm)	1550		Available wavelengths (nm)	1550	
Clocking	Internal, loop-timed, external (BITS), backplane		Clocking	Internal, loop-timed, external (MTS/SETS), 2 MHz, backplane	
Mappings			**Mappings**		
STS-1 SPE	Bulk		AU-3	Bulk	
STS-3c/12c/48c/192c/768c, SPE	Bulk		AU-4	Bulk	
			AU-4-4c/16c/64c/256c	Bulk	
SONET 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		SDH overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, G1, F2, F3, K3, N1, N2, E2, J1, C2, H4	
Error Insertion			**Error Insertion**		
OC-768	Section BIP (B1), line BIP (B2), path BIP (B3), REI-L, REI-P, FAS, bit error		STM-256	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, FAS, bit error	
Error Measurement			**Error Measurement**		
OC-768	Section BIP (B1), line BIP (B2), path BIP (B3), REI-L, REI-P, FAS, bit error		STM-256	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, FAS, bit error	
Alarm Insertion			**Alarm Insertion**		
OC-768	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		STM-256	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			**Alarm Detection**		
OC-768	LOS, LOC, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, PLM/SLM-P, UNEQ-P, TIM-P, pattern loss		STM-256	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	
		Frequency alarm on all supported interfaces.			
Patterns			**Patterns**		
STS-1, STS-3c/12c/48c/192c/768c	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/256c	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 Functional Specifications (continued)

ADDITIONAL TEST AND MEASUREMENT FUNCTIONS

Power measurements	Supports power measurements, displayed in dBm, for optical interfaces.
Frequency measurements	Supports clock frequency measurements (i.e., received frequency and deviation of the input signal clock from nominal frequency), displayed in ppm and bit/s, for optical and electrical interfaces (external clock).
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 on the FTB-8140 module.

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 HO/AU pointer adjustments as per GR-253 and ITU-T G.707.

Generation	Analysis
• Pointer increment and decrement	• Pointer increments
• Pointer jump with or without NDF	• Pointer decrements
• Pointer value	• 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 Burst and Continuous.
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. 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 round-trip delay test tool measures the time required for a bit to travel from the FTB-8140 transmitter back to its receiver after crossing a far-end loopback. Measurements are supported on all supported FTB-8140 interfaces and mappings. Measurements: last RTD time, minimum, maximum, average, measurement count (number of successful RTD tests), failed measurement count.
Multichannel testing	Ability to monitor in real-time errors and alarms, and to perform simultaneous SDT measurements for all STS-1/AU-4 channels; a user-defined threshold can also be applied to the SDT measurements for simple pass/fail results for each channel.
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).
Through mode	Ability to perform intrusive and transparent Through mode analysis of any incoming optical line (OC-768/STM-256, OTU3).
Payload block and replace	Ability to terminate and analyze a specific high-order path element and replace it with a PRBS pattern on the TX side.
K1/K2 OH byte capture	Ability to capture K1/K2 OH byte value transitions.

OTN Functional Specifications

OTN	
Standards compliance	ITU-T G.709, ITU G.798, ITU G.872
Interfaces	OTU3 (43 Gbit/s)
OTU Layer	
Errors	OTU-FAS, OTU-MFAS, OTU-BEI , OTU-BIP-8
Alarms	LOF, OOF, LOM, OOM, OTU-AIS, OTU-TIM, OTU-BDI, OTU-IAE, OTU-BIAE
Traces	64-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709
ODU TCM Layer	
Errors	TCMi-BIP-8, TCMi-BEI (i = 1 to 6)
Alarms	TCMi-LTC, TCMi-TIM, TCMi-BDI, TCMi-IAE, TCMi-BIAE
Traces	64-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709
ODU Layer	
Errors	ODU-BIP-8, ODU-BEI
Alarms	ODU-AIS, ODU-OCI, ODU-LCK, ODU-TIM, ODU-BDI, ODU-FSF, ODU-BSF, ODU-FSD, ODU-BSD
Traces	Generates 64-bytes Trail Trace Identifier (TTI) as defined in ITU-T G.709
FTFL [a]	As defined in ITU-T G.709
OPU Layer	
Alarms	OPU-PLM, OPU-CSF, OPU-AIS
Payload type (PT) label	Generates and displays received PT value
GMP errors	Cm CRC-8, CnD CRC-5
Forward Error Correction (FEC)	
Errors	FEC-Correctable (Codeword), FEC-Uncorrectable (Codeword), FEC-Correctable (Symbol), FEC-Correctable (Bit), and FEC-Stress (Codeword)
ODU Multiplexing	
Mappings	ODU13, ODU23, ODU123, ODU0, ODUflex
Alarms	OPU-MSIM, ODU-LOFLOM
Client	PRBS pattern, STS-3c/12c/48c/192c/768c, AU-4-4c/16c/64c/256c
ODU0	
Muxing	ODU0 into ODU3, ODU0 into ODU13, ODU0 into ODU123
Client types	Pattern, OC-3/STM-1, OC-12/STM-4, GigE using GFP-T
GFP-T errors	SB Correctable, SB Uncorrectable, 10B_ERR
ODUflex	
Muxing	ODUflex into ODU3
Client types	Ethernet using GFP-F or pattern for constant bit rate (CBR)
GFP-F alarms	Client forward defect indication (FDI), client reverse defect indication (RDI), client defect clear indication (DCI)

NOTE
a. Fault type and fault location.

OTN Functional Specifications (continued)

ADDITIONAL FUNCTIONS

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. 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 round-trip delay test tool measures the time required for a bit to travel from the FTB-8140 transmitter back to its receiver after crossing a far-end loopback. Measurements are supported on all supported FTB-8140 interfaces and mappings. Measurements: last RTD time, minimum, maximum, average, measurement count (number of successful RTD tests), failed measurement count.
Multichannel testing	Ability to monitor in real-time errors and alarms, and to perform simultaneous SDT measurements for all ODU0 channels; a user-defined threshold can also be applied to the SDT measurements for simple pass/fail results for each channel.

Additional Features

Scripting	Wide range of SCPI commands powerful enough to provide repeatable testing of complex configuration, yet simple enough to create a 40 gigabit BERT in as little as six commands. The FTB-8140 also includes an intuitive macro recorder enabling users to easily record test actions and automatically create test scripts in VB.Net.
Reports	Supports generation of test reports in .html, .csv, .txt, .pdf formats. Contents of reports are customizable by the user.
Power-up and restore	In the event of a power failure to the unit, the active test configuration and test logger are saved and restored upon bootup.
Store and load configurations	Ability to store and load test configurations to/from non-volatile memory.
Alarm hierarchy	Alarms are displayed according to a hierarchy based on root cause. Secondary effects are not displayed. This hierarchy serves to facilitate alarm analysis.
Configurable test views	This allows users to customize their test views, i.e., to dynamically insert or remove test tabs/windows, in addition to creating new test windows, so as to accurately match their testing needs.
Configurable test timer	Provides the ability for a user to set pre-defined test start and stop times.
Remote access	Available with Windows-based remote management software known as Visual Guardian Lite (optional software package). This allows users to remotely monitor and control the FTB-8140 module via standard Ethernet connection.

Additional Specifications

FTB-8140

SONET/SDH 40 Gbit/s and OTN 43 Gbit/s (optical rates)

Test Interfaces

OTN: OTU3 (43 Gbit/s)	
SONET: OC-768	
SDH: STM-256	

GENERAL SPECIFICATIONS

FTB-8140

Typical weight		2.5 kg (5.5 lb)
Size (H x W x D)		96 mm x 152 mm x 292 mm (3 $^3/_4$ in x 6 in x 11 $^1/_2$ in)
Temperature	operating	0 °C to 40 °C (32 °F to 104 °F)
	storage	−40 °C to 60 °C (−40 °F to 140 °F)

ORDERING INFORMATION

FTB-8140-XX-XX-XX-XX-XX

Model
FTB-8140-NRZ = SONET/SDH test module with 40/43 Gbit/s, 1550 nm, NRZ 2 km transponder
FTB-8140-DPSK = SONET/SDH test module with 40/43 Gbit/s, tunable DPSK transponder

Connector
89 = FC/UPC
90 = ST/UPC
91 = SC/UPC
101 = LC/UPC

Software options
SONET = SONET-BASE-SW
SDH = SDH-BASE-SW
SONET-SDH = Combined SONET/SDH

Other software options
00 = Without other options
ODUMUX = ODU multiplexing functionality [a]
ODU0 = ODU0 mapping [b]
ODUFlex = ODUflex functionality [b]
OTU3 = OTN 43 Gbit/s (G.709/OTU3) [c]
OTN-INTR-THRU = Intrusive OTN Through mode [a]
INTR-THRU-MODE = SONET/SDH intrusive Through mode
MULTI-CH-SDT = Multichannel SDT measurements

Rate option [d]
40G = 40 Gbit/s (OC-768/STM-256)

Example: FTB-8140-NRZ-91-SONET-40G-OTU3

NOTES
a. Must be combined with the OTU3 option.
b. Must be combined with ODUMUX option.
c. Included as standard for FTB-8140-DPSK.
d. Included as standard for FTB-8140-NRZ and FTB-8140-DPSK.

Assessing Next-Gen Networks