8000

SONET/SDH ANALYZER

FTB-8000

- Enables the integration of protocol-, optical- and physical-layer testing into one platform
- Supports DS0/E0 up to OC-192c/STM-64c testing in a single, compact module
- Provides support for SONET, SDH, PDH and T-Carrier
- Automatic signal discovery and alarm/error scan for field troubleshooting
- Remote management for network testing and monitoring

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EXFO
EXPERTISE REACHING OUT

Turning Up Revenue-Generating Services

In recent years, many advances in technology have changed the environment in which transport engineers and technicians find themselves. A major change that has come about in the last few years is the proliferation of IP-based services. As Internet protocol (IP) has progressed from being a means of transferring static data files between government and educational establishments to a ubiquitous technology used to transport voice, video and other demanding services, the performance requirements of the underlying transport network have become more stringent. Thus, testing and qualification of these transport networks has become more important and more challenging.

The FTB-8000 family is a series of modules housed in the FTB-400 platform. These modules allow T-Carrier/PDH and SONET/SDH protocol testing for signals from DS0/E0 to OC-192/STM-64. By integrating DS0/E0 to OC-192c/STM-64c test functions into its FTB-400 Universal Test System, EXFO combines physical-, optical- and protocol-layer testing inside a single test platform. The result: tremendous operational efficiencies when it comes to turning up revenue-generating services in a timely fashion. The same field professional that lit up a new wavelength on a DWDM route and performed an OSA test with an FTB-400 can now, in a snap, complete the final certification of the channel by running an OC-192c/STM-64c BER test.

When it comes to generating revenue, every penny counts. That's why EXFO's FTB-8000 SONET/SDH Analyzer includes a full-fledged suite of test functions for turning up services ranging from OC-192c/STM-64c down to DS0/E0, covering all the requirements for long-haul, metro and access networks.

Housed in EXFO's widely deployed FTB-400 Universal Test System, the FTB-8000 provides advanced DSn, PDH and SONET/SDH test and measurement capabilities. When coupled with EXFO's optical and datacom test modules, it offers a fully integrated telecom test solution.

KEY FEATURES

- DS0/E0 to OC-192/STM-64 testing in a single module
- Intuitive smart user interface (SUI) with highly convenient touchscreen
- Automated signal discovery with active trouble scan
- Support for concurrent DSn/PDH and SONET/SDH tests
- Automated testing with built-in macro recorder and powerful scripting language
- Modular platform offering compatibility with optical/physical-layer and datacom (FTB-8510/FTB-8520 Packet Blazer™) modules
- Remote management for test case execution and monitoring functions

The FTB-400 Universal Test System

The FTB-400 UTS is the first portable telecom/datacom network test platform to combine full test capabilities for DS0/E0 to OC-192c/STM-64c, 10/100/1000 Mb/s Ethernet with optical- and physical-layer testing capabilities, making it a truly universal system.

Designed with a unique layered approach, the FTB-8000 module can be combined with any of the existing or future FTB modules, all within the 2-slot, 4-slot, 7-slot or 8-slot FTB-400 platform. It can also be used as an FTB-400 stand-alone solution for applications requiring only protocol-layer testing.

Maintaining the Infrastructure

The ability to upgrade an existing fleet of FTB-400 platforms to include protocol-layer testing reduces overall cost of ownership. In addition, it provides field technicians with new insight into the behavior of their network. For instance, a technician can now correlate protocol-layer anomalies (such as bit or parity errors) with physical- or optical-layer defects (such as low OSNR or excessive PMD or CD), considerably reducing the amount of time required to troubleshoot a problem in the network. All of this, without having to carry more than a single, field-rugged, portable unit–the FTB-400 UTS.
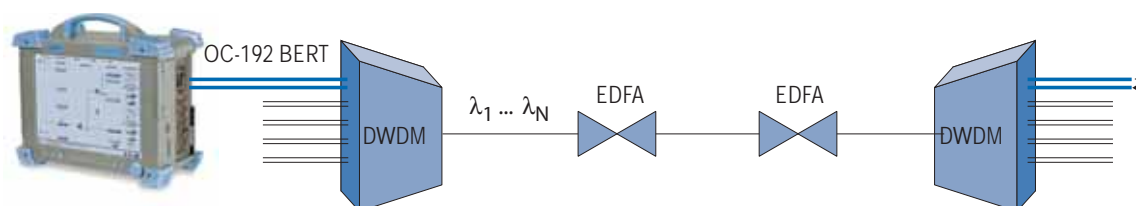
The FTB-8000 performs 10 Gb/s certification of DWDM channels using OC-192c/STM-64c bit-error-rate testing technology.

Smart User Interface (SUI)

As part of EXFO's family of protocol-layer testing products, the FTB-8000 comes with a unique smart user interface (SUI) for unparalleled ease of use. Its test scripting feature enables the automation of field-testing procedures. The FTB-8000 can also be remotely managed via EXFO's Visual Guardian™ element management system (EMS).
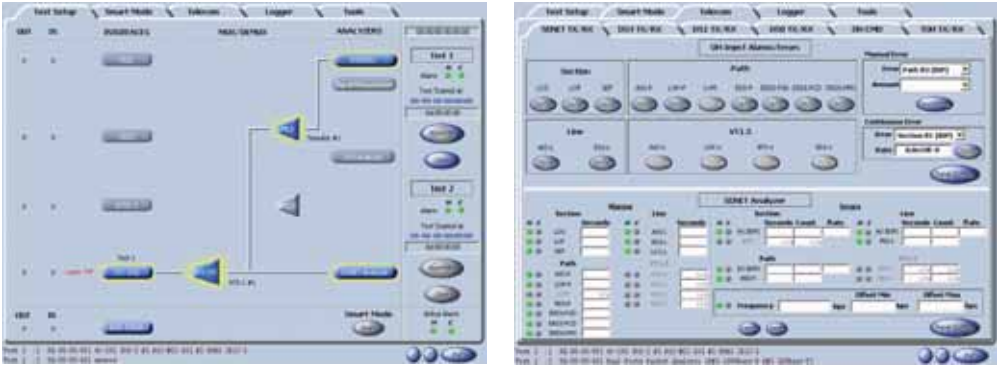
Speed up data management and tailor configurations as well as test formats with the FTB-8000's comprehensive, easy-to-operate SUI.

Monitoring Service-Level Agreements with Smart Mode

The FTB-8000 unleashes the full power of a complete SONET/SDH analyzer in a single module, allowing operators to perform long-term performance monitoring and gather an extensive suite of health parameters concerning their in-service networks. In addition, the Smart mode enables the FTB-8000 to automatically discover the structure of the received SONET/SDH signal, map out the embedded tributaries and scan for alarms and errors.

Dual Test Mode

While traditional test sets only allow users to perform one test at a time, the FTB-8000 offers a Dual Test mode, enabling users to configure and simultaneously execute separate DSn/PDH and SONET/SDH tests, optimizing service turn-up time.

Remote Management

The FTB-80x0, through its optional Visual Guardian™ Lite element management system (EMS), allows you to perform remote testing and data analysis, as well as remote monitoring via standard Ethernet or remote dial-up connections.
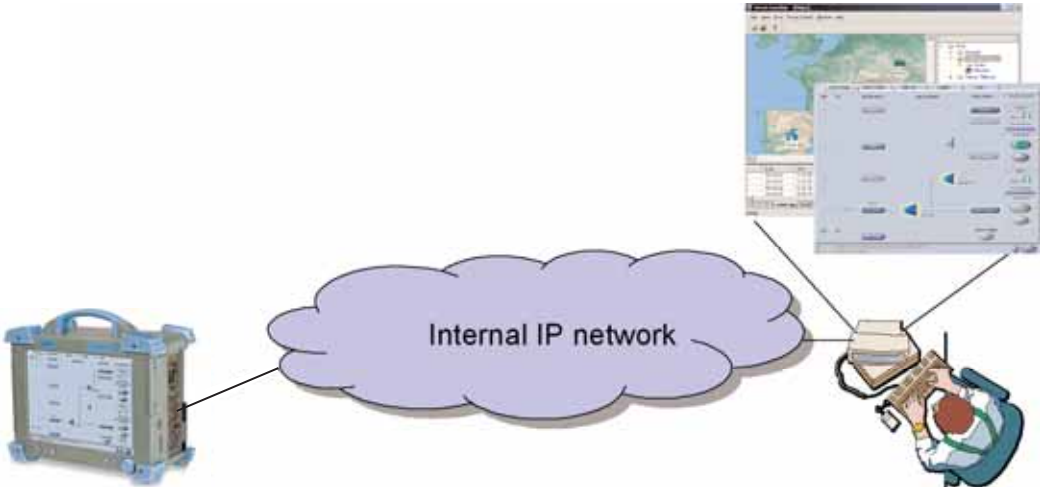

Smart Mode provides automatic discovery of the signal structure of the OC-n/STM-n line, and simultaneously monitors and displays any active alarms and errors on the HO/AU and LO/TU paths, allowing you to easily locate network faults.

The FTB-8000's Visual Guardian Lite allows users to remotely execute tests and perform network troubleshooting and monitoring.

Physical Characteristics

Left Side View

DS0/EO Line in/out
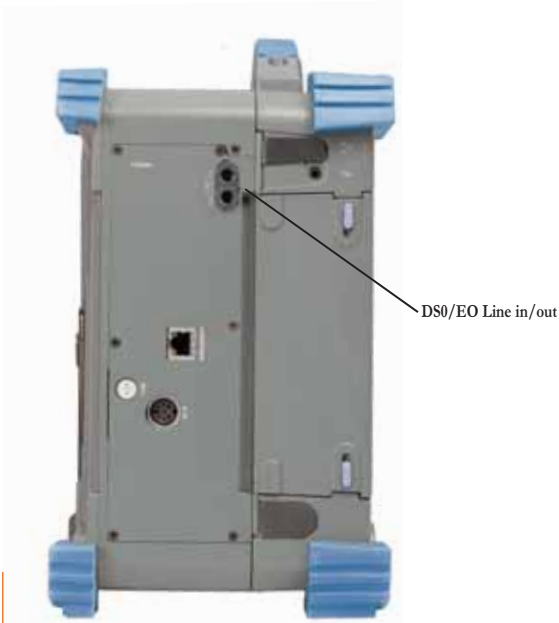
Right Side View: Dual Optics (1310 nm/1550 nm)

1310/1550 nm switchable optics model

OC-48/STM-16 (1550 nm)

OC-48/STM-16 (1310 nm)

OC-3/STM-1/OC-12/STM-4 (1550 nm)

STS-1/STM-0e/STM-1e/E4

OC-3/STM-1/OC-12/STM-4 (1310 nm)

TRIG

DS3/E3

OC-192/STM-64

DS1/E1

DS1/E1
EXT. CLK
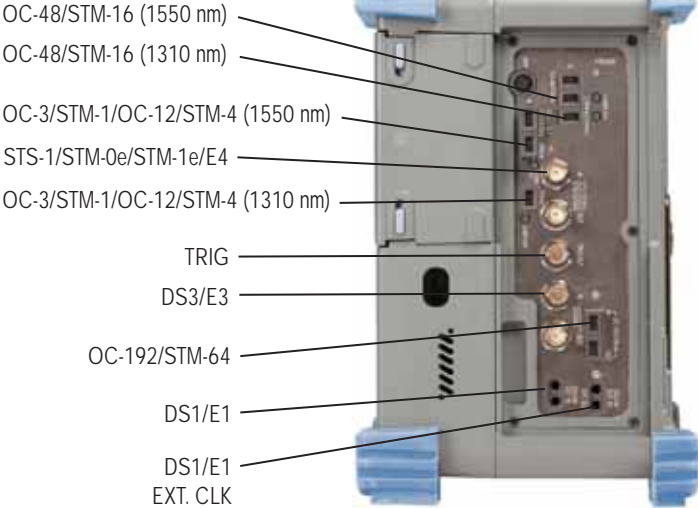
Right Side View: Single Optics
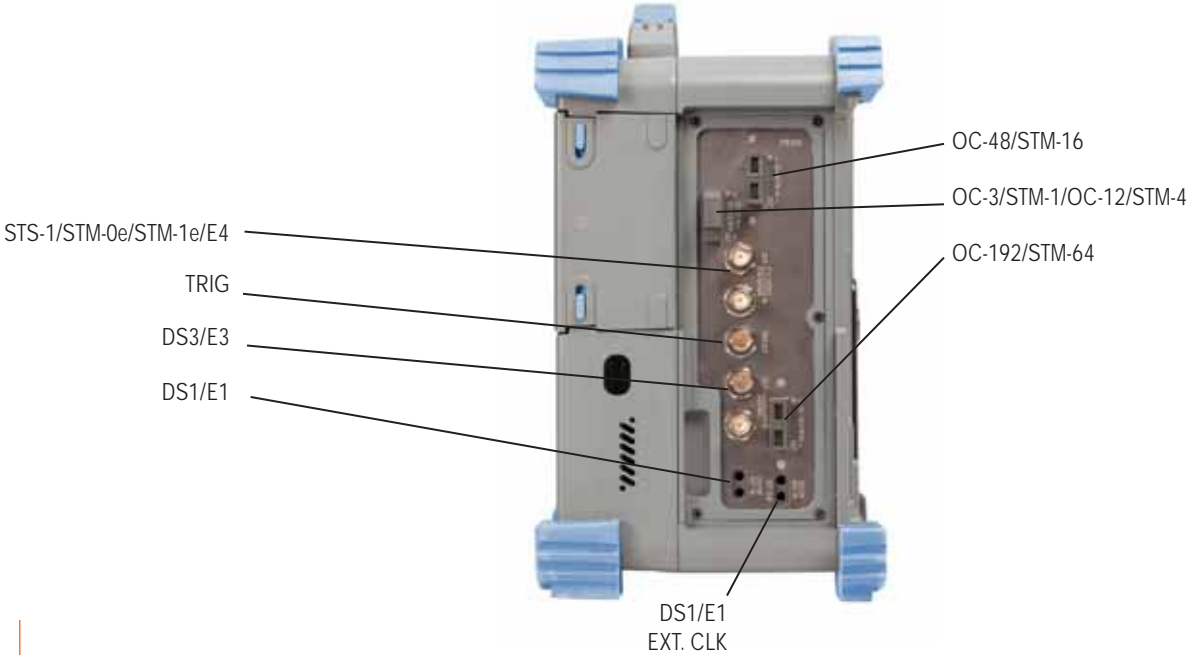
STS-1/STM-0e/STM-1e/E4

TRIG

DS3/E3

DS1/E1

OC-48/STM-16

OC-3/STM-1/OC-12/STM-4

OC-192/STM-64

DS1/E1
EXT. CLK

Electrical Interfaces

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

	Tx Level	Rx Level Sensitivity	Bit Rate	Measurement Accuracy	Jitter	Line Coding	Input Impedance	Connector Type
DS1/1.5M* (1.544 Mbps)	Amplitude Vp-p Setting: Value: • −22.5 dBdsx Typ. = 0.44 Vp-p • −15.0 dBdsx Typ. = 0.86 Vp-p • −7.5 dBdsx Typ. = 2.20 Vp-p • 0 dBdsx Typ. = 5.65 Vp-p • +0.6 dBdsx Typ. = 6.10 Vp-p • +1.2 dBdsx Typ. = 6.60 Vp-p • +1.8 dBdsx Typ. = 7.10 Vp-p • +2.4 dBdsx Typ. = 7.60 Vp-p • +3.0 dBdsx Typ. = 8.20 Vp-p Power dBdsx Setting: Value: • −22.5 dBdx Typ. = − 22.69 dBdsx • −15.0 dBdsx Typ. = −16.87 dBdsx • −7.5 dBdsx Typ. = −8.71 dBdsx • 0 dBdsx Typ. = −0.52 dBdsx • +0.6 dBdsx Typ. = +0.14 dBdsx • +1.2 dBdsx Typ. = +0.83 dBdsx • +1.8 dBdsx Typ. = +1.46 dBdsx • +2.4 dBdsx Typ. = +2.05 dBdsx • +3.0 dBdsx Typ. = +2.71 dBdsx	At 772 KHz (T1) • TERM: +3 to −26 dBdsx (cable loss only) • DSX-MON: −20 to −26 dBdsx (20 dB resistive loss and cable loss of ≤ 6 dB) • BRIDGE: 0 to −6 dBdsx (cable loss only)	Transmit: 1.544 Mb/s ± 4.6 ppm Receive: 1.544 Mb/s ± 130 ppm	Frequency: ± 4.6 ppm Electrical power: • DSX range: ± 2.0 dBm • DSX-MON range: ± 2.5 dBm Peak-to-peak voltage: ± 15 %	Intrinsic jitter (Tx): Meets ANSI T1.403 Input jitter tolerance: Meets AT&T PUB 62411	• AMI • B8ZS	100 ohms ± 15%, balanced	BANTAM jack
E1/2M* (2.048 Mbps)	Amplitude Vp-p • HIGH: Typ. = 6.42 Vp-p • NORMAL: Typ. = 5.60 Vp-p	• TERM: ≤ 37 dB cable loss only • MON: 20 dB resistive loss and cable loss of ≤ 6 dB • BRIDGE: ≤ 6 dB cable loss only	Transmit: 2.048 Mb/s ± 4.6 ppm Receive: 2.048 Mb/s ± 100 ppm	Frequency: ± 4.6 ppm Electrical power: ± 3 dBm Peak-to-peak voltage: ± 15%	Intrinsic jitter (Tx): Meets ITU-T G.823 Input jitter tolerance: Meets ITU-T G.823	• AMI • HDB3	120 ohms ± 15%, balanced	BANTAM jack
E3/34M** (34.368 Mbps)	Amplitude Vp-p • NORMAL Typ. = 2.0 Vp-p • LOW Typ. = 0.50 Vp-p	At 17.184 MHz • TERM: ≤ 12 dB coaxial cable loss only (as per G.703 section 11.3) • Monitor: 20 dB resistive loss and cable loss of ≤ 6 dB	Transmit: 34.368 Mb/s ± 4.6 ppm Receive: 34.368 Mb/s ± 100 ppm	Frequency: ± 4.6 ppm Electrical power • Normal range: ± 2 dBm • Monitor range: ± 2.5 dBm Peak-to-peak voltage: ± 15%	Intrinsic jitter (Tx): Meets ITU-T G.823 Input jitter tolerance: Meets ITU-T G.823	• HDB3	75 ohms ±10%, unbalanced	BNC
DS3/45M** (44.736 Mbps)	Amplitude Vp-p • HIGH Typ. = 1.85 Vp-p • DSX Typ. = 1.42 Vp-p • LOW Typ. = 0.357 Vp-p	At 22.368 MHz • TERM: ≤ 10 dB cable loss only • DSX-MON: 21.5 dB resistive loss and cable loss of ≤ 5 dB	Transmit: 44.736 Mb/s ± 4.6 ppm Receive: 44.736 Mb/s ± 100 ppm	Frequency: ± 4.6 ppm Electrical power • DSX range: ± 2 dBm • DSX-MON range: ± 2.5 dBm Peak-to-peak voltage: ± 15%	Intrinsic jitter (Tx): Meets Telcordia GR-499-CORE Input jitter tolerance: Meets Telcordia GR-499-CORE	• B3ZS	75 ohms ± 10%, unbalanced	BNC
E4/140M*** (139.264 Mbps)	Amplitude Vp-p Typ. = +1.0 Vp-p	At 70 MHz +12 dB coaxial cable loss only	Transmit: 139.264 Mb/s ± 4.6 ppm Receive: 139.264 Mb/s ± 15 ppm		Intrinsic jitter (Tx): Meets ITU-T G.823 Input jitter tolerance: Meets ITU-T G.823	• CMI	75 ohms ± 15%, unbalanced	BNC
STS-1/STM-0*** (51.84 Mbps)	Amplitude Vp-p • HIGH Typ. = 1.91 Vp-p • DSX/NORMAL Typ. = 1.45 Vp-p • LOW Typ. = 0.50 Vp-p	At 25.92 MHz • TERM: ≤ 10 dB cable loss only • MON: 20 dB resistive loss and cable loss of ≤ 5 dB	Transmit 51.84 Mb/s ± 4.6 ppm Receive 51.84 Mb/s ± 50 ppm	Frequency: ± 4.6 ppm Electrical power • DSX/NORMAL range: ± 2 dBm • MON range: ± 2.5 dBm Peak-to-peak voltage: ± 15%	Intrinsic jitter (Tx): Meets Telcordia GR-253-CORE Input jitter tolerance: Meets Telcordia GR-253-CORE	• B3ZS	75 ohms ± 10%, unbalanced	BNC
STM-1e*** (155.52 Mbps)	Amplitude Vp-p Typ. = 1.0 Vp-p	At 78 MHz +12.7 dB coaxial cable loss only	Transmit 155.520 Mb/s ± 4.6 ppm Receive 155.520 Mb/s ± 20 ppm		Intrinsic jitter (Tx): Meets ITU-T G.825 Input jitter tolerance: Meets ITU-T G.825	• CMI	75 ohms ± 15%, unbalanced	BNC

	Tx Level	Rx Level Sensitivity	Frequency	General	Jitter	Line Coding	Input Impedance	Connector Type
Ext. Clock**** DS1/1.5 Mbps	Amplitude Vp-p • 0 dBdsx Typ. = 5.65 Vp-p Power dBdsx • 0 dBdsx Typ. = −0.52 dBdsx	At 772 KHz (T1) +3 to −26 dBdsx (cable loss only)	Transmit: 1.544 Mb/s ± 4.6 ppm Receive: 1.544 Mb/s ± 130 ppm		Intrinsic jitter (Tx): Meets ANSI T1.403 Input jitter tolerance: Meets AT&T PUB 62411	• AMI • B8ZS	100 ohms ± 15 %, balanced	BANTAM jack
Ext. Clock**** E1/2M	Amplitude Vp-p • NORMAL: Typ. = 5.60 Vp-p	≤ 37 dB cable loss only	Transmit: 2.048 Mb/s ± 4.6 ppm Receive: 2.048 Mb/s ± 100 ppm		Intrinsic jitter (Tx): Meets ITU-T G.823 Input jitter tolerance: Meets ITU-T G.823	• AMI • HDB3	120 ohms ± 15%, balanced	BANTAM jack
TRIG		1.5 to 5.0 Vp-p	Transmit: 2.048 MHz ± 50 ppm	Compliance: G.703 synchronization interface section 13			75 ohms ± 15%,	BNC (coaxial)
LINE IN/OUT	Amplitude V-peak Input: 0 to 800 mV peak Output: 0 to 886 mV peak			Maximum load: 300 ohms			> 20 Kohms	3.5 mm audio jack

* The DS1/1.5M and E1/2M interfaces share a common set of BANTAM Tx and Rx jacks.

** The DS3/45M and E3/34M interfaces share a common set of BNC Tx and Rx connectors.

*** The STS-1, STM-0, STM-1e and E4/140M interfaces share a common set of BNC Tx and Rx connectors.

**** The ext. clock DS1/1.5M and E1/2M interfaces share a common set of BANTAM Tx and Rx jacks.

Optical Interfaces

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

	Tx Level Typ. Optical Power	Rx Operation Range	Max Rx level before damage	Optical Characteristics	Bit Rate	Measurement Accuracy	Jitter Compliance
OC-3/STM-1o 1310 - 15 km	−12.00 dBm (−15 to −8)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 IR /G.957 S-1.1 • InGaAsP laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11. • RMS spectral width: 4 nm max. • Central wavelength: Typ. = 1310 nm (Min. = 1274; Max. = 1356)	Transmit: 155.52 Mb/s ± 4.6 ppm Receive: 155.52 Mb/s ± 200 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-3/STM-1o 1310 - 40 km	0 dBm (−3 to +2)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 LR /G.957 L-1.1 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11. • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1310 nm (Min. = 1280; Max. = 1335)	Transmit: 155.52 Mb/s ± 4.6 ppm Receive: 155.52 Mb/s ± 200 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-3/STM-1o 1550 - 80 km	0 dBm (−3 to +2)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 LR-2 /G.957 L-1.2 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1550 nm (Min. = 1480; Max .= 1580)	Transmit: 155.52 Mb/s ± 4.6 ppm Receive: 155.52 Mb/s ± 200 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-12/STM-4o 1310 - 15 km	−12.00 dBm (−15 to −8)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 IR /G.957 S-4.1 • InGaAsP laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11. • RMS spectral width: 4 nm max. • Central wavelength: Typ. = 1310 nm (Min. = 1274: Max. = 1356)	Transmit: 622.08 Mb/s ± 4.6 ppm Receive: 622.08 Mb/s ± 50 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-12/STM-4o 1310 - 40 km	0 dBm (−3 to +2)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 LR /G.957 L-4.1 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11. • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1310 nm (Min. = 1280: Max. = 1335)	Transmit: 622.08 Mb/s ± 4.6 ppm Receive: 622.08 Mb/s ± 50 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-12/STM-4o 1550 - 80 km	0 dBm (−3 to +2)	−8 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 LR-2 /G.957 L-4.2 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11. • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1550 nm (Min. = 1480: Max. = 1580)	Transmit: 622.08 Mb/s ± 4.6 ppm Receive: 622.08 Mb/s ± 50 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-48/STM-16o 1310 - 15 km	−3 dBm (−5 to 0)	−1 to −19 dBm for 1x10E-10 BER using 2E23-1 PRBS	+3 dBm	• GR-253 IR /G.957 S-16.1 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1310 nm (Min: 1266, Max: 1360)	Transmit: 2.48832 Gb/s ± 4.6 ppm Receive: 2.48832 Gb/s ± 500 ppm	Frequency: ± 4.6 ppm Receive: 2.48832 Gb/s ± 500 ppm	G.958
OC-48/STM-16o 1310 - 40 km	0 dBm (−2 to +3)	−9 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	−6 dBm	• GR-253 LR /G.957 L-16.1 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1310 nm (Min: 1280, Max: 1335)	Transmit: 2.48832 Gb/s ± 4.6 ppm Receive: 2.48832 Gb/s ± 500 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-48/STM-16o 1550 - 80 km	0 dBm (−2 to +3)	−9 to −28 dBm for 1x10E-10 BER using 2E23-1 PRBS	−6 dBm	• GR-253 LR-2 /G.957 L-16.2 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1550 nm (Min: 1500, Max: 1580)	Transmit: 2.48832 Gb/s ± 4.6 ppm Receive: 2.48832 Gb/s ± 500 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	G.958
OC-192/STM-64o 1550 - 40 km	0 dBm (−1 to +2)	−2 to −14 dBm for 1x10E-12 BER using 2E31-1 PRBS	+2 dBm	• GR-253 IR-2 /G.691 S-64.2 • DFB laser • Class 1 laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ. = 1550 nm (Min: 1530 ,Max: 1565)	Transmit: 9.95328 Gb/s ± 4.6 ppm Receive: 9.95328 Gb/s ± 100 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	GR-253
OC-192/STM-64o 1550 - 80 km	0 dBm (−2 to +2)	−9 to −24 dBm	0 dBm	• GR-253 LR-2 /G.691 L-64.2 • DFB laser • Class 3B laser complies with 21 CFR 1040.10 and 1040.11 • Spectral width (20 dB down from center): 1 nm max. • Central wavelength: Typ .= 1550 nm (Min: 1530, Max: 1565)	Transmit: 9.95328 Gb/s ± 4.6 ppm Receive: 9.95328 Gb/s ± 100 ppm	Frequency: ± 4.6 ppm Optical power: ± 2 dBm	GR-253

* The OC-3/STM-1o and OC-12/STM-4o interfaces share a common set of IN and OUT connectors.

Functional Specifications

SONET/T-Carrier		SDH/PDH	
Optical interfaces	OC-3, OC-12, OC-48, OC-192	**Optical interfaces**	STM-1o, STM-4o, STM-16o, STM-64o
Available wavelengths	1310 nm, 1550 nm	Available wavelengths	1310 nm, 1550 nm
Electrical interfaces	DS1, DS3, STS-1	**Electrical interfaces**	1.5M, 2M, 34M, 45M, 140M, STM-0e, STM-1e
Standards compliance	Optical and STS-1 interfaces: Telcordia GR-253	Standards compliance	Optical interfaces: ITU-T G.707, G.841, G.957, G.958, G.691
	T-Carrier electrical interfaces: Telcordia GR-499		Electrical interfaces: ITU-T G.703
T-Carrier testing	DS0 analysis, fractional T1, integrated M13 mux, clock slip, pattern slip, G.747, Through mode, DS0 Tx/Rx signaling, DS0 Rx data display, dual DS3 receiver	**PDH testing**	64K/56K analysis, fractional 2M, clock slip, pattern slip, 64K/56K Tx/Rx signaling, 64K/56K Rx data display, Tx/Rx PDH spare bits, integrated E13 mux and E34 mux
DS1 line coding	AMI, B8ZS	2M line coding	AMI, HDB3
DS1 framing	Unframed, SF, ESF	2M framing	Unframed, PCM30, PCM31, PCM30 CRC-4, PCM31 CRC-4
DS3 line coding	B3ZS	34M line coding	HDB3
DS3 framing	Unframed, M13, C-Bit parity	34M framing	Unframed, framed
		140M line coding	CMI
		140M framing	Unframed, framed
Clocking	Internal, loop timed, external (BITS), clock drop	**Clocking**	Internal, loop timed, external (MTS/SETS), 2 MHz, clock drop
SONET testing	STS-1, OC-3/3c, OC-12/12c, OC-48/48c, OC-192/192c, overhead processing, Through mode, Tx/Rx pointer adjustment, SS bits control, SSM decoder, signal label decoder, APS (K1, K2) decoder, SONET disruption time measurements	**SDH testing**	STM-1e, STM-0e, STM-1o, STM-4/4c, STM-16/16c, STM-64/64c, overhead processing, Through mode, Tx/Rx pointer adjustment, SS bits control, tandem connection monitoring (TCM), SSM decoder, signal label decoder, APS (K1, K2) decoder, SDH disruption time measurements

Mappings

SONET		SDH	
VT1.5	DS1 async, DS1 floating	C-11-AU-3, C-11-AU-4	1.5M async
VT2	E1 async	C-12-AU-3, C-12-AU-4	2M async
STS-1 SPE	DS3 async, DS3 floating, bulk filled	C-3-AU-3, C-3-AU-4	45M async, 34M async, bulk filled
STS-3c SPE	Bulk filled	C-4-AU-4	140M async, bulk filled
STS-12c SPE	Bulk filled	AU-4-4c	Bulk filled
STS-48c SPE	Bulk filled	AU-4-16c	Bulk filled
STS-192c SPE	Bulk filled	AU-4-64c	Bulk filled

Test Patterns

DSn/SONET		PDH/SDH	
DS0	2E6-1, 2E7-1, 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 1100,1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted)	64 Kb/s (E0)	2E6-1, 2E7-1, 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 1100,1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted)
DS1	2E6-1, 2E7-1, 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 1100,1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), T1-Daly, 55-Octet	2M	2E6-1, 2E7-1, 2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 1100,1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted)
DS3	2E15-1, 2E20-1, 2E23-1, 1100,1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted)	34M	2E15-1, 2E20-1, 2E23-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted)
STS-1 SPE, STS-3c SPE, STS-12c SPE	2E15-1, 2E23-1(inverted or non-inverted)	140M	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 1111, 32 bit programmable (inverted or non-inverted)
STS-48c SPE, STS-192c SPE	2E15-1, 2E23-1, 2E31-1 (inverted or non-inverted)	C-4, AU-4-4c	2E15-1, 2E23-1 (inverted ornon-inverted)
		AU-4-16c, AU-4-64c	2E15-1, 2E23-1, 2E31-1 (inverted or non-inverted)

Error Generation

DSn/SONET		PDH/SDH	
Control	Single or user-provisioned error rate	Control	Single or user-provisioned error rate
DS0	Bit error	E0	Bit error
DS1	Bit error, framing bit, BPV, bit error+BPV, CRC-6, OOF	2M	Bit error, FAS, CV, bit error+CV, CRC-4, E-Bit
DS3	Bit error, BPV, bit error+BPV, C-Bit, P-Bit, F-Bit	34M	Bit error, FAS, CV, bit error+CV
SONET (STS-1)	BPV, section B1 (BIP), line B2 (BIP), path B3 (BIP), line REI-L, path REI-P, VT BIP-2	140M	Bit error, FAS, CV, 4 x FAS
SONET (OC-3/12/48/192)	Section B1 (BIP), line B2 (BIP), line REI-L, path B3 (BIP), path REI-P, VT BIP-2	C-4, AU-4-4c	RS B1 (BIP), MS B2 (BIP), MS-REI, HP B3 (BIP), HP-REI, LP BIP-2
		AU-4-16c, AU-4-64c	RS B1 (BIP), MS B2 (BIP), MS-REI, HP B3 (BIP), HP-REI, LP BIP-2

Functional Specifications (cont'd)

Error Analysis

DSn/SONET		PDH/SDH	
DS1	Bit error	2M	Bit error
DS3	Bit error, BPV, C-Bit, P-Bit, framing bit, FEBE	34M	Bit error, FAS, CV, bit error + CV
SONET (STS-1)	Section B1 (BIP), BPV, line B2 (BIP), path B3 (BIP), line REI-L, path REI-P, VT BIP-2, VT REI-V, bit error	140M	Bit error, CV, FAS, 4 x FAS
SONET (OC-3/12/48/192)	Section B1 (BIP), line B2 (BIP), path B3 (BIP), line REI-L, path REI-P, VT BIP-2, VT REI-V, bit error	C-4, AU-4-4c	RS B1 (BIP), MS B2 (BIP), HP B3 (BIP), MS-REI, HP-REI, LP BIP-2, LP-REI
		AU-4-16c, AU-4-64c	RS B1 (BIP), MS B2 (BIP), HP B3 (BIP), MS-REI, HP-REI, LP BIP-2, LP-REI

Alarm Generation

DSn/SONET		PDH/SDH	
DS1	AIS, RAI (yellow)	2M	AIS, LOF, RAI
DS3	AIS, RAI, DS3 idle	34M	AIS, LOF, RAI, LOS
SONET (STS-1)	LOS, LOF, SEF, AIS-L, RDI-L, AIS-P, LOM, RDI-P, ERDI-PSD, ERDI-PCD, ERDI-PPD, AIS-V, RFI-V, RDI-V	140M	AIS, LOF, RAI
SONET(OC-3)	LOS, LOF, SEF, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, ERDI-PSD, ERDI-PCD, ERDI-PPD, AIS-V, RFI-V, RDI-V	SDH (STM-1e)	LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, TU-AIS, LP-RFI, LP-RDI
SONET (OC-12/48/192)	LOS, LOF, SEF, AIS-L, RDI-L, AIS-P, LOP-P, LOM, RDI-P, ERDI-PSD, ERDI-PCD, ERDI-PPD, AIS-V, RFI-V, RDI-V	SDH (STM-1o)	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, TU-AIS, LP-RFI, LP-RDI
		SDH (STM-o4/16o/64o)	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-RDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, LP-RFI, TU-AIS, LP-RDI

Alarm Analysis

DSn/SONET		PDH/SDH	
DS0	Pattern loss	E0	Pattern loss
DS1	LOS, loss of clock (LOC), LOF, RAI (yellow), AIS, pattern loss	2M	LOS, LOS Mframe, LOS CRC Mframe, LOC, LOF, AIS, TS16 AIS, RAI, RAI Mframe, pattern loss
DS3	LOS, LOC, LOF, RAI, AIS, pattern loss, DS3 idle	34M	LOS, LOC, LOF, RAI, AIS, pattern loss
SONET (STS-1, OC-3, OC-12, OC-48, OC-192)	LOS, LOF, SEF, AIS-L, RDI-L, LOC-L, AIS-P, LOP-P, LOM, RDI-P, ERDI-PSD, ERDI-PCD, ERDI-PPD, AIS-V, LOP-V, RFI-V, RDI-V	140M	LOS, LOC, LOF, RAI, AIS, pattern loss
		SDH (STM-1e, STM-1o, STM-4, STM-16, STM-64)	LOS, LOF, OOF ,MS-AIS, MS-RDI, MS-LOC, AU-AIS, AU-LOP, H4-LOM, HP-RDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, TU-AIS, TU-LOP, LP-RFI, LP-RDI

Overhead Testing

The FTB-80x0 allows monitoring and manipulation of the following SONET/SDH overhead bits:

SONET		SDH	
STS-1	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5	STM-0e	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, E2, J1, C2, G1, F2, F3, K3, N1
OC-3	J0, E1, F1, D1-D12, K1, K2, S1, M1, Z2, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5	STM-1e/1o	J0, E1, F1, D1-D12, K1, K2, S1, M1, E2, J1, C2, G1, F2, F3, K3, N1
OC-12/48/192	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M1, Z2, E2, J1, C2, G1, F2, H4, Z3, Z4, Z5	STM-4o/16o/64o	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M1, E2, J1, C2, G1, F2, F3, K3, N1

Performance Monitoring

The following ITU-T recommendations, and corresponding performance monitoring parameters, are supported on the FTB-8000 series product line:

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, ESR, SESR
M.2101	ES, SES, BBE, UAS, ESR, SESR, BBER

Pointer Analysis and Generation

SONET	SDH
• Generation and analysis of HO and LO pointer adjustments as per ITU-T G.703	• Generation and analysis of AU and TU pointer adjustments as per ITU-T G.703
• Trigger: single or continuous (negative, positive)	• Trigger: single or continuous (negative, positive)
• Display:	• Measurements:
- Positive and negative pointer adjustments	- Positive and negative pointer adjustments
- Pointer value	- Pointer value

Additional Test and Measurement Functions

Service disruption time	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: DS3-AIS, DS3 pattern loss, SONET AIS-P, SONET AIS-L and SONET pattern loss. Available choices depend on the test case mounted.
	Measurements: last disruption, shortest disruption, longest disruption, service disruption count.
Round-trip delay	The round-trip delay test tool measures the time required for a bit to travel from the FTB-8000 transmitter back to its receiver after crossing a far-end loopback. Supported for Ds1/E1 mounted test cases.
	Measurements: last RTD time, minimum, maximum, average, measurement count (no. of successful RTD tests) minimum round-trip delay recorded.
	Units: milliseconds (msecs).
Through mode	Ability to perform Through-mode analysis of an incoming electrical or optical line (up to OC-192/STM-64 rates).
M13 mux/demux	Ability to multiplex/demultiplex a DS1 signal into/from a DS3 signal. (Note: E1 to DS3 mux/demux available with G.747 software option.)
Tandem connection monitoring	Tandem connection monitoring (TCM) is used to monitor the performance of a subsection of an SDH path routed via different network providers. The FTB-80x0 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. The TC Trace is a 16-byte, ASCII-character pattern that can be continuously transmitted and monitored.
	Error insertion and analysis: TC-IEC, TC-REI, TC-OEI, TC-VIOL
	Alarm insertion and analysis: TC-RDI, TC-ODIC, TC-IAIS, TC-LTC (LOF)
Synchronization status	Ability to monitor and set up synchronization status messages (S1 byte of SONET/SDH overhead). message control and analysis
APS message control and monitoring	Ability to monitor and set up automatic protection switching messages (K1/K2 byte of SONET/SDH overhead).
Signal label control and monitoring	Ability to monitor and set up payload signal labels (C2,V5 bytes of SONET overhead).
Power measurements	Supports power measurements, displayed in dBm, for optical and electrical 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 b/s (bps), for optical and electrical interfaces.
Timing slips	Supports measurement of clock/timing and pattern slips on DS1, DS3, E1 and E3 interfaces.
Frequency offset	Supports offsetting the clock of the transmitted signal on a selected interface to exercise clock recovery circuitry on network elements.
Timeslot loopthrough	Supports the ability to enable loopthrough per individual timeslot.
Audio drop and insert	Ability to drop and insert a DS0/E0 (64 Kb/s, 56 Kb/s) signal from all supported electrical and optical interfaces. Full DS0/E0 analyzer and generator test utility supported with access to all individual voice channels.

Additional Features

Scripting	The built-in scripting engine and embedded macrorecorder provide a simple means of automating test cases and routines. Embedded scripting routines provide a powerful means of creating advanced test scripts.
Dual test case	Supports the ability to mount and perform two tests simultaneously.
Event logger	Supports logging of test results, and the ability to print, export (to a file), or export the information contained in the logging tool.
Power-up and restore	In the event of a power failure to the unit, the active test configuration and results 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.

Functional Specifications (cont'd)

General Specifications

Display[1]	Size: 12.1 in TFT color touchscreen
	Resolution: 800 x 600
	Keyboard: external or via built-in touchscreen
Interfaces[1]	Serial RS-232
	Parallel port
	External monitor
	Two USB 1.1 ports
	Infrared (IrDA) port
	Audio microphone In 3.5 mm
	Audio speaker Out 3.5 mm
	Two PCMCIA type II or one PCMCIA type III
Storage[1]	Internal 30 GB hard drive minimum (over 900,000 OTDR test files)
	Internal 3.5 in 1.44 MB floppy drive
	External USB read/write CD-ROM (optional)
	Flash memory cards (256, 512, 1024 MB) (optional)
	NTFS file system
Power	110/220 V AC (DC option available)
Weight	4.54 kg (10 lb)
Size (H x W x D)	7.1 cm x 25.4 cm x 32.3 cm (2 $^{13}/_{16}$ in x 10 in x 12 $^{11}/_{16}$ in)
Operating temperature	0 °C to 40 °C (32 °F to 104 °F)

Safety

CLASS 1 LASER PRODUCT
21 CFR 1040.10
IEC 60825-1

[1] Please refer to http://documents.exfo.com/specsheets/FTB-400-ang.pdf for more information on the FTB-400 Universal Test System.

Software Options

DS1 FDL	Enables DS1 facility data link (FDL) channel analysis.
DS3 FEAC	Enables DS3 far-end alarm and control (FEAC) analysis.
G.747	Enables E1/2M in DS3/45M analysis, as per ITU-T G.747 recommendation.
Virtual tributary 2 (VT2)	Enables VT2 channel analysis.
Remote control	Windows-based remote management software (Visual Guardian™) allows users to remotely monitor and control the FTB-80x0 unit (via TCP/IP or modem connection).

Ordering Information

The FTB-8000 comes in several configurations to meet your specific testing needs. For module configuration requests not covered in this document, please contact your local EXFO representative.

MODULE

FTB-80XX-XX-XX-XX

- Model → See table below → Software

Model
- 00 = 10 Gb/s, DS0/E0 to OC-192/STM-64
- 10 = 2.5 Gb/s, DS0/E0 to OC-48/STM-16
- 20 = 10 Gb/s, OC-48/STM-16 to OC-192/STM-64

Example: FTB-8000-13-15-03

Software
- 01 = SONET
- 02 = SDH
- 03 = SONETSDH

TEST KIT

TK-400-D4-NXX-XX-FTB-80XX-XX-XX-XX

- TFT active color touchscreen
- Memory
- Receptacle
- See model and software info (left)

Memory
- N10 = Standard 256 MB
- N12 = Additionnal 256 MB (Total of 512 MB)

Receptacle
- 00 = Two-slot receptacle (GP-402)
- AV = Four-slot module receptacle (GP-404)
- H = Seven-slot module receptacle (GP-407)
- BP = Bus protector (GP-2000)

Example: TK-400-D4-N10-BP-FTB-8000-13-15-03

	8000-13-15	8000-13-215	8000-SW-15	8000-15-LH	8000-SW-LH	8010-13-13	8010-13-15	8010-13-LR	8010-SW-SW	8020-13-15	8020-15-15	8020-SW-15	8020-15-LH	8020-SW-LH
	DS0/E0 to OC-192/STM-64	DS0/E0 to OC-192/STM-64	DS0/E0 to OC-192/STM-64	DS0/E0 to OC-192/STM-64	DS0/E0 to OC-192/STM-64	DS0/E0 to OC-48/STM-16	DS0/E0 to OC-48/STM-16	DS0/E0 to OC-48/STM-16	DS0/E0 to OC-48/STM-16	OC-48/STM-16 to OC-192/STM-64	OC-48/STM-16 to OC-192/STM-64	OC-48/STM-16 to OC-192/STM-64	OC-48/STM-16 to OC-192/STM-64	OC-48/STM-16 to OC-192/STM-64
OC-3/STM-1														
Rx (nm)	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550					
Tx (nm)	1310	1310	1310/1550	1310	1310/1550	1310	1310	1310	1310/1550					
Tx reach (km)	15	15	40/80	15	40/80	15	15	15	40/80					
OC-12/STM-4														
Rx (nm)	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550					
Tx (nm)	1310	1310	1310/1550	1310	1310/1550	1310	1310	1310	1310/1550					
Tx reach (km)	15	15	40/80	15	40/80	15	15	15	40/80					
OC-48/STM-16														
Rx (nm)	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550
Tx (nm)	1310	1310	1310/1550	1310	1310/1550	1310	1310	1310	1310/1550	1310	1550	1310/1550	1550	1310/1550
Tx reach (km)	15	80	40/80	80	40/80	15	80	40	40/80	15	80	40/80	80	40/80
OC-192/STM-64														
Rx (nm)	1310/1550	1310/1550	1310/1550	1310/1550	1310/1550					1310/1550	1310/1550	1310/1550	1310/1550	1310/1550
Tx (nm)	1550	1550	1550	1550	1550					1550	1550	1550	1550	1550
Tx reach (km)	40	40	40	80	80					40	40	40	80	80

Complementary Product

FTB-8080 Sync Analyzer

The FTB-8080 Synch Analyzer is a comprehensive test solution for telecom network synchronization assurance, monitoring and troubleshooting applications. It offers a full range of wander and sync testing functionalities, including graphical display of TIE, MTIE and TDEV parameters, as well as comparison to ITU/ANSI/TS standards and user-definable masks. The companion Sync View software suite allows remote data retrieval and test case setup, eliminating the need to visit test sites during prolonged monitoring periods. The FTB-8080 can be used in conjunction with an FTB-80x0 module to provide wander measurements up to OC-192/STM-64 rates.

For more information on the FTB-8080, please refer to its detailed product specification sheet at http://documents.exfo.com/specsheets/FTB-8080-ang.pdf

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- Variable Attenuators

DWDM Test Systems
- OSAs
- PMS analyzers
- Chromatic dispersion analyser

Transport/Datacom
- SONET/DSn (DS0 to OC-192) testers
- SDH/PDH (64 kb/s to STM-64c) testers
- T1/T3 testers
- E1 testers
- 10/100 and Gigabit Ethernet testers
- Fibre Channel testers
- 10 Gigabit Ethernet testers

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