IQS-8120/8130 Transport Blazer

NEXT-GENERATION SONET/SDH TEST MODULES

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

SPEC SHEET

Combines advanced SONET, SDH, DSn, PDH and OTN (optical transport) test functions in a single unit.

KEY FEATURES

- DS0/E0 to OC-192/STM-64/OTU2 testing in a single module
- Supports SONET, SDH, DSn, PDH, next-generation SONET/SDH and OTN testing
- Ethernet-over-SONET/SDH (EoS) testing via GFP, VCAT and LCAS software options
- OTN forward error correction (FEC) and optical channel data unit (ODU) multiplex testing capabilities as per ITU-T G.709
- 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
- SmartMode signal structure discovery for rates of up to 10 Gbit/s, with real-time simultaneous monitoring of all discovered STS/AU and user-selected VT/TU channels
- Intuitive, feature-rich user interface with automated test scripting and multi-user remote management capabilities

PLATFORM COMPATIBILITY

Platform
IQS-600

THE NEXT STEP IN SONET/SDH TESTING

The increased demand for data and video services continues to drive the need for more cost-effective networks. Technologies such as next-generation SONET/SDH/OTN are becoming more important to service providers as they offer an economical means of introducing new revenue-generating, Ethernet-based transport services on existing SONET/SDH infrastructures. In addition, implementation of OTN (ITU-T G.709) will also help reduce the cost of operating DWDM networks by achieving higher transmission quality with longer optical links through the use of forward error correction (FEC).

This opportunity creates the need for test solutions that can help ensure proper deployment, operation and maintenance of standard SONET/SDH, OTN and new Ethernet-based transport networks.

EXFO's IQS-8120 (2.5/2.7 Gbit/s) and IQS-8130 (10/11.3 Gbit/s) Transport Blazer test modules provide advanced DSn/PDH, SONET/SDH, next-generation SONET/SDH and OTN test functions in a single unit, eliminating the need for multiple, purpose-built test and measurement platforms when testing new data-aware SONET/SDH/OTN devices in lab or manufacturing environnements.

SONET/SDH Testing and Troubleshooting

The IQS-8120/8130 Transport Blazer modules offer a wide range of SONET/SDH test functions, allowing users to perform tests 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 64 kbit/s to 10 Gbit/s
- High-order mappings: STS-1/3c/12c/48c/192c and AU-3/AU-4/AU-4-4c/16c/64c
- Low-order mappings: VT1.5/2/6, TU-11/12/2/3
- Unframed optical signal testing at 10 Gbit/s rate
- Section/RS, Line/MS, high-order and low-order path overhead manipulation and monitoring
- Section/RS, Line/MS, high-order and low-order path alarm/error generation and monitoring
- High-order and low-order pointer generation and monitoring
- K1/K2 OH byte capture
- Tandem connection monitoring
- Performance monitoring: G.821, G.826, G.828, G.829, M.2100, M.2101
- Frequency analysis and power measurement
- Frequency offset generation
- Payload block and replace
- Automatic protection switching and service disruption time measurements
- Multichannel SDT measurements and real-time error/alarm monitoring for all STS-1/AU-4 channels
- Round-trip delay measurements
- DS1/DS3 auto detection of line code, framing and test pattern
- Dual DS1/DS3 receiver testing
- Independent transmitter and receiver testing
- Through mode analysis
- Intrusive through mode
- Programmable error/alarm injection
- DS1 FDL
- DS1 loopcodes and NI/CSU loopback emulation
- Fractional T1/E1 testing
- DS3 FEAC

Optical Transport Network (OTN) Testing

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.

With the demand for OTN-enabled devices rapidly increasing, so does the need for an integrated OTN test equipment. The IQS-8120/8130 Transport Blazer modules offer OTN test capabilities for verifying ITU-T G.709 standards compliance. The tests include:

- OTU1 (2.7 Gbit/s) and OTU2 (10.7 Gbit/s) bit rates
- ODU0 (1.25 Gbit/s) container with Gigabit Ethernet and SONET/SDH client signals mapping
- ODUflex with Ethernet client signal mapping
- Over-clocked OTU2 rates: OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s) and OTU2f (11.3176 Gbit/s)
- Unframed optical signal testing at 10.7 Gbit/s, 11.0491 Gbit/s, 11.0957 Gbit/s, 11.2701 Gbit/s and 11.3176 Gbit/s rates
- Synchronous mapping of SONET/SDH signals within OTN as well as synchronous and asynchronous demapping
- Forward error correction (FEC) testing
- Service disruption time (SDT) measurements
- Multichannel SDT measurements and real-time error/alarm monitoring for all ODU0 channels
- Round-trip delay (RDT) 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
- Mux/demux of ODU1/ODU2 testing—generation of four ODU1 into a single ODU2 structure and transporting it over a single wavelength
- ODU multiplexing alarm-generation and analysis
- Through mode analysis
- Intrusive Through mode
- EoOTN testing using internally generated 10 GigE LAN and mapping onto OTU1e and OTU2e rates
- 10 GigE LAN mapping into OTU2 using GFP-F

Multichannel VCAT Testing

The IQS-8120NG/8130NG Transport Blazer's virtual concatenation functionality supports real-time multichannel testing, allowing for each low-order (e.g., VT1.5, VT2, VC-11, VC-12) or high-order (e.g., STS-1/3, VC-3/4) path of a configured virtual concatenation group (VCG) to be controlled and monitored independently. This provides full visibility of all path errors and alarms per VCG member, critical for VCAT circuit troubleshooting. In addition, this multichannel visibility provides a means of generating simultaneous alarms and errors per member, ideal for lab verification applications, network simulation testing or device qualification.

SCALABLE, HIGH-PERFORMANCE TESTING

Next-Gen SONET/SDH Testing

The available suite of next-generation SONET/SDH test functionalities include generic framing procedure (GFP), virtual concatenation (VCAT) and link capacity adjustment scheme (LCAS). These options are available on the IQS-8120NG/8130NG modules when housed in the IQS-600 Integrated Qualification System.

GFP	VCAT	LCAS
› Generation and analysis of frame types (client management/client data)	› High-order and low-order VCAT support	› Emulation and analysis of LCAS protocol (Automatic and Manual modes)
› Alarm/error generation and monitoring	› Simultaneous manipulation and monitoring of each member	› Source and sink state machines control and monitoring
› Overhead manipulation and monitoring	› Alarm/error generation and monitoring	› Real-time generation and monitoring of LCAS control fields
› Transmission and reception statistics monitoring	› Sequence-indicator manipulation and processing	› Real-time insertion and monitoring of LCAS alarms/errors
› Supported over contiguous or VCAT containers	› Group-summary monitoring	
	› Differential delay analysis and insertion	

Ethernet Add/Drop Interface

In addition to its internal PRBS generator, each IQS-8120NG and IQS-8130NG Transport Blazer module includes one 10/100/1000M Ethernet (RJ-45) and one Gigabit Ethernet (SFP) interface. These interfaces can be used to interconnect with an IQS-8510B Packet Blazer Ethernet Test Module or an external Ethernet device (e.g., switch, router, etc.), delivering the industry's first data-integrated next-generation SONET/SDH test solution for advanced Ethernet-over-SONET/SDH service emulation and analysis–ideal for verification lab test applications.

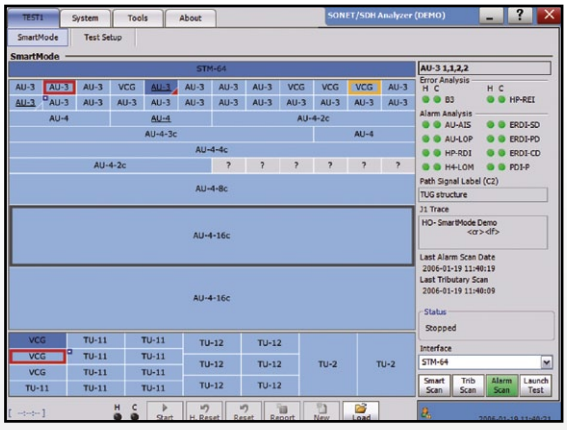
Multiservice QoS Testing for Next-Generation MSPPs

The latest generation of multiservice provisioning platforms (MSPPs) are the heart of today's next-generation SONET/SDH networks. EXFO's IQS-8120NG/8130NG Transport Blazer test modules, in conjunction with the IQS-8510B Packet Blazer Ethernet test module, allow for the generation and analysis of multiple Ethernet test streams over a GFP-enabled SONET/SDH link. Each stream's quality-of-service setting is user-configurable (via IP TOS, Diffserv, Ethernet 802.1 priority bits), providing a means of prequalifying delivery of multiple services over their multiservice provisioning platforms (MSPPs) and corresponding next-generation SONET/SDH networks.

SmartMode: Real-Time Signal Structure Discovery and Monitoring

EXFO's IQS-8120/8130 Transport Blazer modules support a unique feature called SmartMode. This provides users with full visibility of all high-order (STS/AU) and low-order (VT/TU) mixed mappings within the incoming SONET/SDH test signal.

SmartMode automatically discovers the signal structure of the OC-n/STM-n line including mixed mappings and virtual concatenation (VCAT) members. In addition to this in-depth multichannel visibility, SmartMode performs real-time monitoring of all discovered high-order paths and user-selected low-order paths simultaneously, providing users with the industry's most powerful SONET/SDH multichannel monitoring and troubleshooting solution. Real-time monitoring allows users to rapidly troubleshoot software problems, saving valuable time and minimizing debugging time. SmartMode also provides one-touch test case start, allowing users to quickly configure a desired test path and SmartMode specific reporting.



IQS-8120/8130 SmartMode: multichannel signal discovery with real-time alarm scan.

UNSURPASSED CONFIGURATION AND OPERATIONAL FLEXIBILITY

Next-Generation SONET/SDH Testing

EXFO's Transport Blazer series offers four hardware configurations:

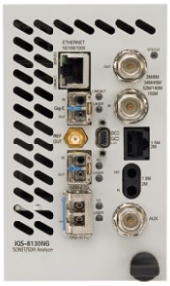
› IQS-8120 supports SONET/SDH and OTN test functions to 2.7 Gbit/s

› IQS-8130 supports SONET/SDH and OTN test functions to 11.3 Gbit/s

› IQS-8120NG supports next-generation SONET/SDH and OTN test functions to 2.7 Gbit/s

› IQS-8130NG supports next-generation SONET/SDH and OTN test functions to 11.3 Gbit/s

IQS-8130 SONET/SDH/OTN



IQS-8130NG with next-generation SONET/SDH/OTN hardware including optical and electrical Ethernet add/drop interfaces

Product Option Flexibility

The Transport Blazer series is highly configurable and it affords customers the flexibility to customize their testing needs. Base SONET/SDH/OTN-only configurations can be easily upgraded to next-generation test functions as new needs arise. This eliminates the need to perform complete hardware and/or platform retrofits, therefore significantly decreasing capital and training expenses.

With the IQS-8120NG and IQS-8130NG Transport Blazer modules, have the choice of purchasing one or more next-generation options (e.g., GFP, VCAT, LCAS) to create a custom configuration to suit their testing needs. At any point, additional next-generation options are available via simple on-site upgrades.

Remote Management

The IQS-8120/8130 Transport Blazer modules, through their optional Visual Guardian Lite™ management software, allow users to perform remote testing and data analysis, as well as remote monitoring via standard Ethernet or remote dial-up connections.

Automated Test Scripting

The IQS-8120/8130 Transport Blazer modules support two methods for automated test scripting. First, by using industry-based SCPI commands, and second, by using a built-in macro recorder that facilitates the recording of test actions and allows to automatically create test scripts. These test scripts can be used as the basis for larger automation routines that can be created in any .NET environment.

Test Logger and Reporting

EXFO's IQS-8120/8130 Transport Blazer modules support a detailed test logger and test reporting tools, enabling users to view any errors/alarms that occurred during the test interval, which can then be used for post-processing results or SLA conformance validation.

IQS-600 Integrated Qualification System

The IQS-8120NG/8130NG Transport Blazer modules are housed in the IQS-600 Integrated Qualification System, a scalable modular rack-mount platform that houses a controller, expansion units and a comprehensive range of plug-in test modules ideal for manufacturing, lab and R&D environments. The IQS-600 platform offers up to ten slots that can support any combination of modules from EXFO's full range of industry-proven protocol and optical test modules. Systems can be expanded to support up to 100 test modules. The IQS-600 family is comprised of the IQS-610P, a ten-slot control unit that can support up to nine IQS-610E 10-slot expansion units, and the IQS-605P, a five-slot control unit with an integrated touchscreen.

Combined with the built-in IQS Manager software, the IQS-600 platform provides an easy-to-use environment to manage your modules, configure your system, launch applications and analyze results. What's more, it can be controlled using local applications or through GPIB, RS-232 or Ethernet interfaces.

EXFO's IQS-8120/8130 Transport Blazer Test Modules are housed in the IQS-600 Integrated Qualification System, EXFO's powerful lab/manufacturing test platform.

ELECTRICAL INTERFACES

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

ELECTRICAL INTERFACES

	DS1	E1/2M		E2/8M	E3/34M	DS3/45M		STS-1e/ STM-0e/52M	E4/140M	STS-3e/ STM-1e/155M	
Tx pulse amplitude	2.4 to 3.6 V	3.0 V	2.37 V	2.37 V	1.0 ± 0.1 V	0.36 to 0.85 V			1.0 ± 0.1 Vpp	0.5 V	
Tx pulse mask	GR-499 Figure 9.5	G.703 Figure 15	G.703 Figure 15	G.703 Figure 16	G.703 Figure 17	**DS-3** GR-499 Figure 9-8	**45-M** G.703 Figure 14	G.253 Figure 4-10/4-11	GR-703 Figure 18/19	**STM-3e** GR-253 Figure 4-12/ 4-13/4-14	**STM-1e/155M** G.703 Figure 22-23
Tx LBO preamplification	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)					0 to 225 ft 255 to 450 ft		0 to 225 ft 255 to 450 ft		0 to 225 ft	
Cable simulation	Power dBdsx –22.5 dBdsx –15.0 dBdsx –7.5 dBdsx 0 dBdsx					450 to 900 (927) ft		450 to 900 (927) ft			
Rx level sensitivity (dynamic range)	For 772 kHz: TERM: ≤26 dB (cable loss only) at 0 dBdsx Tx DSX-MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only) Note: measurement units = dBdsx (Vref = 6 Vpp)	For 1024 kHz: TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only) Note: measurement units = dBm	For 1024 kHz: TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Bridge: ≤6 dB (cable loss only) Note: measurement units = dBm	For 4224 kHz: TERM: ≤6 dB (cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 17.184 MHz: TERM: ≤12 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 22.368 MHz: TERM: ≤10 dB (cable loss only) DSX-MON: ≤26.5 dB (21.5 dB resistive loss + cable loss ≤ 5 dB) Note: measurement units = dBm (Vref = 1.21 Vpp)		For 25.92 MHz: TERM: ≤10 dB (cable loss only) MON: ≤25 dB (20 dB resistive loss + cable loss ≤ 5 dB) Note: measurement units = dBm	For 70 MHz: TERM: ≤12 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	For 78 MHz: TERM: ≤12.7 dB (coaxial cable loss only) MON: ≤26 dB (20 dB resistive loss + cable loss ≤ 6 dB) Note: measurement units = dBm	
Transmit bit rate	1.544 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	2.048 Mbit/s ± 4.6 ppm	8.448 Mbit/s ± 4.6 ppm	34.368 Mbit/s ± 4.6 ppm	44.736 Mbit/s ± 4.6 ppm		51.84 Mbit/s ± 4.6 ppm	139.264 Mbit/s ±4.6 ppm	155.52 Mbit/s ± 4.6 ppm	
Receive bit rate	1.544 Mbit/s ± 140 ppm	2.048 Mbit/s ± 100 ppm	2.048 Mbit/s ± 100 ppm	8.448 Mbit/s ± 100 ppm	34.368 Mbit/s ± 100 ppm	44.736 Mbit/s ± 100 ppm		51.84 Mbit/s ± 100 ppm	139.264 Mbit/s ± 100 ppm	155.52 Mbit/s ± 100 ppm	
Measurement accuracy (uncertainty) Frequency Electrical power	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm DSX range: ±1.0 dB DSX-MON range: ±2.0 dB		±4.6 ppm DSX range: ±1.0 dB DSX-MON range: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	±4.6 ppm Normal: ±1.0 dB Monitor: ±2.0 dB	
Peak-to-peak voltage	±10 % down to 500 mVpp	±10 % down to 500 mVpp	±10 % down to 500 mVpp	±10 % down to 400 mVpp	±10 % down to 200 mVpp	±10 % down to 200 mVpp		±10 % down to 200 mVpp	±10 % down to 200 mVpp	±10 % down to 200 mVpp	
Frequency offset generation	1.544 Mbit/s ± 140 ppm	2.048 Mbit/s ± 70 ppm	2.048 Mbit/s ± 70 ppm	8.448 Mbit/s ± 50 ppm	34.368 Mbit/s ± 50 ppm	44.736 Mbit/s ± 50 ppm		51.84 Mbit/s ± 50 ppm	139.264 Mbit/s ± 50 ppm	155.52 Mbit/s ± 50 ppm	
Intrinsic jitter (Tx)	ANSI T1.403 section 6.3 GR-499 section 7.3	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1	G.823 section 5.1 G.751 section 2.3	GR-449 section 7.3 (categories I and II)		GR-253 section 5.6.2.2 (category II)	G.823 section 5.1	G.825 section 5.1 GR-253 section 5.6.2.2	
Input jitter tolerance	AT&T PUB 62411 GR-499 section 7.3	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	G.823 section 7.1	GR-449 section 7.3 (categories I and II)		GR-253 section 5.6.2.2 (category II)	G.823 section 7.1 G.751 section 3.3	G.825 section 5.2 GR-253 section 5.6.2.3	
Line coding	AMI and B8ZS	AMI and HDB3	AMI and HDB3	HDB3	HDB3	B3ZS		B3ZS	CMI	CMI	
Input impedance (resistive termination)	100 Ω ± 5 %, balanced	120 Ω ± 5 %, balanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced	75 Ω ± 5 %, unbalanced		75 Ω ± 5 %, unbalanced	75 Ω ± 10 %, unbalanced	75 Ω ± 5 %, unbalanced	
Connector type	BANTAM and RJ-48C	BANTAM and RJ-48C	BNC	BNC	BNC	BNC		BNC	BNC	BNC	

SYNCHRONISATION INTERFACES

	External Clock DS1/1.5M	External Clock E1/2M	External Clock E1/2M	Trigger 2 MHz
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

Note

a. Adaptation cable required for BANTAM.

ELECTRICAL INTERFACES (CONT'D)

ETHERNET ADD/DROP INTERFACE

10/100/1000 Base-T (Add/Drop)	Compliance	10 Mbit/s: IEEE 802.3 section 14 100 Mbit/s: IEEE 802.3 section 25 1000 Mbit/s: IEEE 802.3 section 40
	Connector	RJ-45 Ethernet
Gigabit Ethernet (Add/Drop)	Interface/connector	SFP/Dual LC
	Compliance	1000 Mbit/s: IEEE 802.3 Section 40 [a]
	Wavelength/Max Tx level	850, 1310 nm/–3 dBm 1550 nm/+5 dBm

REF-OUT INTERFACE

Parameter	Value					
Tx pulse amplitude	600 ± 150 mVpp					
Transmission frequency	SONET/SDH	OTU2	OTU1e	OTU2e	OTU1f	OTU2f
Clock divider = 16	622.08 MHz	669.33 MHz	690.57 MHz	693.48 MHz	704.38 MHz	707.35 MHz
Clock divider = 32	311.04 MHz	334.66 MHz	345.29 MHz	346.74 MHz	352.19 MHz	353.68 MHz
Clock divider = 64	155.52 MHz	167.33 MHz	172.64 MHz	173.37 MHz	176.10 MHz	176.84 MHz
Output configuration	AC coupled					
Load impedance	50 Ω					
Maximum cable length	3 meters					
Connector Type	SMA					

SONET/SDH AND OTN OPTICAL INTERFACES

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

SONET/SDH AND OTN OPTICAL INTERFACES

	OC-3/STM-1				OC-12/STM-4				E2/8M				OC-192/STM-64/OTU2		
	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	15 km; 1310 nm	40 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm	10 km; 1310 nm	40 km; 1550 nm	80 km; 1550 nm
Tx level	–5 to 0 dBm	–2 to 3 dBm	–5 to 0 dBm	–2 to 3 dBm	–5 to 0 dBm	–2 to 3 dBm	–5 to 0 dBm	–2 to 3 dBm	–5 to 0 dBm	–2 to 3 dBm	–5 to 0 dBm	–2 to 3 dBm	–6 to –1 dBm	–1 to 2 dBm	0 to 4 dBm
Rx operating range	–23 to –10 dBm	–30 to –15 dBm	–23 to –10 dBm	–30 to –15 dBm	–22 to 0 dBm	–27 to –9 dBm	–22 to 0 dBm	–29 to –9 dBm	–18 to 0 dBm	–27 to –9 dBm	–18 to 0 dBm	–28 to –9 dBm	–11 to –1 dBm	–14 to –1 dBm	–24 to –9 dBm
Transmit bit rate	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 (OTU1)				9.95328 Gbit/s ± 4.6 ppm (OC-192/STM-64) 10.70922 Gbit/s ± 4.6 ppm (OTU2) 11.0491 Gbit/s ± 4.6 ppm (OTU1e) 11.0957 Gbit/s ± 4.6 ppm (OTU2e) 11.2701 Gbit/s ± 4.6 ppm (OTU1f) 11.3176 Gbit/s ± 4.6 ppm (OTU2f)	9.95328 Gbit/s ± 4.6 ppm 10.70922 Gbit/s ± 4.6 ppm (OTU2)	
Receive bit rate	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)				9.95328 Gbit/s ± 100 ppm (OC-192/STM-64) 10.70922 Gbit/s ± 100 ppm (OTU2) 11.0491 Gbit/s ± 120 ppm (OTU1e) 11.0957 Gbit/s ± 120 ppm (OTU2e) 11.2701 Gbit/s ± 120 ppm (OTU1f) 11.3176 Gbit/s ± 120 ppm (OTU2f)	9.95328 Gbit/s ± 100 ppm 10.70922 Gbit/s ± 100 ppm (OTU2)	
Operational wavelength range	1261 to 1360 nm	1263 to 1360 nm	1430 to 1580 nm	1480 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	1290 to 1330 nm	1530 to 1565 nm	1530 to 1565 nm
Spectral width	1 nm (–20 dB)				1 nm (–20 dB)				1 nm (–20 dB)				1 nm (–20 dB)		
Frequency offset generation	±50 ppm				±50 ppm				±50 ppm				±50 ppm [b]		
Measurement accuracy (uncertainty) Frequency Optical power	±4.6 ppm ±2 dB				±4.6 ppm ±2 dB				±4.6 ppm ±2 dB				±4.6 ppm ±2 dB		
Maximum Rx before damage [c]	3 dBm				3 dBm				3 dBm				3 dBm		
Jitter compliance	GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH)				GR-253 (SONET) G.958 (SDH) G.8251 (OTN)				GR-253 (SONET) G.825 (SDH) G.8251 (OTN)		
Line coding	NRZ				NRZ				NRZ				NRZ		
Eye safety	SFP/XFP transceivers comply with IEC 60825 and 21 CFR 1040.10 (except for deviations pursuant to Laser Notice No. 50, dated July 2001), for Class 1 or 1M lasers.														
Connector [d]	Dual LC				Dual LC				Dual LC				Dual LC		
Transceiver type [e]	SFP				SFP				SFP				SFP		

Notes

a. SFP/XFP transceivers comply with IEC 60825 and 21 CFR 1040.10 (except for deviations pursuant to Laser Notice 50, dated July, 2001), for Class 1 or 1M lasers.

b. For OTU1e, OTU2e, OTU1f and OTU2f rates, the frequency offset generation is ±115 ppm.

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

d. External adaptors can be used for other types of connectors. For example FC/PC.

e. SFP/XFP compliance: The IQS-8120/8130 selected SFP/XFP shall meet the requirements stated in the "Small Form-Factor Pluggable (SFP) Transceiver Multisource Agreement (MSA)". The IQS-8120/8130 selected SFP/XFP shall meet the requirements stated in the "Specification for Diagnostic Monitoring Interface for Optical Xcvrs".

SONET/SDH FUNCTIONAL SPECIFICATIONS

SONET AND DSN		SDH AND PDH	
Optical interfaces	OC-3, OC-12, OC-48, OC-192	**Optical interfaces**	STM-1, STM-4, STM-16, STM-64
Available wavelengths (nm)	1310, 1550	Available wavelengths (nm)	1310, 1550
Electrical interfaces	DS1, DS3, STS-1e, STS-3e	**Electrical interfaces** [a]	1.5M (DS1), 2M (E1), 8M (E2), 34M (E3), 45M (DS3), 140M (E4), STM-0e, STM-1e
DS1 framing	Unframed, SF, ESF	2M framing	Unframed, PCM30, PCM31, PCM30 CRC-4, PCM31 CRC-4
DS3 framing	Unframed, M13, C-bit parity	8M, 34M, 140M framing	Unframed, framed
Clocking	Internal, loop-timed, external (BITS), inter-module	Clocking	Internal, loop-timed, external (MTS/SETS), 2 MHz, inter-module
Mappings [b]		**Mappings** [b]	
VT1.5	Bulk, DS1, GFP [c]	TU-11-AU-3, TU-11-AU-4	Bulk, 1.5M, GFP [c]
VT2	Bulk, E1, GFP [c]	TU-12-AU-3, TU-12-AU-4	Bulk, 1.5M, 2M, GFP [c]
VT6	Bulk, GFP [c]	TU-3-AU-4	Bulk, 34M, 45M, GFP [c]
STS-1 SPE	Bulk, DS3, GFP [c]	TU-2-AU-3, TU-2-AU-4	Bulk, GFP [c]
STS-3c	Bulk, E4, GFP [c]	AU-4	Bulk, 140M, GFP [c]
STS-12c/48c/192c, SPE	Bulk, GFP [c]	AU-4-4c/16c/64c	Bulk, GFP [c]
SONET overhead analysis and manipulation	A1, A2, J0, E1, F1, D1-D12, K1, K2, S1, M0, 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, G1, F2, F3, K3, N1, N2, K4, E2, J1, C2, H4
Error insertion		**Error insertion**	
DS1	Framing bit, BPV, CRC-6, bit error	E1 (2M)	Bit error, FAS, CV, CRC-4, E-bit
DS3	BPV, C-bit, F-bit, P-bit, FEBE, bit error	E2 (8M), E3 (34M), E4 (140M)	Bit error, FAS, CV
STS-1e, STS-3e	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, BPV, FAS, bit error	STM-0e, STM-1e	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, CV, FAS, bit error
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-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, CV, FAS, bit error
Error measurement		**Error measurement**	
DS1	Framing bit, BPV, CRC-6, excess zeros, bit error	E1 (2M)	Bit error, FAS, CV, CRC-4, E-bit
DS3	BPV, C-bit, F-bit, P-bit, FEBE, bit error	E2 (8M), E3 (34M), E4 (140M)	Bit error, FAS, CV
STS-1e, STS-3e	Section BIP (B1), line BIP (B2), path BIP (B3), BIP-2, REI-L, REI-P, REI-V, BPV, FAS, bit error	STM-0e, STM-1e	RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), MS-REI, HP-REI, LP-BIP-2, LP-REI, CV, FAS, bit error
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-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		**Alarm insertion**	
DS1	LOS, RAI, AIS, OOF, pattern loss	E1 (2M)	LOS, LOS Mframe, LOS CRC Mframe, LOF, AIS, TS16 AIS, RAI, RAI Mframe, pattern loss
DS3	LOS, RDI, AIS, OOF, DS3 idle, pattern loss	E2 (8M), E3 (34M), E4 (140M)	LOS, LOF, RAI, AIS, pattern loss
STS-1e, STS-3e, OC-3, OC-12, OC-48, OC-192	LOS, LOF, 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-0e, STM-1e, STM-1, STM-4, STM-16, STM-64	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-PDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, HP-UNEQ, TU-AIS, LP-RFI, LP-RDI, ERDI-VCD, ERDI-VPD, ERDI-VSD, LP-RFI, LP-UNEQ, pattern loss
Alarm detection		**Alarm detection**	
DS1	LOS, loss of clock (LOC), RAI, AIS, OOF, pattern loss	E1 (2M)	LOS, LOS Mframe, LOS CRC Mframe, LOC, LOF, AIS, TS16 AIS, RAI, RAI Mframe, pattern loss
DS3	LOS, LOC, RDI, AIS, OOF, DS3 idle, pattern loss	E2 (8M), E3 (34M), E4 (140M)	LOS, LOC, LOF, RAI, AIS, pattern loss
STS-1e, STS-3e, OC-3, OC-12, OC-48, OC-192	LOS, LOC, LOF, SEF, TIM-S, AIS-L, RDI-L, AIS-P, LOP-P, LOM, PDI-P, RDI-P, ERDI-PCD, ERDI-PPD, ERDI-PSD, PLM/SLM-P, UNEQ-P, TIM-P, AIS-V, LOP-V, RDI-V, ERDI-VCD, ERDI-VCD, ERDI-VPD, ERDI-VSD, RFI-V, UNEQ-V, TIM-V, PLM/SLM-V, pattern loss	STM-0e, STM-1e, STM-1, STM-4, STM-16, STM-64	LOS, LOF, LOC, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, H4-LOM, HP-RDI, ERDI-PSD, ERDI-PCD, ERDI-PPD, HP-PLM/SLM, HP-UNEQ, HP-TIM, TU-AIS, LP-RFI, LP-RDI, ERDI-VPD, ERDI-VSD, LP-RFI, LP-UNEQ, LP-TIM, LP-PLM/SLM, pattern loss
Frequency alarm on all supported interfaces.			
Patterns		**Patterns**	
DS0	2E9-1, 2E11-1, 2E20-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors	E0 (64K)	2E9-1, 2E11-1, 2E20-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors
DS1	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 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, bit errors	E1 (2M)	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24, 32 bit programmable (inverted or non-inverted), bit errors
DS3	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24 [d], 32 bit programmable (inverted or non-inverted), bit errors	E2 (8M), E3 (34M), E4 (140M)	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, 1-in-8, 1-in-16, 3-in-24 d, 32 bit programmable (inverted or non-inverted), bit errors
VT1.5/2/6	2E9-1, 2E11-1, 2E15-1, 2E20-1, 2E23-1, 2E31-1, 1100, 1010, 1111, 0000, QRSS, 1-in-8, 1-in-16, 32 bit programmable (inverted or non-inverted), bit errors	TU-11/12/2/3	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.			

Notes

a. 1.5M (DS1) and 45M (DS3) interfaces described under SONET and DSn column.
b. VCAT mappings are also available. Please refer to the VCAT section of this document for details.
c. GFP supported only with purchase of GFP-F option.
d. Not supported for E4 (140M).

SONET/SDH FUNCTIONAL SPECIFICATIONS (CONT'D)

NEXT-GENERATION SONET		NEXT-GENERATION SDH	
Generic framing procedure (GFP)		**Generic framing procedure (GFP)**	
Standards compliance	As per ITU-T G.7041, and ANSI T1.105.02	Standards compliance	As per ITU-T G.7041, G.707, and ANSI T1.105.02
Payload	PRBS pattern; Ethernet	Payload	PRBS pattern; Ethernet
Ethernet add/drop	Ability to add/drop Ethernet payload to/from GFP mapped OC-n/OTU signal	Ethernet add/drop	Ability to add/drop Ethernet payload to/from GFP mapped STM-n/OTU signal
Error insertion	Correctable core HEC, uncorrectable core HEC, correctable type HEC, uncorrectable type HEC, correctable extension HEC, uncorrectable extension HEC, payload FCS	Error insertion	Correctable core HEC, uncorrectable core HEC, correctable type HEC, uncorrectable type HEC, correctable extension HEC, uncorrectable extension HEC, payload FCS
Error monitoring	Correctable core HEC, uncorrectable core HEC, correctable type HEC, uncorrectable type HEC, correctable extension HEC, uncorrectable extension HEC, payload FCS	Error monitoring	Correctable core HEC, uncorrectable core HEC, correctable type HEC, uncorrectable type HEC, correctable extension HEC, uncorrectable extension HEC, payload FCS
Alarm insertion	Loss of client signal (LOCS) and loss of client character synchronization (LOCCS) with configurable time interval between 10 and 1200 ms, and loss of frame delineation (LFD)	Alarm insertion	Loss of client signal (LOCS) and loss of client character synchronization (LOCCS) with configurable time interval between 10 and 1200 ms, and loss of frame delineation (LFD), client forward defect indication (FDI), client reverse defect indication (RDI) and client defect clear indication (DCI)
Alarm monitoring	Loss of client signal (LOCS), loss of client character synchronization (LOCCS) and loss of frame delineation (LFD)	Alarm monitoring	Loss of client signal (LOCS), loss of client character synchronization (LOCCS) and loss of frame delineation (LFD), client forward defect indication (FDI), client reverse defect indication (RDI) and client defect clear indication (DCI)
Statistics	Transmit: client data frames (including payload bytes), client management frames, total frames, idle frames, GFP bandwidth usage (%), GFP mapping efficiency (%) Receive: client data frames (including payload bytes), client management frames, total frames, idle (control) frames, reserved (control) frames, invalid frames, discarded frames, EXI mismatches, UPI mismatches, CID mismatches, GFP bandwidth usage (%), GFP mapping efficiency (%)	Statistics	Transmit: client data frames (including payload bytes), client management frames, total frames, idle frames, GFP bandwidth usage (%), GFP mapping efficiency (%) Receive: client data frames (including payload bytes), client management frames, total frames, idle (control) frames, reserved (control) frames, invalid frames, discarded frames, EXI mismatches, UPI mismatches, CID mismatches, GFP bandwidth usage (%), GFP mapping efficiency (%)
Header manipulation	PTI, PFI, EXI, UPI, CID and spare (extension header) fields	Header manipulation	PTI, PFI, EXI, UPI, CID and spare (extension header) fields
Header monitoring	PLI, PTI, PFI, EXI, UPI, CID, spare (extension header) fields, cHEC, tHEC, eHEC	Header monitoring	PLI, PTI, PFI, EXI, UPI, CID, spare (extension header) fields, cHEC, tHEC, eHEC
Virtual concatenation (VCAT)		**Virtual concatenation (VCAT)**	
Standards compliance	Supports high-order and low-order virtual concatenation as per ANSI T1.105	Standards compliance	Supports high-order and low-order virtual concatenation as per ITU G.707
Mappings	High-order STS-1-Xv (X = 1 to 21) STS-3-Xv (X = 1 to 7) Low-order VT1.5-Xv (X = 1 to 64) VT-2-Xv (X = 1 to 64)	Mappings	High-order VC-3-Xv (X = 1 to 21) VC-4-Xv (X = 1 to 7) Low-order VC-11-Xv (X = 1 to 64) VC-12-Xv (X = 1 to 64) VC-3-Xv in AU-4 (X = 1 to 21)
Alarm insertion	LOM, OOM1, OOM2, SQM VCAT and Path alarms can be generated independently on any member of a VCG	Alarm insertion	LOM, OOM1, OOM2, SQM VCAT and Path alarms can be generated independently on any member of a VCG
Alarm monitoring	LOM, OOM1, OOM2, SQM, LOA	Alarm monitoring	LOM, OOM1, OOM2, SQM, LOA
Differential delay	Analysis Range: 0 to 256 ms Display: numerical and graphical Insertion Range: 0 to 256 ms	Differential delay	Analysis Range: 0 to 256 ms Display: numerical and graphical Insertion Range: 0 to 256 ms
Sequence number manipulation and processing	Sequence range: 0 to 63 Sequence number monitoring: current AcSQ (accepted SQ) monitored against the ExSQ (expected SQ); SQM alarm raised on mismatch	Sequence number manipulation and processing	Sequence range: 0 to 63 Sequence number monitoring: current AcSQ (accepted SQ) monitored against the ExSQ (expected SQ); SQM alarm raised on mismatch

SONET/SDH FUNCTIONAL SPECIFICATIONS (CONT'D)

NEXT-GENERATION SONET/SDH (CONT'D)

Link capacity adjustment scheme (LCAS)

Standards compliance	As per ITU G.7042; supported for both low-order and high-order VCAT groups
Test functions	› Emulation of source and sink state machines › Automatic and manual control of source and sink state machines › Independent overwrite capability at the source and sink for each member › Automatic SQ management
Source state machine control	› Add/remove member(s) › Configure: RS-ACK timeout, remote DUT, PLCT threshold › Statistics count: received RS-ACK, unexpected RS-ACK › Error/alarm generation: CRC errors, group ID (GID) mismatch › Error/alarm monitoring: loss of partial transport capacity, loss of total transport capacity, failure of protocol transmission, CRC errors, unexpected member status
Sink state machine control	› Add/remove member(s) › Configure Hold-Off and Wait-to-Restore timers, PLCR threshold › Toggle RS-ACK › Statistics count: transmitted RS-ACK › Error/alarm generation: CRC errors, group ID (GID) mismatch › Error/alarm monitoring: loss of partial transport capacity, loss of total transport capacity, failure of protocol reception, CRC errors, unexpected member status

ADDITIONAL TEST AND MEASUREMENT FUNCTIONS

Power measurements	Supports power measurements, displayed in dBm (dBdsx for DS1), 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.
Frequency offset generation	Supports offsetting the clock of the transmitted signal on a selected interface to exercise clock recovery circuitry on network elements.
Dual DSn receivers	Supports two DS1 or DS3 receivers, allowing users to simultaneously monitor two directions of a circuit under test in parallel, resulting in quick isolation of the source of errors.
Performance monitoring	The following ITU-T recommendations, and corresponding performance monitoring parameters, are supported on the IQS-8120/8130. **ITU-T recommendation** — **Performance monitoring statistics** G.821 — ES, EFS, EC, SES, UAS, ESR, SESR, DM G.826 — ES, EFS, EB, SES, BBE, UAS, ERS, 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 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
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 IQS-8120/8130 transmitter back to its receiver after crossing a far-end loopback. Measurements are supported on all supported IQS-8120/8130 interfaces and mappings. Measurements: last RTD time, minimum, maximum, average, measurement count (no. 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, V5 byte of SONET overhead).
Through mode	Ability to perform Through mode analysis of any incoming electrical (DSn, PDH) and optical line (OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OC-192/STM-64, OTU1, OTU2, OTU1e and OTU2e) either transparently or intrusively.
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.)
DS1 FDL	Support for DS1 Facility Data Link testing.
DS1 loopcodes	Support for generation of DS1 in-band loopcodes with the availability of up to 10 pairs of user-defined loopcodes.
NI/CSU loopback emulation	Ability to respond to DS1 in-band/out-of-band loopcodes.
DS3 FEAC	Support for DS3 for-end alarms and loopback codewords.
DS1/DS3 auto detection	Ability to automatically detect DS1/DS3 line coding, framing and test pattern.
Tandem connection monitoring (TCM) [a]	Tandem connection monitoring (TCM), Option 2 [b], is used to monitor the performance of a subsection of a SONET/SDH path routed via different network providers. The IQS-8120/8130 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, OEI — Error analysis: TC-IEC, TC-REI, OEI, TC-VIOL Alarm generation: TC-RDI, TC-UNEQ, ODI, TC-LTC, TC-IAIS — Alarm analysis: TC-TIM, TC-RDI, TC-UNEQ, ODI, TC-LTC, TC-IAIS
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.

Notes

a. HOP and LOP supported.

b. G.707 option 2.

SONET/SDH FUNCTIONAL SPECIFICATIONS (CONT'D)

ADDITIONAL FEATURES

Scripting	Wide range of SCPI commands powerful enough to provide repeatable testing of complex configuration, yet simple enough to create a 10 gigabit BERT in as little as seven commands. The IQS-8120/8130 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 control	Available with Windows-based remote management software known as Visual Guardian Lite (optional software package). This allows users to remotely monitor and control the IQS-8120/8130 modules via standard Ethernet connection.

OTN FUNCTIONAL SPECIFICATIONS

OTN FUNCTIONAL SPECIFICATIONS

OTN	Standards compliance	ITU-T G.709, ITU G.798, ITU G.872
	Interfaces	OTU1 (2.7 Gbit/s), OTU2 (10.7 Gbit/s), OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s), OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s)
	Client types [a]	All supported SONET/SDH mappings (including next-generation GFP, VCAT, LCAS), NULL, PRBS (2E31-1), ODU1 into OTU2 multiplexing.
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 [b]	As defined in ITU-T G.709
ODU0	Muxing	ODU0 into ODU1, ODU0 into ODU2
	Client types	Pattern, OC-3/STM-1, OC-12/STM-4, GigE using GFP-T
	GFP-T errors	SB Correctable, SB Uncorrectable, 10B_ERR
ODU Multiplexing [c]	Alarms	OPU-MSIM, ODU-LOFLOM
ODUflex	Muxing	ODUflex into ODU2
	Client types	Ethernet using GFP-F or pattern for constant bit rate (CBR)
OPU Layer	Alarm	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)
Ethernet over OTN (EoOTN) [c]	Mapping	Direct mapping into OTU1e or OTU2e; or using GFP-F into OTU2; or using GFP-T into ODU0; or using GFP-F into ODUflex
	BERT	Framed layer 2 supported with or without VLAN
	Pattern	PRBS 2E9-1, PRBS 2E11-1, PRBS 2E15-1, PRBS 2E20-1, PRBS 2E23-1, PRBS 2E31-1 and up to 10 user patterns. Capability to invert patterns
	Error insertion	FCS, 64B/66B block (10 GigE), symbol (GigE), bit
	Error measurement	Jabber/giant, runt, undersize, oversize, FCS, 64B/66B block (10 GigE), symbol (GigE), idle (GigE), false carrier (GigE)
	Error measurement (BERT)	Bit error, bit mismatch 0, bit mismatch 1
	Alarm insertion	Link down, local fault, remote fault, pattern loss
	Alarm detection	Link down, local fault, remote fault, pattern loss
	VLAN	Capability to generate one stream with one layer of VLAN
	Ethernet statistics	Multicast, broadcast, unicast, N-unicast, frame size distribution, bandwidth, utilization, frame rate

ADDITIONAL FUNCTION

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 IQS-8120/8130 transmitter back to its receiver after crossing a far-end loopback. Measurements are supported on all supported IQS-8120/8130 interfaces and mappings. Measurements: last RTD time, minimum, maximum, average, measurement count (no. 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.

Notes

a. Available with ODUMUX option.
b. Fault type and fault location.
c. Available on the IQS-8130 anf IQS-8130NG only.
d. Available on the IQS-8130NG only.

ADDITIONAL SPECIFICATIONS

IQS-8120	IQS-8120NG	IQS-8130	IQS-8130NG
SONET/SDH 2.5 Gbit/s and OTN 2.7 Gbit/s	Next-generation SONET/SDH 2.5 Gbit/s and OTN 2.7 Gbit/s	SONET/SDH 10 Gbit/s and OTN 10.7 Gbit/s	Next-generation SONET/SDH 10 Gbit/s and OTN 10.7 Gbit/s
Analyzer module supporting up to 2.5/2.7 Gbit/s optical rates, as well as electrical DSn/PDH interfaces	Analyzer module supporting up to 2.5/2.7 Gbit/s optical rates, as well as electrical DSn/PDH interfaces	Analyzer module supporting up to 10/10.7 Gbit/s optical rates, as well as electrical DSn/PDH interfaces	Analyzer module supporting up to 10/10.7 Gbit/s optical rates, as well as electrical DSn/PDH interfaces
Test Interfaces			
OTN: OTU1 (2.7 Gbit/s)	OTN: OTU1 (2.7 Gbit/s)	OTN: OTU1 (2.7 Gbit/s), OTU2 (10.7 Gbit/s) OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s) OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s)	OTN: OTU1 (2.7 Gbit/s), OTU2 (10.7 Gbit/s) OTU1e (11.0491 Gbit/s), OTU2e (11.0957 Gbit/s) OTU1f (11.2701 Gbit/s), OTU2f (11.3176 Gbit/s)
SONET: STS-1e, STS-3e, OC-3, OC-12, OC-48	SONET: STS-1e, STS-3e, OC-3, OC-12, OC-48	SONET: STS-1e, STS-3e, OC-3, OC-12, OC-48, OC-192	SONET: STS-1e, STS-3e, OC-3, OC-12, OC-48, OC-192
SDH: STM-0e, STM-1e, STM-0, STM-4, STM-16	SDH: STM-0e, STM-1e, STM-0, STM-4, STM-16	SDH: STM-0e, STM-1e, STM-0, STM-4, STM-16, STM-64	SDH: STM-0e, STM-1e, STM-0, STM-4, STM-16, STM-64
DSn: DS1, DS3, Dual DS1 Rx, Dual DS3 Rx	DSn: DS1, DS3, Dual DS1 Rx, Dual DS3 Rx	DSn: DS1, DS3, Dual DS1 Rx, Dual DS3 Rx	DSn: DS1, DS3, Dual DS1 Rx, Dual DS3 Rx
PDH: E1, E2, E3, E4	PDH: E1, E2, E3, E4 Ethernet: 10/100/1000M and GigE (for EoS testing)	PDH: E1, E2, E3, E4	PDH: E1, E2, E3, E4 Ethernet: 10/100/1000M and GigE (for EoS testing)

GENERAL SPECIFICATIONS

	IQS-8120 and IQS-8120NG	IQS-8130 and IQS-8130NG
Weight (without transceiver)	1.4 kg (3.1 lb)	1.4 kg (3.1 lb)
Size (H x W x D)	125 mm x 74 mm x 282 mm (4 15/16 in x 2 15/16 in x 11 1/8 in)	125 mm x 74 mm x 282 mm (4 15/16 in x 2 15/16 in x 11 1/8 in)
Temperature		
operating	0 °C to 40 °C (32 °F to 104 °F)	0 °C to 40 °C (32 °F to 104 °F)
storage	–40 °C to 60 °C (–40 °F to 140 °F)	–40 °C to 60 °C (–40 °F to 140 °F)

ORDERING INFORMATION

IQS-81XX-XX-XX-XX-XX-XX-XX-XX

Model
See models listed in previous page

Test options
SONET = SONET-BASE-SW
SDH = SDH-BASE-SW
SONET-SDH = Software option for combined SONET/SDH functionality

Rate options [a]
155 = 155 Mbit/s (OC-3/STM-1)
622 = 622 Mbit/s (OC-12/STM-4)
2.5G = 2.5 Gbit/s (OC-48/STM-16)
10G = 10 Gbit/s (OC-192/STM-64) [b]

All rate enablers are included as standard for IQS-8130 and IQS-8130NG modules.

Transceivers SFP telecom [a]
IQS-8190 = Multirate (155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC) optical SFP transceiver module with LC connector; 1310 nm; 15 km reach
IQS-8191 = Multirate (155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC) optical SFP transceiver module with LC connector; 1310 nm; 40 km reach
IQS-8192 = Multirate (155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC) optical SFP transceiver module with LC connector; 1550 nm; 80 km reach
IQS-8193 = Multirate (155/622 Mbit/s, 2.5/2.7 Gbit/s, GigE/FC/2FC) optical SFP transceiver module with LC connector; 1550 nm; 40 km reach

10 Gbit/s transceivers XFP telecom [a, b]
IQS-81900 = Multirate (10-11.3 Gbit/s) optical XFP transceiver module with LC connector; 1310 nm; 10 km reach
IQS-81901= Multirate (10/10.7 Gbit/s) optical XFP transceiver module with LC connector; 1550 nm; 40 km reach
IQS-81902 = Multirate (10/10.7 Gbit/s) optical XFP transceiver module with LC connector; 1550 nm; 80 km reach

Next-generation options [a, e]
00 = Without next-generation software
HO-VCAT = High-order virtual concatenation
LO-VCAT = Low-order virtual concatenation
LCAS = Link capacity adjustement scheme [f]
GFP-F = Generic framing procedure–framed
EoS = Ethernet-over-SONET/SDH [d, g]

Options [a]
G.747 [h]
DS1-FDL
DS3-FEAC
DUAL-RX
SMART_MODE
TCM = Tandem connection monitoring
OTU1 = OTN optical rate 2.7 Gbit/s
OTU2 = OTN optical rate 10.7 Gbit/s [b]
ODUMUX = ODU MUX functionality [b, i]
ODU0 = ODU0 mapping [i]
ODUflex = ODUflex functionality [k]
INTR-THRU-MODE = SONET/SDH intrusive Through mode
OTN-INTR-THRU = OTN intrusive Through mode [j]
OTU2-1e-2e = OTN optical rates 11.0491 Gbit/s and 11.0957 Gbit/s [b]
OTU2-1f-2f = OTN optical rates 11.2701 Gbit/s and 11.3176 Gbit/s [b]
OTU2-GFP-F = 10 GigE LAN over GFP-F into OTU2 [b]
EoOTN = Ethernet-over-OTN functionality [l]
MULTI-CH-SDT = Multichannel SDT measurements

Optical Ethernet transceivers SFP datacom [a, c, d]
IQS-8590 = GigE/FC/2FC optical SFP transceiver module with LC connector; 850 nm; MMF, < 500 m reach
IQS-8591 = GigE/FC/2FC optical SFP transceiver module with LC connector; 1310 nm; 10 km reach
IQS-8592 = GigE/FC/2FC optical SFP transceiver module with LC connector; 1550 nm; 90 km reach

Example: IQS-8130NG-SONET-SDH-10G-IQS-8192-IQS-8592-OTU1-HO-VCAT

Notes

a. Multiple options can be purchased to suit the required test application.
b. Applies only to IQS-8130 and IQS-8130NG models.
c. Enables Ethernet add/drop interface. This option is only applicable for IQS-8120NG and IQS-8130NG modules.
d. Ethernet SFP transceiver must be purchased with the EoS software option.
e. These options are available for IQS-8120NG and IQS-8130NG modules.
f. Must be combined with the HO-VCAT or LO-VCAT option.
g. Must be combined with the GFP-F option.
h. Enables E1/2M in DS3/45M analysis, as per ITU-T G.747 recommendation.
i. Must be combined with the OTU1 and OTU2 options.
j. Must be combined with the OTU1 or OTU2 option.
k. Applicable for IQS-8130NG modules only and must be combined with the OTU2 option.
l. Applicable for IQS-8120NG and IQS-8130NG modules only and must be combined with the OTU2-1e-2e or OTU2-GFP-F option.

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