

10G (OC-192/STM-64) Module Technical Specifications

OC-192/STM-64

Requirements	Meets the requirements of GR-253 (OC-192) and ITU-T G.707 (STM-64)	Patterns	PRBS (normal and inverted): $2^{15}-1$ PRBS, $2^{23}-1$ PRBS, $2^{31}-1$ PRBS, all 0's, all 1's, user-defined 32-bit pattern (per ITU-T 0.151)
Line Code	NRZ	APS Commands	Supports transmission/reception of linear and ring-mode command sequences for K1/K2 bytes (per G.841)
Mapping	<u>OC-192</u> : STS-48, STS-192c (per ANSI T.105.02) <u>STM-64</u> : AU-4-64c, AU-4-16c (per ITU-T G.707) Configuration-dependent support of additional mappings listed in the OC-48/STM-16 and OC-1/STM-0 through OC-12/STM-4 sections	Pointer Control	New value, single adjustments (increment or decrement), burst 2^8 adjustments, increment-decrement, decrement-increment, NDF control, SPE offset, pointer sequences
Line Rate	Tx: N x 51.84 MHz, Rx: N x 51.84 MHz, Stratum III compliant, offset capability ± 100 ppm	Control and Monitoring	<u>OC-192</u> : Overhead: Transmit control over bytes: Transport OH: A1, A2, C1, Z0, D1-D12, E1, E2, F1, K1, K2, J0 (Trace), Z1, Z2; Path OH: C2, F2, G1, J1 (Trace), Z3, Z4, Z5; Receive monitor: Transport OH: All bytes; Path OH: All bytes <u>STM-64</u> : Overhead: Transmit control over bytes: MSOH: A1, A2, Z0, D1-D12, E1, E2, F1, K1, K2, J0 (Trace), Z1, Z2; HP OH: C2, F2, G1, J1 (Trace), F3, K3, N1; Receive monitor: RSOH: All bytes HP OH: All bytes
Input Signal Measurement	Optical power meter: 0 to -26 dBm, ± 1.5 dB, Frequency measurement range: N x 51.84 MHz, ± 200 ppm	Intrusive / Non-intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify section and line overhead bytes
Synchronization	Internal, received SONET or SDH signal, BITS (1.544 Mbps), SETS (2.048 Mbps)	Error Injection	<u>OC-192</u> : B1, B2, REI-L, B3, REI-P, BIT <u>STM-64</u> : B1, B2, MS-REI, B3, HP-REI, BIT
Level (Tx)	<u>1310 nm</u> : single-mode, Intermediate reach-compliant, 1290 to 1330 nm, 1310 nm typical, 0 dB <u>1550 nm</u> : Intermediate reach-compliant, single-mode, 1530 to 1565 nm, 1550 nm typical, 0 dB	Error Injection Rate	BIT: Single, 10^{10} to 10^3 , user-programmable; other errors: Single, 10^{10} to maximum, user-programmable
Level (Rx)	-2 dBm to -14 dBm, -20 typical minimum at 10^{-10} BER with $2^{23}-1$ PRBS	Switch to Protect Measurement	Measure on B1, SEF, OOF, AIS-L, MS-AIS, AIS-P, AU-AIS, and PRBS; 125 microsecond resolution
Spectral Range (Rx)	1290-1600 nm	Round-Trip Delay (RTD) Measurement	Measurement ranges: 125 microseconds resolution
Connectors	SC, FC-PC, ST	Tandem Connection Monitor	In accordance with G.707/ Annex D for High Order Path (via N1), Errors/Alarms: TC-IEC, TC-REI, TC-OEI, TC-AIS, TC-UNEQ, TC-RDI, TC-ODI, TC-LOF, TC-API
Error Measurement	<u>OC-192</u> : B1, B2, REI-L, B3, REI-P, BIT, NDF errors <u>STM-64</u> : B1, B2, MS-REI, B3, HP-REI, BIT, NDF errors (performance measurements per G.821, G.826, M.2101.1)		
Alarm Detection	<u>OC-192</u> : LOF, LOS, SEF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P, pattern sync, concatenation: RS-TIM, HP-TIM, HP-PLM; <u>STM-64</u> : LOF, LOS, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ, RS-TIM, HP-TIM, HP-PLM, pattern sync, concatenation		
Alarm Generation	<u>OC-192</u> : LOF, LOS, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P; <u>STM-64</u> : LOF, LOS, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ		

10G Packet over SONET/SDH Option

No. of Ports/Modules	1	Frame Length	Octet synchronous HDLC-like, framing (RFC 1619 / 1662), variable from 40 bytes to 1.5 Kbytes
Packet Statistics	NRZ	Maximum Packet Rate	1 flag between packets -> 29.22 million packets/second at 40 bytes
Mapping	<u>Counts, seconds</u> : All sent frames, all received frames, all received bytes, all de-stuffed bytes, all PPPs, valid PPPs, all IPs, valid IPs, all UDPs, valid UDPs; <u>Counts, average rate, current rate, seconds</u> : Invalid frame check (CRC-32), invalid UDP, BIT errors for a specified substream (destination IP address, pattern, protocol)	IP/UDP	Checksum
Error Generation	FCS errors (CRC32), IP checksum and BIT errors	PPP	LCP/IPCP/negotiation
Traffic Generation	Single-signal traffic generators with configurable: Source IP address (fixed), destination IP address (fixed), source port, destination port, transmit protocol UDP, payload size, data rate - % bandwidth, pattern -32 BIT, user defined pattern, PRBS ³¹ , or PRBS ³¹ inverted		

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10G Mapping Option

Requirements	Meets the requirements of GR-253 (OC-192) and ITU-T G.707 (STM-64)	Patterns PRBS (normal and inverted)	2 ¹⁵ -1 PRBS, 2 ²³ -1 PRBS, 2 ³¹ -1, PRBS, all 0's, all 1's, user-defined 32-bit pattern (per ITU-T 0.151)
Line Code	NRZ	APS Commands	Supports transmission/reception of linear and ring-mode command sequences for K1/K2 bytes (per G.841)
Mapping	<u>OC-192</u> : STS-192/STS-192c, STS-192/STS-48c, STS-192/STS-12c, STS-192/STS-3c, STS-192/STS-1 (per ANSI T.105.02) <u>STM-64</u> : AUG64/AU-4-64c, AUG64/AUG16/AU-4-16c, AUG64/AUG16/AU-4-4c, AUG64/AUG16/AUG4/AUG1/AU-4, AUG64/AUG16/AUG4/AUG1/AU-3 (per ITU-T G.707)	Pointer Control	New value, single adjustments (increment or decrement), burst 2 ⁸ adjustments, increment-decrement, decrement-increment, NDF control, SPE offset, pointer sequences
Line Rate	10 Gbps, Stratum III compliant, offset capability ±100 ppm	Control and Monitoring	<u>OC-192</u> : Overhead: Transmit control over bytes: Transport OH: A1, A2, C1, Z0, D1-D12, E1, E2, F1, K1, K2, J0 (Trace), Z1, Z2; Path OH: C2, F2, G1, J1 (Trace), Z3, Z4, Z5; receive monitor: Transport OH: all bytes Path OH: all bytes, <u>STM-64</u> : Overhead: Transmit control over bytes: Section OH: A1, A2, Z0, D1 to D12, E1, E2, F1, K1, K2, J0 (Trace), Z1, Z2; HP OH: C2, F2, G1, J1 (Trace), F3, K3, N1; receive monitor: Section OH: All bytes, HP OH: All bytes
Input Signal Measurement	Optical power meter: 0 to -26 dBm, ±1.5 dB, Frequency measurement range: N x 51.84 MHz, ±200 ppm	Intrusive/Non-Intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify section and line overhead bytes
Synchronization	Internal, received SONET or SDH signal, BITS (1.544 Mbps), SETS (2.048 Mbps)	Patterns	2 ⁹ -1, 2 ⁹ -1 inverted, 2 ¹ -1, 2 ¹¹ -1 inverted, 2 ¹⁵ -1, 2 ¹⁵ -1 inverted, 2 ²³ -1, 2 ²³ -1 inverted, 2 ²³ -1, 2 ²³ -1 inverted, any user-defined pattern up to 32 bits, ATM (mapping); pass through with drop and insert: E3 pass through with drop/insert of a single E1 for test (per ITU-T 0.151)
Level (Tx)	<u>1310 nm</u> : Intermediate reach-compliant, single-mode, 1290 to 1330 nm, 1310 nm typical, 0 dB <u>1550 nm</u> : Intermediate reach-compliant, single-mode, 1530 to 1565 nm, 1550 nm typical, 0 dB	Error Injection	<u>OC-192</u> : B1, B2, REI-L, B3, REI-P, BIT <u>STM-64</u> : B1, B2, MS-REI, B3, HP-REI, BIT
Level (Rx)	-2 dBm to -14 dBm, -20 typical minimum at 10-10 BER with 2 ²³ -1 PRBS	Error Injection Rate	BIT: Single, 10 ⁻¹⁰ to 10 ⁻³ , user-programmable; other errors: Single, 10 ⁻¹⁰ to maximum, user-programmable
Spectral Range (Rx)	1290 to 1600 nm	Switch to Protect Measurement	Measure on B1, SEF, OOF, AIS-L, MS-AIS, AIS-P, AU-AIS, and PRBS; 125 microsecond resolution
Connectors	SC, FC-PC, ST	Round-Trip Delay (RTD) Measurement	Measurement ranges: 125 microseconds resolution
Error Measurement	<u>OC-192</u> : B1, B2, REI-L, B3, REI-P, BIT, NDF errors; <u>STM-64</u> : B1, B2, MS-REI, B3, HP-REI, BIT, NDF errors (performance measurement per G.821, G.826, M.2101.1)	Tandem Connection Monitor	In accordance with G.707/ Annex D for High Order Path (via N1), Errors/Alarms: TC-IEC, TC-REI, TC-OEI, TC-AIS, TC-UNEQ, TC-RDI, TC-ODI, TC-LOF, TC-API
Alarm Detection	<u>OC-192</u> : LOF, LOS, SEF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P, pattern sync, concatenation: RS-TIM, HP-TIM, HP-PLM; <u>STM-64</u> : LOF, LOS, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ, RS-TIM, HP-TIM, HP-PLM, pattern sync, concatenation		
Alarm Generation	<u>OC-192</u> : LOF, LOS, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P; <u>STM-64</u> : LOF, LOS, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ		



www.lightwave.com
info@lightwave.com

United States/Caribbean
15550 Lightwave Drive
Clearwater, FL 33760
Toll free: +1 877 442 DIGL
T: +1 727 442 6677
F: +1 727 442 5660

Europe/Middle East/Africa
Eastway Enterprise Centre
7 Paynes Park
Hitchin Hertfordshire
England SG51EH
T: +44 (0) 1462 429719
F: +44 (0) 1462 429760

Asia/Pacific Rim
Digital Lightwave Asia Pacific Pty. Ltd.
236 Balaclava Road
Caulfield North, Victoria
Australia 3161
T: +61 3 9509 4610
F: +61 3 9509 4615

Latin America
Digital Lightwave Ltd.
Rua Helade, 81
Sao Paulo, Brazil 04634-000
T: +55 11 5034 7277
F: +55 11 5034 7424

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