

MSA 2020/2030 Module for NIC Platform



Single Module for Advanced Telecom and Datacom Testing

Multiple protocol support

- SONET/SDH up to 10Gbps
- 10GigE LAN/WAN
- GigE (dual port)
- 10/100/1000BaseT (dual port)
- 100BaseFX
- OTN up to 10.7Gbps
- 10 Gig Ethernet over OTN (OTU-1e & OTU-2e)
- Full ODU Multiplexing
- ATM
- Fibre Channel
- GFP and GFP-T
- VCAT (MSA 2030 only)
- LCAS (MSA 2030 only)
- PDH/T-carrier drop/insert
- All Path Testing™

PLATFORMS



NIC NXG



NIC Plus



NIC EP

The MSA 2020 and 2030 are available in three basic packages, with additional capabilities available as Test Options:

MSA 2020 can support SONET/SDH testing from 51M to 10G, Ethernet testing from 10M to 10G LAN or WAN PHY, Fibre Channel from 1G to 10G and NGN technologies and mappings.

MSA 2030 SONET/SDH Bundle Includes all features of the MSA 2020 SONET/SDH bundle and also supports VCAT and LCAS Test Options.

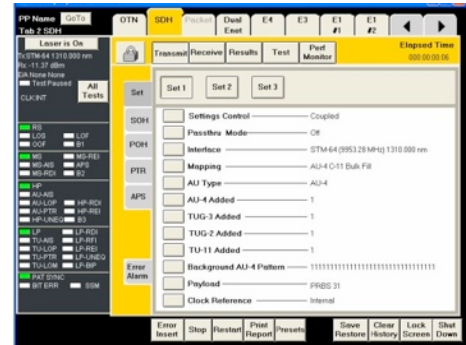
Advanced mapping options include 10G Ethernet over OTN (10.7G, 11.049G, 11.095G) and 10G Fibre Channel over OTN (11.27G, 11.3G)

KEY FEATURES

- SONET/SDH testing from 52M to 10G
- OTN testing up to 11.3G
- Flexible 10G Ethernet testing : 10G LAN (10.3G), 10G WAN (9.953G), 10G Ethernet over OTN (11.049/11.095G)
- Full Fibre Channel test suite : 1G, 2G, 4G, 8G, 10G Fibre Channel, 10G Fibre Channel over OTN
- Support for SONET, SDH and OTN testing
- Full ODU multiplexing support
- ODU-0 with transcoded Ethernet
- Virtual Concatenation & LCAS
- Full GFP support - GFP-T and GFP-F

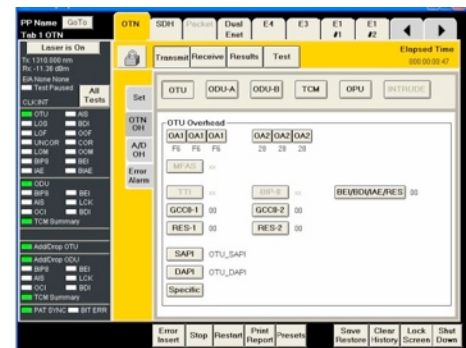
SONET/SDH Testing

- Available with OC-192/STM-64, OC-48/STM-16, OC-12/STM-4, OC-3/STM-1, EC-3/STM-1e, OC-1/STM-0, and EC-1/STM-0e interface
- Complete overhead control and monitor
- Overhead Byte capture
- User-definable alarms for power level, frequency, trace and expected path label
- Line and pointer (STS, VT, AU, TU) frequency offset generation.
- GFP, VCAT, LCAS, ATM and All Path Testing™ options
- Intrusive/Passive Through Mode capability
- APS testing and Service Disruption Measurement with user-selectable criteria



Optical Transport Network (OTN) Testing

- Supports the full range of OTN interfaces: OTU-1 (2.66 Gbps)
 - OTU-2 (10.7 Gbps)
 - OTU-1e (11.049 Gbps)
 - OTU-2e (11.095 Gbps)
 - OTU-1f (11.27 Gbps)
 - OTU-2f (11.3 Gbps)
- Full OTN Multiplexing structure
- Overhead Byte Capture
- Full overhead access/manipulation
- Intrusive/non-intrusive through mode
- GFP mapping
- Support for 10G Ethernet payload (OTU1e/2e)
- Support for 10G Fibre Channel payload (OTU1f/2f)



All Path Testing™ (APT)

- Simultaneous testing of all HP/STS containers/SPEs
- Each path can be configured separately with any test pattern desired
- Supports any combination of homogeneous or mixed mappings
- Auto-detection of mapping type and pattern (if standard PRBS type) for the entire bandwidth
- Service Disruption Measurement on all containers/SPEs simultaneously.
- With selectable criteria, All Path Testing detects single or multiple disruptions, reporting the latest event, shortest, longest and average events.



Ethernet Testing

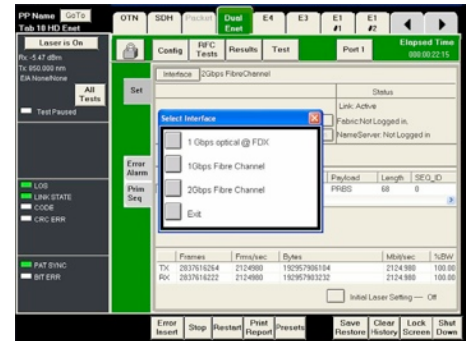
- Available with 10GigE LAN/WAN and 10GigE FEC (OTU-1e, OTU-2e)
- Dual port GigE, 10/100/1000BaseT and 100BaseFX
- Supports RFC 2544 and RFC 1242 Benchmarking with Throughput, Frame Loss, Latency, Back-to-Back Burst and Round-Trip Delay testing
- Up to 32 simultaneous streams per port
- Rate setting by interpacket gap up to 18 minutes, burst traffic, ramped traffic, through mode, ARP support, runt frame support, an increase of max frame size to 16,000 bytes
- IP reflection mode enables RFC testing through routers
- Stacked VLAN (Q in Q), up to four tags per stack



NOTE: Features listed above require specific hardware and software configurations.

Fibre Channel (FC) Testing

- 1/2/4/8/10Gbps Fibre Channel testing
- Mapping of 10G Fibre Channel into OTN (OTU1f/ OTU2f)
- Dual port simultaneous testing
- BER testing, round-trip latency and performance monitoring and characterization of in-service Fibre Channel
- Simultaneous traffic generation and testing at 100% wire speed on all ports
- Supports Primitive Sequence Generation
- Supports RFC 2544 and RFC 1242 Benchmarking with Throughput, Frame Loss, Latency, Back-to-Back Burst and Round-Trip Delay testing
- Characterize performance of Fibre Channel networks for varying frame sizes



Asynchronous Transfer Mode (ATM) Testing

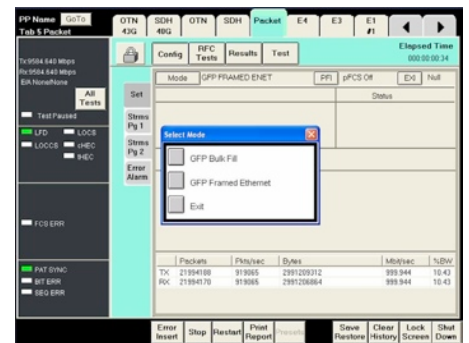
(Requires ATM module)

- Asynchronous Transfer Mode testing at the following rates: 622M, 155M, 52M
- If equipped with A11 or A14 module, installed adjacent to MSA, supports ATM testing (Direct&PLCP) at DS1/E1/E3/DS3 rates
- UNI/NNI interface types
- AAL0, AAL1, AAL5
- PVC and SVC support
- 240 VCCs transmit/255 VCCs receive
- Bit error rate testing plus ATM alarm/error insertion and monitoring
- VCC scan for automatic detection of VCCs



Generic Framing Procedure (GFP) Testing

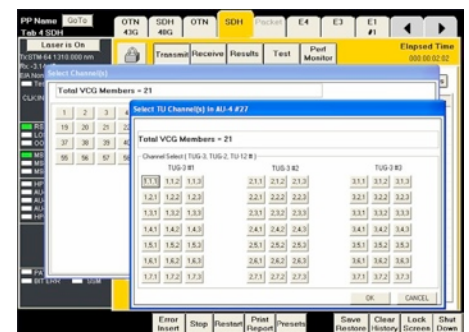
- GFP-F, GFP-T and GFP Bulk
- Supports FULL Ethernet test functionality including the following:
 - 32 independent test streams
 - Supports RFC 2544 and RFC 1242 Benchmarking with Throughput, Frame Loss, Back- to-Back Burst testing
 - IP reflection mode enables RFC testing through routers
- Rate setting by interpacket gap up to 18 minutes, burst traffic, ramped traffic, through mode, ARP support, runt frame support, frame size to 16,000 bytes in GFP-F and GFP-T
- Simultaneously test and monitor OTN, SONET/SDH, GFP and Ethernet layers



Virtual Concatenation & LCAS Testing

(MSA 2030 only)

- High-Order and Low-Order support
- Insert frame delay or pointer delay on each
- VCG member
- Supports GFP payload with Ethernet functionality LCAS Features Include:
 - Monitoring and evaluation of Control
 - Packets
 - Plain text State Machine Trace
 - LCAS Protocol Emulation
- Automatic Source and Sink state machine emulation



NOTE: Features listed above require specific hardware and software configurations.

SONET/SDH FEATURES

OPTICAL INTERFACES

Connector Type	LC
Optical module	SFP - 51/155/622 Mbps, 2.5/2.6 Gbps XFP - 10/10.7 Gbps
Bit rates:	STM-64/OC-192 9.953 Gbps STM-16/OC-48 2.488 Gbps STM-4/OC-12 622.80 Mbps STM-1/STM-1e/OC-3/EC-3 155.08 Mbps STM-0/STM-0e/OC-1/EC-1 51.84 Mbps

ELECTRICAL INTERFACES

Connector Type	75-ohm BNCs — 51 Mbps and 155 Mbps
Line code	EC-3(STS-3)/STM-1e: CMI EC-1(STS-1)/STM-0e: B3ZS
Electrical Level (Tx)	0.5 Vpk ±10%
Electrical Level (Rx)	Terminate and monitor mode meet ITU-T G.772

INTERFACE SPECIFICATIONS

Timing	Internal, external, recovered
Internal Clock	Stratum III compliant (±4.6 ppm)
External Clock	1.544Mb/s, 2.048Mhz (BITS/SETS), 1.544Mhz, 2.048 Mb/s via Bantam connector (120 ohm bal- anced); 8KHz/1.544/2.048/10 MHz via 75-ohm TTC BNC (unbalanced)
Frequency Offset	Tx timing ±100 ppm, in 0.1 ppm increments
Unframed	10.71/9.953/2.66/2.488 Gbps, 622.80/155.08/51.84 Mbps.
Input Freq. Meas.	±200 ppm

FUNCTIONS

SONET Mapping	EC-1/3, STS-192c Bulk, STS-48c Bulk, STS-12c Bulk/ATM, STS-3c Bulk/ATM, STS-1 Bulk/ATM, VT-6 Bulk/ATM, VT-2 Bulk/ATM, VT-1.5 Bulk/ATM, Unframed Bulk With PDH module: E4 Bulk/ATM, DS3 Bulk/ATM, DS1#1 Bulk/ATM, DS1#2 Bulk/ ATM, E1#1 Bulk/ATM, E1#2 Bulk/ATM. ATM mappings require ATM module. Virtual Concatenation mappings.
SDH Mapping	AU-4-64c Bulk, AU-4-16c Bulk, AU-4-4c Bulk/ ATM, AU-4/C-4 Bulk/ATM, AU-4/ C-3 Bulk/ATM, AU-4/C-2 Bulk/ATM, AU-4/C-12 Bulk/ ATM, AU-4/C-11 Bulk/ATM, AU-3/C-3 Bulk/ATM, AU-3/ C-2 Bulk/ATM, AU-3/C-12 Bulk/ATM, AU-3/C-11 Bulk/ ATM, Unframed Bulk. With PDH module: E4 Bulk/ATM, E3 Bulk/ ATM, E1#1 Bulk/ATM, E1#2 Bulk/ATM, DS3 Bulk/ ATM, DS1#1 Bulk/ATM, DS1#2 Bulk/ATM . ATM mappings require ATM module. Virtual Concatenation mappings

Payloads	Test patterns, GFP-F, GFP-T
Test Patterns	PRBS 9, PRBS 9 inverted, PRBS 11, PRBS 11 inverted, PRBS 15, PRBS 15 inverted, PRBS 20, PRBS 20 inverted, PRBS 23, PRBS 23 inverted, PRBS 31, PRBS 31 inverted, user-defined (32-bit), all 0's, all 1's
Automatic Protection Switching Measurement	Support for SONET/SDH transmission/ reception of switching linear and ring-mode command sequences for K1/K2 bytes (per G.841); accuracy is one-frame duration; Results displayed in summary column format and decoded tabular format
Overhead Control	Section/RS, Line/MS OH: A1, A2, J0(Trace)/Z0/ C1, D1-D12, E1, E2, F1, K1, K2, S1, M0/M1, Z1, Z2, E2; Path/HP OH: C2, F2, G1, H4, J1 (Trace), Z3/F3, Z4/K3, Z5/N1(TCM); VT/LP OH: V5, J2 (Trace), Z6/N2(TCM), Z7/K4
Overhead Monitor	Section/RS, Line/MS OH: all bytes; Path/HP OH: all bytes; VT/LP OH: all bytes
Pointer Control	SONET STS/VT and SDH AU/TU: Increment/ decrement single, increment/decrement burst 2-8, new value with NDF, new value without NDF, Pointer sequences (per standards), Payload frequency offset ±100 ppm
Pointer Monitor	SONET STS/VT and SDH AU/TU: Positive Pointer Justification counts, Negative Pointer Justification counts, Pointer Justification seconds, NDF counts, Pointer value (decimal and hexadecimal formats)
Performance Monitoring	Calculates network performance in accordance with ITU/Telcordia standards GR-253, T1.231, G.821, G.826, G.828, G.829, M.2100, M.2101, M.2110, M.2120

KEY SONET/SDH FEATURES

- SONET/SDH testing from 52M to 10G
- Configure and monitor complete SONET / SDH overhead
- User-definable alarms for power level, frequency, trace and expected path label
- Line and pointer (STS, VT, AU, TU) frequency offset +/- 100ppm
- Intrusive/Passive Through Mode
- Overhead Byte capture
- APS testing and Service Disruption Measurement with user-selectable criteria

SONET/SDH FEATURES (CONTINUED)

Alarm Detection	SONET: LOS, Optical Power Hot, Optical Warm, Optical Power Low, Frequency Wide, OPU Generic AIS, LOF, AIS-L, APS(K1/ Change), SEF, RDI-L, PATT SYNC, PLM-P, CONCAT, AIS-P, LOP-P, UNEQ-P, RDI-P, TIM-P, TIM-S, AIS-V, LOP-V, LOM-V, UNEQ-V, RDI-V, RFI-V, TIM-V, PLM-V, TC-RDI-P, TC-ODI-P, TC-AIS-P, TC-UNEQ-P, TC-LOF-P, TC-TIM-P, TC-RDI-V, TC-ODI-V, TC-AIS-V, TC-UNEQ-V, TC-LOF-V, TC-TIM-V, SS MISMATCH	Error Injection	SONET: B1, B2, REI-L, B3, REI-P, BIT, TC-IEC-P, TC-REI-P, TC-OEI-P, TC-BIP-V, TC-REI-V, TC-OEI-V SDH: B1, B2, MS-REI, B3, HP-REI, BIT, HP-TC-IEC, HP-TC-REI, HP-TC-OEI, LP-TC-BIP, LP-TC-REI, LP-TC-OEI
SDH:	LOS, Optical Power Hot, Optical Power Warm, Optical Power Low, Frequency Wide, OPU Generic AIS, LOF, MS-AIS, APS(K1/K2 Change), OOF, MS-RDI, PATT SYNC, HP-PLM, CONCAT, AU-AIS, AU-LOP, HP-UNEQ, HP-RDI, HP-TIM, RS-TIM, TU-AIS, TU-LOP, TU-LOM, LP-UNEQ, LP-RDI, LP-RFI, LP-TIM, LP-PLM, HP-TC-RDI, HP-TC-ODI, HP-TC-AIS, HP-TC-UNEQ, HP-TC-LOF, HP-TC-TIM, LP-TC-RDI, LP-TC-ODI, LP-TC-AIS, LP-TC-UNEQ, LP-TC-LOF, LP-TC-TIM, SS MISMATCH	Error Injection Rate	BIT/Frame: Single, 10-10 to 10-3, user-programmable; Other errors: Single, 10-10 to maximum, user-programmable
Error Detection	SONET: BPV/LCV, Frame (A1, A2), B1, B2, REI-L, B3, REI-P, BIP-V, REI-V, BIT, TC-IEC-P, TC-REI-P, TC-OEI-P, TC-BIP-V, TC-REI-V, TC-OEI-V, NDF-P, NDF-V SDH: BPV/LCV, Frame (A1, A2), B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI, BIT, HP-TC-IEC, HP-TC-REI, HP-TC-OEI, LP-TC-BIP, LP-TC-REI, LP-TC-OEI, AU-NDF, TU-NDF	Intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify Section and Line overhead bytes
Alarm Generation	SONET: LOS, LOF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P, UNEQ-V, RDI-V, RFI-V, AIS-V, LOP-V, LOM-V, TC-RDI-P, TC-ODI-P, TC-AIS-P, TC-UNEQ-P, TC-LOF-P, TC-RDI-V, TC-ODI-V, TC-AIS-V, TC-UNEQ-V, TC-LOF-V SDH: LOS, LOF, MS-AIS, MS-RDI, AU-LOP, AU-AIS, HP-RDI, HP-UNEQ, LP-UNEQ, LP-RDI, LP-RFI, TU-AIS, TU-LOP, TU-LOM, HP-TC-RDI, HP-TC-ODI, HP-TC-AIS, HP-TC-UNEQ, HP-TC-LOF, LP-TC-RDI, LP-TC-ODI, LP-TC-AIS, LP-TC-UNEQ, LP-TC-LOF	Service Disruption Automatic Protection Switching Measurement	Supported for all mappings. SONET triggers: B1 error, SEF, AIS-L, AIS-P, AIS-V, PRBS, LOS, LOF, B1, SEF, AIS-L, AIS-P, AIS-V, BIT errors. SDH triggers: LOS, LOF, B1, OOF, AIS-L, AIS-P, AIS-V, BIT errors. Resolution: 125 microseconds;
		Round-Trip Delay	Supported; SONET/SDH resolution is 125 microseconds;
		Tandem Connection Monitoring	In accordance with G.707/Annex D for High Order , Errors/Alarms: TC-IEC, TC-REI, TC-OEI, TC-AIS, TC-UNEQ, TC-RDI, TC-ODI, TC-LOF, TC-API

OTN FEATURES

General

Timing	Internal, external, recovered
Internal Clock	Stratum III compliant (± 4.6 ppm)
External Clock	1.544/2.048 Mbps (BITS/SETS), 1.544/2.048 MHz via Bantam connector (balanced); 8KHz/1.544/2.048/10 MHz via 75-ohm TTC BNC (unbalanced)
Input Freq. Meas.	± 200 ppm
Receiver Pulling Range	$> \pm 100$ ppm
Line Frequency Offset	± 100 ppm, in 0.1 ppm increments
Line Scrambling	Enabled/Disabled (default is Enabled)
OPU Frequency Offset	As defined in ITU-T publication G.709/Y.1331

OPTICAL INTERFACES

Connector Type	LC; Adapters available (e.g. LC to SC, ST or FC)
Line Code	NRZ
Interface Rates	OTU-1: 2.66 Gbps; OTU-2: 10.71 Gbps,
Modules	All optical interfaces are hot-swappable . SFP: 2.66 Gbps XFP for 10.7Gbps
OTU-1 External Clock Rate	166.629 MHz
OTU-2 External Clock Rate	167.332 MHz
External Clock Amplitude	0.5v ± 0.1 v

KEY OTN FEATURES

- 2.6G, 10.7G, 11.05G, 11.1G, 11.27H, 11.3G line rates.
- SONET/SDH payloads
- 10G Ethernet payload in 10.7, 11.05G, 11.1G OTN rates.
- 10G Fibre Channel payload in 11.27G, 11.3G OTN rates.
- GFP mapping support
- Full multiplex structure to ODU-0
- Intrusive/Passive Through Mode
- Overhead Byte capture
- APS testing and Service Disruption Measurement with user-selectable criteria

OTN FEATURES (CONTINUED)

FUNCTIONS

OTN Mapping	Unframed BERT, Framed BERT, Null Client, Synchronous SONET/SDH, Asynchronous SONET/SDH, GFP, 10G Ethernet, 10G Fibre Channel.	Alarm Generation	LOS, LOF, OOF, LOM, OOM, OTU(SM):AIS, OTU(SM):IAE, OTU(SM):BDI, ODU(PM):AIS, ODU(PM):OCI, ODU(PM):LCK, ODU(PM):BDI, TCM(1-6):BDI
Test Patterns	PRBS 9, PRBS 9 inverted, PRBS 11, PRBS 11 inverted, PRBS 15, PRBS 15 inverted, PRBS 20, PRBS 20 inverted, PRBS 23, PRBS 23 inverted, PRBS 31, PRBS 31 inverted, user-defined (32-bit), all 0's, all 1's	Intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify OTN overhead bytes and generate errors and alarms
Error Detection	Frame (OA1, OA2), MFAS, Correctable FEC errors, Uncorrectable FEC errors, OTU(SM): BIP8, OTU(SM):BEI, ODU(PM):BIP8, ODU(PM):BEI, BIT, TCM(1-6):BIP8, TCM(1-6):BEI	Service Disruption Measurement	Criteria: OOF, OTU(SM):AIS, OTU(SM):BIP8, ODU(PM):AIS, ODU(PM):BIP8, BIT errors; Resolution (one frame duration): OTU-1 is 49µs; OTU-2 is 12µs.
Error Generation	Frame (OA1, OA2), MFAS, Correctable FEC errors, Uncorrectable FEC errors, OTU(SM): BIP8, OTU(SM):BEI, ODU(PM):BIP8, ODU(PM):BEI, BIT, TCM(1-6):BIP8, TCM(1-6):BEI	Round-Trip Delay	Supported for OTN; OTU-1 resolution is 49 microseconds; OTU-2 resolution is 12 microseconds
Error Generation Rate	BIT/Frame: Single, 10 ⁻¹⁰ to 10 ⁻³ , user-programmable; Other errors: Single, 10 ⁻¹⁰ to maximum, user-programmable	Overhead Capture	Up to 255 overhead bytes can be captured and displayed in HEX and ASCII values, and can be printed or saved to a report file. Any one of the following bytes can be captured:
Periodic Burst Generation	Burstable Errors: FRAME, MFAS, OTU(SM):BIP8, OTU(SM):BEI, ODU(PM):BIP8, ODU(PM):BEI, TCM(1-6):BIP8, TCM(1-6):BEI Burstable Alarms: OTU(SM):IAE, OTU(SM):BDI, ODU(PM):BDI, TCM(1-6):BDI Burst Size: 0 to 65535 Frames; OTU-1: 0 to 3209.35ms; OTU-2: 0 to 798.964ms. Burst Period: 0 to 1048575 Frames; OTU-1: 0 to 51350.392ms; OTU-2:.		OTU(SM):FAS OA1(1-3), OTU(SM):FAS OA2(1-3), OTU(SM):MFAS, OTU(SM):TTI, OTU(SM):BIP, OTU(SM):BEI, OTU(SM):GCC0(1-2), OTU(SM):RES(1-2), ODU(PM):TCM(1-6) TTI, OPU:RES(1-3), OPU:PSI, ODU(PM):TCM(1-6)BIP, OPU: JC(1-3), OPU:NJO, ODU(PM):TCM(1-6)BEI, ODU(PM):RES(1-9), ODU(PM):TCM ACT, ODU(PM):FTFL, ODU(PM):TTI, ODU(PM):BIP, ODU(PM):BEI, ODU(PM):EXP(1-2), ODU(PM):GCC1(1-2), ODU(PM):GCC2(1-2), ODU(PM):APS PCC(1-4)
Alarm Detection	LOS, Power Hot, Power Warm, Power Low, LOF, OOF, OOM, LOM, OTU(SM):AIS, OTU(SM):IAE, OTU(SM):BDI, OTU(SM):SAPI, OTU(SM):DAPI, OTU(SM):BIAE, ODU(PM):AIS, ODU(PM):OCI, ODU(PM):LCK, ODU(PM):BDI, ODU(PM), SAPI, ODU(PM):DAPI, TCM(1-6):BDI, TCM(1-6):SAPI, TCM(1-6):DAPI, TCM(1-6):BIAE, OPU: PLM.		Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual

10G ETHERNET WAN SPECIFICATIONS

Requirements	Meets the requirements of GR-253 (OC-192) and ITU-T G.707 (STM-64)	Control and Monitoring	OC-192: 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
Mapping	10G WAN PHY per IEEE 802.3		STM-64: 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
Synchronization	Internal, received SONET or SDH signal		
Error Measurement	OC-192: B1, B2, REI-L, B3, REI-P, NDF errors STM-64: B1, B2, MS-REI, B3, HP-REI, NDF errors (performance measurements per G.821, G.826, M.2101.1)	Error Injection	OC-192: B1, B2, REI-L, B3, REI-P STM-64: B1, B2, MS-REI, B3, HP-REI
Alarm Detection	OC-192: LOF, LOS, SEF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P, concatenation: RS-TIM, HP-TIM, HP-PLM; STM-64: LOF, LOS, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ, RS-TIM, HP-TIM, HP-PLM, concatenation	Error Injection Rate	Single
Alarm Generation	OC-192: LOF, LOS, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, UNEQ-P; STM-64: LOF, LOS, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-UNEQ	Switch to Protect Measurement	Measure on B1, SEF, OOF, AIS-L, MS-AIS, AIS-P and AU-AIS; 125 microsecond resolution
Pointer Control	New value, single adjustments (increment or decrement), burst (2-8) adjustments, NDF control	Round-Trip Delay (RTD) Measurement	Measurement ranges: 125 microseconds resolution

ETHERNET FEATURES

INTERFACES

10-Gigabit Ethernet	Ports: 1 XFP user-pluggable module with LC connector; Data Rate: 10 Gbps; Line Rate: 10.3125 Gbps (LAN), 9.95328 Gbps (WAN); Duplex Mode: Full duplex. Optional XFP modules available for 10GBaseLW, 10GBaseEW, 10GBaseLR, 10GBaseER in accordance with 802.3ae and custom configurations; Tx Level, Tx Wavelength, Rx Level, Rx Spectral Range, and Input Signal Measurement are dependant upon XFP module selected External Eye Clock: SMA, AC coupled PECL (line rate/64)
Gigabit Ethernet	Ports: 2 SFP user-pluggable modules with LC connector; Duplex Mode: Full duplex; Data Rate: 1 Gbps Optional SFP modules available; Tx Level, Tx Wavelength, Rx Level, Rx Spectral Range, and Input Signal Measurement are dependent upon SFP module selected
10/100/1000 BaseT	Ports: 2 ports, fully independent, RJ-45 connectors; Data Rate: 10 Mbps/100 Mbps/1 Gbps; Duplex Mode: Full or half duplex

PACKET SPECIFICATIONS

Frame Type	Statistics and generation of Ethernet frames with UDP/IP, IPv4
Results/Statistics	Received optical power, LOS, link state, jabber, collision (10/100/1000 electrical only) code violation error counts, current rate, average rate, errored seconds; each port accumulates statistics in real time; event log result analysis with time stamp; user-defined test duration time
All Ports Results	Displays all activity, alarms and errors for all ports simultaneously in single screen for easier testing analysis with the option to rearrange rows and columns
LED Indicators	LOS, link state and pattern sync alarms, FCS, code, and payload BIT errors, sequence errors, remote fault/link fault (10 Gig only)
Traffic Stream Generation/Analysis	32 independently configurable traffic generation and analysis streams, reply to link fault (10 Gig only)
Configurable Stream Parameters	Destination port, transmitted bandwidth 0.01% to 100%; Frame length: 64 to 16000 bytes, acceptable bit-error rate, acceptable out-of-sequence rate, acceptable loss rate; MAC source/IP source/destination addresses, UDP source/destination Addresses, VLAN tagging 802.1q.p, VLAN enabled/disabled, VLAN ID 0 to 4095, VLAN QoS levels 0 to 7, UDP payload pattern (all ones, all zeros, PRBS 31, user-defined 32-bit), IP TOS, IP TTL, and IP Fragment Flag, MPLS label
Flow Control	Generation of pause frames with a user specified time of 0 to 65535 Quantas; response to pause packets can be enabled or disabled
Per-Port Tx Statistics	Transmitted packets, packets per second, transmitted bytes, Mbps, % bandwidth of transmitted packets/bytes, average/min/max bandwidth counters
Per-Port Receive Statistics	Received Mbps and bandwidth % rates, received packets/bytes count, received jumbo frames, received pause packets, pause end packets, pause Quantas taken, count of received IP, ICMP, TCP, UDP, and IGMP packets, count of received VLAN tagged frames and VLAN tagged frames per QoS levels 0 to 7, latency (minimum, maximum and average), broadcast, multicast and unicast packets, packet-size distribution, average/min/max bandwidth counters

Per-Stream Transmit Statistics	Transmitted bandwidth %, transmitted packet bytes count
Per-Stream Receive Statistics	Received bandwidth %, Received packets/byte count, out-of-sequence packets, bit errors, latency (minimum, maximum, and average in ms)
Alarm Detection	LOS, link fault, pattern sync, jabber, link fault (10 Gig only), remote fault (10Gig only)
Error Measurements	FCS, IP checksum, code errors, collisions, sequence, Bit, line code, runt, oversized/undersized frame error counts: current rates, average rates, and errored seconds
Error Insertion	FCS, IP checksum, sequence: single, 1e-2 to 1e-7; bit: single, 1e-3 to 1e-10; line code: single
APS Measurements	Maximum, minimum, average, and current protection switch times in ms; user-definable guard band thresholds for filtering receive traffic
Advanced Ping Functionality	Selectable MAC source, IP source and IP destination, number of Ping attempts, Timeout (1-5 sec.), Packet size (64-9600 bytes), Time to live (1-255); Last 4 responses displayed in Ping response win-dow; Full statistics of Ping operation displayed in the Ping Statistics section
MPLS	Up to 4 stacked MPLS Labels. Configurable label value, traffic class, time to live, bottom of stack flag. TX/RX frame counts, packet counts per stack position & traffic class. Average/min/max bandwidth counters
Rates and Negotiation	Supports autonegotiation at applicable rates with status display, including pending link, line rate, full-duplex or half duplex, and master/slave timing mode 1G optical rates: supports "1G full duplex mode" with negotiation enabled or disabled; 10/100/1000: supports autonegotiation for all rates – configures to fastest data rate and duplex mode; 1000 Electrical Only: Line control Auto, Master or Slave
IP Reflection	User-selectable, can reflect all unicast packets or only packets created by Digital Lightwave test instrument
Port-to-Port Testing	Ping, bi-directional bit-error-rate and stream testing; RFC 2544 testing for throughput, frame loss, and latency
RFC 2544 Throughput Test	Measurements are provided for 64, 128, 256, 512, 1024, 1280, and 1518 byte frame standard lengths plus custom lengths, user-defined trial duration time (1 to 600 secs), acceptable loss rate (0 to 100%); resolution rate (1 to 100%) parameters; Results: passing rate %, number of transmitted/received packets, and min/max/average latency values in microseconds
RFC 2544 Frame Loss Test	Measurements are provided for 64, 128, 256, 512, Test 1024, 1280, & 1518 byte frame standard lengths plus custom lengths, User-defined trial duration time (1 to 600 secs); Results: Tested frame rate %, number of transmitted/received frames, % loss
RFC 2544 Back-to-Back Burst Test	Measurements are provided for 64, 128, 256, 512, Test 1024, 1280, & 1518 byte frame standard lengths plus custom lengths, User-defined trial duration time (1 to 600 secs); Results: Number of packets that can be forwarded in a burst per user-specified parameters and number of repetitions

KEY ETHERNET FEATURES

- Full interface support from 10M to 10G LAN / WAN PHY
- Mapping as GFP client
- Test up to 3 ports per module
- Generate and test up to 32 fully independent streams per port
- Support for VLAN and Q in Q VLANs
- PING, ARP tests supported
- RFC 2544 benchmark testing supported. Frame loss, latency, throughput, back to back burst measurements supported.
- MPLS Support

FIBRE CHANNEL FEATURES

INTERFACES

Rates	1 Gbps, 2 Gbps, 4 Gbps, 8 Gbps, 10 Gbps
Ports	SFP user-pluggable, hot-swappable independently configurable for 1G, 2G or 4G, 4 ports (HDE), 2 ports (MSA) XFP user-pluggable, hot-swappable configurable for 8G or 10G, 1 port (MSA only)
Wavelength	1G/2G/4G - 850nm, 1310nm, 1550nm avail. 8G - 850nm, 1550nm avail. 10G - 850nm, 1310nm, 1550nm avail.
Interface Specifications	Optional SFP/XFP modules avail.; Tx Level, Tx Wavelength, Rx Level, Rx Spectral Range, and Input Signal Measurement are dependant upon module selected
Port Modes	Stresses F-Ports of Fibre Channel switches Supports Point to Point modes (with and without Logins) Supports Link State monitoring and status messages including: Active, Failure(LF1), Failure(LF2), Reset(LF1), Reset(LF2), Reset(LF3), Offline(OL1), Offline (OL2), or Offline(OL3) Supports Fabric Login and Name Server Login/ Registration control with status messages including: Unknown, Not Logged in, Waiting for Response, Logged in, and Login Rejected

PACKET SPECIFICATIONS

Frame Type	Statistics and generation of Fibre Channel frames, including Extended Link Service Requests to support Fabric (LOGIN)
Results/Statistics	Received optical power, LOS, link state, code violation error counts, current rate average rate, errored seconds. Each port accumulates statistics in real time.; event log result analysis with time stamp; user-defined test duration time
LED Indicators	LOS, link state and pattern sync alarms; CRC, code and payload BIT errors
Flow Control	Supports Buffer to Buffer Credit flow control. Specify the number of credits to report during login (0 to 65535). Displays the amount of credit (R_RDYs) that is currently pending for return to the far end device and the amount of Buffer to Buffer credit that is currently available for sending frames to the far end device
Traffic Stream Generation	Configurable FC-2 traffic generation; Class of Service 3
Configurable Stream Parameters	WWN Source and Destination addresses; Frame Length (68 to 2090 bytes) Transmit Bandwidth Rate: 0.01% to 100%

Payload pattern (PRBS 31, PRBS 31 INV and user defined pattern)
SOF (Start of Frame), D_ID (Destination Identifier), S_ID (Source Identifier), R_CTL, CS_CTL, TYPE, F_CTL, SEQ_ID, DF_CTL, SEQ_CNT, OX_ID, RX_ID, and PARM, EOF (End of Frame)

R_T_TOV timeout threshold 0.01 to 655.35 ms

RESULTS/STATISTICS

Per-Port Tx statistics	Transmitted frame count, frames/sec, byte count, Mbit/sec, % Bandwidth, count of transmitted R_RDY's
Per-Port Rx Statistics	Received frame count, frames/sec, byte count, Mbit/sec, % Bandwidth, count of received R_RDY's
Per-Stream Tx Statistics	Transmitted frame count, byte count, and bandwidth %
Per-Stream Statistics	Received frame count, byte count, bandwidth Rx %, Payload Bit error count and average error rate. Supports user defined thresholds for determining the acceptable frame loss and bit error rate thresholds. Latency (minimum, maximum, average in ms),
Alarm Detection	LOS, link State and Pattern Sync Seconds;
Error measurements	Code, Alignment, Disparity, EOF, EOFa, CRC, Payload Bit, Oversized frame, Undersized frame Supports Error Counts, Errored Seconds, Average and Current error rates
Buffer to Credit	R_RDY Credit pending information R_RDY Transmitted count R_RDY Received count

ERROR AND ALARM GENERATION

Error Insertion	Code: single error insert CRC: single error insert, rates 1e-3 to 1e -9 Payload Bit: single error insert, rates 1e-3 to 1e -9
Alarm Insertion	LOS

PRIMITIVE SEQUENCE GENERATION

Supports the generation of Primitive Sequences including:
NOS Ordered Set: K28.5 D21.2 D31.5 D5.2
OLS Ordered Set: K28.5 D21.1 D10.4 D21.1
LR Ordered Set: K28.5 D9.2 D31.5 D9.2
LRR Ordered Set: K28.5 D21.1 D31.5 D9.2
Duration: Supports the generation of 1 to 10 consecutive sequences or continuous sequence generation

KEY FIBRE CHANNEL FEATURES

- Supports 1G, 2G, 4G, 8G, 10G Fibre Channel interfaces
- Supports mapping as client into OTU-1f/2f interfaces
- Test up to 3 ports per module
- FC-0, FC-1, FC-2 layer testing
- Point to point and switch fabric circuit testing
- Fabric login
- Buffer to buffer credit analysis
- Frame loss, throughput, latency testing
- Primitive sequences generation

VIRTUAL CONCATENATION SPECIFICATIONS

HO VCAT	STM-64				
SDH Mappings	AU-4-VC4-Xv	X = 1 to 24		OC-3	
	AU-3-VC3-Xv	X = 1 to 24		VT-6-Xv	X = 1 to 21
	AU-4-VC3-Xv	X = 1 to 24		VT-2-Xv	X = 1 to 63
	STM-16			VT-1.5-Xv	X = 1 to 64
	AU4-VC4-Xv	X = 1 to 16		OC-1	
	AU3-VC3-Xv	X = 1 to 24		VT-6-Xv	X = 1 to 7
	AU-4-VC3-Xv	X = 1 to 24		VT-2-Xv	X = 1 to 21
	STM-4			VT-1.5-Xv	X = 1 to 28
	AU-4-VC4-Xv	X = 1 to 4		<i>*Members can be in any available STS-1</i>	
	AU-3-VC3-Xv	X = 1 to 12		Hitless	Per member simultaneous
	AU-4-VC3-Xv	X = 1 to 12		(0 to 256 mS)	
	STM-1			Instant	Per member simultaneous
	AU3-VC3-Xv	X = 1 to 3		(0 to 256 mS)	
	AU-4-VC3-Xv	X = 1 to 3		Payload Patterns	Payload Pattern options common to both High and Low Order mappings: PRBS9 Inv PRBS9 PRBS11 Inv PRBS11 PRBS15 Inv PRBS15 PRBS20 Inv PRBS20 PRBS23 Inv PRBS23 PRBS31 Inv PRBS31 32-Bit User-Defined Pattern
SONET Mappings	OC-192			GFP Bulk	See GFP and Ethernet data sheets for details
	STS-3c-Xv	X = 1 to 24		GFP-F, GFP-T	
	STS-1-Xv	X = 1 to 24		VCAT	LOA, MSU
	OC-48			Alarms Detection	LOM Per member simultaneous OOM1 Per member simultaneous OOM2 Per member simultaneous SQM Per member simultaneous
	STS-3c-Xv	X = 1 to 16			
	STS-1-Xv	X = 1 to 24		PRBS Payload Error	Bit errors, Loss of pattern sync
	OC-12			Alarm Detection	
	STS-3c-Xv	X = 1 to 4		VCAT Error/Alarms	Sequence monitoring, and status monitoring is done per member simultaneously
	STS-1-Xv	X = 1 to 12			
	OC-3			Delay Measure	0 to 256 ms Per member simultaneous
	STS-1-Xv	X = 1 to 3		Delay Generate	Hitless (0 to 256 mS) Per member simultaneous Instant (0 to 256 mS) Per member simultaneous
LO VCAT	STM-64, STM-16, STM-4			Operations	Change channel #, add channel before Selectable per VCAT Member
SDH Mappings*	AU4-TUG3-TUG2-VC2-Xv	X = 1 to 64		VCAT Member	Selectable channel, Delete channel, Delay (ms), Frame Delay, Pointer Delay, Increment Pointer, Hitless Delay (ms), Hitless Frame delay, Hitless Pointer delay, Chane Seq#, Insert LOM, Insert OOM1, Insert OOM2, Sequence Number*
	AU4-TUG3-TUG2-VC12-Xv	X = 1 to 64			
	AU4-TUG3-TUG2-VC11-Xv	X = 1 to 64			
	AU3-TUG2-VC2-Xv	X = 1 to 64			
	AU3-TUG2-VC12-Xv	X = 1 to 64			
	AU3-TUG2-VC11-Xv	X = 1 to 64			
	STM-1				
	AU4-TUG3-TUG2-VC2-Xv	X = 1 to 21			
	AU4-TUG3-TUG2-VC12-Xv	X = 1 to 63			
	AU4-TUG3-TUG2-VC11-Xv	X = 1 to 64			
	AU3-TUG2-VC2-Xv	X = 1 to 21			
	AU3-TUG2-VC12-Xv	X = 1 to 63			
	AU3-TUG2-VC11-Xv	X = 1 to 64			
	STM-0				
	AU3-TUG2-VC2-Xv	X = 1 to 7			
	AU3-TUG2-VC12-Xv	X = 1 to 21			
	AU3-TUG2-VC11-Xv	X = 1 to 28			
	<i>*Members can be in any available AU-3 or Au-4</i>				
SONET Mappings*	OC-192, OC-48, OC-12				
	VT-6-Xv	X = 1 to 64			
	VT-2-Xv	X = 1 to 64			
	VT-1.5-Xv	X = 1 to 64			
				Operations	Delete All, Reset SEQ #s
				Selectable per	Clear operations – items form list above
				All Members (VCG)	
					<i>*Note: When LCAS is enabled, manual sequence number edit is disabled</i>

VIRTUAL CONCATENATION PARAMETERS

Max # of Members Allowed per VCAT Mapping

Max # of Delays per VCAT Member

Interface Rate SONET/SDH	SONET Mapping	SDH Mapping	Max # of (Xv) Members	Maximum Pointer Delays	Maximum Frame Delays	Maximum Combined Delay (ms)
10G OC-192/STM-64	STS-3c-Xv	VC-4-Xv	24	782	2047	255.99984
	STS-1-Xv	VC-3-Xv	24	782*	2047	255.99984
	VT-6-Xv	VC-2-Xv	64	427	511	255.99883
	VT-2-Xv	VC-12-Xv	64	139	511	255.99643
	VT-1.5-Xv	VC-11-Xv	64	103	511	255.99519
2.5G OC-48/STM-16	STS-3c-Xv	VC-4-Xv	16	782	2047	255.99984
	STS-1-Xv	VC-3-Xv	24	782*	2047	255.99984
	VT-6-Xv	VC-2-Xv	64	427	511	255.99883
	VT-2-Xv	VC-12-Xv	64	139	511	255.99643
	VT-1.5-Xv	VC-11-Xv	64	103	511	255.99519
622M OC-12/STM-4	STS-3c-Xv	VC-4-Xv	4	782	2047	255.99984
	STS-1-Xv	VC-3-Xv	12	782*	2047	255.99984
	VT-6-Xv	VC-2-Xv	64	427	511	255.99883
	VT-2-Xv	VC-12-Xv	64	139	511	255.99643
	VT-1.5-Xv	VC-11-Xv	64	103	511	255.99519
155M OC-3/STM-1	STS-1-Xv	VC-3-Xv	3	782*	2047	255.99984
	VT-6-Xv	VC-2-Xv	21	427	511	255.99883
	VT-2-Xv	VC-12-Xv	63	139	511	255.99643
	VT-1.5-Xv	VC-11-Xv	64	103	511	255.99519
52M OC-1/STM-0	VT-6-Xv	VC-2-Xv	7	427	511	255.99883
	VT-2-Xv	VC-12-Xv	21	139	511	255.99643
	VT-1.5-Xv	VC-11-Xv	28	103	511	255.99519

*(764 for AU-4)

LCAS

Complies with the following standards: ITU-T G.707, G.7042, and ANSI T1.105.02-2001.

LCAS Feature Description:
 Each member of the Tx Virtual Container Group (VCG) is supported by a Source state machine. Each member of the Rx VCG is supported by a Sink state machine. Thus, simultaneous testing of a DUT Source and Sink capability is possible. Automatic mode allows the NIC Source to automatically respond to Sink Member Status (MST) and Re-Sequence Acknowledge (RS-Ack). Similarly, the NIC Sink will respond automatically to received CTRL commands and sequence numbers.

LCAS Feature Summary:
 - LCAS for High and Low Order VCAT Mappings
 - A complete test solution for Low Order LCAS testing including full source and sink functionality - Supports LCAS Protocol Emulation
 - Supports VCAT mappings with a payload type of PRBS, GFP-F, or GFP-T - Supports from 1 to 63 Low Order or 1 to 24 High Order VCAT members (dependent on interface/mapping configuration)
 - Generation of Control Packets
 - Supports manual Source and Sink state machine emulation
 - Supports the monitoring and evaluation of control packets
 - Supports selectable Sink Hold Off and Wait to Restore parameters
 - Supports plain text State Machine Trace Logs
 - Supports analysis of Source PLCT, TLCT, LOCT, Mo MST, dUMST conditions - Supports analysis of Sink PLCR, TLCR, LOCR, dSQNC, NON- LCAS conditions - Supports simultaneous graphical per member Source and Sink results

LCAS SPECIFICATIONS

Source State Machine Control (Per Member)	Management command: ADD, ADDN, ALL, REMOVE, REMOVEV, REMOVEALL
Source State Machine Status Member)	Transmitted Sequence Number; Transmitted Control Word – ADD, NORM, EOS, IDLE, (Per DNU, FIXED; Machine State – IDLE, NORM, DNU, ADD, REMOVE; Received Member Status – OK, FAIL; Active Payload Count, RS-ACK Count, RS-ACK Timeout Count
Source State Machine Meas.	No MST seconds, dUMST - Persistent unexpected MST count seconds (Per Member)
Source State Machine Meas. Members)	LOCT - Loss of Capacity Transmit seconds PLCT - Partial Loss of Capacity Transmit (All seconds, TLCT - Total Loss of Capacity Transmit seconds

Sink State Machine Control	Sk automatically detects LCAS is being used and configures Sk state (All Members)
Sink State Machine Control Members)	Management Command: ADD, ADDN, ADD ALL, REMOVE, REMOVEV, REMOVEALL; (Per Hold off time, wait to restore time
Sink State Machine Status (Per Member)	RS-Ack count; Active Payload Count; Machine State - OK, FAIL, IDLE; Received Sequence Number; Received Control Field - ADD, NORM, EOS, IDLE, DNU, FIXED
Sink State Machine Meas.	Non LCAS seconds (Per Member)
Sink State Machine Meas.	LOCR - Loss of Capacity Receive seconds; (All Members) PLCR - Partial Loss of Capacity Receive seconds; TLCR – Total Loss of Capacity Receive seconds; dSQNC – Inconsistent Sequence Number seconds
Source and Sink Machine Trace (All Members)	A state machine trace capability provides State the ability to log the state machines state and transitions from state to state in clear text. All state machines or a specific member of the VCG may be traced. This feature allows the verification of the DUT LCAS protocol implementation as well as a debug tool for researching protocol errors.

Each Source trace entry contains the following information:

Member Number; Time stamp; Transmitted Sequence Number; Transmitted Control Field – ADD, NORM, EOS, IDLE, DNU; Source State Machine State – IDLE, NORM, DNU, ADD, REMOVE; Received Member Status – OK, FAIL; Received Re-sequence acknowledge (RS-Ack)

Each Sink trace entry contains the following information:

Member Number; Time stamp; Received Sequence Number; Received Control Field – ADD, NORM, EOS, IDLE, DNU; Sink State Machine State – IDLE, NORM, DNU, ADD, REMOVE; Transmitted Member Status – OK, FAIL; Transmitted Re-sequence acknowledge (RS-Ack)

KEY VIRTUAL CONCATENATION & LCAS FEATURES

- Higher and lower order mapping support
- Differential delay generation and measurement
- Error detection / generation per VCG member
- Alarm detection & generation per VCG member
- LCAS control packet generation
- Source and sink machine state emulation
- LCAS protocol trace
- LCAS Control Packet error generation and detection

GFP SPECIFICATIONS

Standards Compliance	ITU-T G.7042	Alarm Types Displayed	LOCS, LOCCS, LFD (Loss of Frame Delineation)
Generic Framing Procedure Types	GFP Bulk – full payload rate generation and analysis of GFP frames with PRBS payload Frame-mapped GFP (GFP-F) Transparent-mapped GFP (GFP-T)	User Programmable Controls	PTI – automatically set based on the type of frame generated, Client Data or management/alarm PFI – pFCS enabled or disabled
Supported Interfaces	SONET/SDH: STM-64, OC-192, STM-16, OC-48, STM-4, OC-12, STM-1, OC-3, STM-0, OC-1 OTN: OTU-1 with ODU-1 Mapping, OTU-2 with ODU-2 or ODTU-12 Add/Drop Mapping		EXI – Null extension header or linear frame UPI – automatically based on the GFP mode enabled CID
Supported Mappings for GFP Bulk and GFP-F	AU-4-64c, AU-4-16c, AU-4-4c, AU-4 C-4, AU-3 C-3, STS-192c, STS-48c, STS-12c, STS-3c, STS-1 VC-4-Xv, VC-3-Xv, STS-3c-Xv, STS-1-Xv, VC-2-Xv, VC-12-Xv, VC-11-Xv, VT-6-Xv, VT-2-Xv, VT-1.5-Xv ODU-1, ODU-2	Error Insertion	Single error and rates
Supported Mappings for GFP-T	AU-4-16c, STS-48c VC-4-Xv, VC-3-Xv, STS-3c-Xv, STS-1-Xv, ODU-1	Error Types	Correctable (cHEC)
Conditions Displayed	Per port Results: TX Packets, Packets/sec, Bytes, Mbit/sc/ %BW, Super Blocks (GFP-T only) RX Packets, Packets/sec, Bytes, Mbit/sc/ %BW, Super blocks (GFP-T only)	Alarm Insertion	LOCS, LOCCS, LFD
Error Types Displayed	(error count, errored seconds, average and current error rate for each type) Correctable and uncorrectable cHEC (Core header) Correctable and uncorrectable tHEC (Payload type) Correctable and uncorrectable eHEC (extended header)	Payload	GFP Bulk: PRBS31, 32-Bit User Pattern GFP-F, GFP-T.
		Overhead monitor	Free-running capture and display of PLI, PTI, PFI, CID, EXI, UPI and Spare bytes.

GFP KEY FEATURES

- Support for full Ethernet payload testing
- GFP-T, GFP-F, GFP Bulk testing
- GFP overhead configuration
- Free-running overhead monitoring
- Alarm generation and monitoring
- Error generation and monitoring
- Mapping into SDH/SONET, Virtual Concatenation Groups (VCGs), OTN

ALL PATH TEST FEATURES

DESCRIPTION

Simultaneous Testing

Testing all high-path containers/SPEs simultaneously - even with STS-1 Bulk/ C-3 Bulk mappings, up to 192 simultaneous tests, including Bit Error Rate.

Each path can be configured separately with any test pattern.

Mixed Mapping Support

The All Path Testing Test Option supports any combination of high-path mapping types, homogeneous and mixed, simultaneously.

Auto-Configure

The auto config feature will detect any combination of high-path mapping types. If these AU/Containers/SPEs are bulk filled mappings with standard PRBS pattern, then payload type will also be detected. The auto-configure will then setup both transmit and receive to match the detected mapping types and begin testing.

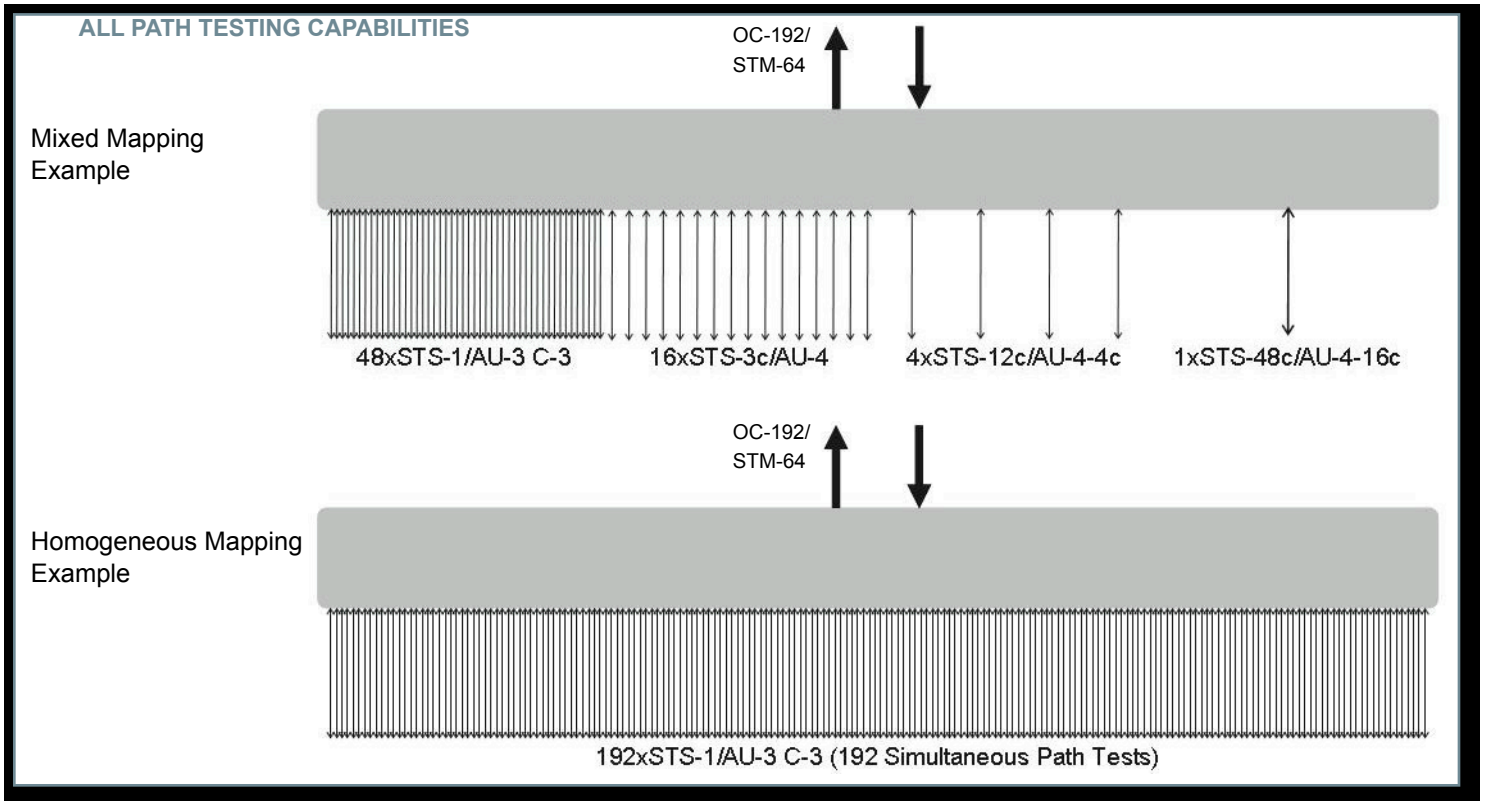
Simultaneous Service Disruption Measurement

With all Bit Error Rate tests running simultaneously, the NIC can also be configured to measure service disruption events on all paths simultaneously.

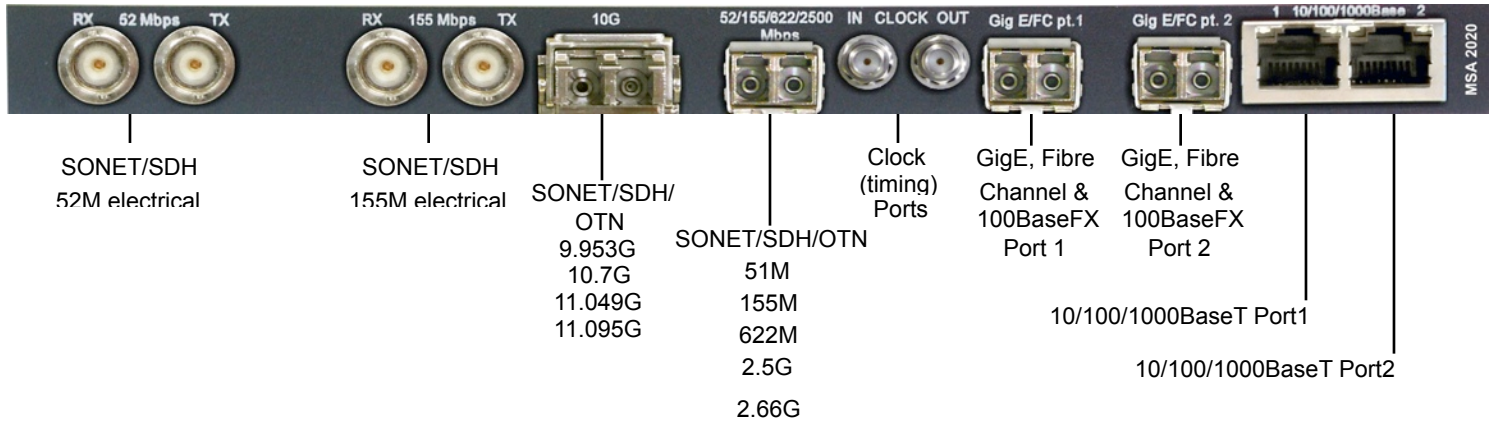
With selectable criteria, All Path Testing detects single or multiple disruptions, reporting the latest event, shortest, longest and average events.

FUNCTIONS

Rates	STM-64/OC-192, STM-16/OC-48, STM-4/OC-12, STM-1/OC-3
Mapping	AU-4-64c, AU-4-16c, AU-4-4c, AU-4, AU-3 C-3, STS-192c, STS-48c, STS-12c, STS-3c, STS-1
TX Payload	Payload may be specified for each container: PRBS9, PRBS9inv, PRBS11, PRBS11inv, PRBS15, PRBS15inv, PRBS20, PRBS20inv, PRBS23, PRBS23inv, PRBS31, PRBS31inv, User Defined.
RX Payload	Payload may be specified for each container: PRBS9, PRBS9inv, PRBS11, PRBS11inv, PRBS15, PRBS15inv, PRBS20, PRBS20inv, PRBS23, PRBS23inv, PRBS31, PRBS31inv, User Defined
Simultaneous Error Detection	On all paths: Bit, B3, REI, TC-IEC, TX-REI, TC-OEI
Simultaneous Alarm Detection	On all paths: AIS, RDI, LOP, UNEQ, TC-RDI, TC-ODI, TC-AIS
Simultaneous Monitoring	Of all paths: Overhead, J1 Trace, Tandem Connection Trace, Pointer justifications, NDF
Parallel Service Disruption Criteria	For individual paths: AIS-P, PRBS independently selected per container/SPE



CONNECTOR PANEL LAYOUTS



ORDERING INFORMATION

Base Modules - MSA 2020 SONET/SDH Bundle:

- MSA 2020 155M to 52M, 1310nm SFP standard - [NL51](#)
- MSA 2020 622M to 52M, 1310nm SFP standard - [NL61](#)
- MSA 2020 2.5G to 52M - [NL71](#)(1310), [NL71b](#)(1550)
- MSA 2020 2.5G to 52M, no optics, sold only with jitter module - [NL78](#)
- MSA 2020 10G to 52M, [NL81](#)(1310/1310), [NL81b](#)(1310/1550), [NL81c](#)(1550/1550)
- MSA 2020 10G only - [NL84](#)(1310), [NL84b](#)(1550)
- MSA 2020 10G only, no optics, sold only with Jitter Module - [NL88](#)

Base Modules - MSA 2030 SONET/SDH Bundle:

- MSA 2030 155M to 52M, 1310nm SFP standard - [N51](#)
- MSA 2030 622M to 52M, 1310nm SFP standard - [N61](#)
- MSA 2030 2.5G to 52M - [N71](#)(1310), [N71b](#)(1550)
- MSA 2030 2.5G to 52M, no optics, sold only with jitter module - [N78](#)
- MSA 2030 10G to 52M, [N81](#)(1310/1310), [N81b](#)(1310/1550), [N81c](#)(1550/1550)
- MSA 2030 10G only - [N84](#)(1310), [N84b](#)(1550)
- MSA 2030 10G only, no optics, sold only with Jitter Module - [N88](#)

Base Modules - MSA 2020 Ethernet Bundle:

- MSA 2020 Ethernet, 850nm SFP (x2) / 1310nm XFP - [NE81](#)

ATM Module (add to any MSA module):

- ATM Testing daughter board - [C9](#)

Optical modules available:

- 100BaseFX - 1310nm SFP GigE/Fibre Channel - 850nm SFP
- GigE/Fibre Channel - 1310nm SFP
- GigE/Fibre Channel - 1550nm SFP
- SONET/SDH/OTN 2.66G to 52M - 1310nm SFP
- SONET/SDH/OTN 2.66G to 52M - 1550nm SFP
- SONET/SDH/OTN 10/10.7/11.049/11.095 - 850nm XFP
- SONET/SDH/OTN 10/10.7/11.049/11.095 - 1310nm XFP
- SONET/SDH/OTN 10/10.7/11.049/11.095 - 1550nm XFP

Test Options for SONET/SDH Bundle modules:

- 10/100/1000BaseT Test Option
- GigE plus 10/100/1000BaseT Test Option
- 10G Ethernet LAN (10.3G) Test Option

Test Options for Ethernet Bundle modules:

- Add SONET/SDH Testing 10G-52M (requires SFP+XFP)
- Add SONET/SDH Testing 2.5G-52M (requires SFP)
- Add SONET/SDH Testing 622M-52M (requires SFP)
- Add SONET/SDH Testing 155M-52M (requires SFP)
- Add SONET/SDH Testing 10G-Only (requires XFP)

Test Options for all modules:

- 10G Ethernet WAN (9.9953G) Test Option
- 10G Ethernet over OTN OTU-1e (11.049G) / OTU-2e (11.095G) Test Option
- 10G Fibre Channel over OTN OTU-1f (11.27G) / OTU-2f (11.3G) Test Option
- 1/2G Fibre Channel Test Option
- 4G Fibre Channel Test Option
- 8G Fibre Channel Test Option
- 10G Fibre Channel Test Option
- OTU-1 (2.66G) Test Option
- OTU-2 (10.7G) Test Option
- ODU Multiplexing Test Option
- GFP over OTN Mapping Test Option
- Generic Framing Procedure (bulk/framed) Test Option
- Generic Framing Procedure-Transparent Test Option
- Virtual Concatenation (VCAT) High-Order Test Option
- Virtual Concatenation (VCAT) Low-Order Test Option
- Link Capacity Adjustment Scheme (LCAS) Test Option
- All Path Testing™ Test Option
- Ethernet 100BaseFX Test Option



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