



WHAT CAN THE NIC DO FOR YOU?

NIC PLATFORM BROCHURE

NETWORK INFORMATION COMPUTER (NIC)

Modular platform for telecom / datacom testing



KEY FEATURES

- Available with battery power option
- Simultaneous and independent testing of multiple ports and multiple streams
- One-box solution for telecom and datacom testing
- Support for multiple bit rates and protocols in a single chassis
- Easy-to-use Graphical User Interface (GUI)
- Remote control GUI included
- Modular, upgradeable design provides investment protection
- Three-year warranty
- Free 24-hour technical support

The NIC is a scalable solution for verifying and qualifying the performance of today's multi-protocol global communications networks.

With a flexible software/firmware-based architecture, the scalable NIC Plus combines in a single platform the multitude of traditional hardware-based test sets required to install, maintain, and monitor high-speed multi-protocol networks.

The NIC is designed to grow as your network grows, and as technologies change.

The NIC products support a variety of test applications for the transport network.

- 100G Ethernet
- OTN up to 112Gbps
- SONET/SDH up to 40Gbps
- NextGeneration (VCAT, LCAS, GFP)
- PDH/T-Carrier
- Ethernet 10/100/1000 Base T, Gigabit Ethernet, 100 Base FX
- 10GigE (LAN, WAN)
- Fibre Channel 1-10Gbps
- ATM
- Jitter/Wander testing
- Optical Spectrum Analyzer

Multiple Chassis Options



NIC NXG



NIC Plus



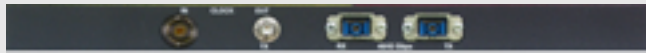
NIC EP

AVAILABLE MODULES

CSA 4100

The CSA 4100 100G Service Analyzer Module delivers the tools you need in order to fully deploy 40G and 100G networks. License SONET/SDH, OTN and Ethernet options as they are required by your rollout, when and where you need them.

MSA 4043



A NIC with MSA 4043 module (Multi-Service Analyzer - 40/43G) is the industry's smallest/lightest 40/43G test solution. NIC Plus / NIC EP can optionally support dual 40/43G testing or provide 1.5M to 43G & Ethernet test in one chassis.

MSA 2020A / 2030A



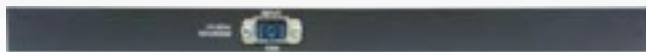
The MSA 2020A and 2030A (Multi-Service Analyzer) modules are available with SONET/SDH testing up to 10G + optional OTN, Ethernet 10/100/1000, GigE, 10GigE LAN/WAN, 100BaseFX, ATM, Fibre Channel, GFP, VCAT, and LCAS.

SSA 1220



The SSA 1220 (Synchronous Service Analyzer) module provides cost-effective SONET/SDH testing from 51M to 10G plus optional OTN, ATM capability and All Path Testing™.

OSA 3010/3020/3030



The OSA 3010 (C-Band), OSA 3020 (L-Band) and OSA 3030 (L-Band and C-Band) are Optical Spectrum Analyzer modules, providing DWDM network testing for the NIC platforms.

HDE 1201/1301



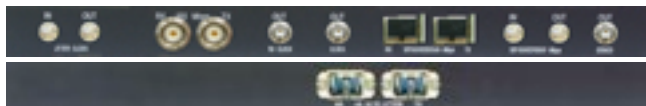
Test up to eight 10/100/1000 ports, four optical GigE ports and one 10GigE port (10GigE in HDE 1301 only), four 1G/2G fibre channel ports. Test up to 48 ports in a single NIC Plus or EP chassis.

PDH 1010/1020 (PDH/T-Carrier)



DS1/E1/E3/DS3/E4 testing with dual DS1/E1 ports, simultaneous and independent testing across all ports and optional jitter and wander (1020 module only).

JWA 2010/2025 (Jitter/Wander)



For Jitter and Wander testing at 51M, 155M, 622M, 2.5G, 2.66G, 10G and 10.7G the jitter modules with Digital Phase Analysis feature industry-standard ITU-T O.172 and O.173 testing.

FibreVu Probe

A digital video inspection probe for visualization of connector end-faces and detection/analysis of connector defects, the FiberVu Probe operates with a PC or with new NIC Platform products.



Network Impairment Observer (NIO)

The NIO application monitors Digital Lightwave NICs, and enables a single user to check on the status of multiple NICs at the same time. It also provides a quick access method to NICs that need to be investigated. Simply click on a single NIC in the list and NIO will launch the Remote GUI, with full control of the NIC. Multiple Remote GUI applications can be run simultaneously.



AVAILABLE MODULES

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 generation and test.
- Overhead Byte Capture
- Full overhead access/manipulation
- Intrusive/non-intrusive through mode
- GFP mapping
- Support for 10G Ethernet payload (OTU1e/2e, ITU Supp.43)
- 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

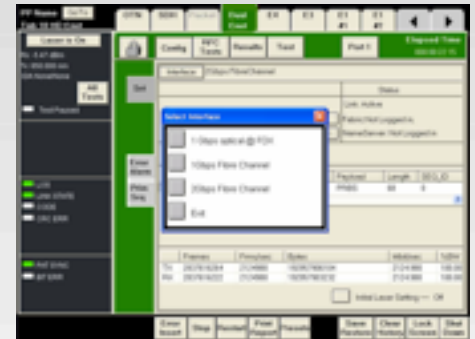
- Available with 10GigE LAN/WAN and 10GigE FEC (OTU-1e, OTU-2e)
- Dual port GigE, 10/100/1000BaseT and 100BaseFX
- Supports RFC 2544 and RFC 1242 Benchmarking with Throughput, Frame Loss, Latency, Back-to-Back Burst and Round-Trip Delay testing
- Up to 32 simultaneous streams per port
- Rate setting 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
- 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



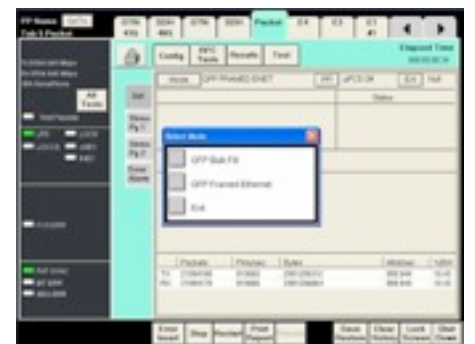
Asynchronous Transfer Mode (ATM) Testing

- Asynchronous Transfer Mode testing on any interface with payload up to 622M.
- 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

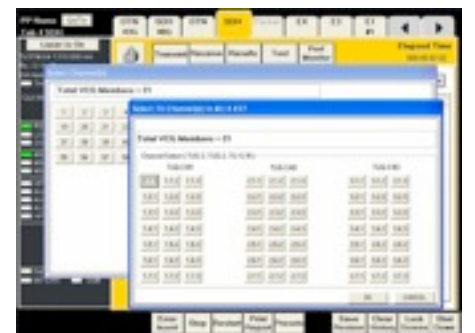
- GFP-F, GFP-T and GFP Bulk
- Supports full Ethernet test functionality including the following:
 - 32 independent test streams
 - Supports RFC 2544 Benchmarking with Throughput, Frame Loss, Back- to-Back Burst testing
 - IP reflection mode enables RFC testing through routers
- Rate setting by interpacket 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:
 - Automatic Source and Sink state machine emulation
 - Monitoring and evaluation of Control
 - Packets
 - Plain text State Machine Trace
 - LCAS Protocol Emulation



CSA 4100 - 40G/100G TEST MODULE

100G. More than just Ethernet.

Daunted by the complexity of 100G Ethernet and OTN networks?

The NIC CSA 100G Service Analyzer Module delivers the tools you need in order to fully deploy 40G and 100G networks utilizing the famed easy-to-use features and intuitive usability of the NIC platform.

Upgrade your existing NICs to support high speed 100G testing or equip new portable or network embedded NICs with your choice of features.

License SONET/SDH, OTN and Ethernet options as they are required by your rollout, when and where you need them.

However you use, it rest assured that the NIC takes the complexity out of delivering your 100G network.

KEY FEATURES

- Multi-protocol support
- Software-deliverable protocol support to meet roll-out schedules
- 40G SONET/SDH compliant with ITU-T G.707 Amend. 2.
- 40G/100G Ethernet compliant with IEEE 802.3ba
- 40G OTL3.4 / 100G OTL 4.10 OTN compliant with ITU-T G.709
- Compliant with CFP MSA 1.4
- Physical layer testing including unframed BERT, PCS BERT and skew generation & measurement
- Interoperable with lower speed NIC modules for end to end circuit testing
- Full featured multi-stream Ethernet testing
- Support for full ODU multiplexing structure
- Support for GFP mappings
- Demultiplex and test from 100G to DS1/E1 channels
- Easy to use GUI for lab and field testing
- Upgrade current NIC hardware to 100G bit-rates

OPTICAL INTERFACE

Interface Type	CFP
Bit rates:	STM-256/OC-768 39.813 Gbps OTU-3 43.018 Gbps 40G Base-R 41.250 Gbps OTU-4 111.809 Gbps 100G Base-R 103.125 Gbps

INTERFACE SPECIFICATIONS

Timing	Internal, external, recovered
Internal Clock	Stratum III compliant (± 4.6 ppm)
External Clock	1.544Mb/s, 2.048Mb/s (BITS/SETS) 2.048 Mb/s via Bantam connector (120 ohm balanced); 8KHz/1.544/2.048/10 MHz via 75-ohm TTC BNC (unbalanced)
Frequency Offset	Tx timing ± 100 ppm, in 0.1 ppm increments
Input Freq. Meas.	± 100 ppm

UNFRAMED BERT

Configuration	4 Lane BERT, 10 Lane BERT.
Bit Rates	40G (4 Lane), 41G (4 Lane), 43G (4 Lane), 103G (10 Lane), 112G (10 Lane).
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. Patterns configured independently per lane.
Test Pattern Seeding	Synchronous, independent.

Error Detection	Bit error count across all lanes. Bit error count per lane. Current bit error rate lane. Average bit error rate per lane.
Error Generation	Bit errors on selected lane. Bit errors on defined lane group. Bit errors on all lanes.
Alarm Generation & Measurement	LOS, Loss of pattern sync.

* Requires additional module

FRAMED PCS BERT

Configuration	41Gbps, 4 Virtual Lanes, 4 Optical Lanes. 103G, 20 Virtual Lanes, 10 Optical Lanes.	Error Detection	Bit error count across all lanes, bit error count per lane, bit current error rate per lane, average bit error rate per lane. BIP-8 error count across all lanes, BIP-8 error count per lane, current BIP-8 error rate per lane, average BIP-8 error rate per lane.
Lane Mapping	Any virtual lanes to any physical lane. Rotated lane mapping.		
Lane Skew	Lane skew measurement per lane. Lane skew generation across any optical lanes. Skew limits range from 0 to 65,000. De-skew tolerance from 0 to 65,000. 41G resolution - 3 bits, 103G resolution - 64 bits.		Invalid Sync Header error count across all lanes, Invalid Sync Header error count per lane, current Invalid Sync Header error rate per lane, average Invalid Sync Header error rate per lane. Invalid Alignment Marker error count across all lanes, Invalid Alignment Marker error count per lane, current Invalid Alignment Marker error rate per lane, average Invalid Alignment Marker error rate per lane. Block error count, current block error rate, average block error rate.
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. Patterns configured independently per lane.	Alarm Generation	Pattern Sync Loss per lane, Loss of Block Lock, Loss of Alignment Marker.
Test Pattern Seeding	Synchronous, independent.	Alarm Measurement	Pattern Sync Loss per lane, Loss of Block Lock, Loss of Alignment Marker, Excessive Skew.
Error Generation	Bit errors, BIP-8 errors, Block error, Invalid Sync Header errors, Invalid Alignment Marker errors.		
Error Generation Modes	Per selected lane, all lanes.		

ETHERNET PCS

Interface	40G Base-R, 4 Virtual Lanes, 4 Optical Lanes. 100G Base-R, 20 Virtual Lanes, 10 Optical Lanes.	PCS Error Detection	BIP-8 error count across all lanes, BIP-8 error count per lane, current BIP-8 error rate per lane, average BIP-8 error rate per lane. Invalid Sync Header error count across all lanes, Invalid Sync Header error count per lane, current Invalid Sync Header error rate per lane, average Invalid Sync Header error rate per lane. Invalid Alignment Marker error count across all lanes, Invalid Alignment Marker error count per lane, current Invalid Alignment Marker error rate per lane, average Invalid Alignment Marker error rate per lane. Block error count, current block error rate, average block error rate.
Lane Mapping	Any virtual lanes to any physical lane. Rotated lane mapping.		
Lane Skew	Lane skew measurement per lane. Lane skew generation across any optical lanes. Skew limits range from 0 to 65,000. De-skew tolerance from 0 to 65,000. 41G resolution - 3 bits, 103G resolution - 64 bits.		
PCS Error Generation	BIP-8 errors, Block error, Invalid Sync Header errors, Invalid Alignment Marker errors.	PCS Alarm Generation	Pattern Sync Loss per lane, Loss of Block Lock, Loss of Alignment Marker.
PCS Error Generation Modes	Per selected lane, all lanes.	PCS Alarm Measurement	Pattern Sync Loss per lane, Loss of Block Lock, Loss of Alignment Marker, Excessive Skew.

ETHERNET PACKET SPECIFICATIONS

Frame Type	Statistics and generation of Ethernet frames with UDP/IP, IPv4	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.
Results/Statistics	Received optical power, LOS, link state, collision 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	Per-Stream Transmit Statistics	Transmitted bandwidth %, transmitted packet bytes count
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	Per-Stream Receive Statistics	Received bandwidth %, Received packets/byte count, out-of-sequence packets, bit errors, latency (minimum, maximum, and average in ms)
LED Indicators	LOS, link state and pattern sync alarms, FCS, code, and payload BIT errors, sequence errors.	Alarm Detection	Link fault, pattern sync.
Traffic Stream Generation/Analysis	32 independently configurable traffic generation and analysis stream.	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
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, 4 sVLAN stacked tags, 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	Error Insertion	FCS, IP checksum, sequence: single, 1e-2 to 1e-7; bit: single, 1e-3 to 1e-10; line code: single
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	APS Measurements	Maximum, minimum, average, and current protection switch times in ms; user-definable guard band thresholds for filtering receive traffic
Per-Port Tx Statistics	Transmitted packets, packets per second, transmitted bytes, Mbps, % bandwidth of transmitted packets/bytes	Advanced Ping Functionality	Selectable MAC source, IP source and IP destination, number of Ping attempts, Timeout (1-5 sec.), Packet size (64-16000 bytes), Time to live (1-255); Last 4 responses displayed in Ping response window; Full statistics of Ping operation displayed in the Ping Statistics section
		IP Reflection	User-selectable, can reflect all unicast packets or only packets created by Digital Lightwave test instrument

* Some functions may require additional module

ETHERNET PACKET SPECIFICATIONS (CONTINUED)

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 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
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	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

OTN

Configuration	OTL3.4 43Gbps, 4 Virtual Lanes, 4 Optical Lanes. OTL4.10 112Gbps, 20 Virtual Lanes, 10 Optical Lanes.	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, FW-SD, FW-SF, BW-SD, BW-SF.
Lane Mapping	Any virtual lanes to any physical lane. Rotated lane mapping.	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, FW-SD, FW-SF, BW-SD, BW-SF.
Lane Skew	Lane skew measurement per lane. Lane skew generation across any optical lanes. Skew limits range from 0 to 65,000. De-skew tolerance from 0 to 65,000. 43G resolution - 3 bits, 112G resolution - 64 bits.	Intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify OTN overhead bytes and generate errors and alarms
Multi-lane Alarm Generation	LOL, LOFOTL, OOFOTL, Generic AIS.	Service Disruption Measurement	Criteria: OOF, OTU(SM):AIS, OTU(SM):BIP8, ODU(PM):AIS, ODU(PM):BIP8, BIT errors; Resolution (one frame duration): OTU-3 is 3.035µs; OTU-4 is 1.168µs.
Multi-lane Alarm Measurement	LOL, LOFOTL, OOFOTL, Generic AIS, Excessive Skew.	Round-Trip Delay	Supported for OTN; OTU-3 resolution is 3.035µs; OTU-4 resolution is 1.168µs.
OTN Mapping	Null Client, Synchronous SONET/SDH, Asynchronous SONET/SDH, GFP, 10G Ethernet, 10G Fibre Channel.	OTN overhead monitor	OTU OH: all bytes ODU OH: all bytes OPU OH: all bytes OTU OH: OA1, OA2, GCC0-1, GCC0-2, Res-1, Res-2, SAPI (trace), DAPI (trace), operator specific (trace) ODU OH: Forward FTFL, Backward FTFL, SAPI (trace), DAPI (trace), operator specific (trace), STAT, GCC1-1, GCC1-2, GCC2-1, GCC2-2, APS/PCC-1, APS/PCC-2, APS/PCC-3, APS/PCC-3, TCM/ACT, Res-1, Res-2, Res-3, Res-4, Res-5, Res-6, Res-7, Res-8, Res-9 OPU OH: PT (PSI-0) justification control
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	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: 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)
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	Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual	
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		
Error Generation Rate	BIT/Frame: Single, 10 ⁻¹⁰ to 10 ⁻³ , user-programmable; Other errors: Single, 10 ⁻¹⁰ to maximum, user-programmable.		
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. Burst Period: 0 to 1048575 Frames.		

* Some functions may require additional module

SONET/SDH

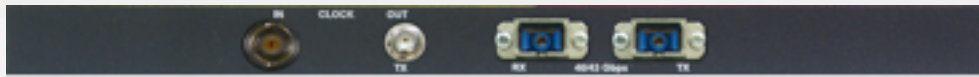
Configuration	STL256.4 40Gbps, 4 Virtual Lanes, 4 Optical Lanes.	Alarm Detection	SONET: LOS, Optical Power Hot, Optical Warm, Optical Power Low, Frequency Wide, OPU Generic AIS, LOF, AIS-L, APS(K1/ Change), SEF, RDI-L, PATT SYNC, PLM-P, CONCAT, AIS-P, LOP-P, UNEQ-P, RDI-P, TIM-P, TIM-S, AIS-V, LOP-V, 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
Lane Mapping	Any virtual lanes to any physical lane. Rotated lane mapping.		
Lane Skew	Lane skew measurement per lane. Lane skew generation across any optical lanes. Skew limits range from 0 to 65,000. De-skew tolerance from 0 to 65,000. Resolution - 3 bits.		
Multi-lane Alarm Generation	LOL, LOFSTL, OOFSTL, Generic AIS.		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
Multi-lane Alarm Measurement	LOL, LOFSTL, OOFSTL, Generic AIS, Excessive Skew.		
SONET Mapping	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 require MSA module.	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 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		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
Payloads Test Patterns	Test pattens, GFP-F, GFP-T 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	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
Service Disruption 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		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
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	OTN overhead monitor	OTU OH: all bytes ODU OH: all bytes OPU OH: all bytes OTU OH: OA1, OA2, GCC0-1, GCC0-2, Res-1, Res-2, SAPI (trace), DAPI (trace), operator specific (trace) ODU OH: Forward FTFL, Backward FTFL, SAPI (trace), DAPI (trace), operator specific (trace), STAT, GCC1-1, GCC1-2, GCC2-1, GCC2-2, APS/PCC-1, APS/PCC-2, APS/ PCC-3, APS/PC-3, TCM/ACT, Res-1, Res-2, Res-3, Res-4, Res-5, Res-6, Res-7, Res-8, Res-9 OPU OH: PT (PSI-0) justification control
Overhead Monitor	Section/RS, Line/MS OH: all bytes; Path/HP OH: all bytes; VT/LP OH: all bytes	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.
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		Any one of the following bytes can be captured:
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)		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)
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		Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual

* Some functions may require additional module

MSA 4043 - 40G TEST MODULE

The 40/43G Testing Module establishes a new industry benchmark for 40/43G testing. The compact NIC 40G chassis, with a single module, is the industry's smallest and lightest 40/43G solution.

In the NIC Plus or NIC EP chassis, the 40/43G module can be combined with other modules providing 1.5M to 43G PDH/T-Carrier, SONET, SDH, OTN, ATM plus Ethernet 10M-10G in a single chassis.



KEY FEATURES

- Smallest, lightest solution for 40/43G testing in NIC 40G chassis
- Dual 40/43G port configuration for bi-directional pass-through mode testing
- Support for SONET, SDH and OTN testing
- Full ODU multiplexing support*
- All-in-one solution for 1.5Mbps - 43Gbps testing + Ethernet 10/100/1000/ GigE/10GigE and NextGeneration (VCAT/LCAS/ GFP) testing*
- NRZ, DPSK codings available to support both line-side and client-side testing
- Supported in existing NIC chassis products.

INTERFACE

Line code	NRZ, Duo-Binary, DPSK
Bit rates	SDH/SONET: STM-256/OC-768 39.813 Gbps OTN: OTU-3 43 Gbps
Connector type	SC
Receiver pulling	±100ppm
Line frequency offset	±100ppm
Optical level (TX)	+3 dBm
TX wavelength	1550nm

MISCELLANEOUS SPECIFICATIONS

SDH/SONET overhead	Section/RS, Line/MS OH: all bytes monitor Path/HP OH: all bytes VT/LP OH: all bytes*
SDH/SONET 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*

OTN overhead monitor	OTU OH: all bytes ODU OH: all bytes OPU OH: all bytes
OTN overhead monitor	OTU OH: OA1, OA2, GCC0-1, GCC0-2, Res-1, Res-2, SAPI (trace), DAPI (trace), operator specific (trace) ODU OH: Forward FTFL, Backward FTFL, SAPI (trace), DAPI (trace), operator specific (trace), STAT, GCC1-1, GCC1-2, GCC2-1, GCC2-2, APS/PCC-1, APS/PCC-2, APS/PCC-3, APS/PCC-3, TCM/ACT, Res-1, Res-2, Res-3, Res-4, Res-5, Res-6, Res-7, Res-8, Res-9 OPU OH: PT (PSI-0) justification control

SONET/SDH FEATURES

Alarm detection	SONET: LOS, Power Hot, Power Warm, Power Low, Frequency Wide, OPU Generic AIS, LOF, AIS-L, APS(K1/K2 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 SDH: LOS, Power Hot, Power Warm, 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-LOF, LP-TC-TIM*, SS MISMATCH G.709 OTN: LOS, Power Hot, Power Warm, Power Low, LOF, OOF, OOM, LOM, OTU:AIS, OTU:IAE, OTU:BIAE, OTU:BDI, OTU:SAPI, OTU:DAPI, ODU:AIS, ODU:OCI, ODU:LCK, ODU:BDI, ODU:SAPI, ODU:DAPI, TCM(1-6):BDI, TCM(1-6):SAPI, TCM(1-6):DAPI, TCM(1-6):BIAE, OPU:PLM
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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* G.709 OTN: LOS, LOF, OOF, LOM, OOM, OTU:AIS, OTU:IAE, OTU:BIAE, OTU:BDI, ODU:AIS, ODU:OCI, ODU:LCK, ODU:BDI, TCM(1-6):BDI, TCM(1-6):BIAE
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* Requires additional module

SONET/SDH FEATURES (CONTINUED)

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* G.709 OTN: Frame (OA1, OA2), MFAS, FEC errors, Uncorrectable FEC errors, OTU:BIP8, OTU:BEI, ODU:BIP8, ODU:BEI, BIT, TCM(1-6):BIP8, TCM(1-6):BEI	Pointer analysis	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)
Error generation	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 G.709 OTN: Frame (OA1, OA2), MFAS, FEC errors, Uncorrectable FEC errors, OTU:BIP8, OTU:BEI, ODU:BIP8, ODU:BEI, BIT, TCM(1-6):BIP8, TCM(1-6):BEI	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
Error/alarm generation	Single insert (errors only) modes Constant generation (alarms only) Programmable rate (errors only) Period m in n frames / m in n ms burst generation	Overhead capture	Triggered capture of up to 256 bytes up to and after the trigger. Configurable capture from RS, MS, HP, LP, OTU, ODU, OPU bytes and pointer movement / OPU justifications. Byte decode performed on all captured data. Trigger event configurable from all errors and alarms or a user specified value within an overhead byte.
TCM (SDH/SONET)	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	Performance Monitoring	Calculates network performance in accordance with international standards GR-253, T1.231, G.821, G.826, G.828, G.829, M.2100, M.2101, M.2110, M.2120 (with graphs)
RTD	Supported for OTN and SDH/SONET signals SDH/SONET resolution: 125 microseconds; OTU-3 resolution: 3 microseconds	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
Service Disruption/Automatic Protection Switching	Supported for all mappings; SONET measures on: LOS, LOF, B1, SEF, AIS-L, AIS-P, AIS-V, BIT errors; resolution is 125 microseconds; SDH measures on: LOS, LOF, B1, OOF, MS-AIS, AU-AIS, TU-AIS, BIT errors; resolution is 125 microseconds; G.709 OTN measures on: LOS, LOF, OOF, OTU:AIS, OTU:BIP8, ODU:AIS, ODU:BIP8, BIT errors; OTU-3 resolution is 3 microseconds;	Mappings	SDH Mappings: AU-4-256c, AU-4-64c, AU-4-16c, AU-4-4c, VC-4, VC-3*, Unframed SONET Mappings: STS-768c, STS-192c, STS-48c, STS-12c, STS-3c, STS-1*, Unframed OTN Mappings: ODU-3, ODU-2, ODU-1, ODU-2 multiplexed into ODU-3, ODU-1 multiplexed into ODU-3, Sync & Async AU-4-256c/STS-768c(and down) mapped into ODU-3, Sync & Async AU-4-64c/STS-192c(and down) mapped into ODU-2, multiplexed into ODU-3, Sync & Async AU-4-16c/STS-48c(and down) mapped into ODU-1, multiplexed into ODU-3*, Unframed.

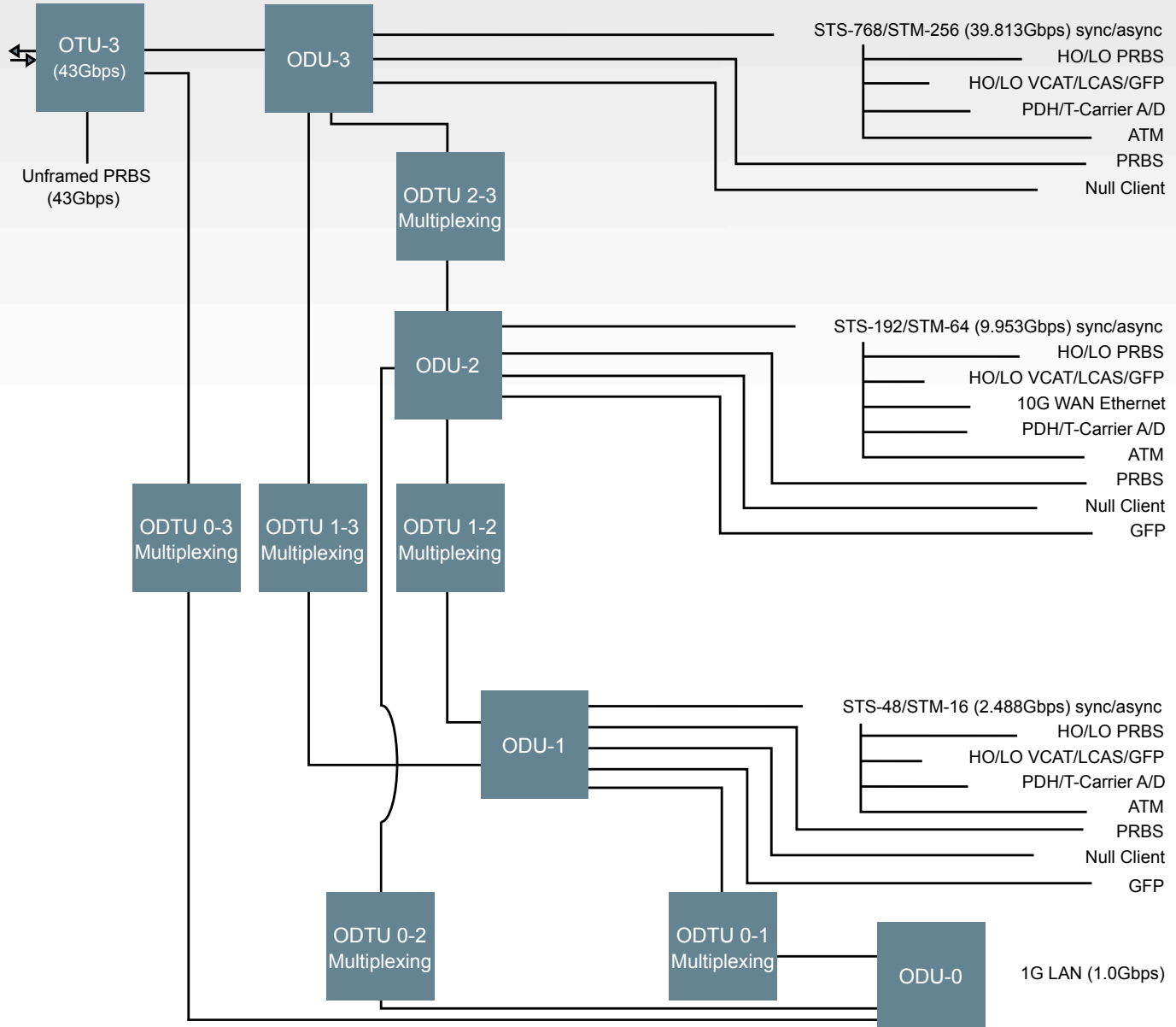
OTN FEATURES

OTN Mapping	Unframed BERT, Framed BERT, Null Client, Synchronous SONET/SDH, Asynchronous SONET/SDH, 10G WAN*, ODTU-03*, ODTU-0123*, ODTU-123*, ODTU-13*, ODTU-23*, GFP Framed*, GFP Bulk*, GFP Transparent*	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-3: 3µs.
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	3 microsecond resolution
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: 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) Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual
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 198.898ms Burst Period: 0 to 3182.409ms		
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.		

* Requires additional module

COMPLETE 43G OTN TESTING SOLUTION

The NIC OTN solution including 43G and MSA modules provides the most complete and flexible OTN solution in the industry with support for the OTN multiplexing hierarchy including transcoded 1000 Base SX mapped into ODU-0 containers.



Ethernet over GFP support with 32 simultaneous streams, RFC 2544 tests, stacked VLAN, QoS, CoS, service disruption and more. See MSA module datasheets for additional information

MSA 2020/2030 MULTI SERVICE ANALYZER

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 supports all the functionality of the MSA 2020 module with the addition of VCAT and LCAS test options for SONET/SDH.

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



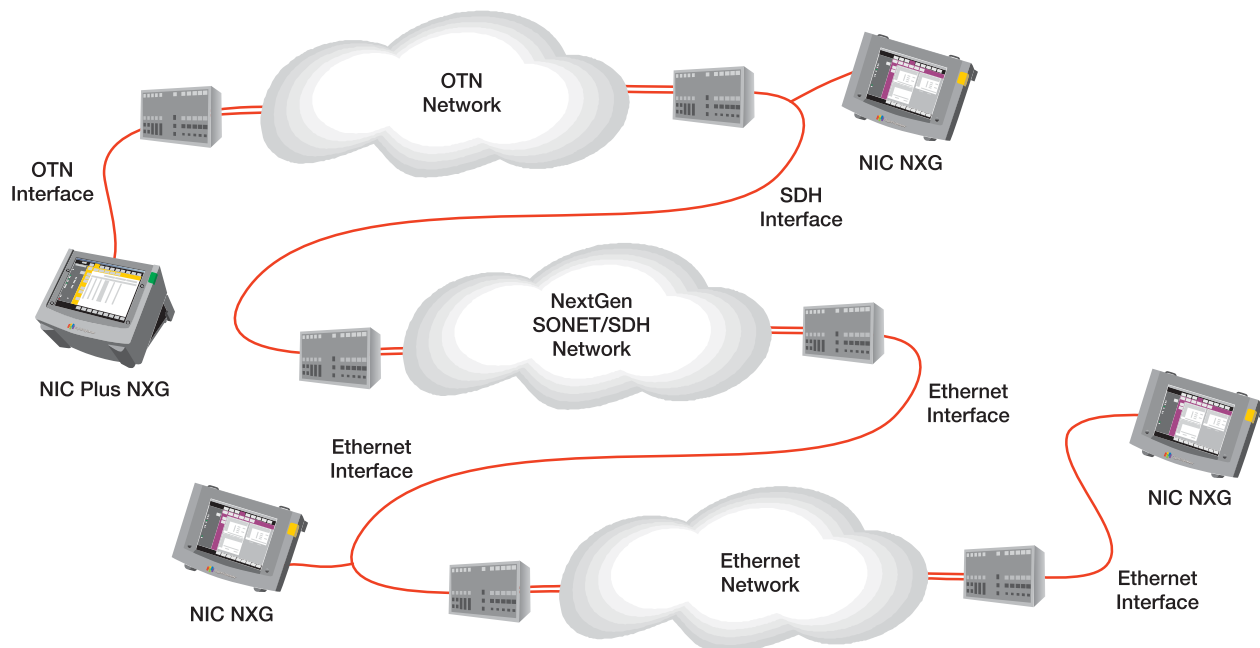
MULTIPLE PROTOCOLS & PROTOCOL MAPPINGS SUPPORTED

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

MULTI-LAYER CIRCUIT TESTING

The MSA 2020/2030 fully supports multi-layer testing. NGN Networks can be tested at each layer of the circuit through either internally de-mapping and analyzing each layer of the test circuit or through the deployment of NICs at different points through the circuit path.

Testing each layer of the circuit is essential in proving the quality of service of the service being delivered to the end customer.



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 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 balanced); 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.	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); Measurement accuracy is one-frame duration; Results displayed in summary column format and decoded tabular format
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	Overhead Control Overhead Monitor Pointer Control Pointer Monitor	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 Section/RS, Line/MS OH: all bytes; Path/HP OH: all bytes; VT/LP OH: all bytes 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 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)
Payloads	Test patterns, GFP-F, GFP-T	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
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		

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; Supported; SONET/SDH resolution is 125 microseconds;
		Round-Trip Delay	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
		Tandem Connection Monitoring	

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 \pm 0.1v

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)

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) Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual
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.		

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		
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)		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
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	OC-192: B1, B2, REI-L, B3, REI-P STM-64: B1, B2, MS-REI, B3, HP-REI
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	Error Injection Rate	Single
Pointer Control	New value, single adjustments (increment or decrement), burst (2-8) adjustments, NDF control	Switch to Protect Measurement	Measure on B1, SEF, OOF, AIS-L, MS-AIS, AIS-P and AU-AIS; 125 microsecond resolution
		Round-Trip Delay (RTD) Measurement	Measurement ranges: 125 microseconds resolution

ETHERNET FEATURES INTERFACES

<p>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)</p>	<p>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</p>
	<p>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</p>
	<p>100 Base FX Ports: 2 SFP user-pluggable modules with LC connector; Duplex Mode: Full duplex; Data Rate: 100Mbps Optional SFP modules available; Tx Level, Tx Wavelength, Rx Level,</p>

PACKET SPECIFICATIONS

<p>Frame Type Statistics and generation of Ethernet frames with UDP/IP, IPv4</p>	<p>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</p>
<p>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</p>	<p>Error Insertion FCS, IP checksum, sequence: single, 1e-2 to 1e-7; bit: single, 1e-3 to 1e-10; line code: single</p>
<p>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</p>	<p>APS Measurements Maximum, minimum, average, and current protection switch times in ms; user-definable guard band thresholds for filtering receive traffic</p>
<p>LED Indicators LOS, link state and pattern sync alarms, FCS, code, and payload BIT errors, sequence errors, remote fault/link fault (10 Gig only)</p>	<p>Advanced Ping Functionality Selectable MAC source, IP source and IP destination, number of Ping attempts, Timeout (1-5 sec.), Packet size (64-16000 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</p>
<p>Traffic Stream Generation/Analysis 32 independently configurable traffic generation and analysis streams, reply to link fault (10 Gig only)</p>	<p>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</p>
<p>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, 4 sVLAN stacked tags, 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</p>	<p>IP Reflection User-selectable, can reflect all unicast packets or only packets created by Digital Lightwave test instrument</p>
<p>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</p>	<p>Port-to-Port Testing Ping, bi-directional bit-error-rate and stream testing; RFC 2544 testing for throughput, frame loss, and latency</p>
<p>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</p>	<p>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</p>
<p>Per-Port Tx Statistics Transmitted packets, packets per second, transmitted bytes, Mbps, % bandwidth of transmitted packets/bytes</p>	<p>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</p>
<p>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.</p>	<p>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</p>
<p>Per-Stream Transmit Statistics Transmitted bandwidth %, transmitted packet bytes count</p>	
<p>Per-Stream Received bandwidth %, Received packets/byte Receive Statistics count, out-of-sequence packets, bit errors, latency (minimum, maximum, and average in ms)</p>	

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 Rx Statistics	Received frame count, byte count, bandwidth % , 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
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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			OC-3	
SDH Mappings	AU-4-VC4-Xv	X = 1 to 24		VT-6-Xv	X = 1 to 21
	AU-3-VC3-Xv	X = 1 to 24		VT-2-Xv	X = 1 to 63
	AU-4-VC3-Xv	X = 1 to 24		VT-1.5-Xv	X = 1 to 64
	STM-16			OC-1	
	AU4-VC4-Xv	X = 1 to 16		VT-6-Xv	X = 1 to 7
	AU3-VC3-Xv	X = 1 to 24		VT-2-Xv	X = 1 to 21
	AU-4-VC3-Xv	X = 1 to 24		VT-1.5-Xv	X = 1 to 28
	STM-4			<i>*Members can be in any available STS-1</i>	
	AU-4-VC4-Xv	X = 1 to 4		Hitless	Per member simultaneous
	AU-3-VC3-Xv	X = 1 to 12		(0 to 256 mS)	
	AU-4-VC3-Xv	X = 1 to 12		Instant	Per member simultaneous
	STM-1			(0 to 256 mS)	
	AU3-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
	AU-4-VC3-Xv	X = 1 to 3			
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		Delay Measure	0 to 256 ms Per member simultaneous
	OC-3			Delay Generate	Hitless (0 to 256 mS) Per member simultaneous Instant (0 to 256 mS) Per member simultaneous
	STS-1-Xv	X = 1 to 3		Operations	Change channel #, add channel before selected 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*
LO VCAT	STM-64, STM-16, STM-4			Selectable per	
SDH Mappings*	AU4-TUG3-TUG2-VC2-Xv	X = 1 to 64		VCAT Member	
	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>			Operations	Delete All, Reset SEQ #s
SONET Mappings*	OC-192, OC-48, OC-12			Selectable per	Clear operations – items form list above
	VT-6-Xv	X = 1 to 64		All Members (VCG)	
	VT-2-Xv	X = 1 to 64			
	VT-1.5-Xv	X = 1 to 64			

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 Management command: ADD, ADDN, ALL, REMOVE, REMOVEV, REMOVEALL (Per Member)

Source State Machine Status Transmitted Sequence Number; Transmitted Control Word – ADD, NORM, EOS, IDLE, (Per Member) 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. LOCT - Loss of Capacity Transmit seconds PLCT - Partial Loss of Capacity Transmit (All Members) seconds, TLCT - Total Loss of Capacity Transmit seconds

Sink State Control Sk automatically detects LCAS is being used and configures Sk state (All Members)

Sink State Control (Members) Management Command: ADD, ADDN, ADD Machine ALL, REMOVE, REMOVEV, REMOVEALL; (Per Member) Hold off time, wait to restore time

Sink State Machine Status (Member) RS-Ack count; Active Payload Count; Machine State - OK, FAIL, IDLE; Received Sequence (Per 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; TLCT – Total Loss of Capacity Receive seconds; dSQNC – Inconsistent Sequence Number seconds

Source and Sink Trace (All Members) A state machine trace capability provides State Machine 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	Error Insertion Error Types	EXI – Null extension header or linear frame UPI – automatically based on the GFP mode enabled CID Single error and rates Correctable (cHEC)
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	Alarm Insertion	LOCS, LOCCS, LFD
Supported Mappings for GFP-T	AU-4-16c, STS-48c VC-4-Xv, VC-3-Xv, STS-3c-Xv, STS-1-Xv, ODU-1	Payload	GFP Bulk: PRBS31, 32-Bit User Pattern GFP-F, GFP-T.
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)	Overhead monitor	Free-running capture and display of full received GFP overhead.
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)		

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

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

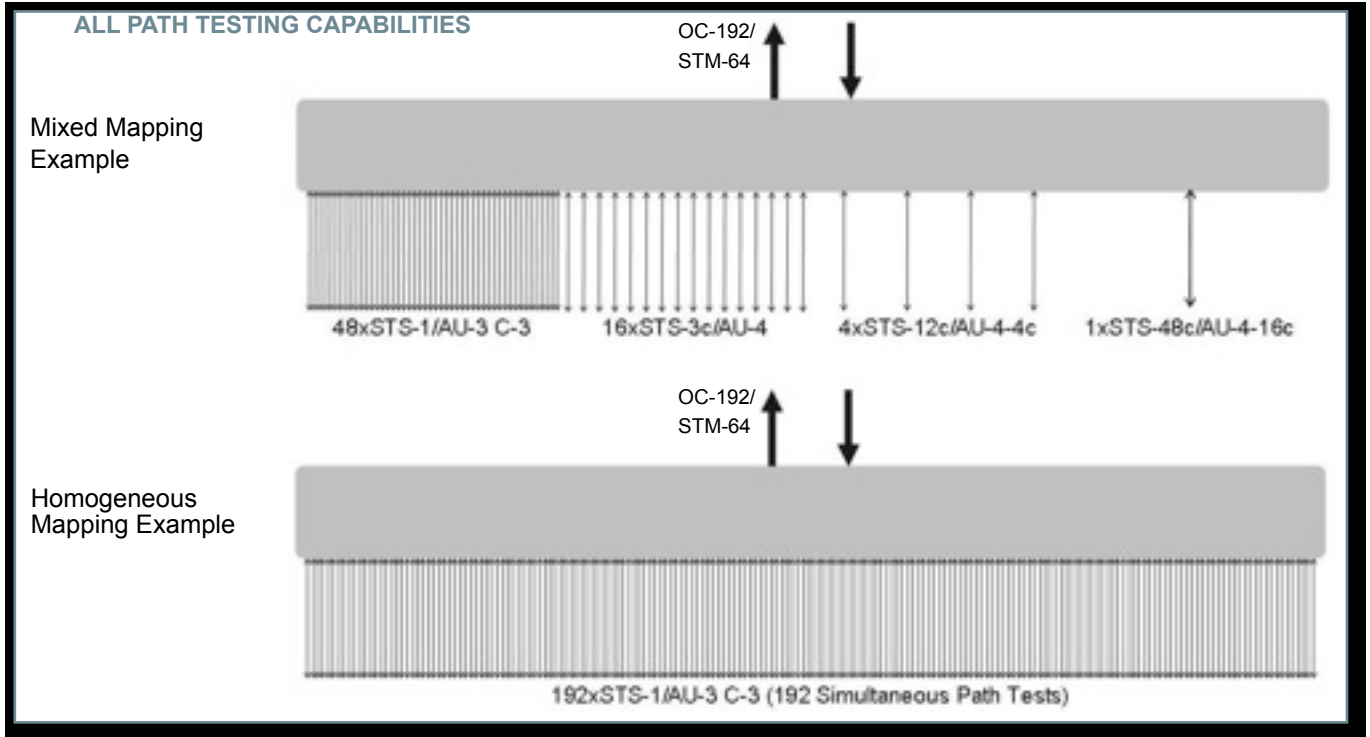
MEASUREMENT

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 Tandem Monitoring	Of all paths: Overhead, J1 Trace, Connection Trace, Pointer justifications, NDF
Parallel Service Disruption Criteria	For individual paths: AIS-P, PRBS independently selected per container/SPE

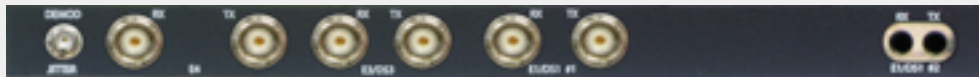


SSA 1220 SYNCHRONOUS SERVICE ANALYZER

The SSA 1220 is the industry's most cost effective SONET/SDH testing solution with optional OTN and ATM testing plus drop-insert to PDH/T-Carrier rates.

In the light and compact NIC chassis or battery-powered NIC BP, the SSA 1220 provides a fully featured SONET/SDH/ OTN/ATM test solution and with additional module can provide PDH/T-Carrier test with drop/insert capabilities or Optical Spectrum Analyzer (OSA).

In the larger 5-slot NIC Plus or NIC EP chassis, numerous configurations are available to provide the exact test solution needed. For example, a single NIC Plus or NIC EP chassis can be equipped with five SSA 1220 modules for multi-port/simultaneous testing. Other configurations include the 40/43Gbps test module, OSA, High-Density Ethernet or other modules.



SYNCHRONOUS PROTOCOLS & PROTOCOL MAPPINGS SUPPORTED

- OTN up to 10.7Gbps
- SONET/SDH up to 10Gbps
- All Path Testing™
- SONET/SDH mapping
- PDH mapping
- ATM

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 balanced); 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

KEY FEATURES

- OC-3 / STM-1 (52M) interface
- OC-12 / STM-4 (622M) interface
- OC-48 / STM-16 (2.5G) interface
- OC-192 / STM-64 (10G) interface
- OTU-1 (2.66 Gbps) interface
- OTU-2 (10.7 Gbps) interface
- Investment protection - Existing NIC products can be upgraded with SSA 1220 modules
- Hot-swappable SFP/XFP optical transceiver modules
- Simultaneous testing of all HP/S TS containers/SPEs with All Path Test option.
- Auto-detection of mapping type and PRBS pattern for the entire bandwidth with All Path Test option.
- Industry-leading OTN testing with available ODU-1 to ODU-2 Mapping, Overhead Byte Capture, full overhead access/manipulation and Intrusive/non-intrusive through mode

SONET/SDH FEATURES (CONTINUED)

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.	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 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.	Error Injection Rate	BIT/Frame: Single, 10-10 to 10-3, user-programmable; Other errors: Single, 10-10 to maximum, user-programmable
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 Section and Line overhead bytes
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	Service Disruption	Supported for all mappings.
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	Automatic Protection Switching Measurement	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;
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	Round-Trip Delay	Supported; SONET/SDH resolution is 125 microseconds;
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	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
		Automatic Protection Switching	Support for SONET/SDH transmission/reception of switching linear and ring-mode command sequences for K1/K2 bytes (per G.841); Measurement 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

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

FUNCTIONS

OTN Mapping	Unframed BERT, Framed BERT, Null Client, Synchronous SONET/SDH, Asynchronous SONET/SDH.
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
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
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
Error Generation Rate	BIT/Frame: Single, 10^{-10} to 10^{-3} , user-programmable; Other errors: Single, 10^{-10} to maximum, user-programmable
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:..
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.

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 \pm 0.1v

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
Intrusive Through Mode	Provides the ability to regenerate optical signal and optionally modify OTN overhead bytes and generate errors and alarms
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 49 μ s; OTU-2 is 12 μ s.
Round-Trip Delay	Supported for OTN; OTU-1 resolution is 49 microseconds; OTU-2 resolution is 12 microseconds
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: 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) Triggers: selected OTN errors or alarms, specified byte values, OPU justifications, manual

ALL PATH TEST FEATURES

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

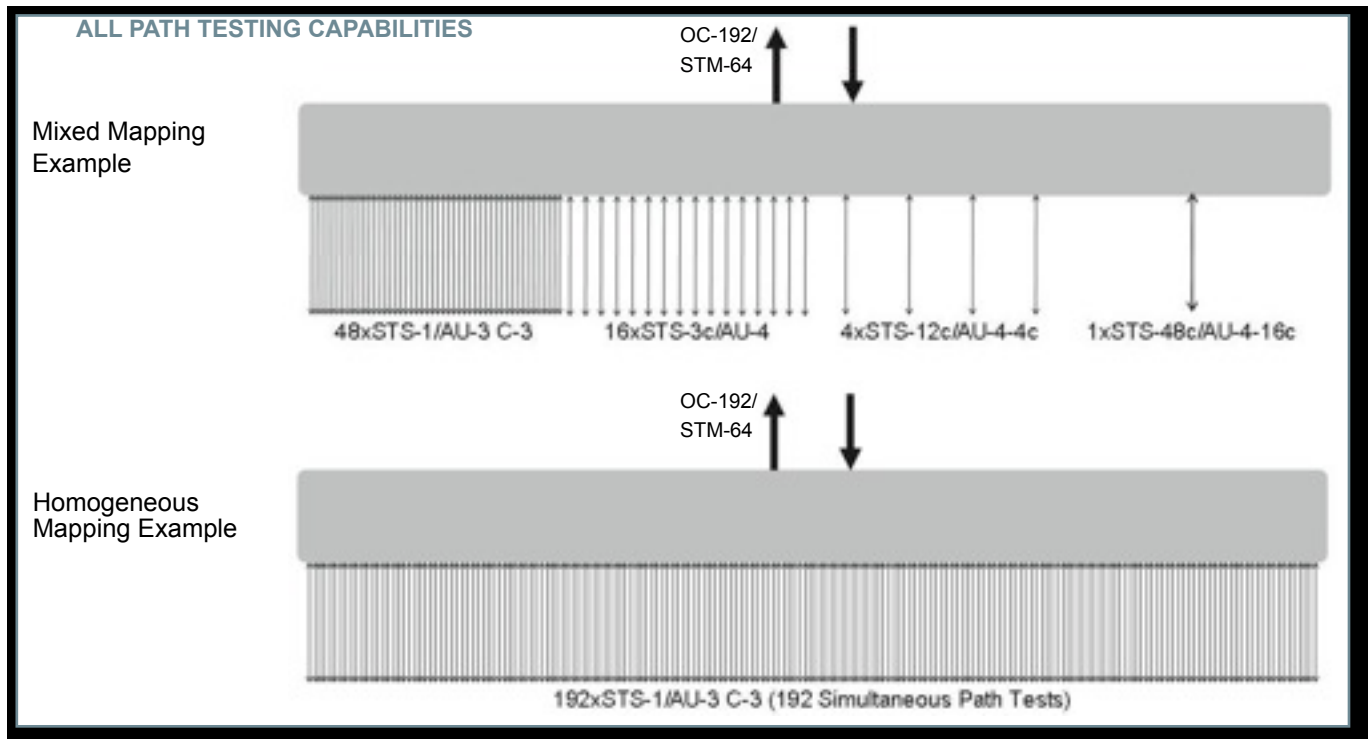
MEASUREMENT

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 Connection Trace	Of all paths: Overhead, J1 Trace, Tandem Monitoring Pointer justifications, NDF
Parallel Service Disruption Criteria	For individual paths: AIS-P, PRBS independently selected per container/SPE



HDE HIGH DENSITY ETHERNET MODULE

Testing multiple Ethernet and Fibre Channel ports simultaneously can shorten overall test time, reduce your implementation time and save money.

With the HD Ethernet module for the NIC platform, you can test up to eight 10/100/1000 ports plus four Gigabit Ethernet or 1 / 2 Gb/s Fibre Channel ports on a single module. Up to four of these modules can be installed in the NIC Plus or NIC EP chassis enabling even higher density. Add 10GigE LAN/WAN testing to fully test Ethernet systems at today's highest datarates.

Streamline your Ethernet and Fibre Channel testing with the HD Ethernet module for the Digital Lightwave NIC Platform.



KEY FEATURES

- Simultaneous and multiple-stream testing on all ports
- 8 Electrical Ethernet interfaces.
- 4 Gigabit Ethernet interfaces.
- Support for 4 1G/2G Fibre Channel interfaces.
- With multiple modules in NIC Plus or NIC EP, test up to 48 ports simultaneously
- Generate up to 32 completely unique traffic profiles per Ethernet port.
- Supports RFC 2544 Benchmarking
- Throughput, Frame Loss, Latency, Back-to-Back Burst and Round-Trip Delay testing
- 10 Gig LAN and WAN support
- IP reflection mode enables loopback testing through Ethernet switches and routers
- Support for up to 4 stacked VLAN tags (Q in Q)
- Configurable Class of Service per Ethernet traffic stream.
- Support for Fibre Channel switch fabric login.
- Buffer to buffer credit analysis.

SUPPORTED INTERFACES

- 10/100/1000 Base-T
- Gigabit Ethernet
- 10G Ethernet LAN PHY
- 10G Ethernet WAN PHY
- 1G/2G Fibre Channel

10G 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	Error Injection	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 Injection Rate	Single
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)	Switch to Protect Measurement	Measure on B1, SEF, OOF, AIS-L, MS-AIS, AIS-P and AU-AIS; 125 microsecond resolution
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	Round-Trip Delay (RTD) Measurement	Measurement ranges: 125 microseconds resolution
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		
Pointer Control	New value, single adjustments (increment or decrement), burst (2-8) adjustments, NDF control		

ETHERNET SPECIFICATION

INTERFACES

<p>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 dependent upon XFP module selected External Eye Clock: SMA, AC coupled PECL (line rate/64)</p>	<p>Gigabit Ethernet Ports: 4 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</p>
	<p>10/100/1000 BaseT Ports: 8 ports, fully independent, RJ-45 connectors; Data Rate: 10 Mbps/100 Mbps/1 Gbps; Duplex Mode: Full or half duplex</p>

PACKET SPECIFICATIONS

<p>Frame Type Statistics and generation of Ethernet frames with UDP/IP, IPv4</p>	<p>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</p>
<p>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</p>	<p>Error Insertion FCS, IP checksum, sequence: single, 1e-2 to 1e-7; bit: single, 1e-3 to 1e-10; line code: single</p>
<p>All Ether 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.</p>	<p>APS Measurements Maximum, minimum, average, and current protection switch times in ms; user-definable guard band thresholds for filtering receive traffic</p>
<p>LED Indicators LOS, link state and pattern sync alarms, FCS, code, and payload BIT errors, sequence errors, remote fault/link fault (10 Gig only)</p>	<p>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</p>
<p>Traffic Stream Generation/Analysis Configurable Stream Parameters 4 independently configurable traffic generation and analysis streams, reply to link fault (10 Gig only) Destination port, transmitted bandwidth 0.01% to 100%; Frame length: 64 to 9600 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</p>	<p>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</p>
<p>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</p>	<p>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</p>
<p>Per-Port Tx Statistics Transmitted packets, packets per second, transmitted bytes, Mbps, % bandwidth of transmitted packets/bytes, , average/min/max bandwidth counters</p>	<p>IP Reflection User-selectable, can reflect all unicast packets or only packets created by Digital Lightwave test instrument</p>
<p>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</p>	<p>Port-to-Port Testing Ping, bi-directional bit-error-rate and stream testing; RFC 2544 testing for throughput, frame loss, and latency</p>
<p>Per-Stream Transmit Statistics Transmitted bandwidth %, transmitted packet bytes count</p>	<p>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</p>
<p>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)</p>	<p>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</p>
	<p>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</p>

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 SPECIFICATION

INTERFACES

Rates Ports	1 Gbps, 2 Gbps SFP user-pluggable, hot-swappable independently configurable for 1G, 2G or 4G, 4 ports (HDE)
Wavelength	1310nm, 1550nm SFPs available
Interface Specifications	Optional SFP/XFP modules avail.; Tx Level, Tx Wavelength, Rx Level, Rx Spectral Range, and Input Signal Measurement are dependent 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: Un- known, 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 deter- mining 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 Pay- load 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 con- secutive sequences or continuous sequence generation
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OSA 3010/3020/3030 OPTICAL SPECTRUM ANALYZER MODULE

Combine telecom and datacom testing with the physical layer test functions of the OSA module in a single NIC chassis in order to meet any network testing challenge.

The OSA module can be used in parallel to any other modules in the NIC chassis allowing simultaneous measurement at the physical layer while running any OTN, SONET/SDH, Ethernet, Fibre Channel or PDH tests at the same time.

APPLICATIONS

- Metro and long-haul DWDM network test and turn-up
- Research and development
- Manufacturing test
- DWDM/CWDM Network Maintenance
- Troubleshooting

KEY FEATURES

- Monitor and test all channels in C-Band or L-Band
- Measures signal level, wavelength and signal-to-noise ratio
- Solid-state system; No calibration required
- Real-time scan of C or L bands
- Auto-scan for quick OSA results
- All-in-one solution for optical and transport-layer testing when used with other modules.

SUPPORTED MEASUREMENTS

- Aggregate optical power
- Channel power
- Channel centre wavelength
- OSNR



COMBINE PHYSICAL AND TELECOM/DATACOM TEST MODULE IN A SINGLE NIC CHASSIS FOR MAXIMUM FLEXIBILITY.

SPECIFICATIONS

Wavelength Range	C-band 1528.77 to 1562.23nm L-band 1568.77 to 1604.03nm
Channel Number	C-band 85 L-band 85
Min. Channel Spacing	50 GHz
Wavelength Accuracy	+/-60 pm
Dynamic Range	60 dB
Max. Input All channels	23 dBm
Channel Input Power Range	-39 to -10 dBm
Channel Power Repeatability	+/-0.1 dB
Channel Power Accuracy	+/-1.0 dB

Polarization Dependence Loss	<0.3 dB
Power Resolution	0.1 dB
Noise Floor	-60 dBm
Peak to Valley	25 dB
OSNR	10-25 dB
OSNR Accuracy	+/-1.5 dB
Response Time	2-3 seconds
Maximum Input Power	-10 dBm
Optical Connectors	SC (standard), ST, or FC (optional)

PDH/T-CARRIER 1010/1020 MODULE WITH OPTIONAL JITTER AND WANDER TESTING

With industry-leading multiple/ simultaneous testing capability, the module can run four tests at the same time, reducing overall test times and providing correlation of alarm/error conditions. The module will run two DS1/E1 tests, a DS3/E3 test and an E4 test simultaneously.



Without optional Jitter/Wander interface



With optional Jitter/Wander interface

SUPPORTED INTERFACES

- DS1 (1.544 Mbps)
- E1 (2.048 Mbps)
- E3 (34.368 Mbps)
- DS3 (44.736 Mbps)
- E4 (139.264 Mbps)

FULL FEATURED TEST SUITE

- Service disruption measurements
- Channelized E1/DS1 testing with audio drop
- Loopback code generation
- Multiplexed PDH structure generation and analysis.
- CAS signaling bits manipulation.



COMBINE WITH OTHER MODULES TO SUPPORT PDH/T-CARRIER
ADD/DROP FROM HIGHER RATE INTERFACES UP TO 43G

KEY FEATURES

- 1.5M/2M/34M/45M/139M interfaces
- Meets requirements of ANSI T1.102, ITU-T G.703, O.151, O.172, G.821, G.826, and M.2100
- Drop and insert from SONET/SDH with MSA 2020/2030 modules
- Multiple/simultaneous testing with All Test Status screen
- ATM mappings if equipped with ATM module + MSA 2020/2030
- Dual DS1/E1 simultaneous testing
- Event logs and graphs for long-term testing and analysis
- Investment protection. Existing NIC products can be upgraded with new PDH/T-Carrier Testing module
- Easy-to-use Digital Lightwave NIC

OPTIONAL JITTER AND WANDER TESTING FEATURES

- Perform Intrinsic Jitter, Jitter Transfer and Jitter Tolerance Testing in accordance with O.171 and O.172.
- T-Carrier and E-Carrier testing with Jitter/Wander options available in one module
- Extremely fast jitter and wander test results with repeatability

INTERFACE SPECIFICATIONS

Line Rates	<p>DS1: 1.544 MHz \pm4.6 ppm with \pm100 ppm offset capability (Tx), 1.544 MHz \pm200 ppm (Rx)</p> <p>E1: 2.048 MHz \pm4.6 ppm with \pm100 ppm offset capability (Tx), 2.048 MHz \pm200 ppm (Rx)</p> <p>E3: 34.368 MHz \pm4.6 ppm with \pm100 ppm offset capability (Tx), 34.368 MHz \pm200 ppm (Rx)</p> <p>DS3: 44.736 MHz \pm4.6 ppm with \pm100 ppm offset capability (Tx), 44.736 MHz \pm200 ppm (Rx)</p>	<p>Clock Accuracy</p> <p>Connectors</p> <p>Line Code</p>	<p>E4: 139.264 MHz \pm4.6 ppm with \pm100 ppm offset capability (Tx), 139.264 MHz \pm200 ppm (Rx)</p> <p>Stratum III compliant</p> <p>DS1/E1 Bantam: 100/120 ohm \pm5% balanced</p> <p>DS1/E1 BNC: 75 ohm \pm5% unbalanced</p> <p>E3/DS3/E4: 75 ohm \pm5% unbalanced</p> <p>DS1: AMI, B8ZS; E1: AMI, HDB3; E3: HDB3; DS3: B3ZS, E4: CMI</p>
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DS1/E1 TESTING SPECIFICATIONS

Framing	DS1: SF(D4), ESF, SLC 96, unfr.; E1: PCM31, PCM31CRC, PCM30, PCM30CRC, unfr.	Performance Monitoring	E1: BPV/Frame/Bit: single error, user programmable 10-5 to 10-3; CRC/FEBE: single error, 10-4 to 10-2
Synchronization	Internal Stratum III compliant, recovered, BITS (1.544Mbps), SETS (2.048 Mbps)	Alarm Detection	DS1: Per ANSI T1.231 E1: Per G.826, G.821, M.2100
Input Signal Level Measurement	DS1: \pm 0.1 Vp to \pm 3.6 Vp E1: +0.1 Vp to +7 Vp	Alarm Generation	DS1: OOF, pattern sync, LOS, AIS, yellow, LOF, idle, clock, E1: AIS, LOF, LOS, pattern sync, yellow, RM-FAI, CASML
Frequency Meas. Range	DS1: 1.544 MHz, \pm 200 ppm E1: 2.048 MHz, \pm 200 ppm	Loop Codes	DS1: AIS, yellow, idle, LOS, OOF, LOF E1: AIS, LOF, RAI, RMFAI, CASMFL, LOS
Measurement Patterns	E1: +0.1 Vp to +7 Vp DS1: QRSS, 26-1, 26-1 INV, 29-1, 29-1 INV, 211-1, 211-1 INV, 215-1, 215-1 INV, 220-1, 220-1 INV, 223-1, 223-1 INV, 3 in 24, all 1's, all 0's, 1 in 8, 1010, 55 Daly, T1-2, T1-3, T1-5, 55 octet, ATM mapping (direct or PLCP) with ATM module, DDS 1-6, multi-pattern, bridge tap, 32-bit user-defined pattern Fractional T1: QRSS, 26-1, 26-1 INV, 29-1, 29-1 INV, 211-1, 211-1 INV, DDS 1-6, 32-bit user-defined pattern, all 1's, all 0's E1: 26-1, 26-1 INV, 29-1, 29-1 INV, 211-1, 211-1 INV, 215-1, 215-1 INV, 220-1, 220-1 INV, 223-1, 223-1 INV, ATM mapping (direct or PLCP) with ATM module, 32-bit user-defined pattern, all 1's, all 0's Fractional E1: 26-1, 26-1 INV, 29-1, 29-1 INV, 211-1, 211-1 INV, 215-1, 215-1 INV, 220-1, 220-1 INV, 223-1, 223-1 INV, 32-bit user-defined pattern, all 1's, all 0's	Loop-back	DS0/64 Kbps: DDS latching and non-latching, Support OCU loopback, CSU loopback, DSU loopback DS1: Transmit: in-band, out-of-band, line loop-back, payload loopback, 4-bit smart jack, 5-bit smart jack, 16-bit user-programmable; receive: Auto response on/off, display of current loop-back status E1: Payload, line, loop-back
Error Measurement	DS1: BPV (code), frame, CRC, Bit, excess 0's E1: BPV (code), frame, CRC, Bit, FEBE	DS0/64 Kbps Signaling	Line and payload loop-back (manual) DS1: (Tx) 24 DS0 (64/56 Kbps) channels; (Rx) Monitor up to 24 DS0 (56/64 Kbps) channels, VF drop to speaker E1: (Tx) 30/31 Contiguous/non-contiguous individual 64 Kbps channels; (Rx) Monitor up to 31 individual 64 Kbps channels, VF drop to speaker
Error Injection	DS1: BPV (code), Bit, frame, CRC E1: BPV (code), Bit, frame, CRC, FEBE	DS0/64 Kbps Signaling	DS1: AB (SF) and ABCD (ESF/SLC96) E1: (Tx) CAS Signaling bits, Global Spare bits, 8 bit sequence byte; (RX) Monitor all 30 CAS Signaling bits simultaneously, SMF I and SMF II
Error Injection Rate	DS1: BPV/Bit: single error, user programmable 10-5 to 10-3; CRC: single error, 10-4 to 10-2; Frame 10-6 to 1 in 2		

E3/DS3/E4 TESTING SPECIFICATIONS

Mapping/Drop Framing	E3/DS3: DS1, E1 (up to 2); E4: E3, E1 E3/E4: Framed, unframed DS3: M13, C-Bit parity, unframed	Error Measurement and Injection	E3: BPV, BIT, frame DS3: BPV, BIT, frame, P-Parity, C-Parity, FEBE E4: Bit, frame, LCV
Synchronization	DS3: Internal Stratum III compliant E3/E4: Internal Stratum III compliant, recovered, BITS (1.544 Mbps), SETS (2.048 Mbps)	Error Injection Rate	DS3: BPV/Frame/Bit: single error, user programmable 10-9 to 10-3; C-Parity/P-Parity: single error, 10-9 to 10-4; FEBE 10-9 to 10-6 E3/E4: single error, 10-9 to 10-3
Input Signal Level Measurement	E3: ± 0.31 Vp to ± 1.2 Vp DS3: ± 0.31 Vp to ± 1.2 Vp E4: ± 0.3 Vp to ± 0.7 Vp	Performance Monitor	DS3: Per ANSI T1.231 E3/E4: Per G.821, G.826, M.2100
Frequency meas. Range	E3: 34.368 MHz ± 200 ppm DS3: 44.736 MHz ± 200 ppm E4: 139.264 MHz ± 200 ppm	Alarm Detection	DS3: OOF, pattern sync, LOS, AIS, idle, X-Bit, yellow, LOF, Frame Mismatch E3/E4: LOS, OOF, pattern sync, AIS, RDI
Patterns	E3/E4: 26-1, 26-1 INV, 29-1, 29-1 INV, 211-1, 211-1 INV, 215-1, 215-1 INV, 220-1, 220-1 INV, 223-1, 223-1 INV, ATM mapping (direct or PLCP) with ATM module, 32-bit user-defined pattern DS3: QRSS, 215-1, 215-1 INV, 220-1, 220-1 INV, 223-1, 223-1 INV, ATM mapping (direct or PLCP) with ATM module, 32-bit user-defined pattern	Alarm Generation	DS3: AIS, idle, yellow, x-Bit, LOF E3/E4: LOS, LOF, AIS, RDI
		Channel Scan	DS3: Scans all 28 DS1 or all 21 E1 Channels for Framing and Payload Pattern E3: Scans all 16 E1 Channels for Framing and Payload Pattern
		FEAC Codes	DS3: Alarm/status codes, loop-back codes
		FEAC Loopback	DS3: DS3 Line, DS1 Line #1 to #28, all DS1 lines

JITTER AND WANDER TESTING SPECIFICATIONS

JITTER/WANDER RELATED I/O

Demod. Jitter Output	Provides an analog output of the measured jitter
Secondary Clock	Provides the ability to measure clock wander
Reference Input	This BITS/SETS input can accept either a framed all 1's data signal or a sine wave clock as a master reference

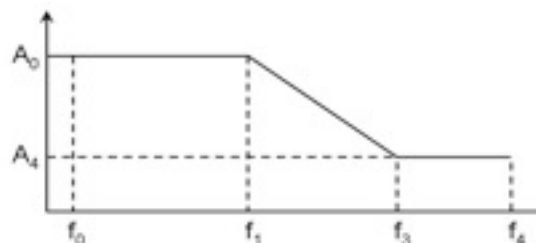
Jitter Amplitude and Frequency Range -

Bit Rate (Mbps)	AO (UI)	A4 (UI)	f0 (hz)	f1 (hz)	f3 (hz)	f4 (hz)
1.544	100	1.5	2	400	8k	40k
2.048	100	1.5	10	900	18k	100k
34.368	100	1.5	100	1000	20k	800k
44.736	100	1.5	2	5000	100k	400k
139.264	100	1.5	100	500	10k	3500k

GENERAL JITTER/WANDER SPECIFICATIONS

ADJUSTABLE JITTER HIT THRESHOLDS

Jitter Statistics and Measurements	Jitter Hit Counts, Jitter Hit Seconds, Peak-to-Peak Jitter, +Peak Jitter, -Peak Jitter, RMS Jitter
RMS Averaging Interval	The RMS jitter averaging period shall have programmable values of 1s, 60s, and infinite
Simultaneous Filtering And Measurements	Simultaneous filtering paths feed an associated set of Jitter Hit Counters and measurement circuits to allow testing at all filter bandwidths simultaneously



JITTER SPECIFICATIONS

Standards Compliance	DS1/E1/E3/DS3/E4 Jitter generation and Measurement exceed O.171 and O.172
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JITTER SPECIFICATIONS (Continued)

JITTER MODULATION FREQUENCY RESOLUTION

Measurement Range Minimum measurement range exceeds
 Peak to Peak O.171 and O.172 (see table below)
 Measurement Resolution 0.001 UI for peak-to-peak jitter;
 0.0005 for RMS jitter

Bit Rate (Mbps)	Modulation Frequency	Minimum Resolution
1.544/44.736	<10kHz	1Hz
	10 to 99.9kHz	10Hz
	100 to 400kHz	100Hz
2.048/34.368/ 139.264	<10kHz	1Hz
	10 to 99.9kHz	10Hz
	100 to 999.99kHz	100Hz
	1 to 3.5MHz	1000Hz

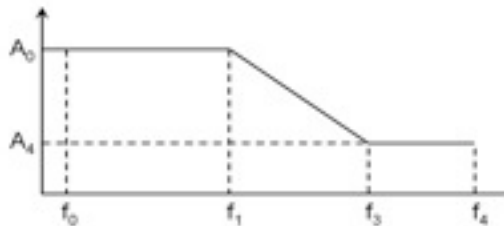
Jitter Measurement Accuracy As per O.171/O.172

FILTERING

Bit Rate (Mbps)	Measurement Mode	High Pass	Low Pass
1.544	Wide Band	10Hz	40kHz
	High Band	8kHz	40kHz
2.048	Wide Band	20kHz	100kHz
	High Band 1	700Hz	100kHz
	High Band 2	18kHz	100kHz
34.368	Wide Band	100Hz	800kHz
	High Band	10kHz	800kHz
44.736	Wide Band	10Hz	400kHz
	High Band	30kHz	400kHz
139.264	Wide Band	200Hz	3.5MHz
	High Band	10kHz	3.5MHz

AMPLITUDE AND FREQUENCY RANGE - MEASUREMENT

Bit Rate (Mbps)	AO (UI)	A4 (UI)	f0 (hz)	f1 (hz)	f3 (hz)	f4 (hz)
1.544	100	1.5	10	400	8k	40k
2.048	100	1.5	20	900	18k	100k
34.368	100	1.5	100	1000	20k	800k
44.736	100	1.5	10	5000	100k	400k
139.264	100	1.5	200	500	10k	3.5M



WANDER MEASUREMENT SPECIFICATIONS

Wander Client A wander client software package running on Windows XP, 2000, 95 or 98 is required for performing wander measurement
 Sampling Rate 1000/s — 300Hz
 Low Pass Filter
 Test Duration
 Amplitude Range ±1 nanoseconds to ±10 microseconds minimum
 Measurement Accuracy As per O.172
 Measurement Statistics A measurement/calculation of Time Interval Error (TIE), Maximum Time Interval Error (MTIE), Time Deviation (TDEV), Maximum Relative Time Interval Error (MRTIE), ADEV (per G.810) must be provided

WANDER GENERATION SPECIFICATIONS

Note: A0 is defined between f0 and f1. A1 is defined at f2.

Bit Rate (Mbps)	f0 (μHz)	f1 (MHz)	f2 (Hz)	A0 (UIp-p)	A1 (UIp-p)
1.544	10	20	10	200K	800
2.048	10	20	10	200K	800
34.368	10	400	10	200K	16K
44.736	10	400	10	200K	16K
139.264	10	2000	10	200K	80K

Wander Accuracy As per O.172
 Generated Wander Resolution 1μHz

SERIAL INTERFACE ANALYSIS MODULE

RS-530

RS-530 Physical Interface	25-pin D-type (female)	Timing	Synchronous or Asynchronous
Impedance	78 ohms, 100 ohms, 124 ohms, 3.8 K ohms (unterminated)	Data Rate (asynchronous)	Up to 128 kbps
Interface Types	DCE and DTE	Data rate (synchronous)	Up to 15 Mbps
Electrical Connection Type	Balanced	Standards Compliance	EIA-530 (v.10 + v.11), EIA-530A (v.10 + v.11)
Test control	NIC/NAA GUI, SCPI (Standard Commands for Programmable Instruments)		

RS-232

RS-232 Physical Interface	25-pin D-type (female)	Timing	Asynchronous
Interface Types	DCE and DTE	Data Rate	50 bps - 125 kbps (asynchronous)
Electrical Connection Type	Unbalanced	Standards Compliance	RS-232 (v.28)
Test control	NIC/NAA GUI, SCPI (Standard Commands for Programmable Instruments)		

Analysis Functions

Emulation	DTE: LL Pin and RL pin can be toggled ON and OFF independently DCE-TT: TM and CTS pin can be toggled ON and OFF independently DCE-ST: TM and CTS pin can be toggled ON and OFF independently Signaling Control lead Polarity: POS or NEG	Rx Clock	Source Synchronous DCE Mode: TT (Terminal Timing uses incoming clock from 25 pin D-Sub) ST (Send Timing uses internal transmit clock output to 25 pin D-Sub) Polarity: Normal, Invert
Test Patterns	Synchronous Mode: MARK (All Ones), 1:1 (1010.. pattern), 63, 511, 2047, 215-1, 220-1, QRSS, PRGM, FOX, USER Asynchronous Mode: MARK (All Ones), 1:1 (1010.. pattern), 63, 511, 2047, 215-1, 220-1, FOX, USER Program Pattern (PRGM): Binary Pattern 3 to 24 bits User Pattern (USER): USER1, USER2, USER3, (Long=2048 (Hex) character) 1:7, T1-1, T1-2, T1-3, T1-4, T1-5, T1-6, DDS-1, DDS-2, DDS-3, DDS-4, DDS-5, DDS-6, 1020 Hz Tone Block Length: Programmable 100 to 1000000 bits Sync Loss Threshold (Low): 100 bit errors in less than 1000 bits of data Sync Loss Threshold (Medium): 250 bit errors in less than 1000 bits of data Sync Loss Threshold (High): 20,000 bit errors in less than 100,000 bits of data Action on Sync Loss: Selectable as CLEAR, HALT, CONTINUE User Pattern Sync Loss Threshold: Programmable to Pattern Length or any number of bytes between 10 and 2048	Flow Control	Out of Band: Selectable using any combination of TR, DM, RS, CS & RR Control Leads In Band: Via single byte, programmable, XON/XOFF characters
		Measurement Parameters	ERRORS: AVG BER, AVG BLER, BER, BITT ERRS, BLOCKS, BLK ERRS, CHAR ERR (Async Only), PAT SLIP (Sync Timing only) TIME: EA SEC, EF EA SEC, ELAP SEC, ERR EA SEC, PATL SEC, %PATL SEC, TIME SIGNAL: DELAY, TX-FREQ, RX-FREQ ALARM: RECEIVER: CLOCK LOSSES, DAT LOSS, PAT-SYNC-LOSS, POWER-LOSS PERFORMANCE (Sync Timing): AVL-SEC, %AVL-SEC, %DEG-MIN, %PAT-SEC, %SES, BER-SES, DEG-MIN, ERR-SES, G.821-%-OF-EFS, G.821-ERR-SEC, G.821-%EFS, SES, UNA-SEC
		Receiver Status	MARK: Indicator lights when Mark signal is present at input SPACE: Indicator lights when Space signal is present at input SYNC: Indicator green when Pattern Sync is established SYNC LOST: Red history indicator will be red after sync loss
Tx Clock	Sources: Internal Synthesizer, Datacom Interface 25-Pin D type Connector Polarity: Normal, Invert Programmable Mode: 50 Hz to 999.99 Hz in 0.01 Hz increments. 1 KHz to 9.999 KHz in 0.1 Hz increments. 10 KHz to 99.999 KHz in 1 Hz increments. 100 KHz to 999.99 KHz in 10 Hz increments. 1 MHz to 9.9999 MHz in 100 Hz increments. 10 MHz to 15 MHz in 1 KHz increments. Fixed Clock Rates (KHz): 1.2, 2.4, 4.8, 9.6, 19.2, 56.0, 64.0, 1544, 2048, 3152, 6312		

ATM MODULE

SPECIFICATIONS

Physical Interfaces	SONET: STS-1, OC-1, OC-3, OC-12, OC-48, OC-192 SDH: STM-0/0e, STM-1/1e, STM-4, STM-16, STM-64 PDH: DS1, DS3, E1, E3	Protocol Generation	AAL0 cell generation, AAL1/AAL5 protocol gen.
Physical Layer PLCP Structure	SONET: VT1.5, VT2, VT6, Full SPE, STS-3c, STS-12c SDH: C-11, C-12, C-2, C-3, C-4, C-4-4 PDH (Direct/PLCP): DS1, DS3, E1, E3 (G.832, G.751)	Error Measurement	HEC correctable and uncorrectable error counts and rates, AAL5 CRC errors, AAL5 length errors; PRBS bit error measurement, loss of PRBS sync; AAL1 SN/SNP error, lost cells, misinserted cell counts and rates; PLCP framing errors, PLCP BIP, PLCP FEBE counts and rates, PLCP B1 CNT, PLCP Framing Error Cnt, cell overflow, BERT analysis
Adaptation Layers Header and Interface Support	AAL0, AAL1, AAL5 Control of all cell header bits; UNI (3.0, 3.1, 4.0) and NNI support	Error Injection	HEC-correctable and uncorrectable errors, HEC error rate from continuous to 10-9, HEC error burst from 1 to 10 on consecutive cells; PLCP B1, PLCP FEBE, PLCP POI, PLCP Frame (A1A2), PLCP (POI)
Channel Capacity	Transmit: 240 channels (independent AAL, service class, and bandwidth on all VCCs) Receive: 256 channels (cell count, bandwidth, AAL5 PDU counts and errors on all channels)	Error Measurement	HEC correctable and uncorrectable error counts and rates, AAL5 CRC errors, AAL5 length errors; PRBS bit error measurement, loss of PRBS sync; AAL1 SN/SNP error, lost cells, misinserted cell counts and rates; PLCP framing errors, PLCP BIP, PLCP FEBE counts and rates
Test Traffic Generation	VCC Channel Count: Transmit foreground and background test channels Traffic Shaping: Foreground traffic shaping: ConstantBit Rate (CBR), real time/non-real time Variable BitRate (rt VBR, nrt VBR), Unspecified Bit Rate (UBR), Available Bit Rate: ABR (for STS-12c or Ac-4-4c only); foreground transmit resolution; background traffic shaping Cell Generation: Foreground VCC payload: 215 - 1 (cross cell PRBS) + INV, user-defined 32-bit pattern, full cell, 0.191 test cell, special OAM generation/ test feature, and burst cell transmission; background VCC payload	Alarm Detection	Cell synchronization loss, F4 and F5 AIS OAM flow (end-to-end/segment), F4 and F5 RDI OAM flow (end-to-end/segment); PLCP yellow alarm (RAI)
Test Traffic Analysis	VCC Channel Count: Receive test channels: Bandwidth analysis, cell count/rate, CLP ratio, CLP indication, BERT analysis, 0.191 Rev0/Rev1 analysis, AAL1 analysis, AAL5 analysis Cell Analysis / QoS: Cell bandwidth analysis (count/rate) - 256 channels; correctable HEC errors; uncorrectable HEC errors; BERT analysis (count/rate); 0.191 analysis I.356 (CER, CMR, CLR, Cell Transfer Delay-CTD, SECB, MTBO, 2-point Cell Delay Variation-CDV); 1-point CDV; Cell misinsertion ratio for AAL1; cell inter-arrival analysis; real-time analysis channels (bandwidth, BERT, 0.191, AAL1, AAL5) and CLP monitoring	Cell Payload Patterns Error Insertion	PRBS 215 - 1, all 1's, 10101010, user-defined pattern HEC-correctable and uncorrectable errors, HEC error rate from continuous to 10-9, HEC error burst from 1 to 10 on consecutive cells; PRBS bit error rates from 10-2 to 10-9, PLCP framing errors, BIP, FEBE
Performance Analysis	CER, CLR, CMR, SECBR	Alarm Generation	Cell synchronization loss, F4 and F5 AIS OAM flow (end-to-end/segment), F4 and F5 RDI flow (end-to-end/segment), PLCP yellow alarm
Protocol Analysis	AAL0: Cell count and bandwidth utilization, bit error count, pattern sync errors AAL1: AAL1 SAR PDU header SNP errors, lost cells, mini-skirted cells for AAL1 VCCs; cell count and bandwidth utilization, bit error count, pattern sync errors; AAL5: CPCS analysis, VCC simultaneous analysis, CRC, PDU length errors Network Impairment: Cell error generation, cell loss, cell misinsertion, CDV, cell reordering, test traffic insertion, VPI/VCI remapping, CLP tagging, CI setting, padding errors	SVC Support	Calling SVCs, called SVCs, load test-call setup, load test-cyclic calls
		SVC Signalling Analysis	Channel set up time, channel tear down, SSCOP link status indication, Tx/Rx attempted calls, Tx/Rx connected calls, Tx/Rx rejected calls, Tx/Rx cleared calls, call reference value
		SVC Monitoring	Call statistics, UNI signalling, ATM layer, AAL-5, signaling filters, UNI signaling errors, SSCOP errors, port, errors/alerts
		OAM Support erate & Analyze)	I.610 OAM support: F4 AIS, F5 AIS, F4 RDI, F5 RDI, (Gen-F4 loopback, F5 loopback, PM OAM support (generate PM OAM with test traffic, receive and analyze PM OAM, forward monitoring PM OAM, backward reporting PM OAM)
		Cell Capture Support	Capture buffer size, capture filter-based on VPI/VCI, sending of captured data after optional modifications by user
		No. of Test Channels	240 Tx, 256 Rx

Optical Jitter & Wander Modules for NIC Platform

Jitter & Wander testing up to 10.7Gbps

PLATFORMS



NIC Plus



NIC EP

The Network Information Computer (NIC) Jitter & Wander modules provides jitter test functionality for SONET/SDH and OTN interfaces up to 10.7Gbps

- OC3 / STM-1
- OC12 / STM-4
- OC48 / STM-16
- OC192 / STM-64
- OTU-1
- OTU-2

The Digital Lightwave patented Digital Phase Analysis (DPA) technology was the first digital jitter solution available.

Digital edge placement and detection techniques provide fast and repeatable measurements with reduced settling times and less need for retesting directly resulting in faster test completion with increased accuracy over standard measurement techniques.

KEY FEATURES

- Stable, repeatable digital jitter measurement
- Applicable to product design, production floor and field
- Wide jitter dynamic range
- Same high resolution for the entire jitter range
- Compliant to ITU-T 0.172, G.825, G.958 and Telcordia GR-253
- Patented Digital Phase Analysis (DPA) technology
- Automated Intrinsic Jitter, Jitter Transfer and Jitter Tolerance Testing
- Extremely fast jitter and wander test results with repeatability

JITTER GENERATION SPECIFICATIONS

Line Rates OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), OC-48/STM-16 (2488.32 Mbps), OTU1 OTN (2666.06 Mbps), OC-192/STM-64 (9953.28 Mbps), OTU2 OTN (10709.00 Mbps)

Automated Jitter Compliance Testing **Jitter Tolerance:** Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter tolerance masks (100 points max), jitter tolerance test types:
 - Power penalty acceptance
 - Power penalty measure
 - Onset of errors acceptance
 - Onset of errors measure

Jitter Transfer: Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter transfer masks (100 points max); accuracy per 0.172

Jitter Modulation Built-in modulation generator (sinewave) frequency source 9 Hz to 80 MHz

Jitter Amplitude 0 to 3600 U_{lpp}, resolution = 0.001 U_{lpp}

Jitter Generator Amplitude Accuracy ±Q% of amplitude setting ±X U_{lpp}-p
 X is the fixed error (defined per 0.172)

Rate	Q
10709.00 Mbps:	8% < 500 KHz
	12% 500KHz–2MHz
	15% >2 MHz
9953.28 Mbps:	8% < 500 KHz
	12% 500KHz–2MHz
	15% >2MHz
2666.06 Mbps:	8% < 500 KHz
	12% > 500 KHz
2488.32 Mbps:	8% < 500 KHz
	12% > 500 KHz
622.08 Mbps:	8% < 500 KHz
	12% > 500 KHz
155.52 Mbps:	8% < 500 KHz
	12% > 500 KHz

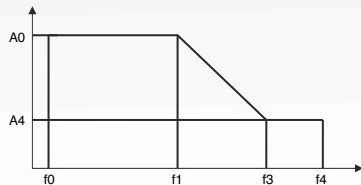
X is the fixed error defined per 0.172
 0.02 UI @ 10709.00 Mbps, 9953.28 Mbps (typical)
 0.02 UI @ 2488.32 Mbps, 2666.06 Mbps
 0.01 UI @ 622.08 Mbps, 155.52 Mbps

Jitter Generator Intrinsic

10709.00 Mbps:	0.040 U _{lpp} ^{6,7}
9953.28 Mbps:	0.040 U _{lpp} ^{5,6}
2666.06 Mbps:	0.050 U _{lpp} ^{1,7}
2488.32 Mbps:	0.040 U _{lpp} ^{1,5}
622.08 Mbps:	0.030 U _{lpp} ^{2,5}
155.52 Mbps:	0.020 U _{lpp} ^{3,5}
STM-1e:	0.030 U _{lpp} ^{4,5}

Notes:

- Optical output, measurement BW 5 kHz - 20 MHz (typical)
- Optical output, measurement BW 1 kHz - 5 MHz (typical)
- Optical output, measurement BW 500 Hz - 1.3 MHz (typical)
- STM1e output, 0 dB Gain, measurement BW 500 Hz – 1.3 MHz (typical)
- Intrinsic values assume a structured STM-Nc signal with a payload of PRBS 2²³ -1
- Optical output, measurement BW 20 KHz - 80 MHz (typical)
- Intrinsic values assume a structured OTU-N signal with a structured SDH payload. The SDH payload is comprised of an STM-Nc signal with a payload of PRBS 2²³ -1. N is 16 for OTU1. N is 64 for OTU2.



Rate (Mb/s)	A0 (UI)	A4 (UI)	f0 (Hz)	f1 (Hz)	f3 (Hz)	f4 (Hz)
10709.0	3600	0.2	9	667	12M	80M
9953.28	3600	0.2	9	667	12M	80M
2666.06	900	0.3	10	2222	6.67M	20M
2488.32	900	0.3	10	2222	6.67M	20M
622.08	450	0.3	10	1111	1.67M	5M
155.52	450	0.3	10	289	433K	1.3M

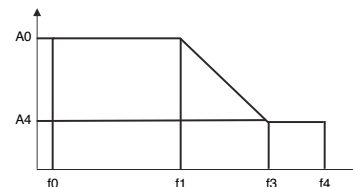
Jitter Generation Frequency Accuracy For fm < 10 MHz ±1%
 For 10 MHz < fm < 60 MHz ± 5%
 For 60MHz < fm < 80 MHz ± 6%

JITTER MEASUREMENT SPECIFICATIONS

Line Rates OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), OC-48/STM-16 (2488.32 Mbps), OTU1 OTN (2666.06 Mbps), OC-192/STM-64 (9953.28 Mbps), OTU2 OTN (10709.00 Mbps)

Automated Jitter Compliance Testing **Jitter Generation:** Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter generation

Jitter Measurement Range



Rate (Mb/s)	A0 (UI)	A4 (UI)	f0 (Hz)	f1 (Hz)	f3 (Hz)	f4 (Hz)
10709.0	3600	0.2	9	667	12M	80M
9953.28	3600	0.2	9	667	12M	80M
2666.06	900	0.3	10	2222	6.67M	20M
2488.32	900	0.3	10	2222	6.67M	20M
622.08	450	0.3	10	1111	1.67M	5M
155.52	450	0.3	10	289	433K	1.3M

Measurement Resolution

0.001 UI for peak-to-peak jitter
0.0001 UI for RMS jitter

Measurement Bandwidths

Bit Rate (Mb/s)	HPF -3dB freq	LPF -3dB freq
10709.00	10 KHz	80 MHz
10709.00	20 KHz	80 MHz
10709.00	50 KHz	80 MHz
10709.00	4 MHz	80 MHz
9953.28	10 KHz	80 MHz
9953.28	20 KHz	80 MHz
9953.28	50 KHz	80 MHz
9953.28	4 MHz	80 MHz
2666.06	5KHz	20 MHz
2666.06	12 KHz	20 MHz
2666.06	1 MHz	20 MHz
2488.32	5KHz	20 MHz
2488.32	12 KHz	20 MHz
2488.32	1 MHz	20 MHz
622.08	1 KHz	5 MHz
622.08	12 KHz	5 MHz
622.08	250 KHz	5 MHz
155.52	500 Hz	1.3 MHz
155.52	12 KHz	1.3 MHz
155.52	65 KHz	1.3 MHz

Ulrms is available on 12 kHz filter at 2666.06 Mbps, 2488.32 Mbps, 622.08 Mbps, and 155.52 Mbps

Ulrms is available on 50 kHz filter at 9953.28 Mbps, 10709.00 Mbps

Frequency Response Of Measurement Function

All high-pass filters (HPF) are first-order (-20 dB/dec); All low-pass filters (LPF) are third-order (-60 dB/dec) maximally flat; HPF -3dB Frequency Error < ±5%; LPF -3dB Frequency Error < ±10%

Measurement filter characteristics meet or exceed requirements of ITU recommendation 0.172

Jitter Measurement Result Accuracy

Peak to peak: ±R% of reading ±W
RMS: ±R% of reading ±.005 UI
R = 5% for all bit rates and measurement bandwidths

Jitter Measurement Result Accuracy

Peak to peak: ±R% of reading ±W
RMS: ±R% of reading ±.005 UI
R = 5% for all bit rates and measurement bandwidths

Measurement Capabilities

Bit Rate (Mb/s)	Measurement Bandwidth	W			
		U _{lpp} (1,2,3)	U _{lpp} (Max)	U _{lrms}	U _{lrms} (Max)
STM-1e	500Hz - 1.3MHz	0.030	0.035		
STM-1e	12KHz - 1.3MHz	0.030	0.035	0.005	0.005
STM-1e	65KHz - 1.3MHz	0.025	0.025		
155.52	500Hz - 1.3MHz	0.030	0.035		
155.52	12KHz - 1.3MHz	0.030	0.035	0.005	0.005
155.52	65KHz - 1.3MHz	0.030	0.035		
622.08	1KHz - 5MHz	0.030	0.035		
622.08	12KHz - 5MHz	0.030	0.035	0.005	0.005
622.08	250KHz - 20MHz	0.030	0.035		
2488.32	5KHz - 20 MHz	0.045	0.050		
2488.32	12KHz - 20MHz	0.045	0.050	0.005	0.005
2488.32	1MHz - 20MHz	0.045	0.050		
2666.06	5KHz - 20MHz	0.045	0.050		
2666.06	12KHz - 20MHz	0.045	0.050	0.005	0.005
2666.06	1MHz - 20MHz	0.045	0.050		
9953.28	10KHz - 80MHz	0.035	0.050		
9953.28	20KHz - 80MHz	0.035	0.050	0.005	0.005
9953.28	50KHz - 80MHz	0.035	0.050		
9953.28	4MHz - 80MHz	0.035	0.050		
10709.00	10KHz - 80MHz	0.035	0.050		
10709.00	20KHz - 80MHz	0.035	0.050	0.005	0.005
10709.00	50KHz - 80MHz	0.035	0.050		
10709.00	4MHz - 80MHz	0.035	0.050		

Notes:

- 1) Typical
- 2) All SONET/SDH values are for a STM-Nc structured signal containing a payload of PRBS 2²³-1
- 3) All OTN values are assumed a structured OTU-N signal with a structured SDH payload. The SDH payload is comprised of an STM-Nc signal containing a payload of PRBS 2²³-1. N is 16 for OTU1. N is 64 for OTU2.

Sliding window of 1 second, 60 seconds, or infinite size (max hold) Peak-to-peak jitter (UI)

- Positive peak jitter (UI)
- Negative peak jitter (UI)
- RMS jitter (UI)
- Jitter hit count
- Jitter hit seconds (variable threshold over entire measurement range)
- Loss of signal seconds count

Notes:

- 1) For structured data signals per 0.172 Annex A
- 2) For optical input power levels between -10 dBm and -12 dBm per 0.172 section 9.4.1 clause b

INTERNAL TRANSMIT CLOCK

Frequency Deviation ±4.6 ppm

TRANSMITTER INPUTS & OUTPUTS

Optical Transmit	Wavelength: 1290-1320 nm / 1529.55-1563.05 nm Average output power: > -2 dBm, 0 dBm typical Extinction Ratio: >10 dB @ 1550 nm; >8.2 dB @ 1310nm; Max power: 5mW (continuous wave)	Reference Clock Output	Frequency: 622.08 MHz Amplitude: >60 mVpp, 800 mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm
STM-1E Transmit	Amplitude: ~1V Coupling: AC, non-Isolated Connector: BNC Impedance: 75 ohm Line Coding: CMI	Trigger Output	Frequency: 622.08 MHz Amplitude: >60 mVpp, 800 mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm

RECEIVER INPUTS & OUTPUTS

Optical Receive	Sensitivity: -22 dBm at bit rates < 2488.32 Mbps (PRBS23, 1x10 ⁻¹⁰ BER) -15 dBm at 9953.32 Mbps (PRBS23, 1x10 ⁻¹⁰ BER) -15 dBm at 10709.00 Mbps (PRBS23, 1x10 ⁻¹⁰ BER) Overload: > 0 dBm (1 dBm typical) Optical Return Loss: <27 dB Wavelength: 1250-1600nm Optical Jitter Measurement range: -10 dBm to -12 dB	STM-1E Receive	Amplitude: 1V Max Coupling: AC, non-Isolated Connector: BNC Impedance: 75 ohm Line Coding: CMI Selectable Gain: Normal (0dB) or monitor (-20dB)
		Recovered Clock Output	Amplitude: >600mVpp, 800mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm
		Demodulated Output	Max Amplitude: 1.0 Vpp +/- 5% Selectable Sensitivity: 1UIpp/V, 4UIpp/V, 16UIpp/V, 64UIpp/V, 256UIpp/V, 1024UIpp/V, 4096UIpp/V, Coupling: DC Connector: SMA Impedance: 50 ohm

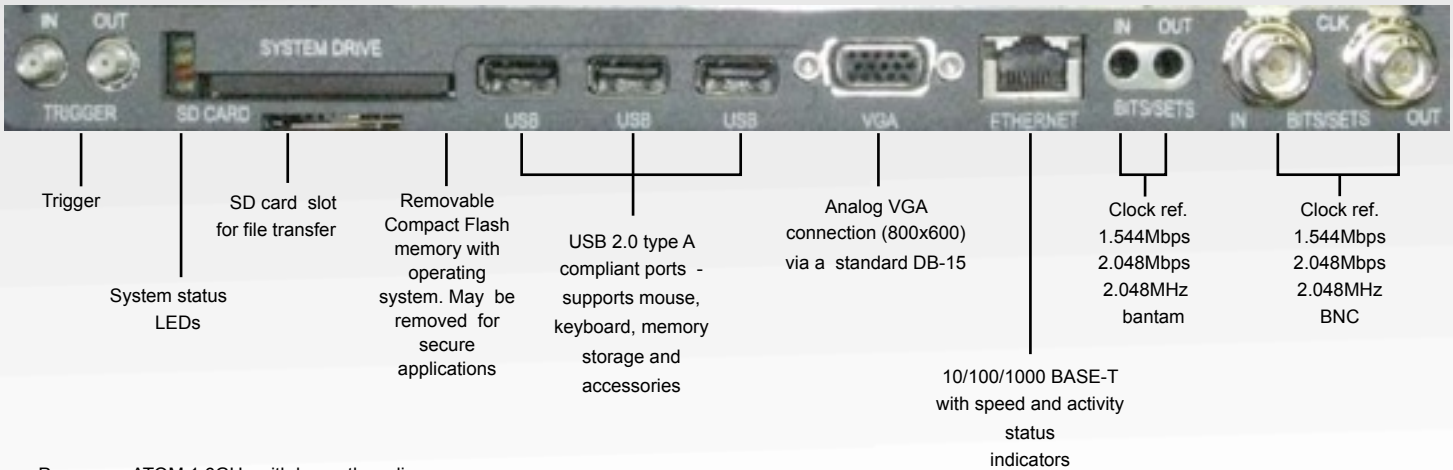
WANDER

Bit Rates	OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), (OC-48/STM-16) 2488.32 Mbps, (OC-192/STM-64) 9953.28 Mbps, (OTN) 10709.00 Mbps	Sample Rate: 50 Hz Sample storage intervals: 20 ms, 1 sec, 10 secs Input frequency: 0 to 10 Hz Anti-alias filter: 10 Hz ± 0.1% first-order roll off Maximum slew rate: ±100,000 ns/sec	
Output Filter	10 Hz ± 0.1% first-order roll off	TIE, MTIE, MRTIE, TDEV measurement range: Unlimited for signals with ±100,000 ns/sec max slew rate	
Maximum Slew Rate	±100,000 ns/sec	Noise: ± 2.5 ns Amplitude Accuracy: ± 1% ± 2.5 ns Bandwidth: 0 Hz to 10 Hz Resolution: 1 nanosecond Observation time: 0.02 to 10,000,000 second	
Wander Patterns	Sine Wave: Modulation frequency range: 1 µHz to 24.9 Hz Resolution: 1 µHz Amplitude range: 0 to 100,000 ns pp @ f _m < 1Hz, 0 to x@f _m > 1Hz where x=(100,000nspp/f _m) Accuracy: ± 0.1% of setting ± 1 ns Trapezoid wave, triangle wave: Similar to sine wave but has linear slews TDEV noise patterns: TDEV tolerance, SSU Type 1 TDEV tolerance Phase transients: Fixed transients: Duration: 16.37 ms Height: 1000 ns or 1200 ns Transient Ramp: User selectable height and duration Duration: 0.02 – 1,000,000 sec Height: 1 – 20,000 ns	Test Masks: Masks from various standards are displayed along with the measurement graphs and tests for pass or fail are performed Integration Time: 0.02 to 167000 second Frequency Offset and Frequency Drift measurements: Calculation and display of frequency offset and drift rate from TIE data	
		Frequency Drift	Range: 0-867.480 ppm/sec Accuracy: < 1% ± 0.01 ppm/sec Bandwidth: 0 Hz to 0.5 Hz Resolution: 0.001 ppm/sec
		Frequency Offset Resolution	0.0000001 ppm
Wander Patterns	Measurement duration: Min: 10 seconds Max: Limited only by external PC available disk space. Disk space used at approximately 1.42 Mbytes per hour (20 ms storage interval).		

COMMON NIC PLATFORM FEATURES

- Test result storage and retrieval
- Test setup storage and retrieval
- Audible alarm/error notification
- Email notification of alarms/errors and test completion
- Remote control GUI included
- Multi-user remote control, 10 simultaneous users
- Supports 512 individual remote user accounts
- Supports optional 802.3 wireless LAN
- Removable memory for use in secure areas

System Controller Specifications



Processor: ATOM 1.6GHz with hyper threading

Internal Memory: 1GB of RAM

Internal storage:

- Industrial grade compact flash - standard
- Field serviceable & removable

Operating System: Windows Embedded Standard

800 x 600 resolution display with matte finish anti-glare touchscreen to minimize glare and fingerprints

Clocking: Supports BITS, SETS, and 2.048MHz clock in and out reference

- Supports reference clock in & out options via standard 100/120 ohm Bantam and 75 ohm BNC connectors
- Internal system reference clock (used for internal clock modes) is a stratum 3

External Ethernet Control: 10/100/1000BASE-T RJ-45 with Speed and Activity status LEDs

USB ports

- 3 external USB type A 2.0 compliant ports
- Supports external peripherals including: GPIB, USB storage, keyboard, mouse, printer, wireless adapters, USB to RS-232, USB to Parallel

SD memory

- External slot on faceplate
- SD supported up to 4Gig

VGA port: Supports an external analog VGA connection (800x600 resolution) via a standard DB-15 front panel connector

Trigger

- Trigger In supports restart or error insertion (user-defined) when trigger pulse is received
- Trigger Out provides trigger pulse when certain errors or alarms (user-defined) are detected

RS-232 Serial port - supports USB to RS-232 adapter

System Status LEDs

- 4 LEDs display the status of the NIC

NIC NXG Chassis*



The NIC NXG Chassis

Two-slot compact chassis for field testing of SONET, SDH, OTN, ATM, Ethernet and DWDM networks. Fits under an airline seat. Can be configured as a NIC 40G, the industry's smallest/lightest 40/43Gbps test solution.

The NIC BP Chassis

Battery power to support applications where power is unavailable or unreliable.

The NIC Plus Chassis

With five-slots available, the NIC Plus and NIC Plus NXG provide telecom and datacom testing in one chassis, capable of unmatched multi-port configurations as well as jitter and wander testing.

NIC BP Chassis*



The NIC EP Chassis

Rack-mount five-slot chassis "Embedded Platform" with remote management software to enable remote circuit turn up, monitoring, troubleshooting and is also optimized for lab and manufacturing applications.

NIC Plus Chassis*



General Specifications

Memory storage: Internal non-volatile memory, USB, PCMCIA

Operating System: Windows XP Embedded

Operating Temperature: 0° to 40° C @ 85% RH

Storage Temperature: -20° to 60° C @ 95% RH

Power Requirements: 100 to 120 and 200 to 240 VAC, 50-60 Hz

Dimensions - NIC: 10.1 H x 12.3 W x 4.7 D in (257 x 312 x 120 mm)

Dimensions - NIC BP: 10.1 H x 12.3 W x 5.0 D in (257 x 312 x 127 mm)

Dimensions - NIC Plus: 13.7 H x 13.0 W x 7.9 D in (348 x 330 x 201 mm)

Dimensions - NIC EP: 7.0 H x 19.0 W x 10.6 D in (178 x 483 x 269 mm)

Weight - NIC: 11 - 12.5 lb, depending on configuration

Weight - NIC BP: 12.5 - 14 lb, depending on configuration

Weight - NIC Plus: 14.5 - 25 lb, depending on configuration

Weight - NIC EP: 14.5 - 25 lb, depending on configuration

Screen - NIC & NIC BP: 10.4-inch active matrix color display with touchscreen

Screen - NIC Plus: 12.1-inch active matrix color display with touchscreen

Power Supply - AC Power Supply and Rechargeable Battery

NIC EP Chassis*



Auxiliary Interfaces

Remote Control/Software Update: 10/100 BaseT, RJ-45

Wireless Remote Control Software Update: 802.11B PCMCIA Support

External Memory: USB or PCMCIA Dual Slot (2 Type II or 1 Type III support)

Input/Output Trigger: SMA

BITS/SETS Clock: Bantam 1.544M/2.048M

Battery Specification

Battery Type: Lithium Ion

Capacity: 95 watt-hours

Voltage input: 24v

Life cycle: 100-300 charges to reach 80% capacity

Warranty: 1 year warranty on battery



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