

Ixia Novus SFP28/QSFP28 High-Density 100/25/10GE Load Module

Evolve Your High-Speed Multi-Rate Ethernet Testing

Ixia Novus 100/25/10GE SFP28/QSFP28 Enables 5G RAN Transport Validation

The new 5G flexible RAN architecture introduces the Ethernet-based fronthaul for carrying time-sensitive radio data over switched networks. The new Ixia Novus 25/10GE SFP28 load module provides the right mix of required interface speeds, time-sensitive networking (TSN) capabilities, and high-scale control and data plane traffic to validate these networks.

Network equipment manufacturers (NEMs) are rapidly developing multi-rate switch/routing devices for 5G fronthaul network to capture market share. These products are expected to support high data rates while meeting the demands for time-critical radio data over Ethernet.

Bandwidth requirements for enterprises, cloud service providers, and global data centers continues to grow rapidly. Cloud service providers and hyper-scale data centers are deploying high-density 100GE and 25GE networking infrastructure solutions to meet these demands.

As data centers, cloud service providers, and large enterprises implement this same high-density network equipment in their own networks, they too need the same type of test solution to verify performance and functionality prior to deployment.

Highlights

- Validate 5G RAN transport network infrastructure
- Validate 100GE, 25GE, and 10GE over copper, multimode and single-mode fiber interconnect media
- Emulate Time Sensitive Networking (TSN) over 25GE interfaces
- Leverage excellent interoperability, functional, and performance test platform for the new 100GBASE-SR4, 100GBASE-LR4, 100GBASE-CR4, 25GBASE-CR, 25GBASE-SR, 25GBASE-LR with auto-negotiation, FEC, and link training
- Generate broad range of traffic and analysis with full L2/3 protocol coverage



Novus SFP28/QSFP28 8-ports, 100/25/10GE 1-slot load module with the eight included QSA adaptors

Key Features

- Multi-vendor interoperability of 100GE, 25GE, and 10GE testing between different speeds that run over these optics and media: Pluggable optical transceivers, active optical cables (AOC), and passive copper direct attach cable (DAC) media
- 8x25GE, 8x10GE SFP28 interface speed support with pluggable QSA56 adaptors. The adaptors are included with the load module.
- Optional 8x100GE QSFP28 speed support for multimode 100GBASE-SR4, single mode 100GBASE-LR4 and 100GBASE-CR4 and passive copper
- Line-rate hardware packet capture and decode tools to detect and de-bug data transmission errors
- An excellent test platform for full line rate 100Gb/s to evaluate the new 100GE and new multi-rate ASIC designs, FPGAs, and hardware switch fabrics that use 25Gb/s SFP28 electrical interface with NRZ encoding
- Benchmark the data plane and protocol emulation performance and scale of ultra-high-density 100/25/10GE-capable network equipment; use industry-standard RFC benchmark tests in large test beds with hundreds of ports in a single test
- Support for advanced features such as: Ethernet Forward Error Correction both RS-FEC and FC_FEC, auto-negotiation, and link training on 100GE, and 25GE speeds
- L2/3 protocol emulation to validate performance and scalability of L2/3 routing/switching and data center test cases using Ixia's IxNetwork application
- Support for TSN Frame preemption (802.1Qbu / 802.13br), Time aware shaper (802.1Qbv) and a variety of 1588v2 profiles.
- Application support including: IxExplorer, IxNetwork, and the related Tcl and automation APIs

Specifications

Product Description	NOVUS-10/25GE8SFP28
Part Number	944-1164
Hardware Load Module Specifications	
Slot / Number of Ports	A 1-slot load module with: <ul style="list-style-type: none"> • 8x100GE native QSFP28 ports (requires 905-1063 or 905-1064 option) • 8x25GE SFP28 ports with QSA56 adaptors • 8x10GE SFP28 ports with QSA56 adaptors
Physical Interfaces	8-ports of native QSFP28 + 8 each QSA56 adaptors
Supported Port Speeds	<ul style="list-style-type: none"> • Optional 100GE/port: 100GE-capable fiber and passive copper cable media • 25GE/port: 25GE-capable fiber and passive copper cable media • 10GE/port: 10GE-capable fiber and passive copper cable media
Number of users	Up to 8-users per load module
CPU and Memory	Multicore processor with 2GB of CPU memory per port for 100/25/10GE speed modes.

Product Description	NOVUS-10/25GE8SFP28
IEEE Interface Protocols	<ul style="list-style-type: none"> • IEEE 802.3 100GBASE-R LAN • IEEE P802.3bj • IEEE P802.3bm • IEEE P802.3by • IEEE 802.3ba • IEEE 802.3ae
Advanced Layer 1 Support	<p>100GE:</p> <ul style="list-style-type: none"> • Auto-negotiation (AN), Clause 73 for passive copper DAC • Link training for 100GE copper cable media, Clause 73 • Ethernet Forward Error Correction RS-FEC, Clause 91 • FEC statistics: <ul style="list-style-type: none"> ◦ RS-FEC Corrected and Uncorrected Codeword Counts • Ability to independently turn ON or OFF AN with Link training, or FEC, or to allow IEEE defaults to automatically manage the interoperability <p>25GE:</p> <ul style="list-style-type: none"> • Auto-negotiation (AN), Clause 73 for passive copper DAC. Compatible with 25G/50G Consortium v 1.6 (uses 25G CID) • Link Training (LT) for 25GE copper DAC media (Clause 93, 110); note: Clause 72 link training patterns are not supported • Ethernet Forward Error Correction: <ul style="list-style-type: none"> ◦ FC-FEC, Clause 74 for BASE-R PHYs ◦ RS-FEC, Clause 108 for 25GBASE-R PHYs ◦ FEC statistics: <ul style="list-style-type: none"> - RS-FEC corrected and uncorrected codeword count - FC-FEC corrected and uncorrected block count - FC-FEC corrected error bits • Ability to independently turn ON or OFF AN with Link training, or FEC, or to allow IEEE defaults to automatically manage the interoperability <p>10GE:</p> <ul style="list-style-type: none"> • Independent SFP28 ports with 10GE speed support
Transceiver Support	<ul style="list-style-type: none"> • 100GBASE-SR4 and 4x25GBASE-SR QSFP28 for multimode fiber <ul style="list-style-type: none"> ◦ Pluggable transceiver • 100GBASE-LR4 QSFP28 for single-mode fiber <ul style="list-style-type: none"> ◦ Pluggable transceiver • 100G PSM4 QSFP28 for single mode fiber <ul style="list-style-type: none"> ◦ Pluggable transceiver ◦ 100GE support requires a point-to-point cable • 25/10GE SFP28-LR for single mode fiber <ul style="list-style-type: none"> ◦ Pluggable transceiver ◦ 25/10GE support requires an LC-duplex single mode fiber cable

Product Description	NOVUS-10/25GE8SFP28
	<ul style="list-style-type: none"> • 25/10GE SFP28-SR for multimode fiber <ul style="list-style-type: none"> ◦ Pluggable transceiver ◦ 25/10GE support requires an LC-duplex multimode fiber cable • SFP28 DAC (support CA-N) <ul style="list-style-type: none"> ◦ Pluggable DAC ◦ 25/10GE support requires a passive copper DAC ◦ This card supports CA-N cables for up to 2 meters in length with RS-FEC turned ON or FC-FEC turned ON or No-FEC turned at all
Cable Media	<ul style="list-style-type: none"> • 100GBASE-SR4 multimode fiber AOC and MT-MT 12-fiber point-to-point cables for QSFP28 • 100GBASE-CR4, passive, copper DAC up to 5 meters in length; note: requires RS-FEC to be enabled • 25GBASE-SR requires an LC-duplex multimode fiber, point-to-point cable • 25GBASE-LR requires an LC-duplex single mode fiber, point-to-point cable • 25GBASE-CR requires a passive copper DAC point-point, up to 3 meters in length; note: requires BASE-R FEC Clause 74 or RS-FEC Clause 91 to be enabled per IEEE 802.4by standard
Load Module Dimensions	<ul style="list-style-type: none"> • 17.3" (L) x 1.3" (W) x 12.0" (H) • 440mm (L) x 33mm (W) x 305mm (H)
Load Module Weights	<ul style="list-style-type: none"> • Module only: 11.8 lbs. (5.35 kg) • Shipping: 19.24 lbs. (8.73 kg) includes eight QSA56 adaptors
Temperature (Ambient Air)	<ul style="list-style-type: none"> • Operating: 41°F to 95°F (5°C to 35°C) • Storage: 41°F to 122°F (5°C to 50°C)
Humidity (Ambient Air)	<ul style="list-style-type: none"> • Operating: 0% to 85%, non-condensing • Storage: 0% to 85%, non-condensing
Chassis Capacity: Maximum Number of Cards and Ports per Chassis Model	
12 slot rack-mount chassis (XGS12-SD/HSL)	12 load modules per chassis: <ul style="list-style-type: none"> • 96-ports of 100GE • 96-ports of 25GE • 96-ports of 10GE
2-slot rack-mount chassis (XGS2-SD/HSL)	2 load modules per chassis: <ul style="list-style-type: none"> • 16-ports of 100GE • 16-ports of 25GE • 16-ports of 10GE
Transmit Feature Specifications	
Transmit Engine	Wire-speed packet generation with timestamps, sequence numbers, data integrity signature, and packet group signatures

Product Description	NOVUS-10/25GE8SFP28		
Max. Streams per Port	100GE	25GE	10GE
	32	32	32
Max. Streams per Port in Data Center Ethernet	100GE	25GE	10GE
	32	32	32
Stream Controls	Rate and frame size change on the fly, sequential and advanced stream scheduler		
Minimum Frame Size	<ul style="list-style-type: none"> 60 bytes at full line rate 49 bytes at less than full line rate 		
Maximum Frame Size	14,000 bytes		
Maximum Frame Size in Data Center Ethernet	9,216 bytes		
Priority Flow Control	<ul style="list-style-type: none"> 8 line-rate-capable queues, each supporting up to 2,500-byte frame lengths 1 queue supporting up to 9,216-byte frame lengths 		
Frame Length Controls	Fixed, increment by user-defined step, weighted pairs, uniform, repeatable random, IMIX, and Quad Gaussian		
User Defined Fields (UDF):	Fixed, increment or decrement by user-defined step, sequence, value list, and random configurations; up to ten, 32-bit-wide UDFs are available		
Value Lists (Max.)	1M / UDF		
Sequence (Max.)	100GE	25GE	10GE
	8K/UDF	8K/UDF	8K/UDF
Error Generation	Generate good CRC or force bad CRC, undersize and oversize standard Ethernet frame lengths, and bad checksum		
Hardware Checksum Generation	Checksum generation and verification for IPv4, IP over IP, ICMP/GRE/TCP/UDP, L2TP, GTP		
Link Fault Signaling	Reports, no fault, remote fault, and local fault port statistics; generate local and remote faults with controls for the number of faults and order of faults, plus the ability to select the option to have the transmit port ignore link faults from a remote link partner		
Latency Measurement Resolution	2.5 nanoseconds		
Intrinsic Latency Compensation	Removes inherent latency error from the 100GE port electronics		

Product Description	NOVUS-10/25GE8SFP28			
Transmit Line Clock Adjustment	Ability to adjust the parts-per-million line frequency over a range of -100 ppm to +100 ppm across all ports on the load module.			
Receive Feature Specifications				
Receive Engine	Wire-speed packet filtering, capturing, real-time latency, and inter-arrival time for each packet group, with data integrity, sequence and advanced sequence checking capability			
Trackable Receive Flows per Port		100GE	25GE	10GE
	Limited Statistics Mode	32K	32K	32K
	Full Statistics Mode	4K	4K	4k
Minimum Frame Size	<ul style="list-style-type: none"> 60 bytes at full line rate 64 bytes at full line rate into the capture buffer 49 bytes at less than full line rate 			
Filters (User-Defined Statistics, UDS)	2 SA/DA pattern matchers, 2x16-byte user-definable patterns with offsets capability for start of: frame, IP, or protocol; up to 6 UDS counters are available			
Hardware Capture Buffer	There are two 512MB hardware capture buffers on the card; user can select which port and/or resource group each capture buffer may be assigned for capture purposes.			
Statistics and Rates	Link state, line speed, frames sent, valid frames received, bytes sent/received, fragments, undersize, oversize, CRC errors, VLAN tagged frames, 6 user-defined stats, capture trigger (UDS 3), capture filter (UDS 4), 8 QoS counters, data integrity frames, data integrity errors, sequence and advanced sequence checking frames, sequence checking errors, ARP, and PING requests and replies, FEC statistics: RS-FEC Corrected and Uncorrected Block Counts, FEC Corrected Error Bits, FEC Sync			
Latency / Jitter Measurements	Cut-through, store & forward, forwarding delay, up to 16 time bins latency/jitter, MEF jitter, and inter-arrival time			
100GE Receive-side PCS Lanes Port Statistics Counters	PCS Sync Errors, Illegal Codes, Remote Faults, Local Faults, Illegal Ordered Set, Illegal Idle, Illegal SOF, Out Of Order SOF, Out Of Order EOF, Out Of Order Data, Out Of Order Ordered Set			
100GE Physical Coding Sublayer (PCS) Receive-side Statistics and Indicators	IEEE 802.3ba-compliant PCS transmit and receive side test capabilities include: Per PCS lane, receive lanes statistics - PCS Sync Header and Lane Marker Lock, Lane Marker mapping, Relative lane deskew up to 104 microseconds for 100GE, Sync Header and PCS Lane Marker Error counters, indicators for Loss of Synch Header and Lane Marker, and BIP8 errors			
Time Sensitive Networking (TSN)	Support for Time Synchronization (802.1AS, 802.1AS-Rev), Frame preemption (802.3br, 802.1Qbu), Time Aware Shaper (802.1Qbv)			

Product Description	NOVUS-10/25GE8SFP28
Layer 2-3 Protocol Support	
Routing and Switching	BGP4/BGP4+, OSPFv2/v3, ISISv4/v6, EIGRP/EIGRPv6, RIP/RIPng, BFD, Seamless BFD, IGMP/MLD, PIM-SM/SSM, STP/RSTP/MSTP, PVST+/RPVST+, Link Aggregation (LACP), LISP
Software Defined Network	OpenFlow, Segment Routing (MPLS and IPv6), BGP Link State (BGP-LS), PCEP, VXLAN, EVPN VXLAN, OVSD, GENEVE, BGP FlowSpec, BGP SR TE Policy, eCPRI
MPLS	RSVP-TE P2P/P2MP, LDP/LDPv6/mLDP, LDP L2VPN (PWE/VPLS), BGP VPLS/VPWS, L3VPN/6VPE, 6PE, BGP RFC3107, MPLS-TP, MPLS OAM, EVPN/PBB-EVPN, Multicast VPN Rosen Draft, NG Multicast VPN
Broadband and Authentication	PPPoX/L2TPv2, DHCPv4/DHCPv6, ANCP, IPv6 Autoconfiguration (SLAAC), IGMP/MLD, 802.1x, Bonded GRE HG
Industrial Ethernet	Link OAM (IEEE 802.3ah), CFM/Y.1731, PBB/PBB-TE, ELMI, Sync-E ESMC, IEEE 1588v2 (PTP)
Data Center Ethernet	DCBX/LLDP, FCoE/FIP, PFC (IEEE 802.1Qbb), TRILL, Cisco FabricPath, SPBM, VEPA
5G RAN Transport	eCPRI, TSN, Static MACsec, 1588v2 (PTP)

Application Support

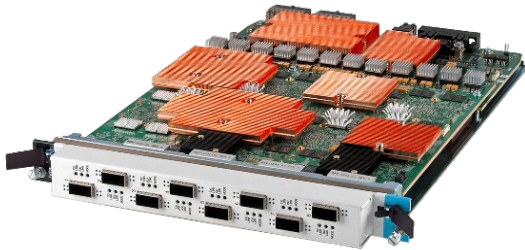
NOVUS-10/25GE8SFP28
<ul style="list-style-type: none"> • IxExplorer: Layer 2-3 wire-speed traffic generation and analysis with HSE PCS Lanes Rx-side testing. Note: Not all Ixia loads modules support Layer 1 BERT and/or the complete set of Tx PCS Lanes test capabilities. • IxNetwork: Wire-rate traffic generation with service modeling that builds realistic, dynamically controllable data-plane traffic. IxNetwork offers the industry's best test solution for functional and performance testing by using comprehensive emulation for routing, switching, MPLS, IP multicast, broadband, authentication, Carrier Ethernet, and data center Ethernet protocols. • Tcl API: Custom user script development for Layer 1-3 testing.

Ordering Information

Load module

944-1164

IXIA NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module, 1-slot with 8-ports adaptor based SFP28 physical interface, L2-3 support with complete protocol coverage. The load module is compatible with the XGS2-SD 2-slot, 3RU standard performance rack-mountable chassis bundle (940-0010), XGS12-SD 12-slot, 11RU standard performance rack-mountable chassis bundle (940-0011), XGS2-SDL 2-slot, 3RU standard performance rack-mountable chassis bundle (940-0013), XGS12-SDL 12-slot, 11RU standard performance rack-mountable chassis bundle (940-0015), XGS2-HSL 2-slot, 3RU high performance rack-mountable chassis bundle (940-0014), and XGS12-HSL 12-slot, 11RU high performance rack-mountable chassis bundle (940-0016).



Speed Options – 100GE

905-1063

IXIA NOVUS 100GE FACTORY INSTALLED OPTION for new purchases of the NOVUS-S 10GE/25GE8SFP28 (944-1164), 8-port, SFP28 10GE/25GE load modules. Note: This option is REQUIRED ON NEW PURCHASES to enable the 100GE speed on the NOVUS-10GE/25GE8SFP28 (944-1164), 8-port, SFP28 10GE/25GE load modules.

905-1064

IXIA NOVUS 100GE FIELD UPGRADE OPTION for the NOVUS-S 10GE/25GE8SFP28 (944-1164), 8-port, SFP28 10GE/25GE load modules.

TSN ENABLEMENT Options

905-1065

IXIA TSN FACTORY INSTALLED OPTION for enabling TSN capability for the new purchase of the NOVUS-10GE/25GE8SFP28 (944-1164), 8-port, SFP28 10GE/25GE load modules. REQUIRES 930-2120 IxNetwork, Optional Software, AVB/TSN Protocols Emulation. Note: This enables support for Frame preemption (802.1Qbu and 802.3br) on 25G link speeds only. Note: This option is REQUIRED ON NEW PURCHASES to enable TSN on the NOVUS-10GE/25GE8SFP28 (944-1164), 8-port, SFP28 10GE/25GE load modules.

905-1066

IXIA TSN FIELD UPGRADE OPTION for enabling TSN capability on the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10GE/25GE load module, 1-slot with 8-ports adaptor based SFP28 physical interface. (944-1164). REQUIRES 930-2120 IxNetwork, Optional Software, AVB/TSN Protocols Emulation. Note: This enables support for Frame preemption (802.1Qbu and 802.3br) on 25G link speeds only.

10GE & 25GE Cables & Transceivers

SFP28-SR-XCVR

Ixia, SFP28 Dual-Rate 25GBASE-SR 25GE and 10GBASE-SR 10GE pluggable optical transceiver, MMF (multimode), 850nm (948-0059). Compatible with the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10GE/25GE load module, 1-slot with 8-ports adaptor based SFP28 physical interface (944-1164)

SFP28-LR-XCVR

Ixia, SFP28 Dual-Rate 25GBASE-LR 25GE and 10GBASE-LR 10GE pluggable optical transceiver, MMF (multimode), 850nm (948-0058). Compatible with the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10GE/25GE load module, 1-slot with 8-ports adaptor based SFP28 physical interface (944-1164)

SFP28-2M-CBL

Ixia, SFP28-to-SFP28 25GBASE-CR1 25GE and SFP28 10GBASE-CR 10GE passive copper, Direct Attach Cable (DAC), point-to-point cable, 2-meter length (942-0128). Compatible with the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10GE/25GE load module, 1-slot with 8-ports adaptor based SFP28 physical interface (944-1164)

100GE Cables & transceivers

QSFP28-SR4-XCVR

QSFP28 100GBASE-SR4 100GE pluggable optical transceiver, MMF (multimode), 850nm, 100m reach. x, and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

Note 1: This transceiver supports both 25GE speed (XM-4x25GE 905-1004 and UPG-XM-4x25GE 905-1005), and the 50GE speed (XM-1x50GE 905-1009 and UPG-XM-1x50GE) capability options on the Multis XM100GE4QSFP28+ENH load module.

Note 2: This transceiver supports the 25GE speed (NOVUS 25GE FAN-OUT Option 905-1007, and the NOVUS 25GE FAN-OUT-UPG FIELD UPGRADE Option 905-1008), and 50GE speed (NOVUS 2x50GE FAN-OUT option 905-1011, and NOVUS 2x50GE FAN-OUT-UPG FIELD UPGRADE Option 905-1012) on the NOVUS100GE8Q28+FAN load module.

Note 3: This transceiver supports 1x40GE and 4x10GE speeds (NOVUS 1x40GE/4x10GE FAN-OUT OPTION 905-1025 and the NOVUS 1x40GE/4x10GE FAN-OUT-UPG FIELD UPGRADE 905-1026) on the NOVUS100GE8Q28+FAN load module.

Note4: Physical fan-out to 4x25GE and 4x10GE speeds using fan-out cable 942-0067 and 942-0068 are supported on the Xcellon-Multis XM100GE4QSFP28+ENH 100-Gigabit Ethernet, Enhanced load module (944-1117), the NOVUS-M100GE8Q28+FAN (944-1156), NOVUS-R100GE8Q28+FAN (944-1147), the NOVUS100GE8Q28+FAN, 8-port, QSFP28 100GE load module (944-1140) .

Note 5: This transceiver supports 1x100GE speed only on the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

QSFP28-LR4-XCVR

QSFP28 100GBASE-LR4 100GE pluggable optical transceiver, SMF (single mode fiber), 1310nm, 10km reach. Compatible with the Xcellon-Multis XM100GE4QSFP28+ENH 100-Gigabit Ethernet, Enhanced load module (944-1117), the NOVUS-M100GE8Q28+FAN (944-1156), NOVUS-R100GE8Q28+FAN (944-1147) the NOVUS100GE8Q28+FAN, 8-port, QSFP28 100GE load module (944-1140), and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

QSFP28-PSM4-XCVR

Ixia QSFP28 100GBASE-PSM4 100GE pluggable optical transceiver, SMF (single mode fiber), 1310nm, 2km reach. MPO Connector (948-0037). COMPATIBLE VISIBILITY PRODUCTS: Vision X Family- MVX-SWCH (991-2033), MVX-NS12PC (991-2030), MVX-PS8PC (991-2032), Vision 7300 Family- M7300-12PC (992-0072), and Vision E100. COMPATIBLE TEST PRODUCTS: IXIA NOVUS100GE8Q28+FAN (944-1140), NOVUS-M100GE8Q28+FAN (944-1147), NOVUS-R100GE8Q28+FAN (944-1156), and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

QSFP28-DR1-XCVR

Ixia QSFP28 100GE 100GBASE-DR1 pluggable optical transceiver, SMF (single mode), 1310nm, 500m reach (948-0055). This optical transceiver is compatible with all Novus load modules: NOVUS-M100GE8Q28+FAN (944-1156), NOVUS-R100GE8Q28+FAN (944-1147), and the NOVUS100GE8Q28+FAN, 8-port, QSFP28 100GE load module (944-1140), and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164). Note: This QSFP28 transceiver converts PAM4 signaling to NRZ signaling.

942-0088

QSFP28 passive, copper, Direct Attach Cable (DAC), 3-meter length for Xcellon-Multis XM100GE4QSFP28+ENH 100GE load module (944-1117), the NOVUS-M100GE8Q28+FAN (944-1156), NOVUS-R100GE8Q28+FAN (944-1147), the NOVUS100GE8Q28+FAN, 8-port, QSFP28 100GE load module (944-1140), and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

942-0092

QSFP28 Active Optical Cable (AOC), multimode fiber, 850nm, 3-meter length. Compatible with the Xcellon-Multis XM100GE4QSFP28+ENH 100-Gigabit Ethernet, Enhanced load module (944-1117), NOVUS100GE8Q28+FAN, 8-port, QSFP28 100GE (944-1140), NOVUS-M100GE8Q28+FAN (944-1156), NOVUS100GE8Q28+FAN (944-1147), and the CloudStorm 2-port, QSFP28 100GE (944-1231 and 944-1232) load modules, and the NOVUS-S 10/25GE8SFP28, 8-port, SFP28 10/25GE load module (944-1164).

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