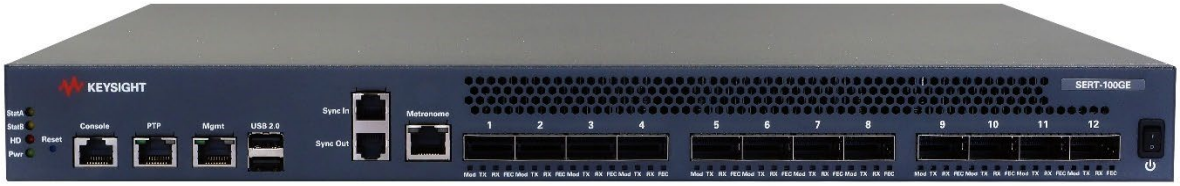
Switch and Edge Router Tester 100GE

Opportunity: Scale Up Your 100GE Network and Lower Your Time to Market while Optimizing Your Test Budget

Disaggregation of control and data plane in 100GE market with increased focus on the data plane validation with Terabits of real-life traffic and moderate or no control plane testing creates the demand for test equipment that is focused on validating these devices. Migration of processing from core to edge routers needs different requirements for testing devices and networks.

The emergence of 400GE, 800GE, and 1.6TE is forcing NEMs and chipset customers to work on multiple generations of Ethernet devices while keeping R&D spending under control.

The current solutions in the market are either high-end or low performance. Both are not suited for the scaling needed in Edge Router testing.



Solution: 12-Port 100GE Platform Customized for Switch and Edge Router Testing

Keysight introduces the Switch and Edge Router Tester 100GE, which is customized for data plane traffic and Edge Router testing.

Delivering a balance of data plane and control plane capabilities, Switch and Edge Router Tester 100GE addresses the market opportunities in testing edge devices. Our newest 100GE product delivers line rate data plane and medium rate control plane traffic with nanosecond latency accuracy and complex protocol and traffic statistics.

With 12-port NRZ native variant, the Switch and Edge Router Tester 100GE appliance is a cost-effective highly scalable solution to hundreds of test ports in the same time domain. Each port is five-speed capable: 100 / 50 / 40 / 25 / 10GE, allowing per physical port user ownership.

KEYSIGHT

Characteristics

- 100GE traffic generator (12 x 100G ports)
- Test Data Center switches for fabric throughput, load balancing and failover
- Validate Edge Router Control and Data plane traffic
- Qualify transceiver and test L1 capabilities
- 5-speed (100 / 50 / 40 / 25 / 10GE)
- NRZ availability
- Standard 1U switch design
- Per front panel port ownership
- Cost-efficient balanced performances

Key Features

- Benchmark the data plane, protocol emulation performance, and scale of 100 / 50 / 40 / 25 / 10GE-capable switch and Edge Routers.
- Use industry-standard RFC benchmark tests in large test beds with hundreds of ports in a single test in the same time domain.
- An excellent test platform to evaluate the 100GE and multi-rate ASIC designs, FPGAs, and hardware fabrics that use electrical interface with NRZ encoding at full line rate.
- High power and cooling support in all QSFP28 front panel ports of the Switch and Edge Router Tester 100GE appliance allow long distance optics support.
- Multi-vendor interoperability of 100GE, 50GE, 40GE, 25GE, and 10GE testing between different speeds that run over Pluggable optical transceivers, Active Optical Cables (AOC), and passive copper Direct Attach Cable (DAC) media.
- Keysight instrumentation, including floating timestamp, sequence number, flow identification, and data integrity.
- Per packet high-latency measurement resolution at 2.5 ns at all speeds.
- Forward Error Correction (FEC) support for 50GE and 100GE speeds.
- Inject packet errors: CRCs, runts, giants, checksum errors, and out of sequence.
- Support for passive, copper direct attached cables (DAC) up to 5 meters in length and AOC.
- Auto-negotiation and Link Training support for 25GE / 50GE / 100GE speeds.
- Overall optical and copper interconnect media support with CMIS support.
- Native IxOS on top of KCOS platform and IxExplorer application support with related Tcl automation.
- IxNetwork application support over Windows or web UI and related RestAPI, Python, Tcl, Perl, or Ruby automation.
- Software protocol bundles that provide easy ordering and bundled packages specifically designed for Switch and Edge Router Tester 100GE appliances.
- Control plane and data plane capture support.
- Multiple chassis can be chained together.
- Per Resource Group (4 physical ports) ppm control.

Specifications

Product Description	Switch and Edge Router Tester 100GE
Part numbers	944-1450, 947-5150
Hardware System Specifications	
RU / number of ports	1RU/ 12 ports
Physical interfaces	12 ports of native QSFP28 NRZ QSFP+ and SFP28 also supported
Supported per port speeds	1x100GE 2x50GE 1x40GE 4x25GE 4x10GE
Number of users	12 users (one user per physical port)
IEEE interface protocols	• IEEE 802.3 100GBASE-R LAN • IEEE P802.3bj • IEEE P802.3bm • IEEE P802.3by • IEEE 802.3ba • IEEE 802.3ae
25G/50G consortium specification	25GE and 50GE speed support compatible with version 1.6 of the specification
Advanced layer 1 support	100GE: • 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: - 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 50GE: • Auto-negotiation (AN), Clause 73 for passive copper DAC. Compatible with 25G/50G Consortium v 1.6 (uses 25G CID) • Link Training (LT) for 50GE copper DAC media (Clause 93, 110); note: Clause 72 link training patterns are not supported • Ethernet Forward Error Correction: • FC-FEC, Clause 74 for BASE-R PHYs • RS-FEC, Clause 91 for 50GBASE-R PHYs • FEC statistics: - 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 • Independent fan-out ports with physical fan-out media for up to 2x50GE per QSFP28 port 40GE: • Link training for copper cable media, Clause 73 25GE: • 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) • Ethernet Forward Error Correction: • RS-FEC, Clause 108 for 25GBASE-R PHYs • RS-FEC corrected and uncorrected codeword count • 10GE: • Independent fan-out ports with physical fan-out media for up to 4x10GE per port

Product Description	Switch and Edge Router Tester 100GE
Optical transceiver support	• 100GBASE-SR4 and 4x25GBASE-SR QSFP28 for multimode fiber • 100GBASE-LR4 QSFP28 for single mode fiber • 100GE PSM4 QSFP28 for single mode fiber • 100GE CWDM4 QSFP28 for single mode fiber • 40GBASE-PLR4 QSFP+ for single-mode fiber • 25GBASE-SR for multimode fiber • 25GBASE-LR for multimode fiber • 10GBASE-SR for multimode fiber • 10GBASE-LR for multimode fiber
Cable media	• 100GBASE-SR4 multimode fiber Active Optical Cable (AOC) and MT-MT 12-fiber point-to-point cables for QSFP28 • 100GBASE-CR4, passive, copper Direct Attached Cable (DAC) up to 5 meters in length • 50GBASE-CR2 passive, copper Direct Attached Cable (DAC) QSFP28-to-2xQSFP28 fan-out media, up to 3 meters in length • 50GBASE-SR2 multimode fiber Active Optical Cable (AOC) media, 850nm, 3-meter length • 25GBASE-SR multimode fiber Optical Cable (AOC) and MT-MT 12-fiber point-to-point cable for QSFP28, 3- meter length is available • 25GBASE-SR multimode fiber MT-to-4xLC fan-out cable for QSFP28, 3-meter and 5-meter lengths are available • 25GBASE-LR single mode fiber MT-to-4xLC fan-out cable for QSFP28, 3-meter length is available • 25GBASE-CR passive, copper Direct Attached Cable (DAC) point-point, up to 5 meters in length • 25GBASE-CR passive, copper Direct Attached Cable (DAC) QSFP28-to-4xSFP28 fan-out media, up to 5 meters in length
Appliance dimensions	438mm x 549mm x 44mm (W x D x H)
Appliance weights	9.2 Kg (20.2 Lbs)
Electrical specifications	Operates on 100–240VAC, 50/60Hz
	AC Maximum current consumption 3.8A (100V) -1.6A (240V)
	AC input considered current rating of protective device (building breaker) – 20A
	Maximum Power Consumption (W) – 380W
	Requires one (1) power source
Temperature (ambient air)	Operating temperature: 5°C to 35°C Non-operating temperature (storage): -40°C to 70°C
Humidity (ambient air)	Operating relative humidity: 10% to 85% RH (non-condensing) Non-operating relative humidity: 5% to 90% RH (non-condensing)
Maximum number of chassis in single test topology	8 chassis or 96x100GE, 192x50GE, 96x40GE, 384x25GE, 384x10GE ports • The Metronome Timing System (942-0090) is used for synchronizing a total of eight or more chassis at one time.
Transmit Feature Specifications	
Transmit engine	Wire-speed packet generation with timestamps, sequence numbers, data integrity, and packet group signatures
Max. streams per port and speed	• 1x100GE: 256 (per Physical port) • 2x50GE: 128 (per fan-out) • 1x40GE: 256 (per fan-out) • 4x25GE: 64 (per fan-out) • 4x10GE: 64 (per fan-out)
Stream controls	• Rate change on the fly • Advanced stream scheduler support
Minimum frame size	• 61 bytes at all speeds

Product Description	Switch and Edge Router Tester 100GE
Maximum data frame size	16,000 bytes at all speeds
Maximum protocol frame size	100G/ 40G – 12,000 bytes Rest of speeds – 8,000 bytes
Priority flow control	1 queue
Frame length controls	Fixed, increment by user-defined step, weighted pairs, uniform, repeatable random
User-Defined Fields (UDF)	• Fixed, counter (increment or decrement by user-defined step), value list, and random configurations. • Up to 4 UDFs supporting fixed, nested counter, random configurations (32-bit or 2x16-bit wide), or value list configurations (64-bit, 2x32-bit, 4x16-bit, or 4x8-bit wide). • Up to 4 additional UDFs supporting fixed, counter, random configurations (32-bit, or 2x16-bit wide). • Split UDFs (for example, 2x16 configuration) support different byte offset per UDF segment. • Total of up to 24 fields or 48 bytes can be defined by UDFs
Physical coding sublayer	PCS Layer Stats
Hardware checksum generation	L2TP/IPv4/IGMP/GRE/TCP/UDP/ICMP/GTP/LISP Good/Bad Checksum Generation
Link fault signaling	All speeds
Latency measurement resolution	2.5 ns
Intrinsic latency compensation	Yes
Transmit line clock adjustment	+/- 100 ppm
Transmit/receive loopback	Yes
Receive Feature Specifications	
Receive engine	Wire-speed packet filtering, capturing, real-time latency, and inter-arrival time for each packet group, with data integrity, and sequence checking capability
Trackable receive flows per port	100G: 32K, 50G: 16K, 25G/10G: 8K
Filters (User-Defined Statistics, UDS)	Up to 6 counters available
Hardware capture buffer (standard)	1MB/ Resource Group (4 ports)
Standard 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 and forward, forwarding delay, latency/jitter, MEF jitter, and inter-arrival time
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, 100G Lane Stats
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
Layer 2-3 Protocol Support	
Technology	Protocol
Routing and switching	BGP4/BGP4+, OSPFv2/v3, ISISv4/v6, RIP/RIPng, BFD, IGMP/MLD, PIM-SM/SSM, STP/RSTP/MSTP, PVST+/RPVST+
Software Defined Network	Segment Routing MPLS (ISIS, OSPFv2, OSPFv3, BGP), Segment Routing IPv6 (ISIS, OSPFv3,L3VPN, EVPN), BGP Link State (BGP-LS), PCEP, BGP SR TE Policy, BGP FlowSpec, Netconf, BIER, Flex-Algo (ISIS, OSPFv2), Seamless BFD, G-SRv6, gRIBI, OpenFlow,

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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, MPLSoGRE, MPLSoUDP
Broadband and authentication	PPPoE/L2TPv2, DHCPv4/DHCPv6, ANCP, IPv6 Autoconfiguration (SLAAC), IGMP/MLD, 802.1x, Bonded GRE HG
Carrier Ethernet & timing	Link OAM (IEEE 802.3ah), CFM/Y.1731, PBB/PBB-TE, ELMI, TWAMP/TWAMP-Light, Sync-E ESMC
Data center Ethernet	VXLAN, EVPN VXLAN, OVSDB, GENEVE, DCBX/LLDP, TRILL, Cisco FabricPath, SPBM
5G	eCPRI

Application Support

Switch and Edge Router Tester 100GE Models
IxExplorer: Layer 2-3 wire-speed traffic generation and analysis with HSE PCS Lanes Rx-side testing. IxExplorer UI can be deployed over Windows operating system. IxExplorer Tcl API: Custom user script development for Layer 1-3 testing
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. IxNetwork can be used via Windows deployed UI or WebUI. IxNetwork APIs: Custom user script development for Layer 1-3 testing using RestAPI, Python, Tcl, Ruby or Perl along with HLT, HLpy, HLruby, HLperl.

Ordering Information

Part Number	Description
Hardware Bundle	
947-5150	Keysight, Switch and Edge Router Tester 100GE, Ethernet hardware bundle with NRZ-based Ethernet per port, speed options included
Software Bundle	
930-2240	Keysight IxNetwork Premium Package for Switch and Edge Router Tester 100GE, node-locked perpetual license; INCLUDES: IxNetwork Base, RFC2544/2889/3918 QuickTest, and Protocol emulation for Routing, Switching, MPLS/VPN, Carrier Ethernet, Timing, Data Center Ethernet, Broadband and Authentication, SDN, and 5G Transport.
930-2241	Keysight IxNetwork Basic Package for Switch and Edge Router Tester 100GE (930-2241), node-locked perpetual license; INCLUDES: IxNetwork Base, RFC2544/2889/3918 and ITU-T Y.1564 QuickTest, and IGMP/MLD emulation.
930-2242	Keysight IxNetwork Routing/Switching/MPLS/VPN Package for Switch and Edge Router Tester 100GE, node-locked perpetual license; INCLUDES: Protocol emulation for Routing, Switching, and MPLS/VPN; REQUIRES: 930-2241 Keysight IxNetwork Basic Package for Switch and Edge Router Tester 100GE.
Appliance	
944-1450	Keysight, Switch and Edge Router Tester 100GE, 12-port, QSFP28, 100GE L2-3 Fixed Chassis.
Speed Options - 25GE, 40GE, 50GE	
930-1451	Keysight, Switch and Edge Router Tester 100GE, 4x25GE LICENSE FAN-OUT FIELD UPGRADE Option for purchases of Switch and Edge Router Tester 100GE fixed chassis
9301452	Keysight, Switch and Edge Router Tester 100GE, 2x50GE FAN-OUT LICENSE FIELD UPGRADE Option for NEW purchases of Switch and Edge Router Tester 100GE fixed chassis
930-1453	Keysight, Switch and Edge Router Tester 100GE, 1x40G/4x10GE FAN-OUT LICENSE FIELD UPGRADE Option for purchases of Switch and Edge Router Tester 100GE fixed chassis
Cables and Transceivers	
QSFP+ and QSFP28 Optical Transceivers and AOC	
QSFP28-DR1-XCVR	Keysight, QSFP28 100GBASE-DR1 100GE pluggable optical transceiver, SMF (single mode), 1310nm, 500m reach. This QSFP28 transceiver converts PAM4 optical signaling to NRZ electrical signaling. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE QSFP-DD appliances and Switch and Edge Router Tester 100GE appliance. For 4x100GE fan-out applications it is used with the QSFP-DD-DR4-XCVR optical transceiver (948-0050) and the QSFP-DD-DR4-CBL MT-to-4x100GE LC fan-out, fiber cable (942-0138)
QSFP28-SR4-XCVR	Keysight, QSFP28 100GBASE-SR4 100GE pluggable optical transceiver, MMF (multimode), 850nm, 100m reach. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
QSFP28-LR4-XCVR	Keysight, QSFP28 100GBASE-LR4 100GE pluggable optical transceiver, SMF (single mode fiber), 1310nm, 10km reach. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all 100GE CloudStorm load modules, all AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
QSFP-PLR4-XCVR	Keysight, QSFP+ 40GBASE-PLR4 40GE pluggable optical transceiver, SMF (single mode), 1310nm, 10 km reach. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all 100GE CloudStorm load modules, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
QSFP28-PSM4-XCVR	Keysight, QSFP28 100GBASE-PSM4 100GE pluggable optical transceiver, SMF (single mode fiber), 1310nm, 2km reach. MPO Connector COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE QSFP-DD appliances and Switch and Edge Router Tester 100GE appliance.
QSFP28-CWDM4-XCVR	Keysight, QSFP28 100GBASE CWDM4 pluggable optical transceiver, SMF (single mode fiber), 2km reach, LC connector. COMPATIBLE NETWORK TEST PRODUCTS: All AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.

Part Number	Description
942-0092	Keysight, QSFP28 Active Optical Cable (AOC), multimode fiber, 850nm, 3-meter length. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, CloudStorm 2-port load modules and Switch and Edge Router Tester 100GE appliance.
QSFP+ and QSFP28 Copper DACs	
942-0071	Keysight, QSFP-to-QSFP 40GE 40GBASE-CR4 Direct Attach Cable (DAC), passive copper, point-to-point cable, 3-meter length. COMPATIBLE NETWORK TEST PRODUCTS: All AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
942-0088	Keysight, QSFP28 passive, copper, Direct Attach Cable (DAC), passive copper, point-to-point, 3-meter length. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, CloudStorm 2-port load modules, all AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
942-0093	Keysight, QSFP28-to-2x50GE QSFP28 Direct Attach Cable (DAC) passive copper, fan-out, 3-meter length. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
942-0094	Keysight, QSFP28-to-4x25GE SFP28 Direct Attach Cable (DAC) passive copper, fan-out, 3-meter length. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
QSFP28 and QSFP Fiber Fan-out Cables	
942-0067	Keysight, MT-to-4xLC fan-out, MMF, 3-meter cable for 4x10GE and 4x25GE fan-out per port. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance. This cable is compatible with QSFP28-SR4-XCVR, 100GBASE-SR4 100GE pluggable transceiver, 850 nm, MMF (QSFP28-SR4-XCVR).
942-0068	Keysight, MT-to-4xLC fan-out, MMF, 5-meter cable for 4x10GE and 4x25GE fan-out per port. COMPATIBLE NETWORK TEST PRODUCTS: All 100GE Novus load modules, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance. This cable is compatible with, QSFP28-SR4-XCVR, 100GBASE-SR4 100GE pluggable transceiver, 850 nm, MMF (QSFP28-SR4-XCVR).

Part Number	Description
QSFP-PLR4-CBL	Keysight, MT-to-4xLC fan-out, SMF, 3-meter cable for 4x10GE fan-out. REQUIRES QSFP-PLR4-XCVR, pluggable, transceiver 1310nm, SMF (single mode). COMPATIBLE TEST PRODUCTS: All 100G Novus load modules, all 100G CloudStorm load modules, all AresONE QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance.
QSFP28-PSM4-CBL	KEYSIGHT, MT-to-4x25GE LC fan-out, SMF, 3-meter cable for 25GE fan-out (942-0127). COMPATIBLE TEST PRODUCTS: All 100GE Novus load modules and Switch and Edge Router Tester 100GE appliance. REQUIRES IXIA QSFP28-PSM4-XCVR 100GE PSM4, pluggable optical transceiver, SMF (single mode fiber), 1310nm, 2km reach, MPO connector (948-0037)
SFP28 Optical Transceivers	
SFP28-SR-XCVR	Keysight, SFP28 Dual-Rate 25GBASE-SR 25GE and 10GBASE-SR 10GE pluggable optical transceiver, MMF (multimode), 850 nm COMPATIBLE NETWORK TEST PRODUCTS: All Novus 10G capable, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance. REQUIRES QSA28 adapter (948-0072) for Network Test Products.
SFP28-LR-XCVR	Keysight, SFP28 Dual-Rate 25GBASE-SR 25GE and 10GBASE-SR 10GE pluggable optical transceiver, MMF (multimode), 850 nm COMPATIBLE NETWORK TEST PRODUCTS: All Novus 10G capable, all AresONE-S QSFP-DD appliances when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE appliance. REQUIRES QSA28 adapter (948-0072) for Network Test Products.
948-0072	Keysight, QSA28 adapter for enabling SFP28/SFP56 interfaces in NRZ and PAM4 mode. COMPATIBLE NETWORK TEST PRODUCTS: All AresONE-S QSFP-DD fixed chassis systems when the NRZ signaling option is installed and Switch and Edge Router Tester 100GE (944-1450). Refer to the individual product datasheets and the Optics and Cable guides for additional configuration information.

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.

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