

Interconnect and Network Performance Tester 1600GE

Validating 224Gb/s electrical lane silicon, interconnects,
and network equipment

Challenges in AI Network Interconnect Validation

The rapid progress of AI can put significant pressure on data centers, highlighting the importance of efficient scaling and optimization.

For decades, validating network interconnect performance was a manual, time-consuming process with limited or no automation and required advanced programming skills to write scripts. That process lacked a centralized system to organize and store interconnect data and reports, making tracking and replicating tests and configurations difficult and time-consuming.

With the increased diversity and scale of AI and data center interconnects, traditional testing methods cannot accurately predict and measure the reliability of today's complex production networks. These traditional methods, while effective, often struggle to keep up with the rapid advancements and increasing complexity of modern AI and data center networks. Automated and AI-driven testing solutions are becoming more prevalent in addressing these challenges.

Deploying 800GE and 1.6T Ethernet solutions helps mitigate infrastructure bottlenecks. Validating high-speed interconnects and realistically emulating complex AI workloads with advanced test tools is essential for ensuring reliable performance.

Future-Proofing AI Data Centers with Advanced Testing

Scalable infrastructure is crucial for AI data centers to manage the increasing demands of AI workloads and evolving technology. Today's AI data centers demand more than component-level validation. Interoperability, performance, and efficiency are system-level metrics that are only measurable under real-world network conditions. Comprehensive test strategies must incorporate both physical-layer testing and full-stack AI workload emulators capable of optimizing system-level and interconnect performance.

By focusing on scalable infrastructure, AI data centers can achieve higher efficiency, reliability, and performance to support the rapid advancement of AI technologies.

The Solutions

The **Interconnect and Network Performance Tester 1600GE (INPT-1600GE)** is a new 1.6 Terabit Ethernet (1.6T) hardware test platform for traffic generation and analysis. It provides functional, performance and interoperability benchmarks over a broad range of silicon chips, interconnects, cables, and networking equipment.

The INPT-1600GE, with the Interconnect Test System software (ITS), delivers a holistic solution that organizes, stores, and uses data intelligently to automate interconnect validation in high-speed Ethernet networks and AI data centers.

Keysight's Interconnect Test System (ITS) software makes it easier to qualify and validate interconnect performance. ITS, an advanced, cohesive software application is designed to validate AI infrastructure, network components, and data center interconnects from 200GE to 1600GE, expanding on the

capabilities of the **Interconnect and Network Performance Tester 800GE benchtop (INPT-800GE)**. The ITS software runs on both the 800GE and 1600GE INPT hardware platforms.

Highlights

Deploy a versatile high-speed Ethernet platform to increase test plan coverage

- Select a benchtop unit or rackmount chassis.
 - **Benchtop Unit:** Offers two OSFP1600 front panel ports in a portable, lightweight, and office-quiet form factor. This model enables manufacturers of 1.6T silicon chips, optical transceivers, and cables to validate interconnection media for data center and AI network infrastructures.
 - **Rackmount model:** Supports regression test beds to validate released products as firmware and software updates are applied to the ASICs, switches and routers. This chassis is best suited for manufacturers of 1.6T switch/router ASICs and networking equipment to help them meet the extensive test requirements of AI data centers
- Support 1x1600GE, 2x800GE, 4x400GE, and 8x200GE configurations.
 - Rackmount model also supports high port count 1600GE test beds, up to 32x1600GE ports.
- Test reliability, stability, performance, and interoperability of Ethernet devices and interconnects that use 212 Gb/s electrical lane interfaces, including silicon chips, optical transceivers, active optical and copper cables, and networking equipment.
- Facilitate high power consumption optical transceivers by delivering up to 40 watts of power and cooling per port.

Drive Faster Innovation

- Empower manufacturers and operators to run more tests simultaneously with the platform's multi-user capability.
- Accelerate the validation process, increasing test case throughput to ensure faster deployment and improved reliability of network equipment and AI infrastructure.

Optimize Interconnect Performance

- Offers Keysight's traditional Layer 1 Bit Error Rate Testing (BERT) and BERT Inferred FEC (BIF).
- Provides additional lower layer test capabilities for the Physical Coding Sublayer (PCS), Forward Error Correction (FEC), and Frame Loss Ratio (FLR) validations, ensuring interconnects are ready for production network deployment.
- Addresses lab test beds for Layer 2 and Layer 3 RFC benchmarks, network, and internetworking protocol emulation for scale and performance validation (with the rackmount chassis).
- Uses extensive Common Management Interface Specification (CMIS) features to enable efficient read/write configuration and reporting tasks. The platform automatically detects Application Selection Code settings and monitors digital optical signals to ensure optimal performance and easier management.

Benchmark and Enhance Productivity in AI interconnects and network infrastructure

- Automate, realistically emulate, and validate AI and machine learning workloads.
- Provide fast, reliable, scalable bench marking and performance testing, enabling operators to gain deep insights into collective communication performance.

- Utilize Keysight’s IxNetwork software with RoCEv2 transport protocol with Data Center Quantized Congestion Notification (DCQCN) congestion control and Priority Flow Control (PFC).
 - Provide a scalable and cost-effective solution to validate data plane traffic management effectiveness in AI clusters, and to optimize network fabric performance.
- Deliver a comprehensive set of tools and measurements with the ITS software. ITS enables users to rapidly build and automate test suites to qualify and benchmark the performance of various 800GE and 1600GE high-speed interconnects.
- Reduce GPU wait time by lowering latency and increasing data throughput.
- Decrease training time and the time needed to create functional Large Language Models (LLMs).

Interconnect and Network Performance Tester 1600GE overview

Model	Function	Description
INPT-1600GE-2P-BT 	Lightweight, portable instrument benchtop unit for high touch testing of products such as silicon chips and various types of interconnects	<ul style="list-style-type: none"> • Layer 1 to 3 test capability • 40 watts per port power and cooling • Weight: 22lbs / 10kg • Dimension (W x L x H) • Inches: 10.86 x 17.00 x 8.06 • Millimeter: 275.7 x 431.8 x 204.8 • Power: (1) cord, supply 100-240VAC, 10-4.5A, 50-60Hz single phase • Ethernet Management port and RJ45 console port • RJ45 sync port to Metronome timing • (4) USB 3.0 ports • Display port • Clock IN/OUT SMAs • Hardware Trigger IN/OUT SMAs
INPT-1600GE-2P-RM 	19" shelf-mounted, rackmount chassis, 2RU, two chassis per network shelf, for closed door lab test beds. Ideal for testing switches and routers.	<ul style="list-style-type: none"> • Layer 1 to 3 test capability • 33 watts per port power and cooling • Weight: 25lbs / 11.3kg • Dimension (W x L x H) • Inches: 8.64 x 26.95 x 3.34 • Millimeter: 219.4 x 684.5 x 84.8 • Power: (1) cord, supply 100-240VAC, 10-4.5A, 50-60Hz single phase • Ethernet Management port and RJ45 console port • RJ45 sync port to Metronome timing • (4) USB 3.0 ports • Display port • Clock IN/OUT SMAs • Hardware Trigger IN/OUT SMAs

Interconnect and Network Performance Tester feature summary

Feature	INPT-800GE benchtop	INPT-1600GE benchtop	INPT-1600GE rackmount
Number of ports	2-port model 4-port model	2-port model	2-port model
Electrical host lane speeds for the Ethernet protocol	8 x 106Gb/s Tx 8 x 106Gb/s Rx	8 x 212Gb/s Tx 8 x 212Gb/s Rx	8 x 212Gb/s Tx 8 x 212Gb/s Rx
Physical interfaces	OSFP800	OSFP1600	OSFP1600
Optical Transceiver Support	Support for all OSFP MSA 800GE compliant modules	Support for all OSFP MSA 1600GE compliant modules	Support for all OSFP MSA 1600GE compliant modules
800ZR, 400G-ZR/ZR+ Coherent Optics transceiver support	Yes ¹	Future ¹	Future ¹
Port speeds ¹	1 x 800GE 2 x 400GE 4 x 200GE 8 x 100GE	1 x 1600GE 2 x 800GE 4 x 400GE 8 x 200GE	1 x 1600GE 2 x 800GE 4 x 400GE 8 x 200GE
Media types	Optical transceivers Active Optical Cables (AOC) Active Electrical Cables (AEC) Active Copper Cable (ACC) Passive Copper Cable (DAC)	Optical transceiver Active Optical Cable (AOC) Active Electrical Cable (AEC) Active Copper Cable (ACC)	Optical transceiver Active Optical Cable (AOC) Active Electrical Cable (AEC) Active Copper Cable (ACC)
IEEE Interface Protocols and ETC industry specifications	IEEE 802.3df IEEE 802.3ck IEEE 802.3bs IEEE 802.3cd Ethernet Technology Consortium 800 Gigabit Ethernet (GbE) v1.1 specification	IEEE P802.3dj 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s (draft)	IEEE P802.3dj 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s (draft)
Other industry specifications	LPO-MSA Common Electrical I/O-112G (CEI-112G-Linear)	LPO-MSA OIF Common Electrical I/O-224G (CEI-224G-Linear)	LPO-MSA OIF Common Electrical I/O-224G (CEI-224G-Linear)
Layer 1 Support			
Layer 1 classical BERT and bit error injection and statistics	Yes	Yes	Yes
BERT Inferred FEC (BIF)	Yes	Yes	Yes
Forward Error Correction, Clause 119 RS(544, 514) KP4	Yes	Yes	Yes
Frame Loss Ratio, Pre-FEC BER and related FEC statistics	Yes	Yes	Yes
Correctable/Uncorrectable FEC statistics and transcoding events	Yes	Yes	Yes
FEC symbol error injection	Yes	Yes	Yes
PCS lanes Tx and Rx test and statistics	Yes	Yes	Yes
Rx Histogram	Yes (included)	Yes (included)	Yes (included)
Digital Optical Monitoring	Yes	Yes	Yes

Common Management Interface Specification (CMIS)	Yes	Yes	Yes
Application Selection Code (AppSel) with auto-detection and port speed matching	Yes	Yes	Yes
Auto-Negotiation / Link Training	Yes	Future ¹	Future ¹
Metronome multiple chassis timing synchronization capability	Yes	Yes	Yes
Ethernet support			
Layer 2 and 3 data plane traffic generation	Yes	Yes	Yes
Data plane hardware capture	Yes	Yes	Yes
Link fault signaling for all speeds	Yes	Yes	Yes
Transmit line clock adjustment (ppm)	Yes	Yes	Yes
Transmit/receive loopback	Yes	Yes	Yes
Latency / jitter measurements (packet level)	Yes	Yes	Yes
Flow tracking	Yes	Yes	Yes
Sequence tracking	Yes	Yes	Yes
Standard statistics and rates	Yes	Yes	Yes
FEC statistics for PAM4 Ethernet speeds	Yes	Yes	Yes
Software Application Support			
IxExplorer for L1-3 functional test and validation with Tcl test automation	Yes	Yes	Yes
IxNetwork RFC benchmark and protocol emulation with REST/Py API test automation	Yes	Future ¹	Future ¹
Interconnect Test System (ITS) for high-speed interconnect qualification and validation with REST/Py API test automation	Yes	Yes	Yes
RoCEv2 over RDMA for AI network infrastructure benchmarking	Future ¹	Future ¹	Future ¹

1. Please contact your Keysight representative to learn more about future product and feature releases.

Interconnect Test System Software

Redefine interconnect data storage and organization

The ITS software includes a first-of-its-kind Interconnect Library (IL) that introduces a new way to organize, retrieve, and use interconnect data, including Common Management Interface Specification (CMIS) data. CMIS standardizes how users program and manage high-speed interconnects, and how they retrieve and use data in networking systems.

This cutting-edge library organizes all data associated with the interconnect, including measurements. It then creates a comprehensive record that can be used to create and execute new tests. Once a record is created, it is automatically added to the IL self-serve database, where users can readily retrieve, reuse, edit, and update records. The IL dramatically increases productivity and accelerates the creation of automated test suites without any advanced programming.

Optimize interconnect validation efficiency

The browser-based ITS software includes a robust, fast graphical user interface (GUI) that runs directly on the INPT-1600GE hardware chassis, or on a client network. ITS allows many users to simultaneously run or schedule tests using the application's unique advanced multi-user test scheduler. This tool increases test case throughput, which allows more tests to run unattended by a greater number of users.

Leverage automated report generator

The automated report generator allows users to report on all data from the IL records, including test results and CMIS data that includes PASS/FAIL information. This tool streamlines the development process for interconnects and enables the use of automated reports by manufacturing test applications.

Provide critical measurements for high-speed interconnect tests

The ITS software supports all Layer 1, Layer 1.5, and Layer 2 measurements required to characterize and validate the performance of optical and copper interconnects from 200GE to 1600GE PAM4 Ethernet speeds. ITS capabilities include:

1. BERT for traditional layer 1 electrical test
2. BERT Inferred FEC (BIF)
3. FEC performance and margin on all electrical lanes
4. New optics and copper cable qualification
5. Validation of CMIS with CMIS Compare
6. Validation of all Ethernet speeds
7. Layer 2 Ethernet frame Tx and Rx traffic
8. System level performance and interoperability
9. RFC Benchmark performance and stress test in real systems



Accelerate interconnect test and validation automation

Having the ability to automate known good tests is critical in order to increase the number of interconnect validations and test case throughput. The ITS software:

1. Provides a robust library of canned tests with pass or fail qualifications, measurements, and tolerance limits.
2. Enables users to create their manufacturing test cases with pass or fail criteria using the ITS playground feature within the easy-to-use GUI.
3. Exports any test to a complete executable script and plays back in the ITS GUI. This includes canned tests or custom tests users create using the playground capability. Users can playback a list of created tests without the need for automation programming.
4. Utilizes the REST API and supports the Python language with a Swagger UI for test automation. This is a fast, efficient and contemporary set of test automation features that allows operators to build executable test suites without any advanced programming skills.

The ITS browser-based software is clean, fast and efficient and reduces the time it takes to create tests and execute them in the desired manner.

KEYSIGHT Interconnect Test System Chassis: TRex

Resource Group 1				800G Fanout Ports		User
Port1	INNOLIGHT	T-OP8CDT-H00 INKBIV130020	36°C 16W	1.1		
Port2	INNOLIGHT	T-OP8CNH-N00 INKBUY030047	36°C 16W	2.1		

Resource Group 2				800G Fanout Ports		User
Port3	Eoptolink	EOLO-138HG-5H-SM UN3G340004	36°C 18W	3.1		
Port4	Eoptolink	EOLO-138HG-5H-SM UN3G340003	36°C 18W	4.1		

Interactive Testing: Playground (Live & Interactive), Tuning (Transceivers)

Automated Tests: CMIS (Compare), CMIS (Verification), BERT (PRBS Data), Ethernet (Link Quality), RFC 2544 (Benchmark Test)

Interconnect Library				
Name	Vendor	Serial Number	Part Number	
test	INNOLIGHT	INKBIV130020	T-OP8CDT-H00	>

Test Queue: No tests queued

Figure 1. ITS home landing page

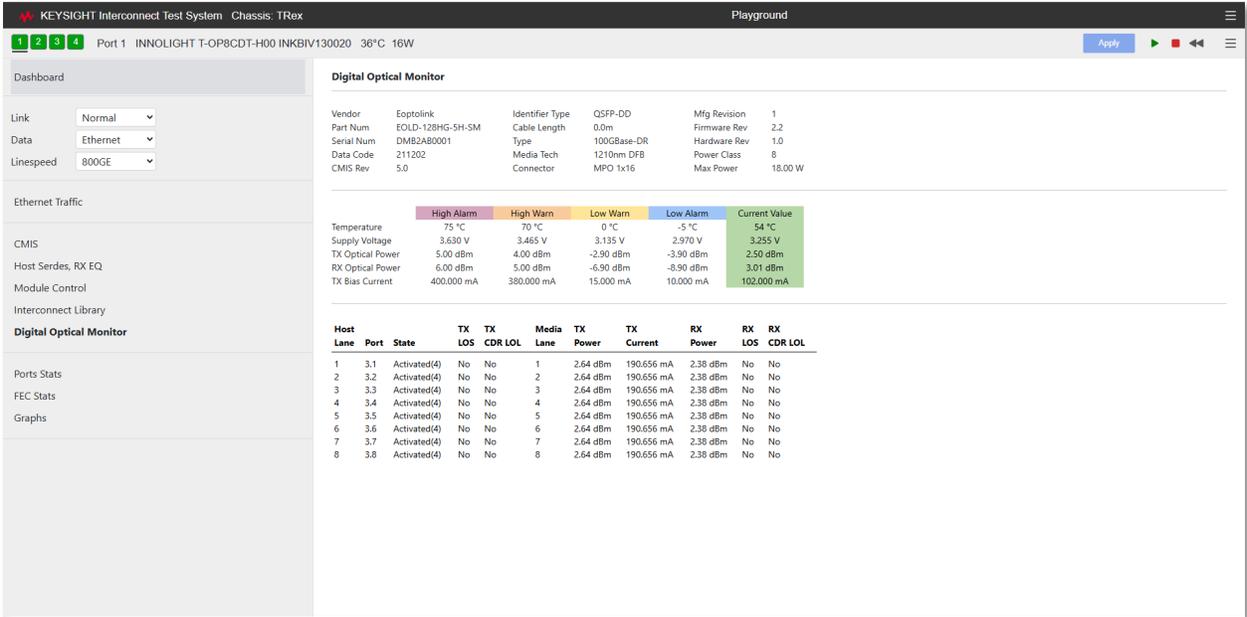


Figure 2. Digital Optical Monitoring page

Conclusion

Keysight's INPT-800GE and INPT-1600GE platform provides the comprehensive hardware functionality that Layer 1 through Layer 3 requires to test and validate high-speed Ethernet, optical and copper interconnects, network equipment, and network infrastructure. ITS software running on the platform standardizes how users program and manage high-speed interconnects, and how they retrieve and use data in networking systems in a revolutionary new way.

For more information

For more insights on validating high-speed Ethernet interconnects in AI environments, see these related resources:

INPT-1600GE Product Page: <https://www.keysight.com/in/en/products/network-test/network-test-hardware/interconnect-and-network-performance-tester-1600ge.html>

Whitepaper: [How AI / ML Networks Differ from Traditional Networks](#)

Blog: [Key Challenges in Scaling AI Data Center Clusters](#)

Press Release: [Keysight Introduces Portable 800GE Benchtop System to Test Artificial Intelligence and Data Center Interconnects](#)

Poster: [Your Path to 1.6T](#)

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