

Keysight Functional Interconnect Test Solutions

Multiple Channel System for Error Performance Validation of Bit Error Ratio and Forward Error Correction Applications

Introduction

As the demand for higher data rates in AI and data center networks accelerates, the industry is transitioning toward 800GE and 1.6 Terabit Ethernet (1.6T) network interconnects and beyond. Interfaces operating at 212Gb/s and 106Gb/s electrical lanes and above are critical to meeting higher bandwidth and throughput network infrastructure requirements. Network infrastructures must deliver increased bandwidth while optimizing power consumption and cost per Gigabit. Emerging standards such as OIF-CEI, IEEE 802.3 (beyond 400G), 800GE and 1.6T pluggable MSAs, define a broad range of high-speed fiber and copper interconnect types. These industry standards set the stage for high-performance solutions capable of meeting stringent device and interconnect error-performance criteria required in advanced, high bandwidth, network infrastructure applications.

The Keysight multiple lane Functional Interconnect Test Solutions (FITS-8CH) provides 8 Tx and 8 Rx channels of functional BER and Forward Error Correction (FEC) error performance validation. The FITS-8CH system addresses error performance validation at 212Gb/s, 106Gb/s, and 53Gb/s electrical lane speeds that use four-level Pulse Amplitude Modulation (PAM4) signaling. It is designed for electrical and optical interconnects such as Active Electrical Cables (AEC), Active Optical Cables (AOC), and high-speed optical transceivers.

FITS-8CH delivers exceptional signal integrity over all channels, freeing up critical design margins to provide clear insight into the performance of your high-speed device and interconnect designs. Whether you are developing next-generation interfaces or tackling the challenges of error performance validation, Keysight empowers you with the precision and reliability required in this rapidly evolving landscape.



Figure 1. FITS-8CH benchtop error performance validation system with High Drive and Chip-to-Module channels.

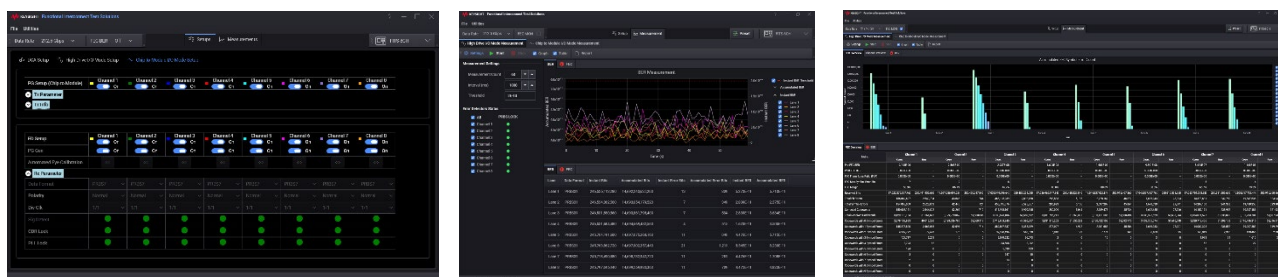


Figure 2. FITS-8CH Windows GUI client application pattern generator and error performance validation system.

Use Case Applications

The FITS-8CH system is intended for the most demanding error performance validation applications in high-speed interconnection systems, including:

- 1.6TbE (1600GE), 800GE, and 400GE PAM4 interconnects' for validation of high-speed electrical and optical interconnect performance for fully retimed optical transceivers, AECs, and AOCs
- PAM4 Bit Error Ratio (BER) performance for all lane speeds.
- The Advanced Option provides:
 - FEC performance monitoring measurement support on 212Gb/s lanes
 - Lane tuning provides the ability to automatically adjust the transmit taps of the pattern generator to open the eye for each lane while interfaced with a Keysight DCA sampling oscilloscope which optimizes the PAM4 signal output from the FITS-8CH coaxial cables and for the Device Under Test. Requires the use of a sampling oscilloscope and related hardware and software accessories that are sold separately.

Key Features and Benefits

Key Features	Benefits
High-Speed Multi-Channel Testing	(8) independent transmit and (8) independent receive differential channels supporting 53Gb/s, 106Gb/s, and 212.5Gb/s PAM4 signaling speeds. FITS-8CH can simultaneously measure real-time BER performance on all (8) transmit and (8) receive channels.
Versatility Across Development and Manufacturing Applications	FITS-8CH is suitable for a wide range of high-speed interconnects and can be used for error performance validation in applications such as: • Product development and QA for pre-production fully assembled interconnects • Manufacturing for sub-assembly mechanical alignment, temperature test, in-line, near-line, and end-of-line error performance validation applications. • FITS-8CH can connect to your 1.85mm RF connector fixture or to standard Module Compliance Boards with module controls over a GPIO interface. GPIO cable is included with chassis.
Advanced Optical and Electrical Interconnect Validation	Suitable for a wide range of high-speed interconnect test applications, including 1.6T, 800GE, and 400GE interconnect standards. Media types are fully retimed optical transceivers (FRO), Active Optical Cables (AOC), and Active Electrical Cables (AEC) Other interconnect types may be supported on 106G and 53G lanes. Please consult your Keysight representative.
Selection of channel voltage options for different applications	High Drive channels and Chip-to-Module channels are available. • High Drive channels are for maximum voltage levels for applications with interconnects that require signals at greater than 1Vpp signal. • Chip-to-Module channels for testing at industry standard Ethernet signal levels up to 1Vp-p.
Performance Under Challenging Conditions	Designed to deliver excellent signal integrity, ensuring that even under the most difficult signaling conditions, accurate BER at all supported channels speeds, and FEC symbol error correction analysis and margin assessment for the 212Gb/s channel speed are achieved.

Preliminary Chassis Specification

Product Description	Functional Interconnect Test Solution 8-Channel Chassis
Part Number	941-1020 Functional Interconnect Test Solutions, model FITS-8CH, 2RU benchtop chassis.
Chassis Connector Systems	• Power ON/OFF • Clock IN / OUT: 2 SMA female connectors on the front panel • 3 USB ports: (2) USB-C with charging capability, (1) USB Type B for laptop • 1 RJ45: 1000/100/10Mbps Ethernet management port for test network • GPIO DB26 (cable with mapped flying leads included) • ESD strap connector
Coaxial Cables with RF Connectors (purchased separately)	• 4-channel coaxial cable assemblies with 1.85mm male plug • Up to four coaxial cable assemblies may be connected to the chassis • Cables lengths can be mixed lengths • Optional, 6-inch (150mm) length with block connector • Optional 12-inch (300mm) length with block connector
Chassis Clock IN – Electrical Specifications	• Frequency: 156.25 MHz, +/- PPM is TBD • 50-ohm termination • Minimum = 0.5 Vpp • Maximum = 3.0 Vpp
Chassis Clock OUT – Electrical Specifications	• Frequency: 156.25 MHz, +/- PPM is TBD • HCSL, 50-ohm • VOH > 0.55 V, VOL < 0.15 V, Swing > 0.55 V
Chassis System Electrical Power	• Operates on 100-240VAC, 50/60Hz: • 4 Amps on 100-125VAC • 2 Amps on single phase, 200-240VAC • FITS-8CH chassis is shipped with (1 each) 100-125VAC North American power cord. Options for international shipments are selected at the time of order placement.
Chassis System Dimensions	Chassis only: • 13.75" (D) x 16.61" (W) x 1.72" (H) • 349.3mm (D) x 422.0mm (W) x 57.7mm (H) Chassis with feet: • 13.75" (D) x 16.61" (W) x 2.27" (H) • 349.3mm (D) x 422.0mm (W) x 57.7mm (H)
Chassis System Weights (preliminary)	• Chassis only: ~8lbs. (~3.6kg) • Shipping: ~8lbs. (~3.6kg) Includes power cord, accessories, and packaging
Temperature (Ambient Air)	• 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)	• Operating: 0% to 80%, non-condensing • Storage: 0% to 80%, non-condensing

Product Description	Functional Interconnect Test Solution 8-Channel Chassis
Industry Specifications support	• Common Electrical I/O – 224G-Very Short Reach • OIF Common Electrical I/O (CEI) 112G IA • OIF Common Electrical I/O (CEI) 56G IA • IEEE P802.3dj Draft Standard for Ethernet Amendment: Media Access Control Parameters for 1.6 Tb/s and Physical Layers and Management Parameters for 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s Operation • IEEE 802.3ck Physical Layer Specifications and Management Parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Based on 100 Gb/s Signaling • IEEE 802.3bs Media Access Control Parameters, Physical Layers and Management Parameters for 200 Gb/s and 400 Gb/s Operation
Safety	• EN 62368-1 / IEC 62368-1 • UL 62368-1 / CSA C22.2 No. 62368-1-19
Emissions and Immunity	• FCC Part 15B, Class A • ICES-003 • EN 55032/35 • AS/NZS CISPR 32 • KS C 9832/35
Regulatory Approvals	• CE (Europe) • UL (USA, Canada) • RCM (Australia, New Zealand) • UKCA (United Kingdom) • KCC (Korea)
Environmental	RoHS Directive 2011/65/EU; Annex II, Directive (EU) 2015/863 WEEE Directive 2012/19/EU China RoHS

Preliminary Technical Specifications

Product Description	Functional Interconnect Test Solution 8-Channel Chassis
Transmit and Receive	
Number of channels	- Group A: High Drive channels, 8 Tx and 8 Rx - Group B: Chip-to-Module channels, 8 Tx and 8 Rx
Channel rate support with PAM4 signaling	- Gbaud: 26.5625, 53.125 and 106.25 - Gb/s: 53.125, 106.25, 212.5
Pattern generation	PRBS7Q, PRBS9Q, PRBS13Q, PRBS23Q, PRBS31Q, SSPRQ, Square Wave, PRBS58Q (FEC Monitor only), and user-defined custom pattern
Bit Error Ratio	Bit Error Ratio statistics on all channels for all supported channel speeds
FEC monitor function	Supported on 212.5Gb/s (106Gbaud) channel rate only. Note: Requires purchase of Advanced Option (930-3365) for RS (544, 514) FEC statistics.
Lane tuning function	Provides the ability to automatically adjust the transmit taps of the pattern generator and its electrical fixture to help to open the eye for each lane while interfaced with a Keysight DCA which optimizes the set up for the Device Under Test. Note: Requires purchase of the Advanced Option for the GUI software (930-3365) and a Keysight DCA which is purchased separately. Please consult your Keysight representative for compatible DCA model support.
Tx output voltage	High Drive channels: - Group A channels: Adjustable up to 2.6 Vpp differential, AC coupled Chip-to-Module channels: - Group B channels: Adjustable up to 900 mVpp differential, AC coupled
Reference Clock output	156.25 MHz nominal frequency, $\pm$ ppm value is TBD
Divided Clock Output	1/2, 1/4, 1/8, 1/16, 1/32 of the baud rate. The divider may be used with the High Drive and Chip-to-Module channels
Digital Pre and Post Emphasis Transmit Taps	- Group A: 14 FIR taps; 2 pre, 1 main, 11 post - Group B: 7 FIR taps; 2 pre, 1 main, 4 post
Rising/Falling time	TBD
Jitter performance	TBD
Rx Input Voltage	- High Drive Group A channels: Differential Vp-p is 380 to 650 mV - Chip-to-Module Group B channels: Differential Vp-p is 600 to 1200 mV
Accessories and Test Automation	
Module Compliance Board (MCB)	Keysight offers an IEEE P802.3dj compliant OSFP1600 224G module compliance board (MCB) that is compatible with Keysight's coaxial cable options that have male 1.85mm RF connectors
Test Automation API	Keysight SCPI API

Application Support

Functional Interconnect Test Solution 8-Channel Chassis

Functional Interconnect Test Solutions software: Windows 11 front panel GUI license is included with chassis purchase. Provides support for channel speed selection, pattern generation, channel health monitoring, tap controls, MCB management with GPIO, error detection, Rx-side statistics (BER), FEC statistics on 212Gb/s channels, reports and graphs, and chassis management. The test automation programming interface is the SCPI API which is included with the purchase of the FITS-8CH chassis.

Software Option (930-3365): The Advanced Option for the Functional Interconnect Test Solutions GUI adds the FEC error correction performance monitoring and interconnect lane tuning capabilities in the GUI. Note: The FEC capability is only for the 212.5Gb/s electrical lane speed.

Ordering Information

Part Number	Description
941-1020	Functional Interconnect Test Solutions, model FITS-8CH, 2RU benchtop chassis with eight (2x4) High Drive I/O front panel coaxial interface channels and eight (2x4) Chip to Module I/O front panel coaxial interface channels. Support for 212.5, 103.25 and 53.125 Gb/s electrical lane speeds for Bit Error Ratio error performance measurement (941-1020). The FITS-8CH chassis provides SMA connectors for Clock IN and Clock OUT and a GPIO DB26 connector and cable for interface to Module Compliance Boards. The SCPI API and the Functional Interconnect Test Solutions Windows GUI are included with the purchase of the FITS-8CH chassis. Note1: For Forward Error Correction (FEC), error correction performance measurement, and device lane tuning capability, a purchase of the Advanced Option for the Coaxial Cable Accessories is required (930-3365). Note 2: Ganged 4-channel coaxial cables, 6-inch (150mm) and 12-inch (300mm) lengths are sold separately as options at an additional price.
Advanced Option for Functional Interconnect Test Solutions Windows GUI	
930-3365	Advanced Option for the Functional Interconnect Test Solutions GUI for the FITS-8CH chassis. Adds FEC error correction performance measurement and interconnect lane tuning capabilities to the GUI for the FITS-8CH chassis. Note: The FEC capability is only for the 212.5Gb/ electrical lane speed (930-3365).
Coaxial Cable Accessories	
942-1414	Ganged, 4-channel coaxial cable assembly with 1.85mm connectors, for FITS-8CH chassis, Group A, High Drive I/O channels, 6 inches (150mm) length. These cables are 1ps phase matched across 8 differential pairs BE70 to SMA cable. These cables are compatible with the FITS-8CH chassis (941-1020), (942-1414).
942-1415	Ganged, 4-channel, coaxial cable assembly with 1.85mm connectors, for FITS-8CH chassis, Group B, Chip to Module I/O, 12 inches (300mm) length. These cables are 1ps phase matched across 8 differential pairs BE70 to SMA cable. These cables are compatible with the FITS-8CH chassis (941-1020), (942-1415).
942-1419	Electrical coaxial loopback cable assembly, 4-channels of 212.5Gb/s each, 1ps phase matched per cable block assembly. This loopback is ONLY for the FITS-8CH chassis (941-1020), (942-1419).
Module Compliance Board	
942-1418	Wilder OSFP1600 IHS 224G Module Compliance Board (MCB), 8x224G PAM4 phase-matched channels with 1.85mm RF connectors. Supports 67 GHz testing with 1.85mm RF connectors with 224G PAM4 (112Gbaud) data rates. Includes a cooling system that supports modules with up to 43 watts power consumption for active interconnects and high-power consumption optical modules. MCB and cooling system power adapters are included. Low-speed signal access is through a 14-position header for module control. Includes CMIS access via USB port using Wilder's CMIS GUI with USB 2.0 1-meter cable (Type A Plug to Type B mini), (942-1418).

For More Information

For more insights, please check the following links:

[N1000A DCA-X Wide-Bandwidth Oscilloscope Mainframe | Keysight](#)

[N1060A 50/85 GHz Precision Waveform Analyzer | Keysight](#)

[N1046A 75/85/100 GHz, 1/2/4 Port, Electrical Remote Sampling Head Module | Keysight](#)

[N1092D 28/45 GHz Quad Optical Channel DCA-M | Keysight](#)

[N1078A 64Gbaud Single-mode Optical / Electrical Clock Recovery | Keysight](#)

FITS-8CH BER and FEC error performance validation solution sets a new standard for high-speed signaling verification for interconnects of many diverse types. It combines advanced test capabilities, error margin, and performance analysis, with intuitive software tools to meet the exact demands of high-speed interconnect test with PAM4 modulation for optical and copper high-speed interconnect technologies.

With FITS-8CH, engineers can confidently validate, and optimize the high-performance electrical, optical sub-assembly and fully assembled interconnect systems required for the next-generation of AI-driven, data-intensive interconnect applications.

For more information or to schedule a demo, please visit [Keysight](#) or contact our expert team for technical assistance.



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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