M8067A ISI Channel Boards

Version 3.0

Emulate channel loss for accurate and repeatable receiver characterization operating at symbol rates up to 64 GBd and 120 GBd

Key Features

- Emulate a wide range of channel loss from 5 to 30 dB with Inter Symbol Interference (ISI) traces for accurate and repeatable receiver characterization
- Six traces with 1.85 mm connectors suitable for symbol rates up to 64 Gbd (M8067A-001 and -002, each with three trace pairs per board)
- Six traces with 1.0 mm connectors suitable for symbol rates up to 120 Gbd (M8067A-003, -004, and -005, each with two trace pairs per board)
- Small size, mechanical brackets for vertical and horizontal placement on test bench, this helps to minimize electromagnetic susceptibility
- Individual s-parameters download simplifies accurate embedding in test environment

M8067A ISI channel boards

KEYSIGHT

Introduction

The M8067A ISI channel boards can be used to emulate a wide range of channel loss for characterizing high-speed digital receivers that are used in server and datacenter network interfaces. The so-called inter-symbol interference (ISI) caused by the channel degradation is a data dependent jitter or a bounded deterministic jitter. The ISI channel boards are designed to be used to emulate channel loss for symbol rates up to 64 GBd and 120 Gbd. A choice of twelve PC board traces with different lengths can be inserted into the signal path. The layout of the trace pairs allows to use them for single ended and differential signals.

For symbol rates up to 64Gbd we offer two boards with 1.85 mm connectors and trace lengths from 3.8” (96.7 mm) to 17.1” (434 mm).

For symbol rates beyond 64 Gbd and up to 120 GBd, we offer three boards with 1.0 mm connectors and trace lengths from 1.4” (35 mm) to 8.8” (222 mm).

For symbol rates below 32 GBd we recommend checking the M8049A ISI channel boards.

With their small size the M8067A ISI channel boards can be located closely to the device under test.

The mechanical brackets allow to place them vertically or horizontally on the test bench. Individual S-parameter files can be downloaded for each serial number.

Emulate channel loss and Intersymbol Interference (ISI)

The channel loss between transmitter and receiver is a critical element for the receiver test for all electrical multi-gigabit serial interfaces. The channel loss depends primarily on the distance between transmitter and receiver and the electrical medium. The channel loss is typically defined by the S21 parameter in dB for certain frequencies. Most electrical interface standards such as PCI Express define that a receiver must tolerate a certain channel loss in the test setup. The M8067A offers a wide range of channels to emulate certain S21 loss characteristic in a repeatable and accurate way for testing electrical interconnects using symbol rates up to 64 GBd and up to 120 GBd.

Emulate frequency-dependent Attenuators

For testing the receivers in medium and long reach electrical interfaces, some standards such as IEEE 802.3ck and the emerging IEEE802.3dj and OIF-CEI-112G and -224G define so-called frequency dependent attenuators. These frequency dependent attenuators emulate the channel loss characteristics of a worst-case channel that can occur in a transmission link. Use the M8067A ISI channel boards to emulate such a frequency dependent attenuator for symbol rates up to 120 GBd, e.g., you can emulate insertion losses between 4.5 and 27 dB at 53.125 GHz (corresponds to a 106.25 GBd symbol rate).

Key applications

- PCI Express 6.0 and 7.0 (64 and 128 GT/s)
- OIF CEI-112G electrical interfaces
- OIF-CEI-224G electrical interfaces
- IEEE 802.3ck Ethernet backplanes, cable and chip-to-chip, chip-to-module interfaces
- IEEE802.3dj Ethernet backplanes, cable and chip-to-chip, chip-to-module interfaces
- Emulate channel loss for receiver tolerance testing
- Emulate frequency dependent loss
- Channel operating margin test

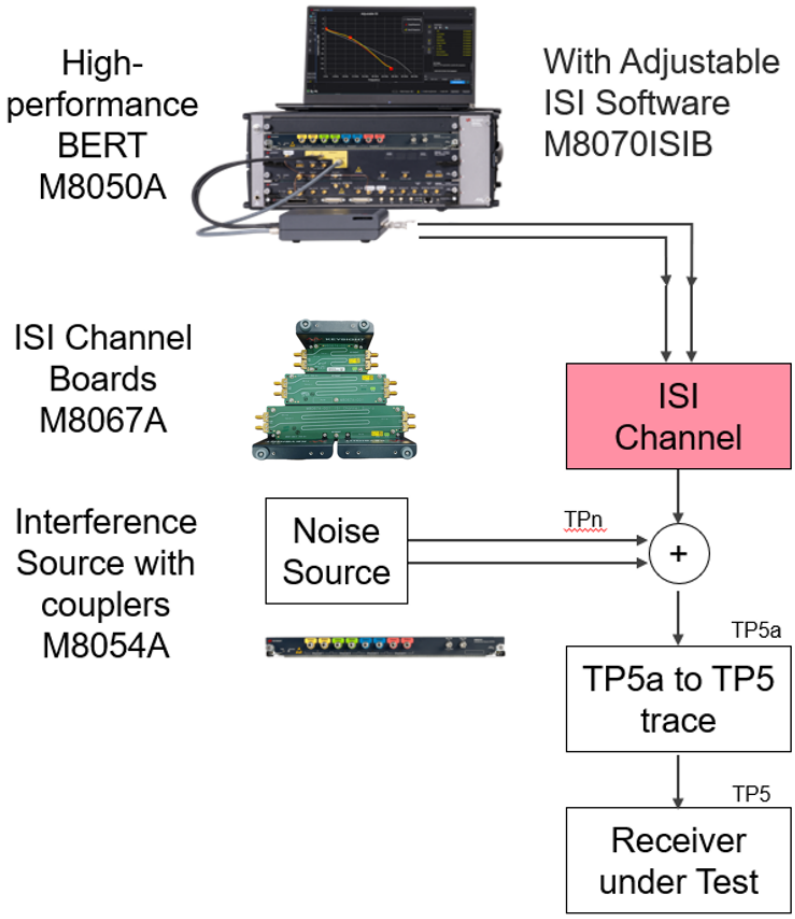

Figure 1. Typical receiver test setup with M8050A high-performance BERT, interference source and ISI channels.

Overview M8067A options

Model	Function	Description
M8067A-001 	This ISI channel board has 1.85 mm connectors. Suitable for symbol rates up to 64 GBd. Approximate IL of 10, 18 and 26 dB @ 26.125 GHz. • For 800G (112 Gbps) • For PCIe (128 GT/s)	3 trace pairs with length of • Trace pair 1: 6.2” (157 mm) • Trace pair 2: 11.6” (296 mm) • Trace pair 3: 17.1” (434 mm)
M8067A-002 	This ISI channel board has 1.85 mm connectors. Suitable for symbol rates up to 64 GBd. Approximate IL of 6, 13 and 22 dB @ 26.125 GHz. • For 800G (112 Gbps) • For PCIe (128 GT/s)	3 trace pairs with length of • Trace pair 1: 3.8” (97 mm) • Trace pair 2: 8.9” (227 mm) • Trace pair 3: 14.4” (365 mm)
M8067A-003 	This ISI channel board has 1.0 mm connectors. Suitable for symbol rates > 64 Gbd and up to 120 GBd • For 1.6T (224 Gbps) receiver test	2 trace pairs with length of • Trace pair 1: 1.4” (35 mm) • Trace pair 2: 4.3” (110 mm)
M8067A-004 	This ISI channel board has 1.0 mm connectors. Suitable for symbol rates > 64 Gbd and up to 120 GBd • For 1.6T (224 Gbps) receiver test	2 trace pairs with length of • Trace pair 1: 2.9” (72.5 mm) • Trace pair 2: 5.8” (148 mm)
M8067A-005 	This ISI channel board has 1.0 mm connectors. Suitable for symbol rates > 64 Gbd and up to 120 GBd • For 1.6T (224 Gbps) receiver test especially for medium and long reach	2 trace pairs with length of • Trace pair 1: 7.3” (185 mm) • Trace pair 2: 8.8” (223 mm)

Specifications for M8067A

Figure 2. Front view of ISI channel boards without brackets. The M8067A Option -001, -002 ISI channel boards shown in the top row have 1.85 mm connectors and the M8067A-003, -004, -005 ISI channel boards shown at the bottom have 1.0 mm connectors.

Figure 3. The 1.0 mm connectors are soldered, and the connectors have a mechanical hold.

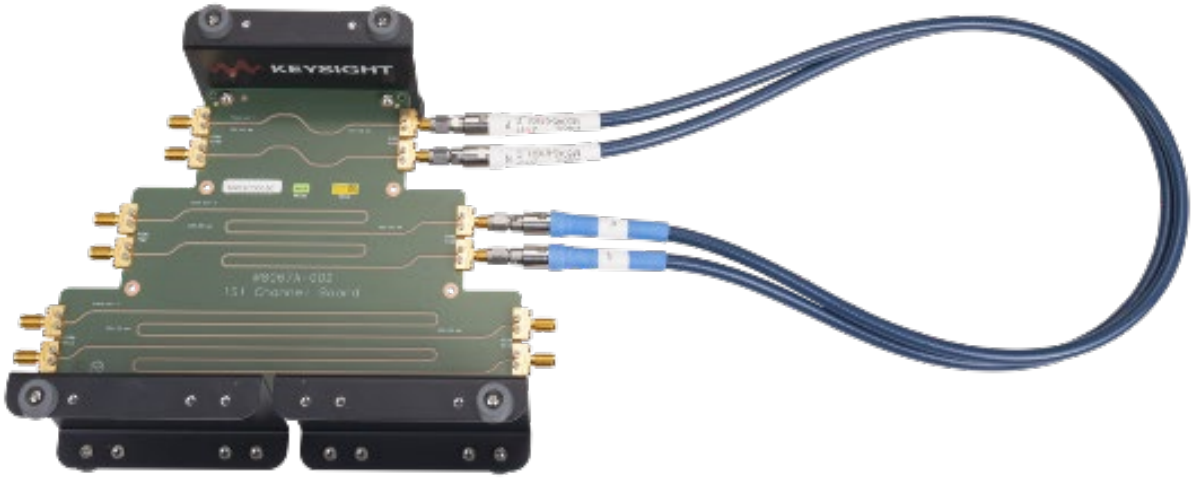

Figure 4. To achieve higher insertion loss, you can cascade two ISI channels by connecting them with a cable.

The below figures describe typical insertion loss and return loss characteristics of the M8067A ISI channel boards.

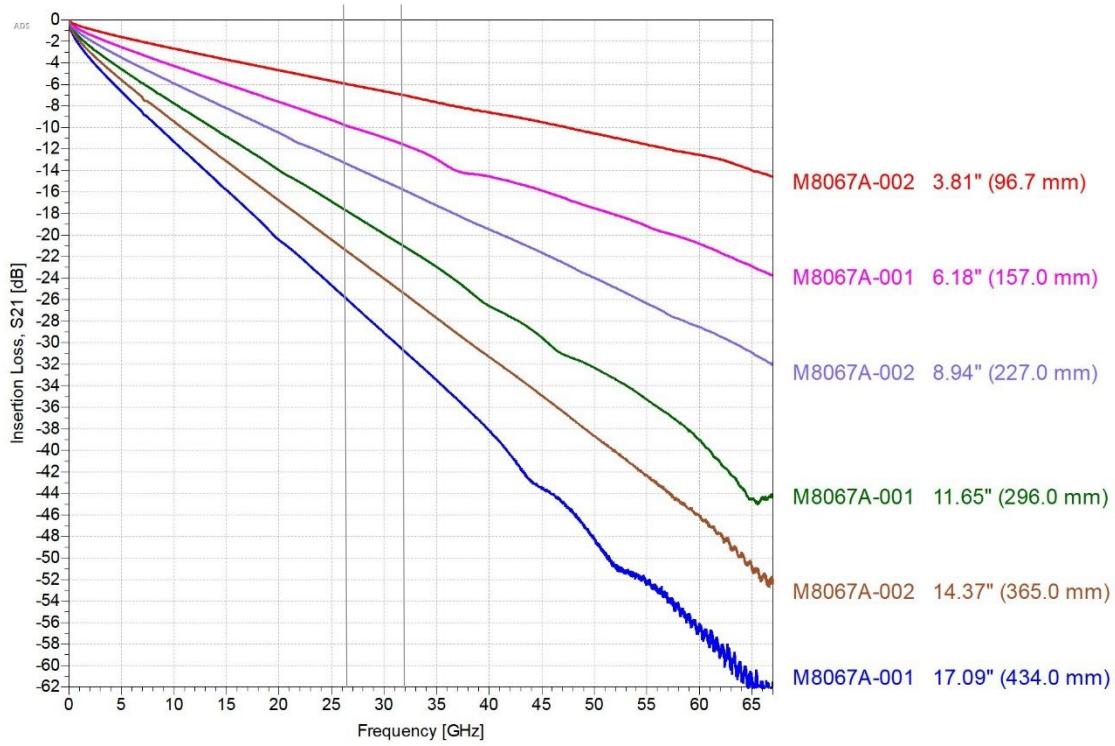

Figure 5. Typical insertion loss of ISI channel board M8067A-001 and -002 with 1.85 mm connectors.

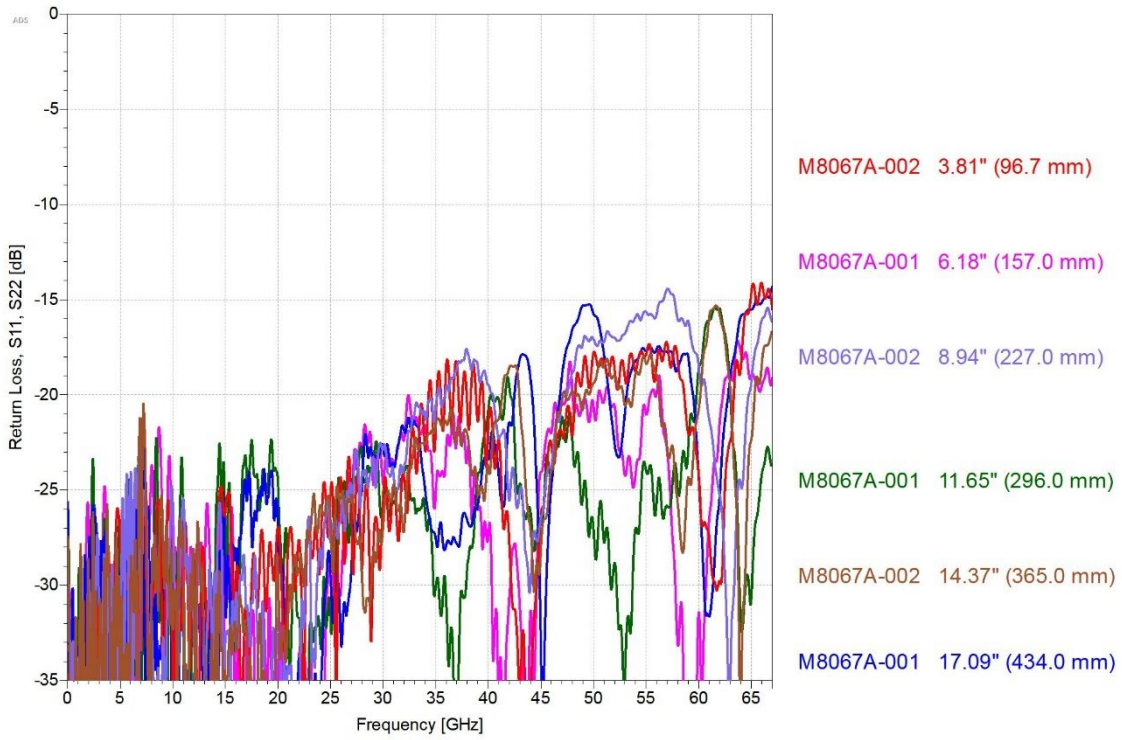

Figure 6. Typical return loss of ISI channel board M8067A-001 and -002 with 1.85 mm connectors.

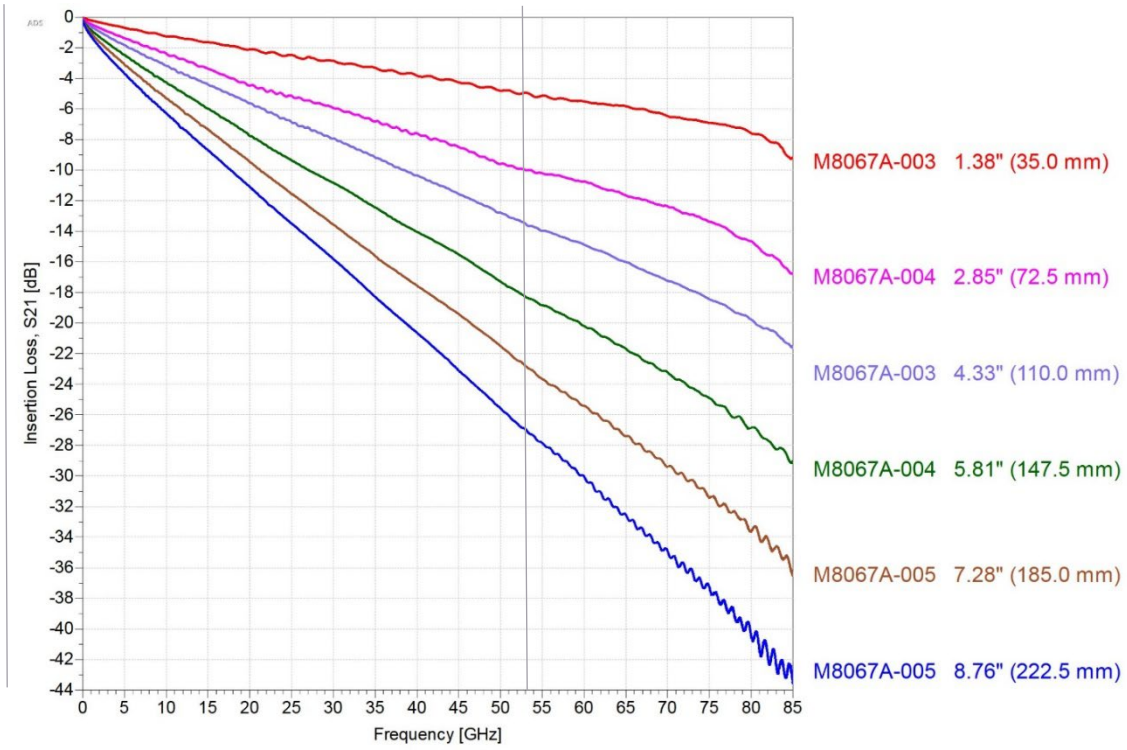

Figure 7. Typical insertion loss of ISI channel board M8067A-003, -004, and -005 with 1.0 mm connectors.

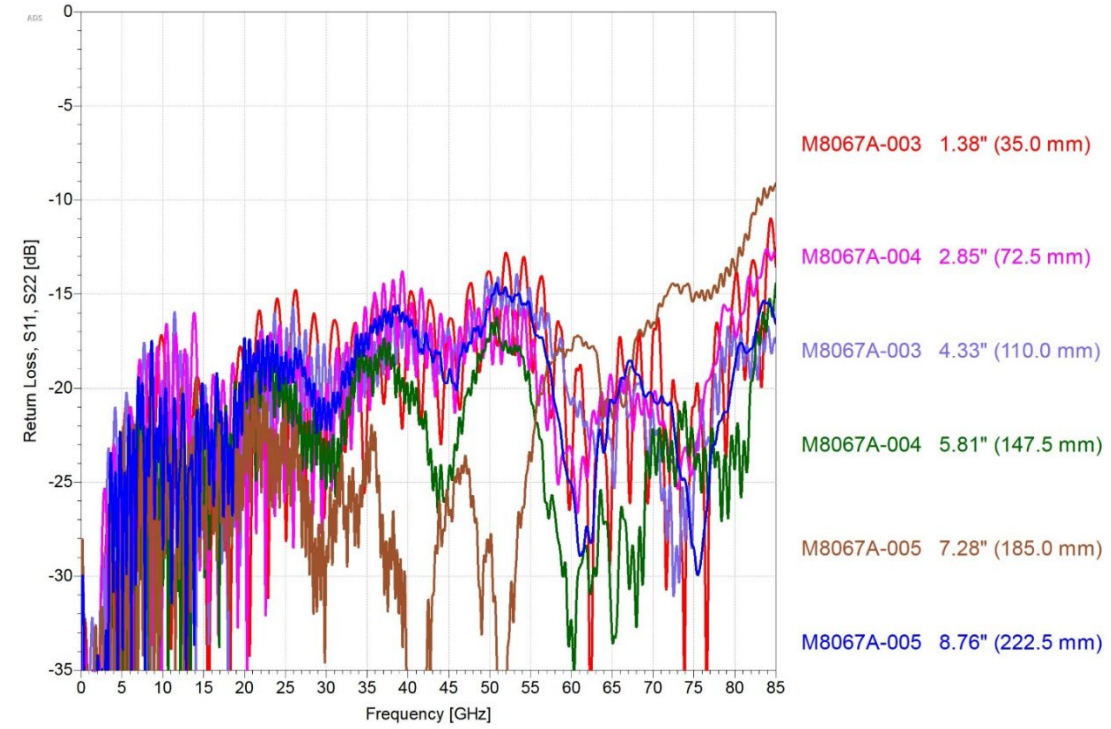

Figure 8. Typical return loss of ISI channel board M8067A-003, -004, and -005 with 1.0 mm connectors.

Table 1. Specifications for M8067A ISI channel boards

	M8067A-001	M8067A-002	M8067A-003	M8067A-004	M8067A-005
Trace lengths	6.2” (157 mm) 11.6” (296 mm) 17.1” (434 mm)	3.8” (97 mm) 8.9” (227 mm) 14.4” (365 mm)	1.4” (35 mm) 4.3” (110 mm)	2.9” (72.5 mm) 5.8” (148 mm)	7.3” (185 mm) 8.8” (223 mm)
PC board material	Astra ® MT77				
Insertion loss	Typical values see figure 5 (excluding cables)		Typical values see figure 7 (excluding cables)		
Insertion loss per inch	~ 1.45 dB/ inch at 26.5 GHz typical ~ 1.7 dB/inch at 32 GHz typical ~ 3.1 dB/ inch at 53 GHz typical				
Insertion loss for M8059A-801 cable			< 3.4 dB (0.5 to 110 GHz) typical		
Insertion loss for M8058A-801 cable	< 1.5 dB (DC to 50 GHz) typical < 2.0 dB (50 to 65 GHz) typical				
Return loss	Better than -17 dB up to 25 GHz typical, Better than -12 dB up to 50 GHz typical, Better than -10 dB up to 67 GHz typical, See also figure 6		Better than -10 dB up to 85 GHz typical See also figure 8		
Individual S-parameters	Downloadable s2p files from Keysight Infoline at: https://wcosisqlk.cos.is.keysight.com/archivews/				
Intra-pair skew	< 2.0 ps typical		< 1.5 ps typical		
Input impedance	50 Ω single ended, ±10% typical				
Max input voltage levels	±5 V				
Interface	Differential or single-ended				
Connectors	1.85 mm, female, soldered	1.85 mm, female, soldered	1.0 mm, female, soldered	1.0 mm, female, soldered	1.0 mm, female, soldered
Torque	Please use the recommended torque wrench, for details see: https://www.keysight.com/main/editorial.jspx?ckey=2516881&id=2516881&lc=ger&cc=DE				

	Symbol rate	26.5625 GBd		32.0 GBd		53.125 GBd		58.0 GBd		64.0 GBd	
	Corresponding UI (Unit interval)	37.647 ps		31.25 ps		18.824 ps		17.241 ps		15.625 ps	
	Pattern	PRBS13Q		PRBS23		PRBS13Q		PRBS13Q		PRBS23	
	Line coding	PAM4		PAM4		PAM4		PAM4		PAM4	
	Trace length	ps	mUI	ps	mUI	ps	mUI	ps	mUI	ps	mUI
M8067A-001	6.2” (157 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	11.6” (296 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	17.1” (434 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M8067A-002	3.8” 97 mm)	20.7	549.3	20.9	667.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	8.9” (227 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	14.4” (365 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Figure 9. Measured ISI Peak-peak jitter generated by the ISI channels for PAM4 signals at 26.5625, 32.0, 53.125, 58.0, and 64.0 GBd for M8067A-001 and -002. N.a. means the value was not measurable.

	Symbol rate	26.5625 GBd		32.0 GBd		53.125 GBd		58.0 GBd		64.0 GBd	
	Corresponding UI (Unit interval)	37.647 ps		31.25 ps		18.824 ps		17.241 ps		15.625 ps	
	Pattern	PRBS13		PRBS13		PRBS13		PRBS13		PRBS13	
	Line coding	NRZ		NRZ		NRZ		NRZ		NRZ	
	Trace length	ps	mUI	ps	mUI	ps	mUI	ps	mUI	ps	mUI
M8067A-001	6.2” (157 mm)	6.5	172.4	7.1	226.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	11.6” (296 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	17.1” (434 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M8067A-002	3.8” (97 mm)	2.2	57.4	2.7	85.8	3.7	198.2	3.7	216.9	4.0	254.7
	8.9” (227 mm)	11.6	308.1	12.8	409.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	14.4” (365 mm)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Figure 10. Measured ISI Peak-peak jitter generated by the ISI channels for NRZ signals at 26.5625, 32.0, 53.125, 58.0, and 64.0 Gb/s for M8067A-001 and -002. N.a. means the value was not measurable.

	Symbol rate	106.25 GBd		112.0 GBd	
	Corresponding UI (Unit interval)	9.412 ps		8.929 ps	
	Pattern	PRBS13Q		PRBS13Q	
	Line coding	PAM4		PAM4	
	Trace length	ps	mUI	ps	mUI
M8067A-003	1.4” (35 mm)	3.49	370.8	3.9	443.5
	4.3” (110 mm)	9.4	1000.9	8.9	1000.1
M8067A-004	2.9” (72.5 mm)	6.2	660	7.05	789.1
	5.8” (147.5 mm)	n.a.	n.a.	n.a.	n.a.
M8067A-005	7.3” (185 mm)	n.a.	n.a.	n.a.	n.a.
	8.8” (223 mm)	n.a.	n.a.	n.a.	n.a.

Figure 11. Typical ISI peak-peak jitter generated by the ISI channels at 106.25 and 112G GBd for PRBS13Q for M8067A-003, -004 and -005. N.a. means the value was not measurable.

Table 2. General characteristics for M8067A

	M8067A-001, -002, -003, -004, -005
Operating temperature	5 °C to 40 °C (41 °F to + 104 °F)
Storage temperature	-40 ºC to +70 ºC (-40 °F to + 158 °F)
Operating humidity	15% to 95% relative humidity at 40 ºC (non-condensing)
Storage humidity	24% to 90% relative humidity at 65 ºC (non-condensing)
Physical dimensions (W x H x D) with connectors and mechanical brackets	M8067A-001: 250.3 x 112 x 195 mm (9.9 x 4.4 x 7.7 inch) M8067A-002: 250.3 x 112 x 195 mm (9.9 x 4.4 x 7.7 inch) M8067A-003: 110 x 112 x 195 mm (4.3 x 4.4 x 7.7 inch) M8067A-004: 110 x 112 x 195 mm (4.3 x 4.4 x 7.7 inch) M8067A-005: 110 x 112 x 195 mm (4.3 x 4.4 x 7.7 inch)
Tool to remove mechanical brackets	Screwdriver Torx-T10 (part number 8710-2853)
Warranty	1 year
Weight net / shipping	M8067A-001: net: 0.74 kg (1.63 lbs)/ shipping: 4.29 kg (9.45 lbs) M8067A-002: net: 0.74 kg (1.63 lbs)/ shipping: 4.29 kg (9.45 lbs) M8067A-003: net: 0.5 kg (1.1 lbs)/ shipping: 2.54 kg (5.60 lbs) M8067A-004: net: 0.5 kg (1.1 lbs)/ shipping: 2.54 kg (5.60 lbs) M8067A-005: net: 0.56 kg (1.23 lbs)/ shipping: 2.60 kg (5.74 lbs)
EMC	IEC 61326-1
Safety	IEC 61010-1
Quality management	ISO 14001, ISO 9001

M8070ISIB adjustable ISI

In addition to the ISI channel boards M8067A, you can use the adjustable ISI software package M8070ISIB to adjust the amount of insertion loss when using the Keysight M8040A and M8050A BERTs.

The adjustable ISI software package M8070ISIB simplifies receiver testing by offering the most flexible way for emulating channel loss for baud rates up to 120 Gbd. Up to a frequency range of symbol rate/ 2 a channel response can be emulated or de-embedded by the pattern generator by specifying a certain insertion loss at specific frequency points. You can combine the integrated channel emulation with actual physical ISI trace boards such as M8067A to result in a target test channel.

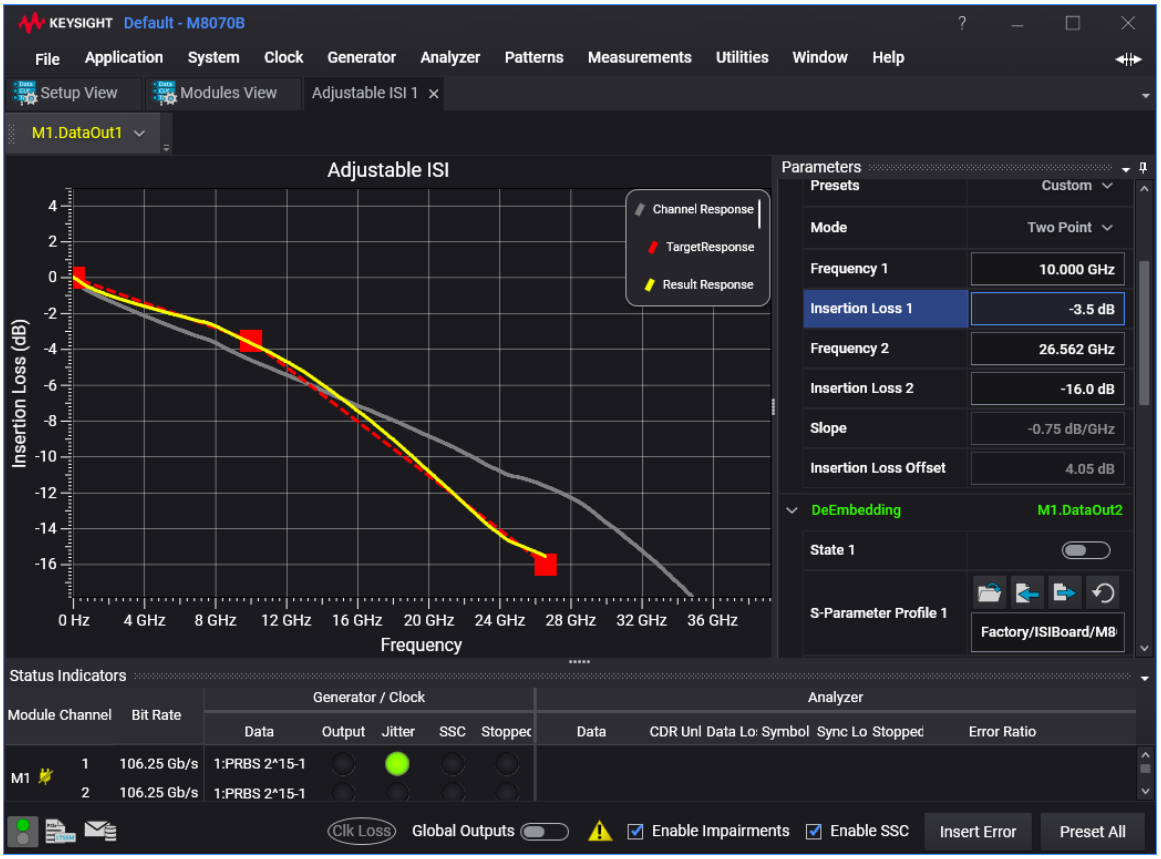

Figure 12. The adjustable ISI software package M8070ISI allows to emulate ISI internally with the M8042A pattern generator module. The example shows as channel response (gray) the insertion loss of an external ISI channel. You can add or remove insertion loss (red for target response) at 2 frequency points.

Specification

The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 5 to 40 °C and after a 60-minute warm up period.

Typical

The characteristic performance, which 80% or more of manufactured instruments will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23 °C).

Nominal

The mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed.

Related Literature

Description	Publication number
M8050A High-Performance BERT 120 GBd - Data Sheet	3122-1338EN
M8040A High-Performance BERT 64 GBd - Data Sheet	5992-1525EN
M8054A Interference Source - Data Sheet	5992-3871EN
M8049A ISI Channels - Data Sheet	5990-7659EN
M8050A High-Performance BERT 120 GBd – Configuration Guide	3122-1285EN

Ordering Instructions

Each M8067A option includes the following by default: functional test certificate and certificate of conformance. Mechanical brackets are pre-mounted.

Description	Option
ISI Channel Board Three Traces 6.2, 11.7, and 17.1 inches, 1.85 mm Connectors	M8067A-001
ISI Channel Board Three Traces 3.8, 8.9, and 14.4 inches, 1.85 mm Connectors	M8067A-002
ISI Channel Board Two Traces 1.4 and 4.3 inches, 1.0 mm Connectors	M8067A-003
ISI Channel Board Two Traces 2.9 and 5.8 inches, 1.0 mm Connectors	M8067A-004
ISI Channel Board Two Traces 7.3 and 8.8 inches, 1.0 mm Connectors	M8067A-005
M8070ISIS Adjustable ISI software package for M8040A and M8050A	M8070ISIB
Keysight Care: Extended 3/5 -year warranty Return-to-Keysight	R1280

Recommended Accessories

Description	Option
Matched cable pair 1.0 mm (m), 0.15 m for connecting with M8050A for symbol rates > 64 Gbd	M8059A-801
Matched cable pair 1.85 mm (m), 0.15 m for connecting with M8040A and M8050A	M8058A-801
Matched coupler pair for external interference source, DC to 40 GHz, 12 dB, 2.4 mm	M8045A-803
Matched coupler pair for external interference source, 1 to 50 GHz, 13 dB, 2.4 mm	M8045A-802
Microwave pick-off tee, matched pair, 1.0 mm through path	N1027A-2P1
Screwdriver Torx-T10 to remove brackets	8710-2853