Keysight Technologies
M8048A ISI Channels
Master Your Next Designs

Data Sheet

Key features

– Emulate a wide range of channel loss with cascadable ISI traces with fine resolution
– 4 short (7.7" to 12.8") and 4 long traces (14.4" to 34.4")
– Real Nelco FR4 PC board material with known S21 parameters
– Differential channels
– Supplementary to Keysight's compliant ISI channels (PCIe®, SATA, DP, HDMI)
– Small size

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Description

The M8048A ISI Channels can be used to emulate channel loss in receiver test setups. A choice of 8 PC board traces with different lengths can be inserted into the signal path. The 8 trace lengths range from 7.7 inch (196 mm) to 34.4 inch (874 mm). By cascading the traces within one box or with the other box a wide range of channels can be emulated with very fine resolution steps. With their small size the ISI channels can be located closely to the device under test. The cascadable ISI channels are complemented by the Keysight Technologies, Inc. compliance channels for SATA, DisplayPort, PCI Express®, and HDMI.

Emulate channel loss

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. Some standards define the receiver test to include a certain channel loss in the test setup. M8048A offers a wide range of cascadable channels to emulate certain S21 parameter conditions in a repeatable and accurate way.

Emulate intersymbol interference

Low-cost Nelco FR4 PC board material is very commonly used in many consumer and computer products. Long electrical cables are also very common (HDMI, DisplayPort and USB) for connecting consumer and computing devices. With increasing bit rates the signal degradations caused by the channel become a critical part for the receiver characterization and compliance test. The so-called intersymbol interference (ISI) caused by the channel degradation is a data dependant jitter or a bounded deterministic jitter. The ISI jitter added by a PC board trace not only depends on the trace length and the PC board material, but also depends on the data rate and the transmitted bit pattern. The ISI jitter a receiver must tolerate is typically defined in ps or mUI by each standard for the required bit rate and compliance pattern.

M8048A-001 Four Short ISI Channels 8 to 13 inches	M8048A-002 Four Long ISI Channels 14 to 34 inches
196 mm = 7.7"	366 mm = 14.4"
240 mm = 9.4"	408 mm = 16.1"
282 mm = 11.1"	620 mm = 24.4"
324 mm = 12.8"	874 mm = 34.4"

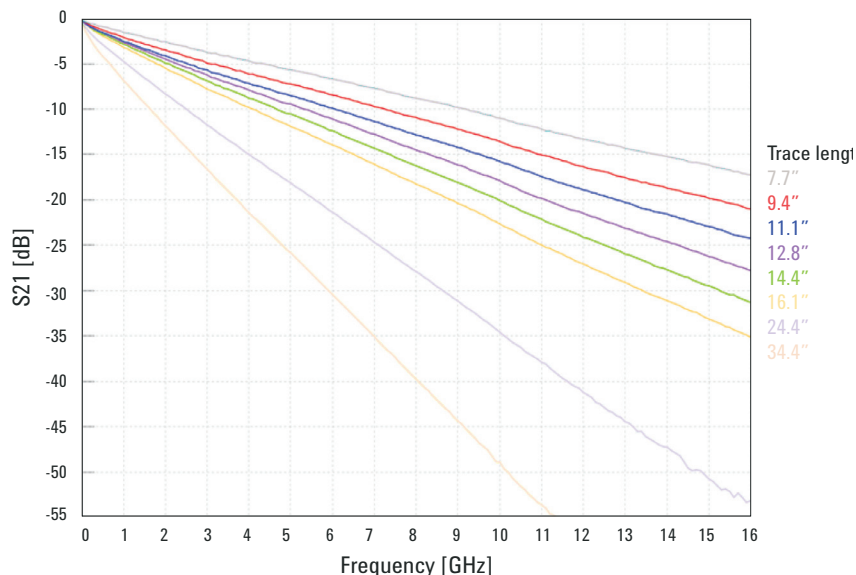Figure 1. M8048A offers eight trace lengths for option 001 and 002.

Figure 2. Shows the typical insertion loss for all M8048A-001 and -002 ISI channels.

Application examples

- SAS
- USB3
- UHS–II
- Thunderbolt
- SATA
- DisplayPort
- PCI Express

M8048A specifications

Figure 3: Front panel view of M8048A option 001 (top) and M8041A option 002 (bottom).

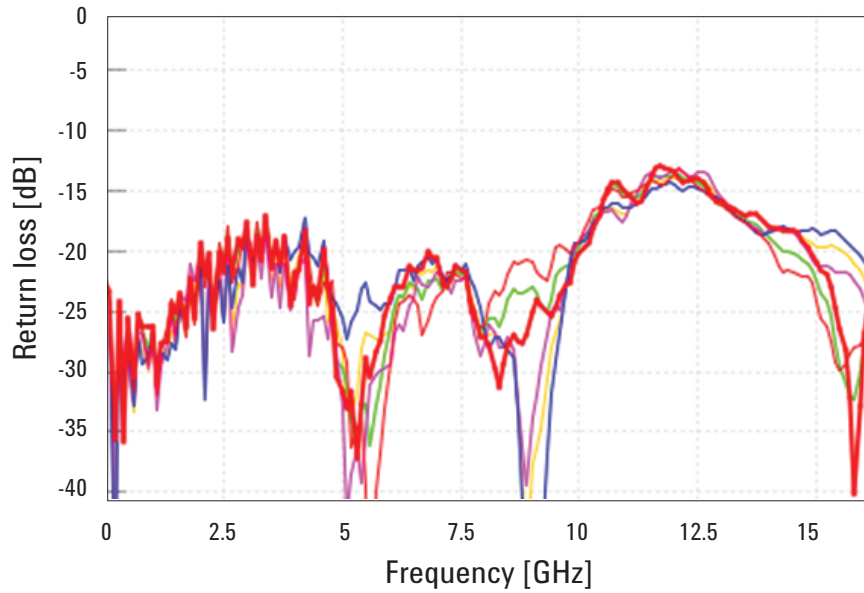| Table 1. Specifications	M8048A-001	M8048A-002
Trace lengths of Nelco FR 4	7.7"(196 mm) 9.4" (240 mm) 11.12 "(282 mm) 12.8"(324 mm)	14.4" (366 mm) 16.1" (408 mm) 24.4" (620 mm) 34.4" (874 mm)
Insertion loss	Typical values see figure 2 (excludes cables)	
Insertion loss for M8048A-801 cable	< 0.7 dB at 8 GHz typical	
Return loss	Better than -16 dB at up to 10 GHz typical Better than -12 dB at up to 16 GHz typical see figure 4	
Intra-pair skew	< 5 ps typical	
Input impedance	100 Ω differential, 50 Ω single ended, ± 10% typical	
Max input voltage levels	± 5 V	
Interface	Differential or single-ended	
Connectors	SMA, female	

Figure 4: Typical return loss (reflection) – example for trace 14.4″.

Pattern PRBS 2^{15}-1

Data rate	1.5 Gb/s		2.5 Gb/s		5 Gb/s		8 Gb/s		10.3 Gb/s		16 Gb/s	
Corresponding UI	667 ps		400 ps		200 ps		125 ps		97.1 ps		62.5 ps	
Trace length	ps	UI	ps	UI	ps	UI	ps	UI	ps	UI	ps	UI
M8048A-001												
7.7″ (196 mm)			< 0.050 UI		10.8	0.054	13.5	0.108	15.6	0.161	24.4	0.391
9.4″ (240 mm)					15.4	0.077	18.3	0.146	21.9	0.226	33.4	0.535
11.1″ (282 mm)					20.7	0.104	24.8	0.198	29.3	0.301		
12.8″ (324 mm)					26.6	0.133	32.3	0.258	39.2	0.404		
M8048A-002												
14.4″ (366 mm)		< 0.050 UI	23.5	0.059	33.8	0.169	41.3	0.330	49.5	0.509		
16.1″ (408 mm)			28.7	0.072	41.0	0.205	51.6	0.412				
24.4″ (620 mm)	47.8	0.072	61.5	0.154	89.4	0.447						
34.4″ (874 mm)	90.0	0.135	114.6	0.287								

Figure 5: Typical ISI jitter values for all traces at PRBS 2^{15} -1 pattern and selected data rates.

Figure 6: Rear panel view of M8048A-001 (left) and M8028A-002 (right).

Table 6. General characteristics	
Operating temperature	5 °C to 40 °C (-23 °F to + 104 °F)
Storage temperature	-40 ºC to +70 ºC (module) (-65 °F to + 158 °F)
Operating humidity	15% to 95% relative humidity at 40ºC (non-condensing)
Storage humidity	24% to 90% relative humidity at 65ºC (non-condensing)
Physical dimensions (W x H x D) with connectors	Bench top (with bumper): 228 x 59 x 221 mm 9 x 2.3 x 8.7 inch Rack mount (without bumper): 213 x 44.5 x 221 mm 8.4 x 1.8 x 8.7 inch
Weight net	950 g (2.1 lb)
Warranty period	1 year return to Keysight
EMC	IEC 61326-1
Safety	IEC 61010-1
Quality management	ISO 14001, ISO 9001

Specification assumptions

The specifications in this document describe the instruments performance. All specifications if not otherwise stated are valid using the recommended cable set M8041A-801 (2.92 mm, 0.85 m, matched pair).

Related Keysight literature

J-BERT M8020A High-Performance BERT Data Sheet	5990-3217EN
N4915A-014 PCIe Compliance Channels Data Sheet	5990-7659EN
N4915A-005 DisplayPort ISI Generator Data Sheet	5990-8688EN
N4915-60001 SATA ISI Channel Data Sheet	n/a

Ordering instructions

Each M8048A option includes the following accessories by default: SMA matched cable pair for cascading ISI channels, functional test certificate, and certificate of conformance

ISI channel, 4 short traces (7.7" to 12.8")	M8048A-001
ISI channel, 4 long traces (14.4" to 34.4")	M8048A-002
SMA matched cable pair for cascading channels, 0.4 m, ±5 ps	M8048A-801
(See figure 7)	

Recommended accessories:

Matched cable pair 2.92 mm, 0.85 m for connecting with M8020A	M8041A-801
Matched cable pair SMA, 0.4 m for cascading M8048A	M8048A-801
(one M8048A-801 is included in M8048A-001 and in M8048A-002 by default)	

Figure 7: Short matched SMA cable pair for cascading ISI channels from two units or within one unit.

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