

Keysight Technologies

Automated Switching Solution for Testing Multi-Lane Bus with an Oscilloscope



Configuration
Guide

Introduction

The Keysight Technologies, Inc. switch matrix software option for compliance applications, when used with switch matrix hardware, enables fully automated testing for multi-lane digital bus interfaces. The automated switching option will be available on compliance applications for multi-lane buses, which include DisplayPort, HDMI, PCI Express, MIPI D-PHY and M-PHY interfaces.

The benefits of this automated switching solution include:

- Eliminate reconnections (and errors)
The new switch matrix capability saves time and makes testing simple by automating testing for each lane of a multi-lane bus.
- Maintain accuracy
Use Keysight's unique N2809A PrecisionProbe and N5465A InfiniiSim to compensate switch path losses and skew.
- Customize your testing
Extend the test application with remote programming hooks and the N5467A user-defined application for device control, equipment control, and test customization.

The automated switching solution is available for different test interfaces, which includes the coaxial (SMA, SMP) interface as well as direct probing through the Keysight InfiniiMax Series probes.



SMA connection test interface



Direct probing test interface

Table 1. Bus standard electrical characteristics and test interface

Bus standards	Number of lanes	Maximum signal bandwidth	Signal type	Test interface
DisplayPort	4	13 GHz	Differential	SMA
HDMI	4	8 GHz	Differential	SMA
PCI Express	1 - 16	12 GHz	Differential	SMA
MIPI D-PHY	1 - 4	6 GHz	Differential	SMA or direct probing
MIPI M-PHY	1 - 4	20 GHz	Differential	SMA or direct probing

Step 1 – Select the switch matrix software option for the application

Product description	Standalone options	New oscilloscope options	Server based options
DisplayPort switch matrix software option	U7232B-7FP	DSO90000-701 (90000A) DSOX90000-701 (90000X/Q)	N5435A-701
HDMI switch matrix software option	N5399B-7FP	DSO90000-702 (90000A) DSOX90000-702 (90000X/Q)	N5435A-702
MIPI D-PHY switch matrix Software option	U7238B-7FP	DSO90000-703 (90000A) DSOX90000-703 (90000X/Q)	N5435A-703
MIPI M-PHY switch matrix software option	U7249B-7FP	DSO90000-704 (90000A) DSOX90000-704 (90000X/Q)	N5435A-704
PCIe switch matrix software option	N5393C-7FP	DSO90000-705 (90000A) DSOX90000-705 (90000X/Q)	N5435A-705

Note: The switch matrix software option requires the compliance application as well as other pre-requisite options. Please check the individual compliance datasheet for more information.

Step 2 – Select the switch matrix correction methods to compensate insertion loss and skew (optional)

Product description	Standalone options	New oscilloscope options	Server based options
InfiniiSim waveform transformation toolset (basic)	N5465A-001	DSO90000-013 (90000A) DSOX90000-013 (90000X/Q)	N5435A-026
InfiniiSim waveform transformation toolset (advanced)	N5465A-002	DSO90000-014 (90000A) DSOX90000-014 (90000X/Q)	N5435A-027
PrecisionProbe*	N2809A-002 (90000A) N2809A-001 (90000X/Q)	DSO90000-001 (90000A) DSOX90000-001 (90000X/Q)	N5435A-044 (excludes test accessories)

* Recommended

Step 3 – Select the switch matrix hardware and the recommended units

Switch matrix hardware			Applications				
Part number	Product description	Configuration	DisplayPort	HDMI	PCIe	D-PHY	M-PHY
U3020AS26	Keysight U3020A-S26 switching test set DC to 26.5 GHz	Dual 6:1	1	1	1	1 ^A or 2 ^B	1 ^A or 2 ^B
BIT-4000-2190-0	2100 Series switch system bundle, quad 6:1 and 6x 2:1 modules, DC to 26.5 GHz	Quad 6:1	1	1	1	1	1
BIT-4000-2192-0	2100 Series switch system bundle, quad 6:1 modules, DC to 26.5 GHz	Quad 6:1	1	1	1	1	1
BIT-4000-2194-0	2100 Series switch system bundle, dual 6:1 modules, DC to 26.5 GHz	Dual 6:1	1	1	1	-	-
BIT-4000-2196-0	2100 Series switch system bundle, quad 4:1 modules, DC to 26.5 GHz	Quad 6:1	1	1	1	1	1
BIT-4000-2198-0	2100 Series switch system bundle, dual 4:1 modules, DC to 26.5 GHz	Dual 6:1	1	1	1	-	-

Note: A SMA connection test interface
B Direct probing interface

The switch matrix instrument is LXI compatible and controlled through the compliance application via LAN interface.

Step 4 – Select the recommended test accessories and units

Part number	Product description	Display-Port	HDMI	PCIe	D-PHY	M-PHY
11443	Matched SMA cable pair	4	4	5	5 ^A	5 ^A
U3020AS26-C01	SMP (m) – SMA (m), 1 meter cable pair to connect probe heads to the switch matrix	–	–	–	4 ^B	4 ^B
U3020AS26-C03	SMP (m) – SMA (m), 16” cable pair to connect probe heads to the switch matrix	–	–	–	4 ^B	4 ^B
U3020AS26-C02	SMP (f) – SMA (m), 1 meter cable pair to connect probe amplifier to switch matrix	–	–	–	1 ^B	1 ^B
U3020AS26-C04	SMP (f) – SMA (m), 16” cable pair to connect probe amplifier to switch matrix	–	–	–	1 ^B	1 ^B

Note: ^A SMA connection test interface
^B Direct probing interface

Step 5 – Select the recommended probe amplifiers for direct probing interface

Part number	Product description	D-PHY	M-PHY
1168A	10 GHz InfiniiMax II Series probe amplifier for 90000A Series oscilloscope	4 ^A	2 ^B
1169A	12 GHz InfiniiMax II Series probe amplifier for 90000A Series oscilloscope	4 ^A	2 ^B
N5442A	Precision BNC adapter to interface InfiniiMax I and II Series probe amplifier with 90000X-/Q-Series oscilloscope	4 ^A	2 ^B
N2800A	16 GHz InfiniiMax III Series probe amplifier for 90000X-/Q-Series oscilloscope	4 ^A	2 ^B
N2801A	20 GHz InfiniiMax III Series probe amplifier for 90000X-/Q-Series oscilloscope	4 ^A	2 ^B
N2802A	25 GHz InfiniiMax III Series probe amplifier for 90000X-/Q-Series oscilloscope	4 ^A	2 ^B
N2803A	30 GHz InfiniiMax III Series probe amplifier for 90000X-/Q-Series oscilloscope	4 ^A	2 ^B

Note:

Superscript ^A 4 probe amplifiers are required for single-ended probing at the D-PHY differential clock and data lanes.

Superscript ^B 2 probe amplifiers are required for single-ended probing at the M-PHY differential data lane.

Step 6 – Select the recommended probe heads for direct probing interface

Part number	Product description	D-PHY	M-PHY
N5381A	InfiniiMax II solder-in probe head	4 ^A	2 ^B
E2677A	InfiniiMax II compatible solder-in probe head	4 ^A	2 ^B
N5425A	InfiniiMax II ZIF solder-in probe head Order N5426A (12 GHz) Order N5451A 7 mm (9 GHz) Order N5451A 11 mm (5 GHz) Order N2884A (12 GHz)	4 ^A	2 ^B
E2678A	InfiniiMax II compatible differential socket head	4 ^A	2 ^B
N5382A	InfiniiMax II differential browser head	4 ^A	2 ^B
N5380B	InfiniiMax II differential SMA head	4 ^A	2 ^B
N5441A	InfiniiMax III solder-in probe head	4 ^A	2 ^B
N5439A	InfiniiMax III ZIF probe head Order N5440A (450 Ω) or N5447A (200 Ω) for a set of 5 ZIF tips with plastic sporks	4 ^A	2 ^B
N5445A	InfiniiMax III browser head Order N5476A for replacement probe tips (set of 4)	4 ^A	2 ^B
N5444A	InfiniiMax III 2.92 mm / 3.5 mm / SMA probe head Order N5448A 2.92 mm head flex cables to extend the cable length	4 ^A	2 ^B

Note:

Superscript ^A A minimum of 4 probe heads are required for single-ended probing at the D-PHY differential clock and data lanes.

Superscript ^B A minimum of 2 probe heads are required for single-ended probing at the M-PHY differential data lane.

Literature

Title	Publication Number
<i>Using Microwave Switches When Testing High Speed Serial Digital Interfaces – Application Note</i>	5991-2375EN
<i>Infiniium 90000A Series Oscilloscopes – Data sheet</i>	5989-7819EN
<i>Infiniium 90000 X-Series Oscilloscopes – Data sheet</i>	5990-5271EN
<i>Infiniium 90000 Q-Series Oscilloscopes – Data sheet</i>	5990-9712EN
<i>N5465A: InfiniiSim Waveform Transformation Toolset for the Infiniium Series Oscilloscopes – Data sheet</i>	5990-4059EN
<i>PrecisionProbe for Bandwidths up to 33 GHz – Data sheet</i>	5990-7940EN
<i>Infiniium Oscilloscope Probes and Accessories – Data sheet</i>	5968-7141EN
<i>U3020AS26 Switching Test Set DC to 26.5 GHz – Data sheet</i>	5991-2163EN

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