Keysight Technologies
DDR4 Parametric Test Reference Solution

Solution Brochure

The DDR4 parametric test reference solution provides complete R&D and system development solution performing turn-on, integration, validation and compliance testing.

KEYSIGHT
TECHNOLOGIES

Unlocking Measurement Insights

Next-Generation DDR4 Parametric Test Challenges

As the DDR technology increases in data rate, the need for signal integrity test and margin characterization becomes crucial. Engineers who work on high-end computing and server applications need a faster and more efficient way to turn on and debug their DDR4 system. The challenges that these engineers face when designing their DDR4 system include:

– Validating signal integrity design measurements as specified in the JEDEC DDR4 specification
– Characterizing design for optimized margin
– Full debug capability to locate problem areas

DDR4 parametric test reference solution

The DDR4 parametric test reference solution is a combination of hardware and software that includes probes, an oscilloscope and automated compliance test and debug software for engineers to test, debug and characterize their DDR4 designs. Signal integrity is crucial for memory system interoperability. Reference clock jitter measurements help you ensure that jitter is well within the specifications, which is the key to reliable and interoperable modular memory systems. Electrical and timing characteristics of other signals are also critical to ensure the memory system functions correctly and stays error free. The data jitter measurements enable characterization of jitter to determine the data valid window.

With the DDR4 compliance test application, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on the JEDEC electrical and timing specifications. The application automatically configures the oscilloscope for each test and provides informative results. It includes margin analysis indicating how close your device comes to passing or failing the test for each specification. Some of the difficulties in performing the tests are connecting to the target device, configuring the oscilloscope, performing the tests and analyzing the measured results. The DDR4 compliance test application does most of this work for you. If you discover a problem with your device, the DDR4 debug tool is available to aid in root-cause analysis.
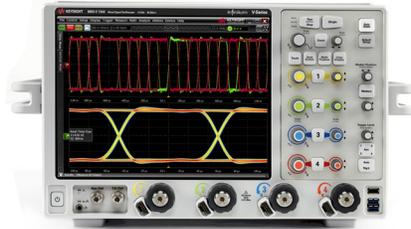
Reference Solution Architecture
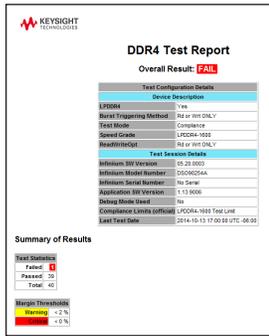
N6462A/DDR4/LPDDR4
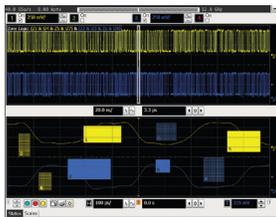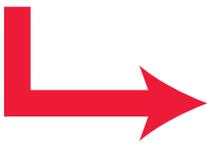compliance test software
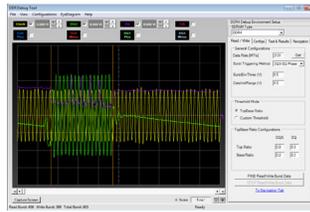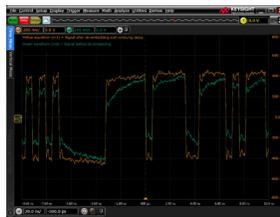

N6462A-3FP
DDR4 debug tool

DDR4 fixtures and probes
N2114/5A DDR4 BGA interposers

MSOV134A Infiniium oscilloscope

N5414B
InfiniiScan+

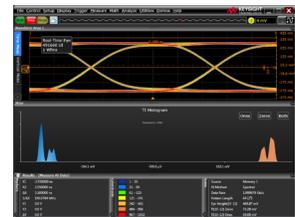N5465A
InfiniiSim

E2688A
Serial data package

N8823A
EZJIT complete

Hardware

Feature	Benefit
MSO V-Series oscilloscopes' analog bandwidth starts at 8 GHz with 10 GSa/s digital sampling rate and DDR4 protocol decode and trigger software package	Reliable measurement of fast signals with accurate DDR4 trigger and decode capabilities
Superior signal integrity BGA probing	Easy access and accurate representation of DDR4 signals
Integration of debug, analysis tool and compliance test software	Easy and fast way to pinpoint design issues

| Product specifications and characteristics	
MSOV134A Mixed Signal Oscilloscope: 13 GHz, 4 analog plus 16 digital channels	
Analog bandwidth	13 GHz (upgradable up to 20 GHz)
Sampling rate	40 GSa/s
Max memory depth	2 Gpts
1169A InfiniiMax II probe amplifier	
Analog bandwidth	12 GHz
Dynamic range	3.3 V peak-to-peak
Input impedance	Differential input R: 50kΩ
E2677A InfiniiMax 12 GHz differential solder-in probe head	
Bandwidth	12 GHz
Different input capacitance	<=270 fF
N2115A DDR4 BGA interposer	
Data width	16 bits

Hardware

Instruments

MSOV134A Mixed Signal Oscilloscope: 13 GHz, 4 analog plus 16 digital channels
www.keysight.com/find/V-Series

Achieve clarity faster with bandwidth upgradability to 33 GHz for best
investment protection. Maximize eye height measurements with the least
amount of noise contribution from the oscilloscope. See the truest jitter
performance of your design with the lowest 100 fs oscilloscope intrinsic
jitter. Debug some of your most difficult designs with the industry's longest
hardware serial trigger.
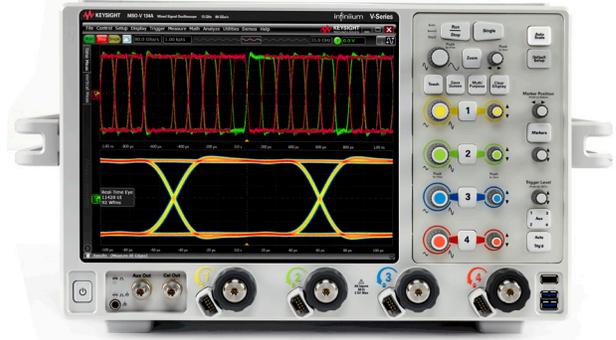
1169A InfiniiMax II probe amplifier
www.keysight.com/find/1169a

InfiniiMax II Series 1169A 12 GHz probing system is designed to be used with
DSO91204A and DSO91304A Infiniium oscilloscopes. It provides real-time
bandwidth to 12 GHz specified and has 13 GHz typical performance. The
innovative InfiniiMax probing system supports even the most demanding
mechanical access requirements without sacrificing performance.

E2677B InfiniiMax 12 GHz differential solder-in probe head
www.keysight.com/find/E2677B

E2677A InfiniiMax differential solder-in probe head and accessories include
20 full-bandwidth and 10 medium-bandwidth damping resistors.

N2115A DDR4 BGA interposer
www.keysight.com/find/n2115a

The N2115A DDR4 BGA interposers provide signal access to the clock,
strobe, data, address and command signals to the DDR4 BGA package for
making electrical and timing measurements with an Infiniium oscilloscope.
With the DDR4 JEDEC specification defined at the DRAM ballout, the
BGA probe adapter provides direct signal access to BGA package for true
compliance testing.

The N2115A DDR4 BGA interposers are soldered between the DRAM and PC
board or DIMM raw card where the DRAM would normally be soldered. They
are designed with the PCB or DIMM footprint on the bottom side and the
DRAM footprint on the top side. The signals from the memory controller chip
and DRAM are then passed directly to the top side of the BGA probe adapter
where they can be accessed with the oscilloscope probes.
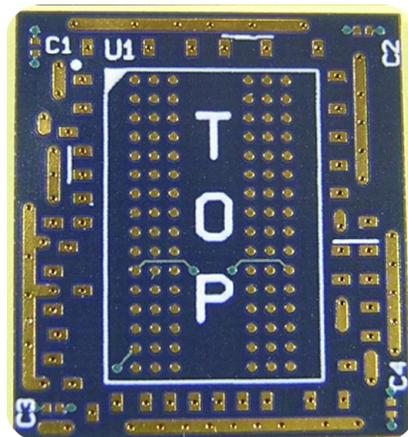
DDR4 Parametric Test Software

The DDR4 parametric test software offers several features to simplify the validation of your designs:

- N5465A InfiniiSim waveform transformation tool to perform probe correction on N2114A or N2115A DDR4 BGA interposer.
- N6462A-1FP DDR4 compliance test software setup wizard for quick setup, configuration and test for compliance testing.
- N6462A-3FP DDR4 debug tool allows for navigation to areas of interest in a saved set of waveforms with JEDEC measurement for pre- and post-compliance testing, which includes electrical, timing and multiple eye diagram analysis.
- E2688A serial data analysis tool and N8834A EZJIT complete software provides BER contour analysis capability for accurate data valid window measurement.
- N5414B InfiniiScan+ provides read and write trigger capability.

N5465A InfiniiSim waveform transformation tool for N2114A/15A DDR4 BGA interposer probe correction

The use of a BGA interposer at higher speeds like DDR4 and LPDDR4 would require probe correction to ensure accurate representation of the signal on the oscilloscope. This can be done with InfiniiSim, which is a waveform transformation toolset software that allows users to build a transfer function file based on the filter that is applied to correct the frequency response of the BGA interposer. You can build the transfer function file for each signal with a "Remove loading effects of a DDR interposer and probe" preset available with the InfiniiSim tool.
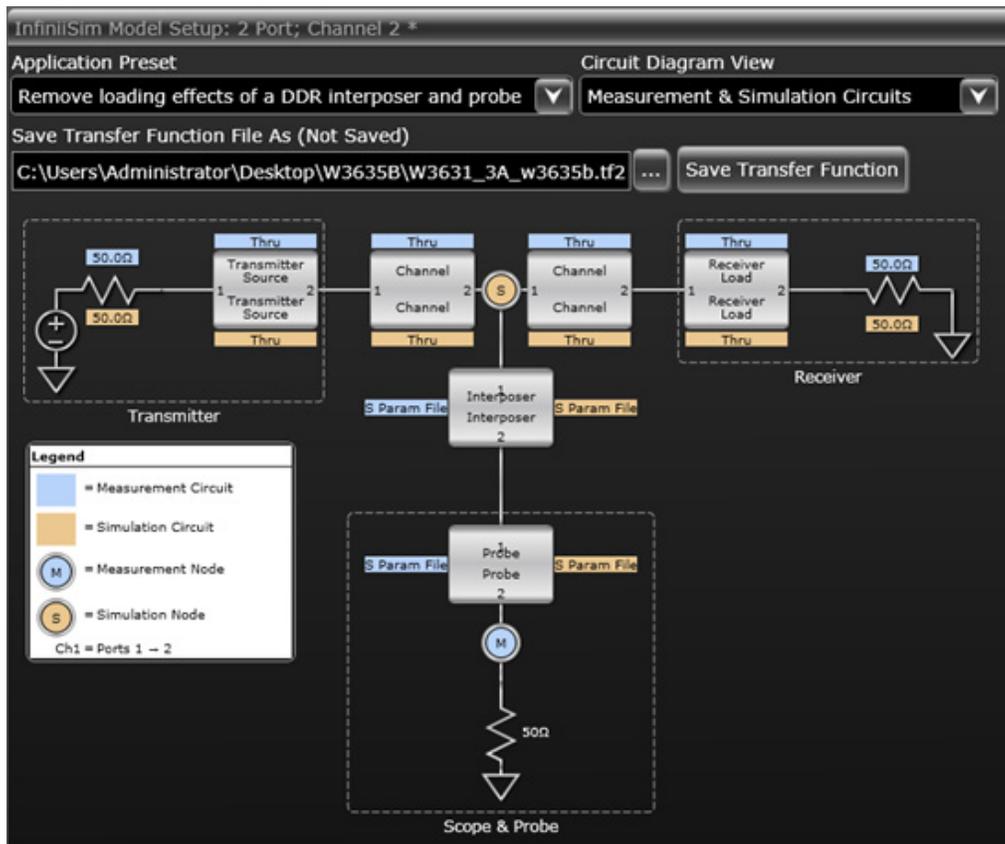

Figure 1. InfiniiSim waveform transformation tool.

N6462A DDR4 compliance test easy test definition

The test application enhances the usability of Keysight Infiniium oscilloscopes for testing DDR4 devices. The Keysight automated test framework guides you quickly through the steps required to define the setup, perform the tests and view the test results. You have the option to use the conventional DQS-DQ phase difference or MSOX logic triggering (used only with MSO90000X Series Infiniium oscilloscopes) for read and write separation. You can then select a category of tests or specify individual tests. The user interface is designed to minimize unnecessary reconnections, which saves time and minimizes potential operator error. You can save the tests and configurations as project files and recall them later for quick testing and reviewing of previous results. The threshold setting wizard helps you automate voltage threshold settings for non-standard operating voltages to increase flexibility to test in non-standard operating voltages. DDR debug tool is a license tool that enables JEDEC measurement on saved waveform traces with navigation capability and markers to identify problem areas for debug and margin testing. You can also perform multiple eye diagram analysis using saved waveform files or output from ADS simulation software.
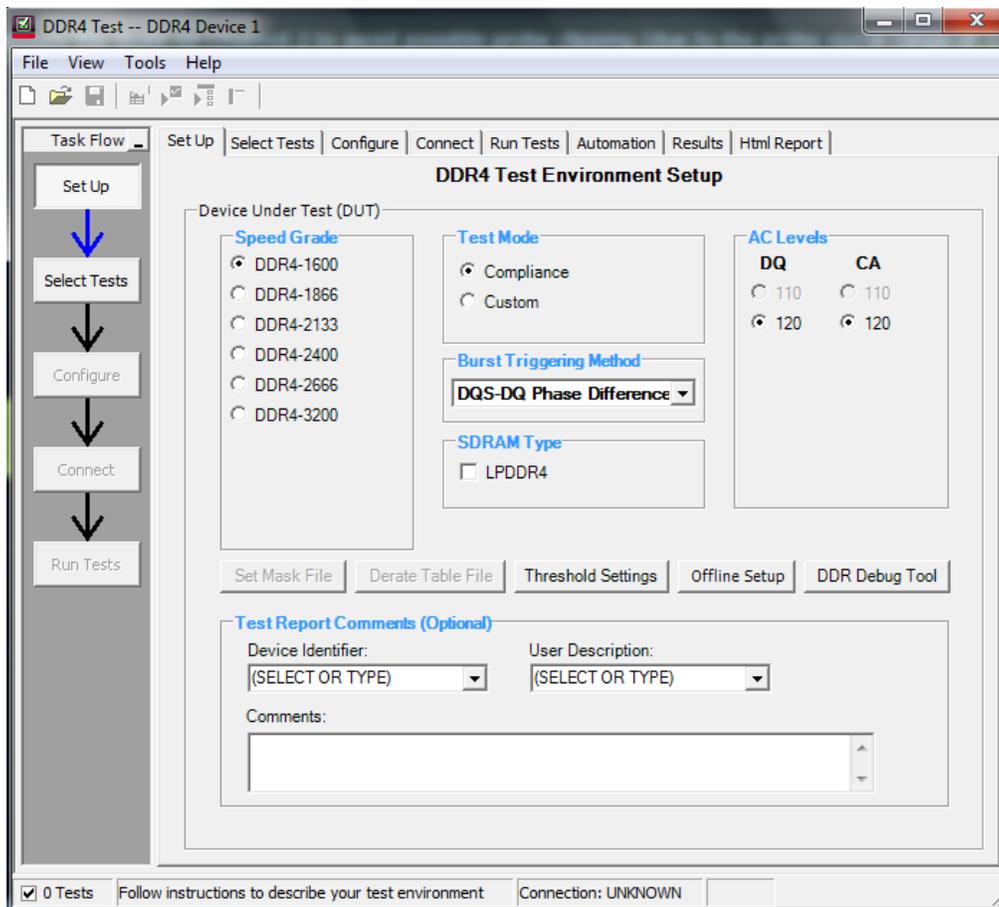

Figure 2. DDR4 application test setup screen. Select compliance or custom test mode and the speed grade of your device.
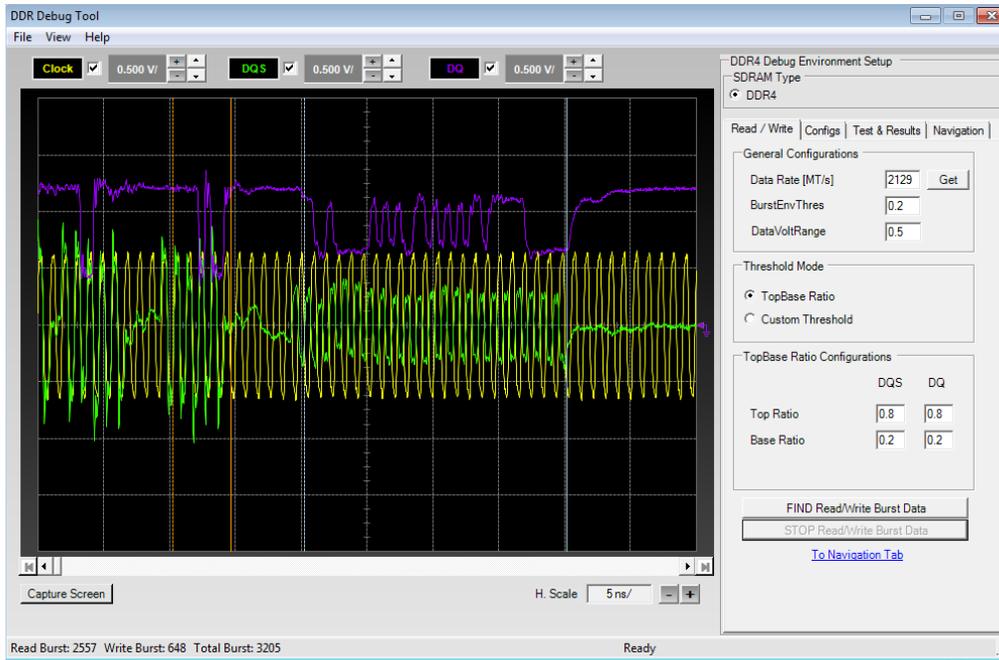
Figure 3. DDR debug tool enables markers to help navigate to bursts of interest with JEDEC measurements and statistical results.
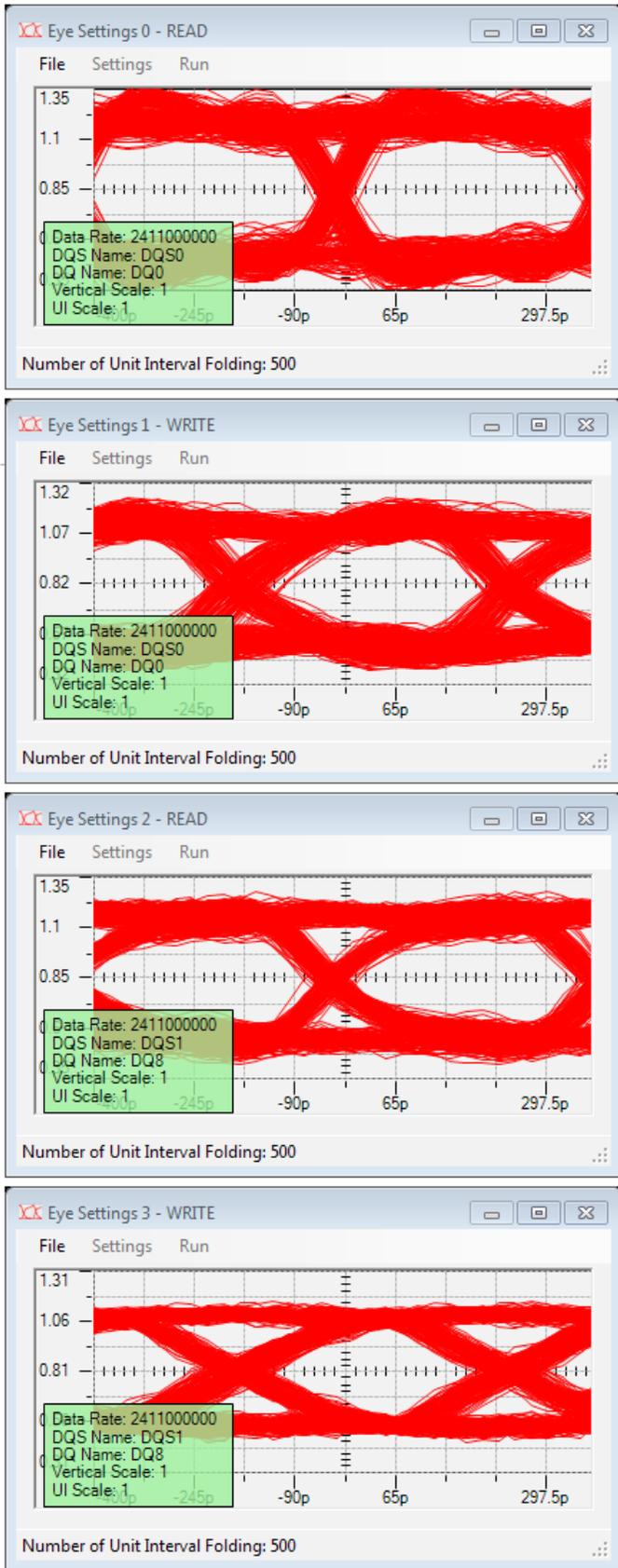
Figure 4. DDR debug tool provides offline eye diagram testing with display of multiple read and write eyes.

BER contour analysis and measurement setup

You can perform BER contour analysis to make accurate data valid window measurements. The BER contour is computed statistically from jitter and noise components of the signal. The timing parameters specific to the BER contour in accordance to the DDR4 and LPDDR4 JEDEC specification are timing data input valid window (TdiVW) and voltage data input valid window (VdiVW).

Figure 5. The BER contour is computed statistically from jitter and noise components.

Recommended reference solution configuration [1]

Hardware

Model	Description
MSOV134A	Analog bandwidth: 13 GHz
	Sampling rate: 40 GSa/s
	Memory: 50 Mpts/channel memory
	Digital sampling rate: 10 GSa/s for 16 channels/ 20 GSa/s for 8 channels
	Digital memory depth: 500 Mpts
	Accessories include two N5442A precision BNC adapters
	Software includes LPDDR4 and DDR4 trigger and decoder
	Includes front cover, power cord, keyboard, mouse, calibration cable, ESD wrist strap and (5) coax adapters
N5442A	Precision BNC adapter
1169A	InfiniiMax II probe amplifier (12 GHz bandwidth)
E2677B	InfiniiMax differential solder-in probe head and accessories (12 GHz bandwidth)
N2115A	x16 DDR4 BGA interposer (includes one BGA interposer and one riser)

Software

Model	Description
N6462A-1FP	DDR4 compliance software
N6462A-3FP	DDR4 debug tool kit
E2688A-1FP	Serial data analysis tool
N5465A-1FP	InfiniiSim waveform transformation tool
N8823A-1FP	EZJIT Complete jitter analysis
N5414B-1FP	InfiniiScan+ event identification software

1. For a more complete set of configuration options, please refer to the DDR4 Parametric Test Reference Solution Configuration Guide, literature number 5992-1449EN.

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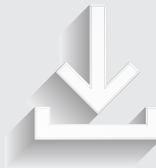
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