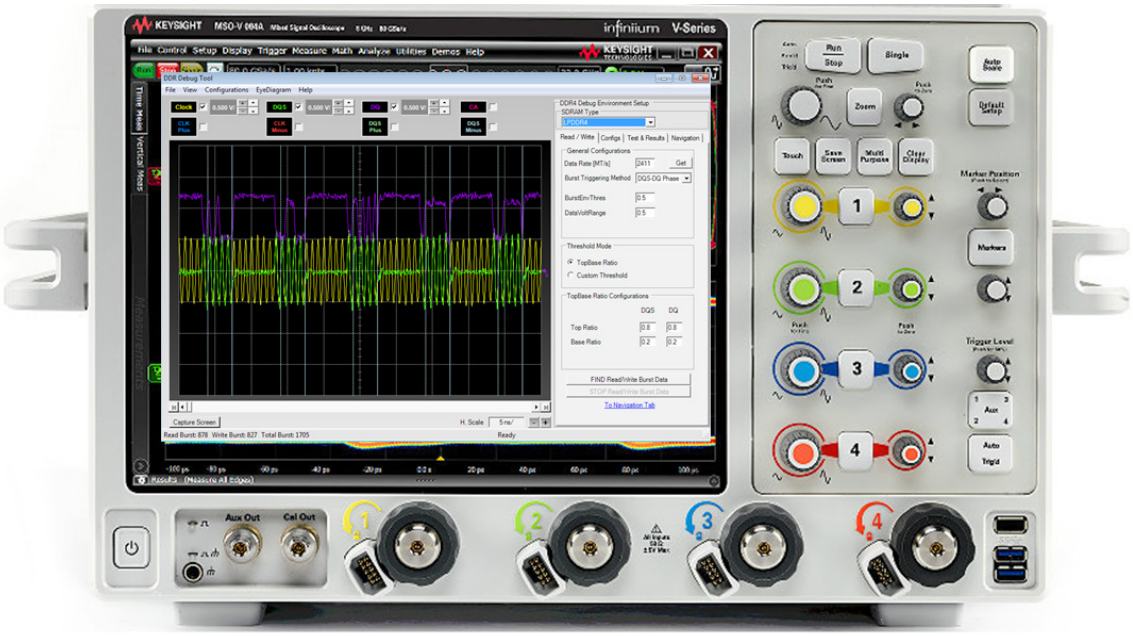
Keysight Technologies

N6462A and N6462B DDR4/LPDDR4 Compliance Test Software

N6462A works with Infiniium 90000A, V-Series, and Z-Series oscilloscopes
N6462B works with Infiniium 9000A and S-Series oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies, Inc. DDR4 and LPDDR4 compliance test application provides a fast and easy way to test, debug and characterize your DDR4 and LPDDR4 designs. The tests performed by the software are based on the JEDEC[1] JESD79-4 DDR4 SDRAM and JESD209-4 LPDDR4 Specification. In addition, the application features Custom mode, which covers crucial measurements such as eye-diagram analysis, mask testing, ringing and other tests that are not covered in the specifications but are critical for characterizing DDR4 and LPDDR4 devices. The test application offers a user-friendly setup wizard and a comprehensive report that includes margin analysis.

DDR4 is an evolutionary upgrade to DDR3 memory systems. DDR4 technology enables higher bandwidth for data transfer than DDR3 and allows you to build devices with even smaller chip footprints that consume less power and generate less heat. DDR4 achieves these advances with enhanced fine ball-grid array (FBGA) packaging, on-die termination, self-calibration and automatic self-refresh for improved control of signal integrity.

LPDDR4 DRAM (with data rates up to 4266 MT/s) is 50 percent faster than the industry's current highest-performance LPDDR3, which operates at 2133 MT/s. The new LPDDR4 also operates at lower electrical power than LPDDR3, which helps reduce power consumption in the mobile applications.

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 new data jitter measurements enable characterization of jitter to determine the data valid window.

The addition of the DDR4 debug tool helps memory designers perform pre- and post-compliance testing with saved oscilloscope waveform traces. The tool allows for navigation capability with measurement markers to help navigate to problem areas for further testing.

The DDR4 and LPDDR4 compliance test application is compatible with Keysight Infiniium digital storage oscilloscopes.

1. The JEDEC (Joint Electronic Device Engineering Council) Solid State Technology Association is a semiconductor engineering standardization body of the Electronic Industries Alliance (EIA), a trade association that represents all areas of the electronic industry.

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Comprehensive Test Coverage

With the DDR4 and LPDDR4 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 and LPDDR4 compliance test application does most of this work for you. If you discover a problem with your device, the Custom mode feature in the test application and debug tools in the oscilloscope are available to aid in root-cause analysis.

Features

The compliance test application offers several features to simplify the validation of your designs:

- New setup wizard for quick setup, configuration and test.
- Enhanced execution speed and proven test algorithm for clock test, which minimizes your compliance test time.
- User-selected tests and configurations based on JEDEC JESD79-4A and JESD209-4 Specification data rate.
- Unique technique to provide read-write burst signal separation on the same bus in real-time mode, allowing powerful debug and analysis.
- Option to use phase difference or mixed signal oscilloscope read/write command trigger, allowing robust read and write separation for JEDEC measurement.
- New wizard tool to automate voltage threshold settings for nonstandard operating voltages adds flexibility in characterization work.
- Ability to analyze the loading effect of adjacent RANK of the same memory channel.
- Test framework provides powerful characterization through multiple trials that show a full array of statistics for each measurement and returns the worst measurement value.
- DDR 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.
- Offline setup allows for compliance testing on saved waveform files from oscilloscope or ADS simulation tool.
- Interface to allow user to export the test result directly to a data repository server via the N8844A Data Analytics Web Service software.

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 review of previous results. Clear menus let you perform tests with minimum mouse clicks.

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.

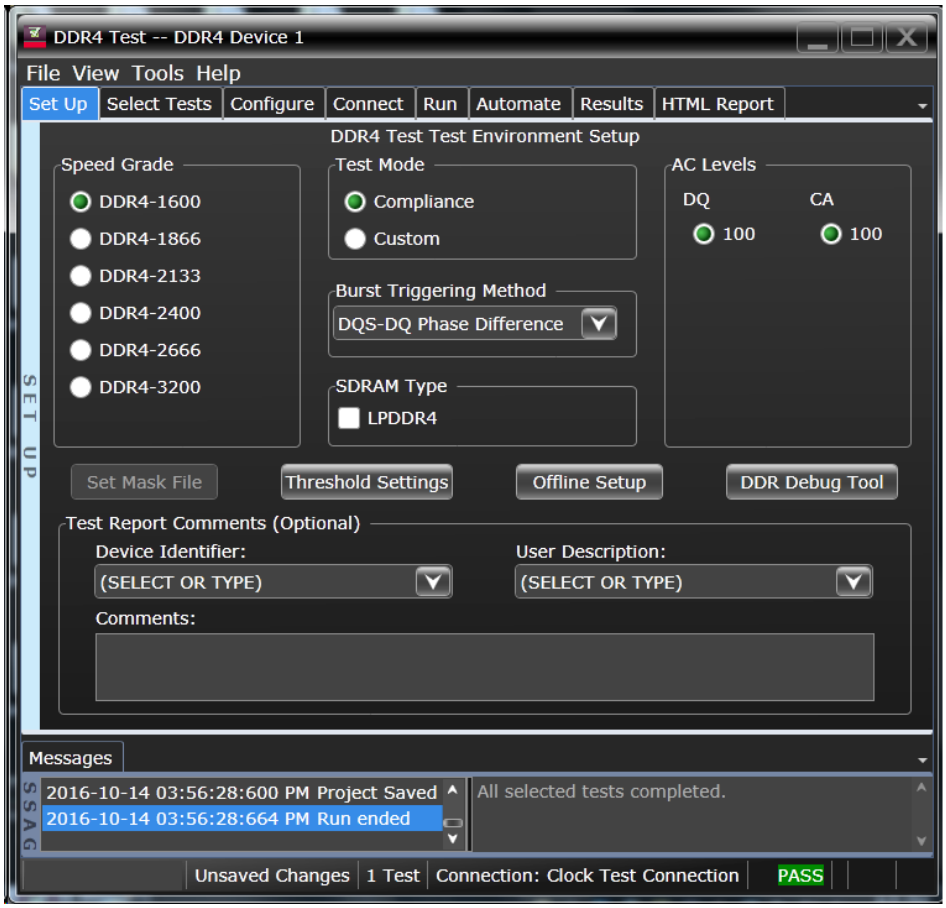


Figure 1. DDR4 and LPDDR4 application test setup screen. Select Compliance or Custom test mode and the speed grade of your device.

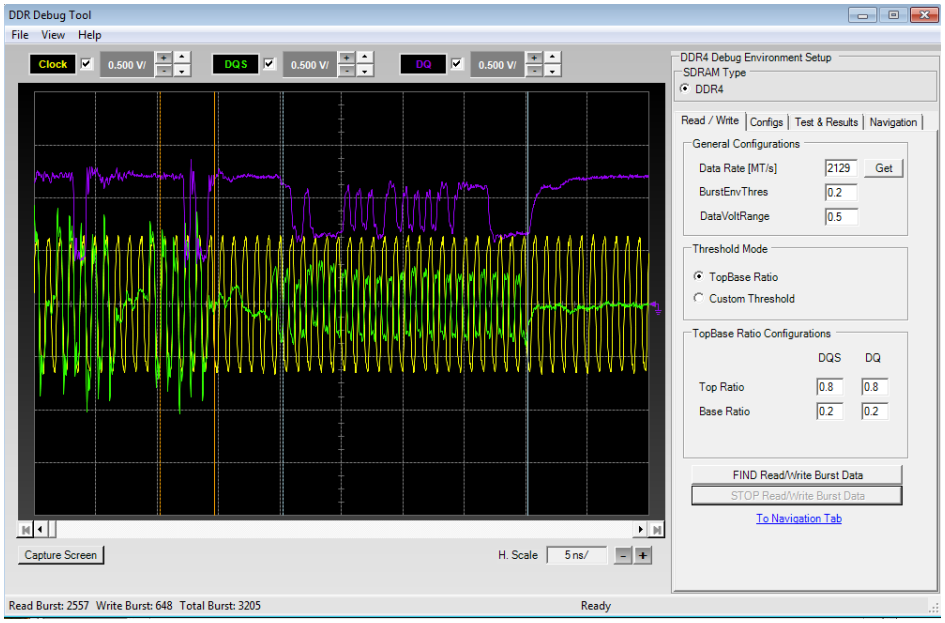


Figure 2. DDR debug tool enables markers to help navigate to bursts of interest with JEDEC measurements and statistical results.

Easy Test Definition (Continued)

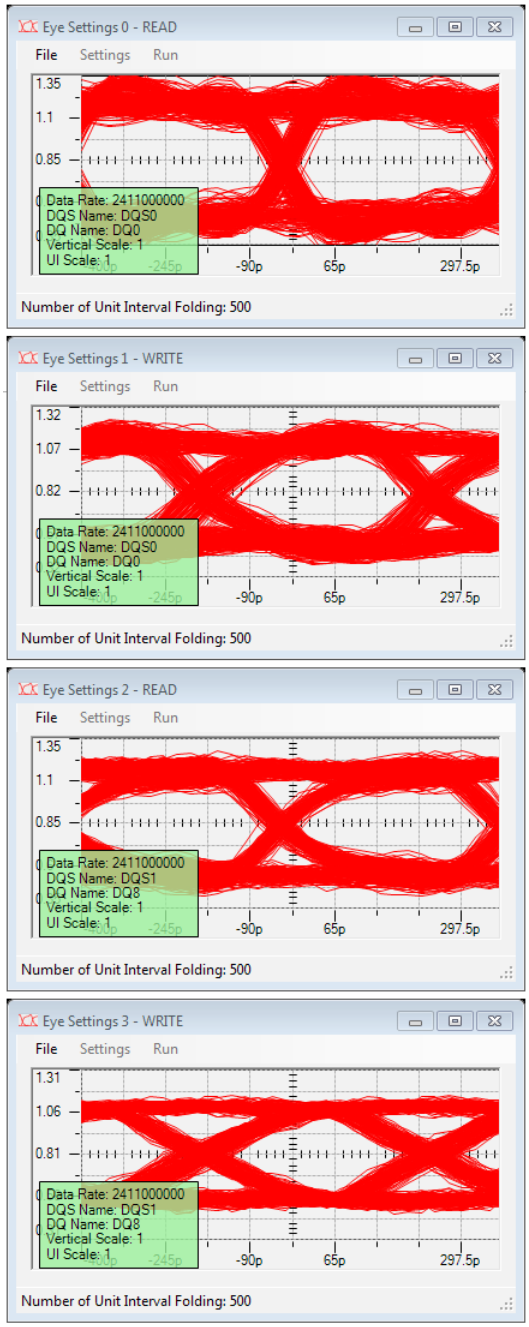


Figure 3. DDR debug tool provides offline eye diagram testing with display of multiple read and write eyes.

Configurability and Guided Connection

The DDR4 and LPDDR4 compliance test application provides flexibility in your test setup. The application lets you define controls for critical test parameters such as voltage threshold values, number of waveforms used for analysis and customizable violation settings. Once you have configured the tests, the connection page will display the connection diagram for the test you have selected.

With the multiple test trial capability, you can extensively characterize the performance of your devices. You can run the selected tests until the stop condition is met. The application will then save the worst-case conditions and help you track down the anomalies in your signals.

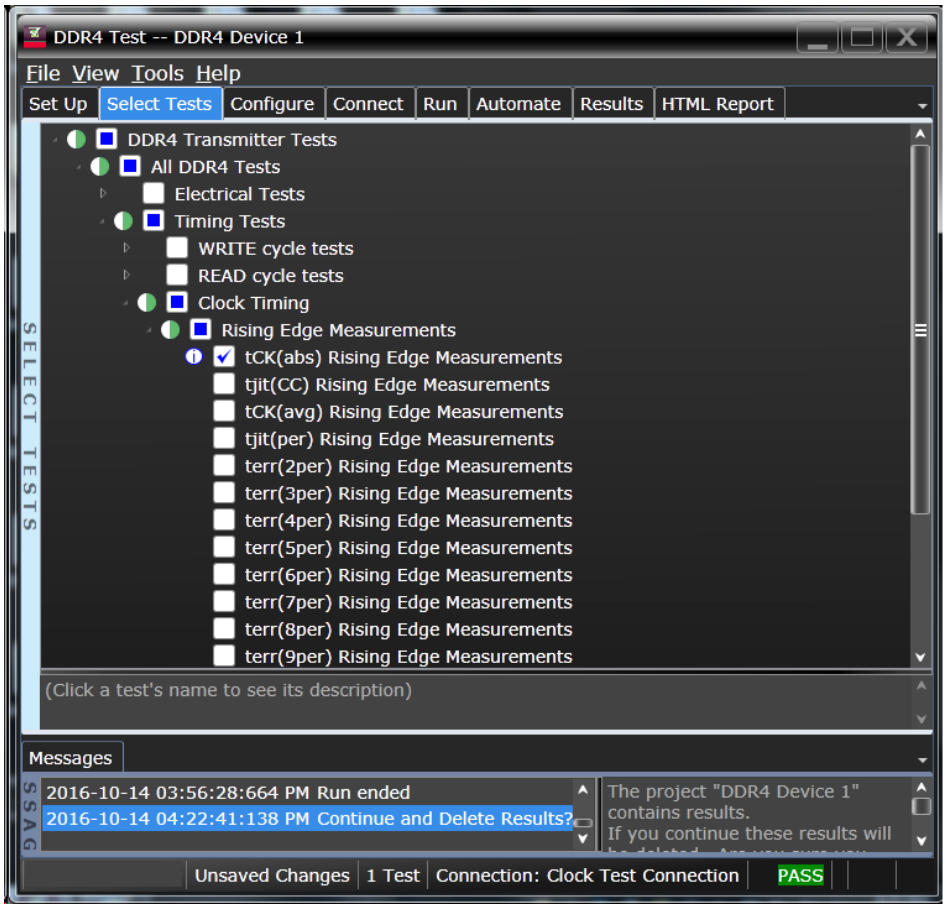


Figure 4. The Keysight automated test engine filters the test selection based on your test setup. You can easily select individual tests or groups of tests with a mouse-click.

Comprehensive Results Analysis

In addition to providing you with measurement results, the DDR4 and LPDDR4 compliance test application reports how close you are to the specified limit. You can specify the evel at which warnings are to be issued. You are provided with a full array of statistics for each measurement, and you can save worst case conditions to extensively test the performance of your device.

The N8844A-6FP data analytics web service software provides an interface that allows the user to export their test result directly to the data repository server via a URL. If the test results are deemed valid, the user would export the test result to the data repository via the N8844A Data Analytics Web Service software. The user can then retrieve the aggregated measurement to be viewed using the Visualization Tool included in the N8844A software. Both the results viewer tools provide graphical plots in histogram or line mode that describes the measurements in different kind of properties.

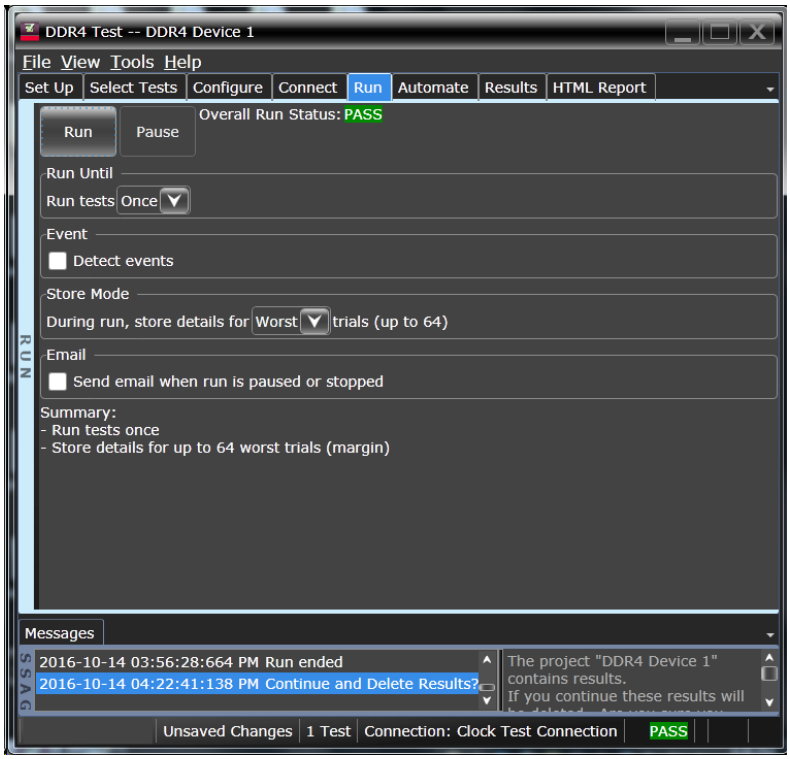


Figure 5. The Repetitive Run feature allows you to run the selected tests until the stop condition is met. It allows you to extensively test the performance of your device.

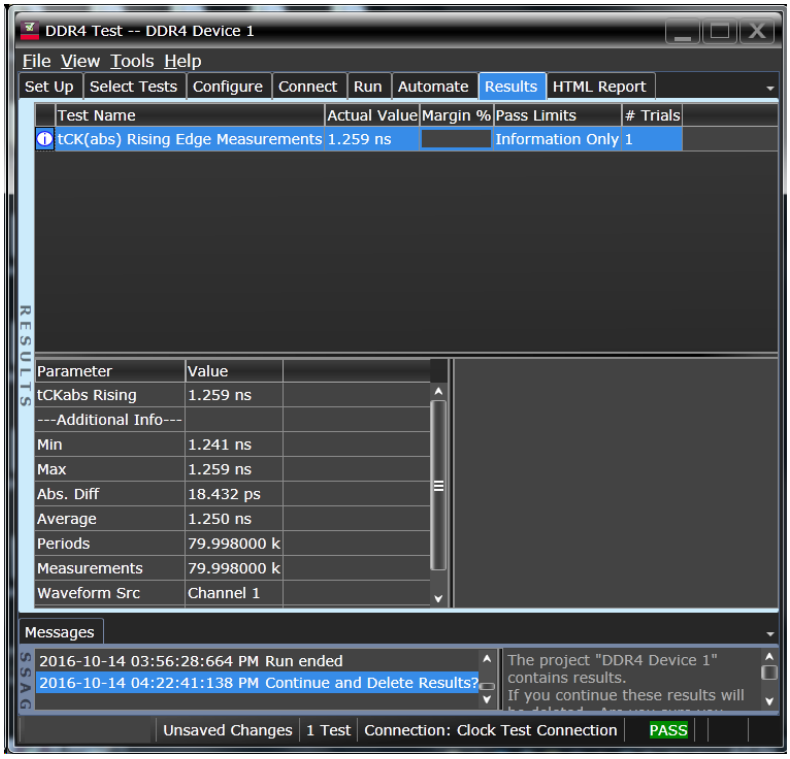


Figure 6. The DDR4 and LPDDR4 test application documents your test parameters, pass or fail status, test specification range, measured values and the pass/fail margin.

Comprehensive Results Analysis (Continued)

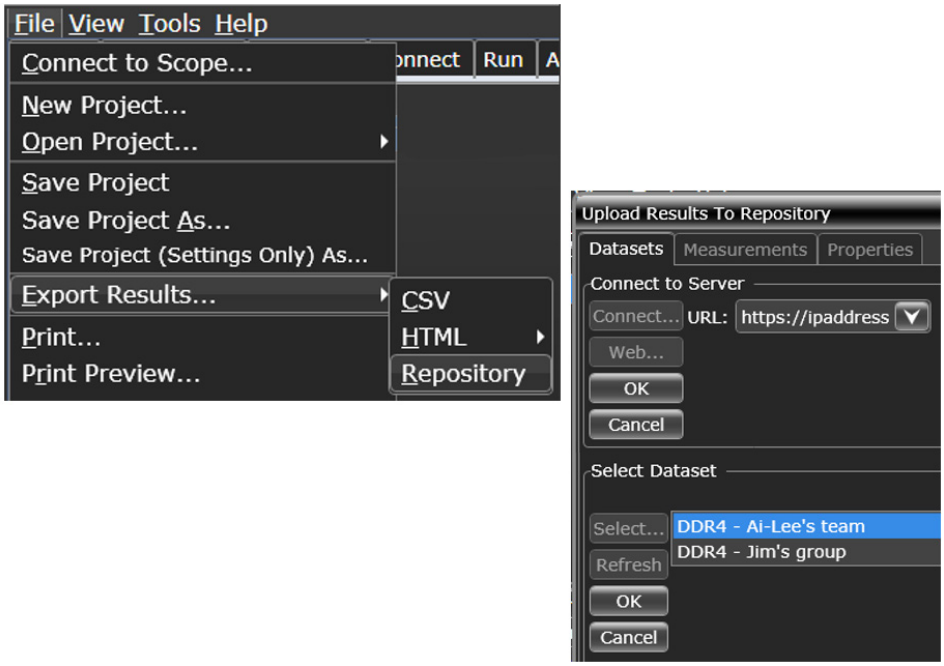


Figure 7. The N8844A-6FP data analytics web service software exports your test result directly to the data repository server. The user exports the compliance test result to the repository via an URL address that connects to the server.

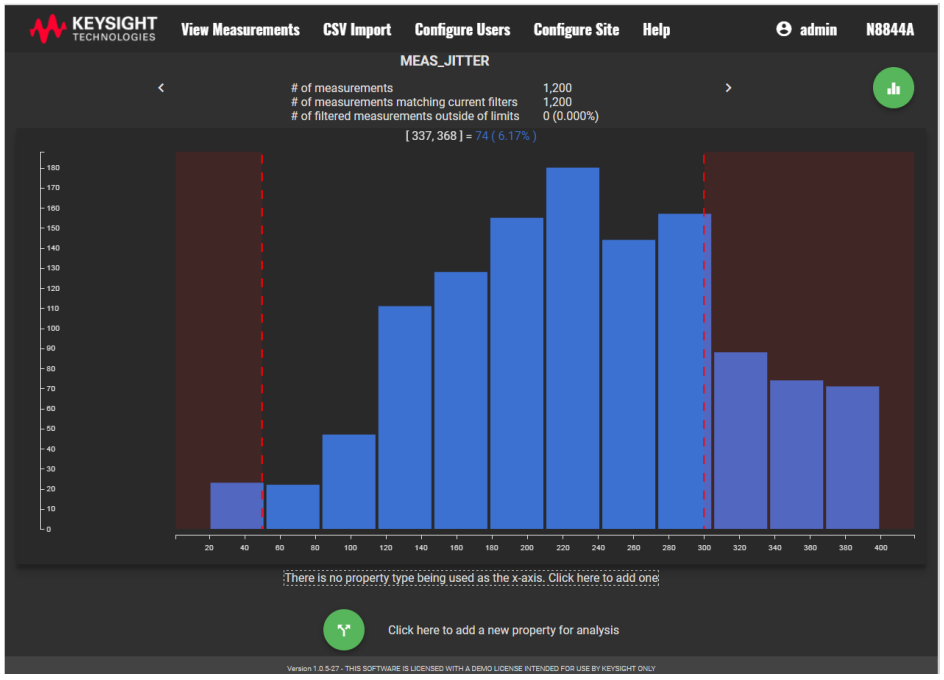


Figure 8. You can retrieve the test result from the data repository for results viewing with the Visualization Tool included in the N8844A data analytics web service software.

Thorough Performance Reporting

The DDR4 and LPDDR4 compliance test application generates thorough HTML reports that capture the performance, status and margins of your device. It also captures screen shots of critical measurements for your reference and documentation. This report is suitable for printing and sharing with your vendors, customers or colleagues.

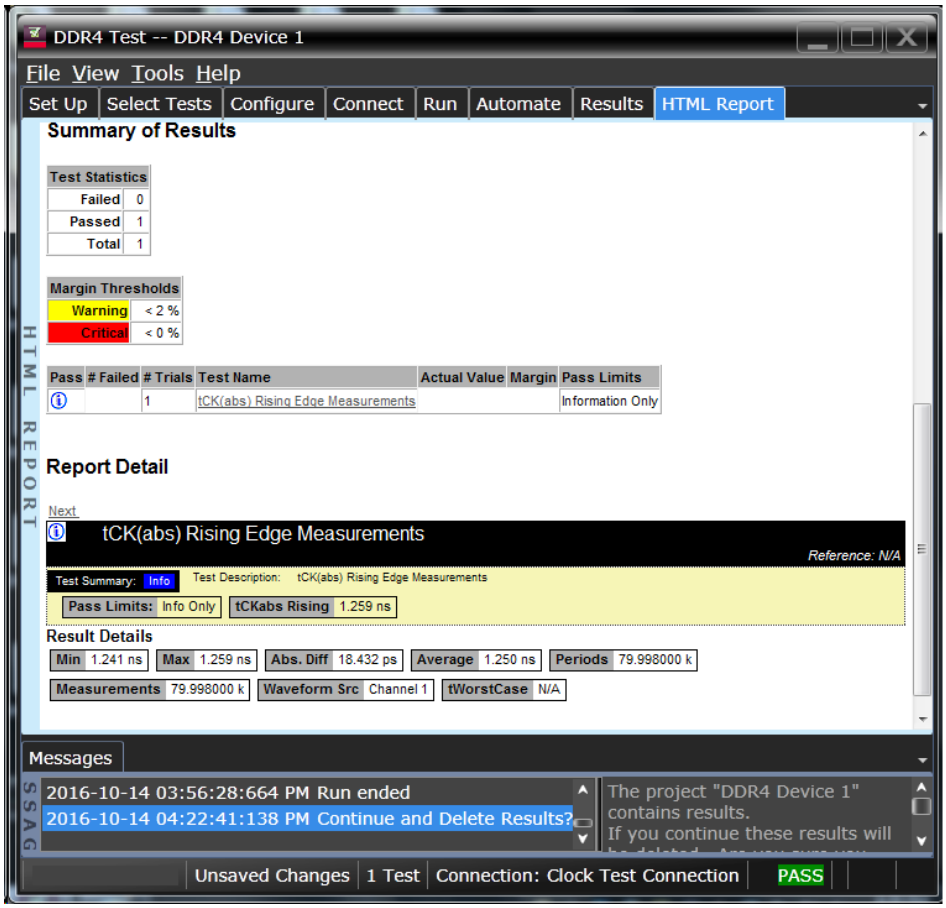


Figure 9. The DDR4 and LPDDR4 test application generates a summary report where you can see your device's test results quickly and clearly. Details are available for each test including the test limits, test description and test results, including saved waveforms. In addition, the pass/fail margin is indicated to give you further insight.

Extensibility

You may add additional custom tests or steps to your application using the User Defined Application (UDA) development tool (**www.keysight.com/find/uda**). Use UDA to develop functional "Add-ins" that you can plug into your application.

Add-ins may be designed as:

- Complete custom tests (with configuration variables and connection prompts).
- Any custom steps such as pre or post processing scripts, external instrument control and your own device control.

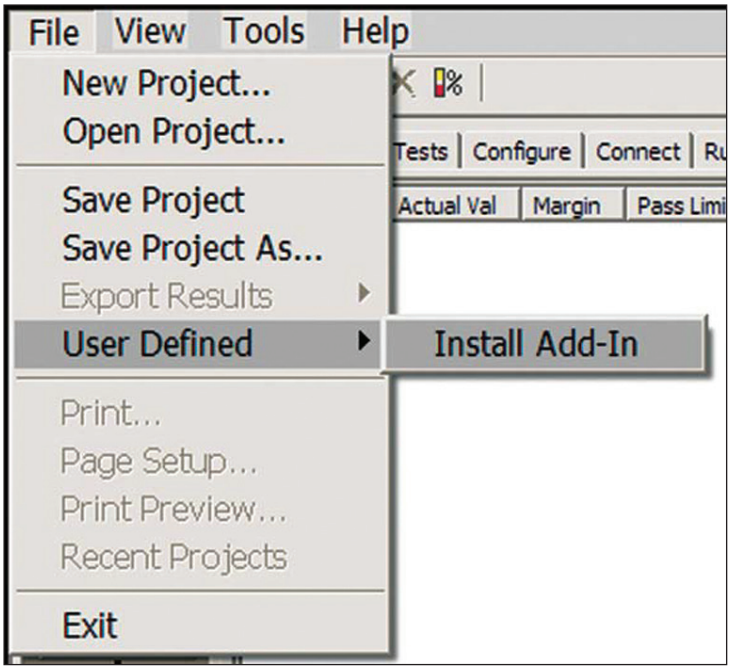


Figure 10. Importing a UDA Add-in into your test application.

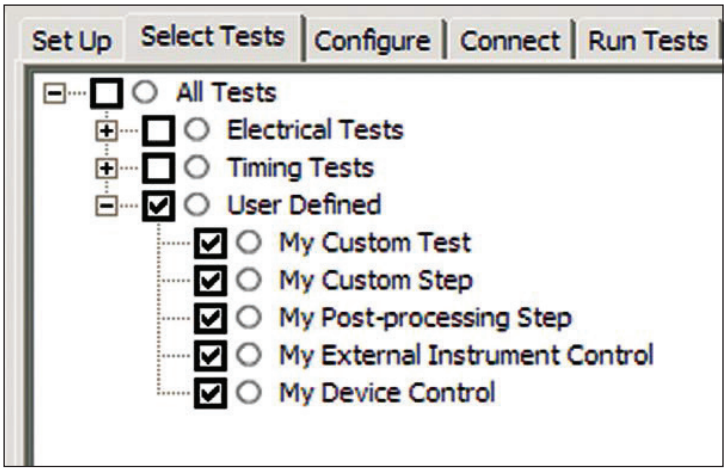


Figure 11. UDA Add-in tests and utilities in your test application.

Automation

You can completely automate execution of your application's tests and Add-ins from a separate PC using the included N5452A Remote Interface feature (download free toolkit from: **www.keysight.com/find/scope-apps-sw).** You can even create and execute automation scripts right inside the application using a convenient built-in client. The commands required for each task may be created using a command wizard or from "remote hints" accessible throughout the user interface. Using automation, you can accelerate complex testing scenarios and even automate manual tasks such as:

- Opening projects, executing tests and saving results.
- Executing tests repeatedly while changing configurations.
- Sending commands to external instruments.
- Executing tests out of order.

Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive:

- Interact with your device controller to place it into desired states or test modes before test execution.
- Configure additional instruments used in your test suite such as a pattern generator and probe switch matrix.
- Export data generated by your tests and post-process it using your favorite environment, such as MATLAB, Python, LabVIEW, C, C++, Visual Basic, etc.
- Sequence or repeat the tests and "Add-in" custom steps execution in any order for complete test coverage of the test plan.

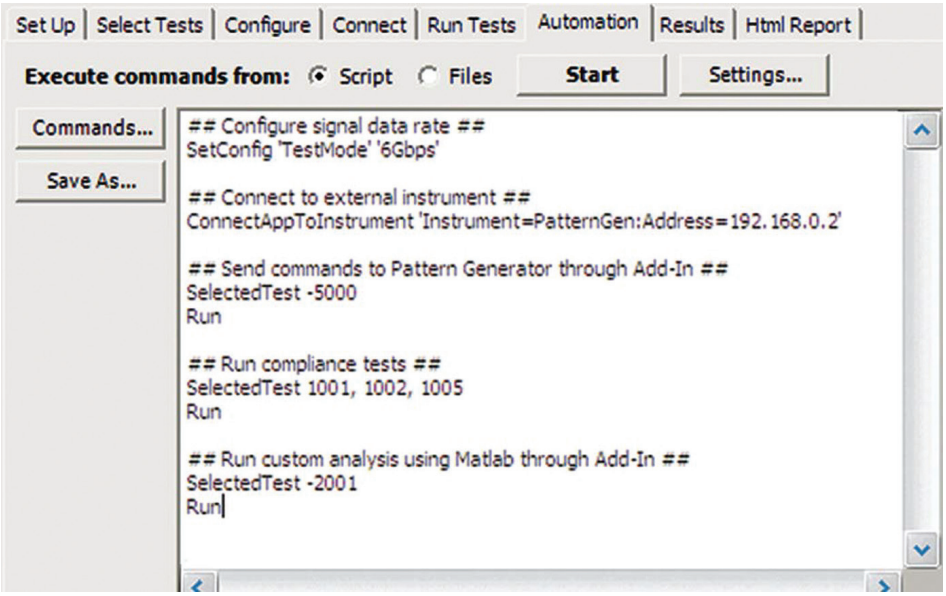


Figure 12. Remote Programming script in the Automation tab.

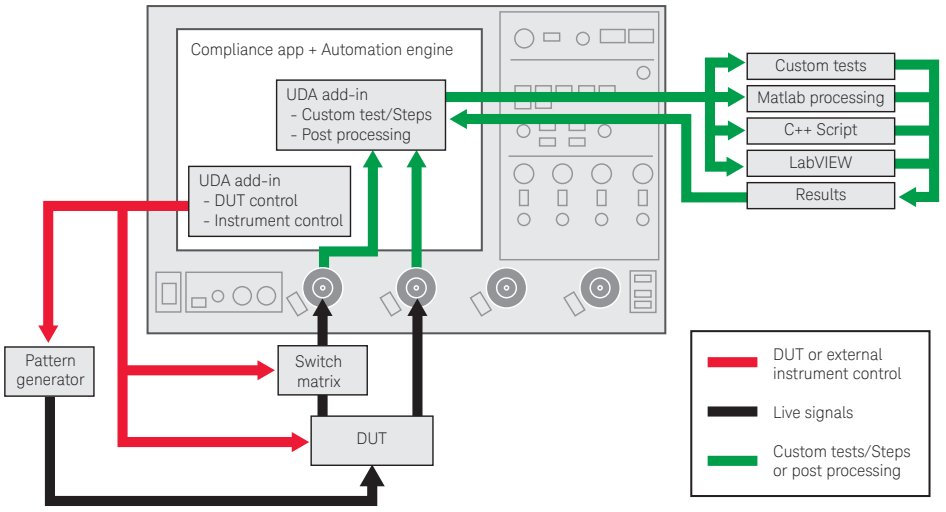


Figure 13. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Requirements and Compatibility

Test performed

The Keysight DDR4 and LPDDR4 compliance test application covers clock, electrical and timing parameters of the JEDEC SDRAM Specifications. The application helps you test all DDR4 and LPDDR4 devices for compliance while using an Keysight 9000 or 90000 Series Infiniium oscilloscope. In addition, the test application's Custom mode feature provides popular test methodologies that are not covered in any specification. These tests help users who want to perform extensive validation beyond the test specification. It also sets up the scope to isolate the read and write signals so you can immediately jump in to debug the signals.

System device requirements

In order to speed your test time, you must use the appropriate RAM test reliability software with the memory system to generate random activity on the memory bus. Memtest is commonly used RAM reliability test software that can run on DOS, Windows and Linux systems.

Note: The JEDEC JESD79- 4 and JESD209-4 specifications does not specify the rise time and fall time for DDR4 and LPDDR4 signals. The required oscilloscope bandwidth is also not mentioned. It is advisable for you to determine the oscilloscope bandwidth requirement based on the fastest rise time and fall time of the DDR4 and LPDDR4 signals.

Recommended oscilloscopes

The DDR4 and LPDDR4 compliance software is compatible with Infiniium Series oscilloscopes with operating software revision 4.20 or higher. For oscilloscopes with earlier revisions, free upgrade software is available at **www.keysight.com/find/scope-apps-sw**.

Data rate	Minimum bandwidth	Minimum channels	Description
Up to 3200 MT/s	13 GHz	3	Infiniium 90000A Series, 90000 X-Series, V-Series and Z-Series oscilloscopes

Requirements and Compatibility (Continued)

Ordering information

Application	License type		Infiniium V-Series/Z-Series	Infiniium S- Series	Infiniium 90000A Series	Infiniium 90000 X-Series	Infiniium 9000 Series
DDR4 and LPDDR4 compliance	Fixed	Factory-installed	N6462A-1FP	N6462B-1FP	DSO90000-058	DSOX90000-058	DSO/MSO9000-058
		User-installed	N6462A-1FP	N6462B-1FP	N6462A-1NL [2] or N6462A-1FP [1]	N6462A-1NL [2] or N6462A-1FP [1]	N6462B-1NL [2] or N6462B-1FP [1]
	Floating	Transportable	N6462A-1TP	N6462B-1TP	N6462A-1TP [1, 2]	N6462A-1TP [1, 2]	N6462B-1TP [1, 2]
		Server-based	N5435A-087				
DDR4 upgrade to LPDDR4	Fixed	Factory-installed	Not available	Not available	Not available	Not available	Not available
		User-installed	N6462A-2FP	N6462B-2FP	N6462A-2FP	N6462A-2FP	N6462B-2FP
	Floating	Transportable	N6462A-2TP	N6462B-2TP	N6462A-2TP	N6462A-2TP	N6462B-2TP
		Server-based	Not available				
DDR4 debug tool	Fixed	Factory-installed	Not available	Not available	Not available	Not available	Not available
		User-installed	N6462A-3FP	N6462B-3FP	N6462A-3NL [2] or N6462A-3FP [1]	N6462A-3NL [2] or N6462A-3FP [1]	N6462B-3NL [2] or N6462B-3FP [1]
	Floating	Transportable	N6462A-3TP	N6462B-3TP	N6462A-3TP [1, 2]	N6462A-3TP [1, 2]	N6462B-3TP [1, 2]
		Server-based	Not available				
LPDDR4 debug tool	Fixed	Factory-installed	Not available	Not available	Not available	Not available	Not available
		User-installed	N6462A-4FP	N6462B-4FP	N6462A-4FP [1]	N6462A-4FP [1]	N6462B-4FP [1]
	Floating	Transportable	N6462A-4TP				
		Server-based	Not available				
Serial data analysis software (included in DSA model)	Fixed	Factory-installed	E2688A-1FP	N5384A-1FP	DSO90000A-003	DSOX90000-003	DSO/MSO9000A-003
		User-installed	E2688A-1FP	N5384A-1FP	E2688A-1NL [2] or E2688A-1FP [1]	E2688A-1NL [2] or E2688A-1FP [1]	N5384A-1NL [2] or N5384A-1FP [1]
	Floating	Transportable	E2688A-1TP	N5384A-1TP	E2688A-1TP [1, 2]	E2688A-1TP [1, 2]	N5384A-1TP [1, 2]
		Server-based	N5435A-003				
InfiniiSim advanced (optional)	Fixed	Factory-installed	N5465A-1FP	N5465B-1FP	DSO90000A-014	DSOX90000-014	DSO/MSO9000A-014
		User-installed	N5465A-1FP	N5465B-1FP	N5465A-1NL [2] or N5465A-1FP [1]	N5465A-1NL [2] or N5465A-1FP [1]	N5465B-1NL [2] or N5465B-1FP [1]
	Floating	Transportable	N5465A-1TP	N5465B-1TP	N5465A-1TP [1, 2]	N5465A-1TP [1, 2]	N5465B-1TP [1, 2]
		Server-based	N5435A-027				
InfiniiScan (optional)	Fixed	Factory-installed	N5414B-1FP	N5415B-1FP	DSO90000A-009	DSOX90000-009	DSO/MSO9000A-009
		User-installed	N5414B-1FP	N5415B-1FP	N5414B-1NL [2] or N5414B-1FP [1]	N5414B-1NL [2] or N5414B-1FP [1]	N5414B-1NL [2] or N5414B-1FP [1]
	Floating	Transportable	N5414B-1TP	N5415B-1TP	N5414B-1TP [1, 2]	N5414B-1TP [1, 2]	N5415B-1TP [1, 2]
		Server-based	N5435A-004				

1. Requires software 5.00 and above.
2. Software 4.30 or above requires Windows 7. N2753A Infiniium Windows XP to 7 OS upgrade kit (oscilloscope already has M890 motherboard). N2754A Infiniium Windows XP to 7 OS and M890 motherboard upgrade kit (oscilloscope without M890 motherboard). Verify the M890 motherboard using the procedure found in the Windows 7 upgrade kit data sheet with the publication number: 5990-8569EN.

Requirements and Compatibility (Continued)

Application	License Type	Installed on a web server	
Data Analytics Web Service Software (1 license)	Fixed	Factory-installed	–
		User-installed	N8844A-1FP
	Floating	Transportable	N8844A-1TP
		Server based	–
Data Analytics Web Service Software (15 licenses)	Fixed	Factory-Installed	–
		User-Installed	N8844A-4FP
	Floating	Transportable	N8844A-4TP
		Server based	–
Data Analytics Web Service Software (Corporate/Unlimited licenses)	Fixed	Factory-installed	–
		User-installed	N8844A-5FP
	Floating	Transportable	N8844A-5TP
		Server based	–
Data Analytics Web Service Software (Corporate/Unlimited licenses)	Fixed	Factory-installed	–
		User-installed	N8844A-5FP
	Floating	Transportable	N8844A-5TP
		Server based	–
Data Analytics Web Service Software (Advance option)	Fixed	Factory-installed	–
		User-installed	N8844A-2FP
	Floating	Transportable	N8844A-2TP
		Server based	–
Data Analytics Web Service Software (for use with Infiniium compliance test software)	Fixed	Factory-installed	–
		User-installed	N8844A-6FP
	Floating	Transportable	N8844A-6TP
		Server based	–

Note. User can order maximum quantity 1 of the N8844A -1FP/TP, -4FP/TP or -5FP/TP for one server setup. User can either buy another set of license for the second sever or use transportable license to move the license from one server to another.

Probe Accessories

InfiniiMax probe amplifiers	
1169A	12 GHz InfiniiMax II probe amplifier

InfiniiMax probe heads	
InfiniiMax I/II probe heads and accessories (compatible with 9000 and 90000 Series, use N5442A precision BNC adapter with 90000X/Q Series)	
N5381A	InfiniiMax II 12-GHz differential solder-in probe head and accessories
N5382A	InfiniiMax II 12-GHz differential browser
E2677A	InfiniiMax II 12-GHz differential solder-in probe head and accessories
N5425A	InfiniiMax II 12-GHz ZIF probe head
N5426A	InfiniiMax II ZIF tips (x10)

To learn more about Infiniium oscilloscope probes and accessories, check out the *Infiniium Oscilloscope Probes and Accessories - Data Sheet* with the Keysight literature number 5968-7141EN.

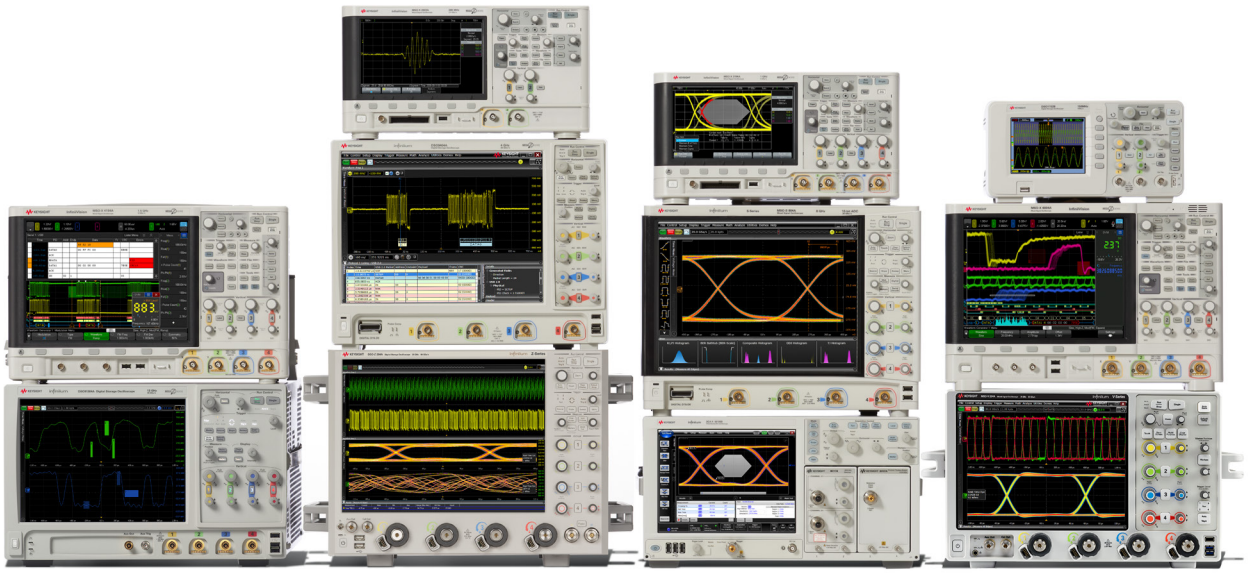
For more information about Keysight's InfiniiMax III probing system, check out the *InfiniiMax III/III+ Probing System - Data Sheet* with the Keysight literature number 5990-5653EN.

Product Website

For the most up-to-date and complete application and product information, please visit our product website at **www.keysight.com/find/n6462a**.

Related Literature

Publication type	Publication number
E2688A, N5384A High-Speed Serial Data Analysis and Clock Recovery Software For Infiniium Oscilloscopes - Data Sheet	5989-0108EN
EZJIT Plus Jitter Analysis Software for Infiniium Oscilloscopes - Data Sheet	5989-0109EN
Infiniium 90000 Series Oscilloscopes - Data Sheet	5989-7819EN
InfiniiScan Event Identification Software for Infiniium Series Oscilloscopes - Data Sheet	5990-5093EN
Infiniium 90000 X-Series Oscilloscopes - Data Sheet	5990-5271EN
N8844A Data Analytics Web Service Software - Data Sheet	5992-1910EN



Keysight Oscilloscopes

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www.axiestandard.org

AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. The business that became Keysight was a founding member of the AXIe consortium. ATCA®, AdvancedTCA®, and the ATCA logo are registered US trademarks of the PCI Industrial Computer Manufacturers Group.

www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. The business that became Keysight was a founding member of the LXI consortium.

www.pxisa.org

PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

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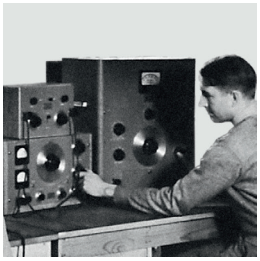

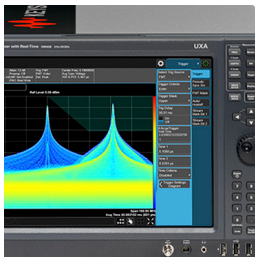

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