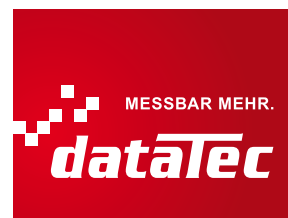


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Mess- und Prüfgeräte

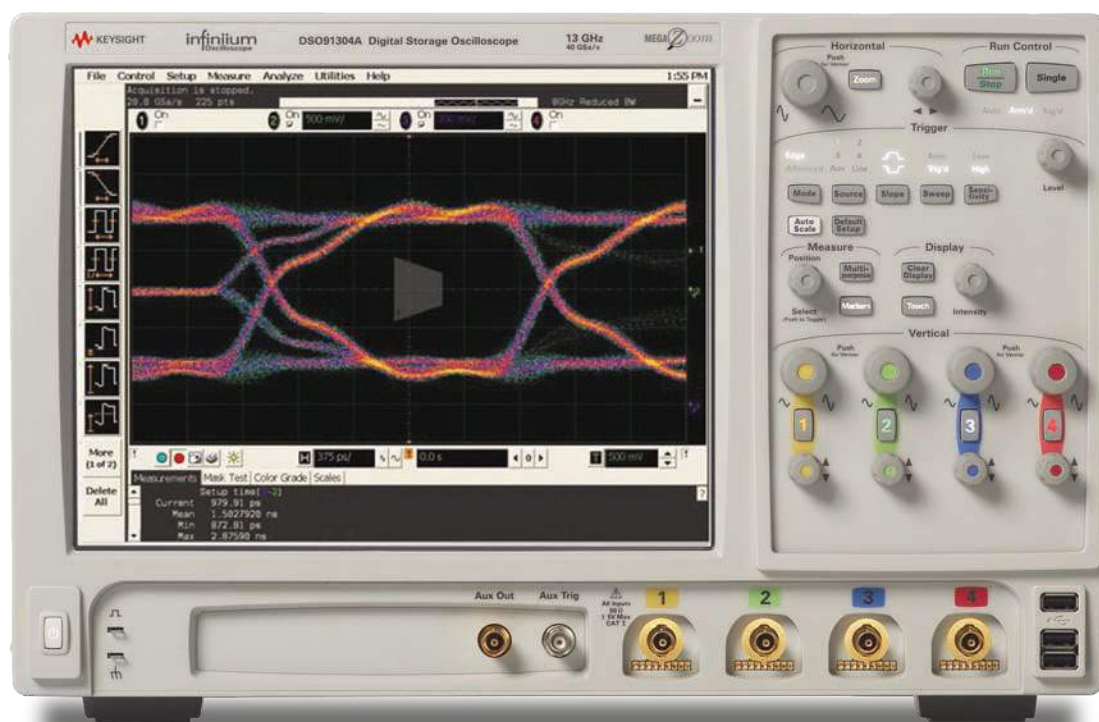


Keysight U7233A

DDR1 Compliance Test Application with LPDDR and mobile-DDR Support

For Infiniium Series Oscilloscopes

Data Sheet



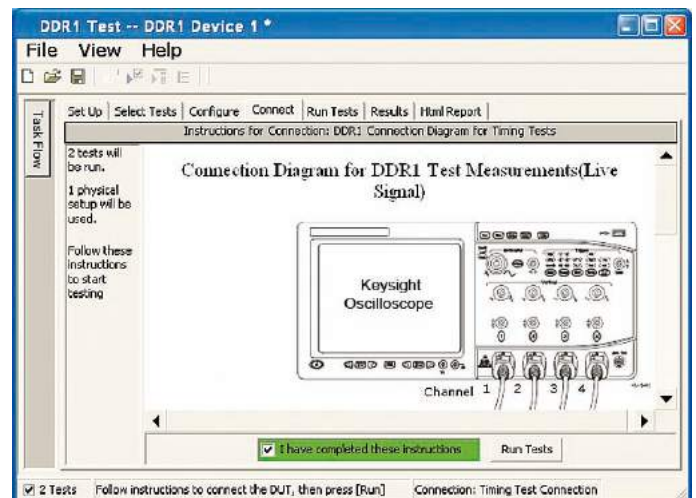
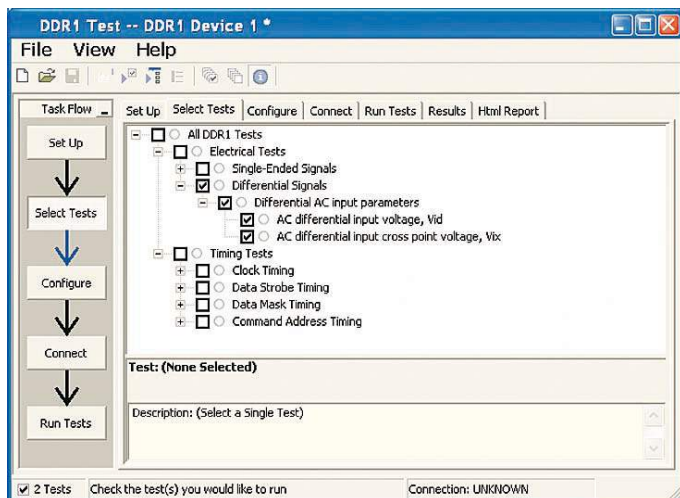
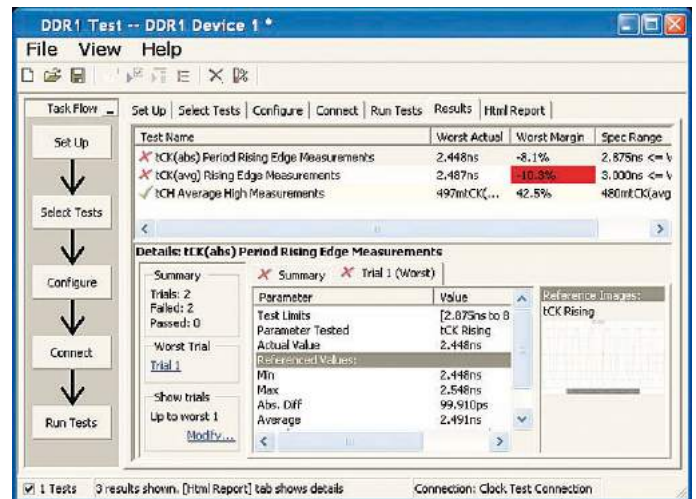
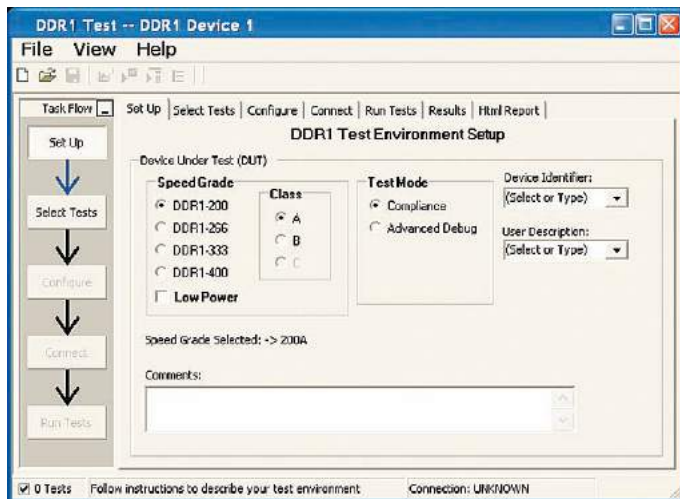
Test, Debug and Characterize your DDR1 Designs Quickly and Easily

The Keysight Technologies, Inc. DDR1 compliance test application provides a fast and easy way to test, debug and characterize your DDR1 designs. The tests performed by the software are based on the JEDEC¹ JESD79E Double Data Rate (DDR) SDRAM Specification and JESD209A Low Power Double Data Rate (LPDDR) SDRAM Specification. In addition, the application features Advanced Debug mode, which provides testing for embedded memory interfaces that do not operate according to the speeds specified by JEDEC. The test application offers a user-friendly setup wizard and a comprehensive report that includes margin analysis.

DDR1 is the first generation of a new breed of memory technology where data is transferred on both the rising and falling clock edges. DDR1 offers a significant performance advantage compared to previous memory technologies that were based on single data rates. As DDR1 manufacturing has matured, product costs have been driven down significantly, which has fueled growth, especially in the consumer product segment. DDR1 comes in two different packages, a fine ball-grid array (FBGA) package and a thin small-outline package (TSOP).

Signal integrity is crucial for memory system interoperability. Compliance to the JEDEC specification is the key to reliable and interoperable modular memory systems. Besides that, it ensures the memory system functions correctly and stays error free.

The U7233A DDR1 compliance test application is compatible with Keysight 9000 and 90000 Series Infiniium 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.

Features

The DDR1 compliance test application offers several features to simplify the validation of your DDR1 designs:

- New setup wizard for quick setup, configuration and test
- Compliance testing of clock, electrical and timing measurements in accordance with the JEDEC JESD79E and JESD209A specifications
- Comprehensive analysis that automates the complex measurements, even when you are not there
- Unique read and write separation techniques with InfiniiScan “Zone Qualify” feature
- Ability to separate and analyze the loading due to adjacent rank of the same memory channel
- Automatically perform derating table calculations for setup and hold time measurements based on slew rate

Comprehensive Test Coverage

With the DDR1 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 DDR1 tests are connecting to the target device, configuring the oscilloscope, performing the tests and analyzing the measured results. The DDR1 compliance test application does most of this work for you.

Easy Test Definition

The test application enhances the usability of Keysight Infiniium oscilloscopes for testing DDR1 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. On the environmental setup page, you can select the type of DDR1 devices, and the framework automatically filters the tests based on your selection. 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 a minimum of mouse clicks.

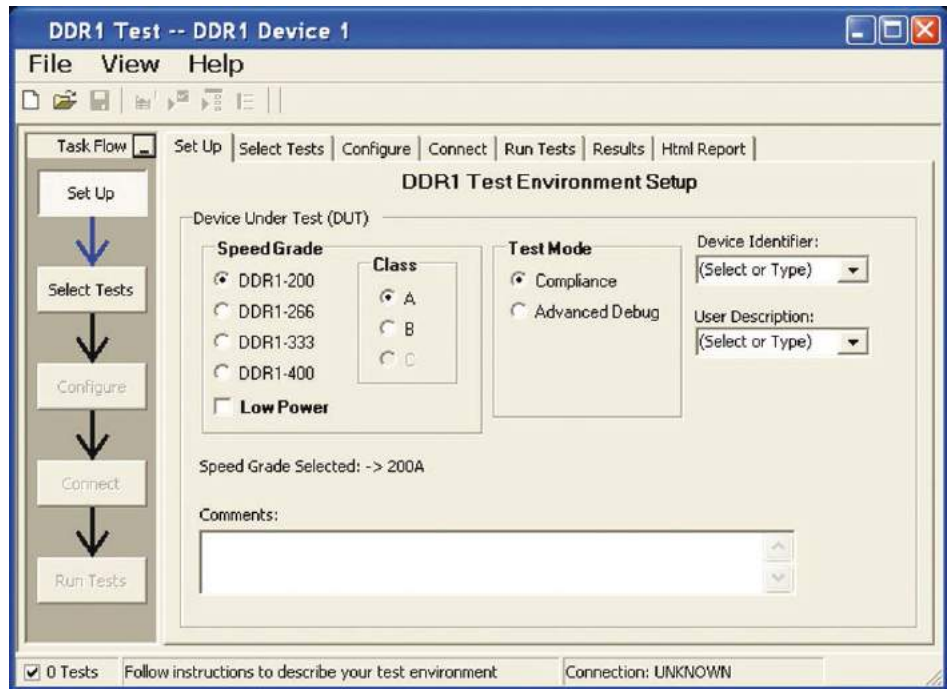


Figure 1. DDR1 application test setup screen. Select Compliance or Advanced Debug test mode and the speed grade of your device.

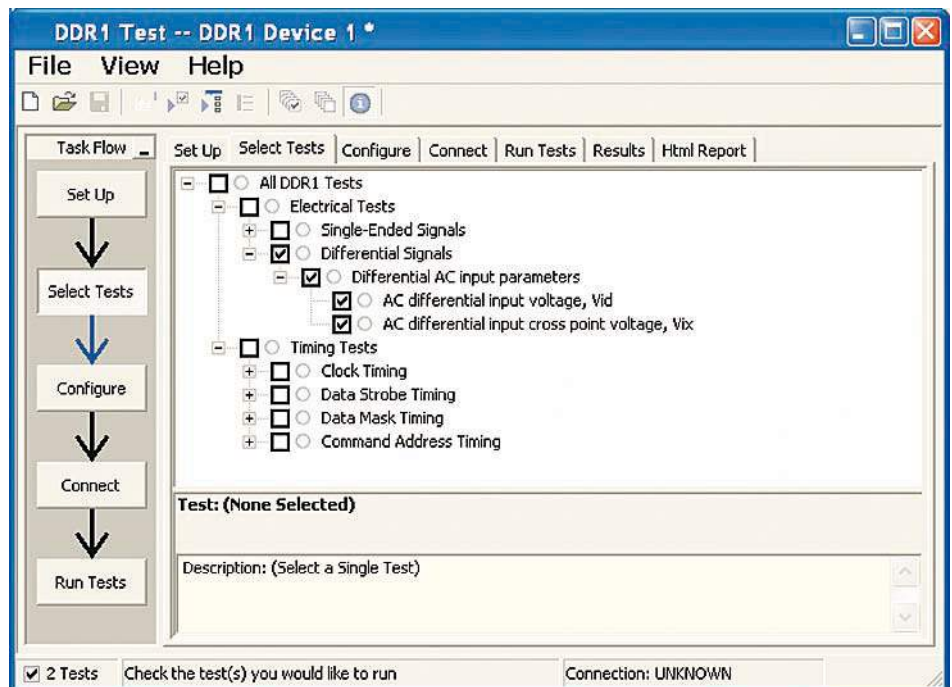


Figure 2. The Keysight automated test engine filters the test selection based on your test setup. You can easily select individual tests or groups of tests with a mouse-click.

Configurability and Guided Connection

The DDR1 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 DDR1 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.

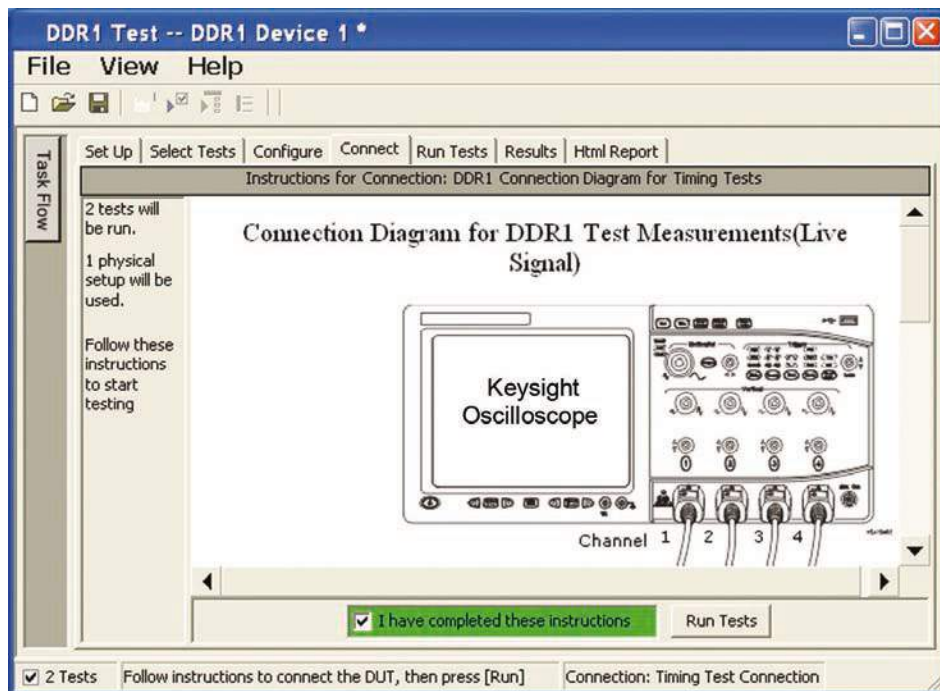


Figure 3. The software prompts you with the connection diagrams for the tests you have selected.

Comprehensive Results Analysis

In addition to providing you with measurement results, the DDR1 compliance test application reports how close you are to the specified limit. You can specify the level 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.

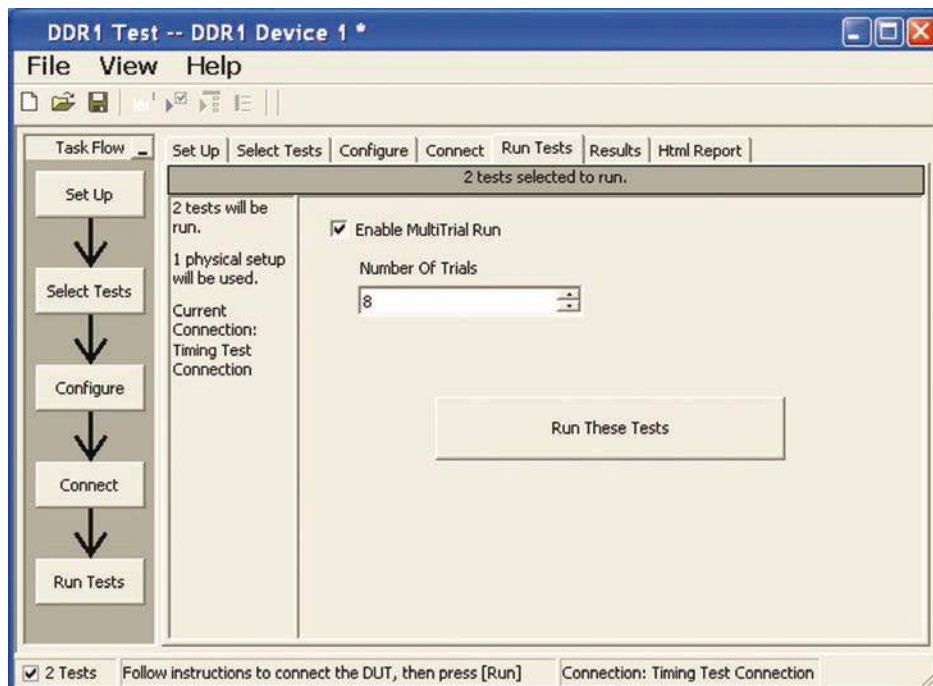


Figure 4. The Repetitive Run feature allows you to run the selected tests until the stop condition is met. It allows you to extensively test the performance of your device.

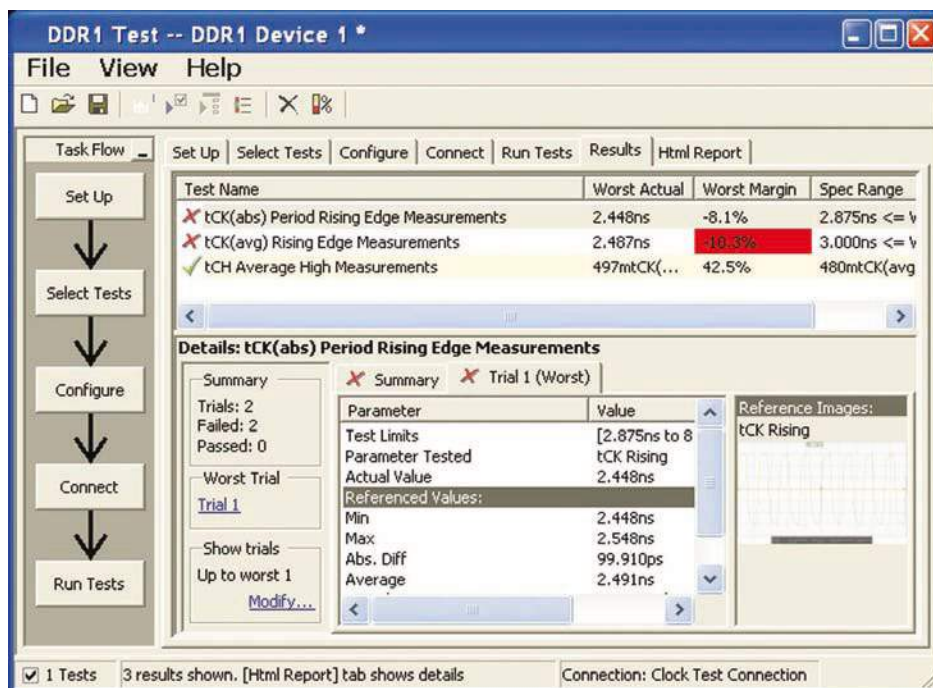


Figure 5. The DDR1 test application documents your test parameters, pass or fail status, test specification range, measured values and the pass/fail margin.

Thorough Performance Reporting

The DDR1 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.

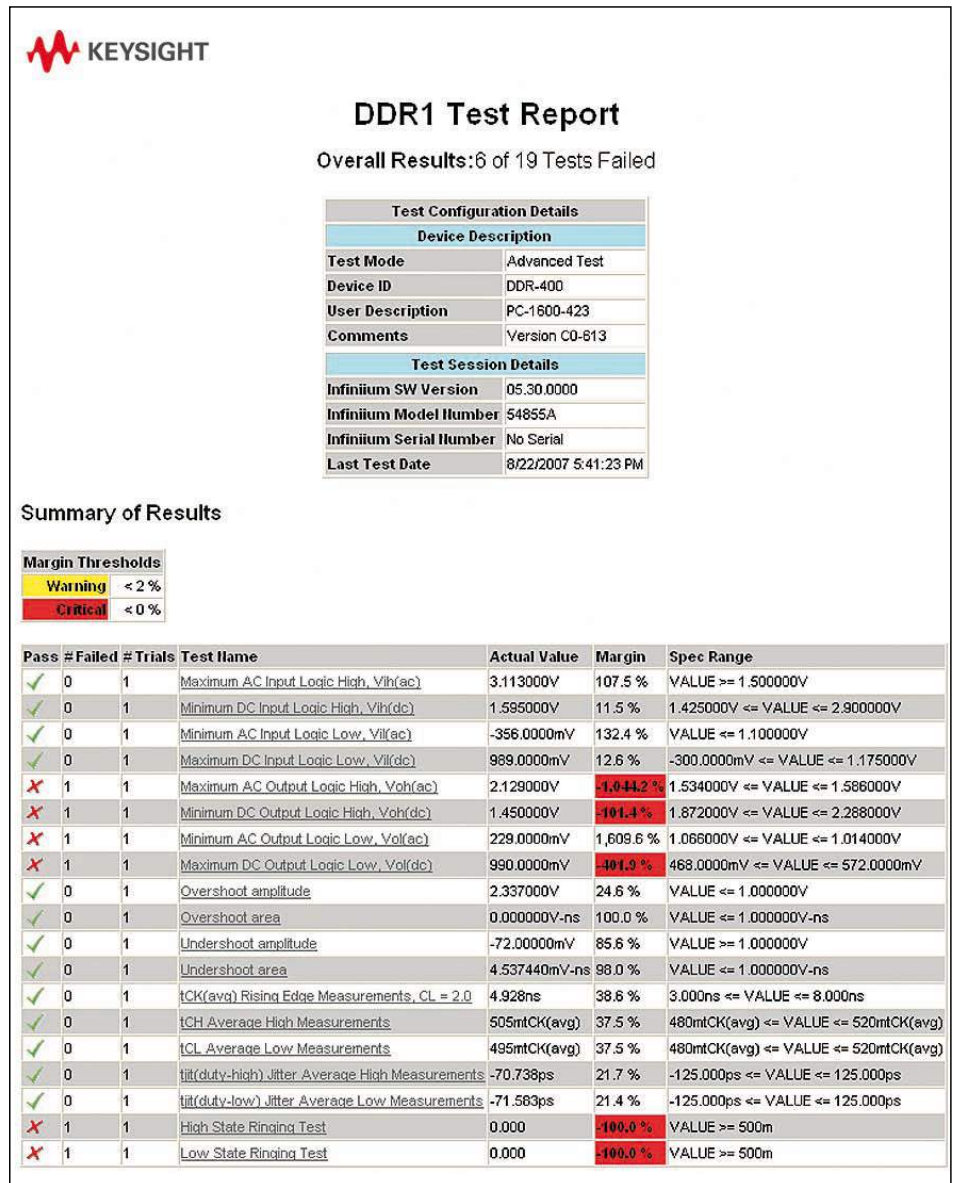


Figure 6. The DDR1 test application generates a summary report where you can see your device's test results quickly and clearly. Details are available for each test including the test limits, test description and test results, including saved waveforms. In addition, the pass/fail margin is indicated 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. 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

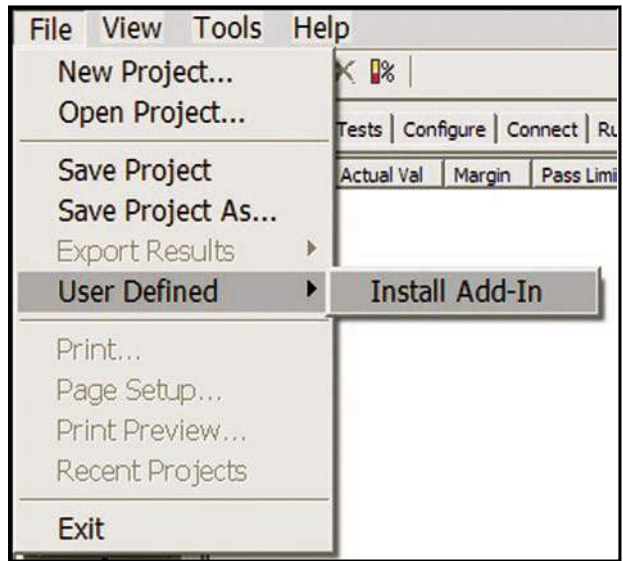


Figure 7. Importing a UDA Add-In into your test application.

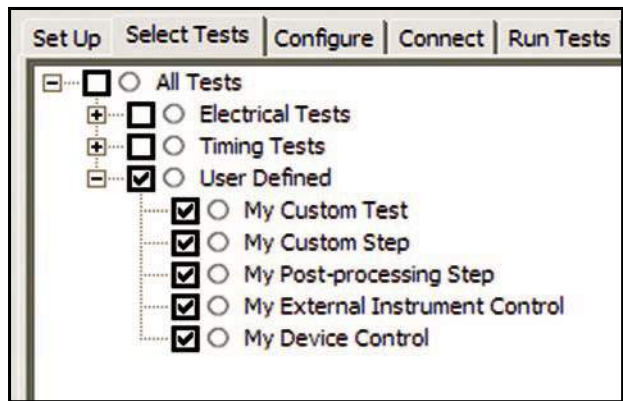


Figure 8. UDA Add-In tests and utilities in your test application.

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). 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.

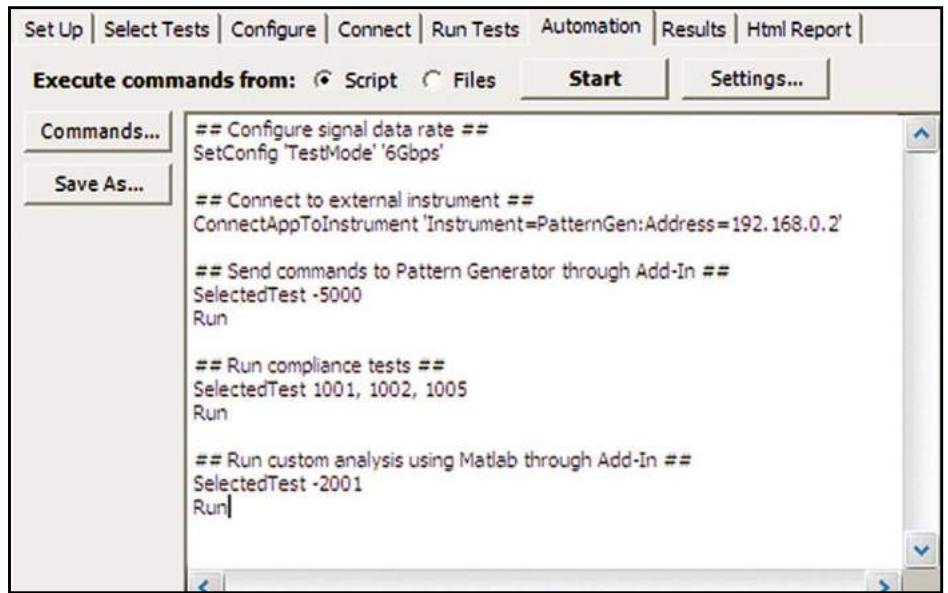


Figure 9. Remote Programming script in the Automation tab.

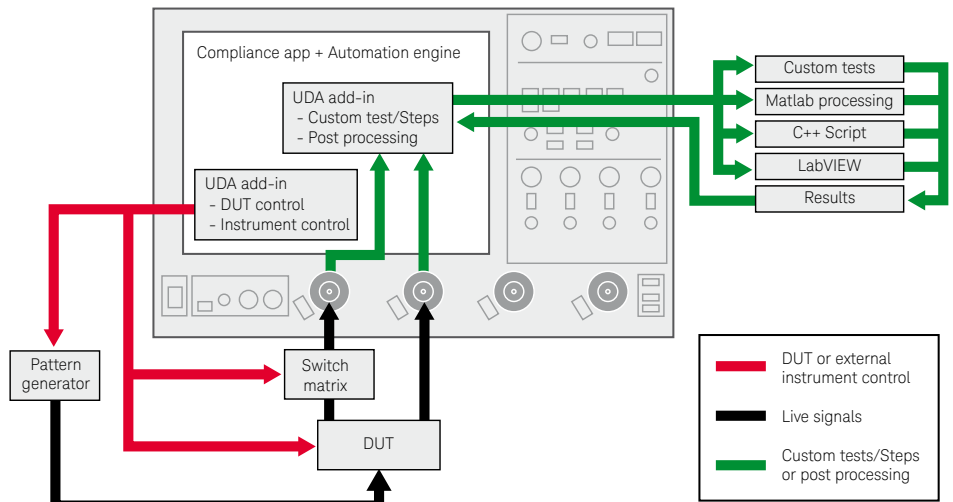


Figure 10. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

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.

Test performed

The Keysight DDR1 compliance test application covers clock, electrical and timing parameters of the JEDEC JESD79E DDR SDRAM Specifications and JESD209A Low Power Double Data Rate (LPDDR) SDRAM Specifications. The application helps you test all DDR1 devices for compliance, using a Keysight 9000 or 90000 Series Infiniium oscilloscope.

In addition, the test application's Advanced Debug 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.

Table 1. JEDEC tests covered by the U7233A test application

| Specification | Speed supported | | | |
|--|-----------------|---------|---------|---------|
| | DDR-200 | DDR-266 | DDR-333 | DDR-400 |
| AC and DC input measurement levels | | | | |
| Table 6 (JESD79E – AC Electrical Characteristics and DC Operating Conditions (page 51) | x | x | x | x |
| Table 7 (JESD79E) – AC Operating Conditions (page 52) | x | x | x | x |
| Table 8 (JESD79E) – Low Power DDR SDRAM Electrical Characteristics (page 52) | x | x | x | x |
| Table 13 (JESD79E) – Input Slew Rate for DQ, DQS and DM (page 60) | x | x | x | x |
| Table 15 (JESD209A) – Output Slew Rate Characteristics (page 63) | x | x | x | x |
| Table 16 (JESD209) – AC Overshoot/Undershoot Specification (page 63) | x | x | x | x |
| Table 20 (JESD79E) – AC Overshoot/Undershoot Specification for Address and Control Pins (page 61) | x | x | x | x |
| Table 21 (JESD79E) – Overshoot/Undershoot Specification for Data, Strobe, and Mask Pins (page 61) | x | x | x | x |
| Electrical characteristics and AC timing | | | | |
| Table 11 (JESD79E) – Electrical Characteristics and AC Timing Part A: DDR333, DDR266, DDR200 Devices (page 56) | x | x | x | |
| Table 11 (JESD79E) – Electrical Characteristics and AC Timing Part B: DDR400A, DDR400B, DDR400C (page 57) | | | | x |
| Table 12 (JESD79E) – AC Timing Variations for DDR333, DDR266 and DDR200 Devices (page 58) | x | x | x | |
| Table 14 (JESD209A) – AC Timing Variations for LPDDR Devices (page 59) | x | x | | |

Table 2. Advanced Debug feature covered by the U7233A test application

| Measurement items | Speed supported |
|--------------------------------------|-------------------|
| All JEDEC tests from compliance mode | User configurable |
| High/low state ringing test | User configurable |

Recommended Oscilloscopes

The DDR1 and LPDDR1 compliance software is compatible with Keysight Infiniium Series oscilloscopes with operating software revision 4.20 or higher. For oscilloscopes with earlier revisions, free upgrade software is available.

| Data rate | Minimum bandwidth | Minimum channels | Compatible oscilloscopes |
|----------------|-------------------|------------------|--|
| Up to 400 MT/s | 2 GHz | 3 | Infiniium 9000, 90000, S-Series and Z-Series |

Ordering Information

To purchase the DDR1 compliance test application, order the following:

Software Options

| Application | License type | | Infiniium Z-Series | Infiniium S-Series | Infiniium 9000 Series | Infiniium 9000 Series |
|---|--------------|-------------------|-----------------------|-----------------------|---------------------------|---------------------------|
| DDR1 and LPDDR1 compliance | Fixed | Factory-installed | U7233A-1FP | U7238B-1FP | Option 031 | Option 031 |
| | | User-installed | U7233A-1FP | U7233A-1FP | U7233A-1NL | U7233A-1NL |
| | Floating | Transportable | U7233A-1TP | U7233B-1TP | U7233A-1TP ^{1,2} | U7233B-1TP ^{1,2} |
| | | Server-based | | | N5435A-021 | |
| DDR compliance software bundle | Fixed | Factory-installed | N5459B-1FP | N5459C-1FP | - | - |
| | | User-installed | N5459B-1FP | N5459C-1FP | N5459B-1NL | N5459C-1NL |
| | Floating | Transportable | - | - | - | - |
| | | Server-based | | | - | |
| Serial data analysis software (included in DSA model) | Fixed | Factory-installed | E2688A-1FP | N5384A-1FP | Option 003 | Option 003 |
| | | User-installed | E2688A-1FP | N5384A-1FP | E2688A-1NL | N5384A-1NL |
| | Floating | Transportable | E2688A-1TP | N5384A-1TP | E2688A-1TP ^{1,2} | N5384A-1TP ^{1,2} |
| | | Server-based | | | N5435A-003 | |
| InfiniiScan | Fixed | Factory-installed | N5414B-1FP | N5415B-1FP | Option 009 | Option 009 |
| | | User-installed | N5414B-1FP | N5415B-1FP | N5414B-1FP | N5415B-1NL |
| | Floating | Transportable | N5414B-1TP | N5415B-1TP | 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, publication number 5990-8569EN.

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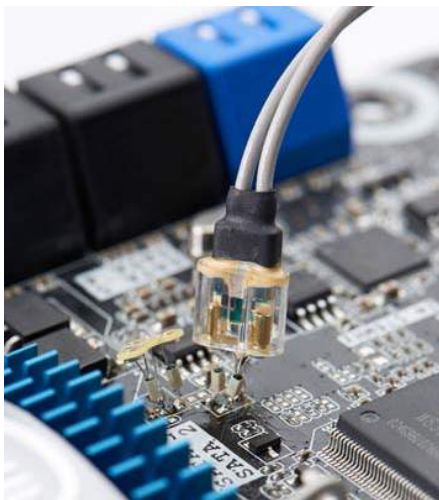


Ordering Information (Continued)

Probe accessories

InfiniiMax probe amplifiers

| Model number | Description |
|--------------|--|
| 1169A | 12-GHz differential probe amplifier |
| 1168A | 10-GHz differential probe amplifier |
| 1134A | 7-GHz differential probe amplifier |
| 1132A | 5-GHz differential probe amplifier |
| 1131A | 3.5-GHz differential probe amplifier |
| 1130A | 1.5-GHz differential probe amplifier |
| N2831A | 8-GHz InfiniiMax III+ probe amplifier |
| N2832A | 12-GHz InfiniiMax III+ probe amplifier |



Use InfiniiMax III+ probe amplifier with QuickTip head for quick and secure connection.

InfiniiMax probe heads

| Model number | Description |
|--------------|---|
| N5381A | InfiniiMax II 12-GHz differential solder-in probe head and accessories |
| N5382A | InfiniiMax II 12-GHz differential browser |
| E2677A | InfiniiMax 12-GHz differential solder-in probe head and accessories |
| E2675A | InfiniiMax 6-GHz differential browser probe head and accessories |
| N5425A | InfiniiMax 12-GHz ZIF probe head |
| N5426A | ZIF tips (x10) |
| N5451A | Long Wire ZIF tips (x10) |
| N2848A | InfiniiMax III QuickTip head |
| N2849A | InfiniiMax III QuickTip tips (4 per kit) |
| E2678A | InfiniiMax 12-GHz differential socketed probe head and accessories |
| E261xA/B | Wedge Adapters to work with E2678A for probing DDR1 TSOP (3 to 8 signals) |
| E264xA | Wedge Adapters to work with E2678A for probing DDR1 TSOP (16 signals) |
| W2637A | x16 LPDDR BGA probes for oscilloscopes and logic analyzers |
| W2638A | x32 LPDDR BGA probes for oscilloscopes and logic analyzers |
| W2639A | LPDDR scope probe adapter |

Related Literature

| Publication title | Publication number |
|--|--------------------|
| <i>Infiniium Oscilloscope Probes and Accessories - Data Sheet</i> | 5968-7141EN |
| <i>E2688A, N5384A High-Speed Serial Data Analysis and Clock Recovery Software - Data Sheet</i> | 5989-0108EN |
| <i>EZJIT Plus Jitter Analysis Software for Infiniium Oscilloscopes - Data Sheet</i> | 5989-0109EN |
| <i>A Time-Saving Method for Analyzing Signal Integrity in DDR Memory Buses - Application Note</i> | 5989-6664EN |
| <i>Infiniium 90000 Series Oscilloscopes - Data Sheet</i> | 5989-7819EN |
| <i>W2637A, W2638A and W2639A LPDDR BGA Probes for Logic Analyzers and Oscilloscopes - Data Sheet</i> | 5990-3892EN |