

Keysight Technologies

# U7243A USB 3.0 Superspeed Electrical Performance Validation and Compliance Software for the Infiniium Series Oscilloscopes

Data Sheet



# Verify and debug your USB 3.0 designs more easily

Keysight Technologies, Inc. U7243A USB 3.0 validation and compliance software provides you with a fast and easy way to verify and debug your USB 3.0 products.

The USB 3.0 electrical test software allows you to automatically execute USB 3.0 electrical tests, and it displays the results in a flexible report format. In addition to the measurement data, the report provides a margin analysis that shows how closely your device passed or failed each test.

The U7243A USB 3.0 electrical test software utilizes the prescribed test methods and algorithms as defined in the USB 3.0 rev 1.0 specification and draft test specification.

By incorporating the USBIF SigTest utility the U7243A USB 3.0 electrical test software will provide you with consistent lab compliance test results with those generated at USBIF workshops or test labs that use the stand-alone USBIF SigTest tool for transmitter compliance verification. The advanced eye pattern and jitter analysis capabilities provided by the SDA electrical test option will allow product developers to quickly perform advanced eye and jitter analysis and debug to the jitter component level.

The USB 3.0 electrical performance validation and compliance software performs a wide range of electrical tests, including both normative and informative requirements, as per the USB 3.0 specification and the USB 3.0 electrical compliance test specification.

\* Note: The final USB 3.0 electrical test specification (rev 1.0) is not yet released. Test coverage and requirements are based on the rev 0.5 revision and will be updated when the final test specification is complete.

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## Features

The U7243A USB 3.0 electrical test software offers several features to simplify the validation of USB 3.0 designs:

- Automated 1M Unit Interval (or greater) testing for highest accuracy
- Results consistent with USBIF SigTest software utility
- Test setup wizard for ease-of-use
- Wide range of electrical tests
- USB 3.0 SigTest clock recovery algorithm
- Automated scope measurement setup
- Test results report generation
- Pass/fail margin analysis
- TP1 eye pattern compliance test mask
- TPO (transmitter) eye pattern test mask
- CTLE signal correction for TP1 tests

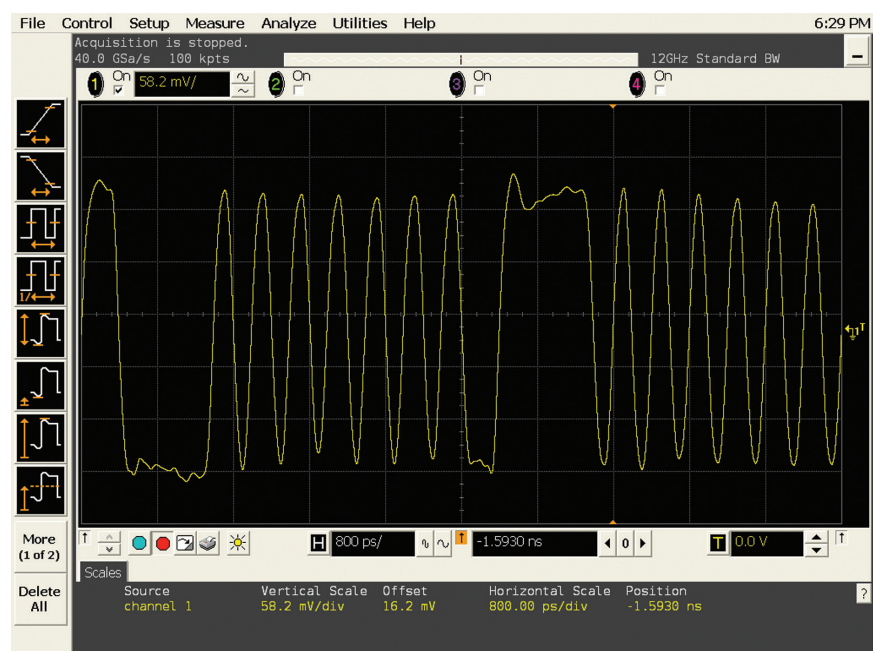
With the USB 3.0 electrical test software, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on the USBIF specified tests.

### USB 3.0 compliance testing

To pass signal quality testing at a USBIF-sponsored compliance workshop, your product must successfully pass “Gold Suite” testing, based on the USBIF SigTest application. The SigTest application tests your device against the minimum signal-quality performance requirements for USB 3.0. If you are developing receivers and transmitters for add-in boards and system motherboards, the USB 3.0 electrical test software helps you execute all the SigTest tests and additional oscilloscope already completed tests.

While SigTest tests provide a good overview of USB 3.0 electrical signal quality, they address only a small subset of the electrical compliance measurements specified in the USB 3.0. The SigTest application also provides minimal reporting capability with pass/fail indication and measurement values, and has limited debugging capabilities to decipher eye mask violations or excessive jitter. For USB 3.0 measurements, the U7243A software automatically calculates deterministic jitter and total jitter at 10-12 BER. Random jitter is also reported for completeness and a voltage margin “eye” diagram is included in the final HTML report. DJ and TJ values are specified in the USB 3.0 specification and are required for compliance verification.

USB 3.0 supports the data rate of 5.0 GT/s as shown above (~3.5 dB de-emphasis)



## Benefits

The U7243A USB 3.0 electrical test software saves you time by setting the stage for automatic execution of USB 3.0 electrical tests. Part of the difficulty of performing electrical tests for USB 3.0 is hooking up the oscilloscope, loading the proper setup files, and then analyzing the measured results by comparing them to limits published in the specification. The USB 3.0 electrical test software does much of this work for you. In addition, if you discover a problem with your device, robust debug tools are available to aid in root-cause analysis. These debug tools are provided by the Keysight E2688A high-speed serial data analysis software and N5400A EZJIT Plus jitter analysis software, which you must install on your oscilloscope to use the USB 3.0 electrical test software.

The U7243A USB 3.0 electrical test software offers many more electrical tests than the SigTest application. Unlike the SigTest application, the U7243A USB 3.0 electrical test software automatically configures the oscilloscope for each test, and it provides an informative results report that includes margin analysis indicating how close your product is to passing or failing a particular test assertion. Table 1 shows a side-by-side comparison of the capabilities of the USBIF SigTest application and the Keysight U7243A electrical test software.

| Capability  | Keysight U7243A                    | USB 3.0 SigTest               |
|---|------------------------------------|-------------------------------|
| Number of measurement assertions                          | 24                                 | 4                             |
| Automated oscilloscopes setup for each measurement        | Yes, guided                        | No, single setup              |
| Measurement results                                       | Pass/fail with margin analysis     | Pass/fail with measured value |
| USB 3.0 test specification based measurements methodology | Yes                                | Yes                           |
| Clock recovery method                                     | USBIF SigTest or 1st/2nd order PLL | USBIF SigTest                 |
| Custom HTML report generation                             | Yes                                | No                            |
| Selectable number of tests performed                      | Yes                                | No                            |
| Multi-trial run support                                   | Yes                                | No                            |
| Debug mode for “what if” analysis                         | Yes                                | No                            |

Table 1. Comparison of capabilities of the Keysight USB 3.0 electrical test software and the USB 3.0 SigTest application.



## Easy Test Definition

The U7243A USB 3.0 electrical test software extends the ease-of-use advantages of Keysight's Infiniium 90000 Series oscilloscopes to testing USB 3.0 designs. The Keysight automated test engine walks you quickly through the steps required to define the tests, set up the tests, perform the tests, and view the test results. You can select a category of tests all at once, or specify individual tests. You can save tests and configurations as project files and recall them later for quick testing and review of previous test results. Straightforward menus let you perform tests with a minimum of mouse clicks

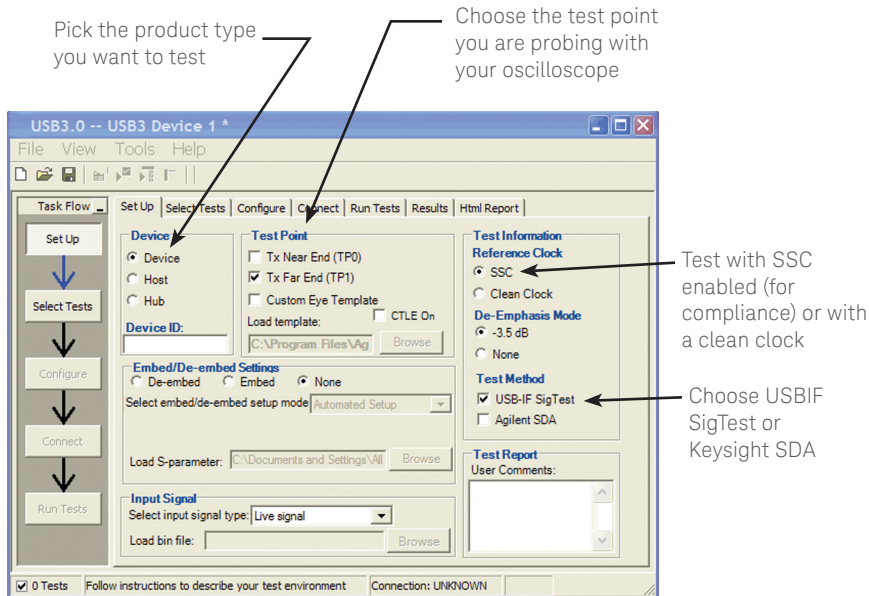


Figure 1. The Keysight U7243A allows you to easily specify the test point you want to use to test the compliance of your device. This makes test setup easy as only the appropriate tests for the test point you pick are shown on later test selection pages.

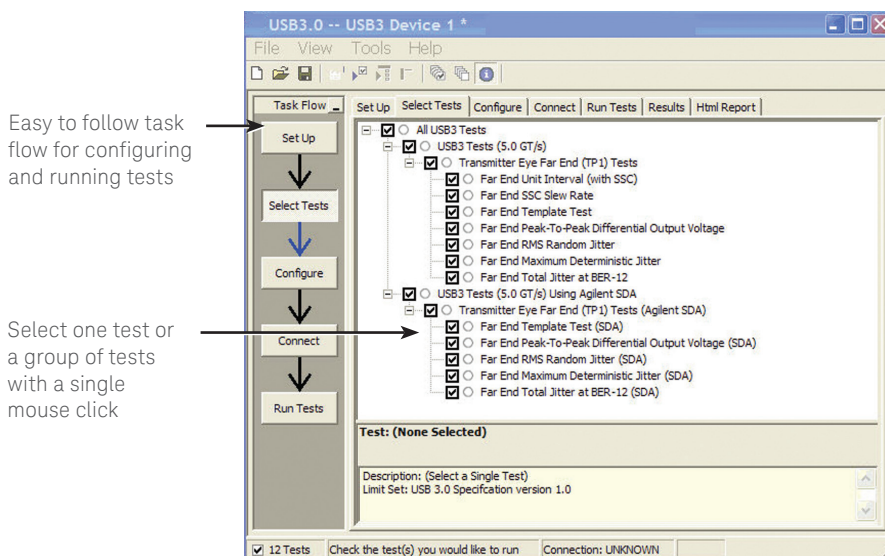


Figure 2. The Keysight automated test engine guides you quickly through selecting tests, configuring tests, setting up the connection, running the tests, and viewing the results. Individual tests or groups of tests are easily selected with a mouse click.

# Configurability and Guided Connections

The U7243A USB 3.0 electrical test software provides flexibility in your test setup. It guides you to make connection changes with hookup diagrams when the tests you select require it.

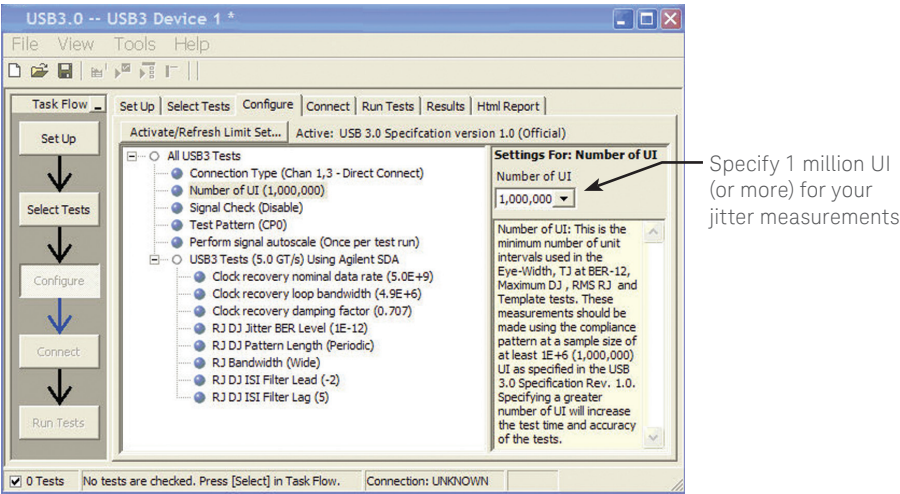


Figure 3. In configuring the tests, you specify the device to test, its configuration, and how the oscilloscope is connected.

If more than one test setup connection is required, you will be notified

You are prompted to make the appropriate connections for the set of tests

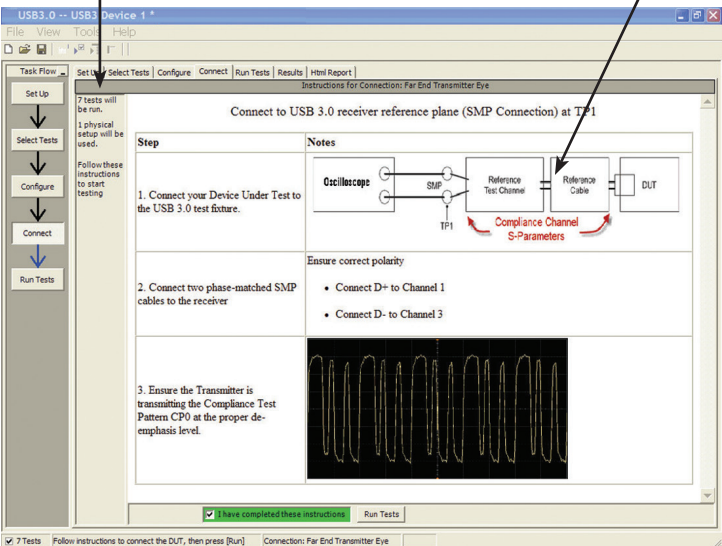


Figure 4. When you make multiple tests where the connections must be changed, you are prompted with connection diagrams and/or photographs.

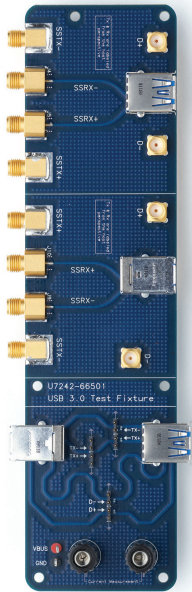


Figure 5. The Keysight U7242A USB 3.0 transmitter and receiver compliance test fixture.

# Reports with Margin Analysis

In addition to providing you with measurement results, the U7243A USB 3.0 electrical test software provides a report format that shows you not only where your product passes or fails, but also reports how close you are to the limits specified for a particular test as-assertion. You can select the margin test report parameter, which means you can specify the level at which warnings are issued to alert you to electrical tests where your product is operating close to the official test limit defined by the USB 3.0 specification.

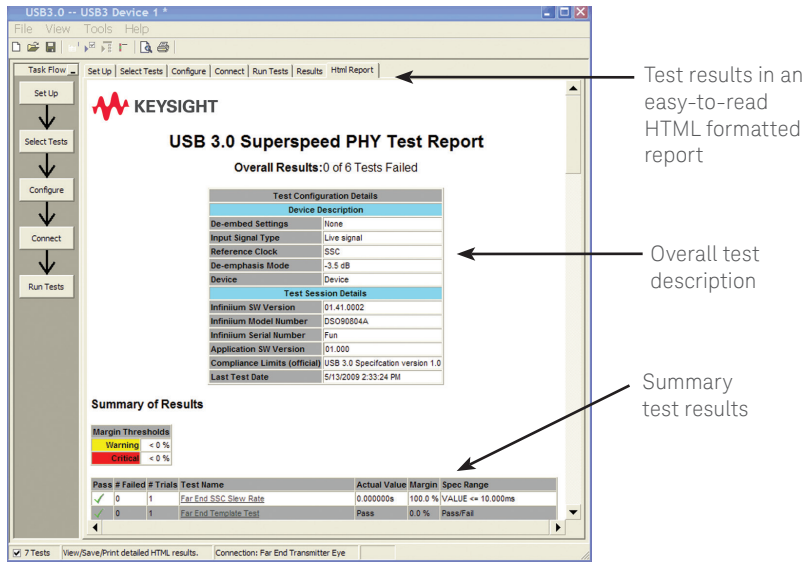


Figure 6. The USB 3.0 electrical test software results report documents your test, indicates the pass/fail status, the test specification range, the measured values, and shows how much margin you have.

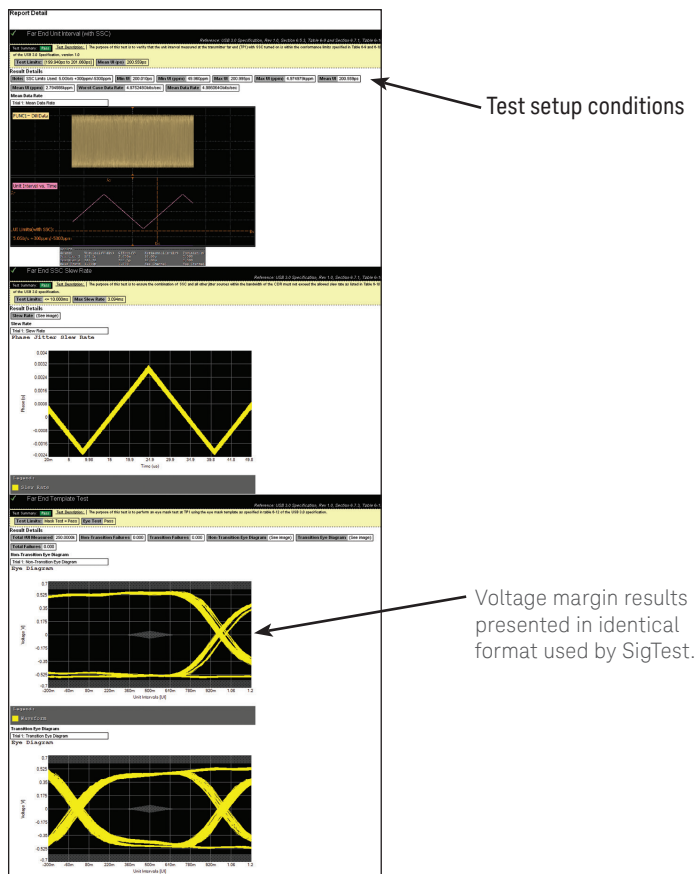
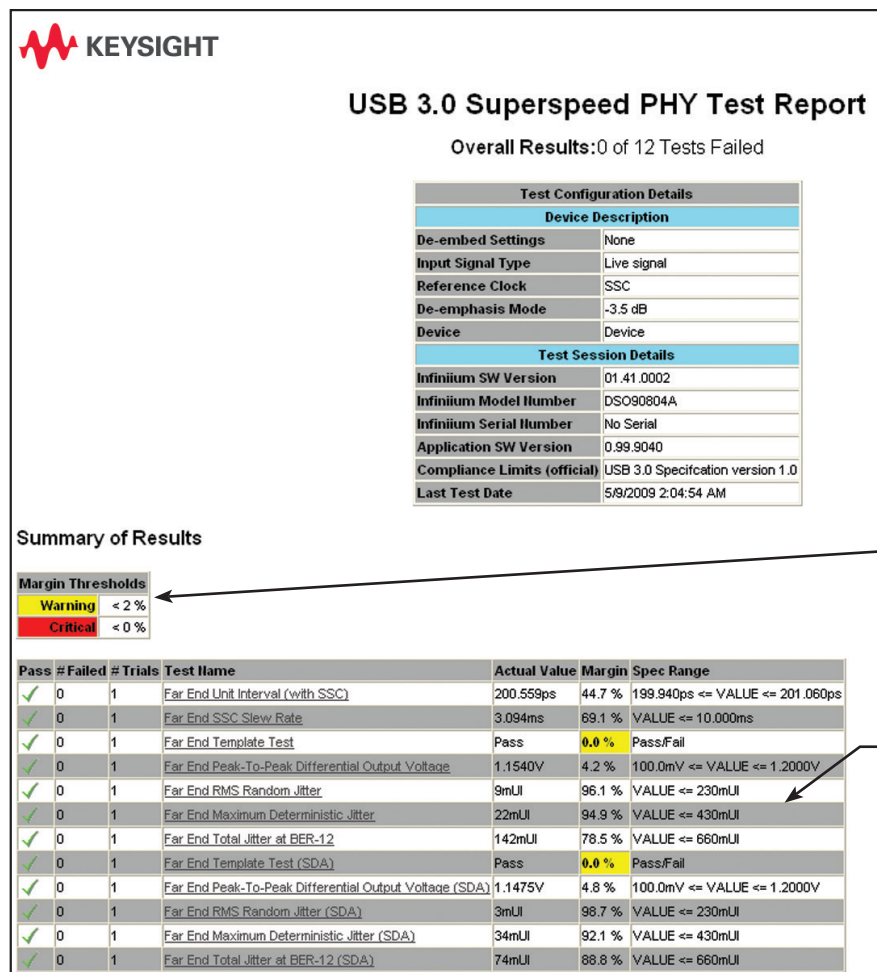


Figure 7. The HTML report provides additional details including test setup conditions, graphical results, and test limits (where appropriate).

## Reports with Margin Analysis (continued)



User set margin thresholds for warning and failure indicators

Margin values indicate when the results are approaching test limits. Warnings and failures are highlighted.

Figure 8. How close you are to passing or failing a test is indicated as a % in the margin field. A result highlighted in yellow or red indicates that the margin threshold level for a warning or failure was detected.

## Extensibility

You may add additional custom tests or steps to your application using the N5467A User Defined Application (UDA) development tool ([www.keysight.com/find/uda](http://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

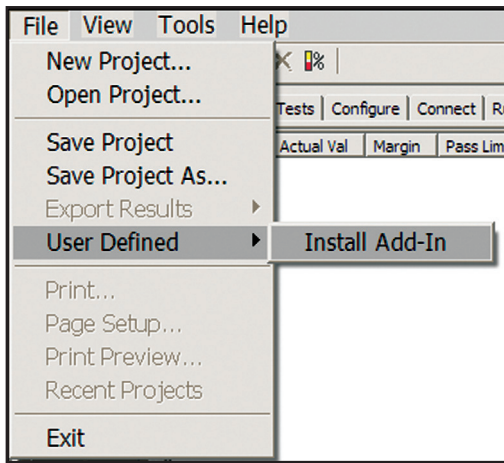


Figure 9. Importing a UDA Add-In into your test application.

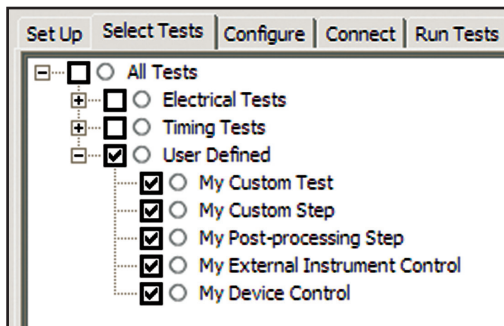


Figure 10. UDA Add-In tests and utilities in your test application.



## 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](http://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.

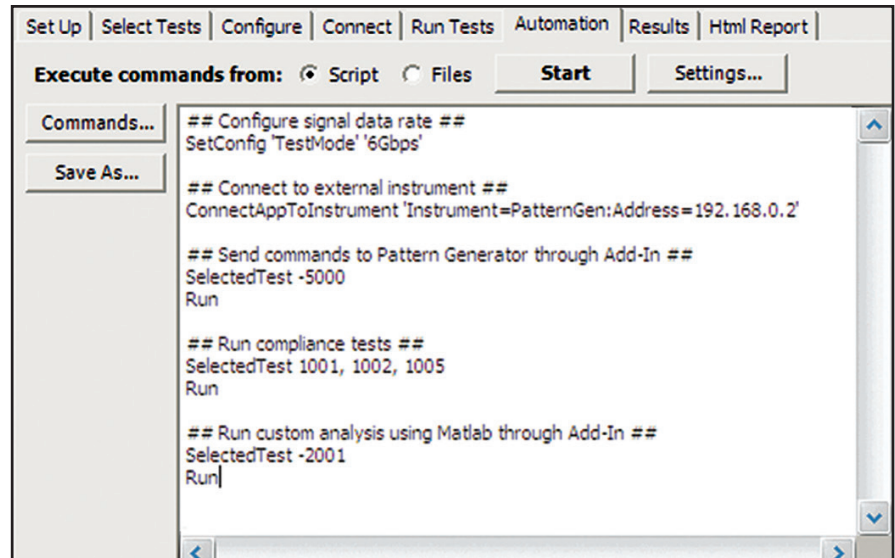


Figure 11. Remote Programming script in the Automation tab.

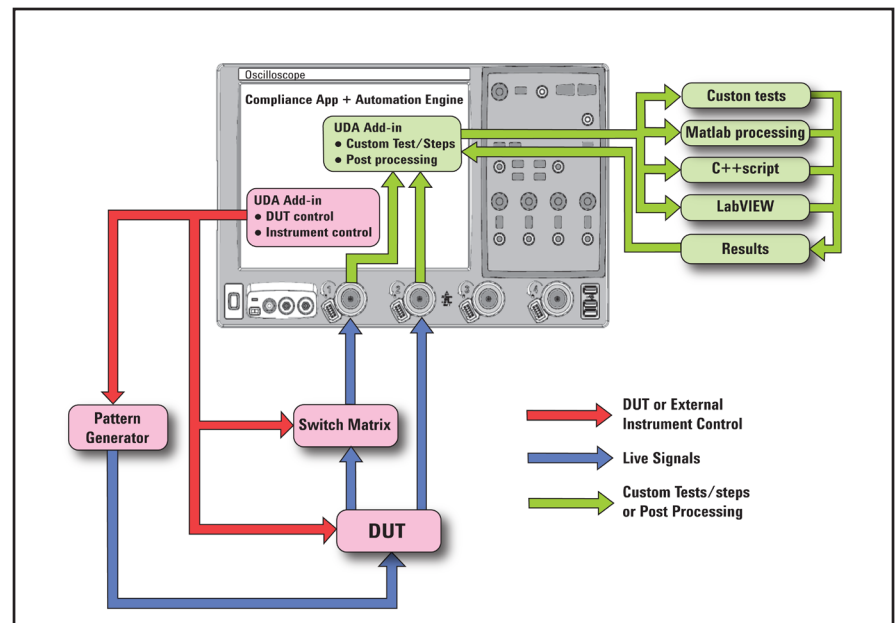


Figure 12. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

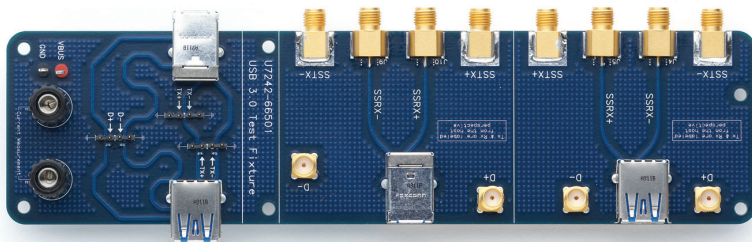
## Keysight U7242A USB 3.0 Electrical Test Fixture

The U7242A USB 3.0 transmitter and receiver fixture key specifications:

- Provides test point access for transmitter measurements
- Single-ended measurements as required by the USB 3.0 specification for transmitter and receiver validation and compliance testing
- Differential measurements of active bus transaction for debug and verification testing
- USB 2.0 power probing features for easy measurement of transient and steady state power states

### Description:

The U7242A USB 3.0 test fixture will help simplify the USB 3.0 measurement process by providing access to the transmitter and receiver measurement points required for USB 3.0 compliance testing. It has been designed for direct SMA connections for easy and accurate measurements with direct connections to the oscilloscope and J-Bert SMA connections. It also includes probing connections for InfiniiMax active differential probes for the characterization and testing of active bus signaling of USB 3.0 and USB 2.0 traffic.





# Powerful Debugging Aids

If your device fails a test, you need to determine how it failed. To use U7243A USB 3.0 electrical test software advanced debug capabilities you must install Keysight E2688A high-speed serial data analysis software and the N5400A EZJIT Plus jitter analysis software options. These tools provide you with many additional powerful debugging capabilities including advanced eye mask testing, eye unfolding capabilities, customizable PLL response testing and advanced jitter histograms with jitter decomposition. The 8b/10b decoding feature lets you identify data-dependent errors that result in eye mask violations caused by intersymbol interference (ISI). You can perform 8b/10b decoding to capture and display serial data synchronized with the analog view of a serial data stream.

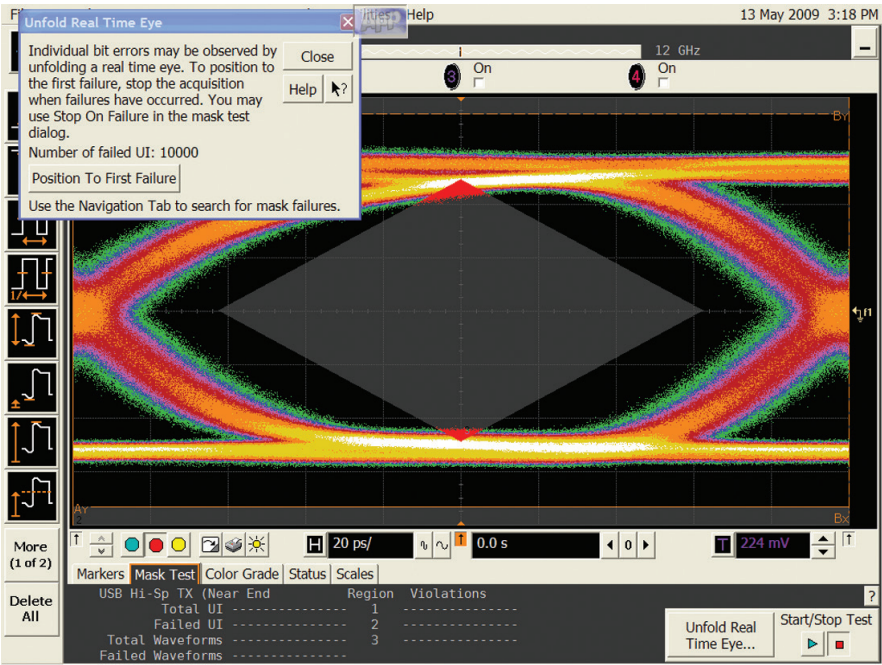


Figure 13. The E2688A serial data analysis tool allows you to analyze the performance of your device with custom PLL response settings to allow for deep analysis of transmitter jitter components and receiver characteristics.

## Powerful Debugging Aids (continued)

Using the E2688A Serial Data Analysis tool you can use the mask test feature to identify the specific digital patterns that caused a specific failure in the eye diagram when testing under the USB 3.0 specification. You can use a modified second order PLL for deep jitter analysis and characterization of what the eye quality would be for your specific receiver PLL response.

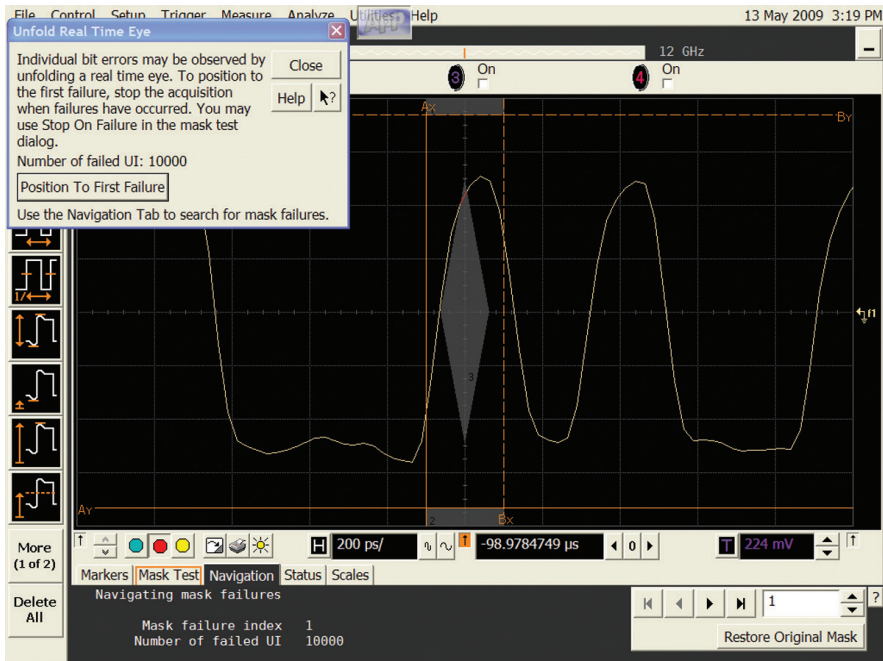


Figure 14. The E2688A SDA software allows you to show the specific waveform that caused the eye diagram failure.

# Powerful Debugging Aids (continued)

The Keysight N5400A EZJIT Plus jitter analysis software is used when the SDA signal quality test option is selected. This powerful jitter analysis software provides advanced validation and debug capabilities to quickly look at various jitter components of your signal. It provides real-time jitter trend, histogram and spectrum displays with composite histograms showing the various jitter subcomponents and distribution.

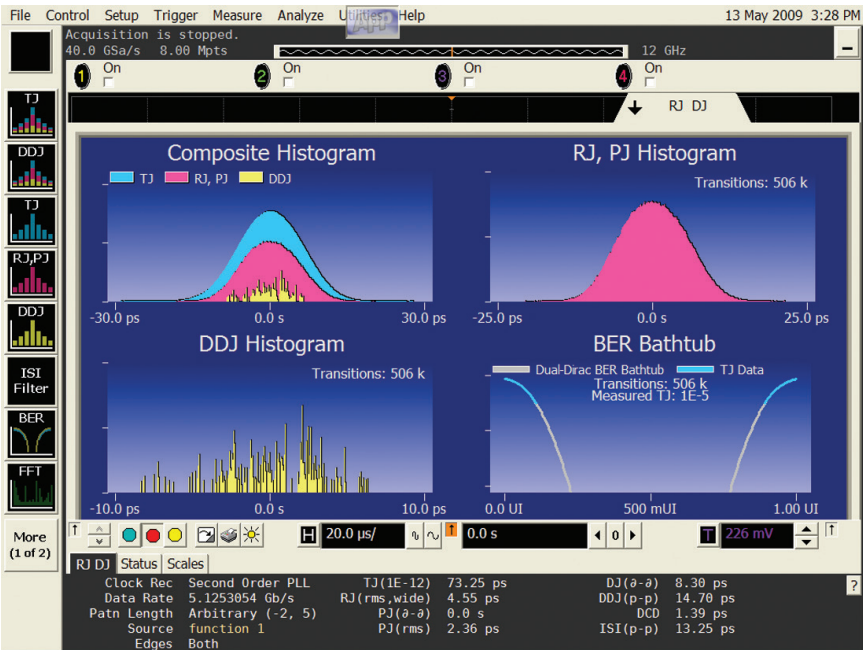


Figure 15. N5400A EZJIT Plus 4-in-1 jitter measurement results display for multiple views of jitter populations and distributions.

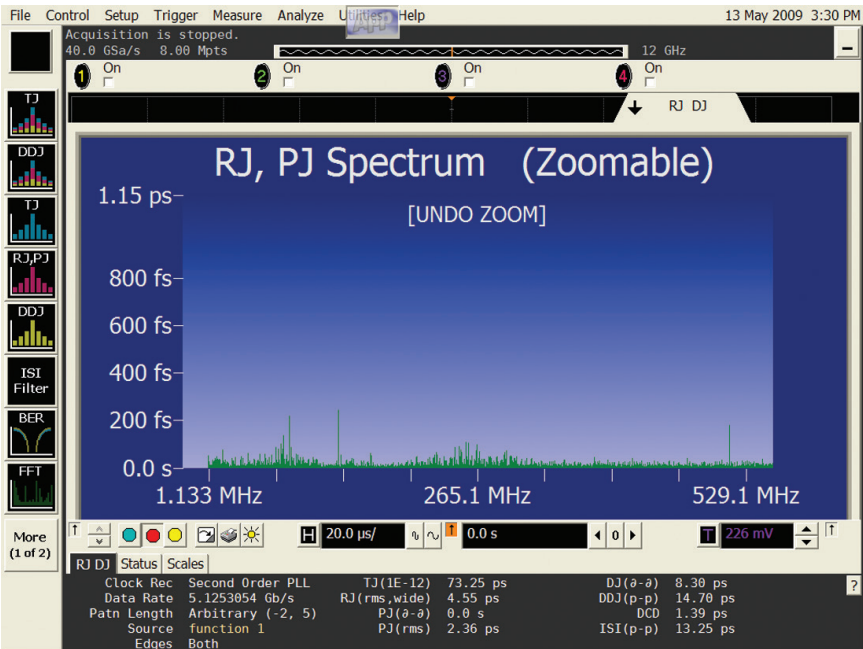


Figure 16. RJ, PJ spectrum provides additional insight into jitter component frequencies and amplitudes.

## Oscilloscope Compatibility

The U7243A USB 3.0 electrical performance validation and compliance software is compatible with Keysight DSO/DSA 90000 Series oscilloscopes with operating system software revision 1.40.0002. The Keysight U7243A tool is also compatible with Keysight 80000 Series oscilloscopes with operating software revision A.05.71 or higher. To use the advanced eye and jitter analysis option, you must also install Keysight E2688A high-speed serial data analysis software and the N5400A EZJIT Plus jitter analysis software. For oscilloscopes with earlier software revisions, free upgrade software is available at: [www.keysight.com/find/infiniium\\_software](http://www.keysight.com/find/infiniium_software)

| Data rate | Recommended oscilloscopes | Bandwidth of recommended oscilloscope |
|-----------|---------------------------|---------------------------------------|
| 5.0 Gb/s  | DSO91304A*                | 13 GHz                                |
|           | DSO91204A                 | 12 GHz                                |
|           | DSO81304A                 | 13 GHz                                |
|           | DSO81204A                 | 12 GHz                                |

\*DSA model equivalents are also compatible

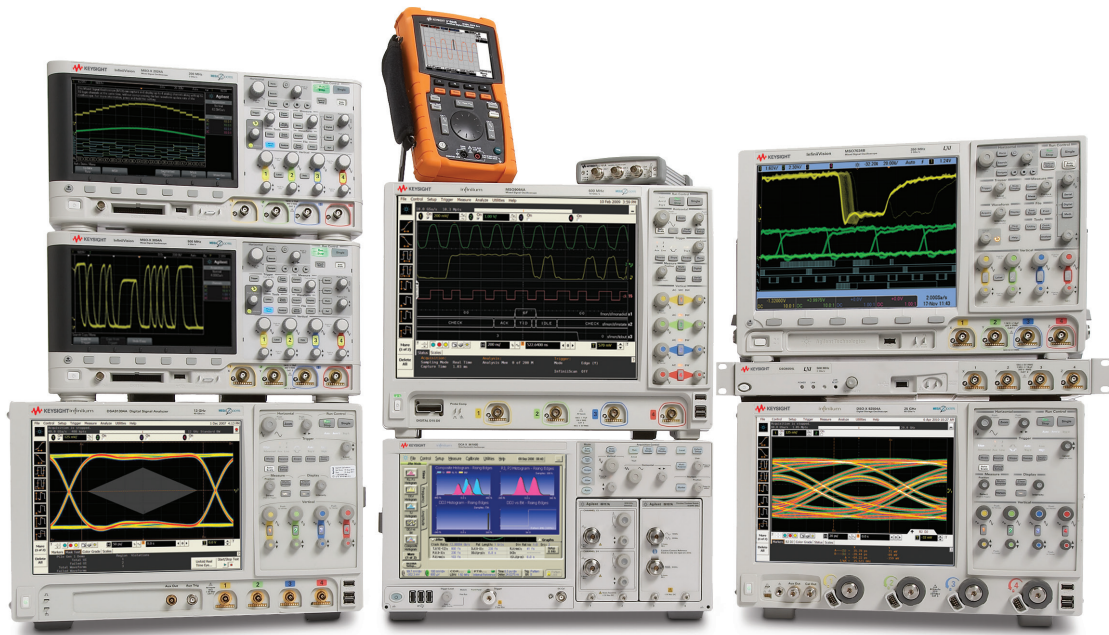
## Ordering Information

To purchase a new license for the USB 3.0 electrical performance validation and compliance software with an Infiniium Series oscilloscope, please order the following:

| Model number      | Description  |
|-------------------|--|
| U7243A Option 001 | USB 3.0 Electrical Test software for Infiniium 90000 Series and 80000 Series oscilloscopes |

## Related literature

| Publication title  | Publication type | Publication number |
|--|------------------|--------------------|
| <i>Infiniium 90000 Series Oscilloscopes</i>  | Data sheet       | 5989-7819EN        |
| <i>E2688A, N5384A High-Speed Serial Data Analysis with Clock Recovery Software for Infiniium Oscilloscopes</i> | Data sheet       | 5989-0108EN        |
| <i>The USB 3.0 Transmitter and Receiver Test Fixture</i>   | Data sheet       | 5990-4118EN        |
| <i>EZJIT and EZJIT Plus Jitter Analysis Software for Infiniium Series Oscilloscopes</i>                        | Data sheet       | 5989-0109EN        |



## Keysight Technologies Oscilloscopes

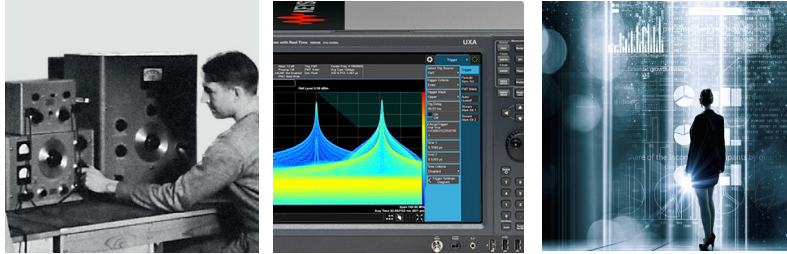
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