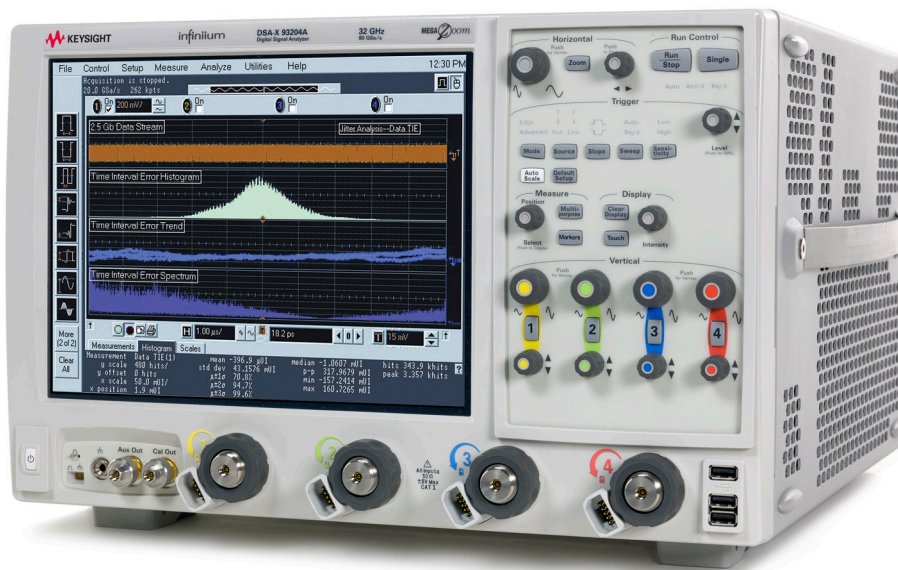# Keysight U7243B USB 3.0/3.1

Superspeed Electrical Performance Validation and Compliance Software

for the Infiniium Series Oscilloscopes

Data Sheet

KEYSIGHT
TECHNOLOGIES

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Verify and debug your USB 3.1 designs more easily

Keysight Technologies Inc. U7243B USB 3.1 validation and compliance software provides you with a fast and easy way to verify and debug your USB 3.1 products.

The USB 3.1 electrical test software allows you to automatically execute USB 3.1 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 U7243B USB 3.1 electrical test software utilizes the prescribed test methods and algorithms as defined in the USB 3.1 rev 1.0 specification and draft test specification.

By incorporating the USBIF SigTest utility the U7243B USB 3.1 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 3.1 electrical performance validation and compliance software performs a wide range of electrical tests, including both normative and informative requirements, as per the USB 3.1 specification and the USB 3.1 electrical compliance test specification.

* Note: The final USB 3.1 electrical test specification (rev 1.0) is not yet released. Test coverage and requirements are based on an early draft test specification and will be updated when the final test specification is complete.

Features

The U7243B USB 3.1 electrical test software offers several features to simplify the validation of USB 3.1 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 3.1 SigTest clock recovery algorith
– Automated scope measurement setup
– Test results report generation
– Pass/fail margin analysis
– TP1 eye pattern compliance test mask
– Gen1 CTLE (5 Gbps) signal correction for TP1 tests
– Gen2 CTLE (10 Gbps) RX EQ transfer function computation

With the USB 3.1 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 3.1 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 3.1. If you are developing receivers and transmitters for add-in boards and system motherboards, the USB 3.1 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 3.1 electrical signal quality, they address only a small subset of the electrical compliance measurements specified in the USB 3.1. 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 3.1 measurements, the U7243B 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 3.1 specification and are required for compliance verification.

Benefits

U7243B benefits

The U7243B USB 3.1 electrical test software saves you time by setting the stage for automatic execution of USB 3.1 electrical tests. Part of the difficulty of performing electrical tests for USB 3.1 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 3.1 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. These tools are included in the USB 3.1 electrical test software for debug and analysis using the specific clock recovery parameters from the specification. If you need to change the settings, you will need the full versions installed on your scope.

The U7243B USB 3.1 electrical test software offers many more electrical tests than the SigTest application. Unlike the SigTest application, the U7243B USB 3.1 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 U7243B electrical test software.

Capability	Keysight U7243B	USB 3.1 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 3.1 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 3.1 electrical test software and the USB 3.1 SigTest application.

Easy Test Definition

The U7243B USB 3.1 electrical test software extends the ease-of-use advantages of Infiniium Series oscilloscopes to testing USB 3.1 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.
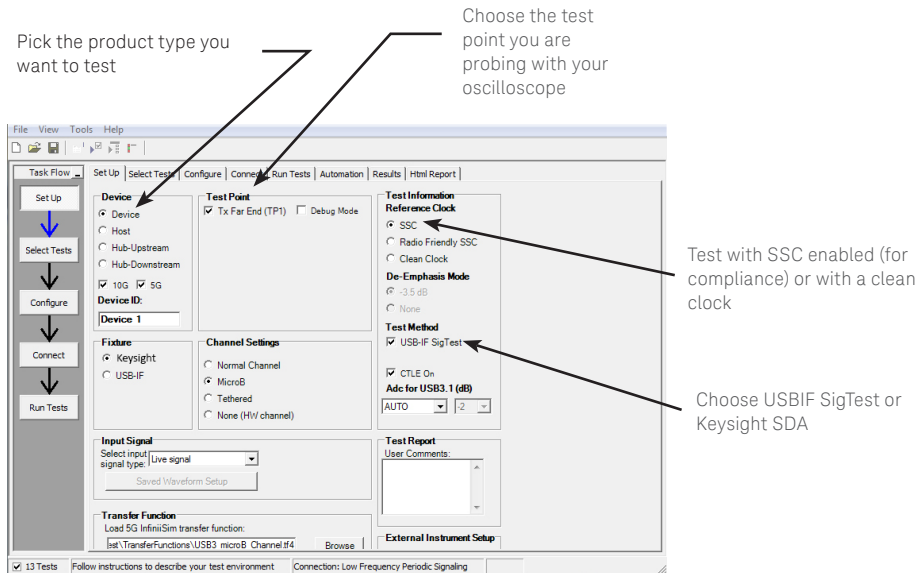

Figure 1. The Keysight U7243B allows you to easily specify the test point you want to use to test the compliance of your device. This makes test setup easy as only the appropriate tests for the test point you pick are shown on later test selection pages.
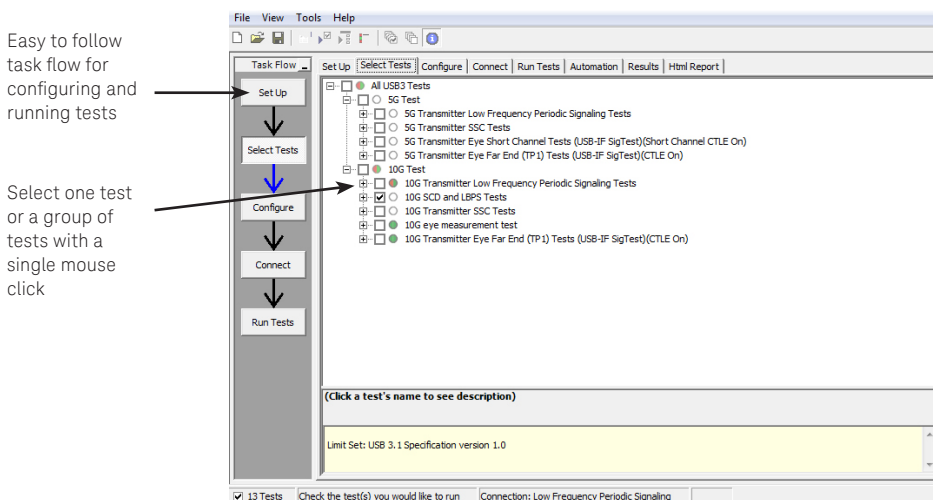

Figure 2. The Keysight automated test engine guides you quickly through selecting tests, configuring tests, setting up the connection, running the tests, and viewing the results. Individual tests or groups of tests are easily selected with a mouse click.

Configurability and Guided Connections

The U7243B USB 3.1 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.
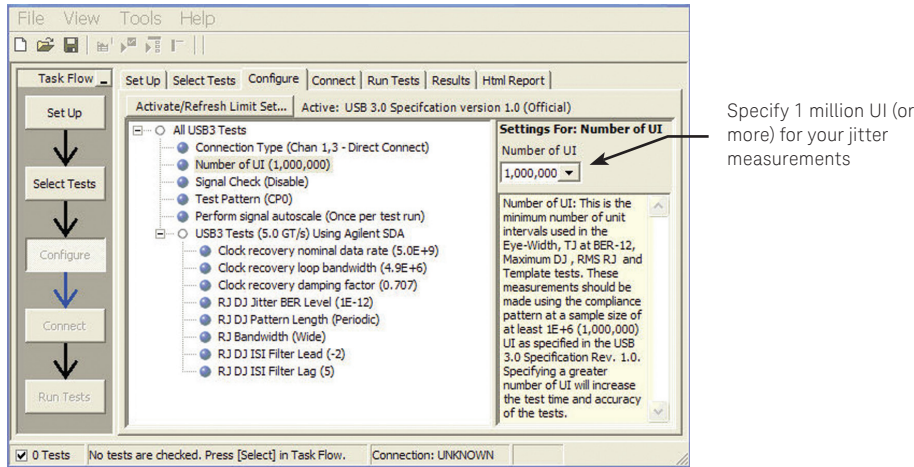

Specify 1 million UI (or more) for your jitter measurements

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

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

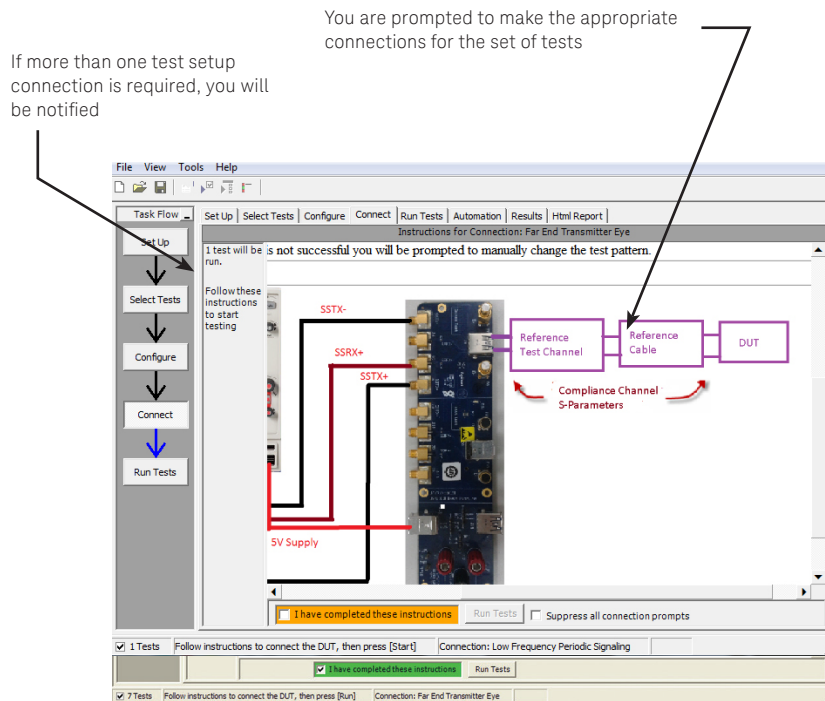If more than one test setup connection is required, you will be notified

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

Reports with Margin Analysis

In addition to providing you with measurement results, the U7243B USB 3.1 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 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 3.1 specification.

Test results in an easy-to-read HTML formatted report

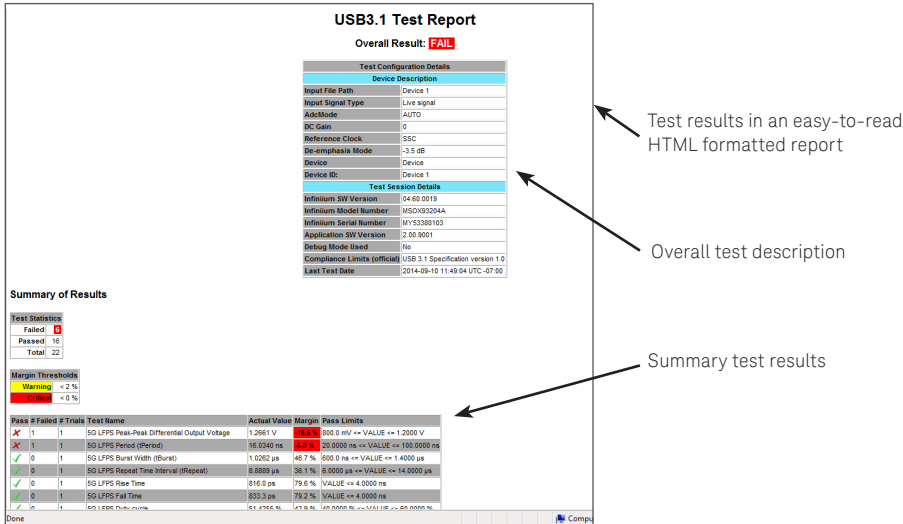Overall test description

Summary test results

Figure 5. The USB 3.1 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.
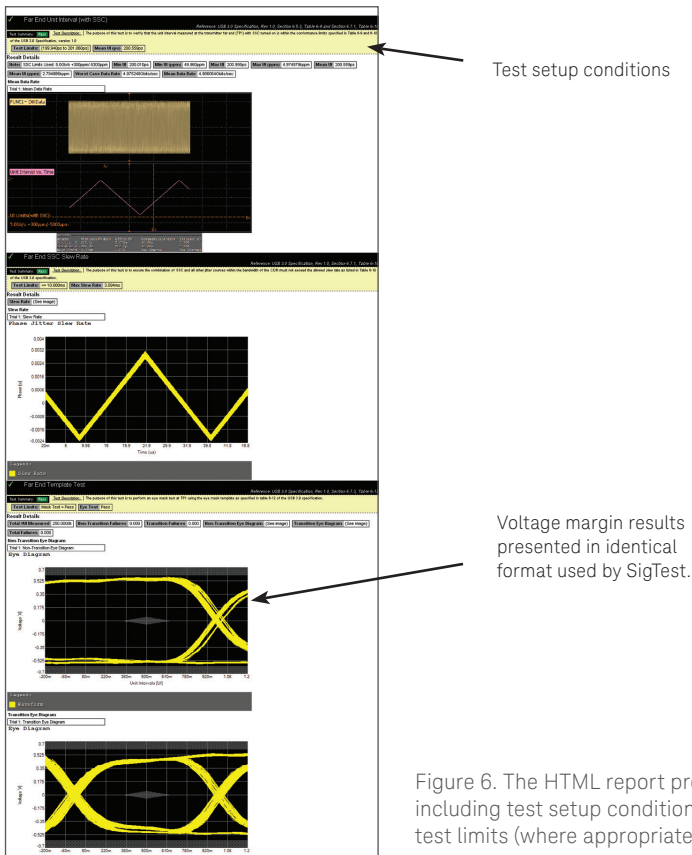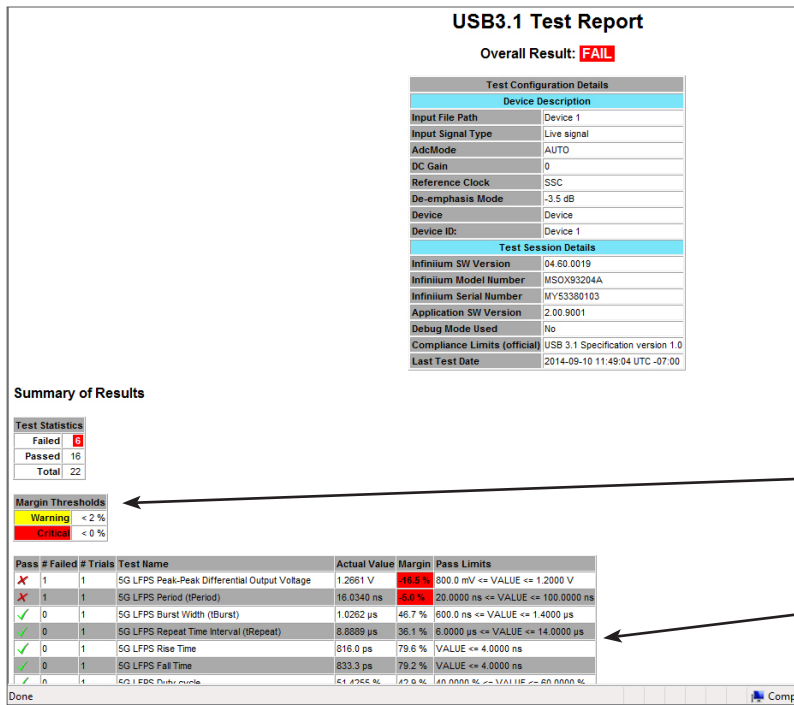

Test setup conditions

Voltage margin results presented in identical format used by SigTest.

Figure 6. 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 7. 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). 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
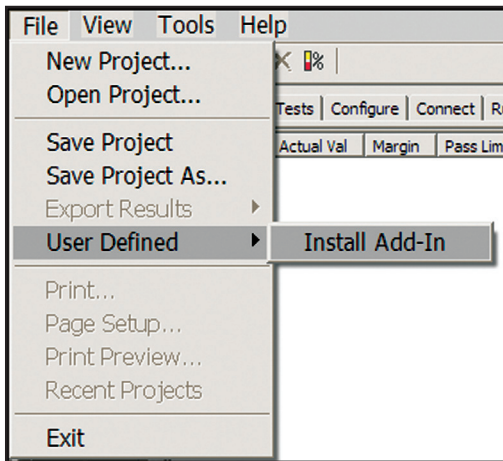

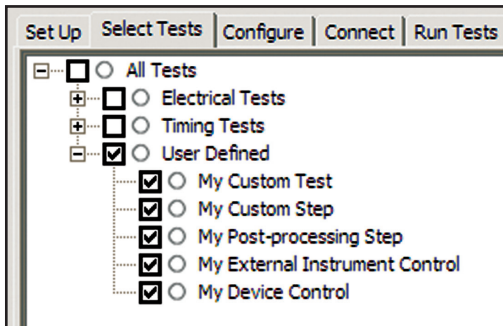Figure 8. Importing a UDA Add-In into your test application.

Figure 9. 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.
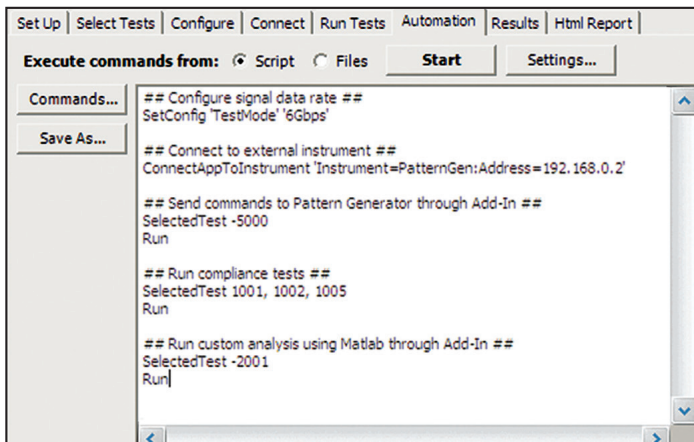

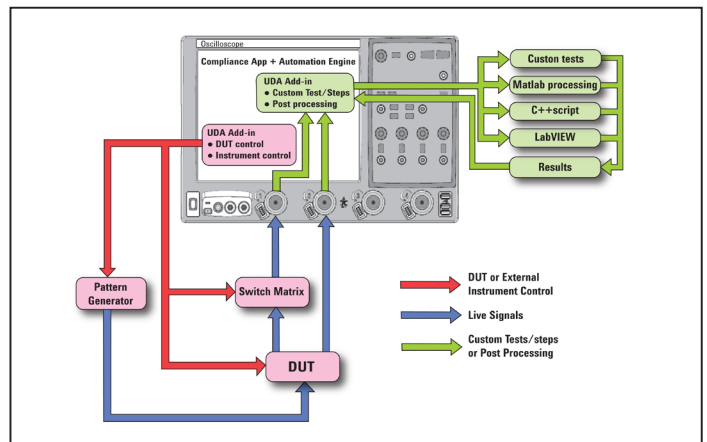
Figure 10.Remote Programming script in the Automation tab.

Figure 11. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Powerful Debugging Aids

If your device fails a test, you need to determine how it failed. To use U7243B USB 3.1 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.
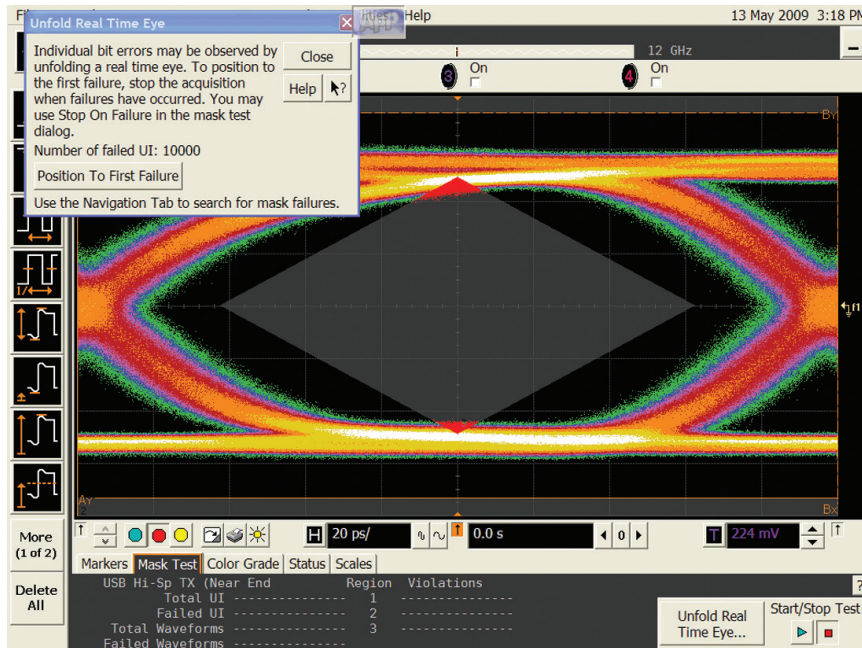

Figure 12. The E2688A serial data analysis tool allows you to analyze the performance of your device with custom PLL response settings to allow for deep analysis of transmitter jitter components and receiver characteristics.

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 3.1 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.
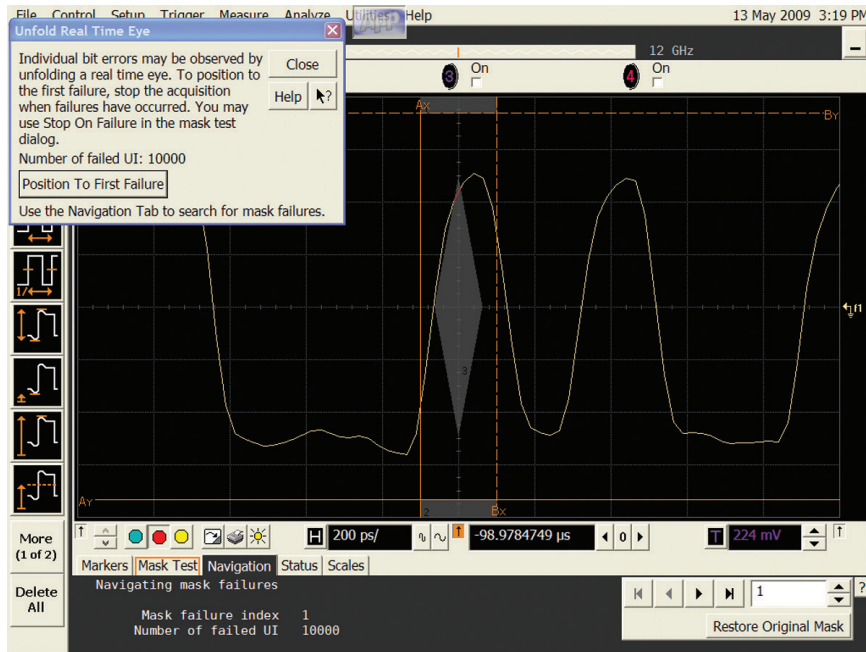

Figure 13. The E2688A SDA software allows you to show the specific waveform that caused the eye diagram failure.

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.
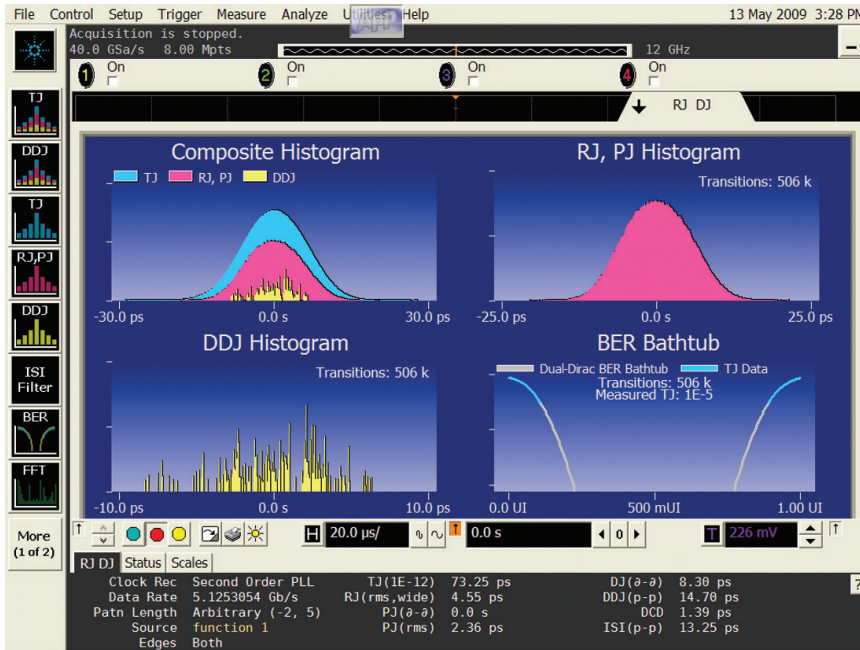

Figure 14. N5400A EZJIT Plus 4-in-1 jitter measurement results display for multiple views of jitter populations and distributions.
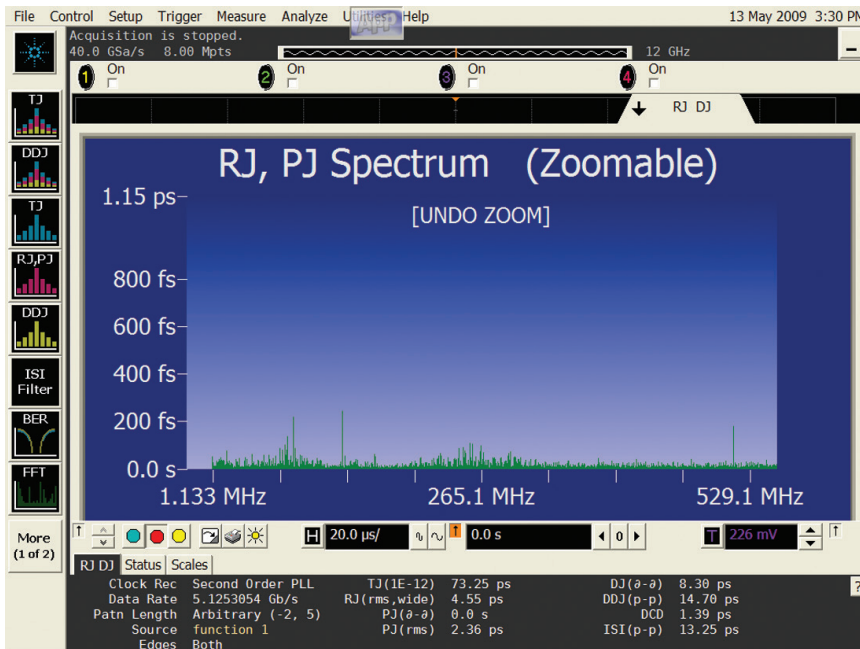

Figure 15. Rj, Pj spectrum provides additional insight into jitter component frequencies and amplitudes.

Recommended Oscilloscopes

The USB Electrical Performance Validation and Compliance (EPVC) software is compatible with Keysight Infiniium Series oscilloscopes with operating software revision 4.60 or higher. For oscilloscopes with earlier revisions, free upgrade software is available at: www.keysight.com/find/scope-apps-sw.

USB specification	Minimum bandwidth	Compatible oscilloscopes
USB 3.0/3.1	16 GHz	Infiniium 90000 X- and Z-Series
USB 3.0	13 GHz	Infiniium 90000A , 90000 X- and Z Series

Table 1. Recommended oscilloscopes. Bandwidth dependent on expected rise times. For rise times < 28 ps (10/90) consider >=20 GHz

Ordering Information

To purchase the USB software with a new or existing Infiniium Series oscilloscope, order the following options.

Compliance software options				
Application	License type		Infiniium Z-Series	Infiniium 90000 Series
EPVC software USB 3.0/3.1	Fixed	Factory-installed	U7243B-1FP	Option 081
		User-installed	U7243B -1FP	U7243B -1NL
	Floating	Transportable	U7243B -1TP	U7243B -1TP[1,2]
		Server-based	N5435A-075	
USB 3.1 EPVC software USB 3.1 upgrade	Fixed	Factory-installed	n/a	n/a
		User-installed	U7243B -2FP	U7243B -2NL
	Floating	Transportable	n/a	n/a
		Server-based	n/a	
USB 3.1 EPVC software USB 3.0 only	Fixed	Factory-installed	U7243B -3FP	Option 041
		User-installed	U7243B -3FP	U7243B -3NL
	Floating	Transportable	U7243B -3TP	U7243B -3TP[1,2]
		Server-based	N5435A-070	

Table 2.

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.

Required oscilloscope measurement software				
Application	License type		Infiniium Z-Series	Infiniium 90000 Series
EZJIT Plus jitter	Fixed	Factory-installed	N5400A-1FP	Option 004
		User-installed	N5400A-1FP	N5400A-1NL
	Floating	Transportable	N5400A-1TP	N5400A-1TP
		Server-based	N5435A-001	
Equalization	Fixed	Factory-installed	N5461A-1FP	Option 012
		User-installed	N5461A-1FP	N5461A-1NL
	Floating	Transportable	N5461A-1TP	N5461A-1TP
		Server-based	N5435A-025	
InfiniiSim (optional)	Fixed	Factory-installed	N5465A-1FP	Option 014
		User-installed	N5465A-1FP	N5465A-1NL
	Floating	Transportable	N5465A-1TP	N5465A-1TP
		Server-based	N5435A-027	

Table 3.

Cables and fixtures	
Model number	Description
U7242A	USB 3.0 test fixture
N4871A	3.5 mm cables phase matched +/- 5 ps
M8048A-801	2.92 mm cables phase matched +/- 5 ps

Table 4.

Related literature

Publication title	Publication type	Publication number
Infiniium 90000 Series Oscilloscopes	Data sheet	5989-7819EN
E2688A, N5384A High-Speed Serial Data Analysis with Clock Recovery Software for Infiniium Oscilloscopes	Data sheet	5989-0108EN
The USB 3.1 Transmitter and Receiver Test Fixture	Data sheet	5990-4118EN
EZJIT and EZJIT Plus Jitter Analysis Software for Infiniium Series Oscilloscopes	Data sheet	5989-0109EN
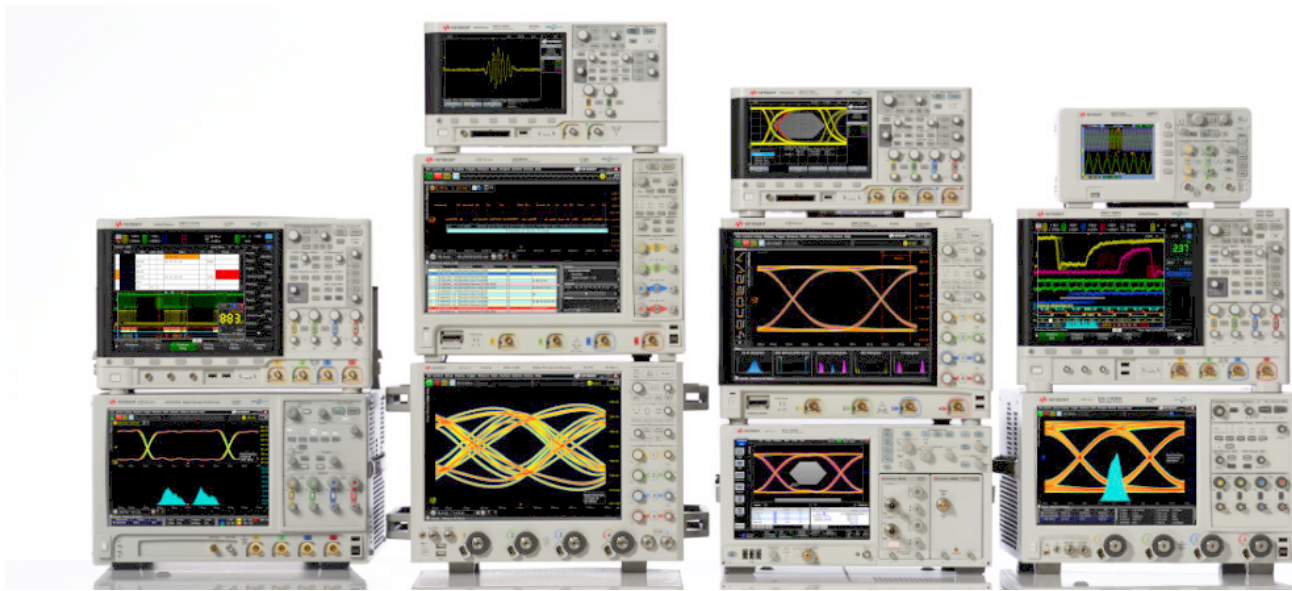
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