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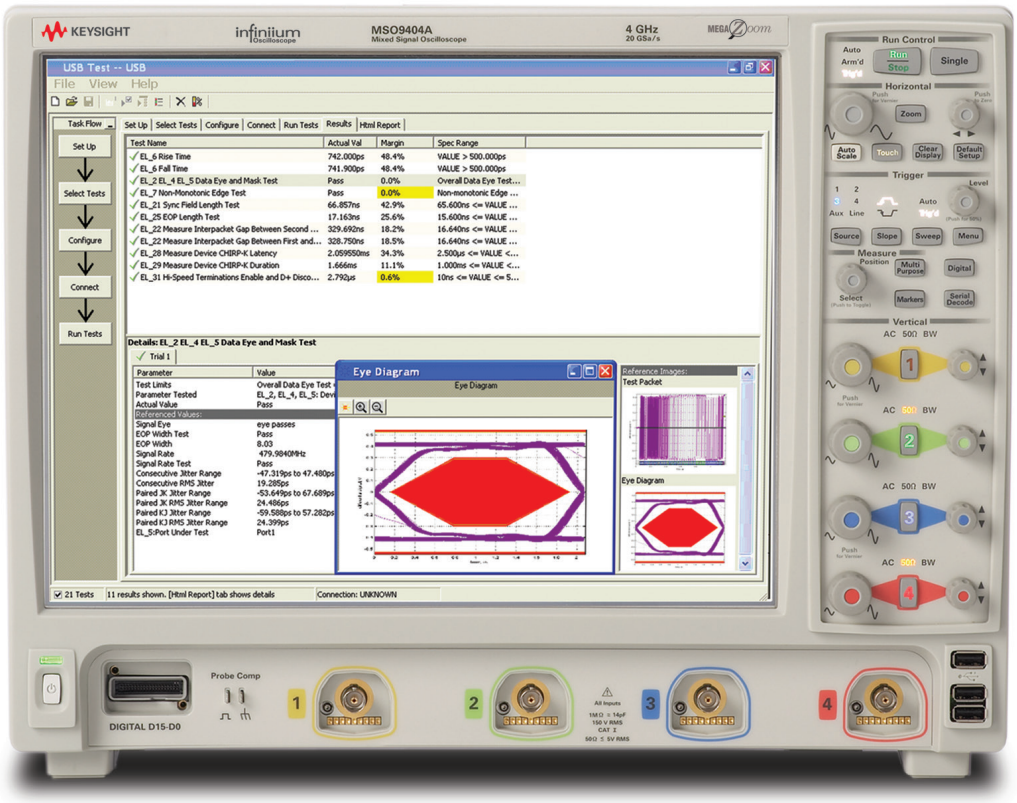
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Keysight N5416A and N5417A
USB Compliance Test Software for Infiniium Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Easily Verify USB Electrical Parameters

The N5416A USB compliance test software for Infiniium oscilloscopes gives you a fast and reliable way to verify USB electrical specification compliance for your USB 2.0 devices, hosts and hubs. The software executes the official USB-IF MATLAB scripts with MATLAB's runtime engine embedded in the oscilloscope.

- Easy-to-use interface for fast setup, configuration and automated test
- Recognized by the USB-IF for USB compliance testing
- Additional features: support for USB OTG (on-the-go) and multi-trial testing
- USB-IF MATLAB script execution inside the Infiniium oscilloscope
- Award-winning Infiniium ease of use
- Test fixtures for USB 1.1 (low- and full-speed), USB 2.0 (high-speed) and USB OTG compliance

With USB compliance test software, you can take the Infiniium oscilloscope you use for everyday debugging and use it to verify USB electrical parameters with the same testing scripts the USB-IF created for official compliance testing at designated workshops. The USB compliance test software has a new setup wizard that allows you to quickly and easily test all facets of electrical compliance of your device, host or hub. The setup wizard menu structure of the N5416A USB test option provides a level of simplicity not found with other vendors multi-tiered menu structures for executing tests and documenting results.

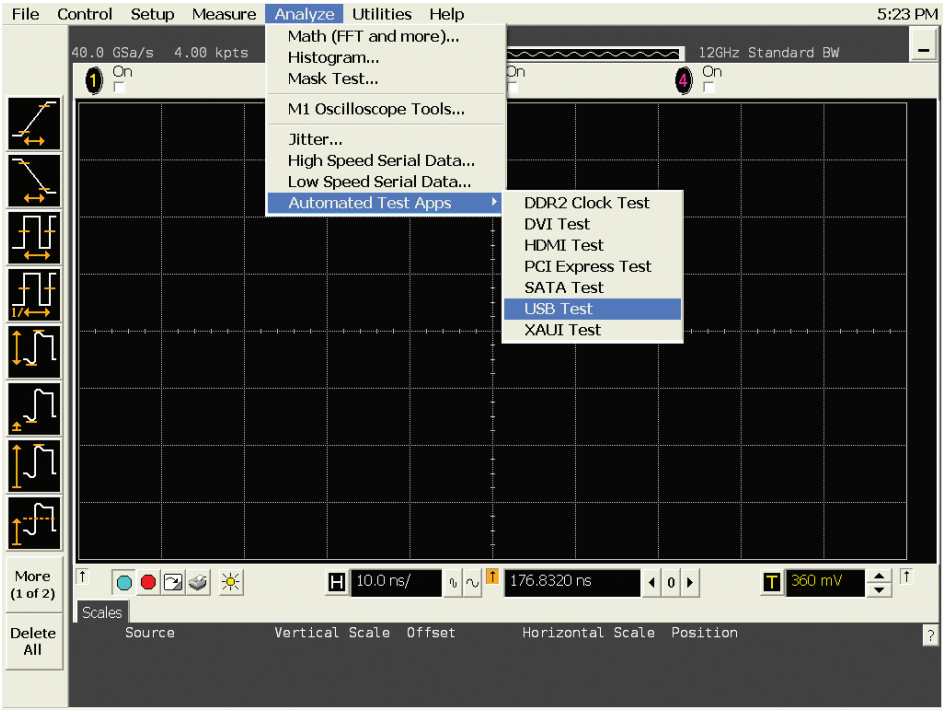


Figure 1. The Infiniium USB compliance tests are incorporated directly into the oscilloscopeís menu structure as a submenu under the Analyze menu.

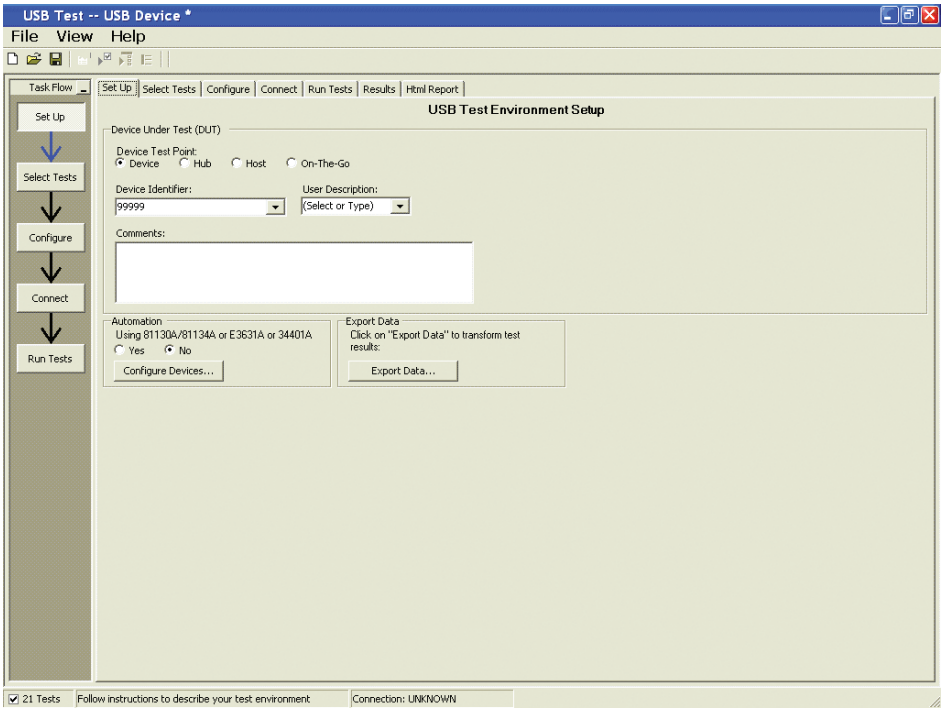


Figure 2. You can configure and launch the Infiniium USB compliance tests through a single window.

Easily Verify USB Electrical Parameters (Continued)

Low-, full- and high-speed tests require compliance with signal quality, inrush current, droop, drop, and backdrive voltage tests. Hi-speed USB requires compliance with an additional suite of tests. These tests are provided by the USB compliance test software, along with USB OTG (on-the-go) test capability (with the automated USB OTG electrical test fixture). Tests can be executed directly from the scope interface under the Analyze menu.

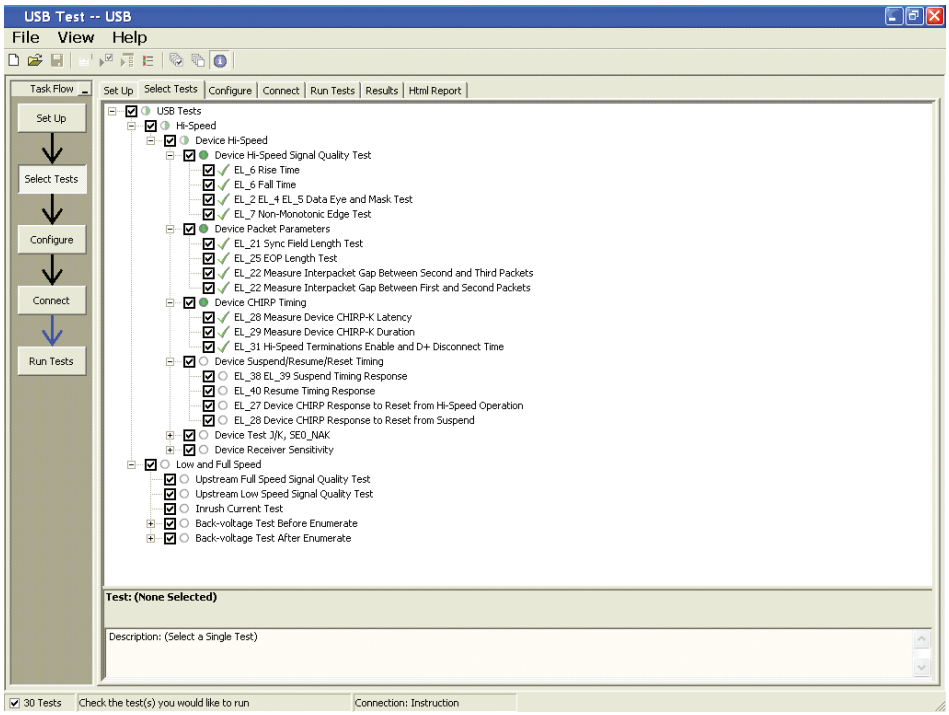


Figure 3. You can select individual tests or the entire list of compliance tests from a single window page.

Benefits

In the past, pre-compliance testing in a lab environment involved capturing data with an oscilloscope, transferring it to a PC and post-processing it with a software program. Keysight Technologies, Inc. has simplified the process by installing a run-time version of MATLAB software in the scope and integrating the USB test option into the Infiniium oscilloscope's menu structure.

Once the test is executed, the test results appear on the Infiniium display in an HTML-formatted window.

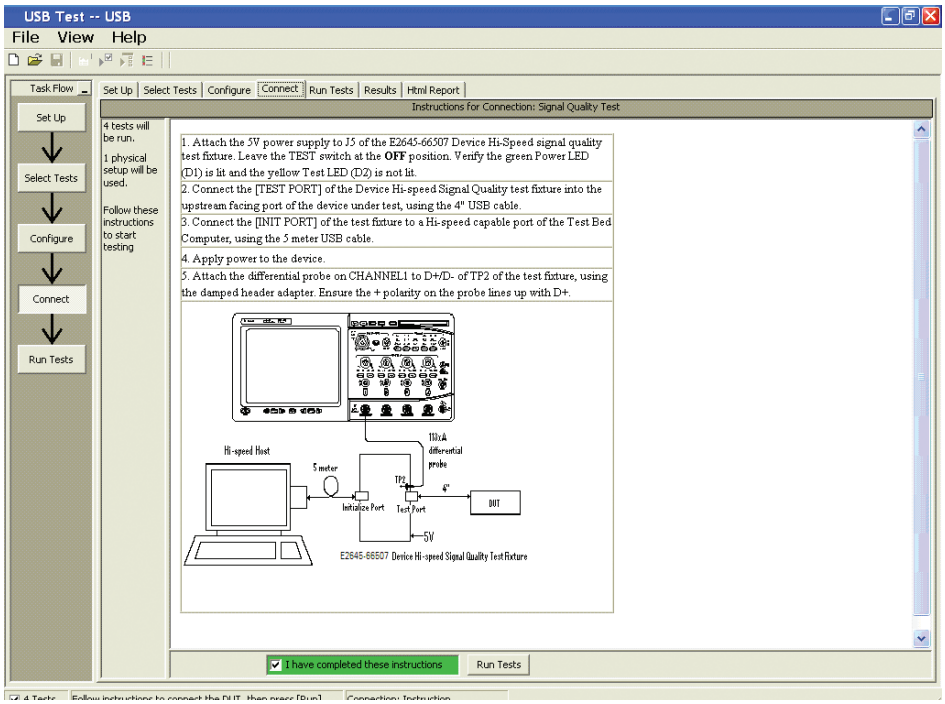


Figure 4. Test instructions and diagrams are included to help you configure your equipment.

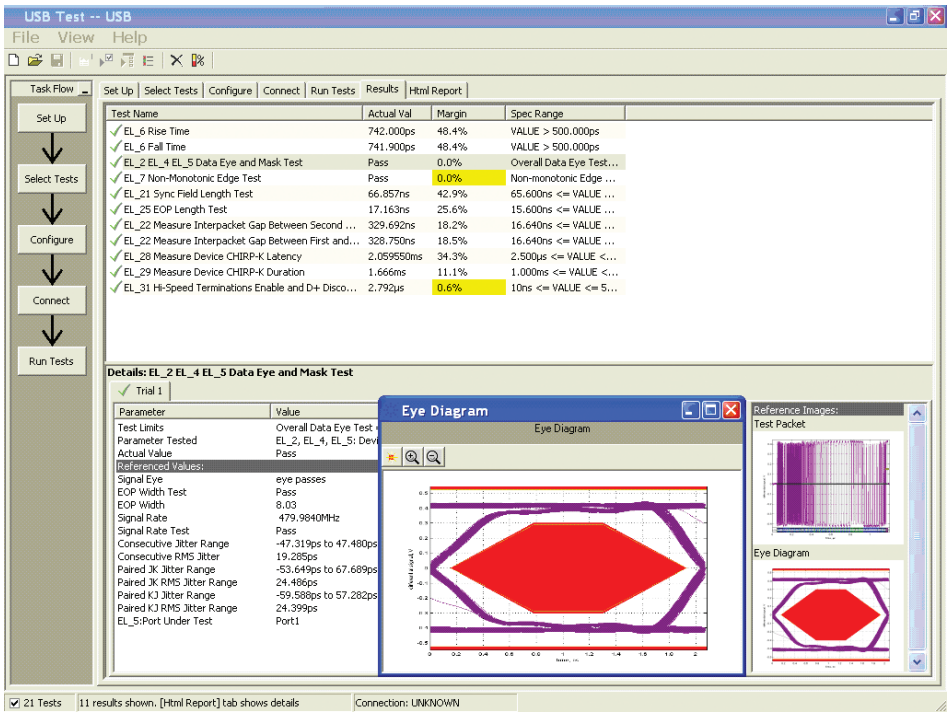


Figure 5. Infiniium scopes automatically display test results in an html window immediately after test execution.

Benefits (Continued)

Each test also automatically saves the PNG, HTML, and TSV files required by the USB-IF. The higher data rates associated with hi-speed USB 2.0 demand a measurement system that will not interfere with your device/host/hub operation by loading the system. The award-winning InfiniiMax probing system, which is compatible with Infiniium oscilloscopes, provides unmatched signal fidelity – ensuring your measurement system does not load the signals under test – so it does not compromise the specification margins for passing the electrical signal quality tests. The InfiniiMax probing system has been approved by the USB-IF for compliance testing. The set of six high-speed test fixtures are highly manageable in a test environment due to their small size. The six fixtures allow you the flexibility to run different tests concurrently when you have more than one host, hub, or device to verify for compliance. The OTG fixture available is the only automated OTG test fixture for USB OTG compliance testing.

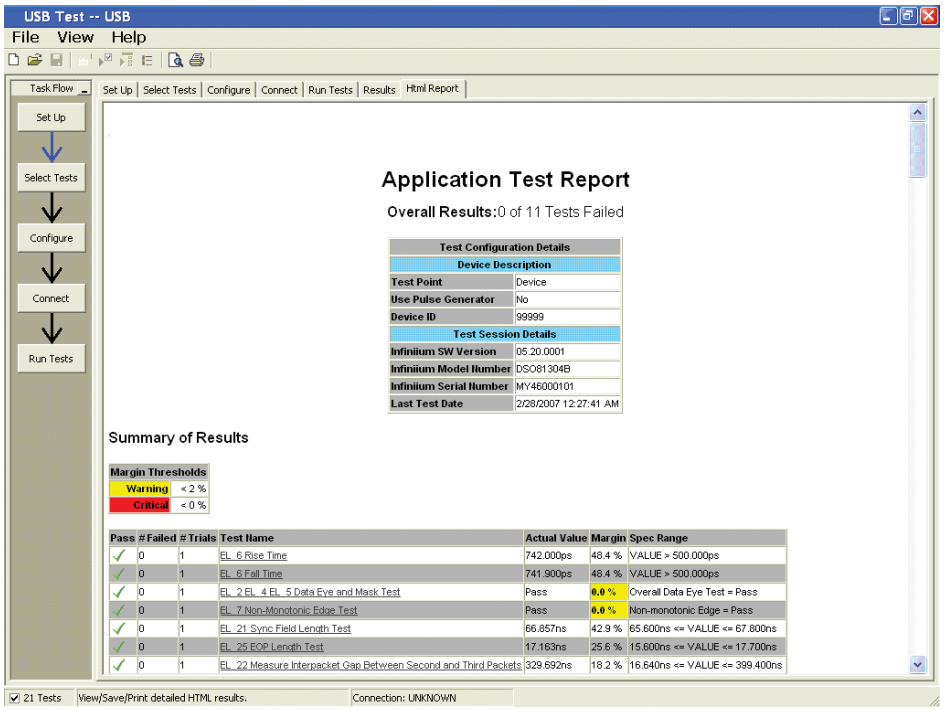


Figure 6. The results are stored in a printable HTML report.

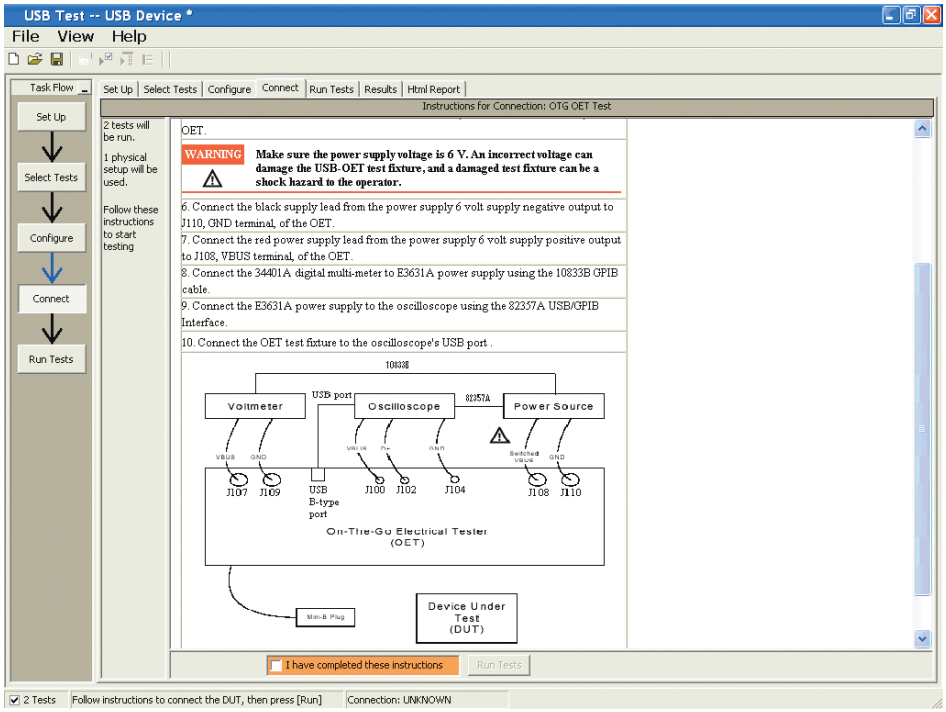


Figure 7. USB OTG test instructions.

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

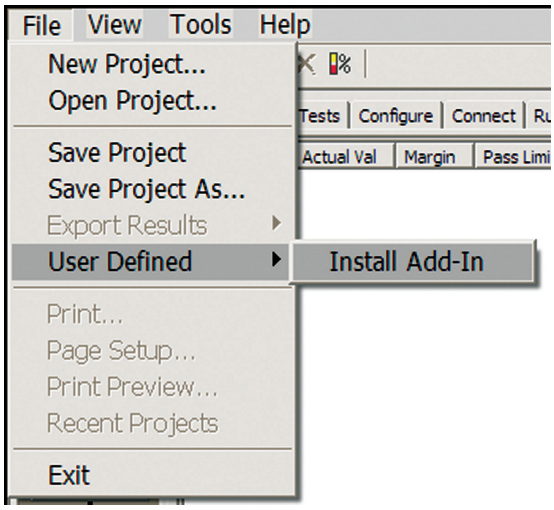


Figure 8. Importing a UDA Add-In into your test application.

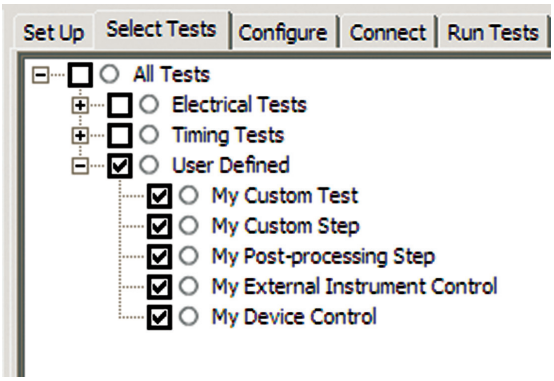


Figure 9. UDA Add-In tests and utilities in your test application.

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.

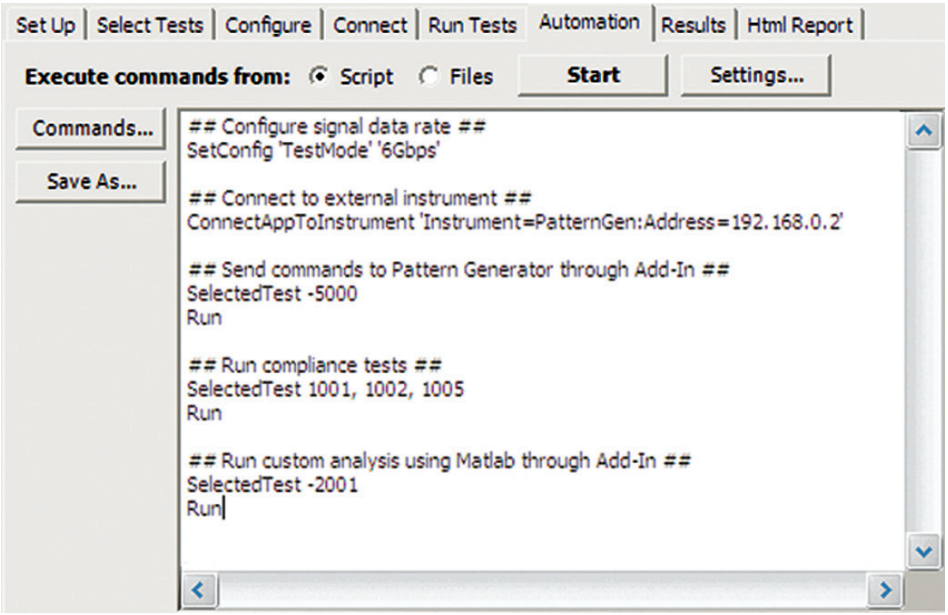


Figure 10. Remote programming script in the Automation tab.

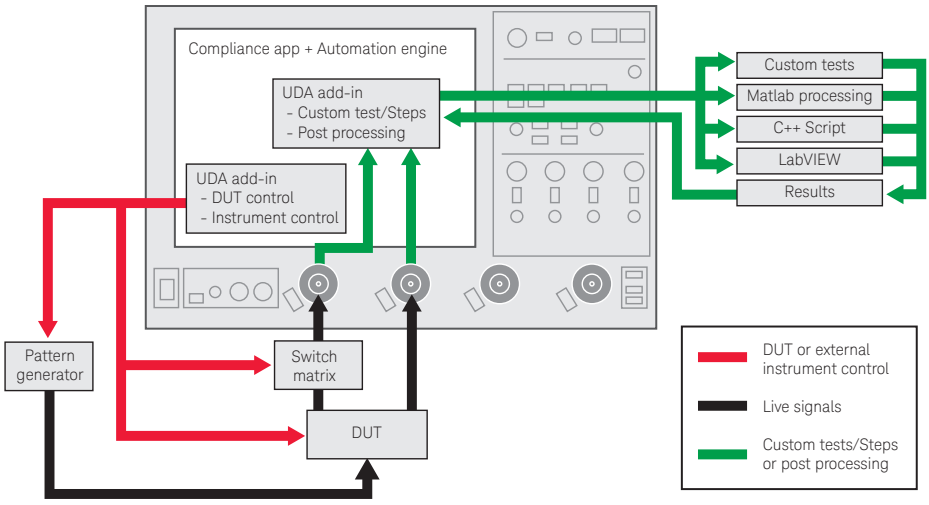


Figure 11. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Recommended Test Equipment

The N5416A USB test option requires an Infiniium 4-channel or 4+16 channel oscilloscope. To run hi-speed USB compliance tests, you will need E2649A/E2649B fixtures. For low/full-speed tests, you will need a E2646B SQuIDD test fixture. For USB OTG tests, in addition to the Infiniium oscilloscope, you will need an N5417A USB OTG test fixture and an E3631A power supply and 34401A digital multimeter.

No fixtures are supplied with the N5416A software. One SQuIDD test fixture must be ordered separately as part number E2646B (for low- and full-speed testing). A set of six high-speed test fixtures for signal quality, receiver sensitivity, TDR, and host disconnect must be ordered separately as part number E2649B. For USB OTG (on-the-go) test, USB OTG electrical fixture must be ordered separately as part number N5417A.

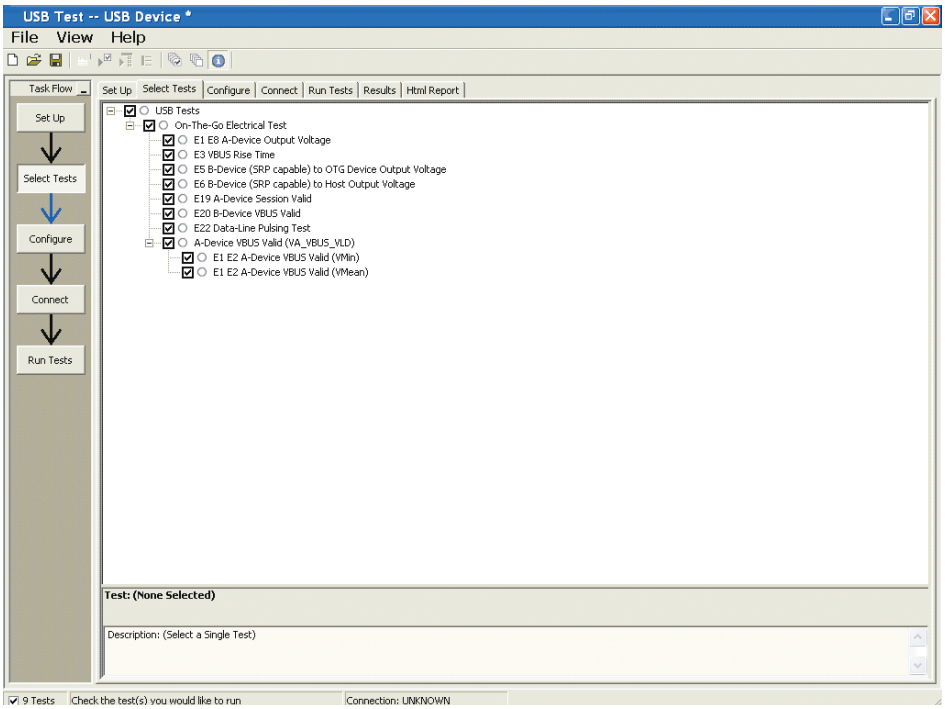


Figure 12. USB OTG test selections.

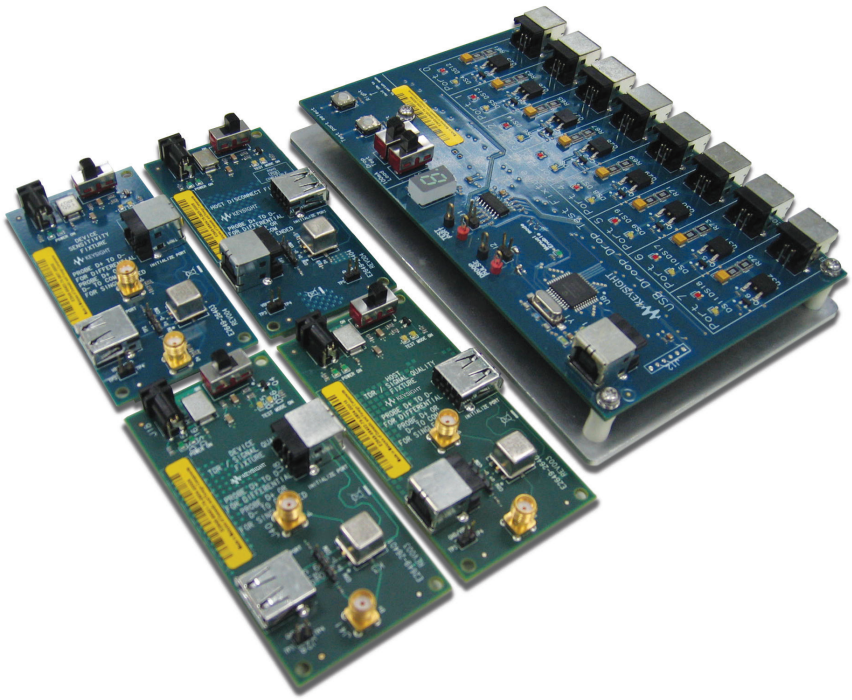


Figure 13. E2649B test fixture.

Recommended Test Equipment (Continued)

Recommended high-speed test equipment [1]

Infiniium Series oscilloscope (recommended bandwidth: 2 GHz or higher)

Model or part number	Description	Quantity
N5416A	USB 2.0 low-/full-/high-speed test option for Infiniium oscilloscopes [2]	1
E2649B	Hi-speed USB 2.0 test fixture set consists of: – E2649-66401 device TDR/signal quality test fixture – E2649-66402 host TDR/signal quality test fixture – E2649-66403 device receiver sensitivity fixture – E2649-66404 host disconnect test fixture – E2649-66405 droop and drop test fixture	1
1131A/32A/34A	InfiniiMax probe amplifier (qty 2 required for hub testing)	1
N5442A	InfiniiMax III 3.5 mm to precision BNC adapter (required for the 90000 X-Series)	3
E2678A	Differential socketed probe head for InfiniiMax probe amplifiers (qty 2 required for hub testing)	1
Digital signal generator [3]	81130A pulse data generator with options: – 11-MB SRAM memory card (UFJ) – 81132A 660-MHz option – 8493C 006 6-dB attenuator – Male SMA cable Or 81134A pulse generator: – 15433B 500 ps transition time converter (for use with the 81134A) – Male SMA cable	 1 2 2 2 2 2
82357B [4]	USB-to-GPIB interface converter	
TDR4	86100A/B/C	1
	54754A	1
	Male SMA cable	2
34401A	Digital multimeter	1
Hi-speed USB	Hardware configuration: 815EEA2 motherboard, Pentium III 700 MHz	1
Test bed computer	256 MB RAM, 40-GB HD, CD (CD-RW), FD, IOGear (or ATEN) USB 2.0 PCI card (5-port)	
	Software configuration: Windows XP	
USB cable	1.5-meter cable [6]	1
	1-meter cable	1
USB-IF tool on host system	HS electrical test tool available from **www.usb.org** (USBHSET.exe)	1

1. High-speed devices must support the full-speed mode. Consult the "Recommended low/full-speed test equipment" table for the required test equipment.
2. Option 8, enhanced bandwidth, is recommended for the 54855A. Option 5, noise reduction, is recommend for the 80000, 90000 and 90000 X-Series oscilloscopes.
3. A digital signal generator is required when testing receiver sensitivity for devices/hubs.
4. 82357A (USB1.1) is obsolete and replaced by 82357B (USB 2.0).
5. The TDR test was deleted from the Hi-speed Test Procedure (Rev. 1.0), but it is still recommended during development.
6. Not available from Keysight. Refer to **www.usb.org** for lists of qualified vendors.

(Note that four damped adapters are included with the E2649A)
(The damped adapter part number is 01130-63201)

Recommended Test Equipment (Continued)

Recommended low-/full-speed test equipment [1]

With Keysight Infiniium Series or 54830B/D, 54832A/D oscilloscopes.

Model or part number	Description	Quantity
N5416A	USB 2.0 low-/full-/high-speed test option for Infiniium oscilloscopes	1
E2646B	One SQuIDD (signal quality inrush, drop/droop) test fixture for low-/full-speed USB 2.0 testing	1
1165A	Miniature passive probe for the 5483x Series oscilloscopes	3
N2873A	Passive probe for the 9000 Series oscilloscopes	3
E2697A	High-impedance adapter with one 10073C passive probe (for the 90000A Series oscilloscopes)	3
10075A	Clip adapter (for each E2697A)	3
8710-2063	Dual lead adapters	3
1147B	50-MHz current probe (for 8000, 54831B/D or 32B/D only)	1
N2782A and N2779A [2]	50-MHz 30 A current probe and 3-channel power supply	1
USB host system	Refer to **http://compliance.usb.org/Interoperability**	1
USB cable	5-meter cable	6
	1-meter cable	1
USB-IF tool on	HS electrical test tool available from **www.usb.org** (USBHSET.exe)	1

1. High-speed devices must support the full-speed mode. Consult the "Recommended low/full-speed test equipment" table for the required test equipment.
2. N2774A and N2775A are obsolete and replaced with N2779A and N2782A.

USB OTG recommended test equipment

Using Keysight Infiniium Series or 54830B/D, 54832A/D.

Model or part number	Description	Quantity
N5417A	USB OTG (on-the-go) electrical test fixture	1
N2873A	Passive probe for the 9000 Series oscilloscopes	2
E2697A	High-impedance adapter with one 10073C passive probe (for the 90000A Series oscilloscopes)	2
E3631	Power supply unit	1
34401	Digital multimeter (DMM)	1
82357B [3]	USB/GPIB interface cable	1
10833A	GPIB cable	1

3. 82357A is obsolete and replaced by 82357B.

Infiniium Series USB 2.0 Compliance Test Application Capabilities

The following table summarizes the features of Keysight's various USB test analysis options in InfiniiVision 6000 X-Series and Infiniium oscilloscopes:

Table 1. USB Testing coverage comparison

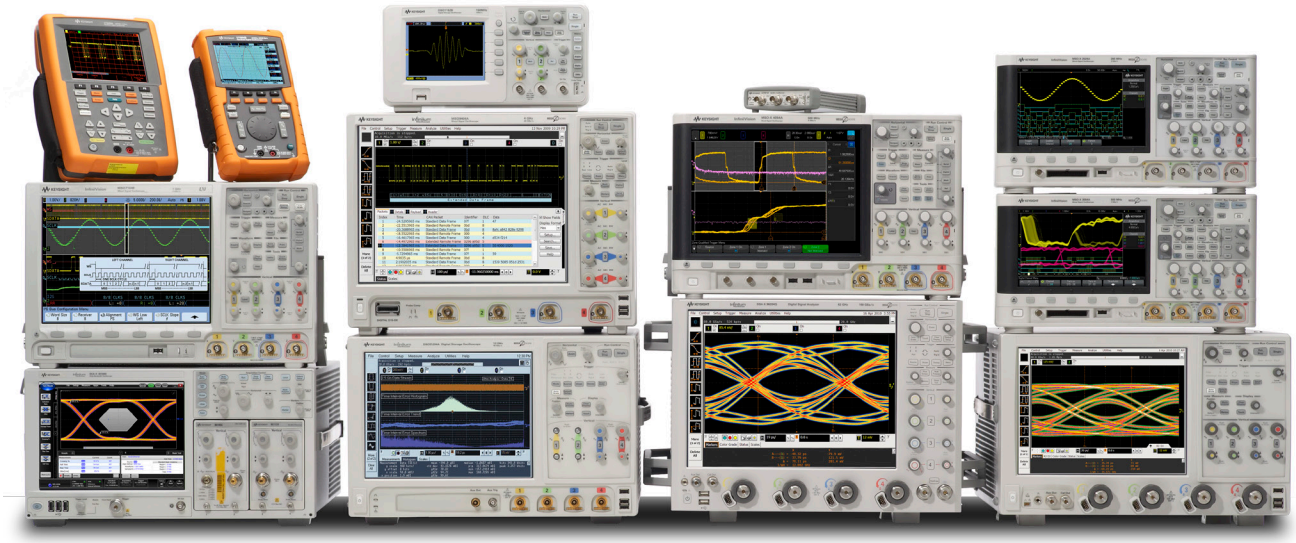
USB measurement	Signal integrity testing with InfiniiVision 4000/6000X with the USBSQ option	Complete USB-IF electrical compliance testing with Infiniium S-Series N5416A option
EL_2 EL_4 EL_5 Data Eye and Mask Test High speed SQ	√	√
Consecutive, paired JK, and paired KJ jitter	√	√
Full and Low speed signal quality	√	√
Sync test	√	√
Cross-over voltage (low- and full-speed only)	√	√
EOP bit-width	√	√
Signaling rate	√	√
EL_6 Device Rise and Fall Time	√[1]	√
Edge rate match (low- and full-speed only)	√	√
HTML pass/fail report generation	√	√
EL_7 Device Non-Monotonic Edge Test	√	√
EL_22 Interpacket Gap Tests		√
EL_28 Chirp-K Latency		√
EL_29 Device CHIRP-K Duration		√
EL_31 Host Hi-Speed Terminations Enable and D+ Disconnect Time		√
EL_38 EL_39 Device Suspend Timing Response		√
EL_40 Device Resume Timing Response		√
EL_27 Device CHIRP Response to Reset from Hi-Speed Operation		√
EL_28 Device CHIRP Response to Reset from Suspend		√
EL_8 Device J Test		√
EL_8 Device K Test		√
EL_9 Device SE0_NAK Test		√
Inrush Current Test		√
Drop/Droop Vbus tests		√
VBus Backdrive tests		√

1. To accurately measure USB 2.0 rise and fall times with less than 10% error for sub 500 ps edges the measurement BW must be at least 2.5 GHz as required for official USB-IF compliance testing.

Ordering Information

Infiniium oscilloscope	Operating system	Software revision	USB test option	Tests
90000A Series		02.10 or higher	N5416A or opt. 29 on new scope purchases	Low-/full-/high-speed
9000 Series		02.00 or higher	N5416A or opt. 29 on new scope purchases	Low-/full-/high-speed
9000 H-Series	Windows 7	04.20 or higher	N5416A or opt. 29 on new scope purchases	Low-/full-/high-speed
90000 X-Series	Windows XP Pro	03.00 or higher	N5416A or opt. 29 on new scope purchases	Low-/full-/high-speed

Note that free upgrade media for Infiniium oscilloscopes is available for order online at **http://www.keysight.com/find/infiniium_software**.



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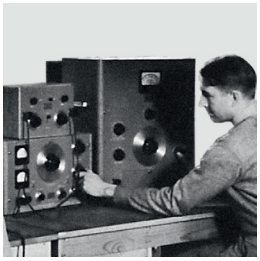
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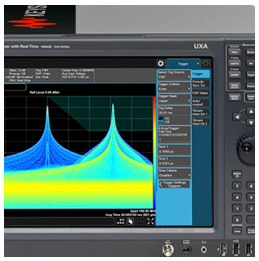
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