

Keysight N8814A

# 10GBASE-KR Ethernet Backplane Electrical Performance Validation and Conformance

For Infiniium Oscilloscopes

Data Sheet

## Table of Contents

Easy and Accurate 10GBASE-KR Ethernet Backplane Design Validation and Debug .....	03
N8814A 10GBASE-KR Compliance Application Software Saves You Time.....	04
Configurability and Guided Connections .....	06
Reports with Margin Analysis.....	07
Extensibility .....	09
Automation .....	10
40GBASE-KR4 Switch Matrix Option.....	11
Switched Matrix Hardware .....	11
Oscilloscope Compatibility .....	12
Measurement Requirements .....	13
Ordering Information .....	13

## Easy and Accurate 10GBASE-KR Ethernet Backplane Design Validation and Debug

The Keysight Technologies, Inc. N8814A 10GBASE-KR Ethernet backplane electrical performance validation and conformance software for Infiniium oscilloscopes provides you with an easy and accurate way to verify and debug your 10GBASE-KR and 40GBASE-KR4 Ethernet backplane designs. The Ethernet electrical test software allows you to automatically execute Ethernet physical-layer (PHY) electrical tests and 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 N8814A 10GBASE-KR Ethernet backplane electrical test software performs a wide range of electrical tests required to meet the 10GBASE-KR Ethernet backplane electrical specifications as documented in the IEEE 802.3ap standard. To meet signal quality requirements, your product must successfully pass conformance testing based on these specifications. Performing these tests gives you confidence in your design. The N8814A 10GBASE-KR Ethernet backplane electrical test software helps you execute a wide subset of the conformance tests that can be measured with an oscilloscope.

### Features

The N8814A 10GBASE-KR Ethernet backplane electrical test software offers several features to simplify the validation of Ethernet designs:

- Setup wizard for quick and clear setup, configuration and test
- Wide range of 10GBASE-KR Ethernet backplane electrical tests for standards conformance
- Accurate and repeatable results with Keysight Infiniium oscilloscopes
- Automated reporting in a comprehensive HTML format with margin analysis

With the 10GBASE-KR Ethernet backplane electrical test software, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on the 10GBASE-KR Ethernet backplane standards.



## N8814A 10GBASE-KR Compliance Application Software Saves You Time

The 10GBASE-KR Ethernet backplane electrical test software saves you time by setting the stage for automatic execution of 10GBASE-KR electrical tests. Part of the difficulty of performing electrical tests for Ethernet backplanes is properly connecting to the oscilloscope, loading the correct setup files, and then analyzing the measured results by comparing them to limits published in the specification. The Ethernet electrical test software does much of this work for you.

The 10GBASE-KR Ethernet backplane 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 that specification.

See Table 2 for a complete list of the measurements made by the 10GBASE-KR Ethernet backplane electrical test software.

### Easy test definition

The 10GBASE-KR Ethernet backplane electrical test software extends the ease-of-use advantages of Keysight's Infiniium oscilloscopes to testing 10GBASE-KR Ethernet backplane designs. The Keysight automated test engine quickly walks you through the steps required to define the tests you want to make, set up the tests, perform the tests, and view the test results. A setup page enables you to quickly make decisions from the outset regarding the choice of tests and perform functions that affect the testing task. The test selections available in the following steps are then filtered according to the choices made in the setup page. While selecting tests, 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.

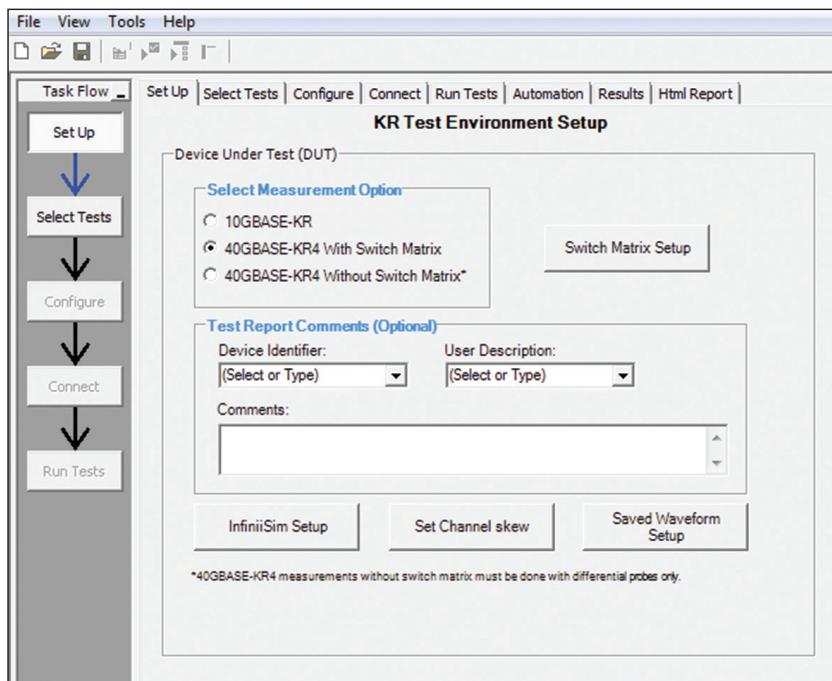


Figure 1. The clean interface allows you to select all tests or specific tests.



## N8814A 10GBASE-KR Compliance Application Software Saves You Time (Continued)

View all of the 10GBASE-KR Ethernet backplane electrical tests in the GUI under selected tests.

- Setup wizard for quick and clear setup, configuration and test
- Clearly see all the 10GBASE-KR Ethernet backplane tests
- Run single or multiple tests based on your needs
- When a test is highlighted, it will show the description of the test along with pass limits
- Accurate and repeatable results with Keysight Infiniium oscilloscopes
- Automated reporting in a comprehensive HTML format with margin analysis

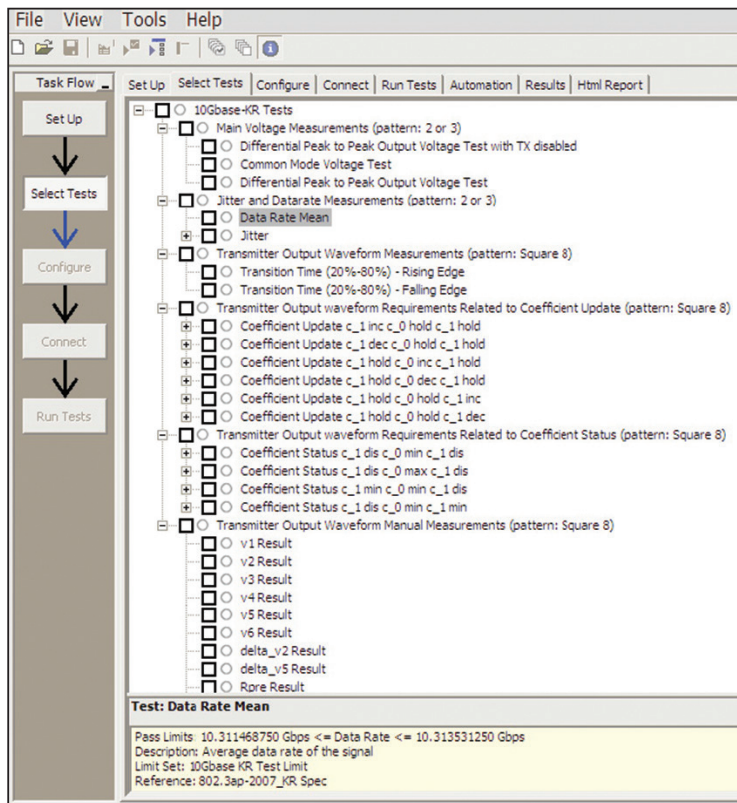


Figure 2. The Keysight automated test engine quickly guides you through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of tests with a mouse-click.



## Configurability and Guided Connections

The N8814A 10GBASE-KR Ethernet backplane 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. You connect the oscilloscope to the device under test using Keysight InfiniiMax active differential probes and/or SMA cables.

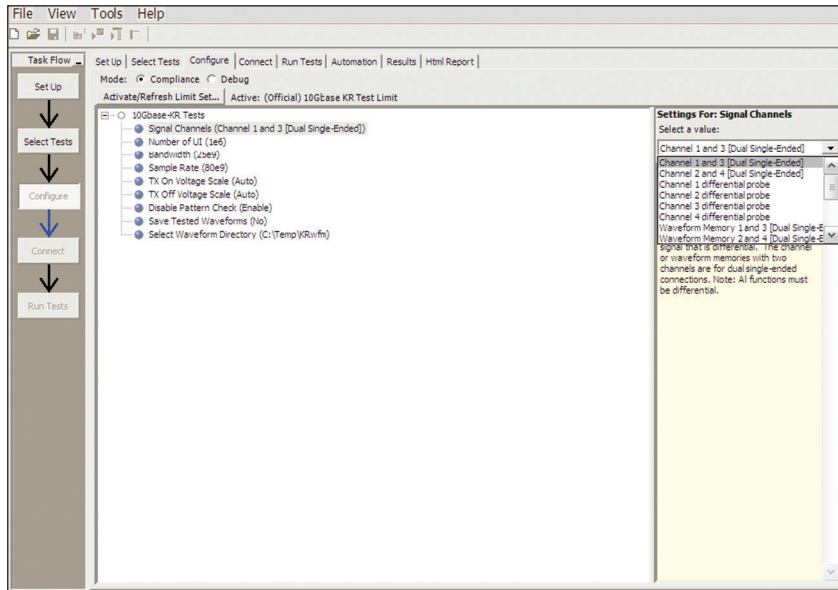


Figure 3. To set up tests, you define the device to test, its configuration, and how the oscilloscope is connected to it.

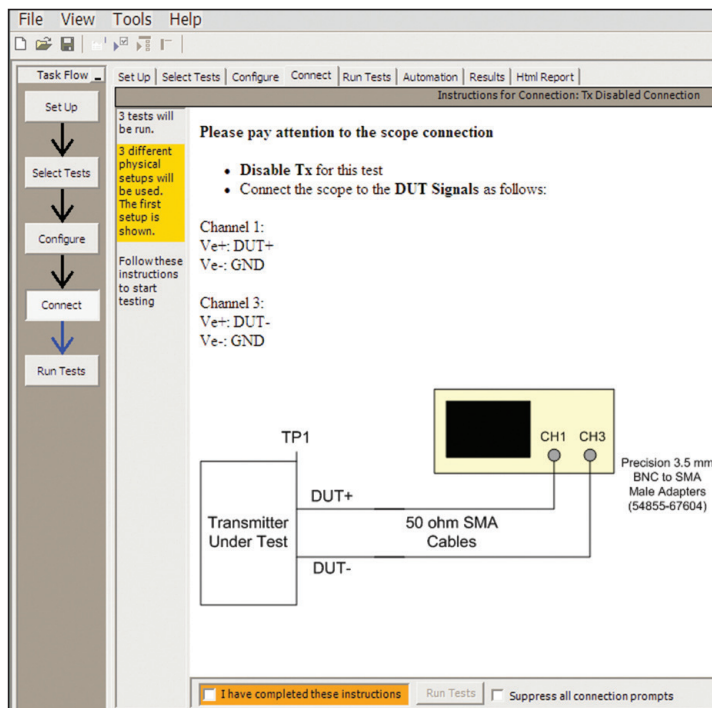


Figure 4. When you make multiple tests where the connections must be changed, the software prompts you with connection diagrams.



## Reports with Margin Analysis

In addition to providing you with measurement results, the N8814A 10GBASE-KR Ethernet backplane electrical test software has 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. 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 10GBASE-KR Ethernet backplane specification.

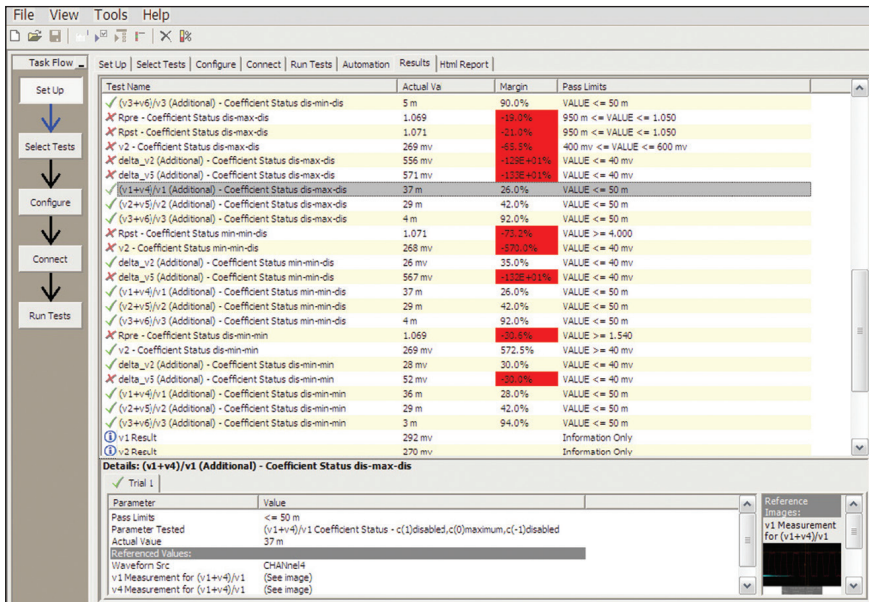


Figure 5. The Ethernet backplane electrical test software results screen shows a summary of the tests performed, pass/fail status, and margin. Clicking on a specific test also shows the test specification and a measurement waveform, if appropriate.

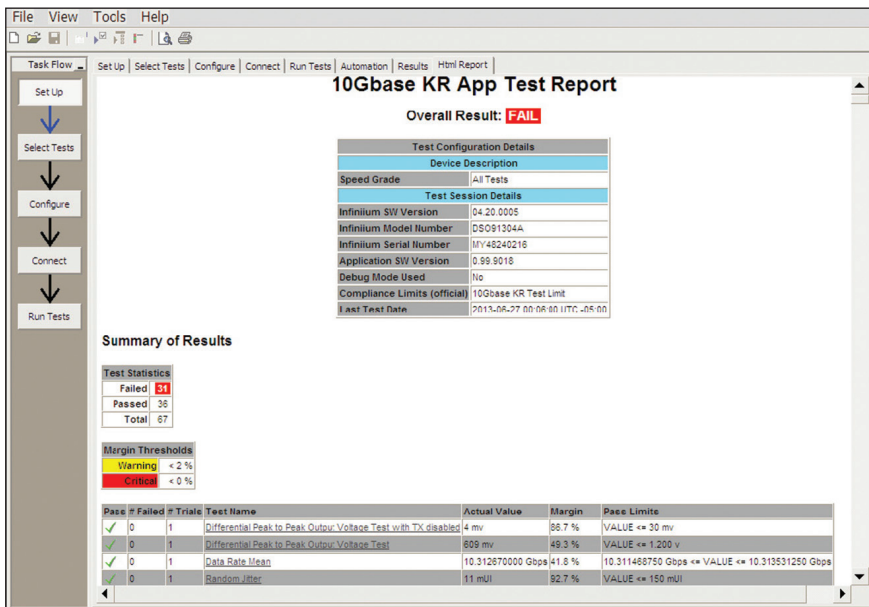


Figure 6. The backplane Ethernet electrical test software HTML report documents your test, indicates the pass/fail status, the test specification range, the measured values, and the margin.





## Reports with Margin Analysis

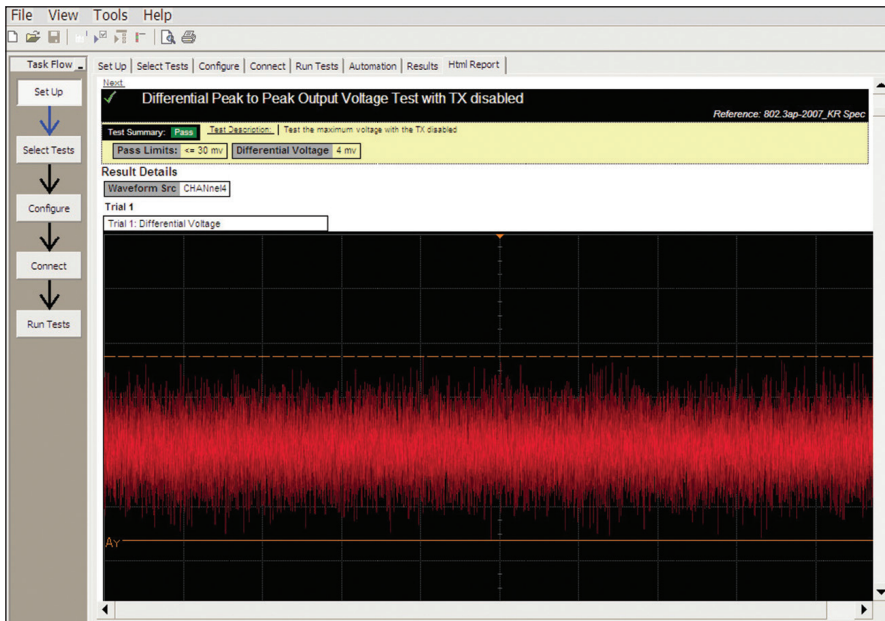


Figure 7. Additional details are available for each test, including the test limits, test description, and test results, including waveforms, if appropriate.

**Summary of Results**

Test Statistics	
Failed	31
Passed	36
Total	67

Margin Thresholds	
Warning	<math>< 2\%</math>
Critical	<math>< 0\%</math>

Pass	Failed	# Trials	Test Name	Actual Value	Margin	Pass Limits
✓	0	1	Differential Peak to Peak Output Voltage Test with TX disabled	4 mV	86.7%	VALUE <math>\leq 30\text{ mV}</math>
✓	0	1	Differential Peak to Peak Output Voltage Test	609 mV	49.3%	VALUE <math>\leq 1200\text{ V}</math>
✓	0	1	Data Rate Mean	10.312670000 Gbps	41.8%	10.311488750 Gbps <math>\leq</math> VALUE <math>\leq 10.313531250\text{ Gbps}</math>
✓	0	1	Random Jitter	11 mUI	82.7%	VALUE <math>\leq 100\text{ mUI}</math>
✓	0	1	Deterministic Jitter	23 mUI	84.7%	VALUE <math>\leq 150\text{ mUI}</math>
✓	0	1	Duty Cycle Distortion	18 mUI	48.6%	VALUE <math>\leq 35\text{ mUI}</math>
✓	0	1	Total Jitter	167 mUI	40.4%	VALUE <math>\leq 280\text{ mUI}</math>
✗	1	1	Transition Time (20%-80%) - Rising Edge	81.291 ps	-149.1%	24,000 ps <math>\leq</math> VALUE <math>\leq 47,000\text{ ps}</math>
✗	1	1	Transition Time (20%-80%) - Falling Edge	82.159 ps	-152.9%	24,000 ps <math>\leq</math> VALUE <math>\leq 47,000\text{ ps}</math>
✗	1	1	v1 - Coefficient Update inc-hold-hold	-9 $\mu\text{V}$	-33.3%	-20,000 mV <math>\leq</math> VALUE <math>\leq -5,000\text{ mV}</math>
✗	1	1	v2 - Coefficient Update inc-hold-hold	-25 $\mu\text{V}$	-33.5%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>
✗	1	1	v3 - Coefficient Update inc-hold-hold	-45 $\mu\text{V}$	-33.6%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>
✗	1	1	v1 - Coefficient Update dec-hold-hold	-264 $\mu\text{V}$	-35.1%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>
✗	1	1	v2 - Coefficient Update dec-hold-hold	-239 $\mu\text{V}$	-31.7%	-20,000 mV <math>\leq</math> VALUE <math>\leq -5,000\text{ mV}</math>
✗	1	1	v3 - Coefficient Update dec-hold-hold	-256 $\mu\text{V}$	-31.6%	-20,000 mV <math>\leq</math> VALUE <math>\leq -5,000\text{ mV}</math>
✗	1	1	v1 - Coefficient Update hold-inc-hold	-48 $\mu\text{V}$	-33.7%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>
✗	1	1	v2 - Coefficient Update hold-inc-hold	-55 $\mu\text{V}$	-33.7%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>
✗	1	1	v3 - Coefficient Update hold-inc-hold	-81 $\mu\text{V}$	-33.9%	5,000 mV <math>\leq</math> VALUE <math>\leq 20,000\text{ mV}</math>

Figure 8. How close your device comes to passing or failing a test is indicated as a percentage in the margin field. A result highlighted in yellow or red indicates that your device has tripped the margin threshold level for a warning or failure.





## 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

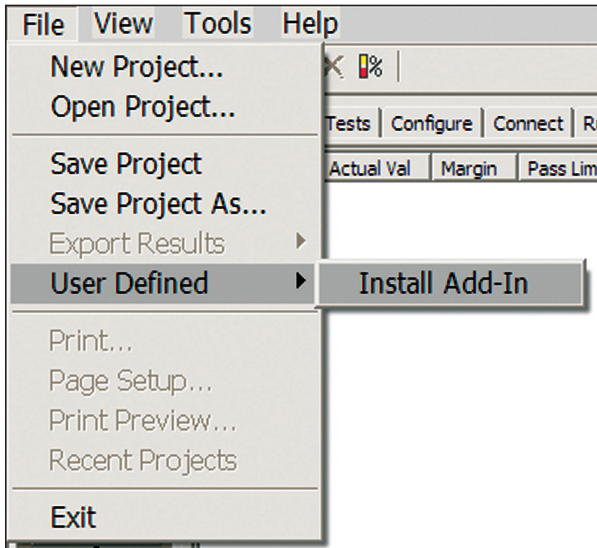


Figure 9. Importing a UDA Add-In into your test application.

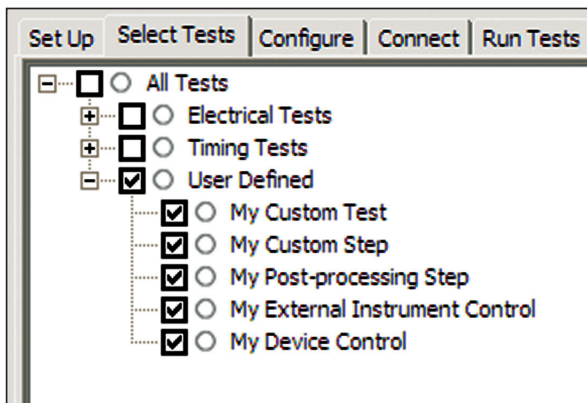


Figure 10. UDA Add-In tests and utilities in your test application.



## 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.

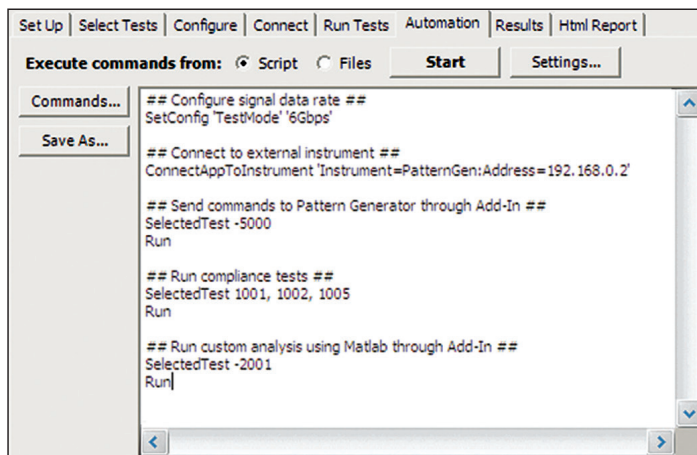


Figure 11. Remote Programming script in the Automation tab.

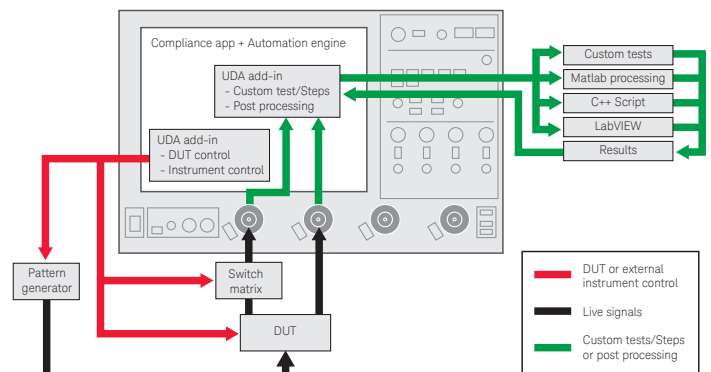


Figure 12. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.



## 40GBASE-KR4 Switch Matrix Option

The Keysight switch matrix software option for the compliance application, used together with switch matrix hardware, enables fully automated testing for multi-lane digital bus interfaces. The benefits of this automated switching solution include:

- Eliminate reconnections, which saves time and reduces errors through automating test setup for each lane of a multi-lane bus.
- Maintain accuracy with the use of unique N2809A PrecisionProbe or N5465A InfiniiSim features to compensate for switch path losses and skew.
- Customize testing by using remote programming interface and the N5467A user-defined application tool for device control, instrument control and test customization.

## Switched Matrix Hardware

Keysight U3020A S26 or BitifEye BIT2100

For more information on the switching solution and configuration, visit [www.keysight.com/find/switching](http://www.keysight.com/find/switching) and the Keysight application note with the publication number 5991-2375EN.

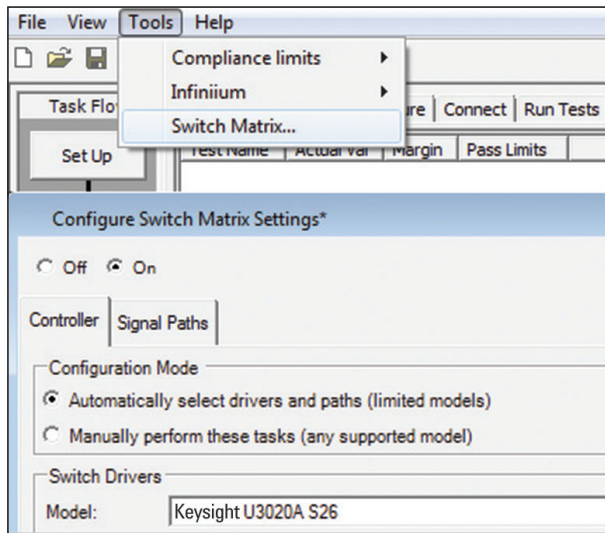


Figure 13. Switch matrix software feature enabled in the compliance application



Figure 14. Automated testing for multi-lane digital bus interface through switch matrix.



## Oscilloscope Compatibility

- The N8814A backplane Ethernet software will run on:
  - 90000A Series, version 4.20 or higher
  - 90000 X-Series, version 4.20 or higher

The minimum recommended bandwidth models and probes are shown below. For oscilloscopes with earlier software revisions, upgrade software is available at: [http://www.keysight.com/find/infiniium\\_software](http://www.keysight.com/find/infiniium_software).

Table 1.

Data rate	Standard	Recommended oscilloscope	Bandwidth of recommended oscilloscope	Recommended probe	Bandwidth of recommended probe
10 Gb/s	10GBASE-KR	DSO/DSAX92504A	25 GHz	N2802A	25 GHz
		DSO/DSAX92804A	28 GHz	N2803A	30 GHz
		DSO/DSAX93204A	32 GHz	N2803A	30 GHz
		DSO/DSAX93304Q	33 GHz	N2803A	30 GHz
		DSO/DSAX95004Q	50 GHz	N2803A	30 GHz
		DSO/DSAX96204Q	62 GHz	N2803A	30 GHz

N8814A 10GBASE-KR backplane Ethernet compliance tests based on the IEEE 802.3ap specification.

Table 2. N8814A 10GBASE-KR Backplane Ethernet electrical tests performed by the N8814A software

Standard reference	Description
IEEE 802.3ap, 72.7.1.3, Table 72-6	Signaling speed
IEEE 802.3ap, 72.7.1.4, Table 72-6	Differential peak-to-peak output voltage (maximum)
IEEE 802.3ap, 72.6.5, Table 72-6	Differential peak-to-peak output voltage (maximum) with TX disabled
IEEE 802.3ap, 72.7.1.4, Table 72-6	Common-mode voltage limits
IEEE 802.3ap, 72.7.1.5, Table 72-6	Differential output return loss (minimum)
IEEE 802.3ap, 72.7.1.6, Table 72-6	Common-mode output return loss (minimum)
IEEE 802.3ap, 72.7.1.7, Table 72-6	Transition time (20 to 80%)
IEEE 802.3ap, 72.7.1.8, Table 72-6	Maximum output jitter (peak-to-peak)
	Random jitter
	Deterministic jitter
	Duty cycle distortion
	Total jitter
IEEE 802.3ap, 72.7.1.11, Figure 72-12	Transmitter output waveform requirements
IEEE 802.3ap, Table 72-7	Transmitter output waveform requirements related to coefficient update
IEEE 802.3ap, Table 72-8	Transmitter output waveform requirements related to coefficient status



## Measurement Requirements

To use the N8814A 10GBASE-KR Ethernet backplane electrical performance validation and conformance software on your Infiniium oscilloscope, you will need oscilloscope probes, probe heads, and other test accessories depending on the Ethernet standard and test suites you want to perform.

## Ordering Information

The following products are used in the total solution for N8814A 10GBASE-KR and 40BASE-KR4 Backplane Ethernet testing solution.

Model number	Description
N8814A	User-installed license
Option 074	Factory-installed license on 90000 Series oscilloscopes
N5435A Option 059	Server-based license for 90000 Series oscilloscopes
N2802A	25 GHz InfiniiMax III Series probe amplifier or
N2836A	InfiniiMax III Series 26 GHz solder-in probe head
40GBASE-KR4 switch matrix option	
DS090000-097	Switch matrix option installed part number
N5435A-124	Switch matrix option server-based license
Option 1FP	10GBASE-KR option
N8890A-1FP	40GBASE-KR4 switch matrix option
N8890-1TP	40GBASE-KR4 switch matrix option (transportable license)
SMA cables required for switch matrix measurements	

## Related Keysight Literature

Publication title	Pub number
<i>Infiniium 90000 Series Oscilloscopes - Data Sheet</i>	5989-7819EN
<i>Keysight N5435A Infiniium Server-Based License for Infiniium Oscilloscopes - Data Sheet</i>	5989-6937EN
<i>E2688A, N5384A High-Speed Serial Data Analysis and Clock Recovery Software - Data Sheet</i>	5989-0108EN
<i>Infiniium 9000 Series Oscilloscopes - Data Sheet</i>	5990-3746EN
<i>Infiniium 90000 X-Series Oscilloscopes - Data Sheet</i>	5990-5271EN



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