Keysight Technologies

N5431A XAUI Electrical Validation Application for Infiniium Oscilloscopes and Digital Signal Analyzers

Data Sheet

KEYSIGHT TECHNOLOGIES

Introduction

Fast and Accurate XAUI Validation with Superior Signal Integrity and Probing

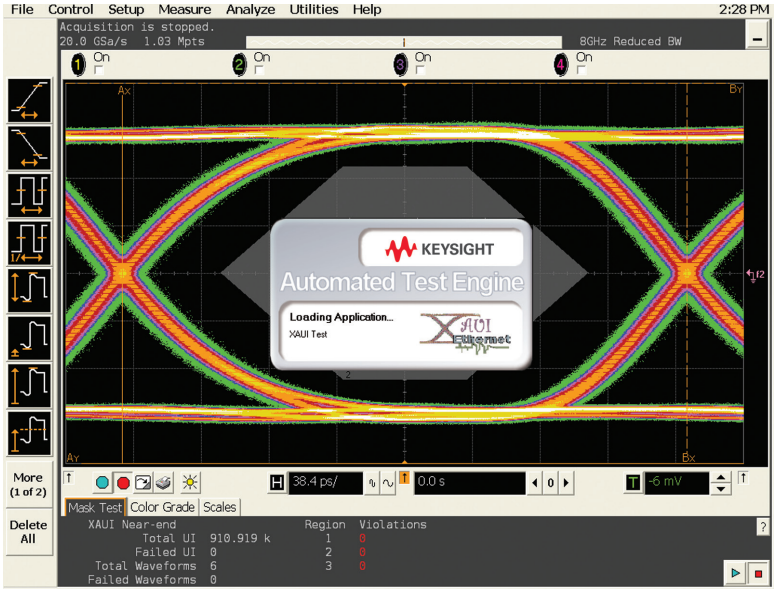
If you are designing XAUI devices, you may face challenges trying to perform design and validation tasks at the same time. The Keysight Technologies, Inc. N5431A XAUI electrical validation application will help you improve your efficiency by providing fast and accurate XAUI validation. The N5431A software, which runs on Keysight Infiniium oscilloscopes and digital signal analyzers, helps you confirm that your devices conform to the XAUI specifications as defined by the IEEE 802.3-2005 10-gigabit Ethernet specification. The superior signal integrity and probing provided by the Infiniium oscilloscopes and digital signal analyzers give you confidence that your designs will meet the specifications.

The application also provides support for the XAUI-derived 10GBASE-CX4 specification. In addition, when testing XAUI devices, the application allows you to test to various other XAUI-derived standards, such as CPRI, OBSAI RP3, 10-Gigabit Fibre Channel XAUI, and Serial RapidIO.

Features

The N5431A XAUI electrical validation application offers several features to simplify the validation of XAUI and XAUI-derived designs:

- Setup wizard for quick setup, configuration and test
- Signal probing using differential probes or single-ended SMA connections
- Test multiple lanes in a single run using differential probes
- Configurable test parameters for flexibility to test to other XAUI-derived standards
- Comprehensive reporting in HTML format with margin analysis
- New test framework that provides powerful characterization capability through the use of multiple trials until a stop condition is met
- Accurate and repeatable measurements on the oscilloscope with the industry's flattest frequency response and lowest noise floor



With the XAUI electrical validation application, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis for XAUI and XAUI-derived specifications. In addition, the application reduces the tedium involved in generating reports. You can easily generate thorough performance reports with the press of a button.

Fast and Easy Test Setup

The N5431A XAUI electrical validation application sets the stage for fast and accurate XAUI validation by offering flexible test setup. Choose between using InfiniiMax differential probes with various probe heads or single-ended SMA connections. You can test up to four XAUI lanes in a single run when you use differential probes

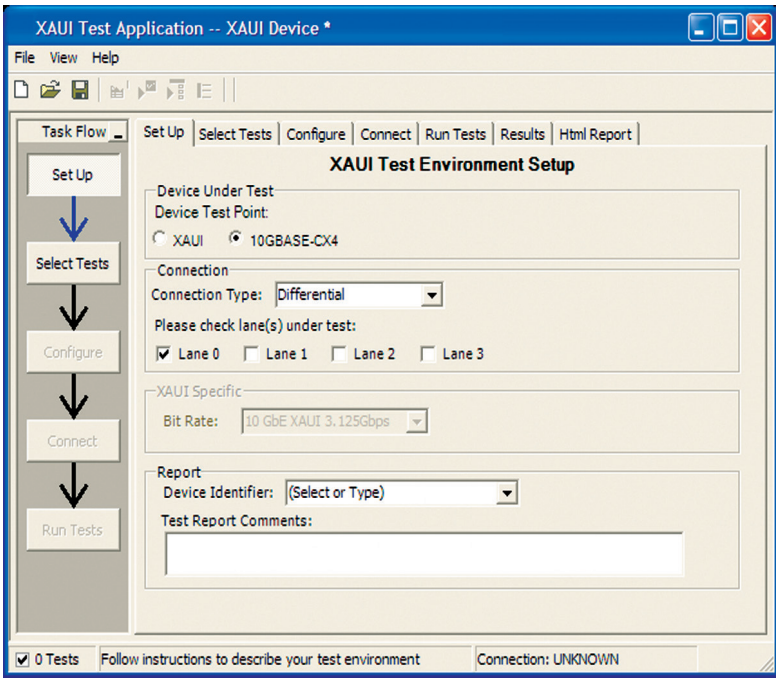


Figure 1. The test setup dialog box makes it easy to configure your tests. Select either XAUI or 10GBASE-CX4 and choose from different connection setups.

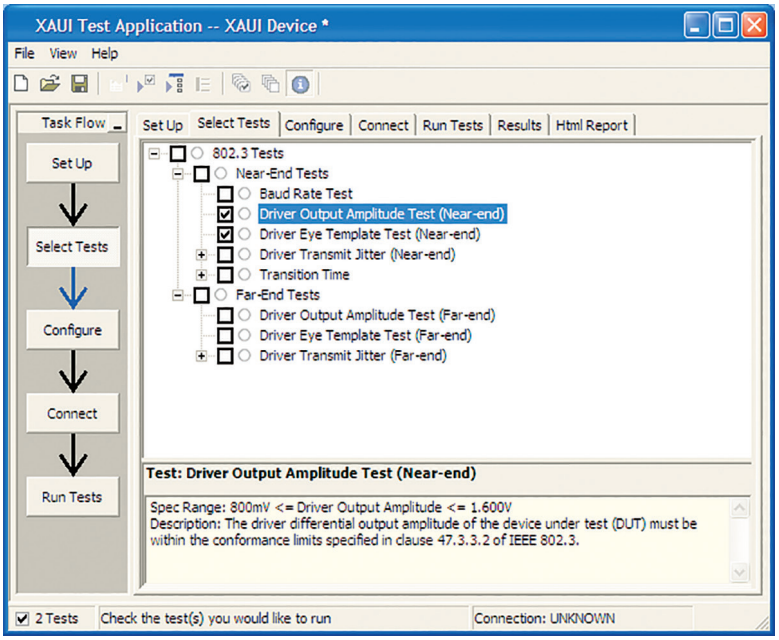


Figure 2. When XAUI is selected, you may use the XAUI-specific portion of the setup screen to select bit rates of various XAUI-derived standards to be tested.

Fast and Easy Test Setup (continued)

Easy test definition

The N5431A XAUI electrical validation application extends the ease-of-use advantages of Keysight's Infiniium oscilloscopes and digital signal analyzers to testing XAUI. The Keysight automated test engine has an easy-to-follow task list to guide you through each step in testing your XAUI device. Under the Select Tests tab, you can pick the tests you want to run. The interface is easy to navigate and a description for each test is provided. The test list is filtered based on the selections made in the Setup dialog box. Select an individual test to run or a whole group of tests. The user interface is oriented to minimize unnecessary reconnections, which saves time and potential operator error. The test setup can be saved as a project that you can recall later for quick testing or review of results.

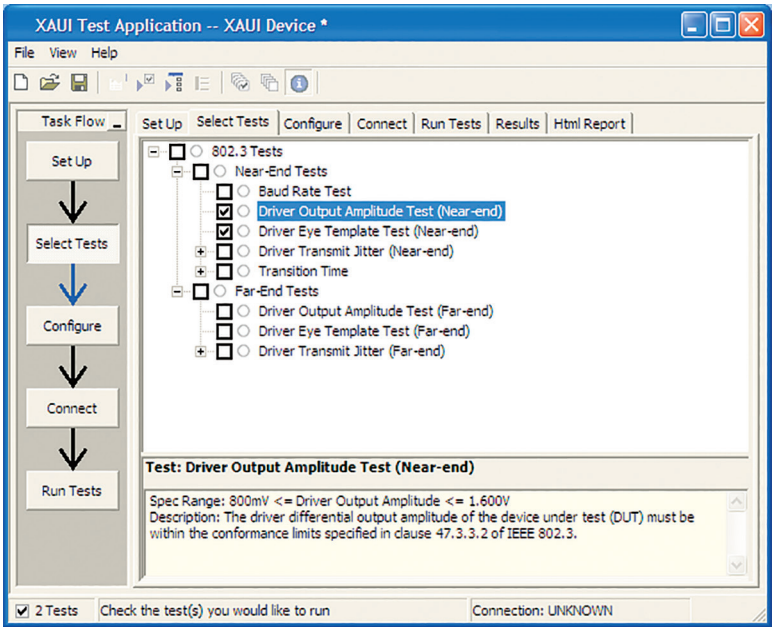


Figure 3. The test list is filtered by the selections you made in the previous step. Easily select a single test or whole groups of tests.

Flexible configuration

The N5431A XAUI electrical validation application allows you to further configure the settings of the test you want to run. Use the default values for the parameters or configure them to your liking. There is also a debug mode that provides a larger set of configurable parameters, enabling you to have full control as you debug and characterize your devices and test to other XAUI-derived standards. The unmatched flexibility allows you to focus on your design without having to worry about the test setup.

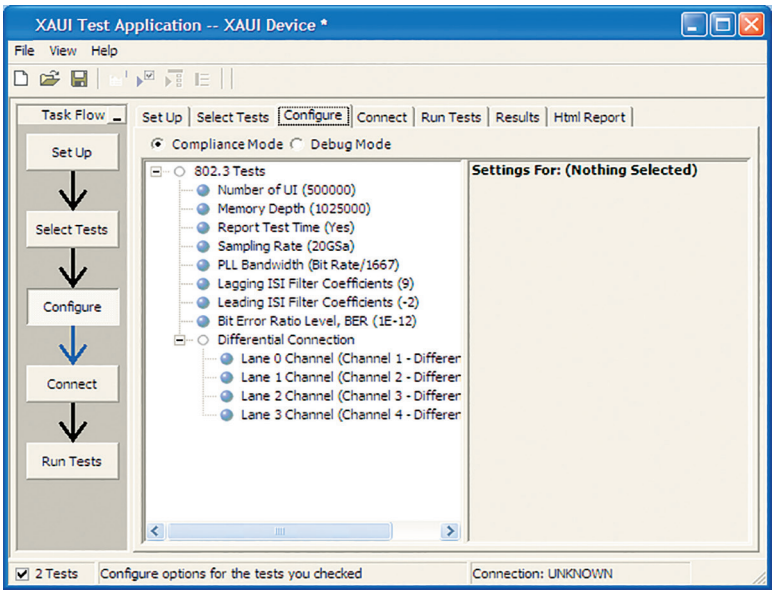


Figure 4. Use the default values or change them to your liking. In debug mode you'll find a larger set of values you can change.

Guided Connections and Testing Multiple Trials

After you have configured the tests to your liking, the N5431A user interface will display a connection diagram with instructions based on the test selections you have made. The instructions specify the connections and test pattern output from the test device.

The N5431A comes with a new multiple test trial capability that enables you to extensively characterize the performance of your XAUI devices. You can run selected tests until the stop condition is met. Worst-case conditions are saved to help you track down infrequent failures. A statistical summary of all the trials is also displayed.

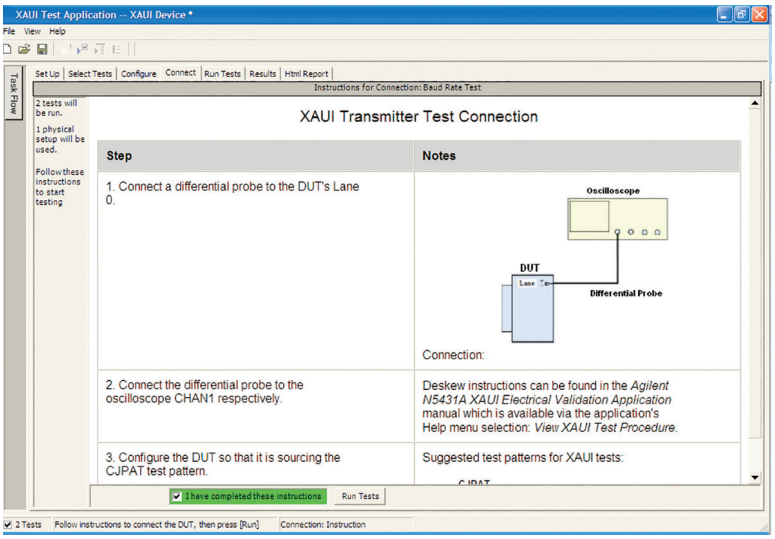


Figure 5. The application prompts you with the connection diagrams and instructions for the tests you have selected.

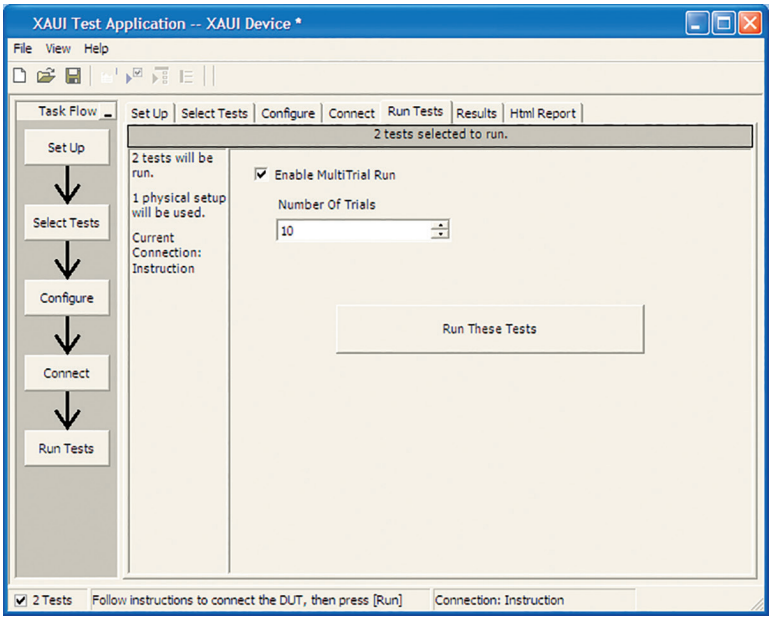


Figure 6. The new MultiTrial feature enables you to run selected tests for a specified number of times for characterization and troubleshooting.

Results with Margin Analysis

The N5431A XAUI electrical validation application goes beyond merely reporting the results of your tests. It provides additional useful information, such as how close your device is to the limits specified for a particular test parameter. You can specify the level at which warnings are issued for the electrical tests where your device is operating close to the official test limit defined by the specification for a given test parameter.

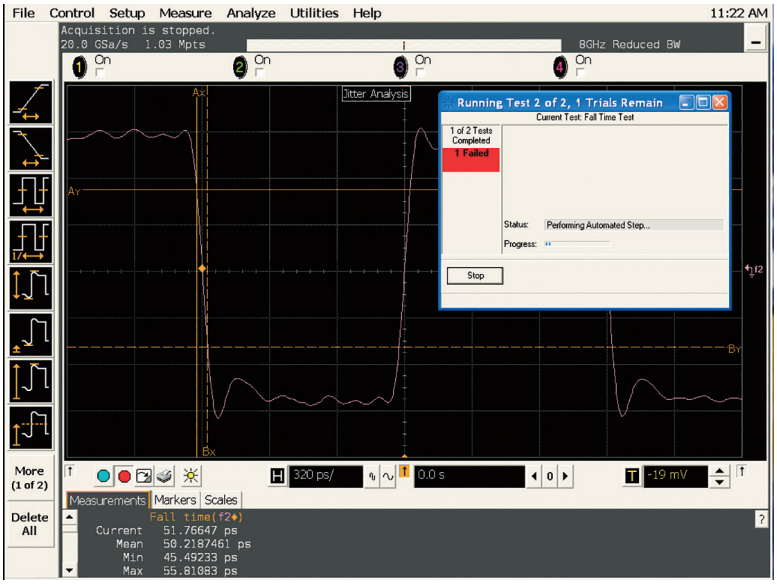


Figure 7. The N5431A helps you to quickly identify problems with your test device. You will notice if any of your tests are failing even while they are running.

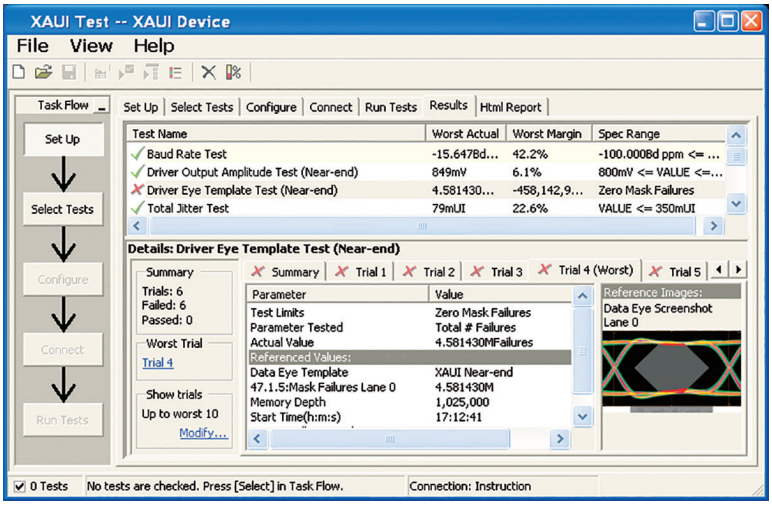
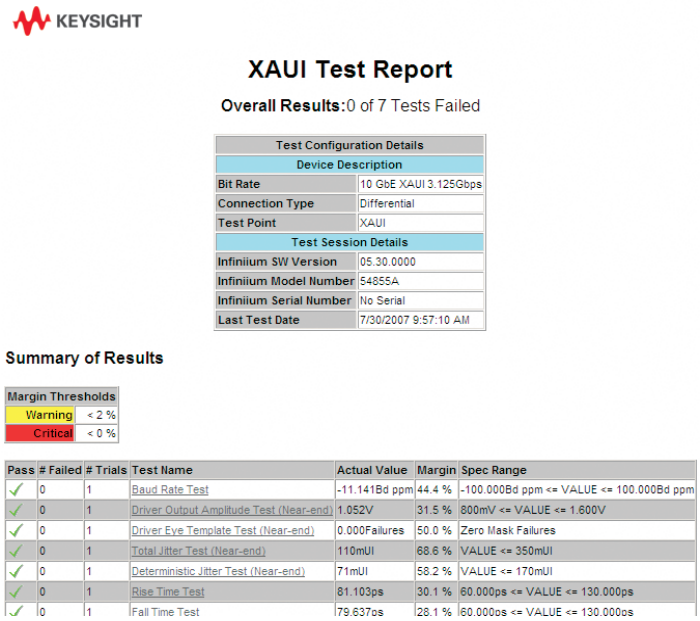


Figure 8. View more than just results with the powerful reporting capabilities of the N5431A.

Thorough Performance Reporting

The N5431A XAUI electrical validation application helps you get your work done quickly by generating thorough HTML reports that capture the performance, status and pass/fail margins of your device. It also saves screenshots of critical measurements for your reference and documentation. These reports are suitable for printing, archiving, or sharing with your vendors, customers and colleagues.



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XAUI Test Report

Overall Results:0 of 7 Tests Failed

Test Configuration Details	
Device Description	
Bit Rate	10 GbE XAUI 3.125Gbps
Connection Type	Differential
Test Point	XAUI
Test Session Details	
Infiniium SW Version	05.30.0000
Infiniium Model Number	54855A
Infiniium Serial Number	No Serial
Last Test Date	7/30/2007 9:57:10 AM

Summary of Results

Margin Thresholds	
Warning	< 2 %
Critical	< 0 %

Pass	# Failed	# Trials	Test Name	Actual Value	Margin	Spec Range
✓	0	1	Baud Rate Test	-11.141Bd ppm	44.4 %	-100.000Bd ppm <= VALUE <= 100.000Bd ppm
✓	0	1	Driver Output Amplitude Test (Near-end)	1.052V	31.5 %	800mV <= VALUE <= 1.600V
✓	0	1	Driver Eye Template Test (Near-end)	0.000Failures	50.0 %	Zero Mask Failures
✓	0	1	Total Jitter Test (Near-end)	110mUI	68.6 %	VALUE <= 350mUI
✓	0	1	Deterministic Jitter Test (Near-end)	71mUI	58.2 %	VALUE <= 170mUI
✓	0	1	Rise Time Test	81.103ps	30.1 %	60.000ps <= VALUE <= 130.000ps
✓	0	1	Fall Time Test	79.637ps	28.1 %	60.000ps <= VALUE <= 130.000ps

Figure 9. The N5431A provides a thorough and flexible reporting format. It updates automatically as tests are rerun.

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

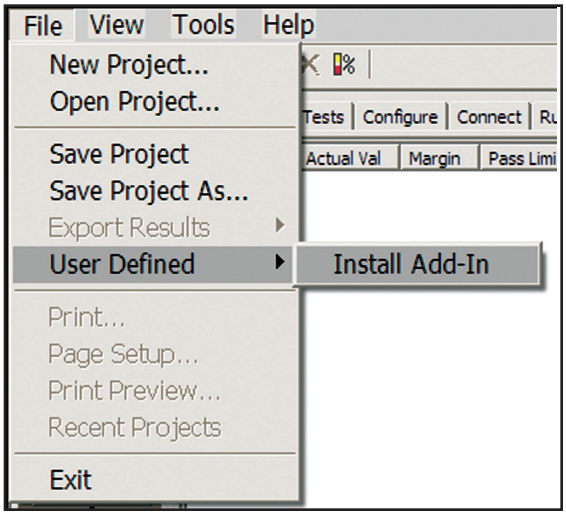

Figure 10. Importing a UDA Add-In into your test application.

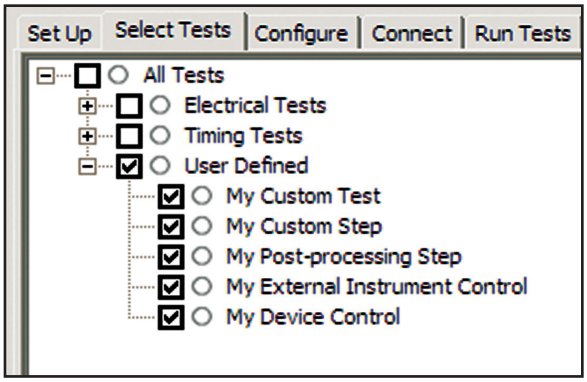

Figure 11. UDA Add-In tests and utilities in your test application.

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.

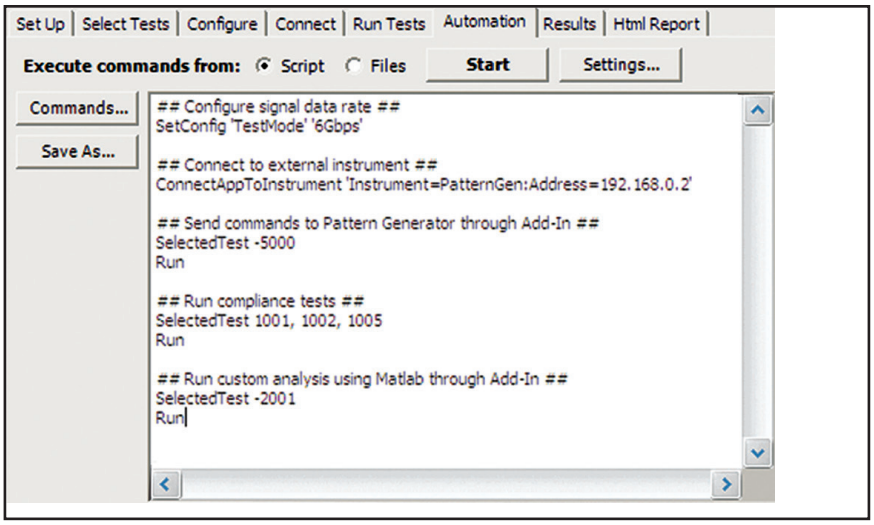

Figure 12. Remote Programming script in the Automation tab.

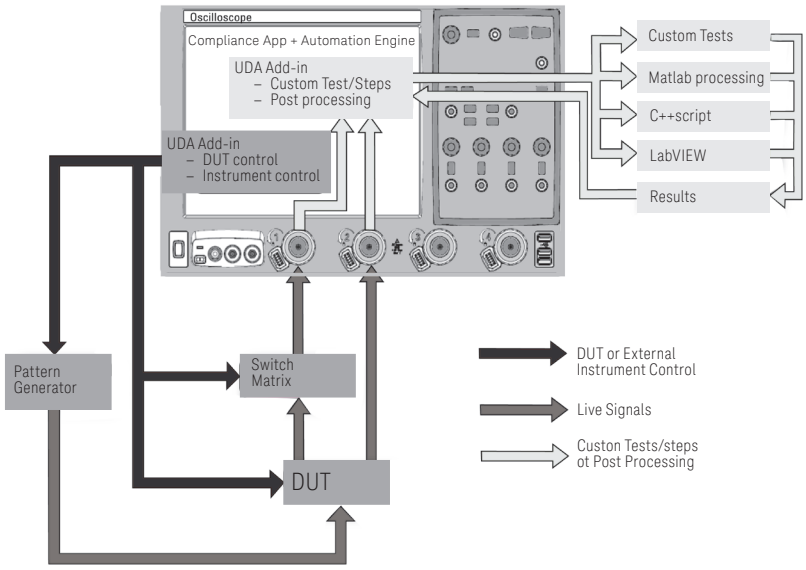

Figure 13. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Measurement Requirements

The N5431A XAUI electrical validation application runs on several models of Keysight's Infiniium oscilloscopes or digital signal analyzers. You will need at least 6 GHz of analog, real-time bandwidth. XAUI has a rise-time range from 60-130 ps. Depending on the rise time of your device and your accuracy requirements, a higher-bandwidth system may be more desirable. Please refer to Table 1 for an overview of rise-times versus recommended bandwidth.

Your device should be able to be configured to output the recommended test patterns described in Annex 48A of IEEE 802.3-2005. These test patterns are required for the proper conformance testing of your XAUI devices.

Rise-time	Recommended bandwidth	Recommended oscilloscope	Bandwidth of recommended oscilloscope
60 ps	10 GHz	DSO81004B DSO/DSA91204A	10 GHz 12 GHz
70 ps - 80 ps	8 GHz	DSO80804B DSO/DSA90804A	8 GHz 8 GHz
90 ps	6 GHz	DSO80604B DSO/DSA90604A	

Table 1. Device rise-times and recommended bandwidth

Notes:

For the DSO80000B and DSO/DSA90000A Series oscilloscope, the following calculations are used to determine the recommended oscilloscope bandwidth:

Maximum frequency content =
0.4/fastest rise or fall time (20-80%)

Scope bandwidth required =
1.4x maximum signal frequency for 3% accuracy measurements

Scope bandwidth required =
1.2x maximum signal frequency for 5% accuracy measurements

Scope bandwidth required =
1.0x maximum signal frequency for 10% accuracy measurements

Tests Performed

The N5431A XAUI electrical validation application covers transmitter electrical parameters of XAUI and 10GBASE-CX4 devices based on the specifications from IEEE 802.3-2005. In addition, the application's debug mode allows control of parameters that can be changed to test to other XAUI-derived specifications.

- The N5431A also provides support for tests common to 10-gigabit Ethernet XAUI for the following standards:
- Common Public Radio Interface (CPRI) based on version 3.0 of the specification
- Open Base Station Architecture Initiative (OBSAI) Reference Point 3 (RP3) based on version 3.1 of the specification
- Serial RapidIO based on Part 6 of the RapidIO Interconnect Specification Rev. 1.3
- 10-gigabit Fibre Channel XAUI

These standards were based on the XAUI electrical interface from IEEE 802.3-2005 clause 47, with the goal that electrical designs for XAUI may be reused after suitable modification.

Parameter	Subclause
Baud rate	47.3.3
Driver output amplitude Differential Single-ended	47.3.3.2
Transition time Rise-time Fall-time	47.3.3.3
Driver eye template tests Near-end Far-end	47.3.3.5
Driver transmit jitter Total jitter Determinstic	47.3.3.5

Table 2. Supported XAUI transmitter parameters from clause 47, IEEE 802.3-2005

Parameter	Subclause
Baud rate	54.6.3.3
Differential output amplitude	54.6.3.4
Lane-to-lane amplitude difference	54.6.3.4
Differential output template	54.6.3.6
Transition time Rise-time Fall-time	54.6.3.7
Driver transmit jitter Total jitter Determinstic	54.6.3.8

Table 3. Supported 10GBASE-CX4 transmitter parameters from clause 54, IEEE 802.3-2005

Parameter	Subclause
CPRI	614.4 MBaud 1228.8 MBaud 2457.6 MBaud 3072.0 MBaud
OBSAI RP3	768 MBaud 1536 MBaud 3072 MBaud
Serial RapidIO (both long and short run)	1.25 GBaud 2.50 GBaud 3.125 GBaud
10-gigabit Fibre Channel XAUI	3.1875 GBaud

Table 4. Supported baud rates for various XAUI-based standards

Oscilloscope Compatibility

The N5431A XAUI electrical validation application runs on the Keysight DSO/DSA90000A Series oscilloscopes with software revision 1.00 and above.

The 54850A (discontinued) and 80000 Series oscilloscopes, including the DSA80000B digital signal analyzers with software revision 5.10 or higher (Windows® XP Pro) are also supported. You can upgrade oscilloscopes with earlier software revisions for free by going to **http://www.keysight.com/find/infiniium_sw_download**.

You will also need the N5400A EZJIT Plus jitter analysis software and the E2688A high-speed serial data analysis and clock recovery software. These are also available as installed options with the Infiniium oscilloscopes. The N5404A deep-memory option for the 54850A and 80000 Series oscilloscope is highly recommended.

Alternatively, you can order the digital signal analyzer (DSA) configuration of the 80000 or 90000 Series oscilloscopes with the appropriate bandwidth. The digital signal analyzer configuration comes preconfigured with the necessary tools to run the N5431A XAUI electrical validation application.

Ordering Information

To purchase the Keysight N5431A XAUI electrical validation application with a new DSO90000A Series oscilloscope, please order the model numbers shown:

Model Number	Description
DSO90000A	Infiniium Series oscilloscope. Select the appropriate bandwidth based on the targeted rise-time
Option 002	EZJIT Plus jitter analysis software installed
Option 003	High-speed serial data analysis and clock recovery software installed
Option 030	XAUI electrical validation application installed

If ordering the DSA configuration:

Model Number	Description
DSA90000A	Infiniium Series oscilloscope with the DSA configuration. Select the appropriate bandwidth based on the targeted rise-time
Option 030	XAUI electrical validation application installed

To purchase the Keysight N5431A XAUI electrical validation application with a new DSA80000B digital signal analyzer, use the following model numbers:

Model Number	Description
DSO80000B	Infiniium Series oscilloscope with software 5.10 or higher
N5431A	XAUI electrical validation application
N5400A	EZJIT Plus jitter analysis software (Option 004 on new oscilloscopes)
E2688A	XAUI electrical validation application installed
N5404A	Deep-memory option (Option 001 on new oscilloscopes – recommended)

Ordering Information (continued)

To purchase the Keysight N5431A XAUI electrical validation application with a new DSA80000B digital signal analyzer, use the following model numbers

Model Number	Description
DSA80000B	Digital signal analyzer with software 5.10 or higher
N5431A	XAUI electrical validation application

The XAUI electrical validation application is also available as an option with the Keysight N5435A Application Server License program. Please refer to the "Related Literature" section for more information on the N5435A.

Recommended test accessories

Select the test accessories that best meet your signal probing requirements.

Model Number	Description
1134A	7-GHz differential probe amplifier
1168A	10-GHz differential probe amplifier
1169A	12-GHz differential probe amplifier
N5380A	InfiniiMax II 12-GHz differential SMA probe head and accessories
N5381A	InfiniiMax II 12-GHz differential solder-in probe head and accessories
N5382A	InfiniiMax II 12-GHz differential browser
E2695A	InfiniiMax 8-GHz differential SMA probe head
E2677A	InfiniiMax 7-GHz differential solder-in probe head and accessories
N5382A	InfiniiMax II 12-GHz differential browser
E2695A	InfiniiMax 8-GHz differential SMA probe head
E2677A	InfiniiMax 7-GHz differential solder-in probe head and propagation delay within 25 ps (or equivalent
11742A	DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors
54855-67604	Precision BNC (m) to 3.5mm (f) adapter

Third-party accessories

This list is provided as a reference for users looking for adapters for devices with CX4 or HM-Zd connectors. Any other equivalent adapter can be used.

Model Number	Description
IBNTSTCX4	CX4 plug to SMA adapter. Orderable from W.L. Gore and Associates, Inc. **www.gore.com**
4X-SMA-12R	4X InfiniBand connector (SFF-8470) to SMA test adapter board. Order from Efficere Technologies **www.efficere.com**
TX/RX Signal*Blade*	Test card for HM-Zd (f) to SMA (f) access. Order from F9 Systems, Inc. **www.F9-Systems.com**
TX/RX Bench*Blade*	Test card for HM-Zd (m) to SMA (f) access. Order from F9 Systems, Inc. **www.F9-Systems.com**

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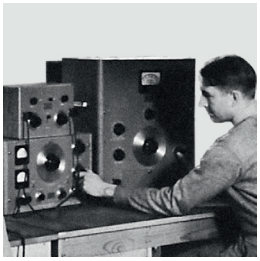

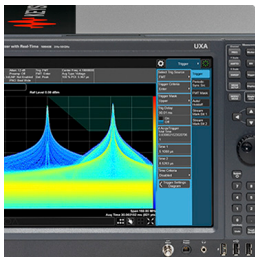

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