

Keysight U7249E

MIPI M-PHY Compliance Test Software for Infiniium Oscilloscopes

Technical Overview



Introduction

Keysight Technologies' MIPI® M-PHY® conformance test software for Infiniium oscilloscopes gives you a fast, easy way to validate and debug your embedded M-PHY data links. The M-PHY electrical test software allows you to automatically execute M-PHY electrical checklist tests for DigRF v4, UniPro, LLI, UFS, SSIC and M-PCIe architectures, and displays the results in a flexible report format. In addition to the measurement data, the report provides margin analysis that shows how closely your product passed or failed each test.

The M-PHY conformance test software performs a wide range of tests required to meet the physical layer requirements per section 5 of the MIPI Alliance Specification for M-PHY and section 1 of the M-PHY Conformance Test Suite (CTS).

The M-PHY conformance test software helps you execute the most difficult physical layer tests for transmitters (TX tests only) that can be measured with a high bandwidth real-time digital oscilloscope. Although there are not currently any requirements for physical layer compliance verification, it is highly recommended that every MIPI M-PHY link be tested against the limits of the physical layer specification to ensure that it conforms to the specification and to minimize concerns with protocol level interoperability.

Key features

The M-PHY conformance test software offers several features to simplify design validation:

- Complete MIPI Alliance Specification for M-PHY v3.0, v4.0 and v4.1, section 5 and M-PHY v3.0, v4.0 and v4.1 CTS v1.0, section 1.
- User selection of tests and configuration of data rate.
- Automated scope measurement setup and programming for increased accuracy, time-savings and repeatability.
- Advanced debug modes for troubleshooting.
- Automated margin analysis and pass/fail conformance reporting.
- Fully integrated SigTest tool for Gear4 Eye diagram test.

With the M-PHY conformance test software, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on not only the MIPI Alliance Specification for M-PHY v3.0 but also v4.0 and v4.1 section 5 requirements and M-PHY CTS v3.0, v4.0 and v4.1, section 1.



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Save Time with M-PHY Conformance Application

The M-PHY conformance test software saves you time by setting the stage for automatic execution of required electrical tests. The primary difficulties associated with performing electrical tests for M-PHY is connecting the oscilloscope to the target device, correctly configuring the oscilloscope's measurement system for ultimate accuracy, issuing the proper commands to perform the tests and then analyzing the measured results by comparing them to limits published in the specification. The M-PHY conformance test software automates this work to provide rapid, accurate and repeatable test execution. In addition, if you discover a problem with your product, debug tools in the oscilloscope are available to aid in root-cause analysis.

Easy Test Definition

The M-PHY conformance test software extends the ease-of-use advantages of Keysight's Infiniium oscilloscopes to testing M-PHY designs. The Keysight automated test engine walks you quickly through the steps required to define and configure the tests, execute the tests and view the test results. You can select a category of tests all at once or specify individual tests. The user interface is oriented to minimize unnecessary reconnections, which saves time and ensures accuracy and repeatability of tests. You can save tests and configurations as project files and recall them later for quick re-testing or review of a previous test. Straightforward menus let you perform tests with a minimum of mouse clicks.

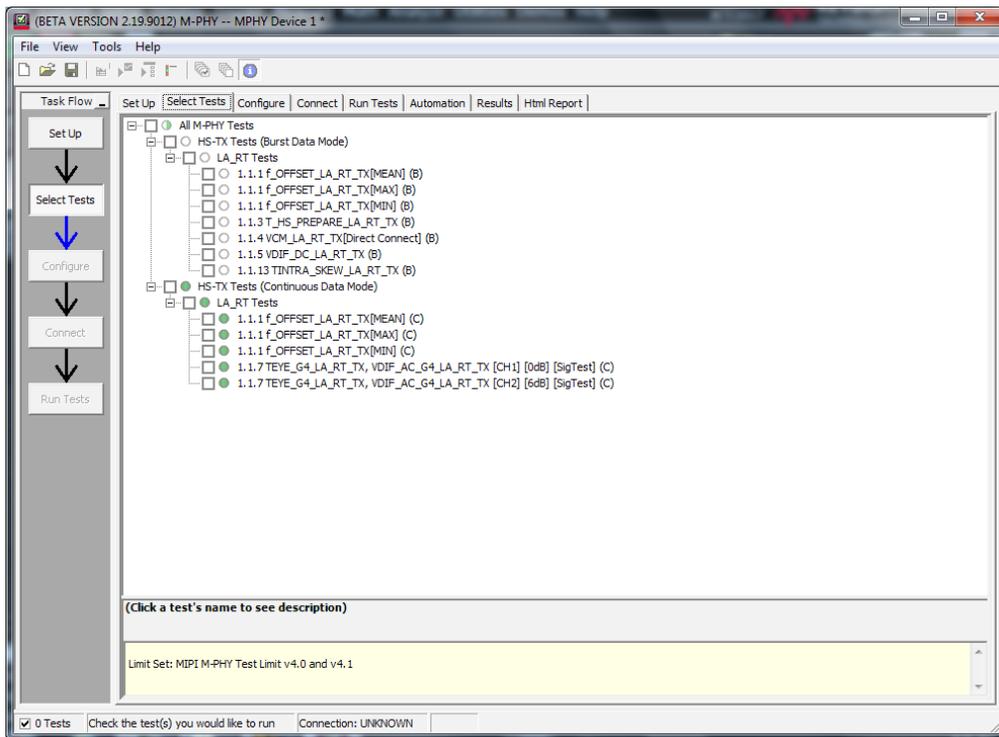


Figure 1. You can easily select individual tests or groups of test with a mouse-click and customize your output report based on the test results you want to see.



Configurability and Guided Connections

The M-PHY conformance test software provides flexibility in your test setup. The M-PHY conformance test software provides you with user-defined controls for critical test parameters such as channel probe configurations, number of measurement observations for tests and the trigger threshold. After you configure the tests to meet your needs, the M-PHY user interface will present you the connection screen that is specific to the configuration data you have selected. This includes the oscilloscope channels used for the test and the routing of any necessary probing needed to perform the tests. In some cases, a configuration change may be necessary to properly make a new set of measurements. Guided configuration diagrams will be presented when each change is needed to ensure proper configuration for the tests. The software is designed to minimize connection changes to increase the efficiency of test operation and save you time.

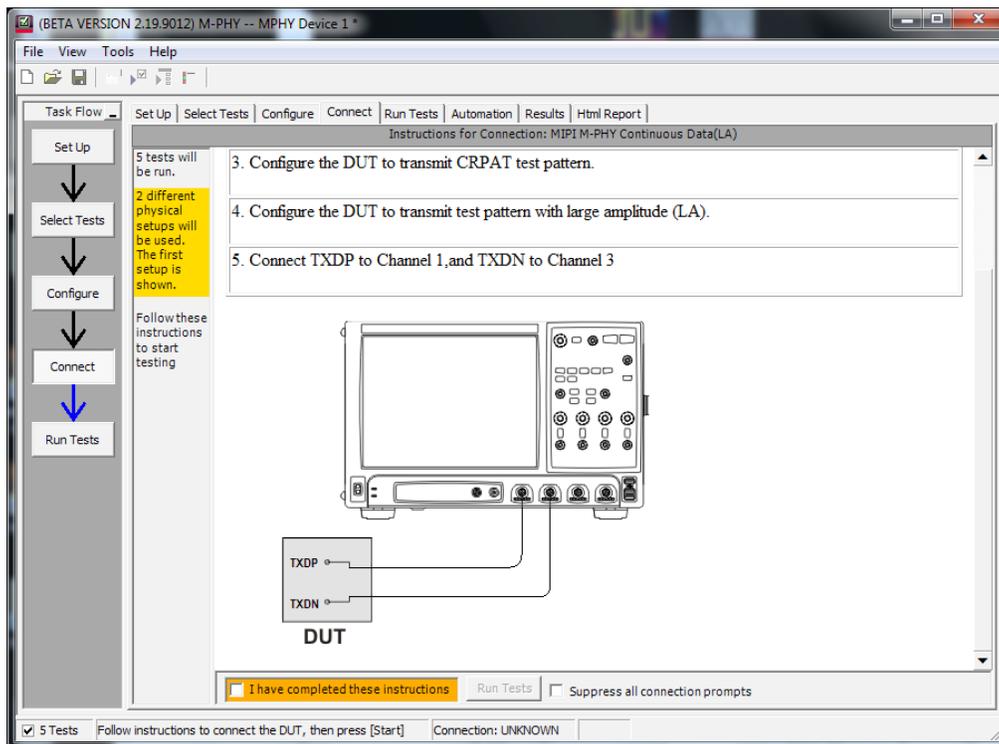


Figure 2. Guided configuration diagrams provide you with channel and probe configurations needed to properly connect to your product and accurately perform tests.



Results Reports with Margin Analysis

In addition to providing you with measurement results, the M-PHY 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. You select the margin test report parameter, which means you can specify the level at which warnings are issued to alert you to the electrical tests where your product is operating close to the official test limit defined by the specification for a given test.

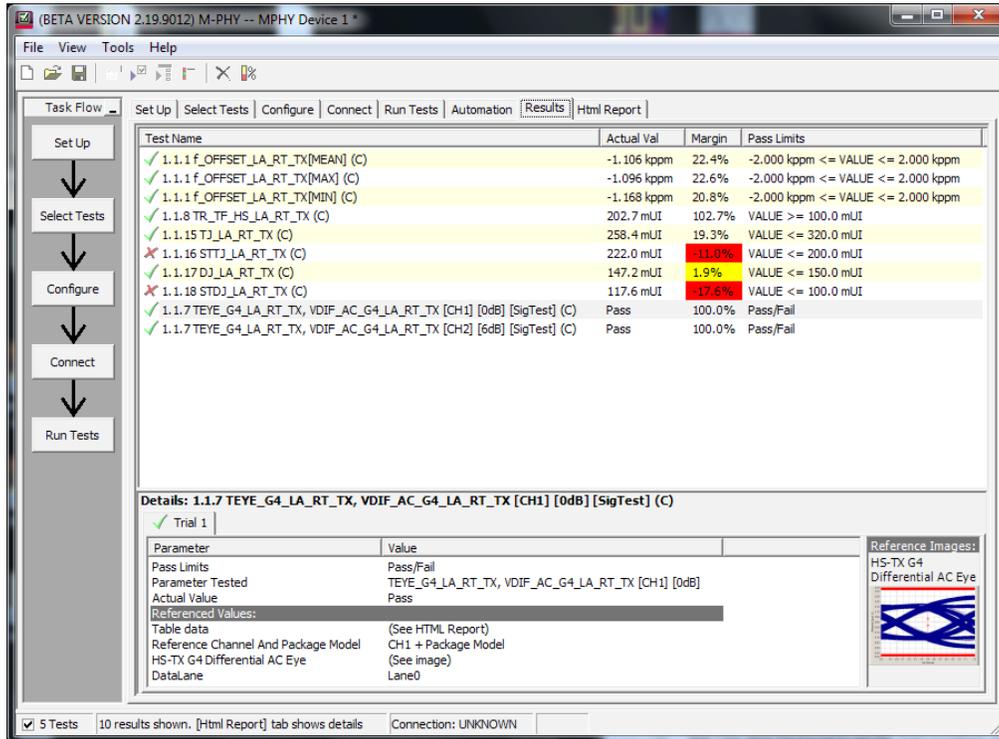


Figure 3. Results reports highlight test margins versus specified limits and a summary of measurements that pass/fail or violate the margin warnings you have set.



Extensibility

You may add additional custom tests or steps to your application using the N5467B/N5467C 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.

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; and
- 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.



Automation (Continued)

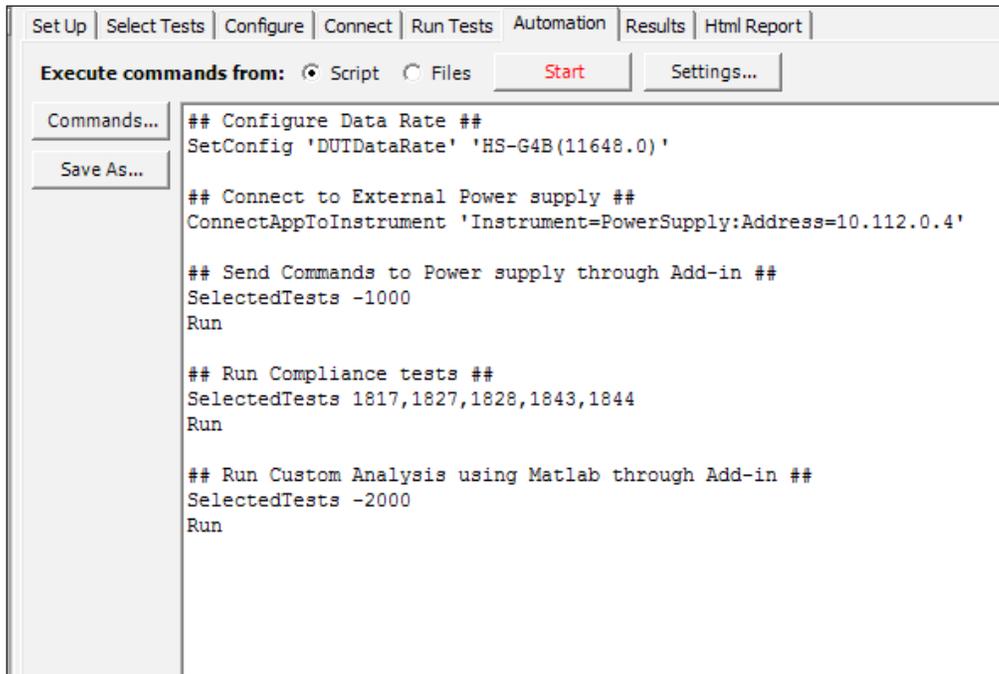


Figure 4. Remote programming script in the Automation tab.

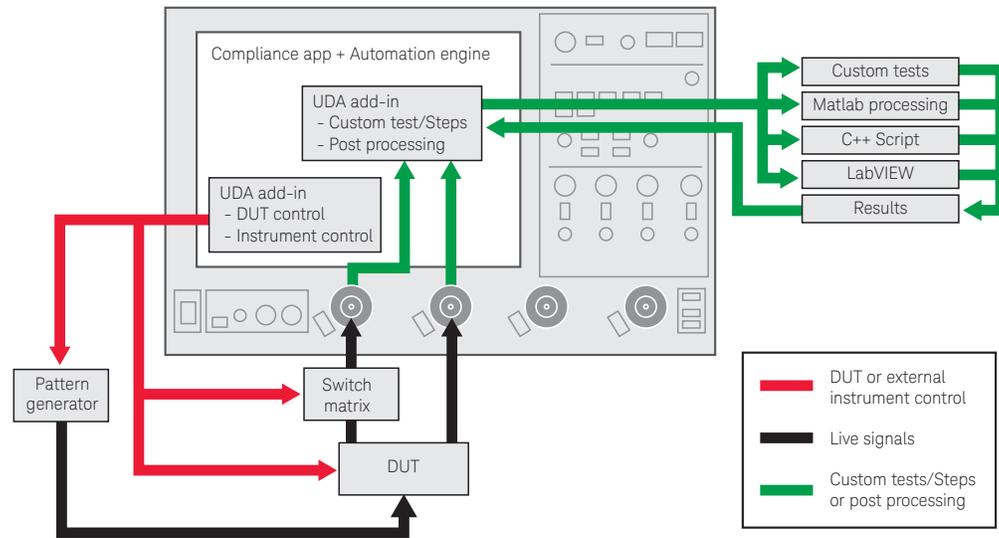


Figure 5. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.



Switch Matrix

The Keysight switch matrix software option for the conformance 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 PrecisionProbe or InfiniiSim features to compensate for switch path losses and skew.
- Customize testing by using remote programming interface and the UDA tool for device control, instrument control and test customization.

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



Figure 6. Automated testing for multi-lane digital bus interface through switching solution.



Supported Test Items

Group 1: HS-TX tests

1.1.1 UIHS and fOFFSET_TX
1.1.2 PSDCM_TX(informative)
1.1.3 THS_PREPARE
1.1.4 VCM_TX
1.1.5 VDIF_DC_TX
1.1.6 TEYE_TX, VDIF_AC_TX(Gear1 and Gear2)
1.1.7 TEYE_HS_G3/G4_TX, VDIF_AC_HS_G3/G4_TX
1.1.8 TR_HS_TX and TF_HS_TX(Informative)
1.1.9 TL2L_SKEW_HS_TX(if supports 2 or more lanes)
1.1.10 SRDIF_TX[MIN/MAX](for Gear1 only)
1.1.11 SR_DIF Monotonicity(for Gear1 only)
1.1.12 Δ SR_DIF_TX (for Gear1 only)
1.1.13 TINTRA_SKEW_TX
1.1.14 TPULSE(Informative)
1.1.15 TJTX(In case, TEYE_TX is fail)
1.1.16 STTJTX(In case, TEYE_TX is fail)
1.1.17 DJTX(In case, TEYE_TX is fail)
1.1.18 STDJTX(In case, TEYE_TX is fail)

Group 2: PWM-TX tests

1.2.1 TPWM_TX
1.2.2 kPWM_TX
1.2.3 TPWM_PREPARE
1.2.4 VCM_TX
1.2.5 VDIF_DC
1.2.6 TEYE_TX(OBSOLETE)
1.2.7 VDIF_AC_TX
1.2.8 TR_PWM_TX and TF_PWM_TX
1.2.9 TL2L_SKEW_PWM_TX
1.2.10 PWM_TX
1.2.10 TOLPWM_G1_LR_TX
1.2.11 TPWM_MINOR_GO_TX

Recommended Oscilloscopes

The M-PHY compliance software is compatible with Keysight Infiniium Series oscilloscopes with operating software revision 6.00.01001 or higher. For oscilloscopes with earlier revisions, free upgrade software is available here: www.keysight.com/find/scope-apps-sw.

Data rate	Minimum bandwidth	Minimum channels	Compatible oscilloscopes
Gear1 (up to 1.46 Gbps)	6 GHz	2	90000, V-Series and Z-Series
Gear2 (up to 2.92 Gbps)	12 GHz		90000, V-Series and Z-Series
Gear3 (up to 5.83 Gbps)	20 GHz		V-Series and Z-Series
Gear4 (up to 11.66 Gbps)	25 GHz		V-Series and Z-Series



Ordering Information

To purchase the M-PHY software with a new or existing Infiniium series oscilloscope. Order the following options.

Software options

Application	License type		V-series	Z-series	90000A	S-series	9000A
M-PHY conformance software	Fixed	User-installed			U7249E-1FP		
	Floating	Transportable			U7249E-1TP		
		Server-based			N5435A-116		
M-PHY conformance software M-PHY v4.0/ v4.1 upgrade	Fixed	User-installed			U7249E-2FP		
Serial data analysis with clock recovery (included in DSA model) - Mandatory	Fixed	Factory-installed	E2688A-1FP		Option 003	N5384A-1FP	Option 003
		User-installed			E2688A-1NL		N5384A-1NL
	Floating	Transportable	E2688A-1TP			N5384A-1TP	
		Server-based	N5435A-003				
EZJIT Complete (included in DSA model) - Mandatory	Fixed	Factory-installed	N8823A-1FP		Option 070	N8823B-1FP	Option 070
		User-installed			N8823A-1NL		N8823B-1NL
	Floating	Transportable	N8823A-1TP			N8823B-1TP	
		Server-based	N5435A-067				
M-PHY switch matrix support (optional)	Fixed	Factory-installed	N8890A-1FP		Option 097	N8890A-1FP	–
		User-installed			N8890A-1FP		
	Floating	Transportable	N8890A-1TP			N8890A-1TP	
		Server-based	N5435A-124				
PrecisionProbe (optional)	Fixed	Factory-installed	N2809A-1FP		Option 001	N2808A-1FP	–
		User-installed			N2809A-1FP		N2809A-1NL
	Floating	Transportable	N2809A-1TP			N2808A-1TP	
		Server-based	N5435A-003				
InfiniiSim (optional, but recommended for Gear3 and Gear4)	Fixed	Factory-installed	N5465A-1FP		Option 014	N5465B-1FP	Option 014
		User-installed			N5465A-1FP		
	Floating	Transportable	N5465A-1TP			N5465B-1TP	
		Server-based	N5435A-027				

Other hardware, probes and accessories

Model number	Description	Quantity
1169B	InfiniiMax II 12 GHz differential probe amplifier for PWM, G1, G2 testing	2
E2669B	Differential probe connectivity kit (contains needed probe header)	1
15443A	Matched cable pair, 2 x SMA(m) to SMA(m) cable included	1
N7010A	Active termination adapter for Gear3, Gear4 testing	2





www.axiestandard.org

AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. The business that became Keysight was a founding member of the AXIe consortium. ATCA®, AdvancedTCA®, and the ATCA logo are registered US trademarks of the PCI Industrial Computer Manufacturers Group.



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LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. The business that became Keysight was a founding member of the LXI consortium.



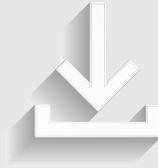
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