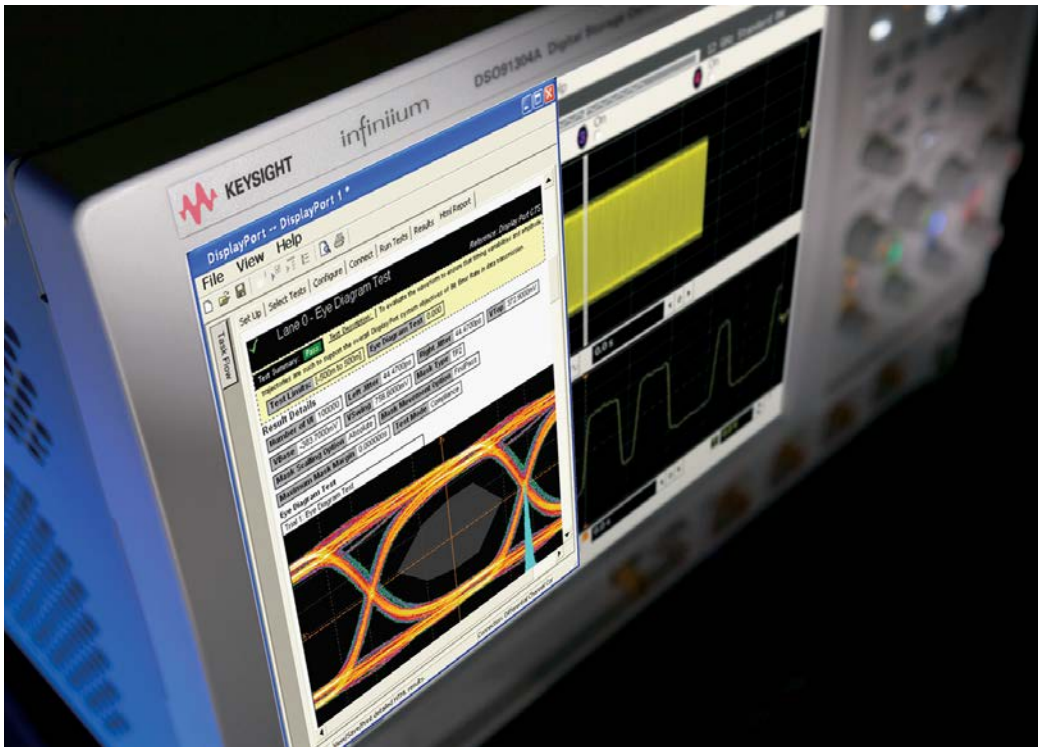
Keysight U7232D

DisplayPort Electrical Performance Validation and Compliance Software

For Infiniium Series Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

DisplayPort Compliance Software Helps You Do The Right Job Faster

Verify and debug your DisplayPort designs more easily

Keysight Technologies, Inc. DisplayPort Electrical Performance Validation and Compliance software for Infiniium Series oscilloscopes (see Table 2) provides you with a fast and easy way to verify and debug your DisplayPort interface designs for sink and source ICs, motherboard systems, computers and graphics cards and now supports the DisplayPort 1.4 specification. The DisplayPort electrical test software is designed for use in DisplayPort Authorized Compliance Test Houses, so you can confidently use it to execute DisplayPort electrical checklist tests as well as employ it as a characterization tool.

To introduce a DisplayPort product to the market, your product must successfully pass compliance testing based on the DisplayPort specification at an approved DisplayPort test center or through a self certification regimen defined by VESA [1] in cooperation with your company. Either way, you will want to use the DisplayPort Electrical Performance Validation and Compliance software to troubleshoot, if necessary, and then to validate the design by performing the tests before the final compliance test run.

Features

The DisplayPort electrical test software is a full-featured package to simplify the validation process of DisplayPort designs:

- Full Physical Layer Testing High speed Lanes
- Full physical layer testing of AUX channels
- Support of 1.2 and 1.4 CTS versions
- Test Status tracking
- Support of MyDP/SlimPort
- Measurement process configurability
- Support of DualMode, or DP++
- Automated scope measurement setup
- Test results reports with pass/fail margin analysis
- Automation control through AUX Channel Controller
- Optional switch control

With the DisplayPort electrical test software, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on the DisplayPort-specified test checklist.

Save time

The DisplayPort Electrical Performance Validation and Compliance software saves you time by setting the stage for automatic execution of DisplayPort electrical tests. Part of the difficulty of performing electrical tests for DisplayPort is connecting the oscilloscope to the target device, configuring the instrument for measurements, executing the test procedures, defining the capabilities of the device under test, and then analyzing the measured results by comparing them to limits published in the specification. The DisplayPort electrical test software does almost all of this work for you. In addition, if you discover a problem with your device, debug tools are available to aid in root-cause analysis.

The DisplayPort software offers the electrical tests for the source as well as important tests for cable and calibration for receiver tolerance testing. The 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. Clock recovery of each lane is accomplished according to the standard by the oscilloscope using proprietary software techniques. See Table 1 for a complete list of the measurements made by the DisplayPort electrical test software.

Easy test definition

The DisplayPort Electrical Performance Validation and Compliance software extends the ease-of-use advantages of Keysight's Infiniium Series oscilloscopes to testing DisplayPort designs. The Keysight automated test engine walks you quickly through the steps required to define the device under test, to select the tests, set up the tests, perform the tests, and view the test results. You can pick high-level test parameters to suit your test process objectives, and then you can proceed to select a category of tests all at once, or specify individual tests. The user interface is oriented to minimize reconnections, which saves you time and minimizes potential for operator error. 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.

Further test process control is also provided through the automation tab of graphical user interface. This tab allows the user to tailor scripts to control external equipment such as power supplies and temperature control units, or to provide a different test flow.

1. Video Electronics Standards Association (**www.vesa.org**)
2. SlimPort is a trademarked implementation of MyDP by Analogix

Test Environment Setup and Test Selection

The DisplayPort Electrical Performance Validation and Compliance software now allows you to define the DUT capability and select test environment variables to better suit your testing goals for speed and cost. The setup process begins with the Setup entry screen (shown in Figure 1). This screen enables selection of the DisplayPort Compliance test specification (for instance 1.2b or 1.4 as shown in Figure 1) and test groupings for hi-speed video lane testing (Physical Layer Tests), AUX Channel and whole device characteristics (AUX PHY and Inrush Tests), or HDMI over the DisplayPort interface (DualMode tests). This screen will also let you choose between exposing just normative (mandatory) tests or all tests: normative and informative. The bottom portion of the environment Set Up tab is dedicated to automation through the AUX test mode. After making the appropriate selections for you testing, the setup continues with DUT characteristics entry and connection specifics when the Test Setup button is selected.

The Test Setup button presents a series of screens that allow the user to enter the key test and environment information because there is a wide range of test connections and optional performance allowed for in the DisplayPort specification.

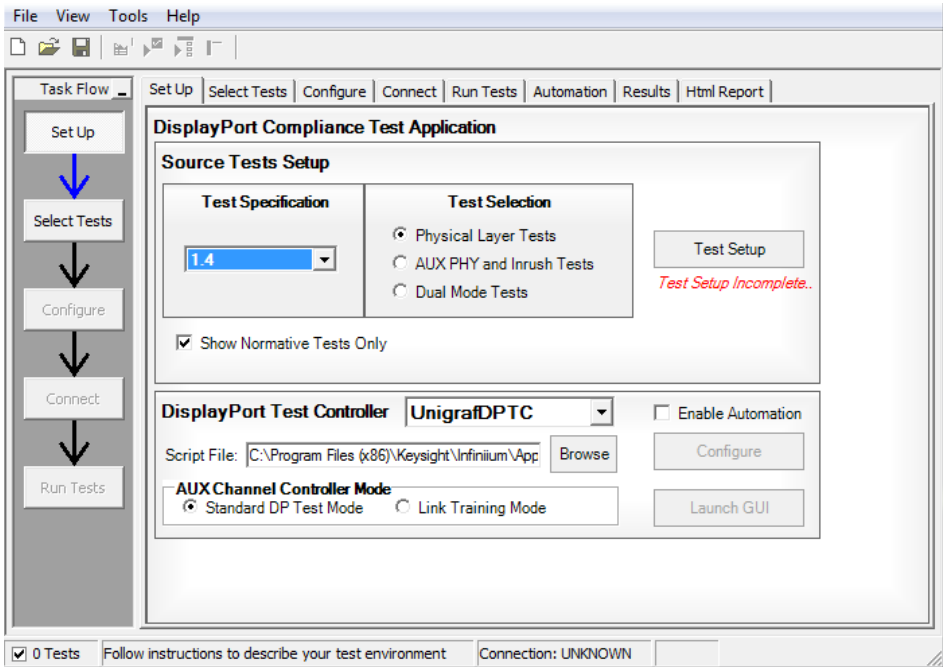


Figure 1. DisplayPort Test Environment Setup.

Some of this test process information is briefly described below.

- Device ID: Enter the device name and other pertinent information
- Operator ID: For compliance test houses to identify the operator for QA process.
- Project ID: For compliance test houses that identify projects by number this enables the report to carry a key identification number to a contract.
- Device type: Allows you to select between cable test, sink test and source test suite. The most common selection is source testing.
- Test type: Define whether tests will be single ended or differential. See Figure 2.
- DUT definition: Select the capabilities of the DUT you wish to test. See Figure 3
- Test fixture selection: Select the test fixture used. See Figure 4.
- Connection type: Single-ended vs. differential connection: Choose between using two channels of the scope to make a differential measurement using an 'A minus B' technique or by using differential probe on each scope channel for each lane, see Figure 4.
- Number of channels: You may choose to test 1, 2, or 4 channel connection. (Note: Differential connection allows full lane selection, while single-ended can only support testing 1 or 2 lanes). See Figure 4.
- Oscilloscope connection: This screen allows you to assign oscilloscope channels and device lanes to test. See Figure 5.

Test Environment Setup and Test Selection (Continued)

The first setup screen is shown in Figure 2 with the Start Project screen. This is where the project information and device specifics such as Test Device, and Test Type are entered. The Test Type refers to whether the tests to be selected from a subsequent menu will be single ended tests only, differential tests only, or both single-ended and differential tests.

A new capability to the DP EPV&C software is to define data pattern; selections are standard DP pattern and arbitrary data pattern.

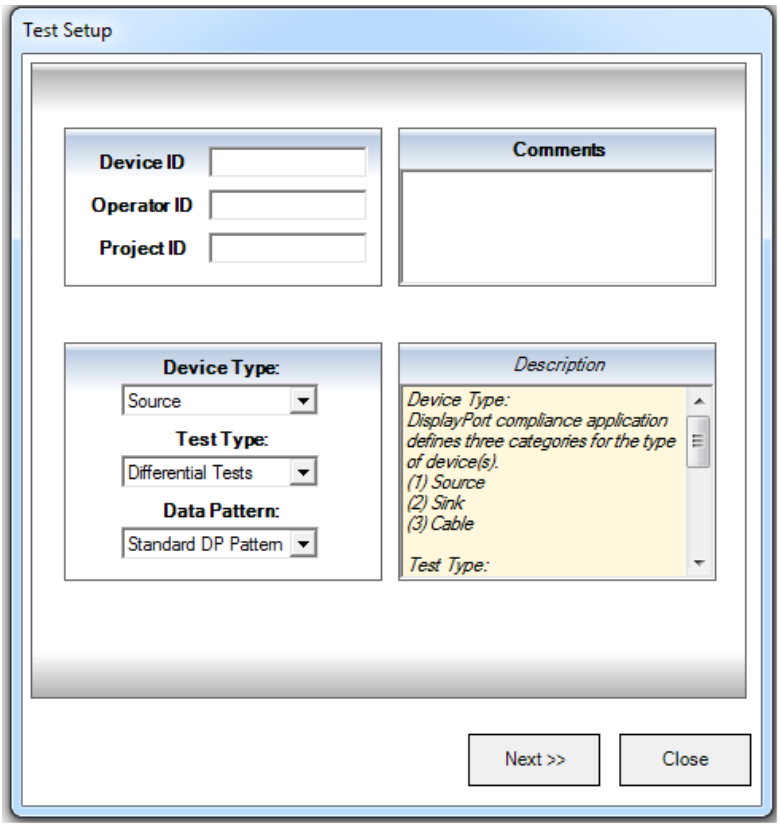


Figure 2. Start Project screen to enter standard test data and select Test Device Type and Test Type. Shown is Test Type = Both to support single-ended and differential tests.

Device definition

Critical information to guide the test process will be the device capability information. This is information about the test device such as the valid levels, pre-emphasis settings, number of lanes, bit rates and whether spread spectrum clocking is enabled or not. These capabilities are identified in the DUT Definition screen in Figure 3.

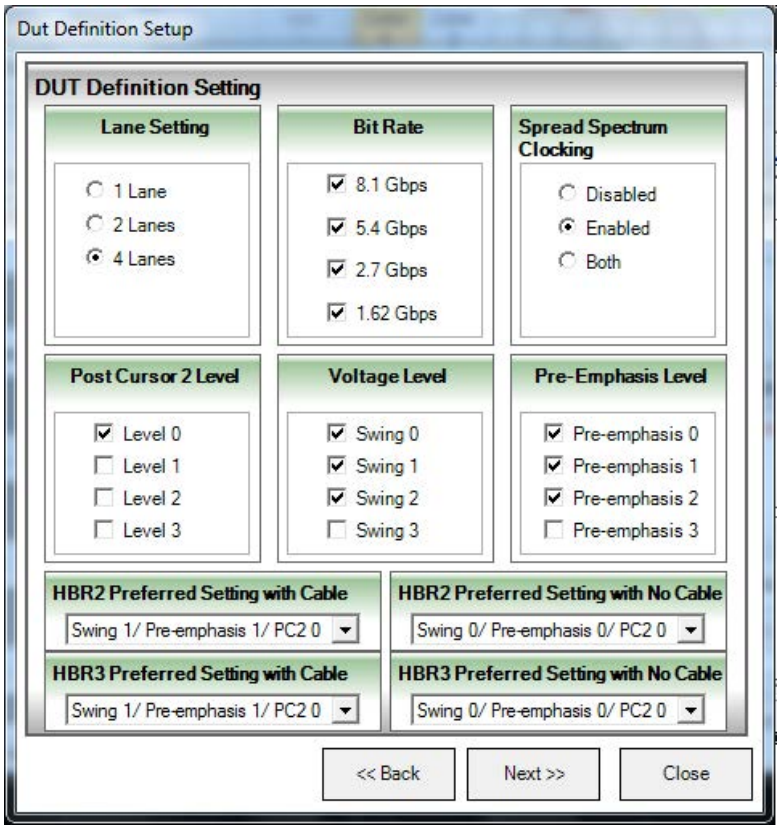


Figure 3. DisplayPort EPVC software DUT Definition Entry in Setup.

Test Connection Setup

Upon completion of the device definition, the Test Connection Setup screen is presented. This screen enables entry of parameters that affect the connection of the device to the oscilloscope. Specifically, the fixture, the type of connection and number of lanes connected. The fixture selection enables not only Keysight fixtures, but any of the current fixtures provided by various fixture vendors as well. While the de-embed files are available for fixtures, the other fixtures will have de-embed files as they are made available. The Connection Type relates to how the signal gets to the scope channel. If by differential probe, then a probe amplifier is assumed (such as the 1169A or N2800A) and the operator will then have the choice of using 1, 2, or 4 channels of test (depending on whether the appropriate number of lanes has been selected). If the Connection Type is selected is single-ended then each differential lane of the test device will have two connections to the scope. By default these are routed to channels 1 and 3, or 2 and 4. This means only two maximum lanes may be tested this way at a time. Note: if the Test Type selection in the Start Project screen was 'Both' or 'Single-Ended', then the Connection Type will default to 'Single ended' and will be grayed out. The number of channels allowed will always be aware of the upstream selections so will limit the number of channels based those inputs.

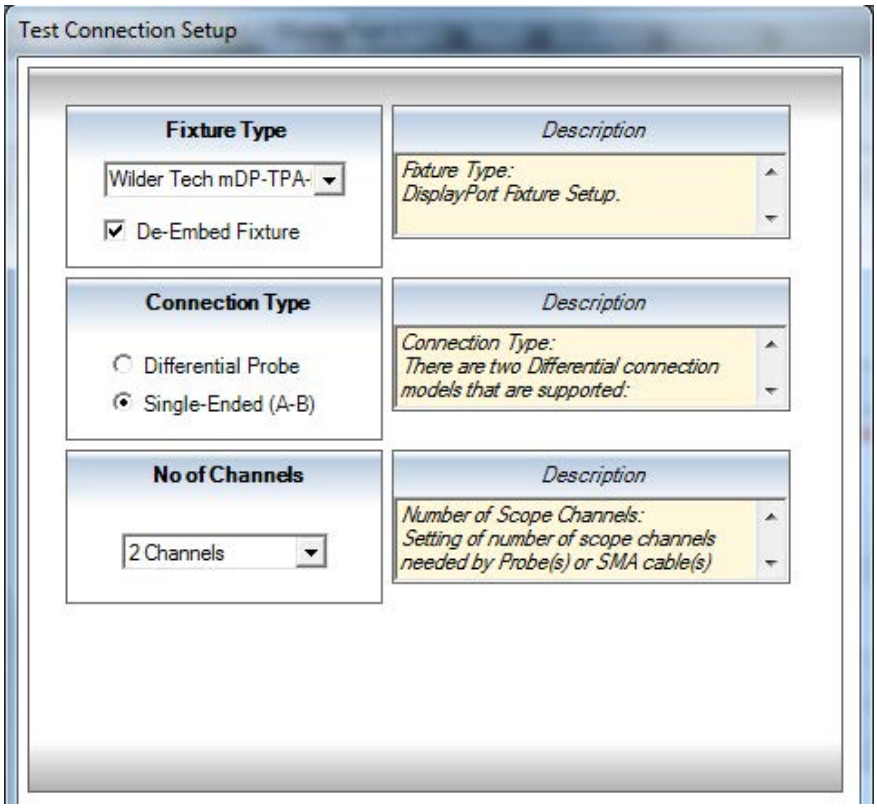


Figure 4. DisplayPort EPVC software Test Connection Setup Screen.

The final screen in the Test Setup loop is the Channel Assignment Setup (shown in Figure 5). It will portray the connection expected in number of channels and type of connection requested. It is editable and if there are channel assignment conflicts, the user is alerted to the fact.

Test Selection

After defining the test environment through the test setup loop, you are presented with only those tests that are appropriate for the environment chosen. For instance, if spread spectrum clocking (SSC) is not enabled, then no SSC tests will appear. This is the case for the optional settings of pre-emphasis and levels as well. If your device definition is one lane only, or your defined device connection is one lane (one differential probe or two single-ended connections) then no inter-pair skew tests will appear in the test suite. This dynamic filtering simplifies your job by ensuring you attempt to test only what is possible for the DUT and the connection model you have chosen.

The DP 1.4 test suite is shown in the Test Selection screen is shown in Figure 6. It is partitioned in groups of tests as a function of the pattern that is required to test. HBR (2.7 Gb/s) and RBR (1.62 Gb/s) bit rates require PRBS7 and D10.2 patterns while HBR2 (5.4 Gb/s) require special patterns such as the HBR2 compliance test pattern that has a repetition length of 2520 bits (referred to as 'CP2520' or 'HBR2CPAT'). Tests may be selected independently and any number of tests may be selected for a given run. If more than one lane is possible to run (as determined by the selections in Setup) then test selection by lane is also possible. If different connections or conditions of test are required from one test to another, a splash screen is presented to the user indicating the required change. When automation mode is used with the AUX Channel Controller, the device is changed automatically and there is no need for the splash screens.

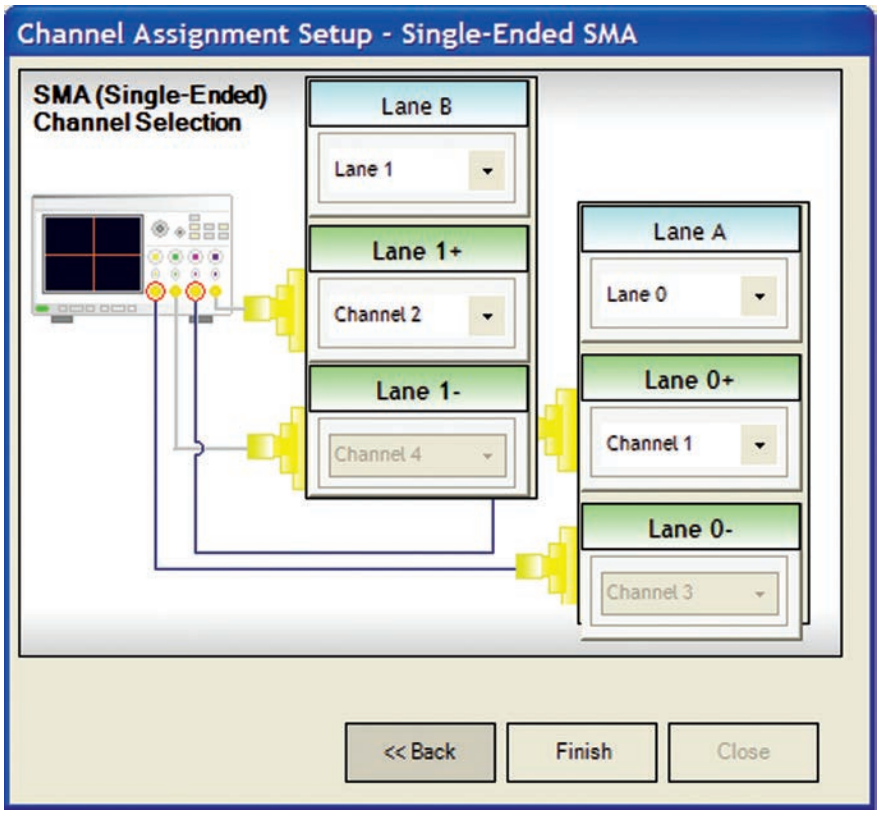


Figure 5. Channel Assignment Setup: Lane and oscilloscope assignment: Two Lane Single-ended Connection using all four scope channels.

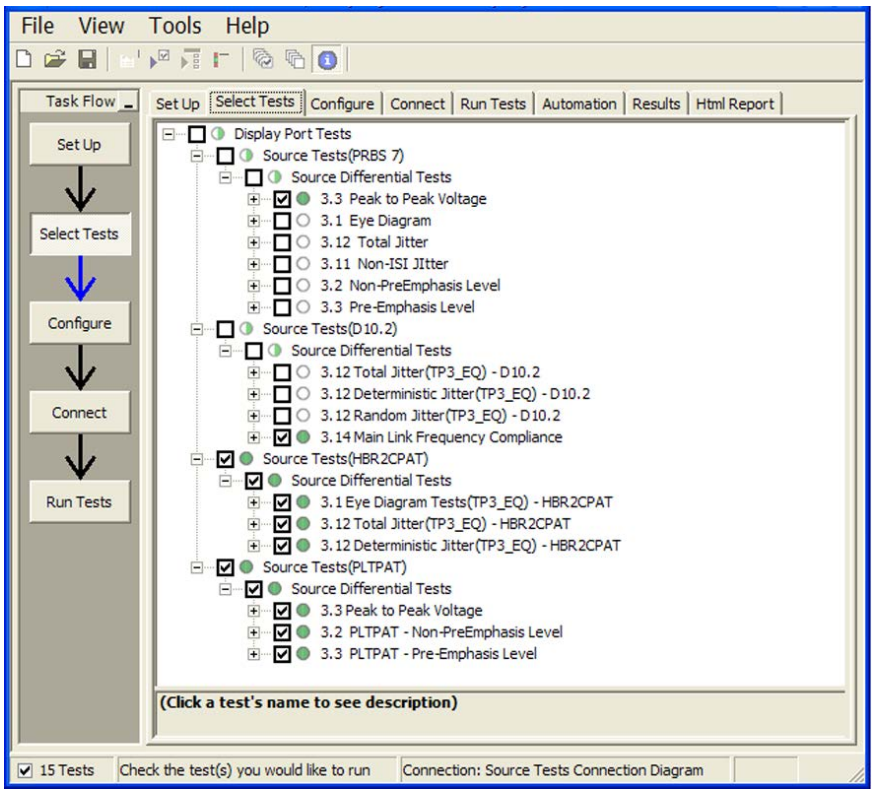


Figure 6. Lists the tests that are selectable and their status. Status bubbles indicate successful completion, failure, or incompletion.

Configurability and Guided Connections

The DisplayPort Electrical Performance Validation and Compliance software provides flexibility in your test setup. It guides you to make connection changes with hookup diagrams when the tests you select require it. For test parameters such as bandwidth, you can select appropriate values. For more critical parameters, such as mask scaling option or number of edges for analysis, default values are tied to the compliance standard; these values can only be altered in the debug screen. In Figure 7 you can see the selection for various eye mask test functions. The default for compliance mode is “Fixed” which places the mask in the center of the eye per the DisplayPort Compliance test specification (shown is ‘Find Margin,’ which will find the range of passing conditions).

Note: For HBR2 the eye diagram testing is different from RBR and HBR as it comprehends 10^{-9} BER limits; so the ‘Find Margin’ capability is not available. For HBR3, the testpoint is TP3EQ with the equalizer being a combination of CTLE and DFE. Because the DFE is computationally complex, a standard mask is used.

After you configure the test to meet your needs, the DisplayPort EPV&C software user interface displays the connection screen, which is specific to the configuration data you have selected. Figure 8 illustrates the typical connection guidance provided for a one channel “A minus B” single-ended connection model for a one lane test setup.

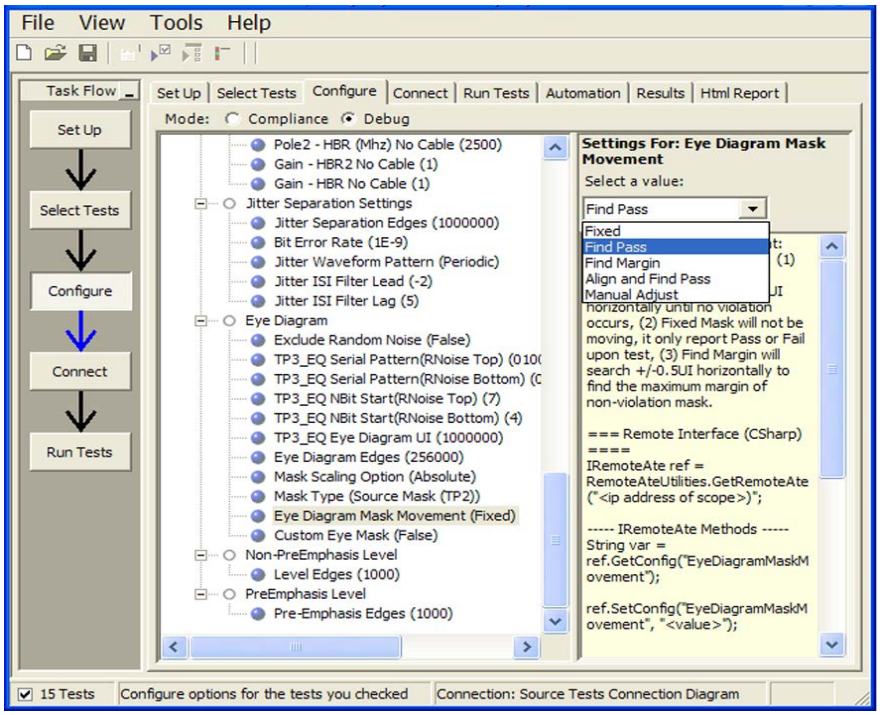


Figure 7. The Configure Tab enables changing measurement parameters in the ‘Debug’ mode to support characterization and debug activities.

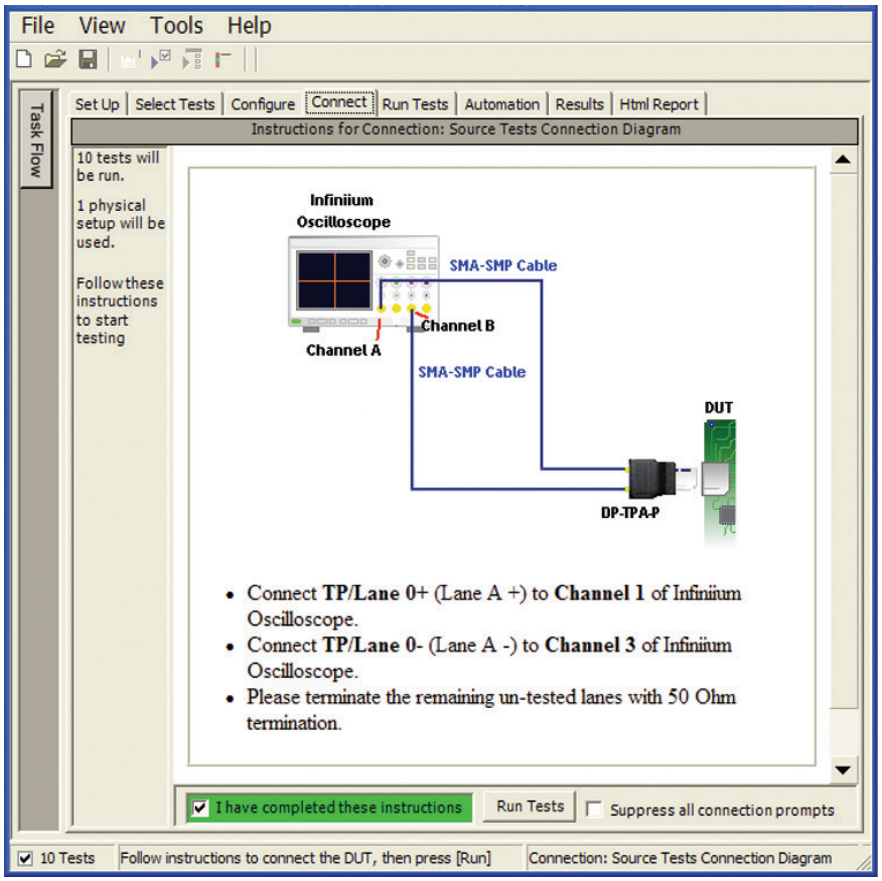


Figure 8. The final step before test is to illustrate the anticipated connection for the test.

Margin Analysis

In addition to providing you with measurement results, the DisplayPort Electrical Performance Validation and Compliance 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 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 DisplayPort compliance test specification for a given test assertion.

Eye margin: Another method of evaluating the eye is provided by sweeping the eye horizontally with the specified mask and determining the last locations on the left and right portions of the interior eye where there are no violations in the mask. The distance from the center mask location is a measure of design margin and is reported as eye margin if that eye mask mode is chosen in the configuration screen (Eye Diagram Mask Movement: Find Margin—see Figure 7 for example).

AUX channel and Dual Mode testing support

The DisplayPort EPV&C software also supports Dual Mode (DP++) testing for devices that are to interoperate with HDMI displays. Eye diagram and jitter tests have been ported from the HDMI software application, which is a preferred application in test labs around the world.

AUX channel testing is a different test suite selectable in the Setup screen. The tests available are shown at the bottom of Table 1.

Dual Mode and the AUX channel test suite are selected in the Setup screen shown in Figure 1.

Margin is calculated:

Single-sided specification:

$$\text{Margin} = (\text{Value}_{\text{Specification}} - \text{Value}_{\text{actual}})/\text{Value}_{\text{Specification}}$$

Double-sided specification:

$$\text{Margin} = \text{lowest of: } (\text{Value}_{\text{Specification_High}} - \text{Value}_{\text{actual}})/\text{Range}_{\text{Specification}}$$

$$\text{and } (\text{Value}_{\text{Specification_Low}} - \text{Value}_{\text{actual}})/\text{Range}_{\text{Specification}}$$

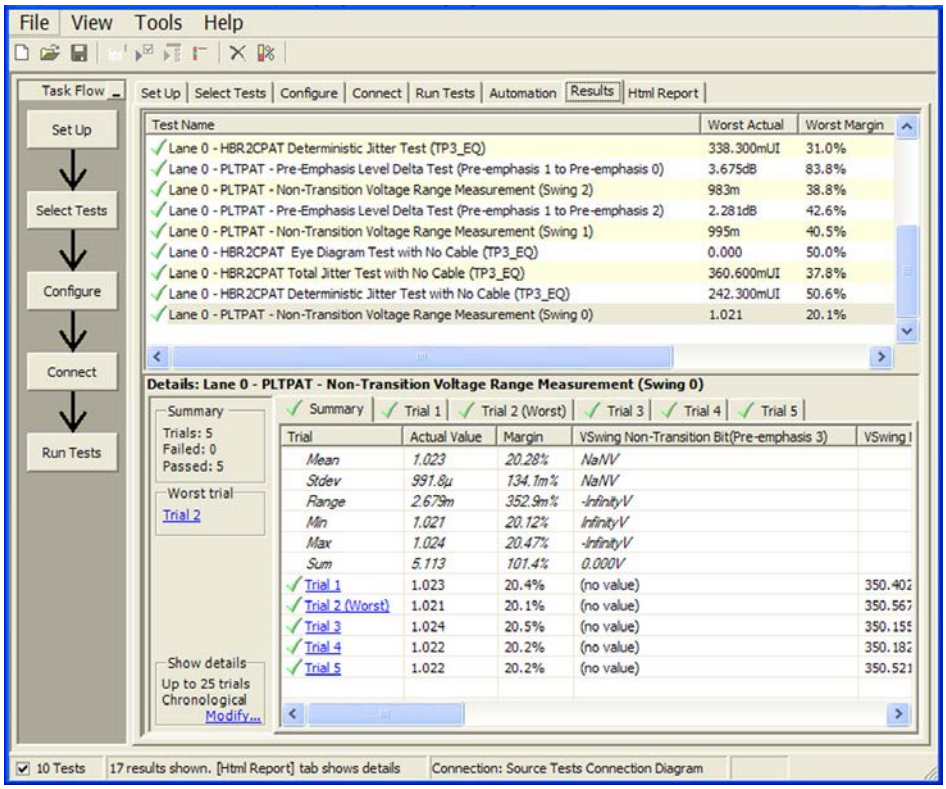


Figure 9. The DisplayPort EPVC test software results report documents your test, indicates the pass/fail status, the test specification range, the measured values, and the margin.

Thorough Performance Reporting

The DisplayPort Electrical Performance Validation and Compliance software generates thorough reports that not only capture the performance and status of the device under test, but also the screen shots of your most significant measurements for your perusal and evaluation. The first page of the report lists equipment and configuration details required in standard quality assurance programs. It also provides a hot-linked results table that will quickly get you to the measurement report section of interest.

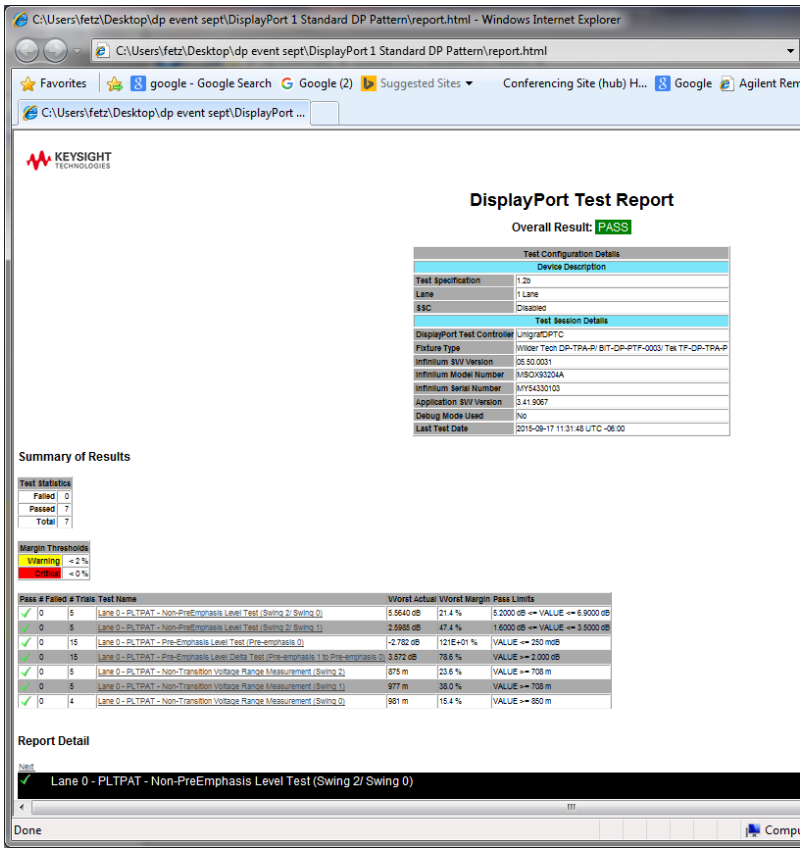


Figure 10. The DisplayPort compliance software generates a summary report where you can see the total test results for your device quickly and clearly. Additional details are available for each test, including the test limits, test description, and test results, including waveforms, if appropriate. All are hot linked to more detailed results further in report. In addition, the margin of the result is indicated to provide further insight.

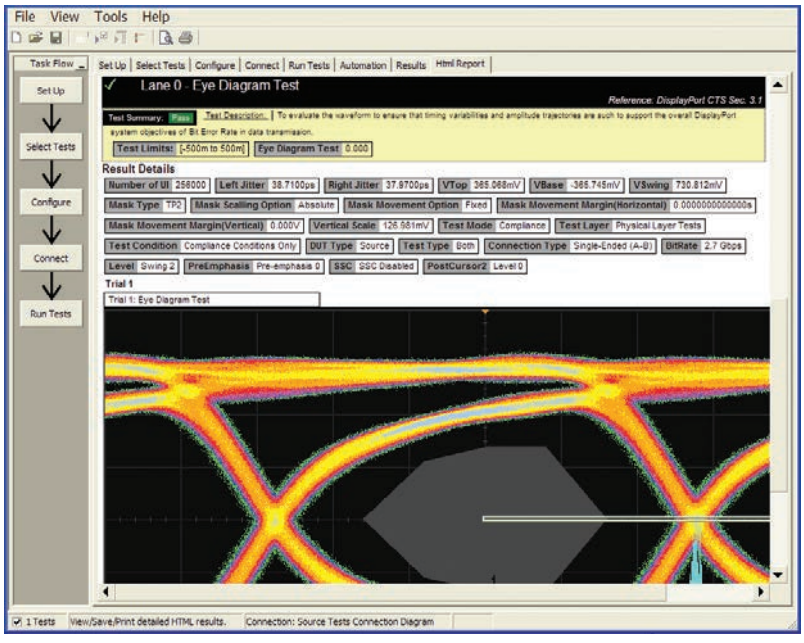


Figure 11. Summary report detail: The DisplayPort software's summary report provides screen shots of all the measurements that have been performed. In this figure you can see the data-eye. Observe the clear status and description at the top and the measurement data just above the eye.

Test Status Tracking

The DisplayPort Electrical Performance Validation and Compliance software can keep track of the status in a test plan and is visually viewable in the Test Run menu (Figures 12 and 13). In addition, you can choose to resume testing the device and the software will continue where it stopped the time before.

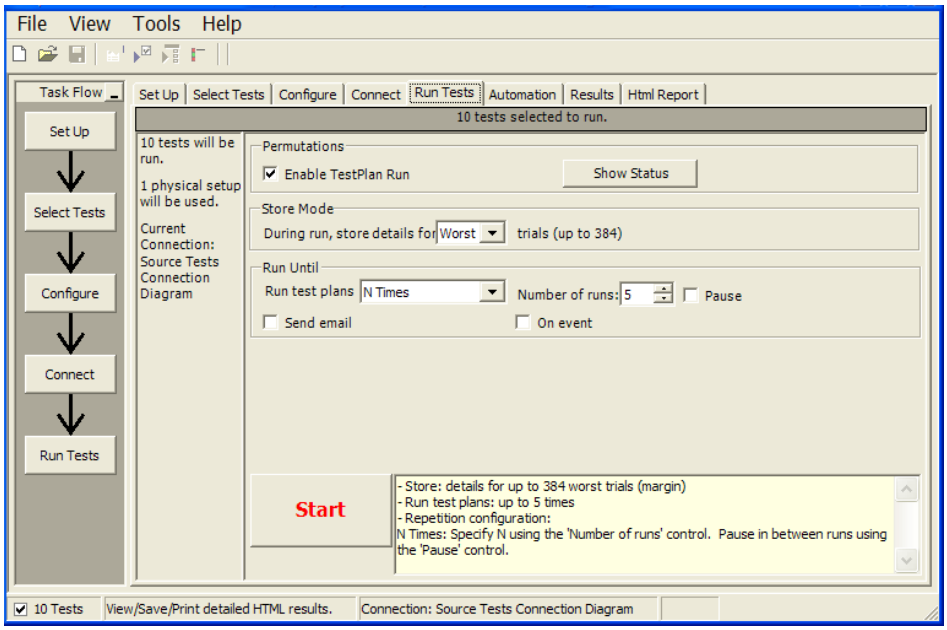


Figure 12. Show Test Status: Test Status selected in the Run Tests menu.

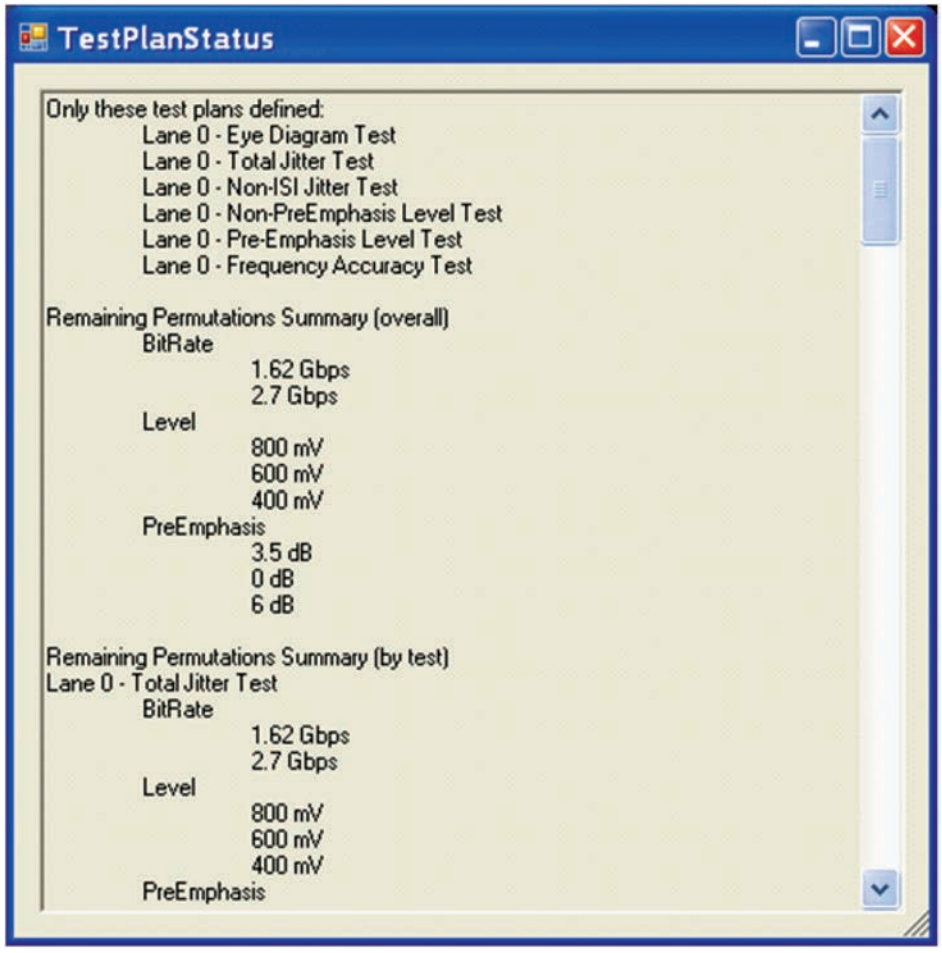


Figure 13. Test Status tracking: When all tests are complete there are no entries below 'Remaining Permutations Summary'.

Extensibility

You may add additional custom tests or steps to your application using the 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

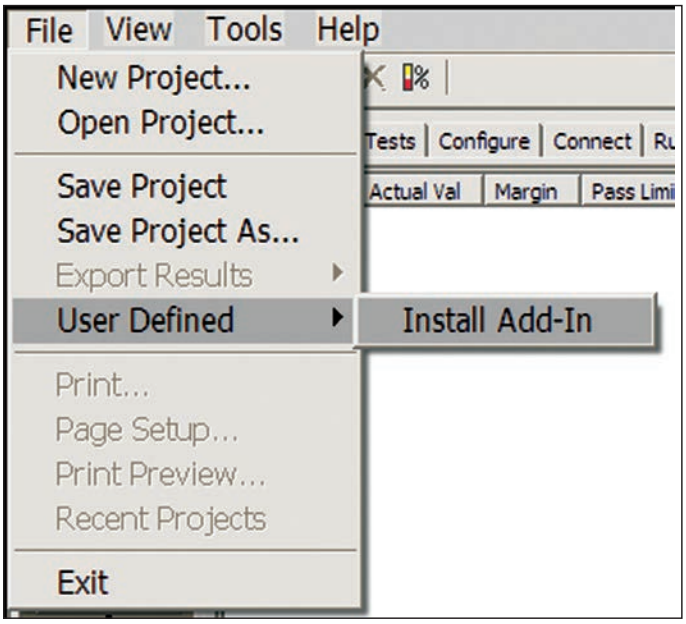


Figure 14. Importing a UDA Add-In into your test application.

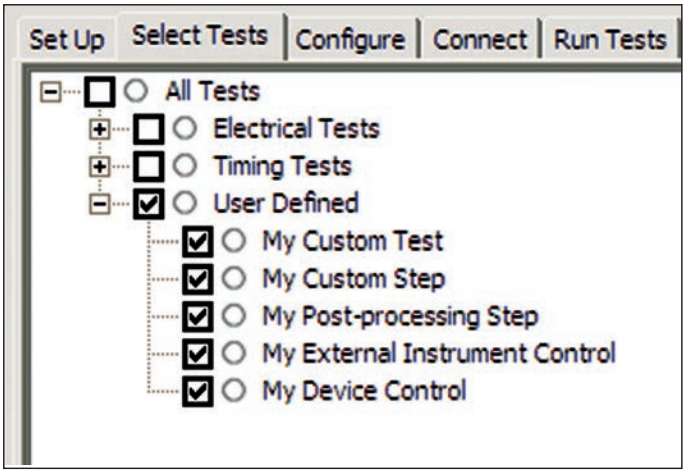


Figure 15. UDA Add-In tests and utilities in your test application.

Automation

You can completely automate execution of your application's tests and Add-Ins from a separate PC using the included 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.

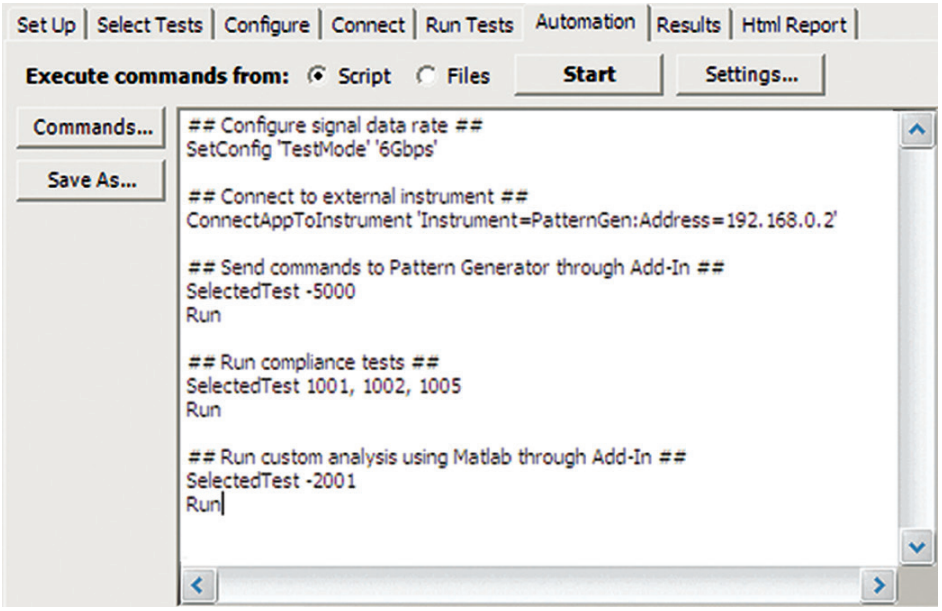


Figure 16. Remote Programming script in the Automation tab.

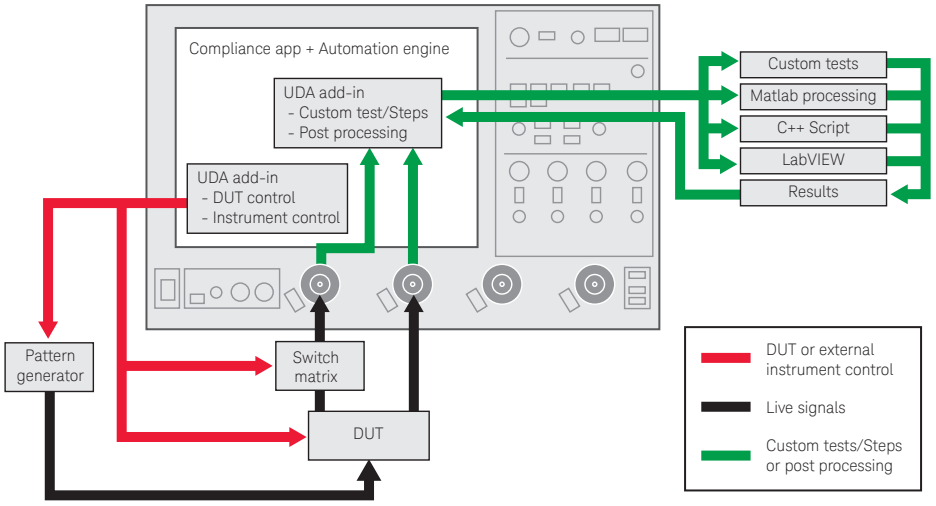


Figure 17. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Switch Matrix

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

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

Figure 18. Automated testing for multi-lane digital bus interface through switching solution.

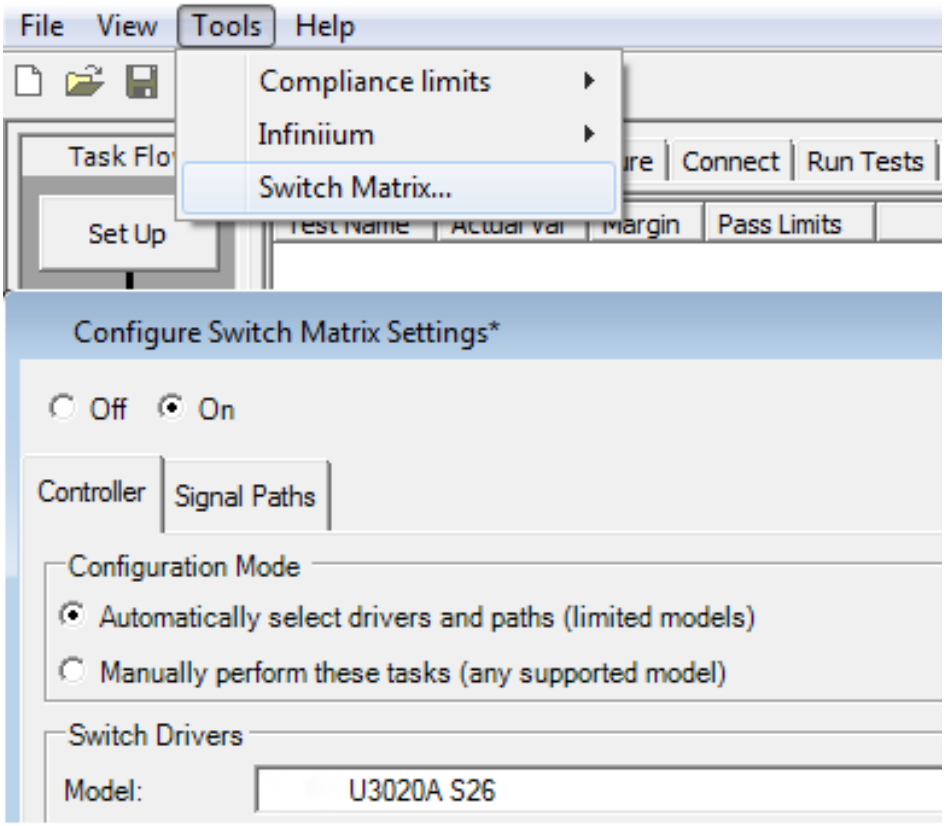


Figure 19. Switch matrix software feature enabled in the compliance application.

DisplayPort Test Point Adapters

DisplayPort has added other connector forms in addition to the original standard connector. These include the Mini-DP connector (mDP), the eDP connector (in 20, 30, 40, and 50 pin versions), and most recently the USB Type-C connector. The DisplayPort Electrical Performance Validation and Compliance software allows you to choose the test point adapter you want and if the file is available from the vendor, it allows you to de-embed it as well.

DisplayPort AUX channel control

The DisplayPort specification allows for automated device control through manipulation of the DPCD (DisplayPort Configuration Data) registers. Those registers are most conveniently controlled by an AUX channel controller. The choice of AUX channel controllers is shown in the ordering information section.

N7015A Type-C connector Test Point Adapter

Figure 20. The Keysight N7015A USB Type-C Test Point Adapter Fixture.

Measurement connections

To use the DisplayPort Electrical Performance Validation and Compliance software with any test point adaptor you will need the cables and other sundry components. The Keysight N7015A USB Type-C TPA fixture or Wilder Technologies TPAs may require extra cables to get to scope channels when connected single-ended. Order from matched cable sets in the accessories table below. Use of differential probe amplifiers and appropriate SMA probe heads is optional. However, if you want connection simplicity, consider these probes for one-time setup and complete characterization for all differential measurements.

You can minimize reconnect time by using four InfiniiMax probes to measure all four Main Link differential data lanes (Lane0, Lane1, Lane2, Lane3) without having to reposition or reconnect probes. To use this capability, select Connection Type: Differential Probe, Number of Channels: Four Channels in the Setup screen.

If you are not using a Test point adaptor but probing signals with solder in differential probes or browsers then you will need to select the appropriate probe head for the task and the probe amplifier system you are using. For instance, if the high speed signals are only accessible through a terminated 50-Ω transmission line (for testing silicon devices for example), you will need to use solder-in differential probe heads for differential probing and select these in the scope channel setup menu.

Tests Performed

The DisplayPort Electrical Performance Validation and Compliance software performs all the anticipated required tests for the DisplayPort Compliance Test Specification 1.4 (CTS 1.4).

Table 1. DisplayPort electrical tests performed by the DisplayPort software

Assertion no.	Test description	Compliance status	Included with DP EPVC software
Section 3	**Source tests**		
Test ID 3.1	Data Eye Diagram	Normative	Yes
Test ID 3.2	Non Pre-Emphasis Level Verification	Normative	Yes
Test ID 3.3	Pre-Emphasis Level Verification	Normative	Yes
Test ID 3.4	Inter-Pair Skew	Normative	Yes
Test ID 3.5	Intra-Pair Skew	Informative	Yes
Test ID 3.6	Differential Transition Time	Omitted [1]	Yes
Test ID 3.7	Single-Ended Rise and Fall Mismatch	Omitted [1]	Yes
Test ID 3.10	AC Common Mode Noise	Informative	Yes
Test ID 3.11	Non-ISI Jitter Measurements	Normative	Yes
Test ID 3.12	Total Jitter Measurements	Normative	Yes
Test ID 3.14	Main Link Frequency Compliance	Normative	Yes
Test ID 3.15	Spread Spectrum Modulation Frequency	Normative	Yes
Test ID 3.16	Spread Spectrum Modulation Deviation	Normative	Yes
Test ID 3.17	Spread Spectrum dF/dt	Informative	No
Test ID 3.18	Dual Mode: TMDS Clock	Normative	Yes
Test ID 3.19	Dual Mode: TMDS Eye Diagram Testing	Normative	Yes
Section 8	**Common tests (refer to CTS 1.2b)**		
Test ID 8.1	AUX Manchester Channel Eye	Normative	Yes
Test ID 8.2	AUX Manchester Channel SensitivityTest	Normative	Yes
Test ID 8.3	Aux Channel DC Test: Aux - Termination	Normative [2]	No
Test ID 8.4	Aux Channel DC Test: Aux + Termination	Normative [2]	No
Test ID 8.5	Inrush/Outrush Tests	Normative	Yes
Test ID 8.6	DP_PWR DC Levels	Normative	No
Test ID 8.7	DP_PWR Current	Normative	No
MyDP Tests			
Tests identified in Section 7.1 and 4.3 of MyDP CTS v1.0			

Recommended Oscilloscopes

The DisplayPort Electrical Performance Validation and Compliance software is compatible with all Infiniium real-time oscilloscopes with latest software revision. For oscilloscopes with earlier software revisions, free upgrade software is available at **http://www.keysight.com/find/infiniium_software**.

Table 2. Recommended oscilloscopes

Minimum bandwidth	Minimum channels	Oscilloscope models
13 GHz [3]	4 channels	Infiniium 90000A, 90000 X-, V-Series, and Z-Series

1. These tests originally included for DisplayPort CTS 1.1, omitted since CTS 1.2 and provided informationally.
2. Tests 8.3 and 8.4 are easily accomplished on a source device with use of an AUX signal breakout device such as the Wilder TPA-DP-A with external resistors, a 3.3 volt power supply and a voltmeter.
3. 13 GHz minimal for HBR3. 16 GHz recommended.

Note that the DisplayPort test software can make other measurements not included here, such as receiver eye measurements and equalized eye measurements as well most of the omitted CTS 1.1 measurements.

Ordering Information

Application	License type		Infiniium V-Series and Z-series	Infiniium 90000 Series	Infiniium 90000 X-Series
DisplayPort EPV&C software (DisplayPort 1.2 and 1.4)	Fixed	Factory-installed	DSOV000-092, DSOZ000-092	DSO90000A-085	N/A
		User-installed	U7232D-1FP	U7232D-1FP [1]	U7232D-1FP [1]
	Floating	Transportable	U7232D-1TP	U7232D-1TP [1, 2]	U7232D-1TP [1, 2]
		Server-based	N5435A-093		
DisplayPort 1.2 upgrade [3] to DisplayPort 1.4	Fixed	Factory-installed	N/A	N/A	N/A
		User-installed	U7232D-2FP	N/A	U7232D-2FP
	Floating	Transportable	N/A	N/A	N/A
		Server-based	N/A		
DisplayPort EPV&C software (DisplayPort 1.2 only)	Fixed	Factory-installed	U7232D-3FP	DSO90000-045	DSOX90000-045
		User-installed	U7232D-3FP	U7232D-3FP [1]	U7232D-3FP [1]
	Floating	Transportable	U7232D-3TP	U7232D-3TP [1, 2]	U7232D-3TP [1, 2]
		Server-based	N5435A-041		
Serial data analysis software (included in DSA model)	Fixed	Factory-installed	E2688A-1FP	DSO90000A-003	DSOX90000-003
		User-installed	E2688A-1FP	E2688A-1NL [2] or E2688A-1FP [1]	E2688A-1NL [2] or E2688A-1FP [1]
	Floating	Transportable	E2688A-1TP	E2688A-1TP [1, 2]	E2688A-1TP [1, 2]
		Server-based	N5435A-003		
EZJIT Plus (recommended)	Fixed	Factory-installed	N5400A-1FP	DSO90000A-004	DSOX90000-004
		User-installed	N5400-1FP	N5400A-1NL [2] or N5400A-1FP [1]	N5400A-1NL [2] or N5400A-1FP [1]
	Floating	Transportable	N5400A-1TP	N5400A-1TP [1, 2]	N5400A-1TP [1, 2]
		Server-based	N5435A-001		
Equalization (required)	Fixed	Factory-installed	N5461A-1FP	DSO90000A-012	DSOX90000-012
		User-installed	N5461A-1FP	N5461A-1NL [2] or N5461A-1FP [1]	N5461A-1NL [2] or N5461A-1FP [1]
	Floating	Transportable	N5461A-1TP	N5461A-1TP [1, 2]	N5461A-1TP [1, 2]
		Server-based	N5435A-025		
InfiniiSim Basic (required)	Fixed	Factory-installed	N5465A-3FP	DSO90000A-013	DSOX90000-013
		User-installed	N5465A-3FP	N5465A-3NL [2] or N5465A-3FP [1]	N5465A-3NL [2] or N5465A-3FP [1]
	Floating	Transportable	N5465A-3TP	N5465A-3TP [1, 2]	N5465A-3TP [1, 2]
		Server-based	N5435A-026		
PrecisionProbe (optional)	Fixed	Factory-installed	N2809A-1FP	DSO90000A-001	DSOX90000-001
		User-installed	N2809A-1FP	N2809A-1NL [2] or N2809A-1FP [1]	N2809A-1NL [2] or N2809A-1FP [1]
	Floating	Transportable	N2809A-1TP	N2809A-1TP [1, 2]	N2809A-1TP [1, 2]
		Server-based	N5435A-003		
DisplayPort switch matrix support (optional)	Fixed	Factory-installed	DSOV000-714, DSOZ000-714	DSO90000A-714	DSO90000-714
		User-installed	U7232D-7FP	U7232D-7NL [2] or U7232D-7FP [1]	U7232D-7NL [2] or U7232D -7FP [1]
	Floating	Transportable	U7232D-7TP	U7232D-7TP [1, 2]	U7232D-7TP [1, 2]
		Server-based	N5435A-714		
InfiniiScan+ (optional)	Fixed	Factory-installed	N5414B-1FP	DSO90000A-009	DSOX90000-009
		User-installed	N5414B-1FP	N5414B-1N L [2] or N5414B-1FP [1]	N5414B-1NL [2] or N5414B-1FP [1]
	Floating	Transportable	N5414B-1TP	N5414B-1TP [1, 2]	N5414B-1TP [1, 2]
		Server-based	N5435A-004		

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.
3. DP upgrades require SDA, InfiniiSim, and Equalization.

Test point access adapters and probes

For physical connection to a DisplayPort device to perform tests with the DisplayPort Compliance Test Software, order one or more of the following TPAs in table below. For four lane simultaneous connection order probe amplifier and appropriate probe head from table below.

Model number	Description	Quantity
N7015A or N7015A Option 016	USB Type-C Test Point Adapter	1
BIT-mDP-PTF-0001	Mini-DP Plug Test Point Access Adapter	1
BIT-eDP-PTF-0001	eDP Plug Test Point Access Adapter	1
BIT-DP-PTF-0003	Standard DisplayPort Plug Test Point Access Adapter	1
BIT-DP-RTF-0003	Standard DisplayPort Receptacle Test Point Adapter. Used in Cable Test or Sink system calibration	As needed
BIT-DP-CONN-0001	Connection Kit for Bitifeye Fixtures. Includes 2 matched sets of SMA-SMA 1 meter cables and low frequency adaptor board.	1
1169A, N280xA, N700xA	13 GHz or greater probe amplifiers	4 (optional)
N5380B, N5444A	SMA differential probe heads	4 (optional)

Fixtures with Prefix 'BIT' are procured through BitifEye Corporation (Note: TPAs available through Wilder Technologies and ICT Luxshare are also recommended).

Connections often require matched cable sets and adapters. See accessory table below for these items.

AUX channel controller (optional)

To purchase AUX channel controller for automated control of the device under test with the DisplayPort software, order:

Model number	Description	Quantity
Unigraf DPR100	AUX channel controller requires hardware and software license	1

Note: DPR100 is available through Unigraf or its distributors - **www.unigraf.fi**

Measurement and test accessories

To complete your test setup, Keysight provides a wide range of cables, adapters, terminations, etc. You may find these useful in troubleshooting, calibrations, etc.

Model number	Description
11667B	Power splitter, DC to 26.5 GHz, 3.5-mm (f) connectors
11636B	Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors
8493B	Coaxial attenuator (3, 6, 10, 20, or 30 dB), DC to 18-GHz, SMA connector
5061-5311	3.5-mm (f - f) adapter, DC to 26 GHz, recommended
1250-1159	SMA (m - m) adapter, DC to 18 GHz
1250-1397	Right-angle adapter, SMA (m - m)
1250-1741	Right-angle adapter, SMA (f - m)
1250-1698	SMA tee adapter (m, f, f), DC to 12.4 GHz
1250-1694	SMA (m) to SMA (f) adapter
N2823A	Cable assembly, coaxial 2.92 mm (m-m) phased matched pair (5 ps), 1 m
N5448B	Cable assembly, coaxial 2.92 mm (m-m) phased matched pair (5 ps) 0.25 m
1810-0118	SMA (m) 50 Ω termination
33SMA-Q50-0-4	SMA push-on adaptors from S.M. Electronics (or equivalent)

Related Literature

Publication title	Publication number
N5990A Test Automation Software Platform - Data Sheet	5989-5483EN
Infiniium 90000 Series Oscilloscopes - Data Sheet	5989-7819EN
Infiniium 90000 X-Series Oscilloscopes - Data Sheet	5990-5271EN
N5399C, N5399D HDMI Electrical Performance Validation and Compliance Software - Data Sheet	5990-5299EN
Infiniium Z-Series Oscilloscopes - Data Sheet	5991-3868EN
Infiniium V-Series Oscilloscopes - Data Sheet	5992-0425EN

For copies of this literature, contact your Keysight representative or visit
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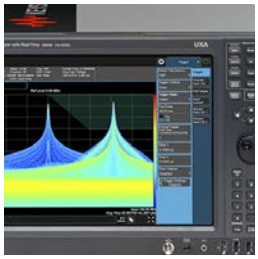

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