TELEDYNE LECROY
Everywhereyoulook™

QPHY-PCIE

PCI Express® 1.0 & 2.0 Serial Data Compliance Software

Instruction Manual

February 2024

Relating to:

MAUI® v.10.6.x.x and later

QualiPHY® v.10.6.x.x and later

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About This Manual

This manual assumes that you are familiar with using an oscilloscope–in particular the Teledyne LeCroy oscilloscope that will be used with QualiPHY–and that you have purchased the QPHY-PCIE software option. Some of the images in this manual may show QualiPHY products other than QPHY-PCIE, or were captured using different model oscilloscopes, as they are meant to illustrate general concepts only. Rest assured that while the user interface may look different from yours, the functionality is identical.

Introduction

About QualiPHY

QualiPHY® is highly automated compliance test software meant to help you develop and validate the PHY (physical-electrical) layer of a device, in accordance with the official documents published by the applicable standards organizations and special interest groups (SIGs). You can additionally set custom variables and limits to test compliance to internal standards.

QualiPHY is composed of a "wizard" application that enables the configuration and control of separate tests for each standard through a common user interface. Features include:

- **User-Defined Test Limits** to ensure devices are well within the passing region, even if subsequently measured with different equipment.
- **Flexible Test Results Reporting** that includes XML Test Record generation to help understand device performance distribution or obtain process related information from the devices under test.

About QPHY-PCIE

QPHY-PCIE is an automated test package performing all the normative, real-time oscilloscope tests for sources in accordance with PCI Express Card Electromechanical Specification, Rev. 3.0.

The software can be run on any Teledyne LeCroy real-time oscilloscope with at least 6 GHz bandwidth for 2.5 GT/s testing or 13 GHz bandwidth for 5.0 GT/s testing and 20 GS/s sample rate.

Software Installation and Setup

QualiPHY is a Windows-based application that can be configured with one or more serial data compliance components. Each compliance component is purchased as a software option.

Oscilloscope Requirements

Hardware

QPHY-PCIE can be run on any Teledyne LeCroy real-time oscilloscope with at least 6 or 13 GHz bandwidth (depending on signal speed tested) and 20 GS/s Sample Rate.

While not required, we recommend running QualiPHY on an oscilloscope equipped with Dual Monitor Display capability. This allows the waveforms and measurements to be shown on the oscilloscope LCD display, while the QualiPHY application and test results are displayed on the second monitor.

See the oscilloscope *Operator's Manual* for instructions on setting up dual monitor display.

Software

The oscilloscope must be installed with:

- MAUI® v.10.6.x.x with an QPHY-PCIE option key
- QualiPHY v.10.6.x.x. with QPHY-PCIE component selected at installation
- SDAIII-CompleteLinq, SDA Expert PCIe® NRZ or SDA Expert Complete (includes required Eye Doctor II)

Note: The version of MAUI and QualiPHY software must match to the second decimal, so upgrade QualilPHY if you have upgraded your oscilloscope firmware. QualiPHY software may be installed on a remote PC, but the MAUI software must be installed on the oscilloscope.

Other Required Equipment

PCIe test requirements change frequently. Below are minimum hardware requirements. For the latest list, go to www.pcisig.com/specifications/pciexpress/compliance

- 2 pair standard SMA-SMA cables for Gen1 fixtures
- 1 pair standard SMA-SMP cables for Gen2 fixtures
- PCIE base board (CBB) for testing System Boards
- PCIe load board (CLB) for testing Add-In Cards

See QPHY-PCIE Testing for more information about test fixtures.

Installing the QualiPHY Application

Download the latest version of the QualiPHY software from:

teledynelecroy.com/support/softwaredownload/ under Oscilloscope Downloads > Software Utilities

The application can be installed on either the test oscilloscope or on a remote host computer. For remote execution, see Setting Up Remote Control.

If the oscilloscope is not connected to the Internet, copy the installer onto a USB memory stick then transfer it to the oscilloscope desktop or a folder on the D:\ drive to execute it.

Run **QualiPHYInstaller.exe** and follow the installer prompts. Choose all the components you plan to activate. If you omit any components now, you will need to update the installation to activate them later.

By default, the oscilloscope appears as local host when QualiPHY is executed on the oscilloscope. Follow the steps under Add Connection to QualiPHY to check that the IP address is 127.0.0.1.

Activating Components in MAUI

The serial data compliance components are factory installed as part of the main application in your oscilloscope and are individually activated through the use of an alphanumeric code uniquely matched to the oscilloscope's serial number. This option key code is what is delivered when purchasing a software option.

To activate an option on the oscilloscope:

1. From the menu bar, choose Utilities > Utilities Setup.
2. On the Options tab, click Add Key.
3. Use the Virtual Keyboard to Enter Option Key, then click OK.

   If activation is successful, the key code now appears in the list of Installed Option Keys.
4. Restart the oscilloscope application by choosing File > Exit, then double-clicking the Start DSO icon on the desktop.

Setting Up the QualiPHY Application

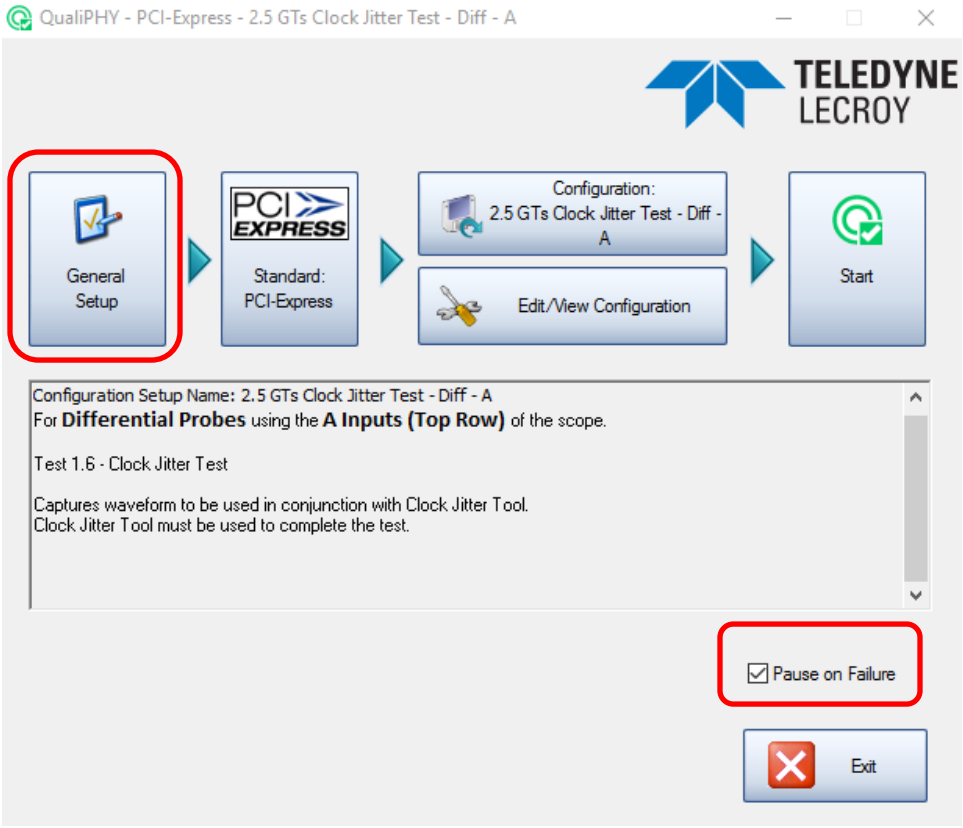
The following general settings will persist with each test session you run in QualiPHY. We recommend these be made as part of initial installation.

To begin, access QualiPHY by either:

- Choosing **Analysis > QualiPHY** from the oscilloscope menu bar
- Double-clicking the **QualiPHY desktop icon** on a remote computer or oscilloscope desktop.

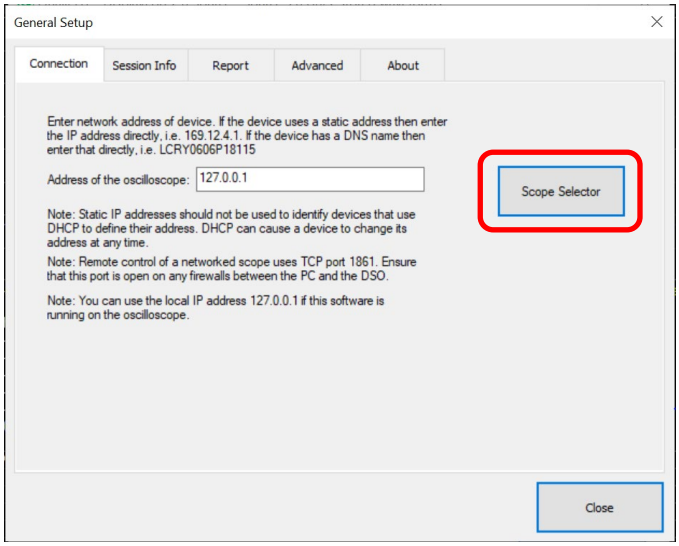
When **Pause on Failure** is checked (default), QualiPHY will pause execution whenever a test fails and prompt you to make corrections before retrying a measurement.

On the Wizard, click the **General Setup** button to continue.



Connection Tab

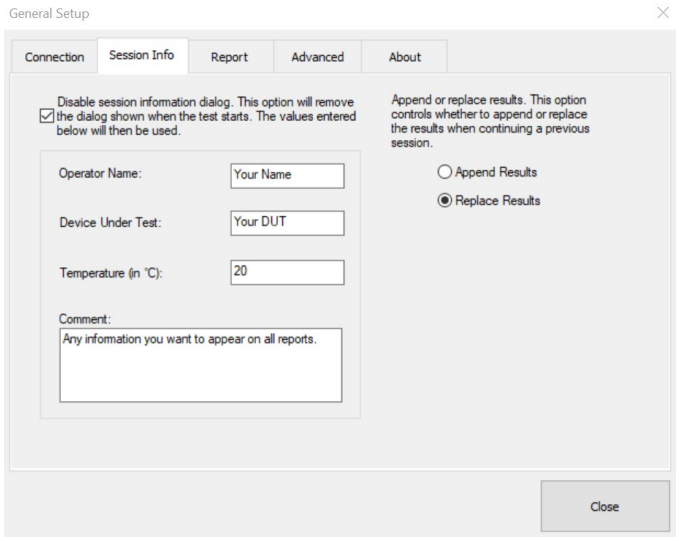
The Connection tab shows the **Address of the oscilloscope** is local host 127.0.0.1 when QualiPHY is run from the oscilloscope. If you are running QualiPHY from a remote computer, this will show the network IP address of the oscilloscope to which QualiPHY is currently connected.



The **Scope Selector** button allows you to choose the oscilloscope used for testing when several are connected to the QualiPHY application on a remote host. See Setting Up Remote Control for details.

Session Info Tab

The Session Info tab contains information that appears on reports, such as: **Operator Name**, **Device Under Test** (DUT) name, **Temperature (in °C)** of the test location, and any additional **Comments**.

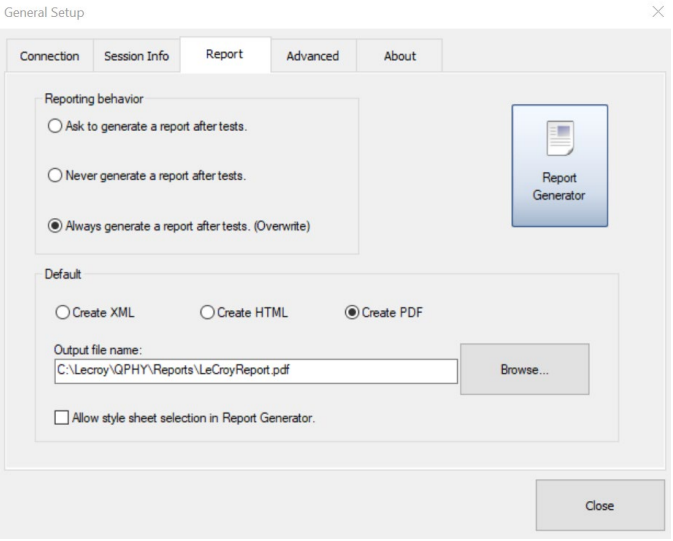


If you check **Disable session information dialog**, these global settings will be used on all reports. Otherwise, you will be presented with a dialog at the start of each session that overrides these settings.

There is also a selection to **Append Results** or **Replace Results** (overwrite) when continuing a previous test session.

Report Tab

The Report tab contains settings related to report generation.



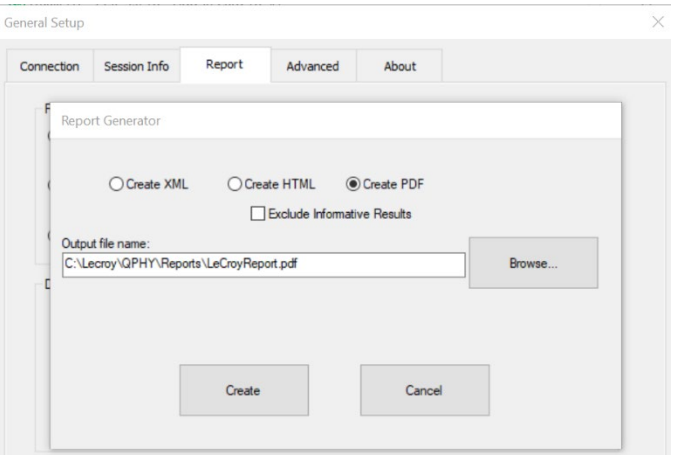
Choose a **Reporting behavior** of:

- "Ask to generate a report after tests"—you'll be prompted to create a new file for each set of test results.
- "Never generate a report after tests"—you'll need to manually execute the Report Generator.
- "Always generate a report after tests" will autogenerate a report of the latest test results.

Choose a **Default** report output file format of XML, HTML, or PDF.

Optionally, check **Allow style sheet selection in Report Generator** to enable the use of a custom .xslt when generating XML and HTML reports. The path to the .xslt is entered on the Report Generator dialog.

The **Report Generator** button launches the Report Generator dialog, which contains the same settings as the Report tab, only applied to individual reports. This dialog appears automatically at the conclusion of each test group if you have selected "Ask to generate a report after tests."



Setting Up Remote Control (optional)

Usually, the oscilloscope is the host computer for the QualiPHY software, and all models that meet the acquisition requirements will also meet the host system requirements. However, the QualiPHY software can be executed from a remote host computer.

To run QualiPHY remotely:

- The oscilloscope must be connected to a LAN and assigned an IP address (fixed or dynamic).
- The host computer must be on the same LAN as the oscilloscope.

Remote Host Computer Requirements

To run the QualiPHY software from a remote computer, these minimum requirements apply:

- Windows 10 Professional Operating System
- 1 GHz or faster processor
- 2 GB (64-bit) of RAM
- Ethernet (LAN) network capability
- Hard Drive:
  - At least 100 MB free to install the wizard application
  - Up to 2 GB per standard installed to store the log database (each database grows from a few MB to a maximum of 2 GB)

Configure Oscilloscope for Remote Control

1. From the menu bar, choose Utilities → Utilities Setup...
2. Open the Remote tab and set Remote Control to TCP/IP.
3. Verify that the oscilloscope shows an IP address.

Add Connection to QualiPHY

1. On the host PC, download and run QualiPHYInstaller.exe.
2. Start QualiPHY and click the General Setup button.
3. On the Connection tab, click Scope Selector.
4. Click Add and choose the connection type. Enter the oscilloscope IP address from Step 3 above. Click OK.
5. When the oscilloscope is properly detected, it appears on the Scope Selector dialog. Select the connection, and click OK.

   QualiPHY is now ready to control the oscilloscope.

Select Connection

Multiple oscilloscopes may be accessible to a single remote host. In that case, go to General Setup and use the Scope Selector at the start of the QPHY session to choose the correct connection.

QualiPHY tests the oscilloscope connection when starting a test. The system warns you if there is a connection problem.

Accessing the Software

Once QualiPHY is installed and activated, it can be accessed from the oscilloscope menu bar by choosing **Analysis > QualiPHY**, or by double-clicking the **QualiPHY desktop icon** on a remote computer.

Select the **Standard** button, then choose the **PCIE > PCIE-Express** menu selections.

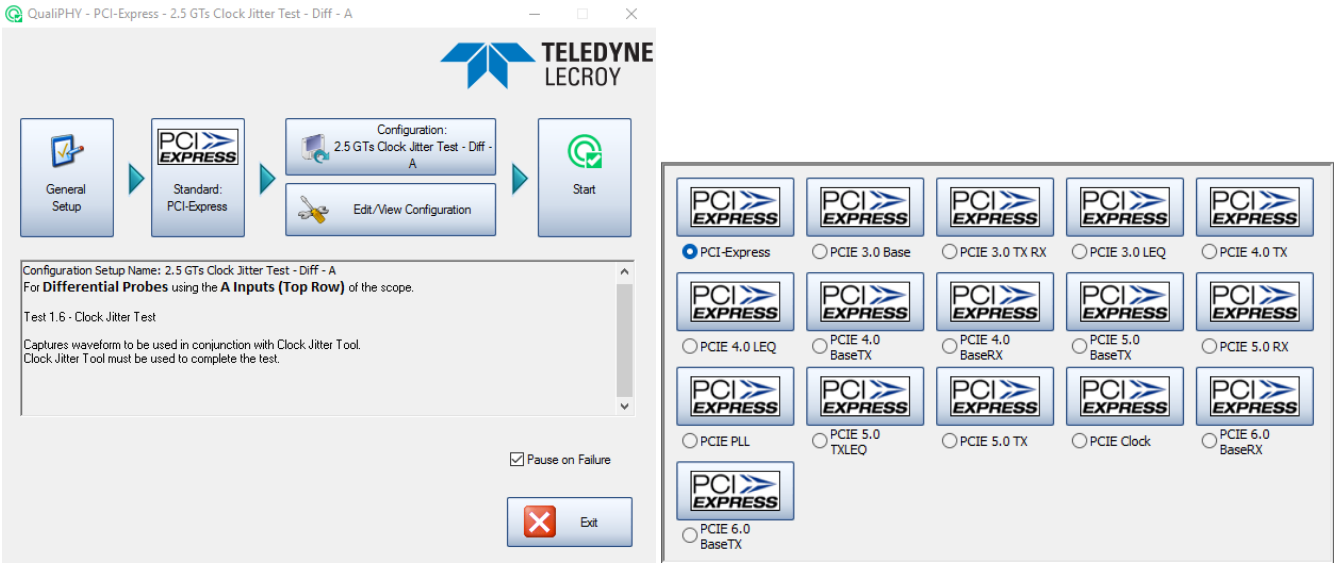


Figure 1 - QualiPHY wizard and Standard selection menu.

Choose the desired **Configuration** and select **Start** to begin testing. The connection diagrams will show how to connect test equipment to the oscilloscope. Follow the prompts when ready to proceed.

QPHY-PCIE Testing

If you are new to QualiPHY, see Using QualiPHY for an overview of the software interface and general procedures.

Prepare Oscilloscope

Before beginning any test or data acquisition, the oscilloscope should be warmed for at least 20 minutes.

Calibration is automatic under software control and no manual calibration is required. This procedure will be run again if the temperature of the oscilloscope changes by more than a few degrees.

Confirm Required Test Modes

The QPHY-PCIE script requires that you place the DUT (Device Under Test) in the required test modes. The script will prompt you to do so before each specific test, but it is recommended that you ensure the DUT is capable of being placed in the required test modes before beginning testing.

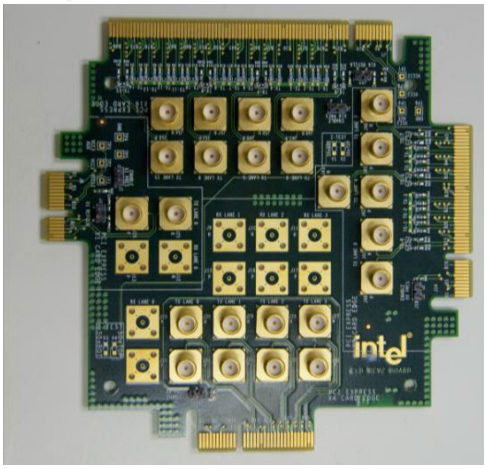
Test Fixtures

The PCI Express standard describes a set of two fixtures used for connection to the signal under test: the Compliance Load Board (CLB) used to test System Boards and the Compliance Base Board (CBB) used to test Add-In Cards. Both the CLB and CBB are available through the PCI special interest group (PCI-SIG) at www.pcisig.org. Fixtures that are compliant with Revision 1.1 of the Base and CEM Specifications are required to execute QPHY-PCIe tests for Gen1 Add-In Cards and System Boards; likewise, fixtures compliant with Revision 2.0 of the specifications are required to execute tests for Gen2 devices.

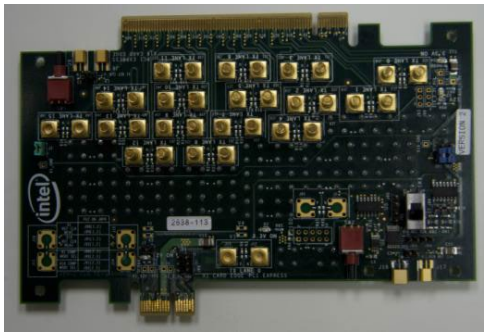
Using SMA type cables with the Gen1 fixtures, or SMA-to-SMP type cables with the Gen2 fixtures, allows positive and negative line attachment of the differential signals directly to separate channels on the instrument. The fixtures are designed to apply the compliance test load to the ports of the device under test. The CBB provides a 100 MHz system clock used by Add-In Cards plugged into the fixture and a socket for a standard ATX power supply.

The 50 Ω impedance on each oscilloscope channel provides the proper loading for compliance testing. All PCI Express Add-In Cards and System Boards must transmit a standard compliance pattern when loaded with 50 Ω to ground on each line – all while no signal is being received.

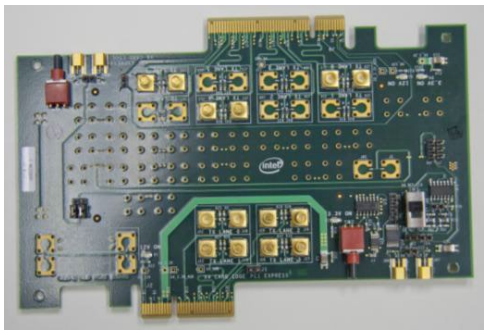
Compliance Load Board



The Compliance Load Board CLB1 provides probing access for 1, 4, 8 and 16 lane connectors that connect to Gen1.1 System Boards. This is used for testing System Boards that only perform at 2.5 GT/s.

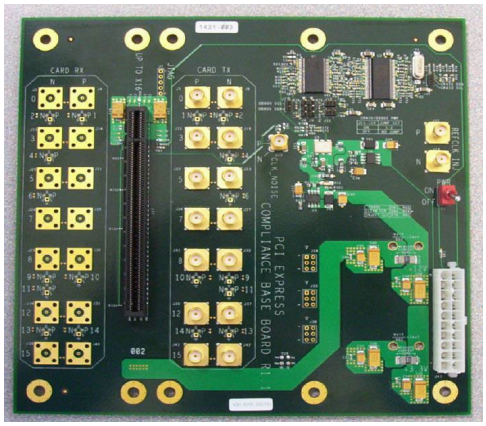


The Compliance Load Board x1/x16 CLB2 provides probing access for 1 and 16 lane connectors that connect to Gen2.0 System Boards that perform at 5.0 GT/s.



The Compliance Load Board x4/x8 CLB2 provides probing access for 4 and 8 lane connectors that connect to Gen2.0 System Boards.

Compliance Base Board



The Compliance Base Board (CBB1) provides probing access for 1, 4, 8 and 16 lane connectors that connect to Gen1.1 Add-In Cards. This is used for testing Add-In Cards that only perform at 2.5GT/s.

The Compliance Base Board (CBB2) provides probing access for 1, 4, 8 and 16 lane connectors that connect to Gen2.0 Add-In Cards. Also, the CBB2 provides a clean reference clock and clock noise injection capabilities.

QPHY-PCIE Test Configurations

Test configurations include variable settings, limit sets, and test selections. See QPHY-PCIE Test Variables for a description of each variable.

For detailed descriptions of calibration and testing, please refer to the Teledyne LeCroy PCIE Gen1 and Gen2 test procedures on PCISIG.com and the official test specification, PCI Express Card Electromechanical Specification, Rev. 5.0.

2.5 GTs Clock Jitter Test

This configuration runs only Test 1.6 Clock Jitter for 2.5 Gbps signals. Variations exist for different source configurations: differential inputs on Input A or Input B, and single inputs on Input A or Input B. The test requires the use of the PCI Express Clock Phase Jitter Test Software, which can be downloaded from:

http://www.pcisig.com/specifications/pciexpress/compliance/compliance_library

Demo

This configuration runs all the Transmitter tests using waveforms saved on the oscilloscope in D:\Waveforms\PCIe\Demo and the default limit set, Compliance Limits. This configuration is meant to easily demonstrate the QPHY-PCIE capabilities when live signals cannot be tested. You will see dialogs and connection diagrams similar to what you would see during an actual test.

Empty Template

This configuration includes all tests and default variable settings specified in the PCIe standard. It is meant to serve as a basis for creating custom configurations. The limit set in use is PCIe 2.1.

Signal Quality Test (CEM), Add-In Card

This configuration is meant to run all the transmitter tests on a PCIe Add-In card. All the variables are set to default, except Device Type is set to “Add-In” and CleanClock is set to “Yes”. The limit set used is PCIe 2.1. Both 2.5 Gbps and 5.0 Gbps Signal Quality tests are run. Variations exist for different source configurations: differential inputs on Input A or Input B, and single inputs on Input A or Input B.

Signal Quality Test (CEM), System

This configuration is meant to run all the transmitter tests on a PCIe System board. All the variables are set to default. The limit set is use is PCIe 2.1. Both 2.5 Gbps and 5.0 Gbps Signal Quality tests are run. Variations exist for different source configurations: differential inputs on Input A or Input B, and single inputs on Input A or Input B.

QPHY-PCIE Test Descriptions

2.5 GT/s Signal Quality Tests

These tests use the “PCIe Compliance” Signal Type selection from the SDAIII analysis software. This can only be done using 2.5 GT/s signals.

- Mean Unit Interval
- Max Unit Interval
- Min Unit Interval
- Min Time Between Crossovers
- Data Rate
- Per Edge RMS Jitter
- Mean Median to Peak Jitter
- Max Median to Peak Jitter
- Min Median to Peak Jitter
- Mean peak-to-peak jitter
- Max peak-to-peak jitter
- Min peak-to-peak jitter
- Minimum transition eye voltage
- Maximum transition eye voltage
- Minimum non-transition eye voltage
- Maximum non-transition eye voltage
- Minimum transition eye voltage margin above eye
- Minimum transition eye voltage margin below eye
- Minimum non-transition eye voltage margin above eye
- Minimum non-transition eye voltage margin above eye
- Transition eye mask violations
- Non-transition eye mask violations
- Minimum Eye Width
- Differential peak to peak voltage

5.0 GT/s Signal Quality Tests

The following tests are run on the 5.0 GT/s compliance pattern with 3.5 dB of de-emphasis and also with 6.0 dB of de-emphasis.

- Mean Unit Interval
- Min Time Between Crossovers
- Data Rate
- Max Peak to Peak Jitter
- Total Jitter at BER of 10e-12
- Deterministic Jitter Delta-Delta
- Random Jitter (RMS)
- Minimum Transition Eye Voltage
- Maximum Transition Eye Voltage
- Minimum Non Transition Eye Voltage
- Maximum Non Transition Eye Voltage
- Minimum Transition Eye Voltage Margin Above Eye
- Minimum Transition Eye Voltage Margin Below Eye
- Maximum Non Transition Eye Voltage Margin Above Eye
- Maximum Non Transition Eye Voltage Margin Below Eye
- Mask Violations Transition Eye
- Mask Violations Non Transition Eye

These tests use the SigTest analysis package that is built into the oscilloscope software. The SigTest settings are set to be the same as when the SigTest software runs independently.

- Bit Rate = 5.0 GHz
- BER = -12
- Eye Type = Monochrome
- UIsPerEye = 1.67UI
- Jitter Filter Settings
    - Order = Brick Wall
    - Corner Freq = 1.5 MHz
    - Damping = 707.11e-3
    - Extra Pole = 0 Hz
    - Delay = 0 fs
- Standard = PCIe2.0 Compliance
- Masks
    - System Testing = System Dual Port 250 mV
    - Add-In Card 3.5 dB Testing = Add-in card 3.5 dB
    - Add-In Card 6.0 dB Testing = Add-in card 6.0 dB

QPHY-PCIE Test Variables

Main Settings

Clean Clock

Specifies whether or not a “clean clock” is in use. This variable maps directly to the “clean clock” variable in SigTest. When set to Yes, it guarantees that the clock does not have SSC and is known to be good. This variable should be set to Yes for Add-In Card testing (using a CBB, which generates the clock), and No for System Board testing (because the System Board generates the clock). This control is only of use in the 2.5 GT/s testing. The new SigTest algorithm for 5 G does not ask for this input. The default value for this variable is No.

Clock Input (Diff Probe or Single-Ended)

For single-ended cable users, channel inputs for all but the Clock Jitter Test are fixed. Single-ended cable users may use this variable to select the Positive Clock input channel for the Clock Jitter Test ONLY. Differential probe users may use this variable to select the Clock input channel for ALL tests.

Negative Clock Input (Single-Ended)

For single-ended cable users, channel inputs for all but the Clock Jitter Test are fixed. Single-ended cable users may use this variable to select the Negative Clock input channel for the Clock Jitter Test ONLY.

Deskew Measure Mode

Specifies the method used for deskewing cables: Wizard Measured or User Defined. Wizard Measured will launch the automated deskew measurement wizard at the start of a test. User Defined allows users to set a known Deskew Value in Picoseconds. Default is Wizard Measured.

Deskew Value in Picoseconds

Specifies the channel + cable deskew between channels C2 and C3. The value is in picoseconds and is applied to the channel C2. This value is only applied to C2 if the Deskew measure mode method variable is set to User Defined.

Device Type

Specifies whether the DUT is a System Board or an Add-In Card. When testing System Boards, both the clock signal and the data signal must be captured simultaneously. When testing Add-In Cards, only the data signal is required for testing. The default value for this variable is System.

Form Factor

This variable allows the user to select whether their form factor is Desktop or Mobile. This variable maps directly to the form factor variable in SigTest. The default value is Desktop.

Input Channels

Specifies which set of oscilloscope inputs to use: the upper-row A Inputs, or the lower-row B Inputs.

Probing Method

Specifies probing method in use: two Single-Ended cables per differential signal, or one Differential probe per signal.

Saved Waveform Path

Full path to the oscilloscope folder from which waveforms are recalled from when running in Demo Mode or when Test Mode is set to Use Saved Data. Default is D:\Waveforms\PCIe. Waveform files are saved in sub-folders with the name of the DUT. The saved waveform files have a channel name prefix (such as "C2") followed by the bit rate, de-emphasis setting, lane number; and the extension ".trc" (e.g., C2_2.5GT_3.5dB_L0.trc). If the Test Mode variable is set to Use Saved Data, the script will look for files with exactly these names in the appropriate directory to repeat the tests using the previously saved data.

Test Mode

Specifies whether the tests should be run on newly acquired data or if previously saved waveforms should be used. If Use Saved Data is selected, the waveforms are recalled from the location specified in the Saved Waveform Path variable. Default is Acquire New Data for compliance configurations and Use Saved Data for Demo configurations.

Use PeRT3

Specifies whether or not to use the PeRT3 to generate the compliance pattern. The PeRT3 option can only be used for products that support loopback. I

Setup PeRT3 Variables

These variables are used only with the PeRT3.

PeRT3 Hostname or IP Address

Hostname or IP Address of the PeRT3 Server machine, *from the point of view of the oscilloscope*. In the default configuration, where the PeRT3 is connected by USB to the oscilloscope, the oscilloscope is the PeRT3 Server, therefore this variable is set to “localhost”. If the PeRT3 is connected to another host, enter the address of that machine.

PeRT3 Amplitude

Amplitude setting for the PeRT3.

PeRT3 Model

PeRT3 model in use.

QPHY-PCIE Limit Sets

The default installation of QPHY-PCIE contains only one limit set called PCIe 2.1 This set contains all the limits defined for PCIe 1.1a and PCIe 2.1.

Using QualiPHY

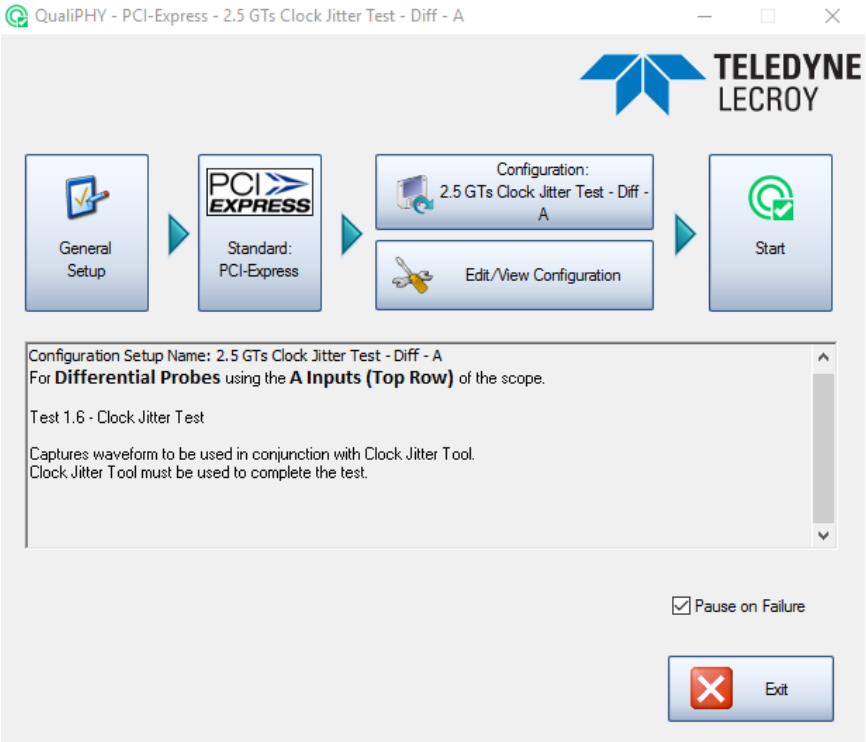
This section provides an overview of the QualiPHY user interface and general procedures. For detailed information about the QPHY-PCIE software option, see QPHY-PCIE Testing.

QualiPHY Test Process

Once general system settings are in place, these are the steps for running test sessions.

Set Up Test Session

1. Connect the oscilloscope to the DUT.
2. Access the QualiPHY software to display the wizard dialog.



3. If running QualiPHY remotely, click **General Setup** and open the **Scope Selector** to select the correct oscilloscope connection.
4. If you have more than one component activated, click **Standard** and select the desired standard to test against. Otherwise, your one activated component will appear as the default selection.
5. Click the **Configuration** button and select the test configuration to run. These pre-loaded configurations are set up to run all the tests required for compliance and provide a quick, easy way to begin compliance testing. See QPHY-PCIE Test Configurations for a description of your configurations.

   You can also create custom configurations for internal compliance tests by copying and modifying the pre-loaded configurations. See Customizing QualiPHY for details.
6. **Close** the Edit/View Configuration dialog to return to the wizard dialog.

Run Tests

1. On the wizard dialog, click Start to begin testing.

   When tests are in progress, this button changes to Stop. Click it at any time to stop the test in process. You'll be able to resume from the point of termination or from the beginning of the test.

2. Follow the pop-up window prompts. QualiPHY guides you step-by-step through each of the tests described in the standard specification, including diagrams of the connection to the DUT for each required test mode.

3. When all tests are successfully completed, both progress bars on the wizard dialog are completely green and the message "All tests completed successfully" appears. If problems are encountered, you'll be offered options to:

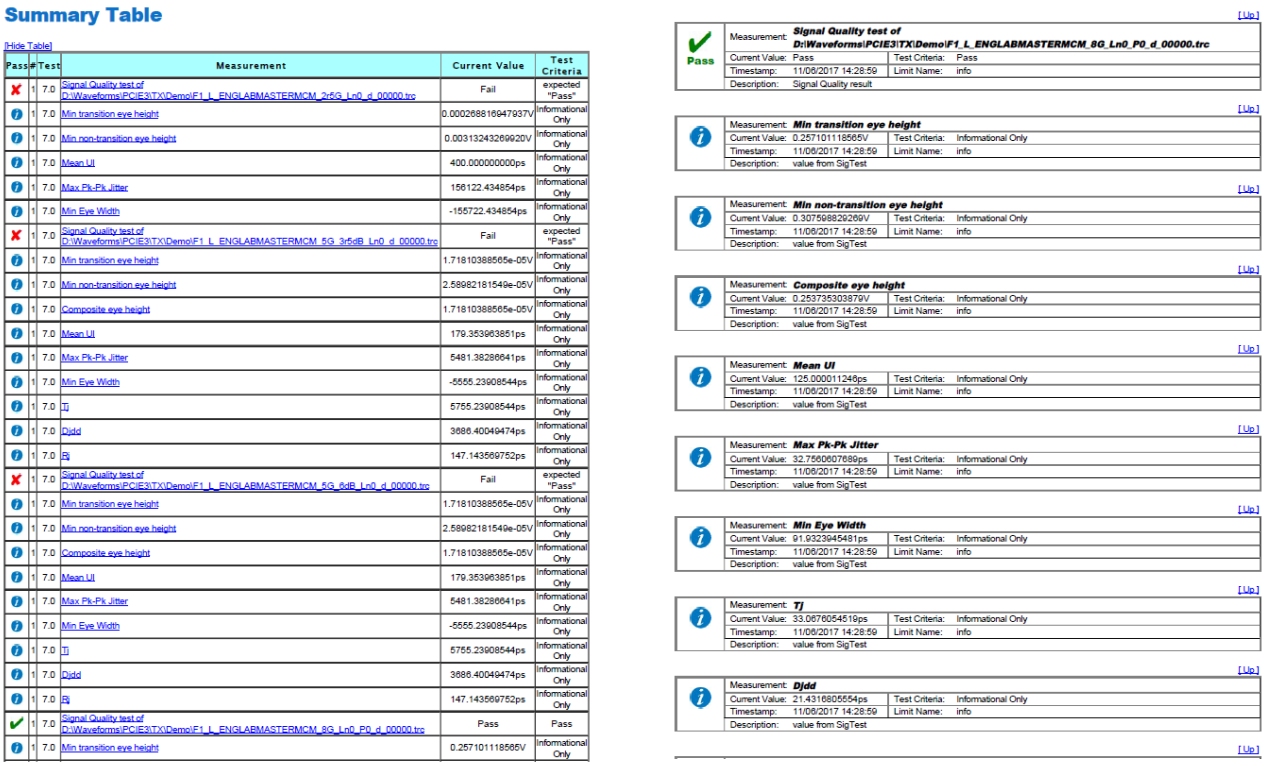
   - **Retry** the test from the latest established point defined in the script
   - **Ignore and Continue** with the next test
   - **Abort Session**

Generate Reports

The QualiPHY software automates report generation. On the wizard dialog, go to General Setup > Report to pre-configure reporting behavior. You can also manually launch the Report Generator from the wizard dialog once a test is run.

The Report Generator offers the same selections as the Report tab, only applied to each report individually, rather than as a system setting. This enables you to save reports for each test session, rather than overwrite the generic report file. There are also options to link a custom style sheet (.xslt) to the report, or to Exclude Informative Results.

The Test Report includes a summary table with links to the detailed test result pages.



Summary Table

[Hide Table]

Pass	#	Test	Measurement	Current Value	Test Criteria
✘	1	7.0	Signal Quality test of D:\Waveforms\PCIE3\TX\Demo\F1_L_ENGLABMASTERMCM_2r5G_Ln0_d_00000.trc	Fail	expected "Pass"
ⓘ	1	7.0	Min transition eye height	0.000268816947937V	Informational Only
ⓘ	1	7.0	Min non-transition eye height	0.00313243269920V	Informational Only
ⓘ	1	7.0	Mean UI	400.000000000ps	Informational Only
ⓘ	1	7.0	Max Pk-Pk Jitter	156122.434854ps	Informational Only
ⓘ	1	7.0	Min Eye Width	-155722.434854ps	Informational Only
✘	1	7.0	Signal Quality test of D:\Waveforms\PCIE3\TX\Demo\F1_L_ENGLABMASTERMCM_5G_3r5dB_Ln0_d_00000.trc	Fail	expected "Pass"
ⓘ	1	7.0	Min transition eye height	1.71810388565e-05V	Informational Only
ⓘ	1	7.0	Min non-transition eye height	2.58982181549e-05V	Informational Only
ⓘ	1	7.0	Composite eye height	1.71810388565e-05V	Informational Only
ⓘ	1	7.0	Mean UI	179.353963851ps	Informational Only
ⓘ	1	7.0	Max Pk-Pk Jitter	5481.38286641ps	Informational Only
ⓘ	1	7.0	Min Eye Width	-5555.23908544ps	Informational Only
ⓘ	1	7.0	Tj	5755.23908544ps	Informational Only
ⓘ	1	7.0	Djdd	3686.40049474ps	Informational Only
ⓘ	1	7.0	Rj	147.143569752ps	Informational Only
✘	1	7.0	Signal Quality test of D:\Waveforms\PCIE3\TX\Demo\F1_L_ENGLABMASTERMCM_5G_6dB_Ln0_d_00000.trc	Fail	expected "Pass"
ⓘ	1	7.0	Min transition eye height	1.71810388565e-05V	Informational Only
ⓘ	1	7.0	Min non-transition eye height	2.58982181549e-05V	Informational Only
ⓘ	1	7.0	Composite eye height	1.71810388565e-05V	Informational Only
ⓘ	1	7.0	Mean UI	179.353963851ps	Informational Only
ⓘ	1	7.0	Max Pk-Pk Jitter	5481.38286641ps	Informational Only
ⓘ	1	7.0	Min Eye Width	-5555.23908544ps	Informational Only
ⓘ	1	7.0	Tj	5755.23908544ps	Informational Only
ⓘ	1	7.0	Djdd	3686.40049474ps	Informational Only
ⓘ	1	7.0	Rj	147.143569752ps	Informational Only
✔	1	7.0	Signal Quality test of D:\Waveforms\PCIE3\TX\Demo\F1_L_ENGLABMASTERMCM_8G_Ln0_P0_d_00000.trc	Pass	Pass
ⓘ	1	7.0	Min transition eye height	0.257101118565V	Informational Only

[Up]

Pass

Measurement: **Signal Quality test of D:\Waveforms\PCIE3\TX\Demo\F1_L_ENGLABMASTERMCM_8G_Ln0_P0_d_00000.trc**
Current Value: Pass | Test Criteria: Pass
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: Signal Quality result

[Up]

Measurement: **Min transition eye height**
Current Value: 0.257101118565V | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Min non-transition eye height**
Current Value: 0.307598829269V | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Composite eye height**
Current Value: 0.253735303879V | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Mean UI**
Current Value: 125.000011246ps | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Max Pk-Pk Jitter**
Current Value: 32.7560607689ps | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Min Eye Width**
Current Value: 91.9323945481ps | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Tj**
Current Value: 33.0676054519ps | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Measurement: **Djdd**
Current Value: 21.4316805554ps | Test Criteria: Informational Only
Timestamp: 11/06/2017 14:28:59 | Limit Name: info
Description: value from SigTest

[Up]

Figure 2 - The Test Report Summary and Details pages (QPHY-PCIE3-TX-RX shown).

Reports are output to the folder C:\LeCroy\QPHY\Reports.

You can add your own logo to the report by replacing the file C:\LeCroy\QPHY\StyleSheets\CustomerLogo.jpg.

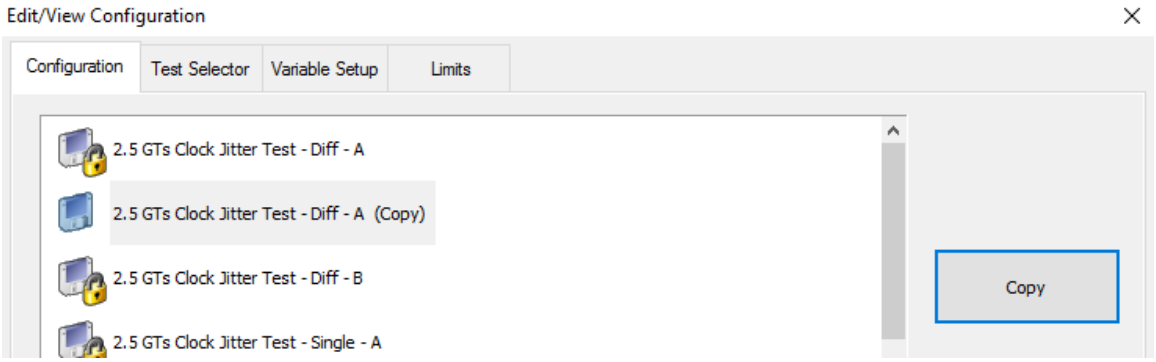
The recommended maximum size is 250x100 pixels at 72 ppi, 16.7 million colors, 24 bits. Use the same file name and format.

Customizing QualiPHY

The pre-loaded configurations cannot be modified. However, you can create your own test configurations by copying one of the standard test configurations and modifying it.

Copy Configuration

1. Access the QualiPHY wizard dialog and select a Standard.
2. Click Edit/View Configuration and select the configuration upon which to base the new configuration. This can be a pre-loaded configuration or another copy.
3. Click Copy and enter a name and description. Once a custom configuration is defined, it appears on the Configuration tab followed by "(Copy)."



4. Select the new, custom configuration and follow the procedures below to continue making changes.

Note: If any part of a configuration is changed, the Save As button becomes active on the bottom of the dialog. If a custom configuration is changed, the Save button will also become active to apply the changes to the existing configuration.

Select Tests

On the Test Selector tab, check the tests that make up the configuration. Each test is defined by the PCIE standard. A description of each test is displayed when it is selected.

To loop any of the tests in this configuration, select the test from the list, then choose to Loop the highlighted test until stopped or enter the number of repetitions.

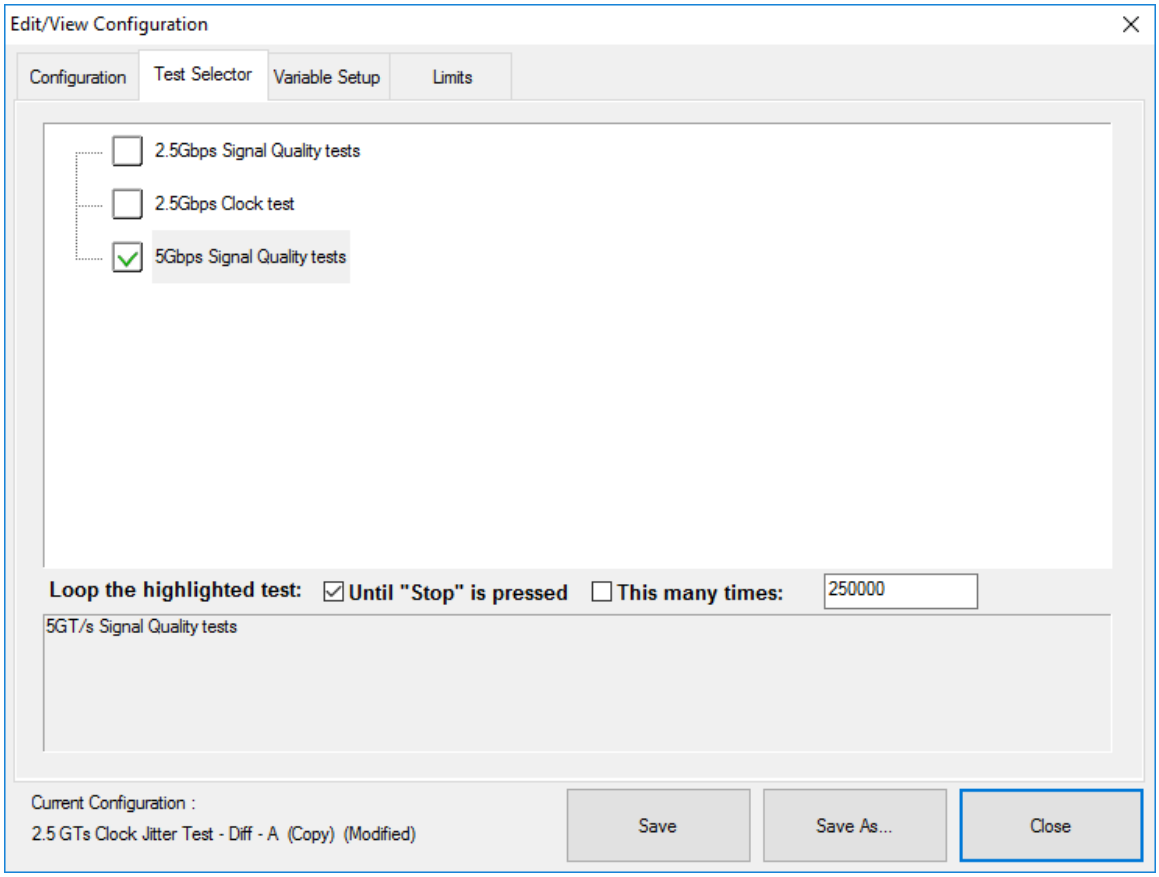


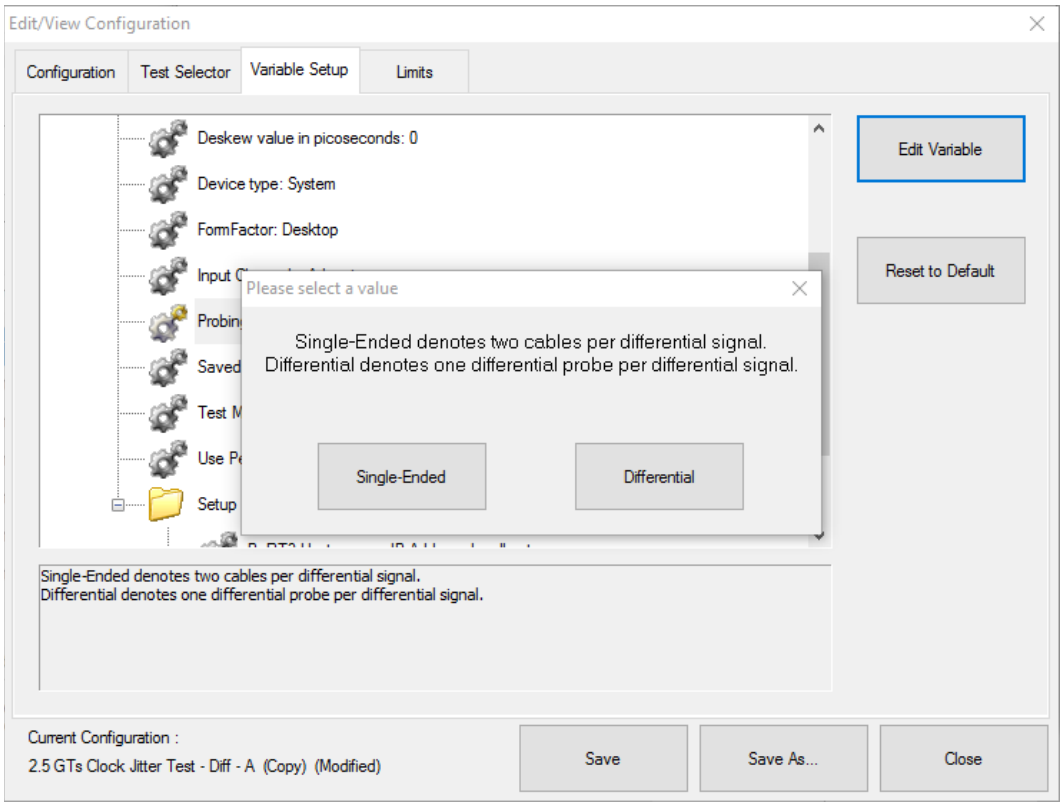
Figure 3 – Configuration Test Selector tab

Edit Variables

The Variable Setup tab contains a list of test variables. See QPHY-PCIE Test Variables for descriptions..

To modify a variable:

1. Select the variable on the Variable Setup tab, then click **Edit Variable**. (You can also choose to Reset to Default at any time.)
2. The conditions of this variable appear on a pop-up. Choose the new condition to apply.



Edit Test Limits

The Limits tab shows the Limit Set currently associated with the configuration. Any limit set can be associated with a custom configuration by selecting it in this field.

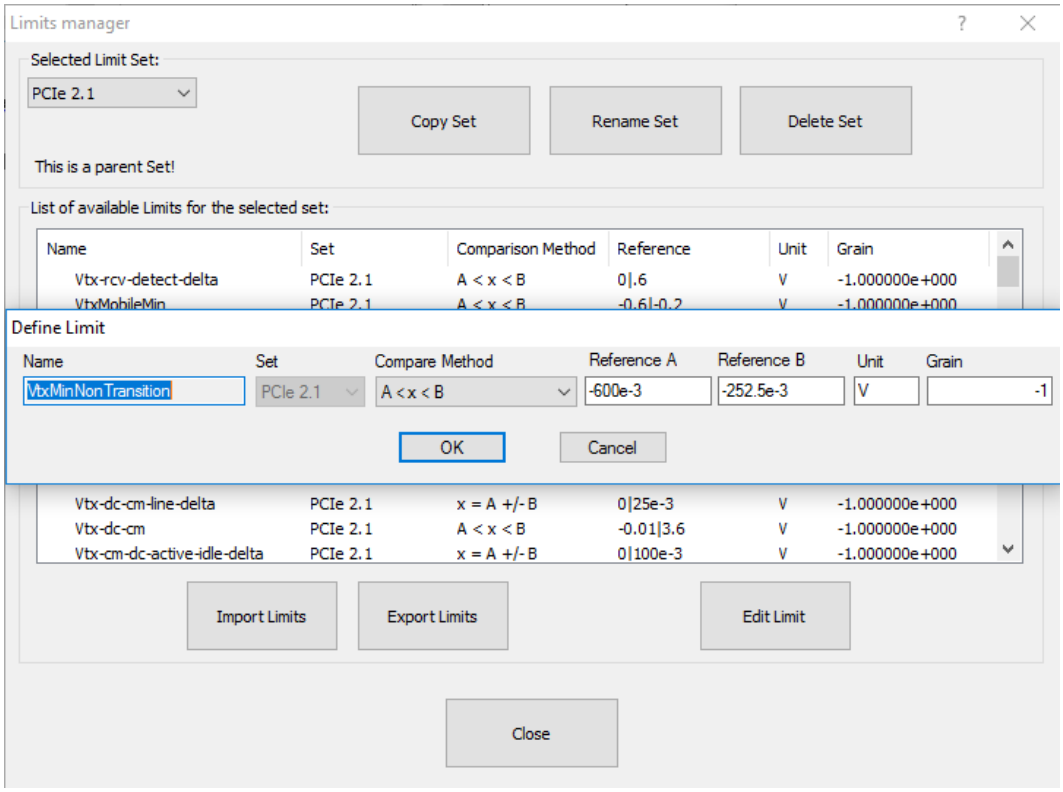
The Limits Manager shows the settings for every test limit in a limit set. Those in the default set are the limits defined by the standard.

To create a custom limit set:

1. On the Limits tab, click **Limits Manager**.
2. With the default set selected, click **Copy Set** and enter a name.

Note: You can also choose to copy and/or modify another custom set that has been associated with this configuration.

3. Double click the limit to be modified, and in the pop-up enter the new values.



You can also **Import Limits** from a .csv file. Navigate to the file location after clicking the button.

Tip: Likewise, Export Limits creates a .csv file from the current limit set. You may wish to do this and copy it to format the input .csv file.

X-Replay Mode

The X-Replay mode window is an advanced (“developer”) view of QualiPHY. The tree in the upper-left frame enables you to navigate to processes in the PCIE test script, in case you need to review the code, which appears in the upper-right frame.

Two other particularly useful features are:

- A **list of recent test sessions** in the lower-left frame. While you can only generate a report of the current test session in the QualiPHY wizard, in X-Replay Mode you can generate a report for any of these recent sessions. Select the session and choose **Report > Create Report** from the menu bar.

- The **QualiPHY log** in the bottom-right frame. The frame can be split by dragging up the lower edge. The bottom half of this split frame now shows the **raw Python output**, which can be useful if ever the script needs debugging.

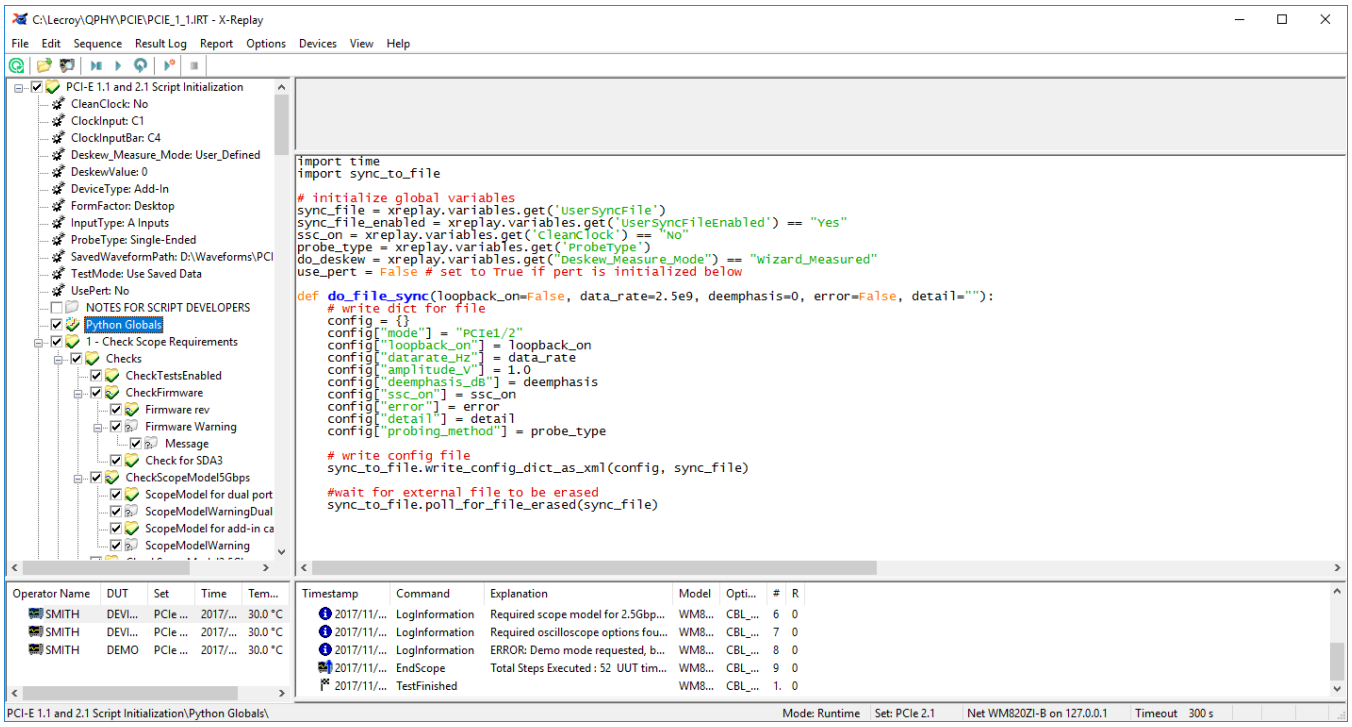


Figure 4 – X-Replay Mode window

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Live Support

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You can also submit Technical Support requests via the website at:

teledynelecroy.com/support/techhelp

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Appendix A: Using SigTest Manager

When the QPHY-PCIe software option is activated on the oscilloscope, the SigTest manager is enabled in the Analysis menu. This tool allows users to have direct access to the SigTest libraries that are built into the oscilloscope software, without having to separately launch the SigTest software. It can be used when testing PCIe 2.0 (5 GT/s), PCIe 3.0, or USB 3.1 signals.

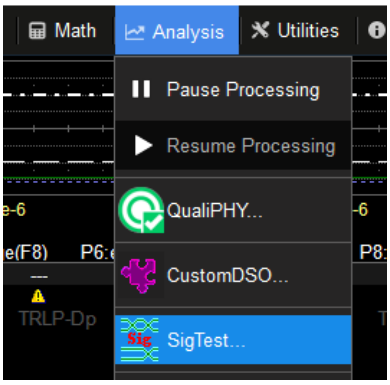


Figure 14. SigTest manager located in the Analysis menu

On the SigTest tab, choose the DataSource input channel and the probing method:1 Input (from a differential probe), or Input1-Input2 (two inputs, probed + and -).

When the probing method is two inputs, enter the DataSourceBar input channel. The software will automatically subtract the two signals.

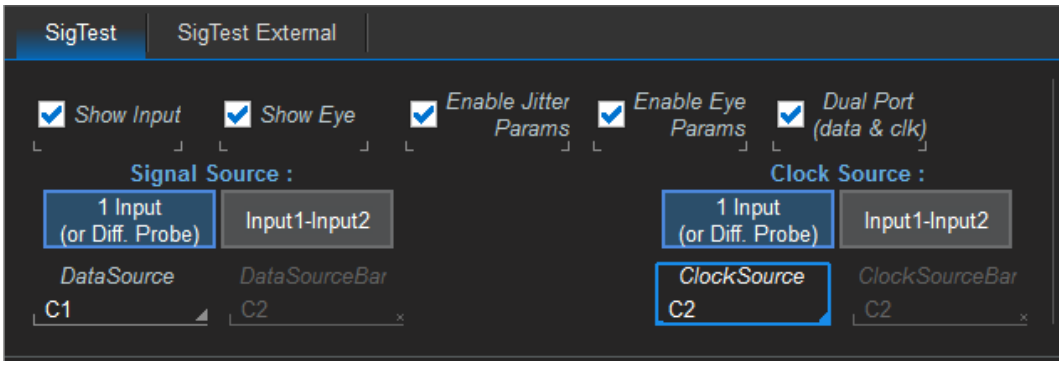


Figure 15. SigTest Tab

The clock signal input(s) may optionally be specified, as well, by checking Dual Port. This activates the Clock Source input controls.

Note: A clock source must be specified for PCIe 2.0 System Testing.

Additionally, you may display the input signal by checking the Show Input box, or display the eye diagram created by the SIGtest library by checking the Show Eye box.

All jitter and eye parameters can be enabled by checking the corresponding boxes.

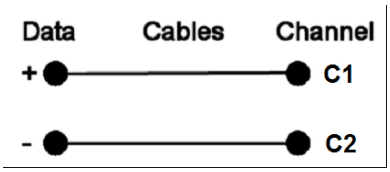
To open the SigTest software and adjust other settings, open the SigTest External tab and select Launch SigTest External.

Appendix B: Manual Deskew Procedure

The following procedure demonstrates how to manually deskew two oscilloscope channels and cables using the differential data signal, without the need for any additional T-connector or adapters.

This can be done once the temperature of the oscilloscope is stable. The oscilloscope must be warmed up for at least a half-hour before proceeding. This procedure should be run again if the temperature of the oscilloscope changes by more than a few degrees.

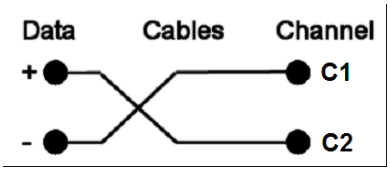
1. Connect a differential data signal to C1 and C2 using two approximately matching cables. Set up the oscilloscope to use the maximum sample rate. Set the timebase for a few repetitions of the pattern (at least a few dozen edges).



2. On the C2 menu, check **Invert**. Now C1 and C2 should look the same.

3. Using the **Measure Setup**, set P1 to measure the Skew of C1, C2. Turn on **Statistics** (**Measure** menu). Write down the mean skew value after it stabilizes. This mean skew value is the addition of Data skew + cable skew + channel skew.

4. Swap the cable connections on the Data source side (on the test fixture), and then press the **Clear Sweeps** button on the oscilloscope (to clear the accumulated statistics; since we changed the input).



5. Write down the mean skew value after it stabilizes. This mean skew value is the addition of (-Data skew) + cable skew + channel skew.

6. Add the two mean skew values and divide the sum in half:

$$\frac{[\text{cable skew} + \text{channel skew}]}{2}$$

7. Set the resulting value as the Deskew value in C1 menu.

8. Restore the cable connections to their Step 1 settings (previous). Press the **Clear Sweeps** button on the oscilloscope. The mean skew value should be approximately zero - that is the data skew. Typically, results are <1 ps given a test fixture meant to minimize skew on the differential pair.

9. On the C2 menu, clear the **Invert** checkbox and turn off the parameters.

In the previous procedure, we used the default setup of the Skew parameter (which is detecting positive edges on both signals at 50%). We also inverted C2 in order to make C1 and C2 both have positive edges at the same time.

Alternately, we clearly could have not inverted C2 and instead selected the Skew Clock 2 tab in the P1 parameter menu and set the oscilloscope to look for negative edges on the second input (C2). However, we believe that the previous approach is more aesthetically pleasing on the display, as it shows C1 and C2 with the same polarity.

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