



# **QPHY-DisplayPort DisplayPort Serial Data Operator's Manual**

**Revision A – November, 2008**

**Relating to the Following Release Versions:**

- **Software Option Rev. 5.7**
- **DisplayPort Script Rev. 1.1**
- **Style Sheet Rev. 1.2**

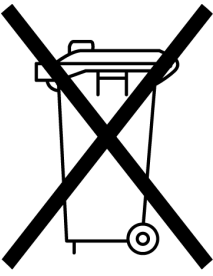
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# QualiPHY™

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## INTRODUCTION TO QUALIPHY DISPLAYPORT

QPHY-DisplayPort is an automated test package performing all of the normative real time oscilloscope tests for sources in accordance with version 1.1 of the VESA DisplayPort PHY Compliance Test Specification. The software can be run on LeCroy's SDA 9000, SDA 11000 and SDA 13000 real time oscilloscopes.

### Required equipment

- SDA 9000, SDA11000 or SDA13000 Oscilloscope
- 4 SMA Male to SMA Male cables
- 8 SMA 50  $\Omega$  Terminators
- DisplayPort Test Fixture (as follows)

### DisplayPort Compliance Test Fixtures

LeCroy recommends using the Efficere ET-DP-TPA-P (plug test adapter) as well as 10 two inch GPPO-to-SMA cables. This equipment is available from Efficere individually or as part of the ET-HDMI-TPA-S Test Adapter Set.

The recommended test fixture for DisplayPort compliance testing is the ET-DP-TPA-S from Efficere Technologies. The ET-DP-TPA-S DisplayPort test adapter set provides a very high bandwidth, low noise evaluation vehicle that enables high-performance characterization of source and sink devices as well as cabling. Single Data Rate (SDR) DisplayPort v1.1 bandwidth requirements exceed 10.8 Gb/s, equivalent to a data transfer rate of 1080 Mbytes/second. This adapter test set will also support Double Data Rates (DDR) anticipated in the v2.0 specification.

**Note:** The above text was taken from the ET-DP-TPA-S datasheet that can be found at [www.efficere.com](http://www.efficere.com)

## USING QUALIPHY DISPLAYPORT

QualiPHY DisplayPort guides the user, step-by-step, through each of the normative source tests described in version 1.1 of the VESA DisplayPort PHY Compliance Test Specification. To do this, the user must setup a test session.

Users choose the test configuration they wish to run. There are five pre-loaded test configurations. They are:

- **All Tests for Compliance (Lane0)**
- **All Tests, High Bit Rate, SSC**
- **All Tests, Reduced Bit Rate, SSC**
- **Demo Mode, High Bit Rate, No SSC**
- **Empty Template**

These pre-loaded configurations provide quick and easy ways to begin compliance testing. If the user does not want to run any of these configurations, they can create their own custom configuration (see the following section entitled **Customizing QualiPHY** for details). The **Empty Template** is a blank configuration meant to serve as an easy way to create your own custom configuration.

The pre-loaded configurations are setup to run all of the compliance tests on Lane 0, with the second lane tested against for Inter-Pair Skew set to Lane 1. If this is not what the user wants, the variables can be modified (see the **QPHY-DisplayPort Variables** section of this manual).

The variables are pre-loaded with the standard settings for compliance testing; however, the user may choose to create their own configuration with the variables set as desired.

## QUALIPHY COMPLIANCE TEST PLATFORM

QualiPHY is LeCroy's compliance test framework which leads the user through the compliance tests. QualiPHY displays connection diagrams to ensure tests run properly, automates the oscilloscope setup, and generates complete, detailed reports.

The QualiPHY software application automates the test and report generation.

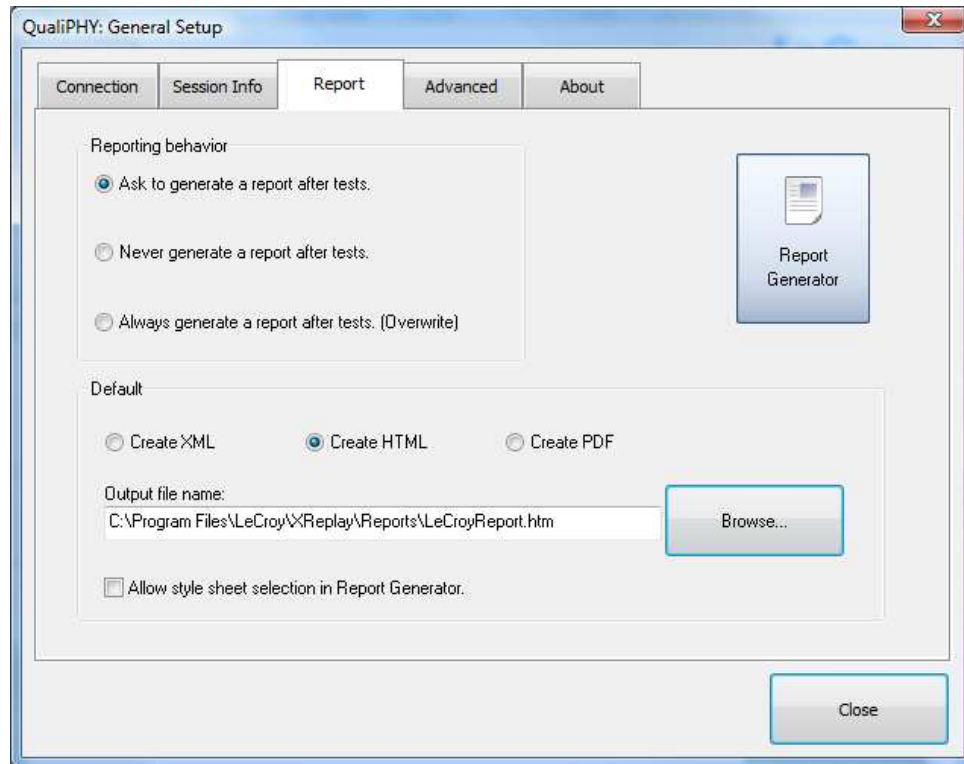


Figure 1. Report menu in QualiPHY General Setup

See the QualiPHY Operator's Manual for more information on how to use the QualiPHY framework.



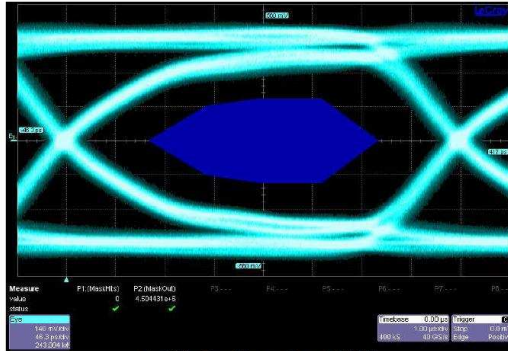
## DPORT Test Report

**Overall result: Pass**

DUT: DUT1  
 Comment: All Tests, both bitrates  
 Time of test: 09/10/2008 15:10:19  
 Operator: Steven  
 Temperature: 20° C

Configuration in use: All Tests, Both Bit Rates  
 Limits in use: Default  
 Standard in use: DPORT  
 Oscilloscope Name: LCRV0409N11978 Model: SDA11000  
 Oscilloscope Serial #: LCRV0409N11978  
 Computer: LECROY TEST

Oscilloscope firmware version: 0.5.6.1 (Build 113609)  
 QualiPHY core version: 0.5.6.0 (Build 113504)  
 QualiPHY script version: 0.0.9.29  
 Stylesheet version: 1.2



Test 3.1 - Eye Diagram Lane0 2.7Gb/s  
 Timestamp: 09/10/2008 15:11:26

### Summary Table

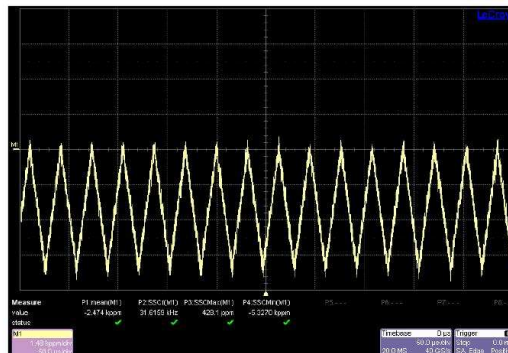
Pass	Test	Measurement	Current Value	Test Criteria
✓	3.1	Eye Mask Hits 2.7Gb/s	0	= 0
✓	3.1	Eye Mask Hits 1.62Gb/s	0	= 0
?	3.2	Non-Preemphasis Peak to Peak Output Level 1.2.7Gb/s	417.9 mV	Informational Only
?	3.2	Non-Preemphasis Peak to Peak Output Level 1.1.62Gb/s	428.2 mV	Informational Only
?	3.2	Non-Preemphasis Peak to Peak Output Level 2.2.7Gb/s	654.4 mV	Informational Only
?	3.2	Non-Preemphasis Peak to Peak Output Level 2.1.62Gb/s	671.3 mV	Informational Only
✓	3.2	Non Pre-Emphasis Voltage 2.7Gb/s Measure 1.600mV to 400mV ratio	3.8956 dB	800.0 mdB <= n <= 6.0000 dB
✓	3.2	Non Pre-Emphasis Voltage 1.62Gb/s Measure 1.600mV to 400mV ratio	3.9052 dB	800.0 mdB <= n <= 6.0000 dB
?	3.2	Non-Preemphasis Peak to Peak Output Level 3.2.7Gb/s	864.8 mV	Informational Only
?	3.2	Non-Preemphasis Peak to Peak Output Level 3.1.62Gb/s	884.6 mV	Informational Only
✓	3.2	Non Pre-Emphasis Voltage 2.7Gb/s Measure 2.800mV to 600mV ratio	2.4213 dB	100.0 mdB <= n <= 5.1000 dB

**Pass** Measurement: **Eye Mask Hits 2.7Gb/s**  
 Limit Name: EyeMaskHits  
 Current Value: 0  
 Test Criteria: = 0  
 Timestamp: 09/10/2008 15:11:26

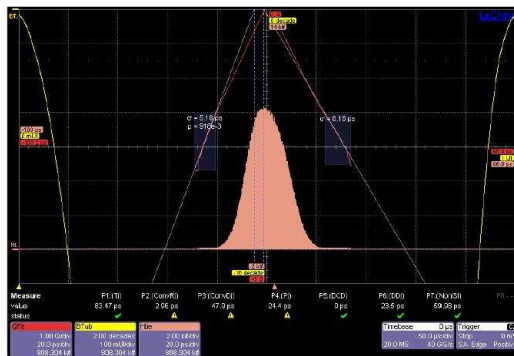
**Pass** Test Criteria: <= 170.0 mUI  
 Timestamp: 09/10/2008 15:44:21

Measurement: **Total Jitter (sec) 1.62Gb/s**  
 Limit Name: InfoOnly  
 Current Value: 83.47 ps  
 Test Criteria: Informational Only  
 Timestamp: 09/10/2008 15:44:21

**Pass** Measurement: **Total Jitter (UI) 1.62Gb/s**  
 Limit Name: TJ\_RBR  
 Current Value: 135.2 mUI  
 Test Criteria: <= 270.0 mUI  
 Timestamp: 09/10/2008 15:44:21



Tests 3.15 - 3.16 Spread Spectrum Lane0 2.7Gb/s  
 Timestamp: 09/10/2008 15:31:43



Tests 3.11 & 3.12 Lane0 1.62Gb/s Non ISI & Total Jitter, Output Level 1, Preemphasis Level 1  
 Timestamp: 09/10/2008 15:44:21

Figure 2. The Test Report includes a summary table with links to the detailed test results



## Oscilloscope Option Key Installation

An option key must be purchased to enable the QPHY-DP option. Call LeCroy Customer Support to place an order and receive the code.

Enter the key and enable the purchased option as follows:

1. From the oscilloscope menu select **Utilities** → **Utilities Setup...**
2. Select the **Options** tab and click the **Add Key** button.
3. Enter the **Key Code** using the on-screen keyboard.
4. Restart the oscilloscope to activate the option after installation.

## Typical (Recommended) Configuration

QualiPHY software can be executed from the oscilloscope or a host computer. The first step is to install QualiPHY. Please refer to the QualiPHY Operator's Manual for installation instructions.

LeCroy recommends running QualiPHY on an oscilloscope equipped with Dual Monitor Display capability (Option DMD-1 for oscilloscopes where this is not standard). This allows the waveform and measurements to be shown on the oscilloscope LCD display while the QualiPHY application and test results are displayed on a second monitor.

By default, the oscilloscope appears as a local host when QualiPHY is executed in the oscilloscope. Follow the steps under **Oscilloscope Selection** (as follows) and check that the IP address is **127.0.0.1**.

## Remote (Network) Configuration

It is also possible to install and run QualiPHY on a host computer, controlling the oscilloscope with a Network/LAN Connection.

The oscilloscope must already be configured, and an IP address (fixed or network-assigned) must already be established.

## Oscilloscope Selection

Set up the oscilloscope using QualiPHY over a LAN (Local Area Network) by doing the following:

1. Make sure the host computer is connected to the same LAN as the oscilloscope. If unsure, contact your system administrator.
2. From the oscilloscope menu, select **Utilities** → **Utilities Setup...**
3. Select the **Remote** tab.
4. Verify the oscilloscope has an IP address and the control is set to TCP/IP.
5. Run QualiPHY in the host computer and click the **General Setup** button.
6. Select the **Connection** tab.
7. Enter the IP address from step 4 (previous).
8. Click the **Close** button.

QualiPHY is now ready to control the oscilloscope.

QualiPHY tests the oscilloscope connection after clicking the **Start** button. The system prompts you if there is a connection problem. QualiPHY's **Scope Selector** function can also be used to verify the connection. Please refer to the **QualiPHY Operator's Manual** for explanations on how to use Scope Selector and other QualiPHY functions.

## Accessing the QPHY-DisplayPort Software using QualiPHY

This topic provides a basic overview of QualiPHY's capabilities. Please refer to the **QualiPHY Operator's Manual** for detailed information.

Access the QPHY-DisplayPort software using the following steps:

1. Wait for the oscilloscope to start and have its main application running.
2. Launch QualiPHY from the **Analysis** menu if installed on the oscilloscope or from the desktop icon if installed on a host computer.
3. From the QualiPHY main window (as follows), select **Standard**, then **DPORT** from the pop-up menu (if not already selected). If you check the **Pause on Failure** box (circled) QualiPHY prompts to retry the measure whenever a test fails.

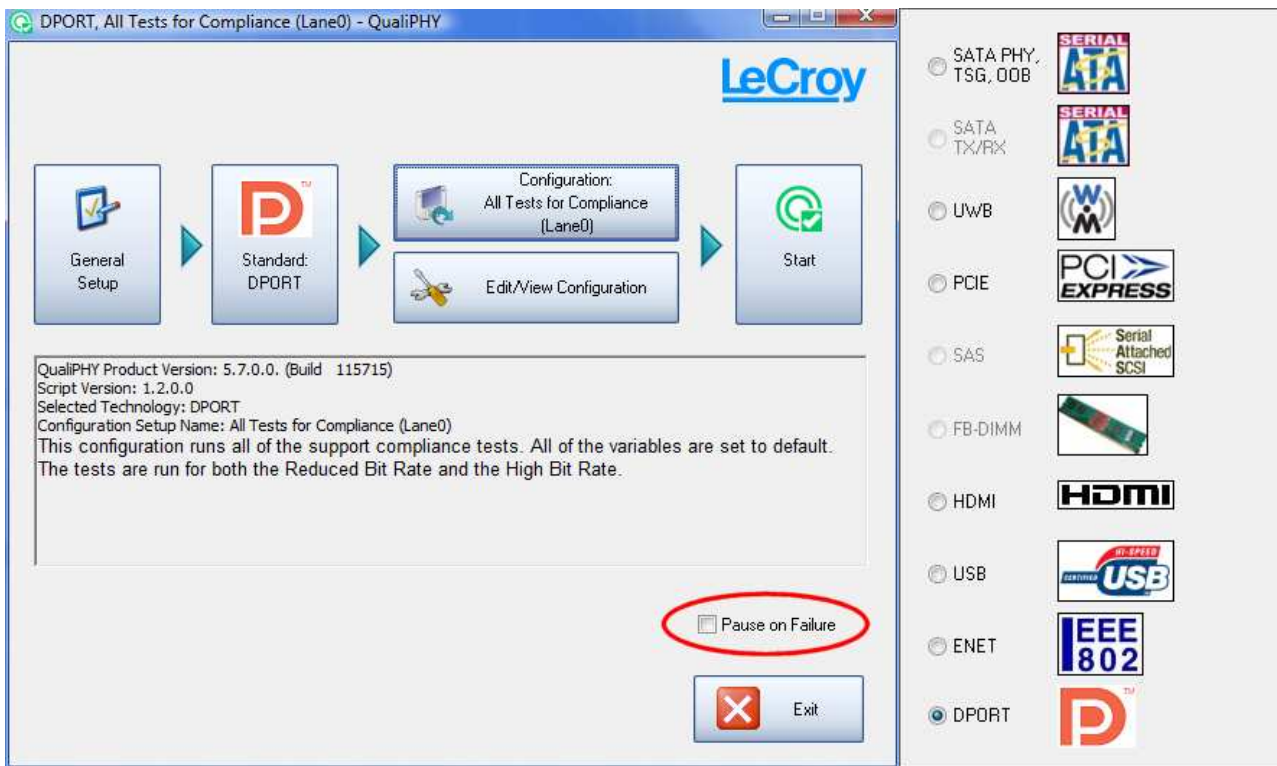
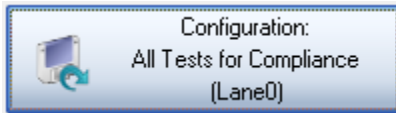


Figure 3. QualiPHY main menu and compliance test Standard selection menu

- Click the **Configuration** button in the QualiPHY main menu:



- Select a configuration from the pop-up menu:

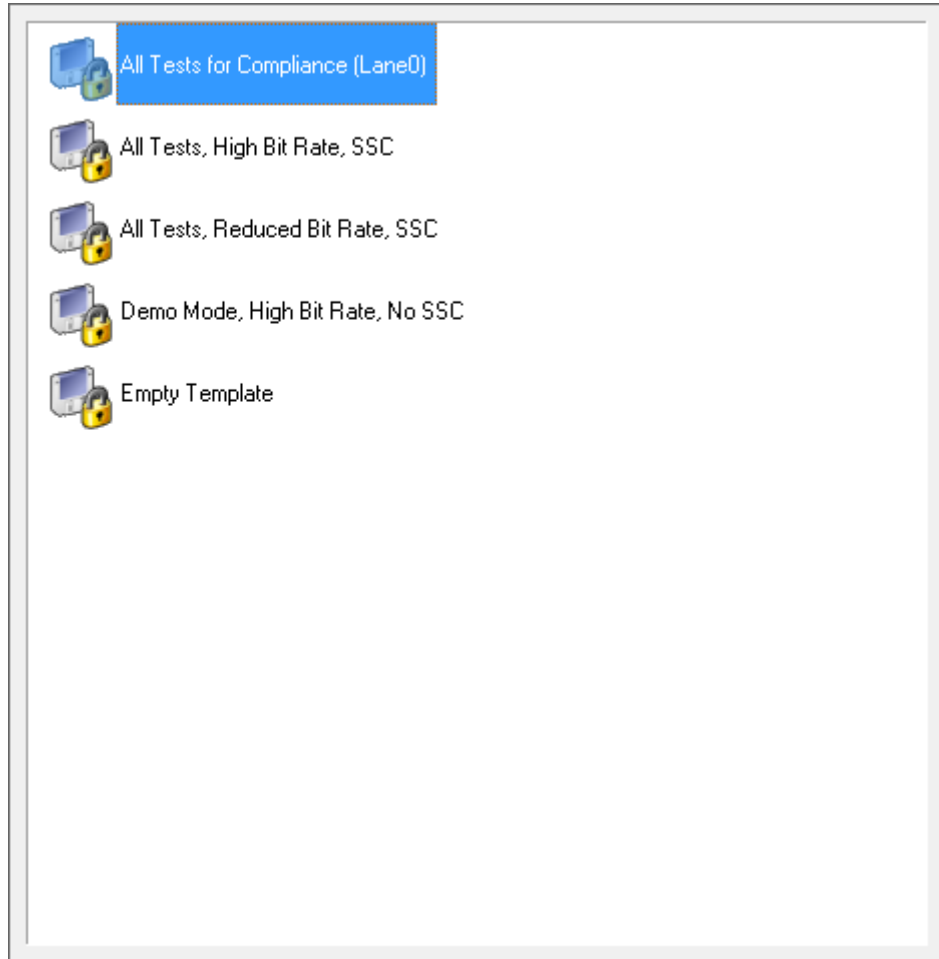


Figure 4. QualiPHY configuration selection menu

- Click **Start**.



- Follow the pop-up window prompts.

## Customizing QualiPHY

The predefined configurations in the **Configuration** screen cannot be modified. However, you can create your own test configurations by copying one of the standard test configurations and making modifications. A description of the test is also shown in the description field when selected.

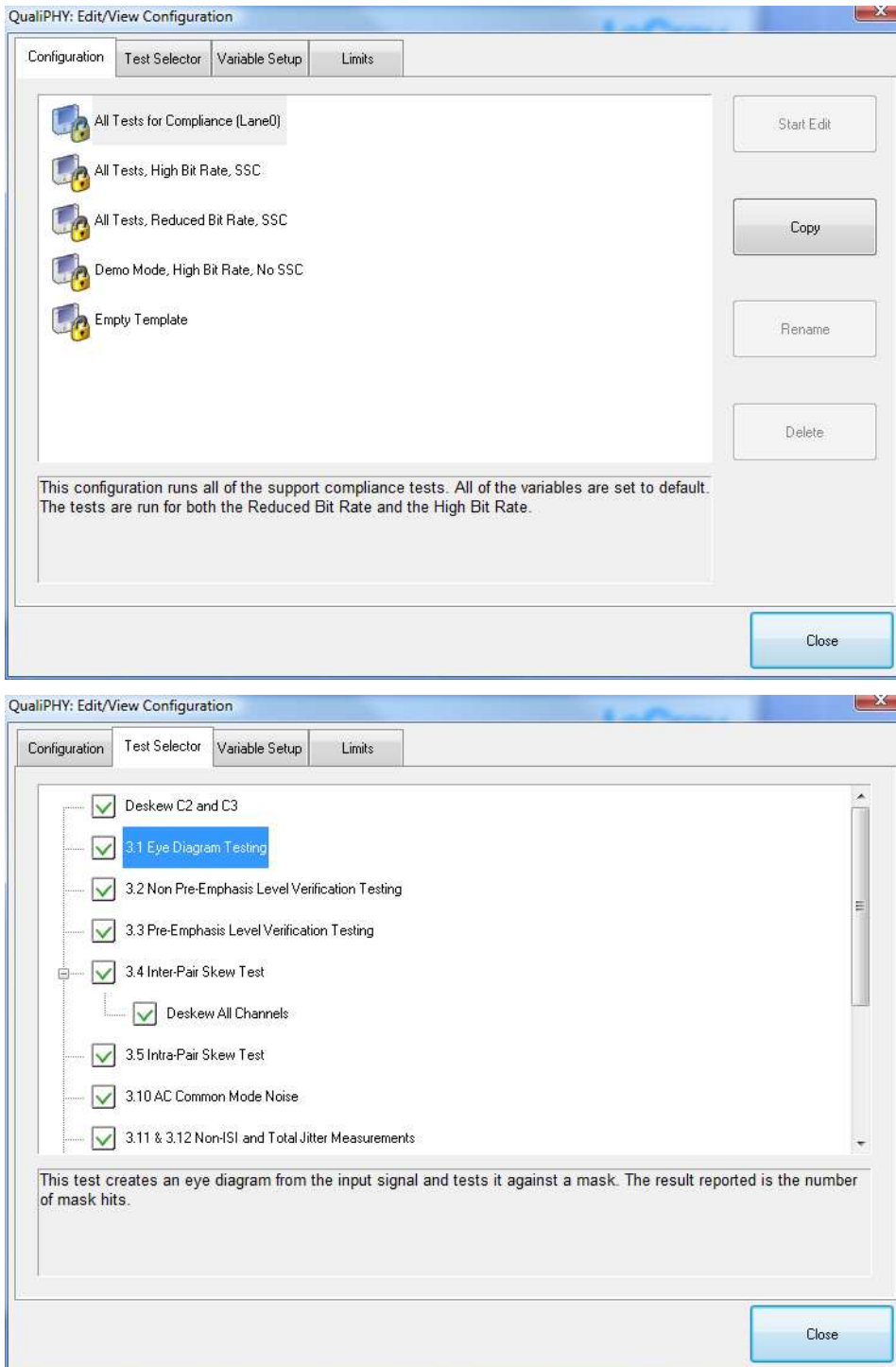


Figure 5. QualiPHY test item selection menu

Once a custom configuration is defined, script variables and the test limits can be changed by using the **Variable Setup** and **Limits Manager** from the **Edit/View Configuration** window.

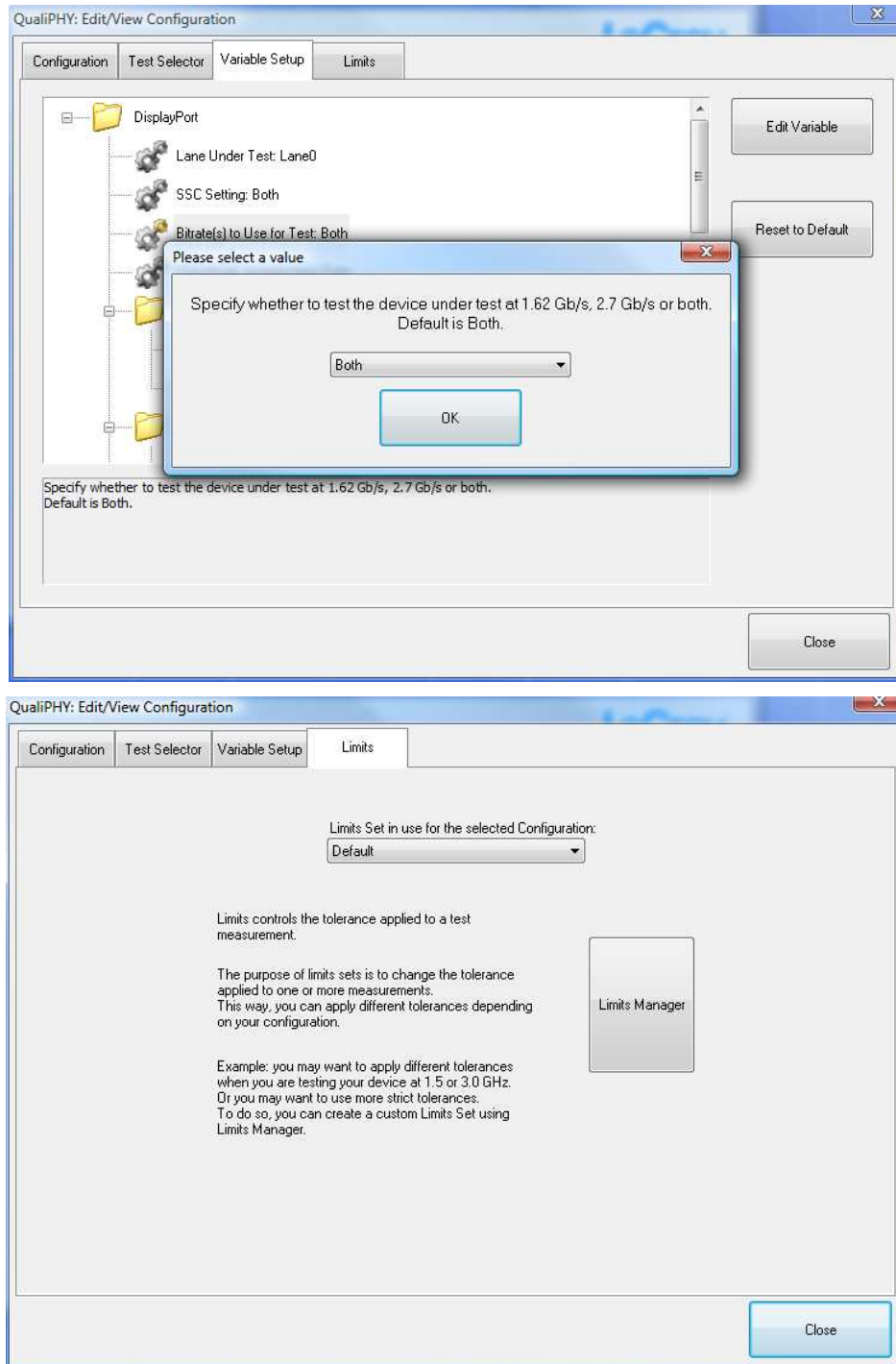


Figure 6. Variable Setup and Limits Manager windows

## QPHY-DisplayPort Operation

After pressing **Start** in the QualiPHY menu, the software instructs how to set up the test using pop-up connection diagrams and dialog boxes.



Figure 7. Start button

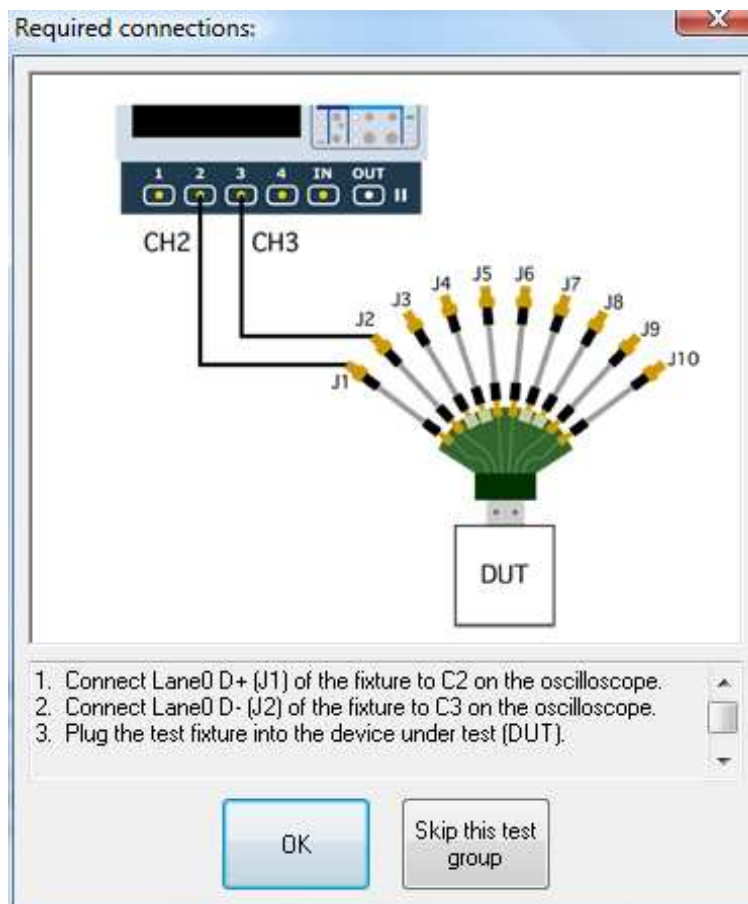


Figure 8. Example of pop-up connection diagram and dialog box

### DISPLAYPORT MEASUREMENT PREPARATION

Before beginning any test or data acquisition, the oscilloscope must be warmed for at least 20 minutes. Calibration is automatic under software control and no manual calibration is required.

This procedure should be run again if the temperature of the oscilloscope changes by more than a few degrees.

**Note:** The QPHY-DisplayPort script automates the process for deskewing 4 cables. The 4 channel deskew procedure automated by the script is very similar to a 2 channel procedure except that the 3<sup>rd</sup> and 4<sup>th</sup> channel are also deskewed with the 1<sup>st</sup> channel as the reference channel.

### QPHY-DISPLAYPORT TEST CONFIGURATIONS

Configurations also include variable settings and limit sets, not just test selections. See the QPHY-DisplayPort Variables section for a description of each variable value and its respective default value.

#### All Tests for Compliance (Lane0)

This configuration runs all of the support compliance tests. All of the variables are set to default. The tests are run for both the Reduced Bit Rate and the High Bit Rate.

#### All Tests, High Bit Rate, SSC

This configuration runs all of the support compliance tests. All variables are set to default except Bit Rate to Use for Test(s), which is set to High Bit Rate.

#### All Tests, Reduced Bit Rate, SSC

This configuration runs all of the support compliance tests. All variables are set to default except Bit Rate to Use for Test(s), which is set to Reduced Bit Rate.

#### Demo Mode, High Bit Rate, No SSC

This configuration runs a demonstration of all of the support compliance tests. All variables are set to default except Bit Rate to Use for Test(s), which is set to High Bit Rate. Saved waveforms are used.

#### Empty Template

This configuration is intentionally left blank so it can easily be copied and configured to the user's custom configuration. All variables are set to their default settings.



## QPHY-DISPLAYPORT VARIABLES

### **Test Mode**

Specify whether to Acquire New Data or Use Saved Data for testing. Default is Acquire New Data.

### **Bitrate(s) to Use for Test**

Specify whether to test the device under test at 1.62 Gb/s, 2.7 Gb/s or Both. Default is Both.

### **Lane Under Test**

Specify the lane for testing. The choices are Lane 0, Lane 1, Lane 2 or Lane 3. Default is Lane 0.

### **SSC**

Specify the state of SSC when running test. The choices are Enabled, Disabled, Both. Default is Disabled (Note: some devices do not allow SSC to be disabled).

## **3.1 Eye Diagram Testing**

### **Output Level to Test**

Specify which output level to use for the Eye Diagram test.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose "0, 1" to use 400 mV and 600 mV. The default value is 800mV.

### **Pre-emphasis Level to Test**

Specify which pre-emphasis level to use for the Eye Diagram test.

The choices are: 0 – 0 dB, 1 – 3.5 dB, 2 – 6.0 dB or 3 – 9.5 dB or any combination. The default value is 0dB.

## **3.3 Pre-Emphasis Level Verification Testing**

### **Output Level to Test**

Specify which output level to use for the Pre-Emphasis Voltage test.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose "0, 1" to use 400 mV and 600 mV. The default value is 800mV.

## **3.4 Inter-Pair Skew Test**

### **Second Lane Under Test**

Specify which lane to use as the second lane in the Inter-Pair Skew test. The choices are Lane 0, Lane 1, Lane 2, Lane 3 or All. Default is Lane 1.

### **Output Level to Test**

Specify which output level to use for the Inter-Pair Skew test.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose "0, 1" to use 400 mV and 600 mV. The default value is 800mV.

### **Only Test At Highest Bit Rate**

Specify whether to run the Inter-Pair Skew test on only the highest bit rate. The Compliance Test Specification Rev. 1.1 only requires this test to be run at the highest bit rate; however, this option allows you to run this test at both the High Bit Rate and the Reduced Bit Rate. This only applies when **Bitrate(s) to Use For Test** is set to Both. Default is Yes.

## **3.5 Intra-Pair Skew Test**

### **Output Level to Test**

Specify which output level to use for the Intra-Pair Skew test.



The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose “0, 1” to use 400 mV and 600 mV. The default value is 800mV.

### ***Only Test at Highest Bit Rate***

Specify whether to run the Intra-Pair Skew test on only the highest bit rate. The Compliance Test Specification Rev. 1.1 only requires this test to be run at the highest bit rate, however this option allows you to run this test at both the High Bit Rate and the Reduced Bit Rate. This only applies when **Bitrate(s) to Use For Test** is set to Both. Default is Yes.

### **3.10 AC Common Mode Noise**

#### ***Output Level to Test***

Specify which output level to use for the AC Common Mode test.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose “0, 1” to use 400 mV and 600 mV. The default value is 800mV.

#### ***Pre-emphasis Level to Test***

Specify which pre-emphasis level to use for the AC common mode test.

The choices are: 0 – 0 dB, 1 – 3.5 dB, 2 – 6.0 dB or 3 – 9.5 dB or any combination. The default value is 0dB.

### **3.11 & 3.12 Non-ISI and Total Jitter Measurements**

#### ***Output Level to Test***

Specify which output level to use for the Non-ISI and Total Jitter tests.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose “0, 1” to use 400 mV and 600 mV. The default value is 800mV.

#### ***Pre-emphasis Level to Test***

Specify which pre-emphasis level to use for the Non-ISI and Total Jitter tests.

The choices are: 0 – 0 dB, 1 – 3.5 dB, 2 – 6.0 dB or 3 – 9.5 dB or any combination. The default value is 0dB.

### **3.14-3.16 Spread Spectrum Tests**

This consists of Main Link Frequency (3.14), SSC Modulation Frequency (3.15) and SSC Modulation Deviation (3.16).

#### ***Output Level to Test***

Specify which output level to use for the Spread Spectrum tests.

The choices are: 0 – 400 mV, 1 – 600 mV, 2 – 800 mV or 3 – 1200 mV or any combination. For example, choose “0, 1” to use 400 mV and 600 mV. The default value is 800mV.

## **QPHY-DISPLAYPORT LIMIT SETS**

The limits in use by QPHY-DisplayPort are the ones specified by the VESA DisplayPort PHY Compliance Test Specification Version 1.1.

## QPHY-DISPLAYPORT TESTS

For additional information about the tests supported by QPHY-DisplayPort please refer to the VESA DisplayPort PHY Compliance Test Specification Version 1.1.

### 3.1 Eye Diagram Testing

This test creates an eye diagram from the input signal and tests it against a mask. The result reported is the number of mask hits.

Pass	Test	Measurement	Speed	Nominal Output Level	Nominal Preemphasis	Current Value	Test Criteria
✓	3.1	<a href="#">Eye Mask Hits</a>	2.7Gb/s	800mV	0.0dB	0	= 0

### 3.2 Non Pre-Emphasis Level Verification Testing

This test measures the peak to peak voltage level of the non pre-emphasis bits. The source device under test should be outputting a PRBS7 pattern. The non pre-emphasis level measurement is defined with regard to specific bits of the pattern and cannot be applied to other patterns such as the D10.2 pattern. For each nominal output voltage level (400 mV, 600 mV, 800 mV and 1200 mV) the measured non-pre-emphasis peak to peak voltage is reported for informational purposes. The compliance measures 1, 2, and 3 are ratios of the measure peak to peak voltage at different levels as defined by the Compliance Test Specification, Rev 1.1.

?	3.2	<a href="#">Non-Preemphasis Peak to Peak</a>	2.7Gb/s	400mV	0.0dB	402.5 mV	Informational Only
?	3.2	<a href="#">Non-Preemphasis Peak to Peak</a>	2.7Gb/s	600mV	0.0dB	622.9 mV	Informational Only
✓	3.2	<a href="#">Non Pre-Emphasis Voltage Measure 1 600mV to 400mV ratio</a>	2.7Gb/s	-	0.0dB	3.7926 dB	800.0 mdB <= n <= 6.0000 dB
?	3.2	<a href="#">Non-Preemphasis Peak to Peak</a>	2.7Gb/s	800mV	0.0dB	811.8 mV	Informational Only
✓	3.2	<a href="#">Non Pre-Emphasis Voltage Measure 2 800mV to 600mV ratio</a>	2.7Gb/s	-	0.0dB	2.3002 dB	100.0 mdB <= n <= 5.1000 dB
?	3.2	<a href="#">Non-Preemphasis Peak to Peak Output Level 4</a>	2.7Gb/s	1200mV	0.0dB	1243.8 V	Informational Only
✓	3.2	<a href="#">Non Pre-Emphasis Voltage Measure 3 1200mV to 800mV ratio</a>	2.7Gb/s	-	0.0dB	3.7058 dB	800.0 mdB <= n <= 6.0000 dB

### 3.3 Pre-Emphasis Level Verification Testing

This test measures the level of pre-emphasis seen in the input signal. The source device under test should be outputting a PRBS7 pattern. The pre-emphasis level measurement is defined as a ratio of peak to peak voltage of the transition bits and the peak to peak voltage of the non-transition width. Therefore, as with Test 3.2, this measurement cannot be applied to other patterns such as the D10.2 pattern. For each nominal level of pre-emphasis (0.0 dB, 3.5 dB, 6.0 dB and 9.5 dB) the peak to peak voltage for both the transition and non-transition bits is reported for informational purposes. The level of pre-emphasis measured is also reported. In some cases, the difference between two measured levels of pre-emphasis is also reported as specified in the Compliance Test Specification, Rev. 1.1.

?	3.3	<a href="#">Vt_0db_PP</a>	2.7Gb/s	800mV	0.0dB	634.4 mV	Informational Only
?	3.3	<a href="#">Vn_0db_PP</a>	2.7Gb/s	800mV	0.0dB	806.3 mV	Informational Only
✓	3.3	<a href="#">Pre-Emphasis 0dB</a>	2.7Gb/s	800mV	0.0dB	-2.082 dB	<= 0 mdB
?	3.3	<a href="#">Vt_3.5db_PP</a>	2.7Gb/s	800mV	3.5dB	1222.1 mV	Informational Only
?	3.3	<a href="#">Vn_3.5db_PP</a>	2.7Gb/s	800mV	3.5dB	826.7 mV	Informational Only
✓	3.3	<a href="#">Pre-Emphasis Result 3.5 dB</a>	2.7Gb/s	800mV	3.5dB	5.478 dB	>= 2.000 dB
✓	3.3	<a href="#">Non-Transition Voltage Range 800mV</a>	2.7Gb/s	800mV	-	20.4 mV	< 240.0 mV

### 3.4 Inter-Pair Skew Test

This test measures the skew between two lanes. The value reported is the actual skew measured minus the nominal skew expected between the two lanes.

✓	3.4	<a href="#">Inter-Pair Skew Lane0 - Lane1</a>	2.7Gb/s	800mV	0.0dB	-29 mUI	0.00 UI +/- 2.00 UI
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### 3.5 Intra-Pair Skew Test

This test measures the skew between D+ and D- of a single lane. The skew is measured at the 50% level of the transition, as determined using the voltage level as defined in Test 3.2. Therefore, as with Test 3.2, this measurement must be made using a PRBS7 pattern as the input signal and cannot be applied to other patterns, such as the D10.2 pattern.

✓	3.5	<a href="#">Intra-Pair Skew</a>	2.7Gb/s	800mV	0.0dB	17.258 ps	0 fs +/- 30.000 ps
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### 3.10 AC Common Mode Noise

This test measures the root mean square of the common mode voltage.

✓	3.10	<a href="#">Vtx-ac-cm</a>	2.7Gb/s	800mV	0.0dB	10.5 mVrms	<= 20.0 mVrms
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### 3.11 Non-ISI Jitter Measurements

This test measures the non-inter-symbol interference jitter. The result is reported in seconds and in unit intervals.

?	3.11	<a href="#">Non ISI Jitter (sec)</a>	2.7Gb/s	800mV	0.0dB	30.11 pS	Informational Only
✓	3.11	<a href="#">Non ISI Jitter (UI)</a>	2.7Gb/s	800mV	0.0dB	81.3 mUI	< 276.0 mUI

### 3.12 Total Jitter Measurements

This test measures the total jitter. The result is reported in seconds and in unit intervals.

?	3.12	<a href="#">Total Jitter (sec)</a>	2.7Gb/s	800mV	0.0dB	66.42 pS	Informational Only
✓	3.12	<a href="#">Total Jitter (UI)</a>	2.7Gb/s	800mV	0.0dB	179.3 mUI	< 420.0 mUI

### 3.14 Main Link Frequency Compliance

This test measures the mean operating frequency of the input signal. The result reported is the deviation from the nominal frequency in parts per million.

✓	3.14	<a href="#">Main Link Frequency Mean (ppm)</a>	2.7Gb/s	800mV	0.0dB	-1.1806 kppm	-5.3000 kppm <= n <= 300.0 ppm
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### 3.15 Spread Spectrum Clock Modulation Frequency

This test measures the spread spectrum modulation frequency. This measurement only applies when spread spectrum is enabled.

✓	3.15	<a href="#">fSSC</a>	2.7Gb/s	800mV	0.0dB	31.6 kHz	30.0 kHz <= n <= 33.0 kHz
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### 3.16 Spread Spectrum Clock Modulation Deviation

This test measures the range of frequency deviation due to spread spectrum. This measurement only applies when spread spectrum is enabled. The result reported is the maximum deviation minus the minimum deviation from the nominal frequency in parts per million.

✓	3.16	<a href="#">SSC Range</a>	2.7Gb/s	800mV	0.0dB	-3.1453 kppm	-5.0000 kppm <= n <= 0.0 ppm
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