



Granite River Labs

**GRL-USB32-TX Transmitter Compliance Test Automation
Solution
User Guide & Method of Implementation (MOI)
for USB 3.2 Transmitter (Tx) Test Application**

Published on 13 November 2024

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1 Introduction

This User Guide & MOI provides information using the GRL-USB32-TX test solution to set up and test an electrical transmitter (Tx) device for USB 3.2 Tx specification compliance.

The main body of this documentation describes how to configure the GRL-USB32-TX solution to capture and test waveforms in a USB 3.2 Host or Device DUT and perform SigTest compliance tests for USB 3.2.

The GRL-USB32-TX software when run from the computer or oscilloscope enables automation control to test the device under test (DUT) for Tx electrical compliance. The GRL automation control enabled PC or scope automates Tx test sequencing and processing of captured waveforms for the DUT at the selected USB 3.2 data rate. The captured waveforms are processed using the SigTest application using the relevant templates. When combined with a satisfactory level of interoperability testing, these tests provide a reasonable level of confidence that the DUT's will function properly in most USB environments.

This documentation covers the following major components for USB 3.2 Tx testing.

- GRL-USB32-TX software configuration and test setup.
- Method of Implementation (MOI) manual test methodology.

2 Resource Requirements

Note: Equipment requirements may vary according to the lab setup and DUT board. Below are the recommended lists of equipment for the typical test setup.

2.1 Equipment Requirements

TABLE 1. EQUIPMENT REQUIREMENTS – SYSTEMS

Equipment	Qty.	Description/Key Spec Requirement
High Performance Real-time Oscilloscope ^[a]	1	≥ 12 GHz bandwidth (For USB 3.2 Gen 1) ≥ 25 GHz bandwidth (For USB 3.2 Gen 2) - Scope measurement software, e.g. Keysight InfiniiSim for Keysight scope or Tektronix Serial Data Link Analysis (SDLA) for Tektronix scope
USB-IF Host Fixture or Third Party Plug Test Fixture	1	For USB host
USB-IF Device Test Fixture Or Third Party Receptacle Test Fixture	1	For USB device

TABLE 2. EQUIPMENT REQUIREMENTS – CABLES

Cable	Qty.
Phase-matched SMA Cable	1 pair
USB Type-A/USB Type-B/USB Micro-A/USB Micro-B/USB Type-C Cable ^[a]	1

^[a] Based on the DUT connector type. Refer to the specific connection diagram in Section 4.1 for the length of cable required.

2.2 Software Requirements

TABLE 3. SOFTWARE REQUIREMENTS

Software	Description/Source
GRL-USB32-TX	Granite River Labs USB 3.2 Automated Transmitter Compliance Test Solution (hardware & software) – www.graniteriverlabs.com Further automation license for Custom DUT, RF Switch, or other bench automation – www.graniteriverlabs.com
VISA (Virtual Instrument Software Architecture) API Software	VISA Software is required to be installed on the controller PC running GRL-USB32-TX software. GRL's software framework has been tested to work with all three versions of VISA available on the Market: 1. NI-VISA: http://www.ni.com/download/ni-visa-17.0/6646/en/ 2. Keysight IO Libraries: www.keysight.com (Search on IO Libraries) 3. Tektronix TekVISA: www.tek.com (Downloads > Software > TekVisa)
SigTest	Standard Post Processing Analysis Software – www.intel.com/content/www/us/en/design/technology/high-speed-io/tools.html

3 Setting Up GRL-USB32-TX Automation Software

This section provides the procedures to start up and pre-configure the GRL-USB32-TX automation software before running tests. It also helps users familiarize themselves with the basic operation of the software.

Note: The GRL-USB32-TX software installer will automatically create shortcuts in the Desktop and Start Menu when installing the software.

To start using the GRL-USB32-TX software, follow the procedures in the following sections.

3.1 Download GRL-USB32-TX Software

Download and install the GRL-USB32-TX software as follows:

1. If the GRL-USB32-TX software is to be installed on a PC (where is referred to as ‘controller PC’), install VISA (Virtual Instrument Software Architecture) on to the PC where the GRL software is to be used (see Section 2.2).
2. Download the software ZIP file package from the Granite River Labs support site.
3. The ZIP file contains:
 - **USB3_2TxTestApplicationxxxxxxxxSetup.exe** – Run this on the PC or on the oscilloscope to install the GRL-USB32-TX application.
 - **USB3_2TxTestScopeSetupFilesInstallationxxxxxxxxSetup.exe** – Run this on the oscilloscope to install the scope setup files.

3.2 Launch and Set Up GRL-USB32-TX Software

1. Once the GRL-USB32-TX software is installed, open the GRL folder from the Windows Start menu. Click on **GRL – Automated Test Solutions** within the GRL folder to launch the GRL software framework.

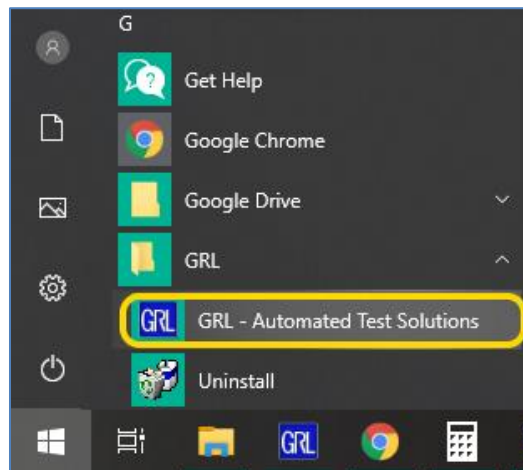


FIGURE 1. SELECT AND LAUNCH GRL FRAMEWORK

2. From the **Application**→**Framework Test Solution** drop-down menu, select “**USB 3.2 Tx Test Application**” to start the USB 3.2 Tx Test Application. If the selection is grayed out, it means that your license has expired.

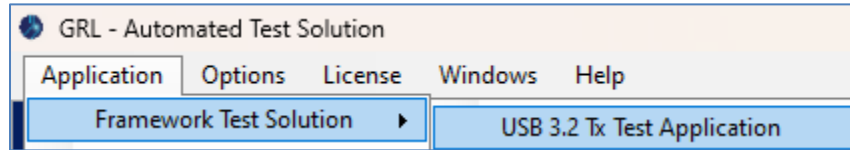


FIGURE 2. START USB 3.2 TX TEST APPLICATION

3. To enable license, go to License→License Details.

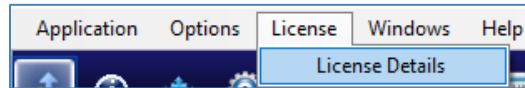


FIGURE 3. SEE LICENSE DETAILS

- a) Check the license status for the installed application.

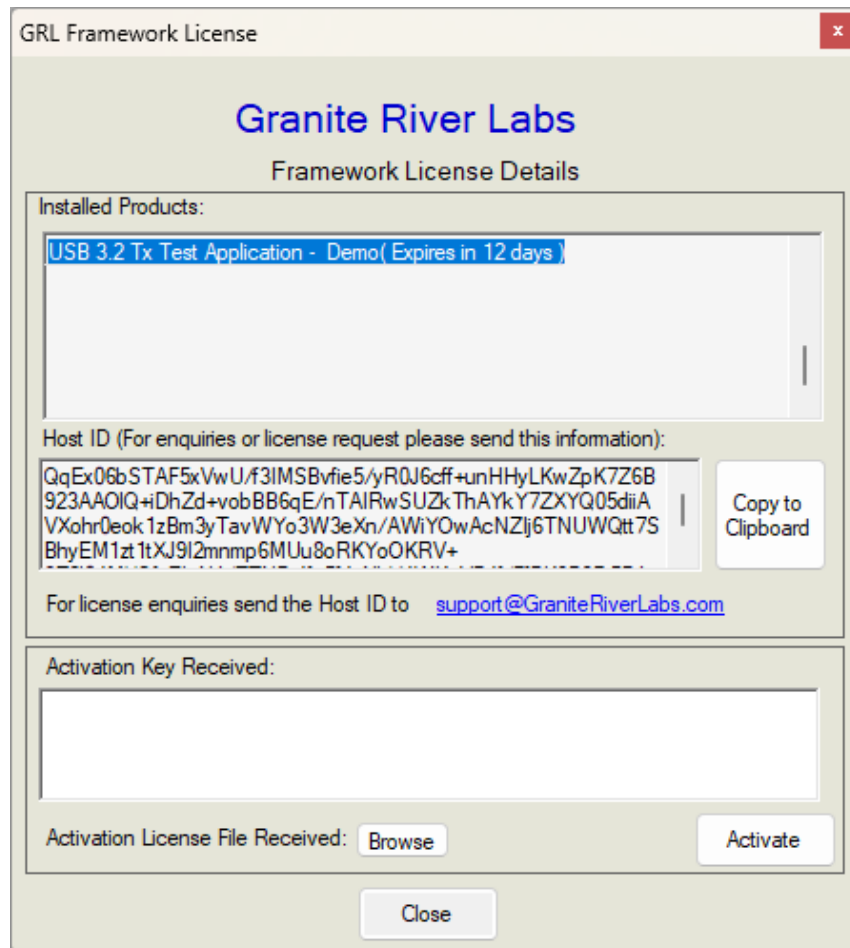


FIGURE 4. CHECK LICENSE FOR INSTALLED APPLICATIONS

b) Activate a License:

- If you have an Activation Key, enter it in the field provided and select “Activate”.
- If you do not have an Activation Key, select “Close” to use a demo version of the software over a free 10-day trial period.

Note: Once the 10-day trial period ends, you will need to request an Activation Key to continue using the software on the same computer or oscilloscope. The demo software is also limited in its capability, in that it will only calibrate the maximum frequency for each data rate. Thus, the demo version cannot be used to fully calibrate and test a device. For Demo and Beta Customer License Keys, please request an Activation Key by contacting support@graniteriverlabs.com.

4. Select the Equipment Setup icon  on the USB 3.2 Tx Test Application menu.
5. Connect the oscilloscope with the controller PC through either GPIB, USB or LAN. (Note: Additional information for connecting the Keysight and Tektronix oscilloscopes to the controller PC is provided in the Appendix of this document.)
6. On the Scope or PC, obtain the network address for the connected oscilloscope from the device settings. This address will be used to connect the scope to the GRL automation software.
7. On the Equipment Setup page of the GRL USB 3.2 Tx Test Application, type in the address of the connected scope into the “Address” field.

Then select the “lightning” button () for the connected scope.

The “lightning” button should turn green () once the application has successfully established connection with the scope.

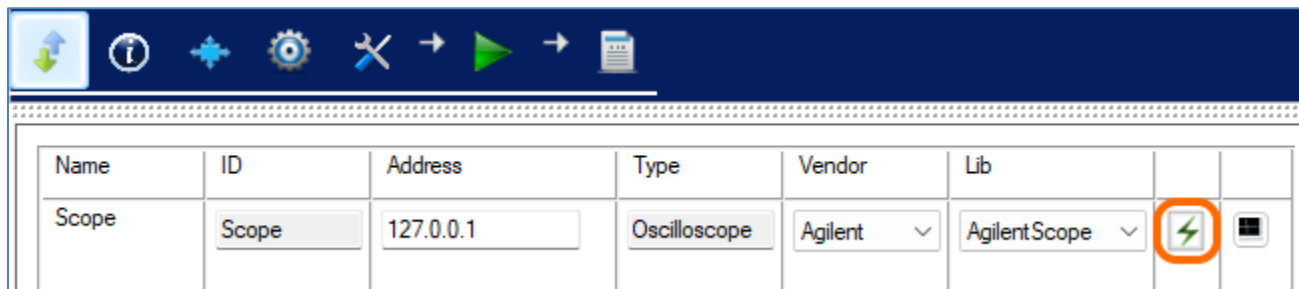


FIGURE 5. CONNECT OSCILLOSCOPE WITH GRL-USB32-TX SOFTWARE

13. (Note: If the GRL-USB32-TX software is installed on the Tektronix Scope, ensure the Scope is connected via GPIB and type in the GPIB network address, for example “GPIB8::1::INSTR.”) If the GRL software is installed on the PC to control the Scope, type in the Scope IP address, for example “TCPIP0::192.168.0.110::inst0::INSTR”. Note to omit the Port number from the address. The “lightning” button should turn green if successfully connected to the instrument.

3.3 Pre-Configure GRL-USB32-TX Software Before Testing

Once all equipment is successfully connected from the previous section, proceed to set up the preliminary settings before going to the advanced test setup.

3.3.1 Enter Test Session Information

Select  from the menu to access the **Session Info** page. Enter the information as required for the test session that is currently being run. The information provided will be included in the test report generated by the software once tests are completed.

- The fields under **DUT Info** and **Test Info** are defined by the user.
- The **Software Info** field is automatically populated by the software.

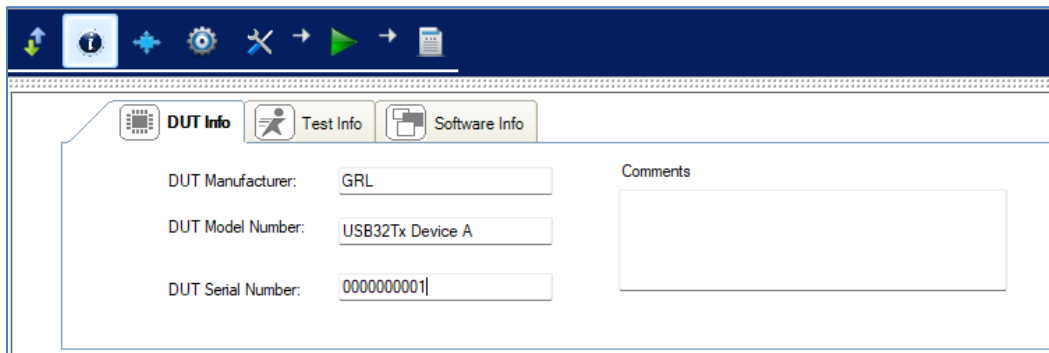


FIGURE 6. SESSION INFO PAGE

3.3.2 Set Test Conditions

Select  from the menu to access the **Conditions** page to set the conditions for testing. The software will run tests for the USB 3.2 speeds and data lanes that are selected.

- Speed** tab: Select the desired USB speed(s) for testing.

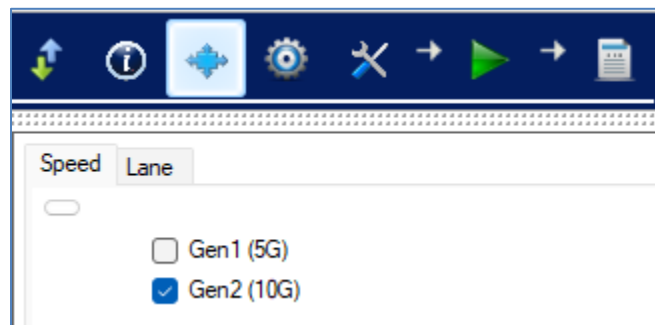


FIGURE 7. SELECT USB SPEED

- Lane** tab: Select the desired data lanes to be tested.

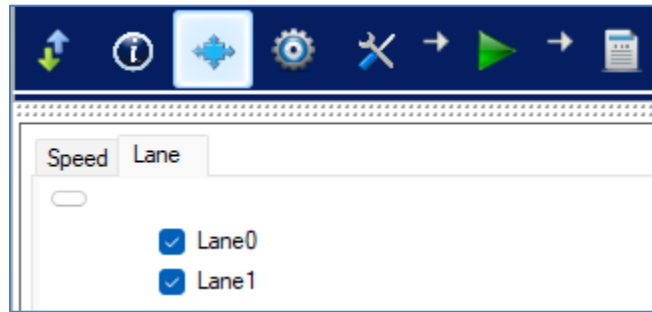


FIGURE 8. SELECT LANE UNDER TEST

4 Testing Using GRL-USB32-TX

The GRL-USB32-TX test solution supports automated Tx compliance testing using the SigTest signal analysis application for USB 3.2 Host and Device DUT's. In a typical test environment, the GRL-USB32-TX automation software is run from the PC/oscilloscope. The GRL automation software will prompt the user to set up the correct connection and test patterns required by the test.

The DUT will transmit the test signal to the oscilloscope that is used to validate the test pattern of the signal. The compliance signal will be captured and saved as a waveform file which is then measured for compliance. When testing is completed, the software will generate a test report detailing all results from all lanes tested.

4.1 Set Up DUT Tx Test with Automation

Once pre-configuration has been completed from Section 3.3, continue with the test setup. The following procedures show how to set up the test environment to perform automated Tx compliance testing for both the Host and Device DUT's.

Note: The channel connections shown in the following connection diagrams are the default settings in the GRL-USB32-TX software and can be modified in the "Configurations" panel (see Section 4.1.6).

4.1.1 Connect Equipment for Low Frequency Periodic Signaling (LFPS) Testing

The connection diagram below shows how to connect the equipment for LFPS testing.

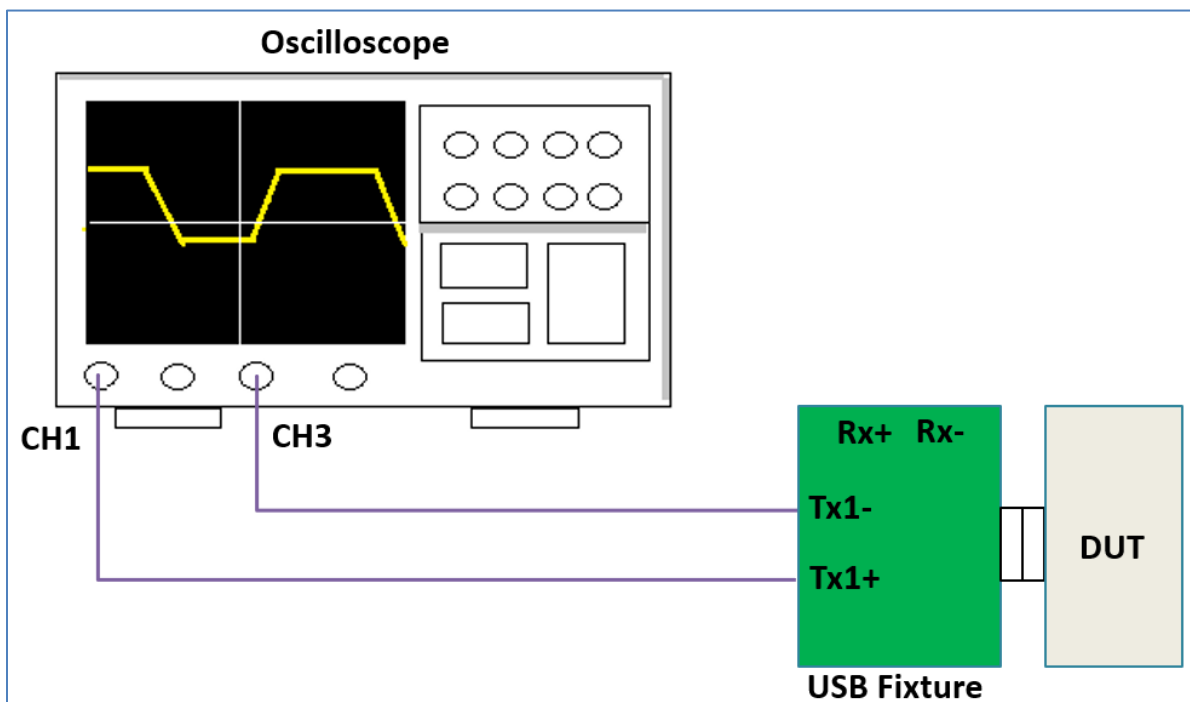


Figure 1. LFPS Test Connection Diagram

1. Connect the DUT to the USB Host/Device Fixture.
2. Connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.

4.1.2 Connect Equipment for USB 3.2 Gen 1 Testing

The following connection diagrams show the different equipment connections for USB 3.2 Gen 1 testing.

4.1.2.1 USB 3.2 Gen 1 Std-A (Host/Device) Connection

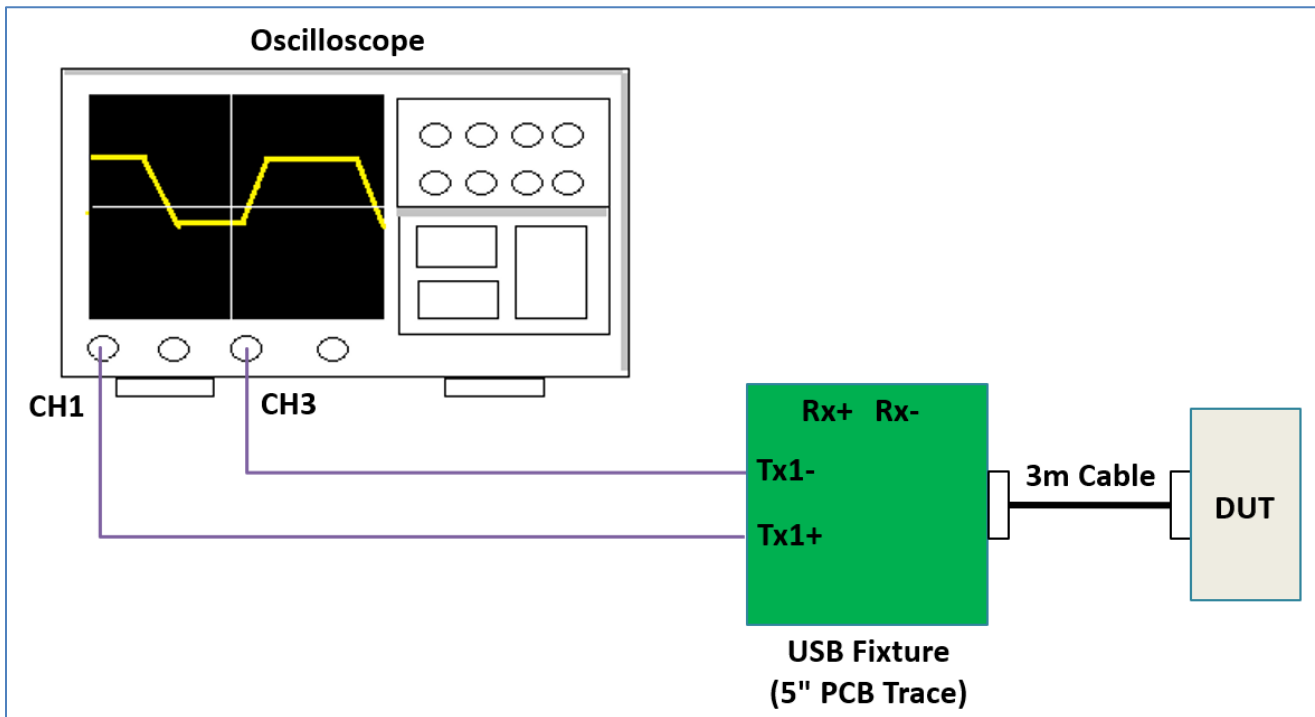


Figure 2. USB 3.2 Gen 1 Std-A (Host/Device) Test Connection Diagram

1. Prepare a USB Host/Device Fixture with embedded 5" PCB Trace.
2. Connect the DUT to the USB Host/Device Fixture using a 3 m cable.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.
5. If using a compliance toggle, connect the toggle to Rx+ and Rx- on the USB Fixture as shown in Figure 3 below.

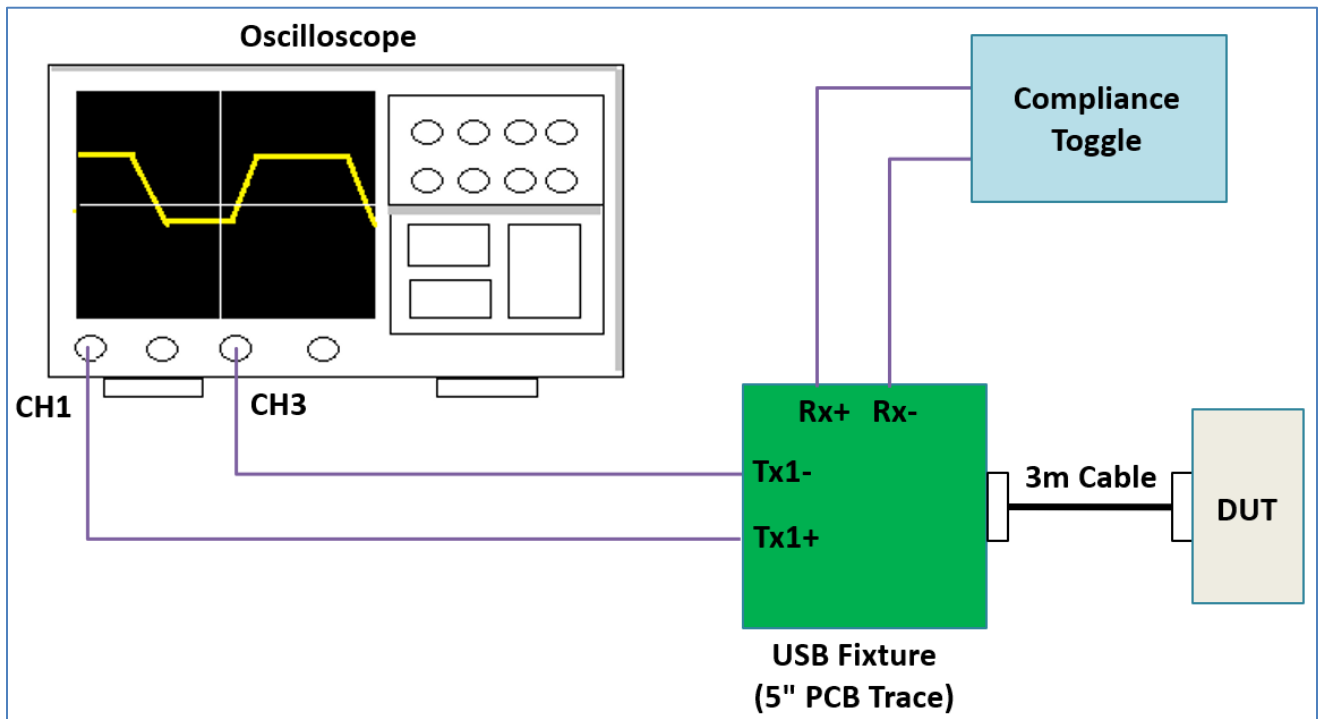


Figure 3.USB 3.2 Gen 1 Std-A (Host/Device) Test with Compliance Toggle Connection Diagram

4.1.2.2 USB 3.2 Gen 1 Std-B (Host/Device) Connection

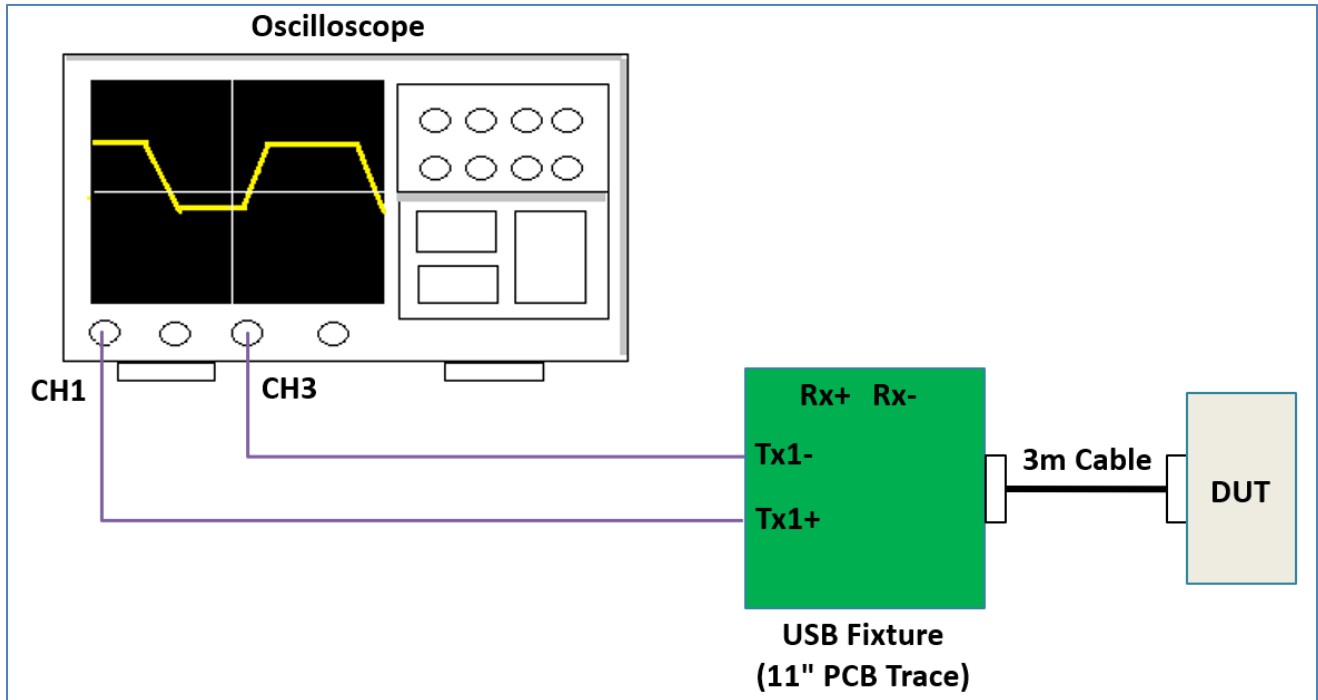


Figure 4. USB 3.2 Gen 1 Std-B (Host/Device) Test Connection Diagram

1. Prepare a USB Host/Device Fixture with embedded 11" PCB Trace.
2. Connect the DUT to the USB Host/Device Fixture using a 3 m cable.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.
5. If using a compliance toggle, connect the toggle to Rx+ and Rx- on the USB Fixture as shown in Figure 5 below.

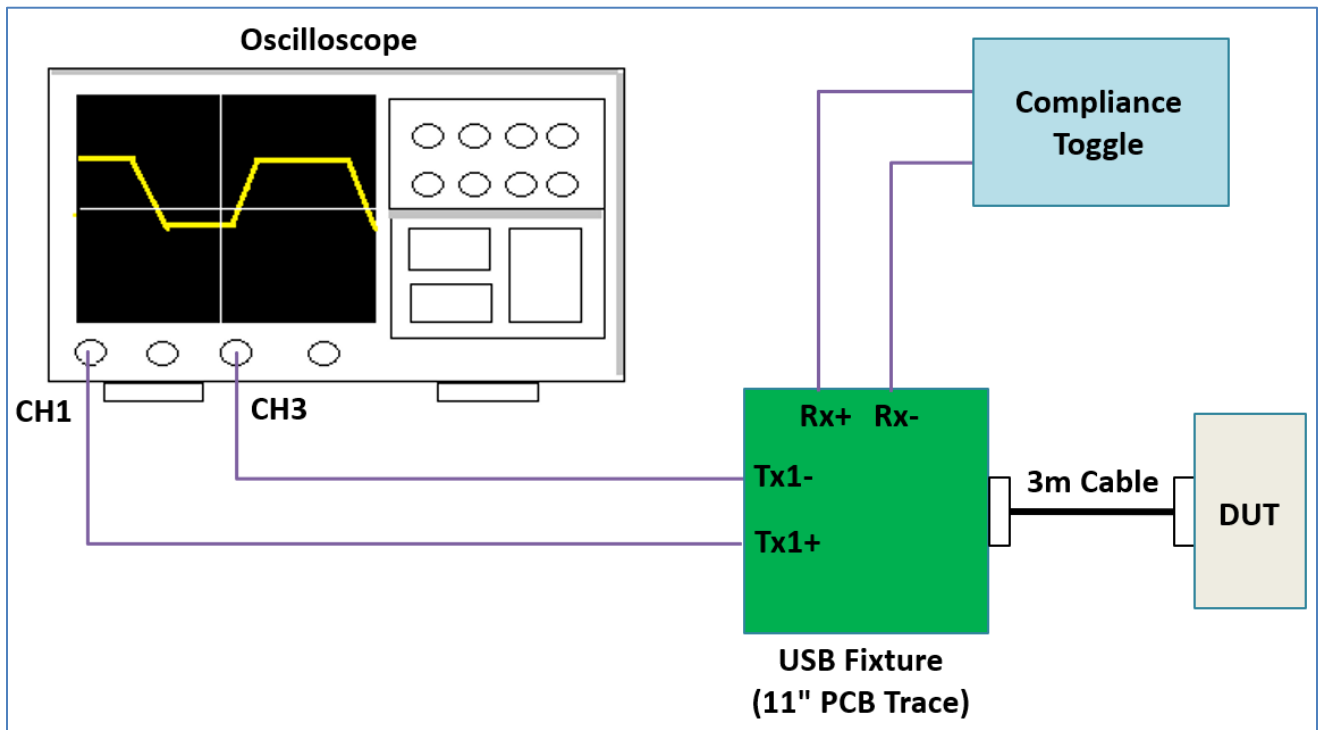


Figure 5.USB 3.2 Gen 1 Std-B (Host/Device) Test with Compliance Toggle Connection Diagram

4.1.2.3 USB 3.2 Gen 1 Micro-B (Host/Device) Connection

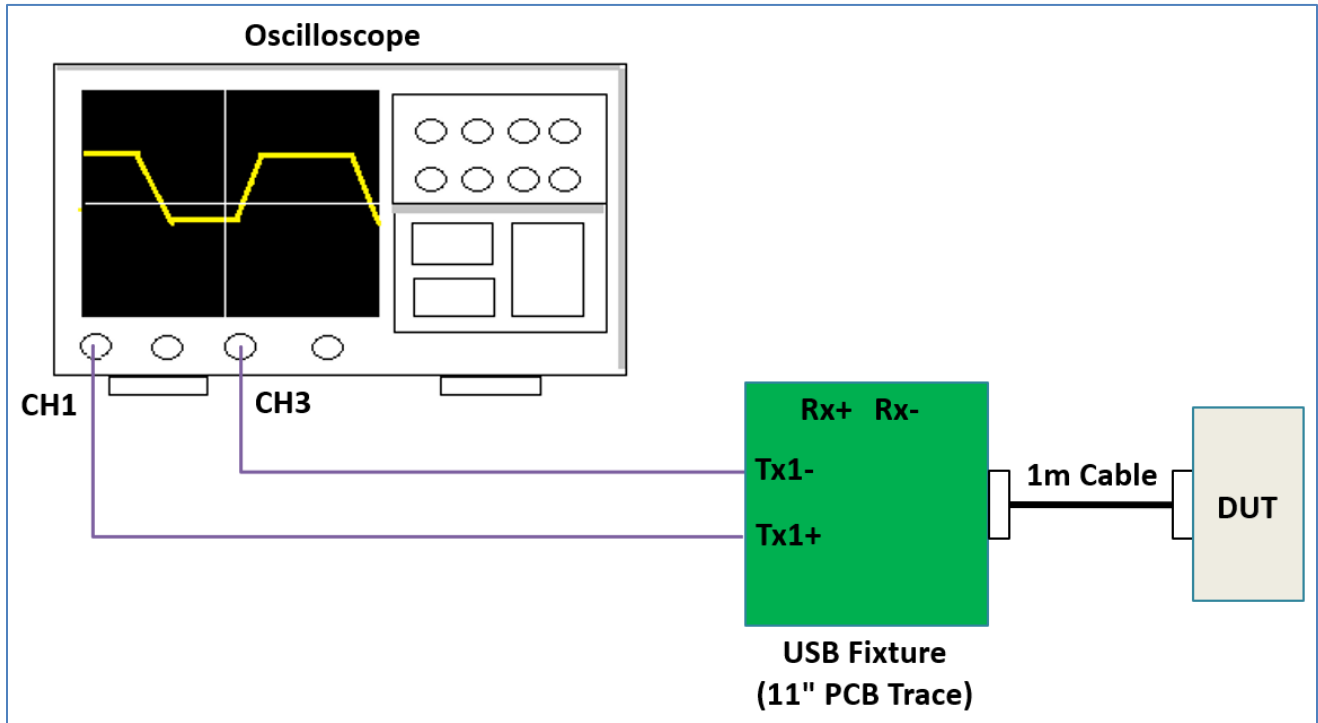


Figure 6. USB 3.2 Gen 1 Micro-B (Host/Device) Test Connection Diagram

1. Prepare a USB Host/Device Fixture with embedded 11" PCB Trace.
2. Connect the DUT to the USB Host/Device Fixture using a 1 m cable.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.

4.1.2.4 USB 3.2 Gen 1 Micro-AB (Host) Connection

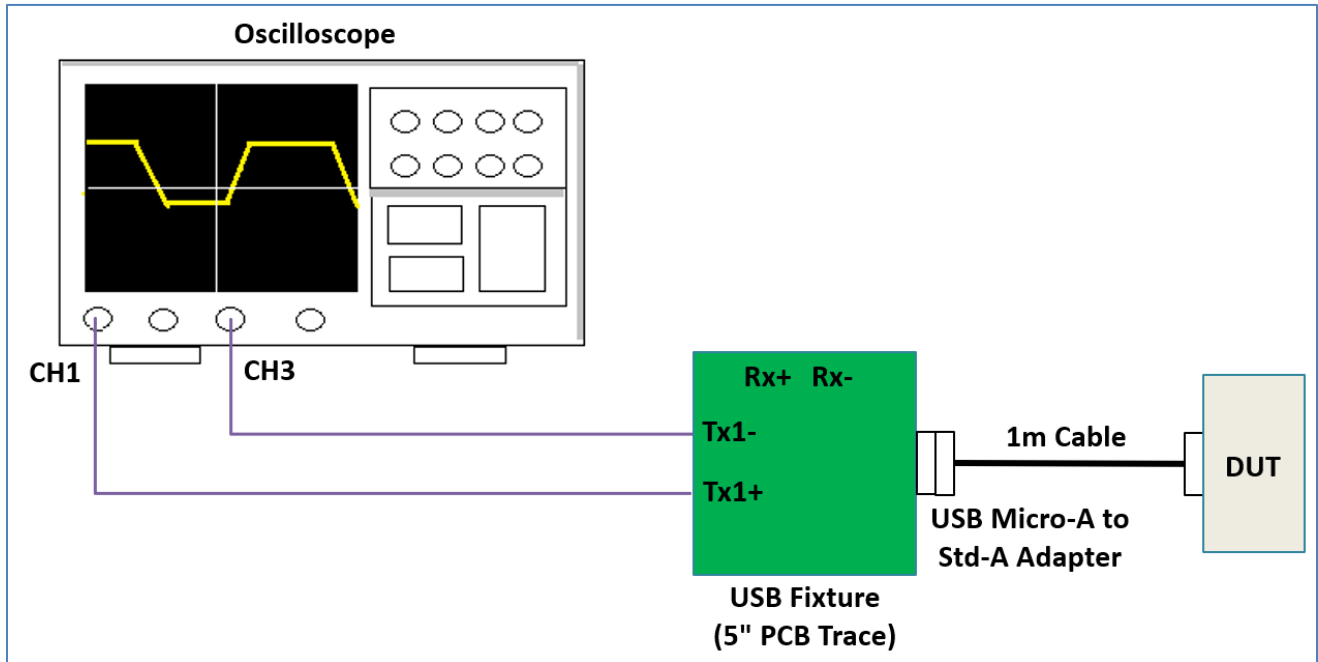


Figure 7.USB 3.2 Gen 1 Micro-AB (Host) Test Connection Diagram

1. Prepare a USB Host Fixture with embedded 5" PCB Trace.
2. Connect the DUT to the USB Host Fixture using a 1 m cable and a USB Micro-A to Std-A Adapter.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.

4.1.2.5 USB 3.2 Gen 1 Micro-AB (Device) Connection

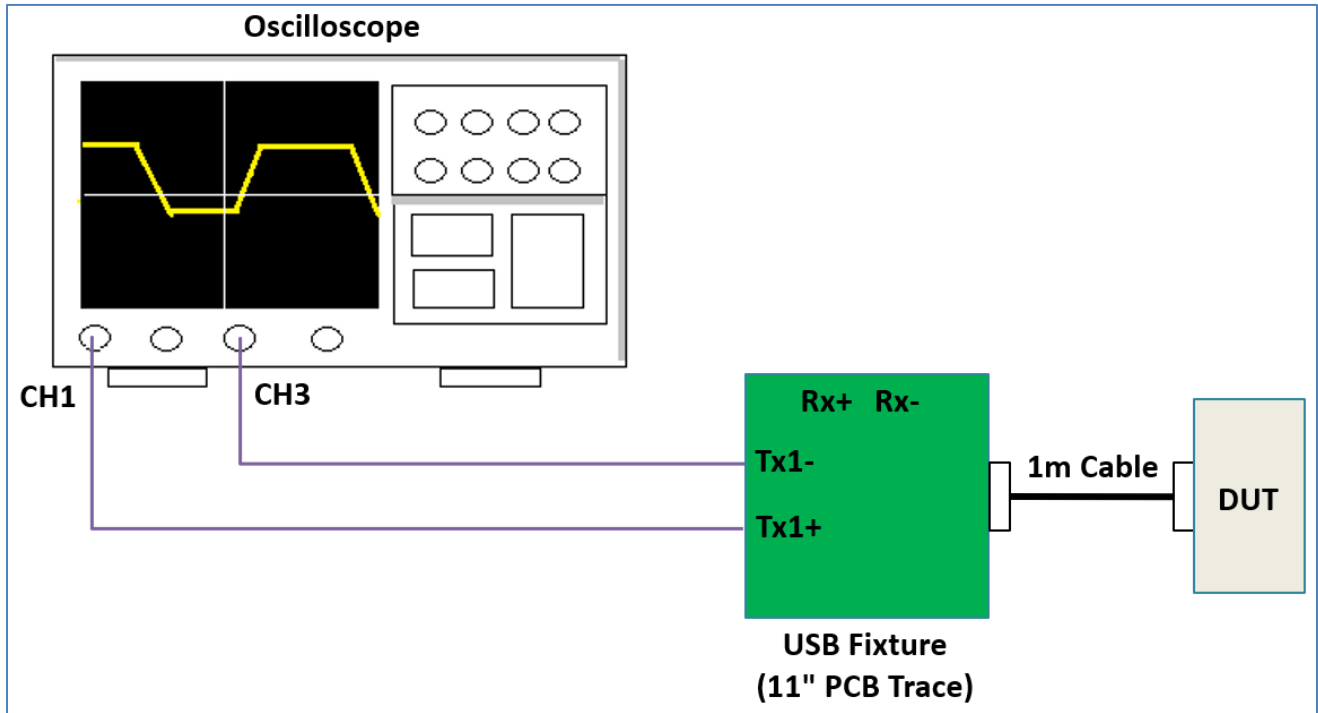


Figure 8.USB 3.2 Gen 1 Micro-AB (Device) Test Connection Diagram

1. Prepare a USB Device Fixture with embedded 11" PCB Trace.
2. Connect the DUT to the USB Device Fixture using a 1 m cable.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.

4.1.2.6 USB 3.2 Gen 1 Type-C (Host/Device) Connection

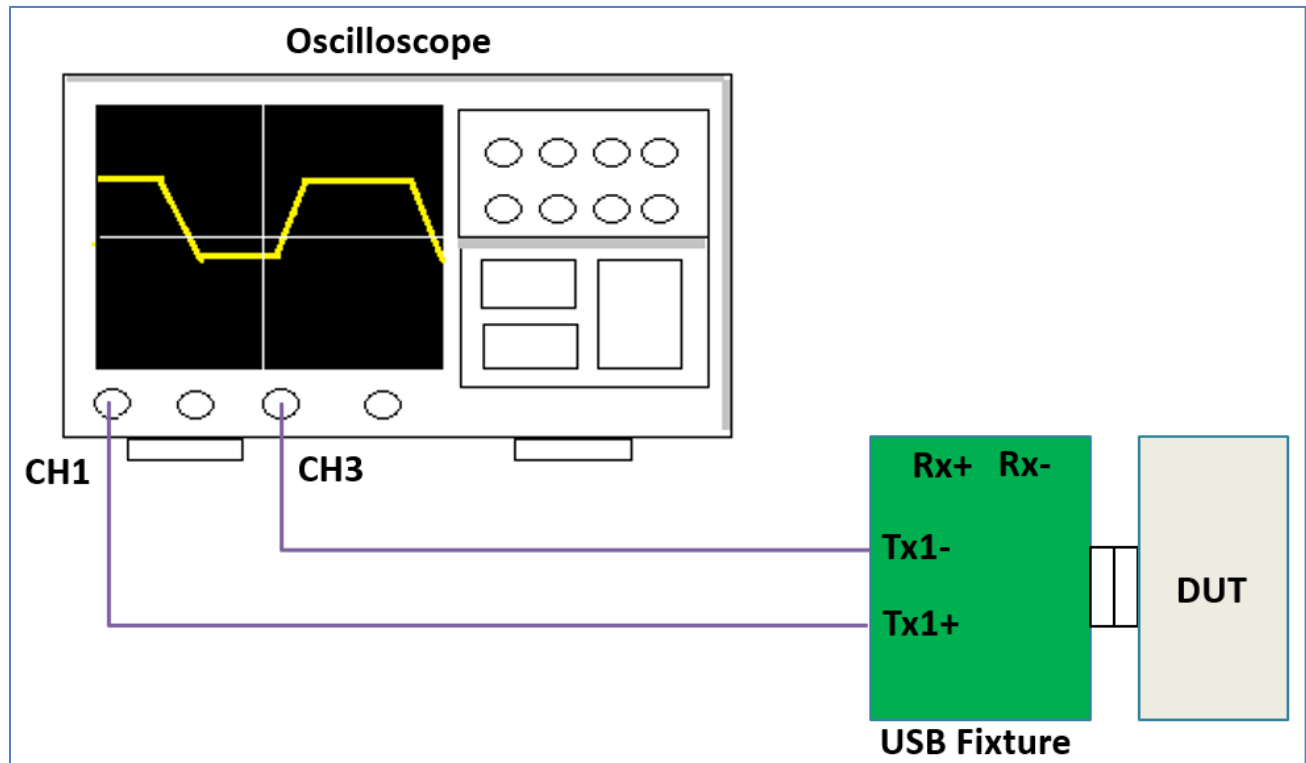


Figure 9. USB 3.2 Gen 1 Type-C (Host/Device) Test Connection Diagram

1. Prepare a USB Host/Device Fixture 1C.
2. Connect the DUT directly to the USB Host/Device Fixture.
3. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
4. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.
5. If using a compliance toggle, connect the toggle to Rx+ and Rx- on the USB Fixture as shown in Figure 10 below.

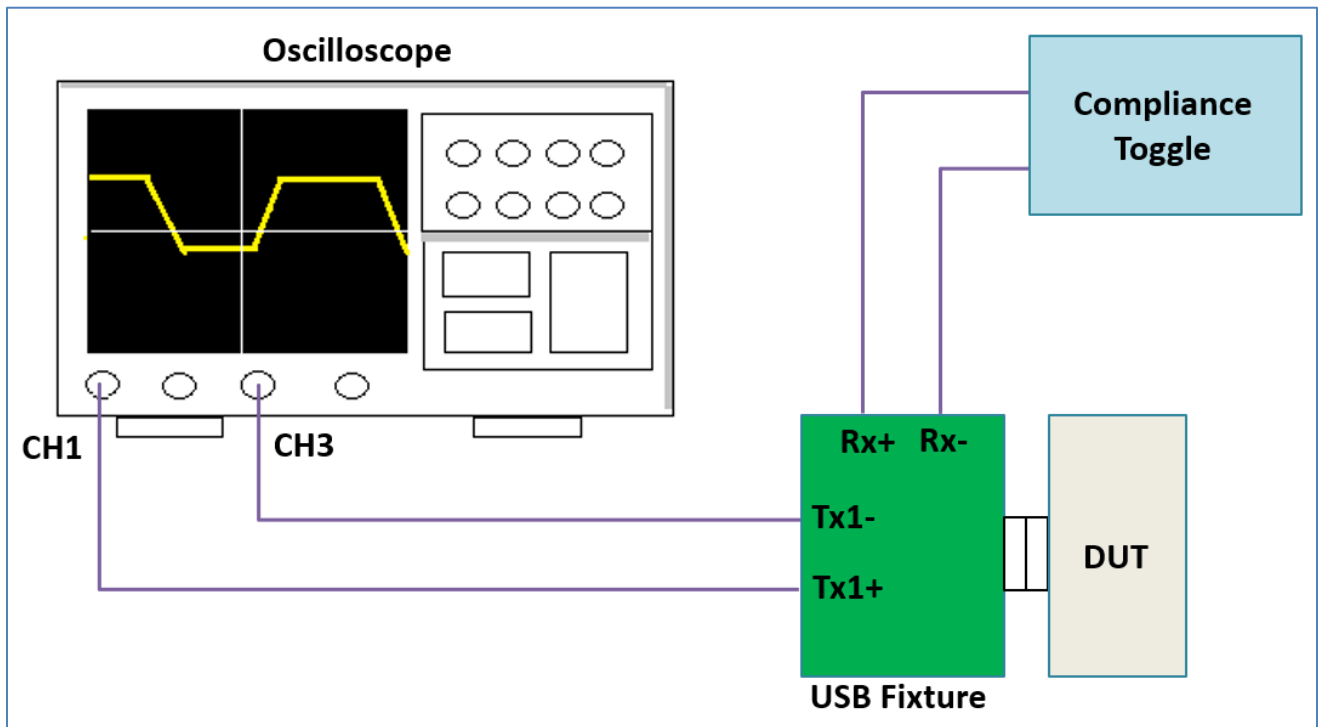


Figure 10. USB 3.2 Gen 1 Type-C (Host/Device) Test with Compliance Toggle Connection Diagram

4.1.3 Connect Equipment for USB 3.2 Gen 2 Testing

The following connection diagram shows the equipment connection for USB 3.2 Gen 2 testing.

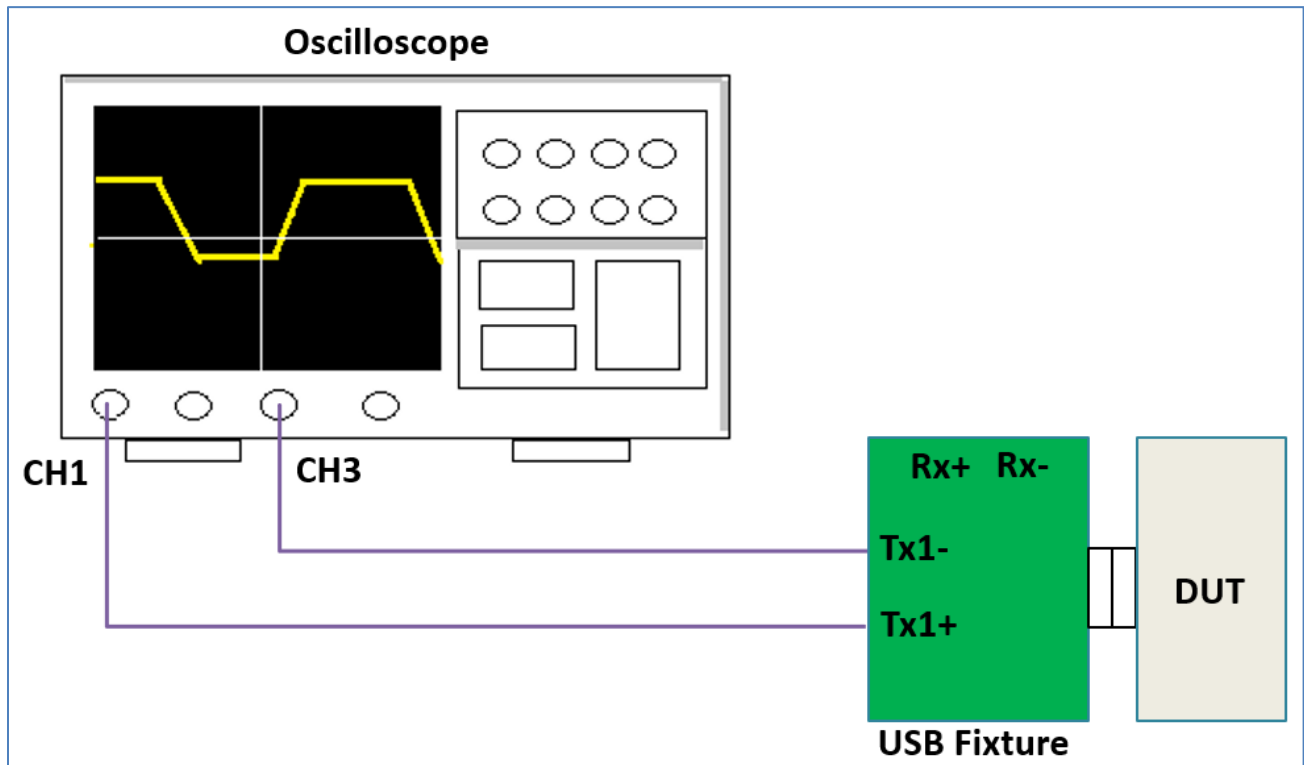


Figure 11. USB 3.2 Gen 2 Test Connection Diagram

1. Connect the DUT to the USB Host/Device Fixture.
2. If testing lane0, connect Channel 1 and Channel 3 of the oscilloscope to Tx1+ and Tx1- on the USB Fixture respectively.
3. If testing lane1, connect Channel 2 and Channel 4 of the oscilloscope to Tx2+ and Tx2- on the USB Fixture respectively.
4. If using a compliance toggle, connect the toggle to Rx+ and Rx- on the USB Fixture as shown in Figure 10 below.

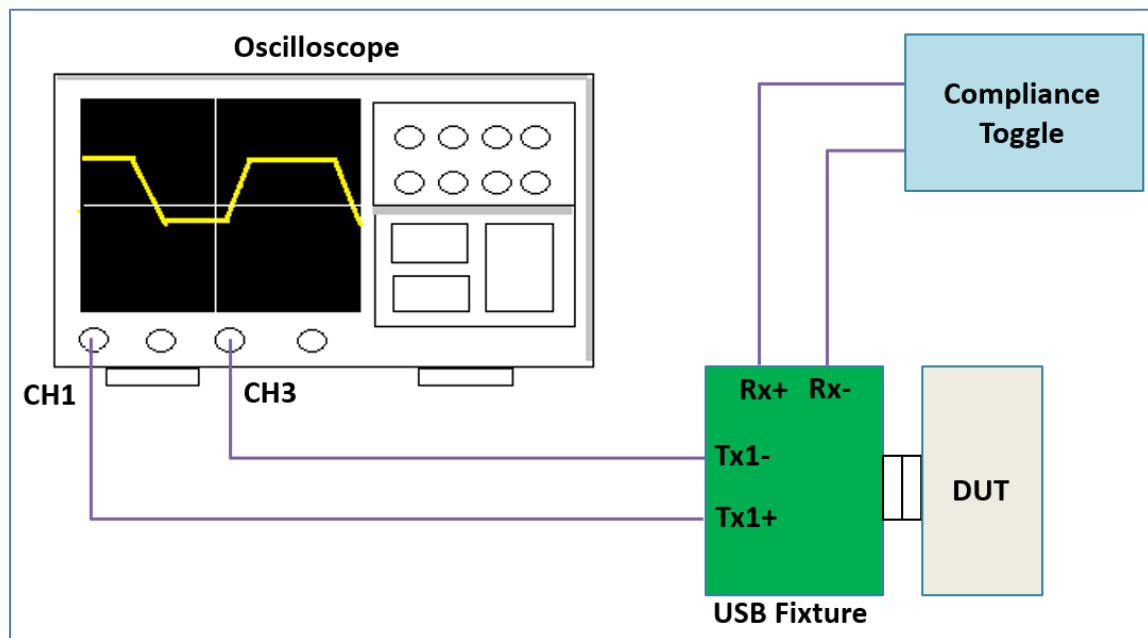


Figure 12. USB 3.2 Gen 2 Test with Compliance Toggle Connection Diagram

4.1.4 Set Up Test Requirements

After setting up the physical equipment, select  from the GRL USB 3.2 Tx Test Application menu to access the Setup Configuration page. Select the DUT to be tested, set up and run SigTest, and set up waveform processing to be applied for testing.

- Device Type** tab: Select “Host”, “Device” or “DRD” (Dual Role device) and the type of connector as supported by the DUT.

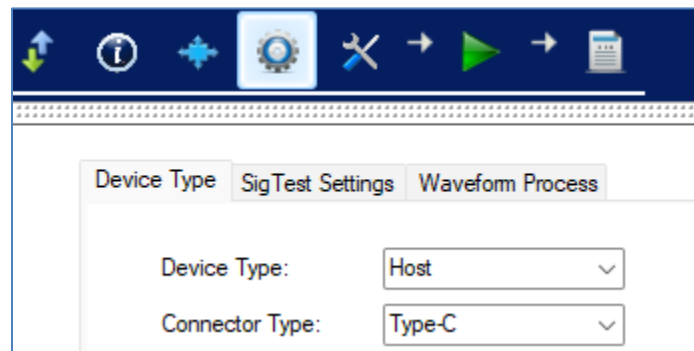


FIGURE 9. SELECT DUT TYPE

- SigTest Settings** tab:

- LFPS Tests** – Enter the Version number of the SigTest for running LFPS tests and also make sure that the SigTest is already installed in the system.

- *5Gbps Long/Short Channel Tests* – Enter the Version number of the SigTest for running USB 3.2 Gen 1 (5 Gbps) long/short channel tests and also make sure that the SigTest is already installed in the system.
- *5Gbps SSC Tests* – Enter the Version number of the SigTest for running USB 3.2 Gen 1 (5 Gbps) SSC tests and also make sure that the SigTest is already installed in the system.
- *10Gbps Tests* – Enter the Version number of the SigTest for running USB 3.2 Gen 2 (10 Gbps) tests and also make sure that the SigTest is already installed in the system.

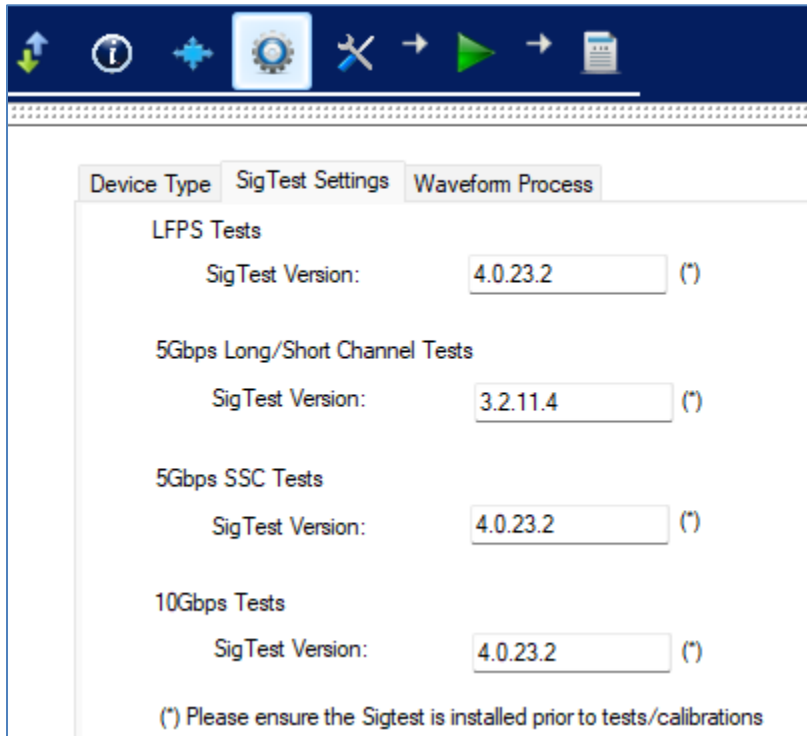


FIGURE 10. SET UP SIGTEST

- c) **Waveform Process** tab: Select “Live Capture” to acquire USB 3.2 waveforms using the GRL software or select “Process Pre-captured waveforms” to use existing waveforms that have been previously captured and saved for analysis.

If “Process Pre-captured waveforms” is selected, enter the directory of the saved waveform file in the Pre-Captured Waveform Path field.

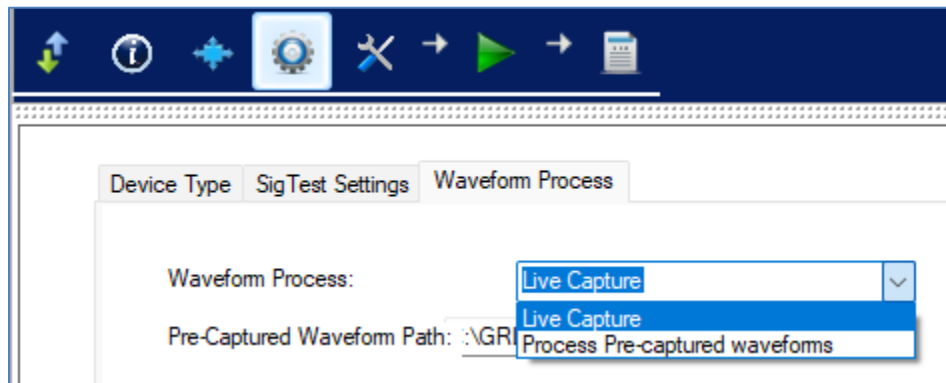


FIGURE 11. SET UP WAVEFORM PROCESSING

4.1.5 Select Compliance Tests

Once test requirements are defined, select **Test List** from the top “Windows” drop-down menu to display and access all tests available for the selected DUT type.

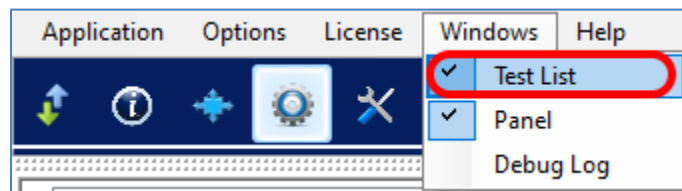


FIGURE 12. DISPLAY TEST LIST PANEL

User can select any of these tests to perform DUT compliance testing for all USB 3.2 Tx parameters.

Note: The Select Tests page will only list DUT-specific tests. For example, if Host is selected as the DUT type, only those tests applicable for the Host device will be shown. Other test parameters such as data rates may also affect the test selection.

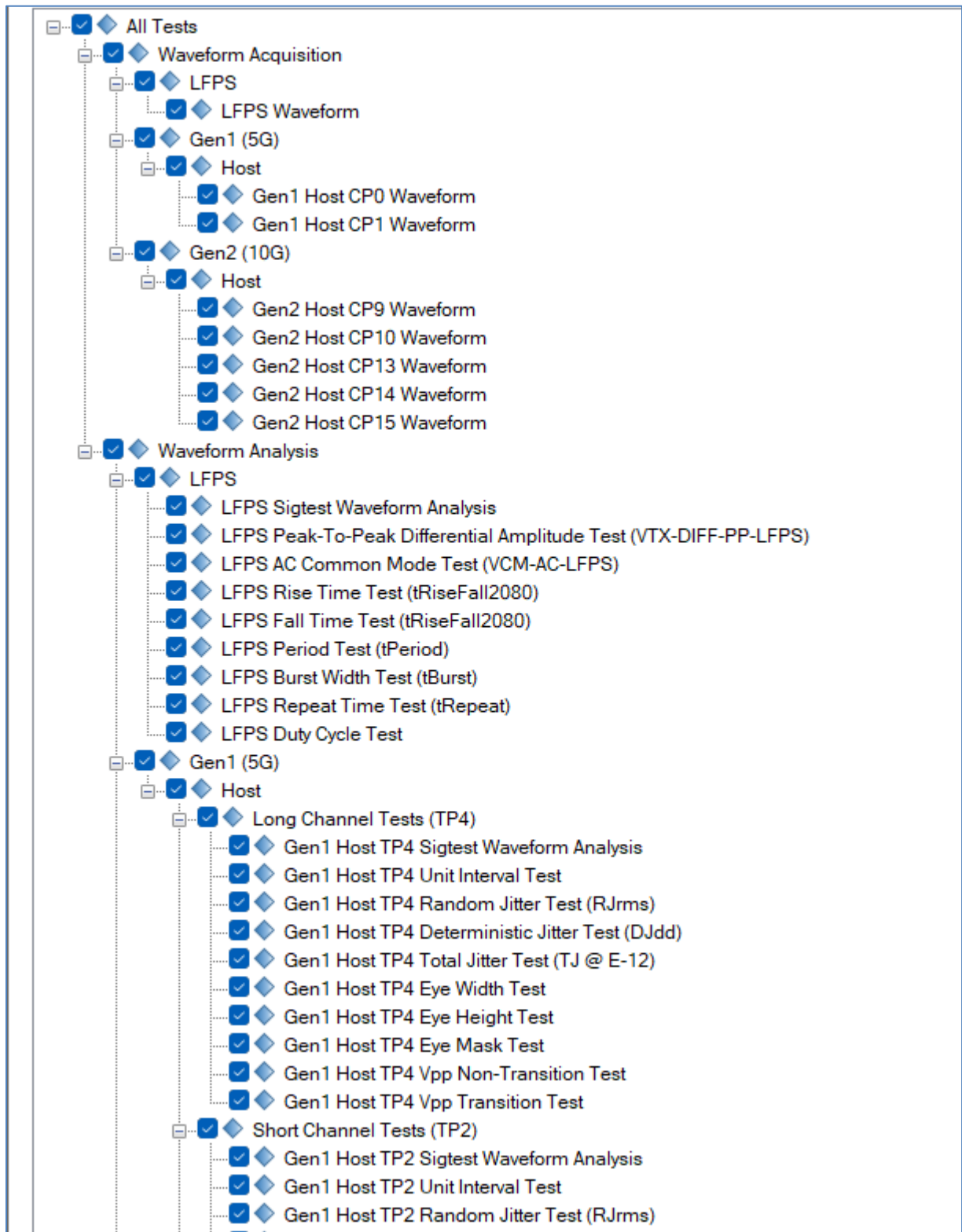


FIGURE 13. SELECT TESTS PAGE

4.1.5.1 Select to Acquire Waveforms

Under “Waveform Acquisition”, select the waveforms to capture for the required USB 3.2 Tx data rates. The software will run a live capture of the selected waveforms prior to analysis.

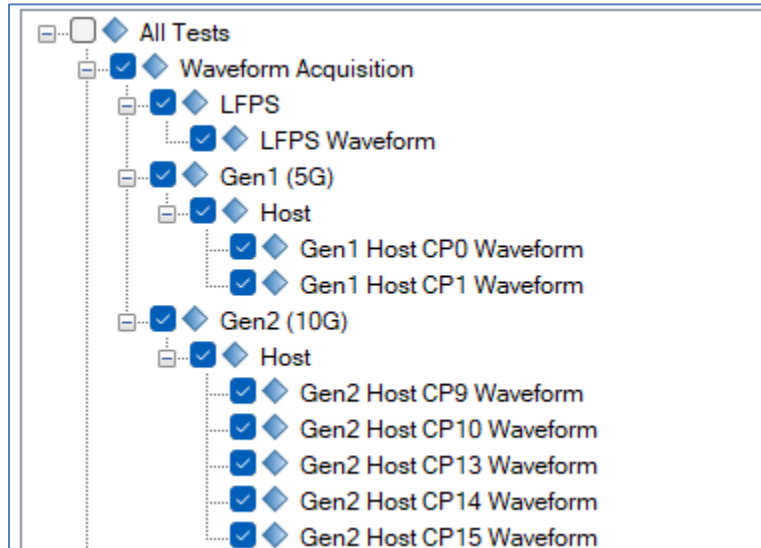


FIGURE 14. SELECT WAVEFORM TO CAPTURE

4.1.5.2 Select Waveform Analysis Tests

Under “Waveform Analysis”, select to perform the SigTest analysis, jitter and eye measurements, and SSC tests for the applicable USB 3.2 Tx waveform. The software will automatically run the selected tests when initiated.

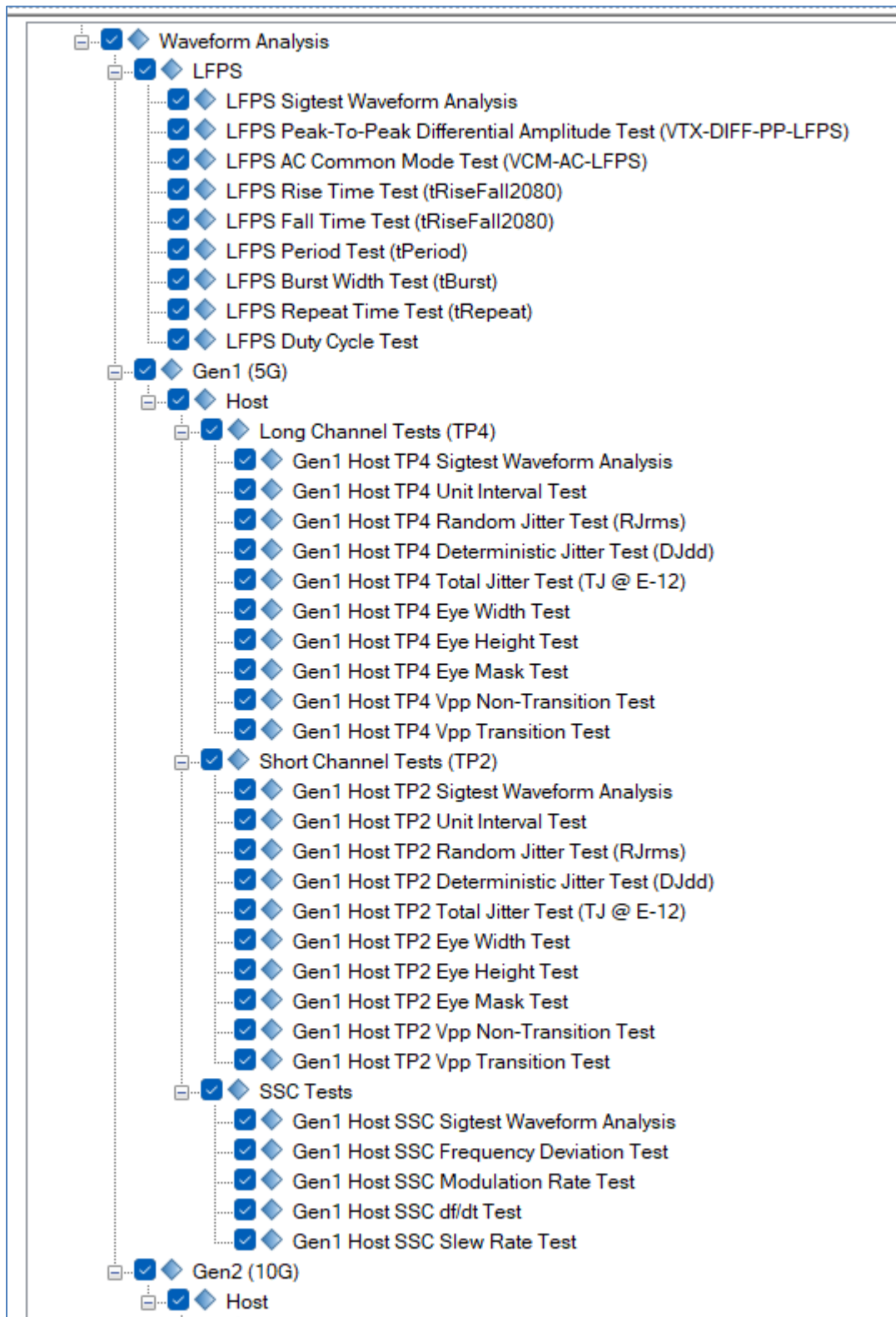


FIGURE 15. SELECT WAVEFORM ANALYSIS TESTS

4.1.6 Configure Test Parameters

After selecting the desired tests, select  from the menu to access the Configurations page. Set the required parameters for testing as described below.

To return all parameters to their default values, select the ‘Set Default’ button.

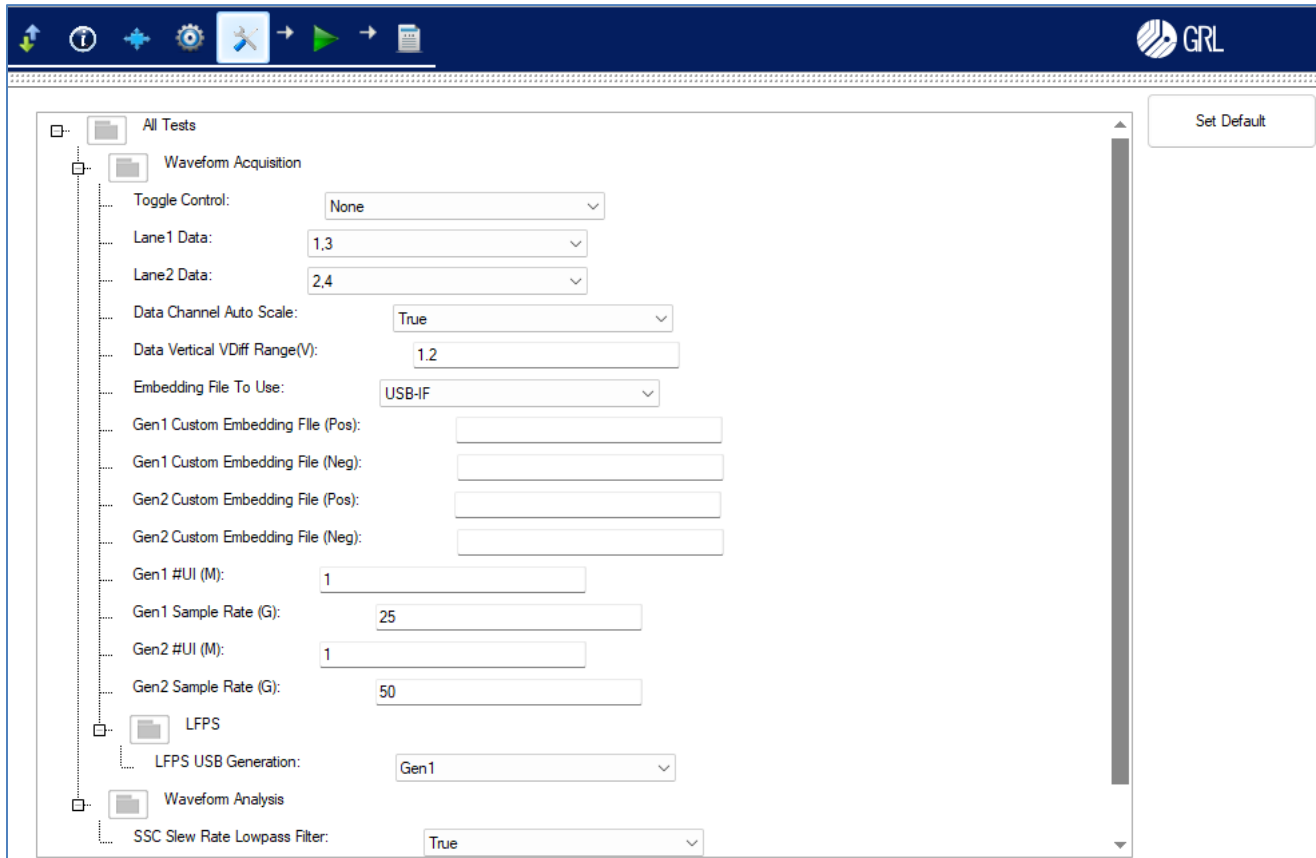


FIGURE 16. TEST PARAMETERS CONFIGURATION PAGE

TABLE 4. TEST PARAMETERS DESCRIPTION

Parameter	Description
Toggle Control	Select to use the Arbitrary Waveform Generator (AWG) or the Anritsu MP1900A BERT simulation method to provide compliance toggle signal to control the compliance state of the DUT. Select “None” if using a manual compliance toggle.
Lane1 & Lane2 Data	Select the Scope channels that are connected to the Data Lanes of the USB test fixture.
Data Channel Auto Scale	Select “True” to enable auto scaling for the data channels during tests.

Data Vertical V_{Diff} Range (V)	Set the vertical range of the Scope to easily detect a change to the voltage level when running tests.
Embedding File to Use	Select to use the USB-IF or a custom embedding file during tests.
Gen1 Custom Embedding File (Pos) / (Neg)	If “Custom” is selected from the “Embedding File to Use” field, enter the name of the file to be used for embedding of the USB 3.2 Gen 1 transmitter differential pair (positive/negative).
Gen2 Custom Embedding File (Pos) / (Neg)	If “Custom” is selected from the “Embedding File to Use” field, enter the name of the file to be used for embedding of the USB 3.2 Gen 2 transmitter differential pair (positive/negative).
#UI (M) [Gen1 / Gen2]	Specify the number of sample points to capture for the USB 3.2 Gen 1 or Gen 2 data rate.
Sample Rate (G) [Gen1 / Gen2]	Specify the real-time sample rate in Gb/s to capture the required waveform data for USB 3.2 Gen 1 or Gen 2.
LFPS USB Generation	Select USB 3.2 Gen 1 or Gen 2 for compliance pattern sequencing using the Low-Frequency Periodic Signaling (LFPS) generator.
SSC Slew Rate Lowpass Filter	Select ‘True’ to enable the low-pass filter for the SSC slew rate.

4.2 Run Automation Tests

Once tests have been selected and set up from the previous sections, the tests are now ready to be run.

Select  from the menu to access the Run Tests page. The GRL-USB32-TX software automatically runs the selected tests when initiated.

Before running the tests, select the option to:

- **Skip Test if Result Exists** – If results from previous tests exist, the software will *skip* those tests.
- **Replace if Result Exists** – If results from previous tests exist, the software will *replace* those tests with new results.

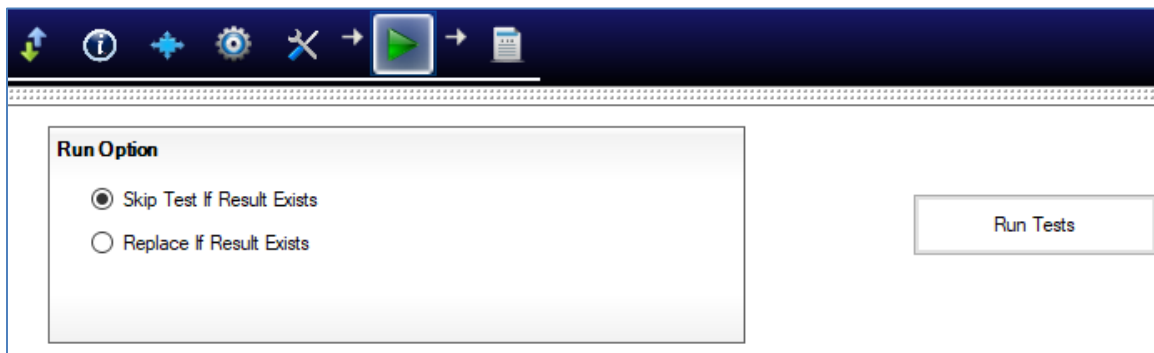


FIGURE 17. RUN TESTS PAGE

Select the **Run Tests** button to start running the selected tests. The connection diagram for the test being run will initially appear to allow the user to make sure that the test environment has been properly set up before testing can proceed. Follow the step-by-step instructions to complete the entire testing.

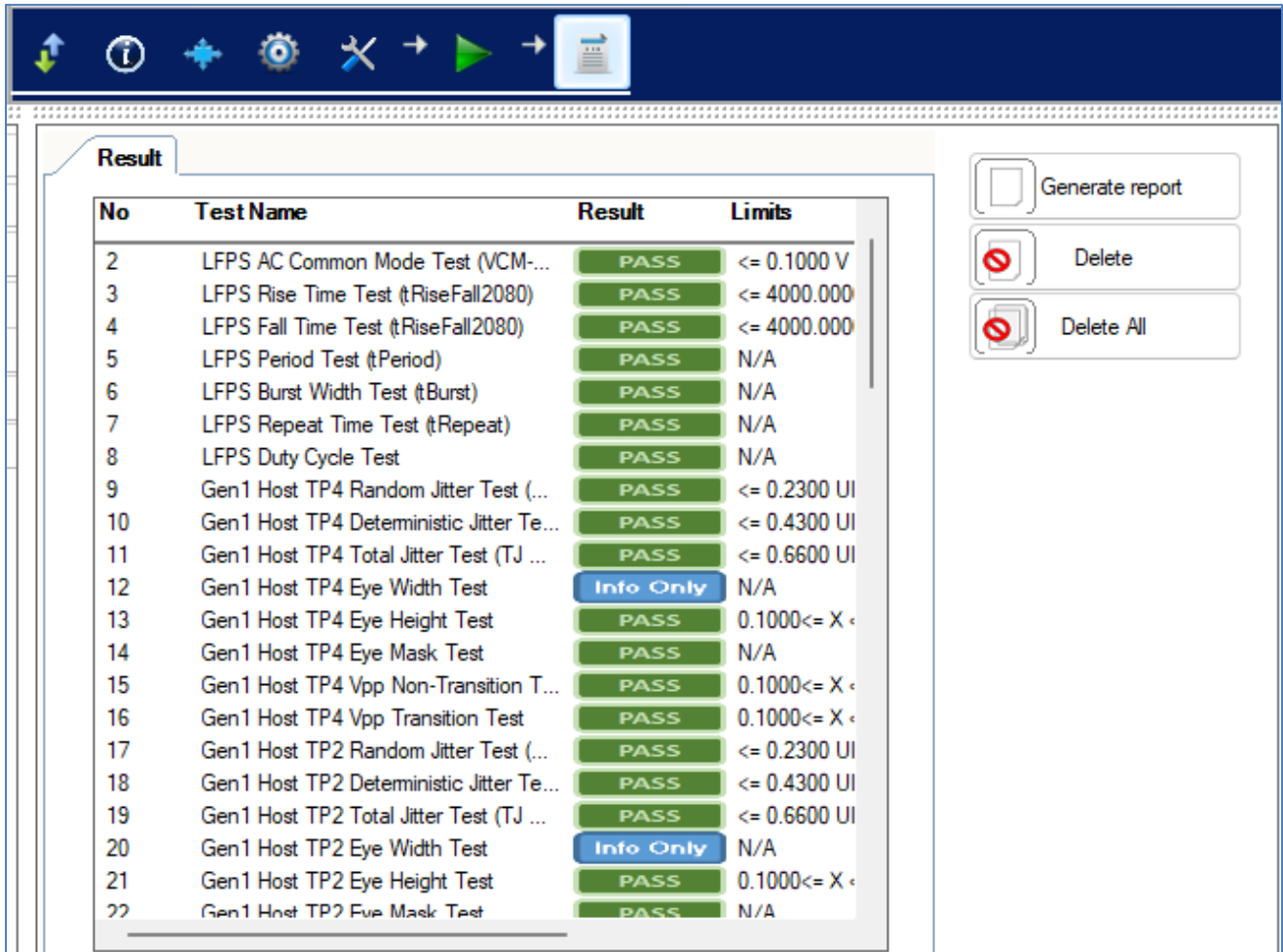
5 Interpreting GRL-USB32-TX Test Report

When all test runs have completed from Section 4, the GRL-USB32-TX software will automatically display the test results on the **Report** page.

Select  from the menu to access the Report page to view the results from each test run.

If some of the results are not desired, they can be individually deleted by selecting the **Delete** button.

Also select the **Generate report** button to generate a detailed test report in the PDF format.



No	Test Name	Result	Limits
2	LFPS AC Common Mode Test (VCM-...	PASS	<= 0.1000 V
3	LFPS Rise Time Test (tRiseFall2080)	PASS	<= 4000.000
4	LFPS Fall Time Test (tRiseFall2080)	PASS	<= 4000.000
5	LFPS Period Test (tPeriod)	PASS	N/A
6	LFPS Burst Width Test (tBurst)	PASS	N/A
7	LFPS Repeat Time Test (tRepeat)	PASS	N/A
8	LFPS Duty Cycle Test	PASS	N/A
9	Gen1 Host TP4 Random Jitter Test (...)	PASS	<= 0.2300 UI
10	Gen1 Host TP4 Deterministic Jitter Te...	PASS	<= 0.4300 UI
11	Gen1 Host TP4 Total Jitter Test (TJ ...)	PASS	<= 0.6600 UI
12	Gen1 Host TP4 Eye Width Test	Info Only	N/A
13	Gen1 Host TP4 Eye Height Test	PASS	0.1000<= X <
14	Gen1 Host TP4 Eye Mask Test	PASS	N/A
15	Gen1 Host TP4 Vpp Non-Transition T...	PASS	0.1000<= X <
16	Gen1 Host TP4 Vpp Transition Test	PASS	0.1000<= X <
17	Gen1 Host TP2 Random Jitter Test (...)	PASS	<= 0.2300 UI
18	Gen1 Host TP2 Deterministic Jitter Te...	PASS	<= 0.4300 UI
19	Gen1 Host TP2 Total Jitter Test (TJ ...)	PASS	<= 0.6600 UI
20	Gen1 Host TP2 Eye Width Test	Info Only	N/A
21	Gen1 Host TP2 Eye Height Test	PASS	0.1000<= X <
22	Gen1 Host TP2 Eye Mask Test	PASS	N/A

FIGURE 18. TEST REPORT PAGE

5.1 Understand Test Report Information

This section gives a general overview of the test report to help users familiarize themselves with the format. Select the **Generate report** button to generate the test report.

5.1.1.1 Test Session Information

This portion displays the information previously entered on the **Session Info** page.

USB 3.2 Tx Test Application Report	
DUT Information	
DUT Manufacturer	: GRL
DUT Model Number	: USB32Tx Device A
DUT Serial Number	: 0000000001
DUT Comments	:
Test Information	
Test Lab	: Granite River Labs
Test Operator	: David
Test Date	: 18/1/2023
Software Version	
Software Revision	: 0.0.0.1

FIGURE 19. TEST SESSION INFORMATION EXAMPLE

5.1.2 Test Summary Table

This table provides an overall view of all the tests performed along with their test conditions and results.

No	TestName	Limits	Value	Results	Speed	Lane
1	LFPS Peak-To-Peak Differential Amplitude Test (VTX-DIFF-PP-LFPS)	0.8000<= X <= 1.2000 V	0.4480 V	Fail	N/A	Lane0
2	LFPS AC Common Mode Test (VCM-AC-LFPS)	<= 0.1000 V	0.0000 V	Pass	N/A	Lane0
3	LFPS Rise Time Test (tRiseFall2080)	<= 4000.0000 ps	120.9847 ps	Pass	N/A	Lane0
4	LFPS Fall Time Test (tRiseFall2080)	<= 4000.0000 ps	120.6446 ps	Pass	N/A	Lane0
5	LFPS Period Test (tPeriod)	N/A	N/A	Pass	N/A	Lane0
6	LFPS Burst Width Test (tBurst)	N/A	N/A	Pass	N/A	Lane0
7	LFPS Repeat Time Test (tRepeat)	N/A	N/A	Pass	N/A	Lane0
8	LFPS Duty Cycle Test	N/A	N/A	Pass	N/A	Lane0
9	Gen1 Host TP4 Random Jitter Test (RJrms)	<= 0.2300 UI	0.0031 UI	Pass	Gen1	Lane0
10	Gen1 Host TP4 Deterministic Jitter Test (DJdd)	<= 0.4300 UI	0.1456 UI	Pass	Gen1	Lane0
11	Gen1 Host TP4 Total Jitter Test (TJ @ E-12)	<= 0.6600 UI	0.1886 UI	Pass	Gen1	Lane0
12	Gen1 Host TP4 Eye Width Test	N/A	0.8114 UI	InfoOnly	Gen1	Lane0
13	Gen1 Host TP4 Eye Height Test	0.1000<= X <= 1.2000 V	0.2535 V	Pass	Gen1	Lane0
14	Gen1 Host TP4 Eye Mask Test	N/A	N/A	Pass	Gen1	Lane0
15	Gen1 Host TP4 Vpp Non-Transition Test	0.1000<= X <= 1.2000 V	0.4881 V	Pass	Gen1	Lane0
16	Gen1 Host TP4 Vpp Transition Test	0.1000<= X <= 1.2000 V	0.4875 V	Pass	Gen1	Lane0
17	Gen1 Host TP2 Random Jitter Test (RJrms)	<= 0.2300 UI	0.0049 UI	Pass	Gen1	Lane0
18	Gen1 Host TP2 Deterministic Jitter Test (DJdd)	<= 0.4300 UI	0.0100 UI	Pass	Gen1	Lane0
19	Gen1 Host TP2 Total Jitter Test (TJ @ E-12)	<= 0.6600 UI	0.0795 UI	Pass	Gen1	Lane0
20	Gen1 Host TP2 Eye Width Test	N/A	0.9205 UI	InfoOnly	Gen1	Lane0
21	Gen1 Host TP2 Eye Height Test	0.1000<= X <= 1.2000 V	0.6832 V	Pass	Gen1	Lane0
22	Gen1 Host TP2 Eye Mask Test	N/A	N/A	Pass	Gen1	Lane0
23	Gen1 Host TP2 Vpp Non-Transition Test	0.1000<= X <= 1.2000 V	0.8730 V	Pass	Gen1	Lane0
24	Gen1 Host TP2 Vpp Transition Test	0.1000<= X <= 1.2000 V	0.9262 V	Pass	Gen1	Lane0
No	TestName	Limits	Value	Results	Speed	Lane
25	Gen1 Host SSC Frequency Deviation Test	-5000.0000<= X <= -4000.0000 ppm	0.4736 ppm	Fail	Gen1	Lane0
26	Gen1 Host SSC Modulation Rate Test	30.0000<= X <= 33.0000 KHz	62.3894 KHz	Fail	Gen1	Lane0
27	Gen1 Host SSC Slew Rate Test	<= 1250.0000 ppm/us	1.2912 ppm/us	Pass	Gen1	Lane0
28	Gen1 Device TP4 Random Jitter Test (RJrms)	<= 0.2300 UI	0.0032 UI	Pass	Gen1	Lane0
29	Gen1 Device TP4 Deterministic Jitter Test (DJdd)	<= 0.4300 UI	0.1443 UI	Pass	Gen1	Lane0
30	Gen1 Device TP4 Total Jitter Test (TJ @ E-12)	<= 0.6600 UI	0.1892 UI	Pass	Gen1	Lane0

31	Gen1 Device TP4 Eye Width Test	N/A	0.8108 UI	InfoOnly	Gen1	Lane0
32	Gen1 Device TP4 Eye Height Test	$0.1000 \leq X \leq 1.2000$ V	0.2459 V	Pass	Gen1	Lane0
33	Gen1 Device TP4 Eye Mask Test	N/A	N/A	Pass	Gen1	Lane0
34	Gen1 Device TP4 Vpp Non-Transition Test	$0.1000 \leq X \leq 1.2000$ V	0.4847 V	Pass	Gen1	Lane0
35	Gen1 Device TP4 Vpp Transition Test	$0.1000 \leq X \leq 1.2000$ V	0.4829 V	Pass	Gen1	Lane0
36	Gen1 Device TP2 Random Jitter Test (RJrms)	≤ 0.2300 UI	0.0049 UI	Pass	Gen1	Lane0
37	Gen1 Device TP2 Deterministic Jitter Test (DJdd)	≤ 0.4300 UI	4.6854 UI	Fail	Gen1	Lane0
38	Gen1 Device TP2 Total Jitter Test (TJ @ E-12)	≤ 0.6600 UI	4.7545 UI	Fail	Gen1	Lane0
39	Gen1 Device TP2 Eye Width Test	N/A	0.0000 UI	InfoOnly	Gen1	Lane0
40	Gen1 Device TP2 Eye Height Test	$0.1000 \leq X \leq 1.2000$ V	0.0000 V	Fail	Gen1	Lane0
41	Gen1 Device TP2 Eye Mask Test	N/A	N/A	Fail	Gen1	Lane0
42	Gen1 Device TP2 Vpp Non-Transition Test	$0.1000 \leq X \leq 1.2000$ V	0.7041 V	Pass	Gen1	Lane0
43	Gen1 Device TP2 Vpp Transition Test	$0.1000 \leq X \leq 1.2000$ V	0.4409 V	Pass	Gen1	Lane0
44	Gen1 Device SSC Frequency Deviation Test	$-5000.0000 \leq X \leq -4000.0000$ ppm	0.3357 ppm	Fail	Gen1	Lane0
45	Gen1 Device SSC Modulation Test	$30.0000 \leq X \leq 33.0000$ KHz	125.5957 KHz	Fail	Gen1	Lane0
46	Gen1 Device SSC Slew Rate Test	≤ 1250.0000 ppm/us	1.1645 ppm/us	Pass	Gen1	Lane0
47	Gen2 Host Deemphasis Test	$2.1000 \leq X \leq 7.0000$ dB	-0.0046 dB	Fail	Gen2	Lane0
48	Gen2 Host Preshoot Test	$1.2000 \leq X \leq 3.2000$ dB	0.0044 dB	Fail	Gen2	Lane0
49	Gen2 Host TP4 Random Jitter Test (RJrms)	≤ 0.1410 UI	0.0037 UI	Pass	Gen2	Lane0
50	Gen2 Host TP4 Deterministic Jitter Test (DJdd)	≤ 0.5300 UI	0.1309 UI	Pass	Gen2	Lane0
51	Gen2 Host TP4 Total Jitter Test (TJ @ E-6)	≤ 0.6710 UI	0.1661 UI	Pass	Gen2	Lane0
52	Gen2 Host TP4 Eye Width Test	N/A	0.8339	InfoOnly	Gen2	Lane0
53	Gen2 Host TP4 Extrapolated Eye Height Test	≥ 0.0700 V	0.3863 V	Pass	Gen2	Lane0
54	Gen2 Host TP4 Eye Mask Test	N/A	N/A	Pass	Gen2	Lane0
55	Gen2 Host TP4 Vpp Non-Transition Test	$0.0700 \leq X \leq 1.2000$ V	0.7633 V	Pass	Gen2	Lane0
56	Gen2 Host TP4 Vpp Transition Test	$0.0700 \leq X \leq 1.2000$ V	0.6797 V	Pass	Gen2	Lane0
57	Gen2 Host TP2 Random Jitter Test (RJrms)	≤ 0.1410 UI	0.0038 UI	Pass	Gen2	Lane0

No	TestName	Limits	Value	Results	Speed	Lane
65	Gen2 Host SSC Frequency Deviation Test	-5000.0000<= X <= -4000.0000 ppm	0.4677 ppm	Fail	Gen2	Lane0
66	Gen2 Host SSC Modulation Rate Test	30.0000<= X <= 33.0000 KHz	117.2581 KHz	Fail	Gen2	Lane0
67	Gen2 Host SSC df/dt Test	<= 1250.0000 ppm/us	1.3203 ppm/us	Pass	Gen2	Lane0
68	Gen2 Device Deemphasis Test	2.1000<= X <= 7.0000 dB	-0.0325 dB	Fail	Gen2	Lane0
69	Gen2 Device Preshoot Test	1.2000<= X <= 3.2000 dB	0.0303 dB	Fail	Gen2	Lane0
70	Gen2 Device TP4 Random Jitter Test (RJrms)	<= 0.1410 UI	0.0038 UI	Pass	Gen2	Lane0
71	Gen2 Device TP4 Deterministic Jitter Test (DJdd)	<= 0.5300 UI	0.1426 UI	Pass	Gen2	Lane0
72	Gen2 Device TP4 Total Jitter Test (TJ @ E-6)	<= 0.6710 UI	0.1784 UI	Pass	Gen2	Lane0
73	Gen2 Device TP4 Eye Width Test	N/A	0.8216	InfoOnly	Gen2	Lane0
74	Gen2 Device TP4 Extrapolated Eye Height Test	0.0700<= X <= 1.2000 V	0.3813 V	Pass	Gen2	Lane0
75	Gen2 Device TP4 Eye Mask Test	N/A	N/A	Pass	Gen2	Lane0
76	Gen2 Device TP4 Vpp Non-Transition Test	0.0700<= X <= 1.2000 V	0.7207 V	Pass	Gen2	Lane0
77	Gen2 Device TP4 Vpp Transition Test	0.0700<= X <= 1.2000 V	0.6734 V	Pass	Gen2	Lane0
78	Gen2 Device TP2 Random Jitter Test (RJrms)	<= 0.1410 UI	0.0038 UI	Pass	Gen2	Lane0
79	Gen2 Device TP2 Deterministic Jitter Test (DJdd)	<= 0.5300 UI	0.1422 UI	Pass	Gen2	Lane0
80	Gen2 Device TP2 Total Jitter Test (TJ @ E-6)	<= 0.6710 UI	0.1781 UI	Pass	Gen2	Lane0
81	Gen2 Device TP2 Eye Width Test	N/A	0.8219	InfoOnly	Gen2	Lane0
82	Gen2 Device TP2 Extrapolated Eye Height Test	0.0700<= X <= 1.2000 V	0.2815 V	Pass	Gen2	Lane0
83	Gen2 Device TP2 Eye Mask Test	N/A	N/A	Pass	Gen2	Lane0
84	Gen2 Device TP2 Vpp Non-Transition Test	0.0700<= X <= 1.2000 V	0.7624 V	Pass	Gen2	Lane0
85	Gen2 Device TP2 Vpp Transition Test	0.0700<= X <= 1.2000 V	0.6819 V	Pass	Gen2	Lane0
86	Gen2 Device SSC Frequency Deviation Test	-5000.0000<= X <= -4000.0000 ppm	0.4799 ppm	Fail	Gen2	Lane0
87	Gen2 Device SSC Modulation Rate Test	30.0000<= X <= 33.0000 KHz	92.7295 KHz	Fail	Gen2	Lane0
88	Gen2 Device SSC df/dt Test	<= 1250.0000 ppm/us	1.1373 ppm/us	Pass	Gen2	Lane0

FIGURE 20. TEST SUMMARY TABLE EXAMPLE

5.1.3 Test Results

This portion displays the results of each test performed in detail along with supporting data points and screenshots.

54. Gen2 Host TP4 Eye Mask Test [Gen2,Lane0]

Pass/Fail Stats	: Pass
SigTest Version	: 4.0.23.2
DUT Type:	: DRD
Connector Type	: Type-C
Max Peak-to-Peak Jitter	: 196.0406 mUI
Min Non Transition Eye Height	: 415.4207 mV
Transition Eye Violations	: 0.0000 #
Non Transition Eye Violations	: 0.0000 #
Total Eye Violations	: 0.0000 #
Test completed time	: 17 January 2023 0:30:13 AM

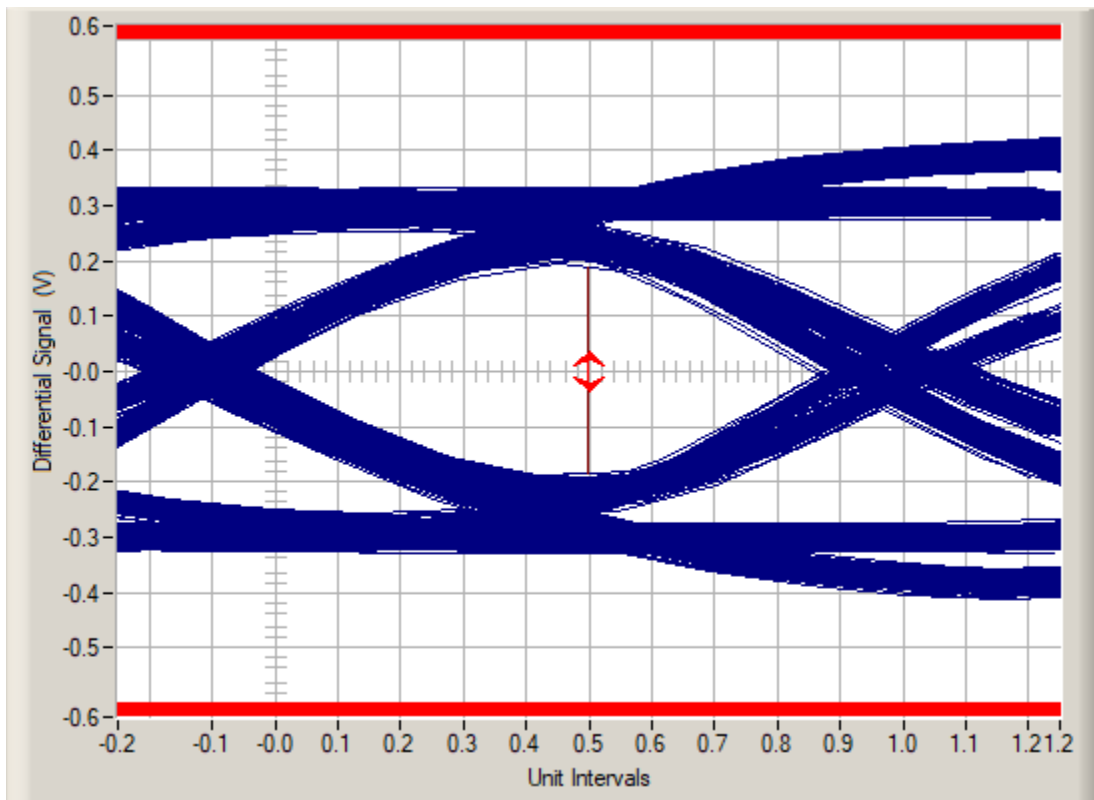


FIGURE 21. TEST RESULTS EXAMPLE

5.2 Delete Test Results

Select the **Delete** button to delete individual test results or **Delete All** to delete all test results.

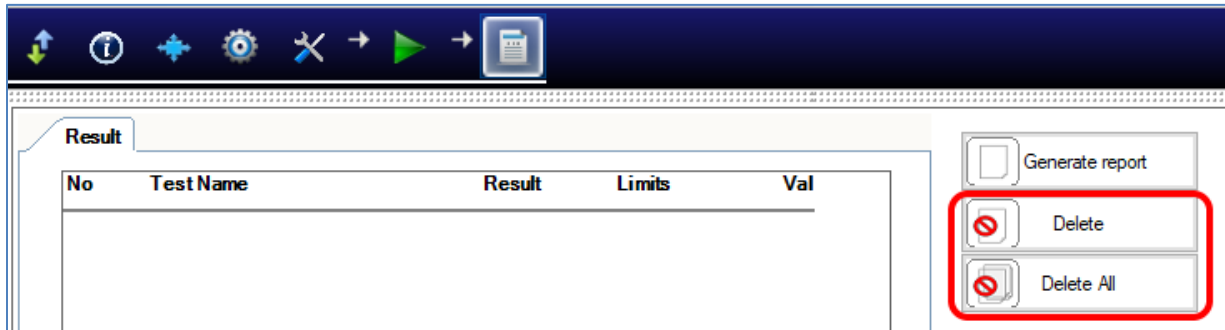


FIGURE 22. DELETE TEST RESULTS

6 Saving and Loading GRL-USB32-TX Test Sessions

The usage model for the GRL-USB32-TX software is that the test results are created and maintained as a 'Live Session' in the application. This allows the user to quit the application and return later to continue where the user left off.

Save and Load Sessions are used to save a test session that the user may want to recall later. The user can 'switch' between different sessions by saving and loading them when needed.

- To **save a test session**, with all of the test parameter information, test results, and any waveforms, select the Options drop-down menu and then select "Save Session".
- To **load a test session** back into the application, including the saved test parameter settings, select Options → "Load Session".
- To **create a new test session** and return the application back to the default configuration, select Options → "New Session".

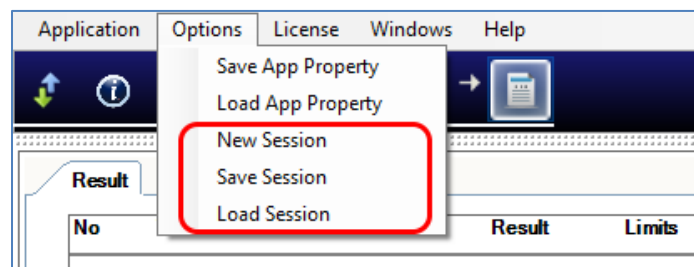


FIGURE 23. SAVE/LOAD/CREATE TEST SESSIONS

The test configuration and session results are saved in a file with the '.ses' extension, which is a compressed zip-style file, containing a variety of information.

7 Appendix A: Method of Implementation (MOI) for Manual USB 3.2 Transmitter Measurements

This section describes how to manually perform USB 3.2 DUT Tx compliance tests.

7.1 Low Frequency Periodic Signaling (LFPS) Tests

The LFPS test group measures various parameters of the DUT's LFPS signaling including:

- LFPS Peak-To-Peak Differential Amplitude ($V_{TX-DIFF-PP-LFPS}$)
- LFPS AC Common Mode ($V_{CM-AC-LFPS}$)
- LFPS Rise/Fall Time ($t_{RiseFall2080}$)
- LFPS Period (t_{Period})
- LFPS Burst Width (t_{Burst})
- LFPS Repeat Time (t_{Repeat})
- LFPS Duty Cycle

The SigTest tool is used to perform measurement analysis. *Note: Ensure that the version of SigTest used supports LFPS measurements.*

7.1.1 Procedure

1. Adjust the DUT to transmit the LFPS signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of five bursts of the LFPS signal.
4. Capture the LFPS differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_5GB**.
8. From the “Template File” drop-down control, select **USB_3_LFPS**.
9. Select the “Test” button to start analysis.
10. Record all the output results.

7.2 USB 3.2 Gen 1 Long Channel Tests

The USB 3.2 Gen 1 Long Channel test group measures various Tx parameters of the USB 3.2 DUT under the effects of a physical channel and the related equalization settings, which include the following parameters:

- Random Jitter (RJ_{rms})
- Deterministic Jitter (DJ_{dd})
- Total Jitter ($TJ_{@E-12}$)
- Eye Width
- Eye Height
- Eye Mask
- Vpp Non-Transition
- Vpp Transition

The SigTest tool is used to perform measurement analysis.

7.2.1 Procedure

1. Adjust the DUT to transmit CP1 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 1M unit intervals.
4. Capture the CP1 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_5gb**.
8. From the “Template File” drop-down menu, select **USB_3_5gb_CP1**.
9. Select the “Test” button to start analysis.
10. Record the output result of the RJ parameter.
11. Adjust the DUT to transmit CP0 signal.
12. Repeat Steps 2 to 6 using the CP0 signal.
13. From the “Technology” drop-down menu, select **USB_3_5gb**.
14. From the “Template File” drop-down menu, select **USB_3_5gb_CP0_RjIN**.
15. Select the “Test” button to start analysis.
16. In the pop-up window, enter the RJ value obtained in Step 10, and select “OK” to continue with analysis.
17. Record the output results of all the parameters.

7.3 USB 3.2 Gen 1 Short Channel Tests

The USB 3.2 Gen 1 Short Channel test group measures various Tx parameters of the USB 3.2 DUT that is directly connected to the measurement device without the effects of a physical channel, which include the following parameters:

- Random Jitter (RJ_{rms})
- Deterministic Jitter (DJ_{dd})
- Total Jitter ($TJ_{@E-12}$)
- Eye Width
- Eye Height
- Eye Mask
- Vpp Non-Transition
- Vpp Transition

The SigTest tool is used to perform measurement analysis.

7.3.1 Procedure

1. Adjust the DUT to transmit CP1 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 1M unit intervals.
4. Capture the CP1 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_5gb**.
8. From the “Template File” drop-down menu, select **USB_3_5gb_CP1_SHORT**.
9. Select the “Test” button to start analysis.
10. Record the output result of the RJ parameter.
11. Adjust the DUT to transmit CP0 signal.
12. Repeat Steps 2 to 6 using the CP0 signal.
13. From the “Technology” drop-down menu, select **USB_3_5gb**.
14. From the “Template File” drop-down menu, select **USB_3_5gb_CP0_RjIN_SHORT**.
15. Select the “Test” button to start analysis.
16. In the pop-up window, enter the RJ value obtained in Step 10, and select “OK” to continue with analysis.
17. Record the output results of all the parameters.

7.4 USB 3.2 Gen 1 SSC Tests

The USB 3.2 Gen 1 SSC test group measures various parameters related to the SSC modulation on the Tx signal of the USB 3.2 DUT, which includes the following parameters:

- Frequency Deviation
- Modulation Rate
- SSC Slew Rate

The SigTest tool is used to perform measurement analysis. *Note: Ensure that the version of SigTest used supports SSC measurements.*

7.4.1 Procedure

1. Adjust the DUT to transmit CP1 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 1M unit intervals.
4. Capture the CP1 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_5gb**.
8. From the “Template File” drop-down menu, select **USB_3_5Gb_SSC_Profile_Test**.
9. Select the “Test” button to start analysis.
10. Record all the output results.

7.5 USB 3.2 Gen 2 Equalization Tests

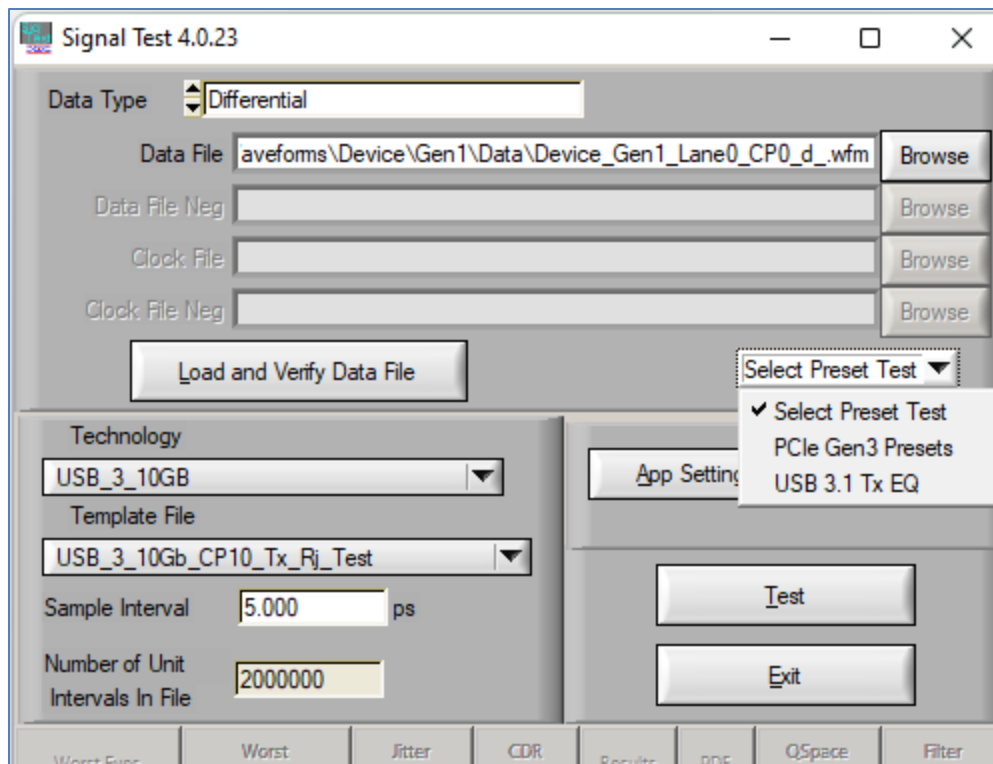
The USB 3.2 Gen 2 Equalization test group measures various Tx equalization parameters of the USB 3.2 DUT, which include the following parameters:

- De-emphasis
- Preshoot

The SigTest tool is used to perform measurement analysis. *Note: USB 3.2 Gen 2 tests are only available in SigTest v4.*

7.5.1 Procedure

1. Adjust the DUT to transmit CP13 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 2M unit intervals.
4. Capture the CP13 differential output waveform.
5. Repeat Steps 1 to 4 for CP14 and CP15 waveform.
6. Launch the SigTest tool.



7. Select **USB 3.1 Tx EQ** from the drop-down menu as shown in the screenshot above.

8. In the pop-up window, specify the path to the folder containing the CP13, CP14 and CP15 waveforms captured previously.
9. Select the “Test” button to start analysis.
10. Record all the output results.

7.6 USB 3.2 Gen 2 Long Channel Tests

The USB 3.2 Gen 2 Long Channel test group measures various Tx parameters of the USB 3.2 DUT under the effects of a physical channel and the related equalization settings, which include the following parameters:

- Random Jitter (RJ_{rms})
- Deterministic Jitter (DJ_{dd})
- Total Jitter ($TJ_{@E-12}$)
- Eye Width
- Extrapolated Eye Height
- Eye Mask
- Vpp Non-Transition
- Vpp Transition

The SigTest tool is used to perform measurement analysis. *Note: USB 3.2 Gen 2 tests are only available in SigTest v4.*

7.6.1 Procedure

1. Adjust the DUT to transmit CP10 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 2M unit intervals.
4. Capture the CP10 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_10GB**.
8. From the “Template File” drop-down menu, select **USB_3_10Gb_CP10_Tx_Rj_Test.dat**.
9. Select the “Test” button to start analysis.
10. Record the output result of the RJ parameter.

11. Adjust the DUT to transmit CP9 signal.
12. Repeat Steps 2 to 6 using the CP9 signal.
13. From the “Technology” drop-down menu, select **USB_3_10GB**.
14. From the “Template File” drop-down menu, select **USB_3_10Gb_CP9_Tx.dat**.
15. Select the “Test” button to start analysis.
16. In the pop-up window, enter the RJ value obtained in Step 10, and select “OK” to continue with analysis.
17. Record the output results of all the parameters.

7.7 USB 3.2 Gen 2 Short Channel Tests

The USB 3.2 Gen 2 Short Channel test group measures various Tx parameters of the USB 3.2 DUT that is directly connected to the measurement device without the effects of a physical channel, which include the following parameters:

- Random Jitter (RJ_{rms})
- Deterministic Jitter (DJ_{dd})
- Total Jitter ($TJ_{@E-12}$)
- Eye Width
- Extrapolated Eye Height
- Eye Mask
- Vpp Non-Transition
- Vpp Transition

The SigTest tool is used to perform measurement analysis. *Note: USB 3.2 Gen 2 tests are only available in SigTest v4.*

7.7.1 Procedure

1. Adjust the DUT to transmit CP10 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 2M unit intervals.
4. Capture the CP10 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.

7. From the “Technology” drop-down menu, select **USB_3_10GB**.
8. From the “Template File” drop-down menu, select **USB_3_10Gb_CP10_Tx_Rj_Test_SHORT.dat**.
9. Select the “Test” button to start analysis.
10. Record the output result of the RJ parameter.
11. Adjust the DUT to transmit CP9 signal.
12. Repeat Steps 2 to 6 using the CP9 signal.
13. From the “Technology” drop-down menu, select **USB_3_10GB**.
14. From the “Template File” drop-down menu, select **USB_3_10Gb_CP9_Tx_Short.dat**.
15. Select the “Test” button to start analysis.
16. In the pop-up window, enter the RJ value obtained in Step 10, and select “OK” to continue with analysis.
17. Record the output results of all the parameters.

7.8 USB 3.2 Gen 2 SSC Tests

The USB 3.2 Gen 2 SSC test group measures various parameters related to the SSC modulation on the Tx signal of the USB 3.2 DUT, which include the following parameters:

- Frequency Deviation
- Modulation Rate
- SSC df/dt

The SigTest tool is used for measurement analysis. *Note: USB 3.2 Gen 2 tests are only available in SigTest v4.*

7.8.1 Procedure

1. Adjust the DUT to transmit CP10 signal.
2. Set up the Scope to display differential output of the DUT Tx lane under test. The differential output is the difference between the positive and negative lanes under test, e.g., Channel 1 – Channel 3.
3. Adjust the horizontal scale to capture a minimum of 2M unit intervals.
4. Capture the CP10 differential output waveform.
5. Launch the SigTest tool.
6. Select the waveform file captured in Step 4.
7. From the “Technology” drop-down menu, select **USB_3_10GB**.

8. From the “Template File” drop-down menu, select **USB_3_10Gb_SSC_Profile_Test**.
9. Select the “Test” button to start analysis.
10. Record all the output results.

8 Appendix B: Connecting Keysight Oscilloscope to PC

If using a Keysight oscilloscope, refer to the following procedure on how to connect the Scope to be used with a PC. The Keysight Scope can be connected to the PC through GPIB, USB, or LAN.

1. Download the latest version of the Keysight IO Libraries Suite software from the Keysight website and install on the PC.
2. When installed successfully, the IO icon () will appear in the taskbar notification area of the PC.
3. Select the IO icon to launch the **Keysight Connection Expert**.
4. Click Rescan.

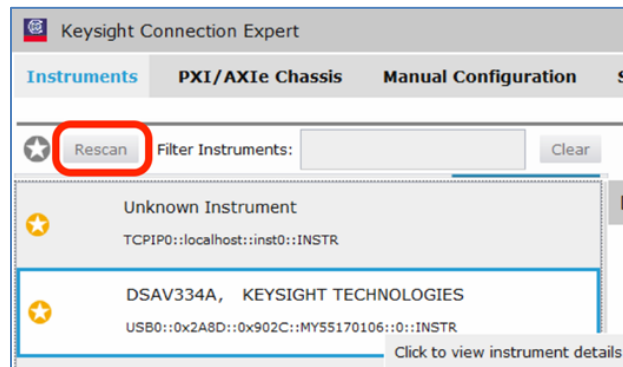


FIGURE 24. KEYSIGHT CONNECTION EXPERT

5. Refresh the system. The Keysight Scope is shown on the left pane and the VISA address is shown on the right pane.

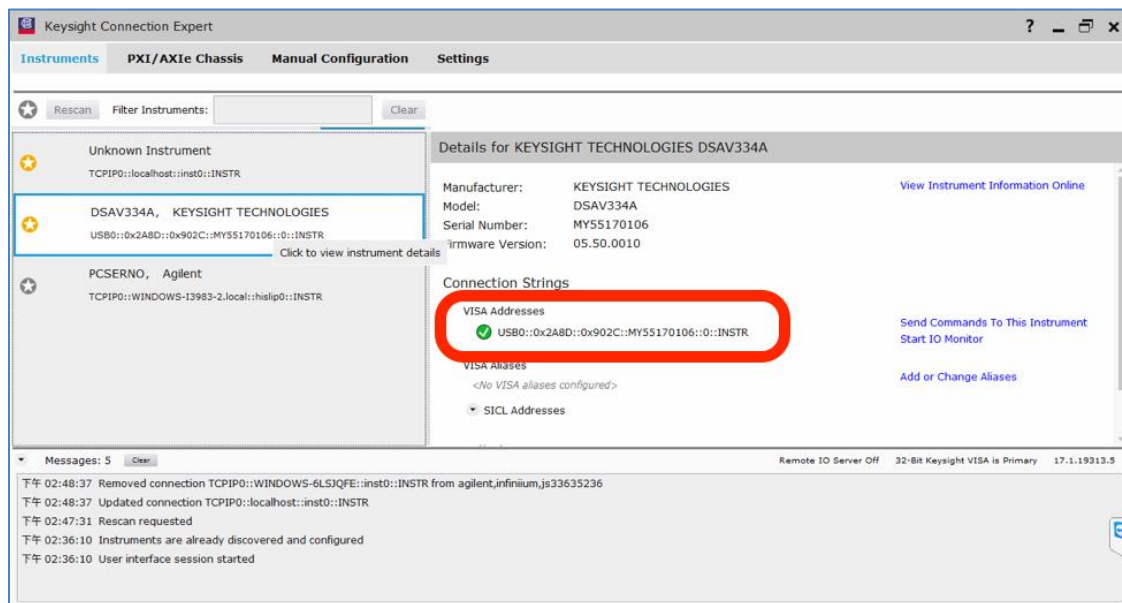


FIGURE 25. OSCILLOSCOPE'S VISA ADDRESS

6. When connecting the Keysight Scope to the PC through GPIB/USB, type in the VISA address into the 'Address' field on the Equipment Setup page of the GRL USB 3.2 Tx Test Application. If connected via LAN, type in the Scope IP address, for example "TCPIP0::192.168.0.110::inst0::INSTR". Note to **omit** the Port number from the address.

9 Appendix C: Connecting Tektronix Oscilloscope to PC

If using a Tektronix DPOJET Series oscilloscope, refer to the following procedure on how to connect the Scope to be used with a PC. The Tektronix Scope can be connected to the PC through GPIB, USB, or LAN.

1. Download the latest version of the Tektronix TekVISA software from the Tektronix website and install on the PC.
2. When installed successfully, open the OpenChoice Instrument Manager application.

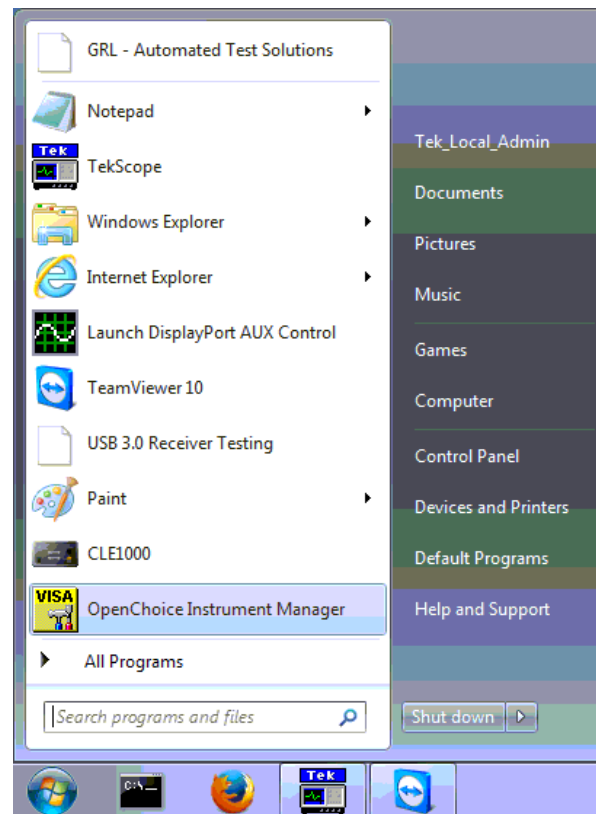


FIGURE 26. OPENCHOICE INSTRUMENT MANAGER IN START MENU

3. The left “Instruments” panel on the OpenChoice Instrument Manager will display all connected instruments. The functional buttons below the “Instruments” panel – “Instrument List Update”, “Search Criteria”, “Instrument Identify” and “Properties” can be used to detect the Scope in case it does not initially appear under “Instruments”.
 - a) “Instrument List Update”: Select to refresh the instrument list and locate new instruments connected to the PC.
 - b) “Search Criteria”: Select to configure the instrument search function.
 - c) “Instrument Identify”: Select to use a supported programming language to send a query to identify the selected instrument.
 - d) “Properties”: Select to display and view the selected instrument properties.

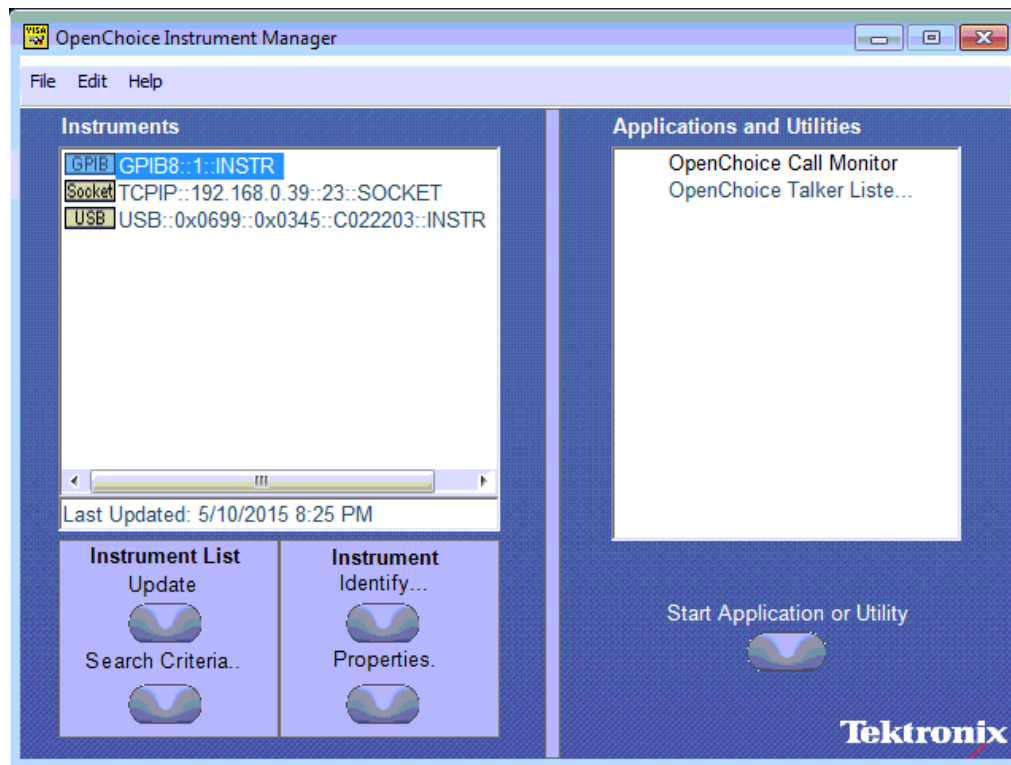


FIGURE 27. OPENCHOICE INSTRUMENT MANAGER MENU

4. If connecting the Tektronix Scope to the PC via USB, select the “Search Criteria” function to ensure that USB connection is enabled, and then select the “Instrument List Update” function. When the Scope appears on the “Instruments” panel, select it and then go to the “Instrument Identify” function. This will display the model and serial number of the Scope once detected. Select the “Properties” function to view the Scope address.
5. If connecting the Tektronix Scope to the PC via LAN, the Scope IP address must be pre-determined beforehand. Then select the “Search Criteria” function to ensure that LAN connection is enabled and type in the Scope IP address. When the Scope shows up in the list, select it followed by “Search”. The Scope should then appear on the “Instruments” panel. Select it and access the “Instrument Identify” function to view the Scope model and serial number as well as the “Properties” function to view the Scope address.
6. On the Equipment Setup page of the GRL USB 3.2 Tx Test Application, type in the Scope address into the ‘Address’ field. If the GRL USB 3.2 Tx Test Application is installed on the Tektronix Scope, ensure the Scope is connected via GPIB and type in the GPIB network address, for example “GPIB8::1::INSTR”. If the GRL software is installed on the PC to control the Scope, type in the Scope IP address, for example “TCPIP0::192.168.0.110::inst0::INSTR”. Note to **omit** the Port number from the address.

END_OF_DOCUMENT