



GRL Platform Solutions

DP2.1 PHY CTS UHBRx Source MOI

[Note: In this MOI, the GRL-DP21-TX Test Software is used to automate the DisplayPort 2.1 PHY CTS UHBRx Source testing along with the Tektronix or Keysight scope.]

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1 Introduction

[Note:

For UHBRx (originally the DP2.1)

UHBRx stands for UHBR20(20G bps), UHBR13.5(13.5G bps), UHBR10(10G bps)]

This User Guide & MOI provides information using the GRL-DP21-TX automation test solution to set up and test an electrical transmitter (Tx) device for VESA DisplayPort Logo Compliance Program certification.

The main body of this documentation describes how to configure the GRL-DP21-TX software to capture and test waveforms in a DisplayPort (DP) 2.1 PHY CTS UHBRx Source system (lane, SSC, data rate, rise/fall time, AC Common mode, jitter and eye measurements). The test automation is carried out in conformance with the DP PHY 2.1 Compliance Test Specification (CTS) with high performance real-time oscilloscopes using supported AUX test controllers and test fixtures.

The GRL-DP21-TX software when run from the computer or oscilloscope enables automation control to test the device under test (DUT) for CTS Tx electrical compliance. The GRL Platform Solutions automation control enabled PC or Scope automates signal quality test sequencing and processing of acquired waveforms for the DUT at the selected DisplayPort data rate. The Tx path is tested for general or worst case compliance with the CTS-specified DP Source device test suite. 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 many DisplayPort Tx environments.

Note: Refer to VESA for approved vendor specific Method of Implementation (MOI's) as technical reference.

2 Resource Requirements

Note: Equipment requirements may vary according to the lab setup and DUT connector type. 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	≥ 21 GHz bandwidth ^[b] 16 GB or above memory RAM Scope setup files and Serial Data Link Analysis (SDLA) filters ^[c] with Windows 7+ OS
Computer (laptop or desktop PC)	1	Windows 7+ OS For automation control (running GRL-DP21-TX software)

^[a] Oscilloscope with scope software requirements as specified in vendor specific MOI's. For example, when using the Keysight Scope, scope software such as Keysight InfiniiSim / EZ-JIT / Serial Data Analysis / Serial Data Equalization that are required for testing and signal processing must be pre-installed on the Scope. Similarly, the Tektronix Scope shall be used with DPOJET (Jitter and Eye Analysis Tools) software for making measurements.

^[b] Oscilloscope with scope bandwidth as specified in vendor specific MOI's.

^[c] Scope setup files (with proper DisplayPort source test patterns) and SDLA filters are distributed with the GRL-DP21-TX software and are installed during installation process. The SDLA software is used for CTLE filters creation and is not required if .flt files have already been created.

TABLE 2. EQUIPMENT REQUIREMENTS – ACCESSORIES

Accessory ^[a]	Qty.	Description
DisplayPort AUX Controller	1	Compatible vendor specific AUX controller For automation control of the DUT
VESA-Approved DisplayPort Test Fixture	1	DisplayPort over USB Type-C® or USB Type-C Plug Test Fixture (Keysight, Wilder-Tech, LS-ICT) – DUT connector type dependent
Standard DisplayPort Cable	1	
Matched-Paired Cable	4	40G Matched-Paired Cable 2.92m L-1m - Phase matched max $\pm 5^\circ$ at 40 GHz - Insertion loss < 1.5 dB max in 10 GHz
USB Cable	1	USB 2.0 Cable

^[a] Based on standard test configuration. May require more or less cables/accessories depending on the DUT connector type. Refer to the DP 2.1 PHY CTS for specific setup requirements of each data rate.

2.2 Software Requirements

TABLE 3. SOFTWARE REQUIREMENTS

Software	Source
GRL-DP21-TX	GRL Platform Solutions DisplayPort 2.1 PHY CTS UHBRx Source Test Automation Software – www.grlps.com (Support > Download Center)
VISA (Virtual Instrument Software Architecture) API Software	VISA Software is required to be installed on the host PC running GRL-DP21-TX software. GRL Platform Solutions' 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)

3 DisplayPort 2.1 Source Test Connection Setup

3.1 DisplayPort over Type-C (DPoC) DUT Setup Using DP AUX Controller

The following procedures show how to set up the test hardware connections on various DUT test lanes using the DisplayPort AUX controller, DPoC plug test fixture and DisplayPort 2.1 control board.

Connect the equipment as follows:

Note: Make sure Power Supplies are connected to the DPoC Plug Fixture and the AUX controller; and LED's are lit before connecting to the DUT.

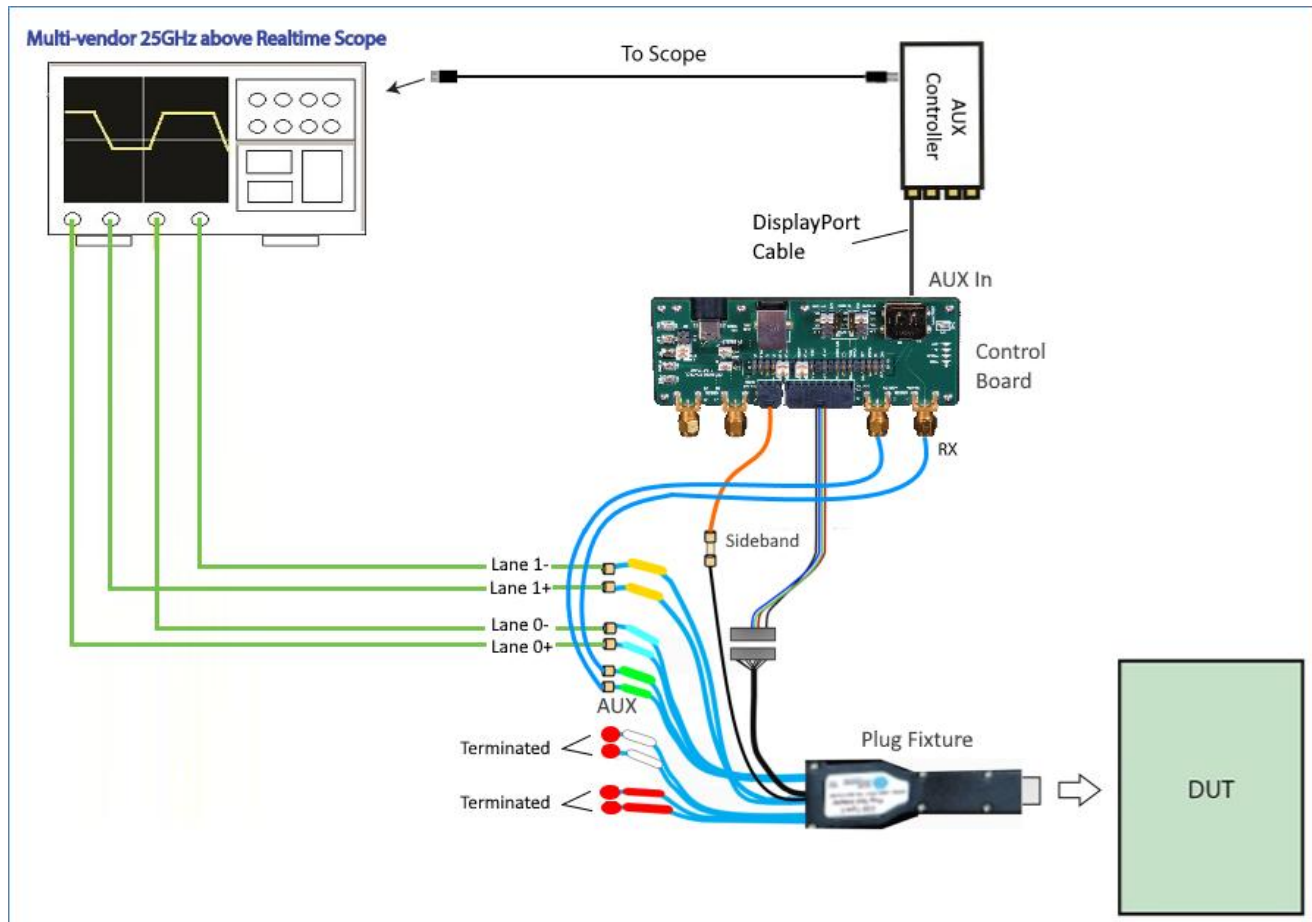


FIGURE 1. TEST SETUP WITH DP AUX CONTROLLER #1

1. Connect the AUX controller to the Scope or control PC using a USB cable. (Note the Scope is used in this test setup.)
2. Attach the DPoC plug fixture to the DUT's USB Type-C receptacle connector.
3. Connect the Scope's channel 1/channel 3 to Lane 0+/Lane 0- of the DPoC plug fixture respectively.
4. Connect the Scope's channel 2/channel 4 to Lane 1+/ Lane 1- of the DPoC plug fixture respectively.

5. Make sure to terminate all other test lanes that are not used.
6. Connect the green AUX cable pair of the plug fixture to the Rx lanes of the DisplayPort 2.1 control board.
7. Connect the sideband cables of the plug fixture to their allocated slots on the control board.
8. Connect the AUX controller to power supply.
9. Connect the AUX controller output to the AUX input connector of the control board using a standard DisplayPort cable.
10. Run the AUX controller test scripts on the Scope.

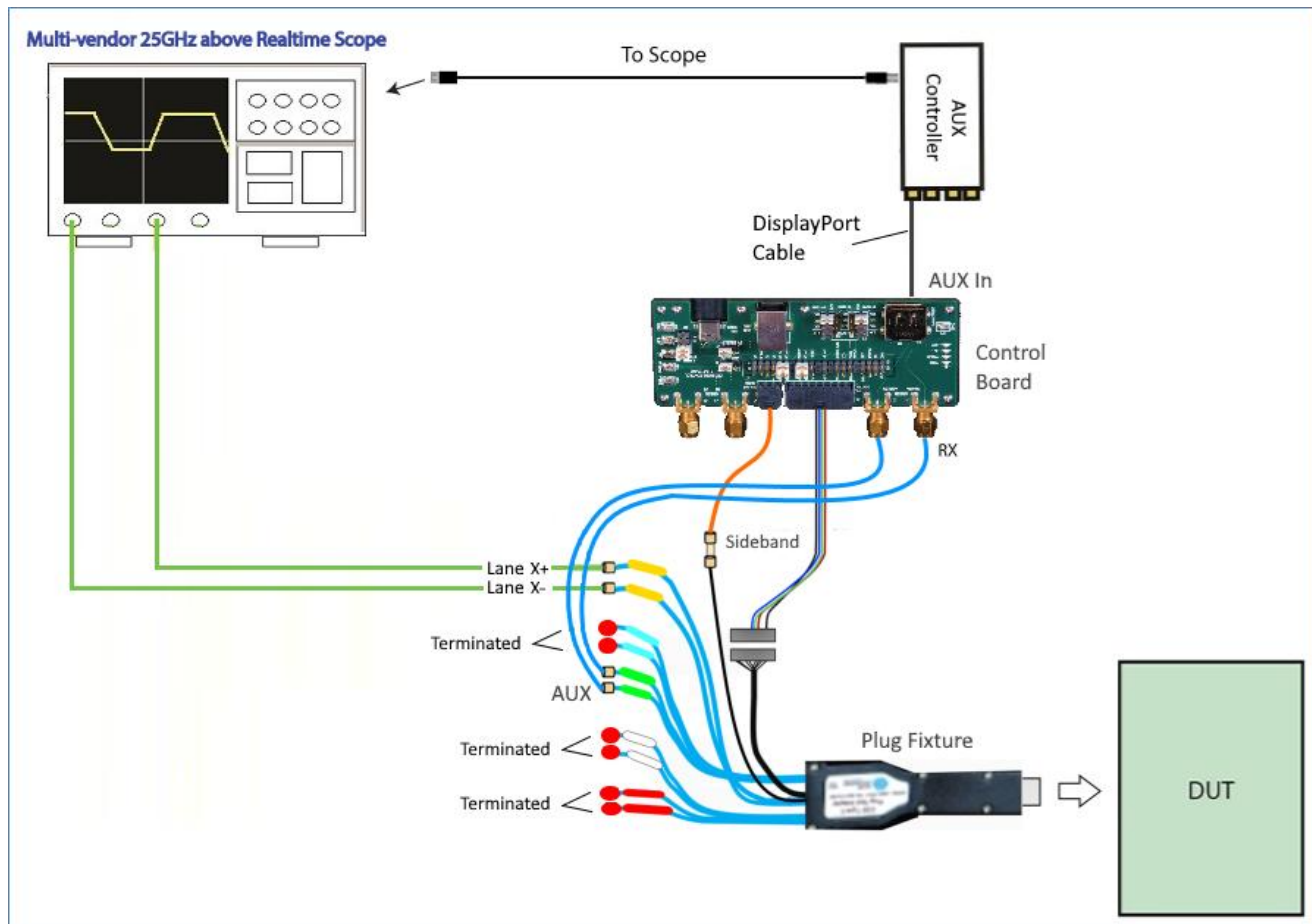


FIGURE 2. TEST SETUP WITH DP AUX CONTROLLER #2

1. Connect the AUX controller to the Scope or control PC using a USB cable. (Note the Scope is used in this test setup.)
2. Attach the DPoC plug fixture to the DUT's USB Type-C receptacle connector.
3. Connect the Scope's channel 1/channel 3 to the DUT lanes to be tested (Lane X-/Lane X+) of the DPoC plug fixture respectively.
4. Make sure to terminate all other test lanes that are not used.

5. Connect the green AUX cable pair of the plug fixture to the Rx lanes of the DisplayPort 2.1 control board.
6. Connect the sideband cables of the plug fixture to their allocated slots on the control board.
7. Connect the AUX controller to power supply.
8. Connect the AUX controller output to the AUX input connector of the control board using a standard DisplayPort cable.
9. Run the AUX controller test scripts on the Scope.

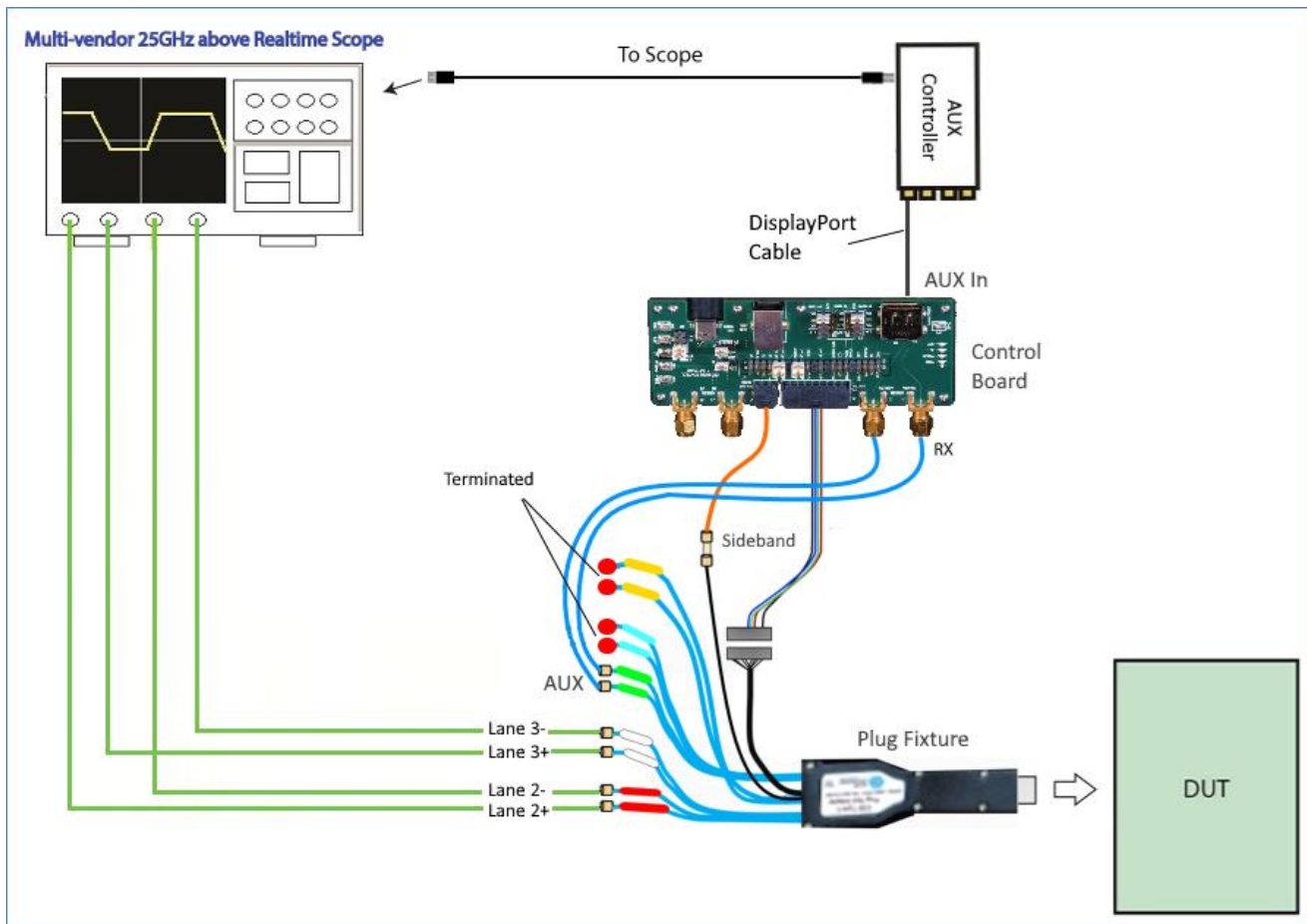


FIGURE 3. TEST SETUP WITH DP AUX CONTROLLER #3

1. Connect the AUX controller to the Scope or control PC using a USB cable. (Note the Scope is used in this test setup.)
2. Attach the DPoC plug fixture to the DUT's USB Type-C receptacle connector.
3. Connect the Scope's channel 1/channel 3 to Lane 2+/Lane 2- of the DPoC plug fixture respectively.
4. Connect the Scope's channel 2/channel 4 to Lane 3+/ Lane 3- of the DPoC plug fixture respectively.

5. Make sure to terminate all other test lanes that are not used.
6. Connect the green AUX cable pair of the plug fixture to the Rx lanes of the DisplayPort 2.1 control board.
7. Connect the sideband cables of the plug fixture to their allocated slots on the control board.
8. Connect the AUX controller to power supply.
9. Connect the AUX controller output to the AUX input connector of the control board using a standard DisplayPort cable.
10. Run the AUX controller test scripts on the Scope.

4 Setting Up GRL-DP21-TX Software

This section provides the procedures to start up and pre-configure the GRL-DP21-TX automation software before running tests. It also helps users familiarize themselves with the basic operation of the GRL-DP21-TX software.

The software installer automatically creates shortcuts in the Desktop and Start Menu. To start using the software, follow the procedures in the following sections.

4.1 Download GRL-DP21-TX Software

Install, launch and set up the GRL-DP21-TX software on the Scope or a controller PC.

1. If using a controller PC, install VISA (Virtual Instrument Software Architecture) on to the controller PC where the GRL-DP21-TX is to be used.
2. Download the software ZIP file package from the GRL Platform Solutions support site.
3. The ZIP file contains:
 - **DP21TxTestApplicationxxxxxxxxSetup** – Run this on the PC or on the oscilloscope to install the application.
 - **DP21TxTestScopeSetupFilesInstallationxxxxxxxxSetup** – Run this on the oscilloscope to install the DisplayPort setup and filter files.
4. Launch and set up the GRL-DP21-TX software as follows:
 - a) Open the **GRL** folder from the Windows Start Menu. Click on **GRL – Automated Test Solutions** within the GRL folder to launch the GRL Platform Solutions software framework.

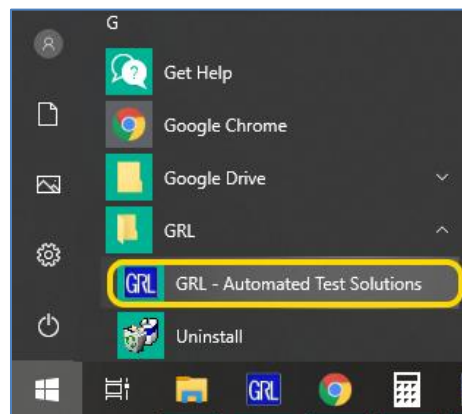


FIGURE 4. LAUNCHING GRL PLATFORM SOLUTIONS SOFTWARE FRAMEWORK

- b) From the **Application** → **Framework Test Solution** drop-down menu, select **DisplayPort 2.1 Tx Test**. If the selection is grayed out, it means that your license has expired.

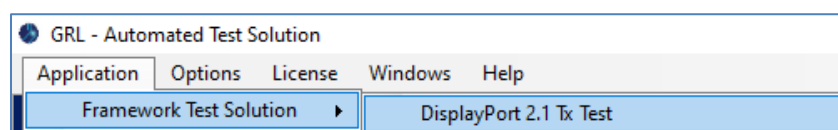


FIGURE 5. START DISPLAYPORT 2.1 TX TEST APPLICATION

- i) To enable license, go to **License → License Info**.

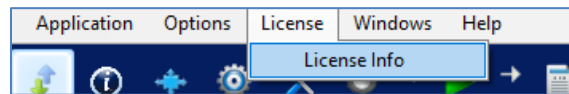


FIGURE 6. SEE LICENSE DETAILS

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

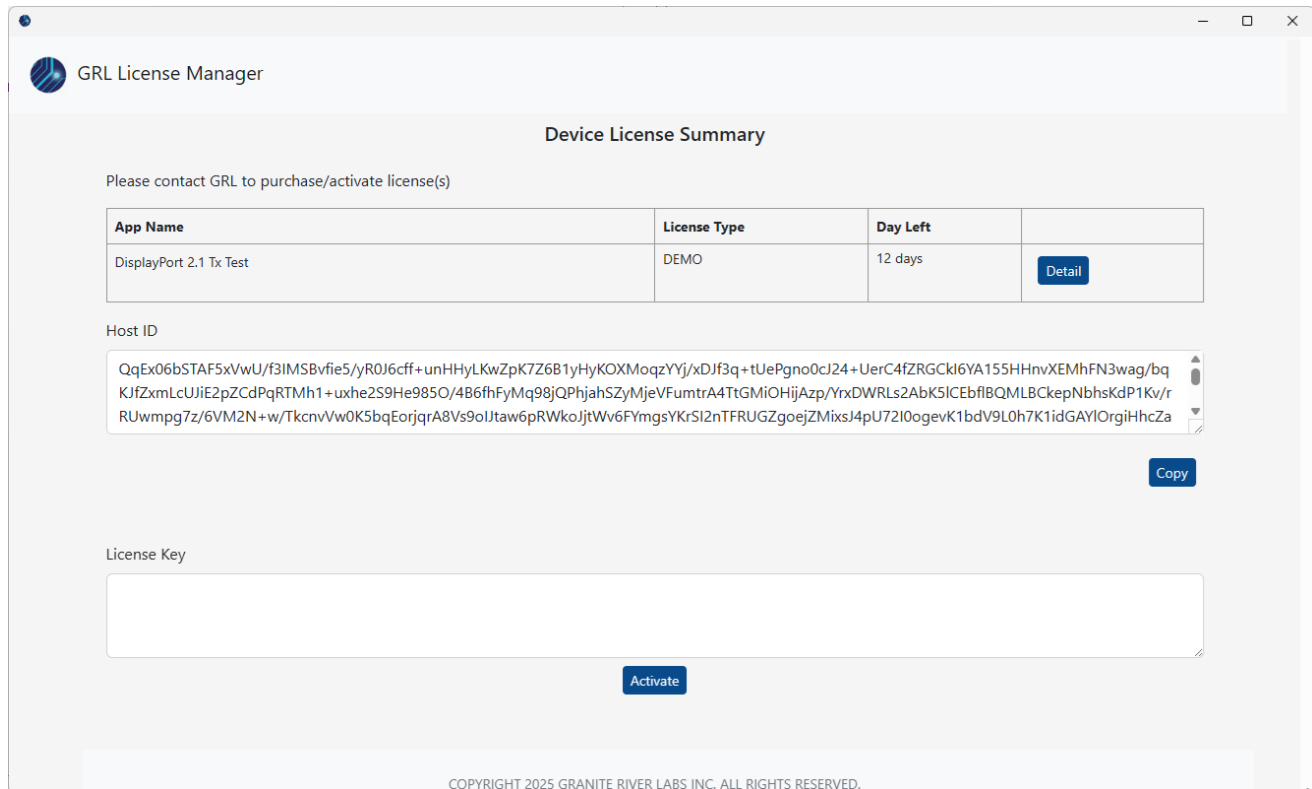


FIGURE 7. CHECK LICENSE FOR INSTALLED APPLICATION

- iii) Activate a License:

- If you have an Activation Key, enter it in the **License Key** field provided and select **Activate**. The installed application is ready for use upon successful activation.
- If you do not have an Activation Key, close the above window to use a demo version of the application over a free 12-day trial period.

Note: Once the 12-day trial period ends, you will need to request an Activation Key to continue using the application on the same computer by contacting support@grlps.com.

5. Select the Equipment Setup icon  on the DisplayPort 2.1 Tx Test Application menu.
6. If using an external AUX hardware controller, connect the controller via USB to the GRL Platform Solutions automation control enabled Scope or PC.

7. On the Scope or PC, obtain the network address for the connected Scope from the device settings. This address will be used to connect the Scope to the GRL-DP21-TX software.
8. If the Oscilloscope is connected to control the PC using LAN, type in the IP Address of the Scope into the “Address” field and click on the “lightning” button . The “lightning” button should turn green  if successfully connected to the Scope.

If the GRL-DP21-TX software is installed on the PC to control the Scope, type in the Scope IP address, for example “TCPIP0::192.168.0.100::inst0::INSTR”. Note to **omit** the Port number from the address. *Refer to Appendix for more information on the Keysight and Tektronix Scope connection requirements.*

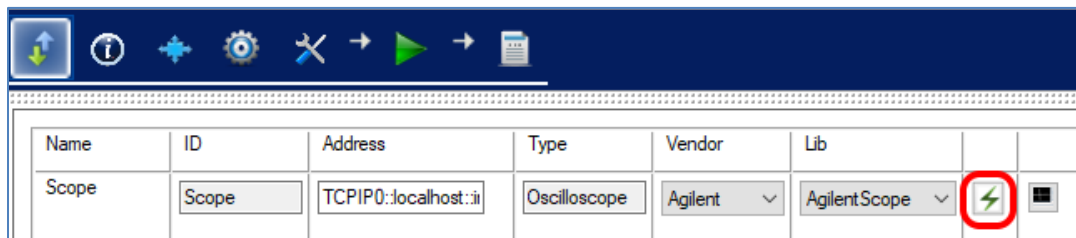


FIGURE 8. CONNECT INSTRUMENT WITH GRL-DP21-TX SOFTWARE

4.1.1 Set Up Remote File Server

1. The **GRLRemoteProxyServer.exe** will also be installed along with the **DP21TxTestScopeSetupFilesInstallationxxxxxxxxSetup** on the Scope. The GRLRemoteProxyServer.exe is installed under the C:\GRL\GRLRemoteProxyServer directory.

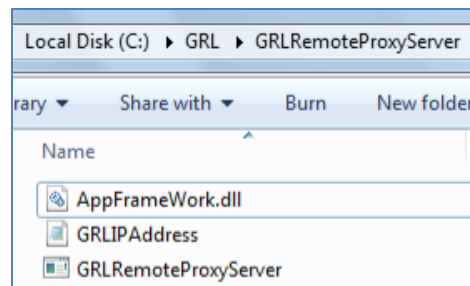


FIGURE 9. INSTALLED GRLREMOTEPROXYSERVER.EXE FILE DIRECTORY

2. If the GRL-DP21-TX software is installed on the PC to control the Scope and SigTest is to be used, the GRLRemoteProxyServer.exe must be run on the Scope to move large waveform files back to the controller PC. The GRL-DP21-TX software will then perform post-processing and analysis of these waveforms using SigTest.
3. When running the GRLRemoteProxyServer.exe, make sure that the controller PC and Scope are connected to the same network, using IP addresses as in following example:
 - Controller PC IP address: 192.168.100.8
 - Scope IP address: 192.168.100.35

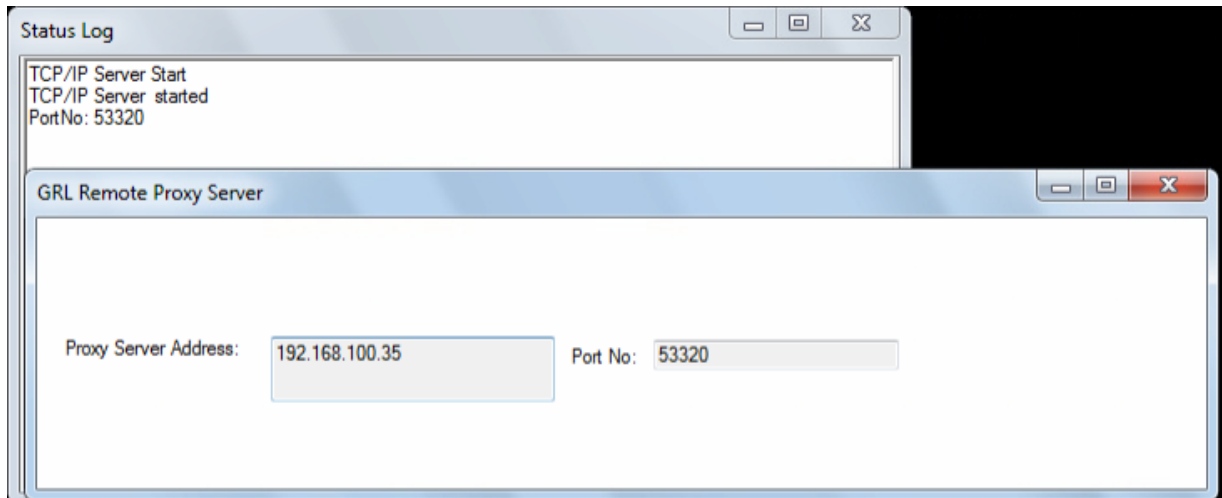


FIGURE 10. VERIFY PROXY SERVER CONNECTION FOR CONTROLLER PC AND SCOPE

4. On the DisplayPort 2.1 Tx Test Application, configure the “Remote File Server IP Address” and “Remote File Server Port No” parameters on the Configurations  page to match the network settings of the Remote Proxy Server as shown in the example below:

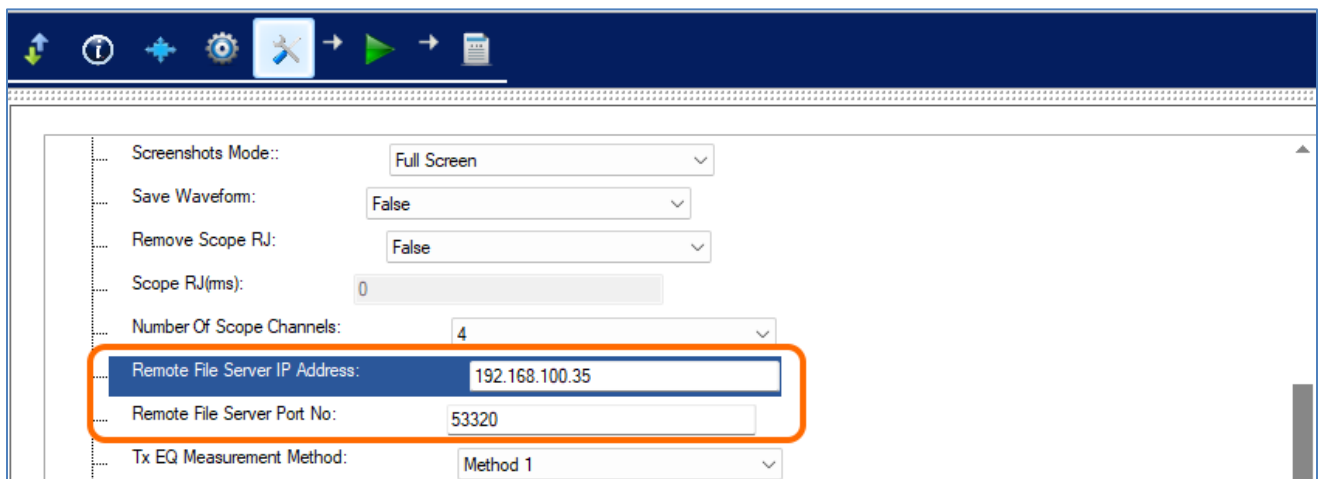


FIGURE 11. CONFIGURE REMOTE PROXY SERVER NETWORK SETTINGS ON GRL PLATFORM SOLUTIONS SOFTWARE

Refer Section 6.4 for more details on parameters available on the Configurations page.

4.2 Pre-Configure Software Before Testing

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

4.2.1 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.

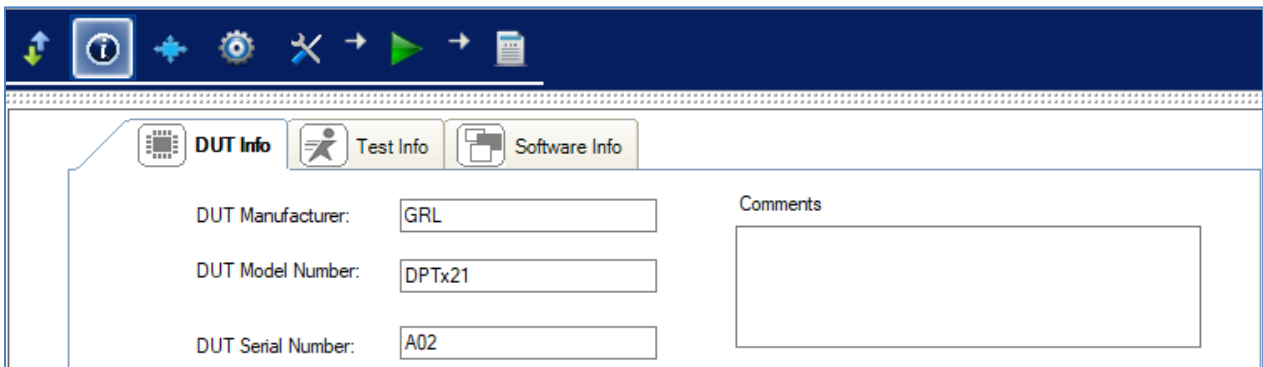


FIGURE 12. SESSION INFO PAGE

4.2.2 Set Test Conditions

Select  from the menu to access the **Test Conditions** page to set the conditions for testing. The software will run tests for the DP source DUT Tx lanes and data rates that are selected.

- Lane** tab: Select the DUT Tx lanes to be tested.

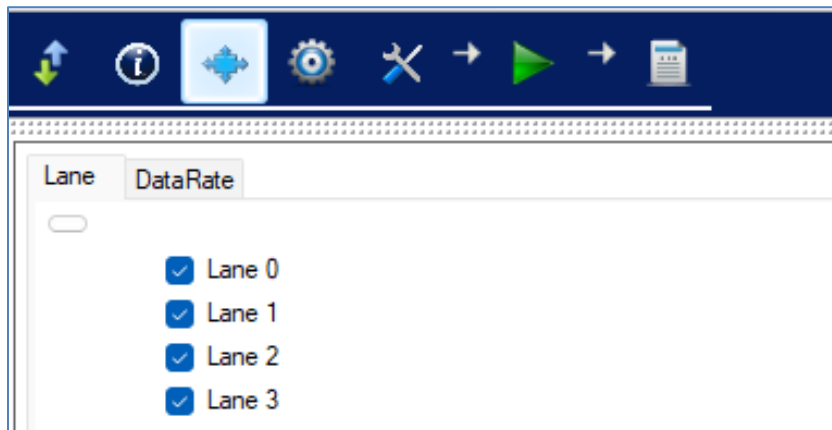


FIGURE 13. SELECT TX LANE UNDER TEST

b) **Data Rate** tab: Select the DisplayPort UHBRx data rates for testing.

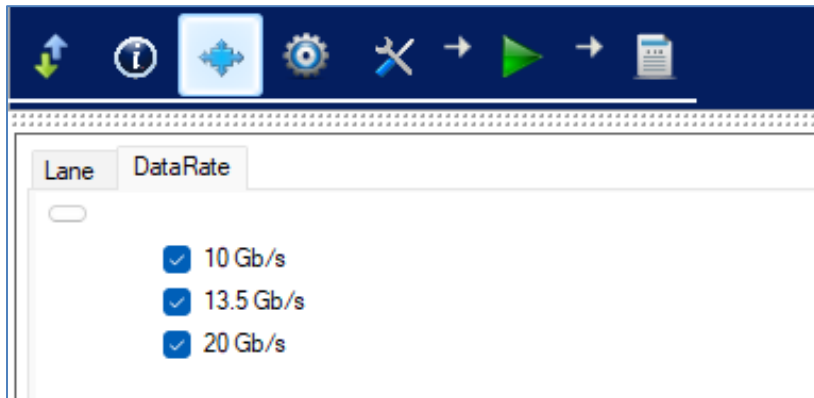


FIGURE 14. SELECT DATA RATE

5 Calibrating Using GRL-DP21-TX Software

5.1 Select Calibration

The Calibration/Tests selection panel allows calibration and tests that need to be performed to be selected. Initially, when starting for the first time or changing anything in the setup, it is suggested to run Calibration first. If calibration is not completed, the subsequent test runs will show an error message.

The DisplayPort 2.1 transmitter should go through a Preset calibration before being tested for compliance. The preset calibration is performed by stepping through preset coefficients of 0 to 15 to obtain an optimized preset which yields the lowest number of DDJ. For the TP3 test case, equalization range of CTLE 0 to -9 will also be applied. A reference equalization will be applied on the oscilloscope to find the optimized eye diagram using the best equalization parameters.

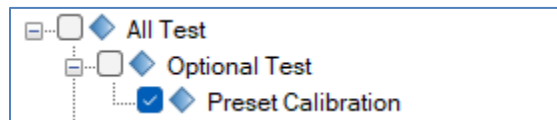


FIGURE 15. SELECT PRESET CALIBRATION

Select the “Preset Calibration” checkbox to perform preset calibration for the DisplayPort 2.1 transmitter. The GRL-DP21-TX software will walk through the user step by step while calibration is being run.

Note: The marking shown on the left of each calibration/test parameter indicates the status of the calibration/test result of the parameter. In the above example,  indicates that calibration/testing has not been run for the specific calibration/test parameter. When calibration/testing has been run and completed successfully for the specific calibration/test parameter with a Pass result, this will be indicated with .

5.2 Configure Calibration Setup



Select  from the main software menu to access the Setup Configuration page.

5.2.1 Set Up Tx Preset Calibration

Select from the preset coefficient range of 0 to 15 to be applied in the Preset calibration.

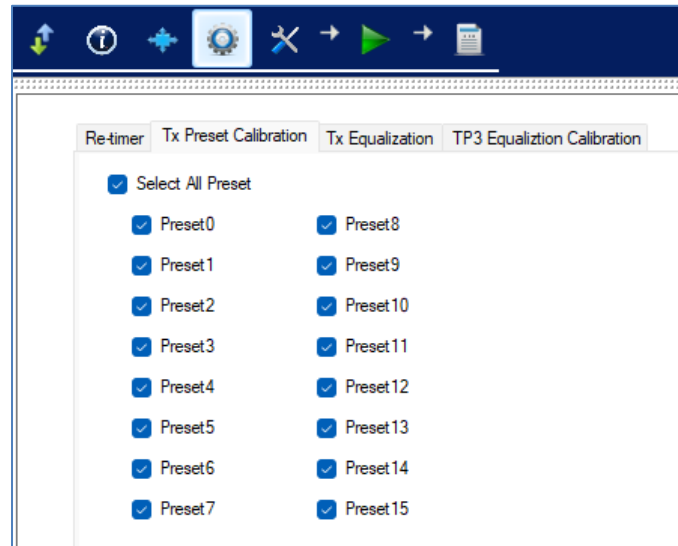


FIGURE 16. SELECT TX PRESET CALIBRATION COEFFICIENT

5.2.2 Set Up Tx Equalization

Select from the preset coefficient range of 0 to 15 or Swing to be applied when running the “4.3 UHBR10 Transmitter Equalization”, “4.3 UHBR13.5 Transmitter Equalization” and “4.3 UHBR20 Transmitter Equalization” tests. This is to ensure that the transmitter equalization Pre-shoot/ De-emphasis falls within the limits of the DisplayPort 2.1 specification.

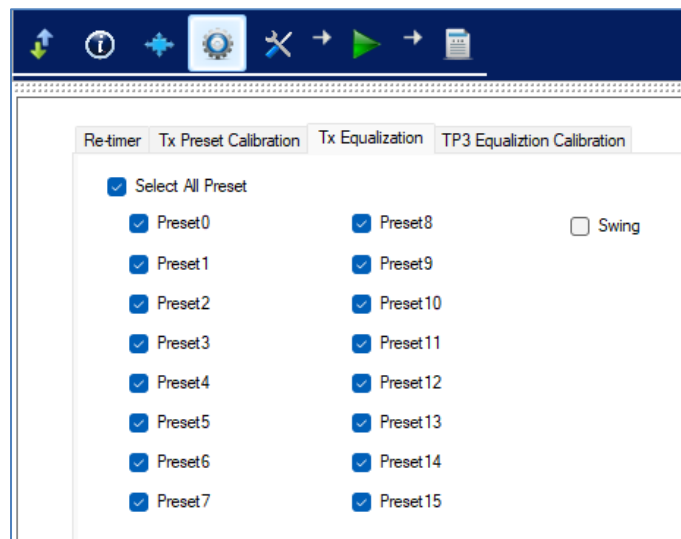


FIGURE 17. SELECT TX EQUALIZATION PRESET COEFFICIENT AND SWING

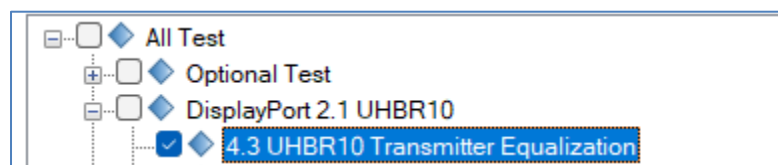


FIGURE 18. SELECT 4.3 UHBR10 TRANSMITTER EQUALIZATION (FOR 10 Gb/S DATA RATE)

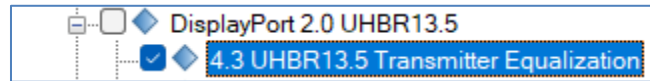


FIGURE 19. SELECT 4.3 UHBR13.5 TRANSMITTER EQUALIZATION (FOR 13.5 GB/S DATA RATE)

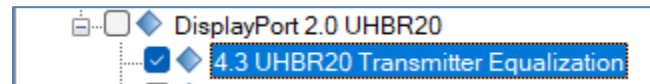


FIGURE 20. SELECT 4.3 UHBR20 TRANSMITTER EQUALIZATION (FOR 20 GB/S DATA RATE)

Note: Equalization must be performed for all presets using SigTest. The GRL-DP21-TX software will run equalization for all presets for the DisplayPort 2.1 Transmitter Equalization tests.

5.2.3 Set Up TP3 Equalization (TP3_EQ) Calibration

The user can assign the CTLE to be applied when running TP3_EQ calibration. A reference equalization will be applied on the oscilloscope to find the optimized eye diagram using the best equalization parameters.

Select from the equalization range of CTLE 0 to -9 to be applied when running the “TP3 Equalization Calibration” for the respective data rate.

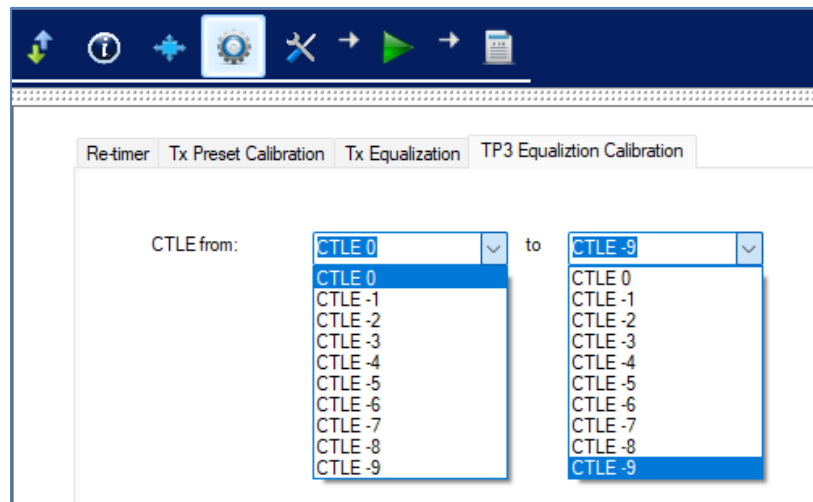


FIGURE 21. SELECT TX EQUALIZATION PRESET COEFFICIENT

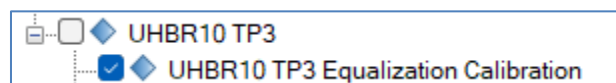


FIGURE 22. SELECT UHBR10 TP3 EQUALIZATION CALIBRATION (FOR 10 GB/S DATA RATE)

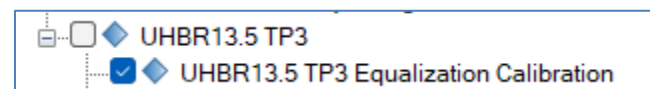


FIGURE 23. SELECT UHBR13.5 TP3 EQUALIZATION CALIBRATION (FOR 13.5 GB/S DATA RATE)

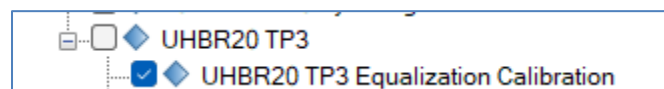


FIGURE 24. SELECT UHBR20 TP3 EQUALIZATION CALIBRATION (FOR 20 GB/S DATA RATE)

6 Testing Using GRL-DP21-TX Software

Once pre-configuration and preset calibration have completed from Section 4.2 onwards, continue with the following test setup on the GRL-DP21-TX software to perform automated DisplayPort 2.1 Transmitter DUT measurements.

6.1 Set Up Transmitter Equalization (Tx EQ)

If Tx EQ is selected or has not been performed in the previous section, the user can assign the presets to be applied when running Tx EQ. The presets chosen in the calibration will be negotiated by the DUT during the compliance tests. When running Tx EQ, the DUT will be using the presets assigned for Tx EQ. Refer Section 5.2.2.

6.2 Set Up TP3 Equalization (TP3_EQ) Calibration

If TP3_EQ Calibration is selected or has not been performed in the previous section, the user can assign the CTLE to be applied when running TP3_EQ calibration. A reference equalization will be applied on the oscilloscope to find the optimized eye diagram using the best equalization parameters. Refer Section 5.2.3.

6.3 Select DUT Tests

The Tests selection panel allows calibration and tests that need to be performed to be selected. The panel displays all DisplayPort 2.1 PHY CTS UHBRx Source compliance tests supported by the GRL-DP21-TX software for selected data rates of the DUT.

Select the tests required to be run on the DUT.

Note: As DUT's may behave differently during testing, it is recommended to always reset the DUT before each test sequence.

Note: The marking shown on the left of each calibration/test parameter indicates the status of the calibration/test result of the parameter. In the above example,  indicates that calibration/testing has not been run for the specific calibration/test parameter. When calibration/testing has been run and completed successfully for the specific calibration/test parameter with a Pass result, this will be indicated with .

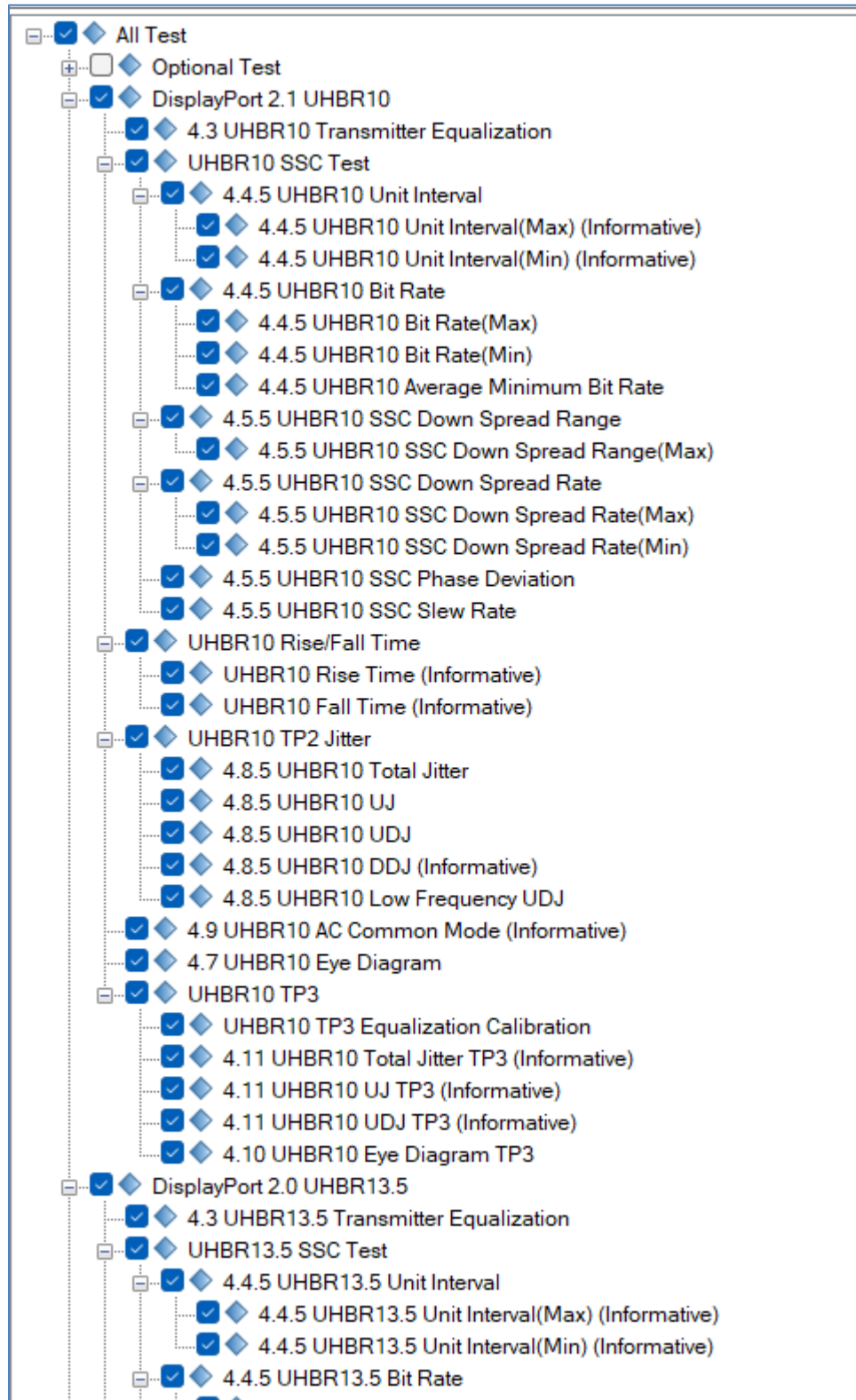


FIGURE 25. SELECT TESTS PANEL

6.4 Configure Test Parameters

Select  from the software menu to access the Configurations page. Set the parameters required for the test setup.

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

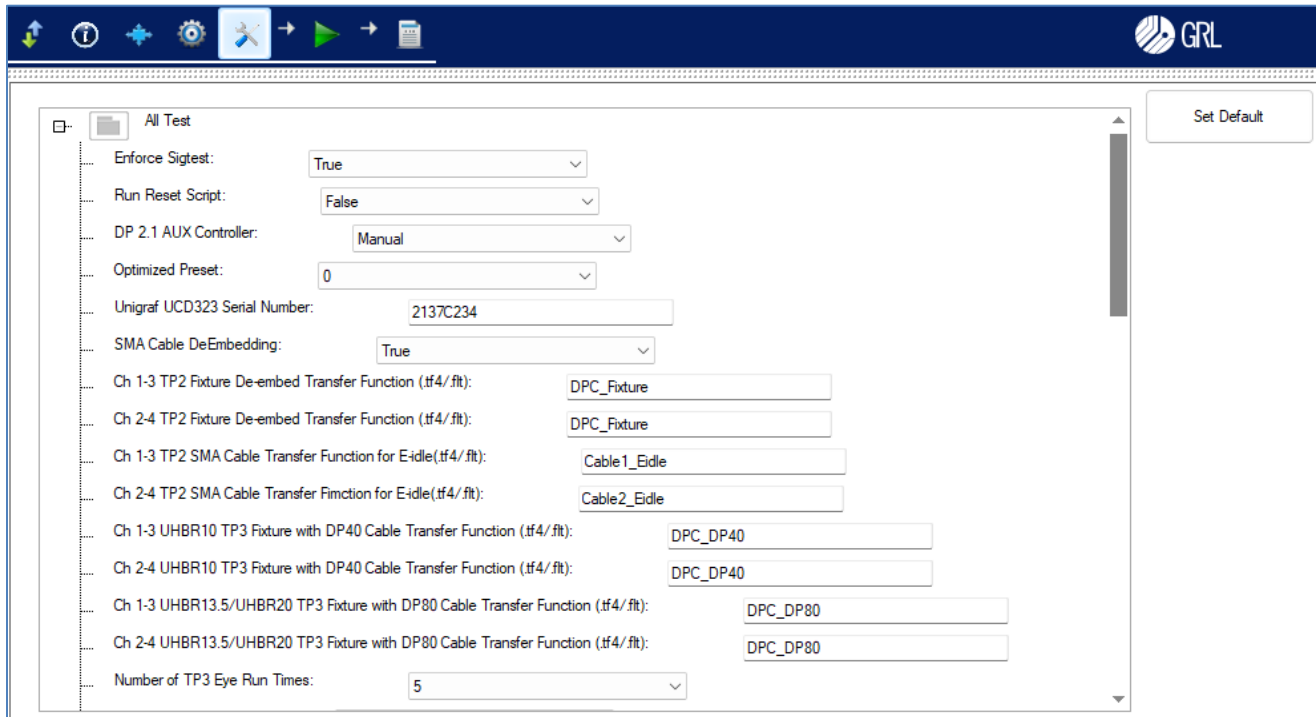


FIGURE 26. TEST CONFIGURATION PAGE

TABLE 4. TEST PARAMETERS

Parameter	Description
Enforce SigTest	Select ‘True’ to use the SigTest application for waveform post-processing.
Run Reset Script	‘False’ is usually the case. Select ‘True’ to perform a reset operation before running the test script.
DP 2.1 AUX Controller	Select the Unigraf UCD-323 DP Source AUX Controller, GRL Platform Solutions Sideband Emulator with support for DisplayPort Aux Emulator and Analyzer (GRL-EMU-DP), GRL Platform Solutions Sideband Emulator with support for DisplayPort Over USB Type-C Sideband Emulator and Analyzer (GRL-EMU-DPC) or a manual method to be used in the test setup.
Optimized Preset	Select ‘Optimized Preset’ to force the DUT to output signals with optimized preset using the value from the ‘Preset Calibration’ test result, or select an original preset value for the DUT to output signals with.

Unigraf UCD323 Serial Number	If the Unigraf UCD-323 DP Source AUX Controller is selected from the “DP 2.1 AUX Controller” field, enter the device serial number.
SMA Cable DeEmbedding	Select ‘True’ to perform de-embedding of the connected SMA cable.
Ch 1-3 / Ch 2-4 TP2 Fixture De-embed Transfer Function (.tf4/.flt)	Specify the transfer function files that will be used to de-embed the fixture connected to the Scope channel pair (1 & 3 or 2 & 4) at the TP2 test point. <i>Note: The .tf4 file format will be used for the Keysight scope while the .flt file format will be used for the Tektronix scope.</i>
Ch 1-3 / Ch 2-4 TP2 SMA Cable Transfer Function for E-idle (.tf4/.flt)	If ‘True’ is selected from the “SMA Cable DeEmbedding” field, specify the SMA cable transfer function files that will be used to de-embed the SMA cable connected to the Scope channel pair (1 & 3 or 2 & 4) in the Electrical Idle state at the TP2 test point. <i>Note: The .tf4 file format will be used for the Keysight scope while the .flt file format will be used for the Tektronix scope.</i>
Ch 1-3 / Ch 2-4 UHBR10 TP3 Fixture with DP40 Cable Transfer Function (.tf4/.flt)	Specify the transfer function files that will be used to de-embed the fixture with embedded DP40 cable connected to the Scope channel pair (1 & 3 or 2 & 4) for the 10 Gb/s host/device DUT at the TP3 test point. <i>Note: The .tf4 file format will be used for the Keysight scope while the .flt file format will be used for the Tektronix scope.</i>
Ch 1-3 / Ch 2-4 UHBR13.5/UHBR20 TP3 Fixture with DP80 Cable Transfer Function (.tf4/.flt)	Specify the transfer function files that will be used to de-embed the fixture with embedded DP80 cable connected to the Scope channel pair (1 & 3 or 2 & 4) for the 13.5 Gb/s or 20 Gb/s host/device DUT at the TP3 test point. <i>Note: The .tf4 file format will be used for the Keysight scope while the .flt file format will be used for the Tektronix scope.</i>
Number of TP3 Eye Run Times	Select the number of eye heights to acquire during TP3 eye diagram optimization.
Screenshots Mode	Select the type of screenshots to be captured when saving test results to a test report: • “Full Screen”: Image of the waveform along with the measurement area. • “Grid”: Image of only the waveform without showing the measurement area.
Save Waveform	‘False’ is usually the case. Select ‘True’ to enable saving the waveform acquisition to a file.
Remove Scope RJ	‘False’ is usually the case. Select ‘True’ to remove the effects of intrinsic Scope random jitter (RJ) components from measurements.

Scope RJ	If 'True' is selected from the "Remove Scope RJ" field, enter the Scope RJ values to be removed.
Number of Scope Channels	Select the oscilloscope channels that are connected in the test setup.
Remote File Server IP Address	Enter the IP address for the GRL Remote Proxy Server. See Section 4.1.1 on how to set up the remote file server.
Remote File Server Port No.	Enter the Port number for the GRL Remote Proxy Server. See Section 4.1.1 on how to set up the remote file server.
Tx EQ Measurement Method	Select the method to be used for Transmitter Equalization measurement.
Link Training Delay (ms)	Set the delay in milliseconds for link training.
Repeat Link Training	Select the number of times to re-run link training.
Prompt DUT Reset	'False' is usually the case. Select 'True' to enable prompt to perform reset for the DUT.
Hot Plug On First Link Training Only	'False' is usually the case. Select 'True' to enable hot plugging to be performed only during the first link training.
Skip Link Training TA IRQ	'False' is usually the case. Select 'True' to skip link training when an IRQ (Request to Service an Interrupt) is issued.
Tx EQ Pattern	Select the pattern to be used for Transmitter Equalization measurement.
SigTest Version	Specify the SigTest version.
SigTest Path	Specify the SigTest file directory.
SigTest Test Flow	Select one of the following options for running SigTest: • "Acquire and Process Waveform": This option will capture waveform signals and perform SigTest analysis at the same time for selected tests. • Acquire Waveform Only: This option will only capture waveform signals for selected tests and will not perform SigTest analysis. • Offline Process Waveform Only: This option will only perform SigTest analysis on existing waveform signals which have been previously saved under a specific file directory. <i>Note: Captured waveforms should be saved under the "C:\GRL\Framework Test Solution\Applications\DP21_TxTest\AppData\Waveforms" file directory.</i>
TP2 SigTest Record Length (μs)	Set the record length of the waveform to be captured at TP2 (in μs) for SigTest analysis.

TP3 SigTest Record Length (UI)	Set the record length of the waveform to be captured at TP3 (in UI) for SigTest analysis.
TP3 Preset Setting	Select the optimized preset at TP2 or TP3 which is the preset that provides the maximum eye area for the given bit rate.
Maximum Parallel SigTest Instance	Select how many times SigTest is to be run at a time.
UHBR10 / 13.5 / 20 Optimized CTLE	Select the optimized CTLE DC Gain that provides the maximum eye area at TP3 for the given bit rate.

6.5 Run Automated 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-DP21-TX software automatically runs the selected tests when initiated. While running tests, the software will guide the user through each of the selected tests by providing step-by-step instructions. Follow these instructions to set up the physical connection and perform the selected tests.

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.

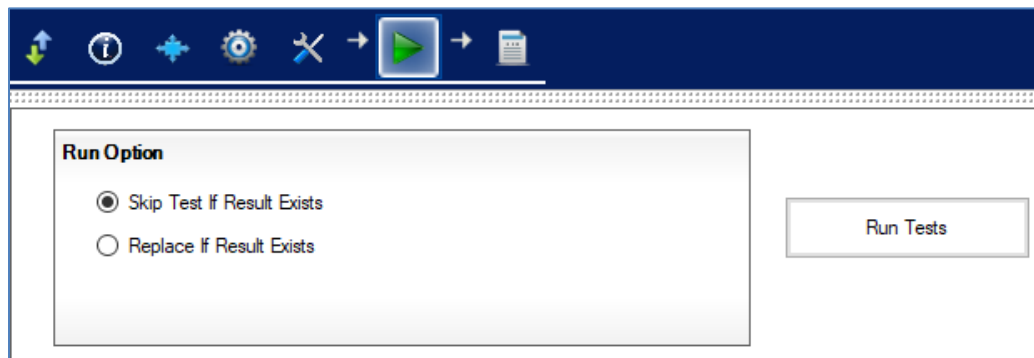


FIGURE 27. RUN TESTS

Click on the **Run Tests** button to start running selected tests.

6.6 Perform Tx Measurements

The following example describes how to use the GRL-DP21-TX software to run a typical automation test on the DUT transmitter lanes.

Note: Prior to running measurements, make sure that test hardware connections for the DUT as described in Section 3 have been properly set up.

1. Select the required DUT test lane(s) and data rates to be tested in the Test Conditions



page. Refer Section 4.2.2.

2. Select and set up the preset calibration to be run. Refer Section 5.

3. Select and set up the tests to be run. Refer Section 6.1 to 6.3.

4. Set up the test parameters for the selected tests in the Configurations  page. Refer Section 6.4.

5. Go to the Run Tests  page and click on the **Run Tests** button to begin testing. Refer Section 6.5.

6. Follow the software instructions step by step to set up the connection and perform the selected tests.

7. Once tests have completed, the test results will be saved automatically and populated on the Report  page. Select the **Generate report** button to view the details of each result. Refer Section 7.

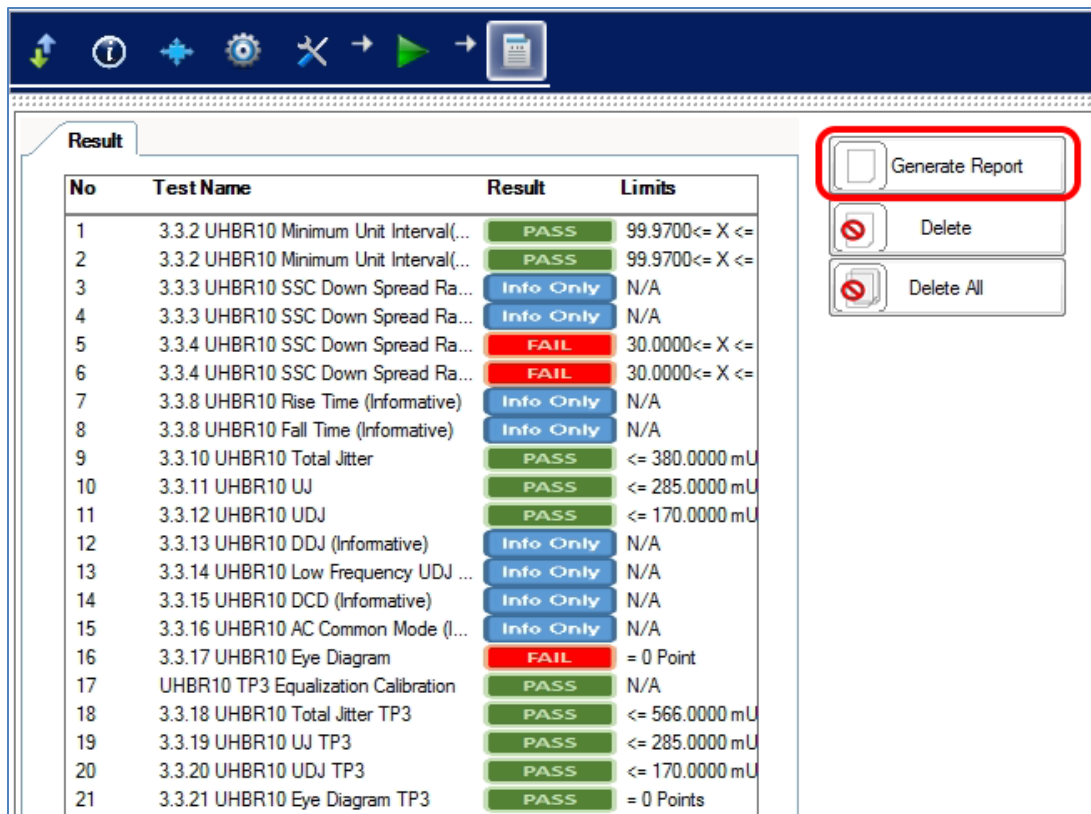
7 Interpreting GRL-DP21-TX Test Report

When all test runs have completed, the GRL-DP21-TX software will automatically display the test results on the **Report** page.

The **Report**  page displays the results from all calibration and test runs. If some of the results are not desired, they can be individually deleted by selecting the **Delete** button. Also for a PDF report, select the **Generate report** button.

7.1 Generate Test Report

Select the **Generate report** button for the detailed calibration and tests report.



No	Test Name	Result	Limits
1	3.3.2 UHBR10 Minimum Unit Interval(...	PASS	99.9700<= X <=
2	3.3.2 UHBR10 Minimum Unit Interval(...	PASS	99.9700<= X <=
3	3.3.3 UHBR10 SSC Down Spread Ra...	Info Only	N/A
4	3.3.3 UHBR10 SSC Down Spread Ra...	Info Only	N/A
5	3.3.4 UHBR10 SSC Down Spread Ra...	FAIL	30.0000<= X <=
6	3.3.4 UHBR10 SSC Down Spread Ra...	FAIL	30.0000<= X <=
7	3.3.8 UHBR10 Rise Time (Informative)	Info Only	N/A
8	3.3.8 UHBR10 Fall Time (Informative)	Info Only	N/A
9	3.3.10 UHBR10 Total Jitter	PASS	<= 380.0000 mU
10	3.3.11 UHBR10 UJ	PASS	<= 285.0000 mU
11	3.3.12 UHBR10 UDJ	PASS	<= 170.0000 mU
12	3.3.13 UHBR10 DDJ (Informative)	Info Only	N/A
13	3.3.14 UHBR10 Low Frequency UDJ ...	Info Only	N/A
14	3.3.15 UHBR10 DCD (Informative)	Info Only	N/A
15	3.3.16 UHBR10 AC Common Mode (I...	Info Only	N/A
16	3.3.17 UHBR10 Eye Diagram	FAIL	= 0 Point
17	UHBR10 TP3 Equalization Calibration	PASS	N/A
18	3.3.18 UHBR10 Total Jitter TP3	PASS	<= 566.0000 mU
19	3.3.19 UHBR10 UJ TP3	PASS	<= 285.0000 mU
20	3.3.20 UHBR10 UDJ TP3	PASS	<= 170.0000 mU
21	3.3.21 UHBR10 Eye Diagram TP3	PASS	= 0 Points

Generate Report

Delete

Delete All

FIGURE 28. REPORT RESULTS PAGE

7.1.1 Test Session Information

This portion is populated from the information entered in the **Session Info** page (refer Section 4.2.1).

DisplayPort 2.1 Tx Test Report	
DUT Information	
DUT Manufacturer	: GRL
DUT Model Number	: DPTx21
DUT Serial Number	: A02
DUT Comments	:
Test Information	
Test Lab	: Granite River Labs
Test Operator	: David
Test Date	: 2 February 2022
Software Version	
Software Revision	: 0.0.0.01

FIGURE 29. TEST SESSION INFORMATION

7.1.2 Test Results Summary Table

This portion is populated from the tests and calibration performed and their results. This gives a summarized view of all the results and test conditions.

No	TestName	Limits	Value	Results	Lane	DataRate
1	3.3.2 UHBR10 Minimum Unit Interval(Max)	99.9700<= X <= 100.0300 ps	99.9984 ps	Pass	L0	Rate_10G
2	3.3.2 UHBR10 Minimum Unit Interval(Min)	99.9700<= X <= 100.0300 ps	99.9983 ps	Pass	L0	Rate_10G
3	3.3.3 UHBR10 SSC Down Spread Range(Max) (Informative)	N/A	0.0027 %	InfoOnly	L0	Rate_10G
4	3.3.3 UHBR10 SSC Down Spread Range(Min) (Informative)	N/A	0.0027 %	InfoOnly	L0	Rate_10G
5	3.3.4 UHBR10 SSC Down Spread Rate(Max)	30.0000<= X <= 33.0000 kHz	386.3552 kHz	Fail	L0	Rate_10G
6	3.3.4 UHBR10 SSC Down Spread Rate(Min)	30.0000<= X <= 33.0000 kHz	386.3552 kHz	Fail	L0	Rate_10G
7	3.3.8 UHBR10 Rise Time (Informative)	N/A	14.8628 pS	InfoOnly	L0	Rate_10G
8	3.3.8 UHBR10 Fall Time (Informative)	N/A	14.8959 pS	InfoOnly	L0	Rate_10G
9	3.3.10 UHBR10 Total Jitter	<= 380.0000 mUI	80.0461 mUI	Pass	L0	Rate_10G
10	3.3.11 UHBR10 UJ	<= 285.0000 mUI	46.1190 mUI	Pass	L0	Rate_10G
11	3.3.12 UHBR10 UDJ	<= 170.0000 mUI	12.5470 mUI	Pass	L0	Rate_10G
12	3.3.13 UHBR10 DDJ (Informative)	N/A	33.9271 mUI	InfoOnly	L0	Rate_10G
13	3.3.14 UHBR10 Low Frequency UDJ (Informative)	N/A	12.4366 mUI	InfoOnly	L0	Rate_10G
14	3.3.15 UHBR10 DCD (Informative)	N/A	7.7761 mUI	InfoOnly	L0	Rate_10G
15	3.3.16 UHBR10 AC Common Mode (Informative)	N/A	84.7618 mV	InfoOnly	L0	Rate_10G
16	3.3.17 UHBR10 Eye Diagram	= 0 Point	3068.0000 Point	Fail	L0	Rate_10G
17	UHBR10 TP3 Equalization Calibration	N/A	N/A	Pass	L0	Rate_10G
18	3.3.18 UHBR10 Total Jitter TP3	<= 566.0000 mUI	113.3455 mUI	Pass	L0	Rate_10G
19	3.3.19 UHBR10 UJ TP3	<= 285.0000 mUI	37.7795 mUI	Pass	L0	Rate_10G
20	3.3.20 UHBR10 UDJ TP3	<= 170.0000 mUI	12.6932 mUI	Pass	L0	Rate_10G
21	3.3.21 UHBR10 Eye Diagram TP3	= 0 Points	0.0000 Points	Pass	L0	Rate_10G

FIGURE 30. TEST RESULTS SUMMARY TABLE EXAMPLE

7.1.3 Test Result Details

This portion is populated from each of the test and calibration results. Here the results are explained in depth with supporting data points and screenshots.

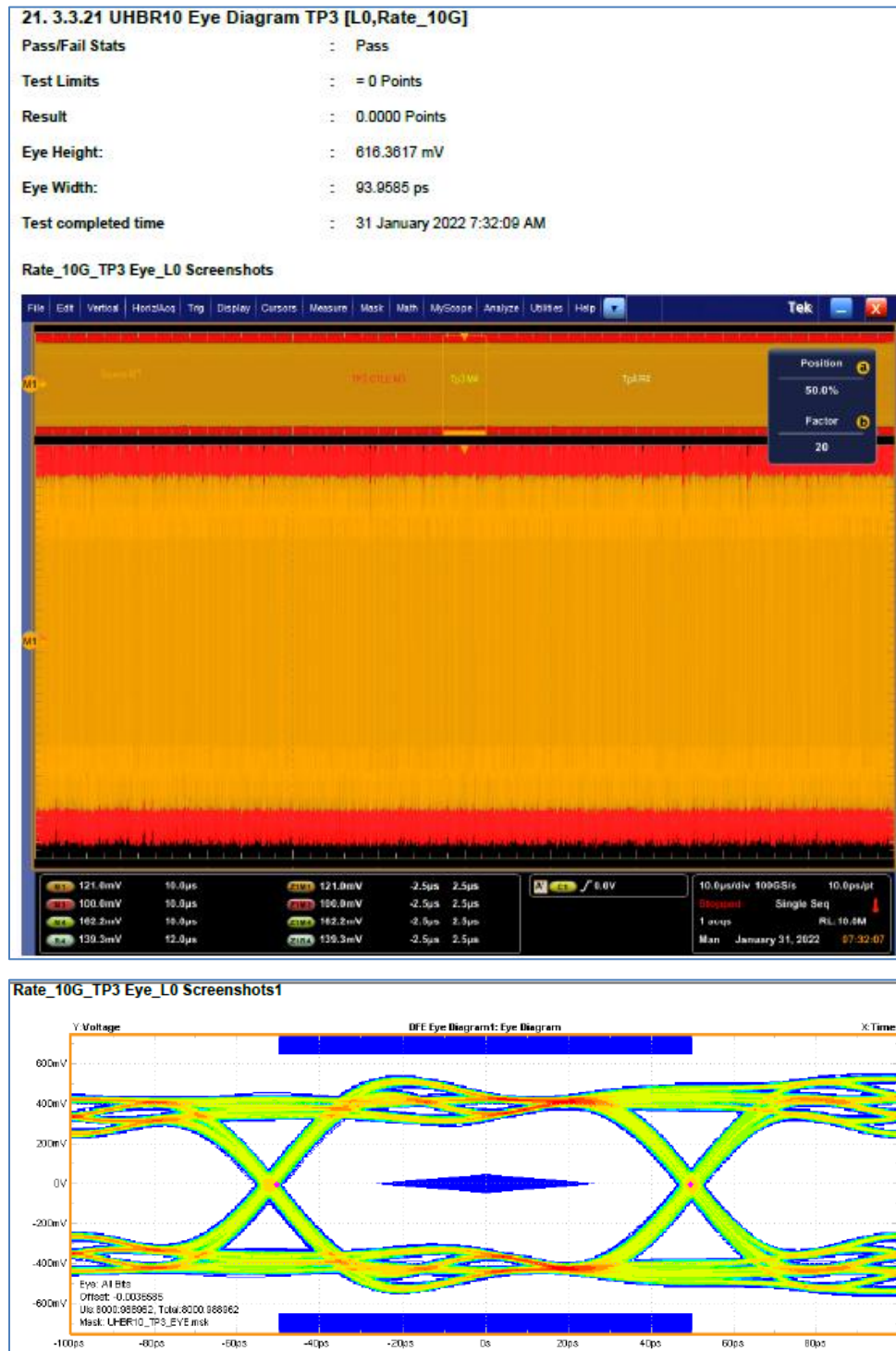


FIGURE 31. TEST RESULT DETAILS EXAMPLE

7.2 Delete Reports

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

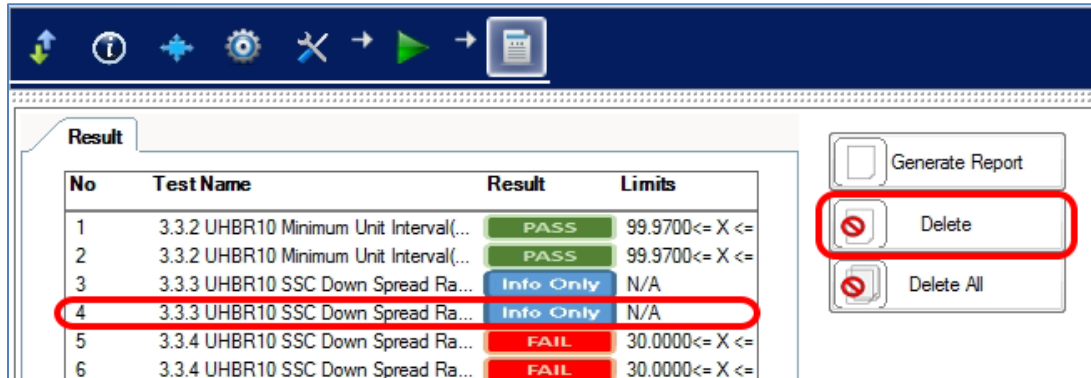


FIGURE 32. DELETE INDIVIDUAL CALIBRATION/TEST RESULTS EXAMPLE

To remove all results, select the **Delete All** button.

8 Saving and Loading GRL-DP21-TX Test Sessions

The usage model for the GRL-DP21-TX automation software is that Calibration and Test Results are created and maintained as a 'Live Session' in the software. This allows you to Quit the software and return later to continue where you left off.

Save and Load Sessions are used to Save a Test Session that you may want to recall later. You can 'switch' between different sessions by Saving and Loading them when needed.

To Save a session, with all of the parameter information, test results, and any waveforms, select **Options** on the menu bar and select **Save Session**.

To Load a session back into the software, including the saved parameter settings, select **Options** on the menu bar and select **Load Session**.

To create a New session and return the software to the default configuration, select **Options** on the menu bar and select **New Session**.

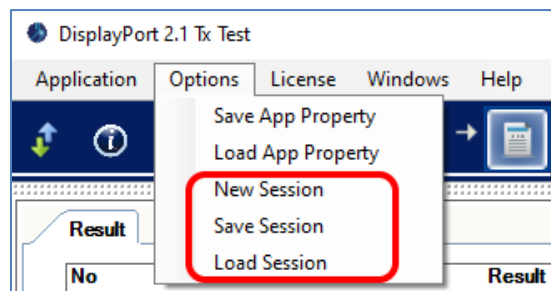


FIGURE 33. SAVING AND LOADING CALIBRATION AND TEST SESSIONS

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

9 Appendix A: 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.

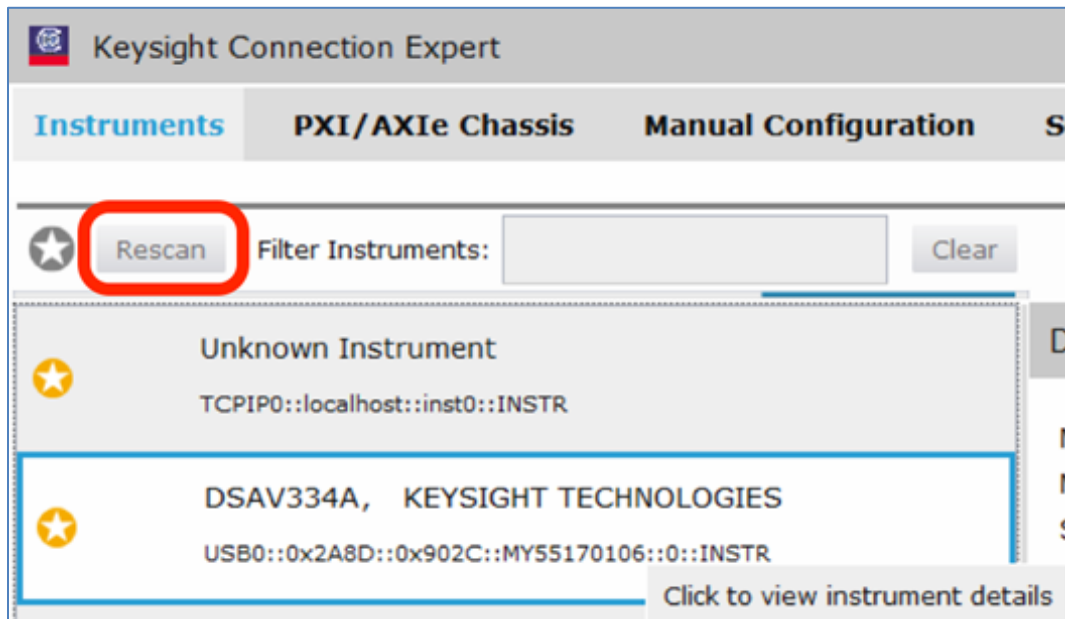


FIGURE 34. KEYSIGHT CONNECTION EXPERT

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

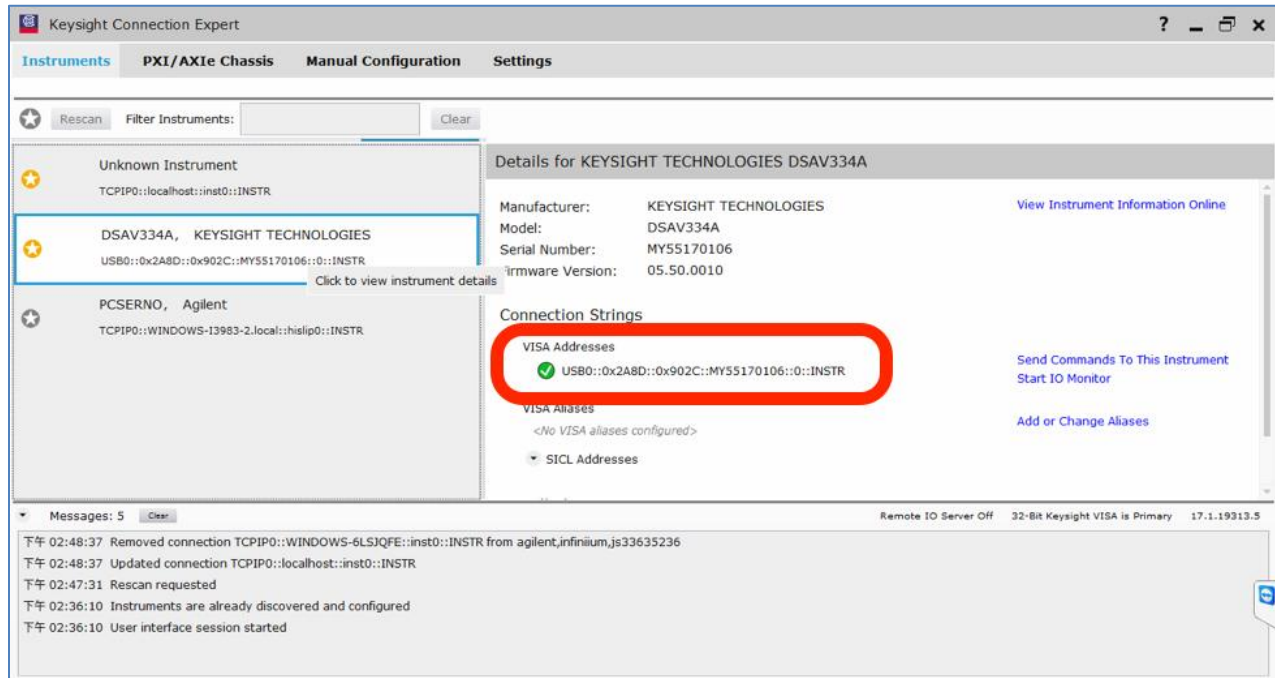


FIGURE 35. OSCILLOSCOPE'S VISA ADDRESS

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-DP21-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. If there is error in connection, type in the Scope IP address as "TCPIP0::192.168.0.4::5025::SOCKET".

10 Appendix B: 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.

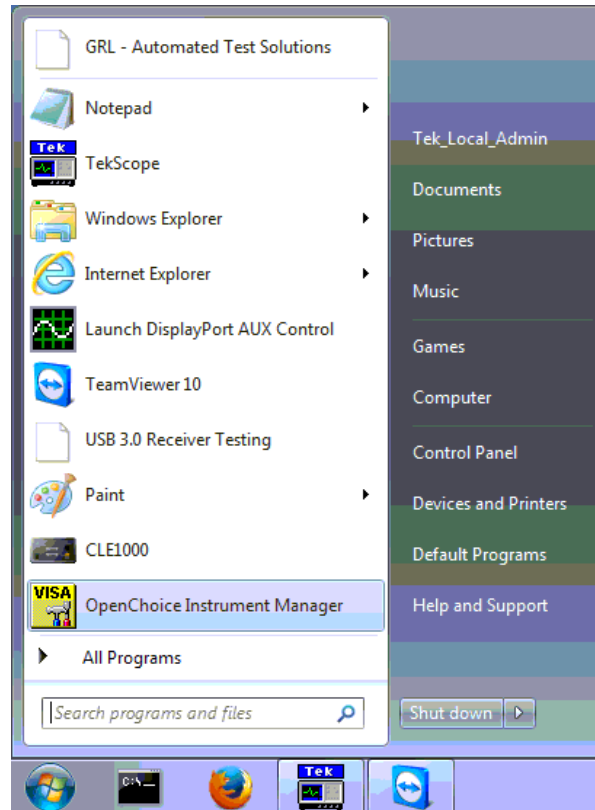


FIGURE 36. OPENCHOICE INSTRUMENT MANAGER IN START MENU

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.

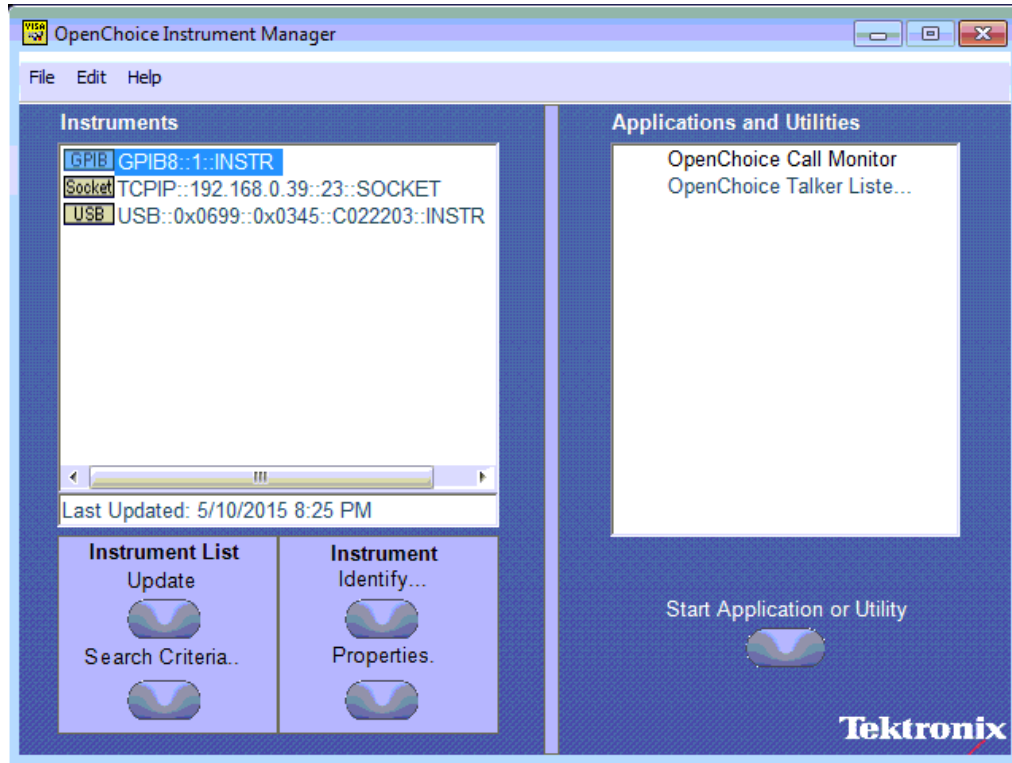


FIGURE 37. OPENCHOICE INSTRUMENT MANAGER MENU

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-DP21-TX Test Application, type in the Scope address into the ‘Address’ field. If the GRL-DP21-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-DP21-TX Test Application 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