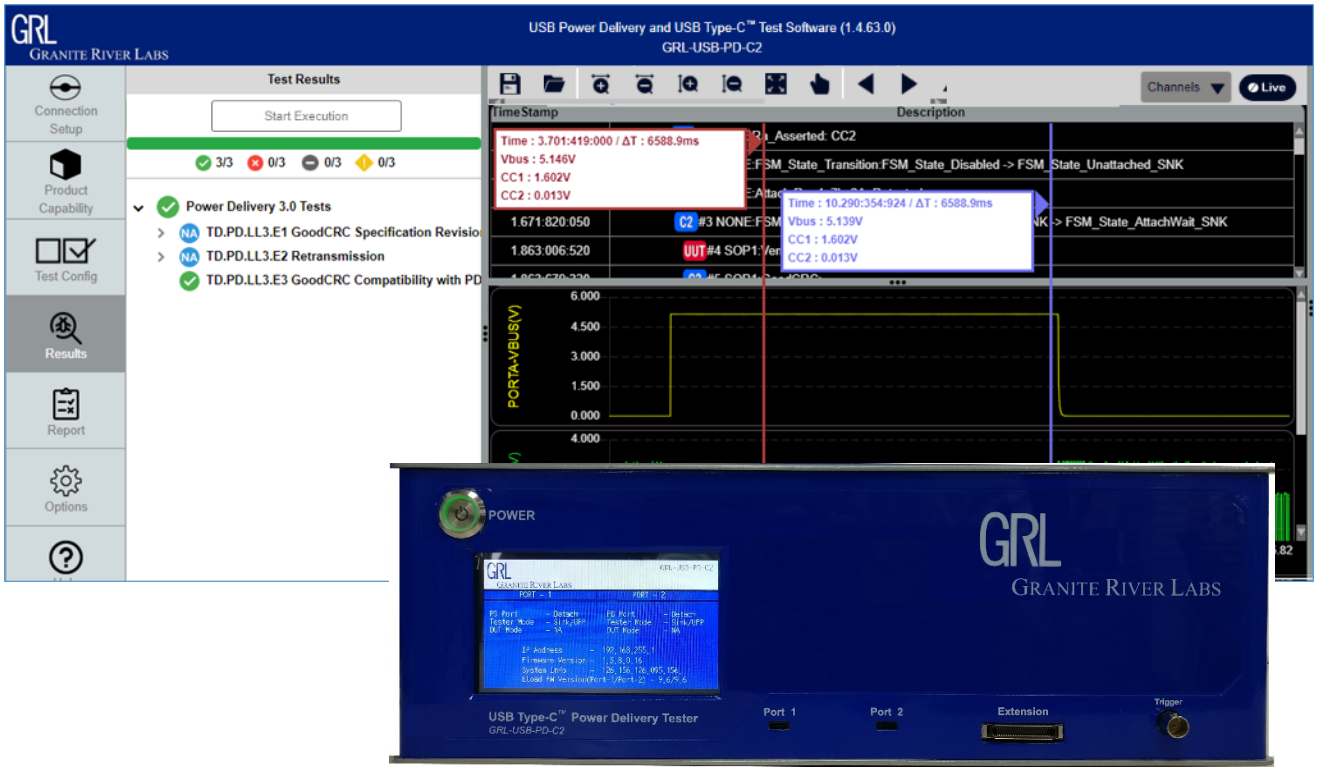
Granite River Labs

USB Type-C™ Power Delivery and Alt Mode Test Quick Start Guide

for GRL USB Type-C Power Delivery Tester and Analyzer (GRL-USB-PD-C2) Browser Application



This material is provided as a reference to install and get started with Rev 1.4.x.x of Granite River Labs (GRL) USB-PD Power Delivery Compliance Test (GRL-USB-PD-C2) Browser Application.

For software support, contact support@graniteriverlabs.com.

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1 Reference Documents

The test methods outlined in this document are tests required by various technology adoptions of the USB Type-C Connector. Specifications that have adopted the USB Type-C Connector and may be referenced in this document include, but are not limited to, the following specification versions.

Note: In order to have access to all specifications, it may be required that you are a member of an industry group and have attained the proper permissions.

1.1 USB-IF

USB-IF Compliance Documents are available for download at:

http://www.usb.org/developers/docs/

Type-C Cable and Connector Specification

USB Power Delivery Specification Rev 3.0 Version 1.2

USB Power Delivery Specification Rev2 Version 1.3

Power Delivery 3 0 Tests Version 1.13 (September 20, 2018)

USB-C Source Power Test Specification Version 0.71 (March 03, 2017)

PD Communications Engine USB PD Compliance MOI Version 1.09 (April 18, 2018)

Deterministic PD Compliance MOI Version 1.14 (September 25, 2018)

1.2 VESA - DisplayPort

Download the DisplayPort document from the VESA Browser site:

http://www.vesa.org/join-vesamemberships/member-downloads/

DisplayPort Alt Mode on USB Type-C Standard, Ver.1.0a, August 5th, 2016

DisplayPort Alt Mode on USB Type-C 1.0a Compliance Test Specification (CTS), Rev 1.0, Jan 24th, 2017

DisplayPort over on USB Type-C Pin Assignment SCR – May 16, 2017

1.3 QC4 Testing

Approval and NDA as a QC4/4+ Adopter is required to gain access to the QC4/4+ Compliance Test Spec. Contact your Granite River Labs or Qualcomm QC4 representative for more details.

Quick Charge 4 Test Specification Version 1.1 (August 30, 2018)

2 Scope of this Quick Start Guide

This Quick Start Guide describes how to use the Browser application of the GRL-USB-PD-C2 USB Type-C Test Controller for performing GRL-USB-PD Compliance Tests. For more details on the GRL-USB-PD-C2 test solution and controller, see related user documentation at http://graniteriverlabs.com/download-center/ and general overview at http://graniteriverlabs.com/usb-pd-c2/.

3 Getting Started with GRL-USB-PD-C2 Browser Application

This section describes how to get started with the GRL-USB-PD-C2 Browser App for USB-PD compliance testing. If you are installing for the first time, please make sure to follow all the steps in this section to verify your setup prior to testing a Unit Under Test (UUT). The procedure is as follows:

1. Install the latest version of GRL-USB-PD-C2 Browser App on the host computer (laptop or desktop) connected to the GRL-USB-PD-C2 Test Controller. For best system operation using this App, GRL recommends that the host PC supports Intel Core i7 and 8GB RAM with Google Chrome version 80.0.3987.122 or above (64-bit). Make sure to clear the browser cache before launching the GRL-USB-PD-C2 browser application server.
2. Make sure the GRL-USB-PD-C2 Test Controller Firmware has been updated to the latest version (see Section 4).

If this procedure is followed and any issues arise, please contact support@graniteriverlabs.com.

3.1 Install GRL-USB-PD-C2 Browser App

1. Download the GRL-USB-PD-C2 Browser App from http://graniteriverlabs.com/download-center/.
2. Run the installer by double clicking the extracted executable (*GRL_GRL-C2_Browser_App_V1x.x.exe*) and then click on the 'Next' button.

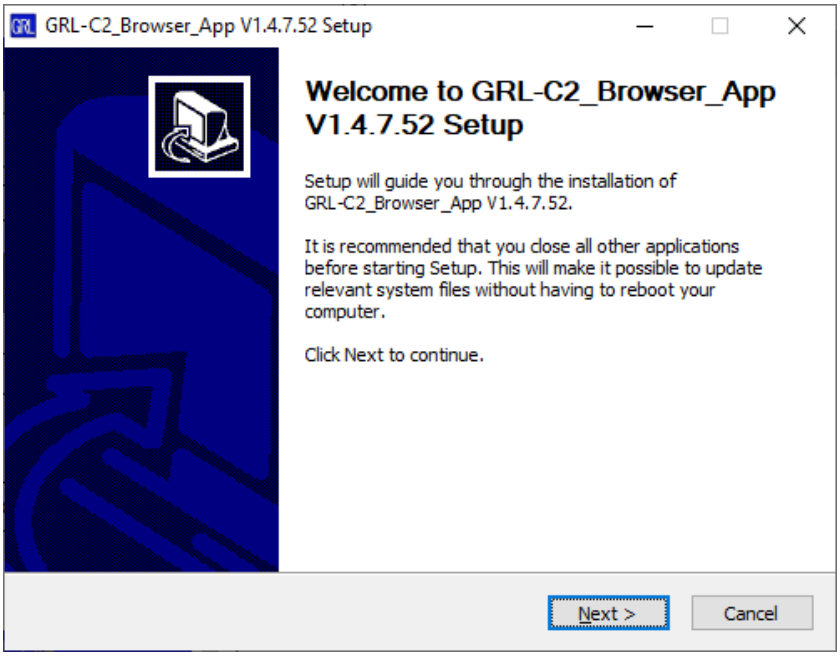


FIGURE 3.1: START GRL-USB-PD-C2 BROWSER APP INSTALLATION

3. Read and accept the license agreement by clicking on the 'I Agree' button.

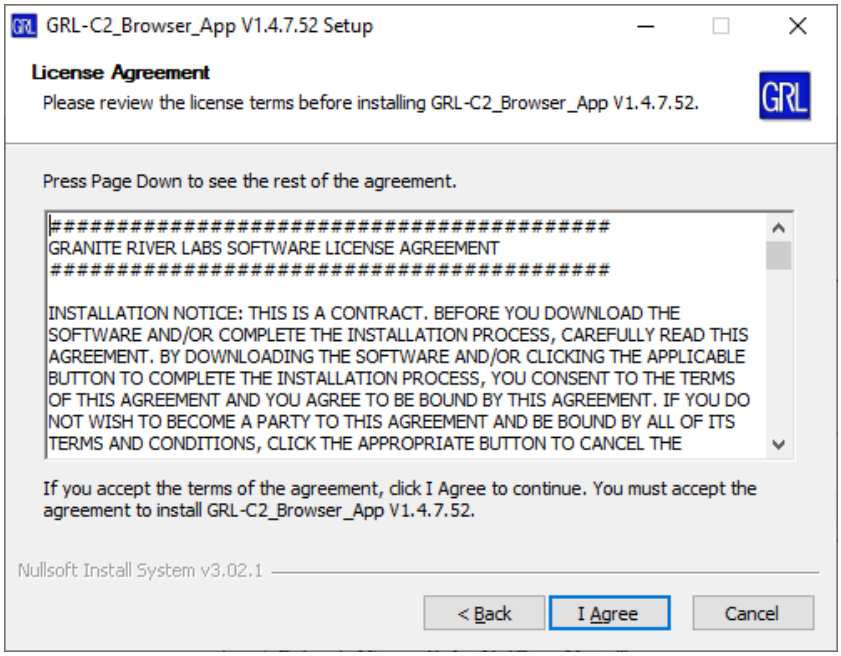


FIGURE 3.2: ACCEPT GRL-USB-PD-C2 BROWSER APP LICENSE AGREEMENT

4. The software installation will then proceed and upon completion, click on the 'Finish' button.

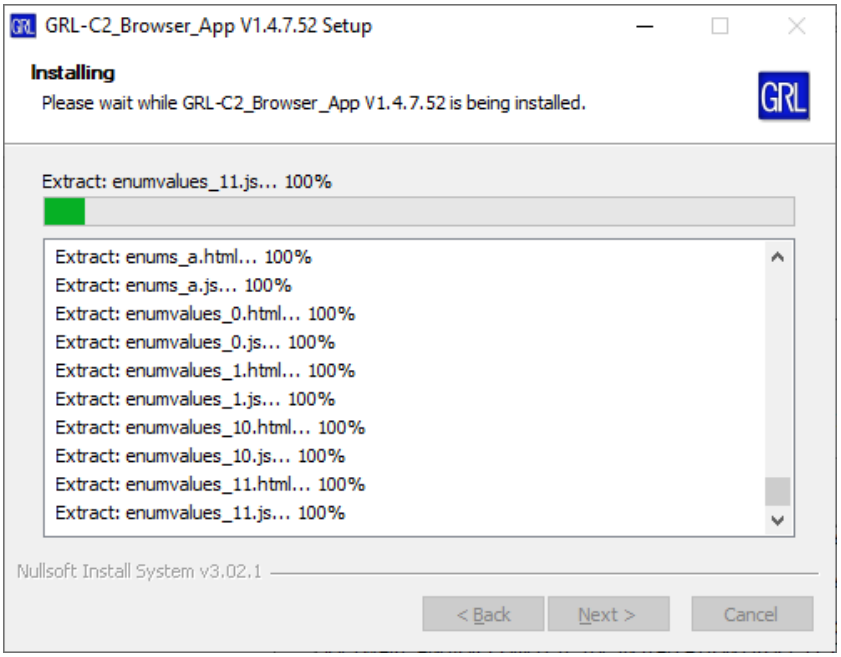


FIGURE 3.3: GRL-USB-PD-C2 BROWSER APP INSTALLATION IN PROGRESS

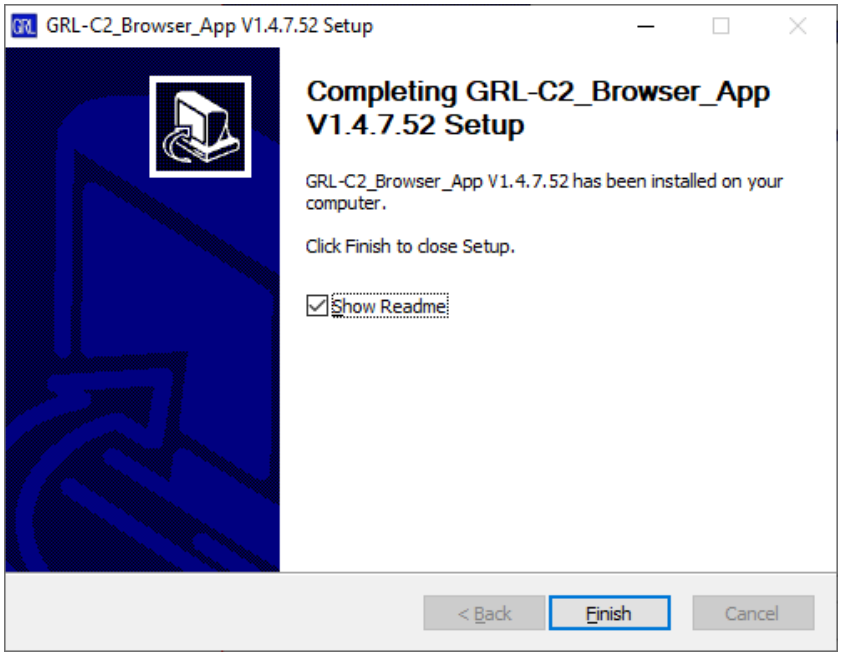


FIGURE 3.4: GRL-USB-PD-C2 BROWSER APP INSTALLATION COMPLETED

5. The GRL-USB-PD-C2 Browser App is now ready for use.

3.2 Start Up and Navigate GRL-USB-PD-C2 Browser App

1. Once installed, you can directly open the GRL-USB-PD-C2 Browser App using the **GRL-C2 - Browser App** desktop shortcut. This will initiate the App server to run backend operations before launching the GRL-USB-PD-C2 Browser App.

   Note: Do not close this window only unless you need to exit from the GRL-USB-PD-C2 Browser App.

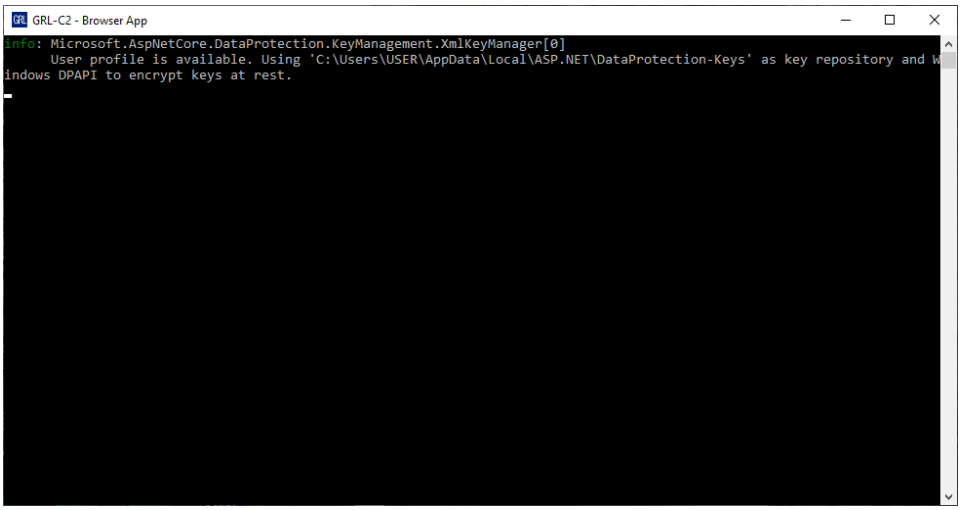


FIGURE 3.5: APP SERVER SCREEN RUNNING BACKEND OPERATIONS

2. The GRL-USB-PD-C2 Browser App should launch after a few seconds on a browser window with the appropriate port number. If for some reason the browser window does not appear after a few minutes, open a new browser tab and navigate to *http://IP address of windows software host PC:5001/* (for example, http://192.168.3.241:5001/).

3. The GRL-USB-PD-C2 Browser App when launched will display “Connection Setup” as the landing screen as follows:

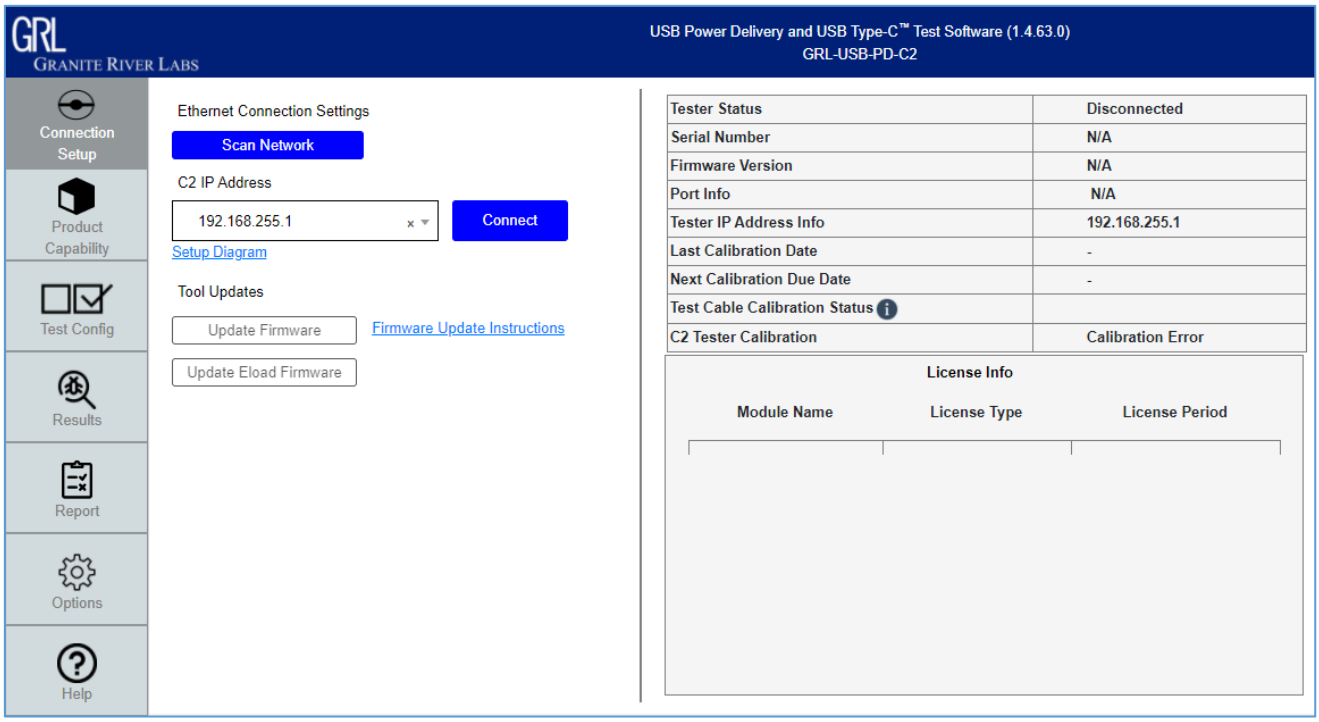


FIGURE 3.6: GRL-USB-PD-C2 BROWSER APP LANDING SCREEN

This screen allows you to set up connection between the GRL-USB-PD-C2 Browser App and the GRL-USB-PD-C2 Test Controller as well as performing firmware/software updates. More details are provided in Section 4.

3.2.1 Using GRL-USB-PD-C2 Browser App in Chrome OS

Note: Make sure that the GRL-USB-PD-C2 Test Controller is connected to a control PC running Windows 10.

1. Install the GRL-USB-PD-C2 Browser App on a Windows 10 control PC connected to the GRL-USB-PD-C2 Test Controller.
2. Once installed, open the GRL-USB-PD-C2 Browser App using the **GRL-C2 - Browser App** desktop shortcut.
3. Open a new Chrome browser tab in Chrome OS and navigate to *http://IP address of windows software host PC:5001/* (for example, http://192.168.3.241:5001/).

Note: Make sure that both the Windows 10 control PC and Google Chromebook are connected to the same Ethernet network (wired or wireless).

3.2.2 Using GRL-USB-PD-C2 Browser App in macOS

Note: Make sure that the GRL-USB-PD-C2 Test Controller is connected to a control PC running Windows 10.

1. Install the GRL-USB-PD-C2 Browser App on a Windows 10 control PC connected to the GRL-USB-PD-C2 Test Controller.

2. Once installed, open the GRL-USB-PD-C2 Browser App using the **GRL-C2 - Browser App** desktop shortcut.
3. Open a new Chrome browser tab in macOS and navigate to *http://IP address of windows software host PC:5001/* (for example, http://192.168.3.241:5001/).

Note: Make sure that both the Windows 10 control PC and Apple Macbook are connected to the same Ethernet network (wired or wireless).

4 Connection and Setup of GRL-USB-PD-C2 Browser App

Figure 4.1 shows how to set up the GRL-USB-PD-C2 Test Controller with the host PC (Control Computer) for testing a USB PD based UUT.

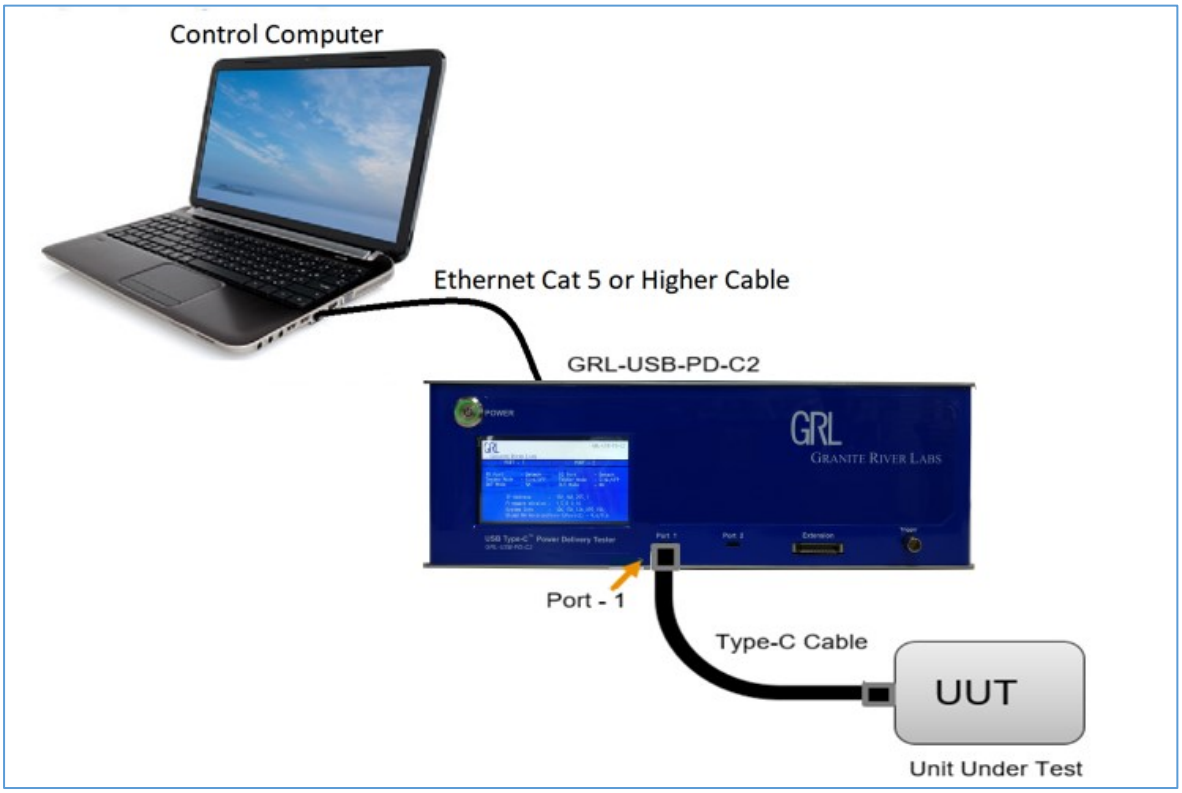


FIGURE 4.1: GRL-USB-PD-C2 HARDWARE SETUP FOR TESTING UUT

The GRL-USB-PD-C2 Browser App loaded on the control computer automates the testing process. Below is a procedure for connecting the hardware and verifying proper hardware connections.

1. Connect Power Supply to the GRL-USB-PD-C2 Controller.
2. Connect the GRL-USB-PD-C2 Controller using a physical Ethernet connection between the control computer and the C2.

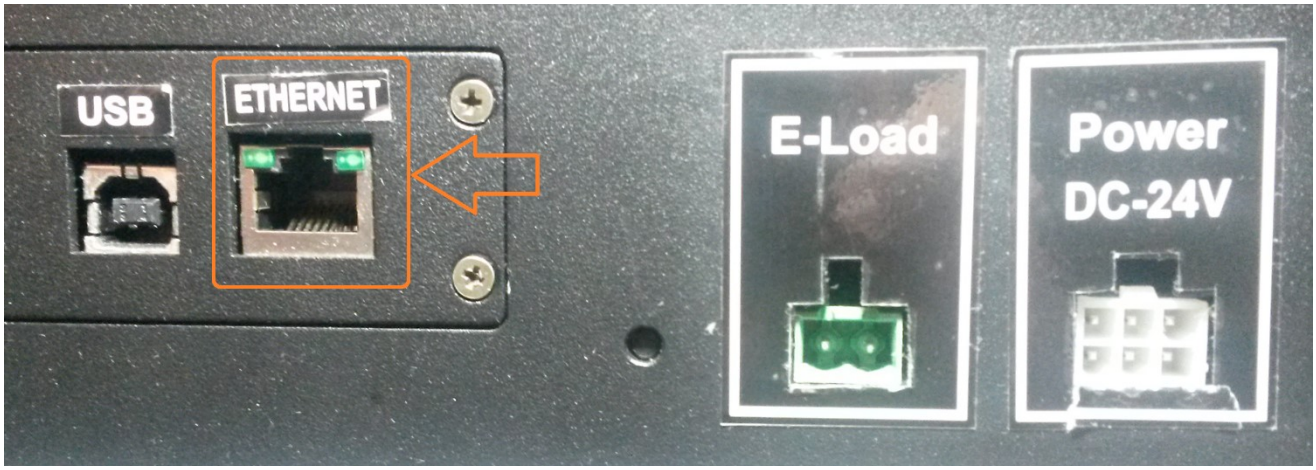
   Note: Automation of the UUT Power Supply switching in the GRL-USB-PD-C2 is handled internally to the C2. Thus, there is no Ethernet, USB or GPIB connection attached to the Power Supply.

4.1 Connect Power Supply to GRL-USB-PD-C2 Controller

Connect the GRL-USB-PD-C2 Power Interface using the 24V, 280W Power Brick included with the controller.

4.2 Connect Ethernet Cable and Turn On GRL-USB-PD-C2 Controller

Connect the Ethernet (RJ-45) connector to one of the control computer's Ethernet ports. A USB to Ethernet adapter can be used if there are no native Ethernet ports on the control computer.



Turn on the GRL-USB-PD-C2 controller using the On/Off button on the front of the instrument.

4.3 Verify GRL-USB-PD-C2 Ethernet Installation

The Ethernet port on the control computer needs to be configured correctly for the GRL-USB-PD-C2 controller to recognize the control computer and vice versa.

To make sure the network connection is set up correctly, open the Network Connections panel from the control panel.

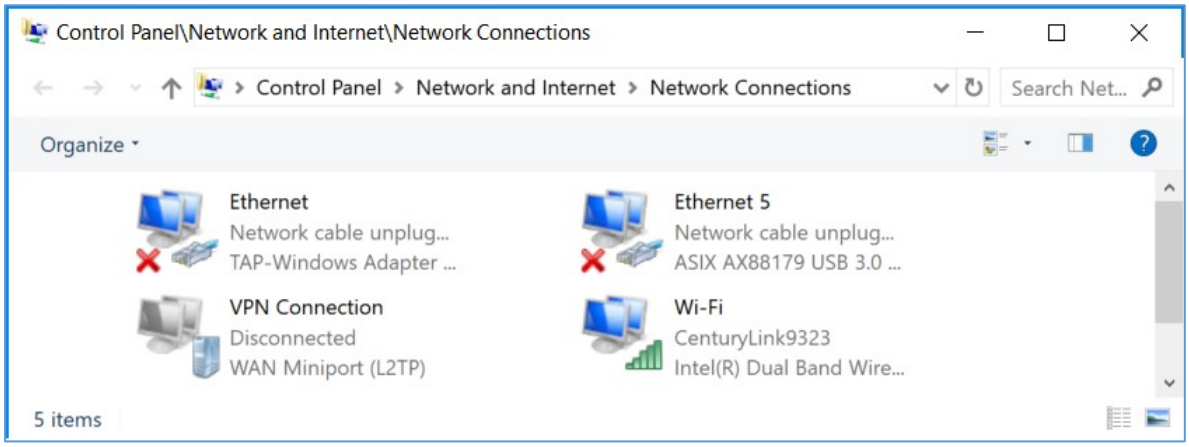


FIGURE 4.2: NETWORK CONNECTIONS BEFORE CONNECTING GRL-USB-PD-C2

Open the Ethernet panel for the Ethernet port that will connect to the GRL-USB-PD-C2, select "Internet Protocol Version 4 (TCP/IPv4)" and click on the "Properties" button below and to the right.

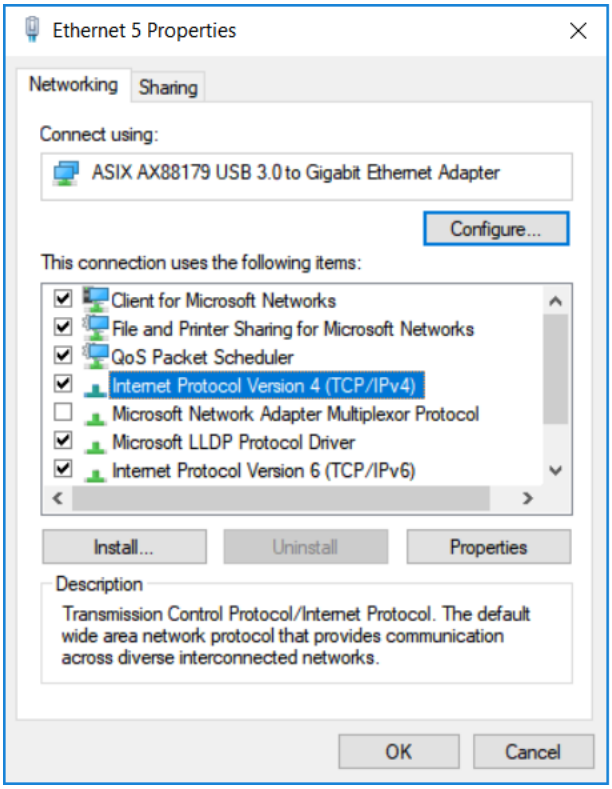


FIGURE 4.3: ETHERNET PROPERTIES

Set up the TCP/IPv4 properties as shown below.

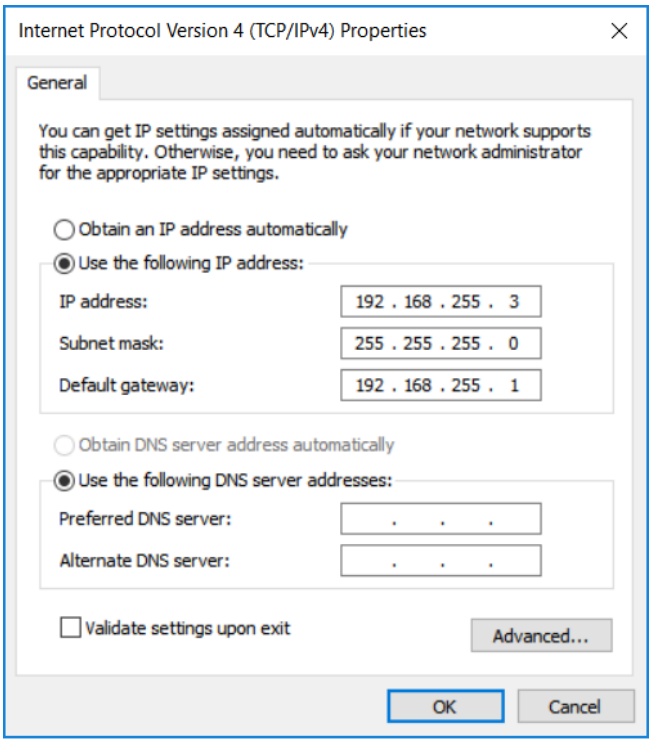


FIGURE 4.4: ETHERNET PROPERTIES WITH TCP/IPV4 SELECTED

Select a static IP address ("Use the following IP address:") which should be 192.168.255.*n* where *n* is any number between 2 and 255. The subnet mask should be 255.255.255.0 and the default gateway should be 192.168.255.1. The rest of the items should remain unchanged.

Click the "OK" button on the Internet Protocol Properties and close the Ethernet Properties. Make sure the GRL-USB-PD-C2 controller is powered on and completely booted up (front panel display shows firmware version number) then connect the Ethernet cable from the GRL-USB-PD-C2 controller to the computer's Ethernet port that was just set up. The network connections panel should now look as pictured in Figure 4.5 below:

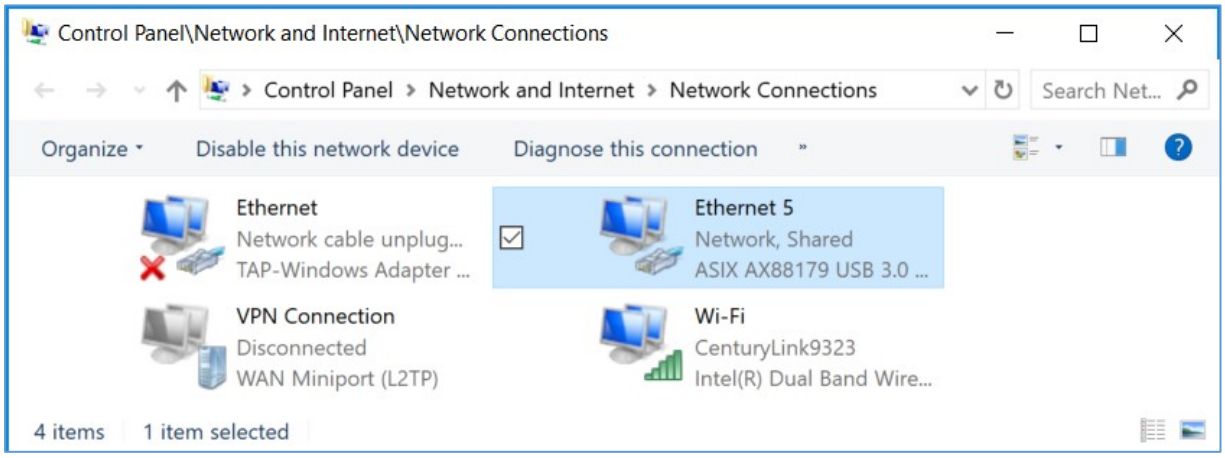


FIGURE 4.5: NETWORK CONNECTIONS AFTER SETUP AND CONNECTION OF GRL-USB-PD-C2

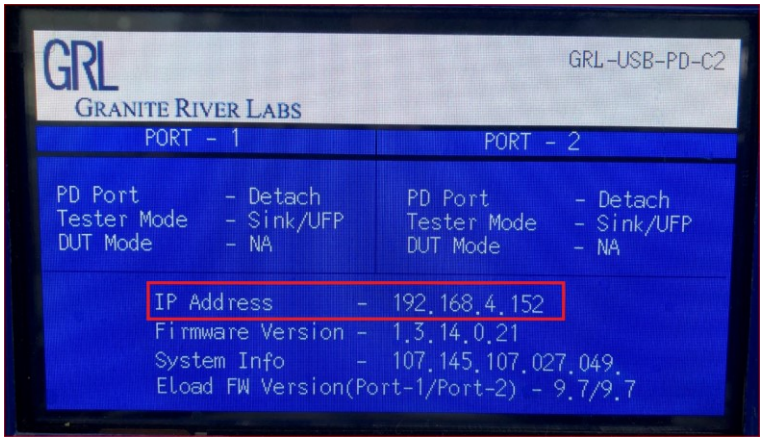
The GRL-USB-PD-C2 controller is now set up and ready for use.

4.4 Connect GRL-USB-PD-C2 Browser App with GRL-USB-PD-C2 Controller

Before running any tests, you should verify that the control computer and the GRL-USB-PD-C2 controller are communicating properly as described below.

To connect the GRL-USB-PD-C2 Browser App (that is running on the control computer) with the GRL-USB-PD-C2 controller:

1. On the GRL-USB-PD-C2 Browser App landing page (Connection Setup screen), enter the IP address as displayed on the GRL-USB-PD-C2 controller screen and click on the **Connect** button. You can also click on the **Scan Network** button to detect all available GRL-USB-PD-C2 controllers connected to the same network.



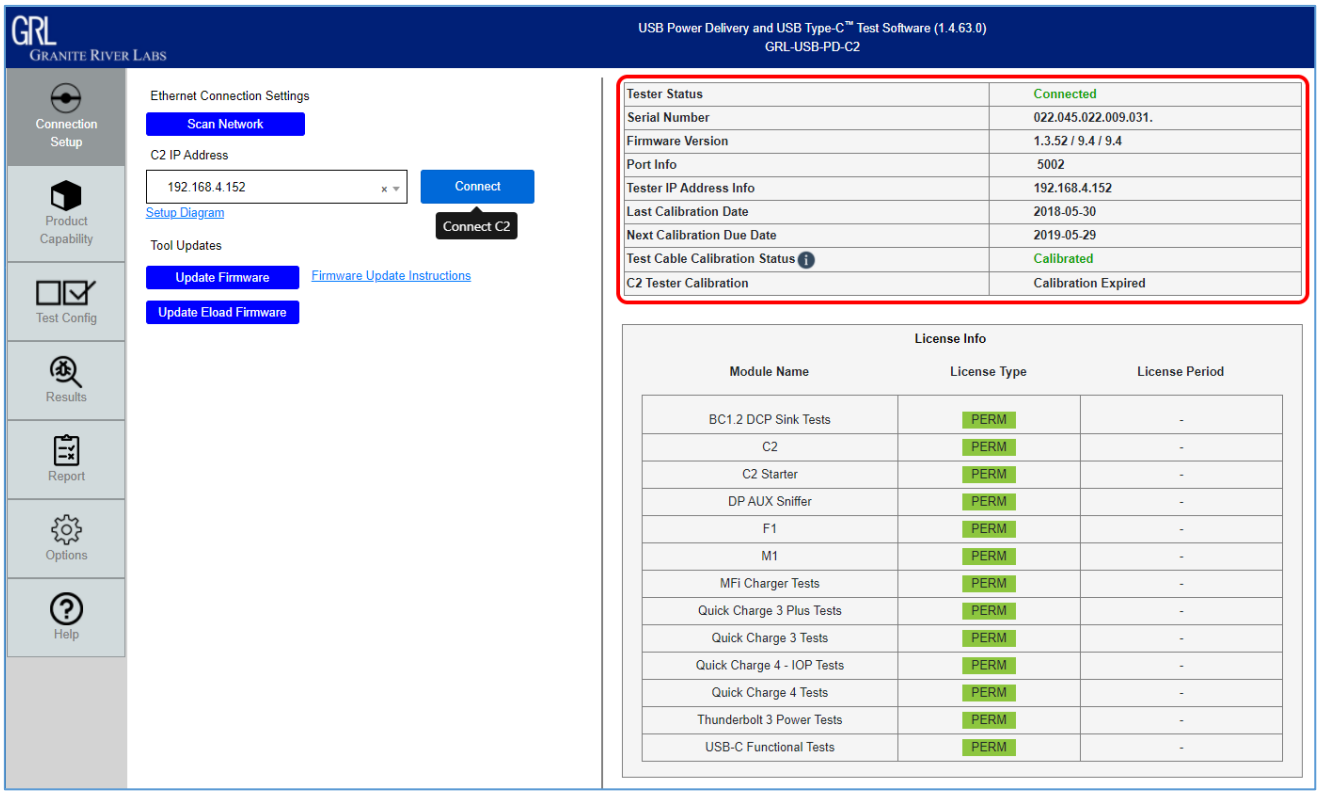


FIGURE 4.6: CONNECTION CONFIGURATION SCREEN AFTER SUCCESSFUL CONNECTION

2. The GRL-USB-PD-C2 controller and Browser App are now connected as indicated by the controller information display (Tester Status, Serial Number, Firmware Version, etc.).
3. Optionally you can also select Setup Diagram below the IP address field to open the test setup connection screen. This shows you how to connect the UUT to Port 1 of the GRL-USB-PD-C2 controller using the USB Type-C cable provided by Granite River Labs or a compliant Type-C cable.

FIGURE 4.7: TEST SETUP CONNECTION SCREEN

Along with each GRL-USB-PD-C2 software revision, a new version of firmware and FPGA code is provided. Use the following procedure to update both the controller's and eLoad firmware and FPGA code.

4. Click on the **Update Firmware** or **Update ELoad Firmware** button to update the GRL-USB-PD-C2 controller's and eLoad firmware respectively. You can select Firmware Update Instructions next to the buttons to display the instructions to guide you through the entire updating process. Follow the instructions step by step to perform the updates accordingly.

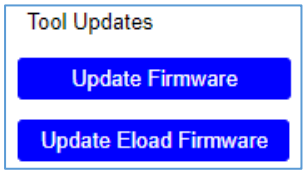


FIGURE 4.8: UPDATE GRL-USB-PD-C2 FIRMWARE BUTTONS

4.5 GRL-USB-PD-C2 Browser App License Activation

The licensing for the GRL-USB-PD-C2 controller is built into the tester hardware so no additional license activation is needed. Take note that certain tests like the Thunderbolt 3 power and Apple MFi tests require separate licensing. Check the "License Info" panel in the *Connection Setup* screen (Figure 4.6) to see which licenses are active on the controller. Contact Granite River Labs support (support@graniteriverlabs.com) if you have licensing questions or concerns.

5 Compliance Testing with GRL-USB-PD-C2 Browser App

The GRL-USB-PD-C2 Browser App is capable of testing to various specifications such as the USB Power Delivery compliance, communications engine and deterministic tests as well as DisplayPort Alt Mode tests and others.

The various screens presented by the GRL-USB-PD-C2 Browser App allow the user to select, configure, run and generate reports from these tests for a variety of devices (Units Under Tests or UUT's). There are also more specific controls that allow the user to configure and debug specific UUT features and capabilities.

5.1 Product Capability

The Device Type and the Capabilities of a UUT define the compliance tests that need to be run on the UUT. There are two ways to gather the capabilities of the tests to be run. Either through using the UUT Type selection and querying the Capabilities of the UUT (**Informational** test mode) or by using a VIF File (**Compliance** test mode).

The *Product Capability* screen allows the user to specify the method to determine the UUT type and display the capabilities of the UUT that is connected to either USB Port 1 or Port 2 or both of the GRL-USB-PD-C2 Test Controller.

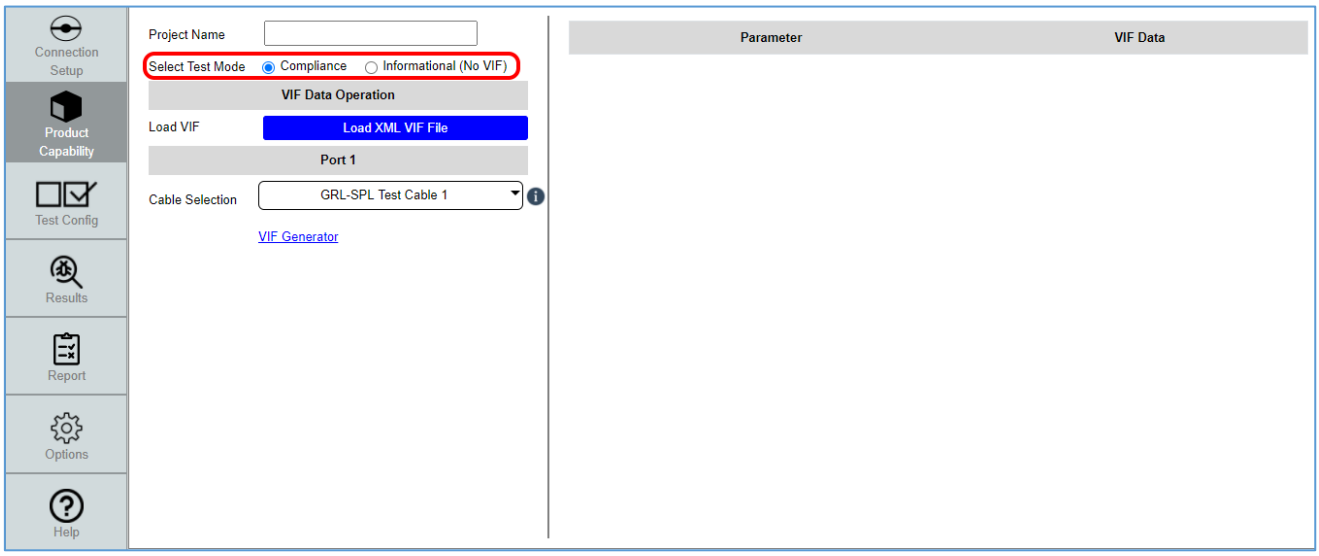


FIGURE 5.1: PRODUCT CAPABILITY SCREEN

You can also specify the name of the test session that is currently running typing into the **Project Name** field at the top of the screen. All the test configuration and results will be saved under the specified name.

If a VIF File is not provided or available:

Select the **Informational (No VIF)** test mode. This method of defining the device type is most useful when a Vendor Information File (VIF) is not available. It allows you to select and configure multiple options to execute tests without a VIF file by selecting the UUT type, reading the UUT capabilities and generating a VIF file from the configuration.

Note: For this version of GRL-USB-PD-C2 Browser App, the Informational test mode is the recommended method to be used.

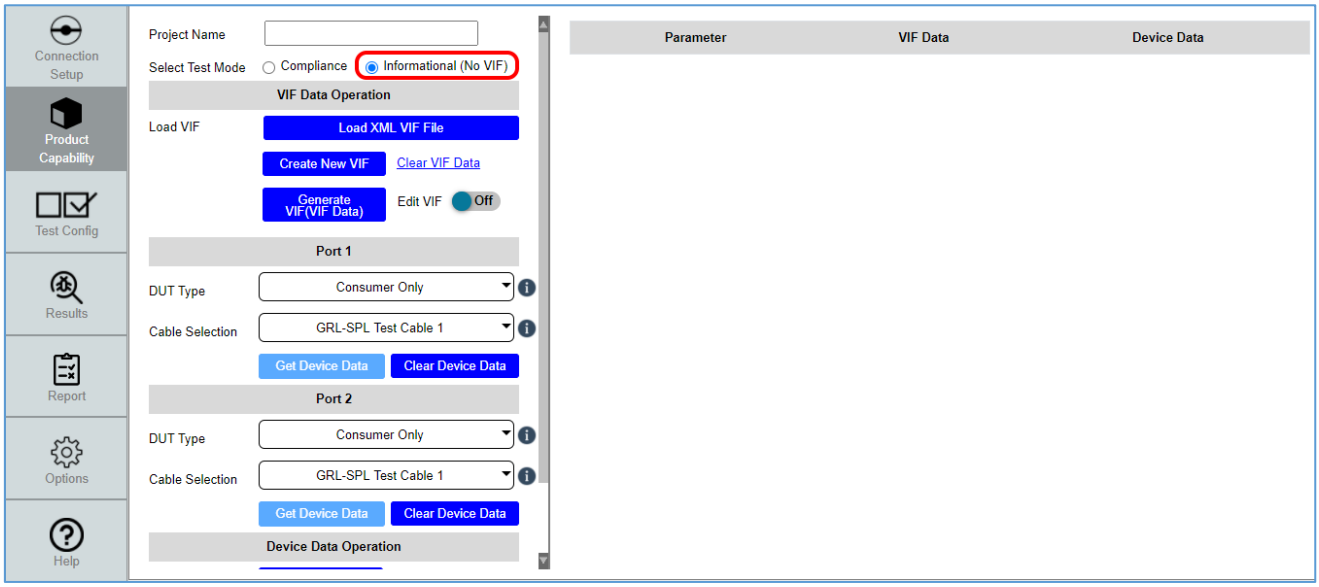


FIGURE 5.2: INFORMATIONAL TEST MODE UUT CONFIGURATION

When testing a new UUT, clicking on the **Clear Device Data** button (see Figure 5.9) will clear all product configuration information including what has been read from a VIF and what was read directly from the device.

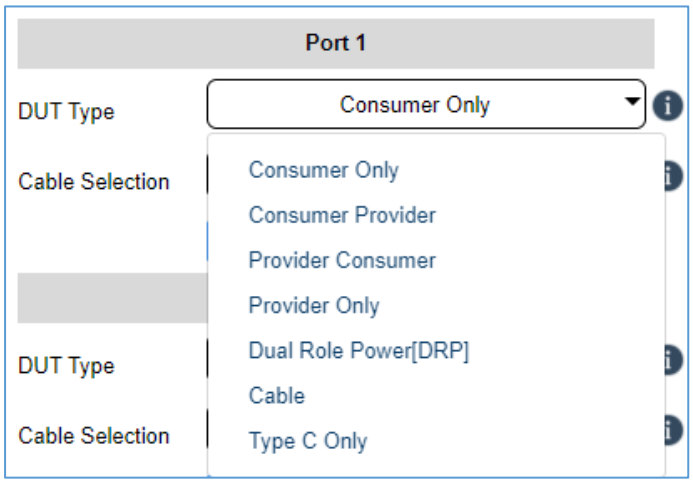


FIGURE 5.3: SELECTING UUT TYPE USING DROP-DOWN MENU

Select the **DUT Type** field to enable the UUT type selection drop-down menus for both Port 1 and Port 2:

- **Consumer Only** – A device with a USB Power Delivery Port (typically a Device's upstream facing port) which sinks power from the power conductor (e.g. VBUS).
- **Consumer/Provider** – A Power Consumer which can also act as a Power Provider.
- **Provider/Consumer** – A Power Provider which can also act as a Power Consumer.
- **Provider Only** – A device with a PD Port (typically a downstream facing port of a Host, Hub, or Wall Wart DFP) which sources power over the power conductor (e.g. VBUS).
- **Dual Role Power (DRP)** – A Consumer/Provider or Provider/Consumer capable port: A port capable of operating as either a Source or a Sink.

- **Cable** – A USB Type-C Cable that has a USB-PD electronic marking chip which indicates through USB-PD messaging its capabilities and vendor information. Such cables are known as Electronic Mark or E-Mark cables.
- **Type-C Only** – A device with a standard USB Type-C Port. When selected, the user can select the Type-C connection state machine of the UUT as either a Source (**SRC**), Sink (**SNK**) or Dual Role Powered (**DRP**):

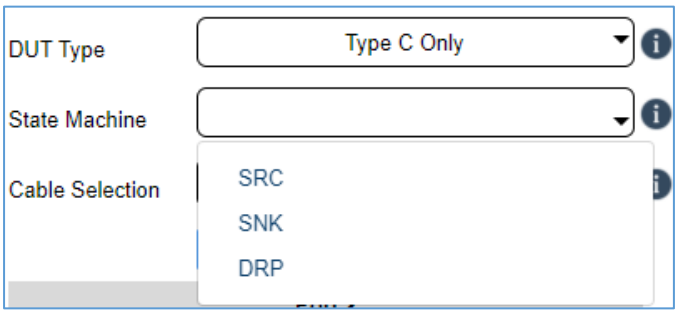


FIGURE 5.4: SELECTING TYPE-C UUT CONNECTION STATE MACHINE

Once the device type has been defined, clicking the **Get Device Data** button Get Device Data will read the device capabilities from the device connected to each respective C2 port. If no device is connected, the user will be notified. If the device type read using the **Get Device Data** button does not match the type selected from the 'DUT Type' drop-down menu, the user will also be notified.

The information from the UUT appears under the Device Data column on the right panel for each respective Port tab and the VIF Data column remains blank.

The **Create New VIF** button Create New VIF allows you to create a new VIF File in XML format from the configuration when clicked. A VIF Config pop-up message will appear as below. Select the DUT Type and select whether or not to set the current configuration as default values, and then click 'Ok'.

FIGURE 5.5: CREATE NEW VIF FILE

You can also save the current configuration to a VIF data file by clicking the **Generate VIF (VIF Data)** button Generate VIF(VIF Data). A Save File pop-up message will appear as below. Specify the name of the file to save as, and then click 'Ok'.

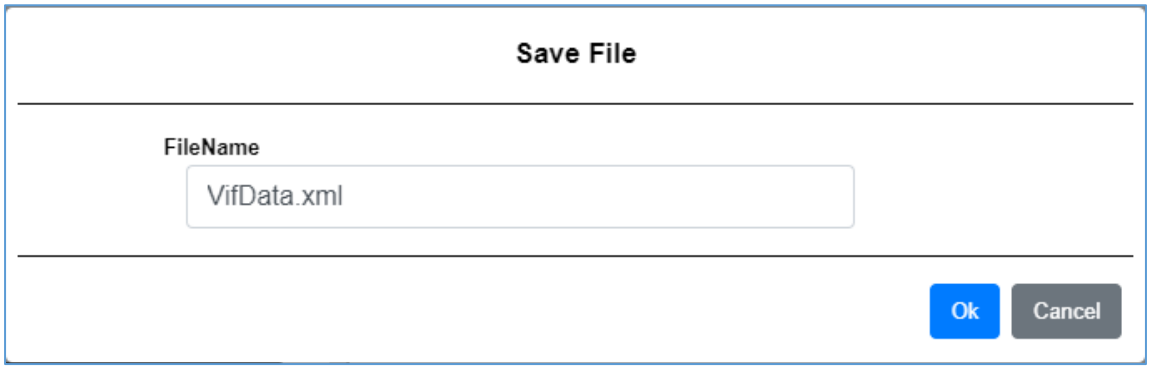


FIGURE 5.6: GENERATE VIF DATA FILE

If a VIF File is provided:

For Certification a Vendor Information File (VIF) must be provided by the Product Vendor. The VIF informs the tester of all its capabilities and provides some input information needed to provide full testing. If the VIF file is not provided, full certification testing cannot be run and tests performed are informational. If Vendor File is provided, use the following procedure:

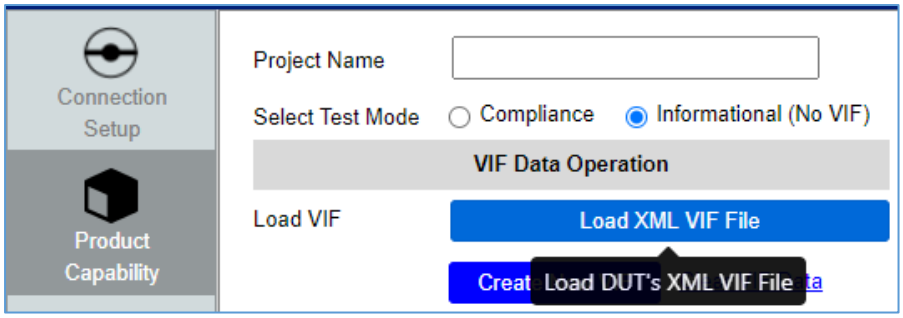


FIGURE 5.7: SELECTING COMPLIANCE TEST MODE USING VIF FILE

Clicking on the **Load XML VIF File** button will read and load information from a selected VIF XML file on the host PC. A file selection dialog box will appear which allows you to navigate to the location of the Vendor Information File (VIF), select the correct file and click the 'Open' button to load it.

Once the VIF file has been selected and loaded, the contents of the VIF file will be displayed under the VIF Data column on the right panel for each respective Port tab. To enable edits to be made to the data, use the 'Edit VIF' slider 

.

When testing a new UUT, clicking on the **Clear Device Data** button (see Figure 5.9) will clear all product configuration information including what has been read from a VIF and what was read directly from the device.

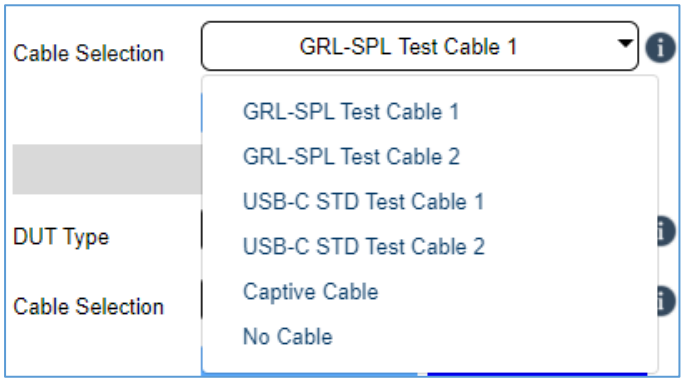


FIGURE 5.8: PRODUCT CAPABILITY TEST CABLE SELECTION

The test cable selection drop-down menu's allow you to specify what cable connects the UUT to the specific USB Port on the GRL-USB-PD-C2 Test Controller. The 'USB-C STD Test Cable' indicates the USB Type-C eMarker cable, while the 'GRL-SPL Test Cable' indicates the GRL special cable provided with the GRL-USB-PD-C2 Test Controller which has been characterized specifically for compliance testing. The GRL special cable does not have an eMarker since, under very specific circumstances, an eMarker cable response can be confused with the UUT response during compliance testing. The 'No Cable' indicates that the UUT is attached directly to the GRL-USB-PD-C2 USB Port without using any cable in between. The 'Captive Cable' indicates the Type-A to non-standard USB connector cable or the Type-C to non-standard USB connector cable.

FIGURE 5.9: PRODUCT CAPABILITY 'GET DEVICE DATA' AND 'CLEAR DEVICE DATA' BUTTONS

Clicking any of both **Get Device Data** Port buttons reads the configuration information from the device connected to that specific Port and displays it.

When configuration information is read from both a VIF and the device, the information is listed side-by-side for easy comparison. This comparison is also provided in the report files. In some cases, if the VIF and Read Capabilities information do not match, the device can fail compliance.

Clicking any of both **Clear Device Data** Port buttons clears all the configuration information in both the 'VIF Data' and 'Device Data' sections of the information display area for that specific Port. This includes all the different categories associated with the information display area as well.

Selecting the Clear VIF Data option resets all the edits made to the configuration to the previous values.

When configuration information is read from the device, you can generate a VIF file of the Read Capabilities information by clicking the **Generate VIF (Device Data)** button 

for the specific Port. A Save File pop-up message will appear as below. Specify the name of the file to save as, and then click 'Ok'.

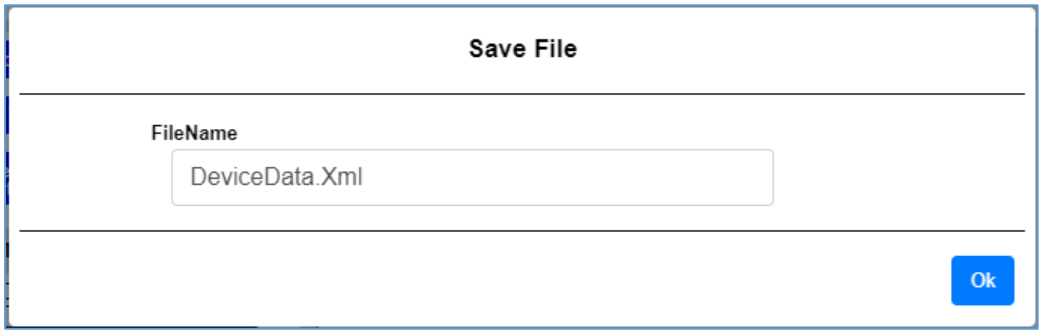


FIGURE 5.10: PRODUCT CAPABILITY VIF FILE GENERATION

To copy the device configuration information to VIF, click on the 

button.

If you want to convert VIF data to the XML file format, select the VIF Generator option. This will direct you to the USB-IF official website for the conversion process. *(Make sure you have permission from USB-IF to access the website.)*

5.2 Test Configuration

The *Test Config* screen allows you to select which set of tests is run on the UUT, set up test parameters for specific test categories, run selected tests and generate test reports.

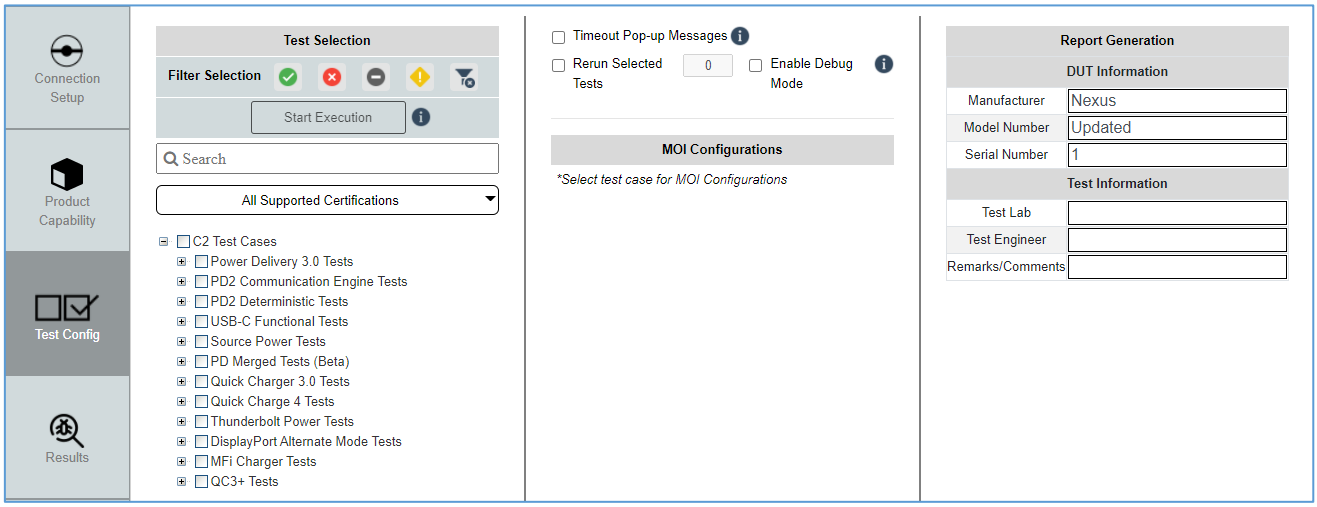


FIGURE 5.11: TEST CONFIGURATION SCREEN

5.2.1 Test Selection and Configuration

Based on the type of UUT selected in the *Product Capability* screen and various specifications, the specific tests available to be run are shown on the "Test Selection" panel:

5.2.1.1 Power Delivery 3.0 Tests

Run the USB Power Delivery compliance tests based on the USB Power Delivery 3.0 specification.

When "Provider/Consumer" or "Dual Role Power (DRP)" is selected as the DUT type (see Section 5.1), an additional input is available to allow the user to perform tests using the GRL Fast Role Swap (FRSWAP) Board (GRL-C2-FR-SWAP-AUTO Box Board) for automating Fast Role Swap based

testing when checked. *Note that the Fast Role Swap test results are currently meant for informational purpose only and not required for certification testing.*

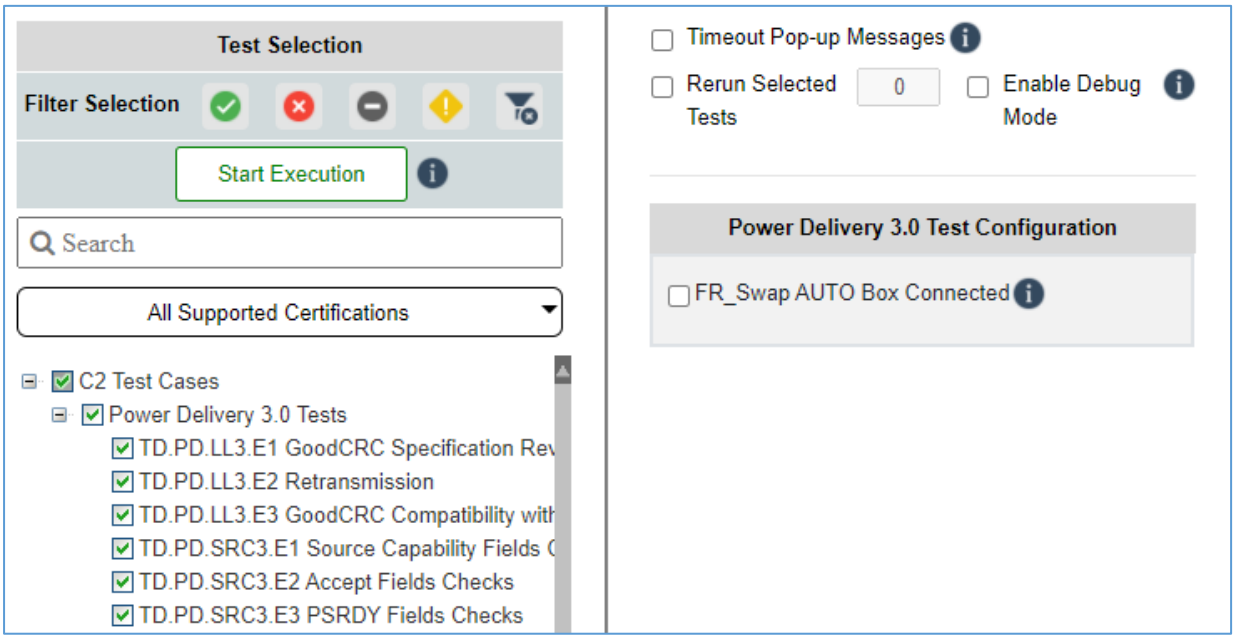


FIGURE 5.12: CONFIGURATION FOR POWER DELIVERY 3.0 TESTS IF "PROVIDER/CONSUMER" OR "DUAL ROLE POWER (DRP)" UUT IS SELECTED

When "Cable" is selected as the DUT type (see Section 5.1), an additional input is available to select the V_{CONN} voltage.

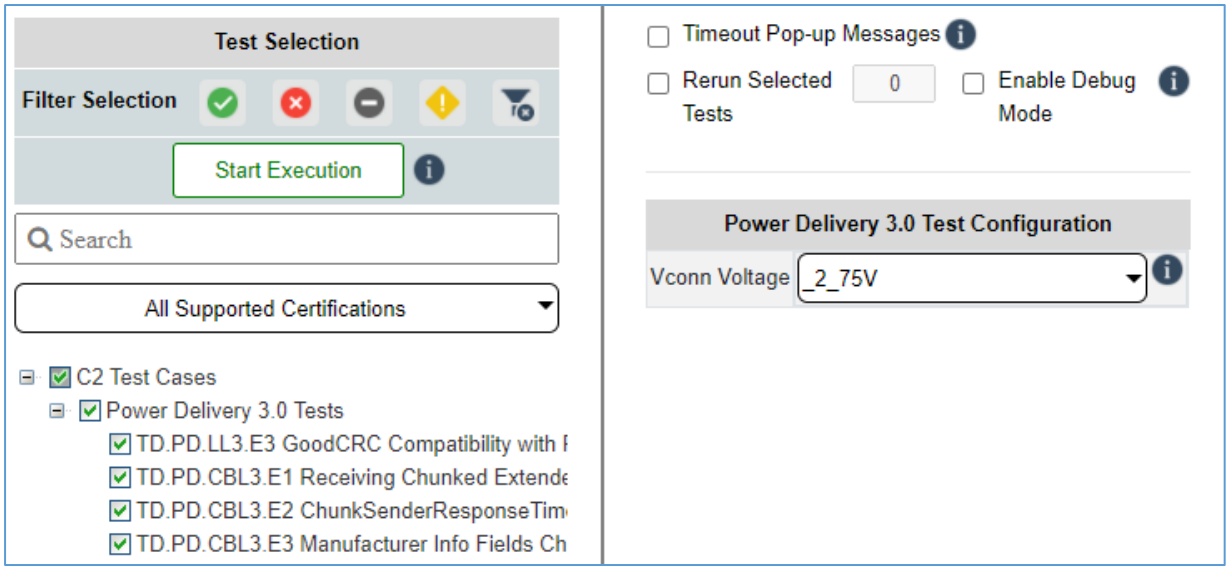


FIGURE 5.13: CONFIGURATION FOR POWER DELIVERY 3.0 TESTS IF "CABLE" UUT IS SELECTED

5.2.1.2 Source Power Tests

Runs the USB-C Source Power Tests or "QuadraMax" tests for power providers. These tests have an additional input that allows for the selection of what port is used in the testing.

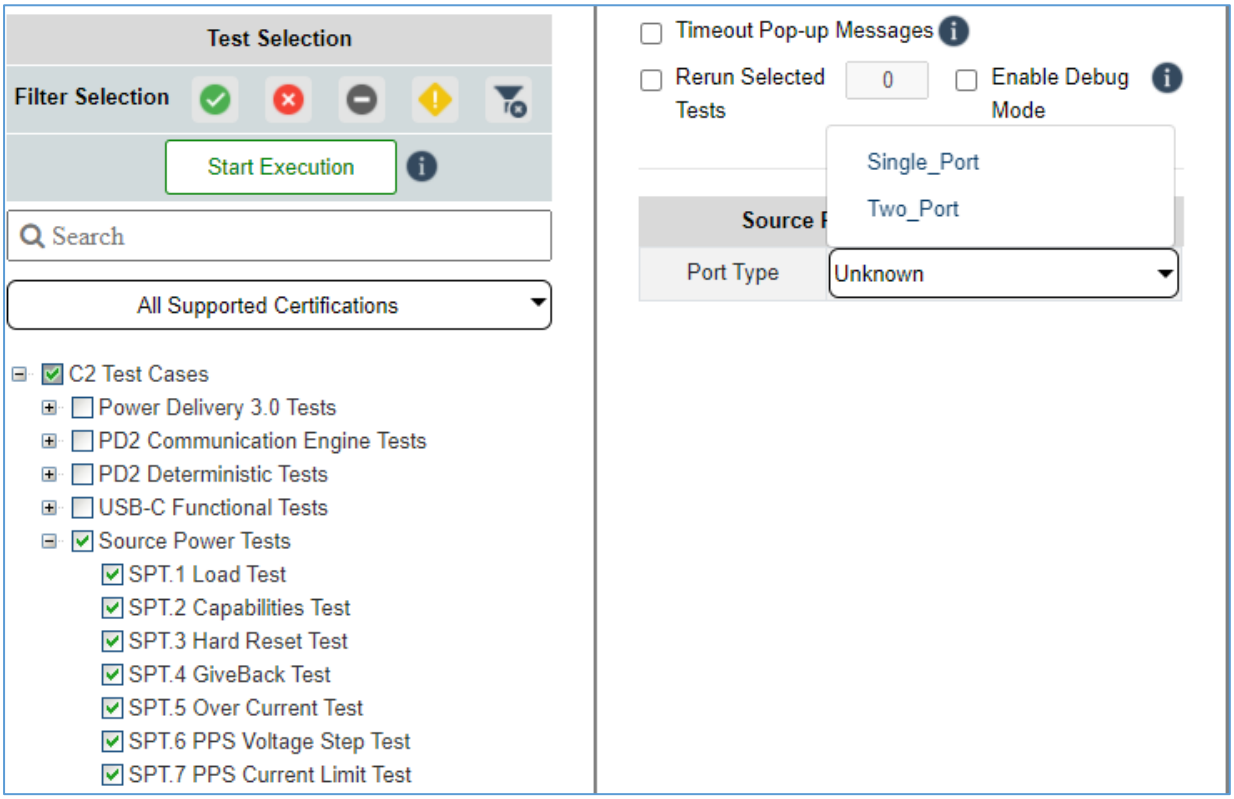


FIGURE 5.14: CONFIGURATION FOR USB-C SOURCE POWER TESTS

5.2.1.3 PD2 Deterministic Compliance Tests

Runs the USB Power Delivery deterministic compliance tests based on the USB Power Delivery 2.0 specification. When "Cable" is selected as the DUT type (see Section 5.1), an additional input is available to select the V_{CONN} voltage.

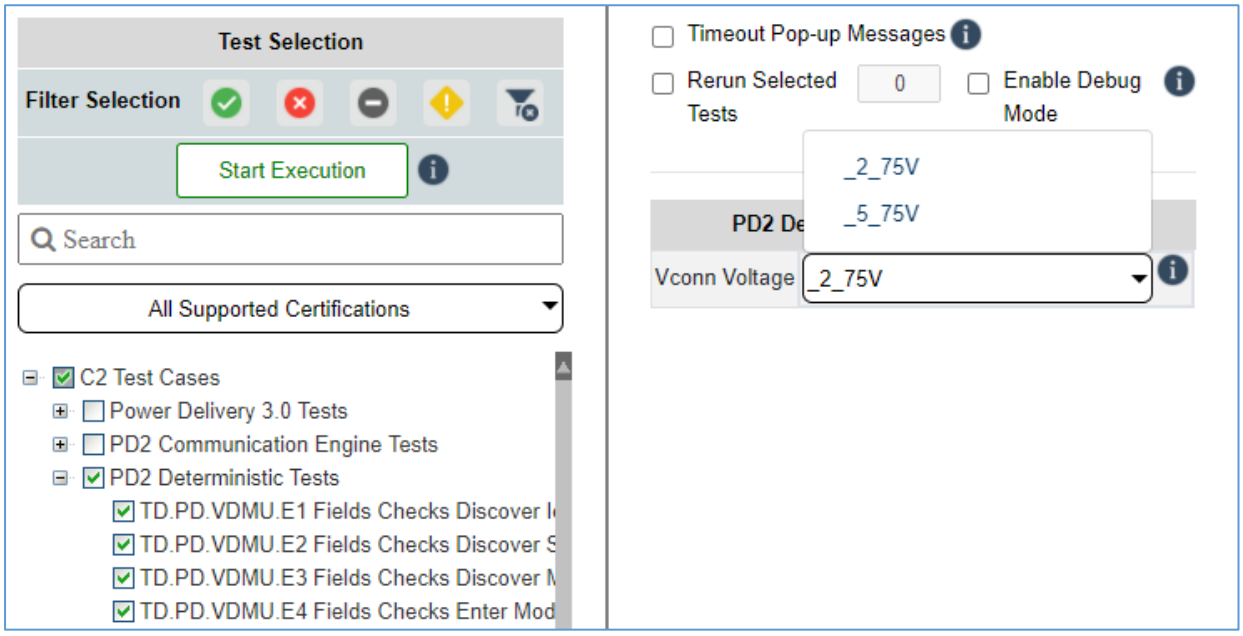


FIGURE 5.15: CONFIGURATION FOR PD2 DETERMINISTIC TESTS

5.2.1.4 PD2 Communication Engine Tests

Runs the USB Power Delivery communication engine compliance tests based on the USB Power Delivery 2.0 specification. These tests have an additional input that allows for the selection of Rx noise source.

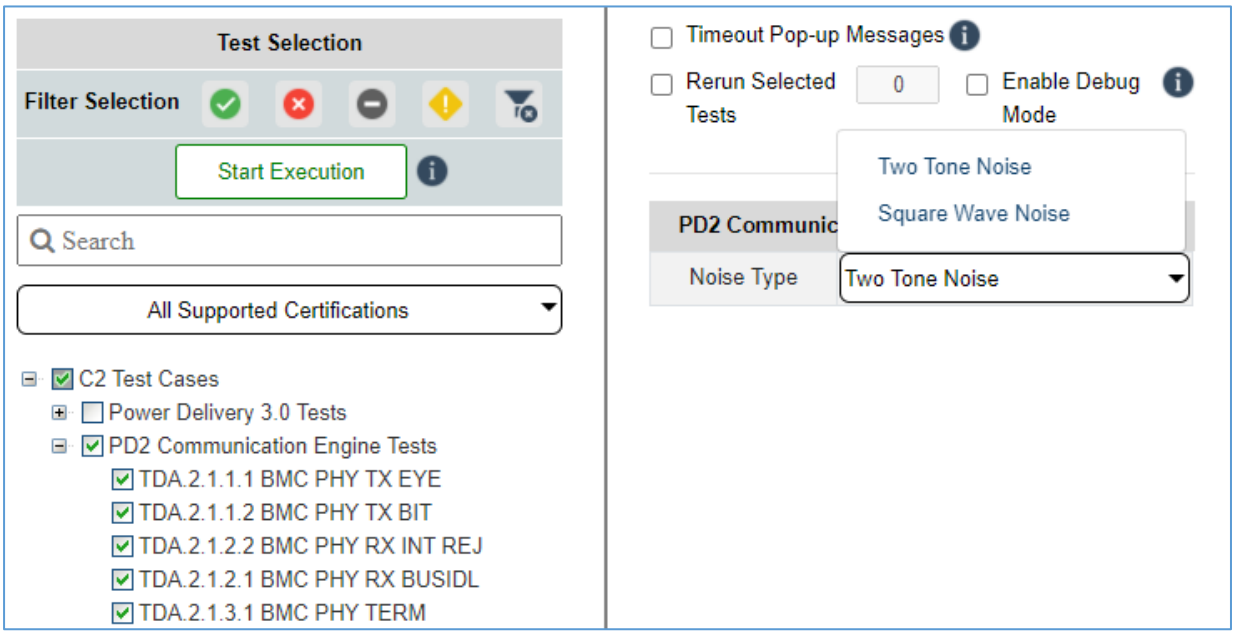


FIGURE 5.16: CONFIGURATION FOR PD2 COMMUNICATION ENGINE TESTS

When "Cable" is selected as the DUT type (see Section 5.1), an additional input is available to select the V_{CONN} voltage.

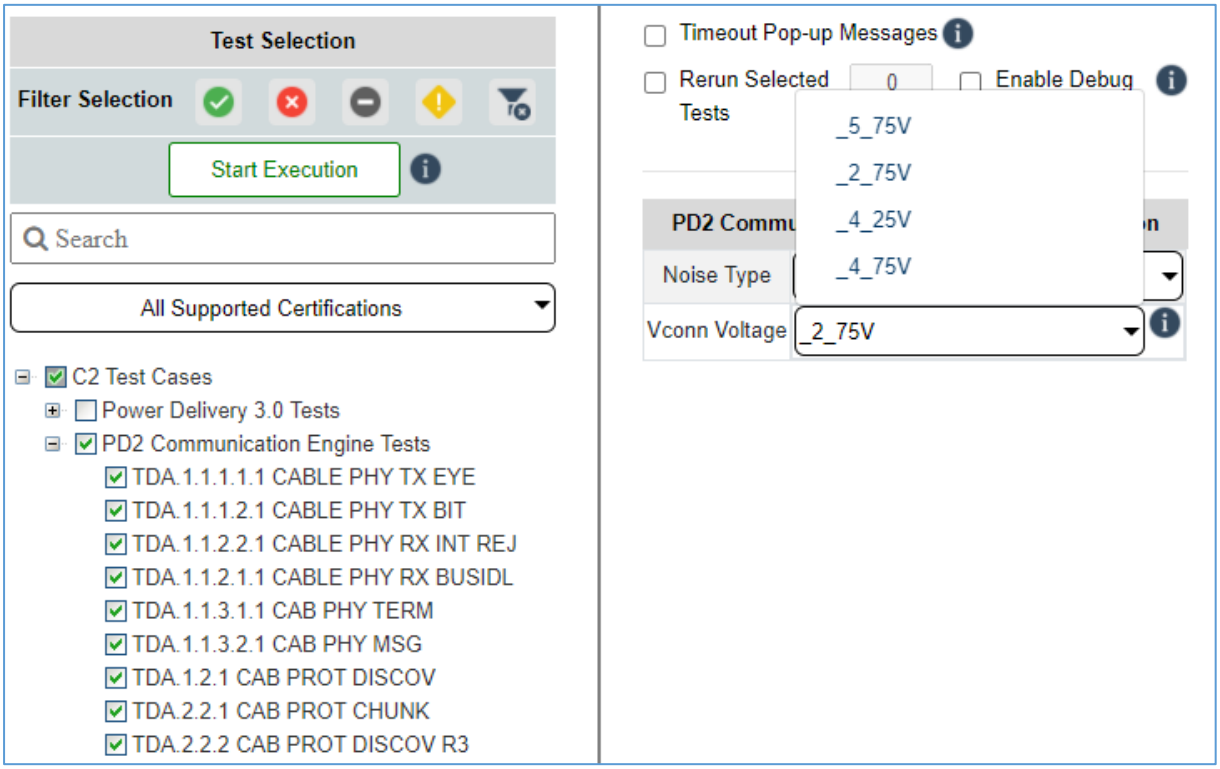


FIGURE 5.17: CONFIGURATION FOR PD2 COMMUNICATION ENGINE TESTS IF "CABLE" UUT IS SELECTED

5.2.1.5 DisplayPort Alternate Mode Tests

Runs the DisplayPort Alternate Mode compliance tests for the Alt Mode based UUT. These tests have additional inputs that allow for the selection of DisplayPort UUT type to be used in testing along with its Source or Sink capability.

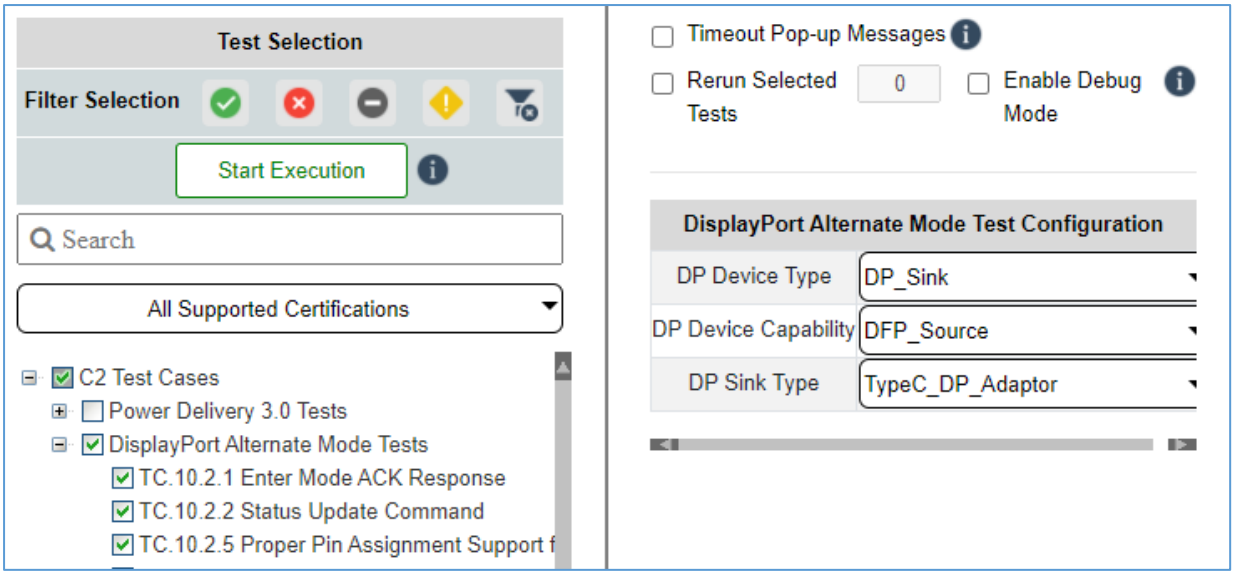


FIGURE 5.18: CONFIGURATION FOR DISPLAYPORT ALTERNATE MODE TESTS

5.2.1.6 Quick Charge 4 Tests

Runs the Quick Charge 4/4+ tests. These tests are proprietary to Qualcomm and are only available with arrangement through Qualcomm. These tests allow selection of the specific Quick Charge 4/4+ specification and additional setting of ambient room temperature to test against.

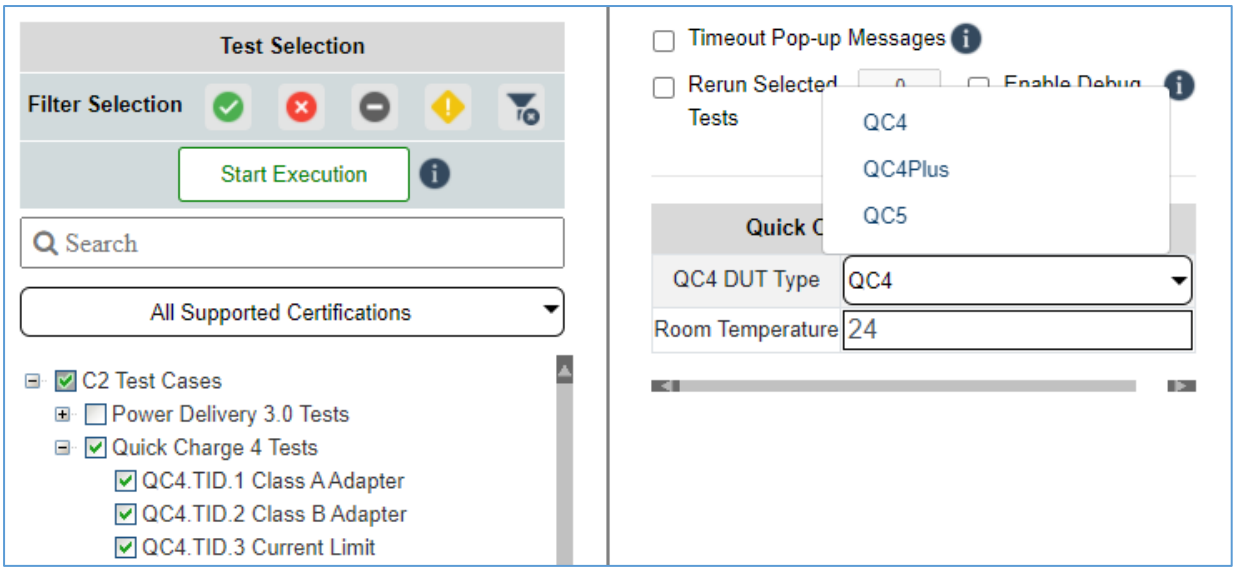


FIGURE 5.19: CONFIGURATION FOR QUICK CHARGE 4 TESTS

5.2.1.7 Quick Charge 3.0 Tests

Runs the Quick Charge Legacy 2.0/3.0 tests. These tests are proprietary to Qualcomm and are only available with arrangement through Qualcomm. These tests have additional inputs to indicate the UUT's Quick Charge specification and what cable is connected to the UUT, to allow the user to indicate the specific current rating (in amps) and power rating (in watts) as well as the IR drop value of the connected device to test against. Further inputs allow the user to specifically select the type of Quick Charge based UUT that is connected to single/dual ports and with/without USB Power Delivery support.

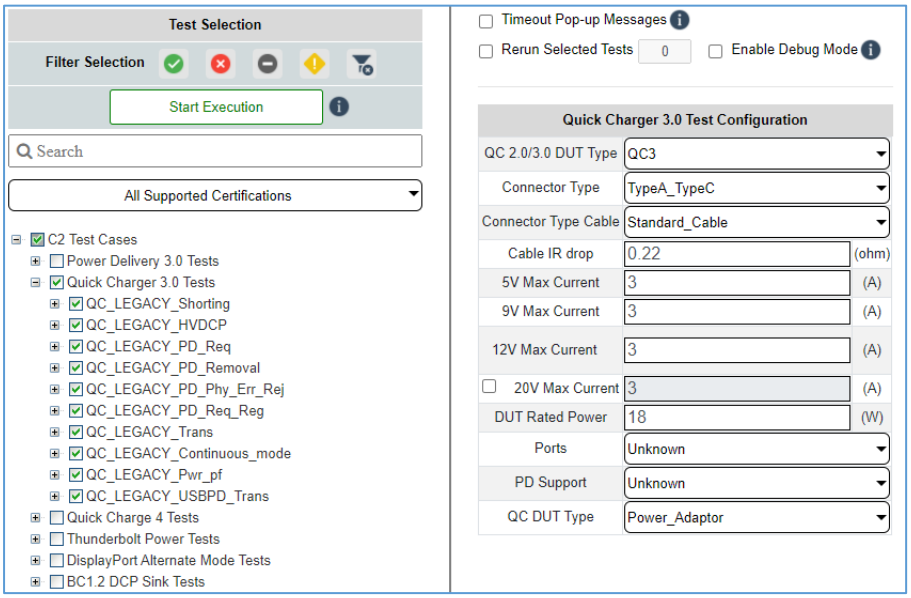


FIGURE 5.20: CONFIGURATION FOR LEGACY QUICK CHARGE TESTS

5.2.1.8 Quick Charge 3.0+ Tests

Runs the Quick Charge 3.0+ tests for power provider UUT's. These tests are proprietary to Qualcomm and are only available with arrangement through Qualcomm. These tests have additional inputs to indicate the UUT's Quick Charge specification and what cable is connected to the UUT, to allow the user to indicate the specific current rating (in amps) and power rating (in watts) as well as the IR drop value of the connected device to test against. Further inputs allow the user to specifically select the type of Quick Charge based UUT that is connected to single/dual ports and with/without USB Power Delivery support.

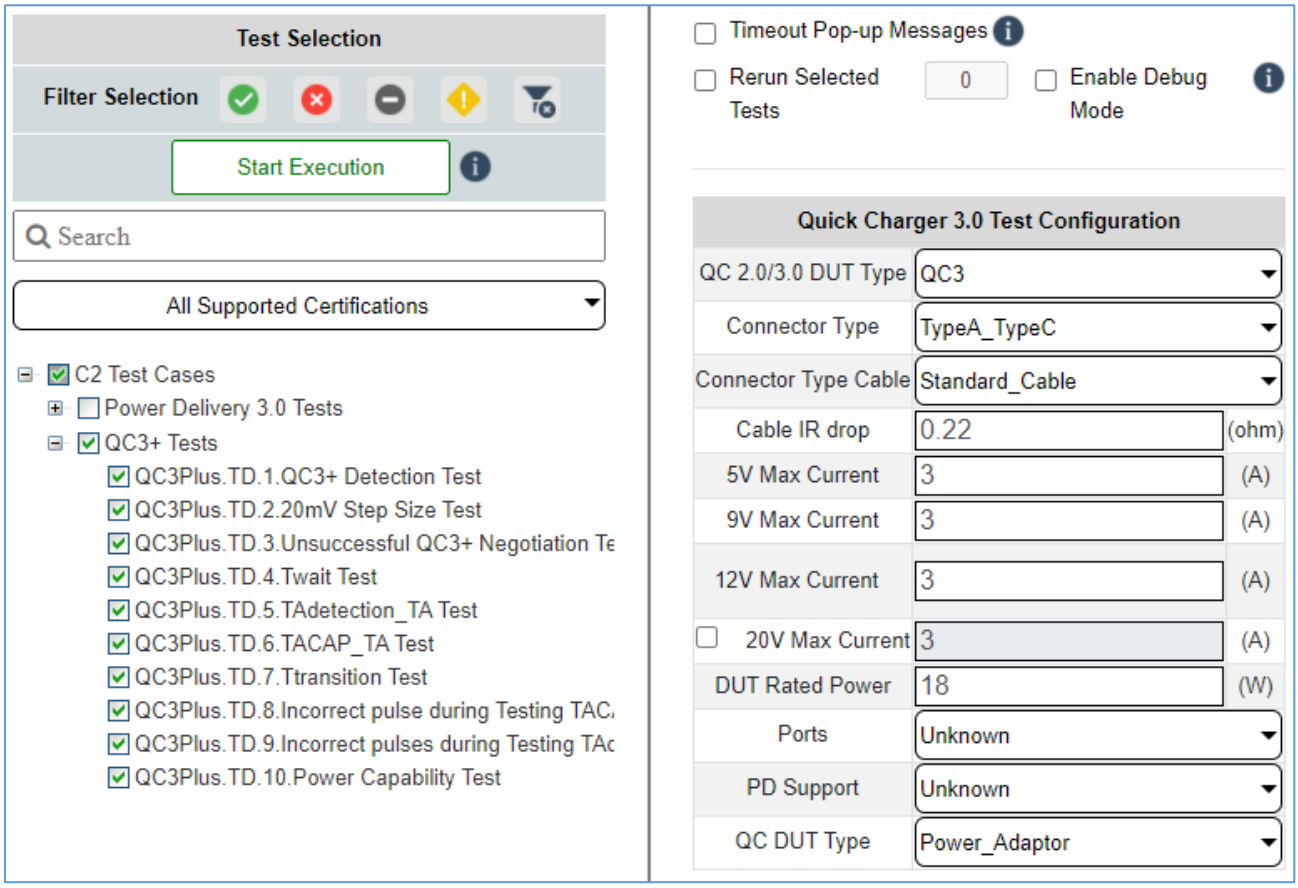


FIGURE 5.21: CONFIGURATION FOR QUICK CHARGE 3.0+ TESTS

5.2.1.9 Thunderbolt Power Tests

Runs the Thunderbolt power compliance tests. These tests have additional inputs to the number of ports to test, whether the UUT is self-powered or bus-powered and whether the UUT is a host or device. Further inputs allow the user to enable the capability mismatch flag and the giveback flag as well as also specify the time duration for adding stressors.

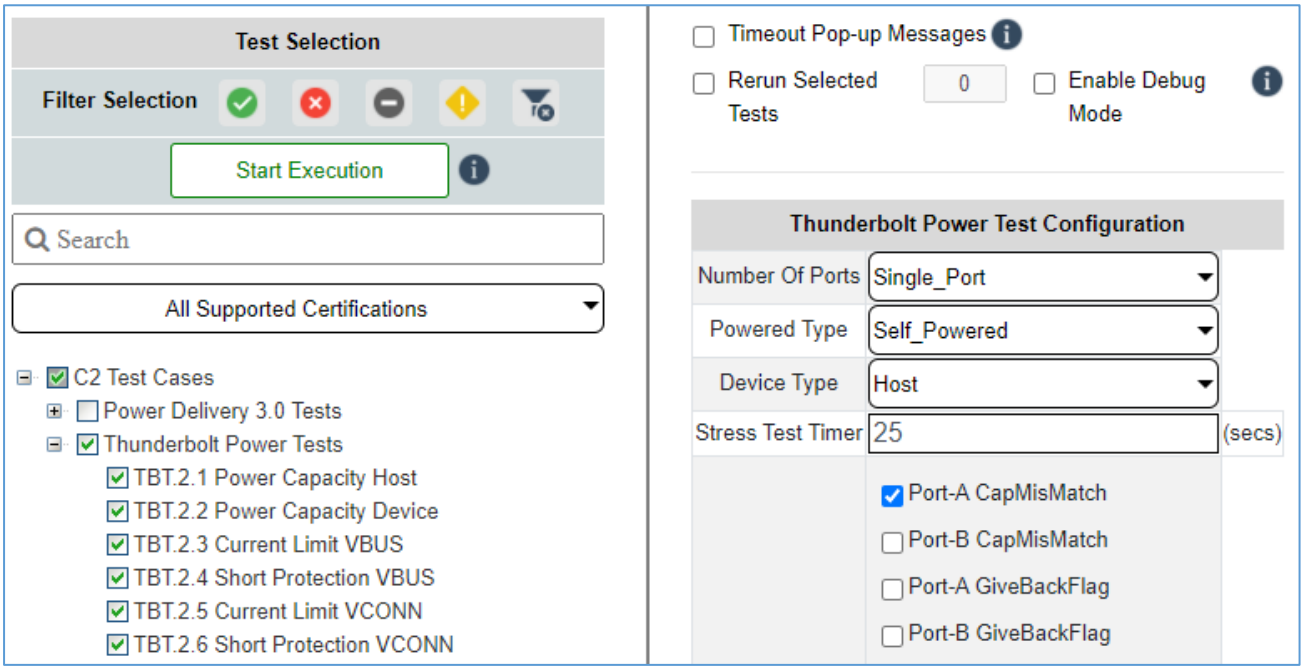


FIGURE 5.22: CONFIGURATION FOR THUNDERBOLT POWER TESTS

5.2.1.10 USB Type-C Functional Tests

Runs the functional compliance tests for USB-C chargers. These tests have additional inputs that allow the user to enable data validation at high USB speeds or through automation as well as select if the UUT is connected to a battery.

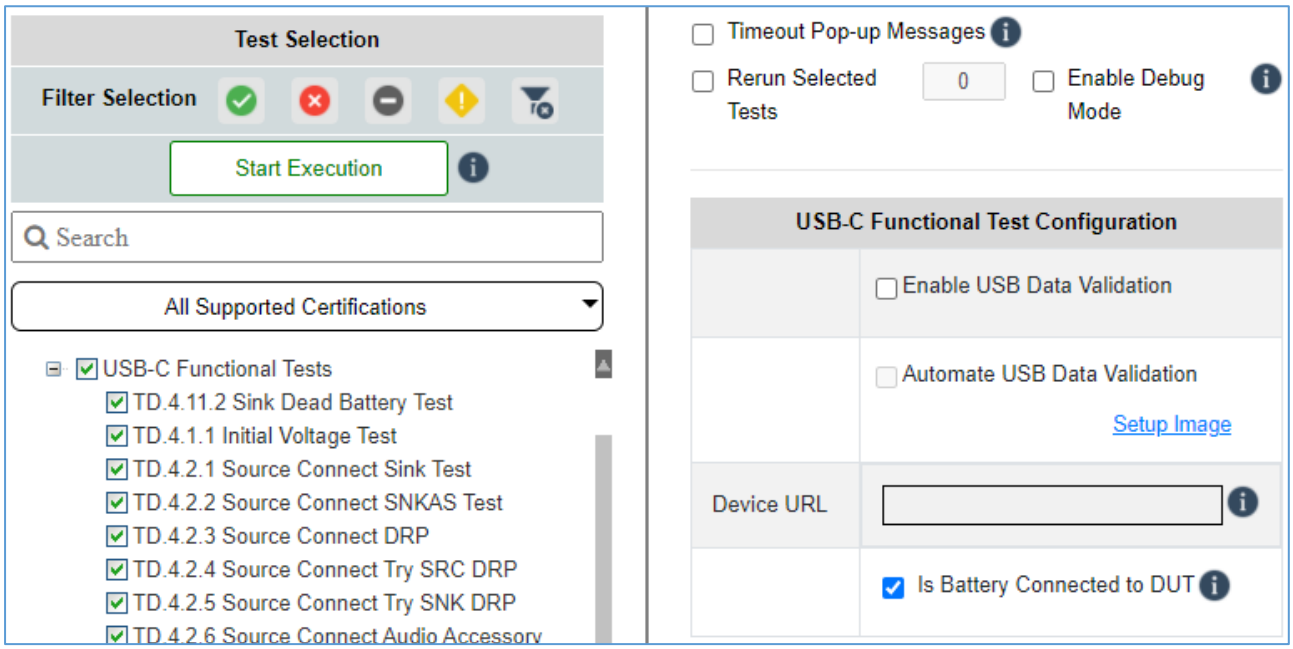


FIGURE 5.23: CONFIGURATION FOR USB-C FUNCTIONAL TESTS

You can refer how to set up the equipment to automate data validation by selecting Setup Image as shown below:

FIGURE 5.24: USB-C FUNCTIONAL TEST AUTOMATION SETUP DIAGRAM

Once the equipment has been set up, enter the URL as shown on the Golden device (i.e., Google Pixel phone) in the "Device URL" field.

5.2.1.11 PD Merged Tests

Runs the merged USB Power Delivery compliance tests as per CTS requirements.

5.2.1.12 MFi Tests

Runs the Apple MFi compliance tests for Apple chargers. These tests have additional inputs that allow the user to configure external eLoad to run the MFi tests. If the charger UUT has a Lightning cable attached to it or a captive cable, select the "Charger has captive lightning plug" checkbox. You will need to select the channel connected to the external eLoad. When the external eLoad is set up properly, enter the correct VISA address of the external eLoad and click "Connect" to establish connection with the external eLoad. Otherwise click on the "Scan Eload" button to reset the connection.

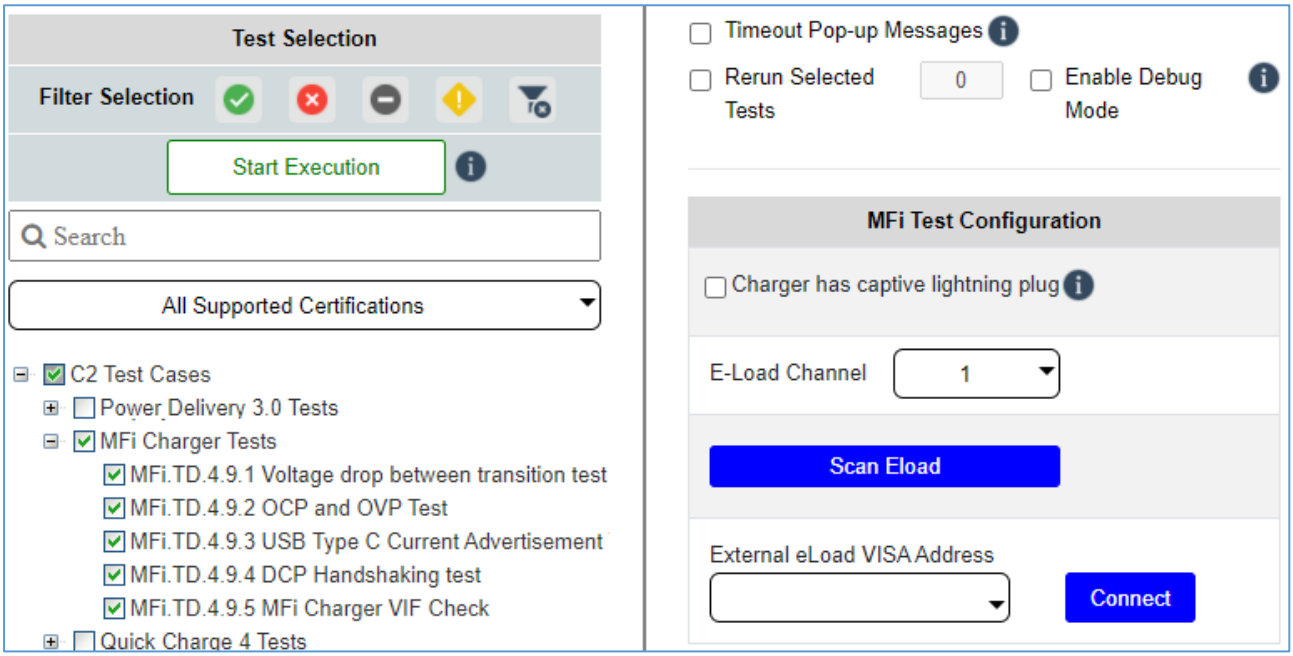


FIGURE 5.25: CONFIGURATION FOR MFI TESTS

5.2.1.13 BC 1.2 Tests

Runs the USB Battery Charging 1.2 tests. These tests have additional inputs to the secondary detection mode, whether implemented or not and maximum current.

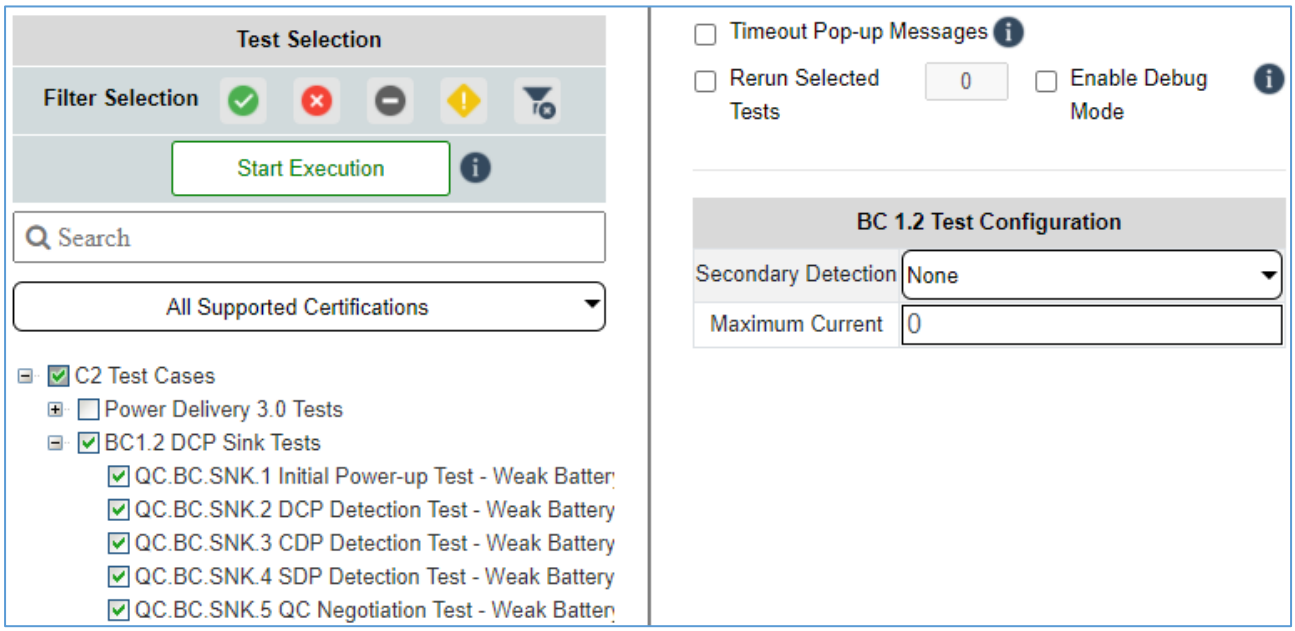


FIGURE 5.26: CONFIGURATION FOR BC 1.2 TESTS

Individual tests are grouped together based on their definition in the selected specification. Selecting a group will cause all tests in that group to be selected and run. Selecting individual tests within a group will run just the individual tests selected.

If you just want to select the tests that comply to a certain certification standard, click on the drop-down menu as shown below to filter out the test list as required.

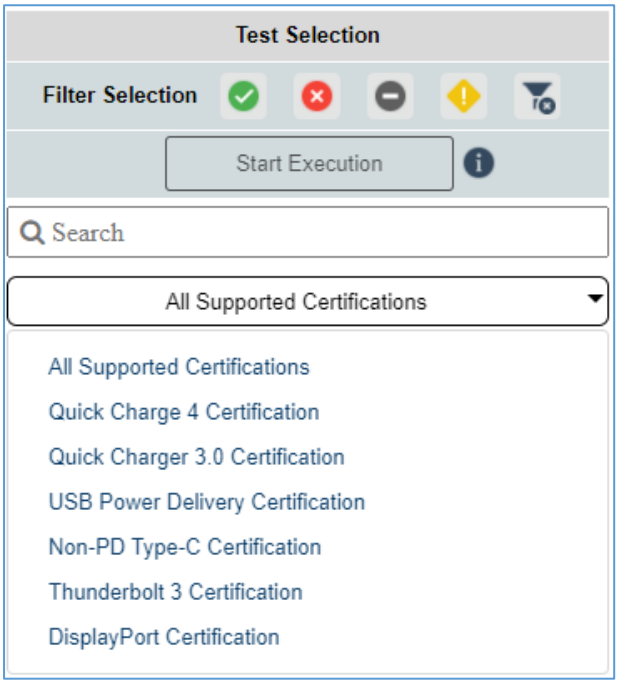


FIGURE 5.27: SELECTING CERTIFICATION COMPLIANCE FOR TESTS

Note: The GRL-USB-PD-C2 supports several Compliance Test Specifications (CTS's) from different technologies using the USB Type-C Connector. For a detailed listing of all the tests and test methodology in the latest version of the specification, refer to the specification documents referenced in Section 1.

5.2.2 Report Generation

The "Report Generation" panel allows full reports to be created after running a set of tests.

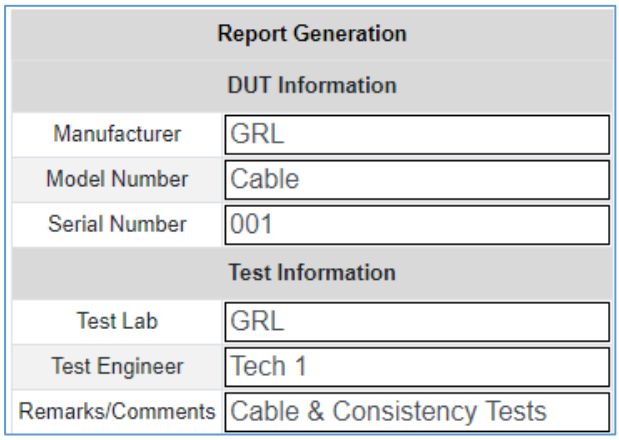


FIGURE 5.28: REPORT GENERATION PANEL

The “DUT Information” and “Test Information” sections are text entry fields in which you can enter information germane to the specific Device Under Test (DUT, another name for the UUT) and the specific set of tests just run. Once tests have completed, the test report can be viewed in the *Report* screen (see Section 5.3).

5.2.3 Running Tests

Once the desired tests have been selected, these tests can be run by clicking on the green **Start Execution** button:

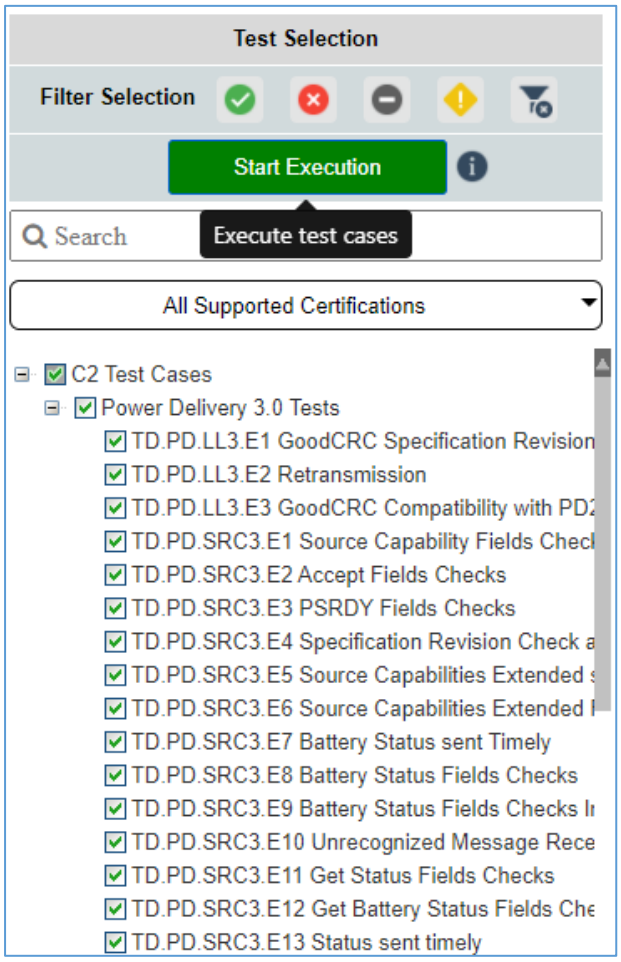


FIGURE 5.29: RUN TESTS

If you are only running tests for informational purpose, you can choose to disable pop-up messages from showing up during test runs by selecting the **Timeout Pop-up Messages** checkbox.

To repeat running selected tests for a specific number of times, select the **Rerun Selected Tests** checkbox and enter the desired number.

For debug purposes, you can choose to turn on debug mode by selecting the **Enable Debug Mode** checkbox. This will cause additional data to be included in test acquisitions to be used for debugging.

FIGURE 5.30: TEST RUN OPTIONS

Once testing has started you can view each test being run in real-time mode on the *Results* screen:

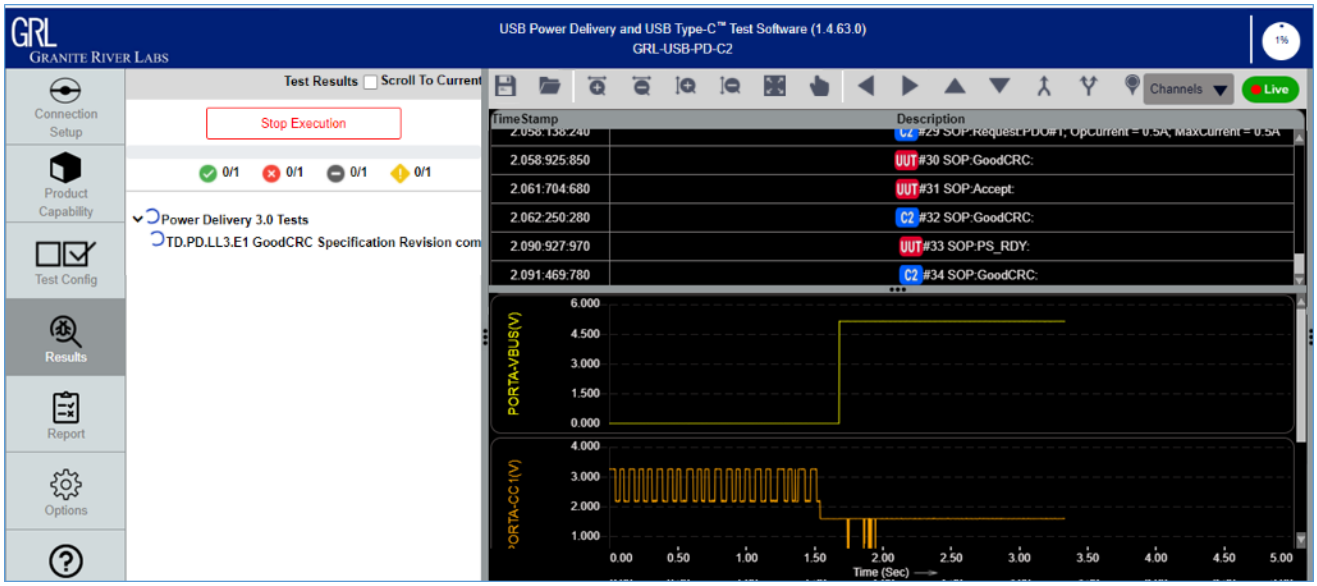


FIGURE 5.31: RESULTS SCREEN – TEST RUN INITIATION

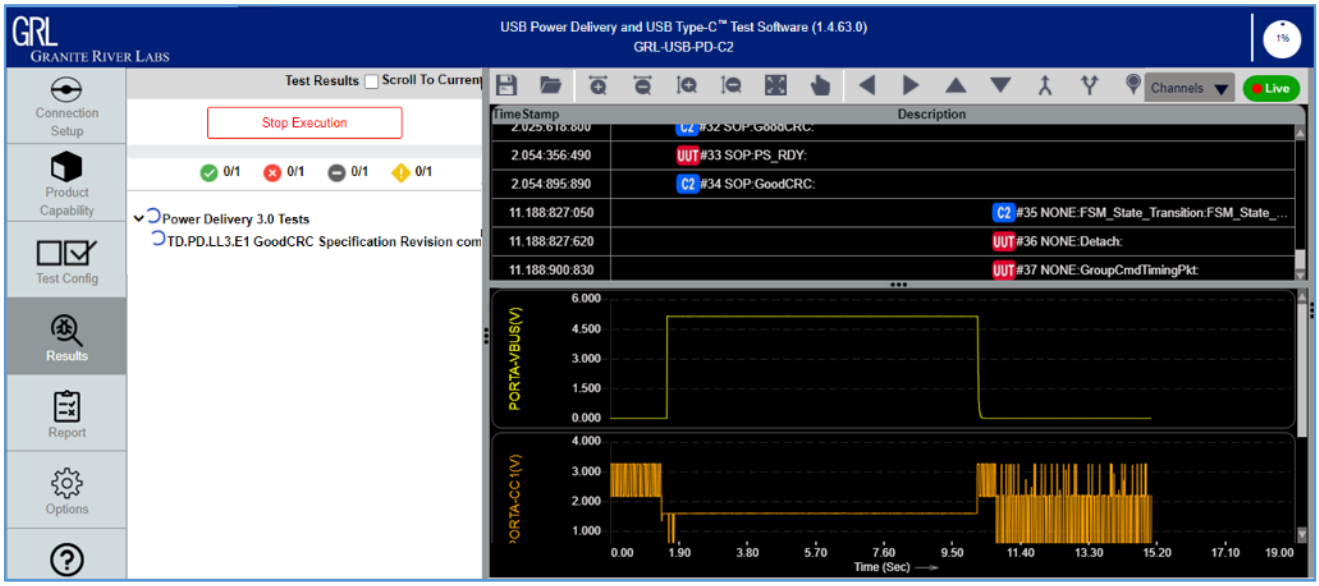


FIGURE 5.32: RESULTS SCREEN – TEST RUN IN PROGRESS

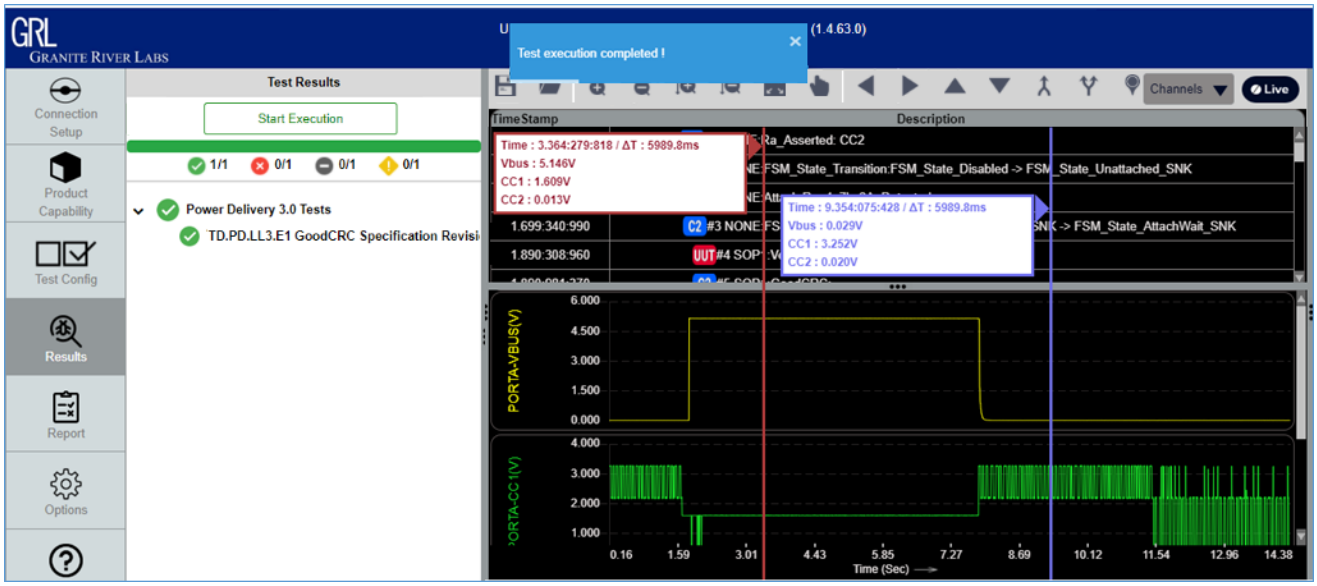


FIGURE 5.33: RESULTS SCREEN – TEST RUN COMPLETION

While tests are running, the Test Results pane will display the pass/fail status of each test as well as each subtest which you can view by clicking the drop-down arrow of the test group if applicable. The PDO communications exchange protocol and waveform displays next to the Test Results pane allow you to scroll to the section representing the start of the selected test– this allows you to trace failing test to determine the cause of the test failure.

You can also track the progress of the test run through the progress indicator 

at the top right corner of the screen. If you only want to view specific channels on the trace plot, select the "Channels" drop down option and click/unclick on the checkbox(s) of the desired channels.

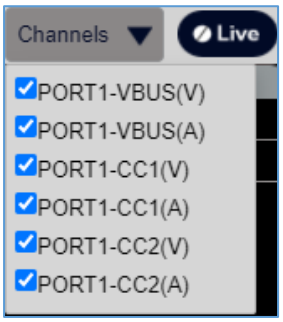
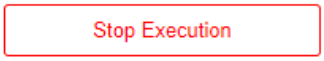


FIGURE 5.34: SELECT TRACE CHANNELS EXAMPLE

When the PDO communications exchange protocol is running, select the **Stop Execution** button 

at the top of the screen at any time to end or pause the process respectively.

The common plot specific buttons can be used to control the power trace view as desired which includes panning, merge/unmerge, fit and zooming in/out of the trace plots. The  button in particular can be selected to enable cursors for a test/subtest which lets you turn on/off markers at certain areas of the plot. Click on a test/subtest to navigate to the exact time stamp and packet details of the plot as shown in the following example:

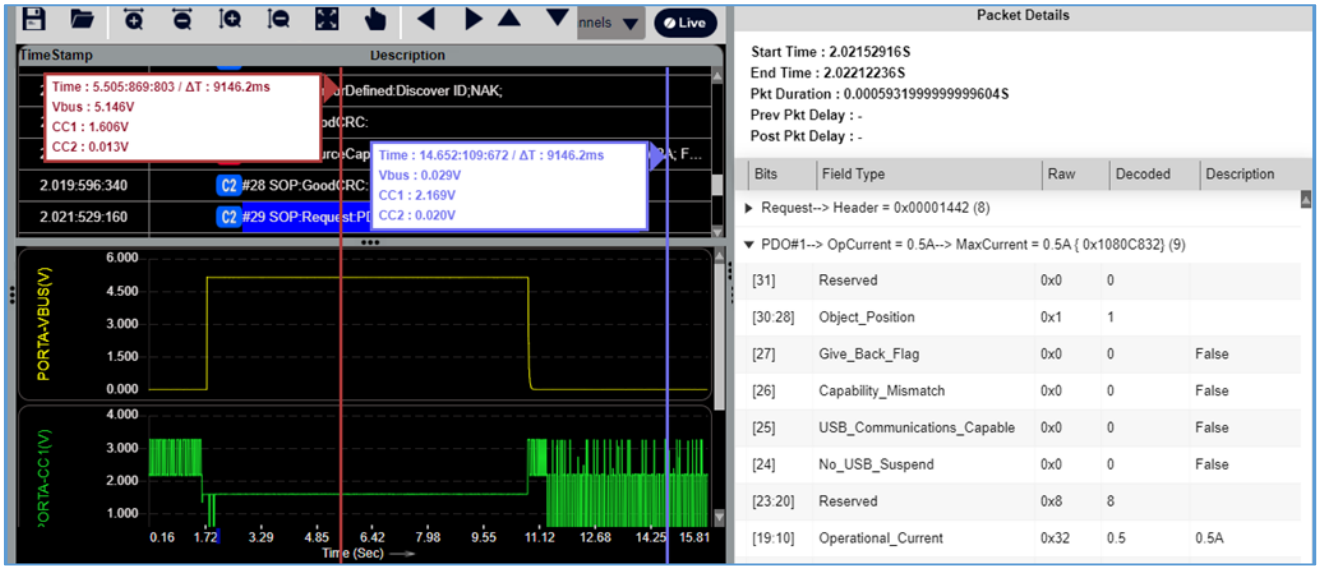


FIGURE 5.35: ENABLE TRACE MARKERS AND VIEW TEST DETAILS EXAMPLE

You can use your mouse cursor to hover on top of each plot specific button to view the description of each button function.

When the testing is complete, the screen displays all the data gathered during the testing process. Select the **Save** button to save the power trace plot to a file and the **Load** button to open and use an existing saved power trace file.

You can then also return to the *Test Config* screen to filter out the test selection list for those tests with Pass/Fail/Warning/Incomplete status. This allows you to easily determine the status of each test using the respective icons under the Test Selection panel. Clicking will undo this function.

5.3 Test Report View

After running a set of tests, the *Report* screen allows full reports to be created:

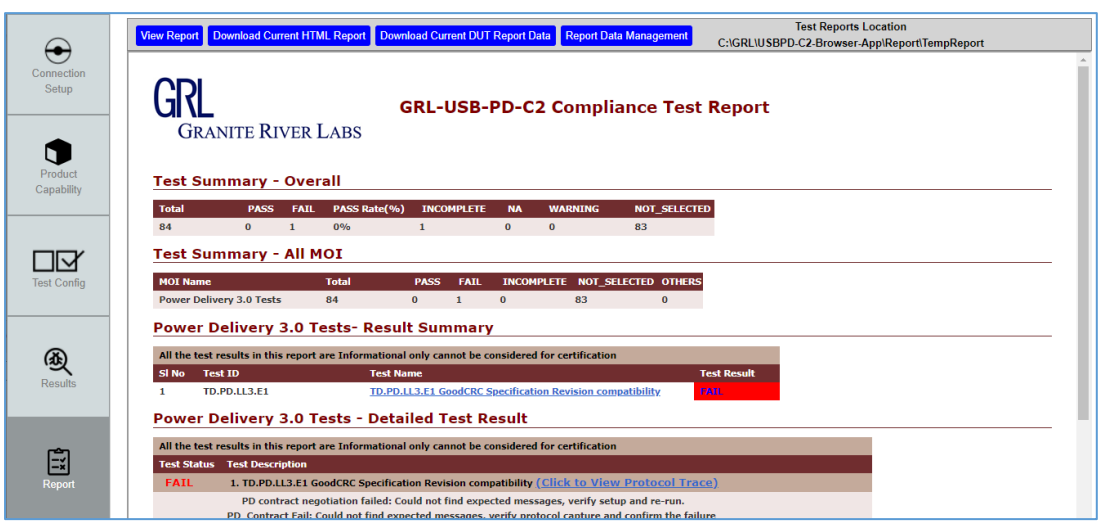


FIGURE 5.36: REPORT SCREEN

The content of the generated reports can consist of one or more of:

- **Configuration** – The product configuration information for the UUT.
- **Packet List** – A list of all the packets exchanged during testing.
- **Test Results** – The individual test Pass / Fail results.
- **Eye Diagrams** – Any eye diagrams created during physical layer (PHY) testing.
- **Saved Images** – Any other images created during the test process.

The most recent set of results for all tests run (regardless of when they were run) will be captured in the generated reports.

Scroll down to view the full report as shown in the example below:

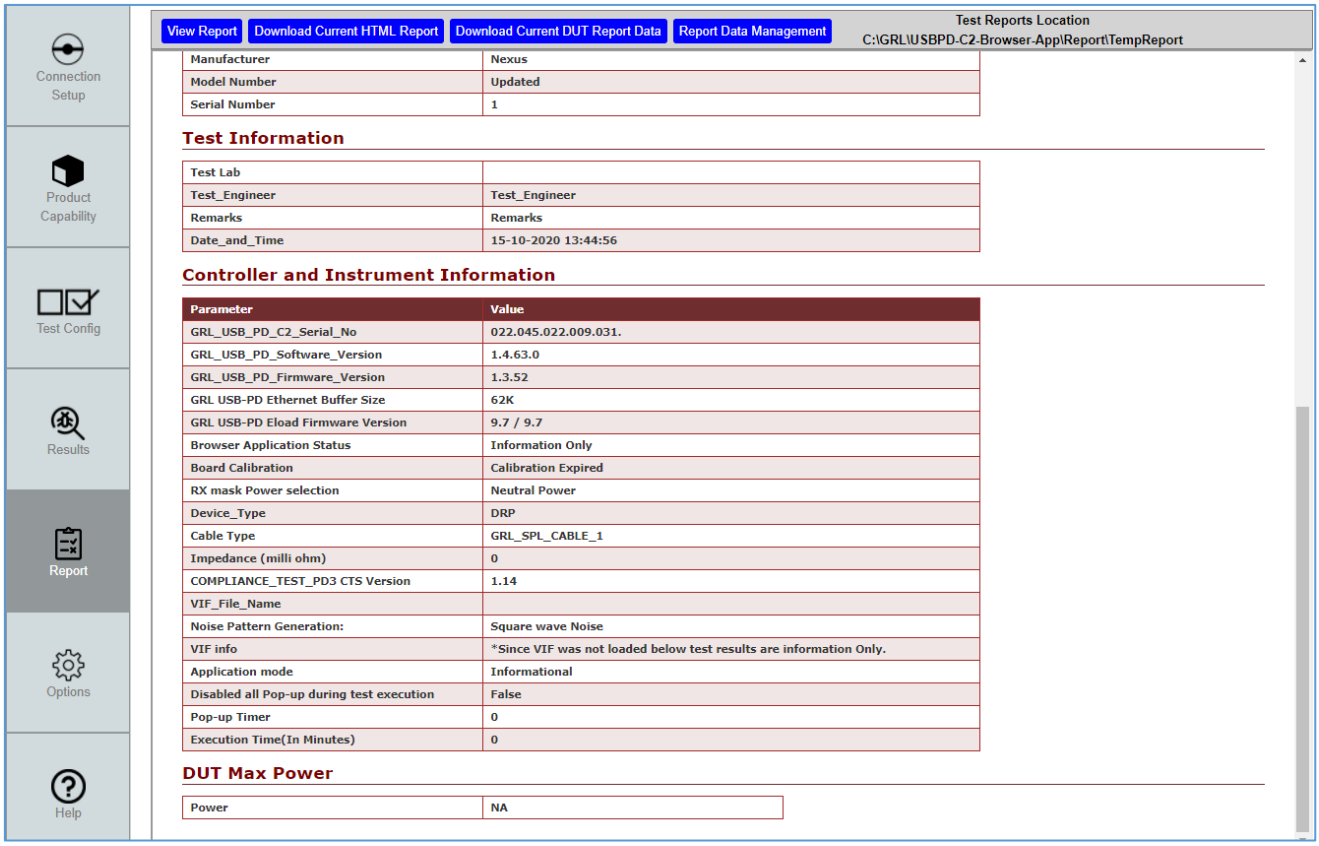


FIGURE 5.37: SCROLL DOWN TO VIEW FULL REPORT

Use these buttons above the report to perform the following functions:

- **Download Current DUT Report Data** button: Save all the result information to a ZIP folder.
- **Download Current HTML Report** button: Save the test report in HTML format.
- **Report Data Management** button: Access other test reports including from previous test runs. This allows you to delete or save the reports as desired from the database.
- **View Report** button: Jump to the beginning of the report.

6 Using the Configuration Controller

This section describes how to use the **Config Controller** utility, which allows the user to:

- configure the DisplayPort AUX or USB-C SBU fixture connected to the GRL-USB-PD-C2 controller for capturing sideband messages for DisplayPort Standard AUX or DisplayPort Alternate Mode respectively, and
- manually send USB-PD commands from the GRL-USB-PD-C2 controller to the UUT.

The *Options* screen will display the Config Controller page by clicking on the **Config Controller** tab at the top of screen:

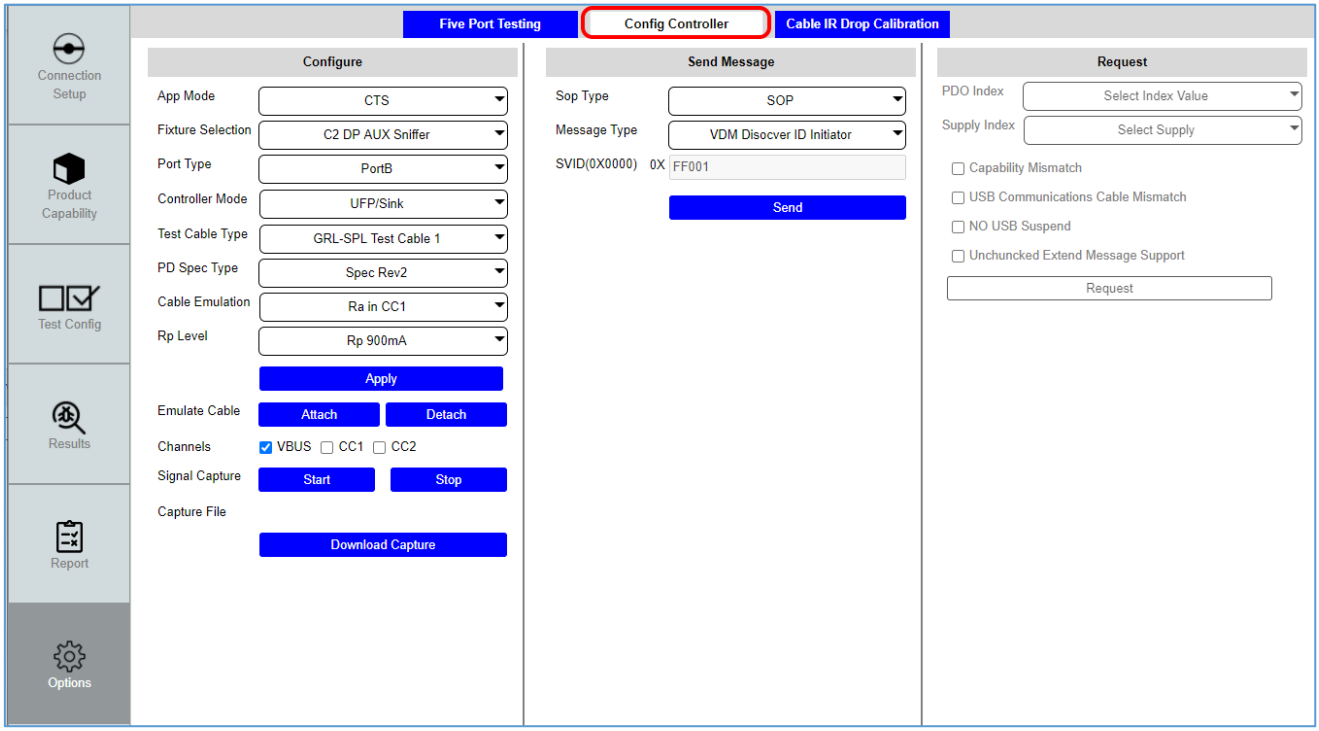


FIGURE 6.1: CONFIGURATION CONTROLLER SCREEN

Testing the UUT for a particular scenario can be performed using the **Config Controller** utility. The screen contains multiple panels with input fields that can be selected to focus on specific capabilities and requirements.

6.1 Configure Panel

The Configure panel allows the user to set the configuration of the controller.

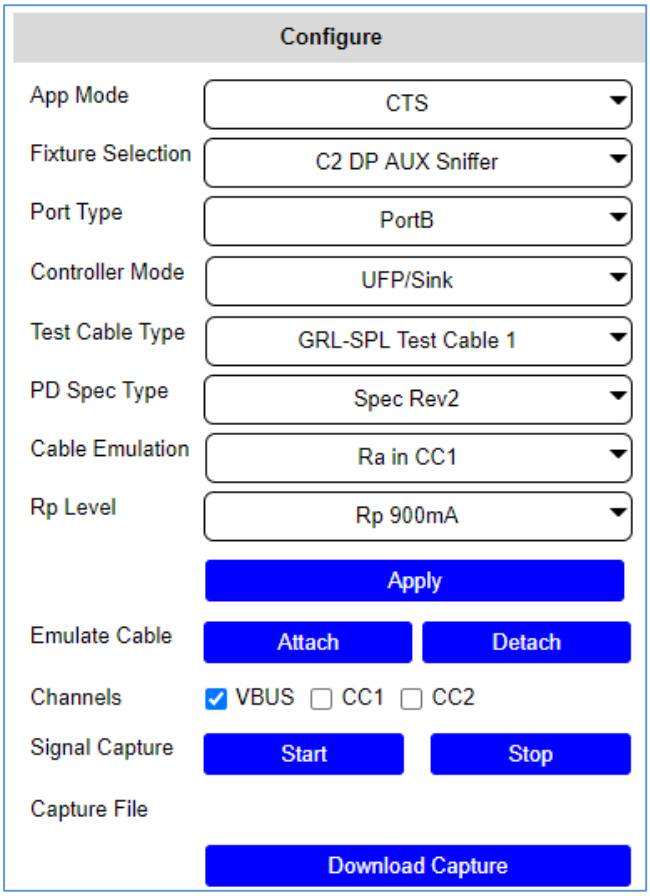


FIGURE 6.2: CONFIGURATION CONTROLLER – CONFIGURE PANEL

- **App Mode** – The App Mode drop down sets the controller's mode of application:
  - **CTS** – Standard USB Power Delivery Protocol for decoding of USB Type-C Power Delivery packets
  - **DP AUX** – DisplayPort Auxiliary Channel for decoding of DisplayPort sideband AUX messages
- **Fixture Selection** – The Fixture Selection drop down sets the external test fixture that is connected to the controller:
  - **C2 DP AUX Sniffer** – GRL DP AUX Sniffer Fixture for sniffing DisplayPort Standard Auxiliary traffic
  - **USB-C SBU** – USB Type-C Sideband Use (SBU) fixture for DisplayPort Alternate Mode over Type-C testing
- **Port Type** – For a 2-port UUT, select either "PortA" or "PortB" to apply the configuration for the selected test port.
- **Controller Mode** – The Controller Mode drop down sets the controller's mode of operation:
  - **UFP/Sink** – Upward Facing Port, sink power
  - **DFP/Source** – Downward Facing Port, source power
  - **DRP** – Dual Role Port
  - **Cable Tester** – Cable only

- **Test Cable Type** – The Test Cable Type drop down allows you to select the type of cable UUT connected to the Controller.
- **PD Spec Type** – The PD Spec Type drop down allows you to select the USB Power Delivery specification limits to be applied accordingly.
- **Cable Emulation** – The Cable Emulation drop down sets the Ra on CC1 or CC2 or both CC lines of the cable UUT if cable emulation is enabled on the controller when using the GRL special test cable for testing.
- **Rp Level** – The Rp Level drop down sets the Rp value on the CC line of the cable UUT.

Clicking the **Apply** button causes all of the above configuration to be set.

- **Emulate Cable** – Select the **Attach** button to perform emulation for a connected cable. Depending on the controller mode, the **Attach** function presents Rp/Rd from the CC line and changes the state of the controller to Source Attach or Sink Attach.

  Select the **Detach** button to stop emulation and remove the connected cable. The **Detach** function removes all the Rp/Rd values from the CC line and changes the state of the controller to Source Detach or Sink Detach.
- **Channels** – Select the display channels (VBUS, CC1 and CC2) to be added to the signal acquisition trace plot.
- **Signal Capture** – Select the **Start** button to start running signal acquisition or the **Stop** button to stop signal acquisition for the UUT. The **Start** function will initiate the test run in the Results screen as shown in the example below:

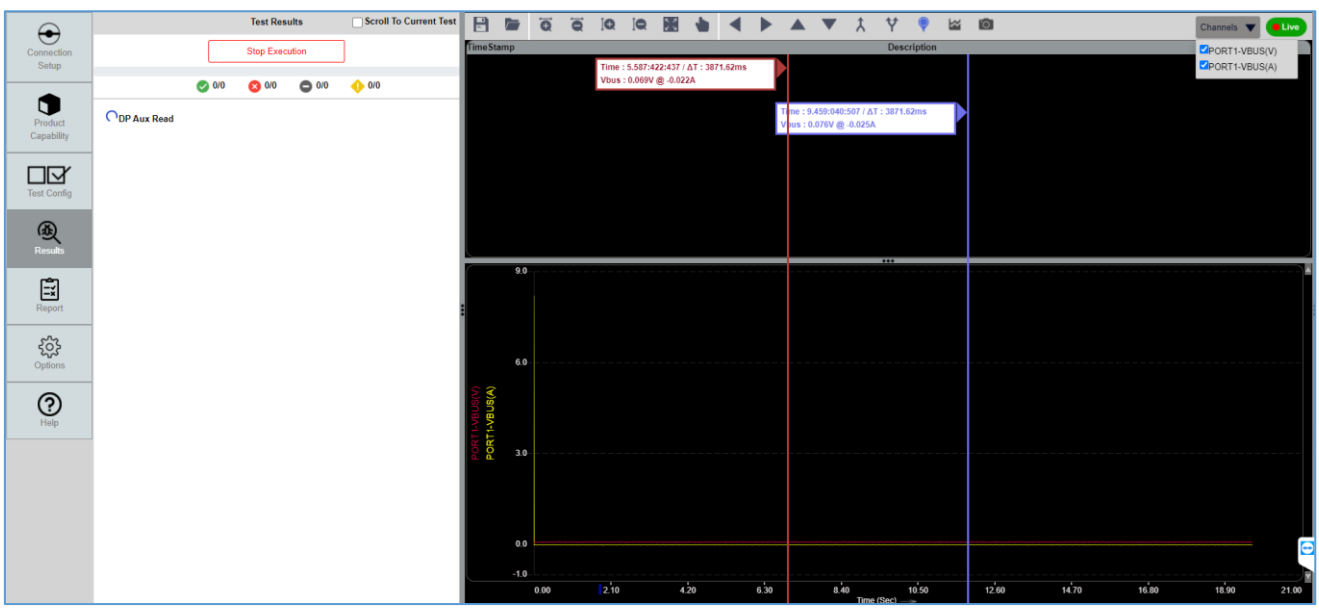


FIGURE 6.3: CONFIGURE PANEL – START SIGNAL CAPTURE IN RESULTS SCREEN EXAMPLE

- **Capture File** – Select the **Download Capture** button to download and save the signal acquisition to a file.

6.2 Request Panel

The Request panel allows the user to select the Request message settings which are sent from the Controller during PD Contract negotiation phase.

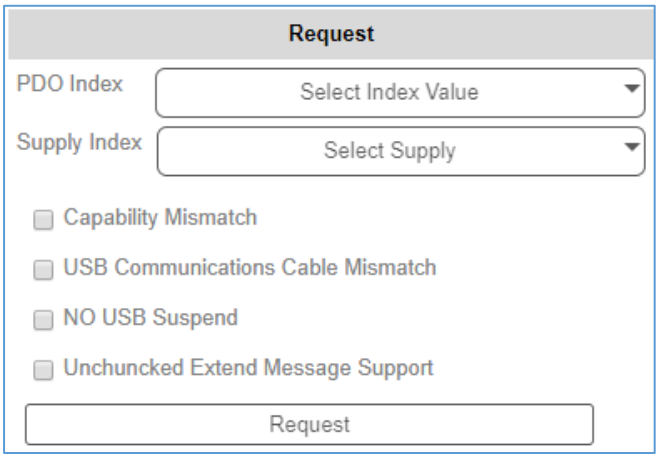


FIGURE 6.4: CONFIGURATION CONTROLLER – REQUEST PANEL

- **PDO Index** – The PDO Index dropdown allows you to select the index of the Power Data Object (PDO) being accessed.
- **Supply Index** – The Supply Index dropdown allows you to select the type of PD power supply being accessed.
- You can also set other options by selecting its respective checkbox, for example, the "**Capability Mismatch**" option is set if there is a check mark in the box next to the title. Clicking on the check box will toggle the value between set and cleared. Similarly, the "**No USB Suspend**" option can be set (check mark in box) or cleared (no check mark) by clicking on the "**No USB Suspend**" check box.

Clicking the **Request** button causes the above configuration to be sent from the Controller.

6.3 Send Message Panel

The Send Message panel allows the user to send run-time messages from the Controller to the connected UUT after a successful PD Contract has been established. The user selects the desired message type then clicks on the **Send** button to send the run-time messages from the Controller to the UUT.

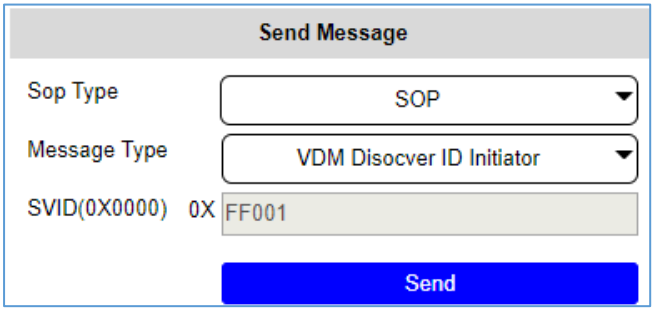


FIGURE 6.5: CONFIGURATION CONTROLLER – SEND MESSAGE PANEL

- **SOP Type** – The SOP Type drop down allows you to select the Start Of Packet (SOP) type in the message sent from the Controller. It includes SOP, SOP1 and SOP2.
- **Message Type** – The Message Type dropdown allows you to select the type of command to be sent from the Controller. This includes Power, Data and VCONN swaps, Resets such as Hard Reset, Cable Reset and Soft Reset, Capability commands such as Get Sink Capability and Get Source Capability, Ping command and BIST Test Data command.
- **SVID(0X0000)** – The SVID field allows you to set the SVID value of mode related messages sent from the Controller. VDM Mode Initiator, VDM Enter Mode Initiator and VDM Exit Mode Initiator are mode related messages. The SVID value is a four digit hexadecimal number.

After selecting the required command as described above, click on the **Send** button to cause the Controller to send the command message to the UUT.

7 Using the Five Port Testing Utility

This section describes how to use the **Five Port Testing** utility, which allows you to set up a multiport switch for the UUT. The *Options* screen will display the Five Port Testing page by clicking on the **Five Port Testing** tab at the top of screen as shown below:

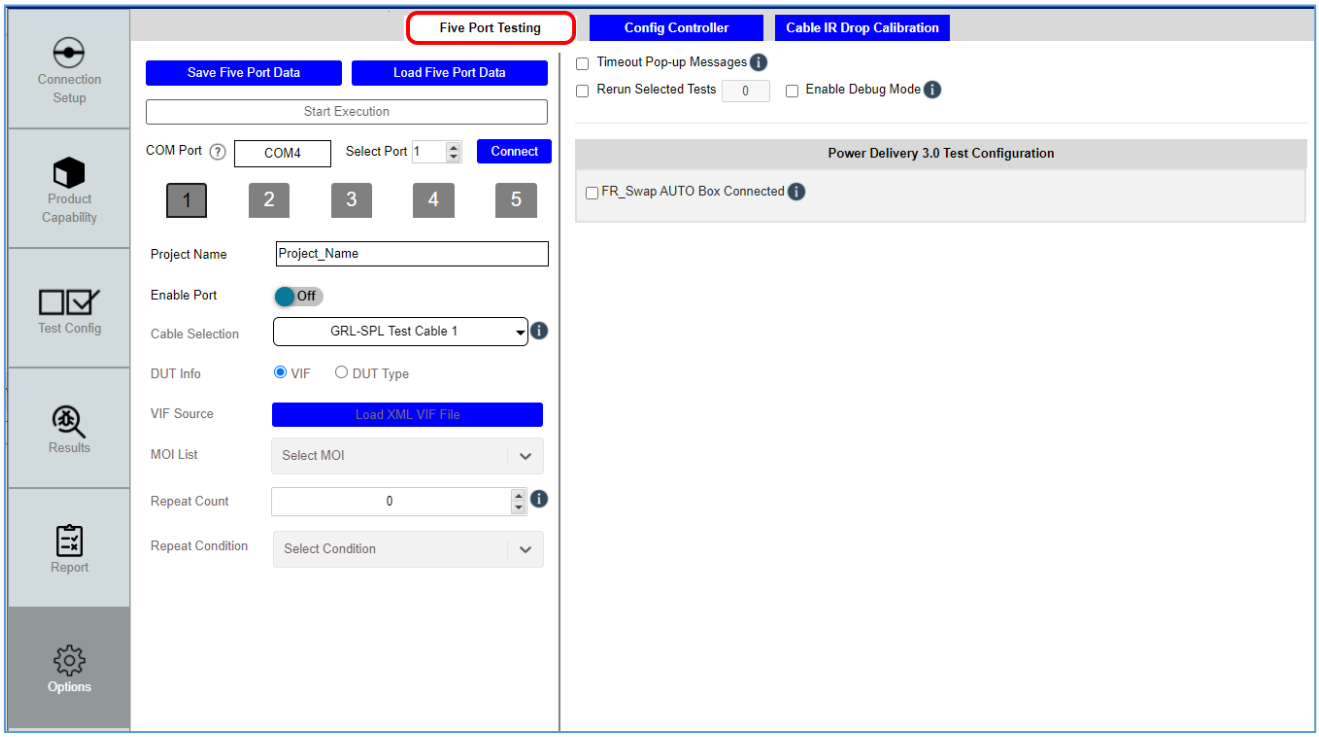


FIGURE 7.1: FIVE PORT TESTING SCREEN

This switch function requires the GRL 5-Port Switch Board (GRL-USB-PD-MULT option) to be used which is provided as a separate accessory for the GRL-USB-PD-C2 controller. The GRL 5-Port Switch Board consists of a five ports switch extension fixture that is plugged in to the GRL-USB-PD-C2 controller and used to connect up to five UUT's to perform switching during tests. For more information on the GRL 5-Port Switch Board, please contact support@graniteriverlabs.com.

To set up the switch for measurements, select and enter the Port value and path that is to be used on the GRL 5-Port Switch Board fixture that is connected with the GRL-USB-PD-C2 controller. Click on the **Connect** button next to it to verify the assigned Port connection.

FIGURE 7.2: FIVE PORT TESTING – ASSIGN AND CONNECT TO PORT

You can also assign new project for the selected Port by entering in the **Project Name** field.

To make configurations to the switch, turn 'On' the **Enable Port** slider 

. The test cable selection drop down allows you to specify what cable connects the UUT to the specific USB Port on the GRL-USB-PD-C2 controller.

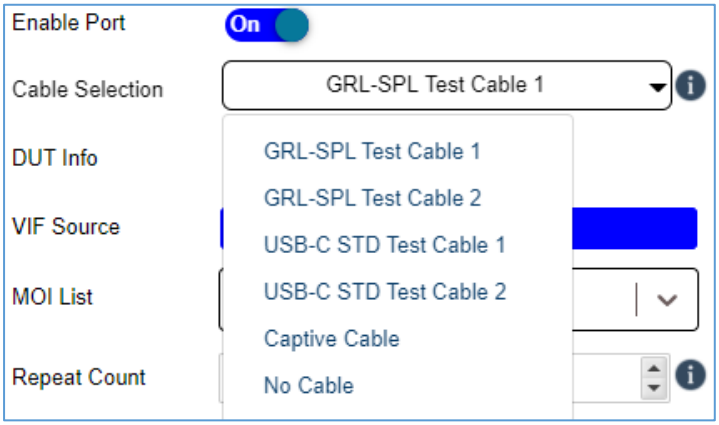
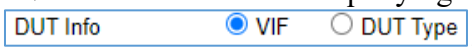


FIGURE 7.3: FIVE PORT TESTING – SELECT CABLE

You can then select whether to use a **VIF** file for the UUT or querying the capabilities of the UUT (**DUT Type**) at the DUT Info field 

.

- If the VIF file is used, clicking on the **Load XML VIF File** button 

will read and load information from a selected VIF XML file on the host PC.
- If acquiring UUT capabilities, select the **DUT Type** checkbox to enable selection of the UUT type being used from the **DUT Type** drop down:

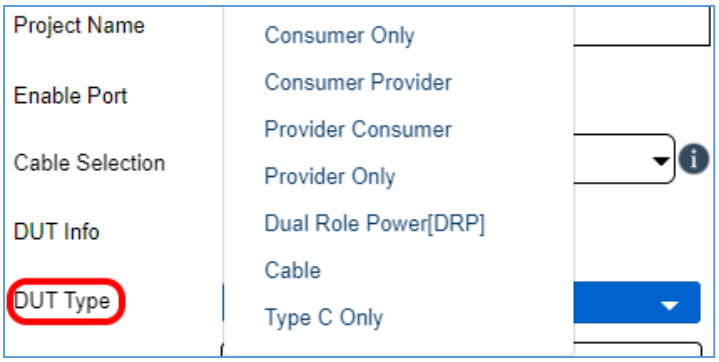


FIGURE 7.4: FIVE PORT TESTING – SELECT UUT TYPE

Finally select the tests that comply to a certain certification standard by selecting the MOI List drop down.

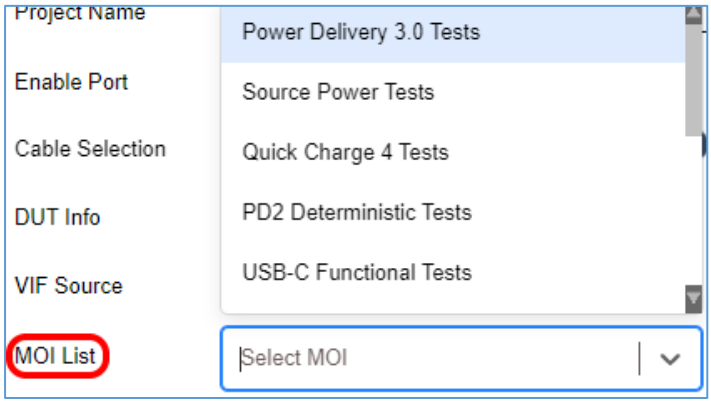


FIGURE 7.5: FIVE PORT TESTING – SELECT MOI TESTS

If required, you can set the number of times to repeat the test sequence (**Repeat Count** field) for the selected test status (**Repeat Condition** drop down).

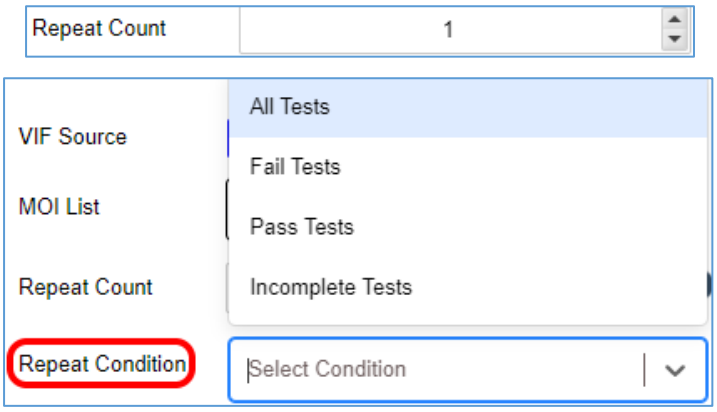


FIGURE 7.6: FIVE PORT TESTING – SET REPEAT TEST AND CONDITION

The 'MOI Configurations' pane on the right allows you to set up parameters for the tests that have been selected from the 'MOI List' drop down.

Once all configurations have been made, click on the top **Start Execution** button to execute the switch function for selected tests.

To save the switch configuration to a file, click on the **Save Five Port Data** button at the top of screen. To load and use a previously saved switch configuration file, click on the **Load Five Port Data** button.

FIGURE 7.7: FIVE PORT TESTING – START TEST AND SAVE/LOAD FUNCTIONS

8 Using the Cable IR Drop Calibration Utility

This section describes how to use the **Cable IR Drop Calibration** utility to perform IR drop calibration to compensate for voltage loss of the cable under test due to high resistance. The *Options* screen will display the Cable IR Drop Calibration page when clicking on the **Cable IR Drop Calibration** tab at the top of screen as shown below:

FIGURE 8.1: CABLE IR DROP CALIBRATION SCREEN

First make sure that the test cable is connected properly to the GRL-USB-PD-C2 controller test ports as shown in the setup image.

Select the **Cable Type** drop down to select what type of cable to be tested and enter a name for the selected cable in the **Cable Name** field.

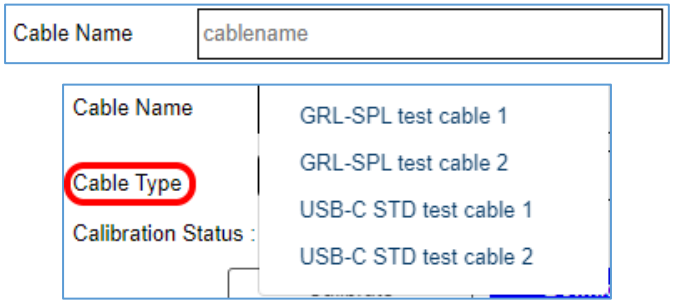


FIGURE 8.2: CABLE IR DROP CALIBRATION – SELECT AND ENTER NAME OF TEST CABLE

Take note of the 'Capture Location' file directory (*Capture Location: C:\GRL\USBPD-C2-Browser-App\CableCompensation*) under the table on the right that is used for saving the cable IR drop calibration data to a file after clicking on the **Download File** button.

Note: If the GRL-SPL-Cable is used, make sure to place the GRL logo on the cable in the upward position to maintain the same cable orientation. Also make sure to maintain the same cable

orientation for the other cable types. These are important to obtain accurate IR drop calibration values.

Finally click on the **Calibrate** button to start running the IR drop calibration. Details of the calibration run will be logged accordingly in the table on the right and the status will be shown next to "Calibration Status".

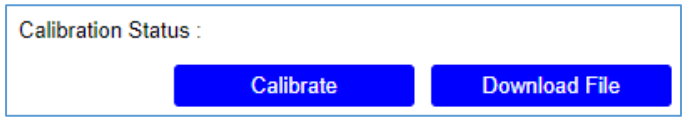


FIGURE 8.3: CABLE IR DROP CALIBRATION – RUN IR DROP CALIBRATION AND SAVE TO FILE

9 GRL-USB-PD-C2 Browser App Information and Help

The *Help* screen allows you to view the current version of the GRL-USB-PD-C2 Browser App as well as a brief description of the GRL-USB-PD-C2 Test Controller. You can also access customer support using the links provided.

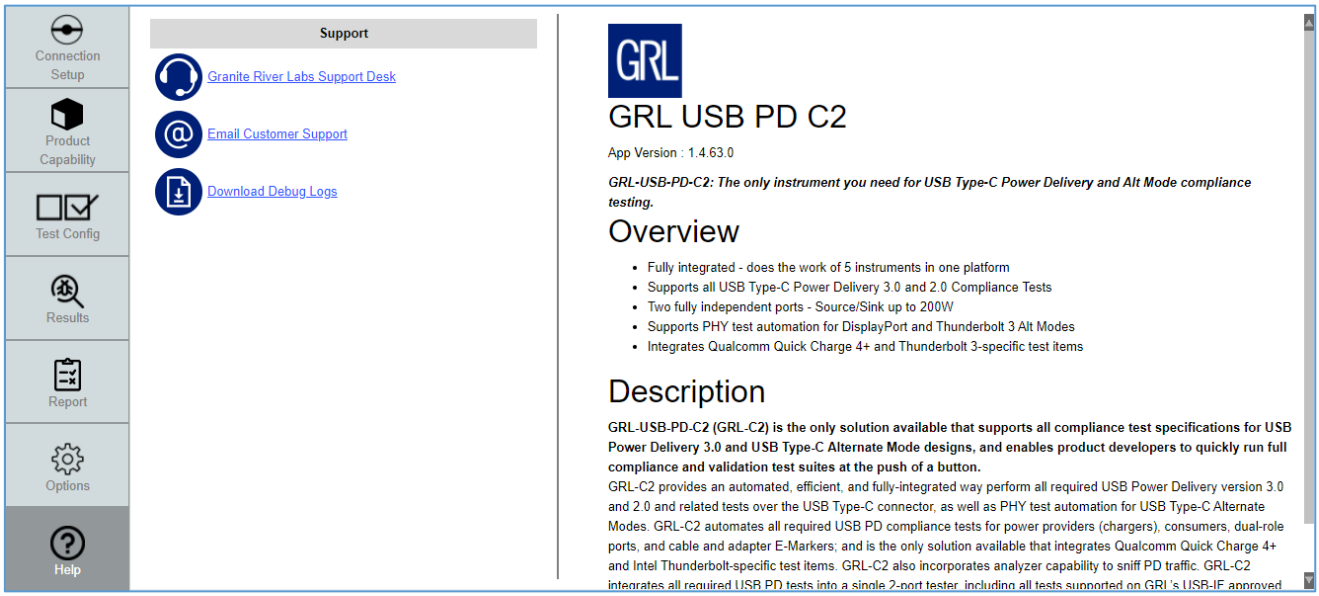


FIGURE 9.1: HELP SCREEN

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